NEW JERSEY

DEPARTMENT OF TRANSPORTATION

STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION

2001

U.S. Customary English Units

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101.01 General.

The titles and headings of the Section, Subsections, and Subparts herein are intended for convenience of reference and shall not be considered as having bearing on their interpretation. Whenever any Section, Subsection, Subpart, or Subheading is amended in the Supplemental Specifications and Special Provisions by such terms as changed to, deleted, or added, it is construed to mean that it amends that Section, Subsection, Subpart, or Subheading of the Standard Specifications. Whenever any reference to page number is made in the Supplemental Specifications and Special Provisions, it is construed to refer to the Standard Specifications.

Working titles that have a masculine gender, such as "workman," "foreman," "materialman," and "flagman" are used in the Contract Documents for the sake of brevity, and are intended to refer to persons of either sex.

When a publication is specified, it refers to the most recent date of issue, including interim publications, before the date of the receipt of bids for the Project unless the issue as of a specific date or year is provided for.

Whenever a slope is indicated in the Specifications, it is given in horizontal to vertical dimensions. The horizontal will be indicated with an "H" and the vertical will be indicated with a "V."

101.02 Abbreviations. { XE "Abbreviations" }

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute Administration
AISC	American Institute of Steel Construction, Inc.
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
API	American Petroleum Institute
AREMA	American Railway Engineering and Maintenance of Way Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
CIAP	Construction Industry Advancement Program of New Jersey
CRSI	Concrete Reinforcing Steel Institute
DBE	Disadvantaged Business Enterprise
ESBE	Emerging Small Business Enterprise
EEI	Edison Electrical Institute
EPA	Environmental Protection Agency of the United States Government
FED-STD	Federal Standard
FHWA	Federal Highway Administration
FSS	Federal Specifications and Standards, General Services
HMA	Hot Mix Asphalt
ICEA	Insulated Cable Engineers Association
IMSA	International Municipal Signal Association
ISO	International Organization for Standardization
ITE	Institute of Transportation Engineers
MSDS	Material Safety Data Sheet
MUTCD	Manual on Uniform Traffic Control Devices
NCHRP	National Cooperative Highway Research Program
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NIST	National Institute for Standards and Technology
NJAC	New Jersey Administrative Code
NJACI	New Jersey American Concrete Institute Administration
NJDEP	New Jersey Department of Environmental Protection
NOAA	National Oceanic and Atmospheric Administration

NJDOT	New Jersey Department of Transportation
OSHA	Occupational Safety and Health Administration
PCI	Prestressed Concrete Institute
RAP	Reclaimed Asphalt Pavement
ROW	Right-of-Way
SI	International System of Units
SSPC	Steel Structures Painting Council
UL	Underwriters Laboratories
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard

101.03 Terms. { XE "Terms" }

When the following terms are used in the Contract Documents, the intent and meaning shall be as follows:

{ XE "Acceptance:defined" **}**ACCEPTANCE. The term "Acceptance" means the formal written acceptance, by the Commissioner, of the Project that has been completed in all respects according to the Contract Documents.

{ XE "Acceptance Testing, defined" **}**ACCEPTANCE TESTING. Testing conducted by the Engineer to measure the degree of compliance to the Contract Documents.

{ XE "Addenda, defined" **}**ADDENDA (Addenda or Addendum used interchangeably). The term "Addenda" means the written or graphic documents and computer disk issued before the opening of bids that clarify, correct, or change the Contract Documents.

{ XE "Advertisement, defined" **}**ADVERTISEMENT. The public announcement, as required by law, that invites bids for work to be performed or materials to be furnished.

{ XE "Award of Contract, defined" **}**AWARD. The term "Award" means the decision of the Department to accept the Proposal of the lowest responsible Bidder, subject to the execution and approval of a satisfactory Contract based thereon and bonds to secure the performance thereof, and such conditions as may hereinafter be specified or as may be specified or required by law.

{ XE "Bidder:defined" **}**BIDDER. The term "Bidder" means an individual, firm, partnership, corporation, or any acceptable combination thereof, acting directly or through a duly authorized representative, legally submitting a bid for the advertised work, and having been qualified to bid on the advertised work pursuant to the provisions of NJSA 27:7-35.1 *et seq.*, and regulations issued thereunder.

{ XE "Bridge, defined" **}**BRIDGE. Any structure, other than a culvert, including supports, erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads and having a length measured along the center of the structure of more than 20 feet between undercopings of abutments or extreme ends of openings for multiple boxes. Structure dimensions are defined as follows:

1. *Bridge Length.* The length of a bridge structure is the overall length measured along the line of survey stationing from back to back of backwalls of abutments, if present, otherwise end to end of the bridge floor; but, in no case less than the total clear opening of the structure.
2. *Bridge Width.* The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom of curbs, or in the case of multiple height of curbs, between the bottoms of the lower risers or, if curbs are not used, between inner faces of parapet or railing.

{ XE "By Others, defined" **}**BY OTHERS. The term "by others" refers to a person, firm, or corporation other than the Contractor or its surety or persons, firms, or corporations in a contractual relationship with the Contractor or the surety, such as a subcontractor, supplier, fabricator, or consultant at any tier. "By others" shall include the Department or other public body.

{ XE "Days:Calendar day, defined" **}{** XE "Calendar Day, defined" **}**CALENDAR DAY. Each and every day shown on the calendar.

{ XE "Change Order:defined" **}**CHANGE ORDER. The term "Change Order" means a written order issued by the Engineer to the Contractor after execution of the Contract authorizing one or more of the following:

1. Changes in the Work.
2. Adjustments in the basis of payment for the Work affected by the changes.
3. Adjustments in the Contract Time.

CLAIMS REVIEW BOARD. The final administrative step in the Department's administrative dispute resolution process is presentation of the dispute to the Claims Review Board. The Board is comprised of three members appointed by the Commissioner for a two-year term. The members of the Board consist of a representative nominated by the CIAP, a Department Manager who serves as Chairperson, and a Neutral Member. All members

of the Board receive equal compensation for their services. The Department and the Contractor equally share the cost of using the Board in an attempt to resolve a dispute. Review of a claim by the Board is available only to Contractors who have escrowed their bid preparation documents, as required by Subsection 103.06, and who have entered into a separate agreement with the Department to share the cost of the Board, as required by Subsection 107.02. The Board may review a claim only after the Department Claims Committee has reviewed it.

COLD WEATHER. The term "cold weather" refers to the period between midnight of November 14 and midnight of March 15, regardless of the ambient temperature, or, for periods outside of these dates, a period when any of three consecutive days from the scheduled date of concrete placement, the average daily temperature is or is expected to fall below 40 ºF. The forecast of the daily temperature data that is required to calculate this average daily temperature shall be obtained from the closest local NOAA monitoring station in the State as specified in the Specifications from the list provided below.

Listing of NOAA monitoring stations in the State:

Northern	Southern	Coastal
Belvidere	Atlantic City WSD AP	Atlantic City
Boonton 1 SE	Audubon	Cape May 1 NW
Canoe Brook	Belleplain St. Forest	Long Branch 2 S
Charlotteburg	Burlington	Sandy Hook
Cranford	Chatsworth	
Essex Fells Svc Bldg	Freehold	
Flemington 3E	Glassboro	
High Point Park	Hammonton 2 NNE	
Jersey City	Hightstown 1 N	
Lambertville	Indian Mills 2 W	
Little Falls	Millville FAA AP	
Long Valley	Moorestown	
Morris Plains 1 W	New Brunswick	
Newark WSD AP	Pemberton 3 E	
Newton	Seabrook Farms	
Paterson	Shiloh	
Phillipsburg	Toms River	
Plainfield	Trenton WSD CI	
Somerville 3 NW	Tuckerton	
Sussex 1 SE	Woodstown	

{ XE "Commissioner of Transportation, defined" **}**COMMISSIONER. The term "Commissioner" means the Commissioner of Transportation of the Department of Transportation of the State of New Jersey, as created by law, acting directly or through duly authorized representatives, such representatives acting within the scope of the particular duties delegated to them.

{ XE "Completion, defined" **}**COMPLETION. The term "Completion" means Completion of the Work. Completion shall occur when:

1. the Work has been satisfactorily completed in all respects according to the Contract Documents;
2. the Project is ready for use by the State to the degree required by the terms of the Contract, and;
3. the Contractor has satisfactorily executed and delivered to the Engineer all documents, certificates, and proofs of compliance required by the Contract Documents, it being understood that the satisfactory execution and delivery of said documents, certificates, and proofs of compliance is a requirement of the Contract.

{ XE "Computer Disk, defined" **}**COMPUTER DISK. The term "Computer Disk" means a diskette furnished by the Department that contains the Department's Electronic Bidding System (EBS), user instructions, and bid items. This Computer Disk will produce a Proposal Form that has the same bid item information contained in the Proposal Form supplied by the Department. The Computer Disk may be used to prepare and print the Proposal Form. Use of the diskette is at the option of the Bidder. The EBS User Guide is available for purchase from the Department.

The following is a listing of the microcomputer system equipment necessary to properly run the EBS program:

1. IBM personal computer (PC), or 100 percent compatible computer (PC/XT/286/386/486/Pentium)
2. a 3½ inch, 1.44 MB floppy diskette drive

3. Hewlett Packard Laser Jet or Ink Jet printer, or 100 percent compatible, connected to the PC's parallel port, PRN

4. minimum of 400K RAM
5. PC-DOS or MS-DOS Version 3.2, or higher

The Department assumes no responsibility for the use of the Computer Disk. The Department will not be liable for any losses, damages, or problems that may arise from the use of the Computer Disk by the Contractor, even if such problems result in the rejection of the Contractor's bid. The Department will not be responsible for any bid item spreadsheet program on the Computer Disk that is not compatible with the Contractor's computer equipment or software. All liability for any damages caused by the use of the Computer Disk shall be borne by the Contractor. The ultimate responsibility for the accuracy of the Contractor's bid remains with the Contractor. Furthermore, the Department will not be held responsible for the loss of or damage to any Computer Disk after the Contractor takes possession of it or it is mailed to the Contractor. If any Computer Disk is lost or damaged, the Contractor may purchase another Computer Disk.

{ XE "Conditional Award, defined" **}**CONDITIONAL AWARD. The term "Conditional Award" means an Award, conditioned upon the later grant of approval by the Federal Government or such other State, governmental body, private party, or combination thereof. Where compliance with a Federal requirement or a requirement imposed as the result of the Project being a cooperative endeavor involving one or more states, governmental bodies, private parties, or a combination thereof, makes it not reasonably possible to award the Contract within the 30 Working Day period fixed by NJSA 27:7-33, the Department may, nevertheless, make a Conditional Award.

CONSTRUCTION ENGINEERING COSTS. The costs incurred by the Department for engineering, inspection, and administration of a Project during construction.

{ XE "Construction Operations, defined" **}**CONSTRUCTION OPERATIONS. Construction operations shall include site clearing, demolition, movement of utilities or other facilities, and actual construction of any of the temporary or permanent structures, roadways, or public improvements required by the Contract. The term shall not include mobilization, procurement and storage of materials and plants, providing engineering, Performance Bond and Payment Bond, surveys, working drawings, field offices, or other schedules, certificates, forms, or documents necessary before the performance of Work on Pay Items.

CONSTRUCTION ORDER. The term "Construction Order" includes Field Orders, Change Orders, and Supplementary Agreements.

{ XE "Contract:defined" **}**CONTRACT. The term "Contract" means the entire and integrated agreement between the parties thereunder and supersedes all prior negotiations, representations, or agreements, either written or oral. The Contract Documents form the Contract between the Department and the Contractor setting forth the obligations of the parties thereunder, including, but not limited to, the performance of the Work and the basis of payment.

{ XE "Contract:Documents, defined" **}**CONTRACT DOCUMENTS. The term "Contract Documents" includes: Advertisement for Proposal, Proposal, Certification as to Publication and Notice of Advertisement for Proposal, Appointment of Agent by Nonresident Contractors, Noncollusion Affidavit, Warranty Concerning Solicitation of the Contract by Others, Resolution of Award of Contract, Executed Form of Contract, Performance Bond and Payment Bond, Standard Specifications, Supplemental Specifications, Special Provisions, Plans, Right-of-Way Plans, Addenda, or other information mailed or otherwise transmitted to the prospective bidders before the receipt of bids, Change Orders, Field Orders, and Supplementary Agreements, all of which are to be treated as one instrument whether or not set forth at length in the form of Contract.

As used in Sections 102 and 103 only, Contract Documents do not include Change Orders, Field Orders, and Supplementary Agreements. As used in Section 102 only, Contract Documents also do not include Resolution of Award of Contract, Executed Form of Contract, and Performance and Payment Bonds.

{ XE "Contract:Time, defined" **}**CONTRACT TIME. The term "Contract Time" means the number of Working Days or Calendar Days including authorized adjustments allowed for Completion. When a specified completion date is shown in the Specifications instead of the number of Working Days or Calendar Days, Completion shall be on or before that date. Specified completion date and Calendar Day contracts shall be completed on or before the day indicated even when that date is a Saturday, Sunday, or holiday.

{ XE "Contractor, defined" **}**CONTRACTOR. The term "Contractor" means the individual, firm, partnership, corporation, or any acceptable combination thereof contracting with the Department for performance of the prescribed Work. Throughout the Contract Documents, the Contractor is referred to as if singular in number. The term "Contractor" means the Contractor or the Contractor's authorized representative.

CONTRACTOR'S LAND SURVEYOR. A person who is legally authorized to practice land surveying in New Jersey according to the provisions of P.L. 1938 c. 342 (C 45:8-27 et seq.), who is in principal charge of all surveying work and setting, moving, or resetting of monuments. He or she may be either an employee of the Contractor or under a subcontract with the Contractor to provide such land surveying services.

COUNTY AND MUNICIPAL PROJECTS. Those projects carried out with County or Municipal Aid from the State, for which the County or Municipality, and not the State, is the contracting party.

CULVERT. Any structure not classified as a bridge that provides an opening to carry water under a roadway.

{ XE "Current Controlling Operation, defined" **}**CURRENT CONTROLLING OPERATION OR OPERATIONS. The current controlling operation or operations is to be construed to include any feature of the Work, which, if delayed at the time in question, delays the overall time of Completion.

{ XE "Days:defined" **}**DAYS. Unless otherwise designated, days as used in the Contract Documents means Calendar Days.

{ XE "Department, defined" **}**DEPARTMENT. The term "Department" means the Department of Transportation of the State of New Jersey, as created by law.

DEPARTMENT CLAIMS COMMITTEE. An administrative body available to review and resolve claims that arise under the Contract. The Committee consists of three voting members representing Design, Construction, and Accounting. Additional non-voting members are a Deputy Attorney General and the Secretary of the Department Claims Committee. Department Claims Committee review is available only after the matter in dispute has been reviewed by the Executive Director of Regional Operations, and only if the requirements for review contained in Subsection 107.02 are met. It is the fourth step in the Administrative Dispute Resolution process.

{ XE "Laboratory:Department, defined" **}{** XE "Department Laboratory, defined" **}**DEPARTMENT LABORATORY. The term "Department Laboratory" means the main testing laboratory of the Department at 930 Lower Ferry Road, P.O. Box 607 Trenton, New Jersey 08625, or such other laboratory as the Department may designate.

DESIGN UNIT. The term "Design Unit" for any particular project means the Department's consultant engineering firm or the in-house design unit that prepared the Contract Plans for that project, except for electrical plans and sign legends in which case the Manager of the Office of Traffic Signal and Safety Engineering shall be considered the Design Unit.

DISPUTE. A disagreement between the Department and the Contractor with regard to the Work or Contract Documents.

EASEMENT. The right to use the land of others for a specific or particular purpose consistent with the grant under which it was made.

{ XE "Engineer, defined" **}**ENGINEER. The term "Engineer" means the State Transportation Engineer, as created by law, acting directly or through the Engineer's duly authorized representatives, such representatives acting within the scope of the particular duties delegated to them.

To avoid repetition, whenever the following words are used, it shall be understood as if they were followed by the words "to the Engineer" or "by the Engineer": "acceptable, accepted, added, allowed, applied, approved, assumed, authorized, awarded, calculated, charged, checked, classified, computed, condemned, conducted, considered, considered necessary, contemplated, converted, deducted, deemed, deemed necessary, deleted, designated, determined, directed, disapproved, divided, documented, established, evaluated, examined, excluded, furnished, given, granted, included, incorporated, increased, indicated, inspected, insufficient, issued, made, marked, measured, modified, monitored, notified, observed, obtained, opened, ordered, paid, paid for, performed, permitted, provided, received, recorded, reduced, re-evaluated, rejected, removed, required, reserved, retested, returned, sampled, satisfactory, scheduled, specified, stopped, submitted, sufficient, suitable, supplied, suspended, taken, tested, unacceptable, unsatisfactory, unsuitable, or used."

{ XE "Equipment:defined" **}**EQUIPMENT. All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction of the Work.

EXECUTIVE DIRECTOR OF REGIONAL OPERATIONS. The term "Executive Director of Regional Operations" means the Executive Director of Regional Operations whose region is in charge of administering the Contract.

{ XE "Extra work, defined" **}**EXTRA WORK. The term "Extra Work" means new and unforeseen work found essential to the satisfactory completion of the Project, as determined by the Engineer, and not covered by any of the various Pay Items for which there is a bid price or by combination of such items. In the event portions of such work are determined by the Engineer to be covered by one of the various Pay Items for which there is a bid price or combinations of such items, the remaining portion of such work will be designated as Extra Work. Extra Work also includes work specifically designated as Extra Work in the Contract Documents.

{ XE "Extreme Weather Conditions, defined" **}**EXTREME WEATHER CONDITIONS. When, solely as a result of adverse weather, the Contractor is not able to work more than 15 days in any one month from April through November, inclusive, the Contractor is entitled to claim that progress of the Work has been affected by extreme weather conditions during that month and may seek an extension of Contract Time consistent with the provisions of Subsection 108.11. The Contractor shall have no claim that progress of the Work has been affected by extreme weather conditions during the months of December through March, inclusive.

{ XE "Field Order, defined" **}**FIELD ORDER. The term "Field Order" means a written order, signed by the Resident Engineer, requiring performance by the Contractor without negotiation of any sort.

HIGHWAY, STREET, OR ROAD. A general term denoting a public way for purposes of vehicular travel, including the entire area within the ROW (see Figure 101-1).

{ XE "Holidays, defined" **}**HOLIDAYS. The following days shall be considered holidays for use in determination of Working Days:

New Year's Day	Labor Day
Martin Luther King's Birthday	Columbus Day
Lincoln's Birthday	Presidential Election Day
Washington's Birthday (Presidents' Day)	Veteran's Day
Memorial Day	Thanksgiving Day
Independence Day	Christmas Day

HOT MIX ASPHALT (HMA) PAVEMENT. The combination of base course, intermediate course, and surface course of hot mix asphalt. These courses are defined as follows:

1. HMA Base Course – the hot mix asphalt layer(s) below 4 inches of the final pavement surface.
2. HMA Intermediate Course – the hot mix asphalt layer, other than the surface course, placed within the top 4 inches.
3. HMA Surface Course – surface layer of a specified thickness.

INSPECTOR. The Engineer's authorized representative assigned to inspect contract performance, methods, and materials related to the Work both on and off the site of the Project.

{ XE "Interagency Engineering Committee, defined" **}**INTERAGENCY ENGINEERING COMMITTEE. The committee formed with representation from the New Jersey Department of Transportation, the New Jersey Turnpike Authority, the New Jersey Highway Authority, and the Port Authority of New York and New Jersey to develop standardized construction specifications among the agencies.

{ XE "Invitation for Bids, defined" **}**INVITATION FOR BIDS. The Advertisement of Proposals for all work or materials on which bids are required. Such advertisement indicates the location of the Project and an estimated quantity of Work to be done or the character and quantity of the material to be furnished and the time and place of the opening of Proposals.

ITS OWN ORGANIZATION. The term "Its Own Organization" shall be construed to include only workers customarily employed and paid directly by the Contractor and equipment owned or rented by the Contractor, with or without operators.

LANE OCCUPANCY CHARGE. A contractual obligation of the Contractor to compensate for the Contractor's use and occupancy of a lane or lanes of the Traveled Way beyond the time period set forth in the traffic control plans or Special Provisions.

{ XE "Pay Item:Major:defined" **}{** XE "Pay Item:Minor:defined" **}{** XE "Minor Pay Items, defined" **}{** XE "Major Pay Items, defined" **}**MAJOR AND MINOR PAY ITEMS. The term "Major Pay Item" means any Pay Item having an original Contract value in excess of ten percent of the Total Contract Price and those items specifically designated as "Major Pay Items" in Subsection 104.05. The original Contract value of a Pay Item equals the per unit price bid for said Pay Item multiplied by the estimated quantity of such item contained in the Proposal Form. All other Pay Items shall be considered "Minor Pay Items."

MATERIALS. Any substances specified for use in the construction of the Project.

MATERIALS QUESTIONNAIRE. The specified forms on which the Contractor shall notify the Engineer of the sources of materials expected to be used.

MEDIAN. That portion of a divided highway separating the paved sections, including both the shoulders and the traveled way.

{ XE "Notice to Proceed, defined" **}**NOTICE TO PROCEED. The term "Notice to Proceed" means the written notice to the Contractor to begin Work.

ON-DUTY POLICE. The term "on-duty" with regard to municipal police shall mean that the work of providing traffic safety services shall be an extension of regular employment for, and sanctioned by, the municipality, even if it is on an overtime pay rate basis. The municipal police, while so working, shall be covered by the municipality's liability insurance coverage.

PAVEMENT STRUCTURE. The combination of surface course and base course, and when specified, a subbase course, placed on a subgrade to support the traffic load and distribute it to the roadbed (see Figure 101-1). These various courses are defined as follows:

1. *Surface Course*. One or more layers of specified material of designed thickness on a base course or a subbase.
2. *Base Course*. One or more layers of specified material of designed thickness placed on the subgrade or subbase.
3. *Subbase*. One or more layers of specified material of designed thickness placed on the subgrade.

{ XE "Pay Item:defined" **}**PAY ITEM. The term "Pay Item" means a specifically described item of Work for which the bidder provides a per unit or lump sum price in the Proposal.

{ XE "Payment Bond, defined" **}{** XE "Performance Bond, defined" **}{** XE "Bond:Performance and Payment: defined" **}**PERFORMANCE BOND AND PAYMENT BOND. The term "Performance Bond and Payment Bond" means the approved form of security, executed by the Contractor and its surety or sureties, guaranteeing complete performance of the Contract in conformity with the Contract Documents and the payment of all legal debts pertaining to the construction of the Project.

{ XE "Plans, defined" **}**PLANS. The approved plans, profiles, typical sections, cross-sections, working drawings, and supplemental drawings, or exact reproductions thereof, which show the location, character, dimensions, quantities, and details of the Work to be done.

POLICE. The term "police" shall mean a person authorized to enforce the laws of the State and its political subdivisions, who has jurisdiction at the Project site, and who has successfully completed a traffic safety program approved by the Department.

{ XE "Preconstruction Conference, defined" **}**PRECONSTRUCTION CONFERENCE. The initial Project meeting conducted by the Regional Construction Engineer, normally held after Award of the Contract and before the start of Work. A separate utility preconstruction conference may be scheduled. The Contractor shall attend preconstruction conferences.

PRESIDING OFFICER. The Engineer or the Engineer's designee in charge of receipt of bids. The Presiding Officer opens each meeting for the receipt of bids and declares when the receipt of bids has been closed.

{ XE "Profile, defined" **}**PROFILE. The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadway. Profile grade means either the elevation or gradient of such trace according to the context. From this, cross-section elevations are established based on the typical section.

{ XE "Project, defined" **}**PROJECT. The specific section of highway or other public improvement together with all appurtenances and construction to be performed thereon, under the Contract. The Project may include work by others under other contracts.

{ XE "Proposal:defined" **}**PROPOSAL. The term "Proposal" means the offer of a bidder, properly signed and guaranteed, on the prepared form furnished by the Department, or printed from the Computer Disk, to perform the Work at the prices therein.

{ XE "Proposal Bond:defined" **}{** XE "Bond:Proposal:defined" **}**PROPOSAL BOND. The term "Proposal Bond" means the security furnished with a bid to guarantee that the bidder shall enter into the Contract if awarded the Contract.

{ XE "Proposal:Form, defined" **}**PROPOSAL FORM. The term "Proposal Form" means the approved form furnished by the Department or printed from the Computer Disk on which the Department requires bids to be prepared and submitted for the Work.

REGIONAL DISPUTE BOARD. A three-member Board comprised of the Resident Engineer's supervisor, an Engineer from the Bureau of Construction Engineering, and the Regional Construction Engineer (Chairperson) that is available under the terms of the Contract to review disputes, which have not been resolved by the Resident Engineer. It is the second step in the Administrative Dispute Resolution process.

REMEDIATED. The term "remediated" means the process that is approved by the New Jersey Department of Environmental Protection to remove all traces of petroleum contamination from soil aggregates that have been classified as ID-27.

{ XE "Resident Engineer:defined" **}**RESIDENT ENGINEER. The term "Resident Engineer" means the field representative of the Engineer having direct supervision of the administration of the Contract.

{ XE "Right-of-Way:defined" **}**RIGHT-OF-WAY (ROW). A general term denoting all of the land, property, or interest therein, usually in a strip, acquired for or devoted to transportation purposes or construction of a public improvement (see Figure 101-1).

RIGHT-OF-WAY PLANS. The most current revisions of the General Property Parcel Maps and Entire Tract Maps approved for use in setting the existing and proposed ROW, including setting out or laying out of various easements within which items of work are to be constructed or used to enable construction thereof.

ROAD USER COSTS. The added vehicle operating costs resulting from establishment of construction, maintenance, or rehabilitation work zones and delay and inconvenience costs incurred by the traveling public.

{ XE "Roadbed:defined" **}**ROADBED. The graded portion of a highway within top and side slopes, prepared as a foundation for the pavement structure and shoulders (see Figure 101-1).

{ XE "Roadside, defined" **}**ROADSIDE. A general term including:

1. The areas between the outside edges of the shoulders and the ROW boundaries.
2. The unpaved median areas between inside shoulders of divided highways.
3. Areas within interchanges.
4. Historic sites.
5. Viewpoints.
6. Scenic strips.
7. Junkyard screening over which the State retains maintenance responsibilities.

{ XE "Roadway, defined" **}**ROADWAY. The portion of the highway, street, or road within the limits of construction (see Figure 101-1).

ROLLING STRAIGHTEDGE. A manually propelled measuring device constructed upon a rigid frame, 10 feet long, wheeled at each end. A third wheel located midpoint is linked to a dial indicator and automatically marks, in dye or water, the length of the surface variations which exceed a tolerance of 1/10 inch.

SHALL. Designates an obligation of the Contractor, unless otherwise indicated.

SHOULDER. The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses (see Figure 101-1).

SIDEWALK. That portion of the roadway primarily constructed for the use of pedestrians (see Figure 101-1).

{ XE "Specialty Items, defined" **}**SPECIALTY ITEMS. Such items shall be limited to work that requires highly specialized knowledge, craftsmanship, or equipment not normally available among contractors qualified to bid on the Contract as a whole, and that are designated as "Specialty Items" in the Contract Documents.

SPECIFICATIONS. The compilation of provisions and requirements for the performance of prescribed work contained in the Standard Specifications, as supplemented by the Supplemental Specifications and Special Provisions, and modified by Addenda or other information giving interpretations or revisions to them which, before the receipt of bids, are transmitted to prospective Bidders.

{ XE "Standard Specifications, defined" **}**1. *Standard Specifications.* The term "Standard Specifications" means the 2001 Standard Specifications for Road and Bridge Construction of the New Jersey Department of Transportation, which has been approved for general application and repetitive use.

{ XE "Supplemental Specifications, defined" **}**2. *Supplemental Specifications.* Approved additions and revisions to the Standard Specifications.

{ XE "Special Provisions, defined" **}**3. *Special Provisions.* Revisions to the Standard and Supplemental Specifications applicable to an individual project.

{ XE "State, defined" **}**STATE. The "State" means the State of New Jersey.

{ XE "State Business Day, defined" **}{** XE "Days:State business day, defined" **}**STATE BUSINESS DAY. A Calendar Day, exclusive of Saturdays, Sundays, State-recognized legal holidays, and such other holidays or State office closings as declared by the Governor. The term "State Business Day" as used in the Contract Documents and the term "Working Day" as used in NJSA 27:7-31 and NJSA 27:7-33 are synonymous.

{ XE "Straightedge, defined" **}**STRAIGHTEDGE. An accurate, 10 feet long, square-edged, straightedge used in testing variations in the surface to verify specified tolerances.

{ XE "Structures:defined" **}**STRUCTURES. Bridges, culverts, inlets, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains, and other features which may be encountered in the Work and not otherwise classed herein.

{ XE "Subcontractor, defined" **}**SUBCONTRACTOR. An individual, firm, partnership, corporation, or any acceptable combination thereof, to which the Contractor subcontracts part of the Work pursuant to Subsection 108.02.

{ XE "Subgrade:defined" **}**SUBGRADE. The surface of the roadbed upon which the first layer of the pavement structure and/or shoulder section is constructed (see Figure 101-1).

{ XE "Substantial Completion, defined" **}**SUBSTANTIAL COMPLETION. The term "Substantial Completion" means the point at which the performance of all Work on the Project has been completed except landscaping items (including the planting of trees, shrubs, vines, ground covers, and seedlings), final cleanup, and repair of unacceptable Work, and provided the Engineer has solely determined that:

1. the Project is safe and convenient for use by the public, and
2. failure to complete the Work and repairs excepted above does not result in the deterioration of other completed Work; and provided further, that the value of landscaping work remaining to be performed, repairs, and cleanup is less than two percent of the Total Adjusted Contract Price.

{ XE "Substructure, defined" **}**SUBSTRUCTURE. All of that part of the structure below the bearings of simple and continuous spans, skewbacks of arches, and tops of footings of rigid frames, together with the backwalls, wingwalls, and wing protection railings.

{ XE "Superintendent of Contractor, defined" **}**SUPERINTENDENT. The Contractor's authorized representative responsible for and in charge of the Work. The Superintendent shall be authorized to receive all communications from the State.

{ XE "Superstructure, defined" **}**SUPERSTRUCTURE. All of that part of a structure above the bearings of simple and continuous spans, skewbacks of arches, and tops of footings of rigid frames, excluding backwalls, wingwalls, and wing protection railing.

{ XE "Supplementary Agreement, defined" **}**SUPPLEMENTARY AGREEMENT. The term "Supplementary Agreement" means a bilateral agreement between the Commissioner and the Contractor, executed on a Change Order form, setting forth the negotiated terms and conditions whereunder changes are to be accomplished, including negotiated adjustments in compensation and

time of Completion. The Supplementary Agreement shall be conclusive as to all questions of compensation and extensions of Contract Time relative to the subject of the agreement excepting only those instances wherein the agreement recites specific exceptions.

{ XE "Surety, defined" **}**SURETY. The corporate body bound with and for the Contractor for the full and complete performance of the Contract and for the payment of all debts and obligations pertaining to the Work.

{ XE "Testing:Agency, defined" **}**TESTING AGENCY. A privately owned facility capable of testing and evaluating component parts, or the whole, for certification of the composition or construction of the material or product. The testing agency must be an AASHTO-accredited laboratory for each field of accreditation and type of material to be tested.

{ XE "Total Adjusted Contract Price, defined" **}**TOTAL ADJUSTED CONTRACT PRICE. The term "Total Adjusted Contract Price" means the Total Contract Price as it is adjusted through the issuance of Change Orders and Field Orders and the calculation of as-built quantities.

{ XE "Total Contract Price, defined" **}**TOTAL CONTRACT PRICE. The term "Total Contract Price" means the correctly determined summation of lump sum bids and products of all quantities for Pay Items shown in the Proposal multiplied by the unit prices bid.

TOWN, TOWNSHIP, CITY. A subdivision of the County used to designate or identify the location of the Project.

{ XE "Traveled Way, defined" **}**TRAVELED WAY. The portion of the roadway for the movement of vehicles exclusive of shoulders and auxiliary lanes (see Figure 101-1).

UNBALANCED BID. The term "Unbalanced Bid" means a materially unbalanced bid where there is a reasonable doubt that award to the Bidder submitting a mathematically unbalanced bid, which is structured on the basis of nominal prices for some work and inflated prices for other work, will result in the lowest ultimate cost to the Department.

{ XE "Utility, defined" **}**UTILITY. A publicly, privately, or cooperatively owned agency or agencies operated by one or more persons or corporations for public service. For purposes of the Contract, railroads shall be considered utilities.

WILL. Designates an action to be taken by the State, the Department, the Commissioner, the Engineer, or any authorized representative, unless otherwise indicated.

{ XE "Work:defined" **}**WORK. The term "Work" means the furnishing of all labor, services, materials, equipment, tools, transportation, supplies, and other incidentals necessary or convenient for the successful completion by the Contractor of the construction described in the Contract Documents and the carrying out of all duties and obligations imposed by the Contract Documents on the Contractor.

{ XE "Working Day, defined" **}{** XE "Days:Working day, defined" **}**WORKING DAY. Any Calendar Day, exclusive of:

1. Saturdays, Sundays, and holidays;
2. Days on which the Contractor is specifically required by the Contract Documents to suspend construction operations; and
3. Days on which the Contractor is prevented by inclement weather or conditions resulting immediately therefrom adverse to the current controlling operation or operations, as determined by the Engineer, from proceeding with at least 75 percent of the normal labor and equipment force engaged on such operation or operations for at least 60 percent of the total daily time being currently spent on the controlling operation or operations.

Should the Contractor prepare to begin work at the regular starting time in the morning of any day on which inclement weather, or the conditions resulting from the weather, prevent the work from beginning at the usual starting time, and the crew is dismissed as a result thereof, and the Contractor does not proceed with at least 75 percent of the normal labor and equipment force engaged in the current controlling operation or operations for at least 60 percent of the total daily time being currently spent on the controlling operations or operations, the Contractor will not be charged for a Working Day whether or not conditions should change thereafter during said day and the major portion of the day could be considered to be suitable for such construction operations.

{ XE "Working Drawings, defined" **}**WORKING DRAWINGS. Stress sheets, shop drawings, diagrams, illustrations, schedules, performance charts, brochures, erection plans, falsework plans, framework plans, cofferdam plans, bending diagrams for reinforcing steel, and any other supplementary plans or similar data which are prepared by the Contractor or any subcontractor, manufacturer, supplier, or distributor, and which the Contractor is required to submit to the Engineer for approval or certification.

101.04 Inquiries Regarding the Project.

{ XE "Plans and specifications:discrepancies and errors" **}{** XE "Plans and specifications:omissions in" **}**Inquiries before the receipt of bids regarding any discrepancy, error, or omission, or concerning the intent or meaning of the Plans, Specifications, or other Contract Documents shall be directed to the Department as provided in the Special Provisions.

Contractors shall rely only upon written responses to their inquiries. Oral responses will be of no effect.

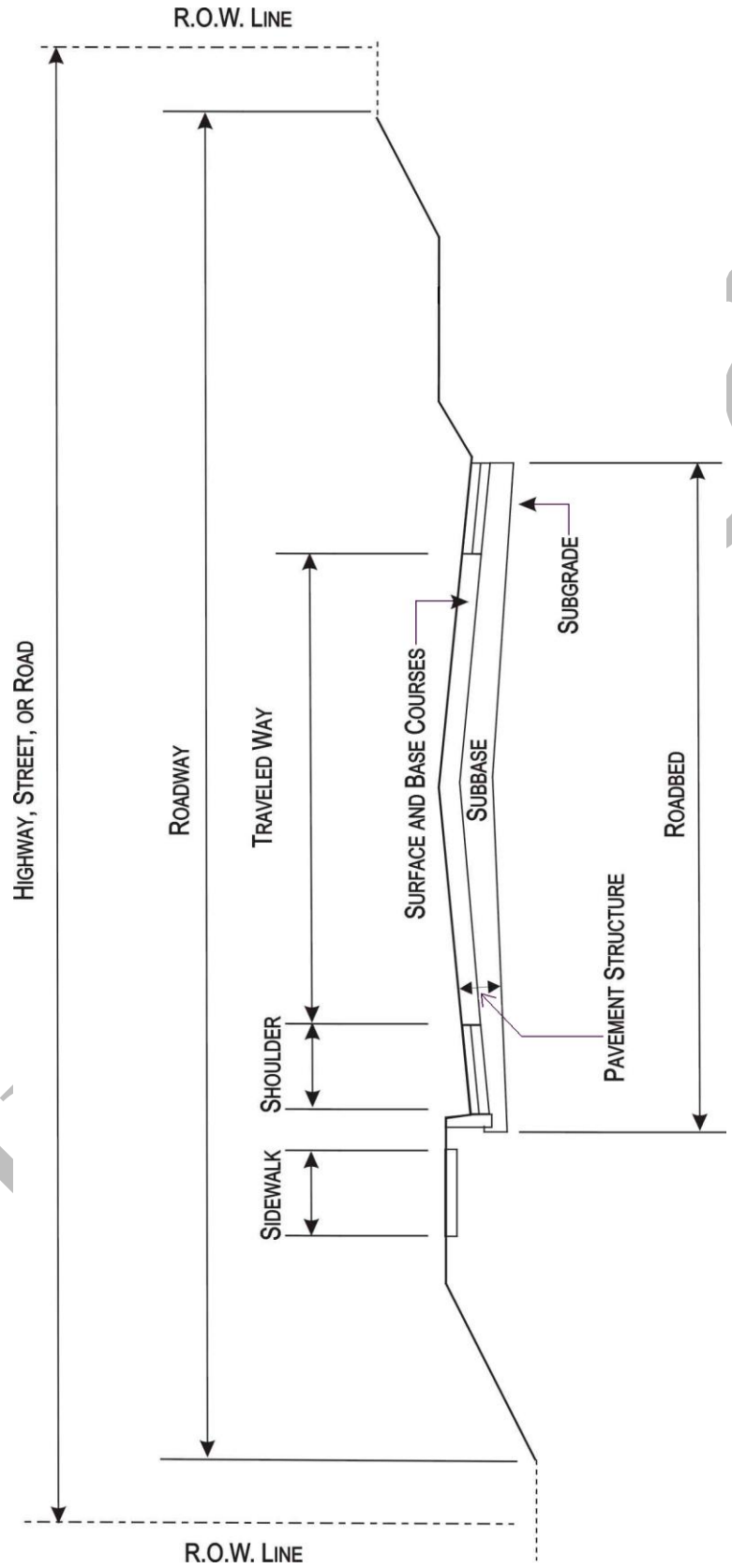
R.O.W. LINE
HIGHWAY, STREET, OR ROAD
ROADWAY
TRAVELED WAY
SHOULDER
SIDEWALK
SURFACE AND BASE COURSES
SUBBASE
SUBGRADE
PAVEMENT STRUCTURE
ROADBED
R.O.W. LINE

Figure 101-1

SECTION 102 - BIDDING REQUIREMENTS AND CONDITIONS{ XE "BIDDING REQUIREMENTS" }

102.01 Prequalification of Prospective Bidders. { XE "Prequalification of prospective bidders" }{ XE "Bidder:prequalification of" }

{ XE "Financial statement (from bidders)" **}{** XE "Statement:financial" **}{** XE "Statement:plant and equipment adequacy" **}**Proposals will be received only from Bidders who, before the delivery of the Proposal, have, as required by statute, submitted under oath, statements relating to their financial ability, adequacy of plant and equipment, organization and prior experience, and other matters, on forms furnished by the Department; who have been prequalified according to Regulations Covering the Classification of Prospective Bidders issued according to NJSA 27:7-35.1 *et seq.* and ownership as required by NJSA 52:25-24.2; and who at the time of delivery of Proposals have effective prequalification ratings of not less than the amounts of their respective bids.

102.02 Disqualification of Prequalified Prospective Bidders. { XE "Bidder:disqualification of" }

{ XE "Proposal:form" **}**The Department reserves the right to disqualify or refuse to receive a Proposal Form from a prospective Bidder even though prequalified as required by Subsection 102.01 or reject a Proposal after having received same for any of the following reasons:

1. Lack of competency or lack of adequate machinery, plant, or other equipment.
2. Uncompleted work that, in the judgment of the Department, might hinder or prevent the prompt completion of additional work, if awarded.
3. Failure to pay, or satisfactorily settle, all bills due for labor, equipment, or material on previous Contracts.
4. Failure to comply with any prequalification regulations of the Department.
5. Default under any previous contract.
6. Unsatisfactory performance on previous or current contracts.
7. Questionable moral integrity as determined by the Attorney General of New Jersey or the Commissioner.
8. Failure to reimburse the State for monies owed on any previously awarded contracts including those where the prospective Bidder is a party to a joint venture and the joint venture has failed to reimburse the State for monies owed.
9. Documented failure to comply with the conditions of permits.

102.03 Contents of the Proposal.

{ XE "Quantities:approximate" **}**Upon request, the Department will furnish prequalified, prospective bidders with a Proposal Form and Computer Disk. The Proposal Form states the location and description of the Project, shows the approximate estimate of the various quantities and kinds of Work to be performed, and includes a schedule of Pay Items for which bid prices are invited. The Proposal Form and accompanying Special Provisions state the number of days or date in which the Project must be completed, the amount of the Proposal Bond, and the date, time, and place of the opening of Proposals.

All papers bound with or attached to the Proposal Form are considered a part thereof and must not be altered and must be submitted with the Proposal. All papers generated from the Computer Disk are considered part of the Proposal Form and must not be altered. These papers must be bound and submitted with the Proposal for official bid.

Other Contract Documents are considered a part of the Proposal whether attached or not.

Prospective bidders are required to pay the Department the sum stated in the Specifications for each copy of the Proposal Form, Computer Disk, Special Provisions, and each set of Plans.

Informational copies of the Proposal Form are available from the Department upon request.

102.04 Interpretation of Quantities in Bid Schedule. { XE "Interpretation of quantities in bid schedule" }

The quantities appearing in the bid schedule are approximate only and are prepared for the comparison of bids. Payment will be made only for the quantities of Work completed according to the Contract. Such payment will be made at the original unit prices for the quantities of Work accepted by the Engineer. The scheduled quantities of Work may be increased or decreased, or Pay Items may be eliminated in their entirety as hereinafter provided.

102.05 "If and Where Directed" Items. { XE "\"If and were directed\" items" }

{ XE "Estimated quantities" **}**The Proposal Form may request bids on one or more Pay Items to be incorporated into the Project "if and where directed" by the Engineer. Such items may not be located on the Plans. The estimated quantities set out in the Proposal Form for such items are presented solely for the purpose of obtaining a representative bid price, but are not intended to indicate the Department's anticipation as to the quantities of such items which are to be

actually incorporated into the Project. Depending on field conditions, such "if and where directed" items may or may not be incorporated into the Project and if incorporated may be many times the estimated quantity or only a fraction thereof.

Incorporation of such items shall only be made on written directions of the Engineer. In the absence of written directions, no such items shall be incorporated into the Project and if incorporated will not be paid for. The Engineer may order incorporation of such items at any location within the Project and at any time during the Contract Time. Claims for additional compensation shall not be made because of any increase, decrease, or elimination of such items, nor because of an increase or decrease in the amount of Work due to the field conditions encountered in incorporating such items into the Project.

102.06 Examination of Contract Documents and Site of Project. { XE "Contract:documents" }{ XE "Examination of contract documents and site of project" }

{ XE "Site conditions" **}**The Bidder shall examine carefully the site of the proposed Project and the Contract Documents before submitting a Proposal. In the event the Bidder's site examination reveals that the site conditions are inconsistent with the Contract Documents, the Bidder shall immediately notify the Department. The submission of a bid is conclusive evidence that the Bidder has made such examination and is fully aware of the conditions to be encountered in performing the Work and is fully aware of the requirements of the Contract Documents and has considered the following:

{ XE "Subsurface conditions" **}1. Investigation of Subsurface and Surface Conditions.** Where the Department has made investigations of subsurface conditions in areas where Work is to be performed under the Contract, or in other areas, some of which may constitute possible local material sources, such investigations are made only for the purpose of study, estimating, and design. Where such investigations have been made, Bidders may, upon written request, inspect the records of the Department as to such investigations subject to and upon the conditions set forth herein. Such inspection of records may be made at the Department of Transportation building, 1035 Parkway Avenue, Trenton, New Jersey, or at such other locations as directed in response to the written request. In the event the Bidder's site examination reveals that the site conditions are inconsistent with the Contract Documents, the Bidder shall immediately notify the Department.

{ XE "Boring logs" **}**Boring logs, if borings are taken, are parts of the subsurface information made available. Such borings, which are taken solely for design purposes, were obtained with reasonable care and recorded in good faith. The soil and rock descriptions shown are determined by a visual inspection of samples from the various explorations unless otherwise noted. These samples are made available for nondestructive examination. The observed water levels and other water conditions indicated on the boring logs are as recorded at the time of the exploration. These levels and other conditions may vary considerably, with time, according to the prevailing climate, rainfall, and other factors.

Boring logs may be inspected at or ordered through the Department's plan file room, 1035 Parkway Avenue, P.O. Box 600, Trenton, New Jersey 08625.

When contour maps have been used in the design of the Project, the Bidders may inspect such maps upon written request, and if available, they may obtain copies for their use.

The records of the Department's subsurface investigation are not a part of the Contract and are made available for inspection solely for the convenience of the Bidder or Contractor. This investigation, while considered by the Department to be sufficient for design purposes in both scope and content, is not necessarily sufficient for construction purposes and is not keyed to the needs of the Bidder and Contractor.

It is expressly understood and agreed that the Department assumes no responsibility whatsoever in respect to the sufficiency or accuracy of the subsurface investigations, the records thereof, or of the interpretations set forth therein or made by the Department in its use thereof other than as used to establish a design for the Project in its as-built condition. There is no warranty or guarantee, either expressed or implied, that the conditions indicated by such investigations or records thereof are representative of those existing throughout such areas, or any part thereof, or that unlooked-for developments may not occur, or that materials other than, or in proportions different from those indicated, may not be encountered.

The availability or use of information described in this Subsection is not to be construed in any way as a waiver of the above provisions, and a Bidder is cautioned to make such independent investigation and examination as necessary to satisfy the Bidder as to conditions to be encountered in the performance of the Work and, with respect to possible local material sources, the quality and quantity of material available and the type and extent of processing that may be required to produce material conforming to the requirements of the Contract Documents.

Information derived from such inspection of records of investigations or compilation thereof made by the Department, the Consultant, or assistants, does not relieve the Bidder or Contractor from any risk or from properly fulfilling the terms of the Contract.

Moreover, New Jersey is a small, heavily populated State whose physical geography has received thorough examination. The Bidder is charged with knowledge of the State's physical geography from publications prepared under the auspices of the Federal and State governments, educational institutions, and others. Therefore, the Bidder, in performing its site investigation, should be fully aware of the following publications and such others as may be listed in the Special Provisions:

a. Bulletin 50, Geologic Series, "The Geology of New Jersey" by H. Kummel, out of print, available generally as library reference material.
b. Geologic Maps of New Jersey, available through NJDEP.
c. Engineering Soils Survey of New Jersey, available through the Bureau of Research, College of Engineering, Rutgers University, New Brunswick, New Jersey 08903.
d. Soil Surveys of Individual Counties prepared by the US Department of Agriculture, Soil Conservation Service, in cooperation with the New Jersey Agricultural Experiment Station and Cook College, Rutgers University, available through local Soil Conservation District Offices.

The Bidder should also conduct such borings, soils tests, and other subsurface investigations and obtain such expert advice on site conditions, both surface and subsurface, as is required for bidding and for the construction of the Project.

2. **ROW Availability**. The Bidder shall consider the effect on its work schedule of any delays in ROW availability as may be set forth under Subsection 108.12. The submission of a bid shall be considered conclusive evidence that the Bidder has considered such delays and made allowance for them in the progress schedule.
3. **Utilities.** The Bidder shall consider the effect on its work schedule of Subsections 105.09 and 105.10. The Bidder shall make a diligent investigation of all utilities on the job site, including any necessary de-energization of power lines, and contact all utilities inquiring as to their planned operations and existing and proposed facilities before bidding.
4. **Other Contractors.** The Bidder shall examine the Project site and adjacent areas so as to be fully aware of other contractors working on or adjacent to the site. The Bidder shall become fully aware of the operations of such contractors before bidding and how their operations affect its progress. The Bidder should also consider, and allow for in bidding, the right of the Department at any time to contract for and perform other or additional work on or near the Project, and the conditions and terms of the Contract relative thereto as set forth in Subsection 105.10.
5. **Mass Diagram and Cross-Sections.** The swell or shrinkage of excavated material and direction and quantities of haul or overhaul as and if shown on said mass diagram are for the purpose of design only, and in like manner as provided in Subheading 1 above, concerning furnishing information resulting from subsurface investigations, the Department assumes no responsibility whatever in the interpretation or exactness of any of the information shown on said mass diagram, and does not, either expressed or implied, make any guarantee of the same.

   Similarly, the cross-sections are not intended to be relied upon to accurately indicate the location or quantities of rock and soil. The Bidder should independently make an investigation as to the location, quality, and quantity of rock and soil.
6. **Existing Structures**. A list of existing structures within the Project will be provided in the Special Provisions. As built plans of existing structures on state owned facilities are available upon written request through the office of Quality Management Services, Engineering Documents Unit, New Jersey Department of Transportation, 1035 Parkway Avenue, P.O. Box 600, Trenton, New Jersey 08625. Plans for existing structures of municipal owned or County owned facilities should be obtained through the Municipality or County. The State assumes no responsibility for the correctness of the Plans. Any information obtained from the existing Plans shall be verified by the Bidder before use of such information for bidding for the construction of the Project. In the event the Bidder's site examination reveals that the site conditions are inconsistent with the Contract Documents, the Bidder shall immediately notify the Department.

102.07 Preparation of Proposal.

{ XE "Proposal:submitting" **}**The Bidder shall submit a Proposal on the forms furnished by the Department or printed from the Computer Disk. The Bidder shall specify a price in figures for each Pay Item. For lump sum items, the price should appear

solely in the box provided for the lump sum item under the column designated as "Amounts." For unit price items the per unit price shall appear under the column designated "Unit Price" in the appropriate box, and the product of the respective unit price and the approximate quantity for that item shall appear under the column designated "Amounts." The Total Contract Price is the sum of all figures shown in the column designated "Amounts" and shall appear at the location provided therefor. When the Bidder intends to bid zero ($0.00) for a Pay Item, a "0" should appear in the "Unit Price" and "Amounts" columns for unit price items or in the "Amounts" column for lump sum items.

{ XE "Alternate Pay Items" **}{** XE "Pay Item:alternate" **}**When the Proposal contains alternate items, the Bidder shall only provide the unit price and amount for the lowest priced alternate item. When alternate items in the proposal have a lump sum pay quantity, the Bidder shall only provide the amount for the lowest priced alternate item. The alternate item for which a price has been provided shall be constructed. When the proposal contains alternate groups of items, the Bidder shall only provide the unit price and amount for each item within the lowest priced alternate group. The alternate group of items for which a price has been provided shall be constructed.

All figures entered in the "Unit Price" and "Amounts" columns and the figure entered for the "Total Contract Price" shall be in ink, typed, or printed from the Computer Disk.

The only entries permitted in the proposal contained on the Computer Disk will be the unit or lump sum prices for items that must be bid. The program on the Computer Disk will perform all extensions of the unit or lump sum prices, calculate the total bid amounts, and print a completed Proposal Form.

The Proposal Form printed from the Computer Disk shall be printed on A4 white paper and shall include all revisions to the proposal included in the latest addendum computer disk issued by the Department. The printed proposal pages from the addendum disk will have the addendum number on every sheet containing bid items. Bids will be accepted only if submitted on the Proposal Form supplied by the Department or printed from the Computer Disk.

The Bidder may make additions or corrections to the unit prices, lump sum prices, or amounts as contained on the computer printed Proposal Form. These changes shall be made in ink.

In all instances, the Proposal Form shall govern. Bid prices presented on any other form or computer disk submitted by the Bidder, if different from those submitted on the Proposal Form, shall not govern.

The Department will supply a form entitled "Listing of Final Revisions" upon which the Bidder should indicate all changes made on the printed Proposal Form. This completed form should be returned to the Department outside of the bid envelope on the day of bid opening.

{ XE "Proposal:form" **}**The Proposal Form must be signed in ink by the Bidder. If the Bidder is an individual, the Bidder's name and post office address must be shown; by a partnership, the name and post office address of each partnership member must be shown; as a joint venture, the name and post office address of each member or officer of the firms represented by the joint venture must be shown; by a corporation, the name of the corporation and the business address of its corporate offices must be shown.

102.08 Balanced Bids. { XE "Balanced bids" }

Each Pay Item should reflect the actual cost, which the Bidder anticipates incurring for the performance of that particular item, together with a proportional share of the Bidder's anticipated profit, overhead, and costs to perform work for which no Pay Item is provided. In no event will the Department consider any claim for additional compensation arising from the bid on an item, or group of items, inaccurately reflecting a disproportionate share of the Bidder's anticipated profit, overhead, and other costs.

102.09 Delivery of Proposals.{ XE "Delivery of proposals" }

Each Proposal should be submitted in a special envelope furnished by the Department. The blank spaces on the envelope shall be filled in correctly to clearly indicate its contents. When an envelope other than the special one furnished by the Department is used, it shall be of the same general size and shape and be similarly marked to clearly indicate its contents. The Proposal shall be mailed or hand carried to the Department at the address and in care of the official in whose office the bids are to be received. Proposals must be received before or at the time and at the place specified in the Advertisement. Proposals will not be accepted after the receipt of bids has been declared closed by the Presiding Officer.

Enclosed in the sealed envelope with the Proposal shall be submitted the following documents:

1. The Proposal Bond as described in Subsection 102.10.
2. An updated financial questionnaire on forms furnished by the Department, properly filled out, signed, and notarized.

When the Bidder submits Proposals for two or more Projects, a single updated financial questionnaire, submitted in a separate envelope, is acceptable instead of a separate questionnaire for each Project.

When the Computer Disk furnished by the Department is used to print the Proposal Form, the Computer Disk shall be updated to include the Bidder's data as instructed in the EBS instructions and returned with the Proposal. The Bidder shall include its vendor ID number in the space provided on the Computer Disk label.

If the Bidder makes corrections or additions in ink to the unit or lump sum prices contained in the Proposal Form printed from the Computer Disk, the Bidder should also submit on the day of bid opening, outside the bid envelope, the completed "Listing of Final Revisions" form as detailed in Subsection 102.07.

102.10 Proposal Bond. { XE "Proposal Bond" }{ XE "Bond:Proposal" }

The Proposal, when submitted, shall be accompanied by a Proposal Bond satisfactory to the Commissioner, on the form furnished by the Department, for a sum of not less than 50 percent of the Total Contract Price.

The Proposal Bond shall be properly filled out, signed, and witnessed, and shall be furnished only by such surety company or companies authorized to do business in this State as are listed in the current US Treasury Department Circular 570 as of the date for receipt of bids for the particular Project.

The Proposal Bond shall be accompanied by a copy of the power of attorney executed by the surety company or companies. The power of attorney shall set forth the authority of the attorney-in-fact who has signed the bond on behalf of the surety company to bind the company and shall further certify that such power is in full force and effect as of the date of the bond.

102.11 Withdrawal of Proposals. { XE "Proposal:withdrawal of" }

A Bidder may withdraw a Proposal after it has been submitted to the Department, provided the request for such withdrawal is received by the Department, in writing or by telegram, before the time set for opening Proposals.

{ XE "Proposal:return of unopened" **}**Proposals shall not be withdrawn after the time designated for the public opening of such Proposal, except that when Proposals for more than one project are to be opened at the same time, a Bidder, at its option, may submit a written request to withdraw its Proposal for the second or succeeding project. The Bidder shall notify the Department, in writing, of its intent to exercise this option before the time set for opening of Proposals. In such event, a short interval of time will be allowed between project Proposal openings to allow the Bidder time to submit an executed Department of Transportation "Request for Withdrawal of Bid" form. Upon presentation of the executed form at the proper time, a Bidder's Proposal will be returned unopened.

102.12 Combination or Conditional Proposals. { XE "Proposal:combination or conditional" }{ XE "Combination or conditional proposals" }

If the Department so elects, Proposal Forms may be issued for projects in combination and/or separately, so that bids may be submitted either on the combination or on separate units of the combination. The Department reserves the right to make awards on combination bids or separate bids to the best advantage of the Department. Combination bids other than those specifically provided for in the Proposal Forms will not be considered. Separate Contracts will be awarded for each individual Project included in the combination.

Conditional Proposals will be considered only when provided for in the Special Provisions.

102.13 Acknowledgment of Revisions. { XE "Acknowledgment of revisions" }{ XE "Proposal:acknowledgment of revisions" }

{ XE "Addenda" **}**When Addenda and other forms of notice giving revisions and interpretations of the Contract Documents are mailed or otherwise transmitted to prospective Bidders, acknowledgment thereof must be made by the Bidder. The acknowledgment shall be sent or hand delivered to the office and/or individual noted on the form and must be received before the Proposal of the Bidder concerned is opened. If the acknowledgment has not been received before the opening of bids, the bid envelope will be returned to the Bidder unopened.

102.14 Public Opening of Proposals. { XE "Proposal:opening of" }

Proposals will be opened and read publicly at the time and place indicated in the Advertisement or such other time and place as may be established by Addendum. Bidders, their authorized agents, and other interested parties are invited to be present.

102.15 Irregular Proposals. { XE "Proposal:irregular" }

{ XE "Proposal:causes of rejection" **}**Proposals will be considered irregular and may be rejected for the following reasons:

1. If the Proposal is on a form other than that furnished by the Department or other than that printed from the Department furnished Computer Disk, or if the form is altered or any part thereof is detached or incomplete.
2. If the Proposal is not properly signed.

3. If the bid is not typed, not in ink, or not printed from the Computer Disk.
4. If there are unauthorized additions, conditional or alternate bids, or irregularities of any kind that may tend to make the Proposal incomplete, indefinite, or ambiguous as to its meaning.
5. If the Bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award. The prohibition does not exclude a reservation limiting the maximum gross amount of awards acceptable to any one Bidder at any one bid letting. However, the Commissioner will make the selection of which Contract or Contracts are to be awarded to such Bidder within the maximum gross amount reserved.
6. If the Bidder makes an alteration of the "Unit Prices" or "Amounts" that have been included by the Department, unless otherwise directed by Addendum received before receipt of bids.
7. Subject to Subsection 103.01, if the Proposal does not contain a unit price for each Pay Item listed or a Total Contract Price. In the case of alternate items or alternate groups of items, the Bidder shall provide prices as stated in Subsection 102.07 and the Proposal.
8. If the Proposal is not accompanied by the Proposal Bond as specified in Subsection 102.10.
9. If the Proposal is not accompanied by an acceptable updated Financial Questionnaire.
10. If acknowledgment of letters and other notices to prospective Bidders, giving revisions of or amendments to the Contract Documents, have not been received as prescribed in Subsection 102.13.
11. If the Commissioner deems it advisable to do so in the interest of the State.

102.16 Disqualification of Bidders. { XE "Disqualification of bidders" }

Any of the following reasons may be considered as being sufficient for the disqualification of a Bidder and the rejection of its Proposal:

1. More than one Proposal for the same work from an individual, firm, partnership, corporation, or combination thereof, under the same or different names. Reasonable grounds for believing that any individual, firm, partnership, corporation, or combination thereof, is interested in more than one Proposal for the work contemplated may cause the rejection of all Proposals in which such individual, firm, partnership, corporation, or combination thereof, is interested.
2. Evidence of collusion among Bidders. Participants in such collusion will not be permitted to submit bids for future work of the Department until reinstatement as a qualified Bidder by the Commissioner.
3. If any Pay Item bid price is obviously unbalanced. However, non-rejection of a bid on this basis shall not be deemed to be a determination by the Department that the bid is balanced.
4. Uncompleted work, which, in the judgment of the Department, might hinder or prevent the prompt completion of additional work, if awarded.
5. Failure to satisfy the pre-award requirements of the Minority Utilization attachments included in the Special Provisions for FHWA funded projects.

SECTION 103 - AWARD AND EXECUTION OF CONTRACT{ XE "EXECUTION OF CONTRACT" }

103.01 Consideration of Proposals. { XE "Proposal:consideration of" }

After the Proposals are opened and read, they are compared on the basis of the correctly determined summation of the correctly determined products of all the quantities for Pay Items shown in the Proposal multiplied by the unit prices bid together with the sums bid for lump sum Pay Items. The Total Contract Price resulting from such comparisons is available to the public upon request. Award will be made on the basis of the Total Contract Price.

In the event of a discrepancy between the unit price bid for any Pay Item and the extension shown for that item under the column of the Proposal Form designated "Amount," the unit price is to govern. Where a unit price is bid for a Pay Item, but no extension is provided, the Department will provide the extension based on the unit price bid and the estimated quantity for that Pay Item. Where an extension is provided by the Bidder in the "Amount" column, but no unit price appears in the "Unit Price" column of the Proposal Form, the Department will provide the unit price by dividing the "Amount" figure provided by the Bidder by the estimated quantity. If there is a discrepancy between the total of the prices provided in the attachment to the Proposal entitled "Supplement for Analysis Of Bid for Pay Item Demolition of Buildings" or the Pay Item "Removal of Asbestos" and the corresponding lump sum price provided in the Proposal for either of those Pay Items, the total of the prices provided in the supplement for bid analysis shall govern and the lump sum price for that Pay Item will be adjusted accordingly.

In the event of a discrepancy between the unit or lump sum prices submitted on the printed Proposal Form and those contained on the Computer Disk or on the "Listing of Final Revisions" form, the unit or lump sum prices submitted on the printed Proposal Form shall govern in all cases.

Where no figure is provided by the Bidder in both the "Unit Price" and "Amount" columns for one or more Pay Items, or where no figure is provided in the "Amount" column for one or more lump sum Pay Items, or where no figure is provided by the Bidder for one or more demolition numbers in the supplement for analysis of either demolition of buildings or removal of asbestos, the Department will consider the amount bid to be zero ($0.00) for that item provided, however, that the Commissioner may reject such a bid if this result be unconscionable and it is shown that the failure to include a bid price was an excusable mistake.

In the event a corporation not incorporated in the State is the lowest Bidder, it shall be authorized to do business in the State pursuant to NJSA 14A:15-2 *et seq*.

The Commissioner may reject any or all Proposals when the Commissioner determines that it is in the public interest to do so. The Commissioner reserves the right to waive technicalities or to advertise for new Proposals.

103.02 Award of Contract. { XE "Contract:award of" }{ XE "Award of Contract" }

The Award will be made to the lowest responsible Bidder whose Proposal conforms in all respects to the requirements set forth in the Contract Documents. The successful Bidder shall also provide to the Department, within the same ten State Business Day period, proof of a valid business registration with the Division of Revenue in the New Jersey Department of Treasury. The Contract will not be entered into by the Department unless the Bidder first provides proof of a valid business registration in compliance with P. L. 2001, c.134 (N.J.S. 52:32-44). The Commissioner will award the Contract or reject all bids within 30 State business days after the bids are received. For FHWA funded projects, Award of the Contract will not be made unless the lowest responsible Bidder has submitted an approved Affirmative Action Plan as specified in the Disadvantaged Business Enterprise Utilization Attachment or the Emerging Small Business Enterprise Utilization Attachment, FHWA Funded Projects, included in the Special Provisions.

The Commissioner may make a Conditional Award pending the approval of the Federal Government, another State governmental body, or private party. Should the Contract not be awarded or conditionally awarded within 30 State business days, all Bidders shall have the right to withdraw their bids. However, the Commissioner and the lowest responsible Bidder and/or the second lowest responsible Bidder can agree to extend the time within which the Commissioner may make an award or conditional award by mutual consent.

At the time of Award or Conditional Award to a Bidder not a resident of the State, such Bidder shall appoint, on the form furnished by the Department, a proper agent in the State on whom service can be made in event of litigation of any type arising under the Contractor or as a result of performance of the Contract. Said agency shall remain in effect during the performance of the Contract and for six years following Acceptance.

The Award or Conditional Award is not binding upon the State until the Contract has been executed by the Commissioner, nor shall any work be performed on account of the proposed Contract until the prospective

Contractor has been notified that the Contract has been executed by the Commissioner, and then only as provided in Subsection 108.03.

103.03 Cancellation of Award. { XE "Cancellation of award of contract" }

{ XE "Conditional Award" **}**The Department reserves the right to cancel an Award or Conditional Award at any time before the execution of said Contract by all parties without any liability against the Department.

103.04 Return of Proposal Bond. { XE "Proposal Bond:return of" }

All Proposal Bonds except those of the two lowest Bidders will be returned within three State business days after receipt of bids.

The Proposal Bond of the lowest and next lowest Bidders will be returned when the Contract and Performance Bond and Payment Bond have been executed and delivered according to the provisions of Subsection 103.06, or, if not executed, when other disposition of the matter has been made by the Commissioner. However, when the Award or Conditional Award has been annulled due to failure of the Bidder to whom award was made to execute and deliver the Contract and Performance Bond and Payment Bond, the Proposal Bond of such Bidder shall become operative as provided in Subsection 103.07.

103.05 Performance Bond and Payment Bond. { XE "Bond:Performance and Payment" }{ XE "Performance bond" }{ XE "Payment bond" }

Within ten State business days of the date of Award or Conditional Award, the Bidder to whom the Contract has been awarded shall complete and deliver a Performance Bond and a Payment Bond on forms furnished by the Department.

Each bond shall be the sum of not less than the Total Contract Price less the lump sum bid for the Pay Item "Performance Bond and Payment Bond" and shall be maintained by the Contractor until Acceptance. In the event of the insolvency of the surety or if the Performance Bond and Payment Bond have not been properly authorized or issued by the Surety company, the Contractor shall furnish and maintain, as above provided, other surety satisfactory to the Commissioner.

All alterations, extensions of Contract Time, extra and additional work, and other changes authorized by the Contract Documents may be made without securing the consent of the surety or sureties of the bonds.

The surety corporation bonds shall be furnished by only those sureties listed in the US Treasury Department Circular 570 and authorized to do business in the State. The bonds shall be accompanied by a certification as to authorization of the attorney-in-fact to commit the surety company and a true and correct statement of the financial condition of said surety company.

Payment for the Performance Bond and the Payment Bond will be made upon commencement of work on the basis of the lump sum bid or the actual cost (gross premium), whichever is less, upon submission of a paid bill and the report of execution issued by the Surety showing the gross premium of the bonds and the broker's fee. Upon Completion, the Department's payment for the Performance and Payment Bond will be adjusted to reflect any increase or decrease in the actual cost of the bonds. Any increase will be based upon the rate schedule certified by the Surety and submitted by the Contractor at the beginning of the Project. If the certified schedule and the paid bill are not submitted at the beginning of the Project, no adjustment will be made. Any increase or decrease in the actual cost of the bonds otherwise known as the adjustment of less than one hundred dollars will be disregarded. The adjustment will be calculated on whichever of the following methods results in the lowest adjustment:

1. The difference between the actual cost paid by the Contractor before the commencement of work and the paid final bill submitted by the surety company or agent.
2. The difference between the actual cost paid by the Contractor before the commencement of work and the final amount as calculated by using the certified schedule submitted at the beginning of the Project.

If the amount of this final bill reflects an increase in the cost of the Performance and Payment Bonds, the Department will pay the Contractor the amount as determined above in the final payment to be made to the Contractor after Acceptance. If the amount of the final bill reflects a decrease in the cost of the Payment and Performance Bonds, the Department will deduct that amount from the final payment made to the Contractor after Acceptance.

Any increase in the construction layout ratio will not be included in the Surety adjustment.

Payment will be made under:

Pay Item	*Pay Unit*
PERFORMANCE BOND AND PAYMENT BOND	LUMP SUM

103.06 Execution and Approval of Contract. { XE "Contract:execution and approval of" }{ XE "Execution and approval of contract" }

The Contract shall be signed by the successful Bidder and returned, together with the Performance Bond and Payment Bond, within ten State business days of the date of Award or Conditional Award. The successful Bidder shall also provide to the Department, within the same ten State Business Day period, proof of a valid business registration

with the Division of Revenue in the New Jersey Department of Treasury. The Contract will not be entered into by the Department unless the Bidder first provides proof of a valid business registration in compliance with P. L. 2001, c.134 (N.J.S. 52:32-44). The successful Bidder who may want to have any or all claims arising under the Contract reviewed by the Claims Review Board, as provided in Subsection 107.02, shall, within the same ten State business day period, escrow its bid preparation documents in sealed boxes with a Custody Agent, and return to the Department a Custody Agreement fully executed by the Bidder and Custody Agent. The Custody Agreement Form will be provided by the Department at the time of award and shall be completed in its entirety and include a list of all documents contained in the escrowed boxes. A failure by the Bidder to escrow its bid preparation documents and to return to the Department the fully executed Custody Agreement in the ten State business day period shall constitute a waiver by the Bidder of any rights to have claims arising under the Contract reviewed by the Claims Review Board. If the Contract is not executed by the Commissioner within 45 State business days following receipt from the Bidder of the signed Contract and Performance Bond and Payment Bond, the Bidder shall have the right to withdraw its bid without penalty. The Contract is not effective until it has been fully executed.

103.07 Failure to Execute Contract. { XE "Contract:failure to execute" }{ XE "Failure to:execute contract" }

{ XE "Annulment of award" **}**Failure on the part of the Bidder to whom the Contract has been awarded to execute and deliver the Contract as provided in Subsection 103.06, and the bonds as provided in Subsection 103.05, in the manner and within the time provided, is just cause for annulment of the Award or Conditional Award and for the exclusion of the Bidder from bidding on subsequent projects for such period as the Commissioner may deem appropriate. If the Award is annulled for the above reasons, the Proposal Bond, as described in Subsection 102.10, shall become forfeited and the State may proceed to recover under the terms and provisions of the Proposal Bond. Award may then be made to the next lowest responsible Bidder, or the Work may be readvertised and constructed under contract, or otherwise, as the Department may decide. The successful Bidder may file with the Commissioner a written notice, signed by the Bidder or the Bidder's authorized representative, specifying that the Bidder refuses to execute the Contract. The filing of such notice has the same force and effect as the failure of the Bidder to execute the Contract and furnish a Performance Bond and Payment Bond within the time herein before prescribed.

SECTION 104 - SCOPE OF WORK{ XE "SCOPE OF WORK" }{ XE "WORK:SCOPE OF" }

104.01 Intent. { XE "Intent of Contract Documents" }{ XE "Contract:intent of" }

The intent of the Contract Documents is to describe a functionally complete and aesthetically acceptable Project to be constructed and completed by the Contractor in every detail according to the Contract Documents. Any Work that may be reasonably inferred from the Contract Documents as being required to produce the intended result shall be supplied whether or not specifically called for. Where the Contract Documents describe portions of the Work in general terms, but not in complete detail, it is understood that only the best construction practice is to prevail and only materials and workmanship of the first quality are to be used.

Only where the Contract Documents specifically describe a portion of the Project as being performed by others is the Work deemed not to constitute construction of the entire Project.

104.02 Changes.{ XE "Changes:in the contract" }{ XE "Quantities:adjustment of estimated" }

The Engineer reserves the right to make, in writing, at any time during the Work, such changes in quantities and such alterations in the Work as are necessary to satisfactorily complete the Project. Such changes in quantities and alterations do not invalidate the Contract nor release the surety, and the Contractor agrees to perform the work as altered.

{ XE "Adjustment of:estimated quantities" **}**If the alterations or changes in quantities significantly change the character of the Work under the Contract, whether such alterations or changes are in themselves significant changes to the character of the Work or by affecting other work cause such other work to become significantly different in character, or not changed by any such different quantities or alterations, an adjustment, excluding loss of anticipated profits, will be made to the Contract. The basis for the adjustment shall be agreed upon before the performance of the work. If a basis cannot be agreed upon, then an adjustment will be made either for or against the Contractor in such amount as the Engineer may determine to be fair and equitable.

If the alterations or changes in quantities do not significantly change the character of the Work to be performed under the Contract, the altered work will be paid for as provided elsewhere in the Contract.

The term “significant change” shall be construed to apply only to the following circumstances:

1. When the character of the Work as altered differs materially in kind or nature from that involved or included in the original proposed construction, or
2. When a major item of work, as defined elsewhere in the Contract, is increased in excess of 125 percent or decreased below 75 percent of the original Contract quantity. Any allowance for an increase in quantity shall apply only to that portion in excess of 125 percent of original Contract item quantity, or in case of a decrease below 75 percent, to the actual amount of work performed.

{ XE "Adjustment of:unit prices of major Pay Items" **}**Changes that solely involve the increase or decrease in the quantity of Pay Items (not involving unit price adjustments pursuant to Subsection 104.05), the elimination of Pay Items, the adjustment of the estimated quantities in the Proposal as the result of as-built calculations, or minor changes in the Work as provided in Subsection 104.03, may be affected by Field Order or Change Order, as determined by the Engineer. All other changes will be included in a Change Order that specifies, in addition to the Work to be done, an adjustment of Contract Time, if any, and the basis of compensation for such Work. A Change Order does not become effective until the Executive Director of Regional Operations has approved the proposed Change Order submitted by the Resident Engineer.

{ XE "Field order" **}**Upon receipt of a Field Order or Change Order, the Contractor shall proceed with the ordered Work. Where the changes involved require a Change Order, and a Change Order has not yet been issued, the Resident Engineer may direct, by Field Order, that the Contractor proceed with the desired Work, and the Contractor shall comply. In such cases, the Engineer will, as soon as practicable, issue a Change Order for such Work.

When the compensation for an item of Work is subject to adjustment under the provisions of Subsections 104.04 through 104.09, the Contractor shall, upon request, furnish the Engineer with adequate detailed cost data for such item of Work. If the Contractor requests an adjustment in compensation for an item of Work as provided in Subsection 104.05, such cost data shall be submitted with the request.

In addition to Field Orders and Change Orders, the terms and conditions relating to changes may be negotiated with the Contractor. If the Contractor signifies acceptance of such terms and conditions by executing a Supplementary Agreement, and if such Supplementary Agreement is approved by the Executive Director of Regional Operations and issued to the Contractor, payment according to the terms and conditions as to compensation and adjustments in the Contract Time therein set forth constitutes full compensation and a mutually acceptable adjustment of Contract Time for all Work included therein or required thereby. The Contractor agrees that a proposed Supplementary Agreement that is not approved by the Executive Director of Regional Operations or

that is rejected by the Contractor shall have no effect and that neither may attempt to use it in any litigation that may result from the Contract.

No claim for additional compensation shall be made because of any such alteration, deviation, addition to, or omission from the Work required by the Contract, by reason of any variation between the approximate quantities in the Proposal and the quantities of Work as done, by reason of Extra Work, by reason of elimination of Pay Items, or by reason of changes in the character of Work except as allowed in this Section. Attention is directed to Subsections 102.08 and 107.27.

No claim for additional compensation or extension of Contract Time within the scope of this Section will be allowed if asserted after Acceptance.

104.03 Minor Changes in the Work. { XE "Changes: minor" }

The Resident Engineer has the authority to order minor changes in the Work not involving an adjustment to the unit or lump sum prices, or an adjustment to Pay Items, or an extension of Contract Time, and not inconsistent with the intent of the Contract Documents. Such changes may be effected by Field Order and are binding on the Department and the Contractor. Additional compensation or extension of Contract Time will not be allowed.

104.04 Procedure and Protest. { XE "Change Order:procedure for protest" }

A Field Order or Change Order may be issued at any time. Should the Contractor disagree with any terms or conditions set forth in a Field Order or a Change Order, the Contractor shall submit a written protest to the Engineer within 15 days after the receipt of such Field Order or Change Order on forms furnished by the Department. The protest shall state the points of disagreement, and, if possible, the specification references, quantities, and costs involved. The protest shall be a specific, detailed statement of the points of disagreement, and the Engineer reserves the right to reject general protests. Rejected general protests that are not cured by the submission of a specific, detailed statement within five days of such rejection will not be considered. If a written protest is not submitted, payment will be made as set forth in the Field Order or Change Order and such payment constitutes full compensation for all Work included therein or required thereby and also is conclusive as to any Contract Time adjustments provided for therein or in establishing that no Contract Time adjustment was warranted.

Protests related to Work ordered by Field Order, but as to which a Change Order is required, shall be made within 15 days after receipt of the Field Order. Subsequent issuance of the Change Order shall not be the basis for a protest except to the extent that the Change Order differs materially from the Field Order.

Where the protest concerning a Field Order or a Change Order relates to compensation, the compensation payable for all Work specified or required by said Field Order or Change Order to which such protest relates, if later deemed appropriate by the Engineer, will be determined as provided in Subsections 104.05 through 104.08 and Subsection 109.03. The Contractor shall keep full and complete records of the cost of such Work and shall permit the Engineer to have such access thereto consistent with Subsection 109.12, as may be necessary to assist in the determination of the compensation payable for such Work.

Where the protest concerning a Change Order relates to the adjustment of Contract Time, the time to be allowed, if later deemed appropriate, will be determined as provided in Subsection 108.11.

104.05 Increased or Decreased Quantities. { XE "Quantities:decreased or increased" }

{ XE "Quantities:adjustment of estimated" **}{** XE "Adjustment of:unit prices of major Pay Items" **}{** XE "Pay Item:Major:eligibility for price adjustment" **}{** XE "Estimated quantities:adjustment of" **}**Increases or decreases in the quantity of a Pay Item will be determined by comparing the total as-built quantity of such item of Work with the quantity contained in the Proposal. In making such a comparison, quantities that are the subject of Supplementary Agreements or Change Orders for Extra Work will not be considered.

Minor Pay Items are not eligible for any adjustment in unit price regardless of how much the total as-built quantity varies from the quantity contained in the Proposal unless eligible for adjustment pursuant to Subsection 104.07.

If the total pay quantity of any Major Pay Item varies from the estimate contained in the Proposal by more than 25 percent, payment will be made according to the following categories:

1. **Increases of More Than 25 Percent.** Should the total as-built quantity of any Major Pay Item exceed the estimate contained in the Proposal by more than 25 percent, the Work in excess of 125 percent of such estimate will be paid for by adjusting the unit price, as hereinafter provided. Alternatively, the Contractor and Engineer may negotiate a Supplementary Agreement for such adjustment.

   Such adjustment of the unit price is to be the difference between the unit price and the actual unit cost, which will be determined as hereinafter provided. If the costs applicable to such item of Work include

overhead, such overhead will be deemed to have been recovered by the Contractor by the payments made for the 125 percent of the Contract quantity for such item already paid, and in computing the actual unit cost, such overhead will be excluded. Subject to the above provisions, such actual unit costs will be determined in the same manner as if the Work were to be paid for on a Force Account basis as provided in Subsection 109.03.

When the compensation payable for the number of units of an item of Work performed in excess of 125 percent of the Engineer's estimate is less than $1,500 at the applicable unit price, the Engineer reserves the right to make no adjustment in said price if the Engineer so elects, except that an adjustment will be made if requested in writing by the Contractor.

2. **Decreases of More than 25 Percent.** Should the total as-built quantity of any Major Pay Item be less than 75 percent of the estimate contained in the Proposal, an adjustment in compensation pursuant to this Subsection will not be made unless the Contractor so requests in writing. If the Contractor so requests, the quantity of said item performed will be paid for by adjusting the unit price as hereinafter provided, or at the option of the Engineer, payment for the quantity of the Work of such item performed will be made on the basis of Force Account as provided in Subsection 109.03, provided, however, that in no case shall the payment for such Work be less than that which would be made at the unit price bid. Alternately, the Contractor and Engineer may negotiate a Supplementary Agreement for such adjustment.

   Such adjustment of the unit price is to be the difference between the unit price and the actual unit cost, which will be determined as hereinafter provided, of the total as-built quantity of the item, including overhead. Such actual unit cost will be determined in the same manner as if the Work were to be paid for on a Force Account basis as provided in Subsection 109.03.

   The payment for the total as-built quantity of such item of Work is not to exceed the payment that would be made for the performance of 75 percent of the estimate contained in the Proposal for such item at the original unit price bid.

   The Contractor further understands and agrees that neither the procedure established under this Subsection nor the review of claims by the Department pursuant hereto shall in any way affect the requirement of the filing of a Notice of Potential Claim or the filing of a suit pursuant to the provisions of NJSA 59:13-1 *et seq*.

104.06 Eliminated Items. { XE "Eliminated items" }

Should any Pay Item contained in the Proposal be found unnecessary for the proper completion of the Work, the Engineer may, upon written order to the Contractor, eliminate such item from the Contract. In such case compensation, if any is appropriate, will be made as provided in this Subsection.

If acceptable material is ordered by the Contractor for the eliminated item before the date of notification of such elimination and if orders for such material cannot be canceled, it will be paid for at the actual cost to the Contractor. In such case, the material paid for becomes the property of the State, and the actual cost of any further handling will be paid for. If the material is returnable to the vendor and if the Engineer so directs, the material shall be returned, and the Contractor will be paid for the actual cost or charges made by the vendor for returning the material. The actual costs of handling returned material will be paid for.

The actual costs or charges will be computed in the same manner as if the Work were to be paid for as provided in Subsection 109.03. However, no profit will be allowed.

A reduction in the Contract Time may be made by the Engineer pursuant to Subsection 109.11, if appropriate.

104.07 Changes in Character of Work. { XE "Changes:in character of work" }

If the Engineer determines that an ordered change in the work materially changes the character of the work of a Pay Item, or a portion thereof, and if the change substantially increases or decreases the actual unit cost of such changed item as compared to the actual or estimated cost of performing the work of said item according to the Contract Documents originally applicable thereto, in the absence of a Supplementary Agreement or unprotested Change Order specifying the compensation payable, an adjustment in compensation will be made according to the following:

{ XE "Supplementary agreement" **}**1. The basis of such adjustment in compensation will be the difference between the actual unit cost to perform the work of said item or portion thereof involved in the change as originally planned and the actual unit cost of performing the work of said item or portion thereof involved in the change, as changed. Actual unit costs will be determined in the same manner as if the work were to be paid for as provided in Subsection 109.03, or such adjustment as is agreed to in a Supplementary Agreement. Any such adjustment is to apply only to the portion of the work of said item actually changed in character.

2. At the option of the Engineer, the work on said item or portion of item, which is changed in character will be paid for as provided in Subsection 109.03.
3. If the compensation for an item of Work is adjusted under this Subsection, the costs recognized in determining such adjustment and quantity involved will be excluded from consideration in making an adjustment for such item of Work under the provision in Subsection 104.05.

Failure of the Engineer to recognize a change in character of the Work at the time a Field Order or Change Order is issued does not relieve the Contractor of the duty and responsibility of filing a written protest within the five-day limit as provided in Subsection 104.09.

An adjustment in compensation will be made if there is an increase or decrease in excess of five percent in solid waste disposal costs incurred as a result of lawful increases or decreases in the rates, fees, or charges of the solid waste facility to be used or due to an order issued by the NJDEP in conjunction with the Bureau of Public Utilities directing the solid waste to be disposed at a solid waste facility other than the disposal facility previously used. Adjustments in compensation will be made according to the provisions above. Adjustments in compensation will not be made if actual disposal costs have changed by less than five percent of the fee structure provided according to the requirements of Subsection 108.04.

104.08 Extra Work. { XE "Extra work" }

The Department reserves the right to require Extra Work as needed for the satisfactory completion of the Project. Such Work will be designated as Extra Work when it is determined by the Engineer that such Work is not covered by any of the various items for which there is a bid price or combinations of such items. In the event portions of such Work are determined to be covered by some of the various items for which there is a bid price or combinations of such items, the remaining portion of such Work will be designated as Extra Work. Extra Work also includes Work specifically designated as Extra Work in the Contract Documents.

The Contractor shall do such Extra Work and furnish labor, material, and equipment therefor upon receipt of a Change Order, Field Order, or Supplementary Agreement. In the absence of such, the Contractor shall not perform, nor be entitled to payment for, such Extra Work.

Payment for Extra Work required pursuant to the provisions in this Subsection will be made as provided in Subsection 109.03, or as agreed to in a Supplementary Agreement.

If the Contractor and the Engineer cannot agree on a Supplementary Agreement for Extra Work and the Engineer deems it inadvisable to have such Work completed on a Force Account basis as provided in Subsection 109.03, the Commissioner may elect to have such Work completed by others, and the Contractor shall not interfere therewith nor have any claim for additional compensation as the result of such election.

104.09 Notification of Changes. { XE "Notification of changes" }

{ XE "Changes:in the contract" **}**The Contractor shall promptly report State conduct that the Contractor believes to constitute a change to the Contract. Except for changes identified as such pursuant to Subsections 104.02 and 104.03, the Contractor shall promptly notify the Engineer in writing, on forms provided by the Department, within five days from the date that the Contractor identifies any State conduct including actions, inactions, and written or oral communications, which the Contractor regards as a change to the Contract terms and conditions. In no event shall the Contractor begin Work or incur any expenses with relation to the claimed change before giving notice.

The notice shall state the following on the basis of the most accurate information available to the Contractor:

1. The date, nature, and circumstances of the conduct regarded as a change.
2. The name, function, and activity of each State individual and official or employee involved in or knowledgeable about such conduct.
3. The identification of any documents and the substance of any oral communication involved in such conduct.
4. In the instance of alleged acceleration of scheduled performance or delivery, the basis for the Contractor's claim of accelerations.
5. In the instance of alleged Extra Work, the basis for the Contractor's claim that the Work is extra.
6. The particular elements of Contract
    a. What Pay Items have been or may be affected by the alleged change.
    b. What labor or materials or both performance for which the Contractor may seek additional compensation under this Section including:have been or may be added, deleted, or wasted by the alleged change and equipment idled, added, or required for additional time.
    c. To the extent practicable, what delay and disruption in the manner and sequence of performance and effect on continued performance have been or may be caused by the alleged change.

d. What adjustments to Contract price, delivery schedule, and other provisions affected by the alleged change are estimated.

Following submission of the notice, the Contractor shall diligently continue performance of the Contract to the maximum extent possible according to the Contract Documents, unless such notice results in a direction by the Engineer, in which event the Contractor shall continue performance in compliance therewith, provided, however, that if the Contractor regards such direction itself as a change, notice shall be given as provided above. All directions, orders, and similar actions of the Engineer will be reduced to writing and copies thereof furnished to the Contractor.

The Resident Engineer will promptly, and in any event within ten days after receipt of notice, respond thereto in writing. In such response, the Resident Engineer will do one of the following:

1. Confirm that the conduct of which the Contractor gave notice constitutes a change, and when necessary direct the mode of further performance.
2. Revise or rescind any communication regarded as a change.
3. Deny that the conduct of which the Contractor gave notice constitutes a change, and when necessary direct the mode of further performance; or
4. In the event the Contractor's notice information is inadequate to make a decision under Items 1, 2, or 3 of this paragraph, advise the Contractor as to what additional information is required, and establish the date by which it should be furnished and the date thereafter by which the Department will respond.

If the Engineer confirms that State conduct effected a change as alleged by the Contractor, and such conduct causes an increase or decrease in the cost of, or the time required for performance of any part of the Work under the Contract, whether changed or not changed by such conduct, an adjustment in compensation will be made according to the provisions of this Section, and the Contract will be modified in writing accordingly. In the case of drawings, designs, or specifications that are defective and for which the State is responsible, the adjustment will be made to include the cost and extension of Contract Time for delay reasonably incurred by the Contractor in attempting to comply with such defective drawings, designs, or specifications before the Contractor identified, or reasonably should have identified, such defect. When the cost of property made obsolete or excess as a result of a change confirmed by the Engineer pursuant to this Subsection is included in the adjustment in compensation, the Engineer has the right to prescribe the manner of disposition of such property. Adjustments will not be made that include increased costs or extensions of Contract Time for delay resulting from the Contractor's failure to provide adequate notice or to continue performance as provided above. Any adjustments of Contract Time will be made pursuant to Subsection 108.11.

The failure of the Contractor to give notice pursuant to the provisions of this Subsection shall constitute a waiver of any and all claims and damages that could have been avoided or mitigated had such timely notice been given. Moreover, no action or inaction of any person shall constitute a waiver of the State's absolute right to receive written notice of an alleged claim pursuant to this Subsection.

The Contractor further understands and agrees that neither the procedure established under this Subsection nor the review of claims by the Department pursuant hereto shall in any way affect the requirement of the filing of a Notice of Potential Claim or the filing of a suit pursuant to the provisions of NJSA 59:13-1 *et seq*.

104.10 Rights In and Use of Materials Found on the Work. { XE "Materials:found on the work" }

The Contractor, with the approval of the Engineer, may use on the Project such stone, gravel, sand, or other material determined suitable by the Engineer, as may be found in the excavation and will be paid both for the excavation of such materials at the corresponding unit price and for the Pay Item for which the excavated material is used except for the provisions for roadway excavation as provided in Subsection 202.04. The Contractor shall replace at its own expense with other acceptable material all of that portion of the excavated material that was needed in the embankments, backfills, approaches, or otherwise. Charge for the materials so used will not be made against the Contractor. The Contractor shall not excavate or remove any material from within the highway location that is outside the grading limits, as indicated by the slope and grade lines, without written authorization. The Contractor will not be paid for the excavation so authorized and shall replace the excavated material at no cost to the State.

104.11 Value Engineering. { XE "Value Engineering" }

The term "proposal" as used in this Subsection is construed to mean a Value Engineering proposal submitted by the Contractor for changing the Plans, Specifications, or other requirements of the Contract. The Value Engineering proposal shall conform with the following:

1. **Purpose and Scope.** The intent of Value Engineering is to share with the Contractor any cost savings generated on the Contract as a result of a proposal or proposals offered by the Contractor and approved by the Department. The purpose is to encourage the use of Contractor's ingenuity and experience in arriving at alternative, lower cost or time-saving construction methods other than those reflected in the Contract

Documents, by the sharing of savings resulting therefrom. The proposals contemplated are those that could produce a savings to the Department without, in the sole judgment of the Engineer, impairing essential functions and characteristics of the Project or a portion of the Work involved. They include but are not limited to safety, service life, stage construction, economy of operation, ease of maintenance, and desired appearance.

2. **Submittal of Initial Proposal.** An initial proposal is required for all Value Engineering proposals and shall outline the general technical concepts associated with the proposal and the estimated savings that will result.

   The initial proposal will be reviewed by the Department and, if found to be conceptually acceptable, approval to submit a final proposal will be granted by the Department. A finding of conceptual acceptability of the initial proposal in no way obligates the Department to approve the final proposal. The Contractor shall have no claim against the State as a result of the rejection of any such final proposal.

3. **Submittal of Final Proposal.** Final proposals will be considered only after Department approval of the initial proposal according to Subheading 2 above. Final proposals will not be considered if submitted after 50 percent completion of the Work has occurred, based on monthly estimates amounting to more than 50 percent of the total adjusted Contract price, unless the remaining Contract Time is one year or more. As a minimum, the following materials and information shall be submitted with each final proposal plus any additional information requested by the Department:
   a. A statement that the final proposal is submitted as a Value Engineering proposal.
   b. A description of the difference between the existing Contract requirements and the proposed change, and the comparative advantages and disadvantages of each, including considerations of safety, service life, economy of operations, ease of maintenance, and desired appearance.
   c. Complete plans, specifications, and calculations showing the proposed revisions relative to the original Contract features and requirements. All plans and engineering calculations shall bear the signature of a Professional Engineer licensed to practice in the State.
   d. A complete cost analysis indicating the final estimate costs and quantities to be replaced by the proposal, the new costs and quantities generated by the final proposal, and the cost effects of the proposed changes on operational, maintenance, and other considerations.
   e. A specific date by which a Change Order or Supplementary Agreement adopting the final proposal must be executed so as to obtain the maximum cost reduction during the remainder of the Contract. This date must be selected to allow the Department ample time, usually a minimum of 60 days, for review and processing a Change Order or Supplementary Agreement. Should the Department find that insufficient time is available for review and processing, it may reject the final proposal solely on such basis. If the Department fails to respond to the final proposal by the date specified, the Contractor shall consider the final proposal rejected and shall make no claim against the State as a result thereof.
   f. A statement as to the effect the final proposal has on the Contract Time.
   g. A description of any previous use or testing of the final proposal on another Department project or elsewhere and the conditions and results therewith. If the final proposal was previously submitted on another Department project, indicate the date, the project, and the action taken by the Department.

4. **Conditions.** Proposals will be considered only after Award of Contract and only when all of the following conditions are met:
   a. The Contractor is cautioned not to base any bid prices on the anticipated approval of a proposal and to recognize that such proposal may be rejected. In the event of rejection, the Contractor is required to complete the Contract according to the Plans and Specifications and the prices bid.
   b. All proposals, approved or not approved by the Department for use in the Contract, apply only to the ongoing Contract or Contracts referenced in the proposal. The proposals shall become the property of the Department and shall contain no restrictions imposed by the Contractor on their use or disclosure. The Department will have the right to use, duplicate, and disclose in whole or in part any data necessary for the utilization of the proposal. The Department retains the right to use any accepted proposal or part thereof on any other or subsequent project without any obligation to the Contractor. This provision is not intended to deny rights provided by law with respect to patented materials or processes.
   c. If the Department already has under consideration certain revisions to the Contract that are subsequently incorporated in a proposal, the Department will reject the Contractor's proposal and may proceed with such revisions without any obligation to the Contractor.

d. The Contractor shall make no claim against the Department for any costs or delays due to the Department's rejection of a proposal, including but not limited to development costs, anticipated profits, or increased materials or labor costs resulting from delays in the review of such proposal.
e. The Engineer will determine whether a proposal qualifies for consideration and evaluation. The Engineer may reject any proposal that requires excessive time or costs for review, evaluation, and/or investigations, or which is not consistent with the Department's design policies and basic design criteria for the Project.
f. The Engineer may reject all or any portion of Work performed pursuant to an approved proposal if the Engineer determines that unsatisfactory results are being obtained. The Engineer may direct the removal of such rejected Work and require the Contractor to proceed according to the original Contract requirements without reimbursement for any Work performed under the proposal, or for its removal. Where modifications to the proposal are approved to adjust to field or other conditions, reimbursement is limited to the total amount payable for the Work at the Contract prices as if it were constructed according to the original Contract requirements. Such rejection or limitation of reimbursement does not constitute the basis of any claim against the State for delay or for any other costs.
g. The proposal shall not be experimental in nature but shall have been proven to the Department's satisfaction under similar or acceptable conditions on another Department project or at another location acceptable to the Department.
h. Proposals will be considered only if equivalent options are not already provided in the Contract Documents.
i. The proposal shall be made based on items of Work scheduled to be done by the Contractor. Anticipated cost savings based on revisions of utility relocations or other similar items to be done by others will not be considered. Proposals that may increase the cost of Work done by others will not be considered.
j. The savings generated by the proposal must be of sufficient significance to warrant review and processing.
k. If additional information is needed to evaluate proposals, this information must be provided in a timely manner, otherwise the proposal will be rejected. Such additional information could include, where design changes are proposed, results of field investigations and surveys, design computations, and field change sheets.

If the proposal is approved, the Contractor shall submit drawings, in ink, on polyester film such as Mylar or Herculene, 4 mils thick, matted on both sides except as follows:

a. Structural drawings may be submitted in pencil.
b. Electrical drawings may be matted on one side and may be submitted in pencil.
c. Cross-section sheets may be 3 mils thick and may be matted on one side.

All plans and engineering calculations shall bear the signature of a Professional Engineer licensed to practice in the State.

Proposals will not be considered that change the following:

a. The type, thickness, or joint designs of a concrete, or HMA surface, intermediate, or base course.
b. The types and thicknesses of the unbound materials underlying a concrete, or HMA surface, intermediate, or base course.
c. The basic design of bridges, defined as the type of superstructure and substructure, span length type and thickness of deck, type of beam and arrangement, geometrics, width, and underclearance.
d. The basic design of retaining walls.
e. The basic design of overhead sign supports and breakaway sign supports.
f. The type of noise barriers.
g. Special architectural aesthetic treatments of structures.

All proposals for changes to bridges and structures shall conform to the current AASHTO Standard Specifications for Highway Bridges as modified by the NJDOT Design Manual for Bridges and Structures.

5. Payment. If the proposal is accepted, the changes and payment will be authorized by Supplementary Agreement. Payment will be made as follows:

a. The changes will be incorporated into the Contract by adjustments in the quantities of Pay Items, agreed upon Extra Work Items or by Force Account, as appropriate, according to the Specifications.

b. The cost of the revised Work as determined from the aforementioned changes will be paid according to Section 109. In addition to such payment, upon Completion, the Department will pay to the Contractor, under a separate Pay Item, 50 percent of the actual savings as reflected by the difference between the above as-built payment and the cost of the related construction required by the original Contract Documents computed at Contract bid prices. However, the Department may disregard the Contract bid prices if such prices do not represent the value of the Work to be performed or to be deleted.

c. The Department's costs for review and processing of the proposal will not be deducted from the savings.

d. The Contractor's costs for development, design, and implementation of the proposal are not eligible for reimbursement.

e. The Contractor may submit proposals for an approved Subcontractor, provided that reimbursement is made by the Department to the Contractor and that the terms of the remuneration to the Subcontractor are satisfactorily negotiated and accepted before the proposal is submitted to the Department. Subcontractors may not submit a proposal except through the Contractor.

104.12 Final Cleanup. { XE "Final cleanup" }{ XE "Cleanup, final" }

Before final inspection and Completion, borrow and local material sources and all areas occupied by the Contractor in connection with the Work shall be cleaned of all rubbish, excess materials, temporary structures, and equipment, and all parts of the Work shall be left in an acceptable condition.

If the Contractor fails to complete final cleanup within the time stated in the Special Provisions for the completion of the Contract or within such further time as may have been granted according to the provisions of the Contract, the Contractor shall pay the State liquidated damages pursuant to Subsection 108.16.

Payment for final cleanup will be made on a lump sum basis.

Payment will be made under:

Pay Item	*Pay Unit*
FINAL CLEANUP	LUMP SUM

SECTION 105 - CONTROL OF WORK{ XE "WORK:CONTROL OF" }{ XE "CONTROL OF WORK" }

105.01 Authority of the Engineer. { XE "Engineer:authority of" }

The Engineer will decide all questions that may arise as to the quality and acceptability of the Work and as to the rate of progress of the Work, all questions that may arise as to the interpretation of the Contract Documents, all questions as to the acceptable fulfillment of the Contract on the part of the Contractor, and all questions as to compensation. All questions as to the interpretation of the Contract Documents shall be submitted to the Resident Engineer in writing.

The Engineer has the authority to suspend the Work wholly or in part pursuant to Subsection 108.14 or 108.15 and to suspend partial payments under Subsection 109.05 due to the failure of the Contractor to correct conditions unsafe for the workers or the general public, for failure to carry out provisions of the Contract, or for failure to carry out orders. The Engineer may also suspend the Work wholly or in part for such periods as deemed necessary due to unsuitable weather, for conditions considered unsuitable for the prosecution of the Work, or for any other condition or reason deemed to be in the public interest.

105.02 Communications. { XE "Communications" }

Unless otherwise directed, all communications with the Department shall be sent to the Resident Engineer. Where communications are directed to persons other than the Resident Engineer, a clear copy shall be sent to the Resident Engineer.

105.03 Plans and Specifications. { XE "Plans and specifications" }

The Plans consist of general drawings and show such details as are necessary to give a comprehensive idea of the construction contemplated. The Plans show details of all structures, lines, grades, typical cross-sections of the roadway, location and design of all structures, and a summary of items appearing on the Proposal Form. The Contractor shall keep one set of Plans available on the Project site at all times. All alterations affecting the requirements and information given on the Plans will be authorized in writing.

Omissions from the Plans or Specifications of details of Work which are manifestly necessary to carry out the intent of the Contract Documents, or which are customarily included, shall not relieve the Contractor from including such omitted details of Work, but they shall be included as if fully and correctly set forth and described.

{ XE "Charges for plans and specifications" **}{** XE "Plans and specifications:charges for" **}{** XE "Plans and specifications:furnished by Department" **}**Plans and Specifications will be furnished upon request at a charge according to rates on file with the Department. The successful bidder receives one copy of the governing Standard Specifications and the number of sets of Plans specified below, without charge, upon Award if requested. However, not more than one free copy of the current Standard Specifications will be furnished to any Contractor, regardless of repeated contract awards to it.

One copy of Supplemental Specifications, Special Provisions, and Addenda is furnished, without charge, with each set of the Plans. Additional copies of Supplemental Specifications, Special Provisions, and Addenda are available upon request, at a charge according to the Departmental rate, except that after Award a maximum of five additional free copies will be furnished to the successful bidder upon request.

Request for Plans, Specifications, and Proposal Forms shall be directed to the Cashier of the Department, accompanied by a check for the proper amount drawn to the order of the New Jersey Department of Transportation. Requests for those items furnished without charge shall be directed to the Bureau of Construction Services, Procurement.

Table of Plans Furnished Without Charge

Amount of Contract		Sets
For More Than	To and Including	of Plans
$ 0	$ 500,000	1
500,000	1,000,000	2
1,000,000	5,000,000	3
5,000,000	10,000,000	4
10,000,000	--	5

105.04 Working Drawings. { XE "Working drawings" }

The Contractor shall submit Working Drawings for those particular items of Work or methods of construction (whether permanent or temporary) for which there are no specific detailed drawings contained within the Contract

Documents before performing such items of work or performing such methods of construction. Working Drawings submitted by the Contractor shall only detail particular work to be performed under the Contract Documents and shall not change the Plans or Specifications. A design change shall only be implemented in compliance with the Department procedure for review and approval of a change of plan. The Engineer will return, without further review, any and all Working Drawings found by the Engineer to be repetitious or duplicative of items of Work specified or detailed within the Contract Documents or found to constitute an apparent change of plan; under such circumstances the Contractor shall have no claim for any delays incurred by reason of such improper submittal.

The Contractor shall review, approve, sign, and submit all Working Drawings in orderly sequence so as not to delay the Work, or the work of any other contractor. The Contractor shall be deemed to represent by its act of submitting a Working Drawing for review and approval for final design of conceptual plans (as more fully stated below) or certification for fabrication of items of Work, that it has in fact verified all field measurements and catalog numbers and other criteria and has determined field construction criteria, materials, and other criteria and that the Contractor has checked and coordinated each submitted Working Drawing with the requirements of the Contract Documents and the Work.

The provisions below, for the certification of Working Drawings, shall only apply to the fabrication of all items of Work. Those provisions shall not apply to the review and approval of the design for proprietary walls, noise barriers, temporary sheeting, sheeting left in place, temporary structures, cofferdams and precast concrete culverts or any other items where conceptual plans were included in the Contract Documents and the Contractor is required to complete the final design plans. The items of such work are subject to Department approval. The Contractor shall submit final design plans and calculations, signed and sealed by a Professional Engineer licensed in the State, to the Engineer for Department approval. The Engineer will cause review and resolution of all comments. Upon resolution and satisfaction of all comments, the designated Design Unit will make a recommendation as to approval directed to the Engineer by affixing a stamp indicating "RECOMMENDED FOR APPROVAL." The Engineer will review said recommendation for approval, and within the Engineer's discretion approve the drawing where warranted by a signature and affixing a stamp indicating "APPROVAL BY THE ENGINEER." The work covered by such Working Drawings shall not begin or be fabricated until at least a facsimile signature of the Engineer's approval is received by the Contractor. The carrying out of the Work or the ordering of those materials relating to submitted working drawings before approval by the Engineer is rendered in writing shall constitute a cause for rejection or non-approval by the Engineer of the submitted working drawing and/or a cause for the temporary suspension of the Work so affected, pursuant to Subsection 108.15.

The Engineer, upon receipt of a submitted Working Drawing relating to fabrication only, will cause the Working Drawing to be reviewed with reasonable promptness but only for conformance with the design concept of the project, and with the details and criteria set forth in the Contract Documents. The designated design unit may either certify compliance, conditionally certify compliance with notation or comment or reject Working Drawings as submitted. It shall be within the sole discretion of the designated design unit whether or not a submitted Working Drawing warrants being "certified," "conditionally certified," or "not certified."

A stamp, signed by the designated design unit, reflecting the determination rendered will be affixed to the submitted drawing. Certification of the submitted Working Drawings, without condition, by the designated design unit will be reflected by a stamp stating "CERTIFIED." Conditional certification by the designated design unit will be reflected by a stamp stating "CERTIFIED AS NOTED." Rejection or non-certification will be reflected by a stamp stating "REVISE AND RESUBMIT."

Where submitted Working Drawings are not certified due to nonconformance with the Contract Documents, poor quality, or other stated problem or error, the submitted Working Drawings will be returned directly to the Contractor by the designated design unit for the project with a copy to the Resident Engineer. The Contractor shall make any and all required revisions, corrections, additions and changes to the Working Drawings and otherwise comply with the directions of the designated design unit and shall promptly re-submit to the Engineer appropriately revised Working Drawings along with the required number of copies. The Contractor shall direct specific attention to the Engineer in writing or on resubmitted Working Drawings to those revisions, corrections, changes, or additions that were not requested or directed by the designated design unit on previous submissions. The above-described process shall apply to all re-submissions and revised Working Drawings. The carrying out of the Work or the ordering of those materials relating to submitted Working Drawings before certification or conditional certification is rendered by the designated design unit in writing shall constitute a cause for rejection or non-certification by the Engineer of the submitted Working Drawings and/or a cause for the temporary suspension of the Work so affected, pursuant to Subsection 108.15.

Where the Working Drawings are either certified or conditionally certified, the designated design unit for the Project will return the Working Drawings directly to the Contractor with a copy to the Resident Engineer. Upon receiving certification or conditional certification from the designated design unit in the form of a signed stamp affixed to the submitted Working Drawings, the Contractor may then order material and carry out any work relating

to a submitted Working Drawing; however, where conditional certification is granted by the designated design unit, as reflected by a signed stamp affixed to the submitted drawing stating "CERTIFIED AS NOTED," the Contractor, as a condition of certification, shall submit to the Engineer revised Working Drawings incorporating or satisfying the conditions of the certification as reflected in the designated design unit's notes or comments within 30 days of receipt of the conditionally certified Working Drawings by the Contractor.

Unless prior written approval of the Engineer has been given to the Contractor, the Contractor shall not make any deviations from the approved, certified or conditionally certified Working Drawings. Where the Contractor fails to abide by the Working Drawings as approved or certified or fails to abide by the conditions of a conditional certification, while performing that item of Work to which same applies, such failure shall constitute a cause for the temporary suspension of such work pursuant to Subsection 108.15.

The designated design unit's certification or conditional certification, or the Engineer's approval of Working Drawings, does not relieve the Contractor of any responsibility or liability or modify such responsibility or liability that the Contractor may have under the Contract Documents or under law or equity arising out of or from the Working Drawings, for errors or omissions contained within the Working Drawings or for work carried out pursuant thereto. Also, the designated design unit's certification or conditional certification or the Engineer's approval of Working Drawings shall not be the basis of a claim by the Contractor against the State for indemnification, extra work, change in the character of the work or other similar cause of action. The designated design unit's certification or conditional certification or the Engineer's approval of a separate item of work is not to be construed as certification or approval of an assembly in which the item of work functions; the entire assembly must also be certified or conditionally certified by the designated design unit or approved by the Engineer.

The design of all permanent and temporary structures shall conform to the current AASHTO Standard Specifications for Highway Bridges or, if directed by the Department, the design shall be based on the current AASHTO LRFD Bridge Design Specifications. Additionally, the provisions of the current NJDOT Bridges and Structures Design Manual shall be adhered to.

Working Drawings shall be 22" x 36" sheets or 8½" x 11" sheets. Seven copies shall be submitted to the designated design unit for review and a copy of the transmittal letter shall be sent to the Resident Engineer, except that for railroad carrying structures, four additional copies shall be submitted to the designated design unit. One additional copy each shall be submitted when an outside testing agency or an outside authority is involved in the Project. The above submittal procedure will simultaneously facilitate both certification and distribution.

Each Working Drawing, shall be identified by a title block in the lower right-hand corner, containing the following minimum information:

1. Route and Section or Contract number
2. Name of bridge/structure (on structural drawings only)
3. Municipality and County
4. Contractor's name
5. Fabricator's name (if applicable).
6. Federal Project Number or Data Processing (D.P.) Number
7. Title of drawing
8. Sheet number

The structure number designated on the Contract Plans for each bridge shall be shown in the upper right-hand corner of each Working Drawing.

Each 22" x 36" Working Drawing requiring certification of fabrication, shall contain two blank blocks placed directly above the title block. One block, designated for design unit certification, shall be used for the stamped markings "CERTIFIED" and "CERTIFIED AS NOTED" and, "REVISE AND RESUBMIT" and the other block is designated for the Contractor's approval stamp. Each 22" x 36" Working Drawing requiring approval of final design, shall contain three blank blocks placed directly above the title block. One block, designated for design unit recommendation for approval, shall be used for the signature and stamped marking "RECOMMENDED FOR APPROVAL," and the second block designated for the Engineer's approval, shall be used for the signature and stamped marking "APPROVAL BY THE ENGINEER." The third block is designated for the Contractor's approval stamp. All calculations required for the Working Drawings shall be submitted on 8½" x 11" paper. The calculation submission shall include a cover sheet, which shall also contain a block for an embossed New Jersey Professional Engineer's seal. Each Working Drawing shall contain a revision block, which shall be located to the left and adjacent to the title block. Working Drawings or calculations submitted on 8½" x 11" sheets shall be accompanied by a cover sheet, which shall contain the above blocks; the blocks shall not be included on the other 8½" x 11" Working Drawing/calculation sheets in the submission. The specific format and direction for submission of Working Drawings will be supplied after Award.

The original tracings for each 22" x 36" Working Drawing or the cover sheet for 8½" x 11" Working Drawings or calculations shall include the Contractor's approval stamp, containing the word "APPROVED," and the Contractor's original signature and date. Future revisions to the original tracing shall have the date within the approval stamp updated with each revision to verify that the revision was reviewed and approved by the Contractor.

Original tracings shall be on 22" x 36," 3.15 mils minimum thickness, polyester film, such as Mylar or Herculene, and shall be done in ink, drafting lead, or similar writing material. All lines and lettering on tracings shall be dense in opacity and of sufficient height and width so as to have residual density to produce microfilm negatives from which legible 11" x 17" prints may be made.

Clear and legible 22" x 36" prints produced from the original tracings shall be submitted as Working Drawings for the following:

1. Precast concrete culverts
2. Site specific items not covered by contract documents
3. Structural steel
4. Bearings
5. Machinery for movable bridges
6. Prestressed concrete beams and piles
7. Permanent steel bridge deck forms
8. Expansion dams/strip seals
9. Armored deck joints
10. Bridge storm drains
11 Sign support structures
12. Breakaway and non-breakaway tubular GA sign support posts
13. Prefabricated modular walls
14. Mechanical stabilized earth (MSE) walls
15. Alternate retaining wall designs
16. Concrete crib walls
17. Noise barriers
18. Cofferdams
19. Sheeting left in place
20. Electrical items for movable bridges
21. Bridge railings and fencing anchorages

Working Drawings and the cover sheet for the following shall be on 8½" x 11" or 22" x 36" medium of any type so as to produce clear and legible prints or facsimile copies:

1. Sign legends
2. Electrical items not pre-approved
3. Impact attenuators
4. Temporary shielding
5. Cofferdams with temporary sheeting
6. Temporary structures
7. Temporary sheeting
8. Recycled/Synthetic routed spacers

Material specification designations shall be noted on the Working Drawings.

The original tracings (sepias not accepted) cited above shall be furnished to the Resident Engineer thirty calendar days prior to Completion. A duplicate set shall be furnished for railroad structures.

All costs for providing the Working Drawings shall be included in the prices bid for the various Pay Items scheduled in the Proposal.

105.05 Conformity with Contract Documents. { XE "Contract:conformity with" }

All Work performed shall be in conformity with the lines, grades, cross-sections, dimensions, and material requirements, including tolerances shown in the Contract Documents. The purpose of tolerances is to accommodate occasional minor variations from the middle portion of the tolerance range that are unavoidable for practical reasons. When a maximum or minimum value is specified, the production and processing of the material and the performance of the Work shall be so controlled that the Work shall not be preponderantly of borderline quality or dimension. Although measurement, sampling, and testing may be considered evidence of conformity, the Engineer will determine whether the Work deviates from the Contract Documents.

In the event the Engineer finds the Work not in conformance with the Contract Documents but that reasonably acceptable Work has been produced, the Engineer will determine if the Work is to be accepted and remain in place. In this event, the Engineer will document the basis of the acceptability of the Work and provide for an appropriate adjustment in the contract price for such Work as deemed necessary. If an appropriate adjustment cannot be negotiated, the Work shall be removed and replaced or otherwise corrected at no cost to the State.

In the event the Engineer finds the Work not in conformance with the Contract Documents, including tolerances resulting in an inferior or unsatisfactory product, the Work shall be removed and replaced or otherwise corrected at no cost to the State.

Neither the observations of the Engineer in the administration of the Contract, nor inspections, tests, or approvals by persons other than the Contractor relieves the Contractor from its obligation to perform the Work according to the Contract Documents.

105.06 Special Inspection, Testing, or Approval.{ XE "Inspection:special" }{ XE "Testing:special" }

Whenever the Engineer considers it necessary or advisable to ensure the proper implementation of the Contract Documents, the Engineer has authority to require special inspection or testing of the Work in addition to that required elsewhere in the Contract Documents, whether or not such Work be then fabricated, installed, or completed. However, neither the Engineer's authority to act under this Subsection, nor any decision made by the Engineer either to exercise or not to exercise such authority, creates a duty or responsibility of the Engineer to the Contractor, any subcontractor, or any of their agents or employees performing any of the Work.

If after commencement of the Work the Engineer determines that any Work requires special inspection, testing, or approval not provided for elsewhere in the Contract Documents, the Engineer will perform such inspection, testing, or approval using Department facilities, by contracting with others for such services, or by instructing the Contractor by Field Order to order special inspection, testing, or approval. If such special inspection or testing reveals a failure of the Work to comply with the requirements of the Contract Documents or, with respect to the performance of the Work, with laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction, the Contractor shall bear all costs thereof, including the Engineer's additional services made necessary by such failure. If tests reveal no such failure, the Department will bear such costs, and a Supplementary Agreement will be negotiated.

105.07 Coordination of Contract Documents.

The Contract Documents are essential parts of the Contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a functionally complete Project.

In case of discrepancy, calculated dimensions will govern over scaled dimensions; Plans will govern over Specifications; Right-of-Way Plans will govern over Plans when setting monuments; Special Provisions will govern over Supplemental Specifications; and Supplemental Specifications will govern over Standard Specifications.

As the Work progresses, it is anticipated that the Contractor shall frequently request information from the Resident Engineer relative to the interpretation and coordination of the Contract Documents. Such applications shall be in writing. Should it appear that the Work to be done or any of the matters relative thereto are not sufficiently detailed or explained in the Contract Documents, the Contractor shall request from the Engineer such further explanations as may be necessary and shall conform to them as part of the Contract.

Both parties realize that in performing the Work, field conditions may require modifications in the Plans and quantities of Work involved. Work under all Pay Items must be carried out to meet these field conditions to the satisfaction of the Engineer and according to its directions and the Contract Documents.

{ XE "Plans and specifications:discrepancies and errors" **}**The Contractor shall not take advantage of any apparent error or omission in the Contract Documents. In the event the Contractor discovers any discrepancy, error, or omission in the Plans, Specifications, or other Contract Documents, or if there is any doubt or question as to the intent or meaning of the Plans, Specifications, or other Contract Documents, the Contractor shall immediately notify the Resident Engineer in writing. The Engineer will promptly make, in writing, such corrections and interpretations as deemed necessary.

105.08 Cooperation by Contractor. { XE "Cooperation by contractor" }

The Contractor shall give the Work the constant attention necessary to facilitate the progress thereof, and shall cooperate with the Engineer, the Department's inspectors, and other contractors in every way possible.

When the Contractor is comprised of two or more persons, firms, partnerships, or corporations functioning on a joint venture basis, said Contractor shall designate in writing, before starting Work, the name of one individual who shall have the authority to represent and act for the joint venture.

{ XE "Superintendent of contractor" **}**The Contractor shall designate in writing before starting Work, a competent, English-speaking superintendent capable of reading and thoroughly understanding the Contract Documents, and thoroughly experienced in the type of construction being performed. The superintendent shall have the authority to represent and act for the Contractor. An alternate to the superintendent, with equal authority and qualifications, may also be designated.

The superintendent or the alternate shall be present at the site of the Project at all times while Work is actually in progress on the Contract irrespective of the amount of Work subcontracted. The superintendent or the alternate shall have full authority to execute orders or direction from the Engineer, without delay, and to promptly supply such materials, equipment, tools, labor, and incidentals as may be required. When Work is not in progress and during periods when Work is suspended, arrangements acceptable to the Engineer shall be made for any emergency Work that may be required.

Whenever the superintendent or the alternate is not present on the site or at the location of any particular part of the Work where it may be desired to give direction, the Engineer may suspend all of the Work or the particular Work in reference until the superintendent or the alternate is present. Such suspension shall not be the basis of any claim against the State.

105.09 Cooperation with Utilities. { XE "Cooperation with utilities" }

{ XE "Public utility" **}{** XE "Utilities, public:determining location of" **}**Within the site of the Project there may be public utility structures, and notwithstanding any other clause or clauses of the Contract, the Contractor shall not proceed with its Work until it has made inquiry at the offices of the Engineer, the utility owners and municipal authorities, or other owners to determine their exact location. The Contractor shall notify, in writing, the utility owners and municipalities or other owners involved of the nature and scope of the Project, and of its operations that may affect their facilities or property. Two copies of such notices shall be sent to the Engineer. The Contractor shall also comply with the State's Underground Facility Protection Act and notify the State's One Call System and identify itself as the State's Contractor and specify the route and section number of the Project before performing Work on the Project. The One Call System can be reached by calling 1-800-272-1000.

The Contractor shall also comply with the State's "High Voltage Proximity Act," codified at NJSA 34:6-47.1 to 47.9 inclusive, as amended and supplemented, concerning safety precautions to be taken in the proximity of certain electric conductors installed above ground. In addition, the Contractor's construction operations shall be according to all rules and regulations promulgated by the New Jersey Commissioner of Labor. The Contractor shall follow all applicable rules and regulations issued thereunder, including but not limited to 29 CFR 1926.550 and according to the NEC. The Department of Labor, Office of Safety Compliance may be contacted for the latest rules, regulations, and guidance. Where the Contractor's construction operations are within the proximity of the regulations sited above, the Contractor shall notify the Office of Safety Compliance describing the project and the construction operations proposed by the Contractor to determine compliance. The Contractor shall provide the Resident Engineer with copies of all correspondence and meetings with the Office of Safety Compliance and that the proposed methods of construction are in fact in compliance with the regulations. Should the Contractor change the previously approved method of construction operations, then the Contractor shall be responsible for notifying the Office of Safety Compliance and again obtaining their approval.

Utility agreements and orders relating to the Project, if available, may be inspected at the Utilities and Railroad Engineering Unit located at 1035 Parkway Avenue, E & O Building, Trenton, New Jersey.

The Contractor shall make a written request to the Engineer ten Working Days in advance of the notice called for in the utility schedules to notify utility owners to proceed with each utility item. The Contractor shall guarantee the site availability for utility operations. The Engineer will notify the utility owners to proceed if in the Engineer's opinion the site will be available for a particular item of utility work.

Utility items constructed or installed by the Contractor for a utility owner must meet the owner's specifications. The owner shall be given the opportunity to inspect the actual material to be installed as well as the installation. The Contractor shall notify the utility owner ten days in advance of the beginning of construction of the utility items.

Electrical installations of the Department constructed either before or as part of the Contract shall be considered a utility, and all provisions of this Subsection shall be applicable. Plans showing the locations of such electrical facilities, particularly those underground, are on file with the Department and should be examined by the Contractor before performing any Work, which would endanger these facilities.

{ XE "Utilities, public:damage to" **}{** XE "Utilities, public:cooperation with" **}**The Contractor shall protect, support, and secure all in-place utility facilities so as to avoid damage to them and their interruption of service. The Contractor shall satisfactorily maintain the flow in drains and sewers at all times. The Contractor shall not move utility facilities

without the owner's written consent, and the facilities shall be as safe and permanent at Completion as they were before the Contractor's involvement. In the event the Contractor damages a utility facility, the Contractor shall notify the owner immediately and the owner may require the damage to be repaired at the Contractor's expense. The Contractor shall pay for the repair of utility facilities damaged by the Contractor within 30 days of the completed repair or the Commissioner may retain sufficient monies due or about to be due the Contractor to reimburse the owner for the repair of its facility. The Contractor shall be responsible to repair house services damaged by the Contractor's operation and must have the repair performed by competent mechanics.

The Contractor shall permit the utility owners or their agents access to their facilities at all times and shall cooperate with them in performing their work.

The Contractor shall be cognizant that where joint use poles or duct banks are used the time frames for work performed by each user are cumulative.

Should the Contractor, solely for its own convenience, cause the utility company to incur costs not covered by the utility agreement, or delay the utility company, or incur costs without prior written approval of the Resident Engineer, the Contractor shall be responsible for these costs and delays. The State will reimburse the utility owner for the Contractor generated costs and deduct these expenses from partial or final payment due the Contractor.

The Contractor shall cooperate with the utility owners concerned and shall notify them, through the Resident Engineer, not less than ten days in advance of the time it proposes to perform any Work that may endanger or affect their facilities. The Contractor assumes the obligation of coordinating its activities with those of the utilities.

For the purpose of establishing the exact location of subsurface utilities, the Resident Engineer may direct the excavation of test pits. Failure of the Resident Engineer to direct the digging of test pits does not relieve the Contractor of its responsibilities regarding the protection and preservation of utilities.

It is understood and agreed that the Contractor has considered in its bid all of the permanent and temporary utility facilities in their present or relocated positions as may be shown on Plans, as described in Specifications and as revealed by its site investigation; is aware that utility company service demands, adverse field conditions and emergencies may affect the owner's ability to comply with the proposed schedules for utility work; and is cognizant of the limited ability of the State to control the actions of the utilities, including the actions of railroads, and has made allowances in its bid that no further compensation or extensions of Contract Time will be granted for delays, inconvenience or damage sustained by the Contractor due to any interference from utility facilities or the operation of moving them.

In addition to the foregoing provisions, the following specific provisions relate to railroads only:

{ XE "Railroad:traffic and property" **}1. Railroad Traffic and Property.** Where the Project includes Work across, over, under, or adjacent to railroad tracks or railroad ROW, the Contractor shall safeguard the traffic, tracks, and appurtenances, and other property of the railroad that may be affected by its work. The Contractor shall obtain the railroad's approval of the method of construction and timing of the Work. The Contractor shall comply with the regulations of the railroad relating to the Work, shall keep tracks clear of obstructions, and shall provide barricades, warning signs, lights, or other safety devices as required by the railroad. Payment for such safety devices will be made according to Section 617.

All Work done within the railroad ROW is subject to the approval of the railroad company in matters affecting operations, railroad property, safety, and train operation. The safety and continuity of railroad operation shall be the first priority when working in proximity to the railroad. The Contractor and subcontractors shall protect and safeguard railroad interests at all times and arrange their work to avoid interruption of train movements and damage to facilities of the railroad. Railroad approval does not release the Contractor from responsibility or liability for any damage that the railroad may suffer, or for which the Contractor may be held liable, by the acts of the Contractor or those of its subcontractors or employees.

The Contractor shall develop a schedule with the railroad for its work within the railroad ROW and submit a copy of the schedule to the Resident Engineer.

The Contractor shall give written notice to the railroad and the Resident Engineer not less than 14 days in advance of when it or its subcontractors shall start Work within the railroad ROW, or other Work that may affect railroad property, in order that necessary arrangements may be promptly made to protect railroad property. In the event the Contractor does not start work on the scheduled date, through no fault of the railroad, and the railroad incurs costs resulting from the Contractor's request for the railroad services, the State will reimburse the railroad, and these costs will be deducted from partial or final payments to be made to the Contractor. If the Contractor does not submit to the Resident Engineer a copy of the notice to the railroad and the Contractor performs the Work within the railroad ROW for which the railroad incurs costs, the State will reimburse the railroad and these costs will be deducted from partial or final payments to be made to the Contractor.

Fouling of railroad facilities track, power lines, and signal systems occur when the railroad parameters for normal operation are jeopardized because of obstructions in close proximity to the facilities. The Contractor shall obtain from the railroad its fouling parameters for the Work site and observe the railroad's regulations concerning fouling. Construction equipment or material shall not be stored or operated within the fouling distance of the railroad facilities without written permission of the operating railroad.

Equipment used on and adjacent to the railroad ROW shall be in first class condition so as to fully prevent any failure that might cause delay in the operation of trains or damage to railroad facilities. Contractor equipment is subject to railroad inspection at all times and shall not stand or be put in operation adjacent to the track without first obtaining permission from the railroad.

The railroad company may assign inspectors or engineers during the time the Contractor is engaged in Work on railroad property for the general supervision of construction operations, to ensure adherence to the Contract documents and applicable railroad requirements, and to ensure the use of approved construction methods. The salary and expense of said inspectors or engineers and the cost of any other engineering services furnished by the railroad will be paid directly to the railroad by the State according to the Railroad Utility Agreement. The State will also reimburse the railroad for Project related costs to be incurred by the railroad as set forth in the Railroad Utility Agreement.

Should the Contractor, solely for its own convenience, cause the railroad to incur costs not covered by the railroad agreement, or delay the railroad, or incur costs without prior written approval of the Resident Engineer, the Contractor shall be responsible for these costs and delays. The State will reimburse the railroad for the Contractor generated costs and deduct these expenses from partial or final payment due the Contractor.

2. **Railroad Insurance.** The applicable insurance provisions are as specified in Subheading 6 of the second paragraph of Subsection 107.23.

105.10 Cooperation Between Contractors. { XE "Cooperation between contractors" }

The Department reserves the right at any time to contract for and perform other or additional work on or near the Project site.

When separate contracts are let within the limits of the Project, or in areas adjacent thereto, the Contractor shall conduct its Work so as not to interfere with or hinder the progress or completion of the work being performed by other contractors. Moreover, the Contractor assumes the positive obligation of cooperating with such other contractors and coordinating its activities with theirs. If there is a difference of opinion as to the respective rights of the Contractor and others doing work within the limits of or adjacent to the Project, the Engineer will decide as to the respective rights of the various parties involved in order to secure the completion of the State's Work in general harmony and in a satisfactory manner. The decision of the Engineer is final and binding and is not cause for claims by the Contractor for additional compensation.

The Contractor shall assume all liability, financial or otherwise, in connection with its Contract, and hereby waives any and all claims against the Department for additional compensation that may arise because of inconvenience, delay, or loss experienced by it because of the presence and operations of other contractors working within the limits of or adjacent to the Project.

The Contractor shall arrange its Work and shall place and dispose of the materials being used so as not to interfere with the operation of the other contractors within the limits of the Project or adjacent thereto. The Contractor shall join its Work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others.

The Contractor is not responsible for damage to Work performed on the Contract or on other contracts within or adjacent to the site of the Project that may be caused by or on account of the work of other contractors. The Contractor is responsible for any damage done or caused by its Work or forces to the work performed by other contractors within or adjacent to the site of the Project, and the Contractor shall repair or make good any such damage in a manner satisfactory to the Engineer and at no cost to the State.

The provisions of this Subsection also apply to utilities and their contractors working on the Project site or adjacent thereto.

105.11 Construction Stakes, Lines, and Grades.

{ XE "Control points and stakes" **}A. For Projects with Construction Layout as a Pay Item.** The Contractor shall provide all Work required in connection with the layout for construction of the Project, using the control points and data furnished by the Engineer.

The Contractor shall furnish all necessary qualified personnel and adequate equipment to preserve such controls throughout the duration of the Contract and shall lay out all of the lines and grades necessary for the complete construction of the Project.

The Contractor shall provide the Engineer with copies of all calculations and staking data at least two Working Days before the use of said stakeout information. The survey notes and data shall include, but not be limited to, field notes that were used to establish and set construction stakes, field notes for the alignment, horizontal, and vertical project control, and field notes to document the easement and the monument location.

The Contractor shall make all necessary computations to establish the exact position of all the Work from the control points that are shown on the Plans or furnished by the Engineer. All the Work shall be referenced to baselines which the Contractor shall establish from the control points, re-establish when necessary, and maintain throughout the life of the Contract so as not to delay the Engineer from making necessary preliminary, interim, and final measurements and from checking the Contractor's layout if the Engineer so desires.

The Department will lay out the work to be done by utility companies using the baselines established by the Contractor. The Engineer will notify the Contractor, in writing, not less than five days in advance of when the baselines shall be established.

The Contractor shall be responsible for the preservation of all control points furnished by the Department for its use in staking out the Work. If such control points are damaged, lost, displaced, or removed, they shall be reset at no cost to the State.

The Contractor shall provide and maintain offset stakes from each main roadway baseline, from each ramp, jughandle, or turnaround baseline, and from each local road baseline, at each station, and outside the limits of grading and construction.

Each stake shall be identified and marked to show the offset distance from the baseline, and the Contractor shall furnish grade sheets showing the cut or fill to the finished profile lines with reference to the offset stakes. Grade sheets for construction of subbase and underlayer preparation shall also include calculations to establish the typical cross-section from the profile grade stake. The Contractor shall provide adequate and accurate offset lines during such construction that require occupation of the baseline points by construction operations.

The Contractor shall be responsible for maintaining the points it has established. Any error or apparent discrepancies found in the Plans or Specifications shall be called to the Engineer's attention in writing for interpretation before proceeding with the Work.

The Contractor shall be responsible for the finished Work conforming to the lines and grades called for on the Plans, and the Contractor shall correct all errors caused by its personnel at no cost to the State.

Attention is directed to the need for caution in laying out and constructing storm drains or headwalls to ascertain that these items do not encroach on private property where easements have not been obtained.

Payment for construction layout will be made on a lump sum basis.

The ratio of payment for construction layout to the lump sum price bid for construction layout shall be the same as the ratio of the Total Adjusted Contract Price exclusive of payment for construction layout, incentives, bonus payments, and Performance Bond and Payment Bond to the Total Contract Price exclusive of the price bid for construction layout and Performance Bond and Payment Bond.

Payment will be made under:

Pay Item	*Pay Unit*
CONSTRUCTION LAYOUT	LUMP SUM

{ XE "Construction layout" **}B. For Projects without Construction Layout as a Pay Item.** The Engineer will set construction stakes establishing lines, continuous profile grade in road work, and centerline and bench marks for bridge work, culvert work, protective and accessory structures, and appurtenances as deemed necessary, and the Engineer will furnish the Contractor with all necessary information relating to lines, slopes, and grades. These stakes and marks shall constitute the field control by and according to which the Contractor shall establish other necessary controls and perform the Work.

The Engineer will provide the Contractor with copies of all calculations and staking data at least two Working Days before the use of said stakeout information. The survey notes and data shall include, but

not be limited to, field notes that were used to set construction stakes, field notes for the alignment, horizontal, and vertical project control, and field notes to document the easement and the monument locations.

The Contractor shall be held responsible for the preservation of all stakes and marks, and if any of the construction stakes or marks have been destroyed or disturbed by the Contractor, the cost of replacing them will be deducted from any monies due or that may become due the Contractor.

The Department will be responsible for the accuracy of lines, slopes, grades, and other engineering work that it provides.

The Contractor shall notify the Engineer, in writing, not less than five days in advance of when construction stakes are required. When possible, requests for engineering services shall include work for not less than one day.

An initial supply of stakes and markers for use by State forces shall be furnished in the amount and to the location designated at the preconstruction conference. Thereafter, for the duration of the Project, stakes and markers, in the amounts as ordered by the Engineer, shall be supplied within seven days of each order.

Stakes and markers will be ordered in multiples of twenty-five. Deliveries shall be made to the survey field office or another site within the Project limits, as directed. All bundles to be left outside shall be covered with polyethylene sheet or other water-resistant covering. Invoices for deliveries of stakes and markers used by State forces shall be supplied to the Engineer.

Construction stakes shall be 1¾ by 1¾ inch dressed square hub, pointed, relatively free of knots, oak or equivalent hardwood, 1½ feet long. Short stakes shall conform to the same specification as the 1½ feet long stake, except short stakes shall be 9 inches long.

Markers shall be dressed grade markers, 1¾ by 1 inch, oak or hardwood equivalent, pointed, relatively free of knots, 1½ feet long or 4 feet long, as ordered.

Stake and marker bundles shall be bound securely with metal strap or wire, and the ends shall be protected.

Payment for furnishing construction stakes and markers will be made by the bundle. A bundle represents either 25 stakes or 50 markers.

Payment will be made under:

Pay Item	*Pay Unit*
CONSTRUCTION STAKES AND MARKERS	BUNDLE

C. Vertical Control. Where construction layout is a Pay Item, and before the beginning of any construction work that requires accurate elevations, rough grading and clearing not included, the vertical control network shall be verified in the field by the Contractor's Land Surveyor. The Contractor shall be responsible for the verification work. In most cases, some vertical control is provided for the Project as shown on the Plans. This control must be verified in the field using, at a minimum, third-order, Class I, procedural standards and equipment. In addition, supplemental benchmarks may be required to provide a denser network for efficient construction surveys. Any discrepancies or errors shall be brought to the attention of the Engineer for resolution before proceeding with the Work. The Contractor shall provide the State with the field notes and calculations of the field verification of the vertical control.

D. Horizontal Control. When construction layout is a Pay Item, the Contractor's Land Surveyor shall be responsible to recover, verify, and check the horizontal control shown on the Plans. The Contractor shall be responsible for all the verification work. The field verification shall be performed at the beginning of the Project, as the control line(s) establish(es) a network of control points which are the basis for all subsequent horizontal work on the Project.

The Contractor's Land Surveyor shall use, at a minimum, third-order, Class I accuracy and procedures to establish and re-establish the horizontal control line. The Project baseline(s) shall be verified and established during the early phases of the Project. This baseline establishes a network of control monuments that are the basis for all subsequent horizontal surveys on the Project. Any discrepancies or errors shall be brought to the attention of the Engineer for resolution before proceeding with the Work. The Contractor shall provide the field notes and calculations of the field verification work.

105.12 Authority and Duties of Resident Engineer. { XE "Resident Engineer" }{ XE "Resident Engineer:authorities and duties of" }

As the direct representative of the Engineer, the Resident Engineer has immediate charge of the engineering details of the Project. The Resident Engineer is responsible for the administration of the Contract. This responsibility includes the authority to reject defective material and to suspend any or all of the Work according to Subsections 108.14 and 108.15.

105.13 Duties of the Inspector. { XE "Inspector's duties" }

Inspectors employed by the Department are authorized to inspect all Work. Such inspection may extend to all or any part of the Work and to the preparation, fabrication, or manufacture of the materials to be used. The inspector is not authorized to alter or waive the provisions of the Contract. The inspector is not authorized to issue instructions contrary to the Contract Documents or to act as foreman for the Contractor; however, the inspector has the authority to reject Work subject to confirmation by the Resident Engineer.

105.14 Inspection of Work. { XE "Work:inspection of" }{ XE "Inspection:of work" }

Each part or detail of the Work is subject to inspection by the Engineer. The Engineer shall be allowed access to all parts of the Work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection. When the Engineer is in or about the site of the Work in the course of its employment, the Engineer is deemed conclusively to be an invitee of the Contractor. If the Contractor is not the owner of the place where fabrication, preparation, or manufacture is in progress, the owner thereof shall be deemed to be the agent of the Contractor with respect to the obligation assumed hereunder. The Contractor or its agent shall be responsible for the payment of claims for injuries to the Engineer due to negligence on the part of the said Contractor or its agent.

At the direction of the Engineer, the Contractor, at any time before Acceptance, shall remove or uncover specified portions of the finished Work that the Engineer had previously inspected. After examination, the Contractor shall restore said portions of the Work to the standard required by the Contract Documents. Should the Work so exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering, or making good of the parts removed, will be paid for as Extra Work; however, should the Work so exposed or examined prove unacceptable, the uncovering, or removing, and the replacing of the covering, or making good of the parts removed, will be at no cost to the State.

The Engineer may order any Work done without the Engineer's inspection to be removed and replaced at the Contractor's expense. Payment for the Work will be made and the uncovering, or removing, and the replacing of the covering, or making good of the parts removed, of the uninspected Work will be paid for as Extra Work only if all of the following conditions are met:

1. The Work removed, uncovered, and/or replaced proves to have been acceptable according to the Contract Documents; and
2. The Contractor gave reasonable notice in writing to the Department that the uninspected work was to be performed; and
3. The Contractor, in performing the uninspected work, did not do so in the face of a directive from the Department that such work not be performed.

{ XE "Inspection:of project by Federal agencies" **}**Projects financed in whole or in part with Federal funds are subject to inspection at all times by the Federal agency involved, or such other Federal agencies as the United States requires. Such inspection does not make the Federal Government a party to this Contract.

When any unit of government or political subdivision or any railroad is to pay a portion of cost of the Work covered by the Contract, its respective representatives shall have the right to inspect the Work. Such inspection does not make any such unit of government or political subdivision or any such railroad a party to the Contract and shall in no way interfere with the rights of either party hereunder.

The Contractor is responsible for carrying out the provisions of the Contract at all times and for control of the quality of the Work regardless of whether an authorized inspector is present or not. This obligation to perform the Work according to the Contract Documents is not relieved by the observations of the Engineer in the administration of the Contract, nor by inspections, tests, or approvals by others. Work not meeting the Contract requirements shall be made good, and unsuitable Work may be rejected, notwithstanding that such Work had been previously inspected and approved by the Department or that payment therefor has been included in a monthly estimate certificate.

105.15 Field Office. { XE "Field office" }

The Contractor shall provide and maintain in good condition one or more construction and survey field offices for the exclusive use of the Engineer at a location or locations approved by the Engineer. The field office or offices

shall be ready for use not later than ten days after the date of mailing of the fully executed Contract to the Contractor and before construction operations begin. The field office or offices shall be maintained until no longer required by the Engineer and then removed. It is estimated that the field office or offices is/are required for three months after Completion. Any building scheduled to be demolished under the Contract shall not be used as a field office.

The types of field offices are as follows:

1. Construction Field Offices.

a. Type A. Type A field office shall be of weatherproof construction located on or in the immediate vicinity of the Project, having a floor area of not less than 576 square feet and a ceiling height of not less than 7½ feet, and having partitions and doors providing three communicating rooms, one with a floor area of not less than 288 square feet and two with a floor area of not less than 144 square feet each.

The field office shall be provided with sufficient natural and artificial light and shall be adequately insulated, heated, and air-conditioned. Doors and windows shall be equipped with adequate locks, and all keys shall be in the possession of the Engineer.

The field office shall have one or more clothes closets of ample size for maximum office requirements, and all stairs shall have safety rails installed.

Sanitary conveniences suitable for use by male and female employees of the Department and conforming to the requirements of Subsection 107.10 shall be provided in the field office or offices and shall be stocked with lavatory and sanitary supplies at all times during the life of the Contract.

Adequate free parking shall be provided and maintained for the field office.

The office shall be equipped with the following for the exclusive use of the Engineer, however, the Contractor shall not be responsible for the replacement of equipment that is lost or damaged due to misuse:

{ XE "Telephone service for field office" **}**(1) One or more telephones, pagers, and answering machines, installed as directed.

(2) Two desks with swivel chairs with casters for each room.

(3) Drafting table with high swivel stool with casters and sufficient drawers for 22" x 36" plans, either attached to the table or in cabinet form, for each room.

(4) Tables and chairs for the use of 16 personnel.

(5) One supply cabinet.

(6) Two plan racks.

(7) Four fire-resistant, four-drawer, legal-size file cabinets with lock and two keys meeting fire underwriters' approval for not less than a one-hour test.

(8) One Class ABC fire extinguisher, or one Class A and one Class B fire extinguisher, meeting fire underwriters approval.

(9) Water cooler with bottled water having both hot and cold water dispensers.

(10) One electronic calculator, ten-key, with trigonometric function capability and printout tape.

(11) One electric typewriter, elite type, with 15-inch carriage.

(12) One compact copying machine, plain paper, with letter and legal size capacity.

(13) One plain paper fax machine with a dedicated telephone line, built-in telephone, auto-dial, re-dial, and auto-receive features.

(14) One digital still camera, with battery charger, extra batteries, 3½-inch 2HD floppy diskette image storage, LCD monitor, at least 640 X 480 pixel resolution, at least a 10X zoom lens, built in flash, MS Windows compatible, special effects and exposure modes, e-mail mode, one box of 3½-inch 2HD floppy diskettes per month (10 diskettes per box) and a carrying case.

(15) First-aid box, which shall be restocked as necessary, containing the following list of supplies:

Quantity	Size	Item
32	¾" by 3"	Brand sheer bandages
20	1" by 3"	Brand fabric bandages
4	Medium	Non-stick pads
2	2"	Soft-gauze bandages
2		Oval eye pads
1	51"	Triangular bandage
1	½" by 180"	Hypo-allergenic first-aid tape
10		Antiseptic wipes
1	⅛ oz.	Burn cream, foil pack
1	8 oz.	First-aid cream
1	100 caplets	Tylenol Extra-Strength caplets
1		Scissors
1		Tweezer
1		First-aid guide
1	½ fl.oz.	Ophthalmic irrigation solution
1		Contents cards
10		Large Latex Disposable gloves
10	0.33 ml	Ammonia inhalants
1	350 ml	Sterile water
1	350 ml	Sterile hydrogen peroxide

(16) Office paper shredder.

(17) A microcomputer system compatible with the Department's "ACES" system. The hardware and software requirements, if required, will be provided in the Special Provisions and shall be acceptable to the Regional Construction and Resident Engineers before purchase/installation.

The microcomputer system shall be installed in the field office. At the time of installation, the Contractor shall ensure that the system is fully operational and meets all Department requirements. All software listed above shall be installed by the Contractor and maintained in the field office. The Contractor shall configure the software to operate with the hardware provided. Any accessories for the microcomputer shall be compatible with the microcomputer.

The Contractor will not be permitted to use this microcomputer system at any time. It is being supplied solely for the Department's use.

The Contractor shall forward all manuals, instructions, software, and literature received with the microcomputer system to the Resident Engineer. The Contractor is responsible for maintaining the microcomputer system in good working condition. Any part of the microcomputer system that becomes inoperable or defective, during the duration of the construction project, shall be replaced by the Contractor within 48 hours.

The microcomputer system, manuals, instructions, software, and literature shall be removed and retained by the Contractor when no longer required as determined by the Resident Engineer, except for the data cartridges and data diskettes, and the hard drive containing the project data, which will become the property of the State.

b. Type B. Type B field office shall conform to the requirements for Type A except that it shall have a floor area of not less than 432 square feet and shall be divided into two communicating rooms, one with a floor area of not less than 288 square feet and one with a floor area of not less than 144 square feet, and equipped with tables and chairs for the use of 12 personnel.

c. Type C. Type C field office shall conform to the requirements for Type A except that it shall consist of one room having a floor area of not less than 288 square feet and be equipped with tables and chairs for the use of eight personnel.

d. Type D. Type D field office shall conform to the requirements for Type A except that it shall have a floor area of not less than 720 square feet and shall be divided into four communicating rooms, one with a floor area of not less than 288 square feet and three with a floor area of not less than 144 square feet each, and equipped with tables and chairs for the use of 20 personnel.

e. Type E. Type E field office shall conform to the requirements for Type A except that it shall have a floor area of not less than 864 square feet and shall be divided into four communicating rooms, two with a floor area of not less than 288 square feet each and two with a floor area of not less than 144 square feet each, and equipped with tables and chairs for the use of 24 personnel.

f. Type F. Type F field office shall conform to the requirements for Type A except that it shall have a floor area of not less than 1,008 square feet and shall be divided into five communicating rooms, two with a floor area of not less than 288 square feet each and three with a floor area of not less than 144 square feet each, and equipped with tables and chairs for the use of 28 personnel, four additional fire resistant file cabinets as per part (7) and tow additional calculators as per part (11) specified under Type A Construction field office.

2. Survey Field Offices.

a. Type S. Type S field office shall conform to the requirements specified above for Type A except that it shall consist of one room having a floor area of not less than 144 square feet and shall be equipped with tables and chairs for the use of four personnel, one plan rack, and one fire-resistant, four-drawer, legal-size file cabinet with lock and two keys meeting fire underwriters' approval for not less than a one-hour test.

b. Type T. Type T field office shall conform to the requirements for Type S except that it shall have a floor area of not less than 288 square feet and shall be equipped with tables and chairs for the use of eight personnel.

Instead of the field office or offices specified above, the Contractor may provide equivalent office space, equipment, and facilities subject to approval of the Engineer.

Setting up the field office or other facilities shall consist of furnishing the office complete with furniture, bookcases, wall clocks, equipment, electricity, water, heating, air-conditioning, installation and activation of telephone lines, telephone sets (touch tone and cellular), pager units, sanitary facilities, and lavatory supplies.

Maintenance of the construction and survey field office or offices, for the time required, shall consist of maintaining the furniture, equipment, and utilities which include the cost of telephone fixed monthly service charges, cellular phone fixed monthly service charges for the plan specified and pager service, providing lavatory supplies, janitorial and waste disposal services weekly, restocking of the first aid box, snow removal services, and one carton of legal and letter sized paper every three months, and one carton of 11" X 17" size paper for the duration of the Project for the copier and fax machine. Maintenance of the field office shall also include the monthly rent. The fax machine, telephone sets, cellular telephone sets, pager units, computer and related equipment shall be repaired or replaced within 24 hours of becoming inoperable or defective.

Payment for setting up the field office of the various types will be made by the unit.

Payment for maintenance of the field office of the various types will be made for each month or fraction thereof that the field office is required except that payment will not be made for any month or fraction thereof for which the Contractor is assessed liquidated damages according to Subsection 108.16.

Telephone service shall consist only of monthly toll call charges and non-fixed charges (e.g. message units and directory assistance) with their related taxes for all telephone lines servicing telephone receivers, fax machines, and micro-computer modems in the field office(s) or other facilities specified. The telephone service will also include payment for the cellular phone use charges, for time used, exceeding the quantity of the service specified.

Payment for telephone service will be made on the actual cost for the monthly land-line toll call charges with their related taxes, and other non-fixed charges with their related taxes, as evidenced by paid bills from the telephone company, submitted within 60 days of receipt from the service provider. Payment will also be made for actual cellular phone use charges with their related taxes for time used exceeding the quantity of the service specified as evidenced by paid bills from the service provider, submitted within 60 days of receipt from the service provider. The Lump Sum amount provided in the proposal is an estimated amount and will be adjusted on the basis of paid bills.

Payment will be made under:

Pay Item	*Pay Unit*
FIELD OFFICE TYPE ___ SET UP	UNIT
FIELD OFFICE TYPE ___ MAINTENANCE	MONTH
TELEPHONE SERVICE	LUMP SUM

105.16 Removal of Unacceptable and Unauthorized Work. { XE "Work:unacceptable and unauthorized" }{ XE "Removal of:unacceptable and unauthorized work" }

All Work that does not conform to the requirements of the Contract is unacceptable unless otherwise determined acceptable under the provisions in Subsection 105.05. Unacceptable Work, whether the result of poor workmanship, use of defective materials, damage through carelessness or any other cause, found to exist before Acceptance, shall be removed immediately and replaced in an acceptable manner at no cost to the State.

Work shall not be done without lines and grades having been given by the Engineer or the Contractor as provided under Subsection 105.11. Work done contrary to the instructions of the Engineer, Work done beyond the lines shown on the Plans, except as herein specified, or any Extra Work done without authority is considered as unauthorized and will not be paid for under the provisions of the Contract. Work so done may be ordered removed or replaced at no cost to the State.

If the Contractor fails to comply promptly with any order of the Engineer made under the provisions of this Subsection, the Engineer will have authority to cause unacceptable Work to be removed or replaced by others and to deduct the costs thereof from any monies due or that may become due the Contractor.

105.17 Load Restrictions. { XE "Load restrictions" }

{ XE "Legal:load limits (equipment)" **}**Within the limits of the Project, the operation of equipment of such weight or so loaded as to cause damage to structures or the roadway or to any other type of construction will not be permitted. Hauling of materials over the base course or surface course under construction shall be limited as directed. No loads will be permitted on a concrete surface course, base course, intermediate course, or structure before the expiration of the curing period. In no case shall legal load limits be exceeded when equipment is used for hauling to and from the Project site unless permitted in writing by the Director of Motor Vehicles. The Contractor shall be responsible for all damage done by its hauling equipment.

The Department will monitor the Contractor's observance of the legal load limits according to the following:

1. For trucks with weigh tickets, a certified weigh ticket shall be furnished with each load.
2. For trucks without weigh tickets that are hauling material for items of 5,000 cubic yards or more, a list of trucks and their motor vehicle classifications shall be furnished before the start of work and shall be updated at the start of each construction season thereafter. A certified weigh ticket showing the gross weight shall be furnished with the first load for each truck for each item. The Resident Engineer shall be notified in advance so that the first load can be documented by measurements and photographs.
3. For trucks hauling HMA from automated batch plants, a list of trucks including the certified tare weights and maximum allowable load for each shall be furnished before the start of work. This list shall be kept current and include all trucks to be used throughout the duration of the Project. Failure to provide this information will be cause for rejection of material.
4. For portland cement concrete delivery trucks, a list of trucks including the certified tare weight and the maximum cubic yard load for each shall be furnished before the start of work and shall be updated at the start of each construction season thereafter.

Any truck found to be in excess of the legal load limit may have that load of material rejected for use on the Project. Repeated violations may be cause for suspension of operations until the condition is remedied to the satisfaction of the Engineer. No payment will be made for any material in excess of the legal truck load limit.

105.18 Automatically Controlled Equipment. { XE "Equipment:automatically controlled" }

Whenever equipment is required to be operated automatically under the Contract and a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually or by other methods only for the remainder of the Working Day on which the breakdown or malfunction occurs, provided this method of operation produces results that otherwise meet the Specifications.

105.19 Maintenance During Construction. { XE "Maintenance during construction" }

Except as provided for below, the Contractor shall be responsible for maintenance within the Project limits until Acceptance pursuant to Subsection 105.23. This maintenance shall consist of continuous and effective work prosecuted day by day, with adequate equipment and forces to the end that the roadway is kept in satisfactory condition at all times.

In the case of a Contract requiring the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations.

{ XE "Opening to traffic:sections of project" **}**On any section opened to traffic, whether provided for in the Contract Documents or opened as directed, any damage to the roadway due to the Contractor's operations shall be repaired at no cost to the State. Nothing in this Subsection shall be construed to limit or change the risks assumed by the Contractor pursuant to Subsection 107.22.

{ XE "Damage to:project:by snow plow" **}{** XE "Maintenance during construction:snow removal" **}{** XE "Snow:removal" **}**The Contractor shall not be responsible for removal of ice or snow from sections of roadways opened to traffic or for damage to the Project caused by the operation of snow plows or other snow removal or de-icing operations carried on by others under the supervision or direction of the Department or of the various counties and municipalities.

The Contractor shall not be responsible for mowing unless an item for mowing is scheduled in the Proposal Form.

The Engineer may direct the Contractor to construct HMA patch according to Section 402 to maintain sections of traveled way and shoulders in a smooth riding condition at all times including seasonal shutdowns. Payment for HMA patch will be made according to Section 402 except for those areas that are damaged by the Contractor's operations.

Except as provided for above, all costs for maintenance during construction shall be included in the various Pay Items scheduled in the Proposal.

105.20 Failure to Maintain Roadway. { XE "Failure to:maintain roadway" }

If the Contractor at any time fails to comply with the provisions of Subsection 105.19, the Engineer will immediately notify the Contractor of such noncompliance. If the Contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the Engineer may proceed to maintain the Project and deduct the entire cost of this maintenance from any monies due or that may become due the Contractor.

105.21 Partial Acceptance. { XE "Partial Acceptance" }{ XE "Acceptance:partial" }

If at any time during the prosecution of the Project the Contractor completes a unit or portion of the Project, such as a structure, an interchange, or a section of road or pavement, the Contractor may request the Engineer to make final inspection of that unit. If the Engineer finds upon inspection that the unit has been satisfactorily completed in compliance with the Contract, the Engineer may accept that unit as being completed, and the Contractor may be relieved of the responsibility of doing further Work on or maintaining that unit or portion of the Project. The Engineer reserves the right to reject the request made by the Contractor, if the Engineer determines that the unit or portion of the Project should not be the subject of a partial acceptance. Such partial acceptance shall in no way void or alter any of the terms of the Contract, including Subsections 107.22 and 107.23, nor shall it be construed as relieving the Contractor of full responsibility for making good defective work or materials found at any time before Acceptance pursuant to Subsection 105.23.

105.22 Substantial Completion. { XE "Substantial completion" }

When the Contractor determines that the Work is substantially complete, the Contractor shall prepare a written notice thereof for submission to the Engineer listing the items remaining to be completed or corrected. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work according to the Contract Documents. If the Engineer determines that the Work is substantially complete, the Engineer will then prepare a letter which states the date of Substantial Completion and establishes a reasonable time within which the Contractor shall complete the planting of trees, shrubs, vines, ground covers, and seedlings, perform the final cleanup, and repair unacceptable Work, which time may be before Contract Time as modified. The letter will be submitted to the Contractor for its prompt compliance therewith.

If, however, the inspection discloses that the Work is not substantially completed to the Engineer's satisfaction, the Engineer will give the Contractor the necessary instructions for completion and correction of same, and the Contractor shall immediately comply with and execute such instructions. Upon completion and correction of the Work, the Contractor shall renotify the Engineer and another inspection will be made.

105.23 Completion and Acceptance{ XE "Completion" }{ XE "Work:acceptance of" }

{ XE "Work:final inspection of" **}{** XE "Inspection:final" **}**Upon receipt by the Engineer of written notice from the Contractor that the Work has reached Completion and is ready for final inspection and Acceptance, the Engineer will promptly make such inspection. When such inspection indicates that the Work is in compliance with the Contract, the Engineer will promptly begin the process to issue a Certificate of Completion stating that, to the best of the Engineer's

knowledge, information, and belief, and on the basis of observations and inspections, the Work has been completed according to the terms and conditions of the Contract. If, however, the final inspection discloses that the Work has not reached Completion, the Engineer will give the Contractor the necessary instructions for the correction of deficiencies, and the Contractor shall immediately comply with and execute such instructions. Upon correction of the deficiencies, the Contractor shall renotify the Engineer, and another inspection will be made. This procedure is to be repeated until a Certificate of Completion is issued.

At the request of the Contractor, the Engineer may issue a Certificate of Completion without receiving all required documents, certificates, or proofs of compliance. The Contractor's request must satisfactorily establish that the Contractor could not reasonably and in good faith provide some of the required documents, certificates, or proofs of compliance at a time contemporaneous with Completion and with the Project being ready for use by the State to the degree contemplated by the Contract. In such instances where a Certificate of Completion is issued, the Contractor shall expeditiously attempt to provide the exempted document, certificate, or proofs of compliance. Final payment will not be made, however, until all such documents, certificates, and proofs of compliance have been satisfactorily executed and delivered to the Engineer.

The Certificate of Completion is issued establishing Completion as of the date of the notice or re-notice from the Contractor. If the Commissioner concurs in the Certificate of Completion, the Contractor will be notified of Acceptance and the date thereof.

After Acceptance, the Contractor is relieved of the duty of maintaining and protecting the Work as a whole, and is not required to perform any further Work thereon. In addition, the Contractor is relieved of its responsibility for damage to the Work that may occur after Acceptance. However, nothing herein shall be construed to limit the provisions of Subsections 107.22, 107.23, 107.26, and 109.14.

SECTION 106 - CONTROL OF MATERIAL{ XE "MATERIALS:CONTROL OF" }

106.01 Source of Supply and Quality Requirements. { XE "Materials:quality requirements" }

{ XE "Debarred, suspended, or disqualified:materials suppliers" **}**All materials for the Project shall be furnished by the Contractor and shall be new, unless otherwise specifically prescribed in the Contract Documents. The materials shall conform to the requirements of the Contract Documents and shall be from approved sources. Only materials that have been approved by the Engineer shall be used.

All aggregate producing facilities supplying materials shall have in place an approved Quality Control Plan which conforms to the minimum requirements of the "Requirements for an Aggregate Products Quality Control Plan." A current copy of the referenced document can be obtained from the Bureau of Materials. Producers who do not have an approved Quality Control Plan will be removed from the Approved Aggregates List, and will not be permitted to supply material.

The producer of portland cement concrete shall have a Quality Control Plan approved annually by the Regional Materials Engineer. The plan shall meet the requirements as outlined in "Requirements for a Portland Cement Concrete Plant Quality Control Plan." A current copy of this document is available from the Regional Materials Engineer. If the producer does not have an approved plan or does not follow the plan, the producer will not be allowed to supply material.

All HMA facilities manufacturing HMA for Department projects shall have an approved Quality Control Program Plan according to the requirements outlined in the report entitled "Hot Mix Asphalt Quality Control Program Plan" prepared by the Department and New Jersey Asphalt Paving Association. A current copy of this document is available from the Regional Materials Engineer. Failure to follow these requirements will result in rejection of HMA materials supplied by the HMA facility.

Materials will not be approved from firms and individuals suspended or debarred by the Department or included in the Report of Suspensions, Debarments, and Disqualification of Firms and Individuals as maintained by the Department of the Treasury, Division of Building and Construction, Bureau of Contractor Prequalification.

{ XE "Materials:questionnaire forms" **}**Promptly after the execution of the Contract, the Engineer shall be notified on Materials Questionnaire Forms furnished by the Department of the sources of materials expected to be used during the six-month period thereafter. Such notice shall be received by the Engineer no later than ten days before the shipment of materials from a previously approved source, and no later than 30 days before the shipment of materials from a source not previously approved, except that, with the Engineer's consent, shipments of materials from approved stocks may be permitted to be made three days after notice to the Engineer. For materials that are not required until more than six

months after the execution of the Contract, such notice shall be received by the Engineer no later than 30 days before the date that such materials need to be ordered so that they are available for the Project at the proper time.

Within 12 hours after receiving a shipment of materials, the Engineer shall be notified of the kind, size, quantity, and location thereof.

In any item of construction, the sources, brands, or types of materials shall not be changed without the consent of the Engineer. Request for such changes shall be filed with the Engineer the number of days in advance of such changes as required above. The request shall state the name and address of the owner, the location of the proposed source, the method of shipment, and the intended use of the material.

The foregoing provisions shall apply with regard to requests by subcontractors for the sources of the materials they propose to use, such requests to be submitted through the Contractor.

The notice provisions of this Subsection shall not be so construed as to relieve the Contractor of its obligation to ensure that all materials required for the construction of the Project shall be available at the time and place necessary for their incorporation into the Work in order that the completion date set forth in Subsection 108.10 is met. If any doubt exists as to the timely availability of any material, the Engineer shall be immediately informed, in writing, of the potential problem and of the action to be taken to guarantee the availability of such material. Stockpiles of materials whose availability is or may be problematical shall be established at an early date.

106.02 Local Material Sources. { XE "Materials:local sources" }{ XE "Laws, ordinances, and regulations:local materials" }

Possible sources of local materials may be designated on the Plans or in the Specifications. The quality of material in such deposits may be acceptable in general, but the Contractor shall determine for itself the amount of equipment and Work required to produce a material meeting the requirements of the Contract Documents. It shall be understood that it is not feasible to ascertain from samples the limits or quantity for an entire deposit, and that variations shall be considered as usual and are to be expected. The Engineer may order procurement of material from any portion of a deposit and may reject portions of the deposit as unacceptable.

The Department may acquire, and make available to the Contractor, the right to take materials from the sources designated on the Plans or described in the Special Provisions, together with the right to use such property as may be specified, for plant site, stockpiles, and hauling roads.

If the Contractor desires to use material from sources other than those designated, the Contractor shall acquire the necessary rights to take materials from the sources and shall pay all costs related thereto, including any which may result from an increase in length of haul. All costs of exploring and developing such other sources shall be borne by the Contractor. The use of material from other than designated sources is not permitted until such preliminary samples as may be required by the Engineer have been obtained and tested at the expense of the Contractor. Additional samples may be required of the Contractor for inspection and testing by the Engineer before approval of and authorization to use the source.

When material deposits are not described in the Special Provisions or where those designated provide insufficient material, the Contractor shall provide sources of acceptable material. When the Contractor provides these sources, the Department assumes the cost of processing samples to determine the suitability of the material except as in Subsection 106.03.

Unless otherwise permitted, borrow pits and quarries occupied by the Contractor, or its subcontractor, or suppliers exclusively for the Project shall be so excavated that water does not collect and stand therein. Sites from which material has been removed shall be left in a neat and presentable condition before Completion. Where practicable, all pits and quarry sites shall be located so that they are not visible from the highway.

106.03 Materials, Inspections, Tests, and Samples. { XE "Materials:inspections, tests, and samples" }

{ XE "Sampling and testing of materials" **}A. General.** All materials will be inspected, tested, and approved before incorporation in the Work. Unapproved materials may be used only with written permission of the Engineer. In the absence of such written permission, unapproved materials will not be paid for and shall be removed at no cost to the State.

All materials being used are subject to inspection, testing, or rejection at any time before Acceptance. A representative of the Department will take samples. Results of tests made with the Department Laboratory's apparatus and conforming to the requirements specified in the prescribed methods of tests, are official and copies of test results will be furnished upon request.

Testing will be performed according to AASHTO or ASTM methods of tests or according to specified Departmental test methods as described in Section 990.

Nothing in this Subsection shall be construed to limit the right of the Engineer to order special inspection or tests as provided in Subsection 105.06.

Except as otherwise provided, all materials will be tested at the expense of the State.

Manufacturers supplying pipe under the Contract shall provide all facilities necessary to carry out the tests required by the Specifications, at their own expense.

Certain materials as specified will be accepted on the basis of Certifications of Compliance according to Subsection 106.04.

The required number of samples and rate of sampling, or Certifications of Compliance for the various materials are as specified in the respective methods of test or in the Subsections applicable to that particular material or Pay Item.

Additional samples shall be required whenever, in the opinion of the Engineer, additional tests are required to determine the quality and suitability of materials for their respective uses.

{ XE "Samples for:soil aggregate" }**B. Sampling and Field Testing of Soil Aggregates.** The sampling and field testing of soil aggregates shall conform to the general requirements for sampling and testing specified in Section 901, and with the following requirements, provided, however, that the following requirements shall govern where there is any conflict or inconsistency between them.

The Contractor shall determine initially, by means of proper sampling and laboratory tests, that soil aggregate materials from proposed sources conform to the requirements of the Specifications. Written notice of the proposed sources of soil aggregate materials, as well as the results of the sampling and testing, shall be given to the Engineer by the Contractor after the initial determination as specified above, and not less than ten days before the time of their intended use. The Engineer may sample and test materials representative of that portion of the source intended to be used.

{ XE "Materials:approval of source of aggregates" }Approval by the Engineer of a proposed source of any aggregate materials does not constitute approval of materials delivered to the site of the Work from that source, but shall be deemed as permission to select and use materials from that source only so long as they conform to the Specifications. The Contractor shall progressively determine for itself by proper sampling and laboratory tests, while the sources are in use, that materials selected from approved sources conform to the Specifications. Should the source contain oversize material, the Engineer may require the Contractor to eliminate such oversize material.

The final and governing determination of conformance or nonconformance with the Contract Documents will be made based on sampling and testing of the materials after they have been placed according to the Contract Documents. All materials in place in the Work that do not conform to the Contract Documents shall be removed and replaced with materials that do conform thereto, or their deficiencies shall be corrected. For those materials subject to density testing, conformance shall include compliance with the density requirement. After the initial corrective action has been taken, the Engineer will take an additional sample, and if necessary, one check sample. If the materials still do not conform to the requirements of the Contract Documents after additional corrective action, the Contractor shall supply the Engineer with a gradation of the in-place material showing the size of sample, all calculations, final gradation, name of person performing the test, date, and location of sample taken. The Engineer will not perform further testing until the Contractor certifies that the rejected material has been corrected. After this certification, the Engineer will analyze one additional sample, and if this sample does not meet the Contract Documents, the material shall be removed.

The Contractor shall excavate test pits and provide such facilities as the Engineer may require to properly sample the source and shall, if the source is approved, remove any overburden that would contaminate the material intended for use on the Project. If soil aggregate materials are obtained by dredging, the Contractor shall provide safe and adequate water transportation for the Engineer to and from the dredges or other boats and shall cooperate with the Engineer in every reasonable way to expedite inspection and sampling of the materials. The cost of such work, facilities, and transportation, in connection with sampling by the Engineer at the proposed source of soil aggregate materials, and the initial and progressive sampling and testing of materials at their sources, performed by the Contractor, shall be included in the prices bid for the various Pay Items scheduled in the Proposal.

Sampling and testing of aggregates that meet the Specifications and are used in the Work will be performed without cost to the Contractor.

The cost of sampling and testing by the Engineer of soil aggregates that do not conform to the Specifications for gradation and density and the cost of sampling and testing of soil aggregates that do conform to the Specifications but are not used in the Work shall be paid to the State by the Contractor at Departmental rates. Such costs may be recovered by the State from any monies due or that may become due

the Contractor. The amount that shall be paid to the State is $300.00 per sample tested for gradation and $200.00 per lot or sub-lot tested for density.

C. Concrete Certification and Training. The Contractor shall appoint sufficient personnel, certified by the NJACI as Concrete Construction Technologists, or personnel certified by ACI as Concrete Transportation Construction Inspectors, to monitor and report daily operations for concrete placement. Documentation of the training and certification of the Contractor's personnel shall be provided to the Engineer prior to the start of concrete operations.

This requirement shall apply for daily concrete placement quantities greater than 21 cubic yards and for all cast-in-place structural concrete placements regardless of quantity. The Contractor shall provide the required concrete pre-placement, concrete placement, and concrete post-placement certifications to the Engineer as noted below.

The on-site certified personnel shall be responsible for monitoring and reporting the placement of concrete, at all times throughout the duration of the Project, on forms provided by the Department. The Contractor's certified personnel shall be present, prior to the start of each concrete placement and shall remain in attendance until all operations associated with the placement have been completed.

The Contractor shall submit to the Resident Engineer, fully completed and signed by the certified personnel, the concrete pre-placement, concrete placement, and concrete post-placement certifications on Department furnished forms. The Contractor shall furnish the concrete pre-placement certification to the Resident Engineer or his designated representative prior to the release of concrete from the plant. The concrete placement certification shall be furnished within one Working Day upon the completion of concrete placement. The concrete post-placement certification shall be furnished within one Working Day upon completion of the required curing duration. The Engineer reserves the right to suspend concrete placement, at no cost to the State, until the designated certified personnel is present on site or until necessary reports have been received.

The responsibilities of the Contractor's certified personnel shall consist of, but are not to be limited to the following:

1. authorizing release of concrete delivery upon completing the necessary concrete pre-placement certification, which includes obtaining an NJDOT representative signature;
2. ensuring proper dimensions of forms, position of reinforcement steel, and maintenance of clearances during concrete placement;
3. ensuring that the proper class of concrete, composition, and proportions are being utilized and within specification requirements;
4. ensuring that the proper handling, placement, consolidation, and finishing are according to the requirements;
5. submission of concrete certifications;
6. suspending the concrete placement until any deficiencies are corrected;
7. ensuring that the concrete curing arrangements are according to the Specifications; and
8. maintaining necessary documents to show compliance.

Failure to submit the certifications stated above will result in nonpayment for the daily placement of concrete until complied with.

Subsequent concrete placements may be suspended by the Engineer for failure to comply with the above requirements.

Separate payment for concrete certifications and training will not be made, but all costs thereof shall be included in the various concrete pay items bid.

106.04 Certification of Compliance.{ XE "Materials:certification of compliance" }{ XE "Certification of compliance" }

Materials or assemblies, as specified, will be accepted on the basis of Certificates of Compliance stating that such materials or assemblies fully comply with the requirements of the Contract. The Engineer must approve the form of Certificates of Compliance.

Materials or assemblies, used on the basis of Certificates of Compliance, may be sampled and tested at any time. If found not to be in conformance with the Contract requirements, materials and assemblies will be rejected whether in place or not. The Contractor shall require the manufacturer or supplier to furnish four copies of Certificates of Compliance with each delivery of materials, components, and manufactured items that are acceptable by certification. One copy shall be furnished to the Resident Engineer, two copies shall be furnished to the Department Laboratory, and one copy shall be retained by the Contractor.

Certificates of Compliance shall contain the following information:

1. Project to which the material is consigned.
2. Name of the Contractor to which the material is supplied.
3. Kind of material supplied.
4. Quantity of material represented by the certificate.
5. Means of identifying the consignment, such as label marking, seal number, etc.
6. Date and method of shipment.
7. Statement that the material has been tested and found in conformity with the pertinent Contract requirements stated in the certificate.
8. Signature of a person having legal authority to bind the supplier.
9. Signature attested to by a notary public or other properly authorized person.

Payments will not be made for materials specified to be accepted on the basis of Certificates of Compliance until the Engineer has received the required Certificate of Compliance.

106.05 Plant Inspection. { XE "Materials:plant inspection" }{ XE "Plant inspection" }

The Engineer may undertake the inspection of materials at the source. Manufacturing plants may be inspected periodically for compliance with specified manufacturing methods. Material samples may be obtained for laboratory testing for compliance with materials quality requirements. Plant inspection may be the basis for the acceptability of manufactured lots as to quality.

In the event plant inspection is undertaken, the following conditions shall be met:

1. The Engineer will have the cooperation and assistance of the Contractor and the producer with whom the Contractor contracted for materials.
2. The Engineer will have full entry at all times to such parts of the plant as may concern the manufacture or production of the materials being furnished.
3. If required by the Engineer, the Contractor shall arrange for approved office space for the use of the inspector. Such space shall be located conveniently in or near the plant.
4. Adequate safety measures shall be provided and maintained. It is understood that the Department reserves the right to retest all materials that have been tested and accepted at the source of supply after the same have been delivered and to reject all materials which, when retested, do not meet the requirements of the Contract Documents.

106.06 Materials Field Laboratory. { XE "Laboratory:materials field" }{ XE "Materials field laboratory" }

{ XE "Inspection:of materials/manufacturing plants" **}**The Contractor shall provide and maintain in good condition a materials field laboratory, including enclosure, for the exclusive use of the Engineer at a location approved by the Engineer. Provisions for this item shall be deferred until the Engineer gives notification that this item is required.

The materials field laboratory shall be ready for use not later than ten Working Days after the date of such notification, shall be maintained until no longer required by the Engineer, and then shall be removed. Testing will not be conducted until the materials field laboratory is ready for use. It is estimated that the materials field laboratory will be required for one month after Completion.

Any building scheduled to be demolished under the Contract shall not be used as a materials field laboratory.

Adequate free parking shall be provided and maintained for the materials field laboratory.

The laboratory shall be of weatherproof construction located on or in the immediate vicinity of the Project, having a floor area of not less than 50 square yards and a ceiling height of not less than 7½ feet. The laboratory shall be provided with sufficient natural and artificial light and shall be adequately insulated, heated, and air-conditioned to maintain temperatures between 68 to 80 ºF. Doors and windows shall be equipped with adequate locks, and all keys shall be in possession of the Engineer.

The laboratory shall have one or more clothes closets of ample size for the maximum office requirements, and all stairs shall have safety rails installed.

Sanitary conveniences suitable for use by male and female employees of the Department and conforming to the requirements of Subsection 107.10 shall be provided in the laboratory and shall be stocked with lavatory and sanitary supplies at all times during the life of the Contract.

The materials field laboratory shall consist of the following:

1. Laboratory. The laboratory shall be equipped with the following for the exclusive use of the Engineer:

a. One or more telephones, installed as directed.

b. Two portable hand held cellular phones. The cellular phone plan shall provide for the anticipated usage of approximately 300 minutes per phone per month. Each of the cellular phones shall have a s a minimum the following features:
   (1) Home rate with no roaming charges within the entire state
   (2) 832 Channel Compatible
   (3) Mute Function
   (4) Back Light Display with Battery Saver
   (5) Signal Strength Indicator
   (6) Individual Call Length Timer
   (7) Full Lock Function
   (8) 30 Memory Number Feature
   (9) Low Battery Warning
   (10) 70 Minute Continuous Use
   (11) 12 hour Standby Mode
   (12) Alphanumeric Display
   (13) Transmission Power 0.6 Watt
   (14) Passive Repeating Antenna for Vehicle
   (15) Spare high capacity Battery Pack
   (16) Home Charging Station
   (17) Cigarette lighter power adapter /charger
   (18) AC charging station
c. Telephone answering machine.
d. Four desks and eight chairs.
e. Work bench, not less than 2½ by 10 feet, and two stools.
f. Shelves and supply cabinets.
g. Drafting table with high swivel stool with casters.
h. Plan rack of sufficient size to hold 15 sets of plans.
i. One fire-resistant, four-drawer, legal-size file cabinet with lock and two keys meeting fire underwriters' approval for not less than a one-hour test.
j. One Class ABC fire extinguisher, or one Class A and one Class B fire extinguisher, meeting fire underwriters' approval.
k. Water cooler supplied with bottled water having both hot and cold water dispensers.
l. One electronic calculator with printout tape.
m. One electric typewriter, elite type, with 15-inch carriage.
n. One compact copying machine, plain paper, with letter and legal size capacity.
o. Plain paper fax machine with a dedicated telephone line, built-in telephone, auto dial, re-dial, and auto-receive features.
p. One 12-inch diameter, minimum, exhaust fan or other means of removing excess heat, dust, and fumes.
q. Minimum of four, three-prong electrical outlets, having a minimum of two 20-ampere, 120-volt circuits.
r. Two gas stoves, each having at least two burners.
s. Commercially bottled gas or gas supplied by a public utility company with at least two connections located as directed.
t. Display area, approximately 3 by 4 feet, for mounting control charts and a wall clock.
u. Sink with hot and cold running water, having adequate pressure, and equipped with two drain-boards and a drain-disposal system capable of handling elutriable material.
v. Metal stand to hold sieves used in washing elutriable material.
w. Wheelbarrow.
x. Shovels, scoops, and pick for sampling soil aggregates and concrete.
y. Equipment and testing apparatus conforming to that listed in AASHTO T 11 (including a mechanical washing machine), T 23, T 27, T 99, T 119, T 121, T 141, T 152, T 180, and T 248. At the direction of the Engineer, three units or the number specified, and testing apparatus will be required to satisfy the inspection and testing frequency anticipated. In addition, all scales shall be electronic, except that required for AASHTO T 121, which shall be portable.

z. Equipment and test apparatus conforming to that listed in AASHTO T 238 and T 239 when the Pay Item "Nuclear Density Gauge" appears in the Proposal. When the Pay Item "Nuclear Density Gauge" is listed in the Proposal, the Contractor shall provide for the Department's exclusive use and for the duration of the Project a soils/moisture nuclear density gauge calibrated to the manufacturer's specifications, and with the following minimum features/capabilities:

(1) Conformance to AASHTO T 238,
(2) Backscatter and direct transmission modes,
(3) 8-inch minimum length of probe,
(4) Automatic warm-up and self test,
(5) Automatic data storage and data transfer features, including an RS232 interface cable, specifically configured to transfer data from the density gauge to the microcomputer system and with data communication software,
(6) Count times of 0.25, 1.0, and 4.0 minutes,
(7) 0.25 pounds per cubic foot dry density precision in direct transmission at 120 pounds per cubic foot and at 1.0 minute, with plus or minus 0.3 percent accuracy,
(8) 0.32 pounds per cubic foot moisture precision at 1.0 minute, with plus or minus 2.0 percent accuracy,
(9) Rechargeable batteries and recharger, and
(10) Type A certified package.

The gauge provided shall be either:

(1) Purchased by the Contractor under the Contractor's United States Nuclear Regulatory Commission (USNRC) License, or
(2) Leased from the gauge manufacturer on the Department's USNRC License. Gauges shall not be purchased by the Contractor on the Department's USNRC License. All calibration and servicing of the gauge, other than routine wipe tests, and all shipping costs shall be the Contractor's responsibility.

aa. Microcomputer workstation hardware and software requirements as indicated. The microcomputer system shall include the following:.

(1) One base computer system(s) having at minimum:

a) Pentium IV Processor at 1.5 GHz or faster, Intel processor with MMX technology, with 512 MB RAM, 32 MB Video RAM, mouse, mouse pad, 60 GB hard drive, one 52X DVD-ROM Drive, one CD-R Recordable Drive, and one 3½-inch, 1.44 MB floppy diskette drive installed as the "A" drive.
b) 56K baud data/fax modem. (e.g., 3Com U.S. Robotics 56K Fax modem, 3Com U.S. Robotics Courier V.Everything/V.34 - 56K ITU / x2 Technology, or Hayes Accura 56K).
c) One dedicated telephone line to be used in conjunction with the microcomputer modem.
d) 19 inch (483 millimeter) or larger Super VGA color monitor having a dot pitch of 0.28 or better, with anti-glare screen, and tilt/swivel capabilities.
e) 250 Megabyte Zip Drive internal or external with backup software for MS-Windows and DOS, and thirty 250 Megabyte formatted data cartridges corresponding to the tape drive size (e.g., Iomega Zip Drive or equivalent).
f) Uninterruptible power supply (UPS) - OMNI 1000 or approved equal (e.g., APC-1000 - American Power Corporation).
g) Surge protector for the entire computer workstation to be used in conjunction with the UPS (e.g., Zero Surge Power, Inc. - Point of Use - 2R-15 amp/120 volts).
h) Static mat, floor type, 4 by 5 feet or larger with grounding capabilities.
i) Computer workstation, printer stand, and/or table having both appropriate surface and chair height.
j) Five boxes of 3½-inch floppy diskettes that match the drive density of the 1.44 MB floppy diskette drive (ten per box).
k) 150 CD-R 700 MB (or larger) recordable CD's compatible to the CD drive.
l) One floppy diskette holder (holds 50, 3½-inch floppy diskettes), and dust covers for the microcomputer, monitor, keyboard, and printer.

m) Two head cleaner kit for 3½-inch floppy diskette drive.

(2) One base printer having at minimum:

a) Laser printer having HP PCL 5 emulation, with a 64 Megabyte expanded memory, appropriate printer cable, and legal size tray (e.g., HP-2200 or equivalent).

b) One printer toner cartridge every other month for the duration of the construction project.

c) One ten-ream carton of 8½" X 11" size paper (500 sheets per ream, weight: 2.2 ounces per square yard, color: white, grain: long, for laser printers and copiers) every two months for the duration of the construction project.

d) One ten-ream carton of legal size paper (500 sheets per ream, weight: 2.2 ounces per square yard, color: white, grain: long, for laser printers and copiers) every three months for the duration of the construction project.

(3) One software package, on CD-ROM with documentation, including:

a) Microsoft Windows, latest version with future upgrades.

b) Microsoft Office Professional latest version. Software package should contain the following: word processor, spreadsheet, and database.

c) Helix Nuts and Bolts Advanced Utilities for Windows, latest version, or compatible software package.

d) Anti-Virus software, latest version with monthly updates (e.g., McAffe Anti Virus, Dr. Solomon's, or Norton's Anti Virus).

e) Visio Professional Graphics Software for Windows, latest version**.**

Hardware and software shall be acceptable to the Resident Engineer before purchase/installation. All software shall be compatible with the computer's operating system.

The microcomputer system shall be installed in the materials field laboratory. At the time of installation, the Contractor shall ensure that the system is fully operational and meets all Department requirements. All software listed above shall be installed by the Contractor and maintained in the materials field laboratory. The Contractor shall configure the software to operate with the hardware provided. Any accessories for the microcomputer shall be compatible with the microcomputer.

The Contractor will not be permitted to use this microcomputer system at any time. It is being supplied solely for the Department's use.

The Contractor shall forward all manuals, instructions, software, and literature received with the microcomputer system to the Resident Engineer. The Contractor is responsible for maintaining the microcomputer system in good working condition. Any part of the microcomputer system that becomes inoperable or defective, during the duration of the construction project, shall be replaced by the Contractor within 48 hours.

The microcomputer system, manuals, instructions, software, and literature shall be removed and retained by the Contractor when no longer required as determined by the Resident Engineer, except for the data cartridges and data diskettes, and the hard drive containing the project data, which will become the property of the State.

bb. First aid box, which shall be restocked as necessary, containing the following supplies:

Quantity	Size	Item
32	¾" by 3"	Brand sheer bandages
20	1" by 3"	Brand fabric bandages
4	Medium	Non-stick pads
2	2"	Soft-gauze bandages
2		Oval eye pads
1	51"	Triangular bandage
1	½" by 180"	Hypo-allergenic first-aid tape
10		Antiseptic wipes
1	.1 oz.	Burn cream, foil pack
1	8 oz.	First-aid cream
1	100 caplets	Tylenol Extra-Strength caplets
1		Scissors
1		Tweezer
1		First-aid guide
1	½ fl.oz.	Ophthalmic irrigation solution
1		Contents cards
10		Disposable gloves
10	0.33 ml	Ammonia inhalants

cc. Hood enclosed on three sides, top, and bottom, of such size to enclose the operations of drying and weighing a recycled concrete aggregate sample, as well as other operations in which a vapor or gas is emitted. The hood shall be designed and constructed in such a manner that any operation involving testing within the hood does not require the insertion of any portion of the tester's body, other than hands and arms, and shall contain an exhaust system which shall be capable of exhausting air to the outside at 33 yards per minute, linear velocity, based upon an interior hood opening measuring 3 by 3 feet, and shall have an exhaust fan rated at 80 to 118 cubic feet per minute.

dd. A light duty oil-less air compressor listed by UL with a 2.5-gallon storage tank, a start/stop switch - 94 psi/125 psi, a 115-volt universal motor, an ASME safety valve, and a 25-foot air hose, equipped with a Quick-Change Blow Gun Kit and Nozzle Kit consisting of a high-flow safety nozzle, a 6-inch extension safety nozzle, a rubber tip nozzle, a needle tip nozzle, and an air screen safety nozzle.

2. Enclosure. A weathertight room or enclosure shall be adjacent to the laboratory, capable of being secured, with concrete floor area of not less than 66 square yards and ceiling height of not less than 7½ feet. It shall be provided with sufficient natural and artificial lighting and shall be adequately insulated, heated, and air-conditioned to maintain temperatures between 60 and 80 ºF. It shall be equipped with a minimum of two 12-inch diameter exhaust fans or other means of removing excess heat, dust, and fumes, a minimum of three three-prong electrical outlets having a minimum of two 20-ampere, 120-volt circuits, and a seven-day spring-driven temperature recording device capable of producing a permanent record of the room temperature.

A cube of concrete, weighing a minimum of 200 pounds and measuring approximately 10 x 10 x 24 inches with a 1 × 10-inch square steel plate fastened to the top, shall be erected on a firm foundation in the enclosure at a location approved by the Engineer.

Located in the enclosure shall be two sound-dampening and dustproof cabinets constructed of at least ¾-inch plywood or other suitable material and of sufficient size to house a large mechanical sample shaker and a small mechanical sieve shaker.

Located in the enclosure, on an outside wall, shall be a separate cabinet for the purpose of housing and storing a nuclear density gauge. The cabinet shall be constructed of ¾-inch plywood or particle board and lead sheathing, or any other acceptable materials, so as to ensure that a radiation reading of no higher than 2 nanorads per hour is obtained by contact measurement of the outside wall of the storage cabinet. This second cabinet must be securable and have a door equipped with a heavy-duty lock with two keys provided. Before this cabinet is constructed, its exact location, materials to be used for its construction, and locking system shall be approved by the Engineer.

Doors and windows to the enclosure shall be equipped with locks, and all keys shall be in the possession of the Engineer.

A sufficient number of water tanks shall be provided, deep enough to fully submerge 12-inch concrete cylinders in an upright position.

Setting up the materials field laboratory shall consist of furnishing the laboratory and enclosure complete with furniture, equipment, electricity, water, heating, air-conditioning, installation and activation of telephone lines, telephone sets (touch tone and cellular), pager units, sanitary facilities, and lavatory supplies.

Maintenance of the materials field laboratory, for the time required, shall consist of maintaining the furniture, equipment, and utilities which includes the cost of telephone fixed monthly service charges, cellular phone fixed monthly service charges for the plan specified and pager services, providing lavatory supplies, janitorial and waste disposal services weekly, restocking of the first aid box, and snow removal services. Maintenance of the materials field laboratory shall also include monthly rent.

Payment for nuclear density gauge will be made by the number of units supplied.

Payment for setting up the materials field laboratory will be made by the number of units.

Payment for the maintenance of the materials field laboratory will be made for each month or fraction thereof that the materials field laboratory is required, except that payment will not be made for any month or fraction thereof in which the Contractor is assessed liquidated damages according to Subsection 108.16.

Payment will be made under:

Pay Item	*Pay Unit*
NUCLEAR DENSITY GAUGE	UNIT
MATERIALS FIELD LABORATORY SET-UP	UNIT
MATERIALS FIELD LABORATORY MAINTENANCE	MONTH

Payment for telephone service will be made according to Subsection 105.15.

106.07 Curing and Storage Facility. { XE "Materials:storage" }

The Contractor shall provide and maintain in good condition a curing and storage facility secure, heated, and air-conditioned, for the exclusive use of and at a location approved by the Engineer. Provisions for this item shall be deferred until the Engineer gives notification that this item is required.

The curing and storage facility shall be ready for use not later than ten days after the date of such notification, shall be maintained until no longer required by the Engineer, and then shall be removed. Testing will not be conducted until the curing and storage facility is ready for use. It is estimated that the curing and storage facility is required for one month after Completion.

Any building scheduled to be demolished under the Contract will not be permitted to be used as a curing and storage facility.

The enclosure for the curing and storage facility shall be capable of maintaining a curing temperature between 60 and 80 ºF throughout the entire facility and shall have a concrete floor area of not less than 300 square feet and a ceiling height of not less than 7½ feet. It shall have at least one three-prong electrical outlet and adequate artificial lighting.

The storage facility shall include a seven-day, spring-driven, temperature-recording device capable of producing a permanent record of the room temperature. A sufficient number of water tanks shall be provided, deep enough to fully submerge 12-inch concrete cylinders in an upright position. The facility shall be equipped with the following:

1. Sanitary conveniences, as specified for a materials field laboratory in Subsection 106.06.
2. One telephone, installed as directed.
3. Telephone answering machine.
4. One Class ABC fire extinguisher.
5. One Class B fire extinguisher, meeting UL approval.
6. Display area, approximately 3 by 4 feet, for mounting control charts and a wall clock.
7. Two desks and four armed chairs with casters.
8. Water cooler with bottled water having both hot and cold water dispensers.
9. One cold water faucet with hose.
10. One wheelbarrow.
11. Equipment and testing apparatus conforming to that listed in AASHTO T 23, T 119, T 141, and T 152. Doors and windows shall be equipped with adequate locks, and all keys shall be in possession of the Engineer.
12. Microcomputer workstation hardware and software requirements will be provided in the Special Provisions.
13. First aid box containing the following list of supplies:

Quantity	**Size**	**Item**
32	¾" by 3"	Brand sheer bandages
20	1" by 3"	Brand fabric bandages
4	Medium	Non-stick pads
2	2"	Soft-gauze bandages
2		Oval eye pads

1	51"	Triangular bandage
1	½" by 180"	Hypo-allergenic first-aid tape
10		Antiseptic wipes
1	.1 oz.	Burn cream, foil pack
1	8 oz.	First-aid cream
1	100 caplets	Tylenol Extra-Strength caplets
1		Scissors
1		Tweezer
1		First-aid guide
1	½ fl.oz.	Ophthalmic irrigation solution
1		Contents cards
10		Disposable gloves
10	0.33 ml	Ammonia inhalants

14. One electronic calculator with printout tape.
15. Plain paper fax machine with a dedicated telephone line, built in telephone, auto dial, re-dial, and auto-receive features.
16. One fire resistant, four-drawer, legal size file cabinet with lock and two keys meeting fire underwriters' approval for not less than a one hour test.
17. Work bench, not less than 2½ by 10 feet, and two stools.
18. Two portable hand held cellular phone(s). The cellular phone plan shall provide for the anticipated usage of approximately 300 minutes per phone per month. Each of the cellular phones shall have as a minimum the following features:
    a. Home rate with no roaming charges within the entire state
    b. 832 channel compatible
    c. Mute function
    d. Black light display with battery saver
    e. Signal strength indicator
    f. Individual call length timer
    g. Full lock function
    h. 30 memory number feature
    i. Low battery warning
    j. 70 minute continuous use
    k. 12 hour standby mode
    l. Alphanumeric display
    m. transmission power 0.6 watt
    n. passive repeating antenna for vehicle
    o. spare high capacity battery pack
    p. home charging station
    q. Cigarette lighter power adapter/charger
    r. AC charging station.
19. A light duty oil-less air compressor listed by UL with a 2.5-gallon storage tank, a start/stop switch - 94 psi/125 psi, a 115-volt universal motor, an ASME safety valve, and a 25-foot air hose, equipped with a Quick-Change Blow Gun Kit and Nozzle Kit consisting of a high-flow safety nozzle, a 6-inch extension safety nozzle, a rubber tip nozzle, a needle tip nozzle, and an air screen safety nozzle.

Doors and windows shall be equipped with adequate locks, and all keys shall be in possession of the Engineer.

Adequate free parking shall be provided and maintained for the curing and storage facility.

Set-up, maintenance, and payment provisions for materials field laboratory as specified in Subsection 106.06 shall apply to the curing and storage facility.

Payment will be made under:

Pay Item	*Pay Unit*
CURING AND STORAGE FACILITY SET-UP	UNIT
CURING AND STORAGE FACILITY MAINTENANCE	MONTH

106.08 Foreign Materials. { XE "Materials:foreign" }

The Contractor shall comply with the appropriate statutes and regulations concerning the use of foreign materials as follows:

1. **Wholly State-Funded Projects.** The Contractor shall comply with NJSA 52:32-1 and NJSA 52:33-1 *et. seq.*, which prohibit the use by the Contractor or subcontractors of farm products or materials produced or manufactured outside of the United States on any public work. Exceptions to this prohibition are allowed upon a finding by the Commissioner that its enforcement would be inconsistent with the public interest, or where the cost of enforcing the prohibition would be unreasonable, or where the material in question is not of a class or kind mined, produced, or manufactured in the United States in commercial quantities and of a sufficient quality. Findings by the Commissioner allowing an exception to this prohibition will be included by the Department in the Contract Documents.

   If the Commissioner finds that in the performance of the Contract there has been a failure to comply with the Federal and State provisions contained in the Contract Documents relative to foreign materials, the Commissioner is to make the findings public, including therein the name of the Contractor obligated under the Contract, and no other contract for the construction, alteration, or repair of any public work in this State will be awarded to such Contractor, or to any partnership, association, or corporation with which such Contractor is associated or affiliated, within a period of three years after such finding is made public.

   Where the use of foreign materials is allowed in the performance of the Contract, such materials shall be furnished according to the following requirements:

   a. Materials manufactured, produced, or mined outside the United States shall be delivered to approved locations within the State unless otherwise permitted, where they shall remain until sampling and testing can be completed.
   b. The Contractor shall, at no cost to the State, arrange for any required testing which the Department is not equipped to perform. All testing shall be performed within the State and is subject to witnessing by the Engineer.
   c. Each lot of foreign material shall be accompanied by a Certificate of Compliance prepared according to Subsection 106.04. In addition, certified mill test reports shall be attached to the Certificate of Compliance for those materials for which mill test reports are required and shall clearly identify the lot to which they apply.
   d. Structural materials requiring mill tests reports will be accepted only from those foreign manufacturers who have previously established to the satisfaction of the Engineer the adequacy of their in-plant quality control to ensure delivery of uniform material in conformance with Contract requirements.
   e. Adequacy of quality control shall be established, at the option of the Engineer, by either submission of detailed written proof of adequate control, or through an in-plant inspection by the Engineer.
   f. Structural materials will not be accepted which cannot be identified with mill test reports and Certificates of Compliance.

{ XE "Buy America requirement" **}2. Federal Aid Projects.** The Contractor shall comply with the Federal statutes and regulations that establish the "Buy America" requirements applicable to the Project. These Federal requirements, which are contained in 23 CFR 635.409 and 23 CFR 635.410, mandate among other things that all manufacturing processes for iron and steel materials and all iron and steel coatings must be performed in the United States.

106.09 Storage and Handling of Materials. { XE "Materials:handling" }{ XE "Materials:storage" }{ XE "Storage of materials" }

Materials shall be stored to ensure the preservation of their quality and fitness. Stored materials, even though approved before storage, may again be inspected before their use on the Project. Stored materials shall be located so as to facilitate their prompt inspection. With the approval of the Engineer, portions of the ROW may be used for storage purposes and for the placing of the Contractor's plant and equipment, but any additional space must be provided by the Contractor at the Contractor's expense. No materials shall be stored within 10 feet, plus the extended boom length of the largest crane on site, of overhead high voltage power lines. The high voltage power line is defined as an aerial power line having a voltage differential in excess of 750 volts between any pairs of conductors or between any conductor and ground. The Contractor shall be responsible for any power outage or de-energization associated with the Contractor's activity in the vicinity of the power lines. Private property shall not be used for storage purposes without written permission of the owner or lessee. Copies of such written permission shall be furnished to the Engineer before storage. Storage sites shall be restored to their original condition at no cost to the State.

Materials shall be handled to ensure the preservation of their quality and fitness. Aggregates shall be transported from the storage site to the Project site in tight vehicles constructed to prevent loss or segregation of materials after

loading and measuring in order that there shall be no inconsistencies in the quantities of materials intended for incorporation in the Project as loaded, and the quantities actually received at the place of operations.

106.10 Unacceptable Materials. { XE "Materials:unacceptable" }{ XE "Defective materials" }{ XE "Materials:defective" }

All materials, whether in place or not, which do not conform to the requirements of the Contract Documents shall be considered as unacceptable, and such materials will be rejected and shall be removed immediately from the site of the Work unless otherwise directed. Rejected material, the defects of which have been corrected, shall not be used until approval has been given.

106.11 Department Furnished Material. { XE "Materials:department furnished" }

The Contractor shall furnish all materials required to complete the Work, except those specified to be furnished by the Department. Material furnished by the Department will be delivered or made available at the points specified in the Special Provisions.

The cost of handling and placing the materials after they are delivered or made available shall be considered as included in the Work for the Pay Item in connection with which they are used.

The Contractor is to be responsible for all material delivered to it, and deductions will be made from any monies due or that may become due the Contractor to make good any shortages and deficiencies, from any cause whatsoever, and for any damage that may occur after such delivery, and for any demurrage charges.

106.12 Substitutes or "Or Equal" Items. { XE "Materials:substitutes or \"or equal\" items" }{ XE "Substitutes or \"or equal\" items" }

Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular supplier, the naming of the item is intended to establish the type, function, and quality required. Unless the name is followed by words indicating that no substitution is permitted, materials or equipment of other suppliers may be accepted if sufficient information is submitted by the Contractor to allow the Engineer to determine that the material or equipment proposed is equivalent or equal to that named. Requests for review of substitute items of material or equipment will not be accepted from anyone other than the Contractor. If the Contractor wishes to furnish or use a substitute item of material or equipment, the Contractor shall make written application to the Engineer for approval thereof, certifying that the proposed substitute performs adequately the functions and achieves the results called for by the general design, is similar and of equal substance to that specified, and is suited to the same use as that specified. The application shall state that the evaluation and approval of the proposed substitute does not prejudice the Contractor's achievement of Completion on time. It shall also state whether or not approval of the proposed substitute for use in the Work requires a change in any of the Contract Documents (or in the provisions of any other direct Contract with the State for Work on the Project) to adapt the design to the proposed substitute, and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified shall be identified in the application, and available maintenance, repair, and replacement service shall be indicated. The application shall also contain an itemized estimate of all costs that result directly or indirectly from approval of such substitute, including costs of redesign, all of which will be considered in evaluating the proposed substitute. The Engineer may require the Contractor to furnish additional data about the proposed substitute.

If a specific means, method, technique, sequence, or procedure of construction is indicated in or required by the Contract Documents, the Contractor may furnish or use a substitute means, method, technique, sequence, or procedure of construction which is acceptable, if the Contractor submits sufficient information to allow the Engineer to determine that the substitute proposed is equivalent to that indicated or required by the Contract Documents. The procedure for review by the Engineer is to be similar to that described in the previous paragraph.

The Engineer is to be allowed a reasonable time within which to evaluate each proposed substitute. The Engineer will be the sole judge of acceptability, and no substitute shall be ordered, installed, or used without either a Construction Order or an approved working drawing. If approval is given, it is on the condition that the Contractor is fully responsible for producing Work in conformity with Contract requirements. If, after trial use of the substituted materials, equipment, means, method, technique, sequence, or procedure of construction, the Engineer determines that the Work produced does not meet Contract requirements, the Contractor shall discontinue the use of the substitute and shall complete the remaining Work with the specified materials, equipment, means, method, technique, sequence, or procedure of construction. The Contractor shall remove the deficient Work and replace it as specified, or take such other corrective action as the Engineer may direct. Changes will not be made in the basis of payment for the Pay Items involved, nor in the Contract Time as a result of authorized substitutes. The Engineer may require the Contractor to furnish at no cost to

the State a special performance guarantee or other surety with respect to any substitute. The Engineer will document the time required by the Department in evaluating proposed substitutions and in making changes in the Contract Documents. When the Engineer determines that a proposed substitute is unacceptable, the Contractor shall reimburse the Department for the cost of evaluating each proposed substitute.

When the Contract Documents permit the use of more than one type of material, equipment, or product, only one type is to be used throughout the Project.

106.13 Fuel Price Adjustment.{ XE "Adjustment of:fuel price" }

Fuel that is eligible for fuel price adjustment will be the sum of the quantities of the eligible Pay Items in the Contract times the fuel usage factors as listed below. The types of fuel furnished shall be at the option of the Contractor.

The fuel required for items not listed and for eligible Pay Items in the Contract that individually require less than 500 gallons of fuel will not be eligible for fuel price adjustment. If more than one Contract Pay Item has the same nomenclature but with different thicknesses, depths, or types, each individual Contract Pay Item must require 500 gallons or more of fuel to be eligible for fuel price adjustment. If more than one Contract Pay Item has the exact same nomenclature, similar Contract Pay Items will be combined and this total must then require 500 gallons or more of fuel to be eligible for fuel price adjustment.

If the as-built quantity of an eligible Contract Pay Item differs from the sum of the monthly estimates, and the as-built quantity cannot by readily distributed among the months in which the eligible Pay Item was constructed, then the as-built fuel price adjustment will be determined by distributing the difference in the same proportion as each monthly estimate is to the total of the monthly estimates.

Eligible Pay Items	**Fuel Usage Factor**
ROADWAY EXCAVATION, EARTH	0.5 Gallons per Cubic Yard
ROADWAY EXCAVATION, ROCK	0.5 Gallons per Cubic Yard
ROADWAY EXCAVATION, UNCLASSIFIED	0.5 Gallons per Cubic Yard
ROADWAY EXCAVATION, REGULATED WASTE	0.5 Gallons per Cubic Yard
MILLING, ____ " DEPTH	0.25 Gallons per Square Yard
MILLING, ____ " AVERAGE DEPTH	0.25 Gallons per Square Yard
MILLING, ____ " VARIABLE DEPTH	0.25 Gallons per Square Yard
MILLING, VARIABLE DEPTH	0.25 Gallons per Square Yard
PROFILE MILLING	0.25 Gallons per Square Yard
SUBBASE	1 Gallon per Cubic Yard
SOIL AGGREGATE BASE COURSE, ____ " THICK	1 Gallon per Cubic Yard
SOIL AGGREGATE BASE COURSE, VARIABLE THICKNESS	1 Gallon per Cubic Yard
DENSE-GRADED AGGREGATE BASE COURSE, ____ " THICK	1 Gallon per Cubic Yard
DENSE-GRADED AGGREGATE BASE COURSE, VARIABLE THICKNESS	1 Gallon per Cubic Yard
RECONSTRUCTED SOIL AGGREGATE BASE COURSE	1 Gallon per Cubic Yard
CONCRETE BASE COURSE, ____ " THICK	0.25 Gallons per Square Yard
CONCRETE BASE COURSE, REINFORCED, ____ " THICK	0.25 Gallons per Square Yard
SOIL AGGREGATE SURFACE COURSE, ____ " THICK	1 Gallon per Cubic Yard
DENSE-GRADED AGGREGATE SURFACE COURSE, ____ " THICK	1 Gallon per Cubic Yard
RECONSTRUCTED SOIL AGGREGATE SURFACE COURSE	0.25 Gallons per Square Yard
DENSE-GRADED FRICTION COURSE, MIX ____	2.5 Gallons per Ton
OPEN-GRADED FRICTION COURSE	2.5 Gallons per Ton
HOT MIX ASPHALT SURFACE COURSE MIX ____	2.5 Gallons per Ton
HOT MIX ASPHALT INTERMEDIATE COURSE MIX____	2.5 Gallons per Ton
HOT MIX ASPHALT BASE COURSE MIX____	2.5 Gallons per Ton
SUPERPAVE HOT MIX ASPHALT ____ ____ ____ SURFACE COURSE	2.5 Gallons per Ton
SUPERPAVE HOT MIX ASPHALT ____ ____ ____ INTERMEDIATE COURSE	2.5 Gallons per Ton
SUPERPAVE HOT MIX ASPHALT ____ ____ ____ BASE COURSE	2.5 Gallons per Ton
CONCRETE SURFACE COURSE, ____ " THICK	0.25 Gallons per Square Yard

CONCRETE SURFACE COURSE, REINFORCED, ___ " THICK	0.25 Gallons per Square Yard
BRIDGE APPROACH SLABS, ___ " THICK	0.5 Gallons per Square Yard
BRIDGE APPROACH TRANSITION SLABS, ___ " AVERAGE THICKNESS	0.25 Gallons per Square Yard
CONCRETE IN STRUCTURES, CULVERTS	1 Gallon per Cubic Yard
CONCRETE IN STRUCTURES, FOOTINGS	1 Gallon per Cubic Yard
CONCRETE IN STRUCTURES, RETAINING WALLS	1 Gallon per Cubic Yard
CONCRETE IN SUBSTRUCTURES, ABUTMENT WALLS	1 Gallon per Cubic Yard
CONCRETE IN SUBSTRUCTURES, PIER COLUMNS AND CAPS	1 Gallon per Cubic Yard
CONCRETE IN SUBSTRUCTURES, PIER SHAFTS	1 Gallon per Cubic Yard
CONCRETE IN SUPERSTRUCTURE, DECK SLABS	1 Gallon per Cubic Yard
CONCRETE IN SUPERSTRUCTURE, SIDEWALKS	1 Gallon per Cubic Yard
CONCRETE IN SUPERSTRUCTURE, PARAPETS	1 Gallon per Cubic Yard
CONCRETE SEAL IN COFFERDAMS	1 Gallon per Cubic Yard
CAST-IN-PLACE CONCRETE PILES, ___ " DIAMETER	1 Gallon per Cubic Yard

For those Pay Items in which the pay unit differs from that which appears in the fuel usage factor, the appropriate conversion will be figured before applying the fuel usage factor. Fuel price adjustment will be determined on a monthly basis by the following formula:

$F = (MF - BF) \times G$

Where:
- F = Fuel Price Adjustment
- MF = Monthly Fuel Price Index
- BF = Basic Fuel Price Index
- G = Gallons of Fuel Eligible for Price Adjustment

The monthly fuel price index, as determined by the Department, will be the average of the retail prices for No. 2 fuel oil and regular unleaded gasoline, as established by the New Jersey Department of Energy. The retail prices for No. 2 fuel oil and regular unleaded gasoline are based on the average of actual retail prices at various locations throughout the State.

The basic fuel price index will be the most recent monthly fuel price index before receipt of bids. Should a monthly fuel price index increase 50 percent or more over the basic fuel price index, no further work shall be performed on items eligible for fuel price adjustment without written approval from the Executive Director of Regional Operations. Should a monthly fuel price index decrease from the basic fuel price index, payments will be decreased accordingly.

Fuel price adjustment will be on a lump sum basis and an estimated amount to cover the fuel price adjustment has been included in the Proposal. Payments for increases will be made from this amount.

Fuel price adjustments will not be made in those months for which the monthly fuel price index has changed by less than five percent from the basic fuel price index.

Payment will be made under:

Pay Item	*Pay Unit*
FUEL PRICE ADJUSTMENT	LUMP SUM

Separate payment will not be made for fuel required for all items in the Contract, all costs thereof shall be included in the prices bid for the various Pay Items scheduled in the Proposal.

SECTION 107 - LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC{ XE "LEGAL:RELATIONS AND RESPONSIBILITY TO PUBLIC" }

107.01 Legal Jurisdiction. { XE "Legal:jurisdiction" }

This Contract shall be construed and shall be governed according to the Constitution and laws of the State.

The State in entering into this Contract does not waive its Sovereign Immunity, except as provided in the New Jersey Contractual Liability Act, NJSA 59:13-1 et seq. The rights or benefits provided the Contractor in this Contract which exceed those provided under that Act and the obligations established under this Contract which vary from those under the Act are contractual in nature and shall not be deemed to expand the waiver of Sovereign Immunity as set forth in that Act.

107.02 Notice of Potential Claim and the Administrative Process for the Resolution of Contract Disputes. { XE "Claims:notice of potential" }{ XE "Laws, ordinances, and regulations:notice of potential claim" }

The various notice provisions set forth in this Contract are contractual obligations assumed by the Contractor in executing the Contract. Any required notice shall be given only on forms provided by the Department. All forms shall be completed in their entirety and signed by the Contractor. Incomplete forms will be rejected and of no effect. Submission of completed notice forms acceptable to the Engineer constitutes compliance with the notice requirements of the New Jersey Contractual Liability Act if such notices are given within the time limits established by that Act, NJSA 59:13-5.

The Contractor agrees that the only evidence of compliance with NJSA 59:13-5 shall be the filing of said forms with the Engineer and that the Contractor shall not claim that any other documents sent or delivered to the Department or any of its officers or employees satisfies this notice requirement.

The Contractor understands that it will be forever barred from recovering against the State if it fails to give notice of any act, or failure to act, by the Engineer, or the happening of any event, thing, or occurrence, according to NJSA 59:13-5 and on the forms required by this Subsection.

The administrative process for the resolution of disputes is sequential in nature and is composed of the following steps:

Step I. Review by the Resident Engineer;
Step II. Review by the Regional Dispute Board;
Step III. Review by the Executive Director of Regional Operations;
Step IV. Review by the Department Claims Committee;
Step V. Review by the Claims Review Board.

Except as provided elsewhere herein, no dispute will be accorded a particular level of review unless the dispute has been reviewed at the preceding level and the Contractor rejects the decision in writing within the time period specified. If the Contractor did not escrow its bid preparation documents pursuant to Subsection 103.06, or if the Contractor fails to enter into a separate agreement with the Department to share the cost of the Claims Review Board as required by this

Subsection, any right to have its claims reviewed by the Claims Review Board is waived. In the administrative process, only the Claims Review Board may have access to the escrowed bid preparation documents. The escrowed bid preparation documents will be returned to the Contractor upon written request at any time before a claim reaching the Claims Review Board. By requesting such a return of the documents, the Contractor waives any right to have any claims heard by the Claims Review Board.

Unless specifically requested by the Department, the submission of additional information by the Contractor at any step of the review process shall cause the process to revert to Step I. If at any step in the process a dispute is resolved, the Contractor must sign an unconditional release as to any and all matters arising from the dispute.

The Contractor must file the necessary form as required by this Subsection to comply with NJSA 59:13-5 to begin the administrative process for the resolution of contract disputes. The Contractor must also notify the Resident Engineer in writing that all documentation in support of the dispute has been provided to the Resident Engineer and that the administrative review process should begin. The Resident Engineer will take no formal action until this written notification is received. The documentation provided to the Resident Engineer shall serve as the basis for evaluating the Contractor's position regarding the dispute throughout the administrative process. As a minimum, the following information must accompany each claim:

1. A detailed factual statement of the claim providing all necessary dates, locations, and items of work affected by the claim, and
2. The date on which facts arose which gave rise to the claim, and
3. A copy of any notice given to the Department pursuant to any other Subsection of the Contract which relates to the matter giving rise to the claim, and
4. The name, function, and activity of each State individual, official, or employee involved in or knowledgeable about the claim, and
5. The specific provisions of the Contract which support or mitigate against the claim and a statement of the reasons why such provisions support or mitigate against the claim, and
6. If the claim relates to a decision of the Engineer which the Contract leaves to the Engineer's discretion or as to which the Contract provides that the Engineer's decision is final, the Contractor shall set out in detail all facts supporting its contention that the decision of the Engineer was fraudulent or capricious or arbitrary or is not supported by substantial evidence, and
7. The identification of any documents and the substance of any oral communications relating to such claim, and
8. A statement as to whether the additional compensation or extension of Contract Time sought is based on the operation of the provisions of the Contract or an alleged breach of contract, and
9. If an extension of Contract Time is sought, the specific days for which it is sought and the basis for such claim, and
10. If additional compensation is sought, the exact amount sought and a breakdown of that amount into the following categories:
    a. Direct Labor
    b. Direct Materials
    c. Job Overhead
    d. Overhead (General and Administrative)
    e. Subcontractor's Work
    f. Other categories as specified by the Contractor.

The Resident Engineer will render a written decision regarding the matter in dispute within 15 Calendar Days of receipt of the Contractor's notification that the dispute resolution process should begin.

The Contractor shall, within 15 Calendar Days of the receipt of the decision by the Resident Engineer, either accept or reject the decision in writing. If the Contractor neither accepts nor rejects the Resident Engineer's decision within 15 Calendar Days of its receipt, the dispute will be considered withdrawn from the administrative process and there will be no further administrative remedy.

If the Contractor rejects the decision of the Resident Engineer, the dispute automatically is forwarded by the Resident Engineer to the Regional Dispute Board. The Regional Dispute Board will, within 15 Calendar Days of receipt of the dispute information from the Resident Engineer, schedule and hold a meeting to review the dispute with the Contractor. This time limit may be extended by mutual agreement of the parties. The Regional Dispute Board will, within 15 Calendar Days of the meeting, issue a written decision, with reasons, regarding the dispute.

The Contractor shall, within 15 Calendar Days of receipt of the decision, either accept or reject it in writing. If the Contractor neither accepts nor rejects the Regional Dispute Board's decision within 15 Calendar Days, the dispute will be considered withdrawn from the administrative process. There will be no further administrative remedy.

If the Contractor rejects the decision of the Regional Dispute Board, the Regional Dispute Board will automatically forward the dispute to the Executive Director of Regional Operations. The Executive Director of Regional Operations will, within 15 Calendar Days of receipt of the dispute information from the Regional Dispute Board, schedule and hold a meeting with the Contractor. This time limit may be extended by mutual agreement of the parties. The Executive Director of Regional Operations will, within 15 Calendar Days of the meeting, issue a written decision, with reasons, regarding the dispute.

The Contractor shall, within 15 Calendar Days of the receipt of the decision of the Executive Director of Regional Operations, either accept or reject it in writing. If the Contractor neither accepts nor rejects the Executive Director's decision within 15 Calendar Days, the dispute will be considered withdrawn from the administrative process and there will be no further administrative remedy.

If the Contractor rejects the decision of the Executive Director of Regional Operations, there will be no further automatic review of the dispute. Unless the Contractor requests further review in writing, the dispute will be considered withdrawn from the administrative process.

The Contractor may request, in writing to the Secretary of the Department Claims Committee in care of the Executive Director of Regional Operations, P.O. Box 607, Trenton, New Jersey 08625, that any dispute or disputes unresolved after review by the Executive Director of Regional Operations be immediately reviewed by the Department Claims Committee, if:

1. a dispute or disputes exceed $250,000; or
2. the Contract is at least 50 percent complete, based upon the adjusted contract price, and the claimed value of the dispute or combined disputes exceeds the lesser of ten percent of the adjusted contract price or $75,000; or
3. it is mutually agreed to by the Contractor and the Department.

Additionally, the Contractor may request in writing at the time of issuance of the final certificate that all unresolved disputes that have gone through the first three steps of the dispute resolution process and that have not been presented to the Department Claims Committee before the issuance of the final certificate be reviewed by the Department Claims Committee as provided in Subsection 109.11. The Contractor's written request must accompany its exceptions to the final certificate, with a copy sent to the Secretary of the Department Claims Committee and the Executive Director of Regional Operations and shall be made within 30 Calendar Days of the issuance of the final certificate.

The Executive Director of Regional Operations, upon receipt of the copy of the request for Department Claims Committee review, will forward the Contractor's claims submission, along with the Director's decision, to the Secretary of the Department Claims Committee. The Department Claims Committee will, within 45 Calendar Days of the receipt of the claims information, schedule a meeting. The Department Claims Committee will, within 45 Calendar Days of the meeting, notify the Contractor in writing of its decision of the claim(s), giving reasons for its decision.

The Contractor shall, within 15 Calendar Days of the receipt of the Department Claims Committee decision, either accept or reject it in writing. If the Contractor rejects the Department Claims Committee decision, there will be no further automatic review of the claim. Unless the Contractor requests further review in writing, the dispute will be considered withdrawn from the administrative process.

If the Contractor neither accepts nor rejects the Department Claims Committee's decision within 15 Calendar Days, the decision of the Department Claims Committee is considered rejected and there will be no further administrative review of the claim by the Department Claims Committee.

Finally, at Completion or at any time during the Project upon mutual agreement between the Contractor and the Department, the Contractor may request, in writing to the Chairperson of the Claims Review Board in care of the Executive Director of Regional Operations, P.O. Box 607, Trenton, New Jersey 08625, that any claim or claims unresolved by the Department Claims Committee be reviewed by the Claims Review Board. The Claims Review Board will review no claim unless the Contractor has escrowed its bid preparation documents as required by Subsection 103.06, and unless the Contractor has entered into a separate agreement with the Department to equally share the cost of using the Claims Review Board. The Department will provide the forms for this cost sharing agreement. The Contractor shall request review by the Board within 30 Calendar Days of Completion or other date mutually agreed upon between the Contractor and the Department. Failure to request review within the required time period shall constitute a waiver by the Contractor of any further review by the Board of its claims.

If the Contractor requests review of its claim by the Claims Review Board, the Department will forward to the Contractor the required cost sharing agreement forms that shall be executed by the Contractor and returned to the Department within ten State business days. A failure by the Contractor to return the fully executed cost sharing agreement to the Department within the ten-day period shall constitute a waiver by the Contractor of any further review by the Board.

If the Contractor requests review of its claim by the Claims Review Board and has fully executed the required cost sharing agreement, its escrowed bid documents will be released upon request of the Claims Review Board Chairperson solely for the Board's exclusive use and information. These documents will be used only to resolve the pending claim.

The Claims Review Board will, within 30 Calendar Days of the request for review by the Contractor, schedule a meeting for the review of the submitted claims. The Claims Review Board will base its review on the escrowed bid documents and the written information previously supplied by the Contractor during the administrative dispute resolution process. The Claims Review Board will, within 30 Calendar Days of the meeting, issue recommendations to the Commissioner for action and the Contractor for information. After submission of the recommendation, escrowed bid documents will be returned to the Contractor, unless the Contractor requests that the Claims Review Board return the documents for continued escrow in the designated repository. A return of the bid preparation documents to the Contractor will constitute a waiver by the Contractor of review of any other claims by the Claims Review Board. The Commissioner will, within 15 Calendar Days, accept, reject, or modify the recommendation of the Claims Review Board and notify the Contractor of the decision.

The Contractor shall, within 15 Calendar Days of notification of the Commissioner's decision, accept or reject the Commissioner's decision. After the passage of 15 Calendar Days, the administrative review process will be at an end.

107.03 Laws to be Observed.

{ XE "Laws, ordinances, and regulations" **}**The Contractor shall keep fully informed of all Federal, State, and local laws, ordinances, and regulations, and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the Work, or which in any way affect the conduct of the Work. The Contractor shall at all times observe and comply with, and shall cause its agents and employees to observe and comply with, all such laws, ordinances, regulations, orders, and decrees and shall protect and indemnify the State and its representatives against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by the Contractor or the Contractor's agents or employees, subcontractors of any tier, suppliers, or materialmen. If any discrepancy or inconsistency is discovered between the Contract Documents and any such law, ordinance, regulation, order, or decree, the Contractor shall immediately report the same to the Engineer in writing.

107.04 Federal Aid.

{ XE "Federal Aid contracts" **}**In all contracts in which the Federal Government participates financially, which contracts are designated as Federal Aid Contracts, the Contractor shall conform in all respects to the requirements contained in the applicable Federally required contractual provisions that are included as part of the Contract Documents for contracts so designated. When any such Federal provisions are in conflict with any other provisions of this Contract, the Federal provisions prevail and take precedence and will be of force over and against any said conflicting provisions as contained in the other Contract Documents.

107.05 Permits, Licenses, and Taxes. { XE "Laws, ordinances, and regulations:permits, licenses" }{ XE "Taxes" }{ XE "Permits and licenses" }

The Contractor shall procure all permits, grants, and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the Work except where the Department has procured such permits, grants, or licenses for temporary or permanent construction. The Contractor shall advise the issuing agency or party of its proposed operations and obtain their cooperation and such supplemental permission as may be necessary. Before submitting its bid, the Contractor should obtain from the Department all available information on the permits, grants, and licenses the Department has obtained. Charges incurred by the Contractor for permits, grants, and licenses in connection with the Work shall be paid by the Contractor and shall be included in the prices bid for the various Pay Items scheduled in the Proposal.

{ XE "Laws, ordinances, and regulations:dredging permits" **}**Before the Contractor performs dredging or channel excavation within tidal waterways for the procurement of materials, or performs therein other work of its own, when such work is not part of the permanent or temporary Work provided for in the Contract, the Contractor shall advise USACE, USCG, and NJDEP, Division of Marine Services and Division of Water Quality of its intended work. If the waterway is not navigable, the Contractor shall notify the Division of Water Quality only. The Contractor shall procure all necessary permits for such work from the above named agencies having jurisdiction and interest and shall comply with their rules and regulations in the performance of the above mentioned work.

The Department of the Army, acting through the Corps of Engineers, is charged with the responsibility for the administration of laws for the protection and preservation of navigation and the navigable waters of the United States. Section 10 (33 USC 403) of the River and Harbor Act of 3 March 1899 specified that: "The creation of any obstruction not

affirmatively authorized by Congress, to the navigable capacity of any of the waters of the United States is prohibited; and it shall not be lawful to build or commence the building of any wharf, pier, dolphin, boom, weir, breakwater, bulkhead, jetty, or other structures in any port, roadstead, haven, harbor, canal, navigable river, or other water of the United States, outside established harbor lines, or where no harbor lines have been established, except on plans recommended by the Chief of Engineers and authorized by the Secretary of the Army; and it shall not be lawful to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of, any port, roadstead, haven, harbor, canal, lake, harbor of refuge, or enclosure within the limits of any breakwater, or of the channel of any navigable water of the United States, unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army before beginning the same." (30 Stat 1151; 33 USC 403)

Failure to obtain a Department of Army Permit is a violation of Section 10 cited above, and penalties therefor may be adjudged. In addition, the owners of such non-authorized structures are considered legally responsible and liable for damages attributable thereto or occasioned thereby.

A pamphlet describing the procedures for applying for a permit together with a list of applicable waterways may be obtained free of charge from the various district offices of the Corps of Engineers.

Section 21 PL 91-224, The Water Quality Improvement Act of 1970, requires a certification in connection with any permit application to conduct any activity, including but not limited to the construction or operation of facilities which may result in any discharge into the navigable waters of the United States. This certification must be made by the State or interstate agency responsible for water quality or by the Secretary of the Interior as the case may be to the effect that there is reasonable assurance that the permitted activity will not violate water quality standards.

Upon receipt of any application for such permit, a public notice is issued to all known interested parties and to the news media to provide an opportunity for individuals and Federal, State, and local governmental agencies to comment on the proposed work being considered. In known controversial cases, a public hearing will be held in order that all views may be presented for consideration. The period normally allowed for receipt of comments is 30 days. If the proposed work is not considered to adversely affect navigation, fish and wildlife, water quality, conservation, aesthetics, recreation, ecology, and other aspects of the public interest, and if no objections are received, the Department of the Army Permit is then issued. If objections to the proposed work are received, an attempt is made to resolve the differences between the objector and the applicant. If this attempt is unsuccessful, the application, objections, and all pertinent information, including the minutes of the public hearing if held, with the District Engineer's recommendations, are forwarded to the office of the Chief of Engineers for an ultimate decision, all of which requires additional time for final action.

Before submitting a bid based on utilizing hydraulically procured soil aggregate materials, bidders shall assure themselves that the NJDEP will issue a permit to dredge such materials.

{ XE "Laws, ordinances, and regulations:sales tax exemption" **}{** XE "Sales tax exemption" **}**NJSA 54:32B-9 provides that any sale or service to the State, or any of its agencies, instrumentalities, public authorities, public corporations (including a public corporation created pursuant to agreement or compact with another state), or political subdivisions where the State is the purchaser, user, or consumer, is not subject to the sales and use taxes imposed under the Sales and Use Tax Act. NJSA 54:32B-8 provides that sales of materials, supplies, or services made to contractors, subcontractors, or repairmen for exclusive use in erecting structures, or building on, or otherwise improving, altering, or repairing real property of the above listed bodies are exempt from the tax on retail sales imposed by the Sales and Use Tax Act. The sales tax exemption does not apply for equipment used for Contract work or for force account work whether the equipment is to be purchased or rented. The exemption provided under NJSA 54:32B-8 is conditioned on the person seeking such exemption qualifying therefor pursuant to the rules and regulations and upon the forms prescribed by the New Jersey Division of Taxation. The required form, "Contractor's Exemption Purchase Certificate" (Form No. ST-13), can be obtained by writing or calling the New Jersey Division of Taxation, Tax Information Services (TIS), P.O. Box 269, Trenton, New Jersey 08625, or any New Jersey Division of Taxation Regional Office.

Pursuant to PL 1995, c.159, and not withstanding and provisions of the law to the contrary, whenever any taxpayer, partnership, or S corporation under contract to provide goods or services or construction projects to the State or its agencies or instrumentalities, including the legislative and judicial branches of the State government, is entitled to payment for those goods or services at the same time a taxpayer, partner, or shareholder of that entity is indebted for any State tax, the Director of the Division of Taxation will seek to set off so much of that payment as is necessary to satisfy the indebtedness. The amount set off shall not allow for the deduction of any expense or other deductions that might be attributable to the taxpayer, partner, or shareholder subject to set-off under this act.

The Director of the Division of Taxation will give notice of the set-off to the taxpayer, partner, or shareholder and will provide an opportunity for a hearing within 30 days of such notice under the procedures for protests established under R.S. 54:49-18. No request for conference, protest, or subsequent appeal to the tax court from any protest shall stay

the collection of the indebtedness. Interest that may be payable by the State, pursuant to PL 1987, c.184 (C.52:32-32 *et seq*.), to the taxpayer shall be stayed.

107.06 Patented Devices, Materials, and Processes. { XE "Patented devices, materials, and processes" }

If any design, device, material, or process covered by letters of patent or copyright is used in the Work, the Contractor shall provide for such use by suitable legal agreement with the patentee or owner. The Contractor shall assume all costs arising from the use of patented materials, equipment, devices, or processes used on or incorporated in the Work. The Contractor shall defend, indemnify, and save harmless the State, any affected third party, or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material, or process, or any trademark or copyright, and shall indemnify the State for any costs, expenses, and damages which it may be obliged to pay by reason of an infringement, at any time during the performance of the Work or after Acceptance.

107.07 Discrimination in Employment on Public Works. { XE "Discrimination in employment" }{ XE "Laws, ordinances, and regulations:discrimination in employment" }

Pursuant to NJSA 10:2-1, the Contractor agrees that:

1. In the hiring of persons for the performance of work under the Contract or any subcontract hereunder, or for the procurement, manufacture, assembling, or furnishing of any such materials, equipment, supplies, or services to be acquired under the Contract, the Contractor, subcontractor, or any person acting on behalf of such Contractor or subcontractor shall not by reason of race, creed, color, national origin, ancestry, marital status, disability, or sex, discriminate against any person who is qualified and available to perform the Work to which the employment relates;
2. The Contractor, subcontractor, or any person acting on behalf of such Contractor shall not, in any manner, discriminate against or intimidate any employee engaged in the performance of Work under the Contract or any subcontract hereunder, or engaged in the procurement, manufacture, assembling, or furnishing of any such materials, equipment, supplies, or services to be acquired under such Contract, on account of race, creed, color, national origin, ancestry, marital status, disability, or sex;
3. There may be deducted from any monies due the Contractor under the Contract, a penalty of $50.00 for each person for each Calendar Day during which such person is discriminated against or intimidated in violation of the provisions of the Contract; and
4. The Contract may be canceled or terminated by the Department, and any monies due the Contractor under the Contract may be forfeited, for any violation of this Subsection occurring after notice to the Contractor from the Department of any prior violation of this Subsection.

107.08 Affirmative Action and Minority or Disadvantaged Business Enterprises or Emerging Small Business Enterprise. { XE "Disadvantaged business enterprises" }{ XE "Affirmative action" }{ XE "Laws, ordinances, and regulations:disadvantaged or minority business enterprises" }{ XE "Laws, ordinances, and regulations:affirmative action" }{ XE "Minority business enterprises" }

It is the public policy of the State and of the United States that no individual, group, firm, or corporation working on or seeking to work on a Public Works Project should be discriminated against on the basis of age, race, creed, color, national origin, ancestry, marital status, disability, or sex. To this end, Affirmative Action and Minority or Disadvantaged Business Enterprise or Emerging Small Business Enterprise Programs have been developed. The Affirmative Action and Minority or Disadvantaged Business Enterprise or Emerging Small Business Enterprise regulations and requirements applicable to the Contract are contained in the Special Provisions for the Project. Any conflicts between these regulations and requirements, and the other provisions of the Contract Documents shall be resolved by the Engineer to further the above stated public policy.

107.09 Restoration of Surfaces Opened by Permit.

The right to construct or reconstruct any utility service in the highway or street, or to grant permits for same, at any time, is hereby expressly reserved by the Department for the public utilities and proper authorities of the municipality in which the Work is done, and the Contractor shall not be entitled to any damages either for the digging up of the street or **{** XE "Utilities, public:delays by" **}**for any delay occasioned thereby.

{ XE "Utilities, public:cooperation with" **}**When an individual, firm, or corporation is authorized through a duly executed permit from the Department, the Contractor shall allow parties bearing such permits, and only those parties, to make openings in the highway. When ordered by the Engineer, the Contractor shall make all necessary **{** XE "Utilities, public:repairs due to" **}**repairs due to such openings, and such necessary work will be paid for as Extra Work or as specifically provided elsewhere in the Contract Documents.

107.10 Sanitary, Health, and Safety Provisions. { XE "Sanitary provisions" }{ XE "Laws, ordinances, and regulations:sanitary, health, and safety provisions" }

{ XE "Health regulations" **}A. Toilets.** The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of its employees and for State field offices and materials field laboratory as may be necessary to comply with the requirements of the State and local health departments, or of other bodies or tribunals having jurisdiction.

The Contractor shall ensure privacy to all employees and Department personnel assigned to the Project by providing on site separate toilet facilities for male and female employees. These facilities shall be portable toilets and clearly marked MEN and WOMEN. They are in addition to the facilities provided in the field office or laboratory.

The total number of facilities shall be determined from the chart listed below. A facility is defined as one unit. A facility site is defined as a location that provides at least one facility for each sex. The maximum distance between the location of facility sites and workers shall be no more than one-half mile.

All toilet facilities shall be in compliance with OSHA Regulation 1926.51(c) with the exception that the State will require that separate toilet facilities be provided for males and females. The sewage disposal method shall not endanger the health of employees and shall be in compliance with all State and Federal regulations.

Toilet facilities shall be cleaned and sanitized a minimum of once per week except from May 15 through September 15 in which these facilities shall be cleaned and sanitized a minimum of twice per week.

Number of Male Employees	Minimum No. of Facilities for Male Use	Number of Female Employees	Minimum No. of Facilities for Female Use
1 - 15	1	1 - 15	1
16 - 35	2	16 - 35	2
36 - 55	3	36 - 55	3
56 - 80	4	56 - 80	4
81 - 110	5	81 - 110	5
111 - 150	6	111 - 150	6
Over 150	6+(1)	Over 150	6+(1)

(1) - One additional facility for each additional 40 employees of each sex.

B. Safety Plan. The Contractor shall observe all rules and regulations of the Federal, State, and local health officials. Attention is directed to Federal, State, and local laws, rules, and regulations concerning construction safety and health standards. The Contractor shall not require any worker to work in surroundings or under conditions that are unsanitary, hazardous, or dangerous to the worker's health or safety.

Before starting work on the Project, the Contractor shall submit to the Engineer a written Safety and Health Program (hereinafter referred to as the "Program"). The Program shall meet or exceed the minimum requirements of this Subsection and any applicable State or Federal regulations. The general introduction of the Program shall include the names, addresses, and telephone numbers of the Contractor's Project Manager, project superintendent and its designee, all competent persons, and the traffic control coordinator.

The Contractor's Program shall include the following:

1. General Introduction.

a. Description. The Program shall describe in detail the means by which the Contractor shall implement and monitor the Program. Implementation and monitoring shall also mean that the Program shall be a document with provision for change to update the Program with new information, new practices or procedures, changing site and environmental conditions, or other situations that could adversely affect site personnel. The Program shall provide guidelines for protecting all personnel from hazards associated with Project operations and activities. The Program shall establish the policies and procedures that are necessary for the Project to be in compliance with the requirements of OSHA and other State and Federal regulatory agencies with jurisdiction, rules, regulations, standards, or guidelines in effect at the time the Work is in progress.

b. Responsibility, Identification of Personnel, and Certifications. The Contractor is solely responsible for creating, implementing, and monitoring the Program.

The Contractor shall identify and designate on-site supervisory level personnel who shall be responsible for implementing and monitoring the Program at all times throughout the duration of the Project and shall have authority to take prompt corrective measures to eliminate hazards including the ability to stop work activities.

Documentation of training provided to the on-site supervisory level personnel shall be included as part of the Program.

For any work activities wherein the Contractor has identified a competent person as defined by OSHA, that person shall be capable of identifying existing and predictable hazards and have the authority to take prompt corrective measures to eliminate the hazards, including the ability to stop work activities.

Documentation of the qualifications of such competent persons identified, including any certifications received, shall be included as part of the Program.

The Contractor shall further identify the qualified safety professional responsible for developing the Program and shall provide that person's qualifications for developing the Program which shall include, but not be limited to, education, training, certifications, and experience in developing this type of Program.

The Program shall contain a certification executed by the qualified safety professional who developed the Program, stating that the Program complies with OSHA and other applicable State and Federal regulatory agencies with jurisdiction, rules, regulations, standards, or guidelines in effect at the time the Work is in progress.

2. **Elements of the Program.** The Program shall address, but not be limited to, the following elements:
    - **a. Management safety policy and implementation statement.**
    - **b. Emergency telephone numbers.**
    - **c. Personnel responsibilities.**
        - (1) Management responsibilities
        - (2) Supervisor's responsibilities
        - (3) Site safety officer responsibilities
        - (4) Employee responsibilities
    - **d. Training.**
        - (1) Regulatory
        - (2) Crew/site talks
            - (a) Subject selection
            - (b) Documentation
        - (3) Site hazard assessment -Daily employee awareness of site operations
    - **e. Safety rules.**
        - (1) General safety rules
        - (2) Personal protective equipment
        - (3) Housekeeping
    - **f. Employee disciplinary policy.**
        - (1) The policy
        - (2) Violation forms
    - **g. Safety checklists.**
        - (1) Project safety-planning checklist
        - (2) Emergency plans and procedures checklist
        - (3) Documentation checklist
        - (4) Protective materials and equipment checklist
    - **h. Traffic control coordinator inspections**.
        - (1) Responsible person
        - (2) Frequency
        - (3) Documentation of actions taken
    - **i. Record keeping.**
        - (1) OSHA 200 log
        - (2) New Jersey Department of Labor L&I-1 forms
    - **j. Emergency action plans, chain of command, and responsibilities.**
        - (1) Guideline for handling emergencies

(2) Accidents involving death or serious injury
(3) Property damage accidents
(4) Fire or explosions
(5) Severe weather

k. Security policy guidelines.
(1) Job site security guidelines for safety
(2) Job site office guidelines for safety

l. Hazard communication.
(1) What is and how to read a Material Safety Data Sheet (MSDS)
(2) Where Program and MSDS are located
(3) How Program information is communicated
(4) Person responsible for communicating Program information
(5) Documentation of hazard communication

m. Additional procedures for project specific situations as applicable.
(1) Compressed gas cylinders
(2) Confined spaces
(3) Cranes
(4) Crystalline silica (stone, masonry, concrete, and brick dust)
(5) Electrical
(6) Equipment operators
(7) Fall protection
(8) Hand and power tools
(9) Hearing conservation
(10) Highway safety
(11) Lead
(12) Lock out/tag out
(13) Materials handling, storage, use, and disposal
(14) Night work
(15) Personal protective equipment
(16) Project entry and exit
(17) Respiratory protection
(18) Sanitation
(19) Signs, signals, and barricades
(20) Subcontractors
(21) Trenching

The scope of work, operations, and environment of the Project will dictate the elements that need to be addressed by the Contractor and may add or delete elements that are to be addressed for a particular project.

Appropriate documentation for each element shall be maintained and made available by the Contractor to show compliance with the Program.

The Program shall be kept on the site and shall apply and be available to all workers and all other authorized persons entering the work site.

The Program shall apply to any work under the Contract whether such work is performed, by way of example and not limitation, by the Contractor's forces, subcontractors, suppliers, or fabricators.

The Program shall be submitted to the Engineer for review before the actual start of work on the Project. Within ten Working Days of receipt, the Engineer will determine whether or not the Program meets the requirements of this Subsection. If the Program does not, it will be returned for revision, and work on the Project may not proceed until the Engineer has accepted the Program. Acceptance of the Program shall not be considered or be construed as an approval of the Program by the Engineer and shall not be considered a part of the Contract and shall not obligate the State to carry out the Program in any manner. Copies of updates to the Program shall be supplied to the Engineer.

If at any time during the Project, the Program is not being complied with as written, the Contractor shall correct such deficiencies.

The Contractor is solely responsible for all aspects of the Program including, but not limited to, the development, revision, implementation, monitoring, and updating of the Program. Pursuant to Subsection 107.22, the Contractor shall defend, indemnify, and save harmless the State from any and all liability from any actions arising directly or indirectly or alleged to arise from the Program.

A copy of each State Department of Labor form, L&I-1, entitled "Employer's First Report of Accidental Injury or Occupational Illness," submitted to the Department of Labor, Division of Workers Compensation, shall be sent to the Office of Capital Project Safety, New Jersey Department of Transportation, 1035 Parkway Avenue, P.O. Box 600, Trenton, New Jersey 08625-0600.

Separate payment will not be made for the Program including, but not limited to, its development, revision, implementation, monitoring, and updating. All costs thereof shall be included in the various Pay Items scheduled in the Proposal.

The Contractor shall admit, without delay and without the presentation of an inspection warrant, any inspector of OSHA or other legally responsible agency involved in safety and health administration upon presentation of proper credentials.

The Contractor shall make available to the Contractor's employees, subcontractors, the Engineer, and the public, all information pursuant to OSHA 29 CFR Part 1926.59 of The Hazard Communication Standard 29 CFR 1910.1200, and shall also maintain a file on each job site containing all MSDS for products in use at the Project. These MSDS shall be made available to the Engineer upon request.

107.11 Public Convenience and Safety. { XE "Public convenience and safety" }

The Contractor shall at all times conduct the Work to ensure the least possible obstruction to traffic. The safety and convenience of the general public and the residents along the highway, and the protection of persons and property shall be provided for by the Contractor as specified under Section 617.

Precaution shall be exercised at all times for the protection of persons and property. The safety provisions of applicable laws, OSHA regulations, building and construction codes, and the rules and regulations of the New Jersey Department of Labor shall be observed.

107.12 Railway Highway Provisions. { XE "Railroad:crossings" }

If the Contract Documents require that materials be hauled across the tracks of any railway, the Department will arrange with the railway for any new crossings required or for the use of any existing crossings. If the Contractor elects to use crossings other than those designated, it shall make arrangements for the use of such crossings.

Construction work performed on or near railroad ROW shall be performed according to Subsections 105.09 and 105.10.

107.13 { XE "Waterways, construction over" }Construction Over or Adjacent to Navigable Waters.

All Work over, on, or adjacent to navigable waters shall be so conducted that free navigation of the waterways is not interfered with, and that the existing navigable depths are not impaired except as allowed by permit issued by USCG or USACE, as applicable.

107.14 Barricades and Warning Signs. { XE "Signs:types:warning" }{ XE "Laws, ordinances, and regulations:barricades and warning signs" }{ XE "Barricades" }

The Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs, and other traffic control devices according to Section 617, and shall take all necessary precautions for the protection of the Work and safety of the public.

107.15 Use of Explosives. { XE "Laws, ordinances, and regulations:explosives, use of" }{ XE "Use of explosives" }

When the use of explosives is necessary for the prosecution of the Work, the Contractor shall exercise the utmost care not to endanger life or property, including new Work. The Contractor shall be responsible for all damage resulting from the use of explosives.

A pre-blasting meeting will be scheduled by the Engineer with the Office of Safety Compliance. The Contractor shall attend the pre-blasting meeting. No blasting will be permitted before the pre-blasting meeting.

Explosives shall be stored safely under lock and key. The storage places shall be marked plainly **DANGEROUS EXPLOSIVES**. The storing and handling of explosives and highly inflammable materials shall conform to the regulations of the Office of Safety Compliance, Mine Safety and Explosives, New Jersey Department of Labor, and to local regulations relating thereto. Proper means shall be used to avoid blasting damage to public and private property. Flaggers shall be provided, when necessary, who shall warn and keep traffic from the danger area, and all persons within the danger area shall be warned and given time to withdraw.

107.16 Protection and Restoration of Property Markers and Land Monuments. { XE "Monuments and markers:preservation of" }{ XE "Protection of:markers and monuments" }

The Contractor shall be responsible for the preservation of all public and private property markers and shall protect carefully from disturbance or damage, all land monuments and property markers until the Contractor's Land Surveyor has referenced their location. Monuments and markers that have been set by governmental and public agencies, shall be moved as directed once the Contractor's Land Surveyor has performed all survey work related to the movement of the aforementioned monuments and markers. If the Engineer discovers any errors in the survey, the cost of checking and correcting these errors will be deducted from any monies due or that may become due the Contractor.

All Geodetic Control Markers such as monuments, disks, and benchmarks within the Project site shall be carefully protected and shall not be disturbed by construction activity. Where such markers are located within the Project and are in danger of destruction or disturbance, the Contractor shall cause its Land Surveyor to properly and accurately relocate all such affected markers before disturbing the location of the original markers. All survey work shall be according to the Geodetic Mark Preservation Guidebook as prepared by National Geodetic Survey. Copies of the guidebook are available from the Geodetic Control Survey Unit, New Jersey Department of Transportation, PO BOX 600, Trenton, New Jersey 08625. The Contractor shall certify in writing to the Geodetic Control Survey Unit that all the survey work was performed according to this guidebook.

107.17 Forest Protection. { XE "Protection of:forests" }

In carrying out work within or adjacent to State or National Forests or Parks, the Contractor shall comply with all regulations of the State Fire Warden, State Division of Parks and Forestry, or other authority having jurisdiction, governing the protection of forests and the carrying out of work within forests, and shall observe all sanitary laws and regulations with respect to the performance of work in forest areas. The Contractor shall keep the areas in an orderly condition, dispose of all refuse, obtain permits for the construction and maintenance of all construction camps, stores, warehouses, residences, latrines, cesspools, septic tanks, and other structures according to the requirements of the Division or such other authority.

The Contractor shall take all reasonable precautions to prevent forest fires and shall require its employees and subcontractors, both independently and at the request of Forestry officials, to do all reasonably within their power to prevent and assist in preventing forest fires, and to make every possible effort to notify a Forestry official at the earliest possible moment of the location and extent of any fire seen by them.

107.18 Opening Sections of Project to Traffic. { XE "Opening to traffic:sections of project" }

Opening sections of the Project to traffic before Completion may be desirable or may be necessary due to conditions inherent in the Work, changes in the Contractor's work schedule, or conditions or events unforeseen at the time the Project was bid. Such openings shall be made only when so directed by the Engineer. Under no condition shall such openings constitute Acceptance or a part thereof, or a waiver of any provisions of the Contract.

The Contract Documents indicate, insofar as possible, which sections are to be opened before Completion. The Contractor shall make no claim for and shall have no right to additional compensation or extension of Contract Time for opening sections of the Project to traffic as indicated in the Contract Documents, or resulting from partial acceptance or changes in the Contractor's work schedule, or for reasons that are due to the fault of the Contractor or any other party, including utilities.

Additional compensation or extension of Contract Time for completion of other items of Work on sections of the Project opened to traffic for reasons other than those indicated in the preceding paragraph will be made as provided in Subsection 109.03 or in a Supplementary Agreement.

If the Contractor is dilatory in completing shoulders, drainage structures, or other features of the Work, the Engineer may so notify the Contractor in writing and establish therein a reasonable period of time in which the Work is to be completed. If the Contractor is dilatory, or fails to make a reasonable effort toward completion in this period of time, the Engineer may then order all or a portion of the Project opened to traffic. On such sections, which are so ordered to be opened, the Contractor shall conduct the remainder of its construction operations so as to cause the least obstruction to traffic, and shall make no claim for and shall have no right to additional compensation or extension of Contract Time.

On sections of the Project opened to traffic whether indicated in the Contract Documents or not, maintenance of the roadway shall be according to Subsection 105.19.

107.19 Independent Contractor.

The relationship of the Contractor to the State is that of an independent contractor, and said Contractor, according to its status as an independent contractor, covenants and agrees that it shall conduct itself consistent with such status, that

it shall neither hold itself out as nor claim to be an officer or employee of the State by reason hereof. The Contractor shall not, by reason hereof, make any claim, demand, or application to or for any right or privilege applicable to an officer or employee of the State, including, but not limited to, workers compensation coverage, unemployment insurance benefits, social security coverage, or retirement membership or credit.

107.20 Third Party Beneficiary Clause.

It is specifically agreed between the parties executing the Contract that no provision of the Contract is intended to make the public or any member thereof a third party beneficiary hereunder, or to authorize anyone not a party to the Contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of the Contract.

It is the further intent of the Commissioner and the Contractor in executing the Contract that no individual, firm, corporation, or any combination thereof, that supplies materials, labor, services, or equipment to the Contractor for the performance of the Work becomes thereby a third party beneficiary of the Contract. The Commissioner and the Contractor understand that such individual, firm, corporation, or combination thereof, has no right to bring an action in the courts of this State against the State, by virtue of this lack of standing, and also by virtue of the provisions of the New Jersey Contractual Liability Act, NJSA 59:13-1 *et seq.*, which allows suit against the State in Contract only on the basis of express contracts or contracts implied in fact.

107.21 Assignment of Contract Funds and Claims. { XE "Assignment of contract funds and claims" }

The Contractor shall not transfer or assign to any party any contract funds, due or to become due, or claims of any nature it has against the State, without the written approval of the Engineer having first been obtained. The Engineer, by sole discretion, considering primarily the interests of the State, may grant or deny such approval.

107.22 Risks Assumed by the Contractor. { XE "Laws, ordinances, and regulations:risks assumed by contractor" }

The Contractor assumes the following distinct and several risks, whether they arise from acts or omissions, whether negligent or not, of:

1. the Contractor, its subcontractors, suppliers, materialmen, employees, agents, and all others working for the Contractor on the Project,
2. the State,
3. third persons, including the traveling public,
4. vandalism, or
5. any other cause,

and whether such risks are within or beyond the control of the Contractor as described in Subheadings 1 through 4 below. Excepted from this assumption of risks are only those risks that arise from solely affirmative acts done by the State subsequent to the execution of the Contract with actual and willful intent to cause loss, damage, or injury. The risks are as follows:

{ XE "Damage to:materials and equipments" **}{** XE "Damage to:project:repair of" **}{** XE "Damage to:project" **}1.** **Risks of Loss or Damage to the Permanent Construction**. Until Acceptance, and within the limits of the Project's work, the Contractor shall bear the risk of all loss or damage to all permanent construction and temporary construction performed under this Contract and to materials, whether or not it has received payment for such construction or materials under Subsection 109.05, 109.06, or 109.07. The Contractor shall take every precaution, as allowed by the Contract against injury or damage to any part of the construction or to materials by the action of the elements, the traveling public, vandalism, or from any other cause, whether arising from the execution or the non-execution of the work. The Contractor shall promptly repair, replace, and make good any such damage or loss without cost to the Department. The Contractor shall not bear such risk of loss or damage, which arises from acts of war or floods, tidal waves, earthquakes, cyclones, tornadoes, hurricanes, or other cataclysmic natural phenomenon unless such loss or damage is covered by insurance.

The Contractor shall, in furtherance of the above paragraph, but not by way of limitation, at the Contractor's expense, provide suitable drainage for the Project and erect such temporary structures where necessary to protect the Work from damage. The Contractor shall assume the risks for failure to take such actions.

In case of suspension of the Work from any cause whatever, the Contractor shall continue to be responsible for the Project as provided above and shall take such precautions as may be necessary to prevent damage to the Project, provide for drainage, and shall erect any necessary temporary structures, signs, or other facilities. During such period of suspension of the Work, the Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established plantings, seedings, and

soddings furnished under the Contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury. If ordered by the Engineer, the Contractor shall properly store, during such suspension of the Work, materials which have been partially paid for or furnished by the Department. The Department will be entitled to the possession of such materials, and the Contractor shall promptly return the same to the Project site when requested. The Contractor shall not dispose of any of the materials so stored except on written authorization. The Contractor shall be responsible for the loss of or damage to such materials.

2. **Risks of Claims on Account of Injury, Loss, or Damage.** The Contractor shall bear the risk of claims, just or unjust, by third persons made against the Contractor or the State, on account of injuries (including wrongful death), loss, or damage of any kind whatsoever arising or alleged to arise out of or in connection with the performance of the Work. The risk of claims, whether or not actually caused by or resulting from the performance of the Work or out of or in connection with the Contractor's operations or presence at or in the vicinity of the construction site or State premises, whether such claims are made and whether such injuries, loss, and damages are sustained, applies at any time both before and after Acceptance.
3. **Risks of Loss to Property of Those Performing the Work.** The Contractor shall bear the risk of loss or damage to any property of the Contractor, and of claims made against the Contractor or the State for loss or damage to any property of subcontractors, materialmen, workers, and others performing the Work, and to lessors. Said risk occurs at any time before completion of removal of such property from the construction site or the State's premises, or the vicinity thereof.
4. **Risks of Claims Related to the Contractor's Safety and Health Program.** The Contractor shall bear the risk of any action from or alleged to arise from the Contractor's Safety and Health Program.

The Contractor shall indemnify and save harmless the State from any and all claims or alleged claims described in Subheadings 2, 3, and 4 above, and for all expense incurred by the State in the defense, including legal and related costs, settlement, or satisfaction thereof. If so directed, the Contractor shall at its own expense defend against such claims, in which event it shall not, without obtaining express advance permission from the State, raise any defense involving in any way jurisdiction of the tribunal, immunity of the State, governmental nature of the State, or the provisions of any statutes respecting suits against the State.

The provisions of this Subsection are also for the benefit of all officers, agents, and employees of the State so that they have all the rights which they would have under this Subsection if they were named at each place above at which the State is named, including a direct right of action against the Contractor to enforce the foregoing indemnity except, however, that the State may at any time in its sole discretion and without liability on its part cancel the benefit conferred on any of them by this Subsection, whether or not the occasion for invoking such benefit has already arisen at the time of such cancellation.

Neither Acceptance nor the making of final payment releases the Contractor from its obligations under this Subsection. Moreover, neither the enumeration in this Subsection nor the enumeration elsewhere in this Contract of particular risks assumed by the Contractor or of particular claims for which it is responsible shall be deemed:

1. To limit the effect of the provisions of this Subsection or of any other provision of the Contract relating to such risks or claims, or
2. To imply that the Contractor assumes or is responsible for risks or claims only of the type enumerated in this Subsection or in any Contract, or
3. To limit the risks that the Contractor would assume or the claims for which the Contractor would be responsible in the absence of such enumerations.

The Contractor expressly understands and agrees that any insurance protection required by the Contract, or otherwise provided by the Contractor, in no way limits the Contractor's responsibility to defend, indemnify, and save harmless the State as herein provided. Such insurance requirements are designed to provide greater assurance to the State that the Contractor is financially able to discharge its obligations under this Subsection and as to the risks assumed elsewhere in the Contract, and are not in any way construed as a limitation on the nature and extent of such obligations.

107.23 Insurance. { XE "Insurance" }

{ XE "Laws, ordinances, and regulations:insurance requirements" **}**The Contractor shall procure and maintain, until Acceptance and at all times thereafter when the Contractor may be correcting, removing, or replacing defective work or completing plantings, insurance for liability for damages imposed by law and assumed under the Contract, of the kinds and in the amounts hereinafter provided, with insurance companies authorized to do business in the State. Before commencing the Work, the Contractor shall furnish to the Department a certificate or certificates of insurance together with declaration pages, in a form satisfactory to the Department, showing that the Contractor has complied with this

Subsection. Insurance binders are not acceptable as a form of insurance certificate. All of the policies of insurance required to be purchased and maintained and the certificates, declaration pages, or other evidence thereof shall contain a provision or endorsement that the coverage afforded is not to be canceled, materially changed, or renewal refused until at least 30 days prior written notice has been given to the Engineer by certified mail. All certificates, notices, or declaration pages shall be submitted to the Regional Construction Engineer whose name and address is included in Subsection 101.04 of the Special Provisions. Upon request, the Contractor shall furnish the Department with a certified copy of each policy itself, including the provisions establishing premiums. For Local Government Aid projects, the Board of Chosen Freeholders of the county or counties and the governing body of the municipality or municipalities within the limits of the Project shall also be included as the named insured on the comprehensive general liability and owner's protective insurance policies.

The types of insurance and minimum limits of liability are as follows:

{ XE "Property damage" **}1. Comprehensive General Liability Insurance.** The minimum limit of liability shall be $1,000,000 per occurrence as a combined single limit for bodily injury and property damage together with excess coverage or umbrella coverage with the same terms and conditions as the primary underlying coverage (following form) in an amount such that the primary and excess coverage or primary and umbrella coverage together equals or is greater than $10,000,000. Said excess or umbrella policy shall contain a clause stating that it takes effect (drops down) in the event the primary coverage is impaired or exhausted.

The above required Comprehensive General Liability policy shall name the State, its officers, and employees as additional named insureds.

The coverage to be provided under this policy shall be at least as broad as that provided by the standard basic, unamended, and unendorsed comprehensive general liability coverage forms currently in use in the State, which shall not be circumscribed by an endorsement limiting the breadth of coverage. Moreover, such policy shall be endorsed so as to delete any exclusions applying to property damage liability arising from explosions or arising from damage to underground utilities and collapse of foundations.

The insurance policy shall be endorsed to include contractual liability coverage, premises/operations coverage, products/completed operations coverage, broad form property damage coverage, independent contractors coverage, and personal injury coverage.

The Contractor shall provide documentation from the insurance company that indicates the cost of naming the State, its officers, and employees as named insureds.

2. **Comprehensive Automobile Liability Insurance.** The policy shall cover owned, non-owned, and hired vehicles with minimum limits of liability in the amount of $1,000,000 per occurrence as a combined single limit for bodily injury and property damage, together with excess coverage or umbrella coverage with the same terms and conditions as the primary underlying coverage (following form) in an amount such that the primary and excess coverage or primary and umbrella coverage together equals or is greater than $10,000,000. Said excess or umbrella policy shall contain a clause stating that it takes effect (drops down) in the event the primary coverage is impaired or exhausted.
3. **Owner's and Contractor's Protective Liability Insurance**. A separate Owner's and Contractor's Protective Liability Insurance Policy shall be provided. The minimum limit of liability shall be $4,000,000 per occurrence as a combined single limit for bodily injury and property damage. The policy is to be written for the benefit of the State, its officers, and employees; they are to be named as the insured. The Contractor shall provide documentation from the insurance company that indicates the cost of the Owner's and Contractor's Protective Liability Insurance Policy.
4. **Workers Compensation and Employer's Liability Insurance.** Workers Compensation Insurance shall be provided according to the requirements of the laws of this State and shall include an all states endorsement to extend coverage to any State that may be interpreted to have legal jurisdiction. Employer's Liability Insurance shall be provided with the following minimum limits:
    a. $100,000 each accident
    b. $100,000 Disease each employee
    c. $500,000 Disease aggregate limit
5. **Marine Liability Insurance.** When a Contractor or subcontractor is engaged in marine operations, it shall be required to obtain US Longshoremen's and Harbor Worker's coverage and Maritime coverage. The Contractor or subcontractor shall also procure and maintain Marine Liability Insurance with protection and indemnity coverage with a minimum limit of liability of $2,000,000 per occurrence.

{ XE "Railroad:insurance" **}6. Railroad Insurance.** In addition to any other forms of insurance or bonds required under the terms of the Contract Documents, the Contractor or subcontractor engaged in work within

or adjacent to railroad ROW shall procure and maintain the insurance coverage hereinafter specified for the railroad(s) listed in the Special Provisions.

The Contractor shall provide railroad protective liability insurance according to 23 CFR 646, Subpart A, as a combined single limit for bodily injury and property damage, in the amount of $2,000,000 per occurrence with an annual aggregate of $6,000,000. A copy of the Federal regulation and form of insurance policy may be obtained upon request to the Department's Bureau of Construction Engineering.

The Contractor's comprehensive General Liability policy shall be endorsed to provide for independent contractors' coverage and to delete any exclusions applying to liability arising out of operations in proximity to railroad property.

The original policy for railroad protective liability insurance and endorsements to the Contractor's comprehensive General Liability Insurance shall be furnished to and approved by the railroad company before the Contractor or subcontractors will be permitted on railroad property. Policies, endorsements, notices of cancellation, or changes, as hereinafter specified in this Subsection, are to be sent by the Contractor to the Engineering Officer or representative whose name and address appear in Subsection 105.09 of the Special Provisions for the railroad(s) listed. The Contractor and its insurance representative must reconcile all policy requirements to the satisfaction of the railroad and the Engineer.

The requirements of this Subheading are in addition to the General Requirements of this Subsection.

The Special Provisions will contain an estimate of the percentage of the Project cost located within or adjacent to the railroad ROW. The ratio is given for informational purposes only and in no way affects or disturbs whatever laws, regulations, etc., that now apply relative to the amount of risk or coverage.

{ XE "Pollution" **}7. Pollution Liability Insurance.** The Contractor or the subcontractor engaged in work involving hazardous substances, as defined in Section 3 of PL 1993, c.139 (C.13:1K-8), or hazardous waste, as defined in Sect. 1 of PL 1976, c.99 (C.13:1E-38), shall procure and maintain pollution liability insurance, also known as "environmental impairment liability insurance."

Pollution liability insurance shall be provided either by endorsement to a commercial general liability policy or as a separate policy. This policy shall cover pollution claims arising form the development and implementation of the specified contaminated material's remedial action work plan and Health and Safety Plan. The minimum limit of liability shall be $5,000,000 per occurrence and $10,000,000 aggregate.

The policy is to be written for the benefit of the State, its officers, employees, and authorized representatives; they are to be named as additional insured. The Contractor shall provide documentation from the insurance company indicating the coverage, limitation of coverage, term of coverage, and cost of the pollution liability insurance policy.

Insurance coverage in the minimum amounts set forth herein shall not be construed to relieve the Contractor for liability in excess of such coverage, nor does it preclude the State from taking such other actions as are available to it under any other provisions of this Contract or otherwise in law.

All proof of insurance submitted to the State shall clearly set forth all exclusions and deductible clauses. The Engineer may allow certain deductible clauses that the Engineer does not consider excessive, overly broad, or harmful to the interests of the State. Standard exclusions will be allowed provided they are not inconsistent with the requirements of this Subsection. Allowance of any additional exclusions is at the discretion of the Engineer. Regardless of the allowance of exclusions or deductions by the Engineer, the Contractor shall be responsible for the deductible limit of the policy and all exclusions consistent with the risks it assumes under this Contract and as imposed by law.

In the event that the Contractor provides evidence of insurance in the form of certificates of insurance, valid for a period of time less than the period during which the Contractor is required by the terms of the Contract to maintain insurance, said certificates are acceptable, but the Contractor shall be obligated to renew its insurance policies as necessary and to provide new certificates of insurance so that the State is continuously in possession of evidence of the Contractor's insurance according to the foregoing provisions.

In the event the Contractor fails or refuses to renew its insurance policy, or the policy is canceled, terminated, or modified so that the insurance does not meet the requirements of this Subsection, the State may refuse to make payment of any further monies due under this Contract or refuse to make payment of monies due or coming due under other contracts between the Contractor and the State. The State may use monies retained under this paragraph to renew the Contractor's insurance for the periods and amounts referred to above. Alternately, the State may default the Contractor and direct the surety to complete the Project. During any period when the required insurance is not in effect, the Engineer may suspend performance of the Contract. If the Contract is so suspended, additional compensation or extension of Contract Time is not due on account thereof.

Payment for Owner's and Contractor's protective liability insurance, railroad protective liability insurance, or pollution liability insurance will be made at the prices bid, except that should the actual costs, as evidenced by the paid

bills, be lower than the bid amounts, payment for the difference between the actual costs and the bid amounts shall not exceed 25 percent of the actual costs and will not be made until Completion. Should the actual costs be higher than the bid amounts, there will be no additional compensation and payment will be made at the bid prices.

Payment will be made under:

Pay Item	*Pay Unit*
OWNER'S AND CONTRACTOR'S PROTECTIVE LIABILITY INSURANCE	LUMP SUM
RAILROAD PROTECTIVE LIABILITY INSURANCE	LUMP SUM
POLLUTION LIABILITY INSURANCE	LUMP SUM

All other insurance costs, as specified in this Subsection, shall be at the Contractor's own expense.

107.24 Personal Liability of Public Officials. { XE "Personal liability of public officials" }

There shall be no liability upon the Commissioner, Engineer, or their authorized representatives, either personally or as officials of the State in carrying out any of the provisions of the Contract nor in exercising any power or authority granted to them by or within the scope of the Contract, it being understood that in all such matters they act solely as agents and representatives of the State. Similarly, for Local Government Aid projects there shall be no liability, either personally or in an official capacity, upon the Board of Chosen Freeholders of the county or counties nor upon the governing body of the municipality or municipalities within the limits of the Project.

107.25 Recovery of Monies by the State. { XE "Recovery of monies by the state" }

Whenever it is provided in the Contract Documents that the State, Department, or Engineer is to withhold or deduct money from any monies due or that may become due the Contractor, or that the Contractor is to pay or return monies for any reason, or that the State, Department, or Engineer can charge against the Contractor certain costs, assessments, or fines, or that the State, Department, or Engineer can recover any sum for any reason from the Contractor, it is understood that the State has available to it any monies due or that may become due the Contractor under the Contract and on other contracts between the Contractor and the Department. Such other contracts shall include joint ventures in which the Contractor is a participant but only to the extent of its participation. The right to recover against the Contractor as herein provided is in addition to and does not affect the right of the State to seek recovery against the Contractor or surety under the Contract, bonds, or as otherwise allowed by the law.

107.26 No Waiver of Legal Rights. { XE "No waiver of legal rights" }

Notwithstanding any other provision of the Contract, for a period of three years after Acceptance, all estimates and payments made pursuant to Section 109, including the Final Certificates and Final Payment, are subject to correction and adjustment for clerical or other errors in the calculations involved in the determination of quantities and payments. The Contractor and the Department agree to pay to the other any sum due under the provisions of this Subsection, provided, however, if the total sum to be paid is less than $100, payment will not be made.

A waiver on the part of the Department of any breach of any part of the Contract is not to be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the Contract, shall be liable to the Department at any time both before and after Acceptance for latent defects, fraud, such gross mistakes as may amount to fraud, or actions affecting the Department's rights under any warranty or guarantee.

107.27 Limitations of Liability.

In any event, whether under the provisions of the Contract, as a result of breach of Contract, tort (including negligence), or otherwise, the State will not be liable to the Contractor for any special, consequential, incidental, or penal damages including, but not limited to, loss of profit or revenues, loss of rental value for contractor-owned equipment, damages to associated equipment, cost of capital, or interest of any nature.

107.28 Environmental Protection. { XE "Laws, ordinances, and regulations:environmental protection" }{ XE "Environmental protection" }

The Contractor shall comply with all applicable Federal, State, and local laws and regulations, and all conditions of permits controlling pollution of the environment. Necessary precautions shall be taken to prevent pollution of land, streams, lakes, ponds, wetlands, groundwater, and reservoirs both within and beyond Project limits with any pollutants or contaminates and to prevent pollution of the atmosphere from particulate and gaseous matter.

All modifications to permits that are proposed by the Contractor shall be submitted to the Department for approval before submitting them to the regulatory agencies having jurisdiction and interest. After receiving the Department's approval, the Contractor shall obtain all other necessary approvals from the appropriate regulatory agencies. If the requests for modifications to permits are not approved by the Department or the regulatory agency, then the Contractor

shall build the Project according to the original approval. Any time required to obtain the approvals will not warrant extensions of Contract time. The Contractor shall perform the Work in compliance with the terms and conditions of all permits procured for the Project. If the Contractor is not in compliance with permit provisions, corrective actions shall be taken immediately. The Engineer may suspend the Work, wholly or in part, according to Subsection 108.15, until such time as the Contractor is fully in compliance with all permits. All corrective and remedial work required to bring the Contractor into compliance shall be performed at no cost to the State.

The Contractor shall pay all fees and violation charges that arise out of or are alleged to arise out of its noncompliance or the noncompliance of its agents, employees, and subcontractors with permit requirements. In its sole discretion, the Department may determine to hold the Contractor responsible for all engineering, inspection, and administration costs (including overhead) incurred as a result of its noncompliance. If it so determines, the Department will deduct the amount of such costs from the monthly estimate and payment due according to Subsection 109.05.

The Contractor shall provide to the Engineer, whenever requested, all documentation pertaining to the noncompliance and related corrective actions taken.

The Contractor shall also comply with the following:

1. **Control of Soil Erosion and Water Pollution.** The Contractor shall employ and maintain soil erosion and sediment control measures during the life of the Project to control erosion and minimize the sedimentation of rivers, streams, lakes, reservoirs, wetlands, floodplains, bays, and coastal waters, as well as prevent contamination of land and water, both within and beyond the project limits. Soil erosion and sediment control shall be according to Section 212.

   The Department's authority for certification of soil erosion and sediment control plans does not include off-Project borrow pits or storage areas that the Contractor uses or establishes to accomplish the Work of the Project. If the land disturbance for this off-Project work is 555 square yards or greater, it is the Contractor's responsibility to provide the Engineer with documentation that a soil erosion and sediment control plan has been approved for this work by the appropriate soil conservation district.

{ XE "Dust pollution,control" **}{** XE "Air pollution control" **}{** XE "Noise pollution control" **}2. Control of Noise and Air Pollution.** The Contractor shall employ all possible methods to minimize noise and dust pollution caused by drilling, blasting, excavation, and hauling operations. These shall include, but shall not necessarily be limited to, use of dust collection devices or water injectors on drilling units.

All construction equipment powered by an internal combustion engine shall be equipped with a properly maintained muffler. Air-powered equipment shall be fitted with pneumatic exhaust silencers. Air compressors shall meet EPA noise emission standards.

Stationary equipment powered by an internal combustion engine shall not be operated within 150 feet of noise sensitive sites without portable noise barriers placed between the equipment and the noise sensitive sites. Noise sensitive sites include residential buildings, motels, hotels, schools, churches, hospitals, nursing homes, libraries, and public recreation areas. Portable noise barriers shall be constructed of plywood or tongue and groove boards with a noise absorbent treatment on the interior surface (facing the equipment).

All methods and devices employed to minimize noise and dust pollution are subject to the daily approval of the Engineer.

{ XE "Historic places" **}3. Historic Places.** The Contractor will not be permitted to use as a disposal site or obtain borrow excavation from locations eligible for or listed on the State or National Registers of Historic Places. Copies of the State and National Registers of Historic Places are available from the Department's Bureau of Environmental Services.

{ XE "Disposal sites" **}4. Disposal Sites Beyond Project Limits.** Material shall not be disposed of beyond the Project limits until the Resident Engineer has approved the location of the disposal site and received a copy of the soil and sediment control plan certified by the soil conservation district according to NJSA 4:24-39 *et seq*.

5. **Borrow Pits.** Material shall not be excavated from a borrow pit beyond the Project's limits until the Resident Engineer has received a copy of the soil and sediment control plan certified by the soil conservation district according to NJSA 4:24-39 *et seq*.

SECTION 108 - PROSECUTION AND PROGRESS{ XE "PROSECUTION AND PROGRESS" }

108.01 Assignment.

The performance of the Contract may not be assigned, except upon the written consent of the Commissioner. Consent will not be granted to any proposed assignment that would relieve the original Contractor or its surety of their responsibilities under the Contract nor will the Commissioner consent to any assignment of a part of the Work under the Contract.

108.02 Subcontracting. { XE "Contract:subcontracting" }{ XE "Subcontracting" }

{ XE "Subcontractor" **}**Subject to the provisions of this Subsection and to the consent of the Commissioner, Work may be subcontracted except that the item of mobilization or any part thereof shall not be subcontracted. It is understood, however, that any consent of the Commissioner for the subcontracting of any Work of the Contract in no way relieves the Contractor from its full obligations for all Work under the Contract, nor the surety of its obligations under the bond. The Contractor shall at all times give its personal attention to the fulfillment of the Contract and shall keep the Work under control. The Contractor shall be responsible for all work of subcontractors which work shall conform to the provisions of the Contract Documents. The consent to the subcontracting of any part of the Work shall not be construed as an approval of the said subcontract or of any of its terms, but is to operate only as an approval of the Contractor's request for the making of a subcontract between the Contractor and its chosen subcontractor.

The Contractor shall perform with its own organization Contract Work amounting to at least 50 percent of the original Total Contract Price except as follows:

1. If the Contract Documents include Pay Items designated as "Specialty Items," as specified in the Special Provisions, the Contractor may deduct the value of these items from the original Total Contract Price before computing the amount of work to be performed by its own organization.
2. The Contractor may deduct from the amount of work to be performed by its own organization the value of all Pay Items subcontracted to certified D/WBE firms indicated on the original DBE or ESBE Form A approved by the State amount of work to be performed by its own organization.

In no event shall the Contractor perform, with its own organization, work amounting to less than 30 percent of the original Total Contract Price reduced according to Item 1 above.

Where an entire item is subcontracted, the value of work subcontracted will be determined based on the Pay Item Contract price. When part of the quantity of a unit price item is subcontracted, the value of the work subcontracted will be determined by Pay Item bid price multiplied by the quantity performed by the subcontractor. If the subcontractor performs part of the work of any unit or quantity of a unit price item, that entire unit will be considered subcontracted, and the value of the work subcontracted will be determined by the Pay Item bid price multiplied by the quantity of units considered subcontracted to the subcontractor. When a portion of a lump sum item or an item which includes specialty work is subcontracted, the value of work subcontracted will be determined based on the estimated cost of the work subcontracted as determined from the breakdown of cost submitted by the Contractor. When part of a sign support structure is subcontracted, the provisions for a lump sum item govern.

{ XE "Subcontracting:application for" **}**Application for subcontracting any part of the Work shall be made by the Contractor on forms furnished by the Department. That form, fully completed in quadruplicate, one original and three copies, shall be furnished to the Regional Construction Engineer. The Contractor shall attach to that form a certified copy of the executed subcontract between the Contractor and the subcontractor. The copy of the subcontract will be used in the review of the application. The Contractor shall also attach to that form, proof of the Subcontractor's valid business registration with the Division of Revenue in the New Jersey Department of Treasury. Pursuant to P. L. 2001, c.134 (N.J.S. 52:32-44), the Contractor is notified that no Subcontract shall be entered into by any Contractor under any Contract with the Department, unless the Subcontractor first provides proof of a valid business registration. The Department will not consent to the proposed Subcontracting unless the Contractor provides the required proof of the Subcontractor's valid business registration.

After review of the application, the consent of or rejection by the Commissioner of the subcontracting will be provided to the Contractor in writing. Before the receipt of the written consent from the Commissioner, Work shall not be performed on the Project under the subcontract.

{ XE "Debarred, suspended, or disqualified:subcontractors" **}**Subcontracting will not be permitted to firms and individuals suspended or debarred by the Department or included in the Report of Suspensions, Debarments, and Disqualifications of Firms and Individuals as maintained by the Department of the Treasury, Division of Building and Construction, Bureau of Contractor Prequalification.

Where the value of work subcontracted exceeds $1,000,000, subcontracting will be permitted only to subcontractors prequalified with the Department for the work type being subcontracted. Moreover, where one subcontractor has pending, and as yet uncompleted, work on more than one Department project, the aggregate value of

which, plus the value of the proposed subcontract, exceeds $1,000,000, such subcontractor must be prequalified with the Department for the work type.

Subcontracting of landscape items will be permitted only to subcontractors holding a landscape prequalification rating with the Department regardless of the value of the subcontract.

Subcontracting of those electrical items that require electricians will be permitted only to subcontractors who are licensed electricians in the State regardless of the value of the subcontract.

Subcontracting of Asbestos Removal, Explosive Blasting, and Lead Paint Abatement items must include evidence of any required certificate(s), license(s), and/or permit(s) with the Request for Approval to Sublet.

The subcontractor shall look only to the Contractor for the payment of any claims of any nature whatsoever arising out of the subcontract. The subcontractor agrees, as a condition of the Commissioner's consent to the making of the subcontract, that the subcontractor shall make no claims against the Commissioner or its agents or employees for any Work performed or thing done by reason of the subcontract, or for any other cause that may arise by reason of the relationship created between the Contractor and subcontractor by the subcontract.

Additionally, the Contractor shall give assurances, before the Commissioner's giving consent, that when minimum wage rates are specified they shall apply to labor performed on all subcontracted Work.

The Commissioner will not consent to the making of any subcontract unless the proposed subcontractor furnishes a statement to the effect that the subcontractor is acquainted with all of the provisions of the Contract.

108.03 Commencement of Work. { XE "Work:commencement of" }{ XE "Commencement of work" }

{ XE "Notice to proceed" **}**Upon execution of the Contract by the Commissioner, a fully executed copy together with a Notice to Proceed will be provided to the Contractor. Receipt of the executed Contract and Notice to Proceed shall constitute the Contractor's authority to enter upon the Project site, provided the Contractor has submitted to the Engineer, and the Engineer has accepted, the insurance certificates required under Subsection 107.23 and a preconstruction conference has been held. Construction operations shall not begin until the Contractor has supplied, and the Engineer has accepted, the progress schedule and other certifications, forms, schedules, and any other information required by the Contract Documents, and until the Contractor has established a field office as required by Subsection 105.15.

Construction operations shall begin within 25 days of the date the Contract is executed by the Commissioner. The twenty-fifth day is the first day of the Contract Time. Failure of the Contractor to begin construction operations within 25 days for any reason shall constitute a Contractor delay. Failure to begin construction operations within 40 days shall constitute a default for which the Commissioner may take whatever action that is deemed appropriate under the Contract.

If the Contractor begins Work before the execution of the Contract by the Commissioner, the Work shall be considered as having been done at the Contractor's own risk and as a volunteer. In no event, however, shall the Contractor work at the Project site before execution of the Contract by the Commissioner unless proof of insurance has been provided according to Subsection 107.23. In the event the Commissioner decides to reject the Contract, the Contractor shall at its expense perform whatever Work is necessary to leave the site in an approved condition. If any of the Work performed before the Commissioner's rejection affects any existing road or highway, the Contractor shall at its expense restore it to its former condition or the equivalent thereof, as approved. However, all Work done according to the Contract Documents before its execution by the Commissioner will, if the Commissioner executes the Contract, be considered authorized Work and will be paid for as provided in the Contract.

The Contractor is not entitled to additional compensation or extension of Contract Time for any delay, hindrance, or interference caused by or attributable to commencement of Work before the twenty-fifth day following execution of the Contract by the Commissioner.

The Contractor shall give the Resident Engineer at least 24 hours advance notice in writing of its intention to start construction operations.

108.04 Progress Schedule and Prosecution of the Work. { XE "Progress schedule" }

At or before the preconstruction conference, the Contractor shall furnish, for approval, a progress schedule showing the order in which the Contractor proposes to prosecute the Work; the dates on which the various work stages, operations, and principal items of Work including procurement of materials and plant will begin; the quantity and kinds of equipment and character of the labor force; and the contemplated dates for completing the same. The progress schedule shall clearly outline the intended maintenance of traffic, the locations where temporary and permanent soil erosion and sediment control measures shall be installed, and such other information as required by the Contract documents or as deemed appropriate for the Project. The progress schedule shall give special consideration to sensitive areas such as wetlands, floodplains, waterways, and parklands to ensure that appropriate staging and seasonal constraints are considered to maximize the effectiveness of the soil erosion and sediment controls. The progress schedule shall also

indicate any time frames when work is restricted in these sensitive areas as outlined in the permits issued by the regulatory agencies. The progress schedule shall also include a detailed, step-by-step outline of the clean-up operations regarding contaminated material. When clean-up operations are involved, four additional copies of this portion of the progress schedule shall be furnished.

At or before the preconstruction meeting, the Contractor shall furnish the name and location of the solid waste facilities to be used as well as the fee structure of each of the facilities. Failure to provide such information will make the Contractor ineligible for adjusted compensation as provided for in Subsection 104.07.

Construction operations shall not begin until the progress schedule has been approved. Five Working Days will be required for review and approval of progress schedules for projects having a duration of two years or less with two additional Working Days for each year or part thereof in excess of two years. Once the progress schedule has been approved, the Contractor shall not deviate from it without first notifying the Engineer in writing.

In scheduling and executing the Work, the following shall be considered:

1. **Staging.** The Contractor shall schedule the Work using such procedures and staging as may be specified in the Contract Documents. Work designated as part of separate stages may be performed simultaneously where provided by the Contract Documents or where approved.

   When the Contract Documents provide for staging or specific procedures, the Contractor may, before submitting a progress schedule, present for written approval of the Engineer, a detailed, written alternate staging plan or procedure which incorporates the requirements of the Department. As a condition of the Engineer's reviewing the alternate staging plan or procedure, the Contractor agrees that it is not entitled to additional Contract Time or compensation arising from possible delays to construction due to the time spent in reviewing the Contractor's staging plan or procedure, regardless of whether the Department accepts or rejects it. If such staging plan or procedure is approved in writing, the Contractor may then prepare a progress schedule consistent with the approval.

   HMA paving operations shall be staged to progress up to the bottom of the surface course. The HMA concrete surface course for the full width of the traveled way, shoulder, and auxiliary lanes shall be paved as a single stage of construction and as the final paving operation.

2. **Prosecution of the Work.** The Contractor shall provide sufficient materials, equipment, and labor to guarantee the completion of the Project according to the Contract Documents and within the time set forth under Subsection 108.10.

   If the Contractor falls ten percent or more of the total project time behind the submitted schedule, the Contractor shall submit a revised schedule for approval.

   Should the Contractor discontinue the prosecution of the Work for any reason, it shall notify the Engineer, in writing, before discontinuing work and at least 24 hours before resuming operations.

   The Contractor shall arrange and prosecute the Work so that each successive construction operation at each location shall follow the preceding operation as closely as the requirements of the various types of construction permit.

   Work that closes or alters the use of existing roadways shall not be undertaken until adequate provisions, conforming to the requirements of Section 617, have been made by the Contractor and approved.

   The Engineer may revise stage construction and maintenance of traffic, if deemed necessary, due to unforeseen circumstances that may arise during construction.

   Compensation for additional expense to the Contractor and allowance of additional time for completion of the Work shall be as set forth in a Change Order or Supplementary Agreement or according to Subsections 108.11 and 109.03.

   When possible, the construction of subsurface structures adjacent to traffic shall be performed while traffic is being diverted from such areas. If traffic must be maintained in such areas, the Work shall be performed expeditiously in stages, as approved, and with minimum interference with traffic.

   Subsurface structure excavation adjacent to traffic shall not remain open overnight unless adequately protected by approved safety devices.

   The Contractor shall proceed with the Work of demolition of the various buildings that are identified with a demolition number as they become available for demolition. If any of the buildings that are to be demolished are not available for demolition at the time the Contractor begins Work on the Project, the Contractor shall temporarily defer its Work in the vicinity of the building and complete the Work when the building is available for demolition.

   Operations adjacent to traffic shall be confined to only one side of the traffic at any one time unless otherwise specified in the Contract Documents.

Concrete curbs to be constructed adjacent to flexible base and surface courses shall be completed, cured, and backfilled before the flexible base and surface courses are constructed.

Underground structures for traffic signals, except for pressure detector installations, shall be constructed before completion of the intersecting road.

3. Intent, Responsibility, and Time. Scheduling of construction is the responsibility of the Contractor. Therefore, it is the Contractor's responsibility to determine the most feasible order of Work commensurate with the Contractor's abilities and the Contract Documents. The requirement for the progress schedule is included to ensure adequate planning and execution of the Work, to assist the Engineer in appraising the Contractor's compliance with the Contract Documents, and to evaluate progress of the Work. The progress schedule will be used for determining extensions or reductions of Contract Time pursuant to Subsection 108.11.

It is not intended that the Engineer, by approving the progress schedule, agrees that it is reasonable in all respects or that following the progress schedule can result in timely completion of the Project. The progress schedule is not a part of the Contract.

If, in the preparation of the progress schedule, the Contractor projects a completion date that is different than that specified under Subsection 108.10, this in no way voids the date set therein. The date as specified in that Subsection governs. Where the progress schedule reflects a completion date that is earlier than that specified as the Contract Time, the Engineer may approve the schedule with the Contractor specifically understanding that no claim for additional Contract Time or compensation shall be brought against the State as the result of failure to complete the Work by the earlier date shown on the progress schedule.

{ XE "Acceleration and default" **}4. Acceleration and Default.** If, in the opinion of the Engineer, the Contractor falls behind its progress schedule, and cannot complete the Work within the time prescribed under Subsection 108.10, as modified pursuant to Subsection 108.11, the Contractor shall take such steps as may be necessary to improve its progress. The Engineer may require the Contractor to increase the number of shifts, begin overtime operations, work extra days including weekends and holidays, or supplement its construction plant and to submit for approval such supplementary schedule or schedules, as may be deemed necessary to demonstrate the manner in which the agreed rate of progress shall be regained, all at no cost to the State.

Failure of the Contractor to comply with the requirements of the Engineer under this Subheading is grounds for the determination that the Contractor is not prosecuting the Work with such diligence as to ensure Completion within the time specified. Upon such determination, the Engineer may terminate the Contractor's right to proceed with the Work or any separable part thereof according to Subsection 108.17.

5. Types of Progress Schedules. All progress schedules shall comply with the foregoing provisions of this Subsection. Regardless of the type of progress schedule used, the Contractor shall supply the Resident Engineer with a weekly work schedule indicating the Contractor's planned work, the subcontractors' planned work, the dates when materials are to be delivered, and a forecast of lane closings.

The progress schedule shall be one of the following depending on whether or not the progress schedule is a Pay Item:

a. When the Progress Schedule is a Pay Item. The progress schedule shall be prepared using the Critical Path Method (CPM) or a comparable network system conforming with the requirements hereinafter prescribed.

The network shall include, as a minimum, one activity for each discrete component part of each Pay Item scheduled in the Proposal. The Engineer may allow grouping of similar Pay Items. The system shall consist of network diagrams and accompanying mathematical tabulations as described hereinafter.

Diagrams shall show the order and interdependence of activities and the sequence and quantities in which the Work is to be accomplished. The basic concept of network scheduling shall be followed to show how the start of a given activity is dependent on the completion of preceding activities and how its completion may affect the start of following activities. No activity duration shall be longer than 20 Working Days without prior approval. The critical path shall be distinguished from other paths on the network. The network diagram shall include the following:

(1) activity description
(2) activity duration (work days)
(3) critical path denoted
(4) event nodes numbered
(5) all restraints noted
(6) all network dummies

(7) slack or float for each activity

(8) Work-Day calendar extending the length of the Contract plus 25 percent additional time.

In addition to construction activities, network activities shall include the submittal and approval of samples of materials and working drawings and the fabrication of special materials. It shall also include all documents and proofs of compliance required by the Contract Documents for Completion.

All activities of the Department, utility companies, adjacent contracts, and other entities that affect progress and influence any special Contract required dates including durations shall be shown in the schedule.

The mathematical tabulation of the network diagram shall include a tabulation of each activity shown on the detailed network diagram.

The following information shall be furnished, as a minimum, for each activity on the tabulation:

(1) event nodes numbered
(2) activity description
(3) estimate duration
(4) earliest start date (calendar date)
(5) earliest finish date (calendar date)
(6) latest start date (calendar date)
(7) latest finish date (calendar date)
(8) Contractor's intended start date
(9) Contractor's intended completion date
(10) slack or float for each activity
(11) quantities involved on each activity based on Contractor's intended start and completion dates
(12) percentages of activity completed
(13) critical path activities denoted

The mathematical tabulation can be either a computer printout or one manually prepared with a column for each of the above requirements. The Contractor shall update the mathematical tabulation on a monthly basis and shall provide the Engineer with updated copies along with any revisions to the network diagrams on the day the monthly Engineer's Estimate is prepared. The updated tabulations shall reflect the current status of activities as outlined on the network diagram. If any delays have occurred, they shall be noted for time consideration, and the updated tabulation sheet shall reflect all changes in dates, duration, and float time.

Conditions may develop which require network logic revisions to the original diagram. If during the progress of the Work major changes develop which necessitate changes in the original plan, the Contractor shall make such changes so as to depict the current mode of operation and shall provide the Engineer with a revised network diagram at no additional cost.

Payment for the accepted progress schedule will be made on a lump sum basis for the schedule completed as specified including all necessary updating. Twenty-five percent of the lump sum bid will be paid upon approval of the initial submission, and the balance paid on approval of updates at a prorated sum based upon the number of anticipated updates to be submitted during the Contract Time.

Payment will be made under:

Pay Item	*Pay Unit*
PROGRESS SCHEDULE	LUMP SUM

b. When the Progress Schedule is not a Pay Item. The progress schedule may be a bar chart or similar type acceptable to the Engineer as to form and substance. The schedule shall be in a suitable scale to indicate the percentage of work scheduled for completion at any time. The progress schedule shall include, as a minimum, one activity for each Pay Item, however, the Engineer may require, and the Contractor shall provide, a breakdown of each discrete component part to be included in the progress schedule for certain Pay Items. The Contractor shall include in the progress schedule, or in a separate submission, a schedule of working drawing submissions. The Contractor shall update the progress schedule when conditions have changed such to invalidate the current schedule.

All costs for furnishing and updating the progress schedule shall be included in the prices bid for the various Pay Items scheduled in the Proposal.

108.05 Mobilization. { XE "Mobilization" }

Mobilization shall consist of the preparatory work and operations necessary for the movement of personnel, equipment, supplies, and incidentals to the Project site, and other work performed or costs incurred before beginning Work.

Payment for mobilization will be made on a lump sum basis regardless of the fact that the Contractor may have, for any reason, shut down its work on the Project or moved equipment away from the Project and back again.

Payment will be made according to the following schedule:

1. When five percent of the Work is completed, 25 percent of the lump sum bid for mobilization or 2.5 percent of the Total Contract Price, whichever is less, will be paid.
2. When ten percent of the Work is completed, 50 percent of the lump sum bid for mobilization or five percent of the Total Contract Price, whichever is less, will be paid.
3. When 15 percent of the Work is completed, 75 percent of the lump sum bid for mobilization or 7.5 percent of the Total Contract Price, whichever is less, will be paid.
4. When 20 percent of the Work is completed, 100 percent of the lump sum bid for mobilization or ten percent of the Total Contract Price, whichever is less, will be paid.
5. When all Work on the Project is complete, payment for the lump sum bid for mobilization in excess of ten percent of the Total Contract Price will be made.
6. The percentage of Work completed shall be the total of payments earned compared to the Total Contract Price. The total of payments earned excludes the amount paid for this item and the amount paid for materials furnished but not incorporated into the Work according to Subsection 109.06, as shown on the monthly estimates of the approximate quantities of Work performed, prepared according to Subsection 109.05.

Payment will be made under:

Pay Item	*Pay Unit*
MOBILIZATION	LUMP SUM

When mobilization is not a Pay Item, all costs for the Work shall be included in the prices bid for various Pay Items scheduled in the Proposal.

108.06 Limitation of Operations. { XE "Limitation of operations" }

The Contractor shall conduct the Work at all times in such a manner and in such sequence that shall ensure the least interference with traffic. The Contractor shall have due regard for the location of detours and for the provisions for handling traffic. The Engineer may require the Contractor to finish a section on which Work is in progress before Work is started on any additional sections if the opening of such section is essential to public convenience.

As a first order of Work, the Contractor's Land Surveyor shall establish the existing and proposed ROW lines on the Project site at those locations where on site storage of equipment, materials, and plant(s) are to be placed.

108.07 Character of Workers, Methods, and Equipment. { XE "Character of workers, methods, and equipment" }

The Contractor shall at all times employ sufficient labor and equipment for prosecuting the several classes of Work to full completion in the manner and time required by the Contract Documents.

All workers shall have sufficient skill and experience to properly perform the Work assigned to them. Workers engaged in special Work or skilled Work shall have sufficient experience in that Work and in the operation of the equipment required to perform the Work satisfactorily.

Any person employed by the Contractor or by any subcontractor who, in the opinion of the Engineer, does not perform Work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Engineer, be promptly removed by the Contractor or subcontractor employing the person and shall not be again employed in any portion of the Work without approval. Should the Contractor fail to remove such person or persons as required, or fail to furnish suitable and sufficient personnel for the proper prosecution of the Work, the Engineer may suspend the Work by written notice until compliance with such orders.

Except for regularly retired employees, the Contractor and its subcontractors shall not, without the written consent of the public employer of such person, engage on a full, part-time, or other basis, during the period of the Contract, any of the professional or technical personnel of the New Jersey Department of Transportation or of any State, county, or municipality, who are or have been at any time during the period of the Contract or for 30 days before Award, in the employ of such public agency.

All equipment that is proposed to be used on the Work shall be of sufficient size and in such mechanical condition as to meet the requirements of the Work and to produce a satisfactory quality of Work. Equipment used on any portion of the Project shall not cause damage to the roadway, adjacent property, or other highways.

{ XE "Debarred, suspended, or disqualified:equipment owners" **}**The Contractor will not be permitted to use equipment that is owned and/or operated by firms and individuals suspended or debarred by the Department or included in the "Report of Suspensions, Debarments and Disqualifications of Firms and Individuals" as maintained by the Department of the Treasury, Division of Building and Construction, Bureau of Contractor Prequalification.

When the methods and equipment to be used by the Contractor in accomplishing the construction are not specified, the Contractor is free to use any methods or equipment that accomplishes the Work. When the use of certain methods and equipment is specified, the specified methods and equipment shall be used unless otherwise authorized according to Subsection 106.12.

108.08 { XE "Working Site" }Working Site.

Except as otherwise provided, any space that the Contractor may require for plant, equipment, storage, or other purposes in addition to that available at the Project site, shall be procured by the Contractor, and the cost thereof shall be included in the prices bid for the various Pay Items scheduled in the Proposal. In the event of default as set forth in Subsection 108.17, the Commissioner has the right to take over and occupy such space, or cause it to be occupied, for the purpose of completing the Project, at the Contractor's expense. If the space is leased, the lease shall contain a provision that in event of default by the Contractor the lease may be assigned to the State or its nominee at their election. The Contractor agrees in event of said default, that it shall make such assignment.

The Contractor shall not use the decks of any completed bridges, or the areas including slopes under any completed bridges, as working sites or storage areas for materials or equipment.

108.09 { XE "Unusual site conditions" }Unusual Site Conditions.

During the progress of the Work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the Contract or if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the Contract are encountered at the site, the party discovering such conditions shall promptly notify the other party in writing of the specific differing conditions before they are disturbed and before the affected work is performed.

Upon written notification, the Engineer will investigate the conditions, and if the Engineer determines that the conditions materially differ and could not have been discovered by the Contractor pursuant to Subsection 102.06 and if they cause an increase or decrease in the cost or time required for the performance of any work under the Contract, an adjustment, excluding loss of anticipated profits, will be made and the Contract modified in writing accordingly. The Engineer will notify the Contractor of the Engineer's determination whether or not an adjustment of the Contract is warranted. Adjustments in Contract Time will be made pursuant to Subsection 108.11. Adjustments in compensation will be made pursuant to Subsections 104.02, 104.03, 104.05, 104.06, 104.08, 109.03, and 109.04.

No Contract adjustment that results in a benefit to the Contractor will be allowed unless the Contractor has provided the required written notice on forms provided by the Department.

No Contract adjustment will be allowed under this clause for any effects caused on unchanged work.

108.10 Time of Completion. { XE "Time (contract):of completion" }{ XE "Completion" }

The Contractor shall complete all or any portion of the Project called for under the Contract in all parts and requirements within the time or times for completion of the Contract set forth in the Special Provisions. Time is of the essence as to all time frames stated in the Contract Documents; therefore, all time frames shall be strictly enforced.

When the Contract Time is on a Working Day basis, the Engineer will furnish the Contractor a weekly statement showing the number of days charged to the Contract for the preceding week and the number of days specified for Completion. The Contractor is allowed one week in which to file a written protest, on forms provided by the Department, setting forth in what respect said weekly statement is incorrect. Otherwise, the statement is deemed to have been accepted by the Contractor as correct.

When the Contract Time is defined by a Calendar Day basis, Contract Time shall consist of the number of Calendar Days stated in the Contract counting from the date set forth in the Notice to Proceed according to Subsection 108.03, including all Saturdays, Sundays, holidays, and non-work days.

When the Contract Time is a specified completion date, the completion date shall be the date on which the Contract reaches Completion.

108.11 Extensions and Reductions of Contract Time. { XE "Extensions and reductions of contract time:extreme weather conditions" }{ XE "Extensions and reductions of contract time:disallowed claims" }{ XE "Extensions and reductions of contract time:claims for" }{ XE "Extensions and reductions of contract time:allowable reasons" }{ XE "Time (contract):extensions and reductions of" }{ XE "Contract:time:extensions and reductions of" }{ XE "Delays:excusable" }{ XE "Delays:extensions of time for" }

{ XE "Delays:damaging for" **}A. Basis for Extension.** Where appropriate under the provisions of this Subsection, extensions or reductions to the Contract Time may be provided by Change Order, however, such extensions or reductions will be allowed only to the extent that the increase or decrease in the Work or delays of the types indicated below affect current controlling operations and the overall Completion. Increases or decreases in Work or such delays that do not affect the overall Completion are not to be the basis for reduction or extension of Contract Time. Extensions of Contract Time will not be granted under this Subsection where it is determined that the Contractor could have avoided the circumstances that caused the request for extension.

If the Contractor is delayed in completion of the Work by reason of changes made under Subsection 104.02, or by failure of the Department to acquire ROW, or by any act of other contractors consistent with Subsection 105.10, or due to the discovery of archeological finds consistent with Subsection 108.13, or the discovery of hazardous substances, or by any act of the Engineer or of the Department not contemplated by the Contract, an extension of Contract Time commensurate with the delay in overall completion of the Contract thus caused will be granted, and the Contractor is relieved from any claim for liquidated damages or engineering and inspection charges.

Additionally, the Contractor may be granted an extension of Contract Time and not be assessed liquidated damages or the costs of engineering and inspection for any portion of the delay in overall completion of the Work beyond the time provided in Subsection 108.10 caused by the following reasons:

1. acts of civil or military authorities, war, or riot;
2. fire;
3. floods, tidal waves, earthquakes, cyclones, tornadoes, hurricanes, or other cataclysmic natural phenomenon (except on Working Day contracts);
4. extreme weather conditions (see Item 1 of the first paragraph in B) (except on Working Day contracts);
5. epidemics or quarantine restrictions;
6. strikes or labor disputes beyond the control of the Contractor which prevent work on the construction operations which are critical to the completion of the Project;
7. shortages of materials (see Item 2 of the first paragraph in B) or freight embargoes;
8. acts of the State in its sovereign capacity;
9. failure of the Engineer to furnish interpretations of the Contract Documents (see Item 3 of the first paragraph in B).

B. Criteria for Evaluation. Extension of Contract Time for the reasons set forth in this Subsection will not be granted unless the Contractor has notified the Engineer in writing of the causes of delay within 15 days from the beginning of any such delay on forms provided by the Department. The Engineer will evaluate the facts and the extent of the delay, and the Engineer's findings will be final and conclusive and will be based on the following:

1. Extensions of Contract Time for extreme weather conditions will be granted according to the following chart:

Number of Days the Contractor's Work is Limited to in One Month as the Result of Adverse Weather Conditions	Extension of Contract Time Allowable
16 - 31	0
15	1
14	2
13	3
12	4
11	5
10	6
9	7

8	8
7	9
6	10
5	11
4	12
3	13
2	14
1	15
0	16

In using the above chart, the Engineer will:

a. consider days for which an extension is granted under the above category "floods, tidal waves, earthquakes, cyclones, tornadoes, hurricanes, or other cataclysmic natural phenomenon" as days on which the Contractor's work is limited as the result of these adverse weather conditions;

b. consider days for which an extension is granted under the above categories for causes other than "floods, tidal waves, earthquakes, cyclones, tornadoes, hurricanes, or other cataclysmic natural phenomenon" as days on which the Contractor worked and was unaffected by adverse weather conditions; and

c. make the above calculation based on the full 30 or 31 days in the Calendar Month as being days on which the Contractor could have worked without regard to Saturdays, Sundays, and holidays.

2. Extensions of Contract Time will not be granted for a delay caused by a shortage of materials unless the Contractor furnishes:

   a. documentary proof that it has diligently made every effort to obtain such materials from all known sources within reasonable distance from the Work, and

   b. further proof in the form of a supplementary progress schedule, as required in Subsection 108.04, showing that the inability to obtain such materials when originally planned, did, in fact, cause a delay in completion of the Contract which could not be compensated for by revising the sequence of the Contractor's operations. The term "shortage of materials" applies only to raw and fabricated materials, articles, parts, and equipment that are standard items and does not apply to materials, parts, articles, or equipment, which are processed, made, constructed, fabricated, or manufactured to meet the specific requirements of the Contract. Only the physical shortage of materials and not the cost of materials will be considered.

3. Extensions of Contract Time will not be granted for failure of the Engineer to furnish interpretations of the Contract Documents until 20 days after receipt of such demand in writing as required by Subsections 105.01 and 105.07, and not then unless such request for an interpretation of the Contract Documents is reasonable and made in good faith, and the failure to respond was unwarranted.

{ XE "Time (contract):claims for extension of" **}**Except where specifically provided in the Contract Documents, the Contractor shall not make any claim for damages or additional compensation for any delay in or hindrance to the performance of the Contract occasioned by any act or omission to act by the State or any of its representatives, or for any of the reasons enumerated in this Subsection and agrees that any such claim shall be fully compensated for by an extension of Contract Time to complete performance of the Work.

Extensions of Contract Time will not be granted due to delays caused by, or in any way related to, the financial condition of the Contractor, subcontractors, sub-subcontractors, materialmen, fabricators, or suppliers. The Contractor and its surety assume full responsibility for ensuring that the financial condition of any of the above does not delay completion of the Contract.

If, as a result of modifications made under Subsection 104.02, 104.05, 104.06, or 108.09, the Work required is reduced or altered so that the time required for Completion is reduced, the Engineer may reduce the Contract Time provided under Subsection 108.10. The Engineer will evaluate the facts and the extent of the reduction. The Engineer's findings thereon will be final and conclusive.

It is the intention of the above provisions that the Contractor or surety is not relieved of liability for liquidated damages or engineering and inspection charges for any period of delay in Completion in excess of that expressly provided for in this Subsection.

108.12 ROW Delays. { XE "Right-of-Way:delays" }

If, through the failure of the Department to acquire ROW, the Contractor sustains losses that could not have been avoided by the judicious handling of forces, equipment, and plant, or performance of the Work is delayed, compensation for such loss and an extension of Contract Time may be granted according to the provisions of Subsection 108.14.

The term "failure to acquire ROW" includes all ROW related delays of any nature, not solely those related directly to acquisition, from the date of execution of the Contract until Acceptance, whether arising from events, or failure of the Department to act, occurring either before or after execution of the Contract.

The Special Provisions will indicate rights-of-way that have not been secured before construction and the approximate anticipated dates of availability.

108.13 Archeological Findings. { XE "Archeological findings" }

When excavating operations encounter prehistoric or historic artifacts or remains, the operations shall be temporarily discontinued in that area. The Engineer will contact the Project Manager who will consult with one of the NJDOT's cultural resource/archeological professionals to determine the appropriate course of action.

The Contractor agrees to make no claim for additional payment or for an extension of Contract Time because of any delays in the progress or alteration of the prosecution of the Work due to such discontinuance of the work or removal of any such remains or artifacts for the first ten days of such delay. Thereafter and beginning on the eleventh day, compensation for such delay and an extension of Contract Time will be considered according to the provisions of Subsection 108.14.

108.14 Suspension of Work for Convenience of the State. { XE "Work:suspension for convenience" }

The Engineer may order the Contractor in writing to suspend, delay, or interrupt all or any part of the Work for such period of time as the Engineer may determine to be appropriate for the convenience of the State.

If the performance of all or any portion of the Work is suspended, delayed, or interrupted by the Engineer in writing for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry) and the Contractor believes that additional compensation or Contract Time or both are due as a result of such suspension, delay, or interruption, the Contractor shall submit to the Engineer in writing a request for adjustment within seven Calendar Days of receipt of the notice to resume Work. The request shall set forth the reasons and support for such adjustment.

Upon receipt, the Engineer will evaluate the Contractor's request. If the Engineer agrees that the cost or time or both required for the performance of the Contract have increased as a result of such suspension and the suspension was caused by conditions beyond the control of and not the fault of the Contractor, its suppliers, or subcontractors, and not caused by weather, the Engineer will make an adjustment (excluding profit) and modify the Contract in writing accordingly. The Engineer will determine and notify the Contractor whether or not an adjustment of the Contract is warranted. Adjustments in Contract Time will be made pursuant to Subsection 108.11. Adjustments in compensation will be made pursuant to Subsections 104.02, 104.03, 104.05, 104.06, 104.08, 109.03, and 109.04.

No Contract adjustment will be considered unless the Contractor has submitted the request for adjustment within the time prescribed.

No Contract adjustment will be allowed under this clause to the extent that performance would have been suspended, delayed, or interrupted by any other cause, or for which an adjustment is provided for or excluded under any other term or condition of this Contract.

The Engineer may order the Contractor in writing to suspend, delay, or interrupt all or any part of the Work for such period of time as the Engineer may determine to be appropriate for the convenience of the State.

If the performance of all or any part of the Work is, for any period of time, suspended, delayed, or interrupted by an act of the Engineer in the administration of the Contract, or as provided under Subsection 108.12 or 108.13, an adjustment will be made for any increase in the cost of performance of the Work, excluding profit, necessarily and directly caused by such suspension, delay, or interruption pursuant to Subsection 109.04, and where appropriate, an extension of Contract Time may be granted as specified in Subsection 108.11. However, adjustment will not be made under this Subsection for any suspension, delay, or interruption to the extent that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault of negligence of the Contractor, or that such adjustment is provided for or excluded under any other provision of the Contract.

The failure of the Engineer to consider the Work suspended and to allow for an adjustment in the compensation or in the Contract Time will not bar recovery under the foregoing provisions, provided the Contractor gives written notice to the Engineer within ten days of the start of the alleged suspension. The failure of the Contractor to give such notice

pursuant to the provisions of this Subsection shall constitute a waiver of any and all claims and damages which would have been avoided or mitigated had such timely notice been given. Such written notification shall be submitted on forms provided by the Department.

108.15 Temporary Suspension of Work{ XE "Work:temporary suspension of" }.

The Engineer has the authority to suspend the Work, wholly or in part, for such period as deemed necessary due to unsuitable weather, or for such time as deemed necessary due to the failure on the part of the Contractor to carry out orders given or to perform any provision of the Contract. The Contractor shall promptly comply with the written order of the Engineer to suspend the Work wholly or in part. The suspended work shall be resumed when conditions are favorable and methods are corrected, as ordered or approved in writing.

In the event that a suspension of Work is ordered as provided above, and should such suspension be ordered by reason of the failure of the Contractor to carry out orders or to perform any provision of the Contract; or by reason of weather conditions being unsuitable for performing any item or items of Work, which work, in the sole opinion of the Engineer, could have been performed before the occurrence of such unsuitable weather conditions had the Contractor diligently prosecuted the Work when weather conditions were suitable; the Contractor, at its expense, shall do all the work necessary to provide a safe, smooth, and unobstructed passageway through the construction area for use by public traffic during the period of such suspension. In the event that the Contractor fails to perform the work above specified, the Department will perform such work and the cost thereof will be deducted from any monies due or that may become due the Contractor. In the event that a suspension of Work is ordered by the Engineer due to unsuitable weather conditions and, in the sole opinion of the Engineer, the Contractor has prosecuted the Work with energy and diligence before the time that operations were suspended, the cost of providing a smooth and unobstructed passageway through the Work will be paid for as Extra Work as provided in Subsection 109.03, or, at the option of the Engineer, such work will be performed by the Department at no cost to the Contractor.

If the Engineer orders a suspension of all of the Work or a portion of the Work, which is the current controlling operation or operations, due to unsuitable weather, the days on which the suspension is in effect are not considered Working Days on Working Day contracts. If a portion of Work at the time of such suspension is not a current controlling operation or operations, but subsequently does become the current controlling operation or operations, the determination of Working Days will be made on the basis of the then current controlling operation or operations. Similarly, on Calendar Day and specified completion date contracts, extensions of Contract Time will be granted only if the suspension affects the overall completion of the Contract and the other requirements of Subsection 108.11 are satisfied.

If a suspension of Work is ordered by the Engineer due to the failure on the part of the Contractor to carry out orders given or to perform any provision of the Contract, the days on which the suspension order is in effect are to be considered Working Days if such days are Working Days within the meaning of the definition set forth in Subsection 101.03. On Calendar Day and specified completion date contracts, extensions of Contract Time will not be granted due to such suspension.

The Contractor shall have no claim for additional compensation as a result of suspension ordered for the reasons set forth in this Subsection, except as to the costs of providing a smooth and unobstructed passageway consistent with the above provisions.

108.16 Failure to Complete on Time. { XE "Failure to:complete on time" }

{ XE "Liquidated damages" **}{** XE "Default of contract" **}**The Contractor and the Department recognize that delay in Completion results in damages to the State in terms of the effect of the delay on the use of the Project, upon the public convenience and economic development of the State, and also results in additional costs to the State for engineering, inspection, and administration of the Contract. Because it is difficult or impossible to accurately estimate the damages incurred; therefore, the parties agree that if the Contractor fails to complete the Contract within the time stated in these Special Provisions, or within such further time as may have been granted according to the provisions of the Contract, the Contractor shall pay the State liquidated damages according to those provided in the Special Provisions. Such liquidated damages shall be paid for each and every day, as hereafter, defined that the Contractor is in default to complete the Contract.

108.17 Default and Termination of Contractor's Right to Proceed. { XE "Termination of contractor's right to proceed" }

If the Contractor:

1. fails to begin the Work under the Contract within the time specified in Subsection 108.03, or

2. fails to perform the Work with sufficient workers and equipment or with sufficient materials to ensure its completion within the Contract Time specified, or any extension thereof, or
3. fails to complete the Contract within the Contract Time specified, as extended, or
4. performs the Work unsuitably or neglects or refuses to remove materials or to again perform such Work as may be rejected as unacceptable and unsuitable, or
5. discontinues the prosecution of the Work, or
6. fails to resume Work which has been discontinued within a reasonable time after notice to do so, or
7. becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or
8. allows any final judgment to stand against it unsatisfied for a period of ten days, or
9. makes an assignment for the benefit of creditors, or
10. fails to acquire or maintain the required insurance, or
11. fails to comply with Contract requirements regarding minimum wage payments, disadvantaged business enterprises, or equal employment opportunity requirements, or
12. is a party to fraud, or
13. for any other cause whatsoever, fails to carry out the Work in an acceptable manner,

the Engineer will give written notice to the Contractor and surety of such delay, neglect, or default, demanding the elimination of such cause for default.

If the Contractor or surety, within a period of ten days after such notice, does not proceed in accordance therewith, then the Commissioner has, upon written notification from the Engineer of the fact of such delay, neglect, or default and the Contractor's failure to comply with such notice, full power and authority without violating the Contract, to declare the Contractor in default and notify the Contractor to discontinue the Work. The declaration of default will be in writing and given to the Contractor and surety. The Department may appropriate any or all materials and equipment on the site as may be suitable and acceptable and may direct the surety to complete the Contract or may enter into an agreement for the completion of the Contract according to the terms and provisions thereof with another contractor or the surety, or use such other methods required for the completion of the Contract, including completion of the Work by the Department.

The Contractor and surety are not relieved of the assessment of liquidated damages under Subsection 108.16 because of the Contractor's default.

All costs and charges incurred by the Department, together with the cost of completing the Work, will be deducted from any monies due or that may become due the Contractor and surety. If such expense exceeds the sum that would be available from such monies, then the Contractor and the surety shall be liable and shall pay to the Department the amount of such excess.

The rights and remedies of the State are in addition to any other rights and remedies provided by law or under the Contract and the Bonds.

If, after notice of default under the provisions of this Subsection, it is determined for any reason that the Contractor was not in default or that the delay was excusable, the rights and obligations of the parties are the same as if the notice of termination had been issued pursuant to Subsection 108.18.

Where the Department's default of the Contractor pursuant to the provisions of this Subsection is found by a court to be legally improper, the Contract will be treated as if terminated for convenience pursuant to Subsection 108.18 and such termination is to be compensated for according to provisions of Subsection 108.18.

108.18 Termination of Contract. { XE "Contract:termination of" }

The Commissioner may, by written order, terminate the Contract or any portion thereof for convenience after determining that for reasons beyond the Contractor's control, the Contractor is unable to proceed with or complete the Work as contracted for, or that termination is in the public interest.

Upon receipt of an Order of Termination for convenience, the Contractor shall not proceed with any item of Work that is not specified in the Order of Termination. The Contractor shall complete all items of Work specified in the termination order. Such Work shall include punch list items and all Work necessary to ensure the safety of the public, to properly secure existing work already constructed or partially constructed, and to secure the Project site. This work so ordered shall be performed according to the Contract Documents and may include items of work not in the original Contract. The Contract shall be considered substantially complete upon completion and acceptance of all items of Work specified in the Order of Termination, except punch list items. After completion of the punch list items and all documents required by the Contract, the Contract shall terminate upon issuance of a Final Certificate and payment. The Commissioner reserves the right to declare in default a Contractor who fails to carry out the conditions set forth in an Order of Termination for convenience.

When the Commissioner orders termination of the Contract for convenience, all completed items of Work as of that date will be paid for at the Contract price. Payment for partially completed work will be paid for at agreed prices or by

Force Account methods described in Subsection 109.03 provided, however, that such payment does not exceed the Contract price of the Pay Item under which the Work was performed. Items that are eliminated in their entirety by such termination will be paid for only to the extent provided in Subsection 104.06. Payment for new items, if any, will be made either at agreed prices or paid for by Force Account methods described in Subsection 109.03.

Materials obtained by the Contractor for the Work but which have not been incorporated therein may, at the option of the Engineer, be purchased from the Contractor at actual cost delivered to a prescribed location or otherwise disposed of as mutually agreed.

Within 60 days of the effective termination date, the Contractor shall submit claims for additional costs actually incurred not covered above or elsewhere in these Specifications. Such claims may include such cost items as reasonable mobilization efforts, overhead expenses attributable to the terminated Project, subcontractor costs not otherwise paid for, actual idle labor cost if Work is stopped in advance of the termination date, and guaranteed payments for private land usage as part of original Contract. Costs which are prohibited under Subsection 107.27 and anticipated profits on work not performed are not allowed.

The Commissioner may also, by written order, terminate the Contract or any portion thereof for cause after determining that reasons for default as stated in Subsection 108.17 exist. The decision whether to terminate for cause or declare the Contractor in default will be made in the sole discretion of the Commissioner acting in the best interest of the State. Before the issuance of an Order of Termination for cause, the Engineer will give written notice to the Contractor and surety of the causes for the proposed termination. The notice will demand the elimination of such causes.

If the Contractor or surety, within a period of ten days after such notice, does not proceed in accordance therewith, the Commissioner may terminate the Contract for cause.

The Order of Termination for cause will terminate the Contractor's right to proceed with any items of Work except as specified in the termination order. Such work will include punch list items and all work necessary to ensure the safety of the public, to properly secure existing work already constructed or partially constructed, and to secure the Project site. This work so ordered shall be performed according to the Contract Documents and may include such items of Work not in the original Contract. Substantial Completion shall occur when all Work specified in the termination order, except for punch list items, is complete and accepted by the Engineer. After the completion of all punch list items and all documents required by the Contract, the Contract shall terminate upon issuance of a Final Certificate and payment.

When the Commissioner orders termination of the Contract for cause, all completed items of Work as of that date will be paid for at the Contract price. Payment for partially completed work will be made either at agreed prices or by Force Account methods described in Subsection 109.03 provided, however, that such payment does not exceed the Contract price of the Pay Item under which the Work was performed. Items that are eliminated in their entirety by such termination will be paid for only to the extent provided in Subsection 104.06. Payment for new items, if any, will be made either at agreed prices or paid for by Force Account methods described in Subsection 109.03. No other costs will be allowed the to Contractor. Profit and overhead not included in the Contract price for Pay Items for work completed or partially completed will not be allowed except that profit and overhead on Force Account work may be paid consistent with Subsection 109.03.

In terminating a Contract for cause, the Department does not waive its right to sue the Contractor for any costs incurred by the Department as a result of the termination, including the additional costs of completing the Project. The Commissioner reserves the right to declare in default a Contractor who fails to carry out the conditions set forth in an Order of Termination for cause.

Where the Department's termination of the Contract for cause pursuant to the provisions of this Subsection is found by a court to be legally improper, the termination of the Contract for cause will be treated as if it had been a termination for convenience, and such termination is to be compensated for according to the provisions of this Subsection governing terminations for convenience.

In terminating a Contract for convenience or cause pursuant to this Subsection:

1. The Contractor shall make cost records available consistent with Subsection 109.12 to the extent necessary to determine the validity and amount of each item for which it seeks compensation.
2. The Contractor shall not be relieved of contractual responsibilities for the Work completed, nor shall the surety be relieved of its obligations for and concerning any just claim arising out of the Work performed.
3. The Contractor shall, if so directed by the Engineer, remove promptly any or all of its equipment and supplies from the Project site or other property of the State. If the Contractor fails to remove the equipment and supplies as directed, the Engineer may remove such equipment and supplies at the expense of the Contractor.

108.19 Lane Occupancy Charges{ XE "Lane occupancy charges" }.

The phrase "lane closure limits" as used herein shall refer to the time period for lane openings as set forth in the Contract Documents. The Contractor is advised that time is of the essence as to all the lane closure limits during which a

lane or lanes of the Traveled Way may be closed by the Contractor to perform the Work. In the event that the Contractor fails to open a lane or lanes of the Traveled Way according to the lane closure limits, the Department will have the right to collect a Lane Occupancy Charge for the use and occupancy of each such lane or lanes beyond the permitted time period until such time that the lane or lanes are reopened to traffic or until such time that the lane closure is allowed to take place again under the lane closure limits.

Except as specifically excluded in the Special Provisions, a Lane Occupancy Charge will be collected by deducting the appropriate charge, calculated according to this Subsection, from the monthly estimate, whenever a lane or lanes are not promptly made available to the traveling public during the lane closure limits for the following reasons: equipment breakdowns; non-extreme weather related causes; late start of work; shortage of labor, materials, fuel, machinery or equipment or by reason of the Contractor's negligence or fault or that of its workers, employees, subcontractors or suppliers. This charge will be collected per lane for that period of time each lane is unavailable to the traveling public beyond the lane closure limits. The Resident Engineer, however, will allow a fifteen-minute grace period per occurrence at no charge to the Contractor. If the Contractor fails to open the Traveled Way before the end of the grace period, the Contractor shall be charged for the first fifteen minute period at half the rate listed below and at the rate indicated for any subsequent time of delay in the opening of the Traveled Way. This charge will be calculated by multiplying the length of time of the delayed opening, in minutes, by the applicable rate or rates per minute as set forth in the Special Provisions and, where more than one lane is involved, by the number of lanes so affected.

The total amount of the Lane Occupancy Charge collected from a Contractor shall not exceed $5,000.00 per day.

The Resident Engineer will keep and record the length of time the lane or lanes are kept closed beyond the lane closure limits. The Resident Engineer also reserves the right to suspend all Work until the next allowable lane closure time period, where the Contractor exceeds the lane closure limits and the grace period extension thereof. Before deduction of any charge from a monthly estimate for occupancy of a lane or lanes of the Traveled Way, the Department will provide the Contractor with a statement of the charges to be collected and the supporting calculations.

A Lane Occupancy Charge, however, will not be collected by the Department from the Contractor where a lane or lanes are closed directly and solely by reason of extraordinary, exigent circumstances defined as: extreme weather conditions, natural cataclysmic phenomena, unanticipated labor stoppages or strikes, acts of the State or its employees, police action, riot or civil unrest, war, fire, natural geologic conditions unknown to the Contractor, or a serious vehicular or pedestrian accident; so long as the Contractor undertakes all reasonable actions that are immediately necessary to open the closed lane or lanes as soon as practicable given the circumstances extant at the time of the occurrence of the event or the events directly causing closure beyond the lane closure limits, no matter the reason thereof. Where, however, the Contractor fails to take appropriate, reasonable action to open a lane closed by reason of extraordinary, exigent circumstances, as defined above, the Engineer will have the right to charge for that period of time that a lane or lanes are closed beyond that period of time reasonably needed by the Contractor, under the given circumstances, to open the closed lane or lanes to the traveling public. Also, this paragraph shall not be construed as limiting, in any manner, the Contractor's liability or risk as governed under Subsections 107.22 Risks Assumed by the Contractor and Subsection 107.23 Insurance, or under any other provisions of the Special Provisions and shall be deemed as only applying to collection of charges from the Contractor for lane closures.

SECTION 109 - MEASUREMENT AND PAYMENT{ XE "MEASUREMENT AND PAYMENT" }

109.01 Measurement of Quantities. { XE "Quantities:measurement of" }{ XE "Measurement of quantities" }

Measurements will be made according to the United States customary English units.

The method of measurement and computations to be used in determination of quantities of Work performed under the Contract are those methods generally recognized as conforming to good engineering practice.

Longitudinal measurements for area computations are made horizontally and deductions are not made for individual fixtures having an area of 9 square feet or less. Transverse measurements for area computations are the neat dimensions shown on the Plans or ordered in writing by the Engineer.

All items that are measured by the linear foot, such as pipe culverts and underdrains, are measured parallel to the base or foundation upon which such items are placed.

In computing volumes of excavation, the average end area method is used.

The thickness of plates and galvanized sheet used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing is measured in decimal fractions of inches.

Materials measured by volume in the hauling vehicle are measured at the point of delivery. Vehicles for this purpose may be of any size or type acceptable to the Engineer, provided that the body is of such shape that the actual

contents may be readily and accurately determined. Bituminous distributors shall be calibrated as described in Subsection 402.03.

Volumes of bituminous materials of the types and grades specified are determined by measuring the material in the calibrated hauling vehicle both before and after discharge. The gross number of gallons delivered is converted to the number of gallons at 60ºF based on the temperature, in ºF, of the material discharged and the temperature-volume correction factors indicated in the applicable tables of Subsection 904.06.

When requested by the Contractor and approved by the Engineer, in writing, material specified to be measured by the cubic yard may be weighed and such weights converted to cubic yards for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined and shall be agreed to by the Contractor before such method of measurement of pay quantities is used.

Net certified scale weights or weights based on certified volumes in the case of rail shipments will be used as a basis of measurement, subject to correction when bituminous material has been lost from the rail car or the distributor, wasted, or otherwise not incorporated in the Work.

When bituminous materials are shipped by truck or transport, net certified weights or volumes subject to correction for loss or foaming may be used for computing quantities.

The term "lump sum" when used as a basis of payment means complete payment for the Work of that item, and that item will not be measured.

When standard manufactured items are specified, such as fence, wire, plates, rolled shapes, and pipe conduit, and these items are identified by unit weight or section dimensions, such identifications are considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances indicated in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

{ XE "Quantities:in the proposal" **}**Whenever the phrase "quantity in the Proposal" is used in this Subsection, it is construed to mean the quantity in the Proposal adjusted for Change Orders.

When the quantity in the Proposal is specified to be the pay quantity, either the Engineer or the Contractor may request that the quantity be measured. If the Contractor makes such a request, it shall be accompanied by drawings, calculations, or other information indicating that the quantity in the Proposal is not correct.

{ XE "Measurement of quantities:Type 1 and Type 2 Pay Items" **}**For Type 1 Pay Items designated below, if the measured quantity is less than five percent different from the quantity in the Proposal, payment will be made based on the quantity in the Proposal. If the Contractor requested the measurement, then it shall pay the State for the cost of the measurement. If the measured quantity is five percent or more different from the quantity in the Proposal, payment will be made based on the measured quantity and there will be no charge for the measurement.

For Type 2 Pay Items designated below, if the measured quantity is less than ten percent different from the quantity in the Proposal, payment will be made based on the quantity in the Proposal. If the Contractor requested the measurement, then it shall pay the State for the cost of the measurement. If the measured quantity is ten percent or more different from the quantity in the Proposal, payment will be made based on the measured quantity and there will be no charge for the measurement.

When the Contractor is required to pay for the measurement of quantities, the following rates apply:

Type 1 Pay Items	**Charge per Unit of Measure**
ROADWAY EXCAVATION, UNCLASSIFIED	$ 0.05 per cubic yard when cross-sections are not required
ROADWAY EXCAVATION, UNCLASSIFIED	$ 0.12 per cubic yard when cross-sections are required
SUBBASE	$ 0.32 per cubic yard
SOIL AGGREGATE BASE COURSE, VARIABLE THICKNESS	$ 0.32 per cubic yard
SOIL AGGREGATE BASE COURSE, ___ " THICK	$ 0.13 per square yard
DENSE-GRADED AGGREGATE BASE COURSE, VARIABLE THICKNESS	$ 0.32 per cubic yard
DENSE-GRADED AGGREGATE BASE COURSE, ___ " THICK	$ 0.13 per square yard

Type 2 Pay Items	Charge per Unit of Measure
CONCRETE BASE COURSE, ___ " THICK	$ 0.13 per square yard
CONCRETE BASE COURSE, REINFORCED, ___ " THICK	$ 0.13 per square yard
CONCRETE SURFACE COURSE, ___ " THICK	$ 0.13 per square yard
CONCRETE SURFACE COURSE, REINFORCED, ___ " THICK	$ 0.13 per square yard
BRIDGE APPROACH SLABS, ___ " THICK	$ 0.13 per square yard
BRIDGE APPROACH TRANSITION SLABS, ___" AVERAGE THICKNESS	$ 0.13 per square yard
CONCRETE IN STRUCTURES, CULVERTS	$ 2.75 per cubic yard
CONCRETE IN STRUCTURES, FOOTINGS	$ 1.60 per cubic yard
CONCRETE IN STRUCTURES, RETAINING WALLS	$ 2.10 per cubic yard
CONCRETE IN SUBSTRUCTURES, ABUTMENT WALLS	$ 2.10 per cubic yard
CONCRETE IN SUBSTRUCTURES, PIER COLUMNS AND CAPS	$ 2.10 per cubic yard
CONCRETE IN SUBSTRUCTURES, PIER SHAFTS	$ 2.10 per cubic yard
CONCRETE IN SUPERSTRUCTURE, DECK SLABS	$ 3.20 per cubic yard
CONCRETE IN SUPERSTRUCTURE, SIDEWALKS	$ 1.60 per cubic yard
CONCRETE IN SUPERSTRUCTURE, PARAPETS	$ 0.32 per linear foot
REINFORCEMENT STEEL IN STRUCTURES	$ 0.01 per pound
REINFORCEMENT STEEL IN STRUCTURES, EPOXY-COATED	$ 0.01 per pound
HOT MIX ASPHALT SIDEWALK, ___ " THICK	$ 0.64 per square yard
CONCRETE SIDEWALK, ___ " THICK	$ 0.64 per square yard
CONCRETE SIDEWALK, REINFORCED, ___ " THICK	$ 0.64 per square yard
HOT MIX ASPHALT ISLAND, ___ " THICK	$ 0.64 per square yard
WHITE CONCRETE ISLAND, ___ " THICK	$ 0.64 per square yard
CONCRETE ISLAND, ___ " THICK	$ 0.64 per square yard
EPOXY WATERPROOFING SEAL COAT	$ 0.64 per square yard
SAW CUT GROOVED DECK SURFACE	$ 0.06 per square yard
FOUNDATION EXCAVATION	$ 0.32 per cubic yard
BRIDGE EXCAVATION	$ 0.32 per cubic yard
CONCRETE DECK OVERLAY PROTECTIVE SYSTEM, TYPE LATEX MODIFIED CONCRETE	$ 3.20 per cubic yard
CONCRETE DECK OVERLAY PROTECTIVE SYSTEM, TYPE SILICA FUME CONCRETE	$ 3.20 per cubic yard
SHEAR CONNECTORS	$0.03 per unit
SHEAR CONNECTORS, GALVANIZED	$0.03 per unit

Note: When calculating the cost of measurement, pay quantities are rounded off to the nearest whole number.

109.02 Scope of Payment. { XE "Payment:scope of" }

The Contractor shall receive and accept the compensation provided for in the Contract as full payment for furnishing all labor, materials, tools, equipment, and incidentals necessary to complete the Work, and for performing all Work contemplated and embraced under the Contract in a complete and acceptable manner. Except where specifically provided elsewhere in the Contract Documents, compensation shall encompass full payment for all risk, loss, damage, or expense of whatever character arising out of the nature of the Work or the prosecution thereof, or for the action of the elements, or for any unforeseen difficulties that may be encountered during the prosecution of the Work until Acceptance. Also, except where specifically provided elsewhere in the Contract Documents, compensation shall include full payment for all expenses incurred as a result of the suspension or discontinuance of the Work as provided in the Contract.

The "Basis of Payment" clause in the Specifications relating to any Pay Item in the proposal encompasses all compensation for work essential to that Pay Item. Work essential to that Pay Item will not be measured or paid for under any other Pay Item in the Contract Documents unless it is stated in the "Basis of Payment" clause for that Pay Item that a portion of the Work will be paid for under another Section or Subsection of the Specifications.

109.03 Force Account Payment. { XE "Force account payment" }{ XE "Payment:force account" }

Where the Contractor and the Engineer cannot negotiate a Supplementary Agreement for Extra Work, or for Work designated to be Force Account payments elsewhere in the Contract Documents, the Department may require the Contractor to do such Work on a Force Account basis and be compensated as provided in this Subsection.

The total costs for labor, materials, equipment, bonds, insurance, and tax as provided below, together with applicable markups constitute full compensation for all direct and indirect costs (including overhead) and profit, and are deemed to include all items of expense not specifically designated. Any adjustments to Performance Bond and Payment Bond will be made as provided in Subsection 103.05.

When forces other than the Contractor's organization perform Work that is paid on a Force Account basis, the Contractor shall reach an agreement with such other forces as to the distribution of payments made by the State for such Work. Therefore, additional payment will not be made by reason of the performance of the Work by a subcontractor or other forces.

It is understood that Force Account payments pursuant to the terms of the Contract are contractual in nature only and are not to be used for any other purpose. More specifically, but not by way of limitation, the Force Account provisions of this Contract are not to be used to prove damages in a court of law in an action for breach of Contract pursuant to the provisions of the New Jersey Contractual Liability Act.

Force Account payment will be based on the following:

1. **Labor.** For all necessary labor and foremen in direct charge of the specific operations, whether the employer is the Contractor, subcontractor, or another, the Contractor shall receive the rate of wage (or scale) actually paid as shown in its certified payrolls for each and every hour that said labor and foremen are actually engaged in such Work.

   The Contractor shall receive the actual costs paid to, or on behalf of, workers by reason of health and welfare benefits or other benefits, when such amounts are required by collective bargaining agreements or other employment contracts generally applicable to the classes of labor employed on the Work.

2. **Bond, Insurance, and Tax.** For bond premiums; property damage, liability, and workers compensation insurance premiums; unemployment insurance contributions; and social security taxes on the Force Account work, the Contractor shall receive the actual incremental cost thereof, necessarily and directly resulting from the Force Account work. The Contractor shall furnish satisfactory evidence of the rate or rates paid for such bond, insurance, and tax.

   Payment for Performance Bond and Payment Bond will be as provided in Subsection 103.05.

3. **Materials.** The Department reserves the right to furnish such materials as it deems advisable, and the Contractor shall have no claims for costs and markup on such materials.

   Only materials furnished by the Contractor and necessarily used in the performance of the Work will be paid for. Sales tax will not be paid on materials that qualify for an exemption under the Sales and Use Tax Act and the regulations issued thereunder, regardless of whether the exemption is used. The cost of such materials shall be the cost to the purchaser, whether Contractor, subcontractor, or other forces from the supplier thereto, together with transportation charges actually paid by it, except as follows:

   a. If a cash or trade discount by the actual supplier is offered or available to the purchaser, it shall be credited to the State notwithstanding the fact that such discount may not have been taken.
   b. If materials are procured by the purchaser by any method which is not a direct purchase from and a direct billing by the actual supplier to such purchaser, the cost of such materials shall be the price

paid to the actual supplier as determined by the Engineer, plus the actual costs, if any, incurred in the handling of such materials.

c. If the materials are obtained from a supply or source owned wholly or in part by the purchaser, the cost of such materials shall not exceed the price paid by the purchaser for similar materials furnished from said source on Pay Items or the current wholesale price for such materials delivered to the job site, whichever price is lower.

d. If the cost of such materials is, in the opinion of the Engineer, excessive, then the cost of such materials shall be the lowest current wholesale price at which such materials are available in the quantities concerned, delivered to the job site, less any discounts as provided in Item a above.

e. If the Contractor does not furnish satisfactory evidence of the cost of such materials from the actual supplier thereof, the cost will be determined according to Item d above.

4. Equipment and Plant.

a. Contractor Owned Equipment and Plant. The hourly rates for Contractor owned equipment and plant will be determined from the applicable volume of the Rental Rate Blue Book (referred to hereafter as the "Blue Book"), published by Intertec Publishing, a Primedia Company, 1735 Technology Drive, Suite 410, San Jose, California 95110.

The Blue Book will be used in the following manner:

(1) The hourly rate will be determined by dividing the monthly rate by 176. The weekly, hourly, and daily rates will not be used.

(2) The number of hours to be paid for will be the number of hours that the equipment or plant is actually used on a specific Force Account activity.

(3) The current revisions will be used in establishing rates. The current revision applicable to specific Force Account work is as of the first day of work performed on that Force Account work and that rate applies throughout the period the Force Account work is being performed.

(4) Area adjustment will not be made. Equipment life adjustment will be made according to the rate adjustment tables.

(5) Overtime shall be charged at the same rate indicated in Item (1) above.

(6) The estimated operating costs per hour will be used for each hour that the equipment or plant is in operation on the Force Account work. Such costs do not apply to idle time regardless of the cause of the idleness.

(7) Idle time for equipment will not be paid for, except where the equipment has been held on the Project site on a standby basis at the request of the Engineer and, but for this request, would have left the Project site. Such payment will be made at one-half the rate established in Item (1) above.

(8) The rates established above include the cost of fuel, oil, lubrication, supplies, small tools, necessary attachments, repairs, overhaul and maintenance of any kind, depreciation, storage, overhead, profits, insurance, all costs (including labor and equipment) of moving equipment or plant to, on, and away from the site, and all incidentals.

(9) Operator costs will be paid only as provided in Subheading 1 above.

All equipment shall, in the opinion of the Engineer, be in good operating condition. Equipment used by the Contractor shall be specifically described and be of suitable size and suitable capacity required for the work to be performed. In the event the Contractor elects to use equipment of a higher rental value than that suitable for the Work, payment will be made at the rate applicable to the suitable equipment. The equipment actually used and the suitable equipment paid for will be made a part of the record for Force Account work. The Resident Engineer will determine the suitability of the equipment. If there is a differential in the rate of pay of the operator of oversize or higher rate equipment, the rate paid for the operator will be that for the suitable equipment.

If a rate is not established in the Blue Book for a particular piece of equipment or plant, the Engineer will establish a rate for that piece of equipment or plant that is consistent with its cost and use in the industry.

The above provisions apply to the equipment and plant owned directly by the Contractor or by entities which are divisions, affiliates, subsidiaries, or in any other way related to the Contractor or its parent company.

b. Rented Equipment and Plant. In the event that the Contractor does not own a specific type of equipment or plant and must obtain it by rental, the Contractor shall inform the Resident Engineer of the need to rent the equipment and of the rental rate for that equipment before using it on the Work. The Contractor will be paid the actual rental for the equipment for the time that the equipment is actually used to accomplish the Work, provided that rate is reasonable, plus the cost of moving the equipment to, on, and away from the Project site. The Contractor shall provide a copy of the paid receipt or canceled check for the rental expense incurred.

5. Profit. Profit shall be computed at ten percent of the following:

a. Total material cost (bare cost F.O.B.).
b. Total direct labor cost (actual hours worked multiplied by the regular hourly rate).

6. Overhead. Overhead is defined to include the following:

a. All salaries and expenses of executive officers, supervising officers, or supervising employees;
b. All clerical or stenographic employees;
c. All charges for minor equipment, such as small tools, including shovels, picks, axes, saws, bars, sledges, lanterns, jacks, cables, pails, wrenches, and other miscellaneous supplies and services; and
d. All drafting room accessories such as paper, tracing cloth, and blueprinting.

Overhead costs for Force Account work shall be computed at 15 percent of the following:

a. Total material cost (bare cost F.O.B.).
b. Total direct labor cost (actual hours worked multiplied by the regular hourly rate).
c. Specific extraordinary overhead expenses, such as hiring of additional supervisory personnel or the use of special minor equipment (as defined above), which the Contractor has to purchase specifically for the Force Account, may be allowed. In such instances, the Contractor will be paid only the reasonable costs of such extraordinary overhead expenses provided the Engineer has agreed to such costs before their being incurred.
d. Total fringe benefits on total direct labor cost as computed above.

The Contractor will be allowed an additional five percent for overhead on the total amount of all work performed by the subcontractors.

7. Records. The Contractor shall maintain its records in such a manner as to provide a clear distinction between the direct costs of Work paid for on a Force Account basis and the costs of other operations.

From the above records, the Contractor shall furnish to the Engineer completed daily Force Account work reports for each day's work to be paid for on a Force Account basis. Said daily Force Account work reports shall be signed by the Contractor and submitted daily. The daily Force Account work reports shall be detailed as follows:

a. Name, classification, date, daily hours, total hours, rate, and extension for each worker and foreman.
b. Designation, dates, daily hours, total hours, rental rate (including a copy of the Blue Book pages used), and extension for each unit of machinery and equipment.
c. Quantities of materials, prices, and extensions.
d. Transportation of materials.
e. Cost of bonds; property damage, liability, and workers compensation insurance premiums; unemployment insurance contributions; and social security taxes.

Material charges shall be substantiated by valid copies of vendor's invoices. Such invoices shall be submitted with the daily Force Account work reports, or if not available, they shall be submitted with subsequent daily Force Account work reports. Should said vendor's invoices not be submitted within 60 days after the date of delivery of the material, or within 15 days after the Completion, whichever occurs first, the Department reserves the right to establish the cost of such materials at the lowest current wholesale prices at which said materials are available, in the quantities concerned, delivered to the location of Work, less any discounts provided in Subheading 3.a above.

The Engineer's records will be compared with the completed daily Force Account work reports furnished by the Contractor, and any necessary adjustments will be made. When these daily Force Account work reports are agreed upon and signed by both parties, said reports become the basis of payment for the work performed but do not preclude subsequent adjustment based on a later audit by the Department.

The Contractor's cost records pertaining to work paid for on a Force Account basis shall be open to inspection or audit by representatives of the Department, during the life of the Contract and for a period of not less than three years after Acceptance thereof, and the Contractor shall retain such records for that period.

Where payment for materials or labor is based on the cost thereof to forces other than the Contractor, the Contractor shall ensure that the cost records of such other forces are open to inspection and audit by representatives of the Department on the same terms and conditions as the cost records of the Contractor. If an audit is to be commenced more than 60 days after Acceptance, the Contractor will be provided a reasonable notice of the time when such audit is to begin. In case all or a part of such records are not made so available, the Contractor understands and agrees that any items not supported by reason of such unavailability of the records will not be allowed, or if payment therefor has already been made, the Contractor shall refund to the Department the amount so disallowed.

109.04 Payment for Contractor's Expenses During Delays. { XE "Payment:expenses during delays" }

If the Engineer finds that the Work was delayed on the entire Contract or any part thereof, because of conditions beyond the control and not the fault of the Contractor for causes as to which the provisions of the Contract authorize compensation, the Contractor will be paid its expenses during that period of delay by Change Order in the following manner:

1. **Labor.** For all necessary nonproductive labor and foremen in direct charge of specific operations who must remain on the Project during such periods of delay due to collective bargaining contracts or other reasons approved by the Engineer, the Contractor is to receive the prevailing rate of wage as shown in its certified payrolls. The Contractor is also to receive the actual costs paid to, or in behalf of, workers by reason of health and welfare benefits, pension fund benefits, or other benefits, when such amounts are required by collective bargaining agreements or other employee contracts generally applicable to the classes of labor employed on the Work.
2. **Bond, Insurance, and Tax.** For bond premiums; property damage, liability, and, workers compensation insurance premiums; unemployment insurance contributions; and social security taxes during the period of delay, the Contractor is to receive the actual incremental cost thereof, necessarily and directly resulting from the delay. The Contractor shall furnish satisfactory evidence of the rate or rates paid for such bond, insurance, and tax.

   Payment for Performance Bond and Payment Bond will be as provided in Subsection 103.05.
3. **Equipment.** For any idle machinery or special equipment other than small tools which must remain on the Project site, with approval of the Engineer, during delays, the Contractor is to receive compensation at one-half the rate calculated pursuant to Subheading 4 of the fifth paragraph of Subsection 109.03. Should the Engineer determine that it is not necessary for machinery or equipment to remain on the Project during delays, the Contractor is to receive transportation costs to remove the machinery or equipment and return it to the Project at the end of the delay period.

   The time for which such compensation will be paid is the actual normal working time during which such delay condition exists, which in no case exceeds eight hours in any one day.

   The days for which compensation will be paid are the Calendar Days, excluding Saturdays, Sundays, and holidays, during the existence of such delay.
4. **Miscellaneous.** The Contractor further receives an amount equal to ten percent of the sum of the above items which is full compensation for overhead, general superintendence, or other costs attributed to the delay for which no specific allowance is herein provided. Payment under this Subsection constitutes full compensation for all items of expense related to such delay.
5. **Profit.** Profit is not allowed under this Subsection.
6. **Records.** Payment will not be made for delays until the Contractor has furnished the Engineer with duplicate itemized statements of the cost as hereinabove specified and detailed as follows:
   a. Name, classification, date, daily hours, total hours, rate, and extension for each worker and foreman.
   b. Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment.
   c. Transportation costs.
   d. Cost of bonds; property damage, liability, and workers compensation insurance premiums; unemployment insurance contributions; and social security taxes.

   The Engineer will compare the Department's records with completed daily reports furnished by the Contractor and make any necessary adjustments. When these daily reports are agreed upon and signed by both parties, said reports become the basis of payment for the expenses incurred, but do not preclude subsequent adjustment based on a later audit by the Department.

The Contractor's cost records pertaining to expenses under this Subsection shall be open to inspection or audit by representatives of the Department during the life of the Contract and for a period of not less than three years after Acceptance thereof, and the Contractor shall retain such records for that period. Where payment for materials, equipment, or labor is based on the cost thereof to forces other than the Contractor, the Contractor shall make every reasonable effort to ensure that the cost records of such other forces are open to inspection and audit by representatives of the Department on the same terms and conditions as the cost records of the Contractor. Payment for such cost may be deleted if the records of such third parties are not made available to the Department's representatives. If an audit is to be commenced more than 60 days after Acceptance, the Contractor is to be provided with a reasonable notice of the time when such audit is to begin. In case all or a part of such records are not made so available, the Contractor understands and agrees that any items not supported by reason of such unavailability of the records will not be allowed, or if payment therefor has already been made, the Contractor shall refund to the Department the amount so disallowed.

109.05 Partial Payments. { XE "Payment:partial" }{ XE "Partial payments" }

{ XE "Payment:monthly estimates" **}{** XE "Monthly estimates" **}**Monthly estimates will be made of the approximate quantities of Work satisfactorily performed according to the Contract Documents during the preceding month. Partial payments on account of such monthly estimate will be made based on the prices bid in the Proposal or as provided by Field Order, Change Order, or Supplementary Agreement. The Contractor is also to be paid under the monthly estimates for materials delivered according to Subsection 109.06.

Before the issuance of each monthly payment before Substantial Completion, the Contractor shall certify, on forms provided by the Department, that:

1. Each subcontractor or supplier has been paid any amount due from any previous progress payment and shall be paid any amount due from the current progress payment; or
2. There exists a valid basis under the terms of the subcontractor's or supplier's contract to withhold payment from the subcontractor or supplier, and therefore payment is withheld.

Additionally, whenever the certification indicates that payment has been or will be withheld from a subcontractor or supplier, the Contractor shall, according to PL 1991, c.507, provide written notice of such non-payment to the subcontractor or supplier and shall provide to the Department, and to the Bonding Company providing the Performance Bond for the Contractor, a copy of the written notice of withholding of payment required by PL 1991, c.507. The notice shall detail the reason for withholding payment and state the amount of payment withheld.

PL 1991, c.507 authorizes any subcontractor or supplier from whom payment is withheld to receive from the Contractor, in addition to any amount due, interest at a rate equal to the prime rate plus one percent if the subcontractor or supplier is not paid within ten Calendar Days after receipt by the Contractor of payment by the State for completed work that is the subject of a subcontract or a material supply agreement and if no valid basis exists for withholding payment. This interest shall begin to accrue on the tenth Calendar Day after receipt of payment by the Contractor. In addition, if court action is taken by a subcontractor or supplier to collect payments withheld by a Contractor, the prevailing party shall recover its court costs from the party against whom judgment is rendered.

Pay Items that are on a lump sum basis will not be measured. However, payment for such items will be included in partial payments consistent with the provisions of the Subsection describing the Work under the lump sum Pay Item. Where the method of payment is not described under the Subsection describing the Work of the lump sum Pay Item, partial payment will be made based on an approximation of the proportionate value of the Work satisfactorily performed to date.

Partial payment will not be made when the monthly estimate shows the total Work and delivered materials payable since the preceding monthly estimate to be less than $1,000, unless the Contractor requests in writing that such payment be made.

From the total amounts ascertained as payable, an amount equivalent to five percent of the amount due on the first 50 percent of the total adjusted Contract price will be deducted and retained pending Substantial Completion. On the remaining 50 percent of the total adjusted Contract price, no percentage of the partial payments is withheld as retainage. Any amounts paid to the Contractor in the form of incentive payments for early Completion and positive pay adjustments will not be included in the adjusted Contract price when calculating retainage.

Such estimate or payment will not be made when, in the judgment of the Engineer, the Work is not proceeding according to the Contract Documents or following the Commissioner giving the Contractor and surety notice of delay, neglect, or default under Subsection 108.17.

Such estimate or payment shall not be construed to be an approval of any defective or improper Work. The Engineer upon determining that any payment under a previous monthly estimate was improper or unwarranted for any

reason may deduct the amount of such payment from the subsequent monthly estimate and partial payments made to the Contractor.

The Department will deduct from any monthly estimate and payment and/or the final payment such amounts as are required to be deducted pursuant to provisions of the Contract Documents.

109.06 Materials Payments. { XE "Payment:materials" }

The monthly estimates and payments made on account thereof may also include, when authorized by the Engineer, an amount equal to the actual cost of materials furnished but not incorporated into the Work, provided, however, that such amount does not exceed 85 percent of the Contract price for the Pay Item into which the material is to be incorporated, and the quantity allowed does not exceed the corresponding quantity estimated in the Contract Documents. Before including payments for such materials in an estimate, the Engineer must be satisfied that:

1. The materials have been properly stored and protected along or upon the Project site or have been stored at locations owned or leased by the Contractor or the Department within the State, except that structural steel may be stored outside the State with the approval of the Engineer; and
2. The materials have been inspected and appear to be acceptable based upon available supplier's certification and/or materials test reports; and
3. The Contractor has provided the Department with an invoice or bill of sale sufficient to show the price paid for the materials and a fully executed Department form "Release of Liens for Materials Stored for Incorporation in Department of Transportation Project"; and
4. The materials, if stored on property not belonging to the State, are fenced in with access limited to the State and the Contractor, and the fenced-in materials are clearly identified in large letters as being without encumbrances and for use solely on the Project; and
5. When such materials are stored in a leased area, the lease is made out to the Contractor and provides that it shall be canceled only with the written permission of the Engineer.

The Contractor assumes full responsibility for the safe storage and protection of the materials and nothing in this Subsection alters the provisions of Subsections 107.22 and 107.23. If materials paid for under this Subsection are damaged, stolen, or prove to be unacceptable, the payment made therefor shall be deducted from subsequent estimates and payments.

Payment for materials as provided in this Subsection shall not be deemed to be an approval of such materials, and the Contractor shall be responsible for and must deliver to the Project site and properly incorporate in the Work only those materials that comply with the Contract Documents.

The Contractor shall pay any and all costs of handling and delivering materials to and from the place of storage to the Project site, as well as any storage rental. Any taxes levied by any government against the materials shall be borne by the Contractor.

Payment for living or perishable plant materials will not be made until they are planted.

109.07 Payments Following Substantial Completion. { XE "Payment:following substantial completion" }

Following Substantial Completion of the Contract according to Subsections 101.03 and 105.22, partial payments to the Contractor will be made only upon certification by the Contractor to the Department, on forms provided by the Department, that:

1. Each subcontractor or supplier has been paid all amounts due from all previous progress payments and shall be paid all amounts due from the current progress payment; or
2. There exists a valid basis under the terms of the subcontractor's or supplier's contract to withhold payment from the subcontractor or supplier, and therefore payment is withheld.

Additionally, whenever the certification indicates that payment has been or will be withheld from a subcontractor or supplier, the Contractor shall according to PL 1991, c.507, provide written notice of such non-payment to the subcontractor or supplier and shall provide to the Department, and to the Bonding Company providing the Performance Bond for the Contractor, a copy of the written notice of withholding of payment required by PL 1991, c.507. The notice shall detail the reason for withholding payment and state the amount of payment withheld.

PL 1991, c.507 authorizes any subcontractor or supplier from whom payment is withheld to receive from the Contractor, in addition to any amount due, interest at a rate equal to the prime rate plus one percent if the subcontractor or supplier is not paid within ten Calendar Days after receipt by the Contractor of payment by the State for completed work which is the subject of a subcontract or a material supply agreement and if no valid basis exists for withholding payment. This interest shall begin to accrue on the tenth Calendar Day after receipt of payment by the Contractor. In

addition, if court action is taken by a subcontractor or supplier to collect payments withheld by a Contractor, the prevailing party shall recover its court costs from the party against whom judgment is rendered.

In the first estimate following Substantial Completion, the Department will reduce retainage to two percent of the total adjusted Contract price unless it has been determined by the Commissioner that the public interest requires the withholding of additional retainage. If retainage is held in cash withholdings, the reduction is to be accomplished by payment under the next partial payment. If retainage is held in bonds, the Department will authorize a reduction in the escrow account.

All monies retained subsequent to Substantial Completion shall be released at final payment.

109.08 Bonds Posted in Lieu of Retainages. { XE "Bond:in lieu of retainages" }

The Contractor may elect to deposit negotiable bonds of the State or any of its political subdivisions, which have been approved by the Commissioner, in an escrow account to secure release of all or a portion of the retainage held under the provisions of Subsection 109.05. Such account shall be established under the provisions of an escrow agreement to be entered into between the Contractor, the Department, and a bank located in the State which is an authorized depository of the State and which has a trust department.

The agreement forms and a list of approved bonds may be obtained from the Department's Bureau of Construction Services. The bonds shall have a rating of at least "B A A" by Moody's Investor Service or "B B B" by Standard and Poors Corporation. Bonds having a lower rating are not acceptable to the Department.

The par value or market value of said bonds, whichever is lower, must be equal to the amount of money being released to the Contractor. If the market value of the bonds on deposit in the escrow account falls below the amount of retainage required by the Contract, the Contractor shall place in the escrow account additional bonds of sufficient value to secure the release of all retainage, or the Department will deduct from current payments amounts sufficient to ensure that the total bond value on deposit plus retainage withheld will equal the total retainage requirement for the Contract.

All bonds deposited in the escrow account to secure the release of retainage must remain acceptable to the Department while they are in the escrow account. The Contractor shall replace any of the bonds held in the escrow account, whenever those bonds decline in rating below the rating required for bonds to be acceptable. Unless the Contractor replaces the unacceptable bonds with acceptable bonds, the Department will withhold from future payments amounts equal to the amount of retainage, the release of which was based upon the value of the now unacceptable bonds.

In the event of a default or termination of the Contract, the Commissioner will notify the bank in writing of such default or termination. Following written notification of default or termination, the bank shall not dispose of, release, or compromise any bonds or the proceeds of called or mature bonds, without written instructions from the Commissioner. If directed by the Commissioner, the bank shall sell any bonds in the escrow account and pay the proceeds of such sale or the proceeds held in the account from called or matured bonds to the Department or to any payee designated by the Commissioner. A copy of the instructions to sell will be sent to the Contractor by certified mail.

The Contractor shall pay any and all charges of the bank for services rendered according to the terms and conditions of the escrow agreement.

109.09 Payment Following Acceptance. { XE "Payment:following acceptance" }

After Acceptance as provided in Subsection 105.23, the Engineer will make an estimate of the total amount of Work done under the Contract and the Department will make a final monthly payment. The Department will pay the balance found to be due after deduction of all previous payments and such further amounts as the Engineer determines to be necessary and proper under the Contract (including those required under Subsection 109.07) pending issuance of the Final Certificate and payment. Retainage is released with this estimate except where the Engineer determines to continue to retain them under the provisions of Subsections 109.07 and 109.10.

109.10 As-Built Quantities. { XE "Quantities:as-built" }{ XE "As-built quantities" }

Following Substantial Completion, the Resident Engineer will finalize as-built quantities for all Pay Items and for Extra Work that has been authorized and incorporated into the Project. The Contractor shall assume the positive obligation of assisting the Resident Engineer in the preparation of such as-built quantities at no extra cost. The Contractor shall have 20 days, from receipt thereof, to accept or reject the proposed final as-built quantities. If the Contractor rejects, the Contractor must submit, together with a notice of rejection, the proposed changes and supporting calculations within said 20-day period. Where the Contractor fails to respond or fails to provide supporting calculations, together with a notice of rejection, within the aforesaid 20-day period, such failure will be construed to be acceptance of the as-built quantities. However, the Resident Engineer will review supporting calculations properly received from the Contractor according to this Subsection, within 20 days, and will accept or reject, in part or in whole, the proposed changes to the as-built Quantities. The Resident Engineer has the discretion to extend the Contractor's 20-day response period, but only upon receipt of a written request from the Contractor, submitted within the aforesaid 20-day period. After the Contractor's acceptance, expiration of the aforesaid 20-day period and any properly granted extensions, or after review of any properly submitted proposed changes; final as-built quantities will be incorporated into a proposed Final Certificate. A claim based upon proposed changes to the as-built quantities that have not been accepted by the Resident Engineer, but which were supported by calculations and submitted within the aforesaid 20-day period, may be reserved by the Contractor according to Subsection 109.11. In addition, the provision of Subsection 109.01 shall also govern.

The Resident Engineer may from time to time, before Completion, prepare as-built quantities and incorporate these quantities into monthly estimate certificates through an appropriate Field Order or Change Order. Such interim as-built quantities are subject to recalculation following Completion. However, nothing contained in these Specifications shall be construed to place on the Engineer the obligation of providing the Contractor with as-built quantities for the Work performed before the issuance of the proposed Final Certificate, nor to provide more than rough, approximate quantities of the Work done for use in the preparation of monthly estimates.

Should it appear to the Engineer at the time of Acceptance that the calculation of as-built quantities might result in the Contractor being obliged to return money to the State, the Engineer may refuse to release retainage pending issuance of the proposed Final Certificate. Where the estimate reveals that an overpayment has been made, the Contractor shall immediately return the amount of the overpayment. If the Contractor fails to remit the overpayment, the Department will avail itself of other funds held on other projects with the same Contractor or against the retainage, and then if necessary proceed against the Contractor or its surety. Where the proposed Final Certificate reveals that no overpayment has been made, the Contractor shall be entitled to payment thereunder and the release of retainage, but the Contractor shall have no claim of any kind for additional compensation as a result of the Engineer's decision to withhold retainage or other monies pending issuance of the proposed Final Certificate.

109.11 Final Payment and Claims. { XE "Payment:claims" }{ XE "Payment:final" }{ XE "Claims:final payment" }{ XE "Final payment" }{ XE "Claims" }

{ XE "Final certificate" **}**The Final Certificate shows the total amount payable to the Contractor, including therein an itemization of said amount segregated as to Pay Item quantities, Extra Work, and any other basis for payment, and also shows therein all deductions made or to be made for prior payments and as required pursuant to the provisions of the Contract Documents. All prior estimates and payments are subject to correction in the Final Certificate.

{ XE "Conditioned acceptance of the final certificate" **}{** XE "Conditioned acceptance of the final certificate" **}**Within 30 days after said Final Certificate has been issued to the Contractor, the Contractor shall either submit to the Engineer a written acceptance of the Final Certificate without exception or a written acceptance of the Final Certificate with exception or reservation. The Contractor's failure to submit any written acceptance within said 30 days will be construed as an acceptance of the Final Certificate without exception or reservation. Final payment will be made to the Contractor in the amount set forth in the Final Certificate, and the Contract will be complete as of the date on which such payment is issued. Failure of the Contractor to accept the tendered Final Payment shall not affect completion of the Contract.

If the Contractor submits to the Engineer its written acceptance of the Final Certificate without exception or reservation, the acceptance shall contain a release signed by the Contractor in the following form:

> *In consideration of the above payment, I hereby release the State of New Jersey, Commissioner of Transportation, the Department, their agents, officers, and employees from all claims and liability of whatsoever nature for anything done or furnished or in any manner growing out of the performance of the Work.*

Upon receipt of such written approval and release, the State will pay the entire sum due thereunder as provided by the New Jersey Prompt Payment Act, NJSA 52:32-32 *et seq.*, and the Contract will be complete as of the date on which that payment is issued.

If the Contractor submits to the Engineer its written acceptance of the Final Certificate conditioned with exception or reservation, the acceptance shall contain a release signed by the Contractor in the following form:

> *In consideration of the above payment, I hereby release the State of New Jersey, Commissioner of Transportation, the Department, their agents, officers, and employees from all claims and liability of whatsoever nature for anything done or furnished in any manner growing out of the performance for the Work except for* _____.

The reservation shall state the specific amounts of the claims being reserved. Failure to state specific amounts shall result in a waiver of such claims. The Contractor can reserve only those claims properly filed with the Engineer pursuant to Subsection 107.02 and not previously resolved. The Contractor waives all claims for which the required notice has not been filed.

{ XE "Claims:notice of potential" **}**The Contractor further understands and agrees that neither the procedure established under this Subsection nor the review of claims by the Department pursuant hereto shall in any way affect the requirement of the filing of a Notice of Potential Claim for the filing of a suit pursuant to the provisions of NJSA 59:13-1 et seq.

If the Contractor conditions its acceptance of the Final Certificate, the Contractor shall at the same time state whether it wants its reserved claims reviewed by the Department Claims Committee. Only reserved claims, which are unresolved after completing the first three steps of the administrative process for the resolution of disputes, as provided in Subsection 107.02, are eligible for review by the Department Claims Committee as provided in that Subsection. If the Contractor states that it does not want Department Claims Committee review of the reserved claims or if it fails to request Department Claims Committee review of reserved claims when it conditions its acceptance of the Final Certificate, the Contractor shall be deemed to have waived any right to Department Claims Committee review of its reserved claims. The State will then pay the amount due under the Final Certificate, and the Contract will be complete as of the date on which the final payment is issued.

If the Contractor requests review of its reserved claims when it conditions its acceptance of the Final Certificate, it shall send at the same time a copy of its request for review to the Secretary of the Department Claims Committee and the Executive Director of Regional Operations as provided in Subsection 107.02. Department Claims Committee review will then take place as provided in Subsection 107.02.

{ XE "Claims:resolution of" **}**If the parties agree to a resolution of all of the reserved claims and execute a Supplementary Agreement confirming the terms of the resolution, the Executive Director of Regional Operations will issue an Amended Final Certificate that will include all sums previously included in the Final Certificate as well as the additional payment being made on the claims. Within 30 days, the Contractor shall submit to the Engineer its acceptance or rejection of the Amended Final Certificate. If the Contractor wishes to accept the Amended Final Certificate, such acceptance shall contain an unconditional release, as described above, which releases all claims. If the Contractor wishes to reject the Amended Final Certificate, written notice of this rejection shall be given to the Executive Director of Regional Operations. If the Contractor rejects the Amended Final Certificate, final payment will be made in the amount set forth in the Final Certificate. Payment will be made pursuant to the terms of the New Jersey Prompt Payment Act, NJSA 52:32-32 et seq., and the Contract will be complete as of the date such payment is issued. Failure of the Contractor to accept the tendered final payment shall not affect the completion of the Contract.

If the parties agree to a resolution of only some of the reserved claims and execute a Supplementary Agreement confirming the terms of the resolution, the Executive Director of Regional Operations will issue an Amended Final Certificate that will include all sums previously included in the Final Certificate as well as the additional payments being made on the settled claims. Within 30 days, the Contractor shall submit to the Engineer its acceptance or rejection of the Amended Final Certificate. If the Contractor wishes to accept the Amended Final Certificate, such acceptance shall contain an unconditional release, as described above, of the settled claims with a reservation only of those claims not settled. After receipt of such acceptance and release, payment will be made by the State, and the Contract will be complete when payment is issued. If the Contractor wishes to reject the Amended Final Certificate, written notice of this rejection shall be given to the Executive Director of Regional Operations. If the Contractor rejects the Amended Final Certificate, final payment will be made on the amount set forth in the Final Certificate. Payment will be made pursuant to the terms of the New Jersey Prompt Payment Act, NJSA 52:32-32 et seq., and the Contract will be complete as of the date such payment is issued. Failure of the Contractor to accept the tendered final payment shall not affect the completion of the Contract.

The Contractor's failure to submit any written acceptance or rejection of the Amended Final Certificate within said 30 days will be construed as a rejection of the Amended Final Certificate, and final payment will be made to the Contractor in the amount set forth in the Final Certificate. Payment will be made pursuant to the terms of the New Jersey Prompt Payment Act, NJSA 52:32-32 et seq., and the Contract will be complete as of the date such final payment is issued. Failure of the Contractor to accept the tendered final payment shall not affect the completion of the Contract.

If the Department Claims Committee determines after review of the claims that no further payment is warranted except for the sum indicated in the Final Certificate, it will so advise the Contractor in writing. The State will pay the sum indicated in the Final Certificate. The Contract will be complete as of the date of issuance of such payment.

At the election of the Contractor upon completion of the Contract, the decision of the Department Claims Committee may be reviewed by the Claims Review Board , as provided in Subsection 103.06, and has entered into a separate cost sharing agreement with the Department for the cost of the Board, as provided by Subsection 107.02.

109.12 Audits.

{ XE "Claims:audits of" **}{** XE "Claims" **}**All claims filed are subject to audit at any time following the filing of such claim, whether or not such claim is part of a suit pending in the courts of this State pursuant to the New Jersey Contractual Liability Act. The audit may be performed by the State or by an auditor under contract with the Department. The audit may begin on ten days notice to the Contractor or its subcontractor. The Contractor, subcontractor, or supplier shall provide adequate facilities that are acceptable for such audit during normal business hours. The Contractor, subcontractor, or supplier shall make a good faith effort to cooperate with the auditors. Failure of the Contractor, subcontractor, or supplier to maintain and retain sufficient records to allow the Department's auditor to verify all or a portion of such claim to the books and records of the Contractor, subcontractor, or supplier shall constitute a waiver of such claim and shall bar any recovery thereunder.

As a minimum, the auditors shall have available to them the following documents unless their availability is otherwise limited by the custody agreement provided for in Subsection 103.06:

1. Daily time sheets and foreman's daily reports.
2. Union agreements.
3. Insurance, welfare, and benefits records.
4. Payroll registers.
5. Earnings records.
6. Payroll tax forms.
7. Material invoices and/or requisitions.
8. Material cost distribution worksheet.
9. Equipment records (list of company equipment and rates).
10. Vendors', rental agencies', and subcontractors' invoices.
11. Subcontractors' payment certificates.
12. Canceled checks (payroll and vendors).
13. Job cost report.
14. Job payroll ledger.
15. General ledger.
16. Cash disbursements journal.
17. Financial statements for all years reflecting the operations on the Project.
18. Income tax returns for all years reflecting the operations on the Project.
19. Depreciation records on all company equipment whether such records are maintained by the company involved, or its accountant, or others.
20. If a source other than depreciation records is used to develop costs for the Contractor's internal purposes in establishing the actual cost of owning and operating equipment, all such other source documents.
21. All documents which reflect the Contractor's actual profit and overhead during the years the Project was being performed and for each of the five years before the commencement of the Project.
22. All documents related to the preparation of the Contractor's bid including the final calculations on which the bid was based.
23. All documents that relate to each and every claim together with all documents which support the amount of damages as to each claim.
24. Worksheets used to prepare the claim establishing the cost components for items of the claim including, but not limited to, labor, benefits and insurance, materials, equipment, subcontractors, and all documents which establish the time periods, individuals involved, and the hours and rates for these individuals.

109.13 Contractor's Compliance with NJSA 34:11-56.25 *et seq*. { XE "Wages:final payment of" }{ XE "Final payment of wages" }

Before the proposed Final Certificate will be issued, the Contractor and subcontractors shall furnish the Engineer with written statements in a form satisfactory to the Comptroller of the Department certifying to the amounts then due and owing from the Contractor and subcontractors filing such statement to any and all workers for

wages due on account of the Contract. The statements shall contain the names of the persons whose wages are unpaid and the amount due to each respectively. The statements shall be verified by the oath of the Contractor or subcontractor, as the case may be, that said party has read such statement subscribed by it, that said party knows the contents thereof, and that the same is true of its own knowledge. Nothing contained herein shall impair the right of the Contractor to receive Final Payment because of failure of any subcontractor to comply with provisions of this Subsection.

109.14 Warranty Against Defective Work{ XE "Warranty against defective work" }.

In addition to any other rights or remedies the Department may have against the Contractor, its officers, employees, agents, subcontractors, fabricators, and suppliers under other provisions of the Contract Documents or as are otherwise allowed in law or equity, the following rights, remedies, and obligations are imposed by this Subsection:

1. On all Projects, all subcontractors', manufacturers', fabricators', and suppliers' warranties, express or implied, respecting any work or materials shall, at the direction of the Engineer, be enforced by the Contractor for the benefit of the State. The Contractor shall obtain any warranties that subcontractors, manufacturers, fabricators, and suppliers would give in normal commercial practice. If directed, the Contractor shall require any such warranty to be executed in writing to the Department. The Engineer may direct the Contractor to undertake litigation to enforce any warranty. Litigation directed to be brought during the life of the Contract and until one year following Acceptance (whether actually instituted within this period or not) shall be at the Contractor's expense. Litigation directed to be instituted after one year following Acceptance will be at the Department's expense.
2. On all Projects funded in whole or in part without FHWA participation, the Contractor warrants that work performed conforms to the Contract requirements and is free of any defect of equipment, material or design furnished, or workmanship performed by the Contractor or any of its subcontractors, fabricators, or suppliers at any tier. Such warranty shall continue for a period of one year following Acceptance. Under this warranty, the Contractor shall remedy at its own expense any such failure to conform or any such defect. In addition, the Contractor shall remedy at its own expense any damage to State owned or controlled real or personal property, when that damage is the result of the Contractor's failure to conform to Contract requirements or any such defect of equipment, material, workmanship, or design. The Contractor shall also restore any work damaged in fulfilling the terms of this clause. The Contractor's warranty with respect to work repaired or replaced hereunder shall run for one year from the date of such repair or replacement.

   The Engineer will notify the Contractor in writing of the discovery of any failure, defect, or damage. Should the Contractor fail to remedy any failure, defect, or damage described in the paragraph above, within 45 days after receipt of notice thereof, the Engineer will have the right to replace, repair, or otherwise remedy such failure, defect, or damage at the Contractor's expense.

   If a Project is funded in part without FHWA participation where a portion of the Work, such as a section of roadway, a structure, or other appurtenance is paid for exclusively without FHWA funds, even where other portions of the Project receive FHWA participation, the warranty applies only to the non-FHWA funded portions of such Projects.
3. Notwithstanding any other provision of this Subsection, unless such a defect is caused by the negligence of the Contractor or its subcontractors, fabricators, or suppliers at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the Department nor for the repair of any damage that results from any such defect in Department furnished material or design.
4. On all projects funded in whole or in part with FHWA participation, the Contractor shall warrant electrical and mechanical equipment to be free of any defect of equipment, material or design furnished, or workmanship performed by the Contractor or any of its subcontractors, fabricators, or suppliers at any tier. Such warranty shall continue for a period of six months from the date of Acceptance. Under this warranty, the Contractor shall remedy at its own expense any such failure to conform or any such defect. In addition, the Contractor shall remedy at its own expense any damage to State owned or controlled real or personal property, when that damage is the result of the Contractor's failure to conform to contract requirements or any such defect of equipment, material, workmanship, or design. The Contractor shall also restore any work damaged in fulfilling the terms of this clause. The Contractor's warranty with respect to work repaired or replaced hereunder shall run for six months from the date of such repair or replacement.

109.15 Affidavit Concerning Gifts to Department of Transportation Employees, etc. { XE "Affidavit concerning gifts" }

The Contractor shall not give any gifts of any nature, nor any gratuity in any form whatsoever, nor loan any money or anything of value to any Department employee, or relative or agent of any Department employee. The Contractor shall not rent or purchase any equipment or supplies of any nature whatsoever from any Department employee, or relative or agent of any Department employee. Similarly, such gifts, gratuities, loans, rentals, or purchases shall not be given to or made from any agent of the Department during the period of time that such agent is performing any function related in any way to the Project. Before receiving final payment, the Contractor shall execute, under oath, an affidavit, on forms provided by the Department, swearing that the Contractor has given no such prohibited gift, gratuities, or loans nor made any such prohibited rentals or purchases.

DIVISION 200 CONTENTS

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DIVISION 200 - EARTHWORK{ XE "EARTHWORK" }

SECTION 201 - CLEARING SITE{ XE "CLEARING SITE" }{ XE "SITE CLEARING" }

201.01 Description.

This work shall consist of clearing of the site; removal of bridges, culverts, and other structures; removal of pipe, inlets, and manholes; removal of sidewalks, driveways, curbs, and gutters; removal of underground storage tanks; removal of existing electrical material and equipment; salvaging of removed, above-ground electrical material; sealing of abandoned wells; and demolition of buildings except for items which are to be removed according to the work of other Sections.

Clearing site shall also include, but not be limited to, the removal of the existing electrical material and equipment designated for removal, as indicated on the plans, such as controller cabinet and equipment, meter cabinet and equipment, traffic signal assemblies, traffic signal standards, pedestal standards, traffic signal cables, loop detector leads, junction boxes, push button assemblies, associated lighting units, service risers and foundations. This item shall also include backfilling the existing holes remaining after removal of existing service risers, foundations, and junction boxes and installation of a water tight cap on all abandoned conduit ends. All service risers abandoned shall be removed to a depth of 12 inches below grade. The removal of the existing foundations and junction boxes shall be according to Section 701.03.

The existing above ground electrical material and equipment designated for removal shall be salvaged according to Subsection 701.03.

MATERIALS

201.02 Materials.

Materials shall conform to the following Subsections:

Snow Fence 907.04
Waterproofing 919.05

CONSTRUCTION

201.03 Clearing Site{ XE "Clearing site" }.

Before excavation or embankment construction is begun in any area, the site of the Project shall be cleared within the limits of construction. The ground surface shall be cleared of all trees, brush, weeds, roots, matted leaves, small structures, debris, and other objectionable material, vegetation, and growth. Soil erosion and sediment control shall be according to Section 212.

In cut sections, all tree stumps shall be grubbed out within the limits of the total cut area.

In fill sections, tree stumps may remain extending not more than 1 foot above original ground surface in those areas where the proposed subgrade, or proposed finished grade in non-pavement sections, is greater than 3½ feet above original ground surface. All tree stumps that lie within 5 feet horizontally or vertically from any proposed structure, pipe, or duct shall be grubbed out.

Trees, shrubs, and other landscape features within the limits of construction that do not interfere with the Project and are designated for preservation shall not be removed but shall be protected during the progress of the Work.

Every necessary precaution shall be taken to prevent damage or injury to existing trees, plants, and other vegetation that are to remain within or adjacent to the Project.

At locations adjacent to operations performed by motorized equipment, a 4-foot high snow fence shall be erected and maintained around all trees, shrubs, and areas containing vegetation, which are to be preserved.

Depressions in excavation areas that lie below the finished subgrade shall be backfilled and compacted to finished subgrade according to Subsection 203.09.

All slopes of cuts, embankments, ditches, channels, waterways, and all structures, both old and new, shall be cleared of all brush, hedges, weeds, heavy vegetation, and other objectionable material or growth. Clearing shall extend to a maximum of 8 feet beyond the top of slopes of roadway excavation and 5 feet beyond the top of slopes of ditches and channels except that such additional clearing shall not be done outside ROW limits.

RFD mailboxes shall be removed and shall be reset at locations acceptable to the owners and the Resident Engineer and according to postal regulations.

Street and road signs shall be removed and shall be reset at the exact locations and in the manner acceptable to the public authorities having jurisdiction thereof.

201.04 Removal of Bridges, Culverts, and Other Structures. { XE "Removal of:birdges, culverts, and other structures" }{ XE "Bridges, existing:removal of" }{ XE "Culverts:removal of" }

Bridges, culverts, and other structures in use by traffic shall not be removed until arrangements have been made to accommodate the traffic.

The substructures of existing structures shall be removed down to at least 3 feet below the natural stream bottom, and those parts outside of the stream shall be removed down to at least 2 feet below natural ground surface. Where such portions of existing structures lie wholly or in part within the limits of a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.

Steel bridges and wood bridges that are to be salvaged for the Department as provided for in the Special Provisions shall be dismantled without unnecessary damage. Steel members shall be match-marked unless such match-marking is waived. Salvageable material shall be removed in sections or pieces and shall be stored at specified places within the Project.

Blasting or other operations necessary for the removal of an existing bridge or structure that may damage new construction shall be completed before placing the new work.

Damages to any portion of an existing structure scheduled to remain shall be repaired at no cost to the State.

201.05 Removal of Pipe, Inlets, and Manholes. { XE "Removal of:pipe, inlets, and manholes" }{ XE "Pipe:removal of existing" }{ XE "Inlets:and manholes:removal of" }

Excavation for the removal of existing pipe, inlets, and manholes shall be according to Subsection 207.04. Backfill shall be made with excavated material according to Subsection 203.09. The Engineer may direct compaction to be according to Subsection 203.10, except that the frequency of measurements may be increased.

Pipe and debris from removal of drainage structures shall be disposed of according to Subsection 201.10. Inlet and manhole castings shall be disposed of unless they are to be used on the Project.

201.06 Removal of Sidewalks, Driveways, Curbs, and Gutters. { XE "Curbs:removal of" }{ XE "Removal of:sidewalk, driveways, curbs, and gutters" }

Concrete sidewalks, driveways, vertical curbs, sloping curbs, barrier curbs, and gutters, designated for removal, shall be disposed of according to Subsection 201.10. Methods and equipment for the removal of barrier curb shall be approved. Damage to adjacent pavement layers caused by removal operations shall be repaired without additional compensation.

201.07 Removal of Underground Storage Tanks.{ XE "Removal of:underground storage tanks" }

Locations and types of underground storage tanks to be removed will be provided in the Special Provisions.

All work performed to remove and dispose of underground petroleum product storage tanks and piping systems, to sample and analyze soils and water, to dispose of or recycle contaminated soils, and to install and seal monitoring wells shall be according to NJAC 7:14B and NJAC 7:26E, as well as appropriate municipal, State, and Federal regulations, and the following:

1. **Clearing Site, Tank Removal.**
   - a. **Permits and Approvals.** The Contractor shall prepare and submit all documents to obtain all permits and approvals necessary for this work. Tanks that are unregistered shall be registered by the Contractor. The charges to prepare the documents and the fees required for all permits, approvals, and registrations shall be paid by the Contractor according to Subsection 107.05.

     An underground storage tank closure plan application and standard reporting form shall be prepared and submitted to the Resident Engineer for review before submittal to the NJDEP. NJDEP approval must be received before commencing removal operations.

     The Contractor shall notify the Engineer and the Department's Bureau of Project Support and Engineering six weeks before the removal of underground tanks to allow for the Department to obtain the EPA hazardous waste generator ID number for the tank contents.

     The Contractor shall notify the appropriate county health official in writing, with a copy to the Engineer and the Bureau of Project Support and Engineering, no less than one week in advance of the underground storage tank removal.

     The Contractor shall ensure that the waste disposal or recycling facility planned for receipt of the material is properly permitted to accept the material. A copy of the permit shall be submitted to the Engineer one week before disposal or recycling.
   - b. **Removal Operations.** The Contractor shall monitor the site with an explosimeter to indicate the presence and concentration of flammable vapors and gas. Should it be determined through this test

that unsafe working conditions exist, the Engineer shall be notified and removal operations shall be immediately suspended until it is determined that conditions are acceptable for resuming work.

All liquids and sludge contained in the underground storage tanks and piping shall be removed before removing the tanks and associated piping systems from the ground and disposed of according to the NJDEP's hazardous waste regulation NJAC 7:26-1, 4, 7-13A and NJAC 7:14A-4, 6, 11. Leakage from the tanks onto the surrounding soil shall be avoided by properly pumping the contents of the tanks into permitted transport vehicles. Should leakage or spillage occur, the Engineer shall immediately be notified. The Contractor shall also notify the NJDEP's Environmental Action Hotline and the county health department within 15 minutes. The Contractor shall be responsible for remediation of such leakage or spillage to the NJDEP's satisfaction according to their investigation and corrective action requirements.

Tank removal operations shall result in the least disturbance to the soil surrounding the tanks. Excavations shall be fenced with approved snow fencing. All tanks shall be free of vapors before transportation off-site. Excavated tanks and piping systems shall be removed from the site and disposed of properly.

Should any evidence of discharge be apparent in the excavated hole, the Contractor shall notify the Engineer and contact the NJDEP's Environmental Action Hotline. The Contractor shall remove all free product contaminated soil from the excavation. Field tests to determine the extent of contaminated soils shall conform to the NJDEP's Bureau of Underground Storage Tanks' requirements and shall be used to determine if additional soils must be excavated. Post excavation soil sampling and analysis shall then be conducted at the limits of the excavation.

Before backfilling, any contaminated water not associated with ground water shall be removed and disposed of. When directed, the excavated hole shall be immediately backfilled according to Subheading 5 of the ninth paragraph of Subsection 201.09.

c. Manifesting and Transporting. The Contractor shall determine the appropriate EPA or NJDEP hazardous waste number and shall be responsible for all labeling and placarding.

The waste hauler shall complete a uniform hazardous waste manifest (EPA Form 8700-22) as required by State and Federal regulations. The Engineer will sign this manifest as the generator. The appropriate number of generator copies of each manifest shall be given to the Engineer before the shipment leaves the site.

A transporter that has a valid New Jersey hazardous waste transporter's permit shall transport the contents of the tanks. Vehicles hauling the contents of the tanks shall be checked before leaving the site. No vehicle that is leaking shall be allowed to leave the site.

One copy of each uniform hazardous waste manifest shall be returned to the Engineer within two business days after notification of receipt at the disposal facility. If the Contractor does not receive notification of receipt of any waste shipment within two weeks of departure from the site, the Contractor shall immediately notify the Engineer and contact the disposal facility to determine the status of the shipment and resolve the discrepancy. Any manifest discrepancies shall be reported to the Engineer and be resolved by the Contractor.

2. Storing Excavated Soil. Excavated soil shall be stockpiled on plastic sheeting having a minimum thickness of 6 mils. The stockpiled soil shall be covered with similar plastic sheeting that shall be held securely in place. The plastic sheeting shall be maintained or replaced as needed for as long as the material remains stockpiled. Stockpiles shall be located where excavation equipment can place the material directly from the excavation onto a stockpile. Where stockpiling of soil is not possible at the site, soil from the excavation shall be stockpiled at a site provided by the Contractor and approved by the Resident Engineer.

Excavated soil shall be stored in such a manner that the soil is completely isolated from the environment and any hazardous materials in the soil are prevented from contact with or being released into the environment. Periodic inspections shall be made by the Contractor to ensure that the stockpiled soils are not released to the surrounding environment by erosion. Stockpiled soil shall not be stockpiled for more than 90 days.

Composite soil sampling and analyses shall be conducted for the stockpiled soil. Stockpiled soil shall be analyzed by a NJDEP certified laboratory. Analyses shall also fulfill the requirements of the disposal facility.

3. Recycling and Disposal of Contaminated Soil. The recycling or disposal of contaminated soil shall be according to State and local regulations and the waste management plan of the district of origin.

The Contractor shall transport the contaminated soil to the recycling or disposal facility and shall obtain appropriate documentation that shall be provided to the Resident Engineer, the NJDEP, and the county of origin.

4. **Monitoring Wells.** Installation, sampling, and analyses shall comply with NJAC 7:26E.

   Upon receipt of approval from the Engineer, the monitoring wells shall be sealed according to NJAC 7:9-9.1 *et seq*.

201.08 Sealing of Abandoned Wells. { XE "Sealing of abandoned wells" }

Abandoned wells within the limits of clearing site shall be filled and sealed as follows:

1. Dug wells shall be filled according to Subsection 203.06.
2. Drilled wells shall be sealed according to the rules and regulations of NJAC 7:9-9.1 *et seq*.

If an alternate method is proposed to seal the abandoned wells, written approval shall be secured from the NJDEP's Division of Water Quality and from the Engineer.

201.09 Demolition of Buildings. { XE "Demolition of buildings" }

A list of occupied properties and vacation dates will be provided in Subsection 108.12 of the Special Provisions.

All buildings to be demolished shall be demolished in place.

Materials and debris shall not be placed or stored within the limits of any existing street. The parking, loading, and operation of trucks on existing highways or streets shall be governed by existing laws, ordinances, and regulations.

The Department reserves the right to eliminate any item of building or structure demolition from the Contract at any time according to Subsection 104.02.

The Department does not assume any responsibility for the condition of the various buildings or loss of fixtures, equipment, materials, or other objects between the submittal of the Proposal and the time of actual possession of the buildings.

All materials including fixtures, equipment, debris, and rubbish shall be removed, as it accumulates, and not stored on the Project. Personal property belonging to owners or tenants and materials to be used in backfilling may remain.

Sale of materials shall not be conducted within the limits of the Project.

Where others have removed buildings, any remaining utility services shall be disconnected and terminated by making arrangements for such disconnection. Foundation walls and steps shall be removed to ground level. All detached buildings and all fixtures, wood, and debris shall be removed from the area.

Demolition operations shall be confined to the limits of the existing ROW and shall conform to the following:

1. **Safety Regulations.** Barricades, steady burning lights, flashing warning lights, warning signs, and **KEEP OUT** signs shall be furnished, erected, and maintained at places and locations where the placing of protective devices are warranted or according to Subsection 107.14.

   Suitable barriers shall be erected and maintained around all operations and all openings in the ground, as long as such operations and openings constitute a hazard or dangerous condition.

   Footway shelter platforms and outlookers shall be erected, lighted, and maintained as required by law or directed.

   Dust that may result from any demolition operation, especially that which may result from the use of chutes, shall be prevented or controlled.

{ XE "Demolition of buildings:utility disconnections" **}2. Utility Disconnections.** Before the demolition of any building, arrangements shall be made for the disconnection and termination of all water, sewer, gas, electric, telephone, cable television, and other facilities that are connected to the building, in conformance with the requirements of the municipalities and companies owning or controlling them.

When only a portion of an occupied structure is to be demolished, demolition and related operations shall be conducted in such a manner as not to interrupt the service to the portion of the structure that is not to be demolished. Where it is necessary to reconnect any facilities to the undemolished portion of the structure, such reconnection shall be made permanent.

The municipalities and companies concerned shall be notified, in writing, when such disconnections, terminations, or reconnections are required, and the work shall be performed according to their standard practices and requirements and under their supervision, or arrangements shall be made for the work to be performed with their forces.

{ XE "Demolition of buildings:rodents control and extermination" **}{** XE "Rodent control" **}3. Rodent Control and Extermination.** Before beginning any demolition operations, a qualified sanitation inspector shall conduct a survey for evidence of current rat activity and shall initiate a control program by a certified pest control operator if the survey indicates that it is necessary.

The application of exterminating materials shall conform to NJAC 7:30 *et seq*.

At least ten days before beginning demolition of any structures, the pest control operator shall begin to rid the structure and adjacent areas within the limits of the Project of any rats or their carcasses and to prevent their migration to other adjacent areas.

Where there is no competing water supply, liquid anticoagulant baits can be used at the discretion of the certified pesticide applicator.

Toxic bait in the form of 1 pound paraffinized block shall also be placed in each manhole or inlet of storm or combination drains located on the same street as the building to be demolished and within the same block, including the entire intersections of the nearest cross streets. Bait shall be placed in suitable locations within the drainage structures, as determined by the pest control operator. The bait block shall be fastened in its location with wire.

All toxic bait in structures or drains shall be inspected and renewed as necessary on the fourth or fifth day after initial baiting.

All visible carcasses of rats shall be removed and disposed of to the satisfaction of the Engineer.

The pest control operator shall submit a signed statement after the initial treatment and each follow-up inspection reporting the amount and type of bait placed in each location and stating the visible results obtained from the rat control program.

The pest control operator must be aware of the antidote noted on the rodenticide label.

4. Demolition Operations. Before beginning demolition operations, wells, cesspools, and outbuildings within the areas to be cleared shall be pumped out and cleaned in a sanitary manner and, after being disinfected as may be required by the health authorities, shall be backfilled to adjacent ground level, as specified in Subheading 5 below.

Wells, cisterns, cesspools, and other openings in the ground outside the area to be cleared shall be maintained without hindrance to their functioning. All well casings shall be securely and permanently capped as specified in Subsection 201.08, and pipes leading into or out of the well shall also be cut off and capped.

Where the portion of a Department-owned property outside the area to be cleared and adjacent thereto has been abandoned, wells and other openings located thereon, which constitute a hazard or dangerous condition shall be covered or backfilled.

Small structures and appurtenances outside the area to be cleared shall be removed if specifically designated for demolition or removal.

Adjacent buildings shall be left in a safe condition and shall not be defaced, marred, or jeopardized in any way, and any damage done to them shall be repaired or restored to the satisfaction of the Engineer at no cost to the State.

Only methods of demolition that ensure that all phases of demolition are confined within the limits of the demolition areas and without hazard to adjacent properties or to the public will be permitted. Under no circumstances shall any structure be set afire.

Chimneys, common to adjacent properties, are not to be demolished and shall not be disturbed other than to give them the necessary support for their continued stability. If necessary, they shall be repointed and capped.

Demolition of buildings having more than three floors shall be restricted to horizontal operations, one floor of each structure to be demolished at a time. The demolition of any structure or structures, except for the stripping of its fixtures, shall be progressive from top to bottom, one floor at a time. However, bay or sectional-type or other demolition techniques may be considered, provided a detailed plan, including the structural framework of the building, is submitted and approved before start of operations. Each shall be removed in such a manner that the integrity and support of adjacent bays or sections is maintained.

Where a portion of a building is to be demolished, the remaining part shall be shored, braced, and supported in such a manner that the integrity and support of all remaining walls, floors, roofs, and their supporting members are maintained and continued in such a way that all shoring, bracing, and support shall be outside the ROW line. The remaining portion of such a partially demolished building shall be boarded up and sealed on the ROW line, and such new closure and its connections to the remaining portion of the severed building shall be weatherproof. Material for such closure shall consist of adequately braced studding of 2 by 4 inch timbers placed no more than 1 foot – 4 inches apart with wood facing, or equal, nailed to the studding and without any holes appearing therein. The wood facing shall be covered with two layers of smooth-finished, 65 pounds per roll, roofing material conforming to ASTM D 224 and having an overlap of not less than 4 inches .

{ XE "Backfilling" **}{** XE "Backfilling:subsurface areas" **}5. Backfilling.** Backfilling of all subsurface areas including cellars shall conform to Subsection 203.09 and the following:

a. Additional materials required for backfilling shall be furnished at no cost to the State. The quality, nature, and source of additional material required for backfilling shall be according to Section 203. The selection of materials shall be approved before use.

b. The Engineer may direct compaction to be according to Subsection 203.10, except that the frequency of measurements may be increased.

c. All operations in connection with backfilling and grading shall be performed and completed in such manner to ensure proper drainage. Before placing the first layers, existing cellar floors and other surfaced areas shall be broken into pieces having areas of not more than 4 square feet with well-defined cracks through the full depth of the floors, or holes of not less than 1 square foot area shall be made through the floors on approximately 10-foot centers to provide vertical drainage. Cellar floors of wood shall be removed.

d. Party wall foundations against which backfill material is to be placed shall first be cleaned, pointed, and waterproofed with two coats of asphalt or tar.

e. Cellars and all other subsurface spaces shall be backfilled and leveled to the adjacent ground elevation.

f. The ground surface shall be graded, if necessary, to eliminate water pockets.

6. Asbestos Removal. Requirements for the removal of asbestos will be provided in the Special Provisions.

201.10 Disposal of Materials and Debris. { XE "Disposal of:debris" }{ XE "Debris:disposal of" }

The disposal of materials and debris accumulated by clearing site; demolition of buildings; and removal of bridges, roadways, culverts, and other structures is regulated under the Solid Waste Management Act (NJSA 13:1 E-1) and is governed by NJAC 7:26 *et seq*. The Contractor shall dispose of the material and debris according to the solid waste management plan developed by the solid waste management district of origin. Proper documentation from the disposal facility shall be submitted to the Resident Engineer.

COMPENSATION

201.11 Method of Measurement.

Clearing site, including bridges, other structures, and tank removals, will not be measured, and payment will be made on a lump sum basis.

Disposing or recycling of contaminated soil will be measured by the ton.

Installation of monitoring wells will be measured by the number of units.

Post excavation soil sampling and all required analyses will be measured by the number of units. A unit shall be comprised of one sampling point.

Composite soil sampling of stockpiles and all required analyses will be measured by the number of units. A unit shall be comprised of each composite sample taken and analyses performed.

Groundwater sampling and all required analyses will be measured by the number of units. A unit shall be comprised of a sampling point.

Sealing of monitoring and abandoned wells will be measured by the number of units.

Demolition of buildings and removal of asbestos will not be measured, and payment will be made on a lump sum basis.

Temporary shielding and bonding and grounding will not be measured, and payment will be made on a lump sum basis.

201.12 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CLEARING SITE	LUMP SUM
CLEARING SITE, BRIDGE (DESCRIPTION)	LUMP SUM
CLEARING SITE, STRUCTURE (DESCRIPTION)	LUMP SUM
CLEARING SITE, TANK REMOVAL	LUMP SUM
DISPOSING OF CONTAMINATED SOIL	TON
RECYCLING OF CONTAMINATED SOIL	TON
INSTALLING OF MONITORING WELLS	UNIT
POST EXCAVATION OF SOIL SAMPLING AND ANALYSES	UNIT
COMPOSITE SOIL SAMPLING AND ANALYSES	UNIT

GROUND WATER SAMPLING AND ANALYSES	UNIT
SEALING OF MONITORING WELLS	UNIT
SEALING OF ABANDONED WELLS	UNIT
DEMOLITION OF BUILDINGS	LUMP SUM
REMOVAL OF ASBESTOS	LUMP SUM
TEMPORARY SHIELDING	LUMP SUM
BONDING AND GROUNDING	LUMP SUM

Payment for clearing site in excess of the amount shown in the following table will not be made until Completion:

Total Contract Price

For More Than	To and Including	Amount
$ 0	$ 100,000	$ 4,000
100,000	500,000	18,000
500,000	1,000,000	35,000
1,000,000	2,000,000	70,000
2,000,000	3,000,000	105,000
3,000,000	4,000,000	140,000
4,000,000	5,000,000	175,000
5,000,000	6,000,000	205,000
6,000,000	7,000,000	235,000
7,000,000	8,000,000	265,000
8,000,000	9,000,000	295,000
9,000,000	10,000,000	325,000
10,000,000	---	(see Note)

Note: Amount will be determined by increasing $325,000 by $25,000 for each $1,000,000, or fraction thereof, in excess of $10,000,000.

Payment for demolition of buildings or removal of asbestos will be reduced accordingly by the deletion of any building as listed in the Supplement for Analysis of the Lump Sum Price Bid attached to the Proposal.

Payment for borrow excavation Zone 3 for demolitions will be made according to Section 204.

Separate payment will not be made for the removal of pipe, inlets, manholes, and other drainage structures and the removal of sidewalks, driveways, vertical curbs, sloping curbs, barrier curbs, and gutters unless otherwise provided in the Special Provisions. When removal of such materials is required within the excavation for the roadway, for new manholes and inlets, or for new or re-laid pipe, it shall be included in the work of these items.

Separate payment will not be made for fees and associated costs required by the disposal, recycling facility, or NJDEP. All costs thereof shall be included in the price bid for the appropriate Pay Item.

Separate payment will not be made for removal of existing traffic signal equipment.

SECTION 202 - ROADWAY EXCAVATION{ XE "EXCAVATION:ROADWAY" }{ XE "ROADWAY EXCAVATION" }

202.01 Description.

This work shall consist of stripping, excavation for the roadway, milling of the traveled way and shoulders, the construction of embankments with the excavated material, and the making of sawcuts in existing bituminous or portland cement concrete materials.

202.02 Classification. { XE "Excavation:classifications" }

A. Roadway Excavation, Earth. Earth excavation consists of the excavation of all materials except rock.

B. Roadway Excavation, Rock. Rock excavation consists of the excavation of boulders more than 1 cubic yard in volume and rock in ledge formations that cannot be excavated except by drilling or drilling and blasting.

C. Roadway Excavation, Unclassified. Unclassified excavation consists of the excavation of all materials of whatever character encountered.

{ XE "Excavation:regulated waste" **}D. Roadway Excavation, Regulated Waste.** Roadway excavation of regulated waste consists of the excavation and disposal of materials classified in the Rules of the Solid Waste Administration, NJDEP, according to the rules and regulations of NJAC 7:26-1 *et seq*.

The classification of regulated waste will be provided in the Special Provisions or will be established by the Engineer.

{ XE "Excavation:wet" **}E. Wet Excavation.** Wet excavation consists of the excavation of muck, mud, unstable materials, and all other materials and objects encountered, of whatever nature that cannot be excavated by ordinary dry excavation methods and equipment.

F. Removal of Concrete Base and Concrete Surface Courses. Removal of concrete base and concrete surface courses consists of the excavation of reinforced and nonreinforced concrete courses including any overlaying surface courses.

G. Removal of HMA Overlay. Removal of HMA overlay consists of the removal of HMA, block, and brick surfaces from reinforced and nonreinforced concrete bases.

CONSTRUCTION

202.03 Stripping. { XE "Stripping" }

Stripping operations scheduled between November 15 and March 1 must be approved before starting the operations. Approval will be based on the Contractor's alternate method for stabilizing disturbed areas when seeding is not reasonable due to seasonal constraints. The alternate method must be approved before implementation.

{ XE "Topsoil:storage of excess" **}**Stripping operations shall not begin until the areas to be stripped have been determined by the Engineer. Vegetation and underlying soil shall be stripped off to a depth of not less than 4 inches and not more than 6 inches below the existing ground surface. Stripped material that is or may be made suitable for use as topsoil shall be stored. Topsoil shall not be stored in areas where it interferes with surface drainage or with the conservation of trees, shrubs and other vegetation that are to remain. Soil erosion and sediment control shall be according to Section 212.

Stripped topsoil in excess of the quantity required for the Project shall be stored at specified locations for future use of the State.

202.04 Excavation{ XE "Excavation" }.

Excavation operations shall not begin until the Department has taken cross-sections of those areas that have been stripped and of those areas cleared according to Section 201 but which are not designated to be stripped. Construction operations shall be scheduled to provide time to take the required cross-sections.

Excavation operations shall be conducted so that material outside of the limits of slopes is not disturbed.

Widening of cuts or varying the slopes according to the stability of the material excavated may be permitted.

Obliteration of old roads shall include filling of all ditches and rough grading to restore approximately the original contour of the ground or to produce a pleasing appearance by forming natural, rounded slopes.

Excavation shall be carried out in such a manner that the grade throughout the work is kept drained at all times. A plowed furrow, 6 inches deep, shall be cut in the existing ground surface, approximately 4 feet outside the slope line at the top of excavation, and turned toward the excavation. A plowed furrow is not required in areas where ditches are to be constructed outside the top of excavation slopes. Side ditches or gutters emptying from cuts to embankments or otherwise shall be so constructed as to avoid damage to embankments by erosion. Ditches to be

used in a cut section, and side and outlet ditches shall be excavated and stabilized, and perimeter soil erosion and sediment controls installed, according to Section 212, before beginning all earthwork. Stabilization for the ditches shall consist of seed, mulch, topsoil stabilization matting, or temporary riprap as required to prevent erosion.

Slopes greater than 25 feet in height shall be excavated and stabilized in stages or equal increments not to exceed 15 feet. Each stage shall be topsoiled, permanently seeded, and mulched, according to Section 808, before proceeding with the next stage. These disturbed areas shall be stabilized according to the time limits established in Subsection 212.03. Repair of damaged seeded areas shall be according to Subsection 808.03.

Excavation operations scheduled between November 15 and March 1 must be approved before starting the operations. Approval will be based on the Contractor's alternate method for stabilizing disturbed areas when seeding is not reasonable due to seasonal constraints. The alternate method must be approved before implementation.

Excavated material shall not be deposited outside the limits of construction without written permission as specified in Subsection 202.12.

{ XE "Embankment:use of excavated HMA in" **}**Excavated **{** XE "Hot mix asphalt (HMA):use in embankments" **}**HMA that is not recycled may be placed in the lower portion of Zone 3 embankment and spread out in layers with the pieces lying flat and not arching with spaces between the pieces filled with earth. The maximum dimension on any side of the HMA shall be 2 feet. The HMA shall not be placed within 2 feet of the final subgrade or less than 3 feet above the highest seasonal high ground water table as defined by the NJDEP or within 2 feet of any underground utility.

Materials from roadway excavation meeting the requirements of Subsection 901.09 may be used for constructing items using soil aggregates. Notification shall be given in writing not less than five working days before use and the work shall be arranged so that all tests and measurements may be made.

When excavation to the finished graded section results in a subgrade or slopes of unstable soil, material shall be removed and the area backfilled with excavated material obtained from the Project, borrow excavation or from subbase material, as directed. The backfill shall be placed and compacted according to Subsection 203.07 or 208.05.

All unstable material shall be used in embankments, as directed, or disposed of according to Subsection 202.12.

202.05 Rodent Control in Dump Areas. { XE "Rodent control" }

Before beginning any excavation operations within the limits of dump areas, one of the following rodent control programs shall be established by a certified pest control operator:

1. **Fumigant.** The pest control operator shall treat all visible rodent burrows with chloropicrin, as per label instructions, not more than one week before excavating that particular area.
2. **Toxic Bait.** The pest control operator shall place toxic bait over the area at least five days and not more than 14 days before excavating that particular area.

   The application of exterminating materials shall conform to NJAC 7:30 *et seq*.

   The pest control operator shall determine the type of toxic bait. The bait shall be placed either in tamperproof bait stations or in areas inaccessible to pets or children as determined by the pest control operator.

   The treated area shall be checked daily for a minimum of four follow-up inspections. The toxic bait shall be renewed on each inspection as necessary to restore the bait to its original amount.

   All visible carcasses of rats shall be removed and disposed of by the pest control operator at the time of placing or inspecting the toxic bait.

   The pest control operator shall submit a signed statement after the initial treatment and after each follow-up inspection reporting the type of anticoagulant, the form, the location, and the amount of bait placed, and the visible results of the rat control for each treatment.

   The pest control operator must be aware of the type of antidote noted on the rodenticide label.

202.06 Excavation in Rock Areas. { XE "Excavation:rock areas" }

Maximum usage shall be made of the excavated rock in embankments.

The portions of roadway that are below grade shall be brought to grade with material from the excavation except that rock fines, granular material, or subbase material shall be used beneath the pavement structure areas. Boulders extending beyond the prescribed limits of excavation may be removed entirely. Any space created outside the prescribed limits by such boulder removal shall be refilled and compacted as specified in Subsection 203.09.

Care shall be taken that undrained pockets shall not be left in the surface of the rock.

After completing the excavation of each lift of rock slope construction and before beginning the next lift, the completed slopes shall be scaled to remove any loose rock fragments.

The Engineer will examine all rock slopes during the excavation to identify possible unstable conditions and to determine the need for stabilization. Whatever assistance and equipment are necessary for such examination shall be provided.

If it is determined that in-place stabilization is required, rock bolting or other stabilization techniques shall be used as directed. Payment for the technique used for stabilization will be made at the appropriate unit prices or according to Subsection 104.02.

When a Pay Item is included for rock excavation, the earth cover shall be removed in advance of the rock in order that measurements of its surface may be taken. Earth cover need only be removed to the extent that its removal is practical, in the opinion of the Engineer, with equipment being used to perform the roadway excavation.

202.07 Blasting Operations. { XE "Blasting:operations and plan" }

{ XE "Blasting:use and storage of explosives" **}**Before drilling and blasting, any existing overburden to the top of rock shall be removed.

Handling explosive materials and conducting blasting operations shall be according to all of the safety regulations of the State regarding explosives. Only standard explosives, blasting agents, detonating cord, delays, blasting caps, and other blasting accessories prepared and packaged by explosive manufacturing firms will be permitted.

All necessary precautions in drilling and blasting operations shall be exercised to preserve the rock remaining in the prescribed finished slope in a natural undamaged condition. Controlled blasting techniques shall be used for forming highway rock cut slopes. The purpose of controlled blasting is to minimize blast damage to the rock backslope to help ensure long term stability.

Blasting operations shall be conducted according to the following:

{ XE "Blasting:plan" **}1. Blasting Plan.** A blasting plan shall be submitted not less than two weeks before commencing drilling and blasting operations and before each subsequent shot thereafter. The blasting plan shall contain the full details of the drilling and blasting patterns and controls to be used for both the controlled and production blasting. The blasting plan shall contain the following minimum information:

a. Station limits of proposed shot.
b. Plan and section views of proposed drill pattern including free face, burden, blasthole spacing, diameters and angles, lift height, and subdrill depth.
c. Loading diagram showing type and amount of explosives, primers, initiators, and location and depth of stemming.
d. Manufacturers' data sheets for all explosives, primers, and initiators to be employed.
e. Initiation sequence of blastholes including delay times and delay system.

The blasting plan submittal is for quality control and record keeping purposes. A review of the blasting plan does not relieve responsibility for the accuracy and adequacy of the plan when implemented in the field.

2. Blasting Test Sections. Before commencing full-scale blasting operations, the adequacy of the proposed blasting plan shall be demonstrated by drilling, blasting, and excavating short test sections, up to 100 feet in length, to determine which combination of method, hole spacing, and charge works best. Additional test sections may be directed when field conditions warrant.

Requirements for controlled and production blasting operations shall apply to the blasting carried out in conjunction with the test shots.

Drilling ahead of the test shot area will not be permitted until the test section has been excavated and the results evaluated. If the results of the test shots are unsatisfactory, revised methods shall be adopted to achieve the required results. Unsatisfactory test shot results include an excessive amount of fragmentation beyond the indicated lines and grade, excessive flyrock, or violation of other requirements.

If at any time during the progress of the work, the methods of drilling and blasting do not produce the desired result of a uniform slope and shear face, within the tolerances specified, drilling, blasting, and excavating in short sections, not exceeding 100 feet long, will be required until a technique is arrived at that produces the desired results.

3. Safety. The entire blast area shall be observed for a minimum of five minutes following a blast to guard against rock fall before commencing work in the cut.

The Engineer will prohibit or halt the blasting operations if it is apparent that through the methods being employed, the required slopes are not being obtained in a stable condition or the safety and convenience of the traveling public is being jeopardized.

{ XE "Blasting:presplitting" }4. Methods of Drilling and Blasting.

a. { XE "Presplitting" **}Presplitting.** Presplitting is a controlled blasting method for constructing a shear plane along a specified cut slope through the controlled use of explosives and accessories in properly aligned and spaced drill holes.

After the overburden and weathered rock have been removed, slope holes for presplitting shall be drilled along the line and in the plane of the cut slope. The slope holes shall be not less than 2 ½ inches and not more than 3 inches in diameter. Operations shall be controlled to ensure that the drill holes do not deviate from the plane of the slope by more than 6 inches and do not deviate within the plane of the slope by more than 6 inches.

The drilling equipment used to drill the presplit holes shall have mechanical devices affixed to that equipment to accurately determine the angle at which the drill steel enters the rock. Presplit hole drilling will not be permitted if these devices are either missing or inoperative. The spacing of the slope holes shall not exceed 3 feet on centers and shall be adjusted as required to produce a uniform and stable shear plane between slope holes. Auxiliary holes, which are identical to the slope holes but are not loaded with explosives, may also be required, under certain conditions, to produce a uniform and stable shear plane.

The length of the slope holes may extend to the full depth of the cut, to a maximum of 50 feet, if hole alignment is maintained. Otherwise, slope holes shall be drilled and blasted in lifts. If presplitting is accomplished in lifts, an offset of not more than 6 inches will be permitted to accommodate the drill head and the lifts shall be so arranged that the toe of the finished cut slope coincides with the toe of slope.

Drill hole conditions may vary from dry to filled with water.

Before the placing of explosives or blasting agents, it shall be determined that the hole is free of obstructions for its entire depth.

The maximum diameter of explosives used in presplit holes shall not be greater than one-half the diameter of the presplit hole and shall not touch the side of the hole.

Only standard explosives manufactured especially for presplitting shall be used in presplit holes, unless otherwise approved. Bulk ammonium nitrate and fuel oil (ANFO) shall not be loaded in the presplit holes.

The amount of explosives used in the presplit hole shall produce the shearing without causing overbreak. The top of the load shall be far enough below the collar to avoid overbreak at the surface. The detonator cord downline shall extend from the collar to the bottom of the bore hole and from the collar to the detonator trunkline or electric blasting caps. The explosive charge shall be primed according to the recommendations of the manufacturer of the commercial explosive or blasting agent.

If fractional portions of standard explosive cartridges are used, they shall be firmly affixed to the detonating cord in such a manner that the cartridges do not slip down the detonating cord nor bridge across the hole. Spacing of fractional cartridges along the length of the detonating cord shall not exceed 2 feet - 6 inches center to center and shall be adjusted to give the desired results.

Continuous column cartridge type of explosives used with detonating cord shall be assembled and affixed to the detonating cord according to the explosive manufacturer's instructions, a copy of which shall be furnished to the Resident Engineer.

The bottom charge of a presplit hole may be larger than the line charges but shall not be large enough to cause overbreak. The top charge of the presplitting hole shall be placed far enough below the collar, and reduced sufficiently, to avoid overbreaking and heaving.

The upper portion of all presplit holes, from the topmost charge to the hole collar, shall be stemmed. Stemming materials shall consist of drill cutting or ⅜-inch clean stone chips.

It is not necessary to stem below the topmost charge unless it is determined that the rock is very seamy and incompetent, in which case, full stemming in such zones may be required.

Presplit holes may be detonated instantaneously or on short delays between each hole. Such delay detonating shall not exceed 25 milliseconds between holes. In any case, all presplit holes shall be detonated before the detonation of any production holes.

Presplitting shall extend a minimum of 50 feet ahead of the production blasting limits, but shall not extend more than 100 feet beyond the exposed presplit face.

b. Production Blasting. Production blasting is a method of drilling and blasting to produce a high degree of fragmentation of the rock mass to be excavated.

The adjacent line of production holes inside the presplit lines shall be drilled in such a manner as to avoid damage to the presplit face. If necessary, the first line of production holes may be drilled parallel to the presplit face to reduce overbreak of this face.

Hole diameter, spacing, delay patterns, explosives, blasting agents, and other variables may be varied to obtain fragmentation acceptable to the Engineer, provided that the existing presplit face is not damaged.

202.08 Removal of Concrete Base, Concrete Surface Courses, and Joints. { XE "Removal of:concrete base course and surface course" }

A. Sawcutting. Before removal of bituminous or portland cement concrete materials, a full depth sawcut shall be performed to provide for the complete removal of said material without damage to the remaining adjacent material.

The saw shall be capable of providing a neat cut the full depth in a single pass.

B. Removal. Equipment that involves the use of a ball, weight, or punch shall not be used in the breaking or removal of concrete within 5 feet of a transverse joint or within 3 feet of any structure or pavement that is to remain in place. The concrete within such restricted areas shall be broken or removed in such a manner as not to damage the adjacent joint structure, pavement, or other structure, which is to remain. Where a partial slab is to be removed, a vertical saw cut shall be made full depth. If any existing transverse expansion joint, other than one scheduled for removal, is damaged by the work to such an extent that it no longer serves its function, such joint shall be removed and replaced.

Joint areas and overlying HMA layers to be removed shall be saw cut full depth parallel to the center line of the joint for the width designated. Following removal of the concrete, the underlying material will be inspected. If the material is wet or unstable, the material shall be excavated and replaced with suitable soil or dense-graded aggregate, or broken stone as designated or directed. Compaction of the material shall be according to Subsection 203.09. Payment for the replacement material will be made as provided for in its respective Section.

Debris from the breaking of concrete base and concrete surface courses shall be contained within the work area. Necessary containment devices shall be used to protect adjacent vehicular or pedestrian traffic from flying debris.

C. Replacement. Joint areas shall be replaced with HMA base course conforming to Section 404. Compaction of the HMA base course shall be according to Subsection 404.18 except that areas not accessible to rollers conforming to Subsection 404.09 shall be compacted by a vibratory drum compactor conforming to Subsection 404.11. The vibratory drum compactors shall be of the self-propelled type, having one or two smooth drums and a minimum centrifugal force of 2,200 pounds force per foot of width of tread of drive roll. Vibratory drum compactors shall be capable of maintaining the frequency of vibration and the amplitude specified by the manufacturer. Instruction plates indicating operational instructions, recommended amplitude, vibrations per minute, and speed settings shall be provided.

D. Disposal. Broken concrete and any overlying HMA materials may be placed in the lower portion of Zone 3 embankment and spread out in layers with the pieces lying flat and not arching with spaces between the pieces filled with earth. The maximum size of the broken concrete shall be 2 cubic feet. The broken concrete shall not be placed within 2 feet of the final subgrade or less than 3 feet above the highest seasonal high ground water table as defined by the NJDEP or within 2 feet of any underground utility. Compaction shall be according to Subsection 203.09. If such use is not possible, the broken concrete shall be disposed of according to Subsection 202.12.

202.09 Milling of HMA. { XE "Hot mix asphalt (HMA):milling of" }{ XE "Milling of HMA" }

Milling of HMA consists of the removal of HMA surface, intermediate, and base courses to the prescribed depth, profile, and cross slope and shall conform to the following:

{ XE "Milling of HMA:equipment" **}1. Equipment.** The milling machine shall be a self-propelled planing, grinding, or cutting machine, with variable operating speeds, capable of removing HMA without the use of heat.

The milling machine shall be equipped with automatic grade controls. The reference system may be either stringline or ski type. If a ski type reference system is used, it shall be a minimum 20-foot ski. Use of the automatic grade controls is required except at intersections and other locations where it is not practical.

Teeth in the milling drum that become dislodged, broken, or unevenly worn shall be replaced immediately with teeth of the same length as the remaining teeth in that row.

{ XE "Milling of HMA:test strip" **}2. Construction Requirements.** A test strip of approximately 500 square yards shall be constructed within the proposed limits of milling before commencement of the milling operations. The test strip shall be used to determine the machine and drum speeds of operation which can produce the proper surface texture and, when profile milling is called for, to determine the cutting depth required to remove ruts and transverse corrugations.

Before the start of milling operations, a meeting shall be held with the Resident Engineer to determine the method of grade control, the length of each milling pass, the method of traffic control to be used, and the side of the traveled way from which milling shall begin.

The milling operation may begin when the above criteria have been established and approved. The machine shall be operated at the speeds and cutting depth determined during the test strip milling. Test strips shall be constructed for each milling machine used. If the area to be milled is less than 2,500 square yards, a test strip may not be required.

The milling operation, including removal of the milled material, shall be carried out in a manner that prevents dust and other particulate matter from escaping into the air, according to Subsection 212.07, Subpart A.

The milling equipment shall be operated in such a manner as to produce milled material that passes a 2 ½ inch sieve. The area of milling shall be cleared of all debris and power broomed to remove fine particles before milling. Before brooming, earth berms shall be removed, as necessary, within the area to be milled to prevent soil and grass from contaminating the milled material. Disposal of debris and earth shall be according to Subsections 201.10 and 202.12.

Provisions shall be made for removal of any water that may be trapped due to the milling operation, such as by lateral saw cuts into the shoulder area. In the event that all areas that are opened to traffic have not been milled to a flush surface by the end of the workday, the longitudinal edges of the milled area exceeding 2 inches high shall be sloped and a smooth transition shall be provided at the transverse edges.

HMA below the specified level of milling that becomes dislodged or delaminated shall be removed and replaced with HMA according to Section 404 at no cost to the State.

The surface of the milled area shall be swept clean before being opened to traffic and before the subsequent construction or resurfacing stage. Sweepings shall be disposed of according to Subsections 201.10 and 202.12.

The milled area opened to traffic before resurfacing shall be free from gouges, continuous grooves, ridges, and delaminated areas and shall have a uniformly textured appearance consisting of discontinuous longitudinal striations which shall not deviate more than 1 inch in 200 feet from a line parallel to the center of the traveled way and shall not exceed ⅜ inch in depth. The milling shall provide a skid resistance not less than that of the original surface before milling and shall permit passage of traffic at the posted speed limit without vehicle operators experiencing impaired directional control.

Areas to be milled which are not accessible to the milling machine shall be removed by other equipment.

The use of milling machines is not permitted on bridge decks when HMA is removed to its full depth.

The time intervals for resurfacing the milled areas will be provided in the Special Provisions.

202.10 Wet Excavation. { XE "Excavation:wet" { XE "Wet excavation" }}

Wet excavation shall be performed so that it assures removal down to firm bottom within the lateral limits.

After the excavation of any area, all material that enters the wet excavation area by sloughage not caused by the operations shall be included in wet excavation.

If a slope failure should develop during wet excavation adjacent to an existing roadway, such operations shall cease immediately. Limits of wet excavation shall be determined and backfilling shall be started at once. When it has been determined that the failure has stabilized, wet excavation shall be resumed at a rate and by a method to be determined by the Engineer.

To determine that the entire depth of material has been removed down to firm bottom, the bottom of the wet excavation area shall be tested, at frequent intervals as the excavation progresses, by taking soundings or samples or by other tests. The Department may take borings and samples to determine if there is any wet excavation material remaining below the bottom of or entrapped within the embankment.

When the wet excavation has been completed to firm bottom, notification shall be given to the Resident Engineer that the wet excavation areas at such locations are available for measurement.

Adequately equipped boats shall be provided at each location where excavation is in progress.

Wet excavation material trapped within or under the backfill embankment or between the new and an existing embankment so as to cause visible areas in the embankment or to be detrimental to the stability of the embankment, roadway, or structures, the entrapped material and the overlying Zone 2 material shall be removed and all such excavated areas shall be backfilled with Zone 2. Additional compensation will not be made for such excavation and backfilling.

All areas of wet excavation outside the embankment slope area but within the wet excavation limits shall be backfilled with Zone 2 material to the level of the adjacent original ground or meadow level. Payment for the backfill material will be made as provided for in Section 204. Areas of wet excavation outside the specified wet excavation limits shall be refilled with Zone 2 material to adjacent original ground level at no cost to the State.

Wet excavation shall be disposed of according to Subsection 202.12 for excess material.

202.11 Partial Wet Excavation. { XE "Excavation:wet" }

Partial wet excavation shall be according to Subsection 202.10 except that removal shall be to a prescribed elevation. Wet excavation shall be performed using such equipment and methods as to permit removal of material to the prescribed elevation without disturbing the material below that elevation. If the methods and equipment being used disturb material below the specified elevation, such operations shall immediately cease. Alternate methods and equipment shall be proposed and, subject to approval, the work may resume.

202.12 Disposal, Use, or Reuse of Excess Material. { XE "Materials:unusable, disposal of" }{ XE "Disposal of:excess or unusable material" }

The Engineer may permit the Contractor to use excess:

- excavated earth to widen or flatten slopes of embankment, to fade embankments into cuts, to use as approved at other locations, or to dispose of it.
- rock excavation along slopes adjacent to streams for slope protection according to Subsection 616.07.
- broken concrete and HMA in the construction of embankments according to Subsections 202.04 and 202.08.

Excess material other than earth or rock not reused as specified above shall be recycled or disposed of according to Subsection 201.10.

Excess earth or rock not used as specified above shall be placed at sites provided by the Contractor outside of the State ROW and out of sight, during all seasons, of any State highway.

Before removing any material from the Project site, the Contractor shall provide, in writing to the Resident Engineer, the location where the material will be placed. The Contractor shall obtain written permission of the property owner(s) on whose property the material is to be placed, and a copy shall be furnished to the Resident Engineer. Once the material leaves the Project limits, the Contractor is the owner of the material, and the Contractor shall be solely responsible for causing the material to be placed in a manner and at a location that is consistent with all applicable Federal, State and local requirements, including any permits that may be issued for the Project. The Contractor shall be liable for any violations that occur as a result of the Contractor's failure to comply herewith. If the disposal of excess material results in a violation notice from any governmental authority, the Contractor shall immediately pursue corrective action. The Contractor shall hold harmless the Department for any violation incurred as a result of improper disposal of materials. If the Contractor fails to correct the violation to the satisfaction of the governmental authority which issued the violation notice, the Department may initiate measures to eliminate the violation and all costs incurred by the Department will be deducted from any monies due or that may become due the Contractor.

202.13 Disposal of Regulated Waste. { XE "Disposal of:regulated waste" }

Regulated waste shall be disposed of according to Subsection 201.10.

COMPENSATION

202.14 Method of Measurement.

Stripping will be measured by the acre. Roadway excavation of the various kinds will be measured by the cubic yard except roadway excavation unclassified, which will not be measured, and payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided for in Subsection 109.01.

If roadway excavation materials are used to construct items of soil aggregates and the final quantities result in an excess of roadway excavation materials, the volume of excavation will be reduced by the volume of soil aggregate constructed. If the final quantities result in borrow excavation material required to complete the embankments, a volume of borrow material shall be furnished, at no cost to the State, equal to the volume of soil aggregate constructed, or equal to the volume of material required to complete the embankment, whichever is less.

Wet excavation will be measured by the cubic yard.

Presplitting will be measured by the square yard.

Removal of concrete base or concrete surface course and the removal of only the HMA overlay will be measured by the square yard.

Sawcutting will be measured by the linear foot.

Joint removal, including adjacent concrete courses, for the width designated will be measured by the square yard. Concrete surface course removal larger than the dimensions designated as joint removal will be measured as removal of concrete base and concrete surface courses.

Milling of the various depths and kinds will be measured by the square yard.

The depth of the completed milling when measured from the original surface to the top of the high spots of the textured surface shall be equal to the prescribed depth of cut except for profile milling for which the depth of cut shall be only that necessary to remove the HMA above the bottom of wheelpath ruts and transverse corrugations while producing a smooth profile and cross-section.

Rumble strip will be measured by the linear foot parallel to the edge of the shoulder.

202.15 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
STRIPPING	ACRE
ROADWAY EXCAVATION, EARTH	CUBIC YARD
ROADWAY EXCAVATION, ROCK	CUBIC YARD
ROADWAY EXCAVATION, UNCLASSIFIED	CUBIC YARD
ROADWAY EXCAVATION, REGULATED WASTE	CUBIC YARD
WET EXCAVATION	CUBIC YARD
PRESPLITTING	SQUARE YARD
REMOVAL OF HOT MIX ASPHALT OVERLAY	SQUARE YARD
REMOVAL OF CONCRETE BASE COURSE AND CONCRETE SURFACE COURSES	SQUARE YARD
SAWCUTTING	LINEAR FOOT
JOINT REMOVAL	SQUARE YARD
MILLING, ___ " DEPTH	SQUARE YARD
MILLING, ___" AVERAGE DEPTH	SQUARE YARD
MILLING, ___" VARIABLE DEPTH	SQUARE YARD
MILLING, VARIABLE DEPTH	SQUARE YARD
PROFILE MILLING	SQUARE YARD

Payment for temporary soil erosion and sediment control measures will be made according to Section 212.

Separate payment will not be made for HMA base course replacement for joint removal.

Separate payment will not be made for debris containment devices used during the breaking of concrete base and concrete surface courses.

SECTION 203 - EMBANKMENT{ XE "EMBANKMENT" }

203.01 Description.

This work shall consist of the construction of embankments and the preparation of the area on which the embankments are placed.

203.02 Embankment.

{ XE "Zones, embankment" **}{** XE "Embankment:zones, definitions of" **}**Zones of embankment are defined as follows:

1. Zone l is the sand blanket placed on swamps, marshes, and other unstable ground in connection with the formation and consolidation of embankment by the vertical drain method or by the sand blanket method.
2. Zone 2 in swamp embankment constructed by the wet excavation and backfill method is that part of the embankment extending upward from the lower limit of the wet excavation to the elevations specified.

   Zone 2 also includes such volume of Zone 2 material that may be placed on swamp or marsh surface, in channels and other critically soft areas, before placing the Zone 1 sand blanket. In swamp embankment constructed by the vertical drain method or by the sand blanket method, Zone 2 is that portion of the embankment extending upward from the top of Zone l to elevations or heights as specified or upward from the swamp surface before placing Zone 3 when Zone l is not proposed or used.
3. Zone 3 in swamp embankment is that embankment above Zone 2. Zone 3 also includes all other areas of embankment constructed on firm ground.

   Zone 3 embankment shall be constructed of soil or rock materials or a combination of these materials obtained from the work specified in Sections 202, 204, 205, 206, and 207. These materials shall be free from stumps, roots, weeds, sod, rubbish, garbage, and any other material that may decay.

MATERIALS

203.03 Materials.

{ XE "Embankment:materials, graduation designations" **}**Borrow Excavation for embankments shall conform to Table 203-1. Soil aggregate materials shall conform to Subsection 901.09.

Table 203-1 Gradation Designations of Embankment Materials

Embankment	Designation
{ XE "Porous fill" **}{** XE "Drainage windrow" **}**Borrow Excavation, Zone 1	I-7
Borrow Excavation, Zone 2	I-11
Borrow Excavation, Zone 3	(Notes 1 & 2)
Borrow Excavation, Zone 2 and Zone 3 (Hydraulically Placed)	I-12
Borrow Excavation, Bridge Foundation (Underwater Area)	I-9 (Note 2)
Borrow Excavation, Bridge Foundation	I-10 (Note 2)
Borrow Excavation, Selected Material	I-13
Porous Fill	I-9
Vertical Sand Drain	I-6
Drainage Windrow	(Note 3)

Note 1: Material shall be composed of soil aggregate or soil aggregate and rock. The portion of material passing the 4-inch sieve shall contain not more than 35 percent by weight of material passing the No. 200 sieve. When composed of soil aggregate and rock, the proportion of soil aggregate shall not be less than that required to fill all rock voids. When embankments are to be constructed outside the ROW in areas where the State has purchased slope rights to construct embankments on existing areas, the top 2 feet – 6 inches shall be constructed with excavated material from the Project or with borrow material, neither of which shall contain stones, broken concrete, or similar objects larger than 2 inches in any dimension.

Note 2: When piles for structures are to be driven, the maximum size aggregate shall be 2 inches. Borrow Excavation, Bridge Foundation (Underwater Area) shall be placed in the dry and compacted according to Subsection 204.03.

Note 3: The material for drainage windrows shall be broken stone, washed gravel, or blast furnace slag conforming to Subsection 901.04, 901.05, or 901.06, and the aggregate size shall be No. 7 or No. 8 as shown in Subsection 901.20, Table 901-1.

Note 4: Zone 2 material to be end-dumped under water may contain oversize material providing the following conditions are met:

a. The portion passing the 4-inch sieve shall be soil aggregate designation I-11.
b. The oversize material shall be no greater in any dimension than 1 foot.
c. The oversize material shall be of a quantity that will not be detrimental to the Zone 2 embankment and shall be so distributed as to prevent nesting.

EQUIPMENT{ XE "COMPACTION:EQUIPMENT" }

203.04 Equipment.

{ XE "Equipment:compaction" **}**Compaction shall be accomplished with one or more of the following:

{ XE "Pneumatic-tired rollers" **}1. Pneumatic-Tired Roller.** Pneumatic-tired rollers shall be of the self-propelled type consisting of two axles equipped with pneumatic tires mounted so as to completely cover the area to be compacted in a single pass. The wheels on at least one axle shall oscillate vertically, either singly or in pairs. The roller shall have a width of not less than 5 feet. Wobble-wheel rollers will not be permitted. The wheels shall be equipped with smooth, wide-tread compactor tires of equal size and diameter, capable of producing a uniform, ground contact pressure on a level, unyielding surface through a range of 60 to 95 pounds per square inch on all wheels. Operating tire contact pressure shall be maintained by the use of ballast, and tire inflation pressure combinations shall not exceed the recommendations of the Tire and Rim Association Incorporated for the applicable tire size and ply rating.

All tires shall be uniformly inflated so that their respective tire pressures do not vary more than 5 pounds. Charts and tabulations shall be furnished showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the tires used.

2. Pneumatic-Tired Roller, 50-Ton. The pneumatic-tired roller shall be capable of being loaded in increments to a gross weight of 50 tons. The tires shall be placed so that the clear width between adjacent tire treads on the same axle shall not be more than the width of the tire. When operating at a gross weight of 50 tons, the tire inflation shall be not less than 90 pounds per square inch, and the load on each tire shall be not less than 12 tons.

{ XE "Dynamic compactor" **}3. Dynamic Compactor.** The compactor shall be a vibratory roller or vibratory pad-type compactor capable of operating at the optimum frequency of vibration required for the size and type of compactor used and for the type of material being compacted. Vibratory pad-type compactors shall be used only when access with a vibratory roller is not practical. Vibratory rollers shall be equipped with a readily visible instruction plate containing the manufacturer's recommended operating frequency, amplitude, and roller speed. A calibrated vibrating reed tachometer shall be provided with each roller to permit a mechanical check of the roller vibration control system.

{ XE "Sheepsfoot roller" **}4. Sheepsfoot Roller.** The tamping type or sheepsfoot roller shall consist of one or more cylindrical sections having studs or feet projecting not less than 6½ inches from the surface and developing a pressure of not less than 200 pounds per square inch of bearing surface when a complete row of tampers is in contact with a level surface.

5. 50-Ton Compactor. The compactor shall consist of four pneumatic-tired wheels mounted on a rigid steel frame. The wheels shall be evenly spaced in one line across the width of the roller and shall be arranged in such a manner that all wheels carry approximately equal loads when operated over an uneven surface. The maximum spacing between adjacent wheels shall not exceed the tire width. The tires shall be capable of operating at inflation pressures ranging from 50 to 90 pounds per square inch. Charts and tabulations shall be furnished showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the tires used.

The compacting equipment shall have a body suitable for ballast loading with such capacity that the gross load may be varied from 25 to 50 tons. Ballast to obtain the required weight shall consist of ingots, concrete blocks, sand bags, or other material, with a uniform, known unit weight, so that the total weight of the ballast used can be determined at all times.

6. Three-Wheel 10-Ton Steel Roller. Three-wheel rollers shall be smooth-faced power rollers, weighing not less than 10 tons and having a force of not less than 330 pounds per inch of width of roller surface when all wheels are in contact with a level surface. The load requirements apply to the rear wheels.

CONSTRUCTION

203.05 Construction Requirements{ XE "Embankment:construction of" }.

A. Preparation of Embankment Areas. Side ditches shall be excavated and stabilized, and perimeter soil erosion and sediment controls installed, according to Section 212, before beginning all earthwork. Stabilization for the ditches and swales shall consist of seed, mulch, topsoil stabilization matting, or temporary riprap as required to prevent erosion.

The ground surface shall not be frozen and shall be free from quantities of snow, ice, and mud when a subsequent layer is placed.

When the embankment is to be placed and compacted on hillsides, or when new embankment is to be compacted against existing embankments, or when the embankment is to be built a portion at a time, the slope against which the embankment is to be placed shall be benched continuously as the embankment is brought up in layers. Benching shall be a minimum of 6 feet in width to integrate the new embankment with the existing slope. Material cut out shall be recompacted along with the new embankment.

In areas outside proposed pavement limits, the following shall apply:

1. Where the final grade of fill is to be less than 1 foot - 3 inches above existing HMA or concrete material, the existing material shall be removed, and the area shall be graded and compacted according to Subsection 203.09.
2. Where the final grade of fill is to be from 1 foot - 3 inches to 3 feet above existing HMA or concrete material, the concrete shall be broken into pieces having a maximum dimension on any side of 2 feet, and the HMA material shall be scarified.

B. Placement. Embankment placed under water or on wet and unstable ground shall be constructed by end-dumping methods. End-dumping shall be used only to such an elevation that permits the use of compacting equipment. The remainder of the embankment shall be placed and compacted as specified in Subsection 203.07 for Zone 3 embankment. End-dumping shall not be started until the suitability of the surface on which the embankment is to be placed has been approved. When interrupted for a period of 24 hours or more, dumping shall not be done until suitability of the surface has been re-approved.

In the construction embankments, starting layers shall be placed in the deepest portion of the fill, and as placement progresses, layers shall be constructed approximately parallel to the finished pavement grade line. Embankment greater than 25 feet in height shall be stabilized in stages of equal increments not to exceed 15 feet. Each stage shall be temporarily seeded and mulched, or topsoiled, permanently seeded, and mulched, according to Section 808, before proceeding with the next stage. At the completion of the final stage of embankment placement, the entire slope, if not previously done, shall be topsoiled, permanently seeded, and mulched. These disturbed areas shall be stabilized according to the time limits established in Subsection 212.03.

During construction of the embankment, when practicable, construction equipment, both loaded and empty, shall be routed over the layers with the travel distributed evenly over the entire width of the embankment. Cemented soil aggregations shall be broken up into smaller pieces and incorporated with other material in the layer.

The work of roadway excavation, embankment, and borrow excavation shall be timed and arranged so that space is reserved in the embankment for excavated earth and rock.

Embankment construction scheduled between November 15 and March 1 must be approved before starting the operations. Approval will be based on the Contractor's alternate method for stabilizing disturbed areas when seeding is not reasonable due to seasonal constraints. The alternate method must be approved before implementation.

C. Drainage and Stability. Embankment shall be constructed so that adequate surface drainage shall be provided at all times. The center of the roadbed shall be constructed higher than the sides, and the surface shall be kept uniformly graded and compacted. At the end of each work day, temporary stabilized earth berms and slope drains shall be constructed along the top edges of the embankment to intercept surface runoff.

To facilitate compaction and drainage of the embankment, sufficient motor graders or other equipment shall be used to keep the embankment smooth and free from ruts during construction.

If, in the opinion of the Engineer, the embankment construction would be adversely affected by the moisture content of the existing or embankment soil being either excessive or deficient, embankment construction shall not continue until the moisture content is reduced or increased, to produce the necessary compaction.

Embankments shall be stable, and any portion shall be replaced which has become displaced or unstable due to carelessness or negligence.

D. Rock in Embankments. Rock shall not be placed in embankments without approval.

Rock shall be placed, in general, to form the base of embankments for the full width of the cross-section. Rock shall also be placed on side slopes where indicated or where directed.

Excess rock placed on the side slopes of completed embankments need not be compacted unless directed.

Rock shall be placed in uniform, loose layers not exceeding in depth the approximate average size of the larger rock, but limited to a maximum depth of 3 feet. Oversize rock shall be reduced in size until it can be incorporated readily in a 3-foot layer. However, rock shall not be dumped in final position, but shall be distributed by blading or dozing in a manner that ensures proper placement in the embankment so that voids, pockets, and bridging are reduced to a minimum. The top layer and sides of all rock embankments shall be limited to a maximum of 1 foot with all voids filled with smaller pieces, spalls, or granular material. The rock embankment shall not be constructed above an elevation 2 feet below the finished subgrade. The balance of the embankment shall be composed of material other than rock, smoothed and placed in layers not exceeding 8 inches in loose thickness, and compacted as specified in Subsection 203.07.

Before rock is placed on compacted embankment constructed of earth, the existing embankment surface shall be sloped from the centerline to the sides at the rate of approximately 1 inch to the foot, and the surface of the embankment shall be thoroughly compacted.

When rock and earth embankment materials are placed at the same time, the rock shall be placed in the outside portion of the embankment, and the earth material placed in the central portion of the embankment. During this construction, the elevations of both portions shall be substantially the same but the elevation of the layers of earth shall be, at all times, above the rock layers to allow for compaction of the layers of earth.

All rock embankments shall be placed so that larger pieces are well distributed and the voids filled to the extent that is practicable.

Rock embankment shall not be placed in localized areas where bearing piles are to be driven or drainage is to be constructed.

Rock obtained from roadway excavation shall be used as backfill for wet excavation areas according to Subsection 203.12, before use in Zone 3 embankment.

In the construction of Zone 2 embankment of rock, except within 1 foot of exposed embankment slopes, the backfill shall be formed entirely of rock materials to the prescribed top of Zone 2.

Work shall be arranged to allow the Engineer to take measurements for determining the amount of rock used in Zone 2 embankment before and following excavation of the rock, and also following placement if sufficient rock is not available to complete the Zone 2 embankment.

E. Compaction with 50-Ton Pneumatic-Tired Roller. The existing ground surface shall be tested initially with the roller empty. As the rolling progresses and at such times as directed, the weight shall be increased in increments commensurate with what the existing ground can support. When the gross loaded weight is a minimum of 50 tons, the entire ground surface within the required limits shall be compacted by not less than five nor more than eight passes. The Engineer will determine the exact number of passes. A pass is defined as the passage of one wheel of the roller over the entire surface.

Whenever the rolling fails to stabilize the material, such material shall be removed to the limits and depths as directed, and the excavated areas shall be backfilled with the borrow excavation and compacted in layers up to existing ground surface.

The material removed shall be disposed of according to Subsection 202.12.

During the rolling operations, the borrow excavation shall be placed in depressions, as directed, to the depth necessary to maintain an even surface for the operation of the roller.

203.06 Backfilling. { XE "Backfilling:bridge structures" }{ XE "Backfilling" }

Backfilling shall be completed and the material compacted before any embankment is placed.

Embankment constructed in the vicinity of bridges and similar structures before the completion of abutments and wingwalls shall terminate temporarily on slopes 5H:1V, or flatter, which shall be located to allow ample space for construction of the structure and for placing and compacting the backfill, porous fill, and remaining adjacent embankment. Embankment and porous fill around and adjacent to arches, rigid frame bridges, culverts, and piers shall be placed simultaneously on both sides to approximately the same elevation.

Where existing pipes and conduits have insufficient earth cover during embankment construction, the pipes and conduits shall be protected against damage by the equipment and operations. Any damage to such facilities that may be caused by the operations shall be repaired.

Porous fill shall be placed in layers and compacted as provided in Subsection 203.10. The maximum layer thickness shall be 1 foot, loose measurement. Material that does not meet the gradation requirements shall be removed and may be blended, off the placement site, to correct gradation and then returned to the site.

Rock backfill shall be placed and constructed, as directed, on slopes where slumping has occurred. The rock shall measure 4 to 12 inches in the longest dimension and shall be according to the geologic classifications in Subsection 901.04.

203.07 Placement and Compaction Methods. { XE "Compaction:methods" }{ XE "Placement and compaction methods" }

Embankment material shall be placed and compacted according to following Subsections:

Zone 3 embankments of sand, sand and gravel, or a combination of other granular materials shall be constructed according to Subsection 203.08. When Zone 3 embankments consist of rock or of nongranular material, when they are of a minor nature, or are so variable as to make the control fill method impractical, in the opinion of the Engineer, Zone 3 embankments shall be constructed according to Subsection 203.09.

The top 6 inches in cut sections shall be compacted according to Subsection 203.09.

Zone 1 and Zone 2 embankments shall be constructed according to Subsections 203.11, 203.12, 203.13, and 203.14.

203.08 Control Fill Method.{ XE "Control fill method" }

A. Control Strips. One or more control strips shall be constructed for the purpose of determining compaction requirements for each material. Any change in the character of the material or the compaction equipment used requires the construction of a new control strip. Each control strip is to remain in place and become a portion of the completed embankment and shall be according to the following:

1. **Material.** The material used in each control strip shall be furnished from the same source and shall be the same type as the material to be used in the embankment. If the control strip compaction is adversely affected because the moisture content of the soil is either excessive or deficient, the control strip construction shall not continue until the moisture content is reduced or increased, to produce the necessary compaction.
2. **Equipment.** The type and weight of the compaction equipment used shall be such that uniform density is obtained throughout the depth of the layer of material being compacted.

   When the embankment material is sand, sand and gravel, or a combination of other granular materials, a pneumatic-tired roller or a dynamic compactor shall be used.
3. **Placing.** The maximum compacted thickness of each layer shall not exceed 8 inches except when it can be shown, in construction of the control strip, that adequate compaction of thicker lifts is possible with the equipment to be used in compaction. Compaction shall be established by demonstrating that a maximum reference density in the control strip, having lifts thicker than 8 inches, is equal to or greater than the maximum reference density attained in a control strip having layers of 8 inches or less in thickness.
4. **Procedure.** The subgrade or course upon which a control strip is constructed shall be approved before the construction of the control strip.

   Each control strip shall consist of an area of at least 400 square yards, and the thickness shall be the same as for at least three compacted layers of the embankment.

   The first two embankment layers of the control strip shall be compacted according to the rolling and vibrating method.

The third layer of the control strip shall be compacted by a minimum of two passes with the compaction equipment. A pass is defined as one passage of one tire, compacting wheel, or vibrating unit over the entire surface of the layer. Compaction shall continue until additional passes result in no appreciable increase in density. The surface of the final lift shall be smooth, dense, and free from ruts and roller marks. Density of the control strip will be determined according to AASHTO T 191, AASHTO T 205, or AASHTO T 238, Method B, and AASHTO T 239 except that only one method will be used throughout the Project.

Upon completion of compaction, a minimum of ten tests will be made at random locations to determine the average in-place dry density of the control strip. If the average dry density of the material in the control strip is equal to or greater than 95 percent of its maximum density as determined by AASHTO T 99, Method C, including the replacement option, then the compaction equipment and its method of use shall be approved for compaction of embankment of the same materials and thicknesses on the Project. The value of this average shall be the reference maximum density. A control strip satisfying the 95 percent of AASHTO T 99, Method C, density requirement shall be established before construction with the test strip type material can proceed on the Project. Failure to achieve this density level in the control strip shall be cause for rejection of the compaction equipment and/or its method of use.

B. Embankment Compaction. Each layer of Zone 3 embankment shall be compacted by the same equipment and the number of passes that obtained maximum density as determined by the control strip procedure.

When a control strip has been constructed for a given material and where the conditions are such that access with compacting equipment specified above is not possible, each layer of embankment shall be compacted to a density of not less than 95 percent of the established reference maximum density.

The density of such inaccessible areas will be determined from the average of five randomly located measurements according to AASHTO T 191, AASHTO T 205, or AASHTO T 238, Method B, and AASHTO T 239 except that only one method will be used throughout the Project.

203.09 Rolling and Vibrating Method. { XE "Rolling and vibrating method" }

Embankment materials, except rock, shall be placed in layers not more than 8 inches thick, loose measurement, except where embankment is compacted with a 50-ton compactor, the layers may be 1 foot thick, loose measurement. Rock shall be placed according to Subsection 203.05, Subpart D. Compaction equipment shall conform to Subsection 203.04. Each layer shall be compacted according to Table 203-2 below.

Table 203-2 Compaction Requirements{ XE "Tables:embankment, compaction requirements" }

Embankment Material	Equipment	Passes Per Layer
Sand, Sand and Gravel	Pneumatic-Tired Roller	5 minimum
	Dynamic Compactor	2 to 5 maximum (As directed)
Silt, Clay	Pneumatic-Tired Roller	5 minimum
	Sheepsfoot Roller	8 minimum
	Three-Wheel 10-Ton Roller	4 minimum
Rock	Dynamic Compactor (Vibratory Roller with 6-Ton minimum static weight at drum)	2 minimum to 5 maximum (As directed)
	A minimum rated compactive force of 600 1bs/in of drumwidth, 50-Ton Compactor	5 minimum

Where the conditions are such that access with compacting equipment specified above is not possible, the embankment shall be placed and compacted according to Subsection 203.10.

203.10 Density Control Method. { XE "Embankment:density control method" }{ XE "Density control method" }

The density control method shall consist of compaction of embankment materials to a density of not less than 95 percent of maximum density. Except as provided for in Subsection 204.03, maximum density shall be determined according to AASHTO T 99, Method C, including the replacement option. The compacted density of

embankments will be determined by taking the average of a minimum of five randomly located measurements for each 1,000 cubic yards placed according to AASHTO T 191, AASHTO T 205, or AASHTO T 238, Method B, and AASHTO T 239 except that only one method will be used throughout the Project.

In no case shall an individual measurement be less than 90 percent of the maximum density.

In addition, porous fill shall be tested as above for maximum density with a minimum of one test series being performed for each 3-foot increment of elevation.

203.11 Hydraulic Fill Method. { XE "Hydraulic fill method" }

If the hydraulic method of filling is used, the points on the cross-section at which the material is discharged and the location of spillways shall be regulated so that material finer than the No. 200 sieve size does not accumulate within the embankment or between it and an existing adjacent embankment. If material finer than the No. 200 sieve size is found in the embankment in such a quantity, location, or distribution that is detrimental to the stability of the embankment, such material and overlying material shall be removed and the area shall be backfilled with conforming material without additional compensation.

Material that is bulldozed or otherwise moved or spread after its hydraulic placement shall be compacted according to Subsection 203.09.

The necessary rights and permits shall be obtained from affected property owners for the construction and maintenance of the supply lines from the site of pumping to the Project. Copies shall be furnished to the Resident Engineer.

Adjacent properties and water channels shall be protected against the spread of the hydraulic fill material and the runoff from the filling operations, unless permission is obtained for the discharge and runoff of such material from the property owners and public authorities or agencies affected. Before Completion, written releases shall be obtained from such property owners, public authorities, and agencies protecting the State against claims on account of any such discharge and runoff on their properties, or by reason of any other conditions adversely affecting their properties which are caused by the operations. Copies of the releases shall be furnished to the Resident Engineer.

Existing vegetation within the highway ROW and other property of the State that is not to be removed shall be protected against damage from the runoff and spread of hydraulic fill material. If any such vegetation is killed or dying before Completion, as a result of the runoff or spread of such material, in the opinion of the Engineer, all such dead or dying vegetation shall be removed from the ROW or other State property at no cost to the State.

Maintenance of adequate drainage flow shall be provided at all times either in existing or new ditches and channels. Upon completion of the embankments, existing and new streams, ditches, and other water channels shall be restored to their former or prescribed cross-section where filling material or sediment from runoff has washed, spread, or has otherwise been deposited. Restoration of ditches and other water channels shall be performed without additional compensation.

203.12 Wet Excavation and Backfill Method. { XE "Wet excavation" }

This method consists of constructing a Zone 2 embankment by end-dumping or hydraulically placing a soil aggregate material into a swamp or wet excavation area which previously had been excavated according to Section 202.

On completion of the wet excavation in a particular area, the excavated area shall be backfilled with Zone 2 embankment. The backfill material may be end-dumped only to such an elevation that permits the use of compacting equipment. The remainder of the Zone 2 embankment shall be placed and compacted as specified for Zone 3 embankment in Subsection 203.07.

The manner of filling and advancing the backfill wedge shall be such as to force all remaining wet excavation material laterally to the sides of the excavation and not entrap it under the fill. All accumulations of wet excavation material at the sides of the excavated area shall be removed as the embankment wedge advances. If wet excavation material is spilled or otherwise deposited on the top or sides of the embankment during this operation, it shall be entirely removed without additional compensation.

The embankment shall not proceed until tests have been performed on the bottom of the excavation to determine that the wet excavation material has been removed down to the firm bottom or the lower limit in partial wet excavation. The formation of the embankment shall proceed continuously except with the necessary interruptions to allow for testing and measuring. When interrupted for a period of more than 24 hours, embankment construction shall not be resumed until the bottom of the excavated area has been tested again and it is determined to be in satisfactory condition.

In widening an existing embankment, the construction of the new embankment shall proceed along and outward from the existing embankment in close coordination with the wet excavation and in such manner that wet excavation material is not entrapped between the existing and new embankments and so as to prevent displacement of unstable materials that may be under the existing embankment.

Precautions shall be taken to prevent settlement or dislocation of, or damage to, any existing adjacent roadways and utility or other facilities therein. If such roadways or facilities are damaged by or as a result of the work, they shall be repaired, replaced, or otherwise restored, without additional compensation, to a condition as good as prevailed at the time the Project started.

203.13 Vertical Drain Method. { XE "Vertical drain method" }

This method consists of the stabilization of foundation soils by placing thereon a drainage layer of Zone 1 material, placing Zone 2 and Zone 1 materials in channels and soft areas, then placing a Zone 2 working table, vertical drains, Zone 3 embankment, and an overload. This method may also include the installation of settlement platforms, control stakes, pore pressure measuring devices, and drainage windrows and shall be as follows:

1. **General.** The work shall be performed in a manner to prevent failures of the embankment and the foundation. The term foundation as used in this connection shall be construed to mean the existing swamp materials and the vertical drains below the bottom of the Zone 1 blanket. Repair of the embankment and foundation damaged by failures shall be performed without additional compensation.

   The work of placing and compacting the embankment will be monitored using the data obtained from readings on the settlement platforms, pore pressure measuring devices, control stakes, and by other monitoring means, and by inspection of the filling operations as they proceed. The suspension of operations may be ordered for up to 45 calendar days at such times as conditions develop which may be detrimental to the work or may cause damage to adjacent property.

   Priority shall be given to the construction of embankments adjacent to bridges and other structures so as to coordinate with proposed bridge construction schedules.

   Embankment operations shall proceed simultaneously at as many locations and with sufficient forces and equipment as may be necessary to complete all embankments within the time necessary to complete the highest embankments at the prescribed controlled rates of filling.

   Where embankment that is to be constructed by the vertical drain method adjoins the embankment to be constructed in wet excavation areas, the wet excavation and backfill shall be completed before the work is started in the vertical drain area.

   The embankment overload shall be compacted according to Subsection 203.07.

2. **Construction of Zone 1 and Zone 2 Embankments.** Settlement platforms shall first be placed and initial elevations determined. Zone 1 material shall then be deposited to a minimum thickness of 4 feet, or to such other thickness as may be specified and shall be graded to a level surface. After the Engineer has taken measurements on the surface of Zone 1 material, Zone 2 material shall be placed on top of Zone 1 material to form a working table. If the working table settles below a specified limiting elevation before vertical drains are installed, additional Zone 2 material shall be placed to bring the working table up to the specified elevation.

   Existing ditches, channels, pockets, and other low areas shall be filled with Zone 1 or Zone 2 material at the locations specified. If excessive settlement occurs or is expected to occur in these or other critically soft or unstable areas, Zone 2 material shall be placed directly on the existing swamp surface before Zone 1 material is placed.

   Zone 1 material may be placed in one layer provided this does not cause excessive displacement of the underlying material. If excessive displacement is anticipated, Zone 1 material shall be placed in two layers. The second layer shall be spread initially at least 20 feet back from the outer edges of the first layer. The second layer may then be completed to the full width one day after the first layer has been placed.

   When Zone 2 is placed directly on existing swamp surface, it shall be placed as specified for Zone 1 embankment.

   End-dump methods may be used in placing the initial layer of Zone 1 or Zone 2 material. The spreading shall be performed with a light bulldozer or other equipment having treads giving equivalent effect, the gross weight of which shall not exceed 17,000 pounds. Heavier bulldozers may be used when authorized and then only if they are equipped with marsh-type extension treads so that they do not displace the underlying foundation soil or force the sand blanket into the foundation soil. If necessary, to avoid the development of mud waves ahead of the placement of the Zone 1 or Zone 2 material in very soft areas or channel areas, the material shall be cast ahead in a thin layer with a small clamshell crane, or with other suitable equipment before spreading additional material with the bulldozer.

   If any mud waves or heaves develop within the proposed limits of Zone 1 and Zone 2 materials in advance of the placing of these materials, they shall be removed down to the elevation of the original ground. If any mud waves or heaves are entrapped under the Zone 1 or Zone 2 materials to a height of more than 1

foot above the original ground, they and the overlying Zone 1 or Zone 2 materials shall be removed and replaced with layers of Zone 1 and Zone 2 material. All work of removing mud waves and heaves and replacement of Zone 1 and Zone 2 materials shall be performed without additional quantity allowance or other additional payment, if such mud waves or heaves were due to negligence.

Zone 2 material shall be placed on top of the Zone 1 material to form the working table and shall be compacted according to Subsection 203.09. However, in forming the working table, not more than 1 foot of Zone 2 material shall be placed in any one day.

After the working table is constructed, the vertical drains shall be installed.

3. Construction of Zone 3 Embankment. Zone 3 embankment shall conform to Subsection 203.07 and the following:

a. When Zone 1 and Zone 2 materials have been placed to form the working table, or when Zone 2 has been constructed to a level higher than the working table and all the required devices have been installed and measurements taken by the Engineer at the appropriate levels, Zone 3 material shall be placed to complete the embankment and overload. The overload thickness shall be increased if directed.

b. If rock is placed in Zone 3 embankment, sufficient earth shall be placed around the settlement platforms and other monitoring devices in advance of placing the rock, to prevent disturbances of or damage to them.

c. Zone 3 material shall be placed at the rate as provided for in the Special Provisions.

{ XE "Wick drains" **}{** XE "Vertical drain method:wick drain" **}4. Installation of Vertical Wick Drains.** Vertical wick drain requirements will be provided in the Special Provisions.

{ XE "Vertical drain method:sand drain" **}{** XE "Sand drains" **}5. Installation of Vertical Sand Drains.** Vertical holes not less than 1 foot - 8 inches in diameter shall be formed from the working table and shall extend through the zone materials and underlying soft material down to the firm stratum, or to such depth as directed. The holes shall be backfilled with the soil aggregate as specified in Subsection 203.03 before the placing of embankment material above the established working table.

The holes shall be formed by jetting a casing down to the required depth by driving a plugged mandrel with a pile driver or by other methods. If the holes are formed by driving a plugged mandrel, the mandrel shall be not less than 1 foot – 8 inches, outside diameter for its full depth. The driving rig shall be equipped with a compressed air supply for forcing the soil aggregate out of the mandrel. If other methods are used, the equipment shall be of such design as to obtain holes of equivalent size and to maintain them at that size until they are filled with soil aggregate. Provisions shall be made for durable markings on equipment for measurement of the depth of holes.

If the holes are excavated by jetting a casing to the required depth, the jetting shall be continued for a sufficient length of time, after the casing has reached required depth, to remove all solid materials within the casing. Holes that contain muddy water shall be pumped out until the water contains not more than a total of two percent, by weight, of silt and clay. After the hole has been backfilled with soil aggregate, the casing shall be removed by such method that leaves the hole completely filled with soil aggregate. Jetted material shall not be permitted to come in contact with Zone 1 materials.

Where obstructions are encountered that cannot be penetrated by the mandrel or other methods in use, the holes shall be formed by spudding with a pointed steel spud of such type and operated by equipment with sufficient driving capacity as to punch through the materials encountered. The following variations in procedure will be permitted:

a. Where obstructions are encountered with the mandrel or spud, the hole may be abandoned and the sand drain installed at a distance not more than 3 feet from the prescribed location of the sand drain. However, where an obstruction is encountered at a depth of more than one-half the depth of the proposed sand drain, and such obstruction cannot be dislodged or penetrated by spudding, a vertical sand drain may be directed to be constructed above the obstruction.

b. Where unusual obstructions do not permit a satisfactory pattern of vertical sand drains, the obstructions shall be removed and discarded. All such excavation shall be refilled.

Any method of excavating or constructing the holes that cause an appreciable disturbance of the adjacent existing ground shall be discontinued. Holes that must be abandoned on account of obstructions shall be backfilled with material conforming to Zone 1 requirements. Holes that are out of place and those that are damaged in excavating, forming the hole, or during the placing of soil aggregate shall be backfilled with Zone 1 material and abandoned. If any previously completed sand drains are damaged or destroyed in excavating for the removal of obstructions, such sand drains shall be replaced with new ones.

Each hole shall be inspected and approved before the soil aggregate is placed. The material jetted or excavated from the holes shall be disposed of according to Subsection 202.12.

{ XE "Pore pressure measuring devices" **}6. Pore Pressure Measuring Devices.** Pore pressure measuring devices shall be installed at intervals specified. They shall be grouped approximately equidistant from the vertical drains.

The pore pressure measuring devices shall be maintained, and any or all components that may be damaged or worn out shall be replaced or repaired. The devices shall remain in place and become the property of the State except those removed because of interference with roadway construction.

{ XE "Settlement platforms" **}7. Settlement Platforms.** Settlement platforms shall be carefully set and leveled. The pipes shall be kept plumb and shall extend upward in sections as the filling progresses, always keeping the pipes a minimum of 4 feet above the top of the embankment.

If the platforms or pipes are disturbed during construction, by the action of tides or otherwise, they shall be restored before additional embankment material is placed at their locations. The pipes shall remain in place upon Completion and become the property of the State except those that may be removed, as directed, because of interference with roadway construction.

{ XE "Drainage windrow" **}8. Drainage Windrows.** Trenches for drainage windrows shall be excavated in the Zone 1 sand blanket and backfilled with materials as described in Subsection 203.03.

9. Control Stakes. Control stakes shall be constructed to indicate any foundation or slope movement.

203.14 Sand Blanket Method. { XE "Sand blanket method" }

This method consists of the stabilization of foundation soils by placing thereon a sand blanket of Zone 1 material, placing Zone 2 and Zone 1 materials in channels and soft areas, and then placing a Zone 2 working table, Zone 3 embankment, and an overload. This method may also include the installation of settlement platforms, pore pressure measuring devices, control stakes, and drainage windrows.

The materials and methods of construction shall be the same as specified in Subsection 203.13 except that vertical drains shall not be installed and the thickness of Zone 1 sand blanket may be varied, as directed, according to the actual ground conditions encountered during progress of the work.

COMPENSATION

203.15 Method of Measurement.

Porous fill and drainage windrows will be measured by the cubic yard.

Breaking of concrete within embankment area will be measured by the square yard.

Rock backfill will be measured by the ton.

Vertical drains of the various kinds will be measured by the linear foot.

Pore pressure measuring devices of the various types will be measured by the unit.

Control stakes and settlement platforms will be measured by the unit.

Pneumatic-tired rolling will be measured by the hour to the nearest one-quarter hour for the time that the compacting equipment is moving for testing or compacting purposes, including the time required for changing the tire pressure or increasing or decreasing the gross load of the compactor. Time required for servicing and repairing the equipment and any time the compactor is immobilized in an unstable material will not be measured.

203.16 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
POROUS FILL	CUBIC YARD
DRAINAGE WINDROWS	CUBIC YARD
BREAKING CONCRETE	SQUARE YARD
ROCK BACKFILL	TON
VERTICAL SAND DRAINS	LINEAR FOOT
VERTICAL WICK DRAINS	LINEAR FOOT
PORE PRESSURE MEASURING DEVICES, TYPE ___	UNIT
CONTROL STAKES	UNIT
SETTLEMENT PLATFORMS	UNIT
PNEUMATIC-TIRED ROLLING, 50-TON	HOUR

Payment for the removal of unusual obstructions that have prevented the formation of a satisfactory pattern of vertical drains will be made according to Subsection 104.02.

Payment for removal of unstable material will be made according to Section 202 for unclassified material.

Payment for the refilling of the excavated areas or depressions caused by the rolling operation of the 50-ton pneumatic-tired roller will be made according to Section 204 for the zone used.

Payment for temporary soil erosion and sediment control measures will be made according to Section 212.

Separate payment will not be made for embankment.

SECTION 204 - BORROW EXCAVATION{ XE "EXCAVATION:BORROW" }

204.01 Description.

This work shall consist of furnishing material required for backfill and embankment in excess of that obtained from roadway excavation and excavation from other items of work, the construction of embankments with borrow excavation material, and the construction of embankment or backfill with a lightweight fill material.

MATERIALS

204.02 Borrow Excavation.

Borrow excavation for embankment material shall conform to Subsection 203.03.

Lightweight fill material for constructing an embankment or backfilling shall be expanded slate or shale, cinders, or blast furnace slag. Blast furnace slag shall conform to Subsection 901.06, except that the quality requirements are deleted.

Lightweight fill materials shall meet the following requirements:

Sodium Sulfate Test (AASHTO T 104) ..... 20% maximum, dry

Unit Weight (ASTM C 29, Rodding Method) ..... 70 lbs/ft^3 maximum, as delivered moisture

Sieve Size	**Percentage by Weight Passing**
2 inch	100
¾ inch	50 - 100
No. 4	5 - 90
No. 50	0 - 55
No. 200	0 - 20

CONSTRUCTION

204.03 Construction Requirements.

{ XE "Borrow pits" **}**Borrow pits shall not be located within sight of any State highway except as authorized. When located within sight of a State highway, borrow pits shall be graded and shaped to final slopes of 3H:1V or flatter, wherever possible, so that they blend into the general topography of the area. Steep slopes and sheer faces shall be avoided. Soil erosion and sediment control shall be according to Section 212.

Placement and compaction with borrow excavation shall be according to Subsection 203.07, except that borrow excavation for bridge foundations on which footings are founded without piles shall not be less than 95 percent of maximum density as determined according to AASHTO T 180, Method D, including the replacement option. The maximum thickness of any layer shall be 1 foot, loose measurement. A minimum of two field density tests will be taken according to AASHTO T 191, AASHTO T 205, or AASHTO T 238, Method B and AASHTO T 239 on each compacted layer at each substructure unit, except that only one of the referenced methods will be used on the Project. The number of field density tests for each compacted layer is to be at least one test for every 1,000 square feet of embankment.

Material that does not meet the gradation requirements shall be removed and may be blended to correct gradation off the placement site and then returned to the site.

Lightweight fill shall be placed in layers not exceeding 6 inches thick. Each layer shall be compacted by the use of dynamic compactors conforming to Subsection 203.04, except that the maximum gross static weight of the compactor shall be 5 tons. The number of passes of the dynamic compactor per layer shall be according to Subsection 203.09. Blast furnace slag and/or cinders shall not be permitted within 1 foot of any concrete structure.

COMPENSATION

204.04 Method of Measurement.

Borrow excavation of the various zones and kinds will be measured by the cubic yard, except that borrow excavation of Zone 3 material equals the volume of Zone 3 embankment less the volume of Project excavation determined by computation as follows:

1. Zone 3 embankment is the volume of embankment plus the volume of stripping in embankment areas less the volume of materials measured under other Pay Items.
2. Project excavation is the volume of roadway excavation plus the volume of excavation for other items of work less the volume of stripping in excavation areas as adjusted by applying the prescribed volume correction factor.

Borrow excavation of Zone 3 material in vertical drain and sand blanket areas will be measured by elevations taken or interpolated from settlement platform readings.

Borrow excavation, lightweight fill will be measured by the cubic yard.

204.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
BORROW EXCAVATION, ZONE ___	CUBIC YARD
BORROW EXCAVATION, BRIDGE FOUNDATION	CUBIC YARD
BORROW EXCAVATION, SELECTED MATERIAL	CUBIC YARD
BORROW EXCAVATION, LIGHTWEIGHT FILL	CUBIC YARD

SECTION 205 - CHANNEL AND DITCH EXCAVATION{ XE "DITCH EXCAVATION" }{ XE "CHANNEL:EXCAVATION" }{ XE "EXCAVATION:DITCH" }{ XE "EXCAVATION:CHANNEL" }

205.01 Description.

This work shall consist of the excavation for the construction of new ditches and water channels and for deepening, widening, and relocating existing ditches and water channels.

Excavation is defined as channel excavation if the bottom width of the excavation is more than 5 feet. If the bottom width of the excavation is 5 feet or less, the excavation is defined as ditch excavation.

205.02 Classification of Excavation.

Channel excavation and ditch excavation are classified as earth, rock, or unclassified as defined in Subsection 202.02, except rock in ditch excavation shall be as defined in Subsection 207.02.

CONSTRUCTION

205.03 Construction Requirements.

Excavated material shall be used for embankments. Excavation shall be according to Section 202, and the excavated material shall be used according to Section 203, except that the material may be permitted to be used adjacent to the channels, graded and sloped to provide drainage flow from the adjacent lands to the channels, and the sites shall be restored to a condition acceptable to the property owners and the Engineer.

Two adequately equipped boats shall be provided, when required, at each location where channel excavation work is in progress, and space and opportunity shall be provided for the work of measuring the bottom of the excavation.

Soil erosion and sediment control shall be done according to Section 212.

205.04 Excess or Unusable Material. { XE "Materials:unusable, disposal of" }

Excess material shall be used according to Section 203, or, if not required for embankments, the material shall be disposed of according to Subsection 202.12.

Unusable material shall be disposed of according to Subsection 202.12.

COMPENSATION

205.05 Method of Measurement.

Channel excavation and ditch excavation, of the various kinds, will be measured by the cubic yard.

205.06 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CHANNEL EXCAVATION, EARTH	CUBIC YARD
CHANNEL EXCAVATION, ROCK	CUBIC YARD
CHANNEL EXCAVATION, UNCLASSIFIED	CUBIC YARD
DITCH EXCAVATION, EARTH	CUBIC YARD
DITCH EXCAVATION, ROCK	CUBIC YARD
DITCH EXCAVATION, UNCLASSIFIED	CUBIC YARD

SECTION 206 - FOUNDATION AND BRIDGE EXCAVATION{ XE "EXCAVATION:FOUNDATION" }{ XE "EXCAVATION:BRIDGE" }{ XE "FOUNDATION EXCAVATION" }{ XE "BRIDGE EXCAVATION" }

206.01 Description.

This work shall consist of excavation for the construction of piers, walls, abutments, box culverts, and other structures.

206.02 Classification of Excavation.

Foundation and bridge excavation are unclassified and shall consist of excavation and disposal of any material of whatever character encountered in the work.

MATERIALS

206.03 Coarse Aggregate Layer. { XE "Coarse aggregate layer" }

Material shall be broken stone or washed gravel conforming to Subsections 901.04 and 901.05. The aggregate size shall be No. 56, 57, or 67 conforming to Subsection 901.20, Table 901-1.

206.04 Backfill Material.

{ XE "Excavation:borrow" **}**Material for backfill shall be made with excavated material free from stones or rock fragments larger than 2 inches in any dimension. Additional material needed shall be borrow excavation as described in Section 204 or shall be porous fill as described in Section 203, as directed.

CONSTRUCTION

206.05 Roadway Embankments{ XE "Embankment:roadway" }.

In excavating for footings that are within new embankments, the excavation shall be so made as to remove the minimum amount of embankment material and the operations conducted so as to cause minimum disturbance to the embankment. The excavated area shall be backfilled and compacted according to Subsection 203.07, and the embankment shall be restored to the final section.

206.06 Preservation of Stream Channel. { XE "Foundation excavation:preservation of stream channels" }

If any excavation is made at the site of the structure before caissons or cofferdams are sunk or in place and after the foundation base is in place, all such excavation shall be backfilled to the original ground surface or riverbed without additional compensation. Material deposited within the stream area from foundation or other excavation or from the filling of cofferdams shall be removed. Soil erosion and sediment control shall be according to Section 212.

206.07 Excavation.

Foundation or bridge excavation shall not be started until all excavations that are to be performed under other items of work have been completed within the limits of foundation or bridge excavation.

Excavations adjacent to pavement, sidewalks, and curbs shall be sheathed and shored to prevent undermining or displacing them.

Substructures, where practicable, shall be constructed in open excavation and, where necessary, the excavation shall be shored, braced, or protected by sheeting, cofferdams, or other similar installations.

Boulders or fingers and ledges of rock projecting into the bottom of the excavation shall be removed to a minimum depth of 6 inches below the bottom of footing and the space backfilled with coarse aggregate layer material and compacted according to Subsection 203.09.

If shale is encountered at the bottom of the footing and the footing is not poured the same day and the shale is exposed to air or water, the shale shall be undercut 4 inches minimum and sealed with concrete, with a rough finish, to the bottom of footing elevation.

In areas where the bottom of footing would rest partly on earth and partly on rock, the rock shall be excavated to 2 feet below the bottom of footing and the space backfilled with coarse aggregate layer material and compacted according to Subsection 203.09.

Except at locations where the concrete footings are to bear against solid rock, the footing shall be constructed by using side forms. Sheeting specified to remain in place may be used as side forms.

Rock or other hard material shall be freed from loose material, cleaned and cut to a firm surface, either leveled, stepped, or roughened, or shall have anchors installed, as required, to produce a suitable surface. All seams shall be cleaned out and filled with concrete, mortar or grout conforming to Section 914.

Care shall be exercised in excavating for stepped footings so as to avoid any disturbance of the bearing material adjacent to the steps. If this material is disturbed so that it does not provide an acceptable bearing surface, the material shall be replaced with footing concrete at no cost to the State.

206.08 Cofferdams. { XE "Foundation excavation:cofferdams" }{ XE "Cofferdams" }

{ XE "Foundation excavation:protection of pavement" **}**Cofferdams used in the preparation and protection of the foundation shall be carried below the bottom of the footings, shall be braced in all directions, and shall be of such construction as to permit them to be pumped and maintained free of water until the construction therein has been completed. The interior dimensions of the cofferdam shall be such as to allow clearance to provide for the construction and inspection of forms and for the handling and pumping of leakage outside of the footing area.

Cofferdams shall be so constructed as to protect the foundation and the construction against damage from a rise in the water elevation.

Timber or bracing of a cofferdam may extend into or through the substructure masonry only with written authorization.

Design calculations and working drawings shall be submitted according to Subsection 105.04.

Cofferdams with all falsework, sheeting, and bracing shall be removed after the completion of the substructure therein except where sheeting is designated to remain.

Vertical structural members supported on rock shall be toed-in sufficiently to ensure stability against movement.

Where sheeting interferes with batter piles, the depth of penetration of the interfering sheets may be reduced or the sheeting may be moved out to provide clearance between the sheeting and the batter piles as authorized.

If the foundation or bridge excavation has become disturbed or distorted due to the construction operation, it shall be cleaned out and restored to an acceptable condition without additional compensation.

Except at locations where a sheet pile cofferdam is indicated, the use of dikes, well points, or other means may be permitted for dewatering the areas of foundation excavation. Plans shall be submitted showing proposed construction and approval shall be obtained before proceeding with the work. The Plans shall be accompanied by evidence of approval according to Subsection 107.05.

When environmental considerations eliminate the need for cofferdams, the Pay Item “Cofferdams” will be deleted.

206.09 Preparation of Footings.

The elevation of the bottoms of footings shall be considered as approximate, and the Engineer may order, in writing, such changes in dimensions or elevation of footings as may be necessary to secure an acceptable foundation.

When the excavation has been completed to the elevation of the bottom of the footing, construction shall only proceed upon approval.

When the rock is shattered below the foundation elevation, the shattered material shall be removed and the space created shall be refilled with the same class of concrete as the overlying footing.

Dewatering shall be done in such a manner as to preclude the possibility of any portion of concrete material being carried away. Dewatering required during the placing of concrete, or for a period of at least 24 hours thereafter, shall be done from a sump located outside the concrete forms.

{ XE "Concrete structures:cofferdam seals" **}**When conditions are encountered which render it impracticable to dewater the excavation before placing the footing, the construction of a concrete seal of such dimensions and thickness as necessary to resist any possible uplift may be permitted. Before placing the concrete seal, the excavation shall be cleared of all objectionable material by the use of sand pumps, spud bars, or other means. The seals shall then be constructed according to Section 501. Dewatering a sealed cofferdam shall not commence until the seal has cured sufficiently to withstand the hydrostatic pressure. The excavation shall then be dewatered, and the seal cleaned of all laitance and prepared for further construction.

When masonry is to rest on an excavated surface other than rock, care shall be taken not to disturb the bottom of the excavation. The final removal of material to grade shall not be made until just before the masonry is to be placed.

When directed, coarse aggregate layer material shall be placed following the completion of the excavation. The material on which the coarse aggregate layer is to be placed shall be shaped to an even surface. The aggregate shall then be placed in 6-inch lifts and compacted according to Subsection 203.07.

206.10 Backfilling. { XE "Foundation excavation:backfilling" }{ XE "Backfilling" }

Backfilling shall be according to Section 203 and with the following:

1. Backfill against footings is permitted after stripping of the footing forms.
2. Backfill shall not be placed against other structures, section, or unit thereof, until the concrete masonry has been in place for 14 calendar days, or until the concrete has cured 72 hours and the minimum strength of an

individual test for each lot of concrete as defined in Section 914 exceeds 3,000 pounds per square inch from an additional two cylinders cast during placement.

206.11 Excess or Unusable Material. { XE "Foundation excavation:excess material, use and disposal of" }

Excess material shall be used according to Section 203, or, if not required for embankments, the material shall be disposed of according to Subsection 202.12.

Unusable material shall be disposed of according to Subsection 202.12.

COMPENSATION

206.12 Method of Measurement.

Foundation and bridge excavation will not be measured and payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided for in Subsection 109.01. When, in the opinion of the Engineer, it is necessary to carry any foundation below the prescribed elevation to reach suitable material, only the volume of additional depth is eligible for consideration of price adjustment as provided in Subsection 104.05 except that negotiations may be finalized when the additional excavation at any location has been performed.

Coarse aggregate layer will be measured by the cubic yard.

Cofferdams will not be measured, and payment will be made on a lump sum basis.

Undercutting and sealing with concrete seal when shale is encountered as specified in Subsection 206.07 will not be measured, and all costs shall be included in foundation excavation or bridge excavation.

206.13 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
COARSE AGGREGATE LAYER	CUBIC YARD
FOUNDATION EXCAVATION	CUBIC YARD
BRIDGE EXCAVATION	CUBIC YARD
COFFERDAMS	LUMP SUM

{ XE "Borrow excavation" **}**Payment for borrow excavation, Zone 3, will be made according to Section 204.

{ XE "Concrete seals" **}**Payment for concrete seals will be made according to Section 501.

Payment of the lump sum price bid for cofferdams where sheet piling is to be left-in-place will be divided equally among the total number of cofferdam units required unless a separate lump sum Pay Item is scheduled for each substructure unit. Partial payment for each substructure unit will be made as follows:

1. 25 percent of the amount bid when driving of the sheet piling has been completed.
2. The balance when the footing construction has been completed and accepted.

Partial payments will not be made for cofferdams where dewatering areas of foundation excavation is accomplished by the use of dikes, well points, or other means according to Subsection 206.08, but payment of the total lump sum price bid will be made upon completion and acceptance of the bridge substructure unit or other structure.

SECTION 207 - SUBSURFACE STRUCTURE EXCAVATION{ XE "EXCAVATION:SUBSURFACE STRUCTURE" }{ XE "SUBSURFACE STRUCTURE EXCAVATION" }

207.01 Description.

This work shall consist of the excavation and backfill for the construction of pipes, electrical conduits, culverts, manholes, inlets, and similar subsurface structures.

207.02 Classification of Excavation.

Rock in the excavation for subsurface structures is defined as boulders more than ½ cubic yard in volume or rock in ledge formation which, in the opinion of the Engineer, cannot be excavated except by drilling or drilling and blasting.

MATERIALS

207.03 Bedding Materials. { XE "Bedding materials and classes" }

Portland cement concrete for Class A bedding shall conform to Section 914.

Material for Class B bedding shall consist of sand or sandy soil, all of which shall pass a ⅜-inch sieve and not more than ten percent of which shall pass a No. 200 sieve.

Material for bedding for corrugated aluminum alloy culvert pipe shall consist of granular soil with the following gradation:

Sieve Size	Percent
1 inch	100
No. 4	80 - 100
No. 200	0 - 12

Material for broken stone shall conform to Subsection 901.04 and for washed gravel shall conform to Subsection 901.05.

CONSTRUCTION

207.04 Construction Requirements.

{ XE "Test pit" **}**Before excavating, existing subsurface structures which may be affected by or interfere with the proposed construction shall be located. If directed, test pits shall be excavated to obtain the required information. Test pits or portions of a test pit shall be dug by hand when in close proximity to utilities or when directed. Excavation beyond that which is necessary to obtain the required information will not be measured for payment. The Contractor shall comply with the State's Underground Facility Protection Act by notifying the State's One Call System before test pit excavation, according to Subsection 105.09. Test pits shall be backfilled according to Subsection 203.06.

The excavation shall be made in open cut and shall be of sufficient size to permit construction of the subsurface structure.

Excavations shall be shored, braced, and sheathed as conditions warrant. If close to existing pavement, sidewalks, curbs, pipes, railroads, or structures of any kind, the excavation shall be secured by sheet piling or other methods so that such facilities and structures are protected.

Excavations located within the traveled way, shoulder, or sidewalk areas shall be excavated with vertical sides except that the sides may be sloped above the bottom of subbase.

Boulders, logs, and any other debris encountered in the excavation shall be removed.

When the material at the bottom of the excavation is unstable, it shall be removed and the space backfilled with granular material.

Subsurface structures or bedding material shall not be placed until the depth of excavation and the material at the bottom of the excavation has been approved.

Excavation for subsurface structures shall conform to the following:

{ XE "Pipes and culverts:excavation for" **}1. Pipes and Culverts.** The width of trench shall be at least 1 foot - 6 inches greater than the outside diameter of the pipe or culvert. When the material at the bottom of the excavation is rock or other hard material, it shall be removed to at least 6 inches for reinforced concrete culvert pipe and 1 foot for corrugated metal, steel, or aluminum alloy culvert pipe below the bottom of the pipe or culvert and the space backfilled with granular material.

Excavation for trenches in embankments shall not proceed until the embankment has been constructed to an elevation of at least 3 feet above the proposed top of the pipe or culvert.

When conditions permit, trenches or pipes shall not be excavated more than 300 feet in advance of laying the pipe.

Trench crossings shall be provided and maintained where necessary.

2. **Structures Other Than Pipes and Culverts.** When the material at the bottom of the excavation is rock or other hard material, it shall be cleaned of all loose material and cut to a level surface.

207.05 Bedding for Pipes and Culverts. { XE "Pipes and culverts:bedding for" }

Recesses shall be provided to accommodate pipe bells and shall be deep enough so that the bell is not resting on the bottom of the recess. The width of the recess shall not exceed the width of the bell by more than 2 inches.

If the class of bedding is not designated, pipes and culverts shall be placed directly on the material at the bottom of the excavation.

Class A bedding shall consist of a concrete cradle constructed according to Section 501.

Class B bedding shall consist of bedding material shaped with a template to fit the lower part of the pipe exterior for at least ten percent of the outside vertical pipe diameter. The minimum thickness of the bedding material, after shaping, shall be 6 inches, and the material shall be compacted according to Subsection 207.06.

Bedding for corrugated aluminum alloy culvert pipe shall be placed as specified for Class B bedding.

In rock cuts, the bedding material shall be either broken stone or washed gravel and shall be placed as specified for Class B bedding.

207.06 Backfilling. { XE "Pipes and culverts:backfilling" }{ XE "Backfilling" }

A. **Pipes and Culverts.** Backfill to a height of 2 feet above the top of pipes and culverts, except underdrains and corrugated aluminum alloy culvert pipe, shall be made with excavated material free from stones or rock fragments larger than 2 inches in any dimension. Below this level, the backfill shall be placed in layers not more than 6 inches thick, and each layer shall be compacted with flat-face mechanical tampers.

Backfill to a height of 2 feet above the top of corrugated aluminum alloy culvert pipe shall be made with a granular soil with the gradation as specified in Subsection 207.03. Below this level, the backfill shall be placed symmetrically on each side of the pipe in layers not more than 6 inches thick, and each layer shall be compacted with flat-faced mechanical tampers.

All backfill more than 2 feet above the top of pipes and culverts, except underdrains, shall be made with excavated material and compacted in 6 inch layers as follows:

1. By vibratory soil compactors, if the backfill material is predominately sand or sand and gravel.
2. By flat-faced mechanical tampers, if the backfill material is not predominantly sand or sand and gravel.
3. Flat-faced mechanical tampers may be substituted for the vibratory soil compactors where the shoring and bracing of trenches or other special conditions make the use of vibratory compactors impractical.

The Engineer may direct compaction to be according to Subsection 203.10 except that the frequency of measurements may increase.

The special backfill in trenches for the underdrains shall be compacted by vibratory compactors. Earth backfill above the special backfill material shall be compacted as specified in Subsection 203.07.

Shoring, bracing, and sheathing shall be withdrawn as the backfilling proceeds.

In rock cuts, the backfill shall be either broken stone or washed gravel.

B. **Structures Other Than Pipes and Culverts.** Backfilling shall be made with excavated material and shall be according to Subsection 206.10, except that backfill shall not be placed against newly constructed masonry or concrete for 72 hours except as authorized.

207.07 Excess or Unusable Material.{ XE "Disposal of:excess or unusable material" }

Excess material shall be used according to Section 203 or, if not required for embankments, the material shall be disposed of according to Subsection 202.12.

Unusable material shall be disposed of according to Subsection 202.12.

COMPENSATION

207.08 Method of Measurement.

Earth excavation for test pits will be measured by the cubic yard.

Earth excavation, additional depth made below the bottom of pipes or subsurface structures caused by changes in grades or by removal of unstable material will be measured by the cubic yard. The quantity excavated will be measured within vertical planes located 9 inches outside the surface of pipes and culverts, and 6 inches outside the neat lines of

other structures. However, for pipes of less than 1 foot - 6 inches in diameter, measurement is based on a trench width of 3 feet.

Rock excavation will be measured by the cubic yard.

Pipe bedding of the various classes will be measured by the cubic yard.

Broken stone or washed gravel will be measured by the cubic yard.

207.09 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
EARTH EXCAVATION FOR TEST PITS	CUBIC YARD
EARTH EXCAVATION, SUBSURFACE STRUCTURES, ADDITIONAL DEPTH	CUBIC YARD
ROCK EXCAVATION, SUBSURFACE STRUCTURES	CUBIC YARD
PIPE BEDDING, CLASS ___	CUBIC YARD
BROKEN STONE OR WASHED GRAVEL	CUBIC YARD

Payment for removal of buried cribbing, heavy timbers, and similar material encountered in subsurface structure excavation which cannot be performed by means of equipment and methods ordinarily used for trench excavation, without special work, and which is outside the limits of roadway excavation or excavation made under any other Pay Item will be made as provided in Subsection 104.02.

Separate payment will not be made for subsurface excavation and backfill except backfill required according to Section 204.

Separate payment will not be made for the granular soil used beneath and as backfill for corrugated aluminum alloy culvert pipe.

SECTION 208 - SUBBASE{ XE "SUBBASE" }

208.01 Description.

This work shall consist of the construction of one or more courses of the subbase and the preparation of the subgrade.

MATERIALS

208.02 Materials.

Materials shall conform to the soil aggregate designations in Subsection 901.09 or as specified.

EQUIPMENT

208.03 Equipment.

Equipment shall include spreading equipment that can spread aggregate, without segregation, and one or more motor graders. The compaction equipment shall be pneumatic-tired or dynamic compactors conforming to Subsection 203.04.

CONSTRUCTION

208.04 Preparation of Subgrade.{ XE "Subgrade:preparation of" }

Before the placing of any subbase, the subgrade shall be shaped and compacted to within a tolerance of plus or minus ½ inch of grade and contour, with no areas consistently high, according to Section 203 and shall be free from water pockets. Subbase material shall not be placed on soft, muddy, or frozen areas, or until all irregularities in the prepared areas, including soft areas in the foundation, have been corrected.

208.05 Spreading and Compacting.

The subbase material shall be deposited on the prepared areas as uniformly as possible to avoid segregation.

Subbase shall be constructed in layers not exceeding a compacted thickness of 8 inches and according to the surface tolerances specified in Subsection 209.03. If the required compacted depth of the subbase exceeds 8 inches, the subbase shall be constructed in two or more layers of approximately equal thickness.

Subbase shall be completed at least 500 feet in advance of construction of the next course.

Except for the subbase layer directly under concrete surface or concrete base course, compaction shall be by the control fill method according to Subsection 203.08 except that a single layer control strip shall be used. The subbase layer directly under the concrete surface and concrete base courses shall be compacted according to Subsection 301.05.

Compaction shall progress gradually from the sides to the center with each succeeding pass uniformly overlapping the previous pass and shall continue until the entire area is shaped and compacted.

Unstable subbase conditions, including soft foundation areas which develop before or ahead of the base course or paving operations, shall be corrected by scarifying, reshaping, and recompacting, or by replacement as required. Work may be suspended to permit such areas to stabilize.

208.06 Protection of Existing Facilities.

If damage is caused to any utility, pipe, facility, building, structure, or to its contents, the method of operation shall be changed so as to avoid such damage. At such locations the subbase and subgrade shall be compacted by the density control method specified in Subsection 203.10.

208.07 Maintenance Under Traffic.

When it is provided in the Special Provisions that traffic is permitted on the completed subbase course, the subbase shall be maintained smooth and uniform until covered by the following stage of construction.

Completed subbase that has been subjected to construction traffic or exposed to the elements for periods in excess of 120 calendar days will be retested for reapproval before construction of the base and surface courses.

Retesting of subbase before 120 calendar days may be required if there is reason to believe it no longer meets specified requirements. In all cases, subbase failing to meet requirements shall be corrected or replaced.

COMPENSATION

208.08 Method of Measurement.

Subbase will not be measured, and payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided for in Subsection 109.01.

208.09 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SUBBASE	CUBIC YARD

SECTION 209 - UNDERLAYER PREPARATION{ XE "UNDERLAYER PREPARATION" }

209.01 Description.

This work shall consist of the final preparation of the surface of the unbound material immediately underlying a concrete or HMA surface, intermediate, or base course.

EQUIPMENT

209.02 Equipment.

Final rolling of such surfaces shall be accomplished by a three-wheel, 10-ton steel roller conforming to Subsection 203.04.

CONSTRUCTION

209.03 Construction Requirements.

{ XE "Backfilling:subsurface structures" **}**The surface shall be prepared after the underlying drains and other subsurface structures have been placed and the backfill has been compacted, and when the subbase, base course, or subgrade has been completed. The specified surface shall not be prepared during freezing weather, when frozen, or when it is unstable because of excessive moisture.

Surfaces shall be shaped and compacted to a firm and even surface within a tolerance of plus or minus ½ inch of grade and contour, with no areas consistently high. Such surfaces shall be shaped and smoothed to correct ridges and other surface irregularities. Final compaction shall be by smooth steel, three-wheel power rollers. Inaccessible areas shall be compacted according to Subsection 203.10.

The subbase surface to receive concrete surface and concrete base courses shall be initially prepared slightly above its required grade and contour so that the final grading operation shall be one of blading and scraping. A three-wheel power roller shall perform the final compaction between forms for concrete surface or concrete base course. Water shall be applied wherever necessary to facilitate compaction. The final preparation of the subbase shall be completed for a distance of not less than 500 feet in advance of construction of the next course.

For concrete surface and concrete base courses, a grading machine shall be mounted on visible rollers riding on the side forms, or on crawler type tracks, or on wheels traveling on a prepared grade. The machine shall be so designed that its cutting edge shall conform to the required cross-section and shall be so arranged that when it is riding on the forms, or traveling on a prepared grade, the cutting edge shall trim the grade to the required cross-section and elevation and dispose of the excess material outside the forms.

If voids develop at the surface of the subbase for the concrete surface or concrete base course, fine granular material of stone, sand, or sand and small gravel particles shall be applied and vibrated or broomed and rolled into place so as to fill all such voids and close the surface. Material in excess of that required to fill the voids shall be removed.

If transverse cracking of the concrete slab occurs within 24 hours of placement, prime coat may be directed to be applied according to Section 404.

The compaction above and on each side of utility and other subsurface pipes and structures that are located at or close to the described surfaces shall be as specified in Subsection 208.06 for compaction of subbase and subgrade under similar conditions, and any damage to such facilities that may be caused by the operations shall be repaired.

Soft, yielding material and areas of nonuniform density shall be reworked, or removed and replaced, and the replacement material graded and compacted according to the provisions for the given material and the underlayer prepared according to this Subsection. Such corrective work shall be done at no cost to the State. Should the soft or yielding condition be due to excessive moisture, work may be suspended in such areas until they sufficiently dry out.

209.04 Drainage and Protection.

Grading shall be performed in such a manner as to provide drainage of water to the side ditches. Side ditches and drains shall be maintained to provide drainage during construction.

Precautions shall be taken to protect the underlayer from damage. Hauling over the finished underlayer shall be limited to that which is deemed essential for construction purposes. In no case shall there be hauling or operation of construction equipment between forms on the finally prepared subbase surface for concrete surface and concrete base courses.

Ruts, ridges, or rough places that develop shall be smoothed and recompacted.

COMPENSATION

209.05 Method of Measurement.

Underlayer preparation for concrete surface and concrete base course will be measured by the square yard.

209.06 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
UNDERLAYER PREPARATION	SQUARE YARD

Payment for prime coat will be made according to Section 404.

Separate payment will not be made for underlayer preparation for HMA or stabilized surface or base courses.

SECTION 210 - SHOULDERS{ XE "SHOULDERS" }

210.01 Description.

{ XE "Shoulders:HMA" **}**This work shall consist of the construction of shoulders of soil aggregate, dense-graded aggregate, bituminous surface treatment, or HMA.

MATERIALS

210.02 Materials.

{ XE "Reclaimed asphalt pavement (RAP):in shoulders" **}**HMA shall conform to Section 903 except that the composition of mixture for the top layer may also include up to 20 percent of RAP. Prime coat and tack coat shall be as specified in Section 404.

Bituminous surface treatment shall conform to Section 402. Other materials shall conform to the following Subsections:

Dense-Graded Aggregate 901.08
Soil Aggregate 901.09

EQUIPMENT

210.03 Equipment.

Equipment for the various types of shoulder construction shall be according to the following Sections:

Dense-Graded Aggregate 401
Soil Aggregate 401
Bituminous Surface Treatment 402
HMA 404

CONSTRUCTION

210.04 Soil Aggregate Shoulders. { XE "Shoulders:soil aggregate" }

Soil aggregate shoulders shall be constructed according to Section 401.

210.05 Dense-Graded Aggregate Shoulders.{ XE "Shoulders:dense-graded aggregate" }

Dense-graded aggregate shoulders shall be constructed according to Section 401.

210.06 Bituminous Surface Treated Shoulders.{ XE "Shoulders:bituminous surface treated" }

The construction of bituminous surface treated shoulders shall consist of a single surface treatment on a previously constructed surface course according to Section 402 except as follows:

1. Where dirt cannot be removed by the use of power brooms and power blowers, the surface shall be flushed with water and allowed to dry.
2. A single application of bituminous material shall be applied at a rate between 0.20 and 0.30 gallon per square yard followed by the spreading of size No. 8 aggregate at the rate of 20 to 24 pounds per square yard.

210.07 HMA.

HMA in shoulder areas shall be constructed according to Section 404.

COMPENSATION

210.08 Method of Measurement.

Soil aggregate and dense-graded aggregate shoulders, of the various thicknesses, will be measured by the square yard.

210.09 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SOIL AGGREGATE SHOULDERS, ___ " THICK	SQUARE YARD
DENSE-GRADED AGGREGATE SHOULDERS, ___ " THICK	SQUARE YARD

Payment for bituminous surface treatment will be made according to Section 402.

Payment for HMA, tack coat, and prime coat will be made according to Section 404.

SECTION 211 - PREPARATION OF ROADBED{ XE "PREPARATION OF ROADBED" }{ XE "ROADBED:PREPARATION OF" }

211.01 Description.

This work shall consist of shaping, grading, and preparing the surface of a previously constructed roadbed.

MATERIALS

211.02 Materials.

The material used to raise the roadbed grade or to fill berm areas shall be material obtained from regrading the roadbed according to Section 202 or from borrow excavation according to Section 203 for Zone 3.

CONSTRUCTION

211.03 Construction Requirements.

Vegetation within the roadbed area shall be removed by means of blading or scraping before the start of final grading and shaping or filling.

Instead of raising the roadbed to the prescribed grade in areas with deficiencies, the roadbed may be prepared according to Section 208, and then any deficiency may be corrected by increasing the depth of the bottom course of subbase.

Compaction of the roadbed material shall be according to Subsection 203.09.

COMPENSATION

211.04 Method of Measurement.

Preparation of the roadbed will be measured by the square yard.

211.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
PREPARATION OF ROADBED	SQUARE YARD

Payment for borrow excavation will be made according to Section 204.

Separate payment will not be made for subbase material used to correct deficiencies in raising the roadbed to the prescribed grade.

SECTION 212 - SOIL EROSION AND SEDIMENT CONTROL{ XE "SOIL EROSION AND SEDIMENT CONTROL" }

212.01 Description.

This work shall consist of the construction and maintenance of various temporary soil erosion and sediment control measures, including relocating them as required for stage construction.

MATERIALS

212.02 Materials.{ XE "Soil erosion and sediment control:materials" }

Haybales shall conform to Subsection 919.13 and shall be bound with wire or baling twine. The twine shall be an ultraviolet light stabilized polypropylene that has a knot strength of 170 pounds and straight break strength of 300 pounds.

Wood stakes, posts, and boards shall be solid, reasonably knot-free lumber conforming to the nominal size specified on the Plans.

Welded steel wire mesh fabric shall conform to Subsection 915.03.

Temporary riprap stones shall consist of a designated median stone (d_{50}) size in the range of 6 to 9 inches conforming to Subsection 901.04.

Coarse aggregate shall consist of broken stone or washed gravel conforming to Subsection 901.03.

Embankment shall be Zone 3 conforming to Subsection 203.03.

Pipe for temporary slope drains shall be a minimum size of 8 inches and shall conform to Section 913. End sections and elbows shall be of the same material as the pipe to which they are to be joined.

Other materials shall conform to the following Subsections:

Broken Stone	901.04
Mulch	909.04
Seed Mixtures	909.06
Sod	909.08
Topsoil Stabilization Matting	909.09
Miscellaneous Materials	909.11
Geotextiles	919.06

CONSTRUCTION

212.03 Construction Requirements.{ XE "Soil erosion and sediment control:construction requirements" }

The Contractor shall incorporate all permanent pollution control features into the Project at the earliest practicable time. Temporary soil erosion and sediment control measures shall be coordinated with the permanent pollution control features and with the construction of pavement, drainage facilities such as pipes, culverts, headwalls, channels, or ditches to the maximum extent practical to ensure economical, effective, and continuous erosion control throughout the life of the Contract, as outlined in the approved progress schedule specified in Subsection 108.04.

Before all grubbing operations, soil erosion and control measures shall be installed. When unstabilized areas caused by site development, grading, or other earth disturbing activities exist beyond 14 calendar days, the areas disturbed shall be seeded and mulched. These requirements pertain to perimeter controls, berms, dams, swales, ditches, and slopes. Upon completion of the grading or construction, disturbed areas shall be permanently stabilized within seven calendar days. Stabilization shall be according to Section 809.

When excavation or embankment construction reaches the finished subgrade, those areas on which paving is to be placed are exempt from the above stabilization requirements. Roadways and haul roads actively being used for daily conveyance of equipment, as well as areas between temporary berms, except median areas, are also exempt.

Streams shall be protected from soil erosion and sediment. Streams being diverted shall be protected through the use of silt fences. Temporary diversion channels shall be lined with geotextile fabric and temporary riprap.

The turbid discharge from dewatering construction activities shall be contained in a dewatering basin to control sediment and provide filtration of water before it being released into adjacent streams or other watercourses.

Soil being stockpiled shall be placed in well-drained areas no closer than 50 feet from streams, wetlands, floodplains, and other watercourses, unless otherwise directed. The stockpiles shall be seeded and mulched according to Sections 808 and 811. Adequate temporary soil erosion and sediment controls shall be provided around the stockpiles until such time as vegetation is established on the piles.

Temporary soil erosion and sediment control measures shall be used to correct conditions that develop during construction that were not foreseen during design, and may include construction work outside of the Project limits. These temporary measures will be paid for according to Section 104.

In the event that temporary soil erosion and sediment control measures are required due to the Contractor's failure, for any reason, to install or maintain soil erosion and sediment controls, either as part of the work or as directed, such work shall be performed by the Contractor at no cost to the State.

If the Contractor is not in compliance with soil erosion and sediment control provisions, corrective actions shall be taken immediately. The Engineer may suspend the work, wholly or in part, according to Subsection 108.15, until such time as the Contractor is fully in compliance. All corrective and remedial work required to bring the Contractor into compliance shall be performed at no cost to the State.

Temporary soil erosion and sediment control measures shall be removed when necessary to allow for the installation of permanent control features, or as permanent controls become functional. Before Acceptance, all items used for temporary soil erosion and sediment control shall be removed unless the Engineer directs that specific items remain in place.

212.04 Soil Erosion and Sediment Control Manager.{ XE "Soil erosion and sediment control:manager" }

The Contractor shall assign to the Project a supervisory-level employee to serve in the capacity of soil erosion and sediment control manager. This employee shall be thoroughly experienced in all aspects of soil erosion and sediment control and construction. The Contractor shall submit the name and applicable experience of this employee to the Engineer for approval at least fourteen calendar days before commencing any work on the Project. Any change in the appointment of the soil erosion and sediment control manager during the term of the Contract shall require a written submission and approval.

The soil erosion and sediment control manager shall have the primary responsibility and sufficient authority for implementing the approved soil erosion and sediment control schedules and methods of operations. The soil erosion and sediment control manager shall coordinate its operations with the Engineer, and shall oversee and supervise all aspects of soil erosion and sediment control on the Project. This includes both on-site and off-site activities, including those involving subcontractors.

The soil erosion and sediment control manager will be required to attend all soil erosion and sediment control meetings held during the life of the Project.

212.05 Limitations of Operations.{ XE "Soil erosion and sediment control:limitations of operations" }

Clearing and grubbing operations shall be so scheduled and performed that grading and mulching, seeding, and other permanent pollution control features can follow immediately thereafter according to the approved progress schedule. Should seasonal limitations make such coordination unrealistic, additional temporary soil erosion and sediment control measures shall be required between successive construction stages, as directed.

The amount of surface area of erodible earth material exposed at one time by clearing and grubbing, excavation, borrow, or fill operations, without stabilization, shall not exceed 17 acres for clearing and grubbing operations, or 17 acres for grading operations without prior approval. The Engineer may increase or decrease these amounts commensurate with the Contractor's capability and progress in keeping the construction current with the approved progress schedule.

212.06 Soil Erosion and Sediment Control Measures.{ XE "Soil erosion and sediment control:measures" }

{ XE "Silt fence" **}A. Silt Fence.** Silt fence shall consist of geotextile fabric at least 3 feet wide to provide for a 2-foot high fence after 1 foot of fabric is buried in the existing soil. Heavy duty silt fence shall consist of geotextile fabric at least 4 feet wide to provide for a 3-foot high fence after 1 foot of fabric is buried in the existing soil. Sections of fabric shall be overlapped a minimum of 1 foot - 6 inches then joined in such a manner that, when in operation, the sections work effectively as a continuous fence. Fence posts shall be installed at a slight angle toward the anticipated runoff source.

Heavy-duty silt fence shall include a welded wire mesh backing for the geotextile fabric. This welded steel wire mesh shall be galvanized and contain 6-inch openings. The geotextile fabric shall be secured to the welded wire mesh.

{ XE "Haybale check dams with temporary stone outlets" **}B. Haybale Check Dams With Temporary Stone Outlets.** Haybales shall be embedded 4 inches into the ground and anchored in place with two wood stakes per bale. The temporary stone outlets, consisting of riprap stones conforming to the requirements for temporary riprap, shall be placed in the center of each flow line. Coarse aggregate size No. 2 shall be placed immediately upgrade of each stone outlet.

The riprap stones and coarse aggregate shall be placed on geotextile fabric that shall be buried in the soil. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 1 foot - 6 inches in the direction of flow.

C. Temporary Stone Check Dams. Temporary stone check dams shall be constructed in ditches to reduce flow velocity.

The check dams shall consist of riprap stones conforming to the requirements for temporary riprap. Coarse aggregate size No. 2 shall be placed immediately upgrade of each check dam.

The riprap stones and coarse aggregate shall be placed on geotextile fabric that shall be buried in the soil. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 1 foot - 6 inches in the direction of flow.

D. Temporary Slope Drains. Temporary slope drains shall be installed on embankment slopes to intercept surface runoff where concentrated runoff will cause excessive erosion of the slope.

The drainpipe shall be staked to the slope or secured with riprap stones to prevent movement or displacement. A flared end section shall be attached at each end of the pipe, and elbows shall be installed as required to conform with the existing changes in slopes.

A temporary earth berm and haybales shall be constructed at the top of slope in the vicinity of the slope drain to intercept runoff and channel the runoff to the slope drain. The haybales shall be embedded 4 inches into the ground and anchored in place with two wood stakes per bale.

Riprap stones, conforming to the requirements for temporary riprap, shall be placed loosely at both ends of the pipe to prevent scour. The riprap stones shall be placed on geotextile fabric that, at the top of slope, shall be draped over the earth berm. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 1 foot - 6 inches in the direction of flow.

{ XE "Inlets:filters" **}E. Inlet Filters.** Inlet filters, consisting of welded wire mesh and geotextile fabric shall be installed to control sedimentation at new inlet drainage structures. Inlet filters of geotextile fabric alone shall be installed to control sedimentation at existing inlet drainage structures.

For new inlet structures, welded steel wire mesh shall be molded around the inlet frames and grates, or inlet structures, and extend a minimum of 6 inches down each side of the new structures. Geotextile fabric shall then be secured to the welded wire mesh. Coarse aggregate size No. 8 shall be placed against the inlet structures to hold the inlet filter in place.

For existing inlet structures, geotextile fabric shall be placed under the grates, over the curb pieces, and extend a minimum of 6 inches beyond. Coarse aggregate size No. 8 shall be placed behind each curb piece and on the geotextile fabric to secure the fabric in place.

Openings required in new inlet walls to provide for temporary drainage shall be covered with welded wire mesh, geotextile fabric, and coarse aggregate size No. 8.

Inlet filters shall be removed the same day as scheduled paving operations.

{ XE "Inlets:protection, haybale barrier" **}F. Inlet Protection, Haybale Barrier.** Inlet protection, haybale barrier shall consist of haybales that completely encircle inlet drainage structures. The perimeter length of the haybale barrier shall be at least four times the perimeter length of the inlet structure. Haybales shall not encroach into the traveled way.

Haybales placed around inlet structures within earthen areas shall be embedded 4 inches into the ground and anchored in place with two wood stakes per bale. Haybales placed around inlet structures within pavement areas shall only be placed on top of the pavement and tied together to prevent movement. Haybales placed on pavement areas shall not be anchored in place.

{ XE "Inlets:sediment traps" **}G. Inlet Sediment Traps.** Inlet sediment traps, consisting of silt fence and temporary stone inlets, shall be constructed to control sedimentation at existing and new inlet drainage structures.

The silt fence shall consist of geotextile fabric whose width shall be at least 3 feet to provide for a 2-feet high fence after 1 foot of fabric is buried in the existing soil. Sections of fabric shall be overlapped a minimum of 1 foot - 6 inches then joined in such a manner that, when in operation, the sections work effectively as a continuous fence. The silt fence shall be installed around the drainage structure and meet into the stone inlets. Fence posts shall be installed at a slight angle toward the anticipated flow.

The temporary stone inlets, consisting of coarse aggregate size No. 2, shall be placed in each flow line upgrade of the inlet structure. The coarse aggregate shall be placed on geotextile fabric that shall be buried in the soil. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 1 foot - 6 inches in the direction of flow.

{ XE "Floating turbidity barriers" **}H.Floating Turbidity Barriers.** Floating turbidity barriers, consisting of 10 mil thick polyethylene plastic sheets suspended from floats, shall be installed in streams or other watercourses to intercept silt outletting from drainage pipes, or caused by construction operations within the waterways.

Barriers shall be located 50 feet from the point of discharge of drainage pipes, or from construction operations affecting the waterways. The barriers shall extend across the entire waterway or radially from the shore line.

I. Temporary Stone Outlet Sediment Traps. Temporary stone outlet sediment traps, consisting of temporary basins and riprap spillways, shall be constructed within existing, new, and temporary ditches.

The spillways shall consist of riprap stones conforming to the requirements for temporary riprap. Coarse aggregate size No. 2 shall be placed immediately upgrade of the spillways.

The riprap stones and coarse aggregate shall be placed on geotextile fabric that shall be buried in the soil. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 1 foot – 6 inches in the direction of flow.

J. Dewatering Basin. Dewatering basins shall be constructed within the ROW of the Project and outside of any undisturbed wetland area, and areas not affected by roadway construction, as a dewatering containment measure to control sediment and provide filtration of water.

The Contractor shall size the dewatering basins to entirely contain the expected discharge of water and sediment based on the flow rate of the pump to be used and the volume of area to be dewatered. The material to be used to form the basin is at the discretion of the Contractor. The outfall of the basin shall be such that the water exiting the basin does not cause erosion to or scour the area onto which the water is being discharged.

212.07 Dust and Dirt Control Measures.{ XE "Soil erosion and sediment control:dust and dirt control" }

A. Dust Control. The Contractor shall employ construction methods and means that keep flying dust to the minimum. The Contractor shall also sprinkle water on the Project and on roads, streets, and other areas immediately adjacent to the Project limits, wherever pedestrian or vehicular traffic, or buildings that are occupied or in use are affected by such dust caused by the Contractor's hauling or other construction operations.

B. Dirt Control. The Contractor shall provide for prompt removal from existing roadways of all dirt and other materials that have been spilled, washed, tracked, or otherwise deposited thereon by its hauling and other operations whenever the accumulation is sufficient to cause the formation of mud, interfere with drainage, damage pavements, or create a traffic hazard.

To minimize tracking of dirt and other materials onto existing roadways, a construction driveway shall be constructed at locations where vehicles exit a work site.

The construction driveway shall consist of a layer of broken stone which shall be a minimum 4 inches thick and 100 feet long where practical, and of sufficient width to serve the intended purpose. The broken stone shall be 2½ inches nominal size, the driveway shall be maintained by top dressing with additional stone, as directed, and shall be removed when no longer required.

212.08 Soil Erosion and Sediment Control Maintenance.{ XE "Soil erosion and sediment control:maintenance" }

Soil erosion and sediment control measures shall be maintained during the construction season as well as during winter months and other times when the Project is closed down, throughout the life of the Project, to ensure that the measures function properly. Soil erosion and sediment controls shall be immediately inspected after each rain, and any corrective work shall immediately be performed to return the soil erosion and sediment control measures to proper function, as directed. Riprap stones, coarse aggregate, silt fence, or haybales damaged due to washouts or siltation shall be replaced as directed.

Sediment traps and basins shall be cleaned out when they are 50 percent filled. Silt fences, stone outlet structures, dams, and haybales shall have sediment removed when the sediment reaches 50 percent of the height of the soil erosion and sediment control measure. Sediment removed shall be disposed of according to Subsection 202.12.

The Contractor shall maintain the floating turbidity barrier by cleaning it periodically and keeping it free from debris to ensure its proper function throughout the duration of the Project, at no additional cost to the State.

COMPENSATION

212.09 Method of Measurement.

Silt fence of the various types will be measured by the linear foot.

Haybale check dams with temporary stone outlets will be measured by the linear foot.

Temporary stone check dams will be measured by the cubic yard.

Temporary slope drains will be measured by the linear foot.

Inlet filters will be measured by the unit.

Inlet protection, haybale barriers will be measured by the unit. A unit shall consist of the total number of haybales necessary to encircle the inlet structure.

Inlet sediment traps will be measured by the unit.

Floating turbidity barriers will be measured by the linear foot.

Temporary stone outlet sediment traps of the various sizes will be measured by the unit.

Dewatering basins will be measured by the unit.

Construction driveway will be measured by the ton.

Roadway excavation, temporary erosion control, required for the construction of temporary berms and ditches, and required for maintenance clean-out of the various soil erosion and sediment controls will be measured by the cubic yard.

Embankment, temporary erosion control, required for the construction of temporary berms and ditches, will be measured by the cubic yard.

Temporary riprap for ditches and channels will be measured by the cubic yard. Geotextile for ditches and channels will be measured by the square yard.

Haybales required as directed and for maintenance replacement of bales for the various soil erosion and sediment controls will be measured by the unit.

212.10 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SILT FENCE	LINEAR FOOT
HEAVY DUTY SILT FENCE	LINEAR FOOT
HAYBALE CHECK DAM WITH TEMPORARY STONE OUTLET	LINEAR FOOT
TEMPORARY STONE CHECK DAM	CUBIC YARD
TEMPORARY SLOPE DRAIN	LINEAR FOOT
INLET FILTERS	UNIT
INLET PROTECTION, HAYBALE BARRIERS	UNIT
INLET SEDIMENT TRAPS	UNIT
FLOATING TURBIDITY BARRIER	LINEAR FOOT
TEMPORARY STONE OUTLET SEDIMENT TRAPS, ___ ' X ___ '	UNIT
DEWATERING BASINS	UNIT
CONSTRUCTION DRIVEWAY	TON
ROADWAY EXCAVATION, TEMPORARY EROSION CONTROL	CUBIC YARD
EMBANKMENT, TEMPORARY EROSION CONTROL	CUBIC YARD
TEMPORARY RIPRAP	CUBIC YARD
GEOTEXTILE	SQUARE YARD
HAYBALES	UNIT

Payment for silt fence or heavy duty silt fence, for maintenance replacement for the various soil erosion and sediment controls, will be made under their respective "Silt Fence" Pay Item.

Payment for top dressing of construction driveways with additional stone will be made under the Pay Item "Construction Driveway."

Payment for temporary riprap for maintenance replacement for the various soil erosion and sediment controls will be made under the Pay Item "Temporary Riprap."

Payment for the various sizes of coarse aggregate for maintenance replacement for the various soil erosion and sediment controls will be made according to Section 302.

Payment for topsoil stabilization matting will be made according to Section 809.

Separate payment will not be made for dust control. All costs thereof shall be included in the prices bid for the various Pay Items scheduled in the Proposal.

DIVISION 300 CONTENTS

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DIVISION 300 - BASE COURSES{ XE "BASE COURSE" }{ XE "SOIL AGGREGATE:BASE COURSE" }

SECTION 301 - SOIL AGGREGATE BASE COURSE AND DENSE-GRADED AGGREGATE BASE COURSE{ XE "BASE COURSE:SOIL AGGREGATE" }{ XE "BASE COURSE:DENSE-GRADED AGGREGATE" }{ XE "DENSE-GRADED AGGREGATE:BASE COURSE" }

301.01 Description.

This work shall consist of the construction of base courses of soil aggregate and dense-graded aggregate and the reconstruction of soil aggregate base course.

MATERIALS

301.02 Materials.

Materials shall conform to the following Subsections:

Dense-Graded Aggregate 901.08
Soil Aggregate 901.09

EQUIPMENT

301.03 Equipment.

Spreading equipment shall include an aggregate spreader that can be adjusted to spread to the specified depth, without segregation, and one or more motor graders. The compaction equipment shall be pneumatic-tired rollers or dynamic compactors complying with Subsection 203.04.

CONSTRUCTION

301.04 New Base Course.

A. Preparation of Subgrade or Subbase. Before placing base course material on the subgrade, the surfaces shall conform to Subsection 208.04. Before placing base course material on subbase, the surfaces shall conform to Subsection 209.03.

B. Placing and Spreading. Material shall not be placed when the subgrade or subbase is frozen or when it is unstable because of excessive moisture. The base course material shall be spread with mechanical spreaders except in limited or restricted areas. If approved, the material may be dumped in windrows or end dumped. Material dumped in windrows or end dumped shall be spread so as to eliminate segregation and all ruts and ridges caused by dumping or hauling over the material.

301.05 Compaction.

{ XE "Compaction:acceptance" **}**Compaction of each layer shall continue until the material complies with the compaction acceptance testing requirements of Subheading 2 of the fifth paragraph below. The in-place dry density of each compacted layer will be determined according to AASHTO T 191, T 205, or T 238, Method B, and T 239 except that only one method will be used throughout the Project.

The base course shall be constructed in layers not exceeding a compacted thickness of 8 inches, and according to the surface tolerances specified in Subsection 209.03.

If the required compacted depth of the base course exceeds 8 inches, the base course shall be constructed in two or more layers of approximately equal thickness. Each layer shall be compacted as specified above.

Water shall be applied uniformly over the materials during compaction in the amount necessary to obtain the required density.

Compaction of the base course shall conform to the following:

{ XE "Base course:soil aggregate:control strips" **}1. Control Strips.** One or more control strips shall be constructed for the purpose of determining compaction requirements. One control strip shall be constructed at the beginning of work. Additional control strips shall be constructed whenever a change is made in the type or source of material and whenever a significant change occurs in the composition of the material from the same source. Each control strip shall consist of an area of at least 400 square yards. The thickness shall be

the same as for completed courses in the pavement section. Each control strip shall remain in place and become a portion of the completed base course.

The material used in each control strip shall be furnished from the same source and shall be of the same type as the material used in the base course whose compaction requirements are established by that control strip. Moisture content of the test strip material shall be within two percent of its optimum moisture content as determined from AASHTO T 99, Method C including replacement option. Compaction of control strips shall be accomplished using the same type and weight of equipment that is to be used for compaction of the remainder of the base course.

The material upon which a control strip is to be constructed must be approved before the construction of the control strip.

The control strip shall be compacted by a minimum of two complete passes with the compaction equipment. A pass is defined as one passage of any one tire, compacting wheel or vibrating unit over the entire surface of the layer. Compaction shall continue until no appreciable increase in density is obtained by additional passes. For this purpose, between successive passes, three density determinations will be made using the same apparatus as is to be used for acceptance testing.

Upon completion of compaction, a minimum of ten tests will be made at random locations to determine the average in-place dry density of the control strip. If the average density of the material in the control strip is equal to or greater than 95 percent of its maximum density, as determined from AASHTO T 99, Method C, including replacement option, then the value of this average shall be the reference maximum density for courses of the same materials and thicknesses. A control strip satisfying the 95 percent of AASHTO T 99, Method C, density requirement shall be established before construction of the additional base courses. If this density level in the control strip is not achieved, the compaction equipment and/or its method of use will be rejected.

2. **Compaction Acceptance Testing.** For the purpose of checking conformance to the compaction requirements, the base course will be divided into lots consisting of approximately 5,000 square yards or 1,000 cubic yards. Each lot of completed base course will be tested for compliance.

   To be acceptable, as determined by the formula below, a lot must have not more than 20 percent of the lot area with a dry density of less than 95 percent of the reference maximum density. If a lot fails to meet this requirement, it shall be reworked and recompacted and shall be resubmitted for acceptance testing.

   The percent of lot area with a dry density less than 95 percent of the reference maximum density shall be determined from the calculated value of the term Q. Q shall be equal to or greater than 0.36.

   The term Q is defined as:

$$Q = \frac{\text{Average Lot Density - 0.95 of the Reference Maximum Density}}{\text{Range of Lot Density}}$$

   where average lot density is the average dry density of five randomly selected locations in the lot and the range of lot density is the absolute difference between the lowest and highest dry density values recorded at these same five locations. The five locations for density tests will be determined by the use of a table of random numbers. One density determination will be made at each of the selected locations using AASHTO T 191, T 205, or T 238, Method B, and T 239 except that only one method will be used throughout the Project. The specified density of all completed lots shall be maintained.

3. **Waiving Standard Compaction Requirements.** When the Special Provisions waive the requirements of Subheadings 1 and 2 above and no alternative method is specified, the base course shall be placed and compacted according to Subsection 203.09.

301.06 Thickness.

The thickness will be measured at a frequency not exceeding 500 feet or as established by means of test holes or other methods. Test holes shall be refilled with base course material and the material recompacted. Any deficiency in total thickness of the base course, in excess of 1 inch, shall be corrected by reconstructing the base course as specified in Subsection 301.07.

301.07 Reconstructed Soil Aggregate Base Course.{ XE "Soil aggregate:reconstructed" }

The existing soil aggregate base course shall be scarified thoroughly to a depth of 3 to 4 inches. Scarified material containing an excess of clay or other unsatisfactory materials shall be removed and replaced with new soil aggregate. If

necessary, new soil aggregate shall be added to obtain the required grade. The new soil aggregate shall be added while the existing surface is in a loose, scarified condition and shall be mixed with the existing soil aggregate.

301.08 Maintenance Under Traffic.

When it is provided in the Special Provisions that traffic is permitted to ride on the completed base course, the base course shall be maintained smooth and uniform until covered by the following stage of construction.

COMPENSATION

301.09 Method of Measurement.

Soil aggregate base course and dense-graded aggregate base course, of the various thicknesses, will not be measured and payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided for in Subsection 109.01.

Reconstructed soil aggregate base course will be measured by the square yard.

New soil aggregate required for reconstruction of soil aggregate base course will be measured by the cubic yard based on the volume in the hauling vehicle according to Subsection 109.01.

301.10 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SOIL AGGREGATE BASE COURSE, ___ " THICK	SQUARE YARD
SOIL AGGREGATE BASE COURSE, VARIABLE THICKNESS	CUBIC YARD
DENSE-GRADED AGGREGATE BASE COURSE, ___ " THICK	SQUARE YARD
DENSE-GRADED AGGREGATE BASE COURSE, VARIABLE THICKNESS	CUBIC YARD
RECONSTRUCTED SOIL AGGREGATE BASE COURSE	SQUARE YARD
SOIL AGGREGATE, DESIGNATION ___	CUBIC YARD

SECTION 302 - ROAD-MIXED STABILIZATION{ XE "ROAD-MIXED STABILIZATION" }{ XE "BASE COURSE:ROAD-MIXED STABILIZATION" }

302.01 Description.

This work shall consist of the construction of base course of existing soil aggregate mixed in place with a stabilizing agent.

MATERIALS

302.02 Materials.

Materials shall conform to the following Subsections:

- Coarse Aggregate 901.03
- Soil Aggregate 901.09
- Water 919.15
- Stabilizing Agents:
  - Bituminous Materials:
    - Cut-Back Asphalt, Grade MC-250 or MC-800 ..... 904.02
    - Emulsified Asphalt, Grade SS-1, SS-1h, CSS-1, or CSS-1h 904.03
    - Inverted Emulsified Asphalt, Grade IEMC-250 or IEMC-800 ..... 904.04
  - Calcium Chloride 919.03
  - Fly Ash 919.07
  - Hydrated Lime 919.09
  - Portland Cement 919.11
- Curing Materials:
  - Emulsified Asphalt, Grade SS-1, SS-1h, CSS-1, or CSS-1h 904.03
  - Polyethylene Sheeting 905.03
  - Waterproof Paper 905.03
  - Water 919.15

302.03 Sampling.

The following quantities of samples shall be submitted for testing and for determination of a design mix at least 45 days before construction of road-mixed stabilized base course:

Aggregates	200 lb
Bituminous Materials	1 gal
Fly Ash	50 lb
Hydrated Lime	25 lb
Portland Cement	25 lb

EQUIPMENT

302.04 Equipment.

Equipment shall include a traveling plant with a rotary mixer capable of mixing the components to a uniform consistency and thickness and proper grade control, motor graders, pneumatic-tired or steel-wheeled vibratory rollers, 10-ton, three-wheel or tandem rollers, and such other equipment and small tools as may be required. The rollers shall conform to Subsection 203.04.

The traveling plant shall be self-propelled or tractor drawn and be capable of maintaining a uniform rate of travel while mixing. It shall be mounted on wheels or tracks of such type that, when loaded to capacity, it does not rut or damage the subgrade or subbase. For bituminous stabilization, the mixer shall be capable of mixing so as to ensure that all particles are completely coated.

Other machines capable of accomplishing the required results in one pass, in regard to both uniformity and depth, are acceptable.

CONSTRUCTION

302.05 Limitations.

Stabilization will not be permitted when the materials to be stabilized are frozen or excessively wet. Emulsions shall be used only when the air temperature is above 50 ºF. Other types of stabilization shall not be started until the surface temperature is at least 40 ºF.

Lime-fly ash stabilization will not be allowed from September 30 to April 1. Portland cement stabilization will not be allowed from October 30 to April 1. No form of stabilization will be allowed in rainy or snowy weather.

302.06 Addition of Aggregates.

When new soil aggregate or coarse aggregate is used for blending or to obtain grade, it shall be added to and placed uniformly on the existing soil aggregate before placement of the stabilizing agent.

302.07 Application of Stabilizing Agent.{ XE "Road-mixed stabilization:application of stabilizing agents" }

A. Rate of Application. Calcium chloride shall be applied at the rate of ½ pound per square yard per inch of compacted depth. Lime-fly ash, portland cement, and bituminous materials shall be applied at the rate specified in the design mix.

B. Spreading. Stabilizing agents shall not be spread or distributed more than two hours before they are to be mixed with the materials to be stabilized. Calcium chloride, portland cement, or lime-fly ash shall not be applied when the moisture content of the windrowed or blanket material exceeds the optimum moisture content of the design mix by more than two percent. For bituminous stabilizing agents, the range of moisture content of the soil aggregate shall be as prescribed in the design mix. The optimum moisture content shall be determined according to AASHTO T 99, Method C, including replacement option.

Windrow type operations will be allowed only when a traveling plant specifically designed for this purpose is used.

The soil aggregate shall be spread to a uniform thickness to the width required. The specified quantity of portland cement, lime-fly ash, or calcium chloride shall be applied uniformly in a trench on top of the windrow or spread uniformly over the aggregate. Stabilizing agent that is lost shall be replaced, without additional compensation, before mixing is started.

302.08 Mixing.{ XE "Road-mixed stabilization:mixing" }

The soil aggregate and stabilizing agent shall be mixed thoroughly to the required depth by means of a traveling plant with a rotary mixer. Water, as required, shall be added from the traveling plant or a metered water truck and shall be mixed with soil aggregate and the stabilizing agent. Mixing shall be continued until the mixture is uniform in

appearance. If more than one pass of the mixer is required, at least one pass shall be made before water or bituminous material is added.

The moisture content of the portland cement, lime-fly ash, or chloride soil aggregate mixture, at the time of a final mixing, shall not vary from the optimum moisture content by more than two percent. Where the application of lime-fly ash creates an unacceptable dust condition, the lime-fly ash may be moistened or the specified quantities of fly ash and lime may be preblended (with or without a portion of the aggregate) with water before application to the soil aggregate or addition to the mixer.

The maximum thickness of a compacted layer shall be 8 inches. When the compacted base course thickness is required to be greater than 8 inches, it shall be constructed in approximately equal depth lifts.

The time between placement of subsequent lifts of lime-fly ash stabilization should be kept as short as possible to ensure that the lower layer has not set up and to ensure bonding with the upper layer. The lower layer shall be kept free of loose material, dirt, or sand. Otherwise, the lower layer shall be lightly scarified to a depth of 1 inch before placement of subsequent layers. Placement of the subsequent lift shall be within four hours.

Subsequent layers of bituminous stabilization containing emulsions shall not be placed for three days. When MC grade cut-back asphalts are used, subsequent layers shall not be placed for five days.

Portland cement stabilization shall not be used for multiple lifts.

If the stabilized material is placed in multiple lanes, the maximum time for placement of an adjacent lane shall be the same as the time permitted between multiple lifts. Adjacent lanes of bituminous material may be laid without delay. For adjacent lanes of portland cement stabilization, the second lane shall be mixed within two hours after the water is added to the first lane.

302.09 Compaction, Shaping, and Finishing.{ XE "Road-mixed stabilization:compaction" }{ XE "Road-mixed stabilization:shaping and finishing" }

A. Compaction. Pneumatic-tired rollers or vibratory rollers shall be used to provide initial compaction of the mixture.

One or more control strips shall be constructed, according to Subsection 301.05, for the purpose of determining the moisture content and density requirements. Any change in the source of materials or methods of construction requires the construction of a new control strip. Each control strip shall remain in place and become a portion of the completed base course. The in-place dry density of each compacted course will be determined according to AASHTO T 191, T 205, or T 238, Method B and T 239 except that only one method will be used throughout the Project.

When portland cement is used as the stabilization agent, the base course shall be compacted at the specified moisture content and with the same equipment and number of passes used to achieve the reference maximum density in the control strip. In inaccessible areas, portland cement stabilized base course shall be compacted to 95 percent of the reference maximum density obtained in the control strip.

For all other stabilizing agents the base course shall be compacted at the specified moisture content to 95 percent of the reference maximum density determined in the control strip.

B. Shaping and Finishing. After the mixture has been compacted, but before the initial set, the surface shall be shaped to the required grade and cross-section. When necessary, the surface shall be lightly scarified with a drag harrow or similar equipment to produce a smooth and uniform surface. The final surface shall be rolled with a tandem roller. The moisture content of the surface material shall be maintained within plus or minus two percent of the specified optimum during finishing operations. Compacting and finishing operations shall be completed within the specified times and shall produce a smooth, dense surface. During the final finishing of the portland cement stabilization, or lime-fly ash stabilization, accumulated material shall be removed.

The number of compaction and finishing units shall be sufficient to ensure completion of the initial compaction within two hours for portland cement and four hours for lime-fly ash, from the time the water is added at the mixer. The final finishing and compaction shall be completed within four hours for portland cement and within eight hours for other stabilizers from the time of mixing.

302.10 Construction Joints.{ XE "Road-mixed stabilization:construction joints" }

At the beginning of each day's construction, a straight transverse construction joint shall be formed by cutting back into the previously completed work to form a true vertical face free of loose or shattered material. For multiple lane and multiple layer sections, the construction joints shall be offset by at least 5 feet.

302.11 Surface and Thickness{ XE "Road-mixed stabilization:surface testing with straightedge" }.

The surface will be tested using a Straightedge at random locations. The variation of the surface from the testing edge of the Straightedge between any two contacts with the surface shall at no point exceed ¾ inch. All depressions exceeding ¾ inch shall be corrected by removing the entire layer and replacing it with new material. High spots may be removed by methods that provide an acceptable surface.

The thickness of the base course will be determined from the test holes dug at random locations at intervals not to exceed 500 feet. If the measured thickness deviates by plus ¾ inch or minus ½ inch from that specified, the base course shall be reconstructed or replaced. Test holes shall be filled with base course material and recompacted.

302.12 Curing and Protection.{ XE "Road-mixed stabilization:curing" }

{ XE "Base course:road-mixed stabilization:bituminous" **}A. Bituminous Stabilization.** No curing material shall be applied. The length of curing time before surface treatment or other surfacing shall be as specified in Subsection 302.08.

B. Calcium Chloride Stabilization. No curing material is required.

{ XE "Base course:road-mixed stabilization:portland cement" **}{** XE "Base course:road-mixed stabilization:lime-fly ash" **}C. Portland Cement or Lime-Fly Ash Stabilization.** If the next layer is to be placed within 72 hours, curing material is not required. If the next layer is not to be placed within 72 hours, the curing material shall be applied as soon as possible but not later than 24 hours after completion of the finish operation. The finished base course shall be kept moist continuously until the curing material or next layer is placed. Placement of the next layer shall not occur within 12 hours after the application of the curing material. The curing material shall be maintained for a seven-day period so that all of the base course is covered during the period, unless the subsequent layer is constructed within the seven-day period.

The emulsified asphalt curing material shall be diluted with an equal volume of water by the manufacturer. Each shipment of the material shall include a certified statement specifying the rate of dilution. The rate of application of the diluted emulsions shall be 0.10 to 0.25 gallons per square yard.

If it is necessary for construction equipment or other traffic to use the surface before the bituminous material has dried sufficiently to prevent pickup, a cover, consisting of clean sand passing a ⅜-inch sieve or other material, shall be applied. All material placed for this purpose shall be removed before placement of the next lift.

Portland cement and lime-fly ash base courses shall be protected from freezing for seven days after construction.

302.13 Maintenance Under Traffic.

Maintenance shall be according to Subsection 105.19.

COMPENSATION

302.14 Method of Measurement.

Road-mixed stabilized soil aggregate base course of the various thicknesses will be measured by the square yard.

Bituminous material used as a stabilizing agent or curing material will be measured by the gallon based on the volume as determined by the temperature-volume correction factors according to Subsection 904.06.

Calcium chloride, lime, fly ash, and portland cement used as stabilizing agents will be measured by the ton.

New soil aggregate and coarse aggregate will be measured by the cubic yard based on the volume in the hauling vehicle according to Subsection 109.01.

302.15 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
STABILIZED SOIL AGGREGATE BASE COURSE, ROAD-MIXED, ___ " THICK	SQUARE YARD
STABILIZING AGENT, BITUMINOUS MATERIAL	GALLON
STABILIZING AGENT, CALCIUM CHLORIDE	TON
STABILIZING AGENT, FLY ASH	TON
STABILIZING AGENT, LIME	TON
STABILIZING AGENT, PORTLAND CEMENT	TON
CURING MATERIAL, BITUMINOUS	GALLON
COARSE AGGREGATE, SIZE NO. ___	CUBIC YARD

Payment for new soil aggregate will be made according to Section 301.

SECTION 303 - PLANT-MIXED STABILIZATION{ XE "PLANT-MIXED STABILIZATION" }{ XE "BASE COURSE:PLANT-MIXED STABILIZATION" }

303.01 Description.

This work shall consist of the construction of base course of soil aggregate and stabilizing agent mixed in a drum or in a batch-type pugmill, and hauled to the Project.

MATERIALS

303.02 Materials and Sampling.

The materials shall be as specified in Subsection 302.02. Samples for testing and for determination of a design mix shall be submitted according to Subsection 302.03.

EQUIPMENT

303.03 Equipment.

The equipment shall be as specified in Subsection 302.04 and in the following Subsections.

CONSTRUCTION

303.04 Limitations.

Limitations on the construction of plant-mixed stabilization shall be according to Subsection 302.05.

303.05 Mixing.

The soil aggregate, stabilizing agent, and water, when necessary, shall be mixed in a stationary or portable mixer equipped with batching or metering devices to measure the quantities of soil aggregate, stabilizing agent, and water, by weight or volume. A bituminous batch-type plant or drum-mixing plant conforming to Subsection 404.04 may be used for mixing these materials.

For a continuous type plant, the pugmill shall be equipped with adjustable paddles or an adjustable baffle that can be locked in position at the discharge end of the pugmill. Either device shall be used to advance or retard the mixture flow through the pugmill to achieve adequate mixing. The plant shall have a manufacturer's plate giving the net volumetric content of the mixer, at several heights, inscribed on a permanent gauge.

A surge hopper with rotary vane or belt feeder shall be used to introduce materials into the mixer. The capacity of the plant shall not be less than 50 tons per hour.

{ XE "Base course:plant-mixed stabilization:lime-fly ash" **}{** XE "Base course:plant-mixed stabilization:portland cement" **}**Lime, fly ash, and cement shall be stored in vertical silos. Fly ash previously stored in open stockpiles shall not be used. Bituminous materials shall be stored in tanks equipped with heating devices.

The soil aggregate shall be loaded into a single compartment bin from a stockpile, or it shall be loaded into multiple bins where the material is to be made by blending to meet gradation requirements.

{ XE "Base course:plant-mixed stabilization:bituminous" **}**For bituminous stabilization, the soil aggregate shall be fed into the plant and combined with emulsified asphalt. Mixing shall be continued until the aggregate is uniformly coated.

For other stabilizers prepared in a batch type plant, the dry materials shall be blended for a period of not less than 15 seconds per cubic yard or three revolutions of the mixing drum, before the introduction of water, when necessary. Water shall be added in sufficient quantity to achieve optimum moisture content according to AASHTO T 99, Method C, including replacement option. The minimum mixing time will be determined from three trial runs.

When non-bituminous stabilizers are prepared in a continuous mixing plant, the mixing time will be determined according to AASHTO M 156 as follows:

$$\text{Mixing Time in Seconds} = \frac{\text{Pugmill Capacity in Pounds}}{\text{Output in Pounds per Second}}$$

The minimum mixing time will be established based on a visual inspection of the output of the dry materials.

Details for anticipated plant operations and layout shall be submitted.

303.06 Preparation of Subgrade or Subbase.

The preparation of subgrade shall be according to Subsection 208.04. The preparation of subbase shall be according to Subsection 209.03.

303.07 Hauling.

The mixture shall be transported from the central plant in vehicles that prevent segregation and loss of moisture and fine materials.

303.08 Spreading.

The mixture shall be delivered to the prepared subgrade or subbase and spread as uniformly as possible with a minimum of manipulation to prevent segregation. Spreader boxes, tracked asphalt laydown machines, or similar equipment with automatic grade control shall be used.

The maximum thickness of a compacted layer shall be 8 inches. When the compacted base course is required to be greater than 8 inches, it shall be constructed in approximately equal depth lifts.

For bituminous stabilization, placement of subsequent layers shall be according to Subsection 302.08.

For portland cement and lime-fly ash stabilization, the time between placement of subsequent lifts should be kept as short as possible to ensure that the lower layer has not set up and to ensure bonding with the upper layer. The lower layer shall be kept free of loose material, dirt or sand; otherwise, the lower layer shall be lightly scarified to a depth of 1 inch before placement of the next layer. The lower layer shall be moistened as required before placement of the subsequent layer.

Placement of the subsequent layer shall be within two hours for portland cement stabilization and within four hours for lime-fly ash stabilization.

If the stabilized material is placed in multiple lanes, the maximum time for placement of an adjacent lane shall be the same as the time permitted between multiple lifts, however, adjacent lanes of bituminous stabilization may be placed without delay.

303.09 Compaction, Shaping, and Finishing.

Compaction, shaping, and finishing operations shall be according to Subsection 302.09.

303.10 Construction Joints.

Construction joints shall be according to Subsection 302.10.

303.11 Surface and Thickness.

Surface and thickness requirements shall be according to Subsection 302.11.

303.12 Curing and Protection.

Curing and protection of the various stabilizations shall be according to Subsection 302.12.

303.13 Maintenance Under Traffic.

Maintenance shall be according to Subsection 105.19.

COMPENSATION

303.14 Method of Measurement.

Plant-mixed stabilized soil aggregate base course of the various thicknesses will be measured by the square yard.

303.15 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
STABILIZED SOIL AGGREGATE BASE COURSE, PLANT-MIXED, ___ " THICK	SQUARE YARD

Separate payment will not be made for the stabilizing agent.

SECTION 304 - LIME-POZZOLAN STABILIZED BASE COURSE{ XE "BASE COURSE:LIME-POZZOLAN STABALIZED" }

304.01 Description.

This work shall consist of constructing a base course of dense-graded aggregate and lime-pozzolan mixed in a continuous or batch-type pugmill plant.

MATERIALS

304.02 Materials.

Aggregate shall conform to Subsection 901.08 except that not more than six percent shall pass the No. 200 sieve. The aggregate combined with the design proportions of lime, fly ash, and water shall produce a mixture conforming to the following:

Method of Test	Limitation
AASHTO T 89	Liquid limit less than 25%
AASHTO T 90	Plasticity index less than 6%

The results of these tests shall be reported as part of the mix design.

Stabilizing agents shall be as follows:

1. Hydrated lime shall conform to Subsection 919.09 with the following modifications:
   a. Total calcium and magnesium oxides on a nonvolatile basis shall not be less than 90 percent by weight.
   b. Mechanical moisture in hydrated lime, as received, shall be less than four percent when tested according to ASTM C 25.
2. Fly ash shall conform to Subsection 919.07 and to the following when tested according to ASTM C 311:

	Limitation
Loss on Ignition	10% Maximum
Combined Silica and Aluminum Oxide	60% Minimum
Moisture	0.5% Maximum

	Sieve Designation	Minimum Percent Passing
Gradation Requirement (When Wet Washed and Dry Sieved)	No. 200	85
	No. 325	80

Bituminous curing materials shall conform to Subsection 904.03 for emulsified asphalt, Grade SS-1 or SS-1H, and for cationic emulsified asphalt, Grade CSS-1 and CSS-1H.

Water shall conform to Subsection 919.15.

304.03 Sampling.

Sampling of aggregate, fly ash, and hydrated lime shall be according to Subsection 302.03.

EQUIPMENT

304.04 Equipment.

The traveling plant, such as an asphalt laydown machine, shall be capable of maintaining a uniform rate of travel while placing and spreading a lift of uniform consistency and thickness. The traveling plant shall have automatic grade control.

Other machines capable of meeting the uniformity and control requirements are acceptable.

Rollers shall conform to Subsection 203.04.

MIXTURE

304.05 Composition of Mixture.

The lime, fly ash, and aggregate shall be proportioned on a dry weight basis within the following limits:

Material	Percent by Weight of Total Dry Mix
Lime	3 to 6
Fly Ash	9 to 24
Aggregate	70 to 88

The lime-to-fly ash ratio shall be 1:3 minimum to 1:4 maximum. The moisture content of the mixture shall be within plus or minus two percent of the optimum moisture of the mixture, as determined by AASHTO T 99, Method C, including replacement option.

The mix design shall be such that when compacted into cylinders, cured for 28 days at 100 ºF, and tested according to ASTM C 593, Part 8, the cylinders shall have a minimum average compressive strength of 1,500 psi with no individual test lower than 1,000 psi. Compaction and moisture content shall be determined according to AASHTO T 99, Method C, including replacement option.

Design mix proportions shall be based on Subsection 304.06.

304.06 Method of Test.

A. Scope. This method of test covers the procedure for determining the design mix proportions for lime-pozzolan stabilized base course.

B. Apparatus. Apparatus shall be according to ASTM C 593 except for compaction and for density and moisture content determinations, the equipment used in AASHTO T 99, Method C, will be used.

C. Sample Preparation. The components of each cylinder shall be weighed separately and then combined to ensure proper proportioning of the mixtures.

D. Procedure. Design mix proportions shall be determined by either Method 1 or 2, as provided below:

1. Method 1. Develop a curve of fly ash content versus dry density of the aggregate-fly ash mixture from a series of moisture-density tests at varying fly ash contents using the maximum dry density of each test determined according to AASHTO T 99, Method C, including replacement option. The fly ash content is the percentage of the dry aggregate by weight. The design mix quantity of fly ash is that amount which produces the maximum density shown in the fly ash versus dry density curve.

The design lime-to-fly ash ratio (between 1:3 and 1:4) shall be determined from a series of three compression cylinders made with mixtures of progressive lime-to-fly ash proportions at the constant fly ash content determined above. The cylinders made at each lime-to-fly ash ratio are to be prepared according to ASTM C 593, Part 8, except that compaction is to be accomplished at the optimum moisture content according to AASHTO T 99, Method C, including replacement option, and that the cylinders are to be cured for 28 days at 100 ºF in containers which do not lose more than 0.25 percent moisture. The proportions producing the greatest compressive strength shall be used in the mix design, provided that the resulting average compressive strength for those proportions is greater than the minimum specified. If this requirement is not satisfied, the percentage of material passing the No. 200 sieve shall be reduced to accommodate greater quantities of lime and fly ash and then redesigned to evaluate the new proportions.

2. Method 2. Prepare three compression cylinders each with three, four, five, and six percent lime content at a lime-to-fly ash ratio of 1:3 and 1:4 for each lime content. The cylinders will be made according to ASTM C 593, Part 8, with exception as noted in Method 1 above.

From the test results above, construct two curves for the average unconfined compressive strength versus the lime content, one curve for the 1:3 ratio and one curve for 1:4 ratio.

At the average minimum allowable compressive strength value required on each curve, draw vertical lines to the respective lime contents. If all average compressive strengths are greater than that required, use three percent lime content. Use the higher of the two for the lime content of the mix design with a lime-to-fly ash ratio of 1:3.5. The resulting design should comply with the mix design requirements. If the design does not comply, use a slightly higher lime content to achieve verification. A change in the percentage of material passing the No. 200 sieve may also be necessary.

E. Report. The report shall indicate the proportions of the lime, fly ash, and aggregate in the mix design. The amount of lime, fly ash, and aggregate are to be expressed as percentages of the weight of the total dry mix to ensure compliance with the limits. The report shall also contain the maximum dry density and optimum moisture content of the mix design proportions according to AASHTO T 99, Method C, including replacement option. If Method 2 is used, the curves at the 1:3 and 1:4 lime-to-fly ash ratios shall be included in the report.

304.07 Verification of the Mix Design.{ XE "Lime-pozzolan stabalized base course:mix design" }

At least 45 days before the production of the stabilized mixture, a mix design shall be submitted for approval along with a statement naming the source of each component and a report showing the results of the applicable tests.

At the Engineer's option, verification of the mix design may be done on an annual basis provided the properties and proportions of the material do not change appreciably. If a project is the continuation of work of the previous construction season and the mix designs were approved, and verification is provided in writing that the same source and character of materials are to be used on the continuing project, the Engineer may waive requirements for the design and verification of new mixes. The approved proportions of materials shall govern during the progress of the work except that another mix design previously approved for the Project may be used, provided that the Engineer is notified at least one working day before the change. Change in source or character of a material shall not be made until approved. Approval will be based on verification of a new mix design.

When unsatisfactory results for a specified phase of the work make it necessary, a new mix design may be submitted for approval.

For verification of the mix design, Department personnel shall prepare six compression test cylinders according to ASTM C 593, except compaction and moisture content shall be determined according to AASHTO T 99, Method C, including replacement option.

304.08 Mixing.{ XE "Lime-pozzolan stabalized base course:mixing" }

The aggregate shall be mixed with the amounts of lime, fly ash, and water specified in the mix design in a stationary or portable batch or continuous type mixer equipped with batching or metering devices for proportioning the components either by weight or volume and shall be of such accuracy that the amounts of aggregate, stabilizing agents, and water based on the total dry weight will be maintained within the following tolerances:

Lime	± 0.5% by Weight
Pozzolan	± 1.5% by Weight
Aggregate	± 2.0% by Weight
Water	± 2.0% by Optimum Moisture

A bituminous batch plant or continuous drum mixing plant conforming to Subsection 404.04 shall be used for mixing the materials. The capacity of the plant shall not be less than 50 tons per hour.

Aggregate sizes shall be stored and handled according to Subsection 901.02. Surge hoppers shall be used to supply aggregate for blending to meet the required gradation. The blend will be sampled daily to check the blended gradation.

Lime and fly ash shall be stored in vertical waterproof silos and delivered to the plant operation by approved means. Fly ash stored in open stockpiles shall not be used.

For batch-type plant, before introducing the water, the lime and fly ash are to be blended together and combined with the aggregate until a uniform mixture is produced, but not less than 15 seconds per cubic yard or three revolutions of the mixing drum are to be used for blending. The minimum mixing time after the water has been added to the mixture shall be determined from three trial runs. The plant shall be capable of discharging the mixture without segregation.

For a continuous type plant, the pugmill shall be equipped with adjustable paddles or an adjustable baffle that can be locked in position at the discharge end of the pugmill. Either device may be used to advance or retard the mixture flow through the pugmill to achieve adequate mixing. The plant shall have a manufacturer's plate giving the net volumetric content of the mixer at several heights inscribed on a permanent gauge. The mixing time shall be determined according to AASHTO M 156.

The minimum mixing time for a continuous plant (pugmill or drum type) shall be determined based on visual inspection of the output of the dry materials.

304.09 Quality Control Testing.{ XE "Lime-pozzolan stabalized base course:quality control testing" }

A. Plant Laboratory. The aggregate-lime-pozzolan material shall be supplied by a plant that meets all requirements of the specifications and has the facilities necessary to ascertain and control the quality of the product.

A plant laboratory shall be provided according to Subsection 405.03 with the following exceptions:

1. Slump cone and rod and unit weight container, 0.5 cubic foot, and equipment for determining specific gravity of sand are not required.
2. There shall be provided proctor molds, 5.5-pound and 10-pound drop hammers, sealable cans with lids, tape, sample extractor, graduated cylinders, oven or cabinet capable of maintaining the required curing temperatures for the required time and capable of holding 250 samples at one time, an approved compression loading machine, and additional equipment necessary to perform moisture-density tests and compression tests.
3. The plant shall be equipped with platform truck scales conforming to Subsection 404.04.

B. Consistency and Compliance Testing. At least one qualified technician shall be provided to perform sampling and quality control testing.

Three random samples for compressive strength tests will be taken each day of production.

Compression tests shall be performed as specified under composition of mixture except that AASHTO T 99, Method C, without replacement option, shall be used.

CONSTRUCTION

304.10 Limitations.

Stabilization will not be permitted when the aggregate or the surface on which the base course is to be laid is wet or frozen. Processing operations for the stabilized base course shall not be started until surface temperature is at least 40 ºF and rising. Construction of the aggregate-lime-pozzolan stabilized base course will not be permitted between September 30 and April 1.

304.11 Spreading.

The mixture shall be transported from the central plant in vehicles that can maintain the moisture content and prevent the loss of the fine materials or segregation.

Preparation of subbase or subgrade shall be performed according to Subsection 208.04.

Plant-mixed aggregate and stabilizers shall be spread uniformly on the prepared subgrade or subbase, with a minimum of manipulation to prevent segregation.

The maximum thickness of a compacted layer shall be 8 inches when the compacted base course is required to be greater than 8 inches, it shall be constructed in approximately equal depth lifts. Placement of subsequent lifts shall be on the same day.

If the stabilized material is to be placed in multiple lanes, placement of adjacent lanes shall be on the same day.

304.12 Compaction, Shaping, and Finishing.{ XE "Lime-pozzolan stabalized base course:compaction, shaping, and finishing" }

A. Compaction. Pneumatic-tired rollers or vibratory rollers shall be used to provide initial compaction of the mixture. Compaction of the stabilized material shall conform to the following:

1. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregate firmly keyed.
2. Water shall be uniformly applied over the materials during compaction in the amount necessary for required density.

B. Shaping and Finishing. On the same day the mixture has been placed and compacted, the surface shall be shaped to the required lines, grades, and cross-sections. When necessary, the surface shall be scarified lightly with a drag harrow or similar equipment to produce a smooth and uniform surface. The final surface shall be rolled with a tandem roller. The moisture content of the surface material shall be maintained within plus or minus two percent of the specified optimum during finishing operations. Compaction and finishing operations shall be completed within the specified times and shall be carried out in such a manner as to produce a smooth, dense surface. During the final finishing, the material accumulated by blading and clipping with a grader shall be removed.

The number of compaction and finishing units shall be sufficient to ensure initial compaction of the processed section of the stabilized base course within four hours from the time the water is added at the mixer. Final finishing and compaction shall be completed on the same day the material was mixed.

Loose or uncompacted pozzolanic material may not be salvaged and shall be removed and disposed of without additional compensation.

The in-place density of the completed base course shall be in conformance with Subsection 301.05.

304.13 Surface and Thickness.

Surface and thickness requirements shall be in conformance with Subsection 302.11.

304.14 Construction Joints.

Construction joints shall be according to Subsection 302.10.

304.15 Curing and Protection.

Curing and protection shall be according to Subsection 302.12, Subpart C.

304.16 Maintenance.

Maintenance of the base course shall be according to Subsection 105.19.

COMPENSATION

304.17 Method of Measurement.

Lime-pozzolan stabilized base course of the various thicknesses will be measured by the square yard.

Stabilizing agents will be measured by the ton. The quantity of stabilizing agents will be based on the stabilizing agent proportions in the mix design and the average moisture content of the mixture as follows:

$$WS = \frac{WT}{W + 1} = W\ Lime + W\ Fly\ Ash + W\ Soil$$

where:

WT	=	Total Weight, tons
WS	=	Weight of Dry Solids, tons
W	=	Average Daily Moisture Content of the Mixture (see Note 1)
W Lime	=	WS x Lime Percent (in mix design), tons
W Fly Ash	=	WS x Fly Ash Percent (in mix design), tons
W Soil	=	Weight, tons

Note 1: Moisture content will be determined by ASTM D 2216 or ASTM D 3017.

Bituminous material used as a curing material will be measured by the gallon based on the volume as determined by the temperature-volume correction factors according to Subsection 904.06.

304.18 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
LIME-POZZOLAN STABILIZED BASE COURSE, ___ " THICK	SQUARE YARD

Payment for bituminous curing material and the various stabilizing agents will be made according to Section 302.

SECTION 305 - CONCRETE BASE COURSE{ XE "CONCRETE BASE COURSE" }{ XE "BASE COURSE:CONCRETE" }

305.01 Description.

This work shall consist of the construction of portland cement concrete base course, with or without reinforcement.

MATERIALS

305.02 Materials.

Portland cement concrete shall conform to Section 914. Other materials shall conform to the following Subsections:

Curing Materials 905.03
Preformed Expansion Joint Filler 908.01
Joint Sealers 908.02
Reinforcement Steel 915.03

Where concrete base course is to be constructed monolithically with curb, the concrete shall conform to the requirements specified for the curb.

EQUIPMENT

305.03 Equipment.

The equipment shall conform to Subsection 405.03 except a slip-form paver, conforming to the requirements specified below, will be permitted.

CONSTRUCTION

305.04 Construction Requirements.

The surface upon which the concrete base course is to be constructed shall be prepared according to Section 209.

Preformed expansion joint filler, ½ inch thick, shall be placed around inlets, manholes, and other similar structures projecting through the base course.

The concrete base course shall be constructed according to Section 405 except as follows:

1. **Joints.** Transverse contraction joints are required and shall be coincident with the transverse expansion joints in adjacent concrete surface course. In addition, one or more transverse contraction joints, spaced equidistantly not less than 13 feet or more than 20 feet apart, are to be installed between the above joints. Elsewhere, contraction joints are to be installed at 15-foot intervals.

   No transverse or longitudinal expansion joints are required.

   When the base course is not constructed full width in one operation or when placing of concrete is temporarily discontinued, it shall be finished against a vertical form or bulkhead, and when resumed, the form or bulkhead shall be removed and the concrete shall be placed against the previously finished concrete.
2. **Surface Finish.** The concrete base course may be hand finished. The surface shall be rough broomed. Edges need not be rounded.
3. **Curing.** If liquid curing compound is used, it shall be removed before surfacing with bituminous concrete.
4. **Surface Tolerance.** The surface will be tested using a Straightedge at randomly selected locations. The variation of the surface, from the testing edge of the Straightedge, between any two contacts with the surface, shall at no point exceed ⅜ inch. Surface variations that exceed ⅜ inch shall be corrected.
5. **Thickness Requirements.** The requirements of Subsection 405.21 do not apply.

{ XE "Slip-form paving" **}{** XE "Base course:concrete:slip-form paving" **}{** XE "Concrete base course:slip-form paving" **}6. Slip-Form Paving.** Subject to a demonstrated ability to adapt slip-form paving methods to the Department's pavement design, the concrete base may be constructed, without the use of fixed forms, according to Section 405 and the following:

   a. After the subbase has been placed and compacted to the required density, the areas that support the paving machine and the areas on which the base is to be constructed shall be graded to the proper elevation. If the density of the subbase is disturbed by the grading operations, it shall be recompacted before concrete is placed. The subbase shall be constructed in advance of placing of the concrete for at least the distance required for an average day's paving. If any traffic is permitted to use the prepared subbase, the subbase shall be checked and corrected immediately before the placing of the concrete.
   b. The concrete shall be placed for the full depth of the slab with a slip-form paver designed to spread, consolidate, screed, and float-finish the concrete in one pass of the machine, or the concrete may be

placed in two layers with a mechanical spreader and then struck off, consolidated, screeded, and float-finished with a slip-form paver designed for this purpose. By either method, the concrete shall be finished in such a manner that a minimum of hand finishing is necessary to provide a dense and homogeneous base. The machine shall vibrate the concrete for the full width and depth of the base.

c. Reinforcement, if specified, shall be placed in the plastic concrete after spreading by mechanical or vibratory means.

d. Any edge slump of the concrete, exclusive of edge rounding, in excess of ¼ inch, shall be corrected before the concrete has taken its initial set and operations shall be modified to prevent recurrence.

e. Alignment and grade shall be controlled by an automatic sensing device in continuous contact with a sensing guide.

f. The concrete shall be placed at a uniform consistency as specified in Section 914, Table 914-1.

g. The slip-form paver shall be operated with a continuous forward movement, and all operations of mixing, delivering, and spreading concrete shall be so coordinated as to provide uniform progress, with stopping and starting of the paver held to a minimum. All vibrations shall automatically cease when the forward movement of the paving machine is stopped. No tractive force shall be applied to the machine except that which is controlled from the machine.

h. In order that the concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, materials shall be made available at all times for the protection of the edges and surface of the unhardened concrete. Such protective materials shall consist of standard metal forms or wood planks having an actual thickness of not less than 2 inches and a minimum actual width of ½ inch less than the thickness of the concrete at its edge, for the protection of the edges, and covering material such as burlap or cotton mats, curing paper, or plastic sheeting material for the protection of the base course. When rain is imminent, all paving operations shall stop and all available personnel shall begin placing forms against the sides of the base course and covering the surface of the unhardened concrete with the protective covering.

305.05 Opening to Traffic.

The opening to traffic shall be as specified in Subsection 405.20 except that the schedule is as follows:

May 16 - Oct 15	Concrete Class C	12 days
Oct 16 - May 15	Concrete Class C	15 days

COMPENSATION

305.06 Method of Measurement.

Concrete base course, with or without reinforcement, of the various thicknesses will not be measured, and payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided for in Subsection 109.01.

305.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CONCRETE BASE COURSE, ___ " THICK	SQUARE YARD
CONCRETE BASE COURSE, REINFORCED, ___ " THICK	SQUARE YARD

Payment for the preparation of the underlayer will be made according to Section 209.

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DIVISION 400 - SURFACE COURSES{ XE "SURFACE COURSE" }

SECTION 401 - SOIL AGGREGATE SURFACE COURSE AND DENSE-GRADED AGGREGATE SURFACE COURSE{ XE "DENSE-GRADED AGGREGATE:SURFACE COURSE" }{ XE "SURFACE COURSE:SOIL AGGREGATE" }{ XE "SURFACE COURSE:DENSE-GRADED AGGREGATE" }{ XE "SOIL AGGREGATE:SURFACE COURSE" }

401.01 Description.

This work shall consist of the construction of surface courses of soil aggregate and dense-graded aggregate and the reconstruction of soil aggregate surface course.

MATERIALS

401.02 Materials.

Materials shall conform to the following Subsections:

Dense-Graded Aggregate 901.08
Soil Aggregate 901.09
Calcium Chloride 919.03

EQUIPMENT

401.03 Equipment.

The equipment shall be according to Subsection 301.03.

When a stabilizing agent is required and is to be mixed on grade, equipment shall also include a traveling plant conforming to Subsection 302.04.

CONSTRUCTION

401.04 Construction Requirements.

{ XE "Surface course:reconstructed soil aggregate" **}**Soil aggregate surface course, dense-graded aggregate surface course, and reconstructed soil aggregate surface course shall be constructed according to Section 301 and this Subsection.

When required, a stabilizing agent (calcium chloride) shall be applied at the approximate rate of ½ pound per inch of every square yard of compacted surface and shall be uniformly spread over the previously placed aggregate before compaction. The aggregate and admixture shall then be thoroughly mixed. Instead of spreading and mixing on the grade, the admixture may be added and mixed with the aggregate at a stationary plant conforming to Subsection 303.05.

401.05 Maintenance Under Traffic.

Maintenance under traffic shall conform to Subsection 105.19.

COMPENSATION

401.06 Method of Measurement.

Soil aggregate surface course and dense-graded aggregate surface course, of the various thicknesses, will be measured by the square yard.

Reconstructed soil aggregate surface course will be measured by the square yard.

401.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SOIL AGGREGATE SURFACE COURSE, ___ " THICK	SQUARE YARD
DENSE-GRADED AGGREGATE SURFACE COURSE, ___ " THICK	SQUARE YARD
RECONSTRUCTED SOIL AGGREGATE SURFACE COURSE	SQUARE YARD

Payment for new soil aggregate required for reconstruction of soil aggregate surface course will be made as specified for reconstructed soil aggregate base course in Section 301.

Payment for calcium chloride will be made according to Section 302.

SECTION 402 - BITUMINOUS SURFACE TREATMENT{ XE "SURFACE COURSE:BITUMINOUS SURFACE TREATMENT" }

402.01 Description.

This work shall consist of the furnishing and placing of bituminous and cover materials.

{ XE "BITUMINOUS SURFACE TREATMENT:BITUMINOUS MATERIALS" }MATERIALS

402.02 Materials.

Materials shall conform to the following Subsections:

Aggregates for Bituminous Surface Treatment 901.11
{ XE "Bituminous concrete patch" **}**Bituminous Concrete Patch 903.04
Bituminous Materials:
Cut-back Asphalts,
Grades RC-250, RC-800, and RC-3000 ..... 904.02
Grades MC-250, MC-800, and MC-3000 ..... 904.02
Emulsified Asphalts,
Grades RS-1 and RS-2 ..... 904.03
Grades CRS-1 and CRS-2 ..... 904.03
Inverted Emulsified Asphalts,
Grades IEMC-250 and IEMC-800 ..... 904.04

{ XE "Bituminous surface treatment:bituminous materials:application temperatures" **}**The range of application temperatures for the bituminous materials, in ºF, shall be as follows:

RC-250	170º-200º	RS-1	70 º-140º
RC-800	205º-235º	RS-2	125º-185º
RC-3000	235º-265º	CRS-1	70º-140º
MC-250	170º-200º	CRS-2	125º-185º
MC-800	205º-235º	IEMC-250	125º-175º
MC-3000	235º-265º	IEMC-800	150º-185º

The type and grade of bituminous material will be provided in the Special Provisions. Within the specified ranges, the quantities of bituminous material and aggregate and the application temperature of the bituminous material will be designated.

Duplicate delivery slips shall accompany each load of bituminous material and shall contain the name of the producer and the supplier, the type and grade of material, the loading temperature of material, and the lot number and date of approval of the material from which delivery is made.

The foregoing chart indicates temperature ranges necessary to provide proper viscosity for spraying and mixing applications for the grades shown. However, the temperature ranges indicated by this chart generally are above the minimum flash point for the RC and MC cut-back asphalts. In fact, some of these cut-back asphalts flash at temperatures below the indicated ranges. Accordingly, safety precautions are mandatory at all times when handling these cut-back asphalts.

{ XE "Bituminous surface treatment:bituminous materials:safety precautions" **}**Safety precautions include, but are not limited to the following:

1. Do not permit open flames or sparks of any kind close to these materials except in heating kettles, mixers, distributors, or other equipment designed for handling and applying them.
2. Do not use an open flame to inspect or examine containers in which these materials have been stored.
3. Vent and ground vehicles transporting these materials.
4. Permit only experienced personnel to supervise the handling of these materials.
5. Comply with all applicable local, State, and Federal laws and regulations.

EQUIPMENT

402.03 Equipment.

{ XE "Pressure distributor" **}{** XE "Bituminous surface treatment:bituminous materials:distributors" **}**Equipment shall include a self-propelled power broom, equipment for heating bituminous material, a pressure distributor, rollers, and aggregate spreading equipment that can be adjusted to spread at the specified rate, and such other equipment and small tools as may be required.

Steel-wheel rollers shall conform to Subsection 404.09. Pneumatic-tired rollers shall conform to Subsection 203.04, except they shall be provided with a device for wetting and cleaning the tires.

The bituminous distributor shall be so designed, equipped, maintained, and operated that bituminous material at a consistent temperature may be applied uniformly on variable widths of surface up to 15 feet within the specified range. Distributor equipment shall include a tachometer, pressure gauges, a calibrated tank, and a thermometer for measuring temperature of tank contents. Accurate thermometers shall be so placed and installed in the truck body as to indicate the temperature of the bituminous material contained therein. Distributors shall be equipped with a separate power unit for the pump and full circulation spray bars adjustable laterally and vertically.

The following shall be furnished with each distributor:

1. A calibration sheet that shows the number of the truck body, the capacity thereof, and an outage table in increments of not over ½ inch. This calibration sheet must be certified by the manufacturer or a testing agency.
2. Metal rod with accurate ¼-inch increments. The rod shall be not less than 1 foot longer than the diameter of the tank.
3. Slip-proof steps with handrail to reach ground level.
4. Slip-proof catwalk with handrail, running along the top of the tank.
5. Slip-proof steps with handrail, leading from catwalk to dome.
6. Fire extinguisher in working order.
7. Sampling system for distributors shall conform to AASHTO T 40.
8. Either analog or digital readout meters calibrated in English units.

CONSTRUCTION

402.04 Limitations.{ XE "Bituminous surface treatment:limitations of placing" }

Bituminous material shall be applied when the surface is dry, firm, cured, and otherwise acceptable, only from April 1 to November 1 and when the air temperature in the shade and away from artificial heat is above 50 ºF.

402.05 Preparation of Surface.{ XE "Bituminous surface treatment:preparation of surface" }

The existing surface shall be cleaned of all dirt and other foreign or loose matter immediately before the first application of bituminous material. Where dirt remains that cannot be removed by the use of power brooms or power blowers and at the option of the Engineer, the surface shall be flushed with water and allowed to dry. All holes and surface failures shall be repaired in advance of the surface construction.

Surface preparation shall be according to the following:

1. **New Construction.** On new construction, the surface of the subbase, base course, or surface course upon which the bituminous treatment is to be placed shall conform to the requirements of the appropriate Section. Soil aggregate or dense-graded aggregate surface shall be treated with a prime coat according to Subsection 404.15.
2. **Previously Treated Surfaces.** Previously treated surfaces shall be prepared for the bituminous treatment as specified in the Special Provisions. Where there are indications of unstable foundation or base failure, excavation shall be made to the depth required, and the unstable material shall be removed and replaced. The replacement material shall be surfaced with patch material. Where directed or approved, the surface shall be patched with plant-mixed bituminous mixture by cutting out the existing surface so as to form square openings with vertical sides. The openings shall be cleaned out and painted with a bituminous material as specified in Subsection 404.15, then filled with patch material that shall be compacted.

402.06 Application of Bituminous Material and Aggregate.{ XE "Bituminous surface treatment:methods of application or placing" }

Bituminous material and aggregate shall be applied by one of the following methods as provided for in the Special Provisions:

1. **Method 1.** The first application of bituminous material shall be applied by pressure distributors at a uniform rate between 0.2 to 0.4 gallons per square yard. The actual rate within that range will be established. Each width of spread shall be not less than one-half of the surface to be treated.

   Areas that are inaccessible to the distributor shall be treated with hand pressure sprayers.

   If less than the full width is being treated, the aggregate shall not be spread on the inside 6 inches of either the first or second application until the adjacent lane has been treated. Immediately after each application of bituminous material has been made, it shall be covered uniformly with size No. 6 or 67 aggregate. The aggregate shall be free of surface moisture, except when asphalt emulsion is used as the bituminous material.

   The aggregate shall be spread from trucks equipped with mechanical spreaders or from self-propelled mechanical spreaders, at a rate established by the Engineer, from 25 to 45 pounds per square yard.

The second application of bituminous material shall be applied in the same manner as the first application, at a uniform rate of 0.3 to 0.5 gallons per square yard. The actual rate within that range will be established. Aggregate size No. 8 shall then be spread in the same manner as the first application at a rate established by the Engineer within the range of 15 to 30 pounds per square yard.

Immediately after each application of cover aggregate, uniform coverage shall be achieved by hand brooming. Additional aggregate shall be placed by hand on thin or bare areas.

2. **Method 2.** The first application of bituminous material shall be applied by pressure distributors at a uniform rate of 0.4 to 0.5 gallons per square yard using the procedures described in Method 1.

After the bituminous material has penetrated, fine aggregate cover shall be spread at the rate of not less than 15 pounds per square yard.

After the curing period and only when permitted, the surface shall be cleaned, and the second application of bituminous material shall be made at the rate of approximately 0.3 gallons per square yard and immediately covered with fine aggregate cover material at the approximate rate of 15 pounds per square yard.

Following each application and during the curing process, the surface shall be dragged as directed. Additional cover material shall be spread when bituminous material comes to the surface before Acceptance.

3. **Method 3.** The application of bituminous material shall be at the rate of 0.25 to 0.45 gallons per square yard and covered with aggregate size No. 8 at the rate of 15 to 30 pounds per square yard using the procedures described in Method 1.

402.07 Rolling and Curing.{ XE "Bituminous surface treatment:rolling and curing" }

Immediately after spreading the cover aggregate and hand brooming where required, the entire surface shall be rolled, beginning at the edges and progressing to the center. Initial rolling shall be done with steel-wheel rollers or by pneumatic-tired rollers followed by a minimum of three complete coverages with the pneumatic-tired roller.

The first application of bituminous material and aggregate shall be allowed to cure for the length of time required before the second application.

The same rolling and curing procedures required in making the first application of bituminous material and cover aggregate shall be repeated in making the second application.

402.08 Maintenance Under Traffic.

Slow-moving traffic may be permitted to use sections after the bituminous material has been covered with aggregate and cured. Traffic shall be controlled.

402.09 Cleanup.

Cleanup shall include sweeping up all quantities of loose, dislodged cover aggregate from the completed surface and along the edges of the completed surface and disposing of the material according to Subsection 201.10.

COMPENSATION

402.10 Method of Measurement.

Bituminous material for bituminous surface treatment will be measured by the gallon according to Subsection 109.01.

Aggregates for the bituminous surface treatment and the bituminous concrete for patching will be measured by the ton. The weight will be determined by certified weigh tickets according to Subsection 404.25.

The number of gallons of bituminous material and the weight of aggregates exceeding the quantities as determined by the application rates, established by the Engineer, will not be measured.

402.11 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
BITUMINOUS MATERIAL FOR BITUMINOUS SURFACE TREATMENT	GALLON
COARSE AGGREGATE FOR BITUMINOUS SURFACE TREATMENT	TON
FINE AGGREGATE FOR BITUMINOUS SURFACE TREATMENT	TON
BITUMINOUS CONCRETE PATCH	TON

SECTION 403 – HOT MIX ASPHALT FRICTION COURSE{ XE "HOT MIX ASPHALT (HMA) FRICTION COURSE" }{ XE "SURFACE COURSE:HOT MIX ASPHALT (HMA) FRICTION COURSE" }

403.01 Description.

This work shall consist of the construction of dense-graded and open-graded friction courses.

MATERIALS{ XE "HOT MIX ASPHALT (HMA) FRICTION COURSE:MATERIALS" }

403.02 Materials.

The materials and their use shall conform to Subsection 404.02 except as follows:

{ XE "Hot mix asphalt (HMA) friction course:crushed gravel" **}{** XE "Crushed gravel friction course" **}**1. Coarse aggregate for dense-graded friction course shall be crushed quartzite conforming to Subsection 901.04 and yielding friction numbers equal to or exceeding the control standard when tested according to ASTM D 3319, or crushed gravel conforming to Subsection 901.05 except that it need not be washed and shall not contain more than ten percent total carbonates as determined according to Section 990, NJDOT A-4. The coarse aggregate for the dense-graded friction course shall be from a single source for the entire Project.

2. Stone sand used for fine aggregate in dense-graded friction course shall not be made from argillite or carbonate rock.

3. Coarse aggregate for open-graded friction course shall be broken stone of gneiss, granite, quartzite, or trap rock conforming to Subsection 901.04 or shall be crushed gravel conforming to Subsection 901.05 except that it need not be washed and shall not contain more than 50 percent of total carbonates (30 percent on Federally-funded Projects) as determined according to Section 990, NJDOT A-4.

403.03 Composition and Preparation of Mixtures.{ XE "Hot mix asphalt (HMA) friction course:composition of mixtures" }

A. Dense-Graded Friction Course. The mixture for dense-graded friction course shall conform to Section 903. Mix I-5 shall be used in transition (run-out) areas where directed**.**

{ XE "Open-graded friction course" **}{** XE "Hot mix asphalt (HMA) friction course:open-graded" **}B. Open-Graded Friction Course.** The mixture for open-graded friction course shall conform to Section 903 and to the following:

Sieve Size	Total Percent Passing by Weight
½ "	100
⅜"	80 - 100
No. 4	30 - 50
No. 8	5 - 15
No. 200	2 - 5
Asphalt Cement, percent by weight of dry aggregate	5.7 - 7.0 (see Note 1)

Note 1: The specific asphalt content for the job mix formula shall be determined. A minimum of three 1,000-gram trial batches having different asphalt cement contents within the specified range shall be mixed in the producer's laboratory at 250 ± 10 ºF and placed on a 8 to 9 inch diameter heat resistant transparent Pyrex dish. The mixture shall be spread on the dish with a minimum of manipulation. The dish shall be placed immediately in an oven at 255 ± 5 ºF for a period of one hour. After one hour the bottom of the dish shall be examined. The mixture with a slight puddle at points of contact between the aggregate and the glass dish shall be selected. Photographs of a desirable drainage condition are on file in the Department Laboratory and can be obtained upon request.

The formula selected and samples of all materials used in the final mixture design shall be submitted by the producer to the Engineer at least three weeks before the initial production date.

Sampling requirements are as follows:

Coarse Aggregate	35 pounds
Fine Aggregate	35 pounds
Mineral Filler	5 pounds
Asphalt Cement	2 quarts

The submitted materials will be tested for verification of the producer's mix design and for resistance to effects of water according to AASHTO T 165 and T 167.

Samples are to be molded at 255 ºF using a pressure of 2,000 pounds per square inch. After four days of immersion at 120 ºF, the index of retained strength must not be less than 50 percent. Should laboratory tests establish the need for a heat-stable, anti-stripping additive, the amount added shall be as directed.

The mixture shall have a minimum void content of 15 percent. Verification of the minimum void content will be made according to Section 990, NJDOT B-6.

During production operations, five random samples will be taken from each lot of approximately 1,000 tons to verify mixture compliance with composition requirements. When a lot is necessarily less than 1,000 tons, samples will be taken at random at the rate of one sample for each 200 tons or fraction thereof.

Sampling and testing for mixture composition will be performed according to Section 990, NJDOT B-2 and B-3.

EQUIPMENT{ XE "HOT MIX ASPHALT (HMA) FRICTION COURSE:EQUIPMENT" }

403.04 Equipment.

The equipment shall be as provided in Section 404 except the open-graded mix shall be transported in clean vehicles with smooth dump beds that have been sprayed with a non-petroleum release agent. Mineral fillers, fine aggregates, slag dust, etc. shall not be used to dust truck beds. The mix shall be covered during transportation to prevent cooling and the formation of lumps. Long hauls, particularly those in excess of 30 miles, may result in separation of the mix and its rejection.

CONSTRUCTION

403.05 Construction Requirements.{ XE "Hot mix asphalt (HMA) friction course:construction and compaction" }

The construction requirements shall be as specified in Section 404 except as follows for open-graded mix:

1. Hand placing shall be avoided except where necessary.
2. Laying temperature of the mix shall not be less than 225 ºF.
3. Ambient temperature shall be 60 ºF minimum.
4. Thickness shall be ¾ ± ¼ inch.
5. Temperature at discharge from the plant shall be maintained from 240 to 270 ºF.

Immediately after spreading and strike-off, the open-graded friction course shall be compacted by a minimum of one pass of a two-axle or three-axle tandem roller conforming to Subsection 404.09. Additional rolling shall be done if and as directed to firmly set the aggregate in the surface.

COMPENSATION

403.06 Method of Measurement.

Friction courses of the various kinds will be measured as specified for HMA in Section 404 except reductions due to nonconformance to job mix formula, air voids, and thickness requirements do not apply for open-graded friction course.

403.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
DENSE-GRADED FRICTION COURSE, MIX ___	TON
OPEN-GRADED FRICTION COURSE	TON

Payment for tack coat will be made according to Section 404.

SECTION 404 – HOT MIX ASPHALT (HMA){ XE "HOT MIX ASPHALT (HMA)" }{ XE "SURFACE COURSE:HMA" }

404.01 Description.

This work shall consist of the construction of base course, intermediate course, and/or surface course of HMA; the treatment and/or sealing of joints and cracks in HMA surface course and portland cement concrete surface course before an overlay; the sealing of saw cuts in HMA overlays constructed over existing portland cement concrete pavement, previously overlaid portland cement concrete pavement and/or composite pavement; the taking of core samples for testing; and the repair of existing pavement.

MATERIALS{ XE "HOT MIX ASPHALT (HMA):MATERIALS" }

404.02 Materials.

HMA shall conform to Section 903. Asphalt binder shall conform to Section 904.01. Patching material for HMA pavement repair and concrete surface pavement repair shall be the HMA mix specified for the roadway surface. Patching material for filling core holes shall be a commercial type of cold mixture approved by the Engineer. An approved HMA conforming to Section 903 may be used, provided the material has a nominal maximum size of ¾ inch or less and remains hot enough to compact.

Other materials shall conform to the following Subsections:

Prime Coat:
- Cut-back Asphalt, Grade MC-30 or MC-70 ..... 904.02

Tack Coat:
- Cut-back Asphalt, Grade RC-70 or RC-T 904.02
- Emulsified Asphalt, Grade RS-1, SS-1, or SS-1h 904.03
- Cationic Emulsified Asphalt, Grade CSS-1 or CSS-1h 904.03

Tack Coat 64-22:
- PG 64-22 ..... 904.01

Joint Sealer, Hot-Poured 908.02

Backer Rod 908.02

{ XE "HOT MIX ASPHALT (HMA):PLANTS AND EQUIPMENT" }EQUIPMENT

404.03 Equipment.

The plant and equipment shall consist of one or more HMA plants, HMA pavers and rollers, sufficient vehicles for transporting HMA mixtures, small tools, and all other equipment necessary for the construction of the HMA base, intermediate, and surface courses, and for conditioning or repairing the existing or previously constructed base or intermediate course.

404.04 HMA Plants.

{ XE "Hot mix asphalt (HMA):plants and equipment:general requirements all mixing plants" **}A. General Requirements for all Mixing Plants.** Plants used for the preparation of HMA mixtures may be of the fully automated batch type or drum mixing type.

All plants shall be designed, equipped, calibrated, and operated to deliver well-coated, homogeneous HMA mixtures complying with the job mix formula. Any defects that adversely affect the functioning of a plant or plant unit or the quality of the mixture shall be corrected immediately. The plants shall consist of the following:

1. **Aggregate Storage.** Storage space shall be provided for each size and source of aggregate. The different aggregates shall be kept separated until they have been delivered to the cold-feed belt or elevator. The aggregate storage area shall be maintained, and the separate materials stockpiled according to Subsection 901.02, except that the use of steel-tracked equipment will be permitted.
2. **Aggregate Bins.** The plant shall have cold-feed aggregate storage bins of sufficient number and capacity to store the amount of aggregate required to keep the plant in continuous operation. The bins shall be designed to prevent overflow of material from one bin compartment to another. There shall be at least one cold-feed aggregate bin for each stockpile of material to be used. An indicator shall be provided on each bin to show the gate opening.

   If crushed recycled container glass (CRCG) is used, a separate cold feed bin shall be required.
3. **Equipment for Preparation of Asphalt Binder.** Tanks for storage of asphalt binder shall be equipped for heating the material to a uniform temperature, under effective and positive

control at all times, to the temperature requirements for the mixture. Heating shall be accomplished so that no flame comes in contact with the heating tank.

A circulating system for the binder shall be provided of adequate capacity to ensure continuous circulation between storage tank and proportioning units during the entire operating period. The discharge end of the binder circulating pipe shall be maintained below the surface of the binder in the storage tank to prevent discharging the hot binder into the open air.

All pipe lines and fittings shall be steam or oil jacketed electrically or otherwise heated and insulated to prevent heat loss.

Provisions shall be made for sampling asphalt binder by means of valves complying with AASHTO T 40 except that a sampling valve shall be located in the lowest third of the storage tank.

4. **Feeder for Dryer.** Separate feeders shall be provided for each size and source of aggregate. Each size shall be fed onto the belt going to the dryer by mechanical feeders with separate adjustable gates. The feeders shall be capable of delivering the separate aggregates onto the belt in proper proportions. The feeders shall provide for adjustment of total feed and proportional feed.

   Means shall be provided to ensure a constant and uniform flow of material from each bin.

   The aggregate shall be fed into the dryer so that uniform production and uniform temperature may be obtained.

5. **Thermometric Equipment.** An armored thermometer or dial thermometer of adequate range shall be fixed in the asphalt binder feed line at a suitable location near the charging valve at the mixer unit, and shall indicate the temperature of the asphalt binder.

   The plant shall also be equipped with a recording thermometer, pyrometer, or other thermometric instrument so placed at the discharge chute of the dryer as to indicate and record automatically the temperature of the heated aggregates.

6. **Dust Collector.** The plant shall be equipped with a dust collector capable of wasting or uniformly returning to the plant all or any part of the material collected as directed. Dust collecting systems shall be installed and operated in compliance with NJAC 7:27-6.1 *et seq.*

7. **Safety.** Adequate and safe stairways to the mixer platform and sampling points shall be provided, and guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required. Overhead protection shall be provided at locations deemed necessary. A hoist or pulley system shall be provided to raise scale calibration equipment, sampling equipment, and other similar equipment from the ground to the mixer platform and return. All gears, pulleys, chains, sprockets, and other hazardous moving parts shall be guarded and protected. Ample and unobstructed space shall be provided on the mixing platform. A clear and unobstructed passage shall be maintained at all times in and around the truck loading area. This area shall be kept free from drippings from the mixing platform.

   Accessibility to the top of truck bodies shall be provided by two platforms located away from the mixing plant to enable samples and temperature data to be obtained from each side of loaded trucks. One platform is acceptable if the truck has room to turn around and return to the platform.

   In addition to the above, the plant shall conform to all State and local safety requirements. When plant production occurs during nighttime hours, permanently fixed lighting shall be provided throughout the plant operations, plant laboratory, and truck scale areas to ensure a clear view of the operations. Permanently mounted lighting shall also be provided at the sampling platforms to sufficiently illuminate the bed of the truck for inspection and sampling operations.

8. **Truck Scales.** Platform truck scales shall be a direct-reading, cabinet dial type or an electronic load cell type with a visual indicating device capable of automatically printing both gross and tare weights and time and date on the delivery ticket. The time and date may be printed automatically by a time clock each time the truck passes over the scale. The scales shall be equipped with a motion detection device or a time delay relay that prevents printing the weight on the delivery ticket until the scale is fully at rest. Tare beams must be removed or permanently locked in place.

   The scale shall have a manufacturer's rating equal to or greater than the maximum gross load being weighed, and the accuracy and certification requirements shall be as specified for plant scales in Subheading 4 of the fifth paragraph of Subpart B below.

   The approaches to the scale at both ends shall have a level grade at the same elevation as the platform. The scale cabinet and dial and the mechanical weight recorder shall be housed in a suitable shelter, furnished with adequate heat and light.

{ XE "Hot mix asphalt (HMA):plants and equipment:surge and storage bins" **}9. Surge and Storage Bins.** A plant may be permitted to store hot mixture in a surge or storage bin provided the bin has received prior evaluation and approval by the Department. Use of the bin shall be in conformance with the limitations on retention time, type of mixture, heater operation, bin atmosphere, bin level, or other characteristics set forth in the Engineer's letter of approval.

Each bin shall be equipped with a device that visually or audibly signals automatically when the material in the bin reaches the 25 ± 5 ton level. The signal device shall be visible or audible from within the plant laboratory, and shall remain in operation until the bin level exceeds the specified minimum.

An evaluation of a surge or storage unit will be made by the Department upon written request by the supplier. The supplier shall submit with its request two copies of plans for its surge or storage system showing bin capacity, heating, and splitter arrangements. The evaluation determines the degree of composition uniformity, the temperature characteristics, and the degree of asphalt binder hardening of the mixture processed through the surge or storage unit. Surge or storage bins shall be capable of discharging mixture having gradation, temperature, and asphalt binder hardening properties of no less quality than mixtures discharged directly from the plant.

For bin evaluation, the method of sampling, rate of sampling and testing, and analysis procedures will be performed according to the requirements of New Jersey Department of Transportation Materials Procedure MP-34, "Approval of Storage Silos for HMA Plants."

The analysis of asphalt binder hardening performed as a part of the prequalification of the surge bin system shall consist of a comparison of the penetration of the asphalt binder from mixture recovery samples obtained at the plant discharge and the surge bin discharge. The penetration of the asphalt binder recovered from the stored mixture samples is acceptable if the average penetration is at least 85 percent of the average penetration of the asphalt binder recovered from mixture samples from the plant discharge. Recovery of asphalt from mixture samples will be performed according to ASTM D 1856.

In the event that the surge or storage system is changed or altered, the Department shall be notified of the modification. Any radical departure necessitates re-evaluation. The Department may re-evaluate any surge or storage system whose performance becomes suspect due to deficiencies in mixture quality.

10. **Emission Control System.** The plant shall be equipped with an emission control system so as to meet all applicable limitations concerning emissions.
11. **Incidental Equipment.** The plant shall be furnished to include all other equipment necessary for proper and continuous operation.

{ XE "Hot mix asphalt (HMA):plants and equipment:fully automated batch-type plants" **}{** XE "Reclaimed asphalt pavement (RAP):plant requirements:fully automated batch-type" **}{** XE "Hot mix asphalt (HMA):plants and equipment:requirements for reclaimed asphalt pavement (RAP)" **}B. Special Requirements for Fully Automated Batch Type Plants.** Daily checks shall be made to ensure that hoppers are discharging completely and that the balance returns to zero tare whenever the hoppers are emptied. When directed, checks shall be made to verify the accuracy of the batch scales within the normal weighing range, and to ensure that the interlocking devices and automatic recordation equipment are functioning properly. When the accuracy of the batch scales is not within the normal weighing tolerances, the Department reserves the right to require that all trucks be weighed on an approved truck scale.

For mixes containing up to twenty-five percent RAP, the batch plants shall have a means for adding the RAP to the heated new aggregate in a manner that does not damage the asphalt binder in the reclaimed material and provides control for proportioning the RAP into the mixture. Batch plants may not be used for mixtures containing greater than 25% RAP. If the RAP is introduced into the system before the hot bins, the proportioning controls shall include weigh belts or belt scales which electronically interlock the new aggregate feed with the RAP feed and vary the feed rates, as required, to maintain the required ratio of new aggregate to RAP.

The recycled HMA mixtures shall be prepared by the heat transfer method of recycling which means that the RAP shall not come in direct contact with the flame in the dryer. When preparing mixtures by the heat transfer method, the batch plant shall be operated as a conventional plant except that the temperature of new aggregate leaving the dryer and the time interval of the dry and wet mixing cycles may need to be adjusted, and provisions must be made for the proportioning of the RAP into the mixture.

Before being combined with the heated new aggregate, the RAP shall pass through a 2½-inch vibrating scalping screen.

Fully automated batch type plants shall include the following:

1. **Dryer.** Plants shall include a dryer or dryers that continuously agitate the aggregate during the heating and drying process. The dryer shall be capable of drying and heating the aggregate to the specified moisture and temperature requirements without leaving any visible unburned oil or carbon residue on the aggregate when discharged from the dryer.
2. **Screens.** Plant screens shall be capable of screening aggregates to the specified sizes and proportions, and shall have capacities in excess of the capacity of the mixer.
3. **Aggregate Hot Bins.** The plant shall include at least four aggregate storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to ensure separate and adequate storage of appropriate fractions of the mineral aggregates. Separate dry storage shall be provided for mineral filler or hydrated lime when used, and the plant shall be equipped to feed such material into the mixer accurately and uniformly. Each bin shall be provided with overflow pipes of such size and at such locations as to prevent backing up of material into other compartments or bins. Each compartment shall be provided with an individual outlet gate, constructed so that when closed there shall be no leakage. The gates shall cut off quickly and completely. Bins shall be provided with means to obtain representative samples. Bins shall be equipped with a device that visually or audibly signals automatically when the level of aggregate reaches the lowest quarter point. The signal device shall be visible or audible from within the plant laboratory and shall remain in operation until the bin level exceeds the minimum.
4. **Plant Scales.** All plant scales shall be of the springless dial type or electronic load cell type, with a readout, and shall be accurate within the tolerances permitted by the New Jersey Department of Law and Public Safety, Office of Weights and Measures, and shall conform to the requirements of the National Institute of Standards and Technology Handbook 44. Scales shall be tested semiannually and certified by the Office of Weights and Measures, New Jersey Department of Law and Public Safety, or a municipal weights and measures agency. This semiannual inspection shall be performed by an approved private scale company if the Office of Weights and Measures, New Jersey Department of Law and Public Safety, or a municipal weights and measures agency cannot perform the work.

   Scales or slave systems shall be so located that they are plainly visible to the plant operator at all times.

   The graduation of scales used in weighing amounts of aggregates less than 5,000 pounds shall not be greater than 5 pounds; for amounts of aggregates from 5,000 to 10,000 pounds, not greater than 10 pounds; and for amounts of aggregates in excess of 10,000 pounds, not greater than 0.1 percent of the capacity of the scales.

   Scales for weighing asphalt binder shall conform to the requirements for aggregate scales, except that they shall read to the nearest pound, and shall have a capacity of not more than 250 percent of the normal amount of asphalt binder required.

   All plants shall be capable of continuously weighing, within the tolerances specified, the various components of the mixture for the full range of batch sizes. All of the following tolerances are based on the total batch weight of the HMA mixture.

Weighing Tolerances	**Percent**
Each Aggregate Component	.....
Mineral Filler	.....
Asphalt Binder	.....
Zero Return (Aggregates)	.....
Zero Return (Asphalt Binder)	.....

   If mineral filler is used in a batch cycle, the allowable tolerance for the aggregate component weighed just before the filler in a cumulative weighing system shall be plus or minus 0.5 percent.
5. **Weigh Box or Hopper.** The equipment shall include a means for accurately weighing each size of aggregate in a weigh box or hopper suspended on scales, and of ample size to prevent overflow to the pugmill.

   The discharge gate shall close so that no material is allowed to leak into the mixer while a batch is being weighed. The weigh box or hopper shall be supported on fulcrums and knife edges so constructed that they are not easily thrown out of alignment or adjustment.

6. **Asphalt Binder Control.** When a asphalt binder bucket is used, it shall be a type recommended by the plant manufacturer. The length of the discharge opening or spray bar shall be not less than three-fourths the length of the mixer and it shall discharge directly into the mixer. The asphalt binder bucket discharge valve and spray bar shall be adequately heated. The plant shall have an adequately heated, quick-acting, nondrip charging valve located directly over the asphalt binder bucket.

   When a volumetric meter is used, it shall automatically meter the asphalt binder into each batch. The dial to indicate the amount of asphalt binder shall have a capacity of at least ten percent in excess of the asphalt binder required in one batch. The meter shall be constructed so that it may be locked at any dial setting and automatically resets to this reading after the addition of asphalt binder to each batch. The dial shall be in full view of the mixer operator.

   For all asphalt binder control units the flow of binder material shall be automatically controlled to begin when the dry mixing period is over. All of the asphalt binder material required for one batch shall be discharged within 15 seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of asphalt binder for the full length of the mixer.

7. **Mixer.** The batch mixer shall be capable of producing a uniform mixture within the job mix tolerances. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust.

   The clearance of paddles shall not exceed 1½ inches from all fixed and moving parts.

8. **Control of Mixing Time.** The mixer shall be equipped with an accurate time lock to control the operations of a complete mixing cycle. It shall lock the weigh box gate after charging of the mixer until the closing of the mixer gate at the completion of the cycle. It shall lock the asphalt binder discharge throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods. The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the start of introduction of asphalt binder. The wet mixing period is the interval of time between the start of introduction of asphalt binder and the opening of the mixer gate.

   The control of the timing shall be adjustable and capable of being set at intervals of five seconds or less. A mechanical batch counter shall be installed as a part of the timing device and shall be so designed as to register only completely mixed batches.

   The setting of time intervals shall be performed in the presence of the Engineer and shall be such as to provide aggregate coating as specified in Subsection 903.02.

9. **Automated Batching and Mixing Control.** Fully automated plants shall include an automatic batching and mixing control system, including an automatic printer system conforming to the following:

   a. The recording equipment and batch scales shall be interlocked and the panels providing access to interlocking devices shall be maintained under sealed conditions.

   b. The system shall contain auxiliary interlocking cut-off circuits to interrupt and stop the automatic cycling of the batching operations any time the weighing tolerances are exceeded, or when any aggregate bin becomes empty, or when there is a malfunctioning of any portion of the control system. A platform truck scale is not required. If, however, the automatic proportioning or recording devices become inoperative or inaccurate, the plant may, with the permission of the Engineer, be operated manually to complete the day's production. A platform truck scale is mandatory for manual operation.

   c. The Department will make independent checks on batch weights by weighing trucks before and after loading, and may request an inspection of the plant scales by the Office of Weights and Measures, New Jersey Department of Law and Public Safety for verification of the automatic printout tickets.

C. **Special Requirements for Drum Mixing Plants. {** XE "Hot mix asphalt (HMA):plants and equipment:drum mixing plant" **}{** XE "Reclaimed asphalt pavement (RAP):plant requirements:drum mixing plant" **}** Drum mixing plants may be used in the preparation of HMA paving mixtures. The heating, coating, and mixing of the HMA mixture shall be accomplished in a parallel flow, counter flow or other approved type of dryer-mixer.

   Drum mixing plants shall include the following:

1. **Aggregate Bins.** The fine aggregate bin compartments shall be equipped with a vibrator or other anti-bridging device that is automatically actuated when bridging of the material occurs, and which automatically shuts off when continuous material flow is restored.
2. **Mineral Filler Bin.** When mineral filler is to be added, it shall be from a bin and feeder separate from the aggregate cold bins. Equipment shall be provided to feed the mineral filler at adjustable rates. The mineral filler feed rate in tons per hour shall be accurate within three percent of the indicated rate throughout the range of the plant's production capacity. The feeder shall be interlocked in such a manner that production is stopped if the flow of mineral filler is interrupted.
3. **Aggregate Feeder.** The plant shall have a mechanical system for uniformly and continuously feeding each aggregate in its proper proportion onto a collecting belt and then into the drum mixer.

   The feeder system shall be designed so that before entering the mixer, the aggregates on the collector belt pass through a 2-inch scalping screen or other device that removes oversize material or debris. One feeder shall be provided for each bin compartment. Each aggregate feeder shall be interlocked in such a manner that production is stopped if flow of aggregate from any of the cold bins is interrupted.

   The control of the quantity of aggregate fed to the drum mixer shall be by a variable speed system that provides for total and proportional control.

   The individual bin feeder belts or the intermediate collecting belt that delivers the aggregate to the main feed for the drum mixer shall be equipped with belt type scales (load cells) capable of continuously displaying, at the operator's station, the weight of aggregate flow in tons per hour or the corresponding percentage of total mix from each individual bin and the accumulated total from each bin in tons. The aggregate feed rate in tons per hour from each bin shall be accurate within one percent of the indicated rate throughout the range of the plant's production capacity.

   Means shall be provided for conveniently diverting the aggregate cold-feed delivery into trucks or other containers for checking the accuracy of the aggregate feed system. Means shall be provided for obtaining representative samples of the composite aggregate from the main feed to the drum mixer at any time during production.

   For mixes containing RAP, the drum mix plant shall have a means for adding the RAP to the dryer-mixer in a manner that does not damage the asphalt binder in the reclaimed material. Control shall be provided for proportioning the RAP into the mixture.

   Means shall be provided for compensating for the moisture in the RAP.

   Before being combined with the heated new aggregate, the RAP shall pass through a 2½ inch vibrating scalping screen.
4. **Asphalt Binder Metering System.** The plant shall have a metering system that introduces the proper amount of asphalt binder into the mix.

   The system shall be capable of measuring the quantity and temperature of the asphalt binder being introduced into the mix and transmitting that data to the operator's station. The metering system shall be interlocked in such a manner that production is stopped if the flow is interrupted.

   The metering system shall include a temperature compensation device to correct the quantity of asphalt binder introduced into the mix to 60 ºF. The flow of asphalt binder to the drum mixer shall be continuously displayed in the operator's station in units of tons per hour, corrected to 60 ºF, or as the corresponding percentage of total mix. The feed rate in tons per hour shall be accurate within one percent of the indicated rate throughout the range of the plant's production capacity. The accumulated weight of asphalt binder fed to the mixer shall be totaled.

   Convenient means shall be provided for diverting the asphalt binder into trucks or other containers for checking the accuracy of the metering system.
5. **Proportioning Controls.** The combined aggregates shall pass over a weigh belt or belt scale that is electronically interlocked with the asphalt binder metering system in such a manner as to automatically vary the asphalt binder feed rate, as required, to maintain the required asphalt binder content in the mixture.

   Provisions shall be made for introducing the moisture content of the cold-feed aggregates into the composite aggregate weigh belt signal and correcting wet aggregate weight to dry aggregate weight. The dry weight of the composite aggregate flow shall be continuously displayed by electronic readout at the operator's station in units of tons per hour and shall be totaled. The composite aggregate feed rate shall be accurate within one percent of the indicated rate. Belt

conveyors shall be equipped with scrapers or other suitable devices to prevent adherence or other loss of the weighed cold-feed aggregate.

Before the start of production of Department mixes, plant controls shall be calibrated. Any changes in or modifications to the equipment or operation occurring subsequent to the initial calibration shall be reported to the Engineer. Depending on the nature and extent of the modifications made, calibration checks or a new plant calibration may be directed. Recalibrating the plant also may be directed if the finished mixture displays composition deficiencies. For each drum mix plant placed in operation, two complete sets of plant drawings, a plant operator's manual, and a plan detailing the method of plant calibration shall be submitted. The Engineer will witness the calibration of the individual cold-feeders at several production rates throughout the range of plant's capacity. A copy of the computations for the combined rate of flow and a plot of calibration charts shall be submitted. Such charts shall indicate the rate of aggregate delivery in tons per hour from each cold-feeder for particular dial settings and gate openings. Calibration points shall be determined by independently diverting each cold-feed into trucks (or running each feed through the plant) and determining the proper console dial setting corresponding to the measured rate of delivery. Such calibration points shall be determined in increments of approximately 100 tons per hour of total aggregate flow.

The Engineer will witness a check on the mineral filler and asphalt binder feeds at several production rate increments throughout the range of the plant's capacity. Calibration of the asphalt binder metering system and subsequent checks shall be accomplished by diverting the asphalt binder into trucks or other containers for weight or volumetric measurements. The method used to calibrate the mineral filler feeder system is subject to approval. The procedures shall be sufficient to ensure that the controls are marked to correspond with the calibration of the asphalt binder and mineral filler feeds.

6. **Drum Mixer.** The drum mixer shall be the type that continually agitates the mixture of aggregate and asphalt binder during heating, and in which the aggregate or asphalt binder is not adversely affected in the drying and heating operations. The mixer discharge shall be equipped with a pyrometer or thermometer probe to record the temperature of the mixture, and the data transmitted to the operator's station.

   Methods and facilities shall be provided for safely and conveniently obtaining representative mixture samples before the mixture's introduction into the surge bin.

   The Engineer may perform test comparisons between the consistency of the asphalt binder in its original form from plant tank samples and in processed form from mixture recovery samples obtained before the mixture's introduction into the surge bin. The results of such consistency tests will be used to determine whether a processing improvement is necessary to eliminate excessive volatilization, oxidation, or other causes of premature hardening.

7. **Surge Bin.** The plant shall be provided with a surge bin system of adequate capacity to minimize production interruptions during the normal day's operation. The surge bin shall conform to Subheading 9 of the second paragraph of Subpart A above.

8. **Emission Control System.** The plant shall be equipped with an emission control system so as to meet all applicable limitations concerning emissions.

9. **Control Console.** The following items shall be part of a control console furnished in the operator's station:

   a. Cold aggregate feed controls capable of both total and proportional control of the aggregates.

   b. Dryer burner controls that automatically control the temperature of the mix and record the mix temperature at the dryer discharge.

   c. Aggregate weigh belt readouts displaying the weight of material being proportioned from each aggregate bin in tons per hour or the corresponding percentage of total mix weight and the total flow over the main feeder to the drum mixer in tons per hour. The accumulated weights in tons from each bin and the total feed to the mixer shall be separately totaled. These separate totals shall be either continuously displayed or available on demand from a printout device.

   d. Mineral filler readouts displaying the weight of material being proportioned from the mineral filler bin in tons per hour or the corresponding percentage of total mix weight together with an accumulative total in tons.

e. Asphalt binder metering system readouts indicating the quantity of asphalt binder, corrected to 60 ºF, being proportioned into the mix together with an accumulative total in tons, and a recording pyrometer or thermometer that records the temperature of the asphalt binder at the pump.

f. Proportioning controls that set the asphalt binder content as well as the aggregate moisture adjustment.

10. Modifications. Modifications to drum mixing plants required for the use of 26 to 50 percent of RAP are as follows:

a. The mixing time shall be such as to achieve an intimate blending of the new and reclaimed materials, and a complete coating of all aggregate particles. If more than an occasional lump of reclaimed material is observed in the mixture as discharged from the drum, the mixing time in the drum shall be modified or other changes in the production process made to correct this condition.

b. The temperature of the mixture at discharge from the plant or surge and storage bins shall be maintained at or above the temperature required to deliver material to the project to achieve optimum compaction.

404.05 Plant Laboratory.{ XE "Hot mix asphalt (HMA):plants and equipment:plant laboratory" }{ XE "Laboratory:HMA" }

A plant laboratory shall be provided and maintained at each plant site for use of the Engineer for sampling and acceptance testing, and for use of the producer for quality control testing during periods of production. The plant laboratory shall also include an office area for use by the Engineer. The costs of the plant laboratory and all the facilities and equipment therein shall be included in the other items in the proposal, and no separate payment will be made for the plant laboratory.

The producer's laboratory technician shall be present during periods of mix production.

The producer's quality control technician must be certified by the Society of Asphalt Technologists of New Jersey, Inc. as an Asphalt Technologist, Level I. Effective January 1, 2002, the HMA producer's quality control technician must be certified by the Society of Asphalt Technologists of New Jersey as an Asphalt Technologist Level II. Equivalent technician certification by Mid-Atlantic Region Technician Certification Program (MARTCP) may be substituted for NJSAT Level I or Level II.

The plant laboratory shall be located to provide an unobstructed view of the trucks as they are loaded.

The plant laboratory, including office area, shall have a floor area of not less than 225 square feet, exclusive of sanitary facilities, a ceiling height of not less than 7½ feet, adequate ventilation and artificial lighting, and sanitary facilities according to Subsection 107.10, except that they shall be within 325 feet of the Laboratory. The plant laboratory shall be weather-tight, heated, and air-conditioned to maintain temperatures for testing purposes between 60 and 80 ºF, and shall have the following:

1. Work benches, totaling not less than 2 by 15 feet, and two stools.
2. Two desks, one table, and at least three armed desk chairs.
3. Four-drawer, legal-size file cabinet with lock and two keys.
4. Shelves and supply cabinets.
5. Electronic calculator with printout tape.
6. Water cooler capable of dispensing hot and cold water, with refrigerator, supplied with bottled water.
7. Telephone, direct, private line with no monitoring or recording devices attached.
8. Class ABC fire extinguisher, or a Class A and a Class B fire extinguisher, meeting fire underwriters' approval.
9. First-aid box, containing the following list of supplies:

Quantity	Size	Item
32	¾" by 3"	Brand sheer bandages
20	1" by 3"	Brand fabric bandages
4	Medium	Non-stick pads
2	2"	Soft-gauze bandages
2		Oval eye pads
1	51"	Triangle bandage
1	½" by 180"	Hypo-allergenic first-aid tape
10		Antiseptic wipes
1	⅛ oz.	Burn cream, foil pack
1	8 oz.	First-aid cream

1	100 caplets	Tylenol Extra-Strength or generic equivalent caplets
1		Scissors
1		Tweezer
1		First-aid guide
1	½ fl.oz.	Ophthalmic irrigation solution
1		Contents cards
10		Disposable gloves
10	0.33 mL	Ammonia inhalants

10. Electrical outlets sufficient in number and capacity for operating the required equipment.
11. Display area, approximately 4 by 4 feet, for mounting control charts.
12. Mechanical shakers, screens, and sieves conforming to AASHTO M 92. The mechanical shaker shall be installed and bolted down in a sound-dampening and dustproof enclosure. When acceptance procedures for fully automated batch plants using hot bin samples according to Section 990, NJDOT B-5 are used, an 8-inch shaker and a larger shaker are required.
13. A minimum 12-inch diameter exhaust fan shall be provided in proximity to the mechanical shaker.
14. Sink with hot and cold running water having adequate pressure, drainboard, and drain capable of handling elutriable material.
15. Stand to hold sieves used in washing elutriable material.
16. Two-element hot plate or electric range having dial-type thermostatic controls to adjust the heat for drying aggregates.
17. Hood, enclosed on three sides, top, and bottom, and of such size as to enclose the operations of extractions, evaporation, and ashing as well as other operations in which a vapor or gas is emitted, and designed, constructed, and maintained in such a manner that any operation involving trichloroethylene within the hood does not require the insertion of any portion of an employee's body other than hands and arms, and which contains an exhaust system for exhausting air to the outside at the required linear velocity, all complying with OSHA Safety and Health Standards.
18. Apparatus according to Section 990, NJDOT B-3 or AASHTO T 308.
19. Apparatus according to AASHTO T 166.
20. Apparatus according to AASHTO T 245 for stability testing by the Marshall Method including an automatic compaction hammer and extrusion jack.
21. Apparatus according to AASHTO T 209.
22. Other necessary small hand tools required for sampling and testing.
23. Microcomputer and work station in conformance to Section 106.06.

Accuracy and certification requirements for all weighing devices used for the testing of HMA mixture samples shall be as specified for plant scales in Subheading 4 of the fifth paragraph of Subpart B of Subsection 404.04.

HMA plants producing more than 2,500 tons of HMA mixture per day shall require increased laboratory facilities and equipment.

404.06 Vehicles for Transporting HMA Mixtures.{ XE "Hot mix asphalt (HMA):plants and equipment:vehicles for transporting mixtures" }

The mixture shall be transported from the mixing plant to the Project in trucks equipped with tight, clean bodies, which may be lightly coated with a soap or lime solution, or other such nonpetroleum-based release agent. Under no circumstance shall a petroleum-based product be used as a release agent. Each truckload shall be covered immediately after loading at the plant with a waterproof, canvas tarpaulin of such size to protect the mixture from the weather. The tarpaulin shall be able to withstand normal handling and placement temperatures of up to 400 ºF (205 ºC) without endangering the structural integrity and serviceability of the fabric. The cover shall lap down along the sides and rear of the truck bed a minimum of 6 inches (150 millimeters), and shall be secured by tie downs at a maximum of 5 feet (1.5 meter) spacing along the sides and rear of the truck. The truck bodies shall be insulated or heated as necessary, to ensure delivery of the mixture at the specified temperature. Any truck causing excessive segregation of the mixture by its suspension or other contributing factors, or that leaks or causes delays shall be removed from the work until such conditions are corrected.

404.07 Materials Transfer Vehicle (MTV).

The MTV shall independently deliver mixtures from the hauling equipment to the paving equipment. A paver hopper insert with a minimum capacity of 15 tons shall be installed in the hopper of conventional paving equipment when an MTV is used.

As a minimum, the MTV shall have a high capacity truck unloading system which will receive mixtures from the hauling equipment; a storage system in the MTV with a minimum capacity of 25 tons of mixture; a remixing system to continuously blend the mixture prior to placement; and a discharge conveyor, with the ability to swivel, to deliver the mixture to the paving spreader while allowing the MTV to operate from an adjacent lane.

404.08 HMA Paver.{ XE "Hot mix asphalt (HMA):plants and equipment:pavers" }

HMA pavers for 8-foot widths or more shall be self-contained, power-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing HMA in the lane widths and thicknesses required.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed.

The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture. Screed or strike-off assemblies shall extend the full width of the course being laid and shall impart initial compaction thereon. The paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mixture.

HMA pavers shall be equipped and operated with automatic grade and slope control. The automatic control system must maintain the screed or strike-off in a constant position relative to profile and cross-slope references. The references shall be such that control of the screed or strike-off position is independent of irregularities in the underlying surface and of spreader operation. When paving in widths exceeding the manufacturer's recommendations for use of the automatic slope control, a grade reference system shall be used on both sides of the paver.

HMA pavers shall be equipped with a sloped plate to produce a wedge edge at longitudinal joints. The sloped plate shall be attached to the paver screed extension.

The sloped plate shall produce a wedge edge having a face slope of 3H:1V. The plate shall be so constructed as to accommodate compacted layer thickness from 1½ to 4 inches. The bottom of the sloped plate shall be mounted ⅜ to ½ inch above the existing surface. The plate shall be interchangeable on either side of the screed.

For surface layers, HMA pavers shall also be equipped with infrared heater(s) of at least 350,000 BTU per hour total capacity to heat the longitudinal edge of the previously placed layer. To achieve bonding of the newly placed layer with the previously placed layer without undue breaking or fracturing of aggregate at the interface, the joint heater(s) shall be positioned not greater than 2 inches above the surface of the previously placed layer. The joint heater(s) shall be equipped with automated controls that shut off the burners when the paving machine stops and reignite them with the forward movement of the paver. The joint heater(s) shall heat an area of the previously placed wedge edge not less than 1 foot - 3 inches of width and 6 feet - 3 inches of length at one time. Heating shall immediately precede placement of the HMA material. A joint heater will not be required on intermediate or base course.

While operating automatically, it shall be possible to manually override the automatic controls.

In the event of mechanical failure of the automatic controls, the use of manual controls may be permitted to finish the day's work, but resumption of work will not be allowed on the following working day until both the grade and slope controls are in working order. Such permission shall not constitute a waiver of any of the applicable quality requirements contained in the Specifications.

Automatic controls will not be required where they cannot be used effectively, such as at intersections.

A stringline or approved electronic grade reference system shall be used for longitudinal grade control on the first lift of paving except that a ski-type may be used if a previously placed strip of HMA, portland cement concrete surface, intermediate course, base course, or other suitable grade reference, such as portland cement concrete gutter or a similar item, has been placed to a specified line, grade, and cross-section, and is to adjoin the strip to be placed. Grade reference system for subsequent lifts of paving shall be ski-type. The use of a joint matching shoe may be permitted instead of the ski.

The stringline reference system shall consist of suitable line supported by devices compatible with the type of automatic paver control system used. The stringline and supports shall be capable of maintaining line and grade at the point of support while withstanding the tensioning necessary to prevent sag in excess of ¼ inch between supports spaced 50 feet apart. Additional supports shall be installed to provide a spacing of 25 feet or less to remove any apparent deviation of the stringline from specified grade. Spacings of 25 feet may be required at the crest and bottom of vertical curves.

All materials, equipment, labor, and incidentals required to construct the stringline reference system shall be furnished and maintained until no longer required. The stringline reference system shall be completely in place sufficiently in advance of the construction to avoid any delay or interruption of the paving operations.

HMA pavers for less than 8-foot widths used for shoulders and similar construction shall be capable of spreading and finishing HMA material in the widths and thicknesses required.

404.09 Rollers.{ XE "Hot mix asphalt (HMA):plants and equipment:rollers" }

Rollers shall consist of steel wheel rollers, or vibratory rollers as described hereinafter. There shall be technical literature available giving the weight and dimensions of the rollers to be used.

Rollers shall be equipped with adjustable scrapers to keep the wheels clean and with means of keeping the wheels moist to prevent HMA from sticking to the wheels. Wheels shall also be free of flat areas, openings, or projections that may mar the surface.

Rollers shall be capable of reversing without backlash and shall conform to the following:

1. **Steel Wheel Rollers.** Three-wheel power-driven rollers shall have a load of not less than 330 pounds per inch of width of tread of rear wheels and a total metal weight of not less than 10 tons.

   Two-axle tandem rollers shall be power driven and shall have a load of not less than 250 pounds per inch of width of tread of drive roll and shall have a total metal weight of not less than 8 tons.
2. **Vibratory Rollers.** Vibratory rollers shall be of the self-propelled type and shall have one or two smooth steel drums. Vibratory rollers used on HMA shall have at least two steel drums. Vibratory rollers having rubber tires on any axle shall not be used on HMA surface course. Vibratory rollers shall have a static weight of not less than 6½ tons, and shall be capable of maintaining the frequency of vibration and the amplitude specified by the manufacturer.

   Each vibratory roller shall be equipped with the following:

   a. Two lights shall be mounted on the fenders, or one light shall be mounted above the roller so as to be visible from a distance of 200 feet, and shall blink when the vibratory system is in operation.
   b. A speed indicator in feet per minute or tenths of a mile per hour shall be provided to permit the operator to closely control the rolling speed.
   c. A vibrating reed tachometer shall be provided with each roller for use by the Engineer to provide a mechanical check on the rollers vibration control system.
   d. Rollers shall be equipped with an automatic vibration disconnect system which automatically shuts off the vibration when the roller is in a stationary position. A mechanical override system shall be provided in the event of temporary failure of the automatic system that shuts off the vibration when the roller is in a stationary position.
   e. Instruction sheets indicating operational instructions, recommended amplitude, vibrations per minute, and speed settings shall be provided on each project.

404.10 Pressure Distributor.{ XE "Pressure distributor" }

The pressure distributor for tack and prime coats shall conform to Subsection 402.03.

404.11 Small Tools.

All necessary small tools, including hand compactors, and suitable means for keeping them clean and free from accumulation of bituminous material, shall be supplied. For pavement repair pneumatic or hand tools shall be used.

1. Sawing equipment for sawing joints shall conform to the requirements of Subsection 405.03, except that dry diamond-edge blades or abrasive wheels shall be permitted providing that the saw cut does not result in excessive spalling at the sawed edges. Dry saws shall be equipped with an approved dust collection system to prevent airborne residue from escaping into the atmosphere. The wet sawing operation shall provide a means for removing the wet slurry from the pavement and joint wall. The blades shall be of such size and configuration that the desired dimensions of the saw cut are achieved in one pass.
2. Pneumatic hammers used to remove existing pavement shall not exceed 31 pounds.
3. The compressor for air blowing shall filter moisture and oil from the air, and shall deliver air at a minimum of 4.6 cubic yards per minute and develop a nozzle pressure of at least 87 psi.
4. Sealing equipment for sealing joints or cracks shall consist of a kettle or melter and applicator wand. The melter shall be constructed as a double boiler, with the space between the inner and outer shells filled with oil or other heat transfer medium. The melter shall include positive temperature control, mechanical agitation, recirculation pumps, and thermometers for continuous reading of the temperature of both the sealing compound and the heat transfer medium. The applicator wand shall be heated or insulated to maintain the pouring temperature of the sealant during the placing operation. Pouring pots or similar devices shall not be used to fill sawed joints or cracks.
5. Vibratory drum compactors shall be the self-propelled type, having one or two smooth steel drums having a minimum centrifugal force of 177 pounds per inch of width of tread of drive roll. Vibratory drum compactors shall be capable of maintaining the frequency of vibration and amplitude specified by the manufacturers. Instruction sheets indicating operational instructions, recommended amplitude, vibrations per minute, and speed settings shall be provided on each project.

CONSTRUCTION

404.12 Preparation of Existing Surface.

Existing concrete and HMA pavements shall be prepared according to the following:

A. HMA Pavement Repair. The existing HMA pavement shall be sawcut with a diamond tipped circular cutting blade from the pavement surface to a maximum depth of 10 inches or to the full depth of bound layers, whichever is less. The sawcut lines shall be parallel and perpendicular to the roadway baseline and 3 inches away, at the closest point, from the damaged area to be repaired.

After the sawcuts have been made, all material within the boundary of the sawcuts shall be removed to form rectangular openings with vertical sides. Flushing of debris will not be allowed. The bottom shall be shaped and compacted to produce a firm, level surface to receive the HMA material. Unstable or loose material shall be removed and replaced with acceptable material, which shall be compacted. The work shall be done in such a manner as not to damage the pavement that is to remain.

Following material removal, the area to be repaired shall be thoroughly cleared of loose material and dried. The vertical edges of pavement shall be painted with a tack coat according to Subsection 404.15 and then backfilled with HMA mixture as specified for the roadway surface. The minimum temperature of the mix when placed shall not be lower than 250 °F, and compaction shall be according to Subsection 404.18 except that areas not accessible to rollers conforming to Subsection 404.09 shall be compacted by a vibratory drum compactor conforming to Subsection 404.11.

The top of the compacted patch shall be flush with the adjacent pavement surface.

Any debris created by this work shall be removed at the end of each work day and disposed of according to Subsection 201.10.

B. Concrete Pavement Repair. The existing concrete pavement shall be sawcut to a depth of 1 inch from the pavement surface. The sawcut lines shall be parallel and perpendicular to the roadway baseline and 2 inches away, at the closest point, from the damaged area to be repaired.

After the sawcuts have been made, all concrete and exposed reinforcement within the boundary of the sawcuts shall be removed. Flushing of this debris will not be allowed. Concrete shall be removed from the areas to be patched in such a manner and to such an extent as to expose a sound concrete surface. Sound concrete, beneath the disintegrated concrete, shall be removed for a depth of not less than ¼ inch and not more than 1inch, and the remainder of the area shall be shaped to produce a level surface to receive the bituminous patch material. The work shall be done in such a manner as not to damage the concrete pavement that is to remain. Any exposed reinforcement steel shall be cut off flush with the sound concrete surface. Care shall be taken so as not to debond the steel embedded in sound concrete.

Only pneumatic or hand tools shall be used in the removal of the disintegrated concrete and in preparing and shaping the damaged areas to be patched. Following material removal, the area to be patched shall be

thoroughly cleaned and dried by air blasting using a compressor complying with Subsection 404.11. Flushing of this debris will not be allowed.

After the area to be patched has been thoroughly cleaned it shall be coated with a tack coat according to Subsection 404.15 and then backfilled with HMA as specified for the roadway surface. The minimum temperature of the mix when placed shall not be lower than 250 °F, and compaction shall be according to Subsection 404.18 except that areas not accessible to rollers conforming to Subsection 404.09 shall be compacted by a vibratory drum compactor conforming to Subsection 404.11.

The top of the compacted patch shall be flush with the adjacent pavement surface.

Any debris created by this work shall be removed at the end of each work day and disposed of according to Subsection 201.10.

C. Sealing of Cracks and Joints in Concrete Surface Course Prior to Overlay. Cracks or joints to be sealed shall be cleaned to a depth of at least 2 inches by use of a rectangular plow, a diamond blade saw, a compressed airjet nozzle, or other suitable equipment. All joint material, incompressibles, rubble and other extraneous materials present in the crack or joint, or adhering to the face of the adjacent concrete slabs, shall be removed.

After the crack or joint has been prepared by either high pressure (nominal 4 tons per square inch) water blasting or sandblasting to the depth of the bottom of the proposed sealer, leaving both faces of the crack or joint clean and free of existing joint sealer and other contaminants.

The crack or joint and both faces of the adjacent slabs shall be cleaned and dried by air blowing or hot compressed air lance just prior to the sealing operation.

The backup material (backer rod) shall be installed in any joint ⅜ inch in width or wider and shall be installed at a depth equal to the joint width. The backer rod shall be installed by a double-wheeled steel roller without stretching or puncturing the backup material.

The sealant shall be cut into small pieces to facilitate uniform melting and shall be melted slowly, with constant agitation.

Pouring shall be done in such a manner that the sealant will not be spilled on adjacent pavement surfaces. Material spilled on the pavement surface shall be immediately removed.

The sealant shall have a maximum 2-inch overband of the crack or joint.

The application temperature of the joint sealant should be approximately 293 °F, or 41 °F below the manufacturer's safe heating temperature. The ambient temperature at the time of application shall be 41 °F or above. The pavement temperature shall be above 50 °F at the time of installation of hot-poured sealing material.

The first one-gallon of material to flow from the applicator wand shall be considered as unusable and shall be discarded into a designated container for disposal.

Cracks or joints are to be sealed to an initial elevation of not more than ¼ inch above the adjacent pavement surface. Cracks or joints which are filled to an elevation less than 1/10 inch below the surface of the upstream slab shall have the sealant removed for the full slab width and full seal depth, and be thoroughly cleaned and resealed, as specified above, at the contractor's expense. This removal of joint material, cleaning and resealing shall be performed the same day as the joint filling occurs.

During all operations, care shall be taken not to damage the pavement. In the event that such damage occurs, it shall be repaired to the satisfaction of the Engineer at no additional expense to the State.

No traffic or construction equipment will be permitted to cross the newly sealed joints for at least one hour, or as specified by the sealer manufacturer's recommendations and as approved by the Engineer.

D. Sealing of Cracks in HMA Surface Course. All cracks ¼ inch wide or wider shall be sealed. The cracks shall be cleaned to a depth of approximately 1 inch by means of a random crack saw, carbide-tipped, rotary-impact router, commercial power-driven wire brush, or by other approved means. The Contractor shall provide acceptable protective screening if cleaning operations will cause damage to or interference with traffic in adjacent lanes.

Immediately before sealant application, the cracks shall be cleaned and dried further with a hot compressed air lance (heat lance), or by air-blasting. Air compressors for air-blasting shall be equipped with oil and moisture-filtering systems.

The cracks shall be sealed with hot-poured joint sealant. The sealant shall be cut into small pieces to facilitate uniform melting and shall be melted slowly with constant stirring. A copy of the manufacturer's recommendations pertaining to the heating and application of the sealant material shall be submitted prior to the start of work. The manufacturer's recommendations shall be adhered to. The temperature of the sealant in

the field application equipment shall not exceed the recommended safe heating temperature. Sealant material shall not be heated at the pouring temperature for more than six hours and shall not be reheated.

Sufficient sealant shall be poured into the cracks so that, upon completion of the work, the surface of the sealant is flush with or not more than 1/5 inch lower than the surface of the adjacent HMA surface course. If the sealant subsides to a lower level, another pouring shall be required. When more than one pouring is required to fill the cracks, succeeding pourings shall be done immediately after shrinkage of the previous pouring. Pouring shall be done in such a manner that the sealant is not spilled on exposed adjacent HMA surface course. Overfilling of the cracks shall also be avoided. If spilling or overfilling occurs, the crack shall immediately be squeegeed. If the Engineer determines that the overfilled crack or spilled sealant creates a slippery, hazardous, or otherwise undesirable condition, the area shall initially be corrected by sprinkling a light application of abrasive (sand or grit material) to absorb the excess materials, restore skid-resistance, and abate the condition caused by the overpour. After the excess material has been absorbed, the area shall be swept clean and restored to its original condition or texture to the Engineer's satisfaction. The Engineer may suspend the work, wholly or in part, according to Subsection 108.15 if overpouring continues, or if any undesirable condition caused by the overpour is not properly restored.

Traffic or construction equipment will not be permitted over the poured joints and cracks until the sealant has hardened sufficiently to resist pickup. The Engineer may direct dry sand to be sprinkled over poured areas at no additional cost to aid in resisting pick-up by traffic.

404.13 Weather Limitations.{ XE "Hot mix asphalt (HMA):construction:weather limitations" }

HMA mixtures shall be placed when the combinations of lift thickness and base surface temperatures are within the limits shown in Table 404-1 below, when it is not raining, and when the base is in a satisfactory condition. For other than surface courses, in case of sudden rain, the placing of mixture then in transit from the plant may be permitted, if laid at proper temperature, and if the base is free of pools of water. Such permission shall in no way waive any of the requirements of the specification.

Base temperature will be measured on the surface on which the lift will be placed. Lift thickness will mean the compacted lift thickness.

Table 404-1 Minimum Base Temperature, **{** XE "Tables:HMA:minimum laydown temperature" **}**

Lift Thickness, inches	Minimum Base Temperature, ^{o}F
≤1	50
1-2	41
≥2	32

If the mix contains modified binder, the minimum base temperature shall be 50 ^{o}F, regardless of lift thickness.

404.14 Preparation of Subgrade or Base Course.

The preparation of subgrade or soil aggregate base course shall be according to Section 208 or 209, and each shall be checked and approved far enough in advance of spreading the HMA base mixture to permit one day's paving operations.

Prior to paving, the Contractor may notify the Resident Engineer, in writing, of areas which have poor subgrade as indicated by sub-surface exploration or non-destructive testing, and thus may not be compacted effectively to meet the Specifications. The Resident Engineer will make final determination on the areas that may be excluded from sampling based on the request and notify the Contractor in writing.

404.15 Conditioning of Existing Surface.{ XE "Hot mix asphalt (HMA):construction:conditioning existing surfaces" }

The surface upon which the HMA is to be placed shall be clean of all foreign and loose material and be dry and free from ice when the paving operations are about to start, and the surface shall be maintained in that condition.

In areas where the distributor spray bar cannot reach, the use of hand spraying equipment will be permitted for tack and prime coat.

All bituminous materials shall be cleaned from exposed surfaces of curbs, gutters, manholes, and other similar structures.

Treatment of the pavement surface shall conform to the following:

{ XE "Tack coat" **}{** XE "Hot mix asphalt (HMA):construction:tack coat application" **}1. Tack Coat.** When HMA is placed on existing portland cement concrete, existing HMA, or newly constructed HMA on which traffic has been maintained, the paved surface shall be given an application of tack coat material, uniformly sprayed and conforming to Subsection 404.02. The application is not acceptable if the material is streaked or ribboned.

Contact surfaces of curbing, gutters, manholes, and other similar structures shall be painted with a thin uniform coating of tack coat material just before the placing of the HMA mixture against them.

Tack coat application shall be according to the following:

Material	Spraying Temp, (ºF)	Gallons per Square Yard	Season
Cut-back Asphalt:			
RC-70	120-190	0.02-0.08	Oct 15-Apr 15
RC-T	85-150	0.02-0.08	Oct 15-Apr 15
Emulsified Asphalt:			
RS-1	70-140	0.02-0.08	All year
SS-1*, SS-1h*	70-140	0.04-0.15	All year
CSS-1*, CSS-1h*	70-140	0.04-0.15	All year

* Diluted with an equal volume of water by manufacturer. Each shipment shall include a certified statement specifying the rate of dilution.

Safety precautions shall be observed when using cut-back asphalts and shall be according to Subsection 402.02.

Before paving, sufficient time shall be allowed to permit the tack coat to cure to a condition, which is tacky to the touch.

All uncoated or lightly coated areas shall be corrected. All areas showing an excess of bituminous material shall be blotted with sand or other similar material. Blotting material shall be removed before paving.

No more tack coat should be applied than can be covered in the same day.

Traffic control shall be provided to prevent vehicles from riding on surfaces upon which tack coat has been applied.

2. Tack Coat 64-22. When Tack Coat 64-22 is specified, the surface upon which the tack is to be applied shall be free from moisture and cleaned of all dirt and other foreign or loose matter. When precipitation has occurred during the previous 24 hours, the Engineer will determine if the tack coat may be applied or if the work will be delayed until the surface is completely dry. No more tack coat shall be applied than can be covered in the same day. Traffic control shall be provided to prevent vehicles from riding on surfaces upon which tack coat has been applied. Tack coat 64-22 shall be applied at a rate of 0.06 – 0.14 gallon per square yard and at a spraying temperature of 325 °F. The spraying temperature and application rate will be adjusted by the Engineer as required to produce a uniform coating so that every part of the surface is covered, with no excess material. All uncoated or lightly coated areas shall be corrected. All areas showing an excess of bituminous material shall be corrected by removing the excess material. The application is not acceptable if the material is streaked or ribboned.

3. Prime Coat.{ XE "Hot mix asphalt (HMA):construction:prime coat application" **}{** XE "Prime coat" **} {** XE "Prime coat:application temperatures" **}**When HMA is to be placed on newly constructed or existing soil aggregate or dense-graded aggregate base courses, the surface shall be given a prime coat of cut-back asphalt conforming to Subsection 404.02.

Prime coat application shall be according to the following:

Material	Spraying Temp, (ºF)	Gallons per Square Yard	Season
Cut-back Asphalt:			
MC-30	85-150	0.15-0.35	All year
MC-70	120-190	0.15-0.35	All year

{ XE "Prime coat:safety precautions" **}**Safety precautions shall be observed when using cut-back asphalts and shall be according to Subsection 402.02.

Application of the prime coat shall be made not less than 12 hours before the placing of the HMA and shall not be made when the base courses are wet or frozen. The Engineer may waive the application of prime coat if a minimum of 5 inches of plant mix HMA will be placed on an unbound aggregate course before opening the roadway to traffic.

404.16 Transportation and Delivery of Mixture.{ XE "Hot mix asphalt (HMA):construction:transportation of mixtures" }

The mixture shall be transported from the mixing plant to the point of use in vehicles conforming to Subsection 404.06. Failure to comply with the provisions of Subsection 404.06 shall be cause for rejection of the HMA at the project site. Loads shall not be sent out so late in the day as to prevent completion of the spreading and compaction of the mixture during daylight, unless sufficient artificial light is provided according to Subsection 617.05.

Plant production and the number of trucks used for transportation shall be such as to ensure delivery of the mixture in sufficient quantities and at such intervals to permit continuous placement of the material with minimal stopping and starting of the paving operation. Failure to maintain such delivery shall be cause to suspend the work.

404.17 Spreading and Finishing.{ XE "Hot mix asphalt (HMA):construction:spreading and finishing" }

The Paving Contractor shall employ an asphalt paving construction technologist (APCT), certified by the Society of Asphalt Technologists of New Jersey, Inc. The Paving Contractor's certified APCT shall be present at the start of each separate and distinct paving operation and shall remain in attendance on a full-time basis until released from that paving operation by the Engineer. Thereafter, the APCT shall be present at least on a part-time basis for every day that the same paving operation is in progress. During those part-time days that the APCT is absent from the Project, the APCT shall be readily available on an on-call basis and shall be able to be at the Project site within one hour of being called. Failure of the APCT to respond within one hour may cause the Engineer to suspend paving operations until such time as the APCT arrives at the Project. The equivalent certification by the Mid-Atlantic Region Technician Certification Program (MARTCP) will be acceptable.

At least 20 calendar days before the start of placing the HMA surface course, a detailed plan of operation shall be submitted to the Engineer for review and approval. This plan shall include the surface course paving sequence for the Project, the number and type of personnel that will be engaged in the work, a complete description of the equipment to be used in spreading and compacting the surface course mixture, and the procedures that will be used to maintain a continuous placement operation according to Subsection 404.16.

The mixture shall be laid upon an approved surface, spread, and struck off to the grade and elevation required. HMA pavers conforming to Subsection 404.08 shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable. Paving courses shall be constructed in layers not less than 3 nor more than 5 times the nominal maximum aggregate size of the HMA mixture being constructed.

HMA having a nominal maximum aggregate size of ⅜ inch or less shall be used in transition (run out) areas, where directed.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked, and luted by hand tools. For such areas, the mixture shall be dumped, spread, and screeded to give the required compacted thickness.

If it is determined that the underlying material has not been compacted and finished to the specified thickness or grade, construction of any subsequent course shall not proceed until corrective measures have been completed.

{ XE "Hot mix asphalt (HMA):construction:joints" **}**Joints shall be constructed according to the following:

1. **Longitudinal Joints.** The longitudinal joint in one layer shall offset that in the layer immediately below by approximately 6 inches. However, the joint in the surface course shall be at the lane lines.

   If a single paver does not spread the mixture the entire width, when practical and when production of the mixture can be maintained, two pavers shall be used. The second unit shall follow the first unit in echelon, and so closely behind the first unit so as not to permit cooling of the longitudinal joint between the two lanes.

   The longitudinal wedge joint shall be formed between all abutting layers except that it shall be optional for paving the longitudinal joint between the lanes when paving in echelon.

   The material being placed in the abutting lane shall be tightly crowded against the face of the previously placed lane. The paver shall be positioned so that in spreading, the material overlaps the top edge of the lane previously placed by 2 to 3 inches. The overlapped material shall be luted back onto the uncompacted mat and should be left sufficiently high to allow for compaction. To ensure a true line, the paver shall closely follow the lines or markings placed along the joint for alignment purposes. The width and depth of the overlapped material shall be kept uniform at all times.

2. **Transverse Joints.** Transverse joints shall be carefully constructed and thoroughly compacted to provide a smooth riding surface. Joints shall be straightedged to check their smoothness. If the line of joint is formed with a bulkhead, it shall form a straight line and vertical face. If a bulkhead is not used to form the joint, the joint shall be made by sawing the compacted mixture for a sufficient distance behind the end of the placement to ensure full thickness and a smooth surface at the joint. The material ahead of the sawed joint shall be

removed. In either case, the joint face shall be painted with a thin coat of hot asphalt binder before the fresh material is placed against it. Cross rolling, unless prohibited by field conditions, is required to obtain thorough compaction of these joints.

404.18 Compaction.{ XE "Hot mix asphalt (HMA):construction:compaction" }

After the HMA has been spread, struck off, and surface irregularities adjusted, it shall be compacted thoroughly and uniformly with rollers conforming to Subsection 404.09.

The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving.

Rolling shall begin at the sides and progress gradually to the center, except that on superelevated curves, rolling shall progress from the lower to the upper edge parallel to the centerline and uniformly lapping each preceding track until the entire surface has been rolled at least once by the rear wheels.

When compacting the longitudinal edge of the first lanes placed using the wedge joint, the breakdown roller shall not extend more than 2 inches over the top of the sloped face of the wedge joint.

Alternate trips of the roller shall be terminated in stops approximately 2 feet from the preceding stop. When paving in echelon, rollers shall not compact within 6 inches of an edge where an adjacent lane is to be placed.

The drive wheels of the rollers shall be toward the paver during compaction operation.

Rollers shall move at a slow but uniform speed. Maximum roller speed shall be 3 miles per hour except for vibratory rollers used on the surface course where the maximum speed shall be 2½ miles per hour. Rolling shall be continued until all roller marks are eliminated and the air voids conform to the specified requirements.

Any displacement occurring as a result of reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of lutes and addition of fresh mixture when required. Care shall be exercised in rolling not to displace the line and grade of the edges of the HMA mixture.

If necessary to prevent adhesion of the mixture to the rollers, the wheels shall be kept moistened with water mixed with very small quantities of detergent or other similar material. Excess liquid will not be permitted.

Along forms, curbs, headers, walls, and other places not accessible to the rollers, the mixture shall be compacted by a vibratory drum compactor according to Subsection 404.11.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform with the surrounding area. Any area showing an excess or deficiency of asphalt binder material shall be removed and replaced.

When the average laydown rate does not exceed 2,000 square yards per hour, initial or breakdown rolling shall be accomplished by at least one three-wheel roller and final rolling shall be accomplished by at least one tandem roller except, if permitted, one vibratory roller, meeting the requirements specified elsewhere herein, may be substituted for both the three-wheel roller and the tandem roller. However, if the vibratory roller does not produce a surface free of roller marks and ridges, a tandem roller shall be used for final rolling.

When the average laydown rate exceeds 2,000 square yards per hour but is less than 4,000 square yards per hour, initial or breakdown rolling shall be accomplished by at least two three-wheel rollers and final rolling shall be accomplished by at least one tandem roller except, if permitted, one vibratory roller, meeting the requirements specified elsewhere herein, may be substituted for one three-wheel roller and the tandem roller. However, if the vibratory roller does not produce a surface free of roller marks and ridges, a tandem roller shall be used for final rolling.

When the average laydown rate exceeds 4,000 square yards per hour, initial or breakdown rolling shall be accomplished by at least three, three-wheel rollers and final rolling shall be accomplished by at least two tandem rollers except, if permitted, one vibratory roller, meeting the requirements specified elsewhere herein may be substituted for one three-wheel roller and one tandem roller, or two such vibratory rollers may be substituted for two three-wheel rollers and the two tandem rollers. However, if the vibratory roller does not produce a surface free of roller marks and ridges, a tandem roller shall be used for final rolling.

Demonstrate compaction capability for a particular vibratory roller as directed. During compaction with the vibratory roller, if there is excessive aggregate fracture or crushing, lateral displacement or compaction waves, the vibratory roller will not be approved.

A mandatory test strip shall be constructed for projects with a combination of more than 5,500 tons of HMA surface course, intermediate and base courses. The test strip shall be constructed for the first 700 to 1,200 square yards placed for each job mix formula. Prior to paving, a detailed plan of the test strip shall be submitted to the Engineer for review and approval. During paving of the test strip, the Contractor shall record and submit the following information to the Engineer:

1. Ambient temperature.
2. Base temperature.

3. Nuclear density gauge readings.
4. Core density readings.

When the temperature of the HMA pavement permits, five cores, 6 inches in nominal diameter, shall be removed and tested according to Subsection 404.23, in order to correlate the nuclear density gauge testing with the core results. The core and nuclear density gauge testing results shall be submitted to the Engineer prior to the next day's paving. Failure to submit the reports will result in suspended paving operations. The core results shall include the bulk specific gravity and maximum specific gravity determined from testing, and the calculated percent air voids. The nuclear density gauge testing results shall include the bulk density as measured by the gauge, the maximum density based on the maximum specific gravity determined at the plant, and the calculated percent air voids.

{ XE "Hot mix asphalt (HMA):construction:compaction:test strip method" **}**Upon completion of the test strip, the Contractor shall determine the appropriate method to proceed. If the Contractor elects to continue production, the day's production including the test strip will be subject to the regular acceptance procedure. If the Contractor elects to discontinue production, the Contractor shall notify the Engineer indicating that a second test strip is necessary due to unsatisfactory results. The paving placed up to that point will be treated as a separate lot, and will not be subject to the lot size requirements stated herein. The test strip lot will be evaluated in accordance with the acceptance plan and pay adjustment provisions of these specifications. If more than two test strips are required, the Contractor shall obtain written approval from the Engineer.

A quality control plan outlining the use of the nuclear density gauge, cores, and the control of the compaction process shall be submitted for approval by the Engineer. Paving operations shall not begin prior to approval of the quality control plan. The Contractor shall perform quality control testing of compaction by use of a thin lift nuclear density gauge in accordance with ASTM D 2950. Cores shall be taken for correlation with the nuclear gauge at a frequency of not less than one core per week and not more than two cores per 1,100 tons. A higher frequency of coring may be approved by the Engineer with valid cause presented by the Contractor. Cores for correlation with the nuclear density gauge shall be tested by the Contractor. Results of both the nuclear density and core testing shall be furnished on a weekly basis to the Engineer. Core and nuclear density results shall include the bulk specific gravity, the maximum specific gravity in accordance with AASHTO T 209, and the calculated air voids. Failure to submit the core and nuclear density test results from the previous week's paving, will result in suspended paving operations.

404.19 Sawing and Sealing Joints.

Sawing and sealing joints in HMA overlays over existing portland cement concrete pavement or previously overlain portland cement concrete pavement or sawing joints in base course shall be according to the following:

1. **Sawing and Sealing Joints in HMA Overlays.** An accurate system for locating and referencing proposed saw cuts shall be established and maintained throughout the duration of the work. The location of the saw cuts shall be directly over the existing concrete pavement joints and cracks and shall be accurately established by a method employing pins and stringline or other positive referencing system. The saw cut locations shall be established before paving. Details of the method for establishing the location of the saw cuts shall be submitted for approval at least two weeks before the start of paving.

   Existing transverse joints that are offset at the longitudinal joint by more than 1 inch, measured between the centers of the joints, require separate saw cuts terminating at the longitudinal joint. Full-depth, full-width HMA replacement of an underlying concrete slab shall have separate saw cuts in the overlay directly over the HMA/slab interface. Overlays shall be saw cut over transverse cracks that are reasonably straight, at least ⅛ inch wide, and extend one full lane width.

   Saw cuts shall be made in a straight line. When a saw cut is to be made over a crack in the existing concrete pavement, the saw cut shall be made over the approximate centerline of the crack.

   The dimensions of the saw cut shall be as follows:

   a. For overlays whose total thickness is 2 inches or less, the saw cut shall be ⅜ to ½ inch wide by ⅝ inch deep.
   b. For overlays whose total thickness is greater than 2 inches, the saw cut shall be a T-shaped cut consisting of the saw cut specified in Item a above plus a ⅛ inch wide saw cut at the center. The total depth of the saw cut shall be according to the following:

Total Thickness of Overlay	Depth of Cut
More than 2 but less than 6 inches	2 ± ¼ inches
6 inches or greater	4 ± ¼ inches

   When approved, the T-shaped cut shall be made in made in two stages. When the two-stage system is permitted, the second saw cut (to complete the specified joint shape) shall be made on the same workday as the first cut.

Saw cutting, cleaning, and sealing shall be a continuous operation. If traffic is permitted on the overlay before sealing of the saw cuts, the saw cuts shall be blown clean before sealing. Any unsealed saw cuts damaged by traffic shall be resawed when sealing operations resume at no additional cost to the State.

Saw cuts shall be made no earlier than one day following placement of the overlay and no later than five days after placement of the overlay.

The transverse saw cut joints shall extend the full width of the traveled way and shall extend into the HMA shoulder to a distance 3 feet beyond the edge of the underlying portland cement concrete pavement.

If cracks appear in a base or intermediate course before placement of the surface course, such cracks shall be referenced and the surface course saw cut shall be made directly over the crack, rather than directly over the joint.

Saw cuts shall be thoroughly cleaned with a water blast (50 psi minimum) immediately after sawing to remove any sawing slurry, dirt, or deleterious matter remaining in the saw cut cavity. Saw cuts shall be blown with air to provide dry surfaces before sealing. All sawing slurry from the wet sawing process shall be immediately flushed from the pavement surface. Saw cuts shall be sealed immediately after cleaning.

The joints shall be sealed with hot-poured sealant. A copy of the sealant manufacturer's recommendations pertaining to the heating and application of the joint seal shall be submitted before the start of work. The manufacturer's recommendations shall be adhered to. The temperature of the sealant in the field application equipment shall not exceed the recommended safe heating temperature. Sealant material shall not be heated at the pouring temperature for more than six hours and shall not be reheated.

The sealant shall fill the saw cuts such that after cooling, the level of the sealer is not more than ¼ inch above nor less than ⅛ inch below the surface. Care shall be taken in sealing so that saw cuts are not overfilled and their final appearance shall present a neat line. Sealant shall be tack free before opening to traffic. Sand, cement, or other fine material shall not be spread on the sealed joints to allow early opening to traffic.

2. **Sawing Joints in Base or Intermediate Course.** If, due to seasonal paving limitations, the surface course is to be placed in the following spring and the thickness of the in-place base or intermediate course is greater than 2 inches, an ⅛ inch wide saw cut shall be made over joints and cracks. The depth of cut shall be determined by the thickness of the base or intermediate course according to the above chart. These saw cuts shall be made before the winter closedown. Sealing or cleaning these saw cuts is not required. The depth of cut of the surface course layer or layers placed the following spring shall be determined by the thickness of the surface course.

404.20 Air Voids Acceptance Plan.{ XE "Hot mix asphalt (HMA):acceptance requirements:air voids" }

Mainline lots are defined as the area covered by a day's paving production of the same lift of placed material consisting of a minimum of 1,100 tons and a maximum of 3,300 tons. Except for test strip lots, daily production areas less than 1,100 tons, shall be combined with previous or subsequent production areas to meet the minimum requirements. When the maximum requirement is exceeded in a day's production, the area of material placed shall be divided into two lots with approximately equal areas.

Ramp pavement lots are defined as the area of highway access ramps consisting of approximately 4,800 square yards of full depth uniform thickness pavement or 9,600 square yards of full depth variable thickness pavement. Ramp pavement lots shall be calculated from the pavement structures within the traveled roadway of access ramps only. Ramps with less than the minimum area may be combined into a single lot. Where two or more non-adjacent ramps are included in a single lot, additional cores may be required to insure that at least one core is taken from each ramp.

Other pavement lots are defined as approximately 4,800 square yards of HMA of full depth, uniform thickness or 9,600 square yards of full depth, variable thickness material in shoulders and other incidental pavement construction. Shoulders less than 5 feet in width are excluded from these requirements.

Each mixture in a given lot shall be compacted so that the combined percentage of material below 2.0 percent voids or above 8.0 percent voids shall be no more than ten percent. Air voids shall be determined from five drilled cores taken from each lot in random locations as directed by the Engineer. All core drilling will be witnessed by the Engineer. The drilled cores shall be tested according to Table 903-5 to determine the air voids content.

Conformance with these requirements shall be determined on the basis of the amount of material estimated to fall outside of the specification limits as follows:

1. Compute the sample mean ($\overline{X}$) and the standard deviation (S) of the N = 5, Sample Size, Test Results.

$$\overline{X} = \frac{X1 + X2 + ... + XN}{N}$$

$$S = [(X1 - \overline{X})^2 + (X2 - \overline{X})^2 + ... + (XN - \overline{X})^2 / (N-1)]^{½}$$

Raising to the ½ power is the same as taking the square root.

2. Compute QL = ($\overline{X}$ - 2.0)/S and QU = (8.0 - $\overline{X}$)/S, where "Q" is the quality index for the lower and upper values.
3. Using Table 914-5, for sample size 5, determine the percentage of material falling outside specification limits associated with QL and QU. Add these two values to obtain the total percent defective (PD).
    a. If PD is less than 50, proceed to Step 5 below.
    b. If PD is greater than or equal to 50, the Department may elect to reevaluate the lot with additional cores as described in Step 4 below. If no additional cores are taken, proceed to Step 5 below.
    c. If PD is greater than or equal to 75, the Department may require the removal and replacement of the defective lot (including any overlying layers) at the Contractor's expense. If this option is not exercised, the Contractor may elect to replace the lot or leave it in place subject to a percent pay adjustment (PPA) of minus 20.
4. If the Department elects to reevaluate the lot, five additional cores are to be taken at new random locations. Using the five new test results, repeat Steps 1 and 2. Using Table 914-5 and the computed QL and QU values, determine the total PD based on the second set of tests. The final PD value is the average of the values obtained from the two sets of tests, subject to the conditions of Step 3.c.
5. Compute the percent pay adjustment (PPA) as follows:

    PPA = 1.0 - 0.1 x PD

    For PD values less than 10, the percent pay adjustment is positive, representing a bonus payment.
6. For short lots use the appropriate chart in Table 914-5 for defective percentage.

404.21 Surface Course Rideability Requirements.{ XE "Hot mix asphalt (HMA):acceptance requirements:surface" }

A. Payment Reductions for New Construction, Reconstruction, or Dualization Projects.

1. Permissible Surface Variations. The HMA surface course will be tested with a Rolling Straightedge that automatically marks, in colored dye, the length of surface variations that exceed a tolerance of ⅛ inch in 10 feet, according to the following:

a. The HMA surface course placed in the traveled way at locations indicated in the Special Provisions shall be constructed so that when tested according to Subpart A.3 below, the measured length of lot exceeding ⅛ inch tolerance shall not exceed 1.3 percent.

b. The HMA surface course placed in areas other than those specified in the Special Provisions will be tested for acceptance according to Subpart A.4 below. The measured length of such areas exceeding the ⅛ inch tolerance shall not exceed 3.5 percent. The number, length, and location of Straightedge tests undertaken to determine conformity in such areas will be at the sole discretion of the Engineer.

2. Control Testing. Control testing during placement shall be conducted as may be necessary to ensure compliance with the specified surface requirement.

3. Rideability Acceptance Plan. Any required sweeping of the surface course before acceptance testing shall be performed.

Conformance to the surface tolerance for HMA placed at the locations specified in Subpart A.1 will be determined in lots, each lot being equal to the total number of tons of mixture accepted and placed each production day, less the weight of such mixture placed in areas other than those specified in Subpart A.1. When the weight of the surface course placed in areas other than those specified in Subpart A.1 cannot be readily determined from weigh tickets and other records, it shall be calculated based on the square yards of such areas paved on the given day, the specified thickness, and the average mix weight per inch thick per square yard.

The acceptance of a lot will be based on the percentage of the total length of the lot having surface variation exceeding ⅛ inch in 10 feet, this percent noncompliance being defined as the lot percent defective length. Lot percent defective length will be computed by adding the lengths, to the nearest foot, of individual surface defects exceeding the specified tolerance, dividing this sum by the total length tested, and multiplying by 100 to convert to percent.

The full extent of the lot will be tested in the longitudinal direction. The transverse location of the test will be in the wheelpaths of vehicle travel, defined as the two imaginary lines located approximately 3 feet on each side of the centerline of the lane and extending for the full length of the lane. The wheelpath of the test will be determined randomly and varied every 300 to 400 feet.

The minimum number of full-length tests required to determine the lot percent defective length is shown in Table 404-2. The 25 percent sampling plan, wherein the number of tests is at least equal to one-fourth of the number of wheelpaths in a day's production, will be used initially. The HMA surface course will be accepted when the lot percent defective length is equal to or less than 1.0 based on the 25 percent sampling plan. If a lot percent defective length of 1.1 to 3.4 is indicated by the tests of the 25 percent sampling plan, additional tests will be performed such that the total number of tests performed equals that shown for the 50 percent sampling plan. If the lot percent defective length in the 25 to 50 percent sampling plan exceeds 3.4, the full length of each wheelpath will be tested.

Table 404-2 Rideability Acceptance Testing Schedule

Sampling Plan	Corresponding Number of Wheelpaths to be Tested: One Lane	Two Lanes	Three Lanes	Four Lanes	Lot Percent Defective Length Measured	Reduction or Retest Requirement
25%	see 50% Sampling Plan	1	2	2	0 to 1.0	None
					1.1 to 3.4	Perform 50% Testing
					3.5 or more	Test each wheelpath
50%	1	2	3	4	0 to 3.4	As per Table 404-3
					3.5 or more	Test each wheelpath
100%	2	4	6	8	All values	As per Table 404-3

When more than one test is specified in Table 404-2, the initial and intermediate transverse locations of each test will be determined randomly. In no case will exact duplicate tests be performed. When testing of all wheelpaths is specified, intermediate transverse variation of the individual tests will not be made. The results of preceding tests will not be included in the computation of lot percent defective length when application of the 100 percent sampling plan is indicated.

Tests may be performed beyond the minimums specified in Table 404-2. In addition to the tests run on randomly selected sites, any area that appears defective may be tested including a previous day's production that is damaged by construction.

If the lot percent defective length is 1.4 to 3.4 inclusive and if the Contractor elects not to remove and replace the HMA surface course, the lot will be accepted upon written request provided that payment for the lot is reduced according to Table 404-3.

Table 404-3 Reduction per Lot Due to Nonconformance to Surface Requirements

Lot Percent Defective Length	Reduction per Lot, Percent
0 - 1.3	None
1.4 - 2.3	12
2.4 - 3.4	30

If the lot percent defective length exceeds 3.4, any or all of the material in the lot may be directed to be removed, replaced, and retested for acceptance. If the material is permitted to remain in place, payment will not be made for that quantity of material.

4. **Other Testing.** The paving operation is acceptable if the percent defective length of the HMA surface course does not exceed 3.5. If the percent defective length exceeds 3.5, the Engineer may

direct that paving operations be discontinued until mutually acceptable paving methods and/or equipment are used.

Additional compensation, extension of Contract time, or other concessions will not be granted because of revised methods or equipment necessary to produce a HMA surface in conformity with the specified surface requirements.

B. Payment Reductions for Resurfacing or Widening Projects.

1. **Permissible Surface Variations.** The HMA surface course will be tested with a Rolling Straightedge that automatically marks, in colored dye, the length of surface variations that exceed a tolerance of ⅛ inch in 10 feet, according to the following:
   a. The HMA surface course placed in the traveled way at locations indicated in the Special Provisions shall be constructed so that when tested according to Subpart B.3 below. The measured length of lot exceeding the ⅛ inch tolerance shall not exceed 3.5 percent.
   b. The HMA surface course placed in areas other than those specified in the Special Provisions will be tested for acceptance according to Subpart A.4 above. The measured length of such areas exceeding the ⅛ inch tolerance shall not exceed 3.5 percent. The number, length, and location of Straightedge tests undertaken to determine conformity in such areas will be at the sole discretion of the Engineer.
2. **Control Testing.** Control testing during placement shall be conducted as may be necessary to ensure compliance with the specified surface requirement.
3. **Rideability Acceptance Plan.** Any required sweeping of the surface course before acceptance testing shall be performed.

   Conformance to the surface tolerance for HMA will be determined in lots. Each lot will generally be one-quarter mile long and one lane wide, the latter dimension being determined from the Plans.

   The specific limits of each lot will be established by starting at one end of the Project and progressing towards the other in one-quarter mile increments in the direction of the traffic. When this procedure results in a remaining pavement length of 1,000 feet or less, that length of pavement shall be included in and become part of the immediately preceding lot. If the pavement remainder is greater than 1,000 feet, it shall be considered a separate lot.

   The acceptance of a lot will be based on the percentage of the total length of the lot having surface variation exceeding ⅛ inch in 10 feet, this percent noncompliance being defined as the lot percent defective length. Lot percent defective length will be computed by adding the lengths, to the nearest foot, of individual surface defects exceeding the specified tolerance. Dividing this sum by the total length tested, and multiplying by 100 to convert to percent.

   The full extent of the lot will be tested in the longitudinal direction. The transverse location of the test will be in the wheelpaths of vehicle travel, defined as the two imaginary lines located approximately 3 feet on each side of the centerline of the lane and extending for the full length of the lane. In addition to the scheduled lot acceptance tests, any previously tested lot that is damaged by construction operations may be retested.

   The Rolling Straightedge will not be used immediately adjacent to or over manholes, utility openings, or similar structures that, in the opinion of the Engineer, have a significant and unavoidable adverse impact on achievable smoothness.

   If the lot percent defective length is 3.5 or more, the HMA surface course shall be removed and replaced or may be accepted upon written request provided that payment for the lot is reduced by 20 percent.

   The Engineer may test the HMA surface course with a response type ride meter before performing lot acceptance testing with the Rolling Straightedge. If, in the opinion of the Engineer, such ride meter tests indicate, to a substantial certainty, that the lot percent defective length does not exceed the acceptable value of 3.5, the lot will be deemed in compliance with surface requirements. If the Engineer judges the ride meter tests to be inconclusive, the specified schedule of Rolling Straightedge tests will be performed and the lot acceptance decision grounded on those results.

   The decision to undertake any optional testing with the ride meter, the specific conduct of the ride meter testing, and the interpretation of the results shall exclusively be the province of the Engineer.

If the lot percent defective length exceeds 3.5, the Engineer may direct that paving operations be discontinued until mutually acceptable paving methods and/or equipment are used.

Additional compensation, extension of time, or other concession will not be granted because of revised methods or equipment necessary to produce a HMA surface in conformity with the specified surface requirements.

C. No Payment Reductions.

1. **Permissible Surface Variations.** The HMA surface course will be tested with a Rolling Straightedge that automatically marks, in colored dye, the length of surface variations that exceed a tolerance of ⅛ inch in 10 feet.
2. **Control Testing.** Control testing during placement shall be conducted as may be necessary to ensure compliance with the specified surface requirement.
3. **Rideability Acceptance Plan.** Any required sweeping of the surface course before acceptance testing shall be performed.

   The HMA surface course will be tested for acceptance according to Subpart A.4 above. The measured length exceeding the ⅛ inch tolerance shall not exceed 3.5 percent. The number, length, and location of Straightedge tests undertaken to determine conformity will be at the sole discretion of the Engineer.

   The percentage of surface variations in noncompliance is defined as the percent defective length which will be computed by adding the lengths, to the nearest foot, of individual surface defects exceeding the specified tolerance, dividing this sum by the total length tested, and multiplying by 100 to convert to percent.
4. **Base or Intermediate Course Acceptance Plan.** The base and/or intermediate courses may be tested as above at the discretion of the Engineer.

404.22 Thickness Requirements.{ XE "Hot mix asphalt (HMA):acceptance requirements:thickness" }

The thickness requirements contained herein shall apply only when each component HMA mixture in the pavement structure on new construction, reconstruction, or dualization projects, is specified to be of a uniform thickness. When such uniform thickness HMA mixtures are specified, the combined total thickness of the mixture or mixtures will be measured to determine compliance with the governing acceptance testing limit shown in Table 404-4. Compliance will be determined based on cores drilled through the entire pavement structure after the final course has been placed. In addition, the surface course will be measured to determine compliance with a minimum thickness requirement using an acceptance testing limit of 1¼ inches. Results of this check on surface course minimum thickness will be used solely to determine whether a remove and replace or an overlay condition exists, not for payment reduction.

Table 404-4 Thickness Acceptance Testing Limits{ XE "Tables:HMA:thickness acceptance testing limits" }

Specified or Total Plan Thickness (Inches)	Acceptance Testing Limit (Inches)
1.5	1.25
2.0	1.70
2.25	1.90
3.0	2.60
4.0	3.50
4.5	3.95
5.0	4.40
5.5	4.85
6.0	5.30
Over 6.0	Specified thickness less 0.7

Conformance to thickness requirements for shoulders and ramps shall be determined in lots consisting of approximately 15,000 square yards or less. Conformance to thickness requirements for mainline pavements shall normally be determined in lots consisting of three contiguous air void lots. Areas consisting of different thicknesses will not be included in the same lot.

A thickness lot shall have not more than 20 percent of the lot area, as determined from Table 404-5 below, less than the governing acceptance testing limit for total thickness shown in Table 404-4 above.

The acceptance of a thickness lot will be determined from thickness measurements of 15 cores obtained by the Engineer for each lot. Each lot will be divided into three sections, and five cores will be removed from random locations

within each section and tested for compliance with thickness requirements. The total core thickness and the thickness of each component HMA mixture contained therein will be determined according to Section 990, NJDOT B-4.

When variations in total thickness cause more than 20 percent of the areas of a lot to be less than the governing acceptance testing limit shown in Table 404-4 above, the lot is unacceptable and shall be removed and replaced or overlaid. However, should the percent of lot deviating from the thickness acceptance testing limit not exceed 40 percent, upon written request, the lot may be left in place without being overlaid provided that the lot payment is reduced according to Table 404-5 below.

The percent of lot area less than the applicable acceptance testing limit shall be determined from the calculated value for the term "QL."

The term "QL" is here defined as:

$$QL = \frac{\text{Average Lot Thickness - Thickness Acceptance Testing Limit}}{\text{Average Range}}$$

Where average lot thickness is the average of the total thickness measurements obtained from the 15 lot cores, average range is the average of the three "R" values in one lot, and "R" is the absolute difference between the smallest and largest total thickness values in each group of five consecutive cores measured.

Table 404-5 Reduction Per Lot Due to Nonconformance to Thickness Requirements

QL		Percent of Lot Area Outside Thickness Acceptance Testing Limit	Reduction per Lot, Percent (see Note 1)
Equal To or Greater Than	Less Than		
0.36	--	0 - 20	None
0.29	0.36	21 - 25	5
0.23	0.29	26 - 30	10
0.17	0.23	31 - 35	20
0.11	0.17	36 - 40	50
--	0.11	Greater Than 40	(see Note 2)

Note 1: Percent reductions are not applicable when the term "QL" is calculated to determine if the surface course complies with the minimum thickness requirement.

Note 2: Remove and replace or overlay.

The term "QL" shall also be calculated for the HMA surface course of each lot independently using the core thickness values for that course and a minimum thickness acceptance testing limit of 1¼ inches. When the "QL" value, so calculated, is less than 0.29 indicating that more than 25 percent of the surface course is outside the minimum thickness acceptance testing limit of 1¼ inches, the surface course in that lot shall be removed and replaced or overlaid, and any reduction for that lot based on total thickness requirements is not applied.

When an unacceptable lot is overlaid, the overlay shall be of the mixture specified for that lot and shall be a minimum of 1½ inch thick if that mixture is HMA Mix I-5 and 2 inches thick if that mixture is HMA Mix I-4 or I-4 HD.

The overlaid or replaced lot is only that material placed up to the specified total thickness of the combined HMA mixtures. For an overlaid or replaced lot, the quantity of material will be determined using the computed average weight of the mixture, the area of the lot and the difference between the specified total thickness and the average thickness of the original 15 lot cores.

404.23 Core Samples.{ XE "Hot mix asphalt (HMA):core samples" }

Upon completion of a lot of HMA paving, the Contractor shall obtain acceptance cores from the finished pavement at random locations as directed, according to this Section and Sections 903 and 990 NJDOT B - 4. For all lots containing a test strip, and the first mainline pavement lot, cores shall be taken no sooner than 12 hours after paving and delivered no later than 48 hours after completion of the lot. All other acceptance cores shall be taken no sooner than twelve hours after completion of the lot and delivered no later than six working days after completion of the lot. All cores shall be taken in the presence of the Engineer at random locations as directed by the Engineer.

The cores shall be 6 inches in nominal diameter and shall contain the full depth of the lift to be tested. Cores to be submitted for air voids acceptance of the surface course and for total pavement thickness shall be full depth of the entire thickness of the pavement and shall be taken after all lifts have been placed. The drilling equipment shall be of sufficient size and power to drill through the entire thickness of the pavement. The drill bit shall consist of a water-cooled diamond-tipped masonry type capable of obtaining a valid test sample through the entire pavement thickness.

The core shall be removed from the pavement without damage to the core. Damaged cores shall not be submitted for testing. After the core has been removed from the pavement, all water shall be pumped from the hole, and the hole shall be filled and compacted with HMA or cold patching material according to Subsection 404.02. The finished patch shall be at least ¼ inch above the surrounding pavement surface to allow for additional compaction by traffic. Cores received at the Laboratory in a damaged condition will not be accepted for testing and shall be re-drilled within 1 foot of the original core location, and delivered to the laboratory within 48 hours after the notification by the Department. Each core shall be identified by number, painted on the side of the sample and accompanied by the appropriate laboratory form, supplied and signed by the Engineer. The cores shall be placed in a ventilated box with a lid capable of being locked and sealed by the Engineer. The boxes shall provide adequate protection to prevent damage during transit. The Engineer will record the seal number on the laboratory form. The sealed boxes shall be transported by the Contractor to the Department Laboratory.

404.24 Opening to Traffic.{ XE "Hot mix asphalt (HMA):open to traffic" }

{ XE "Opening to traffic:HMA surface course" **}**The Resident Engineer will determine when the HMA surface is to be opened to traffic or construction equipment. Traffic or construction equipment will not be permitted on the HMA

surface until 12 hours after its placement except when approved for maintaining traffic according to Subsection 617.04. If traffic is allowed on the HMA surface prior to 12 hours, the HMA mixture using PG 64-22 shall be less than 140 ºF before allowing traffic; HMA mixtures using PG 76-22 shall be less than 176 ºF before allowing traffic.

Opening to traffic as provided above shall not relieve responsibility for the work according to Section 107.

COMPENSATION

404.25 Method of Measurement.

HMA surface course will be measured by the ton excluding wasted material. The weight will be determined by one of the following methods:

1. A weigh ticket printed by an automatic printer system used in conjunction with an automated batching and mixing system. The printed ticket shall show the individual weights of the various components of the HMA mixture in a batch, the total weight of each batch, and the sum of all batch weights in the truckload. At the completion of each days work, a producer's representative shall certify on Department forms that the total weight supplied to each Project was correct.
2. A weigh ticket printed by an automatic scale showing the tare and gross weights of the truck as determined for each trip and the time and date indicating when the truck was tared and when it departed from the plant. Time and date may be printed automatically by a time clock. However, the net weight must be documented on each delivery ticket by a certified weighmaster. Fully automatic scales that print gross, tare and net weights are acceptable if the system is of an approved type according to the requirements of the Department and the Office of Weights and Measures, Division of Consumer Affairs, Department of Law and Public Safety. The signature and official seal of a certified weighmaster shall be affixed to each weigh ticket.

Automatic truck scale weighing devices must be approved and certified by the Office of Weights and Measures, Division of Consumer Affairs, Department of Law and Public Safety.

In the event of breakdown of an automatic printer system, weigh tickets showing the gross, tare and net weight of each truck, as entered and certified by a weighmaster, will be accepted for a period not exceeding the necessary repair time as certified by a licensed repairman.

A weigh ticket shall be furnished for each truckload. Material will not be accepted unless accompanied by a weigh ticket, which shall be legible and clearly indicate the printed heading of the supplier and location of the batch plant, the title of the Project for which delivery is intended, the time and date, truck number, lot number and mix number of material being furnished, and the total net weight in each truckload.

When the material does not conform with the specified thickness or air voids requirements, the quantity of material in the affected lot, termed the Computed Lot Weight, will be determined using the lot area and the average thickness and the bulk specific gravities from the lot cores. When HMA Mix I-5 is directed for use in transition (run-out) areas, the weight will be included with the weight for Mix I-4 or Mix I-4 HD.

HMA pavement repair before overlay will be measured by the square yard of area bounded by the sawcuts. Concrete pavement repair before overlay will be measured by the square yard of area bounded by the sawcuts.

Tack coat, Tack coat 64-22, and Prime coat will be measured by the gallon according to Subsection 109.01 except that the volume of diluted emulsions will be reduced by 50 percent.

Sealing of cracks and joints in HMA surface course will be measured by the linear foot.

Sawing and sealing joints and cracks in HMA overlays will be measured by the linear foot. Sawing joints and cracks in base and/or intermediate course will be measured by the linear foot.

Core samples, HMA, will be measured by the unit.

Asphalt price adjustment for asphalt binder will be determined on a monthly basis by the following formula:

$$A = (MA - BA) \times T$$

where:
- A = Asphalt Price Adjustment
- MA = Monthly Asphalt Price Index
- BA = Basic Asphalt Price Index
- T = Tons of New Asphalt Binder (see Note)

Note: The weight of asphalt binder eligible for price adjustment will be determined by multiplying the percentage of new asphalt binder in the approved job mix formula by the weight of HMA.

Asphalt price adjustment for tack coat and prime coat will be determined on a monthly basis by the following formula:

A = (B) x (I) x (C) x (M) x (G)

where: A = Asphalt Price Adjustment
B = Bid Price for Tack Coat/Prime Coat
I = Asphalt Price Adjustment Factor (see Note)
C = Petroleum Content of the Tack Coat and Prime Coat in Percent by Volume:
Use 100% for cutbacks
90% for inverted emulsions
60% for RS or similar type emulsions
M = Percentage of Bid Price Applicable to Materials Only: Use 82%
G = Gallons of Tack Coat and Prime Coat Furnished and Applied

Note: Asphalt price adjustment factor for a given month will be a percentage increase or decrease determined by comparing that month's monthly asphalt price index with the basic asphalt price index.

The monthly asphalt price index will be the average of quotations from suppliers serving the area in which the Project is located, and will be determined by the Department each month. For that part of the State north of and including Route 195, the asphalt price index will be based on quotations from Chevron, Citgo, and, Valero Refining Company New Jersey. For that part of the State south of Route 195, the index will be based on quotations from Coastal, Chevron, Citgo, and Valero Refining Company New Jersey.

The basic asphalt price index will be the most recent monthly asphalt price index before receipt of bids.

Should a monthly asphalt price index increase 50 percent or more over the basic asphalt price index, no additional HMA shall be furnished for the Project without written approval from the Director of Construction Services and Materials.

Should a monthly asphalt price index decrease from the basic asphalt price index, payments will be decreased accordingly.

Asphalt price adjustment for work performed after the time of completion, as specified in Subsection 108.10, will be based on the asphalt price index for the month in which the work was to be completed, except if the monthly asphalt price index decreases after the completion date, the asphalt price adjustment will be decreased accordingly.

Asphalt price adjustment will be on a lump sum basis, and an estimated amount to cover the asphalt price adjustment will be included in the Proposal. Payments for increases will be made from this amount.

Asphalt price adjustments will not be made in those months for which the monthly asphalt price index has changed by less than five percent from the basic asphalt price index.

404.26 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
HOT MIX ASPHALT SURFACE COURSE MIX ___	TON
HOT MIX ASPHALT INTERMEDIATE COURSE MIX ___	TON
HOT MIX ASPHALT BASE COURSE MIX ___	TON
HOT MIX ASPHALT PAVEMENT REPAIR PRIOR TO OVERLAY	SQUARE YARD
CONCRETE PAVEMENT REPAIR PRIOR TO OVERLAY	SQUARE YARD
SEALING OF CRACKS IN HOT MIX ASPHALT SURFACE COURSE	LINEAR FOOT
SEALING OF CRACKS AND JOINTS IN HOT MIX ASPHALT SURFACE COURSE	LINEAR FOOT
SAWING AND SEALING JOINTS IN HOT MIX ASPHALT OVERLAY	LINEAR FOOT
SAWING JOINTS IN INTERMEDIATE AND BASE COURSE	LINEAR FOOT
TACK COAT	GALLON
TACK COAT 64-22	GALLON
PRIME COAT	GALLON
CORE SAMPLES, HMA	UNIT
ASPHALT PRICE ADJUSTMENT	LUMP SUM

Payment reductions due to nonconformance to job mix formula requirements will be made according to Table 903-6 and will be applied to the in-place lot weight determined from weigh tickets.

Payment reductions due to nonconformance to stability requirements will be made according to Table 903-7 and will be applied to the HMA plant lot weight determined from weigh tickets.

Payment reductions due to nonconformance to air voids requirements will be made according to Subsection 404.20 and will be applied to the lot weight determined according to Subsection 404.25.

Payment reductions due to nonconformance to thickness requirements will be made according to Table 404-5 and will be applied to the lot weight determined according to Subsection 404.25.

Payment reductions due to nonconformance to surface requirements for new construction, reconstruction, or dualization projects will be according to Table 404-3and will be applied to the in-place lot weight determined from weigh tickets as specified in Subsection 404.21, Subpart A.3.

Payment reductions due to nonconformance to surface requirements for resurfacing or widening projects will be according to Subsection 404.21 and will be applied to the weight of material in the affected lot, as computed from the weight per square yard for the mix as established by the job mix formula, the lot area, and the specified plan thickness.

All payment reductions made according to the above are cumulative.

Payment for HMA Mix I-5, when used as an alternate for Mix I-4 or I-4 HD, will be made at the unit price bid for the Pay Item "HMA Mix I-4" or "HMA Mix I-4 HD."

Separate payment will not be made for any test strips and quality control for compaction, including comparison cores, and nuclear density testing. All costs thereof shall be included in the prices bid for Hot Mix Asphalt Surface Course, Hot Mix Asphalt Intermediate Course, and Hot Mix Asphalt Base Course.

SECTION 405 - CONCRETE SURFACE COURSE{ XE "CONCRETE SURFACE COURSE" }{ XE "SURFACE COURSE:CONCRETE, PORTLAND CEMENT" }

405.01 Description.

This work shall consist of the construction of a surface course of portland cement concrete, with or without reinforcement, the construction of joint ties in the existing concrete roadway; cleaning and sealing of exposed joints and cracks in concrete surface course; the taking of core samples for testing; and the construction of transverse concrete grooving of reinforced concrete surface course.

MATERIALS{ XE "CONCRETE SURFACE COURSE:MATERIALS" }

405.02 Materials.

Portland cement concrete shall conform to Section 914. Other materials shall conform to the following Subsections:

Sand 901.09
Curing Materials 905.03
Preformed Expansion Joint Sealer 908.01
Joint Sealer 908.02
Reinforcement Steel for Concrete Base and Concrete Surface courses 915.03

Patching materials for filling core holes in the portland cement concrete pavement shall be fresh concrete conforming to Section 914 and of the same strength as the existing pavement or a commercial patch mix approved by the Engineer that will provide the same strength as the existing pavement.

Ties shall conform to ASTM A 996, Grade 40.

Epoxy grout shall be a two-component, solvent free, 100 percent solids epoxy resin compound that cures under normal temperatures, is non-shrinking and is of high chemical resistance. The epoxy grout system shall consist of a high modulus, gel epoxy resin system meeting the requirements of ASTM C 881, Type 1, Grade 3, Classes B and C, and meeting the performance requirements tabulated below:

	Performance Requirements	
Property	**ASTM Test Procedure**	**Required Results**
Compressive Strength	D 695	10,000 psi minimum
Tensile Strength	D 638	3,000 psi minimum
Flexural Strength	D 790	3,800 psi minimum
Shear Strength	D 732	2,800 psi minimum
Water Absorption	D 570	1.0% maximum
Bond Strength	C 882	psi (see Note)
Effective Shrinkage	C 883	Pass

Note: Shall meet specifications of ASTM C 881.

The epoxy grout materials will require the submission of certified testing results in compliance with all of the above requirements and manufacturer's specifications for materials and installation procedures before acceptance for use.

{ XE "CONCRETE SURFACE COURSE:EQUIPMENT" }EQUIPMENT

405.03 Equipment.

{ XE "Concrete surface course:equipment:batch plant" **}A. Batching Plant.** Portland cement concrete shall be supplied by a batching plant that meets all requirements of the Specifications and has the facilities necessary to ascertain and control the quality of the concrete. The plant shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a bin, hopper, and separate scale for cement shall be included. The weighing hoppers shall be sealed and vented to preclude dusting during operation. The batching plant shall be equipped with a non-resettable batch counter that indicates the number of batches proportioned.

The batching plant shall consist of the following:

1. **Bins and Hoppers.** Bins with separate compartments for fine aggregate and for each size of coarse aggregate shall be provided at the batching plant.
2. **Scales.** The scales for weighing aggregates and cement shall be the beam type, the springless dial type, or the electronic load cell type with a readout. They shall be accurate within 0.5 percent for cement and one percent for aggregate throughout the range of use. When beam type scales are used, a telltale dial shall be provided for indicating to the operator the required load in the weighing beams and for indicating critical position clearly. Poises

shall be designed to be locked in any position and to prevent unauthorized change. The weigh beam and telltale device shall be in full view of the operator who shall have convenient access to all controls while charging the hopper.

Accuracy and certification requirements for plant scales shall be as specified in Subheading 4 of the fifth paragraph of Subpart B in Subsection 404.04.

3. **Water Measuring Equipment.** Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over one percent. Unless the water is to be weighed, the water measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled. The measuring tank shall be equipped with outside taps and valves or other means to permit accurate calibration and to provide for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.
4. **Admixture Dispenser.** An automatic displacement dispenser with plant operation shall be used for adding each admixture.
5. **Automatic Batching System.** Batching plants equipped to proportion aggregates and bulk cement by means of automatic weighing and recordation devices shall consist of a combination of automatic batching controls meeting the following requirements:
    a. All batching equipment in the system for batching by weight must be actuated by a single starting mechanism. A separate starting mechanism is permitted for volumetric batching of water or admixtures not batched at the time of initial weighing.
    b. Each automatic batcher must return to zero balance and each volumetric device must reset to start or signal empty before it may be charged.
    c. The discharge of any ingredient in the system shall not start unless all batching controls have been cleared of the previous batch with scale returning to zero balance and volumetric devices resetting to start or signaling empty. The discharge of any weighed ingredient shall not start until all weighed ingredients have been batched.
    d. For cumulative batchers, interlocked sequential controls shall be provided.
    e. Automatic batching controls shall start the weighing operation of each material and stop automatically when the designated weight of each material has been reached, interlocked in such a way that:
        (1) The charging device cannot be actuated until the scale has returned to zero balance within plus or minus 0.3 percent of the scale capacity.
        (2) The discharge device cannot be actuated until the required material is within the applicable tolerances.
        (3) The discharge device cannot be actuated if the charging device or the discharge device is open.
6. **Recordation.** Each automatic batching plant shall be equipped with an accurate recorder or recorders that provide a permanent and continuous record of batching operations. A maximum of two recording units in lockable enclosures shall be provided with each plant. A batching record shall be removed as directed, and it shall become the property of the Department. Each recorder shall produce a digital record on tickets and shall provide the following information:
    a. The quantity or batched weights of each aggregate, portland cement, water, and admixture.
    b. The zero balance condition of each scale after batchers have been discharged, or before the start of the batching operation.
    c. A means of identifying each admixture batched.
    d. The time, date, and batch number of each batch delivered.
    e. Mix formula or concrete classification identification.

{ XE "Concrete surface course:equipment:plant laboratory" **}{** XE "Laboratory:plant" **}7. Plant Laboratory.** A plant laboratory shall be provided and maintained at each plant site for use of the Engineer for sampling and testing, and for use of the producer for quality control functions. The plant laboratory shall also include an office area for use by the Engineer.

A quality control technician shall be available during production. The quality control technician must be certified by ACI as a Concrete Field Technician, Grade I. Control testing shall include moisture content and gradation of the aggregate and slump and air tests of the plastic concrete.

The plant laboratory shall be located to provide an unobstructed view of the trucks as they are loaded.

The plant laboratory, including office area, shall have a floor area of not less than 225 square feet, a ceiling height of not less than 7½ feet, adequate ventilation and artificial lighting, and sanitary facilities according to Subsection 107.10. The plant laboratory shall be weather-tight, heated, and air-conditioned to maintain temperatures for testing purposes between 68 and 80 ºF, and shall have the following:

a. Work benches, totaling not less than 2 by 15 feet, and two stools.
b. Desk, table, and at least two chairs.
c. Four-drawer, legal-size file cabinet with lock and two keys.
d. Shelves and supply cabinets.
e. Electronic calculator with printout tape.
f. Water cooler supplied with bottled water.
g. Telephone, direct, private line with no monitoring or recording devices attached.
h. Class ABC fire extinguisher, or a Class A and a Class B fire extinguisher, meeting fire underwriters' approval.
i. First-aid box, containing the following list of supplies:

Quantity	Size	Item
32	¾" by 3"	Brand sheer bandages
20	1" by 3"	Brand fabric bandages
4	Medium	Non-stick pads
2	2"	Soft-gauze bandages
2		Oval eye pads
1	51"	Triangle bandage
1	½" by 180"	Hypo-allergenic first-aid tape
10		Antiseptic wipes
1	⅛ oz.	Burn cream, foil pack
1	8 oz.	First-aid cream
1	100 caplets	Tylenol Extra Strength caplets
1		Scissors
1		Tweezer
1		First-aid guide
1	½ fl.oz.	Ophthalmic irrigation solution
1		Contents cards
10		Disposable gloves
10	0.33 mL	Ammonia inhalants

j. Electrical outlets sufficient in number and capacity for operating the required equipment for drying samples.
k. Display area, approximately 4 by 4 feet, for mounting control charts.
l. Mechanical shakers, screens, and sieves conforming to AASHTO M 92. The mechanical shaker shall be installed and bolted down in a sound-dampening and dustproof enclosure.
m. A minimum 12-inch diameter exhaust fan shall be provided in proximity to the mechanical shaker.
n. Sink with hot and cold running water having adequate pressure, drainboard, and drain capable of handling elutriable material.
o. Stand to hold sieves used in washing elutriable material.
p. Two-element hot plate or electric range having dial-type thermostatic controls to adjust the heat for drying aggregates.
q. Platform scale of 200 pounds minimum capacity with a beam or dial with significant graduations of 1/10 pound or less.
r. Balance or balances conforming to AASHTO T 27.

s. Sample splitter or splitters capable of splitting aggregates from 2½ inches gradation size through concrete sand size.
t. Calibrated container for unit weight of aggregates, conforming to AASHTO T 19.
u. Unit weight container, ½ cubic feet, for concrete, according to AASHTO T 121.
v. Slump cone and rod.
w. Pressure air meter (and volumetric air meter when required for lightweight concrete).
x. Equipment for determining specific gravity of both fine and coarse aggregates.
y. Miscellaneous items including rubber hammer, mason's trowels, pointed shovel, small and large sugar scoops, heavy galvanized pail approximately 14-quart capacity, aggregate sample pans, brushes, flashlight, glassware, steel straightedge approximately 18 by 2 inches, and such expendable supplies as are necessary for the tests to be made.

Accuracy and certification requirements for all weighing devices for the testing of samples shall be as specified for plant scales in Subheading 4 of the fifth paragraph of Subpart B in Subsection 404.04.

8. Safety. Adequate and safe stairways shall be provided at points where accessibility to plant operations is required. Overhead protection shall be provided at locations where deemed necessary. All gears, pulleys, chains, sprockets, and other hazardous moving parts shall be guarded and protected.

The plant shall conform to all State and local safety requirements. When plant production occurs during nighttime hours, additional lighting shall be provided throughout the stockpile, plant, and laboratory areas to ensure a clear view of the operations.

{ XE "Concrete surface course:equipment:project site" **}B. Project Site Equipment.** The following equipment shall be available and used on the Project Site to ensure the quality of the finished Work:

1. Scratch Template. An accurately constructed template shall be used to check the elevation of the subbase.

{ XE "Concrete surface course:forms" **}2. Forms.** Straight-side forms shall be made of metal having a thickness of not less than 3/16 inch and shall be furnished in sections not less than 10 feet in length. Forms shall have a depth at least equal to the thickness of the concrete without horizontal joint and a base width equal to not less than the depth of the forms. Flexible or curved forms of wood or metal and of proper radius shall be used for curves of 100-foot radius or less. Forms shall be provided with adequate devices for secure setting so that when in place they shall withstand, without visible deflection or settlement, the impact and vibration of the consolidating and finishing equipment. Flange braces shall extend outward on the base not less than two-thirds the height of the form. The top face of the form shall not vary from a true plane more than ⅛ inch in 10 feet, and the face of the form shall not vary more than ¼ inch . The forms shall contain provisions for locking ends of abutting form sections together tightly and for secure setting. Metal pins shall be of the size and length required to hold the forms rigidly and securely in place, but, unless otherwise authorized, the pins shall be at least 2 feet in length.

Forms with battered top surfaces and bent, twisted, or broken forms shall be removed from the work. Repaired forms shall not be used until inspected and approved. The supply of forms shall not be less than that required for two days of placing concrete.

3. Steel Placing Equipment. Power equipment for placing reinforcement shall accurately position the steel to line and grade.

4. Spreading and Finishing Equipment. Equipment shall include a mechanical power-driven concrete spreader capable of striking off the concrete to the required cross-section and elevation.

The mechanical finishing machine shall be power driven; shall be designed and operated to strike off, screed, consolidate, and float; shall be of ample weight and strength to furnish the necessary pressure; shall be capable of being adjusted to produce the cross-section and finish required; shall have sufficient power and be geared to operate consistently and smoothly; and shall be equipped with at least two oscillating-type transverse screeds and a scraping device to keep the tops of the forms clean.

Vibrators shall be the spud type and may be hand operated and/or attached to the spreader or mounted on a separate carriage. The vibrators shall have a minimum frequency of 5,000 impulses per minute.

Except for hand-held vibrators, all vibration shall be controlled by the forward movement of the spreading and finishing equipment so that vibration automatically ceases when the forward movement of the spreader is stopped.

Tube finishers shall be equipped with a smoothing float or floats suspended from and guided by a rigid frame. The frame shall be carried by four or more visible wheels riding on and constantly in contact with side forms.

Individual traveling bridges shall be furnished as directed.

At least two straightedges, each not less than 10 feet long, with handles at least 3 feet longer than one-half the width of the slab, shall be constructed of light metal or wood and shall be maintained clean and straight.

At least two straightedge templates shall be provided for testing the completed surface. They may be made of wood or metal, shall be not less than 12 feet long, and shall be maintained clean, straight, and free from warp.

5. **Concrete Saw.** When sawing joints is specified, sawing equipment shall be provided, adequate in number of units and power to complete the sawing to the required dimensions and at the rate necessary to prevent uncontrolled cracking, according to Subsection 405.12. The saws shall be equipped with water-cooled diamond-edge blades or abrasive wheels and alignment guides.

   When saw cutting of grooves is specified, the saws shall be of a multi-bladed type, adequate in number of units and power, and equipped with water-cooled, circular, diamond-edge blades and alignment wheels. A system of slurry collection shall be provided.

   At least one standby saw in working order and an ample supply of saw blades shall be provided at the work site at all times during sawing operations.

6. **Tines.** The metal tines shall be tempered spring steel, arranged in a single line and securely mounted in a suitable head (rake) and shall be 1/16 inch thick, ⅛ inch wide, 6 to 8 inches long, and spaced on 1 inch centers. The tines shall be capable of producing a groove of the specified dimensions in the plastic concrete without slumping of the edge or tearing of the surface. Tines shall be maintained so as to remain straight, clean, and free of any concrete buildup. The metal comb (rake) shall be attached to a mechanical device capable of traversing the entire paving width in a single pass at a uniform speed.

7. **Spraying Equipment.** When liquid membrane compound is used for curing concrete, the mechanical spraying equipment shall be mounted on a movable bridge. The equipment shall be the fully atomizing type equipped with a tank agitator. The spraying equipment shall be capable of continuously agitating the liquid membrane during application. Small hand-held spray equipment capable of maintaining the liquid membrane in a mixed condition will be permitted if used according to Subsection 405.14.

8. **Small Tools and Other Equipment.** Small tools shall include such items as edgers, trowels, hand floats, and brushes necessary to produce the results required.

   Water supply equipment shall include pumps or tanks mounted on trucks, of adequate capacity to furnish sufficient water to accommodate this construction and at the required pressure. A pipeline appropriate to the requirements of the construction may be used.

   Equipment and tools as necessary for the construction of special features shall also be on the Project site.

{ XE "CONCRETE SURFACE COURSE:CONSTRUCTION" }CONSTRUCTION

405.04 Preparation of Grade.

The subbase shall be prepared as specified in Section 209 for at least 1 foot beyond the edge of the concrete surface course.

405.05 Setting Forms{ XE "Concrete surface course:forms:setting" }.

The material under the forms shall be compacted and shall be at grade so as to be in firm contact with the form for its entire length. Subbase at the form line that is below grade shall be brought to grade with clean granular material in lifts of ½ inch or less for a distance of 1 foot-6 inches on each side of the base of the form and shall be thoroughly compacted. Imperfections or variations above grade shall be corrected by tamping or by cutting as necessary. Pedestals of subbase or other materials upon which to reset the forms to bring them to grade will not be permitted.

Forms shall be set in advance of the point where concrete is being placed for at least the distance required for the next day's paving. This distance may be reduced, as approved, when a shorter distance is justified by prevailing

conditions. Forms shall be staked into place with not less than three pins for each 10-foot section. All form sections shall be locked tightly and free from play or movement in any direction.

The alignment and grade elevations of the forms shall be checked and corrections made before placing the concrete. The form shall not deviate from the required alignment by more than ¼ inch at any point. Forms that settle or deflect under the spreading and finishing equipment shall be reset or removed. The top and face of forms shall be cleaned, and the face oiled before the placing of concrete. When any form has been disturbed or any grade has become unstable, the unstable condition shall be corrected, and the form shall be reset and rechecked.

405.06 Condition of Subbase.

The subbase shall be cut to proper cross-section by means of the subgrade machine as specified in Section 209. Subbase on widened curves, intersections, and other similar areas may be shaped by hand and checked with special templates.

Before placing the concrete, a scratch template shall be used to check the elevation of the finished subbase. The template shall rest on the forms or adjacent surface. After the subbase is checked with the template, low spots shall be filled and high spots shall be scraped to the proper grade and the surface recompacted. Immediately before placing the transverse joint on the subbase, the subbase at the joint shall have been finished to its required surface and shall have received its final compaction.

In advance of concreting operations, the subbase shall have been prepared as specified in Subsection 209.03. It shall not be muddy, unstable, or frozen, and shall be free of dust and dry earth. If the subbase is dry, it shall be sprinkled by means of a spray nozzle sufficiently in advance of placing the concrete so that the subbase is uniformly dampened to a depth of not less than ½ inch without forming wet spots. However, before May 15 and after October 1, the subbase shall not be sprinkled unless it is dry for more than ½ inch below the surface and its character is such that it should be dampened, in which case only sufficient water shall be applied to dampen the surface.

405.07 Handling, Measuring, and Batching Materials. { XE "Concrete surface course:materials:handling, measuring, and batching" }

The batch plant site, layout, equipment, and provisions for transporting material shall be such as to ensure a continuous supply of concrete to the work.

Stockpiles of aggregates shall be according to Subsection 901.02.

The fine aggregate and each size of coarse aggregate shall be weighed separately into hoppers in the amounts in the job mix design.

Cement shall be measured by weight. Each bag of cement shall weigh 94 pounds, and 94 pounds of bulk cement shall be considered one bag. Batches involving fractional bags are not allowed except when bulk cement is used. When bulk cement is used, separate scales and hoppers shall be used for the cement with a device to indicate the complete discharge of the batch of cement into the batch box or container. The weighing hopper and scale shall be of adequate size, completely encased, with provisions for locking. The hopper discharge mechanism shall be interlocked against opening until the full batch is in the hopper and the scale balanced, against opening while the hopper is being filled, against closing until the hopper is entirely discharged and the scale back in balance, and against opening if the batch in the hopper is either overweight or underweight by more than one percent of the amount specified. The weighing hopper discharge gate shall operate in such a manner so as not to affect the scale balance. The discharge chute, boot, or other such device shall be suspended from the encasement and not from the weighing hopper and shall be so constructed that cement does not lodge therein and there is no loss of cement by air currents or otherwise. There shall be means to ensure the presence in each batch of the entire cement content required.

Where bulk cement is to be used, there shall be provided separate storage for tested and approved cement, which shall be held in such storage for the particular Project or Projects for which it was consigned. Different brands of cement, or the same brand of cement from different mills, shall not be mixed nor shall they be used alternately unless approved.

For individual batches, the following tolerances shall apply based on the required scale reading:

1. Cement: plus or minus 1 percent of the required weight of material being weighed or plus or minus 0.3 percent of scale capacity, whichever is greater.
2. Aggregates 1½ inches or smaller: plus or minus 2 percent of the required weight of material being weighed or plus or minus 0.3 percent of the scale capacity, whichever is greater.
3. Aggregates larger than 1½ inches: plus or minus 3 percent of the required weight of material being weighed or plus or minus 0.3 percent of scale capacity, whichever is greater.

The water measuring system shall be capable of incorporating in the batch, the predetermined quantity of water, to an accuracy of plus or minus 1 percent. The measuring device shall automatically register and stop the flow of the water when the designated quantity has been delivered into the mixing drum.

Plants shall be equipped with a separate dispensing system with a visual sight gauge for each admixture incorporated into the concrete. Admixtures shall be added to the mixing water or sand. Each system shall be capable of dispensing the total amount required to within plus or minus 3.0 percent or 1 ounce, whichever is greater. Convenient means shall be provided to calibrate each system. Such admixture devices shall also be provided with each truck mixer approved for dispensing admixtures at the Project or placement site.

Fly ash shall be stored at the batching plant in a separate storage facility. The scales and batching tolerances shall be equivalent to those specified for portland cement. When fly ash is weighed cumulatively with the cement, the fly ash shall be last in the batching sequence. A split silo containing fly ash and cement will not be permitted.

A representative of the fly ash producer shall be available for technical assistance.

405.08 Mixing Concrete.{ XE "Concrete surface course:mixing concrete" }{ XE "Concrete surface course:mixing concrete:truck mixers" }

Concrete may be mixed at the job site or in a central-mix plant or may be mixed in transit-mix trucks. Mixing time shall be measured from the time all materials are in the drum.

Mixers of a type capable of mixing not less than a one-bag batch, of the class of concrete or mortar required, may be used where only small quantities of concrete or mortar can be placed at a time.

The following mixing methods are permissible:

1. **Mixing on the Project in Truck Mixers.** Mixing on the Project in truck mixers shall not be used for concrete surface course or structural concrete items.

   Truck-mixed concrete shall be materials proportioned at a batching plant and mixed in a revolving-drum truck mixer at the point of delivery following the addition of the proper amount of mixing water.

   Each truck mixer shall have attached a metal plate or plates on which is plainly marked the manufacturer's capacity rating in terms of the gross drum volume, the capacity of the drum in terms of the volume of mixed concrete, and the manufacturer's designated drum speed of rotation for both mixing and agitation. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum may be readily verified.

   The counter unit shall be positioned on the truck so as to be plainly visible if the driver's door is open.

   The mixer shall be capable of producing a thoroughly mixed and uniform mass and discharging the concrete with satisfactory uniformity within the ranges of slump and air entrainment specified for the class and type of concrete being furnished.

   Each truck mixer shall be equipped to carry sufficient water to mix a full capacity load of concrete within the required range of slump and shall also carry wash water as necessary.

   The mixing water tank, pump, and the piping shall be kept clean and free of leaks. An in-line multi-jet or positive displacement meter shall be provided which indicates the amount of mixing water added to the batch. Either meter shall be provided, as a minimum, on one truck mixer for each concrete pay-adjustment item per day. The device shall have an accuracy of plus or minus 1.5 percent, by volume, of the indicated amount dispensed. The meter shall have a nonresettable register with a capacity of 100,000 gallons. A remote, readily visible, resettable three or four-digit counter shall be mounted in the truck cab. The counter shall measure water added to the nearest gallon and shall be provided with a unique mechanical or electrical device for resetting. This device shall remain in the possession of the Engineer during production. The distribution system shall be equipped with three-way valves and bypasses or other suitable means for calibration of the water-measuring device. The water-measuring device shall be calibrated before use and recalibrated whenever any repairs or modifications are made that may affect the calibration. Documentation showing the date and results of calibration of the water-measuring device shall be carried on each truck mixer and copies shall be furnished upon request. Near the measuring device, on the mixing water tank, there shall be stenciled the word calibrated and the date of the last calibration.

   The mixing water-measuring device shall be located so as to be plainly visible to the truck operator when operating the mixing water and the drum controls, and to the Engineer while standing on the ground. All measuring indicators shall be kept clean and in good condition.

   Truck mixers are subject to inspection by the Engineer, including the mechanical condition of the truck mixer, verifying the mixing and agitation rates, the accuracy of the water-measuring device, the size of discharge opening and chutes, and the general condition and wear of the blades. The truck mixer will not be approved for use if any part or section of the pickup and throw-over blades is broken, missing, or excessively

worn. Truck mixers shall be examined daily for cleanliness of the drum and blades, leaks in the mixing water system, and the condition of the water-measuring device and the revolution counter.

The concrete supplier shall maintain, at a convenient location, a copy of the manufacturer's design for each size and type of truck showing the dimensions and arrangements of the blades, the dimensions of the drum, the gross volume of the drum, the recommended rates of rotation for all types of operations, and any other pertinent information.

Before the time mixing water is added at the job site, no water or other fluids will be permitted in the drum of the truck mixer except concrete admixtures that are measured and dispersed with the dry ingredients. Truck mixers may be required to pull under the batch plant with the drums revolving in discharge rotation as an indication that the drum is empty.

The truck mixer, when loaded for mixing concrete, shall not contain more than 63 percent of the gross drum volume.

The maximum elapsed time from the loading of the portland cement into the drum to the discharge of all the concrete from the mixer shall be 90 minutes except that, under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 85 ºF or above, such time limit shall be changed to 60 minutes. However, if retarders are used, the time limit may be increased to a maximum of 90 minutes, if approved. Under very severe conditions, further reductions of the time limits or the size of the loads may be required.

Immediately following the addition of all the mixing water, the mixing revolution counter shall be reset to zero with the drum revolving at the rate of speed designated by the manufacturer for mixing.

Each batch shall be mixed not less than 50 and not more than 100 revolutions at the rate of rotation designated as mixing speed. The concrete shall be mixed into a plastic, uniform mass complying with the specified range of slump and air entrainment. The number of revolutions within the limits specified above, and the control of the consistency shall be as directed.

If the concrete cannot be entirely discharged within ten minutes after the mixing has been completed, the concrete remaining in the drum shall be kept plastic and workable by revolving the truck drum, at the manufacturer's designated speed for agitation, for a period of two minutes in each ten minutes. In no case shall the total revolutions exceed 200.

Before the completion of 100 mixing revolutions, the operator may add water or air entraining agent or both incrementally in order to produce concrete within the required slump or air content range in conformance with Subsection 914.02.

During discharge, drum gates and cover shall be fully opened and the rate of discharge shall be governed by drum speed.

Discharge chutes shall be ample in size, without struts, and capable of handling the concrete within the specified slump range. Use of extension chutes shall be restricted as much as is practical.

Wash water shall be provided in addition to the water required for mixing. If the wash water runs through the measuring device for the mixing water, it shall not be used during any of the periods when mixing water is being measured into the drum. Under no circumstances shall the washdown hose be used to temper the concrete or to aid the flow of concrete in the chute except for pre-wetting the chute. Any concrete that has been wetted with wash water shall be discarded.

Immediately after the discharge of each load, the drum shall be washed out and the wash water and any residue from the previous batch shall be completely discharged before reloading the drum at the batch plant.

{ XE "Concrete surface course:mixing concrete:central-mixing plant" **}2. Mixing at a Central-Mixing Plant.** Central-mix concrete shall be materials proportioned and mixed at a central plant and transported to the point of use in an agitator or non-agitator truck of approved design.

Central-mixing plant mixers shall be of the type and capacity capable of combining the cement, aggregates, and water into a thoroughly mixed and uniform mass within the specified mixing time and of discharging the mixture with a satisfactory degree of uniformity and shall be operated in compliance with the NJAC 7:27-6.1 *et seq*.

Stationary mixers shall be equipped with a timing device that does not permit the batch to be discharged until the specified mixing time has elapsed. Mixing time at the central-mix plant shall be not less than one minute. Mixing time shall be measured from the time all cement and aggregates are in the drum. The batch shall be so charged into the mixer that sufficient water enters in advance of cement and aggregates to prevent caking, and all water shall be in the drum by the end of the first quarter of the specified mixing time.

When the temperature of the mixing water exceeds 100 ºF, the loading sequence shall be modified by mixing all the water and the aggregates and then the cement. Mixing shall begin immediately following the complete charging of the drum and continue for not less than one minute.

Truck mixers for the delivery of central-mix concrete shall have a revolving, watertight drum capable of transporting and discharging the mixed concrete with a satisfactory degree of uniformity. The speed of the drum shall be that stated by the manufacturer to be the agitating speed. Each truck shall have attached thereto, in a prominent place, a metal plate on which is stated the gross volume of the drum, the manufacturer's rating in terms of mixed concrete for agitation, and the speed of rotation for agitation. The volume of mixed concrete in the drum shall not exceed the manufacturer's rating nor shall it exceed 80 percent of the gross drum volume.

The use of open body trucks with agitating mechanism may be permitted provided that the elapsed time from addition of water to the mix until the concrete starts to be deposited in place at the site of work does not exceed 30 minutes.

Non-agitating trucks may be used if the slump of the concrete to be transported is 2 ± 1 inch, the haul road surfaces are maintained in a smooth riding condition, and the elapsed time from addition of water to the mix until the concrete starts to be deposited in place at the site of work does not exceed 30 minutes. Bodies of non-agitating hauling equipment shall be smooth, mortar-tight metal containers and shall be capable of discharging the concrete mix at a controlled rate without segregation. If the concrete is determined to have segregated, the load will be rejected and removed from the site.

Covers over trucks shall be provided when needed for protection.

Except for non-agitating trucks, the maximum length of time from loading at the plant to discharge at the Project shall not exceed 90 minutes, except under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 85 ºF or above, such time limit shall be changed to 60 minutes. However, if the use of retarders is permitted, the time limit may be increased to a maximum of 75 minutes. Under very severe conditions, further reduction of the time limits or the size of the batches may be required. During these intervals, the concrete shall be agitated continuously.

If a truck mixer is used, the provisions for adding water at the Project site are as specified below under the transit mixing method.

Two-way telephone or radiotelephone communication between the site of the placement of concrete and the mixing plant shall be provided.

{ XE "Concrete surface course:mixing concrete:transit mixing" **}3. Transit Mixing.** Transit mix concrete shall be materials, including water, proportioned and introduced into a truck mixer from a one-stop or two-stop batching plant and mixed while the truck is at the plant or a combination of mixing at the plant and on the job site.

A one-stop batching plant shall be a plant where all dry ingredients for each batch of concrete are loaded into the mixer truck simultaneously while water is being introduced.

A two-stop batching plant shall be a plant where the ingredients for each batch of concrete are loaded into the mixer truck at two separate locations.

Each transit mixer shall comply with the requirements for truck mixers except that the mixing water tank and measuring device shall be used only for providing tempering water if necessary.

In addition, all truck mixers used for transit mix concrete shall be equipped with an electrically operated counter unit which shall be non-resettable except by use of a 110-volt device utilizing a nonstandard plug located at the batching plant. The counter unit shall contain two counters. One counter shall record only those revolutions at speeds recommended by the manufacturer of the truck mixer as mixing speed and shall record the total of all such mixing revolutions from the time the truck is loaded. The other counter shall record revolutions of the drum at all speeds and shall record the total revolutions from the time the truck is loaded. The unit shall include an indicator on the front panel that shows if the instrument has been turned off or tampered with in any manner after being reset at the time of loading. The counter unit and the resetting device shall conform with the NEC.

The counter unit shall be positioned on the truck so as to be plainly visible if the driver's door is open.

Instead of the time clock, the counter unit may contain a third counter, an electrically-operated timer, which shall be non-resettable except by use of the 110-volt device.

Mixing and delivery for transit mix concrete shall comply with the requirements for truck mix concrete except as follows:

a. All ingredients including water shall be introduced into the transit mixer at the batch plant.

b. At a one-stop batching plant, at least one-third of the mixing water shall be introduced into the mixer before the dry ingredients and sufficient mix water to wash down the chute shall be introduced after all the dry ingredients have been added.
c. At a two-stop batching plant, the loading sequence shall be one-half to three-quarters of the mixing water, aggregates, cement, and remaining water.
d. As an alternative, at either a one-stop or two-stop batching plant, when the mixing water is less than 100 ºF, slurry mixing can be used. When this method is used, all mixing water is added first, followed by the cement, and mixed at mixing speed for one minute. The remaining ingredients shall then be added.
e. At either a one-stop or two-stop batching plant, when the temperature of the mixing water exceeds 100 ºF, the loading sequence shall be the mixing water, then the aggregates, and then the cement.
f. Sufficient mix water to wash down the chute shall be introduced after all the dry ingredients have been added. However, not less than 80 percent of the mixing water, as established by the mix design, shall be added at the plant.

Mixing shall begin immediately following the complete charging of the drum and continue for not less than 50 nor more than 100 revolutions of the drum at the mixing speed recommended by the manufacturer of the truck mixer. Upon completion of at least the minimum number of mixing revolutions at the plant, the speed of the drum shall be reduced to the agitation speed recommended by the manufacturer. Concrete delivered to the job with less than 100 mixing revolutions may be mixed to not more than 100 revolutions at mixing speed.

Before acceptance testing, mixing water or air entraining agent or both may be added incrementally, at the Project site, in order to achieve the proper slump or air content range in conformance with Subsection 914.02.

If the concrete cannot be entirely discharged within ten minutes after the mixing has been completed, the concrete remaining in the drum shall be kept plastic and workable by revolving the truck drum at the manufacturer's designated speed for agitation for a period of two minutes in each ten minutes.

The maximum elapsed time from loading at the plant to the discharge of all the concrete from the mixer shall be 90 minutes except that under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 85 ºF or above, such time limit shall be changed to 60 minutes. However, if the use of retarders is approved, the time limit may be increased to a maximum of 75 minutes. Under very severe conditions, further reduction of the time limits or in the size of the loads may be required.

Transit mix concrete will be rejected for any of the following reasons:

a. If the concrete is not discharged within the specified time limit after loading all ingredients into the drum;
b. If the indicator on the counter shows that the instrument has been turned off or tampered with;
c. If the non-resettable total revolution counter shows more than 300 revolutions;
d. If the mixing revolution counter shows more than 120 revolutions;
e. If water has been added while the truck mixer is en route to the Project. Two-way telephone or radio communication between the site of the placement of concrete and the batching plant shall be provided.

{ XE "Concrete surface course:mixing concrete:continuous-mixing truck mixers" **}4. Mixing on the Project in Continuous-Mixing-Type Truck Mixers.** Mixing on the Project in continuous-mixing-type truck mixers shall be used for headwalls, utility encasements, manhole and inlet foundations and top slabs, gutters, curbs, headers, barrier curbs and bases, sidewalks, islands, driveways, fence post footings, sign foundations, foundations for electrical items, guide rail end treatment footings, junction boxes, and other miscellaneous items as approved.

If concrete additives are to be used in the mix, means shall be provided for storing the additives on the truck and incorporating them into the mix. A way to check the rate of flow of the additive into the mix and a meter to register the total volume of additive incorporated into the mix during each mixing operation shall be included. Trucks not having functional meters will not be permitted on the Project site.

The concrete shall be mixed in a mixing unit that is part of the truck carrying the dry ingredients. The mixing unit shall be an auger type incorporated in the truck's discharge chute or other approved mixing mechanism. The mixer shall produce concrete of uniform consistency and shall discharge the mix without segregation.

The truck mixer shall have permanently attached thereto, in a prominent place, a metal plate or plates on which are plainly marked the gross volume of the unit in terms of mixed concrete, operating speed, and the

cement constant of the machine in terms of an indicator revolution count required to deliver 94 pounds of cement, all as rated by the manufacturer.

The truck mixer shall be equipped with a cement bin of sufficient capacity to store and supply the quantity of dry cement required to produce the maximum volume concrete capacity of the truck mixer as rated by the manufacturer. The cement bin shall be free of moisture and contamination at all times.

The truck mixer shall be equipped with aggregate bins of sufficient capacity to store separately the quantities of fine and coarse aggregates required to produce the maximum volume concrete capacity of the truck mixer as rated by the manufacturer. Means shall be provided to prevent contamination or intermixing of the fine and coarse aggregates during loading and transporting. Aggregate bins shall be covered when there exists a possibility of moisture entering the bins.

The truck mixer shall be equipped with a means of readily determining the level of aggregates in the aggregate bins without the need for climbing up on the truck. The aggregates shall be maintained at the proper level to cause the correct volume to enter the mix.

The aggregate bins shall be equipped with vibrators or other means of maintaining a smooth, even, and continuous flow of aggregate from the bins.

The truck mixer shall be equipped with water tanks of sufficient capacity to store the quantity of water required to produce the maximum volume concrete capacity of the truck mixer as rated by the manufacturer and at the slump specified for each concrete item. If concrete additives are to be used in the mix, means shall be provided for storing the additives on the truck and incorporating them in the mix including a way to check the rate of flow of the additive into the mix.

The truck mixer shall include a feeder unit mounted under the compartment bins to deliver the ingredients to the mixing unit.

Each bin on the truck shall have an accurately controlled individual gate or feeding mechanism to form an orifice for volumetrically measuring the material drawn from each bin compartment. The cement bin feeding mechanism shall be set to discharge continuously and at a uniform rate, a given volumetric weight equivalent of cement during the concrete mixing operation. The gates of the aggregate bins shall be calibrated at the various openings to discharge the volumetric weight equivalent of aggregates required for various concrete mixes. The mixer truck shall be equipped with a material flow indicator attached to the metering gates to monitor continuous flow of material. The indicator shall sound an alarm when a continuous flow of material does not pass through the metering gates.

The truck mixer shall be so constructed as to permit checking the calibration of the gate openings and meters by means of weight test samples.

The calibration of the gate openings and meters shall be checked and certified for each concrete mix design at least once a year by a testing agency. When approved, a representative of the Contractor may perform the calibration if it can be shown that the representative is knowledgeable in the proper techniques of calibration. The Department shall be notified, at least one week before the date of the annual calibration, in order that the Department may approve the calibration.

A calibration check or a yield test may be required at any time. The accuracy of the mixer to proportion the specified mix is acceptable if the calibration check shows that the equivalent weights of each component are within the following tolerances:

Cement	0 to + 4 percent
Fine Aggregate	± 2 percent
Coarse Aggregate	± 3 percent
Admixtures	± 3 percent
Water	± 1 percent

Each truck mixer shall be equipped with a revolution counter indicator permitting the reading of the volumetric weight equivalent of cement discharged during the concrete mixing operation.

Each truck mixer shall be equipped with fine and coarse aggregate dials to permit adjustment of the gates of the aggregate bins for volumetric proportioning of aggregates.

Each truck mixer shall be equipped with a water meter or gauge to register the discharge rate of water by volume entering the mix.

Each truck mixer shall be equipped with an automatic means of maintaining the operating speed of the proportioning and mixing operations. The truck mixer shall be operated within plus or minus eight percent of the revolutions per minute established by the manufacturer, noted on the aforementioned plate, and the value used during calibration. This tolerance shall be met when the mixer is moving or standing still. A tachometer shall be mounted on the unit to indicate the operating speed.

All indicators, dials, meters, tachometer, and controls shall be in full view and near enough to be read or adjusted by the operator while mixing concrete.

Handling, measuring, and batching of materials shall conform to Subsection 405.07 except as follows:

a. Cement and aggregates shall be proportioned, measured, and batched by a volumetric weight equivalent method. Separate batching equipment and storage bins are not required, and the materials shall be batched in the continuous-mixing-type truck mixer.

b. Each truckload of ingredients shall be accompanied by a sufficient number of delivery tickets such that the operator may supply one copy of the delivery ticket for each Project and for each class of concrete delivered. The delivery tickets shall show the brand name and type of cement, the calibrated cement constant of the machine in terms of the indicator revolution count, the source of aggregates, and the size of the coarse aggregate. The delivery tickets shall be signed by a responsible officer or employee of the concrete supplier. At each Project, for each class of concrete and for each separate mixing operation, the mixer operator shall enter on the tickets the name of the Project, the name of the Contractor, the revolution counter indicator readings indicating the volumetric weight equivalent of cement discharged during that mixing operation, the concrete additive meter reading indicating the total volume of additive discharged into the mix during that mixing operation, the aggregate dial settings, the water and concrete additive flow rates, and the class of concrete delivered. The operator shall sign each completed ticket and furnish one copy.

The following shall apply only to mixing on the Project in truck mixers, mixing at a central mixing plant, and transit mixing above:

1. A delivery ticket, completely filled out, shall be furnished for each load. The tickets shall be serially numbered and shall bear the printed heading of the supplier and the location of the batch plant. Each ticket shall show the name of the Project, the name of the Contractor and subcontractor, if pertinent, the number of cubic meters of concrete and the class and type, the name of each admixture and the quantity shown in liquid measure or weight, the time when loading into the drum was completed as imprinted on the ticket by an automatic clock, the time when the concrete was completely discharged, the amount of mixing water and the amount of tempering water, if used, both in liters, the total number of revolutions on the counter at the time of complete discharge for truck-mix concrete plus the total number of mixing revolutions for transit mix, the date, and the truck number. In addition, for the first ticket of each day, for the first ticket of each pour, and when changes occur in the information, the number of pounds of portland cement with the brand name and type, the number of pounds and the source of the fine aggregate, and the number of pounds and the sizes and sources of the coarse aggregates shall be indicated. The ticket shall be authenticated by an authorized representative of the supplier.
2. The concrete will be rejected if:
   a. the mixer fails to maintain the manufacturer's stated speed of rotation for both mixing and agitation, or is not able to promptly discharge the concrete;
   b. there is any indication of improper batching, lack of uniform distribution of constituents throughout the load, or balling of the cement and aggregates;
   c. the concrete is not discharged within the specified time limit, or if the revolution counter shows a total of more than the permitted number of revolutions. However, if the load has been partially discharged and if the concrete yet to be discharged complies with the specified ranges for slump and entrained air without further addition of water, the discharge and use of the concrete may be permitted.

405.09 Limitations of Placing.{ XE "Concrete surface course:limitations of placing" }

The limitations shall be as prescribed in Subsection 501.11, except that the placing of concrete shall be discontinued in time to allow finishing to be completed in daylight hours. If approved, to complete finishing after daylight hours, an artificial lighting system shall be in place and operable.

405.10 Placing Concrete.{ XE "Concrete surface course:placing:concrete" }

The concrete shall be unloaded into a concrete spreader except that concrete mixed at a central-mix plant may be deposited on the subbase and mechanically spread in such a manner as to prevent segregation of the materials. As deposited, the mixture shall be placed where it requires as little rehandling as possible.

Where small quantities of concrete are to be placed, hand placing and finishing of concrete surface may be permitted. Such work shall be according to Subsection 405.13, Subpart D. The concrete shall be well distributed by the discharge chute across the formed area. In no case shall the concrete be discharged in windrows or piles.

Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels or other appropriate tools. Workers shall not be allowed to walk on previously placed and consolidated concrete.

Where concrete is to be placed adjoining a previously constructed lane and mechanical equipment is to be operated upon the existing lane, that lane shall meet the requirements for opening to traffic in Subsection 405.20.

If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after four days. Precautions shall be employed to prevent damage to the previously constructed concrete. In the event of such damage, all damaged areas shall be repaired at no cost to the State.

To prevent bowing or misalignment of the transverse expansion joints during paving operations, concrete shall be deposited simultaneously on both sides of transverse joints in a uniform fashion without disturbing the joints.

Should any material fall on or be worked into the surface of a completed slab, the material shall be removed immediately and the surface repaired immediately. The finished condition of the surface is subject to approval.

Where two or more lanes of concrete are to be constructed, two adjacent lanes may be constructed as a single operation.

Where two adjacent lanes of concrete are constructed as a single operation, the longitudinal joint between the lanes shall be the sawed type. The saw cut shall conform to Subsection 405.12, Subpart B.

Three or more lanes may be constructed as a single operation, provided that it can be demonstrated that the equipment being used can properly place, strike off, consolidate, finish, and cure the concrete.

405.11 Initial Strike Off of Concrete and Placement of Reinforcement.{ XE "Concrete surface course:placing:reinforcement" }

The placing of the concrete between transverse joints shall be carried out as a continuous operation. If, due to a breakdown in the plant or a delay of more than 30 minutes or other emergency, it is not possible to carry out a continuous paving operation, an intermediate Type A transverse expansion joint shall be constructed and so located that the short slab has a minimum length of 15 feet or of one normal reinforcement mat, whichever is the lesser.

The mixing and placing of the concrete shall progress only at such a rate as to permit proper finishing, protecting, and curing.

A single layer of concrete mixture shall be placed first and then spread and struck off with a mechanical spreader equipped with a screed board so that the entire area between side forms and for a distance sufficient for placing a reinforcement mat is covered to the full depth of the side forms. Mechanical depressors shall be used to secure the steel in place at its proper elevation.

As an alternate, the concrete mixture may be placed in two layers with the first layer placed to such a depth that the surface of the layer is at the proper elevation to receive the reinforcement steel. The next layer of the concrete mixture shall be placed and spread immediately after placing reinforcement steel and in a manner to prevent segregation and so that the surface is at the proper grade when the consolidation and finishing are completed. Concrete of the lower layer which has developed initial set or has been in place more than 30 minutes before being covered with the next layer shall be removed and replaced.

When concrete is constructed without reinforcement, the foregoing requirements for placing the concrete in one layer shall apply.

After the concrete is placed, the portions thereof within 1 foot of transverse, longitudinal, and other joints and within 1 foot of all side forms shall be compacted with suitable tools and by vibrating. The method of vibrating and number of vibrating units shall be such as to ensure the proper density of the concrete adjacent to the ends and sides of the slab and within the areas of the transverse joint structures.

Vibrators shall not be permitted to come in contact with a joint assembly, the subbase, or a side form. In no case shall the vibrator be operated longer than five seconds in any one location.

405.12 Joints.

{ XE "Concrete surface course:joints:sealer" **}A. Joint Sealer.** All joints requiring sealer shall be sealed with hot-poured rubber asphalt before any traffic is permitted. The joint opening shall be cleaned of all extraneous matter. The contact faces of the joint shall be dry at the time of sealing. Compressed-air jets, power-driven wire brushes, and any such additional equipment necessary to clean the joint and dry the contact faces shall be provided. The compound shall not be placed when the air temperature in the shade is less than 50 ºF. The heating kettle in which the compound is prepared for pouring shall be a double-boiler type used with indirect heating, with built-in agitator and equipped with a thermometer to measure the temperature of the sealer. Direct heat will not be permitted.

Where the longitudinal joint between two adjacent lanes was constructed by saw cut, the sawed groove may be filled with a cold-applied type of sealer.

Pouring of this compound for sealing the joints shall be done by the use of hand pots, mechanical methods, or any other method that gives satisfactory results. Pouring shall be done in such a manner that the compound is not spilled on the exposed surface of the concrete. Any excess compound on the surface of the concrete shall be removed immediately.

Joints shall be filled so that upon completion, the compound shall be ⅛ to ¼ inch below the adjacent surface. When more than one pouring is required to fill the joints, the succeeding pouring shall be made immediately after shrinkage of the compound in the previous pouring has taken place. Traffic will not be permitted over the poured joints until the compound has hardened sufficiently to resist pickup.

{ XE "Concrete surface course:joints:longitudinal" **}B. Longitudinal Joints.** Longitudinal joints between adjoining strips or lanes of new concrete shall be of the keyway type. The keyway type longitudinal joint shall also be constructed between strips of existing and new concrete widening where the side of the existing is recessed, but where there is no such recess, the longitudinal joint shall be constructed with vertical plane faces and filled with ¼-inch preformed expansion joint filler. The side of the concrete abutting shoulders and curbs shall be constructed with a recessed face as in the keyway type joint. The joint between the concrete and the curb shall be filled with ½-inch preformed expansion joint filler.

Where adjacent lanes of concrete are constructed one lane at a time, tie-bolts shall be installed in the longitudinal joint between the adjacent lanes.

Where two adjacent lanes of concrete are constructed in a single operation, tie bars shall be installed between the lanes.

Longitudinal sawed joints shall be cut with concrete saws not later than 72 hours after placing concrete and before any equipment or vehicles are allowed on the concrete. The saw cut shall have a depth of 2¼ inches in 8-inch concrete, and a depth of 2¾ inches in 9 inch concrete. The width of the saw cut shall be not less than ⅛ inch or more than ¼ inch. If longitudinal cracking of the concrete occurs, sawing of the concrete shall be started just as soon as the concrete has hardened sufficiently to permit sawing without excessive tearing or raveling of the concrete. The method of repair of concrete in which longitudinal cracking has occurred is subject to approval. If the cracking cannot be satisfactorily repaired, the concrete shall be removed and replaced at no cost to the State.

{ XE "Concrete surface course:joints:transverse expansion" **}C. Transverse Expansion Joints.** Transverse expansion joint assemblies shall be rigid metal devices capable of holding dowels and filler firmly in position during the entire construction operation and shall remain in place. The top of the filler shall be set below the surface of the proposed slab to accommodate the sealant specified. When in position, the filler shall be perpendicular to the surface of the slab. The top edge of the filler shall be protected by a metal channel cap while the concrete is being placed. Dowels shall be placed across transverse expansion joints, parallel to and level with the surface course.

Each day's paving shall be terminated at an expansion joint. Any concrete back to that preceding transverse joint shall be removed.

D. Expansion Joints at Roadway Structures. Preformed expansion joint filler shall be installed at all structures and other features projecting through, into, or against the slab. Such joints shall be ½ inch in width.

E. Longitudinal and Transverse Joint Ties. For placement of the joint tie, holes shall be drilled 9 inches deep into the side of the existing slab, half-way between the top and bottom. The holes shall be spaced as indicated. Joint ties shall not be placed within 2 feet of a transverse expansion or contraction joint. Joint ties shall be omitted when adjacent to bridge approach and bridge approach transition slabs. When the distance from a visible crack extending through the full depth of the exposed edge of the existing concrete roadway is less than 1 foot to the nearest joint tie, said tie shall be omitted.

After drilling, the holes shall be cleaned thoroughly and filled with the epoxy grout. The joint ties shall then be inserted in holes and securely supported in position until the grout has set.

F. Cleaning and Sealing of Cracks and Joints. All exposed joints (transverse and longitudinal) and cracks ¼ inch wide or wider, shall be cleaned and sealed according to Subheading C of Subsection 404.12.

405.13 Final Strike Off, Consolidation, and Finishing.

A. Sequence. The sequence of operations shall be strike off and consolidation, floating and removal of laitance, straightedging, and surface texturing.

The addition of water to the surface of the concrete to assist in finishing operations will not be permitted.

{ XE "Concrete surface course:finishing:machine" **}B. Machine Finishing.** As soon as the concrete has been placed, it shall be struck off and screeded with a finishing machine.

The machine shall go over each area as many times and at such intervals as necessary to give the proper compaction and leave a surface of uniform texture. Excessive operation over a given area shall be avoided. The machine and the travel of the machine on the forms shall be maintained true without lift, wobbling, or other variation that could affect the finish.

During the first pass of the finishing machine, a uniform ridge of concrete shall be maintained ahead of the front screed for its entire length. The moving of rolls of concrete in excess of 6 inches with the finishing machine will not be permitted.

If thorough consolidation of the concrete is not obtained by the vibratory method at joints, along forms, at structures, and throughout the concrete, then other equipment and methods shall be furnished and employed which produce thorough consolidation.

C. Finishing at Joints. The concrete adjacent to joints shall be placed and consolidated against the joint material, under and around all load transfer devices, joint assembly units, and other features that extend into the concrete.

After the concrete has been placed and vibrated, the finishing machine shall be brought forward, operating in a manner to avoid damage or misalignment of joints. If continuous operation of the finishing machine up to, over, and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the front screed is approximately 8 inches from the joint. Segregated concrete shall be removed in front of and off the joint; the front screed shall be lifted and set directly on top of the joint and the forward motion of the finishing machine resumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter, the finishing machine may be run over the joint without lifting the screeds, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

{ XE "Concrete surface course:finishing:hand" **}D. Hand Finishing.** Hand finishing methods will not be permitted except under the following conditions:

1. In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade or in transit to the job when the breakdown occurs.
2. Variable-width areas or other special conditions which make the use of finishing machines impractical may be finished by hand methods.

When hand finishing is permitted, the concrete shall be struck off and screeded as soon as placed. The major part of the concrete above the required grade shall be removed by a hand-operated vibratory screed, moved forward with a combined longitudinal and transverse motion, and so manipulated that it remains in contact with the side forms. The vibrating screed shall be at least 2 feet longer than the maximum width of the slab. It shall be sufficiently rigid to retain its shape and constructed of metal or other suitable material shod with steel.

Screeding shall be repeated until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

Immediately following the longitudinal screeding operation, further finishing with straightedges or lutes, final surface finishing with metal tines, rounding of joint edges, checking of the concrete surface with a straightedge, and the correction of excessive surface irregularities shall be performed as specified for machine finishing except that a mechanical tining machine need not be used. A spud type vibrator shall be used to consolidate the concrete around joints and along forms.

E. Floating. After the concrete has been struck off and consolidated, it shall be further smoothed and trued using hand methods and equipment or a tube finisher as described under Subsection 405.03, Subpart B.

Should the tube finisher be equipped with a fog spray, the fog spray shall be used only when and as directed.

After finishing, any excess water and laitance shall be removed from the surface by a straightedge 10 feet or more in length. Successive drags shall be lapped over one-half the length of the blade.

{ XE "Concrete surface course:straightedge control testing and surface correction" **}F. Straightedge Control Testing and Surface Correction.** Systematic checking of the work during placement shall be performed in order to correct surface irregularities while the concrete is in a workable condition. This checking operation shall be performed after the concrete has been consolidated and the excess water has been removed but while the concrete is still plastic. Such systematic checking shall be performed as follows:

1. After the intended final pass with the finishing machine, the concrete surface shall be checked with a Straightedge parallel to the centerline of the traveled way. Surface variations from the testing face of the Straightedge shall be corrected before the concrete sets. Major deviations shall be corrected by the finishing machine, while minor deviations may be corrected by the straightedge or

float. The addition of water to the surface of the concrete to assist in finishing operations will not be permitted.

2. It is suggested that the checking operation progress in successive 5-foot longitudinal increments, with special attention being given to the concrete surface in the vicinity of joints.

{ XE "Concrete surface course:surface texture" **}G. Surface Texture.** The surface texture shall be a steel tine finish having a uniform pattern of grooves perpendicular to the centerline, spaced at 1 ± ⅛ inch centers, 1/10 ± ¼ inch wide, and ⅛ to ¼ deep. A mechanical comb conforming to Subsection 405.03, Subpart B shall be used to produce the tine finish. The tine finish for the 1-foot of concrete surface adjacent to curbs or raised berms may be omitted.

The tine finish shall be applied when the water sheen has practically disappeared. Finishing shall be completed before the concrete is in such condition that the surface will be torn or roughened by the operation. The finished surface shall be free from rough or porous areas, irregularities, or depressions.

The mechanical comb shall be drawn across the concrete surface at a slow, uniform speed not to exceed 2 feet per second. Successive passes of the mechanical comb shall not overlap by more than 1 to 2 inches.

Hand combs with steel tines shall be available at all times for the purpose of providing a surface texture in the event of a breakdown of the mechanical comb. The hand comb shall be drawn from the center to the edge of the concrete at a constant angle with the surface, exerting constant pressure on the plastic concrete to produce the required uniform texture.

Conformance to the required minimum tine depth of ⅛ inch of the finished concrete surface shall be determined as follows:

Within a lot of approximately 2,000 square yards or less, twenty locations will be randomly selected. At each of these locations, a square of 3 by 3 feet will be marked on the pavement surface. Along the diagonal of the 3 by 3 feet square, ten tine depth readings will be taken at approximately equal intervals using a tire tread depth gauge. An average tine depth will be computed and recorded for each location. A mean value ($\overline{X}$) and the corresponding sample standard deviation (S) for the lot will be computed.

An acceptable lot shall produce a quality index (Q) of 0.15, or greater, where:

$$Q = (\overline{X} - L)/S$$

Where:
- $\overline{X}$ = Sample Mean (average for 20 locations), expressed as a decimal in inches to the nearest 0.001 inch
- L = Acceptance = ⅛ inch
- S = Sample Standard Deviation, expressed as a decimal in inches to the nearest 0.001 inch

Should the lot fail to meet the quality index, a retest will be conducted following the same tine depth measurement procedure on a new sample of 20 randomly selected sites.

If the retest confirms the lot's failure, then the failed lot's surface shall be saw cut groove finished. Saw cutting will not be permitted until the concrete pavement has attained a strength of at least 3,000 pounds per square inch as determined from cylinders cast during placement of the concrete pavement or is at least 14 calendar days old. Grooves shall be cut perpendicular, radial, or longitudinal to the centerline of the roadway. Grooves shall be rectangular in shape. They shall conform to the following dimensions:

Width ..... 0.10 to 0.15 inch
Depth..... ¼ to ⅜ inch

Grooves shall be spaced at 1½ ± 1/16 inch center-to-center of groove. This spacing dimension may be increased up to 3 inches at the end of each pass as necessary. During remedial texturing, the groove dimensions shall be checked at random. If the minimum depth is not achieved, necessary adjustments shall be immediately made.

When saw cutting grooves is required, sawing equipment specifically designed and equipped for the grooving of pavements shall be provided. The saws shall be of a multi-bladed type, adequate in number of units and power to complete the saw cut grooving operation, and equipped with water-cooled, circular, diamond-edge blades and alignment wheels. A system of slurry collection shall be provided. An ample supply of replacement saw blades shall be maintained at the work site at all times during grooving operations.

{ XE "Concrete surface course:edging" **}{** XE "Concrete surface course:marking of slabs" **}H. Edging and Marking.** After the final finish, but before the concrete has taken its initial set, the outside edges of the concrete shall be rounded with an edging tool.

All joints shall be tested with a Straightedge before the concrete has set and corrections made to comply with surface requirements.

The slabs, including bridge approach and bridge approach transition slabs, shall be numbered consecutively as the work progresses and the last slab placed each day shall be marked with the date laid. The marking shall be made on a corner of the slab at the end completed last. The figures shall be of uniform type, 1½ inch high, and plainly and neatly stamped after the final finish.

405.14 Curing.{ XE "Concrete surface course:curing methods" }

The concrete shall be cured by one of the following:

1. White-pigmented liquid compound maintained and protected from damage for a period of not less than 72 hours. When the ambient temperature is expected to fall below 40 ºF, the concrete shall be cured and protected according to Subsection 501.17, Subpart B.
2. Waterproof paper maintained in place for not less than 72 hours.
3. White polyethylene sheeting or white burlap-polyethylene sheeting maintained in place for not less than 72 hours.
4. Burlap maintained wet and in place for not less than 72 hours.
5. Hay or straw maintained wet and in place for not less than 72 hours.

Any of the coverings specified above must be maintained in place until at least the day following concrete placement. If these coverings are removed before 72 hours, the concrete shall be sprayed with white-pigmented liquid compound, or clear or translucent liquid compound, immediately after removal of the coverings. The coating shall be maintained and protected from damage for the balance of the 72-hour period.

Immediately after completing the finishing operations and when marring of the concrete will not occur, the newly placed concrete surface shall be cured according to one of the following methods. Failure to use adequate curing procedures shall be cause for immediate suspension of concrete operations.

Curing shall be applied before any dehydration of the concrete or surface checking occurs and in no event shall the concrete be left exposed for more than 30 minutes between stages of finishing and curing or during the curing period. If the application of water to the surface is required for an interim cure, it shall be applied as a fog spray by means of approved spray equipment.

When clear or translucent liquid compound is used as permitted above, the equipment, method and rate of application, and other provisions specified for curing with white-pigmented liquid compound shall apply.

Equipment and methods of application to be used for the various curing methods shall be as follows:

1. White-Pigmented Liquid Compound. The compound shall be applied in one or two applications as directed. When the compound is applied in two applications, the second shall follow the first within 30 minutes.

The compound shall be applied in a continuous, uniform film by means of power-operated pressure spraying or distributing equipment at the rate directed but not less than one gallon per 200 square feet of surface. The equipment applying the compound shall provide for agitation of the compound. During cold weather, the material may be warmed in a water bath at a temperature not over 100 ºF. Thinning with solvents will not be permitted. Should the method of applying the compound produce a nonuniform film, its use shall be discontinued and the curing shall be done by one of the other methods.

Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted.

If rain falls on the newly coated concrete before the film has dried sufficiently to resist damage, or if the film is damaged in any other way, a new coat of material shall be applied to the affected areas at the rate specified for the original coat. The treated surface shall be protected from damage for a period of at least three days. All vehicular and pedestrian traffic is prohibited except that a minimum of walking will be permitted on the dried film as necessary to carry on the work provided any damage to the film is immediately repaired by the application of another coat of the compound. If hair-checking develops during finishing operations before the curing membrane can be applied, or if there is a breakdown of the spraying equipment, protection of the concrete with wet burlap shall be provided.

2. Waterproof Paper. Waterproof paper blankets shall be not less than 20 nor more than 75 feet in length and shall be of a width so that, when in place, they completely cover the surface of the concrete. Unless the paper has been pretreated to resist such action, an 8-inch pleat to allow for shrinkage of the paper joints in the

blankets shall be cemented together to provide seams with a minimum lap of 4 inches, producing and maintaining a waterproof joint.

The blankets shall be securely weighted down by placing a ridge of earth or light planks on the edges of the blankets just inside the forms or by other approved means such that depressions are not formed in the concrete surface. Adjoining blankets shall overlap not less than 1 foot. This lap shall also be securely weighted down to form a closed joint. If hair-checking develops before the paper can be placed, the concrete shall be covered initially with wet burlap.

Before moving the blankets ahead to new locations, the blankets shall be inspected and all holes and tears shall be repaired with centered patches. When the blankets are no longer serviceable as a single unit, selections may be made from the rejected blankets that, if approved, may serve for further applications, provided that two blankets are used as a single unit. However, the double blanket may be rejected if it no longer provides an airtight cover.

3. **White Polyethylene or White Burlap-Polyethylene Sheeting.** The top surface and sides of the concrete shall be covered with polyethylene or burlap-polyethylene sheeting. The units used shall be lapped at least 1 foot-6 inches. The sheeting shall be placed and weighted down so as to remain in contact with the surface covered. The sheeting shall extend beyond the edges of the slab for a distance at least twice that of the thickness of the concrete. The covering shall be maintained in place for 72 hours after the concrete has been placed.
4. **Burlap.** The concrete shall be covered with strips of wet burlap that, after shrinkage, shall be not less than 2½ feet longer than the width of the slab. Approximately 2 feet shall be allowed for shrinkage of new burlap. The strips shall be laid across the slab and shall overlap not less than one-half the width of the strip to provide a double thickness of burlap. The burlap shall be maintained in a wet condition throughout the specified curing period.

   If a pipeline is to be used to furnish water for sprinkling, it shall have tees and stopcocks not more than 200 feet apart. If this pipeline is used for supplying water for the concrete mixer and other operations, it shall be of sufficient size and operated under sufficient pressure to serve all such operations and to permit sprinkling of the curing material and shall not be removed from the site of sprinkling until the curing period is over.
5. **Hay or Straw.** The entire surface of the concrete shall be covered with a layer of hay or straw not less than 6 inches uniform thickness which shall be placed directly upon the concrete and wet by sprinkling.

   If a pipeline is used to furnish water for sprinkling, it shall comply with Subheading 4 above.

405.15 Surface Requirements.{ XE "Concrete surface course:surface requirements" }

{ XE "Concrete surface course:surface requirements:permissible surface variations" **}A. Permissible Surface Variations.** The surface of the concrete will be tested with a Rolling Straightedge that automatically marks, in colored dye, the length of surface variations that exceeds a tolerance of ⅛ inch in 10 feet.

Concrete placed on a new mainline shall be so constructed that, when tested according to Subpart B below, the measured length of lot exceeding the specified ⅛-inch tolerance shall not exceed five percent.

Concrete placed in non-mainline areas of the Project or constructed adjacent to an existing roadway, for the purpose of widening, will be tested according to Subpart C below.

{ XE "Concrete surface course:surface requirements:acceptance testing" **}B. Surface Compliance Plan.** Before acceptance testing and notching of the expansion joint filler paper necessary to permit passage of the Straightedge, any required sweeping of the surface shall be performed as part of the work.

Conformance to the surface tolerance will be determined in lots, each lot being equal to the number of square yards of concrete surface placed in each production day.

{ XE "Concrete surface course:surface requirements:lot percent defective" **}**The compliance of a lot will be determined from the percentage of the total length of the lot having surface variation exceeding ⅛ inch in 10 feet, this percent noncompliance being defined as the lot percent defective length. Lot percent defective length is computed by adding the lengths of individual surface defects exceeding the specified tolerance, dividing this sum by the total length tested, and multiplying by 100 to convert to percent.

The full extent of the lot will be tested in the longitudinal direction along the wheelpaths, defined as the two imaginary lines located approximately 3 feet on each side of the center of the lane and extending for the full length of the lane. The wheelpath of the test will be determined randomly and varied every 300 to 400 feet.

The minimum number of full-length tests required to determine the lot percent defective length is given in Table 405-1 below. The 25 percent sample plan, wherein the number of tests is at least equal to one-fourth of the number of wheelpaths in a day's production, will be used initially. Final compliance may be based on the results of the 25 percent sampling except that if the lot percent defective length exceeds 13.9, each wheelpath will be tested.

When more than one test is specified in Table 405-1 below, the initial and intermediate transverse locations of each test will be determined randomly. Exact duplicate tests will not be performed. When testing of all wheelpaths is specified, no intermediate transverse variation of the individual tests will be made. The results of preceding tests are not to be included in the computation of lot percent defective length when application of the 100 percent sample plan is indicated.

In addition to the minimum number of tests specified in Table 405-1 below and run on randomly selected sites, any area which appears defective may be tested including a previous day's production which is damaged by construction operations.

If the lot percent defective length is 5.1 to 13.9 inclusive, the lot shall be removed and replaced or the lot may be accepted upon written request provided that the lot is reduced according to Table 405-2 below.

Table 405-1 Surface Acceptance Testing Schedule

	Corresponding Number Tests				Lot Percent Defective	Reduction
Sampling Plan	One Lane	Two Lanes	Three Lanes	Four Lanes	Length Measured	or Retest Requirement
25%	1	1	2	2	0 to 13.9	As per Table 405-2
					14.0 or more	Test each wheelpath
100%	2	4	6	8	All values	As per Table 405-3

Table 405-2 Reduction Per Lot Due to Nonconformance to Surface Requirements{ XE "Tables:portland cement concrete:reduction per lot due to nonconformance to surface requirements" }

Lot Percent Defective Length	Reduction per Lot, Percent
0 - 5.0	None
5.1 - 11.0	2
11.1 - 13.9	5

If the lot percent defective length exceeds 13.9, any or all of the concrete in the lot may be directed to be removed, replaced, and retested for acceptance. If the concrete is allowed to remain in place, the lot quantity will be reduced by 16 percent.

C. Other Testing. The riding surface of non-mainline surface, bridge approach and transition slabs, and lanes constructed for the purpose of widening are not subject to the foregoing surface acceptance requirements.

However, the riding surface of any or all portions of the traveled way of the Project (including, but not limited to, such areas as ramps, acceleration or deceleration lanes, and lanes added to widen an existing roadway) may be tested to determine the adequacy of the paving methods and equipment. The paving operation is acceptable if the riding surface is in substantial conformity with a ⅛ inch in 10-foot surface tolerance. If the paving operation is unacceptable, the particular placement operation involved shall be discontinued until mutually acceptable methods or equipment are used.

Additional compensation, extension of Contract Time, or other concession will not be allowed because of revised methods or equipment necessary to produce substantial conformity with a ⅛ inch in 10-foot surface tolerance.

{ XE "Concrete surface course:surface requirements:remedial measures" **}D. Surface Remedial Measures.** Correction of surface by grinding and resubmission for testing may be permitted provided that correction does not require removal of more than ¼ inch of concrete from the surface. Grinding shall be performed with equipment specifically designed for the purpose and shall employ either a diamond-studded drum or stacked-blade-type cutting head. The texture depth in the ground areas shall be similar to that of the adjacent surface. All ground areas shall be neat areas of uniform appearance. When use of such remedial grinding procedures is requested, a plan shall be submitted in writing setting forth the intended limits of the surface restoration and a complete description of the methods and equipment proposed for use.

405.16 Removing Forms.{ XE "Concrete surface course:forms:removing" }

The side forms shall not be removed until the concrete within them has been in place for at least 12 hours. The forms shall be removed carefully so as to avoid damage to the concrete. After the forms have been removed, the sides of the slab shall be cured using one of the methods indicated in Subsection 405.14. Honeycombed areas shall be repaired as directed and operations shall be modified to minimize further honeycombing.

Precautions shall be exercised with respect to form removal and load applications for portland cement concrete containing fly ash since the rate of strength development may be slower.

405.17 Protection from Traffic.{ XE "Concrete surface course:protection of surface course" }

The concrete surface course and its appurtenances shall be protected from traffic according to Subsections 105.17 and 105.19. This shall include watch persons to direct traffic and the erection and maintenance of warning signs, lights, bridges, or crossovers, etc. Such protection devices and personnel shall be provided without additional compensation.

Warning signs shall be erected and maintained during the entire curing period. The warning signs shall be erected at each end of the section being cured and at intervals of approximately 500 feet along such section. In residential and business areas, the signs shall be erected at intervals of 100 feet. Wood bridging for pedestrian crossovers shall be placed at street intersections and at other established pedestrian crosswalks. The words **KEEP OFF** shall appear conspicuously on each warning sign and shall be stenciled on each waterproof paper blanket and each sheet of polyethylene sheeting.

In order that the concrete be protected against the effects of rain before the concrete is sufficiently hardened, materials for the protection of the edges and surface of the unhardened concrete shall be available at all times. Such protective materials shall consist of covering material such as burlap, curing paper, or plastic sheeting material. When rain is imminent, all paving operations shall stop and all available personnel shall begin covering the surface of the unhardened concrete with the protective covering.

Any damage occurring before Acceptance shall be repaired or replaced at no cost to the State.

405.18 Core Samples.{ XE "Concrete surface course:core samples" }

Upon completion of the portland cement concrete paving, the Contractor shall obtain cores from the finished pavement at random locations as directed according to this Section and Section 914. The Engineer will request the random core locations through the Department's Bureau of Materials.

The cores shall be 4 inches in nominal diameter, and the drilling equipment of sufficient size and power to drill through the entire thickness of the pavement. The drill bit shall be of a water-cooled, diamond-tipped, masonry-type capable of obtaining a valid test sample through the entire pavement thickness. Each core shall be identified by number, painted on the side of the sample and accompanied by the appropriate laboratory form, supplied by the Engineer. The Department will have the samples transported to the central laboratory at no cost to the Contractor.

After the core has been removed from the pavement, the excess cooling water shall be pumped from the hole, and the hole filled flush with the adjacent pavement surface with concrete patch material.

405.19 Defective Work.{ XE "Concrete surface course:defective work" }

From time to time, an examination of the concrete may be made by the Engineer and, as a part of such examination, cores may be taken or sections removed. If such examination discloses that the concrete contains cracks or other defects caused by negligence, poor workmanship, or failure to meet the requirements of the Plans and Specifications, such defective work shall be removed and replaced, if directed, at no cost to the State.

405.20 Opening to Traffic.{ XE "Concrete surface course:opening to traffic" }

{ XE "Opening to traffic:concrete surface course" **}{** XE "Concrete surface course:strength requirements" **}**The Resident Engineer will determine when the concrete surface is to be opened to traffic or construction equipment. Traffic or construction equipment will not be permitted on the concrete surface until test specimens, as provided for under Section 914, have attained a compressive strength of 3,000 pounds per square inch. If such tests are not conducted, the concrete surface will not be opened to traffic or construction equipment until the number of days after placement shown below have elapsed, provided, however, that no concrete surface will be opened for traffic before joints have been filled and sealed, all joint filler material spilled on the surface has been removed, and all curing and other extraneous materials have been removed.

May 16-Oct 15	Concrete Class B	9 days
Oct 16-May 15	Concrete Class B	12 days

For portland cement concrete containing fly ash, opening to traffic is governed solely by the 3,000 pounds per square inch compressive strength requirement and not by time elapsed.

Opening to traffic as provided above shall not relieve responsibility for the work according to Section 107.

405.21 Transverse Concrete Grooving.{ XE "Concrete surface course:transverse concrete grooving" }

Grooves shall be cut in the concrete surface course by a machine equipped with a rotary head, or other approved type head, on which are mounted cutters capable of producing grooves. The grooves shall be clean and neat with sharp corners cut transversely to the centerline. The grooves shall be not less than ⅛ inch or more than ¼ inch deep, 0.095 inch wide, and shall be spaced on ¾ inch centers. A tolerance of plus 1/16 inch will be acceptable in the groove width.

Grooved areas shall begin and end at lines perpendicular to the centerline. Individual grooves shall form a continuous line across the roadway.

Caution shall be exercised when the machine approaches the longitudinal joint so that no damage is done to the joint and so that the ends of the groove neatly abut each side of the joint.

Residue from the grooving operations shall not be permitted to flow across shoulders or lanes occupied by traffic or to flow into gutters or other drainage facilities. Solid residue resulting from grooving operations shall be removed from the concrete surface course before the residue is blown and scattered.

Before traffic is permitted on the grooved area, the area shall be cleaned so that the grooves and surfaces between the grooves are free of concrete dust or other foreign matter.

The actual grooved area of any 2 by 100-foot transverse area of surface course designated to be grooved shall be not less than 90 percent of the designated area. Irregularities in the concrete surface course shall be the only reason for not grooving a section within the area designated to be grooved.

405.22 Bridge Approach and Transition Slabs.{ XE "Concrete surface course:bridge approach and transition slabs" }

Bridge approach slabs and bridge approach transition slabs shall be constructed according to the requirements specified for concrete surface course except as follows:

1. Paving two or more lanes as a single operation will not be permitted.
2. Subpart G of Subsection 405.13 shall not apply.
3. All bridge approach slabs and bridge approach transition slabs shall be textured with an artificial turf drag and shall be saw cut groove finished.

The texturing of the bridge approach and transition slabs shall be performed as follows:

1. Turf Drag. Immediately after finishing has been completed, the surface shall be given a texture with an approved artificial turf drag. The drag shall be made of molded polyethylene with synthetic turf blades approximately ⅝ inches long. There shall be approximately 6,000 blades per square foot.

The drag shall be operated in a longitudinal or transverse direction. Once begun, the direction of texturing shall not be changed. Transverse texturing shall be done from a work bridge.

When texturing is done in the longitudinal direction, the turf drag shall be attached to the finishing machine and shall be a single full-width strip. Small areas inaccessible to the full-width drag may be textured by hand methods.

The turf drag finish shall be applied so as to prevent ridges or gouges forming in the concrete surface. The drag shall be weighted and the contact area changed as required to produce uniform texture. The drag shall be cleaned periodically to remove all hardened concrete particles. Texture resulting from the drag shall stop within 1 foot of curbs.

2. **Saw Cut Grooved Surface.** Grooving will not be permitted until the bridge approach slab and bridge approach transition slab concrete has cured for 14 calendar days and the minimum strength for an additional individual test, as defined in Section 914, exceeds 3,000 pounds per square inch from two cylinders cast during placement.

The surface of concrete bridge approach and bridge approach transition slabs shall be grooved except at the locations shown in Table 405-3 below.

Grooves shall be cut perpendicular or radial to the centerline of the roadway. Radial grooving shall be conducted in partial-width passes. Each pass shall be limited to one lane width. Adjustment along the longitudinal axis of the concrete slab shall be made at no less than 12-feet intervals, and result in a uniformly grooved surface finish.

Grooves shall be rectangular in shape and conform to the following dimensions:

Width ..... 0.10 to 0.15 inch
Depth ..... ¼ to ⅜ inch

Grooves shall be placed at 1½ ± 1/16 inch center-to-center of groove. This spacing dimension may be increased up to 3 inches at the end of each consecutive, multi-bladed, saw cut pass as necessary to accommodate the distance tolerance required at the joint system (see Table 405-3). The required dimension will be determined before actual grooving and shall be approved. The cutting of grooves over an area that has already been grooved will not be permitted. No cutting blade shall be introduced into an already established groove. When it is necessary to rotate the sawing equipment to complete grooving within the tolerances specified in Table 405-3, the longitudinal gap created shall not be located in a wheelpath and shall be limited to 3 inches in width.

Grooves shall terminate within the following limits:

Table 405-3 Saw Cut Grooved Area Limits{ XE "Tables:structures:saw cut grooved area limits" }

Location	Closest Allowable Distance	Farthest Allowable Distance
Drainage Structure	12 in	15 in
Vertical Face (curb or parapet), or Face of Railing (no curb)	12 in	15 in
Joint System	6 in	33 in (see Note)

Note: This distance is a variable that is dependent upon equipment size, in this case, predicated on a 24-inch saw head. This dimension shall be measured perpendicular to the direction of the grooves. The distance shall be measured from the edge of the joint system and in no case should be greater than the width of the saw head plus 9 inches tolerance.

A plan of action shall be submitted for approval, seven days before saw cutting, detailing the layout of the grooving procedure, spacing dimensions at the starting and ending point of each pass, and a description of the saw cutting equipment.

Grooves shall be constructed using multi-bladed saw cutting equipment, fitted with diamond-tipped circular saw blades, except when the use of single blade circular saw equipment is permitted where such equipment is necessary to complete the work.

Before grooving operations, two approved gauges to verify groove depth shall be supplied. The gauges shall be accompanied by the manufacturer's instructions for their use.

During the grooving operations, the groove dimensions will be checked at random. If the minimum groove depth is not being achieved, the Contractor shall stop grooving operations and make adjustments to achieve the minimum depth.

Slurry or debris from the grooving operation shall not be permitted to accumulate. Slurry shall be promptly collected and removed for disposal off site.

405.23 Thickness Requirements.{ XE "Concrete surface course:thickness requirements" }

The concrete surface course shall be so constructed that its average thickness, based on fifteen random cores per lot taken by the Engineer, is equal to or in excess of the thickness specified. In addition, not more than two of fifteen cores of a lot shall be deficient by greater than ¼ inch from the specified thickness.

Conformance to thickness requirements will be determined based on the following:

1. **Procedure.** A lot consists of approximately 14,300 square yards of surface area excluding bridge approach slabs and transition slab areas. Each lot will be divided into fifteen sections of approximately equal area, and one core will be removed from a randomly selected location within each section and tested according to ASTM C 174.
2. **Reduction.** If either of the above core thickness requirements is not met, the lot of concrete surface course to which these cores apply is subject to payment reductions as follows:
   a. When the average thickness is less than the specified thickness, the payment reduction will be determined by the formula below except that, if the average thickness deficiency exceeds ½ inch, the lot may be required to be removed and replaced at no cost to the State.

$$\text{Percent Reduction} = \frac{300 \times \text{Specified Thickness} - \text{Average Thickness}}{\text{Specified Thickness}}$$

   b. When more than two individual cores are deficient by more than ¼ inch, payment for the lot will be reduced by two percent.

COMPENSATION

405.24 Method of Measurement.

Concrete surface course, bridge approach slabs, and bridge approach transition slabs, with or without reinforcement, of the various thicknesses, will not be measured, and payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided for in Subsection 109.01.

Transverse expansion joints of the various types will be measured by the linear foot.

Joint ties will be measured by the unit.

Sealing of cracks and joints in concrete surface course will be measured by the linear foot.

Core samples, Concrete will be measured by the unit.

Transverse concrete grooving will be measured by the square yard and will be determined by multiplying the width of the grooved area by the total horizontal length of lane grooved.

Saw cut grooved bridge approach and transition slabs will be measured by the square yard of surface area actually grooved.

405.25 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CONCRETE SURFACE COURSE, ___ " THICK	SQUARE YARD
CONCRETE SURFACE COURSE, REINFORCED, ___ " THICK	SQUARE YARD
BRIDGE APPROACH SLABS, ___ " THICK	SQUARE YARD
BRIDGE APPROACH TRANSITION SLABS, ___ " AVERAGE THICKNESS	SQUARE YARD
TRANSVERSE EXPANSION JOINT, TYPE ___	LINEAR FOOT
LONGITUDINAL JOINT TIES	UNIT
TRANSVERSE JOINT TIES	UNIT
SEALING OF CRACKS AND JOINTS IN CONCRETE SURFACE COURSE	LINEAR FOOT
CORE SAMPLES, CONCRETE	UNIT
TRANSVERSE CONCRETE GROOVING	SQUARE YARD SAW
CUT GROOVED BRIDGE APPROACH AND TRANSITION SLABS	SQUARE YARD

Separate payment will not be made for the plant laboratory and all the facilities and equipment therein. All costs thereof shall be included in the price bid for the various Pay Items scheduled in the Proposal.

{ XE "Concrete surface course:thickness requirements:payment reductions" **}**Payment reductions due to nonconformance to surface requirements will be made according to Table 405-2 and will be applied to the lot quantity as determined according to Subsection 405.15, Subpart B.

Payment reductions due to the average thickness being less than the specified thickness will be made according to Subheading 2.a. of the second paragraph of Subsection 405.23, and will be applied to the lot area as determined according to Subheading 1 of the second paragraph of Subsection 405.23.

Payment reductions due to more than two individual cores being deficient by more than ¼ inch will be made according to Subheading 2.b. of the second paragraph of Subsection 405.23, and will be applied to the lot area as determined according to Subheading 1 of the second paragraph of Subsection 405.23.

All payment reductions made according to the above are cumulative.

Payment for the preparation of the underlayer will be made according to Section 209.

SECTION 406 – SUPERPAVE HOT MIX ASPHALT (HMA) COURSES{ XE "SUPERPAVE HOT MIX ASPHALT (HMA) COURSES" }{ XE "SURFACE COURSE:SUPERPAVE HOT MIX ASPHALT (HMA) COURSES" }

406.01 Description.

This work shall consist of the construction of base course, intermediate course and/or surface course of Superpave HMA; the treatment and/or sealing of joints and cracks in HMA surface course and portland cement concrete surface course before an overlay; the sealing of saw cuts in Superpave HMA overlays constructed over existing portland cement concrete pavement, previously overlaid portland cement concrete and/or composite pavement; the taking of core samples for testing; and the repair of existing pavement.

MATERIALS{ XE "SUPERPAVE HOT MIX ASPHALT (HMA) COURSES:MATERIALS" }

406.02 Materials.

Superpave HMA shall conform to Section 920. All other materials shall conform to Subsection 404.02.

The requirements for specific Superpave HMA mixtures are identified by the abbreviated fields in the Pay Item description as defined in the following example:

SUPERPAVE HOT MIX ASPHALT 12.5H64 SURFACE COURSE

"SUPERPAVE HOT MIX ASPHALT" – the term "Superpave Hot Mix Asphalt" is located in the first field in the Pay Item description for the purpose of identifying the mixture requirements.

"12.5" – the second field in the Pay Item description designates the nominal maximum size aggregate (in millimeters) for the job mix formula (other sizes may be 9.5, 19, 25, and 37.5mm).

"H" – the third field in the Pay Item description designates the high design compaction level as for the job mix formula based on traffic forecasts as listed in Table 920-2 (other levels may be L=low, M=medium, and V=very high).

"64" – the fourth field in the Pay Item description designates the high temperature (in ^{o}C) of the performance-graded binder (other options may be 70, and 76 ^{o}C). All binders shall have a low temperature of –22 ^{o}C, unless otherwise specified.

"SURFACE COURSE" – The last field in the Pay Item description designates the intended use and location within the pavement structure (other options may be intermediate, or base course).

EQUIPMENT

406.03 Equipment.{ XE "Superpave hot mix asphalt (HMA) courses:equipment" }

The equipment shall be according to Subsections 404.03, 404.04, 404.06, 404.07, 404.08, 404.09, 404.10, and 404.11.

406.04 Plant Laboratory.{ XE "Superpave hot mix asphalt (HMA) courses:plant laboratory" }

The plant laboratory for Superpave HMA shall be according to Subsection 404.05 except that an office area shall be provided with a floor area that is not less than 100 square feet for the exclusive use of the Engineer. A Superpave gyratory compactor conforming to AASHTO T 312 shall be provided instead of the Marshall Method equipment required by AASHTO T 245. Superpave HMA plants producing more than 3,000 tons of mixture per day may be required to increase the laboratory facilities and equipment.

CONSTRUCTION{ XE "SUPERPAVE HOT MIX ASPHALT (HMA) COURSES:CONSTRUCTION" }

406.05 Preparation of Existing Surface.

The preparation of the existing surface shall be according to Subsections 404.12 and/or 404.14.

406.06 Weather Limitations.
The limitations shall be according to Subsection 404.13.

406.07 Conditioning of Existing Surface.
The conditioning of the existing surface shall be according to Subsection 404.15.

406.08 Transportation and Delivery of Mixture.
The transportation and delivery of mixture shall be according to Subsection 404.16.

406.09 Spreading and Finishing.
The spreading and finishing shall be according to Subsection 404.17.

406.10 Compaction.
The compaction of the mixture shall be according to Subsection 404.18.

406.11 Sawing and Sealing of Joints.
The sawing and sealing of joints shall be according to Subsection 404.19.

406.12 Air Voids Acceptance Plan. { XE "Superpave hot mix asphalt (HMA) courses:air voids acceptance plan" }
Traveled Way lots are defined as the area covered by a day's paving production of the same lift of placed material consisting of a minimum of 1,100 tons and a maximum of 3,300 tons. Except for test strip lots, daily production areas less than 1,100 tons, will be combined with previous or subsequent production areas to meet the minimum requirements. When the maximum requirement is exceeded in a day's production, the area of material placed will be divided into two lots with approximately equal areas.

Ramp Pavement Lots are defined as the area of highway access ramps consisting of approximately 4,800 square yards of full depth uniform thickness pavement or 9,600 square yards of full depth variable thickness pavement. Ramp pavement lots will be calculated from the pavement structures within the Traveled Way of access ramps only. Ramps with less than the minimum area may be combined into a single lot. Where two or more non-adjacent ramps are included in a single lot, additional cores may be required to insure that at least one core is taken from each ramp.

Other Pavement Lots are defined as approximately 4,800 square yards of Superpave HMA of full depth, uniform thickness or 9,600 square yards of full depth, variable thickness material in shoulders and other incidental pavement construction. Shoulders less than 5 feet in width are excluded from these requirements.

Each mixture in a given lot shall be compacted so that the combined percentage of material below 3.0 percent voids or above 9.0 percent voids shall be no more than ten percent. Air voids will be determined from five drilled cores taken from each lot in random locations as directed by the Engineer. The Engineer will witness all core drilling. The drilled cores will be tested according to Subsection 920.03(G) to determine the air voids content.

Conformance with these requirements will be determined on the basis of the amount of material estimated to fall outside of the specification according to the following steps:

(1) Compute the sample mean ($\overline{X}$) and the standard deviation (S) of the N Test Results (X1, X2,..., XN):

$$\overline{X} = \frac{X1 + X2 + ... + XN}{N}$$

$$S = [(X1 - \overline{X})^2 + (X2 - \overline{X})^2 + ... + (XN - \overline{X})^2 / (N-1)]^{½}$$

(2) Compute Quality Index.
QL = ($\overline{X}$ – 3.0)/S and QU = (9.0 – $\overline{X}$)/S, where "Q" is the quality index.

(3) Compute Percent Defective. (PD) Using Table 914-5 for the appropriate sample size, determine the percentage of material (PD) falling outside specification limits associated with QL (lower limit) and QU (upper limit). Add these two values to obtain the total PD.

If for any reason the number of available test results is different from N = 5 for initial testing or N = 10 for retesting, tables for the appropriate sample size are to be used for Step 3.

(4) Compute the percent pay adjustment (PPA) for voids for Traveled Way paving (including ramps) and newly constructed shoulders 5 feet in width or more as follows:

a. Surface:

QUALITY	PPA	
PD < 10	$PPA_V = 4 - (0.4\ PD)$	(Eq. 1)
10 ≤ PD < 30	$PPA_V = 1 - (0.1\ PD)$	(Eq. 2)
PD ≥ 30	$PPA_V = 40 - (1.4\ PD)$	(Eq. 3)

b. Intermediate and Base:

QUALITY	PPA	
PD < 30	$PPA_V = 1 - (0.1\ PD)$	(Eq. 4)
PD ≥ 30	$PPA_V = 40 - (1.4\ PD)$	(Eq. 5)

Compute the percent pay adjustment for voids for shoulders (other than newly constructed shoulders) 5 feet or more in width as follows:

c. Surface:

QUALITY	PPA	
PD < 10	$PPA_V = 4 - (0.4\ PD)$	(Eq. 6)
10 ≤ PD < 50	$PPA_V = 1 - (0.1\ PD)$	(Eq. 7)
PD ≥ 50	$PPA_V = 92 - (1.92\ PD)$	(Eq. 8)

d. Intermediate and Base:

QUALITY	PPA	
PD < 50	$PPA_V = 1 - (0.1\ PD)$	(Eq. 9)
PD ≥ 50	$PPA_V = 92 - (1.92\ PD)$	(Eq. 10)

Shoulders less than 5 feet in width are excluded from these requirements.

(5) Retest. If the initial series of N = 5 tests produces a percent defective value of PD ≥ 30 for mainline paving, or PD ≥ 50 for shoulders, the Contractor may elect to take an additional set of N = 5 drilled cores at new random locations, as designated by the Engineer. The additional cores shall be taken within 10 Working Days of receipt of the initial core results. If the additional cores are not taken within the 10 Working Days, the initial core results (N = 5) will be used to determine the percent pay adjustment. When the additional cores are taken, Steps 1 through 3 will be repeated using the combined data set of N = 10 test values to obtain the total PD estimate using Table 914 - 5, and Step 4 will be repeated to obtain the final lot percent pay adjustment using Equations 1 through 10 in Step 4, as appropriate.

(6) Removal and Replacement. If the final lot percent defective based on the combined set of N = 10 tests, or N = 5 if the Contractor fails to take additional cores, is equal to or greater than PD = 75, the Department will require removal and replacement of the lot at the Contractor's expense. When replacement is made, the replaced layers are subject to the same requirements as the initial construction.

(7) Outlier Provision. All cores will be examined for obvious physical damage at the Department Laboratory. Any core found to be damaged shall be replaced by taking an additional core within a two foot radius of the original location.

All acceptance cores will be screened for outliers using a statistically valid procedure. If an outlier is detected, that core shall be replaced by taking an additional core within a 2-foot radius of the original location. The following procedure applies only for a sample size of 5.

Step 1: Arrange the 5 core results in ascending order as follows, in which X1 represents the smallest value and X5 represents the largest value:

X1, X2, X3, X4, X5

Step 2: If X5 is the value suspected of being an outlier, compute:

R = (X5 - X4) / (X5 – X1)

If X1 is suspected of being an outlier, compute:

R = (X2 – X1) / (X5 – X1)

Step 3: If R ≥ 0.642, the value is judged to be statistically significant and the core is excluded.

406.13 Surface Course Rideability Requirements.{ XE "Superpave hot mix asphalt (HMA) courses:surface course rideability requirements" }

The Superpave HMA surface course will be tested with a rolling Straightedge that automatically marks, in colored dye, the length of surface variations, which exceed a tolerance of ⅛ inch in 10 feet.

Conformance to the surface tolerance for Superpave HMA will be determined in lots, each lot being as defined in Subsection 406.12, Air Voids Acceptance Plan.

The acceptance of a lot will be based on the percentage of the total length of the lot having surface variation exceeding ⅛ inch in 10 feet, this percent noncompliance being defined as the lot PD length. Lot PD length will be computed by adding the lengths, to the nearest foot, of individual surface defects exceeding the specified tolerance, dividing this sum by the total length tested, and multiplying by 100 to convert to percent.

The full extent of the lot will be tested in the longitudinal direction. The transverse location of the test will be in the wheelpaths of vehicle travel, defined as the two imaginary lines located approximately 3 feet on each side of the centerline of the lane and extending for the full length of the lane. In addition to the scheduled lot acceptance tests, any previously tested lot, which is damaged by construction operations, may be retested.

The rolling Straightedge will not be used immediately adjacent to or over manholes, utility openings, or similar structures, which, in the opinion of the Engineer, have a significant and unavoidable adverse impact on achievable smoothness.

Any required sweeping of the surface before acceptance testing shall be performed**.**

The percent pay adjustment shall apply for the locations specified in the Special Provisions for subparts A and B below:

A. Payment Reductions for New Construction, Reconstruction, or Dualization Projects. The surface requirements will apply to the surface layer only and will include mainline paving. Ramps and shoulders will be included in these requirements at the discretion of the Engineer**.**

All wheelpaths in all traveled lanes will be tested**.**

1. Permissible Surface Variations. The Superpave HMA surface course will be tested according to the following:

a. The Superpave HMA surface course placed in the traveled way at locations indicated in the Special Provisions shall be constructed so that when tested according to Subpart A.3 below, the measured length of lot exceeding ⅛ inch tolerance shall not exceed 1.3 percent.

b. The Superpave HMA surface course placed in areas other than those specified in the Special Provisions will be tested for acceptance according to Subpart A.4 below. The measured length of such areas exceeding the ⅛-inch tolerance shall not exceed 3.5 percent. The number, length, and location of Straightedge tests undertaken to determine conformity in such areas will be at the sole discretion of the Engineer.

2. Control Testing. Control testing during placement shall be conducted as may be necessary to ensure compliance with the specified surface requirement.

3. Rideability Acceptance Plan. Conformance to the surface tolerance for Superpave HMA placed at the locations specified in Subpart A.1 will be determined in lots, each lot being as defined in Subsection 406.12 Air Voids Acceptance Plan.

To be judged in conformance, the total PD shall not exceed 1.3 percent. Acceptance will be based on the total PD for the lot as follows:

QUALITY	PERCENT PAY ADJUSTMENT (PPA)	
PD < 2.0	$PPA_S = 2.0 – (1.5\ PD)$	(Eq. 11)
PD ≥ 2.0	$PPA_S = 135.0 – 68.0\ PD$	(Eq. 12)

Shoulders less than 5 feet in width are excluded from these requirements.

If the initial tests produce a PD ≥ 2.0, the Department may require an additional test of the entire lot. If this option is taken, the final acceptance will be based on the average of initial and final test results.

If the final lot percent defective length is greater than or equal to 3.5, the Department will require the removal and replacement of the lot at the Contractor's expense. When replacement is made, the replaced layers are subject to the same requirements as the initial construction.

4. **Other Testing.** The paving operation is acceptable if the percent defective length of the Superpave HMA surface course does not exceed 3.5. If the PD length exceeds 3.0, the Engineer may direct that paving operations be discontinued until mutually acceptable paving methods and/or equipment are used.

Additional compensation, extension of Contract time, or other concessions will not be granted because of revised methods or equipment necessary to produce an Superpave HMA surface in conformity with the specified surface requirements.

B. **Payment Reductions for Resurfacing or Widening Projects.** The surface requirements will apply to the surface layer only and will include Traveled Way paving. Ramps and shoulders will be included in these requirements at the discretion of the Engineer.

1. **Permissible Surface Variations.** The Superpave HMA surface course will be tested according to the following:
   a. The Superpave HMA surface course placed in the Traveled Way at locations indicated in the Special Provisions shall be constructed so that when tested according to Subpart B.3 below**,** the measured length of lot exceeding the ⅛ inch tolerance shall not exceed 3.5 percent.
   b. The Superpave HMA surface course placed in areas other than those specified in the Special Provisions will be tested for acceptance according to Subpart A.4 above. The measured length of such areas exceeding the ⅛ inch tolerance shall not exceed 3.5 percent. The number, length, and location of Straightedge tests undertaken to determine conformity in such areas will be at the sole discretion of the Engineer.
2. **Control Testing.** Control testing during placement shall be conducted as may be necessary to ensure compliance with the specified surface requirement.
3. **Rideability Acceptance Plan.** Any required sweeping of the surface before acceptance testing shall be performed.

Conformance to the surface tolerance for Superpave HMA placed at the locations specified in Subpart A.1 will be determined in lots, each lot being as defined in Subsection 406.12 Air Voids Acceptance Plan.

To be judged in conformance, the total percent defective length (PD) shall be less than 3.5 percent. When this limit is exceeded, acceptance will be based on the total percent defective length for the lot as follows:

QUALITY	PERCENT PAY ADJUSTMENT (PPA)
PD < 3.5	$PPA_S = 0$
PD ≥ 3.5	$PPA_S = -100$

If the initial tests produce a percent defective value of PD ≥ 3.5, the Department may require an additional test of the entire lot. If this option is taken, the final acceptance will be based on the average of initial and final test results.

If the final lot percent defective length is greater than or equal to 3.5, the Department will require the removal and replacement of the lot at the Contractor's expense. When replacement is made, the replaced layers are subject to the same requirements as the initial construction.

The Engineer may test the Superpave HMA surface course with a response-type ride meter before performing lot acceptance testing with the rolling Straightedge. If, in the opinion of the Engineer, such ride-meter tests indicate, to a substantial certainty, that the lot percent defective length does not exceed the acceptable value of 3.5, the lot will be deemed in compliance with surface requirements. If the Engineer judges the ride-meter tests to be inconclusive, the specified

schedule of rolling Straightedge tests will be performed and the lot acceptance decision grounded on those results.

The decision to undertake any optional testing with the ride meter, the specific conduct of the ride meter testing, and the interpretation of the results shall exclusively be the province of the Engineer.

If the lot percent defective length exceeds 3.0, the Engineer may direct that paving operations be discontinued until mutually acceptable paving methods and/or equipment are used.

Additional compensation, extension of time, or other concession will not be granted because of revised methods or equipment necessary to produce a Superpave HMA surface in conformity with the specified surface requirements.

C. No Payment Reductions.

1. **Permissible Surface Variations.** The Superpave HMA surface course will be tested with a rolling Straightedge that automatically marks, in colored dye, the length of surface variations, which exceed a tolerance of ⅛ inch in 10 feet.
2. **Control Testing.** Control testing during placement shall be conducted as may be necessary to ensure compliance with the specified surface requirement.
3. **Rideability Acceptance Plan.** The Superpave HMA surface course will be tested for acceptance according to Subpart A.4 above. The measured length exceeding the ⅛-inch tolerance shall not exceed 3.5 percent. The number, length, and location of Straightedge tests undertaken to determine conformity will be at the sole discretion of the Engineer.

   The percentage of surface variations in noncompliance is defined as the percent defective length which will be computed by adding the lengths, to the nearest foot, of individual surface defects exceeding the specified tolerance, dividing this sum by the total length tested, and multiplying by 100 to convert to percent.
4. **Base or Intermediate Course Acceptance Plan.** The base and/or intermediate courses may be tested as above at the discretion of the Engineer.

406.14 Thickness Requirements. { XE "Superpave hot mix asphalt (HMA) courses:thickness requirements" }

The thickness requirements shall apply only when each component Superpave HMA mixture in the pavement structure is specified to be of uniform thickness. Areas consisting of different Superpave HMA mixtures or thicknesses will not be included in the same lot. Lots for thickness requirements will be the same as lots defined under Subsection 406.12, Air Voids Acceptance Plan.

Conformance to thickness requirements will be judged from the full depth cores taken for surface air voids determinations, evaluated according to Section 990, NJDOT B-6. To be in compliance, no more than 10.0 percent of the lot area, as calculated from the test results, shall be less than the plan thickness.

Acceptance will be based on total thickness and thickness of the surface course. Evaluation of the surface course will be performed solely to determine whether a remove-and-replace or an overlay condition exists, not for pay adjustment. To be judged acceptable, no more than 30.0 percent of the surface course shall be of deficient thickness, as calculated by the procedure below.

Acceptance for total thickness will be based on the percentage of the lot estimated to fall below the specified thickness as follows:

(1) Compute the sample mean ($\overline{X}$) and the standard deviation (S) of the N Test Results (X1, X2,..., XN):

$$\overline{X} = \frac{X1 + X2 + ... + XN}{N}$$

$$S = [(X1 - \overline{X})^2 + (X2 - \overline{X})^2 + ... + (XN - \overline{X})^2 / (N-1)]^{½}$$

If for any reason the number of available test results is different from N = 5 for initial testing or N = 10 for retesting, tables for the appropriate sample size are to be used for Step 3.

(2) Compute Quality Index.

QL = ($\overline{X}$ – T_{des})/S, where "Q" is the quality index and T_{des} is the design thickness.

(3) Compute Percent Defective.

Using Table 914-5 for the appropriate sample size, determine the percentage of material (PD) falling below the design thickness associated with QL (lower limit).

(4) Compute the Pay Adjustment.

QUALITY	PPA	
PD < 30	$PPA_T = 1 - (0.1\ PD)$	(Eq. 13)
PD ≥ 30	$PPA_T = 40 - (1.4\ PD)$	(Eq. 14)

(5) Retest. If the initial series of N = 5 tests produces a percent defective value of PD ≥ 30, the Contractor may elect to take an additional set of N = 5 drilled cores at new random locations, as designated by the Engineer. The additional cores must be taken within 10 Working Days of the receipt of the initial core results. If the additional cores are not taken within the 10 Working Days, the initial core results (N = 5) will be used to determine the pay factor. When the additional cores are taken, Steps 1, 2, and 3 will be repeated using the combined data set of N = 10 test values to obtain the total PD estimate using Table 914-5, and Step 4 will be repeated to obtain the final lot percent pay adjustment using Equation 13 or Equation 14, as appropriate.

(6) Removal And Replacement. If the surface layer fails to meet the acceptance requirement, or if the lot percent defective based on the combined set of N = 10 tests, or N = 5 should the Contractor elect not to take additional cores, is equal to or greater than PD = 75, the Department will require removal and replacement of the lot, or milling and overlaying, at the Contractor's expense. When either replacement or milling and overlaying is done, the new layers are subject to the same requirements as the initial construction.

406.15 Combined Pay Adjustment.

The quantity of Superpave HMA for payment for each item will be adjusted according to the percent pay adjustment calculated for each lot.

A. Intermediate and Base:

The lot percent pay adjustment is the value computed under Subsection 406.12, 4(b) or 4(d).

$PPA_{LOT\ (Intermediate,\ Base)} = PPA_V$

B. Surface:

Provided that no individual percent pay adjustment is -100, the overall lot percent pay adjustment (PPA_{LOT}) is computed as the average of the individual percent pay adjustments as follows:

$$PPA_{LOT\ (Surface)} = \frac{(PPA_V + PPA_T + PPA_S)}{3}$$

where

PPA_V = percent pay adjustment computed for air voids content
PPA_S = percent pay adjustment computed for surface course rideablity
PPA_T = percent pay adjustment computed for total pavement thickness

If the percent pay adjustment for any individual characteristic is -100, then the overall percent pay adjustment for the lot will also be set equal to -100. When not all three characteristics apply to a particular lot, the divisor of the overall lot pay equation will be modified accordingly.

406.16 Core Samples.{ XE "Superpave hot mix asphalt (HMA) courses:core samples" }

Core samples shall be according to Subsection 404.23.

406.17 Opening to Traffic.{ XE "Superpave hot mix asphalt (HMA) courses:openting to traffic" }

{ XE "Opening to traffic:superpave HMA surface course" **}**The pavement shall be opened to traffic according to Subsection 404.24.

COMPENSATION

406.18 Method Of Measurement.

Superpave HMA will be measured by the ton excluding wasted material and according to Subsection 404.25 and the following:

When nominal maximum aggregate size ⅜-inch HMA surface course is directed for use in transition (run out) areas, the weight will be included with the weight for superpave hot mix asphalt ___ ___ ___ surface course.

406.19 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SUPERPAVE HOT MIX ASPHALT ___ ___ ___ SURFACE COURSE	TON
SUPERPAVE HOT MIX ASPHALT ___ ___ ___ INTERMEDIATE COURSE	TON
SUPERPAVE HOT MIX ASPHALT ___ ___ ___ BASE COURSE	TON

Payment reductions due to non-conformance to air voids, thickness and rideability requirements will be made according to Subsection 406.15.

Separate payment will not be made for Test Strips and Quality Control for Compaction, including comparison cores and nuclear density testing. All costs thereof shall be included in the prices bid for the Superpave Hot Mix Asphalt Pay Items.

DIVISION 500 CONTENTS

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DIVISION 500 - BRIDGES AND STRUCTURES{ XE "STRUCTURES:BRIDGES" }

SECTION 501 - CONCRETE STRUCTURES{ XE "CONCRETE STRUCTURES" }{ XE "STRUCTURES:CONCRETE" }

501.01 Description.

This work shall consist of the construction of portland cement concrete bridges, viaducts, trestles, culverts, headwalls, retaining walls, abutments, piers, and deck slabs of steel and concrete except those included in other Sections. Corrosion inhibitor admixtures, as stated in Subsection 905.02, may be used in furnishing concrete structures.

This work shall also consist of the furnishing of all materials and labor that is necessary for the removal and disposal of all loose and disintegrated substructure concrete, preparation of the surface, and placement of repair materials for the Pay Item "Pressure Injection, Concrete Cracks."

This work shall also consist of manufacturing, furnishing, and erecting of precast reinforced concrete box culverts. Precast reinforced concrete box culverts shall not be used where the top slab will be used as a riding surface.

The use of precast concrete end sections, including headwalls, upon approval, is permitted. However, precast end sections shall not be used when the skew angle requires that the smallest side of the precast segment is less than 3 feet. In such cases, cast-in-place end sections shall be provided. Adequate provisions shall be made for cast-in-place appurtenances, such as end sections, headwalls, wingwalls, aprons, and cut-off walls. Such provisions shall include proper transition of the precast unit section into the cast-in-place appurtenance section. If the sections do not align, both the cast in place appurtenance and precast unit section shall be redesigned and properly detailed.

Unless otherwise stated, all provisions of Sections 501, 502, and 914 shall apply in the furnishing of precast concrete culverts.

Materials and methods of construction that are used in the furnishing of precast concrete structures and not specifically covered on the Plans and in these Specifications shall conform to the current AASHTO LRFD Bridge Design Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Division II of the current AASHTO Standard Specifications for Highway Bridges. Instead of the applicable AASHTO Specifications, the current ACI Manual of Concrete Practice and the current PCI Precast Prestressed Bridge Design Manual shall be adhered to.

Deck slabs shall be constructed according to the provisions of Subsection 501.12 Subpart 5. Deck slabs that are constructed in two courses shall have the first course constructed of portland cement concrete and the second course of a concrete deck overlay protective system as specified in Subsection 518.06.

As specified in Subheading 19 of Subsection 501.12, the Contractor may construct "Concrete in Superstructure, Deck Slabs with Corrosion Inhibitor Admixture" as a full-depth deck slab. The full-depth deck slab shall be constructed to the same minimum thickness that is required for the two course deck slab construction.

The Contractor has the option of constructing "Concrete in Superstructure, Parapets" by using the slip-forming method of construction. For bridges where a concrete deck overlay protective system is specified for the second course, the overlay shall be placed only after the construction of the parapets by the slip-forming method.

Materials and methods of construction not specifically covered on the Plans and these Specifications shall conform, as applicable, to the current AASHTO Standard Specifications for Highway Bridges or the current AASHTO LRFD Bridge Design or Bridge Construction Specifications.

{ XE "CONCRETE STRUCTURES:CONCRETE:MATERIALS" }MATERIALS

501.02 Materials.

Portland cement concrete, mortar, and grout shall conform to Section 914. Paints and coatings shall conform to Section 912. Other materials shall conform to the following Subsections:

Grit	901.15
Air-Entraining Admixtures	905.01
Corrosion Inhibitor Admixtures	905.02
Chemical Admixtures	905.02
Curing Materials	905.03
Preformed Expansion Joint Filler	908.01
Joint Sealer	908.02
Preformed Elastomeric Joint Sealer	908.03
Reinforced Elastomeric Expansion Dam	908.04

The pressure injected epoxy shall be capable of penetrating the cracks to their full depth and capable of bonding to the surfaces of cracked concrete.

Certificates of compliance shall be furnished according to Subsection 106.04 that the epoxy resin system used for the sealing of concrete cracks meets applicable requirements of Subsection 919.12. A list of epoxy resin products will be provided in the Special Provisions.

Concrete for precast concrete culverts, according to Section 914, shall be Class P concrete. However, coarse aggregate for such concrete shall be washed gravel or broken stone of argillite, granite, gneiss, quartzite, or trap rock conforming to the requirements of Section 901, and shall also be graded as specified for size No. 57 or 67.

Reinforcement steel for precast concrete culverts shall conform to ASTM A 615, Grade 60. Welded deformed steel wire fabric conforming to AASHTO M 221 and having a diameter of at least ⅜ inch may be substituted for deformed bars. Welded wire fabric shall not be shipped in rolls but shall be shipped in mats. Longitudinal ties used to tie the precast units together shall be ¾-inch diameter high-tensile strength steel bars conforming to AASHTO M 275 or ½-inch, Grade 270 polystrands conforming to AASHTO M 203. No splices will be allowed in the ½-inch diameter polystrands, if used. Bars shall be galvanized according to AASHTO M 111. End anchorages (nuts, washers, and anchor plates) to be used with high-tensile strength steel bars shall be approved by the Engineer. End anchorages shall be compatible with the tie rod system and shall be galvanized according to AASHTO M 111. When corrosion protection of the longitudinal ties is specified, the ¾-inch diameter high-tensile strength steel bar shall be used. Anchorages and end fittings for the ½-inch diameter polystrands and the corrosion protection method for the end fittings shall be approved by the Engineer.

Aggregate for the precast concrete culvert coarse aggregate bed shall conform to Subsection 901.03 and shall be size No. 57.

501.03 Chemical Admixtures.{ XE "Concrete structures:concrete:materials:admixtures" }

In the event that the scheduled concrete placement date may produce ambient conditions where it is desirable to control the concrete reactionary properties, or control of the concrete reactionary properties is otherwise warranted, the Contractor may add chemical admixtures, subject to the approval of the Engineer, as an integral part of the design mix for structural concrete members. The use of the chemical admixtures shall conform to the requirements of Subsection 905.02. Additionally, chemical admixtures shall be used according to the manufacturer's product specifications. According to the requirements of Subpart B of Subsection 914.02, to facilitate verification of the concrete mix, mix designs that incorporate the chemical admixture shall be submitted for approval. The admixture quantity used shall be a dosage rate according to the manufacturer's product specifications.

EQUIPMENT

501.04 Equipment.

Equipment shall comply with the requirements of Subsection 405.03.

Equipment for the second course deck slab construction shall comply with the requirements of Subsection 518.03, Subpart A.

Some equipment used for slip-forming concrete parapets may be subject to license fees under United States Patents Nos. 3957405 and 4014633, held by A.C. Aukerman Company. Should the Contractor provide for such use of this equipment, it shall execute a legal agreement according to Subsection 107.06, if applicable.

The slip-forming (extrusion) machine shall have the ability to place the approved concrete mix design through a mold of proper cross-section to produce concrete of the specified shape, surface texture, and density.

The slip-forming machine shall consolidate the freshly placed concrete in one complete pass of the machine. Sufficient internal vibrators shall be provided for consolidating the concrete along the faces of forms and adjacent to joints in such a manner that a dense and homogenous parapet, free from voids and honeycombs, is produced.

The equipment, methods, and processes proposed to be used in the construction of the slip-formed concrete parapet shall be submitted to the Engineer for approval before use. The Contractor shall furnish evidence of successful history and operation of the slip-form (extrusion) machine or other equipment. Without such prior evidence, a demonstration section at the job site shall be constructed, having a minimum length of 100 feet, to verify that the proposed equipment, material, and methods are capable of producing concrete parapets that meet these Specifications.

Equipment used in injecting epoxy resin adhesive into concrete cracks shall be a positive placement fixed ratio type pump. It shall be capable of automatically mixing two components at the nozzle and be equipped with a rubber nozzle arrangement that will allow injection of adhesive at pressures of up to 300 pounds per square inch to ensure complete penetration of cracks. The machine shall be equipped with a pressure gauge at or near the nozzle to check the working pressure.

CONSTRUCTION

501.05 Working Drawings.

Working drawings shall be furnished according to Subsection 105.04.

Before fabrication of precast concrete culverts, the Contractor shall submit complete working drawings and erection plans according to Subsection 105.04.

Working drawings for precast concrete culverts shall show the plan, elevation, and sections of the box units as well as details for all appurtenances such as headwalls, cutoff walls, wingwalls, and aprons. In addition, working drawings shall show details of the neoprene gasket between the precast units as well as all threaded inserts, bar extensions, waterproofing, and end anchorage details for the longitudinal ties.

Erection details for precast concrete culverts shall be complete in every detail including handling point, neoprene gasket details, and the method for pulling the boxes together.

501.06 Falsework.{ XE "Concrete structures:falsework" }

Falsework used to support the forms and concrete shall be supported on sills resting on foundation of sufficient strength to carry the loads without appreciable settlement. Falsework that cannot be founded on solid footings must be supported by falsework piling.

Where the superstructure of the bridge is designed on the assumption of composite action (shear connector design) of the concrete deck slab and stringers under live load and impact, shoring shall not be used to support the stringers at any point in the span length.

Sufficient camber shall be provided in the falsework and forms of each span to allow for the tightening of joints in the forms and supporting falsework.

501.07 Forms.{ XE "Concrete structures:forms" }

Forms shall be mortartight and sufficiently rigid to prevent distortion due to the pressure of the concrete and other stresses incident to the construction operations, including vibration. Forms shall be so constructed and maintained to prevent the opening of joints due to shrinkage of the lumber.

The forms shall be built true to line and grade and shall be held in place by means of studs or uprights and waling, which shall be braced.

All edges shall be chamfered with ½-inch material. All chamfer strips shall be straight, of uniform width, and dressed. Forms shall be given a bevel or draft in the case of all projections to ensure easy removal.

Wood devices of any kind used to separate forms shall be removed before placing the concrete.

Detailed plans for falsework or centering shall be furnished on request. Jacks, wedges, or other devices shall be used to maintain the forms at correct elevation and to permit lowering the centers gradually and uniformly without injury to the structure.

A telltale or other type of indicator shall be attached to the forms and arranged in such a manner that any settlement or movement in the forms or falsework is indicated.

Forms shall conform to the following:

1. **Form Lumber.** Form lumber for all exposed concrete surfaces shall be dressed at least on one side and two edges, and shall be so constructed as to produce mortartight joints and smooth, even concrete surfaces.

   Plywood forms, or forms face lined with plywood, masonite, plastic coating, or other similar material may be used, provided the plywood forms and form linings are of uniform thickness and are mortartight when in position.

2. **Metal Ties.** Metal ties or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least 1 inch from the face without injury to the concrete. In case wire ties are used, cones shall be provided. The cavities shall be filled entirely with mortar and the surface left sound, smooth, even, and uniform in color.

3. **Form Coating.** Before placing reinforcement, all forms shall be treated to prevent the adherence of concrete. Material that adheres to or discolors the concrete shall not be used. For concrete exposed to sea water, the forms shall be heavily coated with shellac or oil.

4. **Metal Forms.** The requirements for forms regarding design, mortartightness, filleted corners, beveled projection, bracing, alignment, removal, reuse, and oiling shall apply to metal forms. The metal used for forms shall be of such thickness that the forms remain true to shape. All bolt and rivet heads shall be countersunk on the face forming the concrete surface. Clamps, pins, or other connecting devices shall be designed to hold the forms rigidly together and allow removal without injury to the concrete. Metal forms which do not present a smooth surface or do not line up shall not be used. Forms shall be free from rust, grease, or other foreign matter.

5. **Fiber Tubes.** Column forms of manufactured fiber tubes will be permitted as forms for round columns of concrete. Column forms shall be rigid and truly circular in section. They shall have a hard, smooth surface on the side in contact with the concrete to produce a satisfactory surface without rubbing. Forms containing asbestos shall not be used.

   Fiber tube column forms shall be erected promptly after delivery. If storage is necessary, the tubes shall be supported not less than 3 feet above the ground for their entire length. Minimum protection shall consist of a tarpaulin which covers the ends of the tubes at all times.

   Column forms shall be erected and held in a vertical position in a manner which prevents distortion of the circular section during placement of concrete.

6. **Reuse of Forms.** The shape, strength, rigidity, mortartightness, and surface smoothness of reused forms shall be maintained at all times. Any warped or bulged lumber shall be resized before being used.

7. **Permanent Steel Bridge Deck Forms.** When permanent steel bridge deck forms are subcontracted, the subcontract shall be according to Subsection 108.02 except that the value of the subcontract is to be based on the value of the work for furnishing and installing the forms.

   The use of permanent steel bridge deck forms shall be governed by the Special Provisions and shall conform to the following:

   a. **Design.** The steel forms shall be designed on the basis of dead load of form, reinforcement, and plastic concrete, plus 50 pounds per square foot for construction loads. The unit working stress in the steel sheet shall be not more than 0.725 of the specified minimum yield strength of the material furnished, but shall not exceed 36,000 pounds per square inch.

      Deflection under the weight of the forms, the plastic concrete, and reinforcement shall not exceed 1/180 of the form span or ½ inch, whichever is less, but in no case shall this loading be less than 120 pounds per square foot total.

      The permissible form camber shall be based on the actual dead load condition. Camber shall not be used to compensate for deflection in excess of the foregoing limits.

      The design span of the form sheets shall be the clear span of form plus 2 inches measured parallel to the form flutes.

      Physical design properties shall be computed according to the AISI Specification for the Design of Cold Formed Steel Structural Members (SG-671).

      The dimensions of both layers of primary deck reinforcement from the top surface of the concrete deck shall be maintained.

      The spacing (pitch) of the ribs (flutes) shall match the spacing of the bottom main reinforcement steel, except on curved girder structures and in the areas of bridge decks with a flared rebar pattern. In these locations, the pitch of the flutes may be independent of the bottom main reinforcement spacing, and the forms may be dropped as necessary to achieve the

minimum 1 inch concrete cover between the main reinforcement steel and the form. Approval from the Engineer to drop the forms shall be obtained before construction of the deck begins.

The forms shall not be considered as lateral bracing for compression flanges of supporting structural members.

The forms shall not be used in panels where longitudinal deck construction joints are located between stringers nor shall they be used for the slab outside the fascia stringers.

Welding will not be permitted to flanges in tension or structural steel bridge elements fabricated from non-weldable grades of steel.

Fabricator's working and erection drawings for the forms, together with Deck Reinforcement Placement Drawings, shall be submitted according to Subsection 105.04. These plans shall indicate the grade of steel, galvanizing specification, the physical and section properties for all permanent steel bridge deck form sheets, and a clear indication of locations where the forms are supported by steel flanges subject to tensile stresses.

Vertical legs of form supports shall be cut at or below the theoretical bottom of deck slab to maintain required concrete cover of reinforcement steel at all locations.

b. Construction. All forms shall be installed according to fabrication and erection plans.

Form sheets shall not be permitted to rest directly on the top of the stringer or floor beam flanges. Sheets shall be securely fastened to form supports and shall have a minimum bearing length of 1 inch at each end. Form supports shall be placed in direct contact with the flange of stringer or floor beam. All attachments shall be made by permissible welds, bolts, or clips. However, welding of form supports to flanges of steels not considered weldable and to portions of flange subject to tensile stresses will not be permitted. Welding and welds shall be according to the ANSI/AASHTO/AWS D1.5 Bridge Welding Code pertaining to fillet welds, except that ⅛-inch fillet welds will be permitted.

Any permanently exposed form metal whose galvanized coating has been damaged shall be repaired as specified in Subsection 503.14.

Transverse construction joints shall be located at the bottom of a flute and ¼-inch diameter weep holes shall be field drilled at not less than 12 inches on center along the line of the joints.

Bottom main reinforcement steel shall be placed at the center of each rib to provide maximum concrete cover. For curved girder structures and bridge decks with a flared rebar pattern, the main reinforcement may be independent of the rib spacing and the forms dropped accordingly.

{ XE "Concrete structures:placing concrete" **}c. Placing of Concrete.** Emphasis should be placed on vibration of the concrete to avoid honeycombing and voids, especially at construction joints, expansion joints and valleys, and ends of form sheets. Calcium chloride or any other admixture containing chloride salts shall not be used in the concrete.

d. Inspection. The method of construction will be observed during all phases of the construction of the bridge deck slab. These phases include installation of the metal forms, location and fastening of the reinforcement, composition of concrete items, mixing procedures, concrete placement and vibration, and finishing of the bridge deck.

Should the Resident Engineer determine the procedures used during the placement of the concrete warrant inspection of the underside of the deck, at least one form panel shall be removed for each span at the location and time selected. This should be done as soon as practicable after placing the concrete to provide visual evidence that the concrete mix and the procedures are obtaining the desired results. An additional section shall be removed if it is determined that there has been any change in the concrete mix or in the procedures which warrants additional inspection.

After the deck concrete has been in place for a period of two days minimum, the concrete shall be tested for soundness and bonding of the forms by sounding with a hammer. If areas of doubtful soundness are disclosed by this procedure, the forms shall be removed, according to Subsection 501.13 and at no cost to the State, from such areas for visual inspection after the concrete has attained specified strength.

At locations where sections of the forms are removed, it is not necessary to replace the forms, but the adjacent metal forms and supports shall be repaired to present a neat appearance and ensure their retention. As soon as the form is removed, the concrete surfaces will be examined for cavities, honeycombing and other defects. If irregularities are found, and it is determined that these irregularities do not justify rejection of the work, the concrete shall be repaired as directed and shall be given a Class 1 finish conforming to Subsection 501.14. If the

concrete where the form is removed is unsatisfactory, additional forms shall be removed to inspect and repair the slab, and the methods of construction shall be modified to obtain satisfactory concrete in the slab. All unsatisfactory concrete shall be removed or repaired.

The amount of sounding and form removal may be moderated, at the Resident Engineer's discretion, after a substantial amount of slab has been constructed and inspected, if the methods of construction and the results of the inspection indicate that sound concrete is being obtained throughout the slabs.

All facilities that are required for the safe and convenient conduct of the Resident Engineer's inspection procedures shall be provided.

e. Quantities. Additional reinforcement steel required for the permanent steel forms shall be provided without additional compensation.

501.08 Reinforcement Steel.{ XE "Concrete structures:reinforcement steel" }

A. Order Lists. Before ordering material, working drawings, order lists, and bending diagrams shall be submitted according to Subsection 105.04.

B. Protection of Materials. Reinforcing steel shall be protected at all times from damage and shall be stored above ground level. When placed in the work, reinforcing steel shall be free of dirt, detrimental scale, paint, oil, or other foreign substances.

All exposed reinforcing steel at construction joints except galvanized or epoxy-coated reinforcement shall be protected with a brush coat of neat cement, mixed with water to a consistency of thick paint, within one week after the placing of the initial concrete, unless it is known that the steel is to be embedded within 30 days. Loose coating shall be removed by lightly tapping with a hammer or other tool, not more than one week before the placing of the concrete.

Epoxy-coated reinforcement bars which are cut in the field shall be either sawed or sheared but shall not be flame cut. When epoxy-coated reinforcing steel bars are cut in the field, the ends of the bars shall be coated with the same material used for repair of coating damage. Repair of epoxy coating due to damage from fabrication, shipping, handling, minor adjustments, and installation shall be according to AASHTO M 284.

Galvanized bars shall not be bent in the field more than ten degrees, regardless of the diameter of the bend. Otherwise, when zinc coated (galvanized) reinforcing steel bars are cut or bent in the field, the sheared ends or damaged areas shall be repaired according to the requirements of ASTM A 780. If a zinc rich paint system is used to perform such repairs, the requirements of Subsection 503.15, for cleaning and painting with inorganic paint systems, shall be followed.

C. Bending. Field bending of bars will be permitted according to Subsection 915.01, Subpart A. Tolerances for field bent bars shall conform to Subsection 915.01, Subpart G. Minor adjustments of Grade 420 bars, including those partially embedded in concrete, shall be by the heat method. Such bending shall be accomplished by preheating the bar to between 1,000 and 1,200 ºF, and then bending as gently and in as gradual an arc as possible. For bars partially embedded in concrete, heating must be performed in such a manner that there is no damage to the concrete. If the bend area is within 9 inches of the concrete, protective insulation shall be used.

Arrangements shall be made for the portable motive-power bending machine manufacturer's technical representative to be on the site for the first two days of production bending, to ensure that the machine is used properly and is of adequate capacity for the Project.

D. Placing and Fastening. All reinforcing steel shall be accurately placed and, during the placing of concrete, firmly held by supports. Bars shall be tied at all intersections except where spacing is less than 12 inches in each direction, in which case alternate intersections shall be tied. Distance from the forms shall be maintained by means of stays, blocks, ties, hangers, or chairs. Blocks for holding reinforcement from contact with forms shall be precast mortar blocks. Blocks shall not be used where they are exposed to view in a finished surface. Bar support chairs shall be plastic, plastic-coated metal, or epoxy-coated metal. Bar chairs, blocks, ties, hangers or stays shall be capable of supporting and maintaining the reinforcement steel in position during placement of concrete. Tie wires shall be plastic-coated or epoxy-coated. The coating of the wire ties shall not crack when the wire ties are twisted or tied to the epoxy-coated reinforcing steel. Reinforcement in any member shall be inspected and approved before any concrete is placed. Welding to reinforcing steel shall be approved. A written welding procedure shall be submitted for approval. The welding procedure shall conform to ANSI/AWS D1.4 Structural Welding Code - Reinforcing Steel.

Reinforcement steel shall be placed within the following tolerances:

	Tolerance
1. Clear concrete protection and for depth "d" (see Note) in flexural members, walls and compression members:	
a. where "d" is greater than 8 inches and less than 24 inches.	± ⅜ inch but cover shall not be reduced by more than ten percent of the specified cover.
b. where "d" is greater than or equal to 24 inches.	± ½ inch but cover shall not be reduced by more than ten percent of the specified cover.
Note: "d" equals specified effective design depth.	
2. Longitudinal location of bends and ends of bars.	± 2 inches except at discontinuous ends of members, the tolerance shall be ± ½ inch.
3. Bar spacing, except where inserts etc. might require some shifting of bars, where spacing is:	
a. equal to or less than 12 inches.	± ⅜ inch
b. greater than 12 inches.	± ½ inch
4. Deck slabs, cover for	+ ¼ inch, - ⅛ inch reinforcement.

When zinc coated (galvanized) reinforcing steel bars are to be used, all miscellaneous hardware including tie wires, nuts, bolts, washers, and other devices, used to support, position, or fasten the reinforcement shall also be galvanized. The specific hardware that the Contractor proposes to use shall be approved by the Engineer. The hardware shall be prepared and galvanized according to the requirements of AASHTO M 232.

Mechanical connectors used for galvanized bar reinforcement shall be galvanized according to the requirements of AASHTO M 232, before installation.

Mechanical connections of all types of coated reinforcing bars shall be made with proprietary mechanical connection devices in a similar way as for uncoated bars. To properly install coupling sleeves on coated bars, the coating shall be completely removed from the ends of the bars over the length of the sleeve and a short distance, minimum 2 inches or, as directed by the Supplier, beyond the ends of the sleeve.

After installation of mechanical connections on coated reinforcing bars, the sleeves and any damaged coating on the bars adjacent to the sleeve shall be touched up with an appropriate compatible patching material with anticorrosive quality equal to that of the original coating.

E. Splices. All reinforcement shall be furnished in the full lengths. Splicing of bars, except where prescribed, will not be permitted without written approval. Splices shall be of the lap type wired together to prevent displacement during placement of the concrete.

Upon approval, mechanical coupling devices may be used on stage construction projects or on repair/rehabilitation projects when adequate clearance for lap splices is not available. The coupling devices shall be protected from corrosion by either galvanizing or epoxy coating. Any coating which is damaged shall be repaired. Repair of epoxy coating shall conform with AASHTO M 284. Repair of zinc coating shall conform with Subsection 503.14. The mechanical coupling device shall develop a minimum of 125 percent of the specified yield strength of the reinforcement steel. Certification of compliance shall be furnished, according to Subsection 106.04, that the coupling devices meet the minimum specified strength.

F. Galvanized Fabric Reinforcement. Mesh sheets shall be overlapped not less than one mesh in width. Overlaps shall be fastened securely at the ends and edges.

G. Slip-Form Method of Construction for Bridge Parapets. All parapet joint locations shall be accurately located and reinforcement steel placed, so that after the joint is saw cut the reinforcement steel will have the minimum concrete clear cover, as shown on the Plans, with applicable tolerances conforming to Subpart D of this Subsection.

A support system shall be designed and constructed by the Contractor capable of restraining the reinforcement cage during slip-forming, so that unacceptable displacements will not occur. The detailing of the parapet reinforcement cage, as shown on the Plans or on the approved Working Drawings, shall not be modified by the Contractor, unless approved.

H. Galvanized Reinforcement Bars. When zinc coated (galvanized) reinforcing steel bars are used, the reinforcement bar shall be Class 1 galvanized after fabrication. According to ASTM A 767, the average coating weight of a minimum of three tests shall be 2 ounces per square foot.

Before galvanizing, the material shall have all grease, dirt, mortar, mill scale, injurious rust, or any other foreign substance removed.

For the purpose of this Subsection, the term "injurious rust" shall be interpreted to mean rust that is not firmly bonded to the steel. Rust that is difficult to remove, even by vigorous scrubbing with a wire brush, shall be considered firmly bonded to the steel.

The galvanized threads of nuts and mechanical connectors that are to be used with galvanized bolts and reinforcement shall be tapped oversize before coating. They shall not be retapped after coating. The minimum additional diameter for Class 2A threads galvanized to Class C shall be as specified in ASTM A 563.

Material galvanized according to this Subsection shall be free from any buildup of unadhered wet storage stains (white rust). These corrosion deposits, if present, shall be removed in a manner satisfactory to the Engineer before use of the material in the work. After removal of these deposits, the coating shall have a uniform appearance free from uncoated spots, lumps, blisters, gritty areas, acid flux, and black spots. Materials with these defects, or not meeting the finish and adherence of coating requirements as defined in the ASTM A 767 specification, will be rejected and shall be immediately removed from the work site. Acceptable material shall be provided to replace rejected material at no additional cost.

To ensure proper conductivity of the galvanized material in the construction of concrete deck slabs, both the top and bottom mat layers shall be composed of galvanized bars. Also, the requirements of Subpart D. above, concerning miscellaneous hardware, shall be adhered to.

The Contractor shall be required to field repair any damage to the galvanized coating that occurs during the shipping and handling of the galvanized material. Bars exhibiting severely damaged coatings shall be replaced. Repairable damage is defined as any bare or loose spots, or breaks in the coating, that affect an area smaller than 4 square inches.

Field repair will be allowed only when the total number of repairable damaged areas in any 10-foot length of bar is less than six. Any material with a total number of damaged areas greater than this amount or material with any damaged area greater than 4 square inches will be rejected.

The galvanized coating shall be repaired according to the requirements of Subpart D Subsection 503.15. As specified therein, the selected paint system shall be sprayed or brush applied. A minimum dry film thickness or 4 mils shall be achieved.

I. Epoxy-Coated Reinforcement Bars – Furnishing, Storage and Placement. Furnishing epoxy-coated reinforcement bars shall conform to the provisions of Subsection 915.01. Epoxy coating application plants shall be certified under the CRSI Fusion Bonded Epoxy Coating Application Plant Certification Program. In the handling, storage, identification, and placing of epoxy-coated reinforcement, the following guidance shall be followed:

1. **Handling.** When unloading epoxy-coated reinforcing bars from a truck, care shall be exercised to minimize scraping of the bundles and bar-to-bar abrasion from sags in the bundles. Do not skid the bundles of bars from the truck bed to the ground ("bar off"). Use power-hoisting equipment for unloading and handling the bundles. Equipment for handling the bars should have protected contact areas. Nylon slings or padded wire rope slings shall be used. Bundles of coated bars shall be lifted at multiple pick points. Hoisting with a spreader beam or similar device is an effective method of preventing sags in bundles of coated bars.
2. **Short-term Storage.** Epoxy-coated bars shall be stored on timbers or other suitable protective cribbing. They shall be stored as close as possible to the area where they will be placed in the structure to keep handling operations to a minimum. Coated bars or bundles of coated bars shall not be dropped or dragged.

3. **Long-term Storage.** Long-term storage of epoxy-coated reinforcing bars at the job site, such as from one construction season to the next, is not recommended. Deliveries of coated bars to the job site shall be scheduled and coordinated with the placing of the bars in the structure to avoid any need for long-term storage. If circumstances or other conditions make it necessary to store coated bars outdoors for an extended period of time, then the bars shall be protected from the direct rays of sunlight and sheltered from the weather. The following storage practices are suggested to prevent deterioration of the coating.
    a. Store the bars above the ground on timbers or other suitable protective cribbing, and space the dunnage close enough to prevent sags in the bundles.
    b. If a relatively large quantity of bars has to be stored in a small area, bundles of straight bars should be stacked with adequate blocking placed between the layers of bundles.
    c. Cover the bars or bundles with opaque polyethylene sheeting or other suitable protective material. For stacked bundles, drape the protective covering over the sides of the bundles around the perimeter of the stack. Secure the covering adequately, and make provisions for adequate air circulation around the bars to prevent condensation under the polyethylene sheeting.
4. **Identification.** To maintain and assure identification of the stored bars, non-metallic tags on the bundles shall be protected, or consideration shall be given to attaching additional back-up galvanized metal tags on all bundles of bars.
5. **Placing.** In general, placing of epoxy-coated reinforcing bars shall be done in the same way as for uncoated bars. The key exception is that coated bars require more careful handling and placing. The same hoisting and handling methods and precautions as discussed above for unloading coated bars from a truck shall be used and followed during all placing operations.

    Once bundles of coated bars have been broken, dragging one bar over another or over any abrasive surface shall not be permitted.

501.09 Handling, Measuring, and Batching Materials.{ XE "Concrete structures:concrete:materials:handling, measuring, and batching" }

Handling, measuring, and batching materials shall conform to Subsection 405.07.

Different brands of cement or the same brand of cement from different mills shall not be used in any structure unless authorized in writing. Only those cements which can produce similar color in the concrete of any structure will be authorized.

501.10 Mixing Concrete.

Mixing of the concrete shall conform to Subsection 405.08.

501.11 Limitations of Placing.{ XE "Concrete structures:limitations of placing" }

At least 30 days before the placement of concrete, a plan of action shall be submitted for approval for the placement of concrete during hot and cold weather conditions as defined herein. In no case, during mixing and placement, shall the temperature of the concrete be less than 50 or more than 90 ºF. When the ambient temperature reaches 75 ºF, the provisions of hot weather concreting, as specified in Subheading 2 of the second paragraph of this Subsection, shall apply. When the temperature of the plastic concrete reaches 85 ºF, immediate steps shall be taken to cool either the mixing water or the aggregates, or both, according to the plan of action. In no case shall concrete be placed when its temperature in the plastic state at the completion of mixing exceeds 90 ºF.

Cold and hot weather concreting shall be according to the following:

{ XE "Concrete structures:limitations of placing:cold weather concreting" **}1. Cold Weather Concreting.** When the Engineer determines that cold weather conditions exist, as defined in Subsection 101.03, measures shall be provided by the Contractor to maintain the concrete temperature between 40 and 80 ºF.

According to Subsection 101.03, cold weather conditions shall be determined by review of forecasted temperatures.

{ XE "Concrete structures:limitations of placing:hot weather concreting" **}2. Hot Weather Concreting.** When the ambient temperature reaches 75 ºF, one or more of the following precautions shall be followed:

a. Schedule work so that concrete can be placed with the least possible delay and, if necessary, start placing during late afternoon, at night or early morning.

b. Use a water-reducing admixture or a water-reducing and retarding admixture according to Subsection 501.03 and the manufacturer's recommendation. When more than one admixture is used, they shall be from the same manufacturer.
c. Sprinkle the coarse aggregate stockpile to cool it by evaporation.
d. Use chilled mixing water or shaved ice to replace part of the mixing water as recommended in ACI 305R, Subpart 2.3.6.
e. In the case of truck mixing, do not rotate the drum during and after the addition of cement to the mix until mixing water is added at the construction site. This may require reduced loads or the utilization of horizontal type mixers.
f. Prevent absorption by sprinkling the underlying material and the wood forms just before placing so that they do not absorb water from the mix.
g. Erect windbreaks to prevent winds from drying exposed concrete surfaces while they are being finished.
h. Screed and float concrete as it is placed and start curing immediately.

501.12 Placing Concrete.{ XE "Concrete structures:placing concrete" }

Concrete shall not be placed until forms and all reinforcing steel have been placed, inspected and approved. The forms shall be clean of all debris immediately before placing concrete, and surfaces not oil treated shall be wetted. Concrete shall be placed so that segregation does not occur and there is no displacement of reinforcement. Concrete shall be placed in the forms as nearly as practical in its final position to avoid rehandling, and a horizontal surface of the plastic concrete shall be maintained. After initial set of the concrete, forms shall not be jarred and no strain shall be placed on the ends of projecting reinforcement. Concrete shall not be placed until all laitance that may have formed on concrete previously placed or until any loose, deleterious material on reinforcing bars has been removed.

The external surface of all concrete shall be worked during the placing so as to force all coarse aggregate from the surface and to bring mortar against the forms to produce a smooth finish substantially free from water and air pockets or honeycombs.

Concrete placement shall conform to the following:

{ XE "Concrete structures:placing concrete:chutes and troughs" **}1. Chutes and Troughs.** Concrete shall not be dumped or dropped for a distance greater than 5 feet, unless confined by closed chutes or pipes.

All chutes, troughs, and pipes shall be kept clean and free from coatings of hardened concrete by flushing with water after each run. The water used for flushing shall be discharged outside of the forms and clear of the concrete already in place.

{ XE "Concrete structures:placing concrete:vibrating" **}2. Vibrating.** The concrete shall be compacted with mechanical vibrators operating within the concrete. When required, vibrating shall be supplemented by hand spading to ensure proper and adequate compaction.

Vibrators shall be so manipulated as to work the concrete around the reinforcement and embedded fixtures and into corners and angles of the forms.

Vibrators shall not be used as a means to cause concrete to flow or run into position. The vibration at any point shall be of sufficient duration to accomplish compaction, but shall not be prolonged to the point where segregation occurs.

At least one additional standby vibrating unit shall be available for individual concrete placements in excess of 10 cubic yards.

{ XE "Concrete structures:placing concrete:underwater" **}3. Depositing Concrete Under Water.** Only concrete classified as seal concrete in Subsection 914.05, Table 914-2, shall be deposited under water. The concrete shall be placed in one continuous operation.

To prevent segregation, the concrete shall be placed in a compact mass in its final position by means of a tremie or a closed bottom dump bucket, and shall not be disturbed after being deposited. Care must be exercised to maintain still water at the point of deposit. Concrete shall not be placed in running water.

{ XE "Concrete structures:placing concrete:tremie" **}**When a tremie is used, it shall consist of a tube not less than 10 inches in diameter, constructed in sections having flanged couplings fitted with gaskets. The means of supporting the tremie shall be such as to permit free movement of the discharge end over the entire top of the concrete and to permit its being lowered rapidly when necessary to choke off or retard the flow. The tremie shall be filled by a method that prevents washing of the concrete. The discharge end shall be completely submerged in concrete at all times and the tremie tube shall contain sufficient concrete to prevent any water entry.

{ XE "Concrete structures:seal concrete" **}**When concrete is placed with a bottom-dump bucket, the bucket shall have a capacity of not less than ½ cubic yard and shall be equipped with loose fitting top covers. The bucket shall be lowered gradually and carefully until it rests upon the prepared foundation or upon concrete already placed. It shall then be raised very slowly during the discharge travel, the intent being to maintain, as nearly as possible, still water at the point of discharge and to avoid agitating the mixture. Seal concrete shall be placed as closely as possible to the top of the seal elevation. Isolated depressions in the top of the placed seal shall not be lower than 6 inches below the theoretical elevation, nor shall any individual peaks project more than 9 inches above the theoretical elevation. Soundings will be taken during the placement of the final lift of each seal, before initial set, to ensure the concrete is placed to these limits. Areas found to exceed the 9-inch tolerance shall be cut down to within the permissible height above the theoretical top of the seal.

At least 30 calendar days before the placement of concrete, a plan of operation shall be submitted for approval. Dewatering shall not begin until the plan of operation has been accepted. After dewatering, all laitance or other unsatisfactory material shall be removed from the surface of the seal by scraping, chipping or other means until sound concrete is exposed.

{ XE "Concrete structures:pier columns" **}4. Pier Columns.** Concrete in columns shall be placed in one continuous operation between construction joints. The concrete shall be allowed to set at least four calendar days before caps are placed provided that the concrete has been conditionally accepted as meeting the requirements of these Specifications, pending results of final compressive strength tests.

{ XE "Concrete structures:deck slabs" **}{** XE "Concrete structures:deck slabs:placing" **}{** XE "Deck slabs, bridge" **}5. Deck Slabs.** At least 20 calendar days before the start of placing bridge deck concrete, a plan of operation shall be submitted for review. This plan shall include a screed and rail erection plan, deck grades, the sequence and rate of placing concrete, the number and type of personnel who shall be engaged in the work, and a complete description of the equipment to be used in handling, placing and finishing the concrete including the weight of the finishing machine.

Computations for setting forms and screed supports shall be based on elevations obtained at points not farther than 10 feet apart on each beam.

Placing of concrete will not be permitted until it is evident that the placement and finishing operation shall be completed within the scheduled time, that experienced concrete finishers are available to finish the deck, that any required weather protective materials are in place and that all necessary finishing tools and equipment are on hand at the site of the work.

Methods, procedures, and equipment shall be used which produce a riding surface according to the texture and surface tolerance requirements specified in Subsections 501.15 and 501.16.

Any request for a change in the number, location or configuration of construction joints shall be included in the plan of operation.

Placement of concrete shall be maintained at a minimum rate of approximately 30 cubic yards per hour for deck slabs of 180 cubic yards or less. When the deck slab is in excess of 180 cubic yards of concrete, the minimum rate of placement shall be approximately 40 cubic yards per hour. The placement of concrete shall be scheduled so that finishing operations can be completed during daylight hours unless adequate lighting facilities are provided on the site and approval is given. The minimum required concrete placement rate for deck slabs or partial depth deck slab replacements which are an average of 6 inches or less in thickness shall be 20 cubic yards per hour.

Unless provisions are made by the Contractor to reduce the atmospheric evaporation rate below 0.15 pounds per square foot per hour, placement of the concrete shall not begin. Additionally, placement of the concrete shall be discontinued when the air temperature begins to exceed 86 ºF or when the evaporation rate begins to exceed 0.15 pounds per square foot per hour. The evaporation rate will be as determined with a nomograph. The publication ACI Committee 305, "Recommended Practice for Hot Weather Concreting" (ACI 305 R-91), may be referred to for guidance. The Contractor shall procure the nomograph.

Fog misting, wind shields, or other methods approved by the Engineer may be used to keep the evaporation rate below 0.15 pounds per square foot per hour. If fog misting is used, the fog misting equipment shall be capable of delivering 2 to 3 gallons of water per minute at 2,000 to 2,500 pounds per square inch using a 40-degree to 50-degree wide-angle nozzle.. The fog nozzle shall be held 6 feet above the concrete surface. Fog misting is not to be used to apply water that is to be worked into the surface of the concrete for finishing purposes. Fog misting shall immediately be ceased if any water accumulation occurs on the surface. The Contractor shall notify the Engineer, in writing, 45 calendar days before the concrete placement, as to which model apparatus he proposes to use.

The measurements for air temperature, relative humidity, and wind speed shall be taken at the location of the concrete placement. Concrete temperatures shall be taken from the sample used for slump and air content tests. These measurements and calculations shall be performed at least once per hour beginning with the initial concrete placement and whenever, in the opinion of the Engineer, changes in atmospheric conditions merit. The Contractor shall supply all the instruments necessary to take these measurements, subject to approval by the Engineer, including two battery operated psychrometers, two concrete thermometers, and two wind gauges. These instruments shall become the property of the Contractor after final Acceptance. All instruments shall be certified by an independent laboratory that has been approved by the Engineer. The instruments shall be certified to be in good working order and as having been calibrated within the two months immediately before use. No separate payment will be made for providing these instruments.

Placement shall not begin and shall be discontinued in the event of rain. The Contractor shall provide a sufficient number of approved covers and take adequate precautions to protect freshly placed concrete from rain. The Resident Engineer may order the replacement of any material damaged by rain.

The concrete shall be delivered, placed, and consolidated at a uniform rate to ensure a continuous operation. Stoppages of concrete placement shall not exceed 20 minutes. The working face of fresh concrete shall at all times be maintained parallel to the finishing machine or other strike-off.

{ XE "Deck slabs, bridge:machine finishing" **}**Unless otherwise designated, a self-propelled finishing machine shall be used for striking-off and finishing the surface. The finishing machine shall be the rotating cylinder type or the oscillating type. Longitudinal or transverse type finishing machines may be used. The finishing machine shall be capable of being propelled both forward and backward to enable repeat passes to be made to correct surface irregularities and to produce a surface which conforms to the required profile grade, cross-section, and surface tolerances. Longitudinal finishing machines shall be of a type capable of concrete placement for the full length of the span, or between designated or approved construction joints. Transverse finishing machines shall preferably be of sufficient size to finish the full width of deck between curbs or the distance between longitudinal construction joints. In areas outside the width of traffic lanes or in areas inaccessible by machine, vibratory screeds or other manually operated strike-offs may be used.

The machine shall travel on steel rails, pipe, or other grade control, which shall be adequately supported by vertical supports securely fastened in place at close spacing to prevent any appreciable deflection between rail supports. The supports for the rails, when located in the deck concrete, shall be of the type which can be removed without disturbing the concrete, or shall be partially removable so that no part remains less than 2½ inches below the finished concrete surface. If such supports are removed before initial set has taken place, the resulting holes shall be filled with deck concrete; if the concrete has hardened, holes shall be filled with non-shrink, nonmetallic grout.

Before placing the concrete, rails or other guides for the finishing machine shall be in place, set to achieve the deck elevations required, and secured for the full length of the concrete placing plus such additional distance that the machine clears all finishing operations.

The finishing machine shall be operated over the full length of the bridge segment to be finished before beginning concreting operations. This test run shall be made with the screed adjusted to its finishing position. During the test run, checks shall be made of the height and deflection of guide rails and of the cover over slab reinforcement and forms. All necessary corrections shall be made before concreting is begun. If the finishing machine is of the longitudinal type, the test run may be omitted when reinforcement clearances preclude movement of the machine across the deck.

Concrete placement and initial strike-off by a transverse finishing machine shall be coordinated so that initial strike-off is never more than 10 feet behind the concrete placement.

Strike-off by a longitudinal finishing machine shall not be initiated until concrete has been placed a minimum of two bays wide for the entire slab length. In this context, a bay is defined as the horizontal distance between adjacent girders. The final pass made by the longitudinal finishing machine shall uniformly lag behind the placement by the minimum two-bay width. Sufficient depth checks shall be made behind the machine and along the full length of the span to ensure achievement of the required section and reinforcement cover.

The concrete shall be given as few passes of the machine as are necessary to obtain a smooth, dense surface of the required contour. A small uniform quantity of mortar shall be maintained ahead of the screed on each pass. At no time shall the quantity of concrete carried ahead of the screed be so great as to cause slipping or lifting of the finishing machine on the rails.

Improper adjustment or operation of the finishing machine which results in unsatisfactory consolidation, reinforcement cover or surface requirement shall be corrected immediately. Unsatisfactory performance, particularly with respect to surface tolerances attained, may be cause for rejection of the equipment.

Work bridges or other positive means of permitting access to the surface of the deck shall be provided for the purpose of finishing, straightedging, making corrections and for other operations requiring access to the surface of the deck after the passing of the screed. Before concrete placing operations begin, substantial bulkheads or headers shall be set and shaped to the required deck surface cross-section. The concrete shall be placed as a monolithic unit in a continuous operation between joints.

When the concrete placing within any complete unit (i.e., for trusses, arches, continuous or cantilevered unit) is to be divided, the placing shall be made and finished in the numbered sequence shown, beginning with the lowest number. All sections having the same number shall be placed before sections of higher number. The sequence of placing for sections having the same number shall be optional. No deck section shall be placed until all previously placed concrete within the complete unit has cured for 72 hours. This requirement may be waived if the succeeding section(s) can be completed within four hours after the start of the initial placement of section(s) of any given unit for that day. This requirement may not be waived for deck slabs on prestressed concrete beams that are continuous for live load. The numbered sequence shown on the Plans shall be adhered to. Written request for approval is required to waive this requirement.

Sidewalks, parapets, and curbs within any one complete unit shall not be placed until all the deck slabs within that complete unit have been placed. The numbered sequence shown shall also apply to pedestrian sidewalk sections over 2 feet-6 inches wide, but it need not apply to safety curbs, 2 feet-6 inches wide or less, curbs and parapets.

For simple spans the placing of concrete shall preferably progress upgrade. However, deck slabs may be placed with a finishing machine in a continuous operation from either end of a bridge regardless of grade.

{ XE "Concrete structures:arches" **}6. Arches.** Arch centering work shall be lowered gradually and symmetrically so as to avoid overstresses in the arch.

Centering shall be placed upon jacks to provide means of correcting any slight settlement which may occur after concrete placement has begun. Any adjustments, made necessary by settlement, shall be made before the concrete has taken its initial set. Railings and copings shall not be constructed until centering has been struck and the arch made self-supporting.

For closed-spandrel arches, such portions of the spandrel walls as may be necessary to avoid jamming of the expansion joints shall be left for construction subsequent to the striking of centers.

For filled-spandrel arches, backfilling of embankment material shall be according to Subsections 206.04 and 206.10, with care being taken to load the ring uniformly and symmetrically.

Concrete in arch rings and ribs shall be placed in the order prescribed. Generally, keys shall be placed at laps in reinforcing steel.

When permitted, arch rings may be cast in a single continuous operation.

{ XE "Concrete structures:parapets" **}7. Parapets.** Care shall be exercised to obtain smooth and tight-fitting forms which can be held rigidly to line and grade and can be removed without injury to the concrete. All moldings, panel work, and bevel strips shall be constructed with neatly mitered joints. All corners in the finished work shall be true, sharp, and clean cut and shall be free from cracks, spalls or other defects.

When parapets are constructed using a slip-form (extrusion) method of construction, the concrete shall be fed to the slip-form machine at a uniform rate. The machine shall be operated at proper speed to produce a well compacted mass of concrete, conforming to the following fabrication tolerances: Free from surface pits larger that ½ inch in diameter and ¼ inch in depth and requiring no further finishing, other than that conforming to the provisions for Class 1 finish in Subsection 501.14. The rate of production shall be no greater than 10 feet per minute.

The grade for the top of the concrete barrier shall be indicated by an offset guide line, set by the Contractor, from survey marks established by the Contractor. The forming portion of the slip-form machine shall be readily adjustable vertically, during the forward motion of the machine, to conform to the predetermined grade line. A grade line gage or pointer shall be attached to the machine in such a manner that a continual comparison can be made between the barrier being placed and established grade line as indicated by the offset guide line.

Parapets for supporting bridge lighting foundations shall not be cast by the slip-form method of construction. In such situations, that portion of the parapet supporting the bridge lighting foundation shall be cast-in-place concrete, with all requirements conforming to the Plans.

Parapet joints shall be saw cut to the width and height as shown on the Plans and shall be saw cut within four hours of the slip-forming operation.

{ XE "Concrete structures:construction and contraction joints" **}8. Construction and Contraction Joints.** Construction or contraction joints shall be located only where shown or authorized. The construction joint between the walls and top slab of a box culvert may be deleted if the joint is designated as optional. If the optional joint is deleted, concrete shall not be placed in the top slab until at least two hours after the final concrete had been placed in the walls.

Newly placed concrete in contact with previously placed concrete (at horizontal construction joints and at contact with existing concrete structures where the joints are exposed to view in the finished structure) shall contain an excess of mortar to ensure bond and provide a neat joint. To provide sufficient mortar for such joints, a layer of portland cement mortar, 1 to 2 inches thick, shall be deposited against the existing concrete into which the regular mix concrete shall be deposited immediately. The cement-sand mortar shall be of the same proportions as in the regular concrete mix except that the coarse aggregate is omitted.

When parapets are constructed by the slip-form method, contraction joints shall be saw cut to a maximum depth of 1 inch past the troweled "V" notch groove. Saw cutting shall be performed within four hours of slip-forming, to prevent shrinkage cracking.

{ XE "Concrete structures:expansion joints" **}9. Expansion Joints.**

a. Bridge Expansion Joints.

(1) Filled Joints.

Filled joints shall be constructed by insertion and subsequent removal of a wooden strip or metal plate. The insertion and removal of the template shall be accomplished without chipping or breaking the corners of the concrete.

When preformed bituminous, cork, sponge rubber or other material is specified, it shall be cut to the same shape and size as that of the surfaces being jointed. It shall be fixed firmly against the surface of the concrete already in place in such manner that it is not displaced when concrete is deposited against it. When more than one piece of filler is used, the abutting pieces shall be covered with a layer of asphalt-saturated "30-pound" roofing felt of not less than 1.8 pounds per square yard, one side of which shall be covered with hot asphalt to ensure proper retention.

When preformed elastomeric joint seals are specified, the sealer shall be installed as soon as practicable after the concrete curing period using a lubricant-adhesive. Temperature limitations of the adhesive recommended by the manufacturer shall be observed. Joints shall be cleaned and shall be free of oil, curing compound and all other foreign materials before the application of the lubricant-adhesive.

The sealer shall be furnished and installed in a continuous length across the full width of slab unless otherwise authorized in writing.

The sealer shall be installed by hand or machine tools and secured in place with the lubricant-adhesive which shall cover both sides of the sealer over the full area in contact with the concrete. The adhesive may be applied to the concrete or the sealer or both.

Compression seals shall be multi-channel extruded shapes conforming to the requirements of AASHTO M 297 except as hereinafter modified. At the time of manufacturing, the seals shall be clearly marked at the top surface at 12 inch ± 1/16 inch intervals and shall show the manufacturer's name or trade mark, the lot number and the size designation at intervals of 5 feet or less. Actual seal dimensions shall not differ from the nominal dimensions by more than 1/16 inch per inch of depth or width or a maximum of ¼ inch, whichever is less.

Preformed compression seals shall be used for small movements between 2 and 2½ inches.

{ XE "Concrete structures:expansion joints:reinforced elastomeric expansion dam" }**(2) Reinforced Elastomeric Expansion Dam.**

The expansion dam shall be anchored to the bridge deck as indicated on the plans, forming a mechanical connection between the metal components molded in the expansion dam and the bridge deck. All exposed steel shall be galvanized. Cavities for anchor bolts shall be provided with tight-fitting, removable, neoprene plugs.

Detailed working drawings of the expansion dam, including all information pertinent to the installation procedure, shall be submitted according to Subsection 105.04.

The expansion dam shall provide a watertight joint. It shall be able to withstand vehicular traffic and shall be capable of preventing debris from clogging the joint and interfering with the natural movement of the bridge.

Minor differences in the configuration of the expansion dam will be permitted subject to written approval; however, any major departure from design and details will not be permitted.

The expansion dam shall be installed as soon as practical after the concrete has cured unless otherwise authorized. Vehicles will not be permitted to pass over the joint until the expansion dam has been installed.

The expansion dam shall be set in a depression formed in the concrete. The shelves of the depression must be in a plane parallel with the surface of the bridge deck or approach slab. The entire depression shall be uniform in width and depth. Any cavities or high area shall be corrected by filling with epoxy grout or grinding.

Stainless steel, automatic, end-welded, or threaded studs that are placed before the concrete is placed may be used to secure the expansion joint to new bridge deck. Anchor bolt lines shall be symmetrical around the theoretical centerline of joint.

The depression in the concrete shall be cleaned of all dirt, loose mortar, or other debris and shall be dry before placing sealant.

Before installation, the expansion joint shall be cleaned by wire brushing both ends and the underside along each anchor bolt line. Sealant shall then be applied to the horizontal surface of the unit and the unit inserted into the depression so as to engage all anchor bolts. All anchor bolts shall be tightened to the torque called for except the two bolts at the end that receive an adjacent unit. All excess sealant shall be removed immediately.

Upon completion of installation, all anchor bolts shall be checked and re-tightened to the proper torque.

The bolt hole recess shall be cleaned and filled with the sealant to a maximum of one-half its depth and immediately closed with a plug.

The top of the expansion joint shall not be closer than ⅛ inch or more than ¼ inch from the top of the unfinished bridge deck.

The epoxy grout or sealant shall be placed immediately following installation of the expansion dam. The opening that is to receive the grout or sealant shall be cleaned of all dirt, loose mortar and other debris before the grout or sealant is placed.

An approved stud welding machine shall be used to weld threaded studs on the top leg of the anchored steel angles. Care shall be exercised while welding the threaded studs and tightening nuts to ensure proper alignment and no thread damage.

(3) Strip Seal Expansion Dam, Glandular Type.

Glandular type strip seal expansion dams shall consist of a molded neoprene rubber gland locked in the cavities of two parallel steel rail sections. The upper and lower lip of the steel rail cavities shall be fabricated such that they do not shear or damage the integrity of the neoprene sealing element during installation or service. The joint system shall provide a watertight seal and shall be designed to withstand the specified bridge design loading. In addition, the joint system shall prevent the intrusion of debris from clogging the joint and interfering with the natural movement of the bridge.

Before fabrication, detailed working drawings of the strip seal expansion joint systems shall be submitted for approval according to Subsection 105.04. The working drawings shall detail all dimensions, anchorages, welding procedures and all other

information necessary to fabricate the joint. A joint installation temperature chart shall be supplied on the working drawings ranging from –10 to 110 ºF for the joint system to be set at the correct width depending on the temperature at erection. In addition, the working drawings submittal shall include a detailed installation procedure for use by the Contractor. The Contractor shall verify all dimensions upon receipt of the working drawings.

The steel retainer rails shall be banded together in the shop to form matching pairs. Each pair shall be marked to clearly identify the location of its placement. The neoprene gland shall be shipped with the steel retainer rails and shall be clearly identified for correct installation into the retainer rails. The top side of the joint shall be clearly marked. All joint materials and assemblies stored at the job site shall be protected from damage, and the assemblies shall be supported to maintain their true shape and alignment.

The joint manufacturer's technical representative shall be present at the construction site on at least the first day of the joint installation to provide supervision to the Contractor.

The Contractor shall follow the manufacturer's detailed installation procedure as outlined on the working drawings.

The strip seal retainer rails shall be set in place according to the temperature erection chart and attached to the superstructure before placement of the deck concrete. The joint system shall be fabricated and erected so that the joint system conforms with the grades and cross slopes of the adjacent deck slab surface. Any galvanized coating of the deck joint system which is damaged during field welding or from other causes shall be repaired by methods outlined in ASTM A 780. Closed-cell foam, baker rod shall be placed in the seal cavity of the steel retainer rails by the Contractor before pouring the deck slab concrete. The backer rod shall remain in place until the rubber gland seal is installed.

The rubber gland seal shall be installed as soon as practical after the concrete has cured, unless otherwise authorized. The metal cavity which will be in direct contact with the rubber gland seal shall be cleaned immediately before the seal placement to remove all dirt, grease, and contaminants and then coated with a lubricant/adhesive to provide a high-strength bond between the rubber gland seal and the mating metal surfaces.

The rubber gland seal shall be installed with the fold facing downward in continuous length over the entire bridge width including the specified locations on the inside faces of the New Jersey shaped parapets and all sidewalk areas. No field splicing of the rubber gland seal will be permitted.

(4) Strip Seal Expansion Dam, Bolt Down Type.

The strip-seal expansion dam, bolt-down type shall consist of a fabric reinforced elastomeric expansion sealer and either steel retainer plates or steel reinforced elastomeric retainer pads.

Detailed working drawings of the expansion dam, including complete installation instructions, shall be submitted according to Subsection 105.04.

The expansion dam shall provide a watertight joint. It shall be able to withstand vehicular traffic and shall be capable of preventing debris from clogging the joint and interfering with the natural movement of the bridge.

Before fabrication, the Contractor shall verify the pertinent dimensions of all existing layouts, grades and openings to adjust for field conditions for fabricating and installing components of the joint sealer.

Minor differences in the configuration of the expansion dam will be permitted subject to written approval; however, any departure from the design parameters and required detailing will not be permitted.

The expansion dam shall be installed as soon as practical after the concrete has cured unless otherwise authorized. Vehicles will not be permitted to pass over the joint until the expansion dam has been installed.

The elastomeric sealer shall be molded and installed as a single piece between the faces of the parapets or barriers, or from the inside face of parapet or barrier to the longitudinal joint. No working or field splicing will be permitted.

The elastomeric sealer shall seal the deck surface, sidewalks, gutters, and curbs to prevent moisture and other foreign materials from entering the joints. The steel surfaces receiving the elastomeric material shall be free of all loose dirt or other foreign matter.

Manufacturer's installation procedures shall be submitted along with working drawings.

Retainer plates or pads and anchor blocks shall be shop cut, beveled, and welded to form pieces not less than 4½ feet in length. Die cast retainer plates may be used upon approval.

The top of the completed retainer pads or plates shall be no closer than ⅛ inch or more than ¼ inch from the top of the bridge deck.

Retainer plate, countersunk holes, and center holes shall be shop fabricated.

Retainer plates, retainer pads, and anchor blocks secured in place along the joint shall have their full cross-sectional areas bearing on each other forming a tightly jointed strip between the faces of the parapets or barriers, or from inside face of parapet or barrier to the longitudinal joint.

Galvanized steel automatic end-welded threaded studs or stainless steel anchor bolts that have been placed before the concrete has been placed may be used to secure the expansion dam to new bridge decks. Anchor bolt lines and stud lines shall be symmetrical about the theoretical centerline of joint.

An approved stud welding machine shall be used to weld threaded studs on the top leg of the anchored steel angles. Care shall be exercised while welding the threaded studs and tightening nuts to ensure proper alignment and no thread damage.

The depression in the concrete shall be cleaned of all dirt, loose mortar or other debris and shall be dry before placing sealant.

Before installation, the expansion dam shall be cleaned by wire brushing both ends and the underside along each anchor bolt or stud line. Sealant shall then be applied to the horizontal surface of the unit, and the unit inserted into the depression so as to engage all anchor bolts or studs. All anchor bolts shall be tightened (except the two bolts at the end that will receive an adjacent unit) to the specified torque. All excess sealant shall be immediately removed.

The bolt hole recess shall be cleaned and filled to a maximum of one half its depth with the sealant and immediately closed with a plug.

Upon completion of the installation, all anchor bolts shall be checked and re-tightened to the proper torque.

b. Steel Components. The plates, angles, or other structural shapes shall be shaped at the fabrication plant to conform to the section of the concrete slab. Fabrication and painting shall conform to Section 503. When specified, the material shall be galvanized instead of painting. Care shall be taken to ensure that the surface in the finished plane is true and free of warping. Methods shall be employed in placing the joints to keep them in correct position during the placing of the concrete. The opening at expansion joints shall be adjusted to account for ambient temperatures.

c. Open Joints. Open joints shall be constructed by insertion and subsequent removal of a wooden strip or metal plate. The insertion and removal of the template shall be accomplished without chipping or breaking the corners of the concrete. Reinforcement shall not extend across an open joint.

{ XE "Waterstops" **}{** XE "Concrete structures:waterstops" **}d. Waterstops.** Metallic waterstops shall be spliced, welded or soldered, as necessary, to form continuous, watertight joints.

Nonmetallic waterstops shall be installed in continuous strips, without splices, except that splices will be permitted at changes in direction when necessary. All splices of nonmetallic waterstops shall be made according to the manufacturer's recommendations. In the cast of polyvinyl chloride waterstops, the heat used shall be sufficient to melt but not char the plastic.

Provisions shall be made to support the waterstops during the progress of work and to ensure their proper embedment in the concrete. The concrete shall be worked in the vicinity of the joints to ensure maximum density and imperviousness. Forms shall be so designed that they can be

removed without damaging the waterstops. Guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from mechanical damage.

10. **Anchor Bolts.**
    a. **Bearings**. Anchor bolts in abutments and piers for bearings shall either be cast-in-place, cast in 3-inch diameter sleeves, or cast in holes drilled after the concrete has set, except that drilling will not be allowed in rigid frame and T-type piers. The use of undercut type expansion anchors is also permitted. If anchor bolt sleeves are utilized, they shall be circumferentially corrugated and shall be galvanized steel or plastic. The wall thickness of the sleeves shall be sufficient to withstand the construction loads applied to them. If holes are drilled, they shall be at least 1 inch larger in diameter than the bolts used. During freezing conditions, anchor bolt holes shall be protected from water accumulations at all times.
    b. **Sign Support Structures**. Anchor bolts for overhead and cantilever sign structures shall be cast-in-place. Setting of anchor bolts before placing the concrete shall be according to Subpart B of Subsection 509.09.
    c. **Bridge Railing, Chain Link Fence, Guide Rail Base Plates, Deck Joints, and Miscellaneous Applications**. Anchor bolts for new construction shall be cast-in-place. Drilled and grouted anchor bolts (e.g., adhesive type) will be permitted if it is determined by the Engineer to be acceptable for specific project applications. Anchor bolts for rehabilitation projects shall either be cast-in-place or drilled and grouted adhesive type anchors bolts. Only adhesive type anchor bolt systems which have been preapproved by the Manager, Bureau of Materials are acceptable for use on the Department projects. Expansion type anchor bolts are not acceptable for use on the Department projects. Adhesive type anchor bolts shall be installed according to Subsection 612.08.

    The design embedment of the adhesive anchor bolts shall be based on a maximum presumptive ultimate concrete compressive strength (f'_c) of 4,000 pounds per square inch unless otherwise indicated on the Plans.

    Shop drawings for adhesive anchoring systems shall be submitted according to the procedures established in Subsection 105.04.

    The embedment depth of the adhesive anchors shown on the shop drawings shall be a sufficient depth into the existing concrete to obtain the required pullout strength as required for the proof load testing according to Subsection 902.06.

    All material specifications for adhesive, anchors, washers and nuts shall be indicated on the shop drawings.

    Anchor bolt holes shall be drilled with a masonry drill. The holes shall be ⅛ inch larger than the bolt diameter unless otherwise instructed by manufacturer's recommendations.

    Holes shall be spaced and located to clear existing deck reinforcement, deck joints, conduit, and junction boxes. The drills used to make the anchor holes shall not spall the opposite side of the concrete element. Precautions shall be taken so that concrete and existing utility conduits are not damaged during the drilling process. Any damage to the existing concrete shall be repaired without additional compensation. When air drills are used and rebar is encountered, the Contractor shall either core drill through the bar and then continue to air drill the remainder of the hole or shall angle the hole with the air drill, if feasible, to bypass the bar. Anchor bolt holes shall be thoroughly clean and dry and shall comply with all manufacturer's recommendations both before and during installation of the adhesive anchors.

    Sufficient adhesive shall be placed in each drill hole to insure that the annular space between the anchor bolt and the hole is fully filled for the entire depth of the hole including any leveling course and into the existing concrete.

    Anchor bolt material for guide rail base plate attachments shall conform with Subsection 902.04.

11. **Shoes and Bearing Plates**. Bridge seat bearing areas shall preferably be finished high and bush-hammered to grade. Shoes and bearing plates shall be set as provided in Section 503.
12. **Drainage and Weep Holes.** Drainage and weep holes shall be constructed in the manner and at the locations required. Ports or vents for equalizing hydrostatic pressure shall be placed below low water, if shown.

    Forms for weep holes through concrete shall be 4-inch clay pipe, polyvinyl chloride, transite, or unreinforced concrete drain pipe.

13. **Pipes, Conduits, and Ducts.** Pipes, conduits, and ducts encased in concrete shall be installed before the concrete is placed. Pipes shall be held or braced rigidly during concrete placement to prevent their displacement. Public utilities shall be installed as specified in Section 510.
14. **Concrete Exposed to Sea Water.** Construction joints shall not be formed between levels of extreme low water and extreme high water. Between these levels, sea water shall not come in direct contact with the concrete for a period of 28 calendar days after being placed. This shall be accomplished by pumping, retention of forms or use of a waterproof concrete coating.
15. **Pumped Concrete**. At least 20 calendar days before beginning operations, a plan of operation conforming to ACI 304.2R shall be submitted for approval, showing method and procedures along with a list of adequate description of equipment and manpower proposed for use, including contingency equipment and manpower. The equipment shall be so arranged that no vibrations result which might damage freshly placed concrete. Aluminum alloy pipe will not be permitted as a conveyance for the concrete nor for any pieces of equipment in contact with the concrete. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there is no contamination of the concrete or separation of the ingredients. After this operation, the entire equipment shall be cleaned.
16. **Concrete Deck Overlay Protective System.** To determine the acceptability of the second course of construction the provisions of Subpart D of Subsection 518.06, shall be followed.
17. **Reinforced Concrete Box Culvert, Precast.**
    a. **Design and Detail Requirements**. The fabricator of precast concrete culvert units shall be certified by the Precast/Prestressed Concrete Institute or the National Precast Concrete Association in the applicable category and be pre-approved before award of the Contract by the Department. The certification will be maintained during production of items for the Project. A copy of the current field audit report shall be submitted to the Department's Bureau of Materials before the start of production. The fabricator shall provide an Engineer's office according to Subsection 502.03, Subpart E.

    Precast concrete units shall be designed with a minimum design compressive strength of f'_c= 5,000 pounds per square inch .

    The cover of concrete over the circumferential reinforcement shall be 1½ inch except on the top slab where it shall be 2 inches.

    Reinforcement bars shall be tied at all intersections except where the spacing is less than 12 inches in each direction in which case alternate intersections shall be tied.

    The wall thickness for the precast culvert shall be a minimum of 8 inches. The top and bottom slab thickness shall be a minimum of 10 inches.

    A flexible, watertight neoprene gasket shall be provided at the joint between the precast units. The gasket shall be continuous around the circumference of the joint and shall contain only one splice.

    A positive means shall be provided to prevent water from entering the vertical joint between the last precast culvert section and any cast-in-place appurtenances such as wingwalls, cutoff walls, aprons, and cast-in-place culvert end sections.

    Two rows of threaded inserts or bar extensions shall be provided in the last precast culvert section for the cast-in-place end section and the wingwall attachment. The same information shall be provided for the headwall attachment, if necessary.

    When the earth fill over the precast culvert is less than 2 feet, the top mat of reinforcement in the roof slab shall be corrosion protected.

    Lifting devices will be permitted in each precast unit for the purpose of handling and erection. If lifting hooks or lugs are used, they shall be galvanized according to AASHTO M 111.

    The precast units shall be tied together with a minimum of four longitudinal rods or strands to ensure an adequate seal and to provide continuity and concrete shear transfer between the precast units. For the purpose of tying units together, a 1½-inch diameter hole shall be preformed in each corner of each unit. If hand holes are used for the installation of the longitudinal ties, they shall be spaced appropriately.

    Design calculations shall be submitted according to Subsection 105.04.

    b. **Fabrication Requirements**. The fabricator of precast concrete culvert units shall be certified by the Precast/Prestressed Concrete Institute or the National Precast Concrete Association in the applicable category and be pre-approved prior to award of the Contract by the Department. The certification will be maintained during production of items for the Project. A copy of the current

field audit report shall be submitted to the Department's Bureau of Materials before the start of production. The fabricator shall provide an Engineer's office according to Subsection 502.03, Subpart E.

Each precast concrete culvert unit shall be identified with a permanent marking. The precast concrete culvert units shall be manufactured in steel forms. Curing of the precast units shall be by any one of the methods specified in Subsection 3.4.3 of the PCI Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products.

If steam curing is used, the PCI Manual is amended as follows. The application of steam within the enclosure shall be delayed for a period of five to six hours when the air temperature is less than 50 ºF and shall be delayed for a period of three hours when the air temperature is 50 ºF or higher. If retarders are used, the waiting period shall be from four to six hours regardless of the air temperature. The temperature in the enclosure shall be maintained between 90 and 150 ºF for a period of 12 hours.

Two representative concrete test cylinders per precast culvert unit, similarly cured, shall be tested after the curing period specified above. Should tests indicate that the precast units have not achieved a compressive strength of 4,000 pounds per square inch or greater, the precast units shall be cured further until the required strength is achieved.

To determine the acceptance or failure of the concrete, one compressive strength test from the two concrete cylinders that are taken from each concrete truck or from each batch of concrete that is produced shall be performed. The two test results shall be averaged together to obtain a single value representing the units. Concrete will be accepted if this averaged single value is equal to or greater than the class design strength as identified in Section 914.05, Table 914-3. Concrete will be accepted with a pay adjustment if the averaged single value is within the range from 1 to 500 pounds per square inch less than the class design strength for the specified concrete class, (i.e. for Class P concrete, this range will be between 5,000 to 5,500 pounds per square inch). The pay adjustment will be according to Section 914. Concrete will be rejected if the averaged single value is greater than an amount that is 500 pounds per square inch less than the class design strength for the specified concrete class. The Engineer may use testing results obtained from concrete cores or nondestructive testing before requiring any corrective action or removal and replacement of the concrete. All costs for coring and testing shall be paid for by the Contractor.

Precast concrete culvert units shall remain in their steel forms for the duration of the steam or natural curing operation. Upon removal of the forms, the entire precast concrete culvert unit including exterior, interior, and all lap surfaces shall be given a Class 1 finish according to Subheading 1 of the fourth paragraph of Subsection 501.14.

Upon approval of the Class 1 finish, precast concrete culvert units shall be given one coat of an epoxy waterproofing seal coat on the exterior of the roof slab. This coating shall be applied in the precaster's plant not earlier than 72 hours after fabrication, and after the concrete compressive strength has reached 5,000 pounds per square inch. The concrete surfaces of the precast units shall be dry before application of the epoxy waterproofing seal coat. The application of the epoxy seal coat shall be in conformance with the product manufacturer's recommendation.

Precast concrete culvert units shall not be shipped until 72 hours after fabrication and after the concrete compressive strength has reached 5,000 pounds per square inch.

The precaster is ultimately responsible for providing a finished product which is acceptable to the Engineer.

c. Construction and Erection. A coarse aggregate layer shall be provided under the precast concrete box culvert. The depth of the coarse aggregate layer shall have a minimum depth of 2 feet. It shall extend 12 inches on each side of the precast box culvert. The coarse aggregate layer shall be compacted according to Subsection 203.09.

Before backfilling, a 2-foot wide strip of filter fabric shall be placed over the top and side transverse joints. The filter fabric shall be according to Subsection 919.06.

If precast concrete culvert units are used in parallel for multicell installations, the parallel units shall be placed a maximum of 6 inches apart, and the 6-inch space between the units shall be filled with nonshrink grout. As an alternate, the 6-inch space may be filled and compacted with Zone 2 or crushed stone conforming to coarse aggregate size No. 57. If crushed stone is used, a 2 foot-8 inch wide strip of filter fabric shall be placed over the longitudinal joint.

One longitudinal tie rod or strand shall be placed in position through a 1½-inch diameter preformed hole located in each corner of the box units (a minimum total of four longitudinal ties) and stressed to a tension of 30,000 pounds each. After tensioning, the exposed end of the ties shall be removed so that no part of the ties or no part of the end fittings extend beyond a point 1 inch inside the anchorage pocket. All hardware associated with the end anchorage system shall be galvanized. The exposed parts of the end fittings shall be coated with two coats of bituminous paint. If hand holes are used for the installation of longitudinal ties, they shall be spaced appropriately. A tensile force versus elongation chart for the strand shall be furnished by the fabricator.

The tie rod bars shall be tensioned by torquing. Precautions shall be taken during the tensioning process to prevent any damage to the concrete under the outside bearing plates. The tensioning process shall be conducted so that the tension being applied may be measured at all times.

Hand hole pockets, longitudinal tie rod sleeves, and lifting lugs shall be grouted after the joints are sealed and the longitudinal ties are tensioned. The grout shall be nonshrink and nonmetallic and conform to Subsection 914.03. Any top slab hand hole pockets or lifting holes which are grouted in the field shall receive one coat of an epoxy waterproofing seal coat after the grout has properly cured.

18. Slip-form Method of Parapet Construction.

a. Concrete supply shall be sufficient to produce a continuous, completely shaped parapet. If concrete placement is interrupted for any reason, the placement shall be protected from drying by several layers of wet burlap. A construction dam, or bulkhead, shall be installed if the interruption exceeds 30 minutes. If the interruption exceeds 90 minutes, further placement shall be discontinued. Concrete placement at this location may then resume only after 12 hours, measured from the time of delay, has elapsed.

b. Concrete placement may begin at the joint beyond the bulkhead, without time constraints. If in the opinion of the Engineer the length of placement between the bulkhead and the next joint cannot be slip-formed, the Contractor shall form the section by methods other than slip-forming.

c. Cold joints in the parapets that are formed due to the attachment of fresh concrete shall be made in the following manner. The set concrete shall have its surface cut to remove all loose, and otherwise unsatisfactory materials. Tools used for this purpose shall be approved by the Engineer before use. The surface shall be scrubbed with a wire broom and shall be kept wet until new concrete is placed. Immediately before placing fresh concrete, the set surface shall be completely coated with portland cement bonding grout and thoroughly brushed in. The bonding grout shall be approved.

d. The ends of parapets at bridge expansion joints shall be coated with epoxy waterproofing seal coat.

e. The concrete shall be cured by means of a clear curing compound conforming to Subsection 905.03. Curing compound shall be sprayed on the concrete surface immediately following the slip-forming and hand finishing operations. The compound shall be applied by means of pressure spraying or distributing equipment at the rate directed, but not less than one gallon per 150 square feet of surface. The equipment for applying the compound shall be such that the compound is applied as a fine spray, with no surface damage to the concrete. The equipment shall also provide for adequate agitation of the compound during application, and shall be approved before work is started. Should the method of applying the compound produce a non-uniform film, or should the spraying equipment fail and duplicate equipment is not immediately available, the application of curing compounds shall be discontinued immediately and the curing accomplished by another method acceptable to the Engineer. The Contractor shall stockpile sufficient approved coverings for protection of the concrete in the event of rain, non-uniform film application, or breakdown of spray equipment.

19. Corrosion Inhibitor Admixture. Corrosion inhibitor admixtures, as specified in Subsection 905.02, may be used in fabricating structural concrete members. Such fabrication shall be according to applicable provisions of Section 501 or Section 502. The use of chemical admixtures, in conjunction with the corrosion inhibitor admixture, subject to the provisions of Subsection 501.03, is permitted. Deck slab construction, unless otherwise stated herein, shall conform to the requirements of Subpart 5 above. The following criteria shall be followed when using a corrosion inhibitor admixture:

a. At least 45 calendar days before the start of the concrete placement, a mix design, containing the corrosion inhibitor admixture, shall be submitted for approval and verification. Approval of the design mix shall be based on the criteria stated below:
   (1) The concrete, containing the corrosion inhibitor admixture, shall have a water to cement ratio of 0.40 maximum.
   (2) Design, control and acceptance testing shall conform to the requirements of Subsection 914.02. The Class of concrete, the concrete slump and the concrete percent air entrainment shall conform to Subsection 914.05 Table 914-2.
   (3) Mix design requirements shall conform to Table 914.03. According to Subsection 905.02 and the manufacturer's product specifications, chemical admixtures may be added to the concrete mix. The corrosion inhibitor admixture shall be thoroughly mixed before chemical admixtures are added.
   (4) The provisions of Section 501 or Section 502 concerning placement, curing and finishing of the concrete shall be followed.
   (5) The corrosion inhibitor admixture shall be added to the concrete at the concrete plant.

b. Actual production of the corrosion inhibitor concrete mix that is to be used in the Project shall not begin until the Engineer accepts the mix design. A representative from the corrosion inhibitor admixture supplier shall be present during the initial placement of the concrete. The use of the corrosion inhibitor admixture shall conform to the quality control conditions that are stated in Subsection 905.02.

c. A four cubic yard sample of the concrete that contains the corrosion inhibitor admixture shall be placed at the job site at a location that is acceptable to the Engineer. The location shall be a non-structural element. If the Engineer believes that there is sufficient knowledge that the concrete, that contains the corrosion inhibitor admixture, will be able to be placed and cured properly, this requirement may then be waived.

20. Pressure Injection. Pressure injection sealing of concrete cracks shall consist of repairing cracks by the introduction of an epoxy resin system. The size, extent and location of cracks in concrete structures to be repaired shall be as shown on the Plans or as directed by the Engineer. Pressure injection sealing of concrete cracks is not applicable to repair of concrete deck slabs.

a. Preparation of concrete cracks. Deteriorated, damaged and loose surface concrete shall be removed from the crack area. A hollow core stopper drill or an equivalent drill into which dust is pulled out of a hole shall be used in providing entry ports at approximately 3-feet intervals for injection of the epoxy resin adhesive into the concrete cracks.

The Contractor shall inform the Engineer as to when this work will be performed. Unless inspection is specifically waived in writing, injection of epoxy adhesive shall be performed only in the presence of the Engineer.

The surface preparation of the concrete area and the mixing and preparation of the materials for the sealing and grouting shall be done according to the manufacturer's product specifications.

b. Sealing of cracks. The line of cracking shall be temporarily sealed with an epoxy crack sealant. This temporary sealer shall provide entry ports for the pressure injected epoxy resin system and shall be capable of containing the injected epoxy resin system. The gel shall be allowed to harden before proceeding with the grouting.

c. Injection of the epoxy resin system adhesive. The equipment for this work shall be as stated in Subsection 501.04. Injection shall begin at the lower entry port and continue until there is evidence of the epoxy adhesive at the entry port directly above, or as the case may be, adjacent to the port being pumped. At this time, the injection shall be discontinued and the port being pumped shall be sealed. The injection shall then be transferred to the next port that indicated the travel of the adhesive in the crack. The length of the crack between the parts shall then be sealed by forcing the epoxy resin adhesive into the crack by using a trowel or spatula. The adhesive gel shall be allowed to harden before proceeding with any grouting. Injection shall be one continuous operation until the crack is filled. The epoxy adhesive manufacturer's recommendations shall be strictly followed as to requirements for safety precautions in handling the epoxy, storage of the material, and mix proportions of the two components and application temperatures. Epoxy resin adhesive shall only be injected when the atmosphere temperature range is within the manufacturer's specification.

When all work is completed and the materials have dried and cured, the crack repair areas exposed to view shall be ground smooth to match the surrounding concrete.

501.13 Removal of Forms and Falsework.{ XE "Concrete structures:forms:removal of" }{ XE "Concrete structures:falsework:removal of" }

Unless concrete strength test specimens are required as controls for form stripping and structure loading, the requirements herein shall apply.

Superstructure load shall not be placed upon finished bents, piers or abutments until authorized, but the minimum time allowed for the hardening of concrete in the substructure before any load of the superstructure is placed thereon shall be 14 calendar days.

Forms and falsework shall not be loosened, disturbed or removed without authorization. Blocks and bracing shall be removed at the time the forms are removed and in no case shall any portion of the wood forms be left in the concrete.

Falsework removal for continuous or cantilevered structures shall be such that the structure is gradually subjected to its working stress. To facilitate finishing, forms used on ornamental work, railings and parapets shall be removed in not less than 12 nor more than 48 hours, depending upon weather conditions. To determine the condition of concrete in columns, forms shall always be removed from them before the removal of shoring from beneath beams and girders.

Forms and their supports may be removed from under arches, bents, pier caps, beams and deck slabs after the expiration of 14 calendar days, column forms after five calendar days, and wall forms and side forms for beams carrying no loads after one calendar day provided that, for structures exposed to sea water, the time for removal shall be as specified in Subheading 14 of the third paragraph of Subsection 501.12.

Falsework and centering for spandrel-filled arches shall not be struck until the back of abutments have been placed up to the spring line. Falsework supporting the deck of rigid frame structures shall not be removed until fills have been placed back of the vertical legs.

Precautions shall be exercised with respect to form removal and load applications for portland cement concrete containing fly ash since the rate of strength development may be slower.

501.14 Finishing Concrete Surface.{ XE "Concrete structures:finishing concrete surface" }

The surface of the concrete shall be finished immediately after form removal.

Vertical outside face of sidewalk and deck slab fascia overhang, vertical surfaces of parapets and all other surfaces to be rubbed shall be given a Class 2 finish. All other concrete surfaces shall be given a Class 1 finish.

In addition to the Class 1 finish, all surfaces of concrete exposed to view in the finished structure shall be finished by rubbing with burlap and grout composed of equal parts of cement and clean, sharp sand to produce a smooth surface of uniform color.

The classes of concrete finish are as follows:

1. Class 1, Ordinary Surface Finish. As soon as the forms are removed, all projecting wire or metal devices that have been used for holding the forms in place and which pass through the body of the concrete, shall be removed or cut back at least 1 inch beneath the surface of the concrete. Lips of mortar and all irregularities caused by form joints shall be removed.

All small holes, depressions and voids that show upon the removal of forms shall be filled with cement mortar mixed in the same proportions as that used in the body of the work. In patching larger holes and

honeycombs, all coarse or broken material shall be chipped away until a dense uniform surface of concrete exposing solid coarse aggregate is obtained. Feathered edges shall be cut away to form faces perpendicular to the surface. All surfaces of the cavity shall be saturated with water, after which a thin layer of neat cement mortar shall be applied. The cavity shall then be filled with stiff mortar composed of one part of portland cement to two parts of sand, which shall be tamped into place. The mortar shall be preshrunk by mixing approximately 30 minutes before using (the length of time may be varied according to the brand of cement used, temperature, humidity and other local conditions). The surface of this mortar shall be floated with a wooden float before initial set takes place. The patch shall be kept wet for a period of five calendar days.

For patching large or deep areas, coarse aggregate shall be added to the patching material and precautions shall be taken to ensure a dense, well bonded and cured patch.

Areas having excessive honeycombs may be considered cause for rejection of a structure. Where written notice is given that a structure has been rejected, said structure shall be removed and rebuilt, in part or wholly, as specified, without additional compensation.

All construction and expansion joints shall be tooled and free of all mortar and concrete.

2. **Class 2, Rubbed Finish.** After removal of forms, the rubbing of concrete shall be started as soon as its condition permits. Immediately before starting this work, the concrete shall be kept saturated with water. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing to set. Surfaces shall be rubbed with a wetted wooden block or a medium coarse carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in proportions used in the concrete being finished. The carborundum stone shall not be used until the concrete has hardened to the state where the sand grinds rather than ravels or rolls. Rubbing shall be continued until all form marks, projections, and irregularities have been removed, all voids filled, and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place. A brush finish or painting with grout will not be permitted.

   After all concrete above the surface being finished has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color.

3. **Class 3, Tooled Finish.** This finish, for panels and other like work, may be obtained by using a bushhammer, pick, crandall, or other approved tool. Air tools, preferably, shall be used. Tooling shall not be done until the concrete has set for at least 14 days or longer, as may be necessary, to prevent aggregate particles from being picked out of the surface. The finished surface shall show a grouping of broken aggregate particles in a matrix of mortar, each aggregate particle being in slight relief.
4. **Class 4, Sandblasted Finish.** The cured concrete surface shall be sandblasted with hard, sharp sand to produce an even, fine-grained surface in which the mortar has been cut away, leaving the aggregate exposed.
5. **Class 5, Wire Brushed or Scrubbed Finish.** As soon as the forms are removed and while the concrete is comparatively green, the surface shall be scrubbed thoroughly and evenly, with stiff wire or fiber brushes, using a solution of one part muriatic acid to four parts water. When the cement film or surface is completely removed and the aggregate particles are exposed, leaving an even pebbled texture having an appearance grading from that of fine granite to coarse conglomerate, the surface shall be washed thoroughly with water containing a small amount of ammonia to remove all traces of acid.
6. **Class 6, Special Surface Finish.** As an alternative to the Class 2 finish, an acrylic latex or other waterproofing type concrete coating may be used after completion of a Class 1 finish on the concrete surface. The finished color of the coating shall be gray, to match the color of the concrete in the structure.

501.15 Deck Slab Surface Texture Finish.{ XE "Concrete structures:deck slabs:surface texture finish" }{ XE "Deck slabs, bridge:surface texture finish" }

The surface of the deck slab shall be finished according to Subsection 405.13 except that Subpart G shall not apply. All concrete bridge deck slabs shall be textured with an artificial turf drag and shall be saw cut groove finished as follows:

{ XE "Concrete structures:deck slabs:surface texture finish:turf drag" **}{** XE "Deck slabs, bridge:surface texture finish:turf drag" **}1. Turf Drag.** Immediately after finishing has been completed, the surface shall be given a texture with an approved turf drag. The drag shall be made of molded polyethylene with synthetic turf blades approximately ½ inch long. There shall be approximately 6,000 blades per square foot.

The drag shall be operated in a longitudinal or transverse direction. Once begun, the direction of texturing shall not be changed. Transverse texturing shall be done from a work bridge.

When texturing is done in the longitudinal direction, the turf drag shall be attached to the finishing machine and shall be a single full-width strip. Small areas inaccessible to the full-width drag shall be textured by hand methods.

The turf drag finish shall be applied so as to prevent ridges or gouges from forming in the concrete surface. The drag shall be weighted and the contact area changed as required to produce a uniform texture. The drag shall be cleaned periodically to remove all hardened concrete particles. Texture resulting from the drag shall stop within 1 foot of curbs.

{ XE "Concrete structures:deck slabs:surface texture finish:saw cutting" **}{** XE "Deck slabs, bridge:surface texture finish:saw cutting" **}2. Saw Cutting.** Saw cutting will be permitted when the deck concrete has attained a strength of at least 4,000 pounds per square inch as determined from cylinders cast during the placing of the concrete deck, as defined in Section 914 and which are at least 14 curing days old. Unless otherwise approved, saw cutting shall be completed before opening to traffic.

When high early strength concrete is used for deck slabs, saw cutting will be permitted when the deck concrete has attained a strength of at least 4,000 pounds per square inch as determined from four additional cylinders cast during the placing of the concrete deck and which are at least seven curing days old.

3. Saw Cut Grooved Surface. The hardened surface of concrete bridge deck slabs shall be grooved except at the locations shown in Table 501-1 below.

At least seven days before saw cutting, a plan of action shall be submitted for approval detailing the layout of the grooving procedure to be followed. Spacing dimensions at the starting and ending point of each pass shall be noted. A description of the saw cutting equipment shall be included.

Grooves shall be cut perpendicular or radial to the centerline of the traveled way. Radial grooving shall be conducted in partial-width passes. Each pass shall be limited to one lane width. Adjustment along the longitudinal axis of the bridge deck shall be made at no less than 12-foot intervals, yielding a uniformly grooved surface finish. Grooves shall be rectangular in shape and shall conform to the following dimensions:

Width ..... 0.10 to 0.15 inch
Depth ..... ¼ to ⅜ inch

Grooves shall be spaced at 1½ ± 1/16 inches center-to-center of groove. This spacing dimension may be increased up to 3 inches at the end of each consecutive, multi-bladed, saw cut pass as necessary to accommodate the distance limits required at the joint system according to Table 501-1 below. The required dimension shall be determined before actual deck grooving and shall be stated in the plan of action. Grooves shall not be cut over an area which has been already grooved. No cutting blade shall be introduced into a groove that has been already established. When it is necessary to rotate the sawing equipment to complete grooving to within the limits specified in Table 501-1 below, the longitudinal gap created shall not be located in a wheelpath and shall be limited to 3 inches of width.

Grooves shall terminate within the limits prescribed in Table 501-1 below.

Table 501-1 Saw Cut Grooved Area Limits{ XE "Tables:portland cement concrete:saw cut grooved area limits" }

Location	Closest Allowable Distance	Farthest Allowable Distance
Drainage Structure	1 ft – 0 in	1 ft – 3 in
Vertical Face (curb or parapet), or Face of Railing (no curb)	1 ft – 0 in	1 ft – 3 in
Joint System	6 in	(see Note 1)

Note 1: This distance is a variable which is dependent upon equipment size. This dimension shall be measured perpendicular to the direction of the grooves. The distance shall be measured from the edge of the joint system and, in no case, shall be greater than the width of the saw head plus a 9-inch tolerance up to a maximum distance of 2 feet-9 inches.

Grooves shall be constructed using multi-bladed saw cutting equipment, fitted with diamond-tipped circular saw blades except when the use of single blade circular saw equipment is permitted where such equipment is necessary to complete the work, as required.

Before grooving operations, two approved gauges to verify groove depth shall be supplied. The gauges shall be accompanied by the manufacturer's instructions for their use.

During grooving operations, the groove dimensions will be checked at random. If the minimum groove depth has not been achieved, grooving operations shall stop and the necessary adjustments shall be made.

Slurry or debris from the grooving operations shall not accumulate in the grooves. Slurry or debris shall not be disposed of in the structure or highway drainage system or on roadway slopes. Slurry shall be collected promptly and removed for off-site disposal.

Sidewalks and top of curbs shall receive a final finish with a fine-bristle broom.

4. **Two-Course Deck Construction.** Upon completion of the first course deck slab placement, it shall be textured with a turf drag finish.

The surface preparation for concrete overlay protective systems shall conform to Subsection 518.06.

Sandblasting and waterblasting equipment shall be approved.

501.16 Concrete Deck Surface Requirements.{ XE "Concrete structures:concrete deck surface requirements" }{ XE "Deck slabs, bridge:surface requirements" }

{ XE "Deck slabs, bridge:permissible surface variations" **}A. Permissible Surface Variations.** The surface of concrete bridge deck slabs will be tested with a Rolling Straightedge that automatically marks, in colored dye, the length of deck surface variations which exceed a tolerance of ⅛ inch in 10 feet.

Deck slabs which are required to be struck and finished with a self-propelled finishing machine shall be so constructed that, when tested according to Subpart C below, the measured length of lot exceeding the specified ⅛-inch in 10 feet tolerance shall not exceed 8.9 percent as specified in Subpart E, Table 501-2, Schedule A below.

When manual strike-off and finishing is permitted and the option for manual methods is used, the deck slab shall be so constructed that the measured length of lot exceeding the specified ⅛-inch tolerance shall not exceed 19.9 percent as specified in Subpart E, Table 501-2, Subschedule B1 below.

If the option to use a self-propelled finishing machine is selected when manual strike-off and finishing is permitted, the deck slab shall be so constructed that the measured length of lot exceeding the specified ⅛-inch tolerance shall not exceed 13.9 percent as specified in Subpart E, Table 501-2, Subschedule B2 below.

{ XE "Concrete structures:concrete deck surface requirements:control testing" **}{** XE "Deck slabs, bridge:control testing" **}B. Control Testing.** Deck slab surfaces shall be systematically checked during placement to correct surface irregularities while the concrete is in a workable condition.

Such systematic control testing shall be performed as follows:

1. After the intended final pass with the finishing machine or other strike-off, the deck surface shall be checked with a metal Straightedge operated parallel to the centerline of the bridge. Surface variations from the testing face of the Straightedge shall be corrected before the concrete sets. Major deviations shall be corrected by the finishing machine or other strike-off, while minor deviations may be corrected by a straightedge or float. The addition of water to the surface of the concrete to assist in finishing operations will not be permitted.
2. The specific conduct of the control testing, including the number and location of Straightedge checks, shall be entirely the province of the Contractor. However, it is suggested that the checking operation progress in successive 5-foot longitudinal increments, with at least one full-slab length straightedge check being made within the transverse limits of each of the designated lanes of traffic.

{ XE "Deck slabs, bridge:aceptance testing" **}C. Acceptance Testing.** Conformance to the surface tolerance for concrete deck slabs will be determined in lots, each lot being equal to the number of cubic yards of deck concrete placed in the designated lanes of traffic in each production day. Such lot quantity will be calculated using the specified nominal deck thickness and excludes the quantity of concrete placed in haunches, end dams, and diaphragms. For the second course of the two-course deck slab construction, such lot quantity will be calculated using the specified nominal thickness of the concrete overlay protective system.

The acceptance of a lot is based on the percentage of the total length of the lot having surface variation exceeding ⅛ inch in 10 feet, this percent noncompliance being defined as the Lot Percent Defective Length. Lot percent defective length is computed by adding the lengths of individual surface defects exceeding the specified tolerance, dividing this sum by the total length tested, and multiplying by 100 to convert to percent.

The full extent of the lot will be tested in the longitudinal direction. The transverse location of the test generally is in the wheelpaths of vehicle travel, defined as the two imaginary lines located approximately 3 feet on each side of the centerline of the lane and extending for the full length of the lane.

The minimum number of full-length tests required to determine the lot percent defective length is equal to the total number of wheelpaths in the lot. The number of tests performed beyond this minimum, if any, and their location, are at the option of the Engineer.

When the lot percent defective length of a deck slab exceeds the value specified in the applicable paragraph of Subpart A above but is less than 25 in the case of a machine-finished deck or 35 in the case of a manually finished deck, and if the slab is not removed and replaced, the lot may be accepted upon written request provided that payment for the lot is adjusted according to Subpart E, Table 501-2 below.

If the lot percent defective length equals or exceeds 25 on any machine finished deck (irrespective of whether such machine finishing was required or optional) or 35 on a manually struck and finished deck, the Engineer may order any or all of the concrete in the lot to be removed, replaced, and retested for acceptance. If the Engineer allows the concrete to remain in place, payment for the lot will be reduced by 15 percent.

Subpart E, Table 501-2 does not apply to the second course of two-course deck slab construction. If the lot percent defective length equals or exceeds 20 on the finished second courses deck slab, the Engineer may order any or all of the concrete in the lot to be removed, replaced, and retested for acceptance. If the Engineer allows the concrete to remain in place, payment for the lot will be reduced by 15 percent.

{ XE "Deck slabs, bridge:cessation of concreting" **}D.Cessation of Deck Concreting**. The Resident Engineer reserves the right to reject bridge deck construction methods or equipment which do not result in surfaces which are in substantial conformity with the ⅛-inch in 10 feet surface tolerance. The deck will be considered in substantial conformity with the required surface tolerance only if the lot percent defective length does not exceed the value specified in the applicable paragraph of Subpart A above.

The continued use of methods and equipment which result in a lot percent defective length of 20 or more on any machine finished deck slab or 35 or more on any manually struck and finished deck will not be permitted. If these limitations are exceeded, deck placement and finishing shall be discontinued until other methods or equipment are proposed for trial and submitted in writing for approval. Approval of this revised plan of operations does not relieve responsibility for the satisfactory performance of the revised method or equipment.

Additional compensation, extension of Contract Time or other concession will not be granted because of revised methods or equipment necessary to produce deck slabs in substantial conformity with the ⅛-inch in 10 feet surface tolerance.

{ XE "Concrete structures:concrete deck surface requirements:surface remedial measures" **}{** XE "Deck slabs, bridge:surface remedial measures" **}E. Surface Remedial Measures.** Regardless of the overall surface conformity of a lot of bridge deck concrete, if surface deviations have a detrimental effect on deck drainage or reinforcement steel cover, the Engineer may require appropriate remedial measures to restore any or all of the deck slab surface to the required grades and surface tolerance. When such remedial procedures are ordered by the Engineer, a plan shall be submitted, setting forth the intended limits of the surface restoration and a complete description of the methods, equipment and materials proposed for use.

Following satisfactory completion of the surface restoration measures to the bridge slab, the lot containing the affected area shall be retested.

Additional compensation, extension of Contract Time or other concessions will not be granted for any surface restorations ordered.

Table 501-2 Reduction Per Lot of Deck Slab Concrete Due to Nonconformance with Surface Requirements{ XE "Tables:portland cement concrete:reduction per lot of deck slab concrete due to nonconformance with surface requirements" }

Schedule A Machine Finishing Required		Schedule B Machine Finishing Optional			
		Subschedule B1 Manual Finishing		Subschedule B2 Machine Finishing	
Lot Percent Defective Length	Reduction Per Lot, Percent	Lot Percent Defective Length	Reduction Per Lot, Percent	Lot Percent Defective Length	Reduction Per Lot, Percent
0-8.9	none	0-19.9	none	0-13.9	none
9.0-13.9	1.0	20.0-27.0	2.5		
14.0-24.9	7.0	27.1-34.9	7.0	14.0-24.0	7.0

Remedial measures will not be required for the surface of the first course construction for high spots which do not exceed the prescribed grade by more than ¼ inch in 10 feet.

501.17 Curing and Protecting Concrete.{ XE "Concrete structures:curing and protecting" }{ XE "Deck slabs, bridge:curing and protecting" }

A. Curing Concrete Under Normal Conditions. Concrete decks, curbs, and tops of sidewalks for one-course deck slab construction shall be cured according to Subheading 4 of Subsection 405.14 with the exception that the minimum wet cure period shall not be less than seven calendar days. According to the provisions of Subheading 3 of Subsection 405.14, the wet burlap shall be covered with white polyethylene sheeting for the seven-day duration. In two-course deck slab construction, the Contractor shall prepare the entire deck surface area according to Subheading 6 of Subpart C of Subsection 518.06 before placing the second course. The second course shall be cured according to Subsection 518.06 C.12.

Other concrete structures and concrete surfaces to receive an epoxy coating, rubbed finish or to be covered with another material shall be cured according to Subheadings 2, 3, 4, and 5 of the sixth paragraph of Subsection 405.14.

{ XE "Concrete structures:curing and protecting:cold weather conditions" **}B. Protection and Curing Under Cold Weather Conditions.** During cold weather, as defined in Subsection 101.03, measures shall be taken to maintain the concrete temperature as specified in Subheading 1 of the second paragraph of Subsection 501.11.

If concrete is placed or is scheduled to be placed at a time when the provisions for cold weather concreting apply according to Subsection 501.11, the Resident Engineer shall be advised of the plans for curing and protecting the concrete. Concrete shall be protected in such a manner as to prevent damage from cold weather. Frozen concrete or concrete damaged by cold weather shall be removed and replaced without additional compensation.

Calendar days on which the surface temperature of the concrete falls below the minimum specified shall not be considered curing days.

Protection under cold weather conditions may be accomplished by heating and housing and by using insulated forms as follows:

1. General. Forms shall be free of ice, snow and frost at time of placing concrete. No substructure concrete shall be placed when the ambient temperature is below 40 ºF, unless the interior of forms, metal surfaces and the surface of the concrete adjacent to the new concrete placement are preheated to that temperature or higher.

Certain procedures and requirements must be adhered to when protecting superstructure concrete. The top of the freshly placed concrete shall be protected as soon as possible with insulating blankets. Tarpaulins or other similar material shall be hung so that the entire section being protected is enclosed. Heated air shall be circulated under this enclosed portion for the full protection period as specified for concrete protected by heating and housing. No superstructure concrete shall be placed when the ambient temperature is below 40 ºF, unless the interior of the

forms, metal surfaces, and the surface of the concrete adjacent to the new concrete placement are preheated to that temperature or higher.

The concrete shall be kept at a temperature not lower than 60 ºF for a period of seven calendar days after placing and then, at a temperature not lower than 40 ºF for a period of four calendar days.

After the specified curing is complete, the temperature of the concrete shall not be permitted to fall at a rate greater than 10 ºF per 12-hour period.

{ XE "Concrete structures:curing and protecting:heating and housing" **}2. Heating and Housing.** Before placing concrete in the forms, housing shall be provided for the section of concrete to be placed so that the temperatures specified can be maintained within such enclosure. Enclosures shall be so arranged as to permit removal of forms and finishing of concrete surfaces without interruption of heating.

The heating system shall be so arranged as to provide uniform heating by forced air or radiation within the enclosure. The heating system shall be operated for a sufficient period of time in advance of placing concrete so that the temperature of form surfaces to be in contact with the concrete, reinforcing steel and abutting construction shall be 70 plus 10 or minus 20 ºF.

During and after the period of placing concrete, the heating plant shall be operated so as to maintain the temperature of the air within the enclosure at 70 plus 10 or minus 20 ºF. Such temperatures shall be maintained in the enclosure until the completion of the curing period.

Salamanders shall be provided at the site or be available within an hour in such quantity as to ensure maintaining the concrete at the minimum temperature specified in the event of a breakdown, and shall be used for such reasonable time as to permit repair of the heating plant, subject to such location, arrangement, operation and provision for moisture.

3. **Insulated Forms.** Insulated forms may be used to protect concrete in abutments, piers, walls and other structure units. The insulation shall be of a type which meets the requirements of cold-weather concreting.

The temperature of the concrete and the temperature of the surface of the forms under the insulation will be checked at intervals, and the temperature of the concrete being mixed shall be adjusted to ensure that the rate of increase in concrete temperature after placement is not greater than 10 ºF per hour. Maximum concrete temperatures shall not be greater than 100 ºF.

The insulated forms shall remain in place for the protection period. The blankets or straw may be removed from tops of footings only as necessary to permit forming for subsequent concrete placements. Approval shall be obtained before loosening forms or removing the top covering.

501.18 Painting Metals.

The exposed surfaces of all metals such as deck joint plates and shapes which are not galvanized or bituminous coated shall be painted. Painting shall conform to Section 503.

501.19 Waterproofing.{ XE "Waterproofing" }{ XE "Concrete structures:waterproofing" }

Waterproofing shall consist of a primer, applied cold, followed by four applications of either tar or asphalt seal coat, applied hot, and three layers of bituminized cotton fabric as follows:

1. **Preparation of Surface.** Before surfaces are waterproofed, they shall be given a Class 1 finish according to Subsection 501.14. Immediately before applying the primer, the surface of the concrete shall be cleaned of all dust or other objectionable material. The surface of the concrete shall be dry and free from frost at the time the primer is applied.

   Joints that are open, but that are not designed to provide for expansion, shall be first caulked with oakum, and then filled, flush with the surface, with hot joint filler.

2. **Application.** Waterproofing shall be applied only in dry weather and when the ambient temperature is above 40 ºF.

   Waterproofing shall begin at the lower part of the surface and continue upward, if on an inclined or vertical surface. On horizontal surfaces it shall begin at one end and continue through to the other end.

   All bitumen, except primer coats, shall be mopped or brushed on the surface to be waterproofed. Spraying will be permitted for primer coats.

   Mopping shall be thorough so that the surface is completely covered and, on fabric, each layer shall be covered so that the weave is concealed and the layers of the fabric entirely separated.

Primer shall be spread over the surface at the rate of not less than 0.2 gallon per square yard and shall be allowed to cure thoroughly before the subsequent coats of hot bitumen are applied.

Not less than 0.25 gallon per square yard shall be used for each coating or between layers of fabric on horizontal surfaces, and not less than 0.30 gallon per square yard on vertical surfaces.

All waterproofing material shall be carried continuously across expansion joints.

Bitumen to be applied hot shall be stirred or otherwise agitated to secure uniform heating and to avoid local overheating.

Application temperatures for asphalt shall be not less than 250 ºF or more than 325 ºF and, for tar, shall be not less than 200 ºF nor more than 250 ºF.

At the point where waterproofing begins and upon the prime coat, a section, 2 inches wider than the strip of fabric to be applied, shall be covered with hot bitumen for the full length of the section and, while the bitumen is still hot, a strip of fabric shall be rolled or pressed thereon. Upon 2 inches of this strip of fabric and the adjoining surface area equal to 2 inches wider than a strip of fabric, a coating of hot bitumen shall be applied and a strip of fabric, full width, shall be rolled or pressed thereon, as required for the first strip. Thereafter, full widths of fabric shall be laid as specified for the first strip, and in such manner that each strip laps the preceding strip by 2 inches. Side laps shall be not less than 2 inches and end laps not less than 12 inches.

The second and third layers of fabric shall be applied in the same manner as the first layer of fabric, but the laps of the layers shall not come directly over the laps of either of the other layers. The third layer of fabric shall be covered with a coat of hot bitumen.

When being placed upon vertical or inclined surfaces, the bitumen between two layers of fabric shall be allowed to cool before placing the next layer of fabric.

When placing upon horizontal surfaces, one layer may be applied immediately following the preceding layer, but care shall be taken not to disturb the preceding layer.

Each strip of fabric shall be laid without folds or creases, and all air bubbles and pockets shall be eliminated.

All surfaces that have been waterproofed with bituminous materials shall be cured before backfilling or other material is placed against them.

501.20 Rock Anchors.

Holes shall be cleaned out by air under pressure. A metal tube, sufficient in length to reach the bottom of the drilled hole, shall be inserted until it touches the bottom of the hole. Grout shall then be placed inside the metal tube which, while being filled, shall be withdrawn gradually allowing the grout to flow into the hole and fill the space behind it. Immediately after the grout has been placed, the steel anchor rod shall be forced into the grout-filled hole by steady pressure or light tapping until it comes to rest on the bottom of the hole.

When the grout has set and hardened sufficiently to be ready for testing, anchor assemblies, amounting to not less than five percent of the total number provided, but in no case less than two, shall be subjected to a pull-out test by the application of a force specified. The test procedure and apparatus are subject to approval.

501.21 Epoxy Waterproofing Seal Coat.{ XE "Epoxy waterproofing seal coat" }{ XE "Concrete structures:epoxy waterproofing seal coat" }

A. Abutment and Pier Seats. The epoxy waterproofing seal coat shall be applied not earlier than seven calendar days after stripping the forms. Before application, the surfaces shall be cleaned of dirt, grease, form oil, or other foreign material which may have accumulated.

The two components of the sealer shall be blended in equal parts by volume, and to each four parts of the mixture thus obtained, there shall be added one part toluene as a thinner. Only enough sealer which can be applied in one hour shall be mixed. The ambient temperature shall be from 40 to 85 ºF at the time of application which shall be by brush only. Two coats shall be applied with the second coat being applied after the first coat is dry. The thickness of the finished coating shall be 10 mils. Before the second coat is dry, and while still tacky, a layer of grit shall be spread over the top surfaces, except on masonry plate bearing areas, and tamped into the sealer. After the sealer has set, all excess grit shall be brushed off.

Bearing surfaces of masonry shall receive the application of sealing compound after they are bush-hammered to the proper elevation.

These waterproofing materials may be toxic and all necessary precautions shall be taken to prevent injury due to their use.

B. Culvert Top Slabs. Epoxy seal coat shall be applied only to top slabs of culverts having less than 2 feet of fill and where HMA overlay is placed directly over the culvert slab. However, epoxy waterproofing seal coat shall not be applied to top slabs which are used as a riding surface.

Epoxy waterproofing seal coat shall be placed only after a dry weather period of at least three days. The concrete surface shall be dry at the time the coating is placed. Air jets or a large vacuum cleaner shall be used to ensure removal of all dust and small particles immediately before coating.

Oil and grease spots shall be removed by scrubbing with hydrochloric acid solution followed by flushing with clear water for about three to five minutes.

The epoxy seal coat shall be applied at the rate of one gallon per 100 square feet. The sealer shall be mixed and applied according to the manufacturer's recommendations. Solvents shall not be added. Hand spraying methods will be permitted provided care is taken to ensure uniform and adequate coverage. The coating shall also be placed on the vertical faces of headwalls for a height of at least 2 inches above the top of fill.

Before the coating has set and while it is still tacky, grit shall be broadcast over the coating by truck spreader or by hand at a uniform rate of at least 5 pounds per square yard on the top surface of the culvert top slab. The grit shall be clean and dry when applied. The grit shall be lightly rolled into the seal coat. When the coating has hardened, the excess grit shall be swept away. The grit removed may be reused on remaining areas to be resurfaced, provided that it is clean and dry.

Backfill or HMA overlay shall not be placed until the sealer has cured sufficiently so as to be tack free. Any areas of the sealer damaged by the operations shall be replaced without additional compensation.

The pot life of the resin, mixing period, maximum time lapse between mixing and grit application and curing period are all dependent on the temperature, humidity, wind conditions and on the proprietary product being used. The manufacturer's recommendations shall be followed.

501.22 Cast Stone.

{ XE "Cast stone lettering panels" **}**Cast stone lettering panels shall be erected in place. The finished product shall conform to the requirements stated on the Plans. Coloring used in the mixture shall be a nonfading mineral especially prepared for use in cast stone.

Cast stone units shall be furnished in one piece, including anchors, and shall be made true and straight. Arrises shall be accurate and clean. A sample of cast stone showing design, coloration and surface finish shall be submitted for approval before casting, if requested.

501.23 Sealing of Joints{ XE "Concrete structures:sealing of joints" }.

Before sealing joints with hot-poured rubber asphalt or cold applied joint sealer, the surfaces of the seams and joints must be clean and dry, and must be free of all loose aggregate, paint, corrosion, form oil and concrete curing compound.

All loose concrete, dirt, and foreign matter shall be removed by sandblasting or by a wire brush. Projections of concrete into the seams shall also be removed. The joints and surfaces adjacent to the seams shall be blown free from all loose dust by means of oil-free compressed air immediately before priming.

Alkaline seepage and form oil shall be cleaned by etching of the concrete surface with hydrochloric acid, thorough rinsing, neutralizing and drying.

The sealing compound shall be made flush with or not more than 1/16 inch above the adjacent surfaces.

501.24 Opening to Traffic.{ XE "Concrete structures:opening to traffic" }

Traffic, heavy equipment, storage of materials, or other loading will not be permitted on a structure or any part thereof until after all forms and falsework have been removed as permitted under Subsection 501.13.

Vehicular traffic of any kind will not be permitted on the deck slab until the deck has been saw cut grooved finished according to Subsection 501.15.

Hand operated buggies, if used, shall be equipped with pneumatic rubber tires and shall not be operated over concrete which has cured less than the seven day wet cured period.

Heavy equipment shall not exceed legal loads unless special lanes are included in the design and the maximum loads are prescribed.

Cranes will be permitted on deck slabs only with specific approval. Stress analysis calculations shall be submitted for loading of the crane, together with location of the crane on the deck slab. Stresses shall not exceed the design allowables by more than 20 percent.

If placement of a crane is permitted, matting shall be provided to protect the deck slab from damage. However, cranes will not be permitted until the concrete has cured 28 calendar days and the compressive strength is not less than the class design strength specified as determined from test cylinders cast during placing of the concrete.

The first course deck slab shall not be loaded with construction equipment until the concrete has cured a minimum of seven days and has attained a strength of not less than 4,000 pounds per square inch as determined from additional concrete cylinders taken at the time of concrete placement as directed by the Engineer. In addition, construction equipment shall not exceed the legal load limit and the size and placement shall be approved by the Engineer before its use.

Concrete cylinders shall be cured under the same conditions as the in-place concrete.

COMPENSATION

501.25 Method of Measurement.

Concrete in the various structures, substructures and superstructures will not be measured and payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided for in Subsection 109.01. Any increase or decrease of the quantity of substructure concrete, from the quantity that is stated in the Proposal, that is due to a change in the final bridge seat elevations to accommodate structural bearing installation, shall not be subject to the provisions of Subsection 109.01 for quantity adjustment.

Concrete seal in cofferdams will be measured by the cubic yard .

Reinforcement steel will not be measured and payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided for in Subsection 109.01, in which case, the weight of steel bar reinforcement will be computed from cutting lists according to Subsection 915.01, Subpart H.

Epoxy waterproofing seal coat and saw cut grooved deck surface will not be measured and payment will be made for the quantity in the Proposal adjusted for Change Orders, except as provided for in Subsection 109.01.

Preformed elastomeric joint sealer, reinforced elastomeric expansion dam, and strip seal expansion dam of the various sizes, will be measured by the linear foot along the centerline including the vertical face of curbs and tops of sidewalks and brush curbs.

Rock anchors will be measured by the linear foot .

Concrete in addition to that required for removable deck forms will not be measured when permanent steel bridge deck forms are used.

Reinforced concrete box culvert, precast will be measured by the linear foot along the centerline.

Overlay protective systems in two-course deck construction will not be measured. The quantity of the overlay protective system will be the quantity in the Proposal adjusted for Change Orders except as provided in Subsection 109.01.

Parapets cast by slip-form method are a non-pay-adjustment-item conforming to Subsection 914.02, Subpart F.

Waterproofing will be measured by the square yard .

Pressure injection of concrete cracks will be measured by the linear foot .

501.26 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CONCRETE IN STRUCTURES, CULVERTS	CUBIC YARD
CONCRETE IN STRUCTURES, FOOTINGS	CUBIC YARD
CONCRETE IN STRUCTURES, RETAINING WALLS	CUBIC YARD
CONCRETE IN SUBSTRUCTURES, ABUTMENT WALLS	CUBIC YARD
CONCRETE IN SUBSTRUCTURES, PIER COLUMNS AND CAPS	CUBIC YARD
CONCRETE IN SUBSTRUCTURES, PIER SHAFTS	CUBIC YARD
CONCRETE IN SUPERSTRUCTURE, DECK SLABS	CUBIC YARD
CONCRETE IN SUPERSTRUCTURE, SIDEWALKS	CUBIC YARD
CONCRETE IN SUPERSTRUCTURE, PARAPETS	LINEAR FOOT
CONCRETE SEAL IN COFFERDAMS	CUBIC YARD
REINFORCEMENT STEEL IN STRUCTURES	POUND
REINFORCEMENT STEEL IN STRUCTURES, EPOXY-COATED	POUND
EPOXY WATERPROOFING SEAL COAT	SQUARE YARD
WATERPROOFING	SQUARE YARD
___ BY ___ " PREFORMED ELASTOMERIC JOINT SEALER	LINEAR FOOT
___ BY ___ " REINFORCED ELASTOMERIC EXPANSION DAM	LINEAR FOOT
STRIP SEAL EXPANSION DAM	LINEAR FOOT
ROCK ANCHORS	LINEAR FOOT

SAW CUT GROOVED DECK SURFACE	SQUARE YARD
REINFORCED CONCRETE BOX CULVERT, PRECAST	LINEAR FOOT
PRESSURE INJECTION, CONCRETE CRACKS	LINEAR FOOT
REINFORCEMENT STEEL IN STRUCTURES, GALVANIZED	POUND
CONCRETE IN SUPERSTRUCTURE, DECK SLABS WITH CORROSION INHIBITOR ADMIXTURE	CUBIC YARD

Payment reductions due to nonconformance with surface requirements will be made according to Subsection 501.16, Subpart E, Table 501-2 and will be applied to the lot volume for concrete in deck slabs.

Payment adjustments for strength will be made according to Subsection 914.02, Subpart E and will be applied to the lot volume for concrete in deck slabs.

All payment reductions or adjustments made according to the above are cumulative.

Payment adjustments for strength will be made according to Subsection 914.02, Subpart E and will be applied to the lot length for concrete in parapets.

Payments for overlay protective systems in two-course concrete deck construction will be made according to Subsection 518.09. Payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided in Subsection 109.01. No separate payment will be made for overlay protective systems used to compensate for low deck grades or when brushed onto the deck surface before placing the overlay. The Contractor shall include such cost in the bid price for the Pay Item "Concrete Deck Overlay Protective Systems, Type ___."

No separate payment will be made for furnishing, incorporating, as well as provision of testing and equipment that is used to provide quality control measures for provision of a concrete mix containing a corrosion inhibitor admixture. Such cost shall be included in the price bid for the applicable concrete Pay Item. When selected as an alternate to two course deck slab construction, the Pay Item "Concrete in Superstructure, Deck Slabs with Corrosion Inhibitor Admixture," shall include the additional concrete that is required to provide the minimum two course deck slab thickness.

No separate payment shall be made for the protection of concrete during the cold weather period. The cost for protecting concrete for the cold weather period shall be included in the price bid for that Pay Item.

SECTION 502 - PRESTRESSED CONCRETE STRUCTURES{ XE "PRESTRESSED CONCRETE STRUCTURES" }{ XE "CONCRETE STRUCTURES:PRESTRESSED" }

502.01 Description.

This work shall consist of the furnishing and erection of prestressed members. All operations pertaining to the fabrication and erection of prestressed concrete structures shall conform to Section 10 of the current AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Section 19 of Division II in the current AASHTO Standard Specifications for Highway Bridges or as amended herein.

Materials, test methods, methods of manufacture, or any other item not specifically covered in the Plans and Specifications shall be according to the Prestressed Concrete Institute (PCI) Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products. Chemical admixtures may be used in the fabrication of prestressed concrete members. Their use shall adhere to the requirements of Subsection 501.03. Corrosion inhibitor admixtures, according to the requirements of Subheading 19 of the third paragraph of Subsection 501.12, may be used in the fabrication of prestressed concrete members.

MATERIALS

502.02 Materials.

Portland cement concrete and grout (non-shrink, nonmetallic) shall conform to Section 914. Other materials shall conform to the following Subsections:

Corrosion Inhibitor Admixture	905.02
Curing Materials	905.03
Preformed Expansion Joint Filler	908.01
Epoxy Waterproofing Seal Coat	912.07
Reinforcement Steel for Structures	915.01
Prestressing Reinforcement	915.02
Bolts and Bolting Materials	917.01
Structural Steel	917.10

Transverse Ties.....917.11
Bearing Pads.....919.02

EQUIPMENT

502.03 Equipment.

A. Jacks. Prestressing shall be done with jacking equipment. If hydraulic jacks are used, they shall be equipped with pressure gauges. The combination of jack and gauge shall be calibrated, and a graph or table showing the calibration shall be furnished. Jacks and pumps shall be calibrated as a unit and shall be clearly marked to ensure they are used as a unit. Should other types of jacks be used, calibrated proving rings or other devices shall be furnished so that the jacking forces may be known.

Before use in manufacture of prestressed members, all jacks to be used, together with their gauges, shall be calibrated and certified by a testing agency.

Calibration of jacks and gauges shall be repeated at intervals of not more than one year. During progress of the work, if any jack or gauge appears to be giving erratic results, or if gauge pressure and elongations indicate differing stresses of more than five percent, recalibration will be required immediately. Means shall be provided for measuring the elongations of reinforcement to at least the nearest 1/16 inch .

B. Forms and Casting Beds. Only metal forms on concrete-founded casting beds shall be used. The forms and casting beds shall be carefully aligned, substantial and firm, braced, and fastened together, sufficiently tight to prevent leakage of mortar and strong enough to withstand the action of mechanical vibrators. The forms should be constructed to permit movement of the members without damage during release of the prestressing force. The casting beds and all form work shall be approved before any concrete is placed therein, but such approval does not signify relief of responsibility for the results obtained. All form release compound shall be VOC compliant and approved for use by the Bureau of Materials.

C. Grouting Equipment. Grouting equipment shall conform to Division II, Section 10 of the AASHTO Standard Specifications for Highway Bridges.

D. Plant Approval. All plants manufacturing prestressed concrete members shall be certified by the PCI to the Category of applicable project work. Also, plants must be so approved by the Department before award of Contract. This certification shall be according to PCI Appendix D, Option (A) of the Manual for Quality Control for Plants and Production of Precast Prestressed Products (MNL-116); Contractor's Option (B) will not be permitted. Written documentation of such certification shall be provided to the Engineer upon request. Requests for Department approval shall be submitted at least three weeks before the date of fabrication.

All plants manufacturing prestressed concrete members shall have a minimum of two load cells that will be used for verifying stressing operations.

A copy of the current field audit report shall be submitted to the Department's Bureau of Materials.

E. Engineer's Office. The Contractor shall provide and maintain in good condition an office, conveniently located, at the prestressing plant for the exclusive use of the Engineer. The office shall be provided and maintained during production and until all items have been shipped to the Project. The office shall have a minimum area of 200 square feet. It shall be adequately heated and cooled to maintain a temperature between 68 and 80 ºF. The doors and windows shall be equipped with adequate locks, and the keys shall be in the possession of the Engineer. The fabricator shall provide the Engineer with access to a facsimile (fax) machine at the fabrication plant for Department or Project related transmissions. The cost for telephone and fax service shall be borne by the fabricator.

The office shall contain:

1. One direct telephone line with an answering machine or voice mail capability
2. Two desks and three chairs
3. One three-drawer file cabinet with lock and two keys
4. One plan table

CONSTRUCTION

502.04 Working Drawings.

Working drawings shall be furnished according to Subsection 105.04 and shall contain the class of concrete, detensioning concrete strength, and tensioning and detensioning patterns. Working drawings showing the pattern and schedule for releasing strands shall be furnished to the inspector before detensioning.

When a prestressed pretensioned beam is designated and a design based on a system other than pretensioning is submitted, the design shall include end blocks.

When a post-tensioned or combination post-tensioned and pretensioned beam is designated and a pretensioned design is submitted, the design may delete the end blocks.

A pretensioned design without end blocks may be submitted.

In the case of multiple span structures, if the design of beams of any one span requires end blocks, the fascia beams for all spans shall have end blocks.

502.05 Inspection and Testing.

The Department shall be notified, in writing, at least 45 days before the start of fabrication so that all component materials may be sampled and tested and the concrete mix design verified. The Department's Bureau of Materials shall be notified in writing a minimum of 21 calendar days before the actual production placement of concrete and 21 calendar days before the Contractor working additional shifts or extended hours that would require the assignment of additional Department inspectors. Quality control of the concrete and acceptance testing will be performed according to Section 914.

Prestressed concrete members shall be fabricated to plan dimensions within the tolerances specified in applicable sections of PCI Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products. Members having dimensions outside the tolerance limits may be subject to rejection unless corrective measures are taken. Beam camber tolerances must be adhered to so that preformed transverse tie holes for prestressed box and slab beams line up correctly during erection, facilitating the placement of transverse ties.

Upon the removal of forms, any unit which has one prestressing strand exposed in excess of 24 diameters, or two or more strands visually exposed, shall be subject to rejection. In addition, honeycombing of the unit, to such an extent that chipping away from honeycombed concrete results in the conditions described for exposed strands, shall also be subject to rejection. The Engineer is the sole judge in determining where the function and use of a particular member is impaired by some dimensional excesses above specified tolerances.

Any unit not fabricated according to the contract documents shall be subject to rejection.

A permanent, unique, identification mark and the date of the casting shall be cast in the top of all members. Upon removal of the forms, the ends of members shall be marked with the same identification marking.

Copies of applicable records shall be kept in conformance with PCI Division 1, Quality Control, and supplied to the Engineer as requested.

The Quality Control Technician performing all tests must be certified to ACI field testing Technician Grade 1.

502.06 Placing Steel.

All reinforcement and prestressing steel shall be accurately placed in position and firmly held during the placing of the concrete. If epoxy-coated reinforcement is used, all ties shall also be epoxy or plastic-coated. The coating of the wire ties shall not crack when the wire ties are twisted or tied to the epoxy-coated reinforcing steel.

Distances from the forms shall be maintained by stays, blocks, ties, hangers, or other such supports. Blocks for holding units from contact with the forms shall be precast mortar blocks. Layers of units shall be separated by mortar blocks or other such devices. Wooden blocks shall not be left in the concrete.

Wires, wire groups, parallel-lay cables, and any other prestressing elements shall be straightened to ensure proper positioning in the enclosures. Bottom strands and side reinforcing bars shall be supported by approved supports at spacings not to exceed 10 feet.

Horizontal and vertical spacers shall be provided, if required, to hold the wires in place in the enclosures.

All lifting devices and reinforcement, including prestressing reinforcement, reinforcing bars, and welded wire fabric shall be free of corrosion, pitting, frost, loose rust, grease, dirt, oil, paint, mill scale, or other deleterious substances. All reinforcement shall be stored above ground, and strand packs shall be covered when not in use. If an anti-bonding agent is used on the forms to facilitate their removal, every precaution shall be taken to protect the prestressing strands against any degree of coating by the anti-bonding agent. Any steel which cannot be cleaned shall not be used.

Enclosures for prestressed reinforcement shall be accurately placed and shall be metallic and mortartight, with the exception that the enclosures may be formed by means of cores or ducts composed of rubber or other such

material which can be removed before installing the prestressing reinforcement. Enclosures shall be strong enough to maintain their shapes under such forces that come upon them. They shall be ¼ inch larger in internal diameter than the bar, cable, strand, or group of wires which they enclose. Where pressure grouting is specified, cores or ducts shall be provided with pipes or other such connections for the injection of grout after the prestressing operations have been completed.

Reinforcement steel shall be placed within the following tolerances:

1. Cover for Reinforcement Steel: Plus ½ inch, minus ¼ inch.
2. Spacing of Reinforcement, excluding stirrups: Plus or minus ½ inch except where inserts, etc., might require some shifting of the bars.
3. Spacing of Stirrup Reinforcement:

Stirrup Spacing (in.)	**Tolerance (in.)**
Spacing ≤ 6	Plus or minus 1
6 < Spacing ≤ 24	Plus or minus 2

4. Projection above top of beams: Plus or minus ½ inch.

In the construction of prestressed concrete I-Beams or prestressed concrete slab and box beams, when the use of galvanized reinforcement steel is planned for the deck construction, reinforcement steel that is used to provide composite action that extends above the bottom of the bottom mat shall be galvanized.

When prestressed concrete piles are to be installed in a project that is located in a marine environment, grit impregnated epoxy-coated prestressing steel strands conforming to the provisions of Subsection 915.02 shall be used. The minimum coating thickness shall be 16 mils. When stored at the site, the strands shall be covered with an opaque polyethylene sheeting or other suitable protective material to protect the reinforcement from exposure to sunlight, salt spray, and weather. For stacked bundles, the protective covering shall be draped around the perimeter of the stack. The covering shall be adequately secured; however, it should allow for air circulation to prevent condensation under the covering. Epoxy-coated prestressing steel shall not be stored within 1,000 feet of ocean or tidal water for more than two months.

502.07 Pretensioning.

The amount of stress to be given each cable shall be as shown on the working drawings. Pretensioning shall be by either the single strand or multi-strand jacking method.

When prestressing is performed by the multi-strand jacking method, the cables shall be brought to a uniform initial tension as specified in Design Aid 11.2.3, "Material Properties Prestressing Steel," of the PCI Design Handbook - Precast and Prestressed Concrete, before be given their full pretensioning. The initial tension of each cable shall be measured by a dynamometer, a gauge, or other such means.

After the initial tensioning, the cables shall be stressed until the specified elongation and jacking pressure are attained.

Draped pretensioned strands shall be pretensioned by either partially jacking at the end of the bed, followed by raising or lowering the strands to their final position, or entirely by the jacking operation.

Low-friction devices shall be used at all points of change in slope of strand trajectory at the time of tensioning of draped pretensioned strands, regardless of the tensioning method used.

If the strands are tensioned in their draped position, they shall be supported by lubricated rollers with bronze bushings or roller bearings at all hold-up points and low-friction, free-turning rollers at all hold-down points, or other such devices.

When strands are deflected after partial tensioning, the strands shall be raised or depressed simultaneously at all points or in an approved specified sequence.

When single strand jacking is used, only one splice per strand will be permitted. When multi-strand jacking is used, either all strands shall be spliced or no more than ten percent of the strands shall be spliced. Spliced strands shall be similar in physical properties, from the same source, and shall have the same twist or lay. All splices shall be located outside of the prestressed units. The ends of the strand lengths to be spliced shall not be torch cut.

Any wire breaks which may occur should be located and the ends tied to the strand with wire to preclude the possibility of raveling during the vibration of the concrete.

The occurrence of more than the permissible number of wire breaks in any particular strand pattern, as shown below, or the occurrence of more than one broken wire in any individual strand requires that the strand or strands be removed and replaced.

For seven-wire strands, the following wire breaks will be permitted to remain on the casting bed under the following conditions:

Less than 20 strands..... 0 wire breaks
20 to 39 strands..... 1 wire break
40 to 59 strands..... 2 wire breaks
60 and more strands..... 3 wire breaks

Failure of wires in parallel wire post-tensioned tendon is acceptable provided the total area of wire failure is not more than one percent of the total area of tendons in any member or more than one wire per tendon (this is comparable to one wire in 15, seven-wire strands).

If a precast or prestressed bed is not poured within 72 hours of tensioning, the Engineer may require the bed to be checked for proper stresses before placement of concrete.

After final stressing, all strands shall be positioned and the stress in the strands shall be uniformly distributed throughout the bed length.

With the cables stressed according to these requirements and with all other reinforcing in place, the concrete shall be cast to the lengths specified. Cable stress shall be maintained between anchorages until the concrete has reached a compressive strength as specified in Subsection 502.09.

For personnel engaged in the tensioning operation, protection shall be provided by means of effective shields adequate to stop a flying strand. These shields shall be provided at both ends of the bed and shall be made of steel, reinforced concrete, heavy timbers, or other material approved by the Engineer.

502.08 Concrete.

The handling, measuring, proportioning, mixing, and placing of concrete shall conform to Section 501. Concrete shall be deposited only in the presence of the Engineer.

All reinforcement shall be free from dirt, loose rust, grease, and other deleterious substances. All items to be encased in concrete shall be accurately placed in position and firmly held during the placing and setting of the concrete. Any inserts to be embedded in the concrete shall be galvanized, stainless steel or epoxy-coated. If, in the opinion of the Engineer, adequate protection of the concrete and forms from inclement weather has not been obtained, work may be suspended.

External vibration may be used to supplement internal vibration. Concrete shall be vibrated internally. Vibrators shall not be used to move the concrete horizontally in the form. The vibrating shall be done in such a manner as to avoid displacement of the reinforcement, prestressing strands, sheaths, shoes, and inserts. Internal vibrators shall have resilient covers when used in the presence of epoxy-coated reinforcing steel.

If concrete is placed on the same bed at different times in the same day, each pour will be considered a separate lot.

The placement of concrete shall not begin and shall be discontinued during periods of any amount of rain at outdoor fabrication facilities. The placing of concrete that arrives after rainfall has started will be delayed until all rainfall has stopped. Concrete will be rejected if any delay exceeds the limits of Section 405 or Section 501. Concrete in transport vehicles shall be protected from the rain during periods of delay in casting by use of covers or other suitable methods. When rain is forecast or imminent, only one individual beam, pile, or other item in a casting bed or form will be started at a time. If rain begins during the placement of concrete, the individual beam, pile, or other item being cast will be finished and immediately covered. The casting of subsequent individual items in that same casting bed or form will not begin until all rainfall has stopped. If casting is delayed and then allowed to resume, all accumulation of water in the forms shall be removed to the satisfaction of the Engineer. The curing of items will begin as required in Subsection 502.11 regardless of whether or not all items scheduled to be cast were completed.

502.09 Transfer of Stress.

The stress transfer shall not be made to the bridge members until the test specimens indicate that the concrete has reached a compressive strength of at least 4,000 pounds per square inch for Class P, 4,500 pounds per square inch for Class P-1, and 5,000 pounds per square inch for Class P-2 concrete.

A minimum of two test cylinders shall be made, and each test cylinder shall exhibit strength greater than that specified for detension for its class. This shall be performed for each lot of concrete for verifying the specified concrete release strength. The test requirements as stated in Note 2 of Table 914-4 of Subsection 914.05 shall be adhered to.

Before any stress is transferred to the bridge members, the pattern and schedule for releasing the strands shall be approved. Forms which tend to restrict the horizontal or vertical movement of the member shall be stripped or loosened before stress transfer.

Transfer of stress shall be either by the multiple strand release method or by the single strand release method.

When the multiple strand method of release is used, either a symmetrical group of strands or all of the strands shall be released gradually and simultaneously. The load on the strands shall be removed from the anchorage and placed on the jacking system. The jack or jacks shall be gradually released until the strands are relaxed.

When the single strand release method is used, the strands shall be detensioned by a slow-heat cutting, using a low-oxygen flame played along the strand for a minimum of 5 inches until the metal gradually loses its strength in the sequence of the pattern and schedule of release. Heat shall be applied at such a rate that failure of the first wire in each strand shall not occur until at least five seconds after heat is first applied. Failure to follow this procedure for transfer of loads will be grounds for rejection of the members involved.

502.10 Removal of Forms and Finishing.

Side forms may not be removed until strength cylinders show that 2,500 pounds per square inch has been achieved. The members shall not be removed from the bottom forms until they have been stressed to sustain all forces and bending moments which may be applied during handling.

Upon removal of the forms, if the Engineer determines that the defective areas can be repaired the area(s) shall be patched according to methods described in Section 3.5.5 of the PCI Manual MNL-116 and as approved by the Engineer. Patched areas shall be adequately cured by methods as outlined in Subsection 502.11.

All formed surfaces of the concrete members shall receive a Class 1 finish according to Subsection 501.14. In addition to the Class 1 finish, all surfaces of concrete exposed to view in the finished structure shall be finished by rubbing and with grout composed of equal parts of cement and sand to produce a smooth surface of uniform color and texture. The top surface of members shall be scored transversely with a stiff wire brush. After hold-down devices are removed from the bottom of the beams, the resulting holes shall be coated with an epoxy bonding compound and plugged with mortar. Vent holes for box beams shall be patched upon removal from forms after the internal void drains are opened.

502.11 Curing.

Curing of the concrete members shall be by any one of the methods specified in applicable sections of the PCI Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products.

If steam curing is used, however, the applications of steam within the enclosure shall be delayed for a period of five to six hours when the air temperature is 50 ºF or lower and shall be delayed for a period of three hours when the air temperature is 50 ºF or higher. If retarders are used, the waiting period shall be from four to six hours regardless of the air temperature. The temperature in the enclosure shall be maintained between 90 and 150 ºF for a period of 12 hours.

When the ambient air temperature is below 50 ºF, the forms shall be covered after the placement of concrete, and sufficient heat shall be applied to maintain the temperature of the air surrounding the unit between 50 and 70 ºF until the end of the waiting period.

When the ambient air temperature is above 100 ºF, a water cure or other approved method shall be initiated as soon as the concrete is able to receive the water without physical damage to its surface. The cure may be discontinued upon introduction of steam, provided that a relative humidity of 100 percent is maintained.

Representative concrete test cylinders, similarly cured, shall be tested after the curing procedure specified. Should tests indicate the concrete members have not achieved a compressive strength of at least 4,000 pounds per square inch for Class P, 4,500 pounds per square inch for Class P-1, and 5,000 pounds per square inch for Class P-2 concrete, the members shall be cured further until the required strength is achieved.

502.12 Post-Tensioning.

Tensioning of the prestressing reinforcement shall not commence until tests on concrete cylinders made of the same concrete and cured under the same conditions indicate that the concrete of the particular member to be prestressed has attained a compressive strength of at least 4,000 pounds per square inch for Class P, 4,500 pounds per square inch for Class P-1, and 5,000 pounds per square inch for Class P-2 concrete.

After the concrete has attained the required strength, the prestressing reinforcement shall be stressed by means of jacks to the desired tension and the stress transferred to the end anchorage.

The tensioning process shall be so conducted that the tension being applied and the elongation of the prestressing elements may be measured at all times. The friction loss in the element; i.e., the difference between the tension at the jack and the minimum tension, shall be determined according to Subsection 5.9.5.2.2b of the current AASHTO LRFD Bridge Design Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, this shall be determined according to Division I, Section 9 of the AASHTO Standard Specifications for Highway Bridges. A record

shall be kept of gauge pressures and elongation at all times and submitted for approval. A record shall be kept of gauge pressures and elongation at all times and submitted for approval.

502.13 Grouting of Bonded Steel.

Grouting shall conform to Section 10 of the current AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Section 10 of Division II in the current AASHTO Standard Specifications for Highway Bridges.

502.14 Transverse Ties and Keyway Grouting.

A. Transverse Ties. Transverse ties for prestressed concrete voided slab and box beams shall consist of high-strength steel bars or ½-inch diameter, 270-kip per square inch strands conforming to Subsection 917.11. If used, no splices will be allowed in the ½-inch diameter strands. Anchorage details and design calculations signed and sealed by a Professional Engineer licensed to practice in the State shall be submitted to the Engineer for approval. Transverse ties shall be installed through 3-inch diameter preformed ducts before the longitudinal keyways are grouted. Transverse ties shall be tensioned before grout placement. The tie rod bars shall be tensioned by torquing to the value indicated on the Plans. The ½-inch diameter tie strands, if used, shall be tensioned to the force indicated on the Plans. Precautions shall be taken during the tensioning process to prevent any damage to the concrete under the outside bearing plates. The tensioning process shall be conducted so that the tension being applied may be measured at all times.

After the transverse ties have been tensioned, the exposed ends at the fascia members shall be removed so that no part of the ties or end fittings extend beyond a point 1 inch inside the exterior face of the prestressed concrete member. All exposed strand or rod ends at end fittings shall be permanently protected from corrosion by a method approved by the Engineer, and the recessed pockets at the fascia shall be filled with grout matching the concrete surface.

B. Grouting of the Longitudinal Keyways Between Adjacent Prestressed Box and Slab Beams. The keyway surface shall be sandblast cleaned of any material which may prevent bonding (e.g. oil, grease, water, dirt, etc.) before erection. Sandblasting may be done at the fabrication plant or in the field. If sandblasting is to be done at the plant, the working drawings shall so indicate. Waterblasting may be substituted for sandblasting.

Immediately before filling the keyway with grout, it shall be cleaned of all debris. After cleaning, it shall be sealed with closed cell foam backer rod at least ¼ inch below the keyway bottom. No further work shall be done to the keyway before the Engineer's inspection and approval of the sealing operations. The ends of the keyway shall also be sealed to prevent grout loss.

Immediately before placing grout, the keyway surfaces shall be thoroughly wetted with clear water. No puddling of water shall be allowed.

Keyways are to be filled with grout conforming to Subsection 914.03.

Grout shall be mixed, placed, and cured as per the manufacturer's recommendations, or as directed. Grout shall be thoroughly rodded as it is placed in the keyway, and it shall be finished flush with the top of the keyway. Only one keyway shall be filled with grout at a time. The grouting operation shall begin at one end of the keyway and proceed continuously to the opposite end. Grout placement interruption will not be permitted.

For the placement of grout, the ambient temperature shall be between 40 and 85 ºF. When ambient temperature is expected to fall below 40 ºF, measures shall be provided to maintain the concrete surface temperature between 40 and 85 ºF. The Contractor shall supply and place suitable curing blankets over the grout after placement. The blankets shall be placed no later than one hour after the grout placement. The curing blankets shall remain on the grouted keyways for a minimum of 48 hours. Curing blankets shall comply with the requirements of Subsection 905.03.

No traffic or equipment shall be permitted on the bridge until grout in the keyways has cured for a minimum of 72 hours.

502.15 Storage, Transportation, and Erection.

All members may be handled immediately after completion of stressing. If stressing is not done in a continuous operation, members shall not be handled before they are sufficiently stressed to sustain all forces and bending moments due to handling. All surface finishing operations shall be completed, and all members shall be in an acceptable condition before being placed in storage.

Units shall be surface dry before removal from beds when air temperatures are below 40 ºF. When the air temperature is below 32 ºF, thermal blankets shall be applied to the beams, and the concrete surface temperature shall be maintained above 32 ºF.

Portions of prestressed concrete beams as delineated on the Plans shall be treated with an epoxy waterproofing seal coat. The epoxy waterproofing seal coat shall not be applied to the top surface of any beam. The seal coat shall be applied at the plant not earlier than 72 hours after the transfer of stress. The concrete surface shall be dry and clean at the time the coating is applied. Before application, the concrete shall be cleaned of dirt, grease, form oil, or other foreign material. The sealer shall be mixed and applied according to the manufacturer's recommendations. Application shall be by brush only, unless otherwise approved by the Engineer. Care shall be taken to ensure uniform and adequate coverage. The color of the epoxy waterproofing seal coat shall closely match the color of the concrete.

Beams shall not be placed outside the bed unless the differential between beam and air temperature is less than 80 ºF.

The Engineer shall be given two working days notice before shipping. During this time the fabricator shall ensure that the prestressed concrete members comply with the Contract requirements.

The prestressed beams shall not be shipped until the minimum 28-day compressive strength has been attained, but in no case before 72 hours total storage time has elapsed following transfer of stress. If shipments are permitted before 28 days following casting, the additional test cylinders must attain a strength of at least 200 pounds per square inch higher than the specified 28-day compressive strength.

Care shall be exercised in handling and moving precast, prestressed concrete members. Precast girders and slabs shall be transported in an upright position, and the points of support and directions of the reactions with respect to the member shall be approximately the same during transportation and storage as when the member is in its final position. If it is deemed expedient to transport or store precast units in other than this position, it shall be done after notifying the Engineer of the intention to do so. Units damaged by improper storage or handling shall be replaced.

Before box and slab beams are moved to storage, all nonmetallic draining devices shall be inspected and opened to provide satisfactory passage of water.

A pre-erection meeting will be scheduled, at least 20 calendar days before the start of erection, before which a written plan of operations shall be submitted. This plan shall include, but not be limited to, the method of erection and the amount and character of equipment and manpower.

Erection of prestressed concrete beams shall not proceed until substructure concrete has been cured for the minimum length of time specified under Subsection 501.13. The embankment backfill shall be in place behind the abutment walls to at least 50 percent of their height before erection unless otherwise approved.

Anchor bolts for masonry plates of structural steel bearings shall be set according to Subsection 501.12.

Dowels used to anchor prestressed concrete voided slabs and box beams to abutments and piers shall conform to Subsection 917.01.

COMPENSATION

502.16 Method of Measurement.

Prestressed concrete members of various sizes will be measured by the linear foot. Structural Bearings shall be measured according to Subsection 503.17.

502.17 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
PRETENSIONED PRESTRESSED CONCRETE BEAMS, ___ "	LINEAR FOOT
PRESTRESSED CONCRETE BOX BEAMS, (TYPE ___), ___ BY ___ "	LINEAR FOOT
PRESTRESSED CONCRETE SLAB BEAMS, (TYPE ___), ___ BY ___ "	LINEAR FOOT

Payment for cast-in-place concrete and reinforcement steel for diaphragms will be made according to Section 501.

Payment adjustments for strength will be made according to Subsection 914.02, Subpart E, and will be applied to the lot length for prestressed concrete beams.

Separate payment will not be made for incorporating chemical admixtures into the concrete mix.

Separate payment will not be made for furnishing, incorporating, as well as provision of testing and equipment that is used to provide quality control measures for provision of corrosion inhibitor admixtures.

Separate payment will not be made for application of an epoxy waterproofing seal coat treatment on prestressed concrete members.

All costs thereof shall be included in the price bid for the applicable prestressed concrete Pay Item.

Payment for Structural Bearings shall conform to Subsection 503.18.

SECTION 503 - STEEL STRUCTURES{ XE "STEEL STRUCTURES" }{ XE "STRUCTURES:STEEL" }

503.01 Description.

This work shall consist of the furnishing, fabrication, erection and painting of bridges, structures, furnishing of structural bearing assemblies, and associated elements which are composed of structural steel and miscellaneous metals.

Materials and construction operations not specifically covered on the Plans and in these Specifications shall be according to the current AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be according to Division II in the current AASHTO Standard Specifications for Highway Bridges.

MATERIALS

503.02 Materials.

A. Materials. Materials shall conform to the following Subsections:

Bearing and Expansion Plates	911.02
Inorganic Zinc Coating System	912.13
Grout	914.03
Bolts and Bolting Materials	917.01
Flooring	917.02
Steel Bearings	917.06
Steel Castings	917.07
Steel Forgings	917.08
Structural Steel	917.10
Zinc-Coating on Steel	917.12
Bearing Pads	919.02

B. Toughness Requirements. Steel bridge member components designated “T” shall conform to the toughness requirements specified in Subsection 917.10.

C. High-Load Multi-Rotational (HLMR) Bearing Assemblies. High-load Multi-rotational bearings shall be defined as bearings that consist of a rotational element of the pot type, disc type, or spherical type when used as a fixed bearing and that may, in addition, have sliding surfaces to accommodate translation when used as an expansion bearing. Translation may be constrained to a specified direction by guide bars. Accordingly, when High-load Multi-rotational bearings are noted on the plans as permitted for use in a project, either type may be provided. In the manufacture of such bearings the following shall apply:

1. **Steel.** Steel that is to be used in the bearing assemblies shall conform to AASHTO M 270, Grades 250 or 345, or 50W, except for steel that is used for guide bars and shear restriction pins and sleeves. The guide bars and shear restriction mechanisms shall be according to the manufacturer’s specifications and as approved by the Engineer.
2. **Elastomeric Disc.** Furnishing of the Elastomeric Disc element shall conform, as applicable to the Design Specifications, to Division II, Section 18 of the current AASHTO Standard Specifications for Highway Bridges or Section 18 of the current AASHTO LRFD Bridge Construction Specifications. For the following two type bearing assemblies, the elastomeric disc element shall conform to the following:
   a. **Pot Bearings.** A Shore A Durometer finish shall be provided. Virgin crystallization resistant polychloroprene (neoprene) or virgin natural polyisoprene

(natural rubber) shall be used as the raw polymer. Individually molded and one piece elastomers shall be used.

b. Disc Bearings. Polyether urethane shall be used.

3. Sliding Surfaces. PTFE sliding surfaces shall conform to Subsection 18.8 of the current AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Subsection 18.8 of Division II of the current AASHTO Standard Specifications for Highway Bridges.

The Polytetrafluorethylene (PTFE) sheet and strip shall be manufactured from pure virgin (not reprocessed) unfilled PTFE resin; from PTFE resin uniformly blended with either 15 percent glass fiber or 25 percent carbon (maximum filler, percent by weight); or, from the fabric containing PTFE fibers. Heat cured, high temperature epoxy capable of withstanding temperatures of –360 to 500 ºF shall be used when bonding the PTFE to its steel substrate. This shall conform to Section 18 of the current AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Section 18 of Division II of the current AASHTO Standard Specifications for Highway Bridges.

4. Sealing Rings. The sealing rings shall be of metal and shall conform to the following requirements:

a. Flat brass rings, ASTM B 36 half hard.

b. Round cross-section wings, Federal Specifications QQB626, Composition 22, half hard.

5. Bronze Elements. Bronze elements shall be in conformance with, as applicable to the Design Specifications, Subsection 18.6.1 of Division II of the current AASHTO Standard Specifications for Highway Bridges or Subsection 18.6.1 of the AASHTO LRFD Bridge Construction Specifications.

6. Stainless Steel. Stainless steel shall conform to the requirements of ASTM A167 Type 304 or ASTM A240 Type 304. The minimum thickness shall be 1/16 inch .

7. Lubricant. The lubricant shall be solid lubricant consisting of a combination of solids having non-deteriorating characteristics as well as lubricating qualities and shall be capable of withstanding long term atmospheric exposure, de-icing, materials and water. The use of molybdenum disulfide and other ingredients which promote electrolyte or chemical action between the bearing elements shall not be used. The use of shellac, tars, asphalts or petroleum solvents as binders is not permitted.

D. Seismic Isolation Bearings. In the manufacture of Seismic Isolation Bearings, the following shall apply:

1. Isolation Bearing assemblies shall include seismic isolation bearing (isolators), sole plates, masonry plates, mounting plates, lead core, steel shims, bolts, washers and anchor bolts.

a. The isolators shall consist of one of the following types:

(1) Elastomeric bearing with lead core type consisting of alternate layers of natural rubber and steel plates with a preformed hole at the center of the unit filled tight with a pure lead plug. The elastomeric bearing shall be vulcanized to the top and bottom load plates.

(2) Sliding bearings consisting of PTFE stainless steel surfaces that are to be used in conjunction with an optional spring/damping assembly.

b. The elastomers of the isolators shall be natural rubber, Type NR Grade 3 per ASTM D4014-81, meeting or exceeding the following requirements:

(1) Heat Resistance.
ASTM D 573 (158 ºF for seven days)
Maximum permissible change in tensile strength: 25 percent
Maximum permissible change in ultimate elongation: 25 percent
Maximum permissible change in durometer hardness: +10 points

(2) Compression Set.
ASTM D 395 Method B (158 ºF for 22 hours)
Maximum permissible set: 25 percent

(3) Low Temperature Properties.
ASTM D 2137 Method A (Brittleness Test at –13 ºF): no failure
ASTM D 1229 (Compression Set at 14 ºF for seven days at 25 percent compression): maximum permissible set: 65 percent.

ASTM D 2240 (Low Temperature Stiffness. Conditioned for 22 hours at –13 ºF): maximum permissible change in durometer hardness: +15 Shore A points

(4) Ozone Resistance of Elastomer. Ozone resistance shall be determined by tests on strips of representative material mounted per Method A of ASTM D 518. The tests shall be performed by ASTM D 1149 at an ozone concentration of 50 ± 5 parts per hundred million at 20 percent strain between 100 ± 2 ºF for 100 hours. The ozone resistance shall be regarded as satisfactory, if on conclusion of a test, no cracks are visible using 7X magnification.

(5) Bond of Elastomer to Steel Laminate. The average of the peak values of force during separation to determine the minimum peel strength shall be at least 40 foot pounds per inch. The failure type shall be 100 percent rubber tear. Peel strength tests shall be performed by ASTM D 429 Method B.

(6) Tensile Strength and Ultimate Elongation of Elastomer. Minimum tensile strength and ultimate elongation tests shall be performed by ASTM D 412. The minimum tensile strength shall be 2,250 pounds per square inch and the minimum ultimate elongation shall be 550 percent.

(7) Shear Modulus at 50 Percent Shear Strain of Elastomer: The shear modulus of the elastomer at 50 percent shear strain shall be determined by ASTM D 4014. The tangent modulus shall be 100 pounds per square inch ± ten percent.

c. Steel reinforcement and load plates shall be made from rolled carbon steel conforming to ASTM A 36 or A 570.

d. The purity of lead shall be established by chemical analysis from a sample of what is used in the isolators. This test shall confirm a minimum of 99 percent purity of the lead.

e. For acceptance of alternate materials, the Contractor must submit a request to the Engineer within 90 days after Contract award. The specific isolator details and description of the materials to be used shall be forwarded with this request to the Engineer.

2. The elastomer of the sliding bearing shall be polyether urethane. The polyether urethane, PTFE and stainless steel elements shall conform to Section 18 of the AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Section 18 of Division II of the current AASHTO Standard Specifications for Highway Bridges.

3. Suppliers of isolation bearing assemblies shall document a minimum of five years of previous history in the design and fabrication of isolation bearings. A list of other state agencies that have approved the system shall also be provided. The design of the isolation bearing assemblies shall be performed and stamped by a Professional Engineer licensed to practice in the State.

E. Elastomeric Bearing Assemblies. In the manufacture of circular or rectangular steel reinforced elastomeric bearings and elastomeric bearing pads, the following shall apply:

1. Elastomer Material. The raw elastomer shall be either virgin neoprene (polychloroprene) or virgin natural rubber (polyisoprene). The elastomer compound shall be classified as being of low temperature grade 0, 2, 3, 4 and 5. The grades are defined by the testing requirements specified in Section 18 of the current AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Section 18 of Division II of the current AASHTO Standard Specifications for Highway Bridges. A higher grade of elastomer may be substituted for a lower one. In the absence of more specific information, bearings shall be Grade 3, 60 durometer elastomer.

The elastomer compound shall meet minimum AASHTO requirements except as otherwise specified by the Engineer. The nominal hardness of the compound shall lie between 50 and 60 for reinforced bearings and between 50 and 70 for plain pads. Test requirements may be interpolated for immediate hardness. If the material is specified by its shear modulus, its measured shear modulus shall lie within 15 percent of the specified value. A consistent value of hardness shall also be supplied for the purpose of defining test limits. All material tests shall be carried out at 73 ± 4 ºF unless otherwise noted. Shear modulus tests shall be carried out using the apparatus and

procedure described in annex A of ASTM D 4014, amended where necessary by AASHTO requirements.

2. **Fabric Reinforcement.** Fabric reinforcement shall be woven from 100 percent glass fibers of "E" type yarn with continuous fibers. The minimum thread count in either direction shall be 635 threads per inch. The fabric shall have either a crowfoot or an 8 Harness Satin weave. Each ply of fabric shall have a minimum breaking strength of 20,300 lbs/in of width in each thread direction.
3. **Bond Strength.** The vulcanized bond between fabric and reinforcement shall have a minimum peel strength of 750 lbs/in. Steel laminated bearings shall develop a minimum peel strength of 1,000 lbs/in. Peel strength tests shall be performed by ASTM D 429 Method B.

503.03 Inspection and Testing.

Inspection and testing shall conform to Section 6 of the ANSI/AASHTO/AWS D1.5 Bridge Welding Code as modified by the following:

1. Steel bridge bearings are considered to be main load carrying members.
2. Structural steel fabricating plants shall be certified under the AISC Quality Certification Program in the following categories by the type of work performed:
   - **a. Simple Steel Bridge Structures (SBr):** Includes highway sign structures, parts for bridges (such as cross frames), unspliced rolled beam bridges.
   - **b. Major Steel Bridges (MBr):** All bridge structures other than unspliced rolled beam bridges.
   - **c. Fracture Critical Members Endorsement (F):** Familiarity with procedures required to produce critical members according to a fracture control plan as defined by AASHTO or AREMA.

   Structural steel fabricators certified by AISC for Major Steel Bridges are automatically certified for Simple Steel Bridges.
3. Quality control inspections shall be performed at least to the minimum extent specified, and additionally, any other testing and inspections necessary to control production quality shall be made. Quality assurance inspections will be performed by the Department.
4. Initial testing for quality control is to be followed by quality assurance testing performed during normal Department working hours. All repairs shall be tested in the same manner. Further assembly is prohibited until quality assurance acceptance by the Department as follows:
   - **a. Shop Inspection.** The Department shall be notified, in writing, 15 calendar days in advance of the date of beginning of work at the fabrication shop, so that arrangements for inspection may be made. Any materials rolled or work done before inspection may be rejected. The term mill means any rolling mill or foundry where the material for the work is to be manufactured and fabricated.

     Certified mill reports that indicate the chemical and physical properties of the material to be used shall be submitted to the Bureau of Materials. Samples and test pieces shall conform to Subsections 105.06 and 106.03.
   - **b. Nondestructive Testing.** Field welded splices, if any, will be inspected by nondestructive tests at the site of erection.

     The Department shall be notified, in writing, not less than 15 calendar days in advance, when any shop or field welding is to be undertaken so that arrangements for inspection may be made.
   - **{** XE "Steel structures:fracture contol plan" **}c. Fracture Control Plan.** Steel bridge members or member components designated as Fracture Critical Members (FCM's) shall conform to the provisions of the most current edition of ANSI/AASHTO/AWS D1.5 Bridge Welding Code, Section 12 "ANSI/AASHTO/AWS Fracture Control Plan (FCP) for Non-Redundant Members."
5. In the furnishing of seismic isolation bearing assemblies, elastomeric bearing test results for both compression stiffness and combined compression and shear (as specified in Section 15 of the AASHTO Guide Specifications for Seismic Isolation Design) shall be provided to the Engineer. The test load for each isolator type shall be provided to the Engineer. The test load for each isolator type shall bedetermined from the maximum design dead load plus live load that is to be applied to that particular isolator type. All test results shall identify the isolators by the supplier identification number.
   - a. During the compression and combined compression/shear tests on completed isolators, each isolator shall be closely inspected for lack of rubber to steel bond, laminate placements faults, or for the appearance of at least three separate surface cracks that are wider and deeper than 1/16 inch. Any isolator showing such signs shall be rejected.
   - b. The results of each isolator test shall be evaluated for the following performance requirements:

(1) The effective stiffness (Keff) shall fall within a range of ± 15 percent of the predicted value;
(2) The slope of the loading curve (K) shall be greater than or equal to 90 percent of the predicted value; and
(3) The average value of energy dissipated per cycle (EDC) shall be equal to or greater than 90 percent of the predicted value.

c. In addition to the requirements of Subsection 106.04, the Contractor's isolator supplier shall submit Certificates of Compliance for the isolators indicating that the materials, fabrication, testing, and installation are according to these Specifications.

d. The following criteria shall be furnished for isolators to be acceptable:
(1) Testing as defined in the AASHTO Guide Specifications for Seismic Isolation Design.
(2) Provision of a copy of the manufacturing specifications.
(3) The name of the firm that will manufacture the system.
(4) Shake table test results demonstrating viability of the complete system.
(5) Analytical results showing maximum seismic forces and displacements at all locations, according to the AASHTO Guide Specifications for Seismic Isolation Design.
(6) Adherence to the design and construction requirements of Section 14 of the AASHTO LRFD Bridge Design Specifications and Section 18 of the AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, adherence shall be to Section 14 of Division 1 and to Section 18 of Division II of the current AASHTO Standard Specifications for Highway Bridges.

CONSTRUCTION

503.04 Working Drawings. Working drawings shall be furnished according to Subsection 105.04.

A. High Load Multi-Rotational Bearing Assemblies. For the furnishing of High-load Multi-Rotational Bearing assemblies, the following information shall be provided:

1. The total quantity of each kind of bearing required (fixed, guided-expansion, or non-guided expansion), grouped first according to type (load range) and then by actual design capacity.
2. Plan view and section elevation including all relative dimensions.
3. Details of all components and sections showing all materials incorporated into the bearing.
4. All ASTM, AASHTO, and other material designations.
5. The maximum design coefficient of friction as noted on the Plans.
6. Clearly describe and detail any welding process used in the bearing manufacture that does not conform to the approved processes of the current ANSI/AASHTO/AWS D1.5 Bridge Welding Code.
7. Vertical, horizontal, rotation, movement, and load capacity.
8. A schedule of all bearing offsets, if required by the Project.
9. Alignment plans.
10. Paint or coating requirements.
11. Installation scheme.
12. Complete design calculations verifying conformance with the provisions of this Section. Stress analysis and the mechanics of standard bearing details are not required.
13. Anchorage details.
14. Bearing pre-set details.
15. Location of the fabrication plant.
16. The manufacturer's name and the name of its representative responsible for coordinating production, sampling, and testing.
17. The fabricator's certification package, according to Subsection 106.04, that shall contain the following:
    a. Material test reports for all steels used except AISI C1018 and C1020 for which a mill conformance certificate is acceptable.
    b. Certificate of Compliance for all non-ferrous metals.
    c. Material test reports for any elastomeric components.
    d. Certificate of Compliance for PTFE and any adhesive used.
    e. A Certificate of Compliance for the bearings, executed by an officer of the manufacturing company.

f. Certificate of Compliance for any dowels or bolts supplied.
g. Test reports for the performance tests.

B. Seismic Isolation Bearing Assemblies. In the furnishing of Seismic Isolation Bearing assemblies, the following shall be provided:

1. Plan and elevation of each isolator size.
2. Complete details and sections showing all materials (with ASTM or other designations) that are incorporated in the isolators.
3. Vertical and horizontal load capacity.
4. Details of the connections of the isolator load plates to the mounting plates.
5. Any required revisions or additions to concrete members, reinforcement steel or other facilities.

C. Final Design of Bearing Assemblies. Final design of bearing assemblies shall be submitted as Working Drawings.

1. Permitted types shall be stated on the Plans and shall be according to Subsection 503.02 and Subsection 503.08, Subpart D. The manufacturer shall submit to the Engineer shop drawings and design calculations that are sufficiently detailed to permit proper review of structural bearings. The shop drawings shall include a tabulation showing total quantity and type of required bearings (fixed, guided expansion, or non-guided expansion), grouped first according to type (load range) and then by actual design capacity shall be provided. The drawings shall show all details of the bearings and of the materials proposed for use and must be approved by the Engineer before fabrication of the structural bearings begins. Such approval shall not relieve the Contractor of all responsibility under the contract for the successful completion of the work.

2. In addition to the submission requirements stated above, the total quantity and type of required bearing (fixed, guided expansion, or non-guided expansion), grouped first according to type (load range) and then by actual design capacity shall be provided.

503.05 Fabrication and Welding.{ XE "Steel structures:fabrication and welding" }

A. Fabrication. Fabrication of steel structures, including but not limited to, bolt holes, finishing and shaping, bolts and bolted connections, pins and rollers, shop assembly, tests, marking and shipping shall conform to Section 11 of the current AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Section 11 of Division II of the current AASHTO Standard Specifications for Highway Bridges.

B. Welding. Welding shall conform to the current ANSI/AASHTO/AWS D1.5 Bridge Welding Code except that electro-slag weldments on main structural members will not be permitted. Welding of miscellaneous details (supports for screed rails, form attachments, connection plates, etc.) to members or parts of members subject to tension or reversal of stress is not recommended and shall only be performed when specifically approved by the Engineer. Where welding cannot be avoided and is authorized, the actual stress range (FSR) at the point of attachment shall not exceed the value from AASHTO Table 10.3.1A, Category F. The attachment of these details is not permitted where the stress range exceeds FSR.

C. Tack Welding. Tack welding of miscellaneous details, if approved, shall conform to the ANSI/AASHTO/AWS D1.5 Bridge Welding Code Subsection 3.3.7. The ANSI/AASHTO/AWS D1.5 Bridge Welding Code is amended as follows:

1. The following is added to the provisions of 3.13.2:
   a. All steel backing of weld on the outside faces of fascia girders shall also be removed and the joints ground or finished smooth.
2. The following is added to the provisions of 6.7:
   a. Butt weld splices in longitudinal stiffeners shall also be tested by nondestructive testing.
   b. All joints subject to tension or reversal of stress and all butt welds shall be tested for the full length of the weld and will be tested for quality assurance.
   c. All welds scheduled for nondestructive testing under quality control and quality assurance inspection procedures shall be ground flush for the full length of the weld. Grinding shall be in the direction of applied stress.
   d. For purposes of quality assurance inspection, groove welds will be tested using ultrasonic testing procedures which may be supplemented by radiographic testing.
   e. When radiographic inspection is performed to butt welds or plate edges, edge blocks shall be used. Edge blocks shall have a length sufficient to extend beyond each side of the weld centerline for a minimum distance equal to the weld thickness, but no less than

2 inches, and shall have a thickness equal to or greater than the thickness of the weld. The minimum width of the edge blocks shall be equal to half the weld thickness, but not less than 1 inch. The edge blocks shall be centered on the weld with a snug fit against the plate being radiographed, allowing no more than a 1/16-inch gap. Edge blocks shall be made of radiographically clean steel and the surface shall have a finish of ANSI 0.12 mils or smoother.

3. The following is added to the provisions of 7.4:
   a. Stud shear connectors shall be installed in the field, only after the structural steel is erected and before placing of reinforcement steel, with automatically timed stud welding equipment connected to a suitable power source.
4. The following is added to the provisions of 3.4.6 and 9.17:
   a. The Engineer will approve any change in number or location of shop or field splices.
5. All shop assembly shall be completed, inspected, and approved by the Engineer before blast cleaning and paint application. All oil and grease shall be removed according to SSPC-SP1 before shop blasting and application of paint.

D. Fabrication of High Load Multi-Rotational Bearing Assemblies.

1. Fabrication. Section 18 - Bearings of the AASHTO LRFD Bridge Construction Specifications shall be followed for the fabrication of multi-rotational bearing assemblies. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Division II, Section 18 of the AASHTO Standard Specifications of Highway Bridges.

2. Painting. Paint shall be applied after completion of all welding. If the time of exposure before welding is to exceed three months, metal surfaces with a protective coating of clear lacquer or other approved coating shall be provided. All steel surfaces, as specified in Subsection 503.15, shall be painted.

3. Testing. The following tests, before installation of the bearings, and in the presence of the Engineer, shall be conducted.

a. Sampling Test. Select one sample, at random from each "lot" of completed bearings at the manufacturer's plant. A "lot" shall consist of one of the following:

(1) No more than 25 fixed bearings of one "load category"

(2) No more than 25 expansion bearings of one "load category"

One load category may consist of bearings of a differing vertical load capacity but the bearings may not exceed a range of capacity differing by more than 300 kips.

b. Friction Test. Only those bearings actually fabricated for the project shall be tested. Test a sample from each lot of expansion bearings. Perform test as specified in Section 18 of the AASHTO LRFD Bridge Design Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, perform test as specified in Division II, Section 18 of the AASHTO Standard Specifications of Highway Bridges.

c. Proof Load Test. One bearing from each production "lot" of fixed and expansion bearings shall be tested. Perform the test as specified in Section 18 of the AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, perform test as specified in Division II, Section 18 of the AASHTO Standard Specifications for Highway Bridges.

d. Material Tests. To assure compliance with appropriate material specifications, one sample of elastomer and one sample of PTFE from each "lot" shall be submitted to the Bureau of Materials for testing.

4. Packing and Shipping.

a. Bearings shall be securely banded together, as units, by the fabricator. They shall be shipped to the Project site and stored without relative movement of the bearing parts or disassembly at any time. The bearings shall be wrapped in moisture resistant and dust resistant material to protect them against shipping and job site conditions. The bearings shall be match marked to indicate the normal position of each bearing.

b. The bearings shall be stored at the Project site in a dry condition and be sheltered free from dirt or dust until installation.

c. The bearings shall be inspected within one week after arriving on the Project. They should not be disassembled unless the fabricator's representative is present. Following the inspection, they should be re-wrapped and kept clean until installation.

d. The sole and top plates of the bearings shall not be removed for separate attachment to the structure except under the direct supervision of the fabricator.
e. With each shipment, a copy of the materials, fabrication and testing compliance certifications shall be enclosed.

E. Fabrication of Seismic Isolation Bearing Assemblies:

1. The tolerance on isolator dimensions shall be as follows:

Dimension	Tolerance
Thickness of Top & Bottom Cover Rubber	
External Dimensions	
Flatness of Exterior Top and Bottom Surfaces of Completed Isolator	1/16 inch from
Variation from Plane Parallel to the Theoretical Surface:	
Top	
Sides	
Overall Isolator Height	

2. Each elastomeric isolator shall be loaded in compression to 1.5 times the test load as defined in Subsection 503.03 for a period of at least 15 hours. Any isolator showing signs of lack of rubber to steel bond, laminate placement faults, or at least three separate surface cracks wider and deeper than 1/16 inch shall be rejected.
3. Exposed steel surfaces, if any, shall be protected from rust by painting according to Subsection 503.15.
4. Each isolator shall be permanently marked on two of the four sides. The marking shall consist of an isolator number specified by the supplier, date of fabrication (month and year), isolator type and supplier (name and address).
5. PTFE and stainless steel fabrication details shall conform to Section 18 of the AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, Division II, Section 18 of the AASHTO Standard Specifications for Highway Bridges, shall be followed.
6. Gross bearing dimensions shall have a tolerance of ±1/16 inch. Out of flatness tolerance shall not exceed 1/16 inch per yard .
7. Every bearing shall have the Project Identification Number, Lot Number, orientation and individual bearing number indelibly marked with ink on two sides.
8. Sliding bearings shall be tested according to Section 18 of the AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, Division II, Section 18 of the AASHTO Standard Specifications for Highway Bridges, shall be followed.
9. Preloaded frictional elements shall be constructed such that a 25 mils deflection in the preload element results in less than 10 percent change in the design frictional resistance.
10. Preload to the frictional element shall not be produced by utilizing an elastomeric material.

503.06 Camber{ XE "Steel structures:camber" }.

All structural steel members shall be cambered at the mill or fabricated in the shop to provide a true curve without abrupt changes.

503.07 Shipping, Handling, and Erection.

A. Shipping and Handling. The Bureau of Materials inspection unit shall be notified at least 48 hours before shipping of structural steel members so that a final quality assurance inspection of the product can be performed. Structural steel members shall be loaded, hauled, and unloaded in such a manner that they will not be deformed, damaged, or subjected to stresses in excess of those provided for in the design. All steel girders and like members shall be shipped and stored with their webs vertical unless their size precludes vertical shipment, in which case horizontal shipment may be considered. Points of bearing shall be placed within 20 percent of the length of the girder from the ends secured with chain tie downs. Long members shall be braced during shipment with temporary vertical stiffeners, if not provided for in the design, extending the full height of the web on both sides of the member. Temporary stiffeners shall be located at the bearing points, mid-

span, and at additional locations to ensure that the maximum interval between blocking does not exceed 25 feet. Temporary stiffeners shall be in full contact with both flanges and the web. The temporary stiffeners should be padded or made of a material which will minimize damage to the painted surface.

Transportation drawings and calculations signed and sealed by a Professional Engineer licensed to practice in the State shall be prepared by the fabricator and submitted to the designer for approval of all steel members requiring shipment with their web horizontal, or for girders which will extend over 20 percent of the length beyond points of bearing. The procedure for submittal shall be in conformance with Subsection 105.04. Generally when steel members are hauled and stored, they shall be placed in a position similar to their final erected position. Extreme care shall be used in turn-over operations to prevent excessive stresses in the flanges.

Transportation drawings shall include at least the following information:

1. Drawings or sketches, fully describing the procedures.
2. Calculations showing the dead load plus impact stresses induced by the loading and transportation procedure. Impact stresses shall be at least 200 percent of the dead load stress.
3. The location of all support points. Supports shall be detailed to be under the flanges regardless of the member's orientation.
4. Tie-downs (types and locations) shall be shown. A sufficient number shall be used to provide redundancy so that if any one tie-down fails, the member will remain stable.
5. Temporary stiffeners shall be shown if they are necessary to provide temporary support to the member during shipping.
6. Details of a four-way articulating bolster for each truck transporter to ensure that truck movements will not produce unnecessary stresses in the attached structural steel.

In the furnishing of Seismic Isolation bearing assemblies, the isolators and their mounting plates shall be assembled at the factory by the isolator supplier. Suitable temporary assembly ties shall be provided so that the entire assembly is shipped, in protective packaging, as a unit. The assemblies shall remain intact when uncrated and installed. Assemblies shall be stored under cover above the ground in the original packaging until installed.

B. Erection. Erection of structures including, but not limited to, handling and storing materials, falsework, methods and equipment, straightening bent materials, assembling steel and connections shall conform to Section 11 of the ASASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Division II, Section 11 of the AASHTO Standard Specifications for Highway Bridges. Also, the following criteria shall be followed:

1. Falsework and all tools, machinery, and appliances including driftpins and fitting-up bolts necessary for the expeditious handling of the work, erection of the network, removal of the temporary construction, maintenance of traffic, and all work necessary to complete the structure shall be provided.
2. At least 20 calendar days before the proposed start of erection, a written plan of operations for review shall be submitted at a pre-erection meeting.
3. Erection of structural steel shall not proceed until substructure concrete has cured and hardened for the minimum length of time specified under Subsection 501.13. Unless otherwise approved, the embankment shall be in place in back of abutment walls for at least 50 percent of their height, before bearings are set to avoid displacement of bearings due to movement of the abutments.

In the installation of Seismic Isolation bearing assemblies, the following shall be provided:

1. The Contractor shall certify to the Engineer that a skilled representative of the isolator supplier will be available to the Contractor to give such aid and instruction in the installation of isolators as required to obtain satisfactory results.
2. The isolators shall be installed level and normal to the gravity loads. Superstructure gradients shall be accommodated with beveled sole plates.
3. There shall be no obstructions, including bolt extensions, that prevent the isolators from deforming horizontally in any direction. The area around each isolator shall be cleaned of all debris and construction materials at the completion of the Contract.
4. The isolators shall be connected to the superstructure and substructures by bolting or other positive mechanical means acceptable to the Engineer.
5. No welding shall be performed on steel in contact with an isolator.

503.08 Setting Shoes and Bearings.

A. Bridge Seat Bearing Areas. Shoes and bearing plates shall not be placed on bridge seat bearing areas that are improperly finished, deformed, or irregular. They shall be set level in position and shall have full and even bearing. Bearing plates shall be bedded on the masonry with either elastomeric bearing pad or preformed fabric pad.

B. Setting Anchor Bolts for Bearings. Anchor bolts for the masonry bearing plates shall be set according to Subheading 10 of the third paragraph of Subsection 501.12.

During the time between the setting of the bolts and placing of the bearings, measures shall be taken against collection of water in holes and its freezing in cold weather by filling the holes with a permanent type antifreeze and sealing the top with a watertight cap of rubber or other suitable material and sealing with rubber-asphalt joint sealer. Before the shoe is set, the material and any other foreign material shall be removed from the holes. The bolts shall be set and fixed by filling the holes with grout.

C. Setting Bearings. Allowance shall be made for the effect of stress deformation and temperature changes when setting bearings. To avoid displacement of bearings due to movement of the abutments the embankment fill height for abutment walls shall be according to the last item in Subsection 503.07. The axis of rockers and segmental roller bearings shall be set in an inclined position so that the rocker or roller is vertical under full dead load at a temperature of 60 ºF. A sketch shall be shown on the erection drawing prepared by the fabricator indicating the proper inclination for setting the bearings at various temperatures.

Rocker bearings shall be adjusted after all loads from the bridge superstructure and approaches are in place, so as to provide the inclination from the vertical necessary to compensate for expansion or contraction in the bridge deck in conformity with the temperature.

The rocker bearings shall have the correct inclination at the time the bridge is accepted.

D. Structural Bearings. This work shall consist of furnishing and installing structural bearing assemblies that are one or more of the following types: High-load, Multi-rotational Bearings as defined in Subsection 503.02 or circular or rectangular Reinforced Elastomeric Bearings, Elastomeric Bearing Pads, and Seismic Isolation Bearings.

1. Handling and Shipping. Structural bearings shall be constructed according to the details shown in the Shop Drawing submission. Furnished bearings shall conform to the loads shown on the Plans and shall provide the performance characteristics that are specified in Subsection 503.02. The manufacturer shall provide the design for each structural bearing assembly. The services of an on-site technical representative, to assist and provide guidance during the initial installation to the Contractor of the bearing assembly, shall be provided by the manufacturer.

Before shipment from the point of manufacture, bearings shall be packaged to ensure that during shipment and storage, the bearings will be protected against damage from handling, weather, and all other normal hazards. Each completed bearing shall have its components clearly identified, be securely bolted, strapped, or otherwise fastened to prevent any relative movement, and marked on its top as to location and orientation in each structure in the project in conformity with the Contract Documents.

All bearing devices and components shall be stored at the work site in an area that provides protection from environmental and physical damage. When installed, bearings shall be clean and free of all foreign substances.

Dismantling of bearings at the site shall not be done unless necessary for inspection or installation. Bearings shall not be opened or dismantled at the site without the direct supervision of, or with the approval of, the manufacturer.

Each structural bearing shall be marked in indelible ink or flexible paint. The marking shall consist of the location, orientation, order number, lot number, bearing identification number, and elastomer type and grade number. Unless otherwise specified in the Contract Documents, the marking shall be on a face which is visible after erection of the bridge.

For all materials used, the manufacturer shall supply certification data consisting of test reports on the bearing performance tests, for any forgings, castings, or hardened material, mill certificates for all other steels used, a certificate of compliance for the bearing as a whole, and for all anchor bolts, dowels or other accessories.

The manufacturer shall also supply a separate sheet showing the materials, critical dimensions and clearances for each bearing other than elastomeric pads.

Unless otherwise specified in the Contract Documents, steel bearing components, other than stainless steel, shall be galvanized according to Subsection 917.12.

Measurement for Structural Bearings shall conform to Subsection 503.17 and payment shall conform to Subsection 503.18.

2. **Anchor Bolts.** Anchor bolts shall meet the requirements of 501.12 Subpart 10, or as amended herein. Anchor bolts shall be provided with anchorage details that permit development of the full tensile strength of the bolt. Hooks or end plates are recommended.

   Anchor bolts shall be swedged or threaded to secure a satisfactory grip upon the material used to embed them in the holes.

   Anchor bolts shall be preset according to the Contract Documents or as specified or as directed by the Engineer.

   Location of anchor bolts shall take into account any variation from mean temperature of the superstructure at the time of setting and anticipated lengthening of the bottom chord or the bottom flange due to dead load after the setting, the intention being that, as near as practicable, at mean temperature and under dead load, the anchor bolts at expansion bearings will center their slots. Anchor bolts or nuts shall not restrict the full and free movement of the superstructure at movable bearings.

3. **Bedding of Masonry Plates.** Filler or fabric materials shall be placed as bedding material under masonry plates when shown in the Shop Drawings. Such material shall be of the type specified in the Shop Drawings or as ordered or approved by the Engineer and shall be installed to provide full bearing on contact areas.

   Immediately before placing the bedding material and installing bearings or masonry plates, the contact surfaces of the concrete and steel shall be thoroughly cleaned.

   Preformed fabric pads used as bedding shall be composed of multiple layers of 0.5 pounds per square yard cotton duck, impregnated and bonded with high-quality, natural rubber, or of equivalent and equally suitable materials, compressed into resilient pads of uniform thickness. The number of plies shall be such as to produce the specified thickness after compression and vulcanizing. The finished pads shall withstand compression loads perpendicular to the plane of the laminations of not less than 10,000 pounds per square inch without detrimental reduction in thickness or extrusion.

   Sheet lead used as bedding shall be common desilverized lead conforming to ASTM B 29. The sheets shall be of uniform thickness and shall be free from cracks, seams, slivers, scale, and other defects. Unless otherwise specified, lead sheets shall be 120 mils in thickness with a permissible tolerance of ± 40 mils.

   Caulking material used as bedding shall be a non-sag polysulfide or polyurethane material conforming to the provisions of Federal Specification TT-S-230, Type II.

   Grout and mortar used for filling under masonry plates shall conform to Subsection 914.03.

4. **Fabrication Requirements for Guides.** Guide bars shall be attached to the body of the bearing by a method that minimizes distortion and allows the flatness tolerance on all parts of the bearing to be met after attachment. The sliding surfaces of the guide system shall be flat and parallel.

   Bolts or threaded fasteners used to attach the guide bars to their supporting plates shall have an embedded thread length adequate to develop their strength.

   If low-friction material is used at the contact interface, it shall be attached to its backing piece by two or more of the following methods simultaneously:

   a. bonding
   b. recessing
   c. mechanical attachment with countersunk fasteners

   If the material is bonded, it shall be etched by the method recommended by the Manufacturer of the material or bonding agent. Recessing shall be one-half of the material thickness. Fasteners shall be countersunk to a depth that ensures that they will not touch the mating material after allowing for wear.

5. **Load Plates.** Load plates shall be made from a single plate or they may be built up from several steel laminates, each oriented in the plane perpendicular to the direction of the load. Built-up load plates shall be jointed by complete seal welding to prevent ingress of moisture. Such welds shall also provide sufficient shear strength to resist the applied loads. The load plates shall have no sharp corners or edges. Holes may be formed by drilling, punching, or accurately controlled oxygen cutting. All burrs shall be removed by grinding.

503.09 High-Strength Bolts.

The installation of high-strength bolts shall be according to the provisions of Subsection 917.01.

503.10 Automatic End-Welded Studs.

Automatic end-welded studs shall be used as shear connectors or for other purposes where called for or directed. They shall conform to Section 7 of the ANSI/AASHTO/AWS D1.5 Bridge Welding Code. When zinc coated (galvanized) reinforcing steel bars are used, shear connectors used to produce composite action shall be galvanized.

Stud shear connectors shall be installed in the field only after the structural steel is erected and before placing of reinforcement steel.

503.11 Field Splice.

Stringers involving field splices shall be completely preassembled in the shop, taking into account their relative position in the finished structure as to grade, camber, and curvature. The built-up stringer or girder may be erected as a unit providing traffic conditions permit. Lateral support shall be provided in hoisting members into position so as to prevent lateral buckling or other damage. Bolt heads of high-strength bolts shall be on the outside of fascia stringers. Built up girders with field splices shall be completely preassembled at the shop.

503.12 Pedestrian Bridge.{ XE "Pedestrian bridge" }

The girders, stiffeners, diaphragms, and steel bridge flooring for each span shall be assembled in the shop and delivered to the site and erected as a unit. As specified hereinafter, the intermediate and finish coats of paint may be applied in the shop or on the site before erection. If painted areas are damaged during transportation or erection, these areas shall be repainted.

503.13 Formed Steel Flooring for Pedestrian Bridges.

Formed steel flooring plates shall be welded at the supports with two ⅛ by 1 inch fillet welds through the holes in each valley. The lapped edges of adjacent plates shall be welded together with a bead, 3 inches long, midway in the span between supports.

Painting is not required for galvanized surfaces.

503.14 Repair Galvanizing.

Where limited areas of galvanized surfaces are damaged during shipping or erection, they shall be repaired by any of the three methods specified in ASTM A 780. In all cases, the repair shall achieve the minimum coating thickness specified for the item.

503.15 Cleaning and Painting of Structural Steel.{ XE "Steel structures:painting of" }

A. General. All shop painting shall be performed in an enclosure which provides the required atmospheric conditions and shall prevent any exposure to inclement weather before the paint being completely cured.

A complete coating system of an inorganic zinc-rich primer, a high-build epoxy intermediate coat, and a urethane finish coat shall be selected from one of the approved coating systems under Subsection 912.13. In the fabrication of steel box girders, a complete coating system, as stated herein, shall be applied to all exterior surfaces. The interior of the box girders shall be prime coated only. The primer shall be an organic zinc primer selected from one of the approved coating systems listed under Subsection 912.15.

Whenever the term “coat” or “coating” is used hereinafter, it shall constitute as many applications as are necessary to achieve the specified dry film thickness.

Whenever there is a discrepancy between these Specifications and the manufacturer’s recommendations, with the approval of the Engineer, the manufacturer’s recommendations shall govern. If shop assembly is required, it shall be completed before cleaning and painting.

Cleaning and painting of structural steel shall conform to the following:

1. Surface Preparation. Where oil and grease are present, these shall be removed according to the SSPC Surface Preparation Specification using No. 1 solvent cleaning (SSPC-SP 1). This cleaning shall be performed before blasting. If contamination remains after blasting, the surface shall be recleaned with solvent.

All steel shall be blast cleaned to a near-white condition as defined in SSPC-SP 10 from the most current SSPC publication. The surface area of steel to be blast cleaned shall be no greater than the surface area of steel that can be prime coated in the same working day. The near-white blast condition may be determined by a NACE No. 2 Visual Standard T.M.-01-75 or Maryland Pictorial Standard if shot blast is used, or SSPC Pictorial Standard VIS-1 (Grade 2½) if sand or grit

is used. The blast cleaning shall leave an anchor profile, from 1.5 to 2.5 mils deep, in a dense, uniform pattern of depression and ridges. Flame cut edges that do not attain the required anchor profile after blast cleaning shall be ground to the required anchor profile. The profile depth shall be determined by the elcometer surface profile gage or Testex replica tape. The pH of the abrasive shall be within the range of 6.0 to 8.5.

Compressed air supply lines shall be provided with oil traps and moisture separators. The traps and separators shall be changed on a regular basis. Compressed air shall be according to the blotter test as described in ASTM D 4285.

All fins, tears, slivers, and burred or sharp edges that are present on any steel member, or that appear during the blasting operations, shall be removed by grinding and the reblasted area shall provide the 1.5 to 2.5-mil anchor profile.

All reaming and drilling of holes in the steel shall be completed and free of burrs or other imperfections, such as torn or ragged edges, before blast cleaning.

All abrasive and paint residue shall be removed from steel surfaces with a commercial grade vacuum cleaner equipped with a brush-type cleaning tool, or by double blowing with clear air. If the double blowing method is used, the top surfaces of all structural steel, including top and bottom flanges, longitudinal stiffeners, splice plates, hangers, etc., shall be vacuumed after the double blowing operations are completed.

The steel shall then be kept dust free until the prime coat is applied. Care shall be taken to protect freshly coated surfaces from subsequent blast cleaning operations. Blast damaged primed surfaces shall be thoroughly wire brushed or, if visible rust occurs, reblasted to a near-white condition. The wire brushed or blast cleaned surfaces shall be vacuumed and reprimed.

2. **Mixing the Coatings.** Coatings shall be mixed according to SSPC-PA 1 and the following:
   a. The coatings shall be mixed in the original containers. The prime coat shall be mixed with a high shear mixer to a smooth, lump-free consistency. Paddle mixers or paint shakers shall not be used. The mixing shall continue until all of the metallic powder or pigment is in suspension, taking care that all of the coatingsolids that might have settled to the bottom of the container are thoroughly dispersed.
   b. The zinc-rich primer mixture shall be strained through a 30 to 60 mesh screen to remove large particles.
   c. Paint containers for spray applications shall be equipped with a mechanical agitator so the mixture is in motion throughout the application period.
   d. In general, the coatings are supplied for normal use without thinning. If it is necessary to thin the coating for proper application, the thinning shall be done according to the manufacturer's recommendations.
3. **Conditions for Painting.** Conditions for painting shall be according to SSPC-PA 1 and the following:
   a. Paint shall be applied on clean dry surfaces only. Paint for the prime and final coats shall not be applied when the temperature of the air, paint, or metal is below 40 ºF, or when the temperature is expected to fall below 40 ºF before the paint is dried. The minimum temperature shall be 50 ºF for the intermediate coat. The coatings shall not be applied when the relative humidity is greater than 85 percent nor when a combination of temperature and humidity conditions are such that moisture condenses on the surface being coated. The relative humidity shall be a minimum of 50 percent during the drying time of the inorganic type primers.
   b. None of the coatings shall be applied when the wind velocity exceeds 20 miles per hour, when the air is misty, or when in the opinion of the Engineer, conditions are unsatisfactory for the work. Also, paint shall not be applied upon damp or frosted surfaces, or when the metal is hot enough to cause the paint to blister, produce a porous paint film, or cause the vehicle (binder) to separate from the pigment.
   c. Paint shall not be applied when the steel surface temperature is lower than 5 ºF above the dew point. The dew point shall be determined by the Engineer using a psychrometer and appropriate tables. The dew point requirement may be presumed to be satisfied if a thin, clearly defined film of water, applied to the cleaned vertical surface with a damp cloth, evaporates within 15 minutes, as determined by the Engineer.

d. Zinc salts, oil, dust, dirt, and other contaminants shall be removed before each coat of paint and any repair coats are applied in the field. The primed surfaces shall be cleaned by a high pressure water washing (800 pounds per square inch minimum).

4. Paint Application. Paint application shall be according to SSPC-PA 1 and the following:

a. The prime coat shall be applied immediately after inspection and acceptance of the surface. The primer shall be applied the same day the metal is cleaned (within eight hours maximum). If the same is blast cleaned and remains unpainted overnight, it shall be blast cleaned again before priming. Succeeding coats shall not be applied until each coat is approved. The minimum drying time between coats shall be according to Subsection 912.13. Depending on site conditions, additional time may be required for proper drying before applying succeeding coats. It is the applicator's responsibility to determine if the coating has dried sufficiently for proper application of succeeding coats. The maximum time interval between coats and required surface preparation procedures, should this interval be exceeded, shall be according to the manufacturer's written recommendations.

b. Before the application of the full prime coat, a prime coating (striping) shall be applied to all edges of plates and rolled shapes, corners, crevices, welds, rivet heads, and exposed parts of bolts. The full prime coat shall not be applied before the striping has set to touch.

c. The coating of paint shall be smoothly and uniformly spread so that every part of the surface will be covered with at least the minimum specified thickness, and so that no excess paint will collect at any point. A dense and uniform appearance is required after each applied coating has dried.

d. If the paint coating is too thin or if portions of the surface are not completely coated, such portions of the work shall be repainted. If the application of the coating at the required thickness in one coat produces runs, bubbles, or sags, the coating shall be applied in multiple passes of the spray gun. Where excessive coating thickness produces surface defects such as "mud-cracking," such coating shall be removed back to soundly bonded coating and the area recoated to the required thickness. In areas of deficient primer thickness, the areas shall be thoroughly cleaned with power washing equipment, as necessary to remove all dirt. The areas shall then be wire brushed, vacuumed, or otherwise prepared as directed, and then recoated.

e. All dry spray shall be removed, by sanding if necessary, before the application of the succeeding coat.

f. Surfaces of steel that will be in contact with concrete shall be given all three coats of paint. Contact surfaces at field bolted connections shall be given a prime coat of paint only. These surfaces shall be masked during subsequent coating operations when applicable. Surfaces within 2 inches of field welds (except for stud shear connectors) shall not be painted, but shall receive a light coat of rust-inhibitive coating and shall be masked during subsequent coating operations.

g. All bolted shop connections shall be removed before the blasting and coating of the girders or beams. The parts shall be blasted separately, primed, then reassembled, and the bolts fully torqued. All field bolted connections shall be given applications of all three coats of the paint system.

h. The coatings shall be applied using either of the following, or any combination thereof that will attain satisfactory results and the film thickness specified, except that spray application is preferable for the zinc-rich primer.

(1) Spray Painting. Spray nozzles and pressures shall be according to the manufacturer's recommendations.

The Contractor is cautioned that special spray guns shall be required for the application of primers specified in systems IEU-6 and IEU-7.

Whenever painting operations are interrupted, the zinc-rich primer remaining in the fluid hose shall be expelled from the hose. Spray equipment which is used for application of zinc-rich primer shall be thoroughly cleaned at the end of each workday.

Compressed air supply lines shall be provided with oil traps and moisture separators. The traps and separators shall be changed on a regular basis. Compressed air shall be according to the blotter test as described in ASTM D 4285.

(2) Brush Painting. Brushes preferably shall be round or oval in shape, but if flat brushes are used they shall not exceed 4½ inches in width. All brushes shall have sufficient body and length of bristle to spread the paint in a uniform coat.

The paint shall be manipulated under the brush to produce a uniform, even coat in contact with the metal or previously applied paint and shall be worked into all corners and crevices. In general, the primary movement of the brush shall describe a series of small circles to fill all irregularities in the surface, after which the coating shall be brushed out and smoothed by a series of parallel strokes until the paint film has an even thickness.

(3) Roller Painting. Rollers, when used, shall be of a type which does not leave a stippled texture in the paint film. Rollers may be used only on flat, even surfaces. Rollers shall be manipulated in a manner which produces a paint film of even thickness with no skips, runs, sags, or thin areas. The roller operation should be closely followed by a bristle brush to level off any air bubbles.

(4) Inaccessible Surfaces. On surfaces which are inaccessible for painting by regular means, the paint shall be applied by sheepskin daubers or sprayed, or by other means if necessary, to ensure coverage of the proper thickness of paint.

The inside of bolt holes shall not be painted.

5. Number of Coats and Film Thickness. A minimum number of three coats shall be applied by either of the following methods:

a. prime, intermediate, and finish in shop; or
b. prime in shop, intermediate, and finish in field.

The dry film thickness of the paint at any point shall be within the following ranges:

For the prime coat.....
For the intermediate coat.....
For the finish coat.....
For the three-coat system.....

The dry film thickness of the prime coat at the contact surfaces of bolted friction splices on main members, and the top of top flanges where stud shear connectors are to be welded shall be within the range of 1 to 2.5 mils. All other contact surfaces and surfaces to be in contact with concrete shall be within the normal primer dry film thickness range of 2.5 to 4 mils.

The dry film thickness for each coat will be determined by a magnetic dry film thickness gage. The gage shall be calibrated and used according to SSPC-PA 2. A Tooke film thickness gage shall be used according to ASTM D 4138 to verify the coating thickness when requested by the Engineer. If the Tooke gage shows that the primer coat is not within the specified thickness range, the total coating system will be rejected even if the total dry film thickness exceeds the 8 mils minimum for the three-coat system.

6. Color. The color of the finish coat shall be as noted on the Plans. When specified, the colors Lake Blue, Foliage Green, and Brown shall match the following color chips of FED-STD-595B:

Lake Blue.....
Foliage Green.....
Brown.....

The primer shall be tinted to contrast the base metal.

The color for the intermediate coat shall be white or an approved color that contrasts with the prime and finish coats.

7. Stenciling. The following information shall be stenciled on the outside web of both fascia beams, on both ends of the structure, and according to the data specified below:

a. The seven-digit structure number.
b. The month and year of completion.

c. The paint system code number.

The markings shall provide uniform 2-inch high, C series letters or numerals with the paint the same as the finish coat except that the color shall be black. The markings shall be located not less than 2 inches above the lower flange and not more than 3 feet from the abutment.

Stenciling shall be completed by the applicator of the final coat when the final coat has dried.

8. **Unsatisfactory Paint Performance and Removal.** The paint performance shall be considered unsatisfactory if rusting occurs; the paint coat lifts, blisters, wrinkles, or as excessive runs or sag, the paint shows evidence of application under unfavorable conditions; the workmanship is poor; impure or unauthorized paint has been used; or for other such reasons as determined.

The unsatisfactory paint shall be removed, the metal recleaned and repainted as specified herein, by the Contractor at no cost to the State.

B. Handling, Storage, and Erection. The paint shall be allowed to dry before loading and shipping the steel. Extreme care shall be exercised in handling the steel in the shop, during shipping, during erection, and during subsequent construction of the bridge. The steel shall be insulated from the binding chains by softeners approved by the Engineer. Hooks and slings used to hoist steel shall be padded. Diaphragms and similar pieces shall be spaced in such a way that no rubbing that may damage the coatings will occur during shipment. The steel shall be stored on pallets at the job site or by other means approved by the Engineer, so that it does not rest on the dirt, so that water pockets are not formed, or so that components do not fall or rest on each other. All shipping and job site storage details shall be submitted for approval before shipping the steel.

Temporary attachments or supports for scaffolding or forms shall not damage the coating system. In particular, sufficient support pads shall be used for fascia bracing. Unpainted surfaces, including bolts and field welded areas, shall be cleaned and the complete coating system shall be applied.

Damaged and contaminated coatings shall be repaired as directed by the Engineer. The repair paint system shall be an organic zinc system as listed in Subsection 912.15 and be supplied by the same manufacturer as the originally applied inorganic zinc system. If the originally applied coating system is not available, the Bureau of Materials shall be contracted for guidance in providing the use of an available system. Paint repairs shall be, as approved by the Engineer, according to the manufacturer's written recommendations.

In damp or cold weather, the shop work shall be kept under cover until thoroughly dry, or until weather conditions permit exposure.

C. Provisions for Inspection. Scaffolding shall be furnished, erected, and approved to permit inspection of the steel before, during, and after each coating.

Approved rubber rollers or other protective devices shall be used on scaffold fastenings. Metal rollers or clamps and other types of fastenings which will mar or damage freshly coated surfaces shall not be used.

In addition to any equipment recommended by the coating manufacturer, the Contractor shall provide, for the exclusive use of the Engineer, the following supplemental equipment to permit the inspection of the coating system. The equipment must be in good and acceptable working condition and shall become the property of the Contractor after the work is accepted.

1. NACE, Maryland, or SSPC Publication.
2. Wet film thickness gages.
3. Dry film thickness gages - Tooke gage and magnetic gage.
4. Temperature gages - battery operated psychrometer and surface thermometer.
5. Adhesion - paint adhesion test kit or elcometer adhesion tester.
6. Cleaning - hypodermic needle pressure gage, Testex "Press-O-Film," and elcometer surface profile gage.
7. NIST calibration standards and plastic shims.
8. Surface contamination analysis test kit.
9. Camera - 35-millimeter automatic with flash.
10. Respirators (self contained breathing apparatus) properly fitted for each person designated by the Engineer, complete with appropriate chemical cartridges, as recommended by the manufacturer, for each type of coating.
11. Paint inspection mirror.
12. Holiday detector.

D. Painting Galvanized Surfaces. Damaged galvanized surfaces shall be repaired as specified under Subsection 503.14. Galvanized surfaces should not be painted unless specified. If painting is required, the galvanized

surface shall be treated before painting according to ASTM D 2092, Method A, followed by an application of the epoxy intermediate and urethane finish coats only.

Structural steel bearings for prestressed concrete beams and structural steel deck joint assemblies shall be zinc-coated according to Subsection 917.12. Quality assurance inspection will be by magnetic thickness gage measurements. The average thickness will be the average of ten readings taken at random locations on each assembly.

E. Protection of Structure, Persons, and Property. Pedestrians, vehicular, and other traffic upon, underneath or adjacent to the bridge, and all portions of the bridge superstructure and substructure shall be protected against damage or disfigurement by spatters, splashes, and smirches of paint or paint materials. Similar protection shall be provided against any damage from the cleaning operations.

Paint dropped on concrete surfaces and all debris from the cleaning operations shall be removed from the superstructure and the substructure. Paint containers and refuse shall be removed from the site.

Adequate canvas or other such material shall be furnished where necessary for such protection.

F. Structures Using Unpainted Weathering Steel.

1. Cleaning and Surface Preparation of Non-painted Steel. For the purpose of obtaining a high degree of weathering uniformity of the non-painted weathering steel, all structural steel components including diaphragms, cross frames, and welded connections shall be blast cleaned according to SSPC-SP6 as soon after fabrication as practical.

The steel shall be kept free and clean of all foreign materials such as grease, oil, concrete spatter, chalk marks, crayon marks, dirt, etc., and any foreign matter that may affect the natural oxidation of the steel.

The steel shall be temporarily protected during concrete operations and any other operation that is likely to be hazardous with respect to soiling of the steel.

Any foreign matter which gets on the steel after it has been blast cleaned is to be removed as soon as possible with solvent according to SSPC-SP 1.

2. Cleaning and Protection of Concrete. The abutments, piers, and other concrete work shall be protected from staining with a wrapping of reinforced polyethylene or similar material, which shall remain in place and be maintained until at least 30 calendar days after the deck slab has been placed.

Before final acceptance of the structure, any rust stains on the substructure concrete shall be removed by a concrete rust stain remover according to the recommendations of the manufacturer. Flushing with water shall follow all applications of rust removing material.

3. Cleaning and Painting of AASHTO M 270, Grade 50W and ASTM A 709, Grade HPS70W Structural Steel. Cleaning and painting of AASHTO M 270, Grade 50W and ASTM A 709, Grade HPS 70W is required for the following:

a. Cap Girders. Clean and paint the exterior surfaces of the top and the sides, including the brackets.

b. Structural Steel Adjacent to Deck Joints. With the exception of steel designated to be galvanized, all structural steel for a distance away from the ends of the girders of three times the depth of the girder shall be cleaned and painted.

c. Integral Abutment Construction. In projects that involve Integral Abutment construction, the ends of the girders shall be cleaned and painted for a distance that extends 1 foot beyond the concrete diaphragm.

G. Rollers and Machined Surfaces. Rollers and machined surfaces shall be coated with a corrosive-preventative compound conforming to Military Specification MIL-C-11796C, Class 3 or MIL-PRF-16173E, Grade 2. The coating shall be applied as soon as practicable before removal from the shop.

503.16 Steel Grid Flooring.

Steel grid flooring shall conform to Section 12 of the AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Division II, Section 12 of the AASHTO Standard Specifications for Highway Bridges. Concrete placement for filled type grid flooring shall conform to Section 501.

COMPENSATION

503.17 Method of Measurement.

Structural steel of the various kinds will be measured by the pound or will not be measured and payment will be made on a lump sum basis.

Components fabricated from metals will be considered as structural steel and computed on the following basis:

	Unit Weight Pound Per Cubic Foot
Aluminum, cast or rolled	173
Bronze or copper alloy	536
Copper sheet	558
Iron, cast	445
Iron, malleable	470
Steel, cast or rolled, including alloy, copper bearing, and stainless	490
Zinc	450

The weight of rolled shapes and of plates, up to and including 36 inches in width, will be computed on the basis of their nominal weights and dimensions, deducting for cuts and open holes, exclusive of high-strength bolt holes.

The weight of plates wider than 36 inches will be computed on the basis of their actual dimensions deducting for cuts and holes, exclusive of high-strength bolt holes. To this will be added one-half of the Permissible Variation in Thickness and Weight as shown in AASHTO M 160.

The weight of castings will be computed from the dimensions shown on the working drawings, deducting for open holes. To this weight will be added five percent allowance for fillets and overrun. Scale weights may be substituted for computed weights in the case of castings or of small complex parts for which computations of weight would be difficult.

The weight of heads, nuts, single washers, and threaded stick-through of all high-strength bolts is based on the following:

Bolts

Diameter of Bolt, inches	Weight in pounds per 100 bolts	Diameter of Bolt, inches	Weight in pounds per 100 bolts
1/2	19.7	1	116.7
5/8	31.7	1⅛	165.1
3/4	52.4	1¼	212.0
7/8	80.4	1⅜	280.0
		1½	340.0

The weight of shop and field fillet welds is based on the following:

Size of Weld, inches	Weight in pounds per linear foot	Size of Weld, inches	Weight in pounds per linear foot
1/4	0.20	5/8	0.80
5/16	0.25	3/4	1.10
3/8	0.35	7/8	1.50
7/16	0.45	1	2.00
1/2	0.55		

In the case of the lump sum basis, the approximate estimated weight is shown for informational purposes only and no guarantee is expressed or implied that it is the correct weight to be furnished.

Steel grid flooring and formed steel flooring will be measured by the square foot.

Shear connectors and shear connections, galvanized, will not be measured, and payment will be made for the quantity in the Proposal adjusted for Change Orders, except as provided in Subsection 109.01.

Structural bearings shall be measured on a unit basis for each type of bearing assembly that is provided.

503.18 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
STRUCTURAL STEEL	LUMP SUM
STRUCTURAL STEEL	POUND

STEEL BEARINGS FOR PRESTRESSED CONCRETE BEAMS	LUMP SUM
STRUCTURAL STEEL DECK JOINTS	LUMP SUM
STEEL GRID FLOORING	SQUARE FOOT
FORMED STEEL FLOORING FOR PEDESTRIAN BRIDGES	SQUARE FOOT
SHEAR CONNECTORS	UNIT
SHEAR CONNECTORS, GALVANIZED	UNIT
STRUCTURAL BEARING ASSEMBLY	UNIT

Structural bearing assemblies shall include payment for furnishing all labor, materials, tools, equipment and incidentals, and all work involving furnishing, testing and installing said bearing assemblies, complete and in place, as shown on the Shop Drawings, as required by these Specifications and the Special Provisions, and as directed by the Engineer.

SECTION 504 - TIMBER STRUCTURES{ XE "TIMBER:STRUCTURES" }{ XE "STRUCTURES:TIMBER" }

504.01 Description.

This work shall consist of the construction of structures or parts of structures, other than piles, composed of treated or untreated timber or a combination of both, on prepared foundations.

MATERIALS

504.02 Materials.

Materials shall conform to the following Subsections:

Timber Connectors and Hardware 918.04
Timber for Structures 918.05
Timber Preservatives 918.06

CONSTRUCTION

504.03 Construction Requirements.

Construction methods shall conform to Section 16 of the AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Division II, Section 16 of the AASHTO Standard Specifications for Highway Bridges.

Cant hooks, peaveys, pikes, or hooks shall not be used.

The design of ring or shear plate timber connectors shall be submitted for approval according to Subsection 105.04. Connectors shall be of corrosion-resistant metal.

Painting requirements will be provided in the Special Provisions.

COMPENSATION

504.04 Method of Measurement.

Timber structures of the various kinds will be measured in 1,000 feet board measure (MBM) of untreated and treated timber, computed on the basis of actual volumes and shortest commercial lengths which could be used.

504.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
TREATED TIMBER STRUCTURES	MBM
TREATED TIMBER STRUCTURES, BRIDGE DECKING	MBM
TREATED TIMBER STRUCTURES, SHEETING	MBM
TREATED TIMBER STRUCTURES, WALES	MBM
UNTREATED TIMBER STRUCTURES	MBM

SECTION 505 - LOAD BEARING PILES{ XE "PILES,LOAD BEARING" }

505.01 Description.

{ XE "Piles, load bearing:steel" **}**This work shall consist of furnishing and driving concrete, steel, and timber piles.

Materials and methods of construction not specifically covered in the Plans and Specifications shall conform to AASHTO Standard Specifications for Highway Bridges.

{ XE "PILES, LOAD BEARING:MATERIALS" }MATERIALS

505.02 Materials.

Portland cement concrete shall conform to Section 914. Other materials shall conform to the following Subsections:

{ XE "PILES, LOAD BEARING:EQUIPMENT" }EQUIPMENT

505.03 Equipment.

A. Types of Hammers. Piles shall be driven with a steam, air, diesel, vibratory, hydraulic, or drop hammer. The type and size of hammer used shall be capable of driving the pile to its ultimate capacity without damage to the pile.

Steam, air, hydraulic, and diesel hammers shall develop a minimum of 6,000 foot-pounds energy per blow. Drop hammers shall have a minimum ram weight of 2,000 pounds and a maximum drop of 8 feet.

{ XE "Piles, load bearing:pile drivers" **}B. Impact Pile Drivers.** Impact pile driving equipment shall be selected according to the following criteria:

1. When the installation of timber piles is planned, and the pile driving equipment is to be analyzed by the Empirical Pile Formula (ENR), the pile design capacity shall be considered achieved when between two to four blows per inch is reached.
2. For installation of all other types of piles, the pile driving equipment is to be analyzed with the Wave Equation Analysis Program (WEAP). The Engineer shall evaluate the driving equipment based upon the anticipated number of hammer blows per inch and the pile stresses at the required ultimate pile capacity, as indicated by the WEAP. For the driving equipment to be acceptable, the number of required hammer blows that are indicated by the WEAP analysis, at the ultimate pile resistance, shall be between three and ten blows per inch. The compressive and tensile pile stresses shall be within the allowable limits.
3. For steam or air hammers, the weight of the ram shall be no less than ½ the weight of the pile; for diesel hammers, the weight of the ram shall be no less than ¼ the weight of the pile.
4. Diesel hammers shall be equipped with gauges and charts for the determination of the actual driving energy produced under any driving conditions.

C. Vibratory Pile Drivers. The vibratory pile driver shall be selected to satisfy the equation in which Driving Amplitude equals two times the Eccentric Moment divided by the Vibratory Load. The solution of this equation shall be between ¼ and ½ inch. The vibratory load shall be the sum of the weight of the pile and the weight of the vibrating mass of the vibrator including the weight of the clamp, housing, and jaws. The Eccentric Moment shall be provided by the Contractor or the manufacturer.

Vibratory pile drivers, with the approval of the Engineer, may be used to advance steel bearing piles. However, the use of an impact pile driver shall be required for at least the final 10 feet of penetration, or when directed by the Engineer.

D. Plant and Equipment. The plant and equipment furnished for steam and air driven hammers shall have sufficient capacity to maintain, under working conditions, the pressure at the hammer specified by the manufacturer. The boiler or tank shall be equipped with a pressure gauge. A gauge shall also be installed which measures the pressure for the hammer intake unless another method is provided to furnish the data necessary for the determination of energy delivered by the hammer.

E. Leads and Followers. Pile driving equipment shall include pile driving leads which are straight and which support the pile and the hammer in proper position throughout the driving operation. The leads shall be constructed in a manner that affords freedom of movement of the hammer while maintaining

alignment of the hammer and the pile to ensure concentric impact for each blow. The leads shall be held in position by guys or braces to ensure support to the pile during driving, except when approved by the Engineer. The leads shall be of sufficient length to make the use of a follower unnecessary and shall be so designed as to permit proper alignment of battered piles. Except where piles are driven through water, followers shall not be used unless approved by the Engineer.

F. Water Jets. Jetting shall only be permitted if approved in writing by the Engineer or when specifically required in the Special Provisions. When jetting is to be performed, the jetting plant shall have sufficient capacity to deliver at all times a pressure equivalent to at least 100 pounds per square inch at two ¾-inch jet nozzles. In either case, unless otherwise indicated by the Engineer, jet pipes shall be removed before the desired pile penetration is reached and the pile shall then be driven to the required tip elevation and bearing capacity with an impact hammer. Also, the Contractor shall control, treat if necessary and dispose of all jet water in a manner satisfactory to the Engineer.

G. Hammer Cushion (Cap Block) and Pile Cushion.

1. **Hammer Cushion.** All impact pile driving equipment except gravity hammers shall be equipped with a suitable thickness of hammer cushion material to prevent damage to the hammer or pile and to ensure uniform driving behavior. Hammer cushions (cap block) shall be a solid block of hardwood with its grains parallel to the axis of the pile and enclosed in a tight-fitting steel housing or the hammer cushions shall be made of manufactured materials, with a strength and durability equal to or greater than hardwood according to the hammer manufacturer's guidelines. Wood chips, wood blocks, rope, wire rope, hose, tires, and asbestos hammer cushions are specifically disallowed and shall not be used. A striker plate as recommended by the hammer manufacturer shall be placed on the hammer cushion to ensure uniform compression of the cushion material. The hammer cushion shall be inspected in the presence of the Engineer when beginning pile driving at each structure or after each 100 hours of pile driving, whichever is less. When the hammer cushion thickness becomes less than 75 percent of its original thickness, it shall be replaced.
2. **Pile Cushion.** The heads of concrete piles shall be protected by a pile cushion made of plywood. The minimum plywood thickness placed on the pile head before driving shall not be less than 4 inches. A new pile cushion shall be provided for each pile. In addition, the pile cushion shall be replaced as soon as the cushion is either split, compressed to half its original thickness, not functioning as intended, or begins to burn. The pile cushion dimensions shall match the cross-sectional area of the pile top.
3. **Pile Drive Head.** Piles driven with impact hammers shall be fitted with an adequate drive head to distribute the hammer blow to the pile head. The drive head shall be axially aligned with the hammer and the pile. The drive head shall be guided by the leads and not be free-swinging. The drive head shall fit around the pile head in such a manner as to prevent transfer of torsional forces during driving while maintaining proper alignment of hammer and pile.

   For steel and timber piling, the pile heads shall be cut squarely and a drive head provided to hold the longitudinal axis of the pile in line with the axis of the hammer.

   For precast concrete and prestressed concrete piles, the pile head shall be plane and perpendicular to the longitudinal axis of the pile to prevent eccentric impacts from the drive head.

   For special types of piles, appropriate driving heads, mandrels or other devices shall be provided so that the piles may be driven without damage.

CONSTRUCTION

505.04 Preparation for Driving.

Excavation, pile caps, collars, points, splicing piles, and painting of steel piles shall be as specified in Division II, Section 4 of the AASHTO Standard Specifications for Highway Bridges. Unless otherwise directed, if the AASHTO LRFD Bridge Design Specifications have been used for the design of the project, then Section 4 of the AASHTO LRFD Bridge Construction Specifications shall be followed. Preparations shall be as follows:

1. **Embankments.** Piles located in embankment shall not be driven until the embankment has been placed, compacted, surcharge removed, and excavation completed.

{ XE "Piles, load bearing:prebored holes" **}2. Prebored Holes.** The diameter of auger may vary as follows:

a. For round piles, not less than 2 inches nor more than the average nominal diameter of piles.
b. For steel H-piles, 4 to 6 inches less than nominal diagonal dimension of piles unless otherwise authorized.

Voids between the round piles or steel H-piles and the prebored material shall be backfilled with granular material.

3. **Furnishing Equipment for Driving Piles.** Before delivery of the equipment to the work site, information regarding the type, striking energy per blow, rated speed, source of energy and serial number of the hammer proposed for use shall be submitted to the Engineer for approval. When the plans and specifications require that a wave equation analysis be performed to determine the adequacy of the proposed pile driving equipment, the Contractor will furnish four copies of a complete analysis to the Engineer for approval 26 calendar days before the anticipated delivery of the equipment to the work site. The wave equation analysis must be signed and sealed by a Professional Engineer licensed to practice in the State. The Contractor will also supply the Engineer with four copies of a completed "Pile and Driving Equipment Data Form," a copy of which can be obtained by contacting the Manager, Geotechnical Engineering Unit. This submission shall be for each pile type and hammer combination with summary and recommendations showing that the proposed hammer will perform adequately.

505.05 Order List of Piles.{ XE "Piles, load bearing:order list" }

Piles shall be furnished according to an order list. When test piles or load tests are specified, the data obtained will be used in conjunction with other available geotechnical information to determine the lengths of production piles to be furnished. The Engineer will not prepare the order list for any portion of the foundation until the required test data representative of the portion has been completed. The order list will be furnished as promptly as conditions permit.

The lengths given in the order list will be the lengths of piles that are needed to be furnished at the Project site. Without added compensation, the lengths may be increased to provide fresh heading and for additional lengths as may be necessary to suit the Contractor's specific method.

505.06 Methods of Driving.{ XE "Piles, load bearing:methods of driving" }

Piles shall be driven by hammers and equipment conforming to Subsection 505.03. In addition, when followers are permitted for use in driving, one pile from each group of ten shall be a long pile driven without a follower, and shall be used as a test pile to determine the average bearing capacity of the group.

Pile driving shall conform to the following:

1. **Accuracy of Driving.** Foundation and fender piles shall be driven with a variation of not more than ½ inch per foot from the vertical or from the batter and shall not be out of the required position by more than 6 inches after driving. Piles for trestle bents shall be driven with variation of not more than ½ inch per foot from the vertical or batter and shall not be out of the required position at the top of the pile by more than 2 inches after driving so that the pile cap may be placed in its proposed location without inducing stresses in the piles.
2. **Penetration.** For all types of piles, including those whose tip elevation is noted, there shall be a procedure for jetting, blasting, or the use of spuds and other work necessary to obtain the penetration required.
3. **Rock Bearing Piles.** Steel H-piles or other steel piles that are intended to bear on rock shall be driven to the refusal necessary to penetrate the rock sufficiently to provide uniform and adequate bearing. Generally, the pile is considered as reaching refusal when a penetration of not less than five blows per ¼ inch has been achieved.

{ XE "Piles, load bearing:test piles" **}4. Test Piles.** Test piles of the specified materials, dimensions, and at the designated locations shall be furnished and driven with an impact hammer unless specifically stated otherwise in the Special Provisions or on the Plans. If the lengths of test piles to be furnished are not provided on the Plans, then the Engineer will provide the test pile order lengths. In general, lengths of test piles will be greater than the estimated length of production piles to provide for variation in soil conditions. The driving equipment and procedure (criteria) used for driving test piles shall be identical to that which the Contractor proposes to use on the production piles. The Contractor shall excavate the ground at each footing location to the elevation of the bottom of the footing before the pile is driven.

The test piles shall be driven to a hammer blow count established by the Engineer and to the specified tip elevation.

505.07 Determination of Bearing Values.

Test piles of the materials and dimensions specified and lengths directed shall be furnished. Test piles shall be driven with the same type of equipment that is used for driving production piles. Test piles shall be driven at the designated locations to the bearing capacity and tip elevation that is shown on the Plans, specified in the Special Provisions, or as directed. The bearing capacity of test piles will be determined by the Engineer by one or a combination

of the following methods, as indicated in the Special Provisions or on the Plans. The Engineer shall be the sole judge in determining bearing capacity and the length of pile to be driven.

{ XE "Piles, load bearing:load tests" **}1. Static Pile Load Test.** Compression load tests shall be made where prescribed or directed. All static load testing shown in the plans shall be completed before the driving of any production piling. The Contractor shall obtain the services of a professional testing laboratory, or Professional Engineer with satisfactory pile load test experience, to conduct the load test in compliance with these specifications, to record all data, and to furnish reports of the test results to the Engineer.

Compression load tests shall be performed by procedures set forth in ASTM D 1143 using the quick-load compression test method, except that the test shall be taken to plunging failure or the capacity of the loading system. The testing equipment and measuring system shall conform to ASTM D 1143, except that the loading system shall be capable of applying 150 percent of the ultimate pile capacity or 1,000 tons, whichever is less. The Contractor shall submit to the Engineer for approval, detailed plans of the proposed loading apparatus, prepared by a Professional Engineer licensed to practice in the State. The apparatus shall be constructed to allow the various increments of the load to be placed gradually without causing vibration to the test pile. When the approved method requires the use of tension (anchor) piles which will later be used as permanent piles in the work, such tension piles shall be of the same type and diameter as the production piles and shall be driven in the location of the production piles when feasible.

The top elevation of the test piles shall be determined immediately after driving and again just before load testing to check for heave. Any pile which heaves more than ¼ inch shall be redriven or jacked to the original elevation prior to testing. Unless otherwise specified in the contract, a minimum three-day waiting period shall be observed between the driving of any anchor piles or the load test pile and the commencement of the load test.

Pipe and shell pipes whose walls are not of adequate strength to sustain the test loading when empty, shall have the required reinforcement and concrete placed before loading.

Loads for load tests for cast-in-place concrete piles shall not be applied until the concrete in the test pile has set at least seven days. The total test load to be applied to piles shall be as specified in the Special Provisions.

Upon completion of each test, the Contractor will furnish the Engineer with four copies of all load test records/reports for approval. These records must be signed and sealed by a Professional Engineer licensed to practice in the State. Data obtained will be used in conjunction with other available geotechnical information to determine the lengths of production piles to be furnished.

After the completion of load tests, the load used shall be removed and the piles, including anchor piles, may be used in the structure if found by the Engineer to be satisfactory for such use. Test piles not loaded may be used similarly. If any pile, after serving its purpose as a test or anchor pile, is found unsatisfactory for use in the structure, it shall be removed if so ordered, or shall be cut off below the ground line or footings as directed.

2. Empirical Pile Formula. The ENR formula will be used in the absence of Special Provisions to the contrary.

3. Wave Equation Analysis Program. (WEAP). When a Wave Equation Analysis is specified but Dynamic Pile Load Tests will not be performed, the ultimate bearing capacity of the pile, the anticipated number of hammer blows per inch, and the anticipated compressive and tensile pile stresses at the required ultimate pile capacity will be determined by using the wave equation analysis.

4. Dynamic Pile Load Tests. Dynamic measurements will be taken during the driving of piles that are designated as dynamic load test piles by the contract documents or as directed by the Engineer. The ultimate capacity of the pile will be determined with pile analyzer instruments. The stresses in the pile shall be monitored during driving to ensure that the pile is not damaged by excessive compressive or tensile stresses. The dynamic testing shall conform to ASTM D 4945. The Contractor shall engage the services of a Specialty Subcontractor that is experienced in the dynamic monitoring of piles. Within 48 hours of the completion of each test, the Contractor shall furnish the Engineer with four copies of the pile dynamic monitoring report. This report shall contain a record of the test data obtained and an interpretation thereof, and must be signed and sealed by a Professional Engineer licensed to practice in the State. Further analysis of the Pile Dynamic Analyzer (PDA) test results will also be required, using the Case Pile Wave Analysis Program (CAPWAP). The Contractor shall furnish the Engineer with four copies of the CAPWAP report. Production piles shall not be driven until the PDA/CAPWAP test pile results are reviewed and the production pile order lengths and driving criteria are provided by the Engineer.

The specialty Subcontractor shall submit verification to the Engineer that all components of the apparatus for obtaining dynamic measurements and the apparatus for recording, reducing, and displaying data

have been calibrated by the equipment manufacturer within the past 12 months. Monitoring of test piles shall be performed during the full length of driving and, if restrike is required, during restriking.

The specialty subcontractor shall be selected by the Contractor and be approved by the Engineer. Approval will be based on qualifications and previous experience on similar projects.

The Contractor shall drive the piles to the depth at which the dynamic equipment indicates that the required ultimate bearing capacity has been achieved and to the required tip elevation, unless directed otherwise by the Engineer. If needed to maintain acceptable stresses in the piles, the Contractor shall reduce the driving energy transmitted to the pile by using additional cushions or reducing the energy output of the hammer. If non-axial driving is indicated by dynamic test equipment measurements, the Contractor shall immediately realign the driving system.

If specified in the Special Provisions or directed by the Engineer, before restriking the dynamic load test pile, the Contractor shall wait up to a minimum of 24 hours and until after the instruments are reattached. The hammer shall be warmed up before restrike begins by applying at least 20 blows to another pile. The restrike should be terminated when the amount of penetration reaches 6 inches or the total number of hammer blows reaches 50, whichever occurs first. If the established hammer blow count is not attained on restrike, the Engineer may direct the Contractor to drive a portion or all of the remaining test pile length and repeat the "set up" restrike procedure. After restrike, the Engineer will determine whether or not additional pile penetration and testing is required. When ordered by the Engineer, the test pile driven to plan grade and not having the required hammer blow count shall be spliced and driven until the required bearing is obtained.

Production piles shall not be driven or jetted until the PDA/CAPWAP test pile results and the Static Pile Load Test Reports are reviewed and the driving criteria and production pile order lengths are provided by the Engineer.

505.08 Defective Piles.{ XE "Piles, load bearing:defective" }

The procedure for driving shall not subject the piles to excessive and undue abuse producing crushing and spalling of the concrete, injurious splitting, splintering and brooming of the wood, or deformation of the steel. Manipulation of piles to force them into proper position, considered to be excessive, will not be permitted. Any pile damaged by reason of internal defects, improper driving, use of an improper hammer, or driven out of its proper location shall be corrected without additional compensation by one of the following methods approved for the pile in question:

1. The pile shall be withdrawn and replaced by a new and, if necessary, longer pile.
2. A second pile shall be driven adjacent to the defective pile; the defective pile shall be removed to at least 24 inches below cut-off elevation and the hole filled with sand if a cast-in-place pile.
3. The pile shall be spliced or built up as otherwise provided herein or a sufficient portion of the footing extended to properly embed the pile.

Any pile which heaves more than ¼ inch by the driving of adjacent piles or by any other cause shall be re-driven. Any pile which cannot be driven as specified due to an obstruction shall be considered complete if adequate penetration has been achieved in the sole judgement of the Engineer. In such case, the length of the pile driven is to be added to the total aggregate length.

505.09 Timber Piles.{ XE "Piles, load bearing:timber" }

Timber piles shall be stored, handled, and cut off as prescribed in Section 4 of the AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Division II, Section 4 of the AASHTO Standard Specifications for Highway Bridges. Timber piles shall be driven to production pile order lengths unless otherwise directed. If timber piles are delivered substantially longer than the ordered length, the pile should be cut off at the tip end in advance so that the maximum diameter butt end remains in the structure.

505.10 Cast-In-Place Concrete Piles.{ XE "Piles, load bearing:concrete, cast-in-place" }

The inspection of steel shells, reinforcement, and placing of concrete shall be according to Section 4 of the AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Division II, Section 4 of the AASHTO Standard Specifications for Highway Bridges.

505.11 Manufacture of Precast Concrete Piles and Precast Concrete Pile Caps.

The manufacture of precast concrete shall conform to Section 502. The water method of curing shall be used except that steam curing as specified in Subsection 502.11 may be authorized.

Piles shall not be driven until cured for not less than 21 days and, when ambient temperatures are below 40 ºF, for a longer period as determined by the Engineer.

Concrete piles for use in seawater shall be cured for not less than 30 days before being used.

505.12 Extensions and Splices.{ XE "Piles, load bearing:splices" }

A. Steel Piles, Pipes, and Shells. Full length steel piles, pipes, and shells shall always be used where practicable, but if splices cannot be avoided, the method of splicing and splice location for each pile shall be submitted for approval.

{ XE "Piles, load bearing:concrete, precast" **}B. Precast and Prestressed Concrete Piles**. Splices for precast concrete piles shall be avoided, unless they are needed to produce short extensions or "build-ups" that may be added to the top of reinforced concrete piles to correct for unanticipated events. Before cutting off or building up such piles, they shall be braced securely to prevent any vibration during the cutting or building-up operation.

After the driving is completed, the concrete at the end of the pile shall be cut away leaving the reinforcing steel exposed for a length of 30 diameters. The final cut of the concrete shall be at right angles to the axis of the pile.

The Contractor shall not order precast or prestressed concrete production piles until it has received direction as to order lengths from the Engineer. The production pile order lengths shall be based on results that are obtained from driven test pile data.

C. Timber Piles. In no case shall timber piles be spliced.

505.13 Cut-Offs and Cappings.{ XE "Piles, load bearing:cut-offs and cappings" }

Tops of foundation piles shall be embedded in the concrete footing at least 1 foot except that at locations of tremie concrete, the piles shall project at least 6 inches above the top of the seal concrete. The length of pile cut-off shall be sufficient to permit the removal of all injured material. The distance from the side of any pile to the nearest edge of the footing shall be a minimum of 9 inches. When the cut-off elevation for a precast concrete pile is below the elevation of the bottom of the cap, the pile shall be built up from the butt of the pile to the elevation of the bottom of the cap by means of a reinforced concrete extension. Cutoff of all piles shall be made at right angles to the axis of the pile at the designated elevation. The cuts shall be made in clean, straight lines.

Cut-offs of steel bearing piles shall be made at right angles to the axis of the pile. The cuts shall be made in clean, straight lines.

All piles shall be cut-off to a true plane at the elevations required and anchored to the structure, as shown on the Plans.

All cut-off lengths of piling shall remain the property of the Contractor and shall be properly disposed of.

505.14 Painting Steel Piles and Pipe Shells{ XE "Piles, load bearing:painting" }.

When steel piles or pipe shells in the completed structure extend above the original ground line or finished ground surface, they shall be protected by three coats of paint as specified in Subsection 503.15. This coating shall extend from an elevation 3 feet below the bed of waterway or finished ground surface respectively to the top of the exposed steel. Finish coat color shall be gray to match the concrete color.

COMPENSATION

505.15 Method of Measurement.

A. Test Piles, Furnished. Test Piles Furnished will be measured by the linear foot. The length of Test Piles, Furnished will be based on the criteria that is stated in Subsection 505.06, Subpart 4. If the required penetration for any one Test Pile is greater than the length that has been directed, the extension length ordered by the Engineer will be included for payment in the linear foot of Test Piles Furnished. Splices for such Test Piles will be measured for payment according to the provisions of this subsection. If the Contractor orders shorter Test Piles than directed and extensions are required, splices and any cut-off length will not be considered for measurement and payment.

B. Test Piles, Driven. Test Piles Driven will be measured by the linear foot. The total length shall be the total linear foot length that has been installed and accepted and that is measured below the cut off elevation for all of the driven Test Piles. Lengths of piles that are used to replace Test Piles that have been previously accepted by the Engineer, but are somehow damaged before completion of the Project, will not be paid for.

C. Production Piles, Furnished. Production Piles Furnished, of the various kinds and sizes, including buildups or extensions, as ordered by the Engineer, will be measured by the linear foot. If the required penetration for

any one Production Pile is greater than the length that has been directed, the extension length ordered by the Engineer will be included for payment in the linear foot of Production Piles Furnished. Splices for such Production Piles will be measured for payment according to the provisions of this subsection. If the Contractor orders shorter Production Piles than directed and extensions are required, splices and any cut off length will not be considered for measurement and payment.

D. Production Piles, Driven. Production Piles Driven will be measured by the linear foot. The total length shall be the total linear foot length that has been installed and accepted and that is measured below the cutoff elevation for all of the driven Production Piles. Lengths of Piles that are used to replace Production Piles that have been previously accepted by the Engineer, but are somehow damaged before completion of the Project, will not be paid for.

The quantity of cast-in-place pipe or shell concrete piles furnished, including Test Piles, will be the actual number of linear feet of steel pipe or shell piles ordered by the Engineer. The quantity of cast-in-place pipe or shell concrete piles driven, including Test Piles, will be the actual number of linear feet of steel pipe or shell piles driven, cast, and left in place in the completed and accepted work, measured from the pile tip to the cutoff elevation.

No separate measurement will be made for reinforcing steel, excavation, drilling, cleaning holes, drilling fluids, sealing materials, concrete, required caging, and other items required to complete the work. No separate measurement will be made for closure plates for close-end pipe piles.

The number of pile shoes measured for payment will be those shoes actually installed on piles that have been accepted for payment by the Engineer.

No separate payment will be made for shoes used at the option of the Contractor, and that are not shown on the plans or specified to be used. Pile shoes ordered by the Engineer will be paid for as extra work.

The number of splices measured for payment will be only those splices actually made and as required to drive the piles in excess of the order length furnished by the Engineer.

Splices for steel H-piles will be measured per each individual splice except splices within the pile lengths ordered by the Engineer will not be measured unless the ordered length is in excess of 80 feet.

No separate payment will be made for splices used at the option of the Contractor, when not shown on the plans or specified to be used. Pile splices ordered by the Engineer will be paid for as extra work.

Prebored holes used to facilitate pile driving procedures which are specified or directed by the Engineer will be measured by the linear foot from the bottom of the foundation excavation elevation to the bottom of the hole elevation.

No separate payment shall be made, for jetting, spudding or any other method used to facilitate pile driving procedures. The cost shall be included in the price of driven piles.

The quantity of load tests to be paid for will be the number of load tests completed and accepted, except that load tests made at the option of the Contractor will not be included in the quantity measured for payment.

No separate payment shall be made for the loading apparatus constructed for the Static Pile Load Test.

Dynamic pile load tests will be measured per unit when specified by contract documents. No separate payment will be made for dynamic pile load tests and CAPWAP analysis performed on piles which require restriking, Restriking and a CAPWAP analysis of a dynamic pile load test will not be measured and will be included in the Dynamic Pile Load Test (Dynamic) Item. When dynamic pile load tests (Dynamic or PDA Monitoring) are used, no payment for installation of test piles will be made until recorded data is submitted to the Engineer.

Furnishing equipment for driving piles will not be measured, and payment will be made on a lump sum basis.

505.16 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
PREBORED HOLES	LINEAR FOOT
TEST PILES, FURNISHED	LINEAR FOOT
TEST PILES, DRIVEN	LINEAR FOOT
CAST-IN-PLACE CONCRETE PILES, FURNISHED, ___" DIAMETER	LINEAR FOOT
CAST-IN-PLACE CONCRETE PILES, DRIVEN, ___" DIAMETER	LINEAR FOOT
PRECAST CONCRETE PILES, FURNISHED, ___ X ___"	LINEAR FOOT
PRECAST CONCRETE PILES, DRIVEN, ___ X ___ "	LINEAR FOOT
PRESTRESSED CONCRETE PILES, FURNISHED	LINEAR FOOT
PRESTRESSED CONCRETE PILES, DRIVEN	LINEAR FOOT
STEEL H-PILES, HP, FURNISHED, ___ " X ___LBS/FT	LINEAR FOOT
STEEL H-PILES, HP, DRIVEN, ___ " X ___LBS/FT	LINEAR FOOT
UNTREATED TIMBER PILES, FURNISHED, ___ " DIAMETER	LINEAR FOOT
UNTREATED TIMBER PILES, DRIVEN, ___" DIAMETER	LINEAR FOOT
TREATED TIMBER PILES, FURNISHED, ___" DIAMETER	LINEAR FOOT
TREATED TIMBER PILES, DRIVEN, ___" DIAMETER	LINEAR FOOT
SPLICES, FOR STEEL H-PILES	UNIT
STATIC PILE LOAD TESTS	UNIT
DYNAMIC PILE LOAD TESTS	UNIT
FURNISHING EQUIPMENT FOR DRIVING PILES	LUMP SUM
PILE SHOES	UNIT

Payment of 75 percent of the lump sum price bid for furnishing equipment for driving piles will be made when the equipment necessary for driving piles is furnished and driving of test piles has commenced. Payment for the remaining 25 percent will be made when the work of driving piles is entirely completed on an individual bridge basis. If piles are deleted from the design, or if the number of pile units is decreased, payment for the remaining 25 percent will be made without any reduction. If the number of pile units is increased, no increase in payment will be made in the total remaining 25 percent.

Payment for test piles furnished and production piles furnished will include full compensation for all costs that are involved in the furnishing and delivery of all piles to the project site.

Payment for test piles driven and production piles driven will include full compensation for all costs involved in the actual driving and cutting off of piles and pile shells.

Payment adjustments for strength will be made according to Subsection 914.02, Subpart E and will be applied to the footage for cast-in-place, precast, or prestressed concrete piles.

SECTION 506 - BULKHEADS, FENDER SYSTEMS, AND DOLPHINS{ XE "BULKHEADS" }{ XE "FENDER SYSTEMS" }{ XE "DOLPHINS" }{ XE "STRUCTURES:BULKHEADS" }

506.01 Description.

This work shall consist of the construction of concrete, steel, and timber bulkheads, fender systems, and dolphins.

MATERIALS

506.02 Materials.

{ XE "Bulkheads:concrete sheet piling" **}**Portland cement concrete for concrete sheet piles shall conform to Section 914 and Table 914-2 for prestressed concrete piles. Other materials shall conform to the following Subsections:

Tie rods, plate washers, turnbuckles, nuts, bolts, washers, and all other hardware in bulkheads shall be of steel with dual coating system consisting of zinc coating (galvanizing) and coal tar epoxy-polyamide paint. Coal tar epoxy-polyamide paint shall be applied immediately after the installation of all connections except that tie rods, excluding threaded ends, shall be painted at least 72 hours before the installation. All galvanized surfaces to receive coal tar epoxy-polyamide paint shall be cleaned according to the procedure given under Painting Galvanized Steel in Steel Structures Painting Manual. Galvanizing shall not be damaged during the cleaning process.

Concrete materials, proportioning, and construction requirements shall conform to Section 501.

Materials not covered by the above provisions shall conform to Division II of the AASHTO Standard Specifications for Highway Bridges.

EQUIPMENT

506.03 Equipment.

The equipment shall conform to Sections 501.04 and 505.03.

CONSTRUCTION

506.04 Timber Structures.{ XE "Bulkheads:timber structures" }

The methods of construction for timber structures shall conform to Section 16 of the AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Division II, Section 16 of the AASHTO Standard Specifications for Highway Bridges. Also, the following amendments and additions shall be followed:

1. Handling and driving of timber piles shall conform to Section 505.
2. Nails shall be driven with sufficient force to set the heads flush with the surface of the wood. Deep hammer marks in wood surfaces may be cause for rejection. All cutting, framing, and boring of treated timbers shall be done before treatment.
3. Timbers, sheeting, and piles shall be handled without dropping, breaking of outer fibers, bruising, or penetrating the surface with tools. They shall be handled with rope slings. Cant hooks, peaveys, spikes, or hooks shall not be used.
4. All cuts and abrasions in treated timbers, sheeting, and piles, after having been trimmed, shall be covered with two applications of a mixture of 60 percent creosote and 40 percent roofing pitch or brush coated with at least two applications of hot creosote and covered with hot roofing pitch.
5. Before driving bolts, hot creosote shall be poured into all bolt holes in such a manner that the entire surface of the hole is coated. Any unfilled holes, after being treated with creosote, shall be plugged with creosoted plugs.

506.05 Sheet Piling.

The method of manufacture and the construction of all prescribed types of sheet piling shall conform to Section 505 except that lighter driving equipment or vibratory pile drivers may be used.

Sheet piling shall conform to the requirements of Subsection 917.09 and the following:

{ XE "Bulkheads:timber sheet piling" **}1. Timber Sheet Piling.** The lower ends of timber sheet piling shall be drift sharpened to wedge against the adjacent timbers. If the tops are battered in driving, they shall be left slightly high and then cut off at the required elevation. After cutting, the ends of sheeting members and wales shall be treated with two applications of coal tar creosote.

{ XE "Bulkheads:steel sheet piling:coating steel" **}2. Coating Steel.** All surfaces of sheeting, plates, and wales shall be blast cleaned conforming to SSPC-SP 6 of the Steel Structures Painting Council and then at least 72 hours before driving shall be coated with coal tar epoxy-polyamide paint in the manner prescribed below:

a. Promptly after blast cleaning, the surfaces shall be given two coats of coal tar epoxy, each at a coverage rate of not more than 125 square feet per gallon, but in no case shall the dry film thickness of the two coats total less than 16 mils at any point. Application may be by brush, roller, or spray. The first coat may be thinned not more than ten percent with a solvent recommended by the coating manufacturer; the second coat shall not be thinned. The first coat shall be thoroughly dry before applying the second coat. The second coat shall be dry and hard before handling the steel.

b. Damaged or rejected areas of coating shall be cleaned of all foreign or loose material and promptly recoated. The loose or damaged coating in the surrounding area shall be removed, and the surface of the remaining sound film, immediately adjacent thereto, shall be brushed with methyl isobutyl ketone to provide a good bonding surface for the new coats.

c. The top coat shall be dry before driving, however, coated areas shall not be driven until the top coat has cured for at least 72 hours.

3. Alignment. The completed piling shall be vertical, in line, driven to the prescribed depth, cut off to a straight line at the prescribed elevation, and practically watertight at the joints.

COMPENSATION

506.06 Method of Measurement.

Sheet piling of the various kinds will be measured by the square foot of projected area exclusive of indentation of pile section.

Tie rods will be measured by the pound based on the weight table in Subsection 503.17.

506.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CONCRETE SHEET PILING	SQUARE FOOT
STEEL SHEET PILING	SQUARE FOOT
TREATED TIMBER SHEET PILING	SQUARE FOOT
TIE RODS	POUND

Payment for timber wales, caps, and other structural members used in bulkhead and fender system construction will be made according to Section 504.

Payment for piles used in bulkhead and fender system construction will be made according to Section 505.

SECTION 507 - PNEUMATICALLY APPLIED MORTAR{ XE "PNEUMATICALLY APPLIED MORTAR" }

507.01 Description.

This work shall consist of the removal and the restoration of deteriorated concrete with pneumatically applied mortar.

For structural steel members, encased or non-encased, this work shall consist of cleaning, priming, and encasing of these members with pneumatically applied mortar.

MATERIALS

507.02 Materials.

Materials shall conform to the following Subsections:

Fine Aggregate	901.12
Curing Materials	905.03
Epoxy Bonding Coat	912.06
Reinforcement Steel for Structures	915.01
Portland Cement	919.11
Water	919.15

CONSTRUCTION

507.03 Preparation and Cleaning.{ XE "Pneumatically applied mortar:cleaning of surfaces" }

Cleaning of structural steel shall conform to Subsection 514.05.

Cleaning and replacement of reinforcement shall conform to Subheading 2 of the sixth paragraph of Subsection 518.04.

Cleaning of concrete shall consist of removal of deteriorated concrete to a sound concrete surface and to a minimum of ¾ inch behind the first mat of reinforcement. In the case of abutment, pier seat or column repairs, removal shall not extend under the bearing seats or more than 15 percent of the column cross-sectional area without approval.

Removal shall be by chipping with pneumatic hammers and chisels weighing not more than 30 pounds with the bit removed. Repair procedures for beams shall conform to Subsection 201.04.

Cavities shall be chipped so that their sides form an approximate 90-degree angle to the exposed surface for at least ½ inch in depth. Areas that are to receive the mortar course shall be cleaned by flushing or scouring with compressed air jets to ensure removal of all loose particles.

The newly chipped and sandblasted concrete surfaces or primed steel surfaces shall be coated thoroughly with epoxy bonding coat before application of the mortar.

507.04 Applying Mortar.

Before construction, test specimens shall be made by each application crew using the equipment, materials and mix proportions proposed for each type of repair on the Project.

{ XE "Pneumatically applied mortar:test panels" **}**Test panels shall be at least 30 by 30 inches for each mix, each type of repair and for each shooting position to be encountered on the job including the overhead position. The same reinforcement as is in the structure shall be provided in at least half the panels to test for proper embedment of the reinforcing steel. Test panels shall be fabricated in the same thickness as the structure, but thickness shall not be less than 3 inches or the least dimension of the proposed repair, whichever is less. Test panels shall be field cured in the same manner as the work. Test panels shall be gunned preferably against similar support conditions, such as a 6-inch thick precast concrete slab section or equivalent, to simulate actual field conditions for concrete repairs to pier surfaces. Panels shall be field cured in the same manner as the work, except that test specimens shall be soaked in water for a minimum of 40 hours before testing.

At least five 3-inch diameter cores or 3-inch cubes shall be cut from each test panel not earlier than five days after applying the mortar. The specimens shall be delivered to the Engineer for testing. Test specimens are to be cured and tested according to AASHTO T 24.

For acceptance purposes, the average 28-day core strengths, as a minimum, shall be equal to f'_c = 3,450 pounds per square inch for cores with L/D = 2.0. For cores with L/D between 1.0 and 2.0, the correction factors specified in AASHTO T 24 shall apply. For cube specimens, the average strength, as a minimum, shall be equal to f'_c / 0.85.

The cut surfaces of the specimens will be examined carefully and additional surfaces shall be exposed by sawing or breaking portions of the test panels, as directed. The mortar shall be bonded to the existing substrate and

reinforcing bars and shall be sound and uniform. Cut and broken surfaces shall be free of honeycomb, laminations, and sand pockets.

Unreinforced test panels, from which four cubes or cores shall be obtained, shall be at least 1 foot square and 3 inches thick thick and shall be made during each day of application of pneumatically applied mortar. The cores shall be tested in pairs for 28-day strength. The average compressive strength for these pairs shall be 3,300 pounds per square inch minimum. If 250 square feet or less per day are applied, sampling requirements may be reduced or waived.

The mortar shall be applied in one or more layers to the total thickness required to restore the area as detailed over the original lines of the adjoining surface. Where the cavity exceeds 4 inches in depth, a layer of mesh shall be used for each 3-inch depth of mortar. However, in no case shall wire mesh be placed behind existing reinforcement. For concrete encased steel members, steel rods, ⅜-inch nominal diameter, shall be attached to the steel member by wiring through existing holes provided for the purpose. Welded wire fabric, WWF 2 by 2 - W10 by W10, galvanized, then shall be securely fastened to the anchors with wires, spaced not more than 1 foot-6 inches apart.

The time interval between applying successive layers in sloping, vertical, or overhanging work must be sufficient to allow initial set to develop. During the time initial set is developing, the surface shall be cleaned to remove the thin film residue to provide bonding with succeeding applications.

Texture of finished surface shall be a natural gun finish troweled to meet originally constructed contours.

Clear liquid curing compound shall be applied immediately after applying the mortar course.

Unless otherwise designated, the areas of concrete and encasement to be repaired will be determined before work begins and access to the areas shall be provided.

Scaffolding and shielding requirements will be provided in Subsection 201.04 of the Special Provisions.

The list of the approved manufacturers for power driven fasteners will be provided in the Special Provisions.

COMPENSATION

507.05 Method of Measurement.

Pneumatically applied mortar will be measured by the square foot.

507.06 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
PNEUMATICALLY APPLIED MORTAR	SQUARE FOOT

SECTION 508 - METAL BRIDGE RAILING AND FENCE{ XE "BRIDGE RAILINGS, METAL" }{ XE "FENCES AND FENCE MATERIAL" }{ XE "BRIDGE FENCE" }

508.01 Description.

This work shall consist of the construction of metal railing and fence on bridges. This work shall also consist of the fabrication and construction of a 4-Bar Open Steel Bridge Railing System on a bridge.

MATERIALS

508.02 Materials.

Materials shall conform to the following Subsections:

Chain-Link Fence	907.02
Metal Railing:	
Aluminum Alloy	911.01
Structural Steel, Carbon	917.10
Aluminum-Pigmented Alkaline-Resistant Paint	912.01
Mortar and Grout	914.03
Bolts and Bolting Material	917.01
Zinc Coating on Steel	917.12
Bearing Pads, Elastomeric	919.02
Caulking Compound	919.04

In the furnishing of a 4-Bar Open Steel Bridge Railing, anchor studs, washers, and exposed nuts shall conform to ASTM F 568, Class 8.8, and all other bolts and nuts shall conform to ASTM F 568, Class 4.6. Also, rail bars shall conform to ASTM A 500 or A 501, rail post shall conform to ASTM A 709, Grade 50, and all other shapes and plates shall conform to ASTM A 709, Grade 36.

CONSTRUCTION

508.03 Working Drawings.

Working drawings shall be furnished according to Subsection 105.04. Minor variations in details of metal railings and chain-link fence may be permitted. However, any major departure from the design will not be accepted.

508.04 Construction Requirements.

All railing posts shall be vertical. Railing shall not be placed on a span until the centering or falsework is removed and the span is self-supporting.

The base plates of the posts shall be attached to top of parapet by anchor bolts set in the concrete. Bolts set before concreting shall be held securely in place by a nut above the form template and a threaded aluminum alloy washer in conformance with ASTM F 901, Alloy 6061-T6 below the form template. The lower fastening shall prevent passage of mortar onto the exposed bolt threads.

Where posts are set in aluminum sleeves that have been previously installed in the concrete, the annular space between the posts and sleeves shall be filled with aluminum-impregnated caulking compound. Surfaces receiving the caulking compound shall be dry and free from dirt, oil, paint, and other deleterious materials. Care shall be taken to secure a dense and complete seal. The top of the compound shall be beveled sufficiently to drain freely.

Where necessary for vertical alignment of the railing, lead strips for steel railings and aluminum shims for aluminum railings shall be placed under the perimeter of base plates. The strips shall be 1¼ inch wide and of the required thickness. The strips, when placed, shall project ⅛ inch from the base plates. When the railing has been aligned, the nuts shall be tightened on the anchor bolts and the lead or aluminum shims caulked to form a watertight seal between the base plates and the concrete of the parapet or other foundation. The anchor bolts shall be tightened again, where necessary, and all bolts shall not project more than ¼ inch above the nut and shall be staked to prevent the loosening of the nut due to vibration or vandalism. Care shall be taken to prevent injury to the concrete and impairment of the bond between the bolt and the concrete.

508.05 Steel Railing.

A. Fabrication and Erection. Fabrication and erection of ferrous metal railing shall be done according to Section 503 with the exception that the welding of tubular structures shall be done according to the ANSI/AASHTO/AWS Bridge Welding Code D1.5. In the case of welded railing, all exposed joints shall be finished by grinding or filing, after welding.

Railings shall be adjusted before fixing in place to ensure matching at abutting joints and correct alignment and camber throughout their length. The railing shall be so fabricated as to allow for minor adjustments in both horizontal and vertical directions. In the bottom of the sealed end, a ½-inch hole for drainage shall be provided.

B. Painting. Ferrous metal railing shall be given three coats of paint as specified in Subsection 503.15. All coats may be applied in the shop but all damaged coating shall be touched up before or after erection. No painting is required on railing or posts where galvanizing is specified.

508.06 Aluminum Railing.

A. Fabrication and Erection. The fabrication and erection of aluminum railing shall conform to Subsection 508.04 and to the following:

1. Material ½ inch thick or less may be sheared, sawed, or milled. Material over ½ inch thick shall be sawed or milled. Cut edges shall be true, smooth, and free from excessive burrs or ragged breaks. Re-entrant cuts shall be filleted by drilling before cutting.
2. Rivet or bolt holes shall be drilled or subpunched 3/16 inch smaller than the nominal diameter of the fastener and reamed to size. The finished diameter of holes shall not be more than seven percent greater than nominal diameter of the fasteners. Anchor bolt holes and slotted bolt holes to take care of expansion shall be provided.

B. Protection Against Other Materials. Where aluminum surfaces are to be in contact with metals other than stainless steel or other compatible metals, the contact surfaces shall be coated by painting the dissimilar metals with a prime coat of zinc chromate primer followed by one coat of aluminum metal paint, aluminum-impregnated caulking compound of a heavy brushing consistency, or by an elastomeric bearing pad separator.

Aluminum surfaces to be placed in contact with concrete shall be given a heavy coat of an aluminum-pigmented, alkaline-resistant paint.

The paint shall be applied without the addition of thinner.

After erection, all spaces between base plates and concrete shall be caulked with an aluminum-impregnated caulking compound.

A ⅛-inch minimum thickness elastomeric bearing pad may be placed under each post as an alternative. The pad shall cover the entire contact area between post and concrete and shall be trimmed to the shape of the post base.

C. Finishing. After the concreting has been completed, the aluminum bridge railing shall be cleaned, removing any accumulation of oil, grease, dirt, or other foreign materials. A solvent cleaner may be used. Where mechanical means are used to remove stains, grease, and minor scratches, the resulting finish shall be uniform in appearance over the entire tube.

Finished tubing shall be free from grease and stains, gouges, dents, and burrs and shall have a minimum of rubs, scratches, and minor extrusion marks from the dies. Painting of aluminum alloy railing is not required.

508.07 Chain-Link Fence, Bridge.

The fence shall be fabricated and erected according to this Section and Section 614.

COMPENSATION

508.08 Method of Measurement.

Chain-link fence of the various sizes will be measured by the linear foot.

Metal railing of the various kinds and sizes will be measured by the linear foot.

508.09 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CHAIN-LINK FENCE ALUMINUM-COATED STEEL, BRIDGE, ___ '___" HIGH	LINEAR FOOT
CHAIN-LINK FENCE, PVC-COATED STEEL BRIDGE, ___ '___" HIGH	LINEAR FOOT
CHAIN-LINK FENCE, BRIDGE ___ '___" HIGH	LINEAR FOOT
CHAIN-LINK FENCE ALUMINUM-COATED STEEL, BRIDGE ___ '___" HIGH, CURVED TOP	LINEAR FOOT
CHAIN-LINK FENCE, PVC-COATED STEEL, BRIDGE ___ '___" HIGH, CURVED TOP	LINEAR FOOT

CHAIN-LINK FENCE, BRIDGE, ___ '___" HIGH CURVED TOP	LINEAR FOOT
METAL RAILING (___RAIL, ALUMINUM)	LINEAR FOOT
METAL RAILING (___RAIL, STEEL)	LINEAR FOOT
4-BAR OPEN STEEL BRIDGE RAILING	LINEAR FOOT

SECTION 509 - SIGN SUPPORT STRUCTURES{ XE "STRUCTURES:SIGN SUPPORT" }

509.01 Description.

This work shall consist of the furnishing, fabrication, and erection of sign support structures. Materials and construction operations not specifically covered in the Plans and Specifications shall be according to the current AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

{ XE "SIGNS:SUPPORT STRUCTURES:MATERIALS" }MATERIALS

509.02 Materials.

Materials shall conform to the following Subsections:

Electrical Conduits and Fittings 906.07
Aluminum Alloys 911.01
Grout 914.03
Bolts and Bolting Material 917.01
Structural Steel 917.10
Zinc Coating on Steel 917.12

Steel pipe shall be certified by mill test report to meet ASTM A 53, Type E or S, Grade B with the exception that API 5L, Grade B may be used when the specified wall thickness is greater than ½ inch. Only Electrical Resistance Welded (ERW) manufactured single seam pipe is permitted. However, when the required pipe size is greater than 24 inches in diameter, double seam pipe may be used. A mill test report must be provided. It shall be certified and signed by the pipe manufacturer and describe the physical and chemical properties and the pipe and the manufacturing process that was used to produce the pipe.

All other steel shall conform to AASHTO M 270, Grade 36 or 50. This steel shall meet supplementary requirements for notch toughness (Charpy Testing, Zone #2).

According to Subsection 106.04, upon completion of fabrication, the fabricator shall provide a notarized certification of compliance. A legible copy of all mill test reports for materials that are incorporated into the work shall be included.

Steel anchor bolts, nuts, and washers shall conform to ASTM F 1554, Grade 36. The anchor bolts shall be hot dip galvanized according to ASTM A 153, Class C.

Chord splice assembly fasteners shall be high strength steel conforming to ASTM A 325 and shall be hot dip galvanized according to ASTM A 153, Class C. All other fasteners shall be stainless steel conforming to ASTM A 320, Grade B8, Class 1.

Caps for the ends of chords and tops of posts shall be steel conforming to AASHTO M 270 Grade 36 and shall be hot dip galvanized according to ASTM A 153.

After complete fabrication, each steel section shall be hot dip galvanized according to ASTM A 123. If size permits, then a single-dip galvanizing process is preferred.

Portland cement concrete, reinforcement steel, and curing material shall be as specified in Subsection 501.02.

CONSTRUCTION

509.03 Working Drawings.

Working drawings shall be furnished according to Subsection 105.04. Minor variations in details may be permitted. However, any major departure from the design will not be accepted.

A copy of the welding procedure shall be submitted by the fabricator before fabrication.

In addition to the criteria of the current AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, Variable Message Sign (VMS) support structures shall be designed according to the criteria of the current NJDOT Design Manual for Bridges and Structures. VMS cabinet enclosures or message boards and associated connections shall be analyzed for stresses in the base metal and welds that are caused by fatigue loads that are produced from natural wind and truck induced gust loads.

509.04 Steel Structures.{ XE "Signs:support structures:steel structures" }{ XE "Structures:steel" }

{ XE "Signs:support structures:welding" **}**Welding and fabrication shall be performed by an AISC certified plant and shall be done according to the AWS D1.1, Structural Welding code. All quality control and quality assurance inspectors shall be AWS Certified Welding Inspectors (CWI), qualified according to the provisions of AWS QC1. Quality control inspections are the responsibility of the fabricator and shall be performed, at least, to the minimum extent specified, and additionally, any other testing and inspection necessary to control production quality shall be made. Quality assurance inspections will be performed by the Department. All weldments will be inspected visually. Dye penetrant testing will be required at the discretion of the Engineer. Magnetic particle testing will be performed at a frequency of ten percent of the number of welds per unit, performed as a quality control function. For cantilever sign support structures, all chord splice assembly welds and post base welds shall be 100 percent magnetic particle inspected by the fabricator.

Radiographic inspection will be at the discretion of the Engineer.

After fabrication, the steel assemblies shall be hot-dip galvanized according to Subsection 917.12. When possible, galvanizing of the units shall be performed by the single-dip process. As specified in AASHTO M 111, the minimum coating thickness shall be based on the category and thickness of the steel to be galvanized. Inspection of the coating will be made by magnetic thickness gauge measurements as specified in ASTM A 123 for each truss chord and each post or tower shaft. Diagonals and struts will be inspected for coating thickness at a frequency of ten percent for each truss unit.

Galvanized areas damaged during shipping or erection shall be repaired as specified in Subsection 503.14. The repairs shall be authorized by the Engineer before execution.

Bridge mounted sign supports shall be made of tubular steel and galvanized. Each structure shall consist of one truss assembly attached to existing concrete parapets as shown on the plans. The truss sections shall be all-welded, one-piece units, with diagonals and verticals milled for exact fit and welded to the chords. Ends of chords shall be capped. Attachment of the support assembly shall be as shown in detail on the Plans.

509.05 Aluminum Alloy Members.{ XE "Signs:support structures:aluminum alloy" }

Welding and fabrication for aluminum members shall be according to Sections 1 through 6 and Section 10 of the ANSI/AWS D1.2 Structural Welding Code - Aluminum. Flame cutting of aluminum alloy materials is not permitted.

All weldments will be inspected visually. Dye penetrant testing will be required at the discretion of the Engineer.

Welders shall be qualified according to the ANSI/AWS D1.2 Structural Welding Code - Aluminum.

509.06 Inspection.{ XE "Signs:support structures:inspection" }

Written notice shall be given not less than 15 calendar days in advance of when welding is to be undertaken so that arrangements for inspection may be made.

The fabricator shall schedule its work in such a way that the inspection may be performed between its first and second work shifts and shall provide sufficient indoor space during winter months and inclement weather to perform these inspections.

Before shipping, the completed and accepted truss units shall be assembled in the shop and the truss span checked for dimensions, straightness, alignment, and camber. The camber shall be measured with the truss units on their sides.

Defects in weldments identified by visual, penetrant, or X-ray inspection shall be corrected by removing the defect and rewelding.

509.07 Release for Shipping.{ XE "Signs:support structures:release for shipping" }

Sign support structures will be accepted and released for shipping on the basis of a total structural unit being completed and inspected. This approval and release for shipment will be provided by the Department Laboratory or the testing agency, in writing, directly to the fabricator with a copy to the Contractor. This notice will be provided within ten working days after completion of the inspection for the total structure. The fabricator shall notify the Department's inspector in writing at least two days before shipping steel structure units to the galvanizer or to the Project site.

The structures shall be loaded on trucks or rail cars in such a manner that they may be transported and unloaded at their destination without being excessively stressed, deformed or otherwise damaged. Reinspection may be required on the site of erection for such cause.

509.08 Erection.{ XE "Signs:support structures:erection" }

Structural components shall be handled with care to prevent damage and shall be stored according to Subsection 509.09. Detailed written instructions and drawings for the erection of all structures shall be supplied before erection.

All walkways, luminaires, signs, and miscellaneous attachments shall be installed within the same eight-hour period that the trusses are erected.

Sign Support Structures shall be manufactured and erected as follows:

1. Subsequent to the fabrication requirements of Subsection 509.09, after welding and galvanizing, the truss abutting chord splices, shall be connected according to the criteria stated in Subsection 11.5.6 of the AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, conformance shall be to Subsection 11.5.6 of Division II of the AASHTO Standard Specifications for Highway Bridges.

   Snug tight is defined as the tightness that exists when all surfaces on the joint are in firm contact with one another.

   The use of the following equipment and procedure shall be followed to provide the connection.

   a. To facilitate a sequential tightening, two working platforms from which the bolt assembly tightening may be accomplished from opposite sides of the structure, shall be provided. The sequential tightening shall progress by initiating and progressing the tightening of the bolts in a pattern whereby a 180 degree opposite side repetition is maintained. Each bolt nut shall be sequentially tightened to the same calibrated increment.
   b. To sequentially tighten the bolt assembly to a snug tight condition, two impact wrenches shall be provided.
   c. A tensioning measuring device, such as a Skidmore-Wilhelm calibrator or other bolt tensioning device shall be used to calibrate the torque wrench, to perform the rotational capacity test of the bolt assemblies that is specified in Subsection 917.01 Subpart 4, and to confirm that the bolt assemblies can attain the minimum bolt tension that is specified in the Plans.
   d. For those projects designed according to the AASHTO Standard Specifications for Highway Bridges, Division II criteria shall be followed in setting the calibrated torque wrench to provide a tension not less than five percent in excess of the minimum tension value specified on the Plans. For those projects designed according to the AASHTO LRFD Bridge Design Specifications, the criteria of the AASHTO LRFD Bridge Construction Specifications shall be followed.
   e. When the erection of a Variable Message Sign (VMS) support structure is planned, to determine the load on the final bolt assembly, a load measuring device, equivalent to the StressTel BoltMike Ultrasonic Testing Equipment, shall be used. This type device is to be used to measure the elongation of the bolt assembly. The data derived from this equipment shall be provided to the Engineer.

2. The following sequence shall be followed to erect sign support structure posts or tower shafts:

   a. Clean threads of anchor bolts and nuts before post or tower shaft installation and lubricate as necessary.
   b. Clean, to the satisfaction of the Engineer, the top of the concrete pedestals or caissons to assure that they are free of dirt or other foreign materials.
   c. Install the top and bottom bolt assemblies as indicated on the plans and set level.
   d. Clean top and bottom surfaces of post or tower shaft base plates. Remove any burrs that would prevent proper seating of the connected parts in the snug tight condition.
   e. Install post or tower shafts. Posts or tower shafts must fit freely over anchor bolts and be seated on all leveling nuts. The contractor shall not force posts or tower shafts onto anchor bolts. Adjust leveling nuts to plumb the posts or tower shafts.
   f. Install washers and nuts on top of the post or tower shaft base plates. Beeswax or equivalent shall be generously applied to all of the top nut's bearing surfaces and internal threads.
   g. Sequentially draw down the nuts to contact the washers with a hydraulic impact wrench. The sequential tightening shall progress by initiating and progressing the tightening of the bolts in a pattern whereby a 180 degree opposite side repetition is maintained. The bolt nuts shall be sequentially tighten to the same calibrated increments.
   h. Recheck plumbness of posts or tower shafts and adjust leveling nuts as necessary.
   i. In the presence of the Engineer, fully tighten the bolt nuts. Progress by sequentially tightening the nuts on opposite sides of the base plate (180 degrees apart). Tighten the nuts with a hydraulic torque wrench, that is equivalent to the Hytorc XLT-Series Square Drive Wrench.
   j. Set the hydraulic torque wrench to provide the tension indicated on the Plans.

   After the posts or tower shafts are erected and all nuts have been tightened as outlined above, a second nut shall be added to each anchor bolt and made snug tight, or the use of ANCO self locking nuts, as provided

by Haydon Bolts, Inc. may be used to maintain the connection. After the installation of the second nut, or self-locking nut, the leveling nuts shall be brought to a snug tight condition. The space between the top of the pedestal and the bottom of the post shall remain open.

Before erection of the posts, tower shafts and trusses, the Contractor shall submit to the Engineer for approval a scheme showing the proposed equipment to be used, including calculations, and lift points to maintain the truss assembly in plumb position during placement. The Contractor shall also submit to the Engineer for approval a proposed scheme for traffic control during the erection of the towers and trusses.

When the erection of Variable Message Sign (VMS) structures is planned, the Contractor shall provide two stainless steel U-bolts, to the NJDOT Bureau of Materials, which are to be used for the mounting of the VMS boards. They shall be submitted two weeks before the scheduled erection for testing. Two U-bolts per lot shall be submitted.

When warranted, the Contractor shall verify in the field the location of an electrical power source. This verification shall be made before the foundation construction and before fabrication of the structure.

509.09 General.

{ XE "Signs:support structures:fabrication" **}A. Fabrication.** The loading, transporting, unloading, and erection of structural materials shall be done so that the metal is kept clean and free from injury in handling.

Structural materials shall be stored above the ground upon platforms, skids, or other supports. They shall be kept free from accumulation of dirt, oil, acids, or other foreign matter.

Any structural material which has been deformed shall be straightened before being laid out, punched, drilled, or otherwise worked on in the shop. Sharp kinks or bends are cause for rejection

In the fabrication of cantilever sign support structures, the following shall apply:

1. Care shall be taken by the fabricator to ensure that the splice plates and truss chords do not warp excessively during fabrication and that they will meet the surface contact tolerances given below. After galvanizing, truss and posts shall be returned to the fabricator before shipment for final shop assembly to verify camber, alignment and contact of splice mating surfaces.
2. Splice mating surfaces may be ground or milled to achieve the desired surface contact. However, ASTM A 6 requirements for permissible variation (under specified thickness) shall be maintained. Galvanizing damaged by grinding or milling shall be repaired according to Subsection 503.14.
3. Truss and posts shall be assembled and bolts torqued to the required value specified in the Plans.

B. Concrete Pedestals. Excavation and backfill shall be performed according to Section 206. Concrete construction requirements shall conform to Section 501.

Anchor bolts shall be set into a template for alignment and elevation and shall be secured in position to prevent displacement while concrete is being placed. The steel reinforcement and conduit elbows shall have been placed and secured before the placing of concrete.

The top surface of the concrete pedestal shall be leveled off below the bottom of the base plate of the post or tower shaft by the amount shown on the Plans.

{ XE "Electrical work:conduits, bridge" **}C. Installation of Conduits.** Galvanized steel conduit ells in pedestals shall be furnished and installed. Where this conduit is not to be extended to a junction box, the lower end of each ell shall terminate 3 feet from the face of the pedestal and 18 inches below grade and shall be capped with a standard galvanized steel pipe cap. The upper end of each ell shall project above the pedestal for a sufficient distance to terminate at the level of the bottom of the handhole in the sign support post or tower shaft, or at a maximum of 2 inches below such level, at which point it shall be terminated by means of a ground bonding bushing (with closure disk in conduits not to be extended).

D. Handholes and Wire Outlets. Where a cable passes through a hole or runs along a surface at any point on the complete assembly, such holes and surfaces shall be deburred and free of sharp edges or protuberances that may, in any manner, damage the cable.

E. Protection Against Other Materials. Where aluminum surfaces are to be in contact with other metals, Subsection 508.06, Subpart B shall apply.

F. Posts and Tower Shafts. Posts and tower shafts shall be erected in position to engage the anchor bolts on top of the concrete pedestal and adjusted for plumbness by manipulating the leveling nuts on the anchor bolts.

Posts and tower shafts shall not be erected upon the completed pedestals until authorized, but the minimum time allowed for the curing of the concrete before any load is placed thereon shall be seven calendar days. Footings shall be backfilled before erection.

COMPENSATION

509.10 Method of Measurement.

Sign support structures of the various kinds will be measured by the number of each.

509.11 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CANTILEVER SIGN SUPPORT, STRUCTURE NO.___	UNIT
BRIDGE MOUNTED SIGN SUPPORT, STRUCTURE NO. ___	UNIT
BUTTERFLY SIGN SUPPORT, STRUCTURE NO. ___	UNIT
OVERHEAD SIGN SUPPORT, STRUCTURE NO. ___	UNIT

Payment for foundation excavation will be made according to Section 206.

Payment for concrete and reinforcement steel will be made according to Section 501.

Payment for load bearing piles will be made according to Section 505.

Payment for sheeting will be made according to Section 513.

SECTION 510 - PUBLIC UTILITIES IN STRUCTURES{ XE "PUBLIC UTILITIES:IN STRUCTURES" }

510.01 Description.

This work shall consist of the construction of electric and telephone conduits and gas and water mains on bridges.

MATERIALS

510.02 Materials.

Materials shall conform to the following Subsections:

Fiberglass Pipe	913.10
Bolts and Bolting Material	917.01
Structural Steel	917.10
Timber for Structures	918.05
Gaskets	919.08

Steel pipe sleeves shall conform to ASTM A 252 and shall be galvanized according to ASTM A 123.

Channel supports, rods, bolts, nuts, washers, inserts, and other hardware required for the permanent installation shall be hot-dip galvanized according to ASTM A 123 or A 153.

Gas or water mains shall conform to the following:

{ XE "Gas mains" **}1.Gas Mains.** Pipe, pipe sleeves, pipe hanger assemblies, expansion joints, and seals between the pipe and sleeves shall be furnished by the gas company. Pipe, in 20 foot or longer lengths, shall be delivered to the job site, by the gas company, close to the point where it is to be used.

2. **Water Mains.** Materials shall be as provided in the Special Provisions.

CONSTRUCTION

510.03 Construction Requirements.

A. Electric and Telephone Conduits. Couplings shall be used to connect all conduits and shall be placed on terminal ends. Expansion couplings shall be used at expansion joints. Galvanized steel pipe lengths shall be joined with standard screw couplings conforming to requirements for galvanized wrought iron pipe couplings.

Steel pipe sleeves shall be installed in the abutment backwalls. The annular space between conduit and sleeves shall be caulked with asphalt-impregnated hemp.

All conduits shall be rodded, and No. 9 galvanized fish wires placed therein.

Structural steel shapes and plates for utility supports shall be furnished and erected according to Section 503.

The conduit installation is subject to inspection and approval of the utility company.

B. Gas Mains. The gas company shall be notified at least three working days in advance of when pipe delivery is required. The pipe shall be unloaded at the delivery point and shall be moved into place on the structure and joined together by welding. The gas main shall terminate approximately 5 feet beyond the abutments at each end of the bridge structure. Expansion joints shall be installed in the main as instructed by the gas company representative. Structural shapes and plates for utility supports shall conform to Section 503.

Before welding, the pipe shall be aligned on the common axis, properly gapped and firmly held by a welding clamp. All welding areas shall be cleaned to a bright metal surface by wire brushing or grinding. The first or stringer bead shall be deposited at least 50 percent around the circumference in equally spaced segments before the weld clamp is removed. Before applying the next pass, all tack welds and each bead shall be cleaned free of scale and oxide.

Welding shall conform to the manual arc welding procedure according to API 1104 - Standard for Field Welding of Pipe Lines and Related Facilities. Welders shall be qualified under API 1104 standards.

All welds shall be examined by radiographic (X-ray) inspection by a qualified inspection company acceptable to the gas company. The welds shall be accepted only if they meet API 1104 standards of acceptability. The X-ray films and one copy of the radiographic inspection report are to be delivered to the gas company. Defective welds shall be removed from the line and the pipe rebeveled by grinding and rewelded. Repair welds also shall also be inspected radiographically according to the provisions of this paragraph.

Before sections of pipe are welded together, each length shall be cleaned by passing a fiber and wire pipe brush of proper size through it.

Hangers shall be adjusted to provide uniform support of the pipe across the bridge and to align it in the abutment sleeves.

Upon completion of the installation, the carrier pipe shall be given a bottle test with air, for 24 hours, at a pressure specified by the gas company with test caps and gauges supplied by the gas company. Caps or expansion joints, if used, shall be anchored to prevent movement during the test. The method employed to anchor caps and expansion joints is subject to approval of the gas company inspector.

After completion of the test and relieving the test pressure, anchoring devices shall be removed as directed by the gas company inspector.

The pipe and hanger supports shall be cleaned and painted according to gas company specifications. Copies of these specifications are available upon written request to the gas company.

The installation of gas mains is subject to inspection and approval of the utility company.

C. Water Mains. The construction of water mains shall be according to the provisions in the Special Provisions.

COMPENSATION

510.04 Method of Measurement.

Utility conduits and mains will be measured by the linear foot including the length projecting beyond the rear face of the abutment.

510.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
ELECTRIC CONDUITS	LINEAR FOOT
TELEPHONE CONDUITS	LINEAR FOOT
___ " GAS MAINS	LINEAR FOOT
___ " WATER MAINS	LINEAR FOOT

SECTION 511 - STRUCTURAL PLATE PIPE{ XE "STRUCTURAL PLATE PIPE" }{ XE "PIPE:STRUCTURAL PLATE" }

511.01 Description.

This work shall consist of the construction of structural plate pipe, pipe arches, and structural plate arches.

MATERIALS

511.02 Materials.

Materials shall conform to the following Subsections:

Aluminum Alloy Structural Plate for Pipe, Pipe Arches, and Arches 913.01
Structural Steel Plate for Pipe, Pipe Arches, and Arches 913.14

CONSTRUCTION

511.03 Working Drawings.

Working drawings shall be furnished according to Subsection 105.04.

511.04 Excavation, Bedding, and Backfill.

Excavation, bedding, and backfilling shall be according to Section 206 and the following:

1. When filling around and over arches before headwalls are in place, the first fill material shall be placed midway between the ends of the arch, forming as narrow a ramp as possible, until the top of the arch is reached. The ramp shall be built evenly from both sides and the fill material shall be compacted as it is placed. After the two ramps have been built to the top of the arch, the remainder of the fill material shall be deposited from the top of the arch both ways from the center to the ends, and as evenly as possible on both sides of the arch.
2. If the headwalls are built before any fill material is placed around and over the arch, the fill material shall first be placed adjacent to one headwall until the top of the arch is reached, after which it shall be placed from the top of the arch toward the other headwall, with care being taken to deposit the material evenly on both sides of the arch. In multiple installations, the procedure specified above shall be followed, but care shall be used to bring the material up evenly on each side of each arch so that unequal pressure is avoided.
3. Construction of pipe or arch systems for stream diversions shall be according to Subsection 602.04.

511.05 Fabrication.

A. Description of Plates. Plates shall consist of structural units of galvanized corrugated steel or of corrugated aluminum alloy, whichever is specified. Single plates shall be furnished in standard sizes to permit structure length increments of 2 feet.

The plates at longitudinal and circumferential seams of structural plates shall be connected by bolts.

B. Forming and Punching Plates. Plates shall be formed to provide lap joints. The bolt holes shall be so punched that all plates having like dimensions, curvature, and the same number of bolts per foot of seam shall be interchangeable.

Bolt holes along those edges of the plates that form longitudinal seams in the finished structure shall be staggered in rows 2 inches apart, with one row in the valley and one on the crest of the corrugation. Bolt holes along those edges of the plates that form circumferential seams in the finished structure shall provide for a bolt spacing of not more than 12 inches. The minimum distance from center of the hole to edge of plate shall be not less than one and three-quarters times the diameter of the bolt. The diameter of the bolt holes in the longitudinal seams except those at the plate corners shall not exceed the diameter of the bolt by more than ⅛ inch.

Plates for forming skewed or sloped ends shall be cut to give the angle of skew or slope specified. Burned edges shall be free from oxide and burrs. Identification numbers shall be placed on each plate to designate its proper position in the finished structure.

511.06 Erection.

Structural plate pipe, pipe arches, and arches shall be erected in their final position by connecting the plates with bolts at longitudinal and circumferential seams. Drift pins may be used to facilitate matching of holes. All plates shall be placed in the order recommended by the manufacturer with joints staggered so that not more than three plates come together at any one point. All bolts shall be drawn tight, without overstress, before beginning the backfill.

After the pipe or arches have been erected, all erection bolts and all spots where damage has occurred to galvanized coating shall be field galvanized according to Subsection 503.14. Damage to bituminous coating shall be repaired with two coats of hot asphalt coating.

511.07 Elongation.

Elongated structural plate shall be formed so that the finished pipe is elliptical in shape, with the vertical diameter approximately five percent greater than the nominal diameter of the pipe. Elongated pipe shall be installed with the longer axis vertical.

Pipe arches shall not be elongated.

COMPENSATION

511.08 Method of Measurement.

Structural plate pipe, pipe arches, and plate arches will be measured by the linear foot along the bottom centerline for pipe and pipe arches, and by the average of the spring line lengths for structural plate arches.

511.09 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
___ " STRUCTURAL PLATE PIPE, ___ THICK	LINEAR FOOT
___ BY ___ " STRUCTURAL PLATE PIPE ARCH, ___ THICK	LINEAR FOOT
___ BY___ " STRUCTURAL PLATE ARCH, ___ THICK	LINEAR FOOT

Payment for excavation will be made according to Section 206.

SECTION 512 - TEMPORARY STRUCTURES{ XE "TEMPORARY:STRUCTURES" }{ XE "STRUCTURES:TEMPORARY" }

512.01 Description.

This work shall consist of the structural design, construction, maintenance, and removal of temporary structures including substructures and approaches.

MATERIALS

512.02 Materials.

Any material or combination of materials which are appropriate for the type of structure may be used.

CONSTRUCTION

512.03 Working Drawings.

Working drawings and design calculations shall be furnished according to Subsection 105.04.

512.04 Capacity.

{ XE "Structures:temporary:design loads" **}**Design loadings shall conform to the current New Jersey Department of Transportation Design Manual for Bridges and Structures.

512.05 Structures.

For waterway structures, the elevation of the bottom of the floor system shall not be lower than the ordinary high-water elevation. A waterway opening shall be provided which is at least equal to the waterway opening provided by the existing structure at ordinary high-water level. If there is no existing structure, the temporary bridge shall be constructed to provide a waterway opening at least equal to that indicated for the new structure at ordinary high-water level.

Curbs shall be painted white.

512.06 Maintenance.

Each temporary structure and the approaches shall be maintained to safely accommodate traffic. Barricades, signs, lights, and flaggers shall be provided where specified. Temporary structures shall be removed after the new work is open to traffic.

COMPENSATION

512.07 Method of Measurement.

Temporary structures of the various kinds will not be measured, and payment will be made on a lump sum basis.

512.08 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
TEMPORARY STRUCTURE, ONE-WAY	LUMP SUM
TEMPORARY STRUCTURE, TWO-WAY	LUMP SUM
TEMPORARY STRUCTURE, PEDESTRIAN BRIDGE	LUMP SUM

Payment of 75 percent of the lump sum price bid will be made when the temporary structure is opened to traffic. Payment for the remaining 25 percent will be made when the temporary structure has been removed.

SECTION 513 - SHEETING, TEMPORARY AND LEFT IN PLACE{ XE "TEMPORARY:SHEETING" }

513.01 Description.

This work shall consist of the structural design, construction, and maintenance of temporary and left in place sheeting. This work shall also consist of the removal of temporary sheeting.

MATERIALS

513.02 Materials.

Any type of sheeting and system of bracing may be used that is adequate and effective in safely withstanding the external forces to be sustained during construction.

CONSTRUCTION

513.03 Working Drawings.

Working drawings and design calculations shall be furnished according to Subsection 105.04.

Design of steel sheet piles shall conform to the structural design criteria as provided in Subsection 513.04.

513.04 Construction Requirements.

Structural members for the temporary and left in place sheeting and bracing system shall be of adequate size and cross-section with physical properties for proper functioning and shall be braced to protect workers, adjoining properties, and the public. The structural design for steel sheet piles shall account for combined stresses that act in more than one direction and shall determine the maximum effect of the principal stresses on the steel sheet pile. The sheet pile design shall account for the maximum forces that the steel sheet piles will be subjected to during all construction operations. Structural design for steel sheet piles shall be initially based on sizing the sheet pile section modulus for the maximum longitudinal bending moment. This design represents the minimum design for steel sheet piles. The structural design for steel sheet piles shall also include a check for the principal stresses within the sheet pile at all locations that may produce maximum stress effects, and these stresses shall be checked against the appropriate material yield point. The principal stresses shall include the effects of bending stresses in the longitudinal (vertical) direction and the transverse (horizontal) direction. The use of the Henckly-Von Mises (Yield Distortion Energy) criterion to combine stresses and relate the principal stresses to a failure criterion (Material Yield Point) is permissible. Additional stress and stability checks for local buckling effects, shear effects, web stability, and the effects of wale deflections and reactions shall also be investigated for adequacy for the final designed sheet pile structure. Design calculations shall be submitted according to Subsection 513.03.

The sheeting shall be tight and continuous for its entire length.

Except for untreated timber, the Resident Engineer may authorize leaving the temporary sheeting in place. When sheeting is left in place, the upper portion shall be removed to at least 3 feet below finish ground.

Safety provisions shall comply with the requirements of Subsection 107.11.

Materials which obstruct the installation shall be excavated and removed according to Section 202.

COMPENSATION

513.05 Method of Measurement.

Temporary sheeting will be measured by the square foot.

Sheeting left in place will be measured by the square foot.

Where sheeting is required to be cut at the spring line of a pipe so as not to disturb the pipe, measurement will be made for the square feet left in place. The remainder will be measured as temporary sheeting.

513.06 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
TEMPORARY SHEETING	SQUARE FOOT
SHEETING LEFT IN PLACE	SQUARE FOOT

SECTION 514 - PAINTING EXISTING BRIDGES{ XE "PAINTING OF EXISTING BRIDGES" }{ XE "BRIDGES, EXISTING:PAINTING OF" }

514.01 Description.

This work shall consist of the cleaning and painting of structural steel and metal surfaces on existing bridges with one of the following coating systems:

Epoxy Mastic Coating System

Organic Zinc Coating System

Only one of the above coating systems shall be used on each bridge in a Contract. An exception to this restriction is when repainting of surfaces that will be in contact with freshly placed concrete is involved in a project. For such occurrences, a prime coat of the organic zinc or epoxy mastic systems may be used. The appropriate surface preparation method shall be utilized.

Whenever the term “coat” or “coating” is used hereinafter, it shall constitute as many applications as are necessary to achieve the specified dry film thickness.

Whenever there is a discrepancy between these Specifications and the manufacturer’s recommendations, with the approval of the Engineer, the manufacturer’s recommendations shall govern.

MATERIALS

514.02 Materials.

Materials shall conform to the following Subsections:

Epoxy Mastic Coating System.....912.14
Organic Zinc Coating System.....912.15

For the epoxy mastic coating system, a complete coating system of an aluminum epoxy mastic primer and a urethane finish coat shall be selected from one of the approved coating systems described in Subsection 912.14. However, when the only surfaces requiring repainting are surfaces that will be in contact with freshly placed concrete, the epoxy mastic coating system shall be one coat of a non-aluminum epoxy mastic primer, approved by the Department’s Bureau of Materials.

For the organic zinc coating system, a complete coating system of an organic zinc-rich primer, a high-build epoxy intermediate coat, and a urethane finish coat shall be selected from one of the approved coating systems described in Subsection 912.15. The color of the finish coat shall be as noted on the Plans. When specified, the colors Lake Blue, Foliage Green, and Brown shall match the following color chips of FED-STD-595B:

Lake Blue..... Chip No. 25189
Foliage Green ..... Chip No. 24172
Brown ..... Chip No. 30111

The primer shall be tinted to contrast the base metal.

The color for the intermediate coat shall be white or an approved color that contrasts with the prime and finish coats.

The blast cleaning medium shall be a reclaimable abrasive capable of providing the specified anchor profile. When site conditions, such as location of electrical lines over railroad lines or adequate space is not available for positioning of the recycling equipment, prohibit the use of a reclaimable abrasive medium, the abrasives used for the blast cleaning shall be low dusting, silica-free abrasives, commonly referred to as Star Blast, Copper Blast, Green Lightning, Green Diamond, Black Beauty (under 100 pounds per square inch nozzle pressure), or an approved equal for which the pH levels used shall be between 6.0 and 8.5. The Contractor shall submit samples of the materials to be used as blast cleaning mediums to the Engineer for approval.

EQUIPMENT

514.03 Equipment.

The equipment shall include cleaning and painting equipment; tools; tackle; scaffolding; facilities for protection of pedestrians, vehicular, and other traffic upon, underneath, or adjacent to the bridge; facilities for protection of all portions of the structure against disfigurement by spatters, splashes, and smirches of paint and paint materials; facilities for protection of all portions of the structure against cleaning operations; and facilities for the protection of the environment, according to Subsection 514.13.

Equipment that uses compressed air shall have oil traps and moisture separators installed in the air supply lines. The traps and separators shall be changed on a regular basis, according to the manufacturer's recommendations. Compressed air shall comply with the requirements of the blotter test as described in ASTM D 4285.

CONSTRUCTION

514.04 Limits of Cleaning and Painting.

A. General. Surfaces to be cleaned and painted shall include all surfaces of existing structural steel which have previously been painted and surfaces of other metal. They shall include structural steel girders; beam and metal plate flooring; towers and bents; metal protection for piers and abutments; metal railings on bridge spans, wingwalls, and along the bridge approaches; and metal work exposed on the bridge deck and sidewalks. On drawbridges, the work includes cleaning and painting of bridge houses, warning and crash gates, and counterweights. Woodwork, if any, shall be painted with two coats of appropriate paint.

Surfaces to be cleaned and painted shall also include the top surfaces of top flanges of existing steel girders excluding the shear connectors. In such cases only a prime coat is to be applied to the top flanges of the girders.

Aluminum alloy metal work and galvanized metal used as permanent metal deck forms for concrete decks and bridge deck grid flooring shall not be painted.

The Contractor's progress schedule, submitted according to Subsection 108.04, shall include the sequence for the cleaning and painting operations in conjunction with other operations at each bridge.

When more than one bridge is to be painted, the Engineer may specify at any time the sequence in which the structures shall be cleaned and painted.

The Work shall be contained above the bridge seats and between the backwalls of the abutments with the exception of some railings, stairs, and navigational aids which may lie outside of the abutments.

Structural members and appurtenances fabricated of either unpainted aluminum or copper shall not be painted.

When the Work is over water, and if applicable in the Contract, included shall be the painting of navigational signal lights and other navigational aids attached to the bridge or fender system, as directed.

The electrical junction boxes and conduit, light posts and arms, warning lights, and navigational lights on all bridges shall be painted with a touch-up coat first and then a second field coat of aluminum paint conforming to Subsection 912.02.

All components/materials that are not scheduled for blast cleaning and painting shall be adequately protected during those operations. All blast damage to or paint overspray on these components/materials is to be repaired or removed to the satisfaction of the Engineer at the Contractor's expense.

B. Epoxy Mastic Coating System. The limits for the specified methods of surface preparation shall be delineated and as directed. When spot blast cleaning is specified, before the cleaning operations the Contractor shall remove accumulated dirt and dust and shall complete a thorough examination and survey of the existing surfaces to identify areas of paint failure and corrosion that will require blast cleaning outside the limits designated. The areas of blast cleaning shall be such that a completely intact, firm, and adhering existing paint film is attained.

C. Organic Zing Coating System. All structural members to be painted shall be blast cleaned.

514.05 Cleaning Methods.

A. General.

1. Hand/Power Tool Cleaning. Before hand/power tool cleaning, all visible oil, grease, and salts shall be removed by solvent cleaning according to SSPC-SP 1. All existing surfaces shall then be cleaned by a high pressure water washing (800 pounds per square inch minimum) which shall include a corrosion inhibitor. All existing paint left on the surface after hand/power tool cleaning shall be adequately roughened before paint application. Existing

surfaces to be prepared by hand or power tool cleaning, or a combination of both, shall comply with the requirements of SSPC-SP 2 and SSPC-SP 3, respectively.

2. **Blast Cleaning.** Blasting residues, spent blasting medium, rust particles, paint particles, and dust associated with the work shall be captured, contained, collected, and disposed of according to Subsection 514.13.

Before blast cleaning, the tops of bottom flanges shall be scraped to remove accumulated dust, dirt, and debris. All visible oil, grease, and salts shall also be removed by solvent cleaning according to SSPC-SP 1.

Before beginning the cleaning operations on each bridge, the Contractor shall prepare a test panel on an existing girder, for the approval of the Engineer, of each blasting method to be used. The test panel shall be maintained for the duration of the Project using a clear coating and shall serve as a reference standard. At the completion of all work, the panel shall be cleaned and coated according to these Specifications.

Existing surfaces to be prepared by commercial blast cleaning shall be according to SSPC-SP 6. The blast condition may be determined by use of NACE No. 3 Visual Standard or Maryland Pictorial Standard if shot blast is used, or SSPC Pictorial Standard VIS-1 (Grade 2) if abrasive or grit is used. The blast cleaning shall leave the required anchor profile in a dense, uniform pattern of depressions and ridges. The profile depth shall be determined by the elcometer surface profile gage or Testex replica tape.

Existing surfaces to be prepared by near-white blast cleaning shall be according to SSPC-SP 10. The near-white blast condition may be determined by use of a NACE No. 2 Visual Standard TM-01-75 or Maryland Pictorial Standard if shot blast is used, or SSPC Pictorial Standard VIS-1 (Grade 2½) if abrasive or grit is used. The blast cleaning shall leave the required anchor profile in a dense, uniform pattern of depressions and ridges. The profile depth shall be determined by the elcometer surface profile gage or Testex replica tape.

The surface area of steel to be blast cleaned shall be no greater than the surface area of steel that can be prime coated in the same working day.

If water is used in the blast cleaning procedure, the blasted surface shall be cleaned by rinsing with fresh water with an acceptable corrosion inhibitor added, or with fresh water followed immediately by an inhibitive treatment. The surface shall then be blasted to remove residue.

All fins, tears, slivers, and burred or sharp edges that are present on any steel member or that appear during the blasting operations shall be removed by grinding, and the reblasted area shall provide the required anchor profile.

All abrasive and paint residue shall be removed from steel surfaces with a commercial grade vacuum cleaner equipped with a brush-type cleaning tool or by double blowing with clean air. If the double blowing method is used, the top surfaces of all structural steel, including top and bottom flanges, longitudinal stiffeners, splice plates, hangers, etc., shall be vacuumed after the double blowing operations are completed. The steel shall then be kept dust free until the prime coat is applied.

Care shall be taken to protect freshly coated surfaces from subsequent blast cleaning operations. Blast damaged primed surfaces shall be thoroughly wire brushed or, if visible rust occurs, reblasted to the required condition. The wire brushed or blast cleaned surfaces shall be vacuumed and reprimed.

B. Epoxy Mastic Coating System. Except where commercial blast cleaning, according to Subpart A.2. above, is specified in the Special Provisions, all existing surfaces shall be hand/power tool cleaned according to Subpart A.1 above. All commercial blast cleaned surfaces shall leave an anchor profile from 1.5 to 3 mils deep.

C. Organic Zinc Coating System. All existing surfaces shall be near-white blast cleaned according to Subpart A.2. above. Near-white blast cleaned surfaces shall leave an anchor profile from 1.5 to 2.5 mils deep.

514.06 Painting Galvanized Surfaces.

Galvanized surfaces and galvanized surfaces made bare by the cleaning operations shall be treated before painting according to ASTM D 2092, Method A. When using the organic zinc coating system, this treatment shall be followed by an application of the epoxy intermediate and urethane finish coats only. When using the epoxy mastic coating system, the full coating system may be applied.

514.07 Conditions for Painting.

A. General. Conditions for painting shall be according to SSPC-PA 1 and the following:

1. Paint shall be applied on clean dry surfaces only. Coatings shall not be applied when the temperature of the air, paint, or metal, or the relative humidity is expected to be outside of specified limits before the paint is fully cured, nor shall coatings be applied when a combination of temperature and humidity conditions are such that moisture condenses on the surface being coated.
2. None of the coatings shall be applied when the wind velocity exceeds 20 miles per hour, when the air is misty, or when, in the opinion of the Engineer, conditions are unsatisfactory for the work. Also, the paint shall not be applied upon damp or frosted surfaces or when the metal is hot enough to cause the paint to blister, produce a porous paint film, or cause the vehicle (binder) to separate from the pigment.
3. Paint shall not be applied when the steel surface temperature is lower than 5 ºF above the dew point. The dew point shall be determined by the Engineer using a psychrometer and appropriate tables. The dew point requirement may be presumed to be satisfied if a thin, clearly defined film of water, applied to the cleaned vertical surface with a damp cloth, evaporates within 15 minutes, as determined by the Engineer.
4. Zinc salts, oil, dust, dirt, and other contaminants shall be removed before each coat of paint and any repair coats are applied in the field. The primed surfaces shall be cleaned by a high pressure water washing (800 pounds per square inch minimum).
5. The Contractor shall provide a suitable facility for the storage of paint that will be according to the latest OSHA regulations. This facility must provide protection from the elements and ensure that the paint is not subjected to temperatures outside the manufacturer's recommended extremes.

B. Epoxy Mastic Coating System. The epoxy mastic coating shall not be applied when the temperature is below 50 ºF or when the relative humidity is above 90 percent. The urethane coating shall not be applied when the temperature is below 40 ºF or when the relative humidity is above 90 percent. When the only surfaces requiring repainting are surfaces that will be in contact with freshly placed concrete, a non-aluminum epoxy mastic primer approved by the Department's Bureau of Materials, Office of Inspection, shall be used. For the non-aluminum epoxy mastic primer, surface preparation shall be according to Subsection 514.05, Subpart A.1 and applied according to the manufacturer's recommendations.

C. Organic Zinc Coating System. The organic zinc or epoxy coating shall not be applied when the temperature is below 50 ºF or when the relative humidity is above 90 percent. The relative humidity shall be above 50 percent for the organic zinc coating. The urethane coating shall not be applied when the temperature is below 40 ºF or when the relative humidity is above 90 percent.

514.08 Number of Coats and Film Thickness.

A. General. The dry film thickness for each coat will be determined by a magnetic dry film thickness gauge. The gauge shall be calibrated and used according to SSPC-PA 2. A Tooke film thickness gauge shall be used according to ASTM D 4138 to verify the coating thickness when requested by the Engineer. If the Tooke gauge shows that the prime coat is less than the specified minimum thickness, the total coating system will be rejected. Required corrective work, as directed, shall be at the Contractor's expense.

The gauges shall be calibrated on a relatively smooth section of the blasted web, not in a heavily pitted area.

B. Epoxy Mastic Coating System. A minimum of three coats shall be applied in the field: spot prime (over blast cleaned or exposed surfaces), prime, and finish coats. A full prime coat shall be placed over the entire surface, including areas that have been spot primed.

The dry film thickness of the paint at any point shall not be less than the following minimums:

Spot prime coat	5 mils
Prime coat	3 mils
Finish coat	2 mils

C. Organic Zinc Coating System. A minimum of three coats shall be applied in the field: prime, intermediate, and finish coats.

The dry film thickness of the paint at any point shall not be less than the following minimums:

Prime coat	3 mils
Intermediate coat	3.5 mils
Finish coat	2 mils

514.09 Mixing the Coatings.

A. General. Coatings shall be mixed according to SSPC-PA 1 and the following requirements.

The coatings shall be mixed in their original containers. Each coat shall be mixed to achieve and maintain a homogeneous mixture. Single component coatings shall be poured several times from one container to another (boxing) until the composition is uniform. When recommended, paint containers for spray applications shall be equipped with a mechanical agitator so that the mixture is in motion throughout the application period.

B. Organic Zinc Coating System. The prime coat shall be mixed with a high shear mixer to a smooth, lump-free consistency. Paddle mixers or paint shakers shall not be used. The mixing shall continue until all of the metallic powder or pigment is in suspension, taking care that all of the coating solids that might have settled to the bottom of the container are thoroughly dispersed. The mixture shall be strained through a 10 to 24-mil screen to remove large particles.

514.10 Thinning Paint.

In general, the coatings are supplied for normal use without thinning. If it is necessary to thin the coating for proper application, the thinning shall be done according to the manufacturer's recommendations.

In cool weather the paint may be warmed to reduce the viscosity. Such warming may be accomplished by heating the paint containers in water or placing them on steam radiators.

Coatings and thinners shall be stored and protected from the weather in enclosed structures at 40 to 110 ºF. The enclosure shall be equipped with a recording thermometer.

514.11 Paint Application.

A. General. Paint application shall be according to SSPC-PA 1 and the following:

1. The prime or spot prime coat shall be applied immediately after inspection and acceptance of the surface. The prime or spot prime coat shall be applied the same day the metal is cleaned, but not until the cleaning operation is far enough ahead to eliminate the danger of dirt or other material from the cleaning operations from falling or blowing onto the fresh paint. All blast cleaned surfaces shall be primed or spot primed the same day before any contamination, formation of rust, or any other deterioration of the prepared surface.
2. The minimum curing time between coats shall comply with the requirements of Subsection 912.14 for the Epoxy Mastic Coating System and Subsection 912.15 for the Organic Zinc Coating System. Depending on site conditions, additional time may be required for proper curing before applying succeeding coats. It is the applicator's responsibility to determine if the coating has cured sufficiently for proper application of succeeding coats; however, succeeding coats shall not be applied until each coat is approved. The maximum time interval between coats and required surface preparation procedures, should this interval be exceeded, shall comply with the requirements of the manufacturer's written recommendations.
3. Before the application of the full prime coat, a prime coating (striping) shall be applied to all edges of plates and rolled shapes, corners, crevices, welds, rivet heads, and exposed parts of bolts. The full prime coat shall not be applied before the striping has set to touch.
4. The coating of paint shall be smoothly and uniformly spread so that every part of the surface will be covered with at least the minimum specified thickness and so that no excess paint will collect at any point. A dense and uniform appearance is required after each applied coating has cured.
5. If the paint coating is too thin or if portions of the surface are not completely coated, such portions of the work shall be repainted. If the application of the coating at the required thickness in one coat produces runs, bubbles, or sags, the coating shall be applied in multiple passes of the spray gun. Where excessive coating thickness produces surface defects such as "mud-cracking," such coating shall be removed back to soundly bonded coating and the area recoated to the required thickness. In areas of deficient primer thickness, the areas shall be thoroughly cleaned with power washing equipment, as necessary to remove all dirt. The areas shall then be wire brushed, vacuumed, or otherwise prepared as directed, and then recoated.
6. All small cracks, joints, and cavities which were not sealed in a watertight manner by the first coat of paint shall be filled with a plastic caulking compound or other similar caulking compound, conforming to Federal Specification TT-C-598B (2). The compound shall be permitted to dry before the second coat of paint is applied. Any cracks or defects found in the steel by the Contractor should be immediately reported to the Engineer according to Subsection 108.09.

7. The coatings shall be applied using brushes, rollers, spray equipment, or any combination of equipment that will attain satisfactory results and the film thickness specified, as follows:

a. Spray Painting. Spray nozzles and pressures shall comply with the requirements of the manufacturer's recommendations.

Whenever painting operations are interrupted, the zinc-rich primer remaining in the fluid hose shall be expelled from the hose. Spray equipment which is used for application of the zinc-rich primer shall be thoroughly cleaned at the end of each workday with an approved solvent. The left over solvent and paint waste material shall be disposed of properly. Spray application is preferred for the zinc-rich primer.

b. Brush Painting. Brushes preferably shall be round or oval in shape, but if flat brushes are used, they shall not exceed 4½ inches in width. All brushes shall have sufficient body and length of bristle to spread the paint in a uniform coat.

The paint shall be manipulated under the brush to produce a uniform, even coat in contact with the metal or previously applied paint and shall be worked into all corners and crevices. In general, the primary movement of the brush shall describe a series of small circles to fill all irregularities in the surface after which the coating shall be brushed out and smoothed by a series of parallel strokes until the paint film has an even thickness.

c. Roller Painting. Rollers, when used, shall be of a type which does not leave a stippled texture in the paint film. Rollers may be used only on flat, even surfaces. The rollers shall be manipulated in a manner which produces a paint film of even thickness with no skips, runs, sags, or thin areas. The roller operation should be closely followed by a bristle brush to level off any air bubbles.

d. Inaccessible Surfaces. On surfaces which are inaccessible for painting by regular means, the paint shall be applied by sheepskin daubers or sprayed, or by other means if necessary, to ensure coverage of the proper thickness of paint.

e. Stenciling. The following information shall be stenciled on the outside web of both fascia beams, on both ends of the structure, and according to the data specified below:

(1) The seven-digit structure number.
(2) The month and year of completion.
(3) The paint system code number.

The markings shall provide uniform 2-inch high, C series letters or numerals with the paint the same as the finish coat except that the color shall be black. The markings shall be located not less than 2 inches above the lower flange and not more than 3 feet from the abutment. In the case of a bascule bridge, stencil information should be placed 3 feet from the heel of the bascule span.

In addition, all memorial or commemorative metal plaques, if any, which may be affixed to the structure or appurtenance thereof, shall be thoroughly cleaned by the Contractor. The Contractor shall submit in writing to the Engineer, for approval, the proposed method along with a sample of any material intended to be used for cleaning. The Contractor shall conduct its cleaning operation in a good workmanship manner, according to the approved method, that ensures the removal of all the accumulated dirt, extraneous marking, and corrosion are removed to the satisfaction of the Engineer without marring, eroding, or staining the plaques in any way. Costs incurred for the cleaning of plaques shall not be paid for separately, but shall be deemed to be included in the various Pay Items scheduled in the Proposal.

B. Epoxy Mastic Coating System. The aluminum epoxy mastic primer shall not be applied to surfaces that will be in contact with freshly placed concrete. One coat of a non-aluminum epoxy mastic primer approved by the Department's Bureau of Materials, Office of Inspection, shall be used instead.

Spray or roller application shall not be used for the spot prime coat on the surfaces prepared by blast cleaning or other exposed bare metal surfaces.

C. Organic Zinc Coating System. Whenever painting operations are interrupted, the zinc-rich primer remaining in the fluid hose shall be expelled from the hose. Spray equipment which is used for application of zinc-rich primer shall be thoroughly cleaned at the end of each workday with an approved solvent. Spray application is preferable for the zinc-rich primer.

514.12 Unsatisfactory Paint Performance and Removal.

The paint performance shall be considered unsatisfactory if rusting occurs, if the paint coat lifts, blisters, wrinkles, has excessive runs or sags, or shows evidence of application under unfavorable conditions, if the workmanship is poor, if impure or unauthorized paint has been used, or for other such reasons determined by the Engineer.

The Contractor shall remove any unsatisfactory paint, and the metal shall be recleaned and repainted as specified herein at no cost to the State.

514.13 Protection of Environment, Structure, Persons, and Property.

Pedestrians, vehicular, and other traffic upon, underneath, or adjacent to the bridge, and all portions of the bridge superstructure and substructure shall be protected against damage or disfigurement by spatters, splashes, and smirches of paint or paint materials. Canopies and drop cloths shall be furnished where necessary for such protection. Drilling holes, field welding or bolted connections may not be used to secure the containment system to the bridge structure.

Paint dropped on concrete surfaces and all debris from the cleaning operations shall be removed from the superstructure and the substructure. Paint containers and refuse shall be removed from the site.

The Contractor is hereby advised that the existing paint systems on the bridge(s) may include red lead or basic lead silica chromate paint or both red lead and basic silica chromate paint as components.

Dependent upon whether blast cleaning or epoxy mastic surface preparation is required, the Contractor shall take all necessary precautions in the surface preparation stage to contain, collect, and dispose of the waste as hazardous according to the requirements stated herein.

It shall be the Contractor's ultimate responsibility to ensure the health and safety of all the Contractor's employees and subcontracting personnel. The Contractor shall develop a pollution control system for the complete capture, containment, collection, and disposal of the waste generated by the work. The system and the Contractor's operation shall be in compliance with all EPA, NJDEP, OSHA, USCG, and other regulatory agencies with jurisdiction, rules, regulations, standards, and guidelines in effect at the time that the Work is in progress. According to Section 107, the Contractor shall be liable for any fines or cost incurred as a result of its failure to be in compliance with all Federal, State, and local laws. All references to the "workers or employees" shall mean the "Contractor's employees and subcontracting personnel."

Projects that involve lead paint abatement shall require that the Contractor's personnel, who perform the lead paint abatement, be trained in the applicable workers' programs that concern health and safety compliance and that concern environmental regulations regarding lead abatement. Each supervisor and worker of the Contractor must be certified as to successful completion of this training. The training shall be performed by the Department of Health and Senior Services. Certification shall be performed by the Department of Community Affairs, Division of Codes and Standards.

The performance of lead abatement activities shall be performed only by trained and certified personnel. Also, only lead abatement practices as described in the SSPC Publication "Industrial Lead Paint Removal Handbook," shall be used. The Department of Labor will monitor projects for compliance with the training and certification requirements. Random inspections shall be performed under the supervision of the Engineer.

Protection of the environment, structure, persons, and property shall be according to Subsections 107.10, 107.28 and the following:

1. Blast Cleaning Requirements.

a. Pollution Control System. Before commencing work on the structure(s), the Contractor shall submit a pollution control system for review and approval, according to Subsection 108.03, as stated elsewhere herein, in writing and with sketches according to Subsection 105.04.

The Contractor's pollution control system shall set forth, in detail, the specific system the Contractor proposes for the complete capture, containment, collection, and disposal of the waste generated by the Work. The Contractor shall be in compliance with all EPA, NJDEP, OSHA, USCG, and other regulatory agencies with jurisdiction, rules, regulations, standards, and guidelines in effect at the time the Work is in progress. The system shall also describe the method the Contractor proposes for reclaiming the blasting medium and the provisions for health and safety.

If at any time during the execution of the work, any part of the pollution control system fails to function at the required level of efficiency, the Contractor shall immediately suspend the affected operation(s). Work shall not resume until modifications to correct the cause of the failure have been made and approved. If the failure is due to adverse weather conditions such as high winds, the Contractor shall immediately suspend the affected operations until the weather conditions become favorable. No additional payment will be made for any corrective actions required.

The review and acceptance of the pollution control system will not relieve the Contractor of the responsibility for attaining the required degree of capture, containment, collection, and disposal, or the required degree of protection of the operation equipment and appurtenances, or to comply with all laws, rules, regulations, standards, or guidelines in effect during the execution of the work.

The pollution control system and any other equipment employed by the Contractor shall not encroach upon the bridge clearances over traveled roads or navigable water, unless approved.

The pollution control system shall consist of the containment and waste disposal plans. The emergency management plan shall be a part of the waste disposal plan. The Contractor shall not deviate from any part of the approved pollution control system without the approval of the Engineer. The containment and waste disposal plans shall be as follows:

(1) Containment Plan.

(a) Description. This shall consist of furnishing, erecting, maintaining, and removal of enclosures as required to contain and collect waste resulting from the removal of coatings in the preparation of steel surfaces for painting. Also included is the vacuum collection of such waste and the storage of waste in suitable containers.

The Contractor shall consider each structure and the type of containment required for each, using the best available technology, in order to meet all Federal, State, city, and local regulations.

(b) Materials. Materials and equipment shall be of satisfactory quality to perform the work and shall be reviewed by the Engineer for approval. The enclosures shall be constructed of such materials that will prevent the passage of fine particles.

Tarpaulins, if used, shall be made of solid, watertight material(s) and shall be secured continuously at the seams. The use of open mesh or burlap material is not allowed.

(c) Construction. The working drawings shall indicate the specific design of the containment plan(s) to be employed including, but not limited to, the following:

1. Types of materials;
2. Structural element sizing and connections;
3. Maximum loading permitted;
4. Maximum deflection permitted;
5. Design of hangers;
6. Assembly and disassembly procedures; and
7. An analysis of the load which will be added to the existing structure by the proposed system when put into use.

The loading analysis shall be performed by a Professional Engineer licensed to practice in the State. The analysis shall ensure that when put into use, the proposed system will not induce a load on the superstructure or

substructure that will create an adverse overstress condition or otherwise induce an undesirable effect on the structure and affected members.

Containment drawings shall include complete details of the following:

1. Type of solid/rigid floor (specify maximum load). Provide details concerning the materials that will be used for the flooring, how it will be constructed, dimensions, and how funnels may be used. Should the ground be used as the solid/rigid flooring, describe how it will be secured to the ground and incorporated into the containment enclosure.

   Should a floating platform be utilized, include details about its construction such as materials and dimensions. Describe how waste is to be off-loaded from the platform, how the platform is to be tied off, and how storage drums are to be handled if they are to be loaded onto the platform.
2. The run-off route from existing deck drains through the enclosure.
3. Type of canvas.
4. Type of bracing material.
5. Type of connection to structure. Welding is not permitted and bolting is by permission only.
6. Type of lighting inside the containment structure during blasting and inspection.
7. Type of dust collection equipment. Air flow inside the containment structure shall be designed to meet any applicable OSHA standards. Describe how the dust collector will be incorporated in the containment enclosure and how make-up air will be provided.
8. List the sequences of operations that shall be used to construct the containment.

The enclosures shall be dust proof and wind resistant and shall be designed and erected to contain, as well as facilitate, the collection of waste resulting from the surface preparation. Blast cleaning shall proceed only within containment enclosures approved by the Engineer and shall not commence until approved.

The containment enclosure shall extend from the bottom of the deck down to ground level or to a solid work platform. Materials for the enclosure shall be framed and fastened securely to prevent billowing or opening from the weather. All edges and seams of tarpaulins, if used, shall have a flap that clamps over the connecting edges for the entire enclosure. These flaps shall be completely fastened along the tarpaulin edges to prevent dust from escaping.

During blast cleaning, if the containment enclosure is allowing waste to escape, work shall be stopped until the enclosure is repaired satisfactorily. Any waste released from the enclosure shall be cleaned up by the Contractor immediately. If the wind velocity is high enough to cause the containment enclosure to billow, the Contractor shall cease blast cleaning and lower the enclosure after cleaning up all the waste.

The storage containers and storage location shall be reviewed by the Engineer and shall be located so as not to prevent a traffic or safety hazard. Container storage sites shall be in areas that are properly drained and run-off water will not pond around or near the containers. Storage containers shall be closed and covered (tarpaulin) at all times except during placement, sampling, and disposal of the waste.

According to Section 107, the Contractor is liable for any fines or costs incurred as a result of its failure to be in compliance with the Specifications and all Federal, State and local laws.

The Contractor shall be familiar with and consider all technology available for blast cleaning work associated with each structure within the Project including, but not limited to, the following techniques:

1. Control ventilation.
2. Mini enclosures.
3. Containment booms.
4. Blast enclosures (rigid and flexible).
5. Filter materials.
6. Solid drapes.
7. Vacuum blasters.
8. Water curtains.
9. Centrifugal blasters.
10. Negative pressure enclosures.
11. Wet scrubbers.
12. Cyclones.
13. Ground and water covers.
14 Most recent technological advancements and such other techniques as may be applicable.

The Contractor shall employ one or a combination of the available techniques for each structure to meet the capture, containment, collection, and disposal requirements. The cost thereof shall reflect the type of containment and equipment selected to achieve the conditions set forth in the Specifications. No additional payment will be made for any corrective action required to attain the specified requirements.

The Contractor shall use a vacuum truck(s) or equivalent method to capture, contain, collect, store, and dispose of all rust and paint particles, dust, and all other contaminated material generated by the Work, either in the vicinity of or within the containment system.

The Engineer may request the Contractor to conduct or request others to conduct air quality, water quality, or such other testing which will determine the quantity of any materials that may be escaping from the containment plan(s) employed on the Project. If it is determined that pollution of the environment adjacent to the site has occurred, the Contractor shall be responsible for the cost of all required corrective action.

Reference information on enclosures can be obtained from the following sources:

1. National Cooperative Highway Research Program Report 265 (NCHRP 265).
2. Journal of Protective Coatings and Linings, January 1988, Volume 5, No. 1.
3. Steel Structures Painting Council Manual, Volume 1.
4. Industrial Ventilation, a manual of recommended practices, 20th Edition, American Conference of Governmental Industrial Hygienist.

(2) Waste Disposal Plan. This plan shall describe, in detail, the means by which the Contractor intends to handle, store, transport, and dispose of the waste generated by the removal of the existing paint systems. The Contractor is hereby advised that the existing paint systems on the bridges may include red lead and/or basic lead silica chromate paints as components. It has been determined, that after this waste has been removed and collected from surface preparation work, the rust, paint particles, and dust associated with the work and any other materials contaminated in the cleaning process will be designated as "Hazardous Waste," EPA Classification No. D008.

If during the execution of the Contract the classification of the waste is changed, an adjustment for disposal and storage will be made according to Sections 104 and 109. The Contractor shall handle, store, transport, and dispose of all waste in strict compliance with the current waste management regulations prepared by the EPA,

NJDEP, OSHA, USCG, and other regulatory agencies with jurisdiction promulgating rules, regulations, standards, and guidelines. The Contractor shall not begin cleaning or blasting until it has submitted final documentation that the Contractor has an approved disposal site and all required permits for the handling, storage, and transportation of hazardous waste.

The hazardous waste generator identification number(s) for use on the manifest will be obtained by the Department's Bureau of Project Support during the development of the Special Provisions on a project to project basis. The number(s) will be provided in the Special Provisions.

The Contractor shall continuously monitor the quantity of the waste captured, contained, collected, stored, and disposed of, as documented by the official waste manifests required at the time offered for transportation to the disposal facility. The Contractor shall maintain a complete and accurate record, located on the site, of all blasting medium purchased, delivered, and utilized during the execution of the Work. Both the record of the blasting medium delivered and utilized, and the record of the waste disposed of shall be submitted on a regular basis, as determined by the Engineer, to allow for verification inspections. The records shall be kept current and be available at all times on the Project site.

The Contractor shall document the handling, sampling, manifesting, transporting, and disposal of hazardous waste. The Contractor shall organize and maintain the material shipment records.

Manifests are required by the Federal Resource Conservation and Recovery Act (RCRA), the State, and the state in which the treatment/disposal facility is located. The Contractor shall obtain manifest forms and material code numbers. The Contractor shall complete the shipment manifest records using the New Jersey Department of Transportation, Bureau of Project Support and Engineering, P.O. Box 600, Trenton, New Jersey 08625 as the mailing address. The Engineer will sign the manifest as the generator. The manifest will verify the material type (code number) and quantity of each load in units of volume and weight.

All original manifests shall be submitted to the Department's Bureau of Project Support and two copies of each manifest shall be submitted to the Engineer within four business days following shipment. Any manifest discrepancies shall be reported immediately to the Engineer and be resolved by the Contractor to the satisfaction of the Engineer.

The Contractor shall ensure that all operations associated with the handling, loading, transportation, and disposal of hazardous and regulated materials are in compliance with applicable Federal and Department regulations, as well as all local applicable requirements.

Applicable regulations and requirements include, but are not limited to the following:

(a) 49 CFR 100 to 179 - DOT Hazardous Material Transport and Manifest System Requirements;
(b) 40 CFR 263 - RCRA standards applicable to transporters of hazardous waste;
(c) NJAC 7:26 - New Jersey solid and hazardous waste regulations that govern waste handler responsibilities, vehicle placard requirements, container requirements, manifest requirements, and responsibilities and requirements for collectors and haulers of hazardous and non-hazardous solid waste;
(d) Posted weight limitations on roads and bridges; and
(e) Other local restrictions on storage and transportation of hazardous waste.

Before any disposal activities taking place, the Contractor shall identify all proposed waste transporters by submitting for the Engineer's review and approval commitment letters from those transporters properly licensed and insured. Along with each commitment letter, the Contractor shall include, but not be limited to the following:

(a) the name and EPA identification number of the transporter;

(b) name, address, and telephone number of responsible contact for the transporter;
(c) list of all types and sizes of transportation vehicles and equipment to be used;
(d) a description of proposed transportation methods and procedures for transporting waste materials;
(e) all necessary permit authorizations; and
(f) previous experience in performing the type of work specified herein.

As part of the waste disposal plan, the Contractor shall incorporate an emergency management plan outlining specific procedures to be followed in the event the primary containment system fails to contain the materials and results in pollution of the environment. Details of equipment, materials and methods that will effectively contain material that escapes during a failure of the primary system shall be provided. The necessary components of the emergency management plan shall be available at the site at all times when the blasting work is in progress.

Also included shall be an outline of those person(s) to be notified in the event of a failure resulting in pollution of the environment according to the rules and regulations of the applicable agencies, as stated herein. The emergency management plan should be especially detailed on any project where the work is primarily over a body of water.

Any spillage of waste during disposal operations, i.e., loading, transport, and unloading shall be cleaned up according to NJDEP regulations NJSA 58:10-23.11 *et seq.* at the Contractor's expense. The Contractor is liable for any fines or costs incurred as a result of its failure to be in compliance with this special provision and all Federal, State, and local laws.

The contained waste materials shall be removed to storage or disposed of at regular intervals (once each working day, minimum) during the execution of the Work, as required according to the waste disposal plan, field conditions, and the direction of the Engineer. The Contractor shall also remove all errant waste from the bridge deck, structural steel, piers, abutments, and other areas of the Work, at least once a day or more frequently if required or directed.

All personnel protection equipment, decontamination liquids that become contaminated due to contact with hazardous waste or materials containing hazardous substances, and other expendable wastes shall be stored separately and disposed in containers identified by the Contractor in the waste disposal plan.

Storage containers sized for the job shall conform to the Code of Federal Regulations Title 49, Chapter 1, paragraph 173.510a (1), (5), and paragraph 178.118. Each storage container shall have a protective liner and removable lid. Also, these containers shall not have any indentations or shipping damage that would allow seepage of the material contained within. Containerization of bulk solid waste materials shall be in liquid tight, closed-top roll-offs or similar containers subject to the Engineer's approval.

The Contractor shall provide, install, and maintain any temporary loading facilities on-site as required until completion of material handling activities. The location and design of any facilities shall be included in the waste disposal plan.

All expendable material generated from construction activities within the containment, including respirator cartridges, disposable coveralls, boots and gloves, and suits shall be placed in watertight containers. The Contractor shall arrange for the containerization, transportation, and disposal of all expendable wastes generated from the work site(s) on or related to the Project.

Waste shall be contained in watertight containers in an on-site staging area until transportation vehicles arrive for off-site disposal. The Contractor shall dispose of waste within 75 days or before the Contract ends, whichever comes first.

If waste materials are to be stored on or near the site, the Contractor shall submit a detailed description of the proposed method to contain the stored material and submit all necessary permits or licenses required as part of this plan before commencing any work. The Contractor's attention is directed to the fact that storage of hazardous waste

materials must comply with all applicable Federal and State rules and regulations for storage of such materials.

The Contractor shall ensure that the waste transporter's appropriate choice of vehicles and operating practices shall prevent spillage or leakage of hazardous or contaminated material from occurring during the route to the final disposal site.

The Contractor shall only use the transporters identified in its waste disposal plan. Any use of substitute or additional transporters must have previous written approval from the Engineer at no additional cost to the Department. The Contractor shall not combine contaminated material from other projects with material from the site(s) included under the Contract.

Before any disposal activities the Contractor shall also specify the proposed transportation/storage/disposal (TSD) facility, including a commitment letter from the TSD facility indicating that it has the capacity to accept the estimated volume of waste material and stating that it will be open for business during the Contract duration to accept the estimated volume of waste materials specified herein. The Contractor shall also submit a list of permitted alternative TSD facilities to be utilized in the event the approved facility ceases to accept waste materials generated under the Contract.

The Engineer reserves the right to contact and visit the disposal facilities to verify the agreement to accept the stated material and to verify any other information provided. This does not in any way relieve the Contractor of its responsibilities under the Contract. The Contractor shall obtain and submit a copy of the test results of the waste from the TSD facility to the Engineer.

b. Lead Health and Safety.

(1) Lead Health and Safety Requirements. As a minimum, when up to 500 tons of blast cleaning is required in the Project or when epoxy-coated mastic surface preparation is required, the following requirements and provisions shall be complied with by the Contractor.

(a) Permissible Exposure Limit (PEL). The Contractor shall ensure that no employee is exposed to lead at concentrations greater than 50µg/m^3 of air averaged over an eight hour period. (Reference 29 CFR 1929.62(C)).

(b) Exposure Assessment. The Contractor shall determine if any employee is or will be potentially exposed to airborne concentrations of lead at or above the action level. The task "trigger" method outlined in 29 CFR 1926.62(D)(2) may be used until the actual exposure assessment is documented (Reference 29 CFR 1926.62 (D), 1910.134 (B) (8), and OSHA Publication No. 3142 "Lead in Construction").

(c) Methods of Compliance. The following hierarchy shall be used for controlling exposure to lead:

1) Engineering and work practice controls
2) Personal protective equipment (Reference 29 CFR 1926.62 (E) (F), 1926.55 (B), 1926.57, 1910.94 (A), 1926.354, and OSHA Publication No. 3142 "Lead in Construction").

(d) Respiratory Protection. Respiratory protection shall be provided and used according to 29 CFR 1926.62 (F). (Reference 29 CFR 1926.62 (F), 1910.134, 1910.94, and 1926.103).

(e) Protective Work Clothing and Equipment. The Contractor shall provide clean, dry protective work clothing and equipment. (Reference 29 CFR 1926.62 (G), 1926.28(A), 1910.132, and 1910.94).

(f) Hygiene Facilities. The Contractor shall provide changing and showering facilities. The Contractor shall ensure that employees do not eat or drink in contaminated areas. Eating facilities shall be provided for employees exposed above the PEL, without regard to respirators. (Reference 29 CFR 1926.62 (I), 1926.21, 1926.51, and 1910.141).

(g) Housekeeping. All work areas shall be kept clean and free of lead to the extent that the work process allows. Cleaning with compressed air is prohibited. The Contractor shall use only a vacuum with a H.E.P.A. filter or

wet cleaning methods when removing lead dust. (Reference 29 CFR 1926.62 (H), 1926.25, and 1926.20).

(h) Medical Surveillance Program. All workers who are potentially exposed to lead shall be monitored in a systematic program of medical surveillance as outlined in 29 CFR 1926.62 (J). This program shall include at a minimum the following:

1) The Contractor shall provide a pre-employment physical exam for all employees which shall consist of a medical questionnaire which ascertains previous medical history related to lead exposure and symptomatology of lead exposure or exposure to any other toxins; blood lead and zinc protophrphyrin (ZPP) counts together with hemoglobin and hematocrit, blood urea nitrogen, and serum creatinine; physician's approval for employee to wear negative pressure respirators; and a thorough hands-on physical exam that includes special attention to systems affected by lead, e.g., renal, hematological, neurological, gastrointestinal, cardiovascular, and reproductive.
2) Monthly blood lead sampling and ZPP counts shall be conducted and the levels evaluated and posted monthly, at the job site, for the duration of the lead exposed portion of any Project.
3) Workers whose blood lead levels exceed 50 micrograms per 100 grams of whole blood shall be removed from further airborne lead exposure in excess of 30 micrograms per cubic meter of air averaged over an eight hour period, based upon biological monitoring or a physician's determination.
4) Employees shall be retrained, and respiratory protection shall be upgraded for employees whose blood lead levels exceed 40 micrograms per 100 grams of whole blood at any time during their employment.
5) Post employment or yearly physical exams (whichever comes first) shall be conducted for all employees who had blood lead levels in excess of 40 micrograms per 100 grams of whole blood at any time during their employment. This examination shall include as a minimum, blood lead and ZPP counts and a thorough hands-on physical as stated in (h) 1) above.
6) The Contractor shall ensure that any physician who provides these physical exams and tests has been made aware of the employee's job duties, any airborne lead levels, the inherent lead exposure, and if applicable, all previous medical history and blood levels generated by other physicians.
7) The Contractor shall ensure that all physicians conducting blood monitoring shall have all samples analyzed at a New Jersey clinical laboratory approved by OSHA that has demonstrated proficiency in blood lead analyses.
8) The Contractor shall ensure that employees are provided copies of their individual blood lead levels and ZPP levels and are made aware of the meaning of such results within five calendar days after receipt of such results.

(i) Employee Information, Signs, and Training. Employees shall be informed of as a minimum, the hazards of lead and trained in the precautions to take when working with lead. The appropriate warning sign shall be posted where exposure is above the PEL. The sign shall be illuminated, clean, and visible (Reference 29 U1926.21 and 1926.59).

(j) Record Keeping. The Contractor shall maintain and provide employee access to all exposure and their individual medical records. (Reference 29 CFR 1910.20).

(k) Reference Documents.

1) 29 CFR 1926.
2) 29 CFR 1910.
3) OSHA Publication No. 3142 "Lead in Construction."
4) State of New Jersey, Department of Health, Hazard Alert, "Persons Engaged in Abrasive Blasting, Welding and Torch Cutting, Grinding, and Spray Paint Operation on Lead Painted Steel Surfaces Are at Risk of Lead Poisoning."
5) NIOSH Alert, "Request for Assistance in Preventing Lead Poisoning in Construction Workers."
6) Section 5 (A) (1) of the OSHA Act.

Copies of any OSHA standard and explanatory material can be obtained free of charge by calling or writing the OSHA Office of Publications, Room S-1212, United States Department of Labor, Washington, DC 20210.

(l) Compliance Assistance Resources – Enforcement.

US Department of Labor/OSHA
Marlton Area Office, Marlton Executive Park, Building 2, Suite 120, 701 Route 73 South, Marlton, NJ 08053
Counties Served: Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, Monmouth, Ocean, and Salem.

US Department of Labor/OSHA, Avenel Area Office, Plaza 35, Suite 205, 1030 St. George Avenue, Avenel, NJ 07001
Counties Served: Hunterdon, Somerset, Middlesex, and Union.

US Department of Labor/OSHA, Parsippany Area Office, 299 Cherry Hill Road, Suite 304, Parsippany, NJ 07054
Counties Served: Sussex, Morris, Essex, Warren, and Hudson.

US Department of Labor/OSHA Hasbrouk Heights Area Office 500 Route 17 South, 2nd Floor Hasbrouk Heights, NJ 07604
Counties Served: Bergen and Passaic.

(m) Compliance Assistance Resources – Consultation.

New Jersey Department of Labor,
Div. of Occupational Health and Safety Consultation Services, P.O. Box 953, Trenton, NJ 08625-0953

State of New Jersey, Dept. of Health, P.O. Box 360, Trenton, NJ 08625-0360
National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, Ohio 45226
For concerns regarding engineering controls contact the Engineering Control Technology of NIOSH.

(2) Lead Health and Safety Plan (LHASP). When over 500 tons of structural steel are to be blast cleaned, in addition to the Lead Health and Safety Requirements called for in the Special Provisions, the following additional requirements and provisions shall be complied with by the Contractor.

The LHASP plan shall describe, in detail, the means by which the Contractor intends to implement and maintain the protocols necessary for protecting all personnel from hazards associated with the Project operations and activities. The plan will establish and maintain policies, programs, and procedures that are necessary to be in compliance with OSHA and other regulatory agencies with jurisdiction, rules, regulations, standards, or guidelines in effect at the time the Work is in progress.

The plan shall be kept on site and shall apply to all workers entering the Work area. This plan shall be a dynamic document with provision for change to reflect new information, new practices

or procedures, changing site environmental conditions, or other situations which may affect site workers.

A certified copy of the LHASP shall be filed with the Engineer before the initiation of Work. Filing of the plan will not constitute approval by the Department of its provisions.

The LHASP may include, but not be limited to, the following elements:

(a) General introduction.
(b) Lead health and safety organization and responsibilities.
(c) Exposure assessment.
(d) Methods of compliance.
(e) Respiratory protection.
(f) Protective work clothing and equipment.
(g) Hygiene facilities and practices.
(h) Housekeeping.
(i) Medical surveillance program, including removal and protection procedures.
(j) Decontamination procedures.
(k) Employee information, signs, and training procedures.
(l) Record keeping.

The general introduction to the LHASP shall include structure locations; names, addresses, and telephone numbers for the Contractor's project manager, field superintendent, qualified person responsible for the LHASP, and available emergency assistance; and an approval sheet with the signatures of the project manager, field superintendent, and qualified person, which shall precede the general information.

Procedures to be followed to protect personnel and the general public in case of emergencies will be defined in the general introduction of the LHASP. Potential emergency situations to be addressed include, but are not limited to, overt personnel exposure, personnel injury, fire or explosion, and environmental incident (i.e., spread of hazardous substances). For each emergency scenario, a chain of command and responsibilities must be clearly defined. In addition, a contingency plan for large-scale emergencies such as site evacuation or other situations where significant outside emergency services and interactions are required shall be developed. The emergency plan shall include designation of responsible on-site and off-site personnel, chain of command, facility services, and interface with government agencies.

The medical surveillance, removal, and protection program shall be provided by a physician, certified or eligible for certification in occupational medicine by the American Board of Preventive Medicine.

The Contractor shall engage "qualified person(s)" to develop and to implement the LHASP. The qualifications of the person(s) assigned and responsibility for all aspects of the plan shall be included under the lead health and safety organization and responsibilities section of the LHASP. These person(s) are defined as follows:

(a) Health Professional (HP). The health professional shall be an industrial hygienist, toxicologist, safety engineer, or environmental health professional competent in the recognition, evaluation, and control of safety and health hazards in the work place.

(b) Health and Safety Officer (HSO). The health and safety officer shall be a competent person capable of identifying existing and predictable lead hazards. The individual shall have the authority to take prompt corrective measures to eliminate the hazards. The individual shall have the following experience:

1. laboratory experience
2. experience studying field conditions
3. completed courses and formal experience necessary to perform technical monitoring, consulting, testing, and inspecting.

The HP shall certify monthly in writing to the Engineer on the Contractor's compliance to the LHASP and the requirements of other agencies or organizations. The HSO shall be on the site at all times when required implementation of the LHASP is in progress. The HP shall approve all changes to the LHASP. The Engineer shall be immediately informed by the HP or HSO on all major decisions regarding any changes to the LHASP.

2. Epoxy Mastic Surface Preparation.

a. Pollution Control System. Epoxy mastic surface preparation may produce dust and can generate airborne debris, both of which shall be contained. Since airborne dust and debris can be generated, workers may be exposed to lead and shall be properly protected. Before commencing work on the structure(s) the Contractor shall submit a pollution control system for review and approval, according to Subsection 108.03, as stated elsewhere herein, and in words and with sketches according to Subsection 105.04.

The system shall set forth, in detail, the specific pollution control system the Contractor proposes for the complete capture, containment, collection, and disposal of the waste generated by the Work. The system shall describe the method the Contractor proposes for reclaiming airborne dust and debris and the provisions for health and safety. If at any time during the execution of the work, any part of the pollution control system fails to function at the required level of efficiency, the Contractor shall immediately suspend the affected operations(s). Work shall not resume until modifications to correct the cause of the failure have been made and approved. If the failure is due to adverse weather conditions such as high winds, the Contractor shall immediately suspend the affected operations until the weather conditions become favorable. No additional payment will be made for any corrective actions required. The pollution control system and any other equipment employed by the Contractor shall not encroach upon the bridge clearances over traveled roads or navigable water, unless approved.

It is reiterated that the review and acceptance of the pollution control system will not relieve the Contractor of the responsibility for attaining the required degree of capture, containment, collection, and disposal, or the required degree of protection of the operation equipment and appurtenances, or to comply with all laws, rules, regulations, standards, or guidelines in effect during the execution of the Work. The pollution control system shall consist of the containment plan and the waste collection and disposal plan. The emergency management plan shall be a part of the waste disposal plan. The Contractor shall not deviate from any part of the approved pollution control system without the approval of the Engineer. The containment and waste collection and disposal plans shall be as follows:

(1) Containment. The Contractor shall be familiar with and consider all technology available for epoxy mastic surface preparation associated with each structure within the Project including, but not limited to, the following techniques:

(a) Control ventilation.
(b) Mini enclosures.
(c) Containment booms.
(d) Blast enclosures (rigid and flexible).
(e) Filter materials.
(f) Solid drapes.
(g) Vacuum blasters.
(h) Water curtains.
(i) Centrifugal blasters.
(j) Negative pressure enclosures.
(k) Wet scrubbers.
(l) Cyclones.
(m) Ground and water covers.
(n) Most recent technological advancements and such other techniques as may be applicable.

Reference information on enclosures can be obtained from the SSPC Guide 6I (con) "Guide for Containing Debris Generated During Paint Removal Operations." Section 5 of this guide lists components and requirements for various types of containment enclosures, including monitoring techniques. Class 1 being the most stringent and Class 5 the most lenient. Class 3, with non-permeable walls is recommended as a minimum.

Containment can consist of "local" systems such as small enclosures where power tools are used, or certain enclosed vacuum blasting techniques where suction captures the abrasive and paint residue directly from the surface, conveyed to a preparation to remove the dust and fine particles, and recycling of the recovered abrasive to the blast nozzle.

The Contractor shall employ one or a combination of the available techniques for each structure to meet the capture, containment, collection, and disposal requirements. The cost thereof shall reflect the type of containment and equipment selected to achieve the conditions set forth in the Specifications. No additional payment will be made for any corrective action required to attain the specified requirements.

(2) Hazardous Waste Collection and Disposal. It has been determined, that after this waste has been removed and collected from surface preparation work, the rust, paint particles and dust associated with the work, and any other materials contaminated in the cleaning process will be designated as "Hazardous Waste," EPA Classification No. D008.

If during the execution of the Contract the classification of the waste is changed, an adjustment for disposal and storage will be made according to Sections 104 and 109.

The hazardous waste generator identification number(s) for use on the manifest will be obtained by the Department's Bureau of Project Support during the development of the Special Provisions on a project to project basis. The number(s) will be provided in the Special Provisions.

The Contractor shall handle, store, transport, and dispose of all waste in strict compliance with the current waste management regulations prepared by the EPA, NJDEP, OSHA, USCG, and other regulatory agencies with jurisdiction promulgating rules, regulation, standards, and guidelines. The Contractor shall not begin cleaning or blasting until it has submitted final documentation that the Contractor has an approved disposal site and all required permits for the handling and storing of hazardous waste.

The Department will sign the manifest as the generator. The Contractor shall obtain manifest forms, obtain material code numbers, and complete the shipment manifest records as required by the appropriate agencies for verifying the material type (code number) and quantity of each load in units of volume and weight.

All original manifests shall be submitted to the Department's Bureau of Project Support and two copies of each manifest shall be submitted to the Engineer within four business days following shipment. Any manifest discrepancies shall be reported immediately to the Engineer and be resolved by the Contractor to the satisfaction of the Engineer.

The Contractor shall ensure that all operations associated with the handling, loading, transportation, and disposal of hazardous and regulated materials are in compliance with applicable Federal and Department regulations, as well as all local applicable requirements.

Applicable regulations include, but are not limited to, the following:

(a) 49 CFR 100 to 179 - DOT hazardous material transport and manifest system requirements;
(b) 40 CFR 263 - RCRA standards applicable to transporters of Hazardous waste;
(c) NJAC 7:26 - New Jersey solid and hazardous waste regulations that govern waste handler responsibilities, vehicle placard requirements, container requirements, manifest requirements, and responsibilities and requirements for collectors and transporters of hazardous and nonhazardous solid waste;
(d) Posted weight limitations on roads and bridges; and
(e) Other local restrictions on storage and transportation of hazardous waste.

b. Lead Health and Safety Requirements. As a minimum, the Contractor shall comply with the lead health and safety requirements and provisions stated under 1.b.(1) above.

514.14 Provisions for Inspection.

The Contractor shall provide safe access to the Work area, the necessary ventilation, safety equipment and adequate lighting for the complete inspection of the Work.

Scaffolding shall be furnished, erected, and approved to permit inspection of the steel before, during, and after the cleaning and coating applications.

Approved rubber rollers or other protective devices shall be used on scaffold fastenings. Metal rollers or clamps and other types of fastenings which will mar or damage freshly coated surfaces shall not be used.

In addition to any equipment recommended by the coating manufacturer, the Contractor shall provide the supplemental equipment to permit the inspection of the coating system. The equipment shall be for the exclusive use of the Engineer and shall be in good working condition. This equipment shall be provided to and approved by the Engineer before the start of the Project. The equipment will become the property of the Contractor after final Acceptance. The equipment shall be as follows:

	Equipment	Minimum No. Required
1.	SSPC Publication Volume 1 & 2	1 set
2.	Wet film thickness gauges	4
3.	Dry film thickness gauges - Tooke gauge	3
4.	Positector 6,000 gauge	2
5.	Battery operated psych	2
6.	Surface thermometer	4
7.	Paint adhesion test kit or	1
	Elcometer adhesion tester	2
8.	Hypodermic needle pressure gauge	1
9.	Testex “Press-O-Film”	2
10.	Elcometer surface profile gauge	2
11.	NIST calibration standards	2 sets
12.	Plastic shims	2 sets
13.	Surface contamination analysis test kit	2
14.	35-millimeter automatic camera with autoflash, autofocus, zoom lens and capable of printing the date on the picture	1
15.	Respirators (self contained breathing apparatus) shall be properly fitted for each person designated by the Engineer complete with appropriate chemical cartridges as specified by the manufacturer.	As required
16.	Paint inspection mirror	4
17.	Holiday detector	2
18.	Atkins digital thermometer; accuracy - plus or minus one percent of reading	2
19.	Binoculars	1

COMPENSATION

514.15 Method of Measurement.

Painting existing steel bridges will not be measured, and payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided for in Subsection 109.01.

Hand/power tool, commercial blast, and near-white blast cleaning of horizontal and vertical surfaces will not be measured, and payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided for in Subsection 109.01.

Painting and near-white blast cleaning of bearings will be measured by the number of units.

Painting and near-white blast cleaning of miscellaneous appurtenances will not be measured, and payment will be made on a lump sum basis.

Lead health and safety, containment, and waste disposal plans will not be measured, and payment will be made on a lump sum basis.

For those projects where the only required structural steel that is to be cleaned and painted is the top surfaces of girder top flanges, the following will apply:

1. Painting existing steel bridges will not be measured, and payment will be made on a lump sum basis.
2. Hand/power tool cleaning will not be measured, and payment will be made on a lump sum basis.

For those projects where epoxy mastic surface preparation with hand/power tool cleaning is warranted and the affected structural steel is confined to limited areas, painting existing steel bridges will be measured, and payment will be on a square foot basis.

514.16 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
PAINTING BRIDGES - EXISTING STEEL	LUMP SUM
PAINTING BRIDGES - EXISTING STEEL	TON
HAND/POWER TOOL CLEANING	LUMP SUM
HAND/POWER TOOL CLEANING	SQUARE FOOT
COMMERCIAL BLAST CLEANING	SQUARE FOOT
NEAR-WHITE BLAST CLEANING	TON
PAINTING AND NEAR-WHITE BLAST CLEANING - BEARINGS	UNIT
PAINTING AND NEAR-WHITE BLAST CLEANING – MISCELLANEOUS APPURTENANCES	LUMP SUM
LEAD HEALTH AND SAFETY PLAN	LUMP SUM
CONTAINMENT PLAN	LUMP SUM
WASTE DISPOSAL PLAN	LUMP SUM
TESTING, IF AND WHERE DIRECTED	LUMP SUM

Separate payment will not be made for stenciling. The costs of materials, labor, etc. shall be included in the Pay Item "Painting Bridges - Existing Steel" for each structure.

Separate payment will not be made for cleaning to the requirements of SSPC-SP 1 solvent cleaning for any paint system. All costs associated with this cleaning method shall be included in the Pay Item "Painting Bridges - Existing Steel" for each structure.

Separate payment will not be made for the equipment used to inspect the steel and coating system as described in Subsection 514.14. All costs thereof shall be included in the prices bid for the various Pay Items scheduled in the Proposal.

Separate payment will not be made for the preparation of the required pollution control system submission, which includes the containment plan and waste disposal plan or the implementation of each plan, as it pertains to the Project site including but not limited to permits; capture, containment, collection, storage and disposal costs; and revisions, alterations and resubmissions; and all record keeping that may be required during the execution of the Work. All costs thereof shall be included in the lump sum price bid for the respective Pay Items "Containment Plan" and "Waste Disposal Plan."

Separate payment will not be made for the preparation of implementation of the LHASP, as it pertains to each structure including but not limited to any revisions, alterations, or resubmissions that may be required during the execution of the Work. All costs thereof shall be included in the lump sum price, bid for the Pay Item "Lead Health and Safety Plan."

For those projects where the only required structural steel that is to be cleaned and painted is the top surfaces of the girder top flanges, or for those projects where epoxy mastic surface preparation is required, separate payment will not be made for provision of a containment plan, waste disposal plan, lead health and safety plan, and all, as required, needed work for the protection of the environment, structures, persons, and property. All costs thereof shall be included in the lump sum price bid for the Pay Item "Painting Bridges - Existing Steel."

Any additional testing of the air, water, and soil directed by the Engineer and not included in any other Pay Items of the Contract will be paid for under the Pay Item "Testing, If and Where Directed." Payment will be based on the actual cost as evidenced by paid receipts from the testing laboratory. The Contract quantity will be lump sum and the bid price will be $10,000 for each occurrence in the Contract Proposal. No overhead or profit will be paid for this

item. The State reserves the option of conducting any or all additional testing utilizing the Department Laboratory. The Contractor shall make no claim for payment for testing performed by the Department.

SECTION 515 - GRANITE MASONRY{ XE "GRANITE MASONRY" }

515.01 Description.

{ XE "Granite:facing for pier shafts" **}**This work shall consist of the construction of granite masonry facing for pier shafts.

MATERIALS

515.02 Materials.

Materials shall conform to the following Subsections:

CONSTRUCTION

515.03 Working Drawings.

Working drawings shall be furnished according to Subsection 105.04 and shall show all stone masonry, individual stones in position, their face dimensions, anchor clamps designating marks, and such other sections and drawings as are necessary to cut and set the work.

515.04 Cutting and Delivery.

The facing pattern shall be coursed ashlar masonry. The stones shall have lengths between 4 and 8 feet and shall be of such heights as comply with the heights of courses, including bed joints. Thicknesses not less than 8 inches nor more than 12 inches, including projections measured from the theoretical front arris line, shall be provided. Curved stones at ends of piers shall conform to these thickness requirements.

The front face shall be smooth, split surfaces with a 3-inch maximum projection on straight stones and a 4-inch maximum projection on curved stones, and no part of the face shall recede back of the arris lines. Arrises shall be cut sharp and true to pattern with a maximum tolerance of ¼ inch from the theoretical true arris. Snipped corners over ⅜ inch will not be permitted. Drill holes shall not appear in the face.

The back may be quarry-split surface but in no case shall rear projections exceed the prescribed 12-inch maximum measurement from the arris line. The face of the granite shall be as smooth as possible to the arris line.

The joint surface of stones shall be cut full and square for not less than 2 inches back of the arris line, and the balance of the joint surfaces roughed off on a batter away from the joint of not more than 1 in 12. Depression in a joint surface shall not be greater than 3 inches and a distance of more than 6 inches from the arris line.

Lewis holes will be permitted in all stones weighing over 100 pounds except that Lewis holes or other holes will not be permitted in exposed surfaces without approval.

Holes for anchor clamps shall be at least 4 inches from any face of the stone and shall be of such size as to allow at least 3/16 inch for mortar between metal and stone.

The granite shall be handled, loaded, and fastened for delivery so that there is no danger of spalling or breaking of the stones during transit. All holes shall be protected from the weather, during shipment and storage, in such a way as to prevent the collection of water which may freeze. At all times during handling and storage, the granite shall be kept clear of the ground. Should the surrounding ground at storage sites be of such a nature that the granite may become stained by spattering during rainstorms, steps shall be taken to protect it and, should any of it become stained, the stain shall be removed or else the stones so stained shall be replaced.

515.05 Mortar and Anchors.

Setting mortar shall be mixed in such quantities as needed for immediate use. For very small batches, mortar shall be mixed in a batch-type machine mixer. Materials which have been mixed for a period exceeding 30 minutes shall not be used on any portion of the work. Retempering of mortar will not be permitted.

Anchor cramps required to tie the granite firmly to the concrete pier shaft shall be furnished. They shall be of the general character as indicated and shall be of stainless steel. At least two anchors shall be used for each stone.

515.06 Setting.

Granite facing shall be set before the concrete directly behind it is placed. The work shall not be constructed in freezing weather or when the stone contains frost except by written permission and conforming to such conditions as may be expressed. Under no circumstances shall salt be used for thawing out holes.

Bed joints and vertical joints shall average ¾ inch in thickness with a tolerance of plus or minus ¼ inch.

All joints, sinkages, holes, and any other spaces between stones, or between stones and metal parts, shall be filled with mortar, packed tightly. Hardwood wedges, soaked in water before use and removed before the mortar has set hard, may be used to facilitate proper setting. Each stone shall be cleaned by brushing or other means and drenched with water immediately before it is set, and the bed which is to receive it shall be cleaned and settled in place with a wooden maul. Stones shall not be dropped or slipped but shall be placed without jarring any stone already laid. Heavy hammering will not be allowed after a course is laid. All mortar droppings or smears on the exposed faces of the granite shall be brushed off immediately after the stone is set. Stones becoming loose after the mortar is set shall be removed, cleaned and relaid with fresh mortar.

515.07 Pointing.

All joints shall be raked out to a depth of 1 inch, cleaned out, mortar set, and pointed.

Pointing shall be done with lead wool of commercial quality. It shall be driven into the joints with caulking tools so as to fill all openings, and then finished with a pointing tool so as to give flush joints.

515.08 Protecting and Cleaning Stonework.

As soon as stonework is set, it shall be protected from damage from weather or other causes until final completion and acceptance of the work.

Immediately after laying and while mortar is still fresh, all face stones shall be cleaned of all mortar stains and shall be kept clean until the work is completed. Before final acceptance, the surface shall be cleaned using wire brushes and muriatic acid if necessary.

In hot or dry weather, the masonry shall be protected from the sun and shall be kept wet for a period of five days after completion.

COMPENSATION

515.09 Method of Measurement.

Granite masonry will be measured in square feet, computed on the basis of the total front surface area of granite facing, including joints, measured as theoretical smooth planes along the neat and arris lines.

515.10 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
GRANITE MASONRY	SQUARE FOOT

SECTION 516 - CONCRETE CRIB WALLS{ XE "CONCRETE CRIB WALLS" }{ XE "WALLS:CONCRETE CRIB" }

516.01 Description.

This work shall consist of the furnishing and installation of precast reinforced concrete units to form a crib wall. All provisions of Sections 501 and 914 shall apply except as modified herein.

MATERIALS

516.02 Materials and Equipment.

A. Materials. Materials shall conform to the following Subsections:

Porous Fill	203.03
Coarse Aggregate Layer	206.03
Broken Stone	901.04
Concrete Crib Members	910.05

B. Equipment. Equipment shall be according to Subpart A of Subsection 405.03.

CONSTRUCTION

516.03 Working Drawings.

Working drawings shall be furnished according to Subsection 105.04. Cribbing with dimensions varying from the prescribed sizes may be permitted.

516.04 Placing Crib Members.

Excavation and backfill shall be constructed according to Section 206. The foundation for the crib wall shall be normal to the face of the cribbing and shall be approved before any of the cribbing is placed. Any devices cast in the cribbing units for handling purposes shall be removed flush with the face after erection. If a slight adjustment is needed to correct the alignment, a shim made of neoprene shall be used.

516.05 Filling Crib.

The fill for crib walls shall be broken stone, size No. 2, and shall be placed behind the front face of the cribbing and the remainder of the enclosure shall be filled with porous fill. As the filling progresses, bulkheads shall be placed, or other methods shall be used, to keep the broken stone and porous fill material within their prescribed limits. The filling of the interior and backfilling behind the crib shall progress simultaneously with the erection of the cribbing. The space behind the cribbing shall be filled with embankment material free from large lumps, clods, rocks, or other debris. All material shall be placed in loose layers not exceeding 6 inches in depth and compacted by means of flat-faced mechanical tamper. This method of filling and compacting the interior and backfill shall be continued until the embankment is level with the top of the structure. Where the backfill is accessible to a roller, the backfill may be compacted according to Subsection 203.06. Care shall be exercised in the placing and compacting of material between and back of the crib cells so that the cribbing is not damaged.

COMPENSATION

516.06 Method of Measurement.

Concrete cribbing will be measured by the cubic yard as determined by the number and volume of each size of stretchers and headers. However, if another design is used that involves a greater volume, measurement will be made only for the lesser.

Broken stone fill will be measured by the cubic yard.

516.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CONCRETE CRIBBING	CUBIC YARD
BROKEN STONE FILL FOR CRIB WALL	CUBIC YARD

Payment for foundation excavation and coarse aggregate layer will be made according to Section 206.

Payment for porous fill will be made according to Section 203.

SECTION 517 - STORM DRAINS, BRIDGE{ XE "BRIDGE STORM DRAINS" }{ XE "STORM DRAINS:BRIDGE" }

517.01 Description.

This work shall consist of the construction of scuppers, inlets, and downspouts for surface drainage of bridge decks.

MATERIALS

517.02 Materials.

Materials shall conform to the following Subsections:

Fiberglass Pipe 913.10
Steel Alloy Pipe 913.13
Bolts and Bolting Material 917.01
Zinc Coating on Steel 917.12

Frames shall be gray iron castings and grates shall be ductile iron castings conforming to Subsection 917.03.

Ladder rungs shall conform to Subsection 915.01, Subpart B except that plain bars shall be furnished.

CONSTRUCTION

517.03 Working Drawings.

Working drawings shall be furnished according to Subsection 105.04.

517.04 Construction Requirements.

A. Inlet Frames, Grates, and Scuppers. The bearing surfaces of frames and grates shall be machined so that the grates have uniform bearing on the frames. They shall be match marked before being delivered. Inlet frames, grates, and scuppers if fabricated from steel shall be zinc-coated.

B. Steel Alloy Pipe. Areas where galvanizing has been damaged shall be repaired as specified under Subsection 503.14. The type of threaded concrete inserts for support brackets and clamp shall be approved.

C. Fiberglass Pipe and Fittings. Fiberglass pipe and fittings may be substituted where steel alloy pipe is specified.

Runs of pipe shall be supported at spacings not exceeding those recommended by the manufacturer of the pipe. Supports that have point contact or narrow supporting areas shall be avoided. Standard sling, clamp, and clevis hangers and shoe supports designed for use with steel pipe may be used. A minimum strap width for hangers shall be 1½ inches for 6-inch diameter pipe and 2 inches for 12-inch diameter pipe. Straps shall have 120 degrees contact with the pipe. Pipe supported on surface with less than 120 degrees contact shall have a split fiberglass pipe protective sleeve bonded in place with adhesive.

All fiberglass pipe and fittings shall be pigmented resin throughout the wall. Color to be standard concrete gray or designated color. Painted gel-coat or exterior coating will not be acceptable. Fiberglass pipe and fittings shall be handled and installed according to the manufacturer's recommendations.

COMPENSATION

517.05 Method of Measurement.

Inlet frames and grates, and scuppers will be measured by the number of units.

Pipe of various sizes will be measured by the linear foot.

517.06 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
INLET FRAMES AND GRATES	UNIT
SCUPPERS	UNIT
___" STEEL ALLOY PIPE	LINEAR FOOT

SECTION 518 - BRIDGE DECK REHABILITATION{ XE "BRIDGE DECK REHABILITATION" }

518.01 Description.

A. Repair of Concrete Deck. This work shall consist of the removal and disposal of loose and disintegrated concrete, the preparation of the surface, cleaning or replacement of existing reinforcement steel, application of epoxy bonding coat, and placing of concrete patch materials.

{ XE "Bridge deck rehabilitation:membrane waterproofing" **}{** XE "Membrane waterproofing" **}B. Membrane Waterproofing.** This work shall consist of the placing of a waterproofing membrane on the surface of the existing bridge deck before placing an overlay of HMA.

C. Concrete Deck Overlay Protective System. This work shall consist of the construction of a concrete deck overlay protective system according to Subsection 518.06 A.

{ XE "Bridge deck rehabilitation:scarification" **}D. Scarification.** This work shall consist of scarifying existing concrete bridge decks before repair of concrete deck or placing of concrete deck overlay protective systems.

{ XE "REPAIR OF CONCRETE DECK:MATERIALS" }MATERIALS

518.02 Materials.

{ XE "Repair of concrete deck" **}{** XE "Bridge deck rehabilitation:repair of concrete deck" **}{** XE "Deck slabs, bridge:repair of" **}A. Repair of Concrete Deck.** Class A concrete shall conform to Section 914. For all concrete deck repairs, the coarse aggregate shall be size No. 8. It shall be a maximum of ½ inch in size, not exceed one-half the thickness of section to be placed and be broken stone or crushed gravel.

Other materials shall conform to the following Subsections:

Coarse Aggregate	901.12
Epoxy Bonding Coat	912.13
Reinforcement Steel, Deformed Bars	915.01
Latex Emulsion Admixture	919.10
Silica Fume Admixture	919.10
Quick-Setting Patch Materials	919.12

{ XE "Bridge deck rehabilitation:membrane waterproofing:product approval" **}**A quick-setting patching material products list, from which a product may be selected for use in a project, will be provided in the Special Provisions. The Type classifications are according to the descriptions provided in Subsection 919.12. The provisions of Subsection 919.12 shall be adhered to in selecting a product. Quick setting patching materials are only to be used for deck repairs on bridges where installation of a Concrete Deck Overlay Protective system is not scheduled. Additional products will be considered for approval only after testing by the Department Laboratory and evaluation in the field, in service under all kinds of weather conditions. An extension of Contract Time will not be allowed due to delays caused by or in any way related to such testing and evaluation by the Department.

Certification shall be furnished, according to Subsection 106.04, in the product selection. The certification, shall state that the product meets the requirements of Subsection 919.12. Additionally, the Contractor shall verify, with the product supplier, that the quick setting patching material will satisfactorily perform in achieving the desired concrete deck repair.

When LMC overlay is specified, epoxy resin patching material shall not be used. Other patching material systems shall not be used if the coefficient of thermal expansion of the patching material system, as determined according to ASTM C 531, is 25 percent greater or less than the coefficient of the LMC mix to be used in the overlay.

{ XE "Bridge deck rehabilitation:scarification" **}B. Membrane Waterproofing.** A membrane waterproofing products list will be provided in the Special Provisions. Additional products will be considered for approval if they conform with the requirements of Subsections 919.05 and 919.19. Certification of compliance shall be furnished according to Subsection 106.04 before approval. Membrane waterproofing shall conform to the properties of Subsection 919.05.

C. Concrete Deck Overlay Protective Systems. Materials shall conform to Subsection 501.02 and the following:

1. Coarse Aggregate. Coarse aggregate shall comply with the requirements of Subsection 901.12, Item (A). Coarse aggregate shall be size No. 8 with a maximum ½-inch size, not exceed one-half the thickness of the section to be placed, and be broken stone or crushed gravel.

2. Fine Aggregate. Fine aggregate shall comply with the requirements of Subsection 901.12, Item (B).
3. Concrete Admixtures. Admixtures shall comply with the requirements of Section 905, and AASHTO M I94.
4. Bonding Grout. Bonding grout shall consist of equal parts, by volume, or portland cement and fine aggregate, mixed with sufficient water to form a slurry. The consistency of the slurry shall be such that it can be applied with a stiff synthetic bristle brush or broomed to the prepared surfaces in a thin, even coat that will not run or accumulate in pockets or depressions. Retempering shall not be allowed.
5. Curing Materials. Wet burlap shall conform to Subsection 905.03.
6. Refer to Subsection 518.06 for Concrete Deck Overlay Protective System Types. A list of supplies will be provided in the Special Provisions.

EQUIPMENT

518.03 Equipment.

A. Concrete Overlay Protective System. The equipment used to place the concrete shall comply with the requirements of Subsection 405.03, Item (A). The following criteria shall also be adhered to:

1. The equipment should provide positive control of the flow of water and admixture into the mixing chamber. Water flow should be indicated by flow meter and be readily adjustable to provide for minor variations in aggregate moisture. The admixture discharge pipe shall be readily accessible for determining proportioning accuracy.
2. The placing and finishing equipment shall also conform with Subsection 405.03, Item (B)(4) and the following:

   The machine must be able to span the entire placement transversely and shall be equipped with one or more rotating cylinders, augers and vibratory units (either rollers, cylinders or pans).
3. The Contractor shall supply fog misting equipment which is capable of delivering 2 to 3 gallons of water per minute at 2,000 to 2,500 pounds per square inch using a 40 degree to 50 degree wide-angle nozzle or as approved by the Engineer. The Contractor shall notify the Engineer, in writing, 45 calendar days before concrete placement which model apparatus will be used.
4. The operation of equipment or vehicles on or over the deck slab shall be in conformance with the requirements of Subsection 405.17. Runways shall be provided when concrete transporting devices are expected to operate over exposed reinforcing steel. Vehicular traffic shall not operate on or over the overlay until the overlay has been sawcut grooved according to Subsections 518.06 C.13.
5. The Contractor shall supply a continuous recording thermometer capable of recording ambient temperatures and the temperature of the concrete in the 30 to 100 °F range. The thermometers shall provide a recording capability over a 24 hour continuous period. The Contractor shall provide any ancillary equipment, supplies and labor necessary for the calibration of this equipment.
6. Scarification equipment shall comply with the requirements of Subsection 518.03, Item (B).
7. A sufficient number of stiff nylon bristle push-brooms, nylon bristle straight brooms and pails shall be provided.
8. To ensure that the surface to be overlaid is damp and ready to receive the material, the equipment should be capable of spraying water over the entire placement width as it moves ahead.

{ XE "Scarification" **}{** XE "Deck slabs, bridge:scarification" **}B. Scarification.** The equipment shall be self-propelled and capable of scarifying a minimum of 1,000 square yards per day across the cutting path in one pass to a minimum depth of ¼ inch. It shall be capable of establishing profile grades by referencing from existing grades and shall have a means for controlling cross slopes.

The equipment shall have a means for removing milled material from the surface and for preventing dust and other materials from escaping into the air.

The equipment shall have a floating type head that allows for deeper cutting in areas of deteriorated concrete. It shall have the capability of locking out the head float.

Pneumatic and equivalent electric hammers, not heavier than nominal 30-pound class, and triple-headed tampers fitted with star drills not less than 2 inches in diameter may be used to remove concrete surfaces adjacent to curbs and scuppers.

C. Silica Fume Concrete Overlay. The overlay concrete shall be mixed by transit mixers only. The equipment used to place the concrete shall comply with the requirements of Subsection 405.03, Item No. 3. The following shall also be required for this work:

1. Bonding Grout Mixer. The mixer shall be the type designed for mixing mortar. It shall have a minimum capacity of 3½ cubic feet. The mixer shall be approved by the Engineer before use.
2. At least two batching boxes of 3½ cubic feet capacity each shall be approved at the site for the proportioning of sand and cement.

{ XE "Bridge deck rehabilitation:latex modified concrete overlay" **}D.Latex Modified Concrete Overlay.** The overlay concrete shall be mixed by continuous mixing type truck mixers only. The equipment used to place the overlay concrete shall comply with the requirements of Subsection 405.08, Item No. 4. and the following:

1. They should be self-propelled and be capable of carrying sufficient unmixed dry, bulk cement, sand, coarse aggregate, Modifier A, and water to produce on the site not less than 6 cubic yards of concrete.
2. Mixers should be calibrated to accurately proportion the specific mix. Where placements involve more than 100 cubic yards, calibration of cement and latex should be checked at 100 cubic yard intervals. The yield will be required to be within a tolerance of one percent according to the following tests:

   With the cement mixer set to zero and all controls set for the desired mix, activate the mixer, discharging mixed material into a 7 cubic feet container that is 3 by 3 by ¾ feet in size. When the container is level-struck full, and provision for setting the material into all corners is made, the cement meter must show a discharge of five bags per cubic yard of cement.

CONSTRUCTION

518.04 Repair of Concrete Deck.{ XE "Bridge deck rehabilitation:repair of concrete deck" }

A. Repairs of concrete deck are classified as follows:

1. Type A Repair shall consist of removing all delaminated or deteriorated deck concrete from ¾ inch minimum to the top layer of the existing top reinforcement steel and placing of Type I quick-setting patch material to the level of the existing concrete deck or to the level of the scarified deck surface, if scarification is scheduled or directed.

Type A Repairs are to be used only by Department maintenance forces.

2. Type B Repair shall consist of removing all delaminated or deteriorated deck concrete to a minimum depth of 1 inch below the bottom of the top layer of existing reinforcement steel to a maximum depth of 50 percent of the thickness of the existing concrete deck and placing of Class A concrete or Type IA quicksetting patch material, whichever is specified, to the level of the existing concrete deck or to the level of the scarified deck surface, if scarification is scheduled or directed.

3. Type C Repair shall consist of removing all delaminated or deteriorated deck concrete for the full depth of the existing deck and placing Class A concrete or Type IA quick-setting patch material, whichever is specified, to the level of the existing concrete deck or to the level of the scarified deck surface, if scarification is scheduled or directed.

As per the criteria stated in Subheading 4 of the sixth paragraph of Subsection 405.14, when using a Type IA quick setting patch materials, the patched area shall be wet cured by covering with wet burlap immediately after complete placement and finishing of the material. The patched area shall be kept covered for a period of three hours.

For those projects, where installation of a concrete overlay protective system is scheduled, spalled, delaminated or deteriorated concrete shall be repaired by placement of the concrete overlay material type that is to be used or by placement of Class A concrete. The provisions of Subheading 2 below shall be followed.

Before commencement of concrete removal, a field survey shall be performed for each stage of construction for the purpose of establishing existing grades and cross slopes and for determining proposed finished grades and cross slopes. The cross slopes where given on the Plans are theoretical and approximate and are not intended to be actual.

A minimum of three deck elevations in each span shall be taken for each stage of construction, at the centerline of the bearings and centerline of span along each lane line and gutter line before proceeding with concrete removal or scarification.

The Contractor shall take additional field measurements that are necessary to establish existing grades or cross slopes and to develop finished grades and cross slopes in transition areas.

{ XE "Repair of concrete deck" **}B. Repairs of concrete decks shall conform to the following:**

1. Deck Preparation. Written notice shall be submitted not less than 14 calendar days in advance of when the site is available for a deck condition survey by the Department. Surveys will be scheduled during daylight hours of working days unless the working time is restricted in the Contract Documents. Surveys will be performed only if the ambient temperature has been above 40 ºF for a minimum of 72 hours before the beginning of the survey and only if the deck is dry. Lighting facilities shall be furnished and maintained for any survey work scheduled during the hours of dusk or darkness. In all cases, traffic controls required for the safe and convenient conduct of the survey shall be provided.

The deck condition survey will be made before scarification, if scheduled, and after the removal of any existing HMA overlay and waterproofing membrane. The survey may include, but not be limited to, the following procedures:

a. visual inspection,
b. coring samples for chloride analysis,
c. delamination survey, and
d. electrical-potential measurement (half-cell testing) as described in FHWA Report No. DP-84, "Corrosion Detection in Reinforced Concrete Bridge Structures."

The data obtained will be used to determine the repair limits which will be designated as promptly as conditions permit.

Before the start of the survey, the Contractor shall furnish a properly connected half-cell meter equivalent to an M.C. Miller Co. Model IA electronic potential meter with an intermediate electrode extension, a 30-inch PVC extension, 100 feet of 1/16-inch diameter wire, 1 pint of distilled water, a 4 by 6 by 1-inch sponge, and two alligator clips. The Contractor shall retain ownership of the meter and accessories upon completion of the Project.

{ XE "Repair of concrete deck:construction procedures" **}2. Construction Procedures.** Repair areas shall be saw cut to a ¾-inch depth before scarification, if scheduled, and before removal of deteriorated concrete in the designated areas.

During removal for Type C Repair, temporary shielding shall be provided to prevent debris from falling below the deck.

All loose and disintegrated concrete shall be removed from the areas to be repaired in such a manner and to such an extent as to expose a sound concrete surface. Sound concrete (beneath the disintegrated concrete) shall be removed for a depth of not less than ¼ inch and not more than 1 inch, and the remainder of the area and all exposed reinforcement shall be cleaned and roughened by sandblasting. The work shall be done in such a manner as not to damage the concrete that is to remain.

Removal of concrete or preparing and shaping areas to be repaired may be performed by power chipping or hand tools, except that pneumatic hammers heavier than nominal 30-pound class (33 pounds maximum) will not be permitted. Pneumatic hammers and chipping tools shall not be operated at an angle exceeding 45 degrees relative to the surface of the deck slab. Such tools may be started in the vertical position but must be immediately tilted to a 45-degree operational angle. Pneumatic hammers heavier than nominal 15-pound class (20 pounds maximum) will not be permitted for chipping areas directly below the top longitudinal reinforcing steel or in areas adjacent to primary girder reinforcement steel, such as stirrups in prestressed concrete girder configurations. Technical data sheets for pneumatic hammers intended for use shall be submitted at the preconstruction meeting for approval.

Hand chipping methods shall be used to remove concrete adjacent to exposed reinforcing steel. Care shall be taken so as not to damage or debond the reinforcement steel, or to shatter the concrete beyond the area to be repaired.

For Types B and C Repair, all corroded reinforcing bars shall be cleaned by sandblasting, waterblasting, or wire brushing. Those bars that have lost 25 percent or more of their original

cross-sectional area shall be supplemented by splicing in new epoxy-coated reinforcement steel of the same diameter. In supplementing existing bars, they shall be lapped at least 30 bar diameters and wired together. If necessary, additional chipping of concrete shall be done to provide for this lap. Where reinforcement is broken or missing, new bars shall be lapped at least 30 bar diameters on each side of the break. For Type A Repair, where the bond between existing concrete and reinforcing steel has been destroyed, or where more than half the diameter of the steel is exposed, the concrete adjacent to the bar shall be removed to a depth according to a Type B Repair. A minimum of 1 inch clearance around the bar is required except where lower bar mats make this impractical. In the concrete removal operation, if the epoxy-coated reinforcement is damaged, the reinforcement shall be repaired according to AASHTO M 284 at no cost to the Department.

In areas of Type C Repair, forms shall be provided to enable placement of the concrete or quick-setting patch material. These forms may be suspended from existing reinforcing bars by wire ties for small areas, and in the case of large area openings, they shall be supported by blocking from the beam flanges.

The sides of the concrete at the location of Type C Repair shall be inclined so that the top area of the repair is larger than the bottom.

When Class A concrete is specified for Types B and C Repair, all operations shall conform to the applicable provisions of Section 501 and the following:

a. An epoxy bonding coat shall be applied to the surface of sound concrete in the repair area just before placing the Class A concrete. The epoxy bonding coat shall not be allowed to completely dry before the placement of the Class A concrete. To assure a proper bond, the consistency of the coating shall be tacky to the touch. If the coating has completely dried, it shall be roughen, by whatever means chosen by the Contractor, to the satisfaction of the Engineer. The epoxy bonding coat shall then be reapplied.

b. Traffic, equipment, or other loading will not be permitted on the deck slab when Class A concrete is used as a patch material until the concrete has cured 72 hours and the minimum strength for an additional individual test as defined in Section 914 exceeds 4,000 pounds per square inch from two cylinders cast during placement. When Class A concrete is used, the repair areas shall be cured according to the provisions of Subsection 518.06.C.12, for the 72 hour period. An air cure period will not be required.

When installation of a concrete overlay protective system is scheduled, all existing patched areas shall be completely removed before placement of the overlay.

When quick-setting patch materials are specified for Type A, B, or C Repair, all operations shall conform to the manufacturer's recommendations. Two copies of the manufacturer's technical data sheets shall be submitted at the preconstruction meeting. A technical representative of the manufacturer shall be present on the site to provide guidance in the preparation and placement of the quick-setting patch material based on prevailing climatic and job conditions. The representative shall be present at least during one complete cycle of the procedures required for the initial placement.

When a concrete overlay protective system type is used for deck repairs, the repair areas shall be brushed with a thin layer of the overlay material that is to be used to complete the overlay. The material shall then be placed, spud vibrated and compacted by hand methods to fill the repair areas. Upon completing the repairs, the areas shall be cured according to the provisions of Subsection 518.06.C.12. for a period of 72 hours. An air cure period will not be required. The provisions of Subsection 518.06 shall be followed for the installation of the overlay.

When an existing concrete overlay protective system is to repaired, the same overlay type material shall be used to complete the repairs. Adequate measures, to the satisfaction of the Engineer, shall be used to remove the deteriorated overlay areas. The repair areas shall be brushed with a thin layer of the overlay material. The material shall then be placed, spud vibrated and compacted by hand methods to fill the repair areas. The repaired areas shall be cured according to the provisions of Subsection 518.06.C.12 for a 72-hour period. An air cure period will not be required.

518.05 Membrane Waterproofing.{ XE "Bridge deck rehabilitation:membrane waterproofing" }

{ XE "Bridge deck rehabilitation:membrane waterproofing:deck preparation" **}A. Deck Preparation.** Repair of concrete deck shall be performed according to Subsection 518.04. The repairs shall be completed and accepted before installation of the membrane waterproofing.

B. Construction Procedures. Requirements for cleaning and surface preparation of concrete on the existing bridge deck slabs, construction equipment, temperature and weather conditions, application of primer, and other operations pertaining to placing the membrane waterproofing may vary with the proprietary product. Two copies of the manufacturer's technical data sheets shall be submitted at the preconstruction meeting. Construction shall be done in strict conformance to the manufacturer's recommendations. The manufacturer's technical representative shall be on the site for the first full day of the initial construction to recommend methods for surface preparation, priming, and installation of the membrane waterproofing based on prevailing climate and job conditions.

518.06 Concrete Deck Overlay Protective Systems.

A. Concrete Deck Overlay Protective Systems. The Contractor may select one of the following concrete deck overlay protective systems for the second course deck construction. The concrete shall be uniform in composition and consistency and shall conform to the mix design requirements stated below. Mixing capability shall be such that placing and finishing can be accomplished in one continuous operation without any delay before the formation of the plastic surface film. According to AASHTO T 23, a minimum of four test cylinders for compression testing will be made for each day's placement for each mixer unit. This is with the exception that the demolded cylinders are to be air cured.

At least 45 calendar days before the planned start of the overlay placement, a mix design shall be submitted for approval and verification. Verification and approval of the design mix shall include testing properties that are specified for the overlay. Compressive strength testing requirements shall be 4,000 pounds per square inch at 28 days. Trial batches shall be prepared of the same materials and proportions required by the mix design that has been submitted for approval and verification. Department personnel will be present during verification batching to ensure that the proportions and ingredients batches are according to the proposed mix design. At least three tests (six cylinders) for compression testing shall be prepared, cured, and delivered according to AASHTO T 23 or AASHTO T 126, except that the demolded cylinders shall be delivered to the Department laboratory where they will be tested for a 7 and 28 day compressive strength.

{ XE "Bridge deck rehabilitation:latex modified concrete overlay" **}1. Latex Modified Concrete**. Certification shall be furnished, according to Subsection 106.04, that the manufacturer of the latex emulsion admixture has verified the compatibility of the proposed cement to be used in the LMC mix.

The latex modified concrete shall have the following design mix:

{ XE "Bridge deck rehabilitation:latex modified concrete overlay:design mix" }{ XE "Latex modified concrete overlay:design mix" }DESIGN MIX CRITERIA

Cement, bags (cu ft)/cu yd (94 lb bags) .....
Latex emulsion admixture, gallons per bag .....
Water, gallons per bag .....
Air content, percent of plastic mix according to AASHTO T 152 ..... 6.5 max
Slump, inches (see note 2) .....
Percent fine aggregate according to percent of total aggregate, by weight .....
Weight ratio range (dry basis):
cement .....
sand .....
coarse aggregate .....
Design Strength @ 28 Days .....
Verification Strength @ 28 Days Cl

The net water added shall be adjusted to control the slump within the prescribed limits and should produce net water-cement ratios of 0.30 to 0.40 by weight.

The slump will be measured four to five minutes after discharge from the mixer. LMC shall not be placed during this waiting period.

The dry weight ratios are approximate but, due to gradation changes or variable specific gravities, may be adjusted by the Engineer within the weight ratio ranges.

2. **Silica Fume Concrete**. The mix design shall include the sources of fine and coarse aggregates and the composition of silica fume admixture such as fineness, silica content, total chloride ion content, solids content for slurries and moisture content for powders.

Certification shall be furnished, according to Subsection 106.04, that the manufacturer of the silica fume admixture has verified the compatibility of the proposed cement to be used in the silica fume concrete mix.

The silica fume concrete for the bridge deck overlay shall have the following design mix:

DESIGN MIX CRITERIA

Maximum Cementitious Content (lb/ft^3)	24 ± 0.40
Silica Fume Content	7% ± 0.5% of total cementitious content
Water/Cementitious Ratio	0.40
Fine Aggregate (% of Total Aggregate by Weight)	54 ± 2
Coarse Aggregate (% of Total Aggregate by Weight)	46 ± 2
Air Content %	7 ± 2
Slump inches	6 ± 2
Design Strength @ 28 Days	Class A, Table 914-3
Verification Strength @ 28 Days	Class A, Table 914-3

The above W/C ratio represents the total quantity of water required. If a silica fume slurry is used, the slurry water shall be included in the calculation as a mix water. The free moisture content of both the fine and coarse aggregates shall be included in the calculation as mix water. Retempering with water is not permitted.

A Type F or Type G high-range water reducing admixture shall be added to provide a slump within the allowable range. It shall be added at the plant or project site, using a method approved by the Engineer. Additions of admixtures at the site shall not exceed two in number and the total quantity from all additions shall not exceed the manufacturer's maximum dosage rate. Each time the admixture is added at the work site, the concrete shall be mixed an additional minimum 30 revolutions. Upon successful trials, as exhibited by consistent slump and air content results, the Engineer may allow the high-range, water reducing admixture to be added at the concrete batching facility. Regardless of where the high range water reducing admixture is added, the total number of the mixer's revolutions shall not exceed 160.

According to the limitations and guidance specified in Subsections 914.02 B., 919.07 and 919.18, fly ash or ground granulated blast furnace slag may be used as a replacement for portland cement.

According to the provisions of Subsections 501.03 and 905.02, Type B Chemical Admixtures may be used to retard the setting of the silica fume concrete overlay protective system.

Certification shall be furnished, according to Subsection 106.04, that the manufacturer of the admixture has verified the compatibility of the proposed cement to be used in the overlay mix.

The net water added shall be adjusted to control the slump within the prescribed limits and should produce net water-cement ratios of 0.30 to 0.40 by weight.

The slump will be measured four to five minutes after discharge. The concrete shall not be placed during this waiting period.

The dry weight ratios are approximate but, due to gradation changes or variable specific gravities, may be adjusted by the Engineer within the weight ratio ranges.

B. Quality Assurance Verification. According to AASHTO T 277, permeability testing to document the quality of the concrete overlay material shall be performed at 28, 56 and 90 day intervals. At least 45 calendar days before the planned start of the overlay placement, a report to include laboratory data to document completed results of permeability testing shall be submitted to the Bureau of Materials. The permeability samples used for this testing shall be cylindrical samples with a 4-inch diameter and at least 8 in length. They shall be moist cured in the same manner as the strength cylinders. The test value shall be the result of the average value of tests on two specimens from each batch.

The Contractor shall also submit six additional cylindrical samples to the Department Laboratory for performance of the AASHTO T 277 test by the State.

C. Furnishing and Installation. Furnishings and installation of a concrete deck overlay protective system shall conform to the following criteria:

1. **Storage of Materials**. When the concrete materials are stored on the Project site, they shall be maintained according to Subsection 405.07.

   Admixtures shall be stored in enclosures which can protect them from freezing or from prolonged exposure to temperatures in excess of 86 ºF. The manufacturer's recommendations shall be followed.

2. **Definitions.**
   a. Curing Hour. A curing hour is defined as any hour, beginning with the hour of placement, during which the ambient air temperature at the concrete surface remains at or above 50 ºF, as measured by a recording thermometer.
   b. Curing Temperature. This shall be the air temperature between the concrete surface and its protective covering.
3. **Design Control and Acceptance Testing.** Design control and acceptance testing shall conform with the requirements of Subsection 914.02. Verification strengths, slump requirements and air entraining percentages shall conform with Table 914-3 Mix Design Requirements.
4. **Stockpiling Aggregates**. Aggregate stockpiles shall be maintained according to the requirements of Subsection 901.02.
5. **Construction Plan**. At least 30 days before the proposed start of placement of the overlay, the Contractor shall submit a plan for the construction of the overlay for approval by the Engineer. The written plan shall include the following:
   a. The proposed method of operation
   b. Equipment descriptions
   c. Number of mixing trucks to be used
   d. A plan for discontinuing placement and protecting the overlay during unfavorable weather conditions
   e. Contingency plans for interruptions of pours, work schedules, limits of pours
   f. Traffic vibration mitigation
   g. List of material's suppliers
   h. Knowledge level of Contractor's or Subcontractor's work force
   i. Maintenance and protection of traffic

   At the time of submission, the Contractor shall request a pre-overlay meeting with the Engineer to discuss the written plan. The plan should demonstrate the ability of the Contractor to place, finish, texture, and cover the overlay within thirty minutes of placement on the deck and according to the equipment and manufacturers' recommendations.

{ XE "Latex modified concrete overlay:surface preparation" **}6. Surface Preparation**. The following procedure shall be followed in preparing surfaces that are to receive the concrete overlay:

   a. Before commencement of concrete removal, and again on the finished surface after completion of the overlay, a field survey shall be performed by the Contractor to establish existing, proposed, and actual finished grades and cross slopes. A minimum of three deck elevations at the centerline, along each lane line and along the gutter line, at the same location of each span, shall be taken for each stage of construction. The Contractor shall take additional field measurements necessary to establish existing grades or cross slopes and to develop and document finished grades and cross slopes in transition areas.
   b. Within a 48-hour period before placing the overlay, the entire surface that is to receive the overlay shall be cleaned by wet sandblasting, shrouded dry sandblasting with dust collectors, shot blasting, or high pressure water blasting to remove any loosened chips of concrete, curing compound, laitence, oil or any other residue that may impede the bonding of the overlay to the concrete substrate. All cleaning equipment shall be approved by the Engineer. Air supplies for all cleaning operations shall be equipped with an oil trap in the air line and shall supply air free from oil that may contaminate the deck surface. When high pressure waterblast is used, the pressure of the water shall be a minimum of 5,000 pounds per square inch and shall be capable of producing the desired results.
   c. All reinforcing steel, or other steel which will be in contact with the new overlay shall be cleaned of all grease, dirt, concrete mortar and injurious rust. Injurious rust shall include all scale, loose rust deposits, or all rust not firmly bonded to the steel. Rust and concrete

deposits, which in the Engineer's opinion cannot be removed by surface cleaning, shall be considered firmly bonded and may remain.

d. The cleaned deck surface shall be protected by covering all surfaces to receive the overlay with a 6 mil minimum thickness, polyethylene film, until the overlay placement is to begin. If more than 48 hours elapse from the termination of surface cleaning operations to beginning of the overlay placement, then a second stage surface cleaning will be required regardless of the apparent condition of the receiving surfaces.

e. If in the Engineer's opinion, contaminants, which might interfere with bonding, are present on the prepared surface, a second stage surface cleaning shall be performed. This shall be done in areas directed by the Engineer. A light coating of orange colored rust, that forms on the exposed existing reinforcing steel after first stage surface cleaning, is not considered detrimental to bond. It may remain unless the time limit stated above is exceeded, or if ordered to be removed by the Engineer.

f. In scheduling the overlay placement, a 12 hour duration shall be planned for prewetting the entire area that is to be overlayed the next day. Upon completion of the 12 hour period, the saturated surface shall be covered with polyethene sheeting.

Any standing water in depressions, holes, or areas of deteriorated concrete removal shall be blown out with compressed air that is equipped with an oil trap.

7. Silica Fume Concrete Overlay. In the installation of a silica fume concrete overlay, the following shall apply:

a. Bonding Grout Application. After the surface has been cleaned and prewetted, immediately before placing the overlay concrete, a thin (approximately ⅛-inch) coating of bonding grout shall immediately be vigorously and thoroughly broomed or brushed onto the saturated surface-dry prepared surface. All surfaces to be in contact with the silica fume overlay, including the slab, curb, longitudinal and transverse joints shall be coated with the bonding grout.

The bonding grout shall be applied with a stiff, synthetic bristle brush or broom. At all joints brooming shall be done with straight brooms. Care shall be exercised to ensure that all prepared surface areas receive a thorough, even coating, and that no excess bonding grout be permitted to collect in pockets. This shall be done to ensure that the bonding grout is evenly absorbed into the prepared surface.

The rate of bonding grout application shall be limited to the surface area which can be covered with the new concrete overlay before the bonding grout begins to dry out (typically 3 to 4 feet directly in front of the paver). Time limits will depend on atmospheric conditions and will be determined by the Contractor at the site. If the Engineer has determined that drying has occurred, the Contractor shall remove the bonding grout and place new bonding grout. Bonding grout removal shall be by sandblasting, waterblasting, or removed by other means approved by the Engineer.

No bonding grout mixing or placement will begin until the Engineer has approved all surface cleaning operations. The bonding grout shall consist of equal parts, by volume, of portland cement and fine aggregate, and shall be mixed with sufficient water to form a slurry.

b. Bonding Grout Mix. Bonding grout shall be thoroughly mixed at the site, in a well lit area, in an approved mechanical mixer. The fine aggregate and cement shall be measured in separate cubic foot batching boxes. The fine aggregate and cement shall be dry mixed for one minute and then water shall be added to form a slurry. Mixing will continue for a minimum of three minutes following the introduction of water. The Engineer may require that the mixer be cleaned after each batch.

If bonding grout has dried or become unworkable, as determined by the Engineer, it shall not be incorporated in the work. No retempering will be permitted.

8. Latex Modified Concrete Overlay. In the installation of a latex modified concrete overlay, the following shall apply:

a. Latex modified concrete shall be brushed onto the wetted prepared surface. All vertical and horizontal surfaces shall receive a thorough even coating.

b. The brushed material shall not be allowed to become dry before placement of the overlay concrete. Brushed material, as directed by the Engineer, that is not useful shall be disposed of and replaced.

c. Stones that accumulate as a result of the brushing operation shall be disposed of.

9. Joints. The location of construction joints shall be as prescribed or directed. A bulkhead of Styrofoam or other approved material shall be installed at each deck joint to the required grade and profile before placing the concrete overlay.

{ XE "Latex modified concrete overlay:placing and finishing" **}10. Placing and Finishing**. Placing and finishing shall conform to the following:

a. Traffic on the structure being overlayed shall be restricted as specified in the Plans or elsewhere in these Specifications. Bumps, potholes, or other defects or conditions on the bridge deck surface including the approaches, that might, under traffic, produce vibration on the structure on which the overlay is being placed, shall be patched or repaired before the placement of the overlay.

b. The finishing machine shall make a dry run over the entire bridge deck area to assure that the minimum thickness of prescribed overlay is attained.

c. The overlay placement shall be continuous. Where delays occur due to sudden inclement weather, equipment failure, insufficient equipment or labor, disruption in material supply, or other conditions, a temporary bulkhead or joint shall be installed and placement shall stop. The Contractor shall provide a sufficient amount of approved covers for the protection of the overlay in the event of delays. Before resuming the overlay placement in the area of the joint or bulkhead, a 48-hour, wet, curing period must be completed, and the entire surface area including the vertical surfaces of the joint shall be cleaned. A new edge shall be sawcut a minimum of 6 inches back from any defect in the surface. Sawcutting the new edge shall not be done before the end of the two-day, wet, curing period. In no case shall the sawcutting or removal be permitted to damage the overlay that is to remain. To prevent drying, the Engineer may permit mitigation of unavoidable delays of up to 15 minutes by placing wet burlap over the fresh, unfinished concrete.

d. As per the conditions stated in Subpart 11 below, fog misting shall begin immediately after placement and shall continue after the finishing operation until the placement of wet burlap.

e. The overlay admixture manufacturer shall supply guidance to the Contractor or the subcontractor concerning finishing and handling of the concrete. The manufacturer shall have ACI certified concrete technicians on the site for the full day of the initial construction. Recommended methods and operational techniques based on prevailing climatic and job conditions shall be provided.

f. The concrete shall be placed and struck off to approximately 3/16 inch above final grade. It shall then be consolidated and finished to the final grade by the finishing machine.

g. Spud vibration shall be required in deep pockets, edges, and adjacent to joint bulkheads. Hand finishing with a float may be required along the edge of the placement or on small areas of repair. Edge tooling is required at joints except next to metal expansion dams, curbs, and previously placed lanes.

h. A portable lightweight or wheeled work bridge shall be used behind the finishing operation for touchup work, surface texturing, and curing cover placement.

{ XE "Latex modified concrete overlay:temperature restriction" **}11. Weather and Temperature Restrictions**. The concrete overlay shall not be placed at air temperatures lower than 50 ºF. It can be placed at 50 ºF and rising, provided that the air temperature is forecast to remain above 50 ºF for the first 12 hours of the curing period.

If it is probable that the air temperature could fall below 36 ºF at any time during the planned placement or wet cure period, at least 30 calendar days before the scheduled placement, a plan of action for cold weather concreting, as defined in Subsection 501.11, shall be submitted for approval.

Unless provisions are made by the Contractor to reduce the atmospheric evaporation rate below 0.15 pounds per square foot per hour, placement of the concrete overlay will not begin. Additionally, placement of the concrete overlay will be discontinued when the air temperature begins to exceed 86 ºF or when the evaporation rate begins to exceed 0.15 pounds per square foot per hour. The evaporation rate will be as determined with a nomograph. The publication ACI Committee 305, "Recommended Practice for Hot Weather Concreting" (ACI 305 R-91 may be referred for guidance). The Contractor shall procure the nomograph.

Fog misting, wind shields, or other methods approved by the Engineer may be used to keep the evaporation rate below 0.15 pounds per square foot per hour. If fog misting is used, the fog misting equipment shall be capable of delivering 2 to 3 gallons of water per minute at 2,000 to 2,500 pounds per square inch using a 40 degree to 50 degree wide-angle nozzle. The fog nozzle shall be held 6 feet above the concrete surface. Fog misting is not to be used to apply water that is to be worked into the surface of the concrete for finishing purposes. Fog misting will immediately be ceased if any water accumulation occurs on the surface. When required, fog misting will continue until the concrete has reached its initial set or in all cases to where the application of wet burlap will not damage the surface of the overlay. The Contractor shall notify the Engineer, in writing, 45 calendar days before the concrete placement, which model apparatus he proposes to use. The use of fog misting equipment may be waived if it is determined by the Engineer that the fog misting operation is not practical. That is, if mitigating circumstances, such as high traffic speeds, will cause the misting to become airborne and not permit the overlay surface to be maintained in a moistened condition, the fog misting operation may be waived by the Engineer. However, the Contractor shall satisfy the Engineer that the use of wind shields or other methods are not capable of permitting the work.

The measurements for air temperature, relative humidity, and wind speed shall be taken at the location of the concrete placement. Concrete temperatures shall be taken from the sample used for slump and air content tests. These measurements and calculations shall be performed at least once per hour beginning with the initial concrete placement and whenever, in the opinion of the Engineer, changes in atmospheric conditions merit. The Contractor shall supply all the instruments necessary to take these measurements, subject to approval by the Engineer, including two battery operated psychrometers, two concrete thermometers, and two wind gauges. These instruments shall become the property of the Contractor after Acceptance. All instruments shall be certified by an independent laboratory that has been approved by the Engineer. The instruments shall be certified to be in good working order and as having been calibrated within the two months immediately before use. No separate payment shall be made for providing these instruments.

Placement will not begin and placement will be discontinued in the event of rain. The Contractor shall provide a sufficient number of approved covers and take adequate precautions to protect freshly placed concrete from rain. The Resident Engineer may order the replacement of any material damaged by rain.

If overlays are placed at night or during early morning hours, such work shall be illuminated to provide a safe working environment and to provide sufficient light to achieve the required quality of work. Lighting will be subject to the approval of the Engineer.

{ XE "Latex modified concrete overlay:curing" **}12. Curing**. After completion of the overlay placement and finishing, the entire overlay surface shall be completely covered with clean, wet burlap. The burlap shall be lapped a minimum of 12 inches and have been presoaked for a minimum of 24 hours and shall be drained of excess water before its application. The burlap shall be kept continuously wet and shall be protected from displacement and the Contractor shall take measures to ensure that the burlap lays flat in a manner acceptable to the Engineer. Lapped edges are not required to be sealed.

Failure to apply wet burlap within 15 minutes after concrete overlay placement shall be cause for rejection of overlay work as determined by the Engineer. The burlap shall be kept wet for a continuous period of 72 hours by either a continuous wetting system or an

intermittent sprinkler as approved by the Engineer. The removal of burlap at the end of the wet curing period shall be done late in the day so as to reduce the thermal shock to the overlay.

The overlay shall then be air cured for an additional fourcalendar days.

The Contractor shall inform the Engineer of the intended curing procedure 30 days before the overlay placement.

13. **Saw Cut Grooving**. After completion of the minimum total curing time of 14 calendar days, the overlay shall be grooved according to Subsection 501.15, Item 3, provided that the concrete has attained a strength of at least 4,000 pounds per square inch as determined from cylinders cast during the placement. Construction equipment needed for saw cutting the overlay will be permitted to operate on the overlay. Saw cutting equipment that is to be used shall not overstress the concrete deck or the overlay.
14. **Deck Surface Tolerance Requirements**. Testing for deck surface tolerance requirements during placement of concrete overlay shall be according to Subsection 501.16.

{ XE "Latex modified concrete overlay:opening to traffic" **}15. Opening to Traffic**. Vehicular traffic of any kind shall not be permitted on the overlay excepting that as specified above in Subpart 13 above for saw cutting operations. This shall be until the minimum curing period has elapsed and then only on the condition that test cylinders made at the time of placement have a minimum compressive strength of 4,000 pounds per square inch. In the event that the 28-day cylinders fail to produce a compressive strength of 4,000 pounds per square inch, the Engineer may order that the overlay be removed, replaced and tested for acceptance, all at no cost to the Department.

16. **Limitation of Operations**. Actual placement of the overlay shall be performed as directed by the Engineer with consideration of traffic loads and vibrations.
17. **External Heat Provisions**. If the Contractor elects to maintain curing temperatures by this method, he shall furnish sufficient canvas and framework, or other type of housing, to enclose and protect the concrete slab in such a way that the air surrounding the fresh concrete overlay can be kept at a temperature range of between 45 and 85 ºF for the specified curing period. Any time in which the curing temperature falls between 32 and 45 ºF will not be counted as curing hours. At the end of the curing period, the heat shall be gradually reduced at a rate not to exceed one half degree per hour until the temperature within the enclosure equals the temperature outside the enclosure.

    Enclosures used for overlay pours must completely enclose the existing slab on all five sides. There shall be sufficient room between the top of the existing slab and the top of the enclosure to allow placement of concrete overlay by any normal means.

    External heat shall be provided by means of stoves, salamanders, or steam equipment supplied and operated by the Contractor at its expense. Sufficient equipment shall be supplied to continuously maintain the specified temperatures of fresh concrete overlay to compensate for the accumulation of carbon monoxide gas.

    All exposed concrete overlay surfaces within the heated area shall be kept wet during the heating period unless heat is supplied in the form of live steam.

    Materials and equipment necessary to erect the enclosures and provide external heat shall be present on the job site and approved by the Engineer 30 days before any concrete overlay is placed.

    Heating appliances shall not be placed in such a manner as to endanger formwork or expose any area of concrete overlay to drying out or injury due to excessive temperatures.

    Temperature limits shall be maintained for seven calendar days.

    Continuous wetting will not be required. However, the burlap shall be kept wet by wetting at regular intervals in a manner satisfactory to the Engineer.

    Enclosures for heat retention shall be properly vented to prevent surface disintegration due to carbonation.

D. Acceptance Testing. After the total curing period has been completed, the overlay will be visually inspected for cracking or other damage. A delamination survey to verify bonding between the overlay and substrate after the overlay construction shall be performed. Before this survey is performed, the Contractor shall clear the survey area of all construction equipment, operations, and debris and clean the area by using compressed air or an equivalent method. Adequate traffic control shall be maintained during the bridge deck survey. The survey will be scheduled during the daylight hours of working days (and not less than five calendar days after the concrete overlay has been placed in any span). The Engineer will arrange for the performance of this survey by the Department.

Surface cracks not exceeding ⅜ inch in depth shall be sealed with a low viscosity epoxy sealer or a low viscosity methacrylate monomer penetrating sealer which is to be approved by the Engineer. Cracks exceeding ⅜-inch in depth shall be repaired by methods approved by the Engineer, or the affected portion of the overlay shall be removed and replaced. Delaminated or unbonded portions of the wearing surface or portions damaged by rain, other weather effects, or construction activity shall be removed and replaced. All corrective work identified above shall be at the Contractor's expense. Should the concrete overlay require this repair procedure, then the concrete overlay shall be tested and evaluated by petrographic examination at the Contractor's expense according to the latest ASTM C 856 specifications before any repairs are performed and after concrete repairs have been performed. The Contractor shall submit a certified copy of the test results from an independent testing laboratory to the Engineer.

The Engineer will be the sole judge in determining where the function and service of the deck may be impaired. Removal and replacement of the overlay or corrective actions shall be made in those areas prescribed by the Engineer before the deck slab will be considered for acceptance and opening to traffic. A plan for corrective action, describing the methods, equipment, and materials to be used, shall be submitted in writing for approval by the Engineer before beginning corrective action operations.

518.07 Scarification.{ XE "Bridge deck rehabilitation:scarification" }

Provisions shall be made so that the existing transverse and longitudinal joints are not damaged below the limits of scarifications.

Saw cuts for repair of concrete deck, if scheduled, shall be completed according to Subsection 518.04 before scarification. If, after scarification, other areas of deteriorated concrete are prescribed for repair beyond the initial saw cut peripheries, new saw cuts shall be made for the additional repair limits designated.

All concrete and other materials removed as a result of the scarifying operation shall be completely removed by hand, power broom, vacuum, or such other means, and disposed of. Flushing of this debris will not be permitted. Debris shall be removed at the end of each work day.

COMPENSATION

518.08 Method of Measurement.

Repair of concrete deck of the various types will be measured by the square foot.

Membrane waterproofing will be measured by the square yard.

Concrete deck overlay protective systems will not be measured. The quantity of these overlays will be the quantity in the proposal adjusted for change orders except as provided in Subsection 109.01. Overlay material used in Type A and Type B Repairs will not be measured.

Scarification will be measured by the square yard.

518.09 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
REPAIR OF CONCRETE DECK, TYPE ___	SQUARE FOOT
MEMBRANE WATERPROOFING	SQUARE YARD
CONCRETE DECK OVERLAY PROTECTIVE SYSTEM	CUBIC YARD
SCARIFICATION	SQUARE YARD

Payment for the quantity of the concrete deck overlay protective system in excess of 125 percent of the estimated quantity will be made at 75 percent of the contract bid price and conflicting provisions of Subsection 104.05 do not apply. The Contractor will be paid for the bid item "Concrete Deck Overlay Protective System," at the price bid for concrete that provides a minimum compressive strength of 4,000 pounds per square inch at 28 days and a coulomb resistivity reading of a maximum of 2,000 at 90 days. Pay adjustments for strength and resistivity deficiencies will be applied independent of one another. Failure to meet this strength requirement will result in the deficient lot being reclassified as a pay adjustment and subject to the provisions of Subsection 914.02, Subpart F. Failure to meet the resistivity requirement will result in a pay reduction at the rate of $115.00 per cubic yard for all concrete in the deficient lot.

No separate payment will be made for the overlay material that is brushed onto the deck surface before the overlay, or for all required instruments, lighting to illuminate the work site or material that is used to repair bumps, potholes or defective areas. The Contractor shall include the cost of such material as well as all required permeability testing in the bid price for the Pay Item "Concrete Deck Overlay Protective System."

Payment for reinforcement steel will be made according to Section 501.

At bridge deck repair areas outlined as either Type B or Type C Repair on the Plans or at locations designated, final payment for each outlined area will be made for only one of the two repair types determined by the final depth as measured in the field and according to the construction details regardless of original designation or preparatory work for another repair type.

SECTION 519 - PREFABRICATED MODULAR WALLS{ XE "PREFABRICATED MODULAR WALLS" }{ XE "RETAINING WALLS:PREFABRICATED MODULAR WALLS" }

519.01 Description.

This work shall consist of the construction of Prefabricated Modular Wall systems that are composed of precast concrete units, concrete leveling pads, joint materials, fasteners, select granular or broken stone backfill material and all other appurtenant items of construction within the common structure volume as shown on the Plans or specified herein.

Except as may be modified within this Section, all provisions of Sections 501, 502 and 914 shall apply in furnishing Prefabricated Modular Walls. A list of Prefabricated Modular Wall systems that are acceptable for use in a Project, shall be provided in the Special Provisions.

The manufacturer shall provide the design and engineering for each wall structure. The services of an on-site technical representative, to assist and provide guidance during construction of the leveling pad and installation of the first two-panel courses, as a minimum, shall be provided by the wall manufacturer. Two copies of the manufacturer's installation manual shall be furnished to the Engineer.

The Contractor shall make its own arrangements to purchase the materials and services from the manufacturer. All other labor, materials, equipment, and tools shall be supplied by the Contractor as required to prepare the site, construct the leveling pad, construct the wall, place and compact the backfill material, and construct the coping, traffic barrier, or noise barrier.

Materials, test methods, methods of manufacture or any other item not specifically covered on the Plans and Specifications shall be according to the Prestressed Concrete Institute (PCI) "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products."

All plants manufacturing prefabricated Modular Wall units shall be certified by the National Precast Concrete Association (NPCA) or the PCI to the category of applicable work. Plants must be so approved by the Department before award of Contract.

{ XE "PREFABRICATED MODULAR WALLS:MATERIALS" }MATERIALS

519.02 Materials.

Materials shall conform to Subsection 501.02 and the following:

1. **Concrete Class**. Concrete for precast concrete facing panels shall conform to Class P according to Section 914. Concrete for leveling pad where required shall be Class B concrete conforming to the requirements of applicable portions of Section 914, for unreinforced footings.
2. **Joint Filler Material.** Joint filler material for horizontal joints for footings shall conform to Subsection 908.01. Filler for front face horizontal joints between units shall be closed-cell polyethylene foam backer rod conforming to AASHTO M 153, Type 1, 1¼-inch, fiber, expansion, joint material, in conformance with Subsection 908.01, may be used.
3. **Geotextile Material.** Material to be placed inside the units over all vertical joints of the front face shall be 1 foot wide and conform to the Retaining Structure Filter requirements of Subsection 919.06.
4. **Backfill Material**. Backfill material, in conformance with the following, shall be select granular borrow excavation material or broken stone.
    a. Select granular borrow excavation shall conform to porous fill, designation I-9 according to Section 203.
    b. Broken stone shall conform to Subsection 901.04. Size numbers 56, 57, or 67, as specified in Subsection 901.20, Table 901-1, may be used. The maximum compacted thickness of each layer shall be 8 inches.
5. **Coarse aggregate**. Coarse aggregate layer shall be material obtained from an approved commercial source and processed into stone size ASTM C 33, size No. 67.
6. **Weep Holes**. Where shown on the Plans, weep holes shall be constructed in the manner and at the locations required. Ports or vents for equalizing hydrostatic pressure shall be placed below low water, if shown. Forms

for weep holes through concrete shall be 4-inch clay pipe, polyvinyl chloride, transite, or unreinforced concrete drain pipe.

7. **Back of Wall Drainage**. Underdrains, where shown on the Plans, shall conform to Section 601.

CONSTRUCTION

519.03 Construction.

A. **{** XE "Prefabricated modular walls:fabrication" **}Fabrication and Curing.** The units shall be cast in steel forms and in a manner that will ensure the production of uniform units. The transporting, placement, and compaction of concrete shall be by methods that will prevent the segregation of the concrete materials and the displacement of the reinforcement steel from its proper position in the form. Concrete shall be carefully placed in the forms and vibrated externally and internally sufficiently to produce a surface free from imperfections such as honeycomb, segregation, cracking, or checking. The units may be removed from the forms at any time when removal can be accomplished without damage to the panel. Unless otherwise indicated on the Plans or elsewhere in the Specifications, the finish for the front face shall be Class 1 finish conforming to Subheading 1 of the fourth paragraph of Subsection 501.14. The rear face shall have a uniform surface finish free of open pockets of aggregate.

Wall panel units shall be cured by any one of the methods specified in the PCI Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products (MNL-116). If steam curing is used, however, the applications of steam within the enclosure shall be delayed for a period of five to six hours when the air temperature is 50 ºF or lower, and shall be delayed for a period of three hours when the air temperature is 50 ºF or higher. If retarders are used, the waiting period shall be from four to six hours regardless of the air temperature. The curing period shall be maintained at 145 ± 40 ºF for a period of 12 hours.

Two concrete test cylinders, similarly cured, shall be tested after the curing procedure specified. Should either test cylinder indicate the precast units have not achieved a compressive strength of 4,000 psi or greater, the precast units shall be cured further until the required strength is achieved.

The name of manufacturer, name of project, date of manufacture, mark numbers, and type of unit according to the approved erection drawings shall be clearly marked in the inside face of each unit.

{ XE "Prefabricated modular walls:inspection and rejection" **}B. Inspection and Rejection.** The quality of materials, the process of manufacture, and the finished units shall be subject to inspection by the Engineer before shipment. Individual units will be rejected because of any of the following:

1. Variations in the exposed face that substantially deviate in texture.
2. Dimensions not conforming to the following tolerances:
    a. Face of panel, length or height: plus or minus 3/16 inch.
    b. Deviation from square when measured on diagonal: 5/16 inch for units up to 10 feet wide, ¾ inch for larger units.
3. Honeycombed or open texture not properly repaired.
4. Defects which would affect the structural integrity of the unit.

{ XE "Prefabricated modular walls:shipment" **}C. Shipment.** The precast units shall not be shipped until the minimum 28-day compressive strength has been attained and a minimum of 72 hours after fabrication and shall meet the acceptance criteria in Section 914.

Handling devices, as required, shall be galvanized and shall be provided for the purpose of handling and placing. Care shall be taken during storage, transporting, hoisting, and handling of all units to prevent cracking or damage. Units damaged by improper storing, transporting, or handling shall be replaced or repaired.

{ XE "Prefabricated modular walls:installation" **}D. Installation.** The foundation bed for the structure shall be approved by the Engineer before erection is started. Before wall construction, the foundation bed shall be compacted with a vibratory compactor. Any foundation soils found to be unsuitable shall be removed and replaced with coarse aggregate.

At each unit foundation level, either a precast or cast-in-place footing or a leveling pad shall be provided. The footings shall be Class B concrete, be given a wood float finish, and shall reach a compressive strength of 2,000 pounds per square inch before placement of wall modules. The completed footing surface shall be constructed according to grades and cross slopes shown on Plans. When tested with a Straightedge, the surface shall not vary more than ⅛ inch in 10 feet.

The units shall be installed according to the manufacturer's recommendations. Special care shall be taken in setting the bottom course of units to true line and grade. While erecting each subsequent course, line,

and grade shall be examined, and deviations shall be corrected to prevent cumulative inaccuracies in alignment. Joint filler and rubber pads shall be installed. Joints at corners or angle points shall be closed.

Backfill material that is to be used inside and behind all units shall be free from organic or other deleterious material. Prefabricated modular wall units shall be filled one course at a time. Units 4 feet or less in height shall be filled in one layer and then thoroughly compacted with a vibratory tamping device. Units which are more than 4 feet in height shall be filled in two approximately equal layers and thoroughly compacted after each layer is placed.

Backfill placement shall follow erection of each course of modular wall unit. Backfill shall be placed in such a manner as to avoid any damage or disturbance to the wall materials or misalignment of the face panels. Any wall materials which become damaged or disturbed during backfill placement shall be either removed and replaced at the Contractor's expense or corrected as directed. Any misalignment or distortion of the units due to placement of backfill outside specified limits shall be corrected. Backfill material placement shall conform to the following:

1. **Select Granular Material.**
    a. The select granular backfill material shall be compacted to 95 percent standard proctor.
    b. The moisture content of the select granular backfill material before and during compaction shall be uniformly distributed throughout each layer.
    c. Select granular backfill materials shall have a placement moisture content that is less than or equal to the optimum moisture content.
    d. Select granular backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable throughout the entire lift.
    e. The optimum moisture content shall be determined according to AASHTO T 99, Method C.
    f. Select granular backfill material placed within 1 foot of any drainage structure or utility line which is included in the reinforced earthen volume shall not have any particle greater than 3 inches in maximum dimension.
    g. The maximum lift thickness of select granular backfill material shall not exceed 10 inches loose measurement. The Contractor shall decrease this lift thickness to obtain the specified density.
2. **Broken Stone Backfill.**
    a. Use of broken stone backfill shall conform to the requirements of Subsection 901.04.
    b. The maximum lift thickness of broken stone backfill shall not exceed 8 inches.
    c. According to the provisions of Subsection 919.06, Item 2., when broken stone backfill material is used, geotextile filter fabric material shall be placed at the interface of the broken stone and regular roadway materials and embankments.
3. **Compaction of Backfill Material. Backfill material compaction shall adhere to the following criteria:**
    a. Backfill material conforming to the requirements specified herein shall be placed and compacted simultaneously with the placement of the modular units.
    b. Placement and compaction shall be accomplished without distortion or displacement of the units.
    c. At each panel level the backfill material shall be roughly leveled to an elevation approximately 2 inches above the level of the next course of units.
    d. The compaction shall take place in a direction that is parallel to the wall.
    e. The specified compaction of the select granular backfill material shall be accomplished by use of large, smooth drum, vibratory rollers with the exception of the 5-foot zone directly behind the units.
    f. The 95 percent standard proctor compaction of the select granular backfill material, shall be performed on each course according to Subsection 203.10. AASHTO T 238, Method B and AASHTO T 239 shall be used to determine the achieved density.
    g. To provide the proper density of the broken stone backfill, compaction shall be achieved by at least four passes with a vibratory roller that has a total operating weight of 8 to 10 tons. The roller shall be set in the vibratory mode and at a speed of between 1.5 and 2.5 mph.

h. Within 5 feet of the wall small, single or double drum, hand operated, walk-behind vibratory rollers, or walk-behind vibrating plate compactors shall be used, and at least three passes shall be made.

i. When there is evidence of wall displacement or disturbance, compaction shall be accomplished by use of a smooth drum static roller.

j. At the end of each day's operation, the Contractor shall slope the last placed level of backfill away from the wall facing to rapidly direct runoff of rainwater away from the wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

When erecting a battered wall, placement of backfill behind the wall shall closely follow erection of successive courses of units. At no time shall the difference in elevation between the backfill and the top of the last erected course exceed 6 feet.

All units above the first course shall interlock with the lower courses. Vertical joint openings on the wall's front face shall not exceed ¾ inch. The front face vertical joints shall have 12-inch wide strips of filter fabric behind each joint starting 2 feet below grade.

The overall vertical tolerance of wall (plumbness from top to bottom) shall not exceed ½ inch per 10 feet of wall height.

519.04 Working Drawings.{ XE "Prefabricated modular walls:working drawings" }

The Contractor shall submit detailed Working Drawings including design calculations, signed and sealed by a Professional Engineer licensed in the State, giving complete information as to the proposed method of fabrication and erection of precast units and related components. Design parameters shall be verified and be consistent with those parameters that are in place at the time of Advertisement. Working Drawings shall be prepared and submitted according to Subsection 105.04. The submission of Working Drawings shall include, but not be limited to, the descriptive plan presentations that are listed in Subsection 521.01.

COMPENSATION

519.05 Method of Measurement.

The method of measurement will be according to Subsection 521.04.

Porous structure backfill within the modular units and weepholes will not be measured for payment. The cost of this material shall be considered included in the unit price bid.

519.06 Basis of Payment.

Payment will be made according to Subsection 521.05.

SECTION 520 - MECHANICALLY STABILIZED EARTH (MSE) WALLS{ XE "MECHANICALLY STABALIZED EARTH (MSE) WALLS" }{ XE "RETAINING WALLS:MECHANICALLY STABALIZED EARTH (MSE) WALLS" }

520.01 Description.

This work shall consist of the complete construction of Mechanically Stabilized Earth (MSE) wall structures that are composed of precast concrete facing panels, concrete leveling pads, steel reinforcement strips, joint materials, fasteners, select granular or broken stone backfill materials and all other appurtenant items of construction within the common structure volume as shown on the Plans or specified herein.

In addition, when a MSE wall is constructed adjacent to a roadway that will be subjected to chemical deicing, installation of a High Density Polyethylene (HDPE) geo-membrane liner system shall be included. All labor, materials, transportation, handling, storage, supervision, tools and other equipment that may be necessary to install and test the HDPE liner system shall be included.

The manufacturer shall provide the design and engineering for each wall structure. The services of an on-site technical representative, to assist and provide guidance during construction of the leveling pad and installation of the first two-panel courses, as a minimum shall be provided by the wall manufacturer. Two copies of the manufacturer's installation manual shall be furnished to the Engineer.

The Contractor shall make its own arrangements to purchase the materials and services from the manufacturer. All other labor, materials, equipment, and tools shall be supplied by the Contractor as required to prepare the site, construct the leveling pad, construct the wall, place and compact the backfill material, and construct the coping, traffic barrier, or noise barrier.

Materials, test methods, methods of manufacture or any other item not specifically covered on the Plans and Specifications shall be according to the PCI "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products."

All plants manufacturing MSE wall facing panels shall be certified by the National Precast Concrete Association (NPCA) or the PCI to the category of applicable work. Plants must be so approved by the Department before award of Contract.

Except as may be modified within this Section, all provisions of Sections 501 and 914 shall apply in furnishing MSE Wall Systems. A list of MSE systems, that are acceptable for use in a Project, shall be provided in the Special Provisions.

MATERIALS

520.02 Materials.{ XE "Mechanically stabalized earth (MSE) walls:materials" }

Materials shall conform to Subsection 501.02 and the following:

1. **Class of Concrete.** Concrete for precast concrete facing panels shall conform to Class P according to Section 914. Concrete for leveling pad where required shall be Class B concrete conforming to the requirements of applicable portions of Section 914, for unreinforced footings.
2. **Dowel Bars.** Dowels shall be of steel conforming to ASTM A 36, galvanized according to ASTM A 123, or PVC rod meeting the requirements of ASTM D 1784, Type 1, Grade 1.
3. **Soil Reinforcement**. Soil reinforcement material shall conform to the following requirements:
   a. Soil reinforcement strips shall conform to ASTM A 572, Grade 65.
   b. Soil reinforcement welded wire mesh shall conform to ASTM A 185. The minimum size welded wire shall be W 11.
   c. Steel reinforcement strips, wire mesh, and similar materials shall be hot-dip galvanized according to AASHTO M 111.
4. **Miscellaneous Hardware**. Miscellaneous hardware shall conform to the following requirements:
   a. High-strength bolts shall conform to ASTM A 325. Plates and bars for steel strap connections shall conform to AASHTO M 270, Grade 250. Bolts shall conform to ASTM A 307.
   b. Coil inserts for attachments shall be fabricated from cold drawn steel wire conforming to AISI C 1035. Coil bolts shall be ductile iron conforming to ASTM A 1011, Grade 50.
   c. Tie strips shall conform to ASTM A 1011, Grade 50.
   d. All material for attachments shall be galvanized according to ASTM A 123, except for threaded devices which shall be galvanized according to ASTM A 153, Class C. After galvanizing, all attachment surfaces which are not to be embedded in concrete shall be coated with coal tar epoxy polyamide paint conforming to Subsection 912.04.

e. Bearing pads shall be preformed fabric pads conforming to Subsection 919.02, Subpart B.

f. Geotextile material shall conform with Subsection 919.06.

5. High Density Polyethlene (HDPE). HDPE geo-membrane liner systems shall have a nominal thickness of 30 mils. The geo-membrane shall be manufactured of new, first quality resin and shall be compounded and manufactured specifically for the intended purpose. The resin manufacturer shall certify each batch for the following properties:

Property	Test Method	Requirements
Specific Gravity	ASTM D 792	> 0.940
Melt Index	ASTM D 1238	< 0.4g/10 min.
Carbon Black Content	ASTM D 1603	2% - 3%

If requested by the Engineer, the HDPE supplier shall make available this certification for the Engineer's verification of the material.

The surface of the HDPE geo-membrane liner system shall not have striations, roughness, pinholes or bubbles and shall be free of holes, blisters and any foreign matter; such as, soil or oil accumulation.

All seams of the HDPE geo-membrane liner system shall be, as per the manufacturer's specifications, sealed or overlapped to prevent leakage.

{ XE "Mechanically stabalized earth (MSE) walls:materials:backfill requirements" **}6. Backfill Material.** Backfill material, to be used in the MSE structure volume, shall be select granular borrow excavation material or broken stone. The following requirements shall be met:

a. Select Granular Borrow Excavation Material. The select granular borrow excavation shall be free from organic material or, as determined by the Engineer, any other unsuitable material. As determined by AASHTO T 27, the select granular borrow shall conform to the following gradation limits:

Sieve Size	Percent Passing
6 inches	100
3 inches	70 - 100
No. 4	30 - 80
No. 40	0 - 25
No. 200	0 - 10

The frequency of sampling of select granular backfill necessary to ensure gradation limits shall be performed at least once for every 2,000 cubic yards of material placed or whenever the appearance or behavior of the material noticeably changes and as directed.

Select granular backfill shall meet the following requirements:

Recommended electrochemical limits:

Property	Standard	Test Procedure
Resistivity, ohm-cm	Greater than 3,000	AASHTO T 288
pH	Acceptable Range of 5 – 10	AASHTO T 289
Organic Content	1.00% Maximum	AASHTO T 267
Chloride	Less than 100 ppm	AASHTO T 291
Sulfates	Less than 200 ppm	AASHTO T 290

If the resistivity is greater or equal to 5,000 ohm-cm the chloride and sulfates requirements may be waived.

The frequency of sampling of select granular backfill necessary to ensure electrochemical limits shall be performed at least once for every 1,000 cubic yards of material that is placed. A minimum of two samples per structure shall be taken. Whenever the appearance or behavior of the material changes and as directed, additional samples shall be taken.

The materials shall be substantially free of shale or other soft, poor-durability particles. The material shall have a magnesium sulfate soundness loss of less than 30 percent after four cycles, measured according to AASHTO T 104, or a sodium sulfate loss of less than 15 percent after five cycles determined according to AASHTO T 104. The frequency of sampling of select granular backfill necessary to ensure a magnesium sulfate soundness loss of less than 30 percent after four cycles shall be the same as the sampling rate to ensure electrochemical limits.

The Contractor shall furnish to the Engineer a Certificate of Compliance certifying that the select granular backfill material complies with this Section. A copy of all test results performed by

the Contractor which are necessary to ensure compliance with these Specifications shall also be furnished.

b. Broken Stone Material. The broken stone shall conform to Subsection 901.04.

(1) Size numbers 56, 57, or 67 as specified in Subsection 901.20, Table 901-1 may be used.

(2) The maximum compacted thickness of each layer shall be 8 inches.

7. Stone Pocket Material. Coarse aggregate stone pocket material shall be obtained from an approved commercial source. Stone shall conform to ASTM C 33, size No. 67.

CONSTRUCTION

520.03 Methods of Construction.{ XE "Mechanically stabalized earth (MSE) walls:construction methods" }

A. Panel Fabrication.

1. Tie strips, connecting pins, PVC pipe, lifting devices, and all embedded items shall be set in place to the dimensions and tolerances shown on the Plans before casting of the panels.
2. Before installation in the units, the reinforcement and any other embedded material shall be free of frost, dirt, oil, or any material that may prevent bond between it and the concrete.
3. The panels shall be placed without interruption and shall be consolidated by an approved vibrator, supplemented by such hand tamping as may be necessary to force the concrete into the corners of the forms and prevent the formation of stone pockets or cleavage planes.
4. Clear form oil of the same manufacture shall be used throughout the casting operation.
5. The precast units shall be manufactured in steel forms cast on a flat area, the front face of the form at the bottom, the back face at the upper part. Embedded items shall be set in the rear face.

B. Curing.

1. Curing of the precast units shall be by any one of the methods specified in Division 3, Section 4 of the PCI Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
2. If steam curing is used, Subsection 3.4.2 of the PCI Manual is amended as follows:
   a. The applications of steam within the enclosure shall be delayed for a period of five to six hours when the air temperature is 50 ºF or lower and shall be delayed for a period of three hours when the air temperature is 50 ºF or higher.
   b. If retarders are used, the waiting period shall be from four to six hours regardless of the air temperature.
   c. The curing temperature shall be maintained at 145 ± 10 ºF for a period of 12 hours. Two concrete test cylinders, similarly cured, shall be tested after the curing procedure specified. Should tests indicate the precast units have not achieved a compressive strength of 4,000 psi or greater, the precast units shall be cured further until the required strength is achieved.
   d. Forms may be removed as soon as their removal will not cause distortion of the hardened concrete.

C. Shipping.

1. Panels shall not be shipped until the minimum 28-day compressive strength has been attained and a minimum of 72 hours have elapsed following curing procedure.
2. The panels shall meet the acceptance criteria in Section 914.

D. Finishing of Panels.

1. Unless otherwise indicated on the plans, or elsewhere in the Specifications, front face concrete surface shall have a Class 1 finish conforming to Subheading 1 of the fourth paragraph of Subsection 501.14.
2. The rear face shall have a uniform surface finish free of open pockets of aggregates or surface distortions in excess of ¼ inch.

{ XE "Mechanically stabalized earth (MSE) walls:construction methods:defects" **}{** XE "Mechanically stabalized earth (MSE) walls:construction methods:tolerances" **}E. Panel Fabrication/Defect Tolerances.**

1. All units shall be manufactured within the following tolerances:
   a. All dimensions within ¼ inch.
   b. Deviation from vertical, ⅛ inch per 5 feet.
2. Units shall be subject to rejection because of failure to meet any of the above tolerance limitations. requirements specified above.
3. In addition, any or all of the following defects shall be sufficient cause for rejection:

a. Defects that indicate imperfect molding.
b. Defects indicating honeycombed or open texture concrete.
c. Defects in the physical characteristics of the concrete, such as:
d. Stained front face due to excess form oil or other reasons.
e. Signs of aggregate segregation.
f. Broken or cracked corners.
g. Tie strips bent or damaged.
h. Lifting inserts not usable.
i. Exposed reinforcing steel.
j. Cracks at the PVC pipe or pin.
k. Insufficient concrete compressive strength.
l Panel thickness in excess of ¼ inch from that shown on the plans.

4. The Engineer will determine whether spalled, honeycombed, chipped, or otherwise defective concrete shall be repaired or be cause for rejection. Repair of concrete, if allowed, shall be done in a manner satisfactory to the Engineer. Repair to concrete surfaces which will be exposed to view after completion or construction shall be approved.

F. Panel Identification. The name of the manufacturer, name of the project, date of manufacture, the production lot number, and the piece-mark shall be clearly scribed on the rear face of each panel.

G. Panel Handling.

1. All units shall be handled, stored, and delivered in such a manner as to eliminate the danger of chipping, cracks, fractures, and excessive bending stresses as recommended by the manufacturer or approved by the Engineer.
2. Precast concrete panel units shall be inspected upon arrival at the work site to determine conformance to dimensional tolerances, as well as shipment damage. An additional inspection shall be made before erection to determine any damage that may have occurred during storage.

H. Back of Wall Drainage. A 2 by 2-feet stone pocket, filter fabric, and a 8-inch corrugated steel underdrain pipe (CSUP) shall be placed as shown on the Plans.

I. Unclassified Excavation. Unclassified excavation shall be according to the requirements of Section 206 and in conformity with the limits and construction stages shown on the Plans.

J. Wall Foundation.

1. The foundation for the structure shall be graded level for a width that exceeds by 2 feet, minimum, the length of soil reinforcement or mesh.
2. Before wall construction, the foundation bed, if not in rock, shall be compacted to 95 percent standard proctor.
3. Any foundation soils found to be unsuitable shall be removed and replaced with a layer of compacted fill according to Section 203.
4. If subexcavation of foundation material is required, the Contractor shall perform the excavation to the limits shown on the Plans.
5. Materials that are excavated shall be replaced with structure backfill material that meets the requirements of the particular MSE wall system. The material shall be compacted to a density that is not less than 95 percent of the maximum density as determined by AASHTO T 99, Method C or D.
6. At each panel foundation level, an unreinforced concrete leveling footing shall be provided to the elevation detailed on the Plans.
7. The footing shall be of Class B concrete and shall cure for a minimum of 24 hours before placement of wall panels. Methods of construction for cast-in-place concrete shall conform to the requirements of applicable portions of Section 501.
8. Footing elevations shall be as shown on the Plans, within a tolerance of plus ⅛ inch, minus ¼ inch.
9. At this time, install underdrains and drainage piping.

K. Precast Concrete Panels Placement.

1. Precast concrete panels shall be placed vertically with the aid of a light crane. For erection, panels shall be handled by lifting devices set into the upper edge of the panels.
2. Panels shall be placed in successive horizontal lifts as placement of the backfill proceeds. The recommendations of the panel manufacturer and the sequence shown on the Plans shall be followed.

3. Unless otherwise detailed on the plans, the design of the MSE structure is based on the reinforcement being installed perpendicular to the back of the facing panel. In specific, limited situations, it may be necessary to skew reinforcement from its design location, perpendicular to the facing panel, in either the horizontal or vertical plane. The effect of skewing any mesh must be reviewed by the manufacturer. The placement of any reinforcement in a skewed manner must be authorized in writing by the manufacturer before placement in the field.

L. Vertical/Horizontal Panel Tolerances.

1 External bracing shall be required for the initial lift.

2. Vertical tolerance (plumbness) and horizontal alignment tolerance shall not exceed ¾ inch, when measured along a straightedge.

3. The maximum allowable offset in any panel joint shall be ¾ inch. The overall vertical tolerance of the wall (plumbness from top to bottom) shall not exceed ½ inch per 10 feet of wall height.

M. Soil Reinforcement Placement.

1. Reinforcement strips or mesh shall be placed normal to the face of the wall, unless otherwise shown on the Plans or directed.

2. Before placement of soil reinforcement or mesh, the backfill material shall be compacted according to applicable requirements for backfill placement or, as specified herein.

N. Backfill Material Placement. Backfill placement shall follow erection of each course of panels. Backfill shall be placed in such a manner as to avoid any damage or disturbance to the wall materials or misalignment of the face panels. Any wall materials which become damaged or disturbed during backfill placement shall be either removed and replaced at the Contractor's expense or corrected as directed. Any misalignment or distortion of the wall facing panels due to placement of backfill outside specified limits shall be corrected. Backfill material placement shall conform to the following:

1. Select Granular Material.

a. The select granular backfill material shall be compacted to 95 percent standard proctor.

b. The moisture content of the select granular backfill material before and during compaction shall be uniformly distributed throughout each layer.

c. Select granular backfill materials shall have a placement moisture content that is less than or equal to the optimum moisture content.

d. Select granular backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable throughout the entire lift.

e. The optimum moisture content shall be determined according to AASHTO T 99, Method C.

f. Select granular backfill material placed within 1 foot of any drainage structure or utility line which is included in the reinforced earthen volume shall not have any particle greater than 3 inches in maximum dimension.

g. The maximum lift thickness of select granular backfill material shall not exceed 10 inches loose measurement. The Contractor shall decrease this lift thickness to obtain the specified density.

2. Broken Stone Backfill.

a. Use of broken shall conform to the requirements of Subsection 901.04.

b. The maximum lift thickness of broken stone backfill shall not exceed 8 inches.

c. At each reinforcement strip level, the broken stone shall be roughly leveled and compacted before placement of the reinforcement.

d. According to the provisions of Subsection 919.06, Item 2, when broken stone backfill material is used, geotextile filter fabric material shall be used at the interface of the broken stone and regular roadway materials and embankments.

O. Compaction of Backfill Material.

1. Backfill material conforming to the requirements specified herein shall be placed and compacted simultaneously with the placement of facing and soil reinforcement.

2. Placement and compaction shall be accomplished without distortion or displacement of the facing or soil reinforcement. Sheepsfoot or grid-type rollers shall not be used for compacting backfill within the limits of the soil reinforcement.

3. At each level of soil reinforcement, the backfill material shall be roughly leveled to an elevation approximately 2 inches above the level of the connection at the facing before placing the soil reinforcement.
4. The compaction shall take place in a direction that is parallel to the wall.
5. The specified compaction of the select granular backfill material shall be accomplished by use of large, smooth drum, vibratory rollers with the exception of the 5-foot zone directly behind the facing panels.
6. The density requirements specified in N.1., above for compaction of the select granular backfill material, shall be performed on each layer that is placed according to Subsection 203.10. AASHTO T 238, Method B and AASHTO T 239 shall be used to determine the achieved density.
7. To provide the proper density of the broken stone backfill, compaction shall be achieved by at least four passes with a vibratory roller that has a total operating weight of 8 to 10 tons. The roller shall be set in the vibratory mode and at a speed of between 1.5 and 2.5 mph.
8. Within 5 feet of the wall, small, single or double drum, hand operated, walk-behind vibratory rollers, or walk-behind vibrating plate compactors shall be used, and at least three passes shall be made.
9. When there is evidence of wall displacement or disturbance, compaction shall be accomplished by use of a smooth drum static roller.
10. At the end of each day's operation, the Contractor shall slope the last placed level of backfill away from the wall facing to rapidly direct runoff of rainwater away from the wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

P. High Density Polyethlene (HDPE).

1. HDPE geo-membrane liner systems shall be delivered and, before installation, stored so that no damage is caused to the material.
2. Before liner installation, it shall be assured that the area that is to lined shall be smooth and free of sharp objects or debris of any kind. No equipment or tools shall damage the membrane by handling, equipment or personnel movement.
3. The HDPE shall be placed below the pavement and just above the first row of reinforcements. The HDPE shall be sloped to drain away from the facing panels.
4. HDPE installation shall not be done during any precipitation or in the presence of excessive moisture such as fog or dew. The Engineer shall be the sole judge in determining satisfactory conditions.
5. Seams shall be oriented parallel to the line of maximum slope. Seams shall have a finished overlap of between 3 to 4 inches.
6. Field testing of seams, according to the manufacturer's specifications, shall be conducted to verify satisfactory seaming conditions.
7. When backfilling, care shall be taken to prevent any damage to the HDPE system. The Contractor shall slope the last placed level of backfill away from the wall facing to rapidly direct runoff of rainwater away from the wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

520.04 Working Drawings.{ XE "Mechanically stabalized earth (MSE) walls:working drawings" }

Working drawings for MSE walls shall be in accordance with Subsection 105.04. The working drawing submission shall include, but not be limited to, the descriptive plan presentations that are listed in Subsection 521.03.

COMPENSATION

520.05 Method of Measurement.

The method of measurement for construction of the MSE wall structure shall be according to Subsection 521.04.

520.06 Basis of Payment.

Payment for the construction of the MSE wall structure will be made according to Subsection 521.05.

SECTION 521 - ALTERNATE RETAINING WALL DESIGNS{ XE "RETAINING WALLS:ALTERNATE DESIGNS" }

521.01 Description.

The provisions of this Section apply to construction at various locations on the Plans where alternate retaining wall designs are permitted. The Plans offer the Contractor the option of constructing alternate types of proprietary retaining walls at each site. In addition, at some locations a non-proprietary type of construction may be detailed as an alternate. At designated locations, a combination of both non-proprietary and proprietary types of construction may be specified.

Notwithstanding the provisions of Subsection 104.11, only those wall types designated shall be constructed. Recommendations by the Contractor for constructing other types, either proprietary or non-proprietary, will not be accepted.

Under this Section, work shall include construction of the wall complete, together with all other appurtenant items of construction within the common structure volume designated on the plans, including, but not necessarily limited to, removing existing structures, excavation and embankment, leveling pads, footings, special backfill materials, underdrain pipe and stone pockets, temporary sheeting, copings, piles, pile driving equipment, and drainage items. Where reinforced concrete parapets are part of the wall, construction shall include epoxy-coated reinforcement, bridge chain-link fence, noise barrier, embedded rigid metallic conduit, and junction boxes for roadway lighting facilities.

For the disposition of excess excavation materials within the common structure volume, the provisions of Subsection 202.04 shall apply.

At each site, the Plans indicate the common structure volume which applies to all alternates, proprietary and non-proprietary.

Final design of alternate retaining walls shall be submitted as Working Drawings in accordance with Subsection 105.04. The Working Drawing submission shall include, but not be limited to, the following:

1. An elevation view of the wall indicating elevations at the top of the wall and at the beginning and end wall stations
2. A numbered panel layout for fabrication and erection purposes
3. All breaks in vertical alignments and elevations at whole stations and at plus 10-meter increments
4. Elevations at the top of leveling pads or footings
5. Locations of all steps in the leveling pads or footings
6. Panel or unit length and size and designation
7. The location of the proposed final ground line
8. Plan view of the wall, which indicates the offset from the construction baseline to face of wall units at all changes in horizontal alignment
9. Distance from front of wall to the extreme limit of module
10. ROW limits and their relationship to the wall, with offsets and stations to corners
11. Location of any noise walls or sign structures near the wall by station and offsets
12. Centerline of any drainage structures or utilities behind and passing through or under walls
13. All piles, if warranted, on any adjoining structure’s foundation plans with details to avoid any conflict
14. General notes, design parameters, soil characteristics, and factors of safety
15. Typical panels as well as special panels, such as at bends, dimensions necessary to construct the element, the location of reinforcing steel in the element and the location of reinforcement element attachment devices, that are embedded in the panels
16. All details for footings and leveling pads, including step details and actual maximum bearing pressure
17. Architectural details, such as special facing finish, texture, and color
18. All details for the construction of walls around obstructions
19. Connections to barriers, copings, signs, lights, railing, fences, noise barriers, or any other element
20. Fully detailed design computations
21. Typical sections of the wall indicating internal drainage and surface drainage behind the wall, typical cross-sections of cut and fill sections and limits and extent of select granular backfill material placed above original ground
22. All details for constructing walls around bridge supports, drainage facilities, sign footings, or any other element and particular attention shall be given to accommodating wall construction at bridge abutments
23. Limits and extent of common structure value, such as excavation, volume of concrete, reinforcement steel, backfill, etc
24. All quantities and Special Provisions, including suggested sequence of construction, necessary to construct the wall

MATERIALS AND CONSTRUCTION

521.02 Materials and Methods of Construction.

All materials, methods of construction, and other work pertaining to reinforced concrete cantilever walls shall conform to Section 501.

All materials and methods of construction pertaining to furnishing and constructing precast concrete crib walls shall conform to Section 516.

All materials and methods of construction pertaining to construction of proprietary wall alternates shall conform to the applicable provisions of Section 519 for prefabricated modular walls and of Section 520 for mechanically stabilized earth walls.

When a proprietary wall system, that does not categorically fall under the type designated in either Section 519 or Section 520, Specifications shall be provided in the project Special Provisions to fully describe all required guidelines and materials to facilitate placement of the wall system.

521.03 Working Drawings.

According to the provisions of Subsection 105.04, final design of alternate retaining walls shall be submitted for approval as shop drawings. Additionally, final designs shall conform to the current AASHTO Standard Specifications for Highway Bridges and to criteria established in subsection 1.17.3 of the NJDOT Bridges and Structures Design Manual. The shop drawings shall include detailed computations and all details, dimensions, and quantities necessary to construct the wall. The design and fully detailed plans shall be prepared to Department standards current at the time of submission and shall be consistent with the Plans. The soil unit weight and the frictional factor of broken stone shall be included in the design calculations. As such, designs shall account for two type backfill materials, porous fill and broken stone. The shop drawing submission shall include, but not be limited to, the following:

1. An elevation view of the wall indicating elevations at the top of the wall and at the beginning and end wall stations.
2. A numbered panel layout for fabrication and erection purposes.
3. Designation of all breaks in vertical alignments and elevations at whole stations and at 25-foot increments.
4. Elevations at the top of leveling pads or footings.
5. Locations of all steps in the leveling pads or footings.
6. Panel or unit length and size and designations.
7. The location of the proposed final ground line.
8. Plan view of the wall which indicates the offset from the construction baseline to face of wall units at all changes in horizontal alignment.
9. Distance from front of wall to the extreme limit of module.
10. ROW limits and their relationship to the wall, with offsets and stations to corners.
11. Location of any noise walls or sign structures near the wall by station and offsets.
12. Centerline of any drainage structures or utilities behind and passing through or under walls.
13. All piles, if warranted, on any adjoining structure's foundation plans with details to avoid any conflict.
14. General notes, design parameters, soil characteristics, and factors of safety.
15. Typical panels as well as special panels, such as at bends. Dimensions necessary to construct the element. The location of reinforcing steel in the element. The location of reinforcement element attachment devices that are embedded in the panels.
16. All details for footings and leveling pads, including step details and actual maximum bearing pressure.
17. Architectural details, such as special facing finish, texture, and color.
18. All details for the construction of walls around obstructions.
19. Connections to barriers, copings, signs, lights, railing, fences, noise barriers, or any other element.
20. Fully detailed design computations.
21. Typical sections of the wall indicating how internal drainage and surface drainage behind the wall is handled. Typical cross-sections of cut and fill sections. Limits and extent of select granular backfill material placed above original ground.
22. All details for constructing walls around bridge supports, drainage facilities, sign footings, or any other element. Particular attention shall be given to accommodating wall construction at bridge abutments.
23. Limits and extent of common structure value, such as excavation, volume of concrete, reinforcement steel, and backfill, etc.
24. All quantities and Special Provisions, including suggested sequence of construction, necessary to construct the wall.

25. The plans and design computations shall be signed and sealed by a Professional Engineer licensed to practice in the State.

COMPENSATION

521.04 Method of Measurement.

The Plans indicate at each site the structure volume common to all alternate retaining wall designs. Except as otherwise may be provided for on the Plans or specified herein, within this volume, no quantity other than the projected wall area will be measured.

Alternate retaining walls will be measured by the square foot. The area measured will be the product of the average height determined by extending the final ground lines at the top and bottom of the wall to a vertical plane of the front face of wall and the total length of wall indicated.

521.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
RETAINING WALL, LOCATION NO. ___	SQUARE FOOT

SECTION 522 - NOISE BARRIERS{ XE "NOISE BARRIERS" }

522.01 Description.

This work shall consist of the construction of roadway and bridge noise barriers. Roadway noise barriers shall be made of precast concrete, glued-laminated timber, or aluminum. Bridge noise barriers shall be made of aluminum or precast concrete. All noise barriers shall consist of posts, panels, purlins, girts, foundations, where applicable, and all other associated members and attachments necessary for fabrication and erection. The Contractor, at its option, may utilize prestressed concrete posts and panels instead of the proposed precast posts and panels. However, the design calculations and detailed drawings shall be submitted according to Section 105 of the Standard Specifications, for the Designer's approval. Prestressed post and panels shall conform to Section 502.

Materials and methods of construction not specifically covered in the Plans and Specifications shall conform to AASHTO Standard Specifications for Highway Bridges, Structural Glued-laminated Timber Voluntary Product Standard PS56 (National Institute of Standards and Technology, U.S. Department of Commerce), AITC standards, AWPA standards, ACI Manual of Concrete Practice, and the PCI Manual 117. The applicable editions and revisions of the above standards and specifications shall be the editions and revisions that are current at the time of bidding.

MATERIALS

522.02 Materials.

Materials shall conform to the following Subsections:

Broken Stone	901.04
Washed Gravel	901.05
Aluminum Bolts, Nuts, and Washers	911.01
Mortar and Grout	914.03
Reinforcement Steel in Structures	915.01
Aluminum Structural Shapes	916.01
Aluminum Rivets	916.01
Bolts and Bolting Material	917.01
Structural Steel	917.10
Zinc Coating on Steel	917.12
Timber	918.05
Bearing Pads, Elastomeric	919.02

Concrete for foundations and pedestals shall be Class B conforming to Section 914.

Coarse aggregate for use at the base of drilled shaft foundations shall be broken stone or washed gravel. The aggregate standard size shall be No. 57 and shall conform to the gradation shown in Table 901-1.

Additional material for aluminum noise barriers shall conform to the following:

1. Ribbed sheet aluminum panels and aluminum flashings shall be as specified on the Plans.
2. Paint for the panels and flashings shall be baked-on, factory applied, and of a color matching adjacent roadway noise barriers. Color chips shall be submitted to the Engineer for color selection.

3. Exposed parts of fasteners shall be painted with enamel paint conforming to Federal Specification TT-E-489 and shall match the color of the noise barrier.

All bolts, studs, and washers which are used to attach aluminum noise barriers to bridge parapets, retaining walls or dissimilar materials shall be stainless steel and shall conform to Subsection 917.13.

Concrete for precast roadway noise barrier posts and panels shall be Class P conforming to Section 914, except that the use of a superplastizer admixture containing lignosulfanates is prohibited. The Contractor, at its option, may use a superplasticizer that does not contain lignosulfanates. Should superplasticizers be used, the Contractor shall produce two 24 by 24 by 4-inch sample panels. One sample panel shall contain the superplasticizer admixture, and the other panel shall not. The concrete for both sample panels shall be batched, finished and cured at the same time and shall be representative of how the actual members will be finished and cured. The concrete batching may be done during the verification batching for the Project. A representative of the manufacturer of the concrete admixture shall be present at the time of concrete batching. Should the sample panels indicate unacceptable color variations in the concrete, as determined by the Engineer, the Engineer may prohibit the use of the superplasticizers for noise barriers. A consistent source of cement, fine aggregate and coarse aggregate shall be used for all precast elements to ensure uniformity of color. Cement of the same brand and coming from the same mill shall be used throughout the entire job to minimize color variation.

Precast concrete that is to be integrally colored shall use a pigment coloring system. Pigment for integrally coloring concrete shall be a chemically pure material pigment. The exact quantity of pigment to be added shall be determined based on the preparation, examination, and approval of a 24 by 24 by 4-inch test panel. The test panels shall be prepared according to Subsection 522.05, Subpart B utilizing the specified integral color to produce one 24 by 24 by 4-inch test panel.

Curing materials and methods of construction for curing integrally colored concrete shall be according to the manufacturer's recommendations and Subsection 502.11. The tint used for all the concrete in the posts and panels shall be from the same batch.

A high quality form release oil, compatible with the integral color and based on the integral color manufacturer's recommendations, shall be used.

The color of grout used for filling holes at recessed inserts shall match the color of precast panels and posts or the surface to which it is applied.

Coarse and fine aggregate shall conform to the requirements of ASTM C 33 and Subsection 901.12. The maximum size of coarse aggregate shall not be larger than No. 67 as listed in Table 901-1 of Subsection 901.20, and it shall be washed. Adherent fines shall not exceed one percent. Total adherent and non-adherent fines shall not exceed 1.5 percent.

Preformed, closed cell, polyethylene foam backer rod joint filler shall conform to ASTM D 3204, Type I. Cold applied joint sealer shall be a one-part, low-modulus silicon rubber type conforming to Federal Specifications TT-S-1543, Class A or TT-S-00230C, Type II, Class A with a minimum elongation of 600 percent. The cold applied joint sealer shall match the color of the precast concrete items.

All bolts used for construction of timber noise barriers shall conform to ASTM A 325 and shall be galvanized according to ASTM A 153. All hardware shall conform to AASHTO M 270, Grade 36 and shall be galvanized according to AASHTO M 111.

CONSTRUCTION

522.03 Working Drawings.

Working drawings shall be furnished according to Subsection 105.04. Minor variations in details may be permitted subject to approval of the Engineer, however, any major departure from the design shown on the plans will not be approved. If minor variations are submitted on the working drawings, it shall be clearly noted on the drawings.

Before fabrication, the Contractor shall submit complete working drawings and erection plans. Working drawings shall cover each type of unit to be used and shall show exact dimensions and handling details.

Working drawings shall include the width and location of all construction haul roads adjacent to noise barriers being constructed.

Working drawings for bridge noise barriers shall show precise mounting details including the locations of all required threaded inserts. Reinforcement steel patterns in precast panels and bridge parapets shall be shown to ensure proper installation and to avoid conflicts. Complete plan and elevations shall be included.

Working drawings for post and panel roadway noise barriers shall include the plan and elevation drawings of the barriers. Noise barrier drawings shall clearly show the top and bottom elevations of the wall at each post location as well as indicate all steps, post hole diameters and depths. Reinforcement steel patterns in precast panels shall be shown to ensure proper installation and to avoid conflicts. If post hole casings are required, they shall also be shown.

Erection details shall be complete in every detail including handling points and anchorage details and shall include erection instructions and sequence of operations. Method(s) of stabilization of post holes before placing concrete shall also be addressed.

522.04 Shop Inspection.

At all times while the work is being performed, the Engineer or the Engineer's representatives shall have free access, for the purpose of inspection, to all parts of the manufacturer's operations that concern the manufacture of the materials ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy the inspector that the material is being furnished according to the Specifications.

522.05 Precast Concrete Noise Barriers.{ XE "Noise barriers:precast concrete" }{ XE "Precast:noise barriers" }

A. General. The fabricator of precast concrete noise barriers shall have a minimum of five years experience with architectural assemblage of similar products. All precasting operations shall be performed indoors within a controlled environment and from a central batch mixer. A plastic or other temporary structure is acceptable provided it is sturdy enough to endure weather conditions and is able to maintain environmentally controlled conditions. The enclosure shall not be heated by fossil-fueled heaters unless the exhaust fumes are vented to the outside away from the enclosure.

Deformed Welded Wire Fabric may be used as an alternate to reinforcing bars for precast concrete panels. The Welded Wire designation and spacing shall meet the minimum area of steel as determined by design. Deformed welded wire fabric shall not be shipped in rolls but shall be shipped in mats. Mesh sheets shall be overlapped not less than one mesh in width or as required by design, whichever is greater. Overlaps shall be fastened securely at the ends and edges.

B. Test Posts and Panels. Before the start of normal noise barrier fabrication and before the fabrication and construction of the test posts and panels, the concrete precaster shall construct and submit to the Department's Bureau of Landscape and Urban Design for color approval, a 24 by 24 by 4-inch sample panel. The sample panel shall be constructed utilizing the approved noise barrier concrete mix design and specified integral color requirements. The specified finish shall be included on one side.

Fabrication of the test posts and panels shall not commence until working drawings have been approved by the Engineer and by the Department's Bureau of Landscape and Urban Design. The concrete precaster shall then construct, at its plant or at a location determined by the Engineer if there is more than one precaster involved with the Project, an acceptable sample noise barrier wall consisting of five posts and four sections of panels. The precaster shall erect the four panel sections with a minimum of two panels for each section. Two sections shall show the specified sound absorptive finish, if applicable, and two sections shall be erected with the standard concrete finish without the sound absorptive finish. The wall shall be the same size and configuration as the noise barriers to be used on the Project. These test sections will be used to determine the acceptability of the various surface treatments, color, and quality of construction of both the roadway and residential sides of the noise barrier.

Integrally colored posts and panels shall be uniform in color consistency and free from discoloration and blemishes. The sample noise barrier shall include the specified finishes for both highway and residential sides, and all panel and post detailing as directed in the Plans.

The Resident Engineer and the Department's Bureau of Landscape and Urban Design shall be notified in writing, at least 14 days before the construction of the sample noise barrier wall so that the appropriate Department representatives may be present to determine the acceptability of the finished posts and panels.

The Engineer, in conjunction with the Department's Bureau of Landscape and Urban Design, will determine whether the color and various surface treatments of the posts and panels are acceptable. If test sections are found to be unacceptable, the concrete precaster shall make additional samples until an acceptable product is produced.

Once test posts and panels have been approved, they shall be retained and used as the standards to determine acceptability of production posts and panels. The panels may be used on the Project at the end of precasting operations when released by the Engineer.

The Contractor may use the sample noise barrier, which was previously submitted for color and texture approval, for the application and approval of the concrete penetrating stain. Final approval of all color and surface features on the sample noise barrier must be received before the application of the stain on the sample noise barrier.

C. Concrete Placement. Concrete shall be deposited only in the presence of and by methods approved by the Engineer. All reinforcement shall be free of dirt, loose rust, grease, and other deleterious substances. All

items to be encased in the concrete shall be accurately placed in the position shown on the Plans and firmly held during the placing and setting of the concrete.

Concrete shall be vibrated internally or externally, or both, as required. The type, number, and method of application of vibrators shall be approved by the Engineer. Internal vibrations shall be applied to the concrete for time intervals of approximately ten seconds and at points not more than 18 inches apart. Vibrators shall not be used to move concrete horizontally in the form. The vibrating shall not displace any reinforcement inserts.

Form liners, where required, shall not leak at the joints and seams must be fused according to the manufacturer's recommendations. No unfused seams will be permitted. The placement of seams will be subject to the approval of the Engineer. Form liner seams shall be placed so that the architectural finish will be unbroken and continuous.

Precast concrete posts and panels shall be free of honeycombing or voids and shall be true to size and dimensions within the following limits:

1. Casting tolerances (overall height and width measured at the face adjacent to the mold when cast):

10 feet or under	±⅛ inch
Over 10 feet	+ ⅛ inch, - 3/16 inch
Thickness	±⅛ inch
Out of square	¼ inch

2. After casting tolerances:

   Bowing and warpage: 1/360 panel dimension with a maximum of ¾ inch; differential bowing or camber between adjacent members of the same design shall not exceed ⅜ inch.

3. Position of cast-in items:

Recessed handling inserts	± ⅜ inch
Reinforcement	± ½ inch
Threaded inserts	± ¼ inch

D. Finishing Concrete Surfaces. The cap of all exposed surfaces of the concrete posts and the top concrete panels shall receive a Class 1 surface finish according to Subsection 501.14. The remainder of the exposed surfaces of the posts and panels on the roadway side shall be according to the approved sample panels.

The finish for concrete surfaces will be specified on the Plans or in the Special Provisions. If a rough finish is specified on the residential side of the noise barrier posts and the concrete panels, they shall receive a fuzzy finish produced in the following manner: When a tight uniform surface has been achieved and as soon as the water sheen has disappeared, the surface shall be textured to a fuzzy (rough) finish. The finish surface is produced with a 2-feet asphalt rake with every other tine removed. This tool is used to rake up the outer face to a depth of about 1 inch with a swirling motion in such a manner as to not gouge the surface or leave any tine marks. The minimum concrete over the rebars must be maintained. The concrete shall then be allowed to dry normally.

Before commencing with panel production, the fuzzy finish will be evaluated and approved according to the Specifications.

Form liners shall be constructed in such a manner as to prevent concrete leakage at joints and must be fused by a "hotmelt" system. No glue, caulking, or unfused seams will be permitted.

E. Concrete Curing. Curing of the precast units shall be by any of the methods specified in Division 3, Section 4 of the PCI Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products. The curing method to be used shall be submitted in writing for approval before the start of fabrication.

If steam is used, Subsection 3.4.2 of the PCI Manual is amended as follows:

1. The applications of steam within the enclosure shall be delayed for a period of five to six hours when the air temperature is 50 ºF or lower and shall be delayed for a period of three hours when the air temperature is 50 ºF or higher.
2. If retarders are used, the waiting period shall be from four to six hours regardless of the air temperature.
3. The curing temperature shall be maintained at 145 ± 10 ºF for a period of 12 hours.

Two concrete test cylinders, similarly cured, shall be tested after the curing procedure specified. Should the tests indicate that the precast units have not achieved a compressive strength of 5,000 pounds per square inch the precast units shall be cured further until the required strength is reached.

Forms may be removed after the precast units have achieved a compressive strength of 3,000 pounds per square inch.

To determine the acceptance or failure of the concrete, one compressive strength test from the two concrete cylinders that are taken from each concrete truck or from each batch of concrete that is produced shall be performed. The two test results shall be averaged together to obtain a single value representing the units. Concrete will be accepted if this averaged single value is equal to or greater than the class design strength as identified in Subsection 914.05, Table 914-3. Concrete will be accepted with a pay adjustment if the averaged single value is within the range from 1 to 500 pounds per square inch less than the class design strength for the specified concrete class, (i.e. for Class P concrete, this range will be between 5,000 and 5,500 pounds per square inch). The pay adjustment will be according to Section 914. Concrete will be rejected if the averaged single value is greater than the amount that is 500 pounds per square inch less than the class design strength for the specified concrete class. The Engineer may use testing results obtained from concrete cores or nondestructive testing before requiring any corrective action or removal and replacement of the concrete. All costs for coring and testing shall be paid for by the Contractor.

F. Staining Concrete Surfaces. Precast concrete noise barriers shall be stained by the application of a concrete penetrating stain. The concrete penetrating stain shall be a single component, water based, thermoplastic acrylic emulsion which carries its color and water repellent protection into the concrete.

The penetrating stain shall conform to the following performance requirements:

Physical Properties

Condition	Results	Test Method
Dry-through Time	25 minutes, maximum	ASTM D 1640
Dry-to-recoat Time	1 hour, maximum	ASTM D 1640
Oil, Wax, and Silicon Content	None 200 pounds per square inch, minimum	ASTM D 4541
Adhesion to Concrete	(Average of five tests)	Elcometer Test
Gloss Flat	No visible	ASTM G 23
Weather-O-Meter Carbon Arc	Degradation 500 hours	Atlas Test
Solids by Weight	57 ± 2 percent	
Viscosity	70 to 75 Krebbs Units	ASTM D 562

The Contractor shall submit a Certificate of Compliance according to Subsection 106.04.

The color of the concrete penetrating stain shall match the approved concrete noise barriers that have been precast utilizing an integral color.

The unpigmented, clear, non-volatile portion of the stain shall match the infrared spectrograph on file at the Department Laboratory. The concrete penetrating stain shall comply with New Jersey state laws regulating the use of volatile organic compounds and solvents and the following:

1. Test Staining. Before any staining operations, the Contractor shall complete a test staining program for color acceptance and surface area coverage. This work shall be performed either at the concrete precaster's plant on the noise barrier test wall or at the Project site on a portion of an erected noise barrier under the same circumstances as the actual staining. One complete noise barrier section, including posts, shall be stained.

Before ordering, a sample shall be submitted for approval of the concrete stain and color. Accompanying the sample shall be the manufacturer's literature which shall include materials specifications, physical properties, including ASTM test methods utilized, manufacturer's recommended application rates for the various surface textures and porosity, current application instructions, and material safety data sheets.

The Contractor shall apply the stain according to the manufacturer's recommendations, and the work shall be representative of the job site application. The stain test sample must be approved by the Engineer and the Department's Bureau of Landscape and Urban Design before actual staining operations and the ordering of any further quantities of stain. When approved, the sample area shall serve as a standard of acceptance for all further work.

A standard for color will be established based on the approval of the full size noise barrier staining. A stain batch shall be designated by batch number and date and will remain the standard for the entire Project.

The final color and form liner finish shall match that of the adjacent existing noise barrier components.

2. **Application Procedures.** The concrete penetrating stain shall be applied according to the manufacturer's written instructions and precautions. Surfaces to receive the concrete penetrating stain shall be structurally sound, fully cured, clean, dry, and free from dust, curing agents, oil, grease, efflorescence, and any other contaminants that could prevent proper adhesion. If necessary, the surfaces to be stained shall be pressure washed until all surface contamination has been completely removed. In addition, glazed or glossy surfaces must be chemically or mechanically abraded to remove gloss to allow adhesion.

Before use, the stain shall be thoroughly mixed using the appropriate mechanical means and shall be mixed during spraying operations as required by the manufacturer to maintain uniformity.

All concrete stain is to be of the same batch and lot. The stain shall be delivered to the spraying site in original, sealed 5-gallon plastic pails or open head 55-gallon drums, clearly labeled with the manufacturer's name, brand name, type of material, batch and lot numbers, date of manufacture, and color.

At the time of stain application, both the concrete and air temperatures must be between 45 and 90 ºF. The Concrete shall be completely dry. Stain shall not be applied unless weather conditions will permit complete drying of material before rain, fog, dew, or temperatures beyond the prescribed limits.

The concrete penetrating stain shall be spray applied using conventional or airless spray. The stain shall be applied in two thin coats to provide a uniform appearance. The first coat shall be applied at the precast plant. The final coat applied in the field shall be consistent with the quality and appearance of the approved sample. The rate of application shall be according to the manufacturer's recommendations. The area of coverage may vary depending on absorption rates of the various surface materials and textures to obtain complete coverage.

The completed stain surfaces shall be consistent with the quality and appearance of the approved sample area. If unevenness in color and lines of work termination exist, the Engineer may have all such surfaces resprayed by the Contractor. Respraying, if required, shall be carried to a natural break-off point.

Stain may be brushed or roller applied only at locations where over spray would affect adjacent materials and where not practical for spray application. Adequate protection shall be provided to protect adjacent persons, vehicles, and property from over spray during staining operations.

G. Storage and Transportation. After curing, the units shall be stored, stacked, and transported in a manner to prevent the development of cracks or other deformities.

The top side of all precast concrete units shall be marked for identification and proper placement on the erection drawings. In addition, the length, size, and type of reinforcement shall be marked on the unit.

522.06 Timber Noise Barriers.{ XE "Noise barriers:timber" }{ XE "Timber:noise barriers" }

The fabricator of timber noise barriers shall have a minimum of five years experience with architectural assemblage of similar products.

Timber noise barriers shall be fabricated according to the details shown on the Plans. Assembly of the component lumber within an individual glulam panel shall be accomplished using a stagger lay up procedure with random width plys. Edge joints shall be staggered laterally from the adjacent joint immediately above or below it by at least the net thickness of the lamination according to PS56. The width of the inner edge joint shall not exceed 1¼ inch. The width of open edge joints on the face panel may vary from ½ to ¾ inch , however, the width of a single joint should be held approximately constant from one end of the panel to the other. The outside edge of the face ply shall not be scant of the full width at any point by more than ¼ inch over the full length of the panel. The outside edge of the inner ply shall not be scant by more than ⅜ inch over the length of the panel. Excessively warped panels causing misalignment of the noise barrier or otherwise hampering the proper erection shall be rejected at the discretion of the Engineer. Both faces of the panel shall be free of skip and glue stain. The edge joints on the face of laminations shall be routed to remove squeeze-out glue, loose grain, and foreign material to a minimum depth of ½ inch.

Fabrication of solid sawn lumber elements and workmanship shall conform to the provisions of Section 504. Panels shall be preassembled in the shop into units of four panels with purlins, battens, and all connection hardware to minimize the number of elements to be connected in the field. Each unit can then be erected and connected to the posts. The panels, when erected, shall rest on seating angles and be temporarily connected to the posts. After alignment and adjustment, all connections shall be tightened in their final position.

The same preservative treatment shall be applied to all components of the noise wall to ensure a uniformity of color and appearance. All galvanized surfaces damaged during shipment or installation shall be field repaired in conformance with Subsection 503.14.

Predrilling of holes shall be used for all spike connections. All nailed parts such as battens and nailers shall be precisely aligned to provide an air-tight fit.

"Cross banding" at the middle layer of the 1⅞-inch glulam panel shall be used on the top and bottom of all panels. Any additional cross banding shall be placed at the center of all panels which are more than 15 feet in height.

Preassembled units shall be installed according to detailed erection drawings furnished by the Contractor and approved by the Engineer. Erection shall be in a manner that will prevent excessive bending about either axis. Structurally damaged units will not be acceptable.

522.07 Foundations.{ XE "Noise barriers:foundations" }

Post holes for noise barriers shall be constructed by augering or as otherwise approved. Excavation of post holes shall not start until final earth grading has been completed along the proposed alignment of the noise barrier for a distance of at least five panels in each direction. Before post hole excavation, the Contractor shall verify the location of any existing utility conduits. If an existing utility conduit is encountered during the construction of post holes, the Department's Bureau of Utilities and ROW shall be contacted. The conduit may be relocated or the post may be relocated by the Contractor as directed by the Engineer. Any damage done to existing utility lines shall be repaired by the Contractor.

If borings in the general vicinity of the noise barriers indicate conditions which may impede the advance of augering equipment, other suitable equipment and procedures may be required to construct the post holes at the locations and to the depth specified.

The actual location of any post hole shall not vary from the specified location of the axial center of the post embedded in that hole by more than 1 inch in any direction. The actual diameter of the hole constructed may be larger, but may not be more than 1 inch smaller than the nominal diameter indicated on the Plans.

The Contractor shall be responsible to take all measures and precautions necessary to prevent the collapse of the post hole sides. Where soil surrounding the post hole is disturbed as a result of the Contractor's operations, all such disturbed soil shall be removed as directed and replaced with earth embankment and shall be compacted.

The post hole concrete shall be poured against undisturbed earth or smooth wall permanent metal casing installed in such a manner that the outside of the permanent casing bears against minimally disturbed earth. A temporary steel casing may be used to keep the post hole open before placing concrete. The Contractor shall remove all water from all the post holes before foundation concrete is poured. The holes shall be free of all earth, broken rocks, cobbles, boulders, remnants of abandoned structures, utilities, and other debris and materials.

If, in the Engineer's opinion, the permanent metal casing has been installed such that a void exists around the casing or the soil has been excessively disturbed, one of the following methods shall be applied:

1. The void shall be grouted. Grout shall conform to Subsection 914.03 except that it shall have a 1:3 (cement to fine aggregate) ratio and the nonmetallic grout provisions shall not apply. Grout shall be applied at a pressure equal to one-half of the overburden pressure at the bottom of the casing.
2. The void shall be backfilled with pneumatically applied sand thoroughly tamped into place.
3. The void shall be backfilled with soil excavated from the hole. The backfill shall be in 8 inch loose lifts and compacted by the density control method as provided for in Subsection 203.10.

The remedial method shall be as specified by the Engineer and shall depend upon the extent of the void or the disturbance. Should one of the remedial methods listed above be used, corrugated metal casing can be substituted for smooth wall metal casing.

Permanent metal casing shall be steel or aluminum. Steel casing shall be zinc-coated.

Posts shall be set plumb, unless otherwise shown on the plans, and set in the holes and secured in place in a precise position to accept the panels. Posts shall be set into the holes a minimum of 6 inches above a layer of coarse aggregate and encased in concrete such that the specified fixed positions of the noise barrier elements are achieved within the following tolerances:

1. The plan position of the embedded posts shall not vary more than ½ inch in any horizontal direction, including out-of-plumbness for the vertical posts, from the theoretically symmetrical and interlocking positions with the panels to be inserted as shown on the Plans.
2. The vertical position of the embedded posts shall not vary more than ½ inch from the position shown on the Plans.
3. The panel seat area shall be constructed such that the top of the panel is level and within ¼ inch of the elevation shown on the Plans.

The panel units shall not be erected before the foundation concrete has reached the specified 28-day compressive strength. Care shall be taken to prevent foundation concrete from staining the precast posts. Any visible foundation concrete splashed onto the posts shall be removed.

522.08 Erection.

{ XE "Noise barriers:precast concrete:panels and posts" **}A. Precast Concrete Panels and Posts.** Precast units shall be installed according to detailed erection drawings furnished by the Contractor and approved by the Engineer. The units shall be erected in a manner to prevent excessive bending about either axis. Precast concrete panels shall be set with the face of the panel plumb and the top of the panel level. Special care shall be taken in setting the bottom panel in an exact horizontal position. The faces of adjacent units shall be flush within a tolerance of plus or minus 1/16 inch.

Precast structural members shall be handled carefully at all times so that no overstressing, crazing, chipping, or cracking of the concrete occurs. The post, panel, and other components shall be analyzed by the Contractor to reflect the actual method of construction to be used. The analysis shall be performed to verify that no adverse conditions to any components, as stated above, occur. If required from the analysis, temporary strengthening for the various components may be required and shall be provided by the Contractor. Damaged panels shall not be patched, but rather replaced with new panels. Handling and erection of the panel units and posts shall be performed using suitable equipment. After the precast panels are erected, all lifting hook holes shall be filled with grout. The grout shall be stained to match the color of the panels.

Precast concrete noise barriers shall not permit the passage of light after they are erected.

If recessed handling inserts are used they shall be the Contractor's option and responsibility and shall be galvanized according to ASTM A153.

{ XE "Noise barriers:timber:panels, posts, and associated members" **}{** XE "Timber:noise barriers:panels, posts, and associated members" **}B. Timber Panels, Posts, and Associated Members**. Preassembled units shall be installed according to detailed erection drawings furnished by the Contractor and approved by the Engineer. The units shall be erected in a manner to prevent excessive bending about either axis. Preassembled panel units, members, and posts shall be handled carefully so that no overstressing, warping, cracking, chipping, or splintering of the timber occurs. Panel units, members, and posts damaged in any manner by handling or erection methods shall not be repaired, but rather replaced with new panels.

Timber noise barriers shall not permit the passage of light after they are erected.

{ XE "Noise barriers:aluminum:panels, posts, and associated members" **}C.Aluminum Panels, Posts, and Associated Members.** Aluminum units shall be erected plumb. All girts shall follow the vertical profile of the top of the concrete bridge parapet. Panel lengths shall be field cut to provide proper lap for connection at the top and bottom girts due to parapet profile. All structural posts and girts shall be completely enclosed by flashing. A ½-inch thick neoprene sponge seal shall be installed to provide a tight fit between bottom girder and the top of the barrier parapet.

Aluminum noise barriers shall not permit the passage of light after they are erected.

COMPENSATION

522.09 Method of Measurement.

The quantity of noise barriers will be measured as the total number of square yards of noise barrier in a plane parallel to the front face of the wall. The barrier will be measured from the top of the wall to the bottom of the wall from end post to end post of each noise barrier.

Noise barrier, foundations will not be measured and payment will be made on a unit basis.

522.10 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
NOISE BARRIER, ROADWAY	SQUARE YARD
NOISE BARRIER, BRIDGE	SQUARE YARD
NOISE BARRIER TEST POSTS AND PANELS	LUMP SUM
NOISE BARRIER, FOUNDATIONS	UNIT

Separate payment will not be made for any remedial work required to complete the noise barriers, including replacement of unacceptable test posts and panels; for repainting of panels and posts due to unevenness in color and lines of work termination; for relocation of utility conduits or noise barrier posts due to interference with post hole construction, and repair of utility conduits damaged during post hole construction; for replacement or remediation of disturbed soils adjacent to post holes as a result of the Contractor's operations; and for temporary strengthening of the various precast structural components as may be required from the Contractor's analysis of adverse conditions that may occur during handling.

No separate payment will be made for reinforcement, concrete coloring, form liner or other finishing requirements, test samples, neoprene pads or anchor bolt, and all costs thereof shall be included in the item "Noise Barrier, Roadway."

No separate payment will be made for cleaning, pressure washing or any other preparation required before application of the penetrating concrete stain and the costs thereof shall be included in the item "Noise Barrier, Roadway."

No separate payment will be made for excavation, dewatering, reinforcement or concrete and all associated costs thereof shall be included in the item "Noise Barrier, Foundations."

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DIVISION 600 - INCIDENTAL CONSTRUCTION

SECTION 601 - UNDERDRAINS{ XE "UNDERDRAINS" }{ XE "PIPE:UNDERDRAINS" }

601.01 Description.

This work shall consist of the construction of underdrains and subbase outlet drains. Underdrains shall include perforated corrugated steel pipe and broken stone pockets behind abutments and walls.

MATERIALS

601.02 Materials.

Materials shall conform to the following Subsections:

Aggregates for Underdrains	901.13
Concrete Pipe	913.04
Corrugated Aluminum Alloy Underdrain Pipe	913.06
Corrugated Steel Underdrain Pipe	913.09
Plastic Drainage Pipe	913.11
Semicircular Steel Pipe for Underdrains	913.12
Vitrified Clay Pipe	913.15
Geotextiles	919.06
Salt Hay	919.13

Portland cement concrete for pipe plugs shall conform to Section 914.

Ordering of materials for underdrains shall be deferred until such time during roadway excavation that the required quantity and lengths of underdrains is determined.

CONSTRUCTION

601.03 Excavation and Backfilling.

Excavation shall be according to Subsection 207.04. Backfilling shall be according to Subsection 207.06.

601.04 Laying of Pipe.{ XE "Pipe" }{ XE "Pipe:laying" }

Laying of pipe shall be according to Subsection 602.04 and the following:

1. Joints of bell and spigot type pipes shall be packed with burlap or salt hay to permit the flow of water but not the passage of backfill material into the pipe.
2. All areas of bituminous coating that have been damaged shall be painted with two coats of hot bituminous material conforming to AASHTO M 190.
3. All areas of polymer coating that have been damaged shall be repaired according to the manufacturer's recommendations.

Dead ends of pipe underdrains shall be plugged with concrete according to Subsection 613.05 or closed with a pipe cap.

COMPENSATION

601.05 Method of Measurement.

{ XE "Subbase outlet drains" **}**Subbase outlet drains will be measured by the linear foot. For each stone pocket, 18 inches of subbase outlet drain will be allowed.

Pipe for subbase outlet drains will be measured by the linear foot.

Underdrains of the various types will be measured by the linear foot.

601.06 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SUBBASE OUTLET DRAIN	LINEAR FOOT
___ " CORRUGATED STEEL UNDERDRAIN PIPE	LINEAR FOOT
___ " CORRUGATED ALUMINUM ALLOY UNDERDRAIN PIPE	LINEAR FOOT
UNDERDRAIN, TYPE ___	LINEAR FOOT

Payment for rock excavation will be made according to Section 207.

Separate payment will not be made for pipe plugs.

SECTION 602 - PIPES

602.01 Description.

{ XE "Storm drains" **}{** XE "Pipe:storm drains" **}**This work shall consist of constructing storm drains for surface drainage and the removing and disposing of foreign materials of whatever character encountered from within existing pipe.

This work shall also consist of the installation of a resin-impregnated, flexible tube inserted into an existing pipe by use of a hydrostatic head or air pressure.

MATERIALS

602.02 Materials.{ XE "Pipe:materials" }

Materials shall conform to the following Subsections:

Portland cement concrete for pipe plugs, encasements, or saddles shall conform to Section 914.

Where corrugated metal culvert pipe is designated, corrugated aluminum alloy culvert pipe or corrugated steel culvert pipe may be used.

Where corrugated metal culvert pipe arch is designated, corrugated aluminum alloy culvert pipe arch or corrugated steel culvert pipe arch may be used.

{ XE "Pipe:end sections" **}**End sections shall be of the same material as the pipe or pipe arch to which the end sections are attached.

For jacked pipe, reinforced concrete culvert pipe shall conform to Subsection 913.04 except that the pipe shall be Class V, Wall B, tongue and groove type.

The tube material shall conform to the requirements of ASTM F 1216. The tube shall be fabricated to a size that, when installed, conforms to the internal circumference and length of the original pipe.

The wall color of the interior tube surface after installation shall not be of a dark or non-reflective nature that could inhibit proper closed-circuit television inspection.

CONSTRUCTION

602.03 Construction Requirements.

Excavation, bedding, backfilling, and disposal of excess material shall conform to Subsections 207.04, 207.05, 207.06, and 207.07 respectively, and the following:

1. Trench openings shall not remain open overnight, unless adequately protected, within or adjacent to roadways on which traffic is being maintained or within the normal limits of pedestrian access.
2. When installing storm drains across private property, the topsoil and sod disturbed by excavation operations shall be salvaged for use in restoring the area to its original condition.
3. Except where necessary to maintain flow, drains shall not be placed in embankment until it has been constructed to a height of at least 3 feet above the top of the pipe or to the top of the embankment, whichever is lower, and then a trench shall be excavated for placing of the pipe.
4. Existing drainage flow during construction shall be maintained until proposed drainage facilities are completed and put into service.
5. Corrugated aluminum alloy culvert pipe shall be handled carefully to prevent damage and denting. All pipe shall be lifted off of the delivery vehicle to avoid damage while unloading. Pipe shall not be dragged off the vehicle. Pipe shall be stored in an area where it will not be damaged during construction operations. When pipe is stacked, it shall be properly blocked or strapped. Pipe that is damaged will be rejected by the Engineer and shall not be used on the Project.
6. If heavy construction equipment (100 kips axle load) will be used in or over the vicinity of corrugated aluminum alloy culvert pipe, a temporary compacted cover of a minimum of 4 feet shall be placed over the top of the pipe. The materials for the temporary cover shall be excavated material free from stones larger than 1 inch in any dimension.

602.04 Laying of Pipe.{ XE "Pipe:laying" }

Before the laying of pipe, the method to control alignment and grade shall be submitted for approval. The method shall be a laser system or grade board setup to establish a reference grade and alignment control directly above or in the pipe.

The laying of pipe shall begin at the downstream end of the pipe line. The lower segment of the pipe shall be in firm contact with the bedding throughout its full length. Bell or groove ends of pipe shall be placed facing upstream. Perforated pipe shall be laid with the perforations at the bottom.

All areas of polymer coating that have been damaged shall be repaired according to the manufacturer's recommendations.

Where the ends of pipes are to enter existing concrete or masonry walls, the pipe shall be neatly cut to fit the inside face of the wall and the pipe shall be grouted in place. Where pipes are to enter below the paved invert of existing structures, the existing concrete shall be cut and shaped to form a new channel.

Where storm drains are to be constructed in two or more stages, a temporary pipe plug shall be constructed in the end of the pipe at the termination of each stage except where it is required to keep the pipe open for temporary drainage.

Where temporary or permanent pipe is to be used for a stream diversion, the pipe system shall be constructed outside of the existing stream bed while flow is maintained in the existing stream. Should the pipe system be required to be within the existing stream channel area, a temporary stream diversion shall be constructed while flow is maintained in the existing stream channel. When this temporary channel is completed, the stream flow shall then be diverted into this channel while the pipe system is constructed within the existing stream bed. When the pipe system is completed, the stream flow shall then be diverted into the pipe. Soil erosion and sediment control of the stream channels shall be according to Section 212.

Pipe will be inspected before backfill is placed. Any pipe found to be out of alignment, excessively settled, or damaged shall be taken up and relaid or replaced.

602.05 Joining Pipe.{ XE "Pipe:joining" }

Joints for rigid pipe shall be made with mortar, grout, or gaskets. Other types of joints recommended by the pipe manufacturer may be permitted. Corrugated pipe shall be joined by coupling bands.

For mortar joints, the pipe ends shall be cleaned and wetted with water before the joint is made. Stiff mortar shall be placed in the lower half of the bell or groove of the pipe section already laid and on the upper half of the spigot or tongue of the section to be laid. The two pipe sections shall then be tightly joined with their inner surfaces flush and even. Any voids occurring in the outside of the joint shall be filled. Lifting holes shall be filled with stiff mortar.

For pipes 36 inches and larger, the inside of the joint shall be finished smooth. For pipes smaller than 36 inches, the joint shall be cleared of protruding mortar. The completed mortar joints shall be protected against rapid drying if not immediately backfilled with earth. In cold weather, mortar for pipe joints shall be prepared and protected according to Subsection 603.05.

Gaskets shall be installed to form a flexible watertight seal. Rubber and flexible plastic gaskets shall be installed according to recommendations of the manufacturer.

602.06 Reinforced Concrete Culvert Pipe, Jacking and Tunneling Methods.

Sheeting, bracing, shoring, jacking frame, tunnel liners, shields, and other materials necessary for the complete installation of the reinforced concrete culvert pipe shall be of the required strength and construction and shall be approved.

Types, sizes, and number of jacks and other equipment used shall be as required for the proper installation of the pipe.

Installation procedures shall conform to the following:

1. **Jacking Method.** Details of the proposed methods and equipment to be used for jacking operations shall be submitted before starting the work. The Contractor shall bear full responsibility for methods used and for any damage occurring while performing the work. Jacking operations shall be conducted to ensure that there is no interference with the continuous operation of traffic on the Project.

   Excavation and backfilling of the jacking pit shall conform to Section 207.

   Project site conditions which may be present, and the extent to which such conditions may affect methods of operations, shall be determined according to Subsections 102.06 and 108.09.

   Additional compensation or extension of contract time will not be made for inconvenience and delays resulting from the presence of water or for the pumping of water, but such work shall be considered as incidental to the pipe installation.

The horizontal distance from the face of the jacking pit to the edge of the roadbed shall be sufficient to protect the roadbed and to ensure maintaining traffic operations according to Section 617. The jacking pit shall be sheeted, braced, and shored in such manner as to maintain the stability of the embankment and shall be of the necessary size and design to provide for proper operation of the jacks. The force of the jacks shall be transmitted uniformly to the end face of the end pipe. End sections of pipes that are damaged during jacking shall be replaced without additional compensation.

As each succeeding reinforced concrete pipe section is placed against the preceding jacked pipe, ½ inch diameter manila rope shall be inserted around the entire groove of the joint and set into place with asphalt cement so that possible spalling of the joint edges, due to jacking, may be reduced and to provide an opening of the inside of the pipe joint for final mortaring.

The leading section of the reinforced concrete pipe shall be provided with a shield or cutting edge covering a minimum of the upper third of the pipe perimeter which projects beyond the end of the pipe and supports the embankment materials above. Excavation of materials within the jacked pipe shall be performed by hand methods only. Augers will not be permitted. Conveyor systems will be permitted for removing the soil being dug by hand. Excavation shall not be carried beyond the end of the shield or cutting edge.

Jacking operations shall be performed on a 24-hour basis to prevent the pipes from freezing up. Provisions shall be made to have sufficient materials, equipment and qualified technicians available to deal with any situation that might otherwise result in an interruption of operations.

In the event that an immovable obstruction is encountered ahead of the leading pipe, or further progress in jacking becomes impossible or impractical due to the nature of compactness of the soil, or the direction of the pipe has deviated considerably from the proposed alignment and efforts to correct the misalignment have failed, then jacking from one side may be discontinued and jacking may be begun at the other side. If the jacking operation must again be discontinued, for any of the reasons stated above, the remainder of the installation beneath the embankment must be performed by the tunneling method as specified below.

Precautionary measures must be taken to ensure the flatness of the proposed grade of the invert of the pipe and to maintain correct vertical and horizontal alignment. If necessary, jacking of the pipe may begin at a slightly lower elevation than the prescribed grade or the pipe may be directed downward to offset the possibility of the pipe rising to such an elevation within the embankment as to cause ineffective drainage.

Necessary controls shall be provided to ensure proper horizontal and vertical alignment of the pipe. The alignment shall be checked at the request of the Engineer.

2. **Tunneling Method.** If it is determined that the tunneling method is required, excavation beyond the end of the jacked pipe shall proceed by hand methods only and shall not advance beyond the end of the jacked pipe, shield, or previously placed tunnel liner plate more than the length (along the drain) of the liner plate to be placed.

   Joints in reinforced concrete pipes placed within tunnel liners shall be filled with mortar according to Subsection 602.05. Remaining joint openings on the inside of jacked pipes shall be filled with mortar and the inside surface finished smooth. Jointing between pipes that do not meet exactly shall be accomplished by forming a smooth concrete collar or plug, at least 6 inches in depth, to connect the two pipes.

   Sheeting, bracing, and shoring shall be removed provided that removal does not result in an unstable condition in the embankment. If sheeting, bracing, or shoring is left in place, it shall be cut off approximately 6 inches below the finished grade of the embankment.

3. **Alternate Method.** An alternate method, other than jacking or tunneling, may be employed for installing the pipe beneath the embankment provided that the alternate method is approved. If such approval is granted and the alternate method does not produce the desired results, use of such alternate method shall be discontinued and installation shall be completed by the jacking or tunneling method.

602.07 Cleaning Existing Pipe.{ XE "Pipe:cleaning existing" }

Pipe cleaning shall be performed in such manner, using approved methods and equipment, to permit proper drainage. Damage to the existing drainage system as result of careless or improper cleaning operations shall be repaired without additional compensation. Materials removed from existing pipe shall be disposed of according to Subsection 201.10.

602.08 Relaid Pipe.{ XE "Pipe:relaid" }

Existing pipes to be relaid which are outside the limits of excavation for new pipes shall be removed and the trenches shall be backfilled and compacted. The pipe shall be cleaned and relaid as specified for new pipe.

602.09 Cured-in-Place Pipe{ XE "Pipe:cured-in-place" }.

Construction operations for cured-in-place pipe shall be performed according to local, State, or Federal safety requirements. The Contractor shall submit copies of the manufacturer's recommended method of installation to the Engineer.

Before entering manholes for inspection and cleaning operations, an investigation shall be conducted according to ASTM F 1216 to determine the presence of toxic or flammable vapors.

Inspection of the pipeline shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections or blind service connections by closed-circuit television or actual entry according to ASTM F 1216. A video tape of the inspection, in VHS format, and a suitable log shall be submitted to the Engineer. The existing pipeline shall be cleaned of internal debris before the installation of the tube.

The Contractor shall designate the location where the tube is to become vacuum impregnated with resin before installation. The tube shall be installed in the existing pipe through a manhole or other access point by means of an inversion process according to ASTM F 1216.

The finished pipe shall be continuous over the entire length of an inversion run, from invert to invert, and shall be free of dry spots, lifts, and delaminations according to ASTM F 1216. After the new pipe has been cured in place, the existing active service connections shall be reconnected, generally without excavation.

Inspection of interior pipelines shall be conducted by means of a television camera and remote control cutting device according to ASTM F 1216. The Contractor shall provide the Department with a video tape, in VHS format, showing the completed work including restored connections.

Upon completion of the installation, the Contractor shall restore the surrounding area to its original state to the approval of the Engineer.

COMPENSATION

602.10 Method of Measurement.

Pipe of the various sizes, kinds, and classes will be measured by the linear foot except for the distance between inner faces of inlet and manhole walls. Pipes with sloped or skewed ends will be measured along the invert.

Corrugated aluminum alloy culvert pipe that is designated to be heavier than 16 gauge will be measured with the quantity of 16 gauge pipe. Corrugated steel culvert pipe that is designated to be heavier than 14 gauge will be measured with the quantity of 14 gauge pipe.

Reinforced concrete culvert pipe, of the various sizes, installed by the jacking and tunneling methods, will be measured by the linear foot.

End sections of the various sizes and kinds will be measured by the unit.

Cleaning existing pipe of the various sizes will be measured by the linear foot.

Relaid pipe of the various sizes and kinds will be measured as specified above for pipe.

Cured-in-place pipe, of the various sizes and thicknesses, will be measured by the linear foot from end of pipe to end of pipe. The length will include any intermediate manholes.

602.11 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
___ " DUCTILE IRON CULVERT PIPE	LINEAR FOOT
___ " DUCTILE IRON WATER PIPE, CLASS___	LINEAR FOOT
___ " CORRUGATED ALUMINUM ALLOY CULVERT PIPE	LINEAR FOOT
___ " CORRUGATED STEEL CULVERT PIPE	LINEAR FOOT
___ " CORRUGATED METAL CULVERT PIPE	LINEAR FOOT
___ " REINFORCED CONCRETE CULVERT PIPE	LINEAR FOOT
___ " REINFORCED CONCRETE CULVERT PIPE, CLASS___	LINEAR FOOT
___ " REINFORCED CONCRETE CULVERT PIPE, JACKING AND TUNNELING METHODS	LINEAR FOOT
___ " CORRUGATED ALUMINUM ALLOY END SECTIONS	UNIT
___ " CORRUGATED STEEL END SECTIONS	UNIT
___ " CORRUGATED METAL END SECTIONS	UNIT
___ " REINFORCED CONCRETE END SECTIONS	UNIT
___ " CORRUGATED STEEL SEWER PIPE	LINEAR FOOT
___ " REINFORCED CONCRETE SEWER PIPE, CLASS ___	LINEAR FOOT
___ "X ___ " CORRUGATED ALUMINUM ALLOY CULVERT PIPE ARCH	LINEAR FOOT
___ "X ___ " CORRUGATED STEEL CULVERT PIPE ARCH	LINEAR FOOT

___ "X ___ " CORRUGATED METAL CULVERT PIPE ARCH	LINEAR FOOT
___ "X ___ " REINFORCED CONCRETE CULVERT PIPE ARCH, CLASS ___	LINEAR FOOT
___ "X ___ " CORRUGATED ALUMINUM ALLOY END SECTIONS	UNIT
___ "X ___ " CORRUGATED STEEL END SECTIONS	UNIT
___ "X ___ " CORRUGATED METAL END SECTIONS	UNIT
___ "X ___ " REINFORCED CONCRETE END SECTIONS	UNIT
____"X ___ " CORRUGATED STEEL SEWER PIPE ARCH	LINEAR FOOT
___ "X ___ " REINFORCED CONCRETE SEWER PIPE ARCH, CLASS ___	LINEAR FOOT
___ "X ___ " REINFORCED CONCRETE ELLIPTICAL CULVERT PIPE, CLASS ___	LINEAR FOOT
CLEANING EXISTING PIPE, ___" TO ___ " DIAMETER	LINEAR FOOT
CLEANING EXISTING PIPE, OVER ___" TO ___ " DIAMETER	LINEAR FOOT
CLEANING EXISTING PIPE, ___ " DIAMETER	LINEAR FOOT
RELAID (SIZE AND KIND) PIPE	LINEAR FOOT
____" CURED-IN-PLACE PIPE, ___" THICK	LINEAR FOOT

Payment for rock excavation will be made according to Section 207.

Payment for concrete for pipe encasements, saddles, and permanent pipe plugs will be made according to Section 613.

Separate payment will not be made for material used as a temporary cover over corrugated aluminum alloy culvert pipe.

Separate payment will not be made for cleaning, inspection, videotaping of the pipe, and reconnecting service connections required for cured-in-place pipe.

SECTION 603 - INLETS AND MANHOLES{ XE "INLETS:AND MANHOLES" }

603.01 Description.

This work shall consist of the construction, reconstruction, and cleaning of inlets and manholes. Cleaning shall consist of removing and disposing of dirt, refuse, debris, litter, and other foreign materials encountered within the area of drainage structures.

MATERIALS

603.02 Materials.

Portland cement concrete shall conform to Section 914. Other materials shall conform to the following Subsections:

Aggregate for Coarse Aggregate Bed	901.03
Clay or Shale Brick	910.01
Concrete Block for Inlets and Manholes	910.02
Concrete Brick	910.04
Mortar and Grout	914.03
Reinforcement Steel	915.01
Castings for Drainage Structures	917.03
Waterproofing	919.05
Epoxy Bedding and Bonding Compound	919.17

Ladder rungs shall conform to Subsection 915.01, Subpart B, except that plain bars shall be furnished.

CONSTRUCTION

603.03 Excavation and Backfilling.

Excavation shall be according to Subsection 207.04. Backfilling shall be according to Subsection 207.06.

603.04 Concrete Construction.

Concrete construction shall be according to Subsections 501.11 and 501.17.

603.05 Block and Brick Construction.

Concrete block and brick shall be laid with staggered joints. All horizontal joints, all vertical joints of brick, and all key ways of vertical joints of concrete block shall be filled with mortar. All horizontal joints and, in brick, all vertical joints shall be not more than ⅜ inch wide. The outside wall shall be plastered with a minimum thickness of ½ inch of mortar troweled to a smooth finish.

When the working day temperature is below 40 ºF, mortar shall be prepared by heating the mixing water and sand to produce mortar between 50 and 100 ºF. Masonry shall be maintained above 32 ºF for 24 hours by a protective covering.

Inlet and outlet pipes shall extend through the walls of manholes and inlets beyond the outer surface for a sufficient distance to allow for connections, but shall be cut off flush with the wall on the inside surface.

Inlets and manholes shall be so constructed around the pipes as to prevent leakage and form a neat connection.

603.06 Precast Concrete Inlets and Manholes.

Precast concrete inlets and manholes may be used where there are no conflicts with existing underground structures and utilities that require changes in pipe location, size, or type. Modifications to precast concrete inlets and manholes that may be required due to changes in pipe location, size, or type are subject to approval and shall be made without additional compensation.

Welded steel wire fabric used for reinforcement need not be galvanized. Handling devices, if used, shall be removable and the holes filled with concrete.

Unless stated otherwise, all provisions of Sections 501, 502, and 914 shall apply.

603.07 Inverts.

Inverts shall be constructed to cause the least possible resistance to flow. The shape of the inverts shall conform uniformly to inlet and outlet pipes. A smooth and uniform finish is required.

603.08 Inlets.

To provide temporary drainage, one or more blocks shall be omitted in selected course or courses of the structure. Before construction of base and surface courses at inlets where blocks are temporarily omitted, the required blocks shall be placed and the inlet walls completed.

Curb inlet castings shall be set to final grade after adjacent curb forms have been set and approved, and before the placement of concrete for the adjacent curb.

Soil erosion and sediment control shall be according to Section 212.

603.09 Castings and Fittings.

Inlet and manhole frames, grates, and covers shall be fitted together and match-marked to avoid rocking of covers and grates. All castings shall be set firm and snug and shall not rattle.

If castings are to be set in concrete or cement mortar, all anchors or bolts shall be in position before the concrete or mortar is placed. The casting shall not be disturbed until the mortar or concrete has set.

When castings are to be placed upon previously constructed masonry, the bearing surface of masonry shall be brought to line and grade to present an even bearing surface so that the entire face or back of the casting can come in contact with the masonry. Castings shall be set in mortar beds or anchored to the masonry as indicated.

{ XE "Inlets:and manholes:using existing castings" **}**Existing inlet castings, existing frames, existing extension rings, and existing manhole castings that are not to be reclaimed by the Department or used on the Project shall become the property of the Contractor and shall be disposed of to the satisfaction of the Engineer.

603.10 Reconstruction, Conversion, and Cleaning of Existing Structures.

A. Reclaimed Castings. Inlets and manholes shall be constructed using existing castings reclaimed from manholes and inlets on the Project that are to be out-of-service and to remain in place or are to be removed. The castings shall be removed carefully from the existing drainage structures. All concrete and mortar and other adhering matter shall be removed from the castings. The reclaimed castings shall be stored carefully. Any castings which are required for use on the Project and which are lost, broken, or damaged shall be replaced without additional compensation.

B. Reconstructing Inlets and Manholes. This work shall consist of removing the existing castings, removal of walls and ladder rungs to the necessary depth, disposal of the masonry, reconstruction of the walls, installing existing ladder rungs if in good condition or new rungs, if required, and setting existing castings if in good condition or new castings, if required, at the specified grade.

C. Converting Existing Inlets into Manholes. This work shall conform to Subpart B above except that one of the following may be required:

1. Inlet walls may be removed or raised to the necessary elevation to allow construction of a concrete slab to accommodate the new frame.
2. Inlet walls may be removed down to the existing footing upon which a circular manhole shall be constructed.

D. Resetting Castings. Castings of existing structures shall be removed and reset to new elevation. Masonry of existing structures shall be built up or removed as may be necessary to conform to required surface grades and elevations. Mortar shall attain a strength of 2,500 pounds per square inch before the casting is exposed to traffic. Adjustment of grades and elevations in excess of 1 foot will be considered as reconstructing inlets and manholes.

E. Cast Iron Curb Pieces. Cast iron curb pieces of existing inlets shall be removed and new curb pieces shall be installed. If the frame and grate are damaged by construction operations so that they cannot be used, they shall be replaced without additional compensation.

F. New Castings. New castings shall be furnished and set on existing structures. Masonry of existing structures shall be added to or removed as may be necessary to conform to new surface grades and elevations.

G. Extension Frames and Rings. Extension frames for inlets and extension rings for manholes shall be used to raise existing structures to proposed grades and elevations. If existing grates or covers are loose and wobble after being set in the extension frames or rings, they shall be ground to obtain a tighter fit or they shall be replaced as directed. When structures contain existing frames or rings, these extension frames or rings shall be removed. The castings shall then be raised using new extension frames or rings. The number of multiple rings/frames permitted will be the minimum number of commercially available rings/frames necessary to achieve proposed grades. Any damage to galvanized coatings shall be repaired according to ASTM A 780.

H. Cleaning. The Contractor shall obtain approval for the methods and equipment to be used to clean the drainage structures before starting work. Disposal of debris and materials removed shall be according to

Subsection 201.10. The Contractor shall repair, at no cost to the State, all damage to the existing drainage system caused by the cleaning operations.

I. Epoxy Bonding. Epoxy shall be applied to cast-iron frames and rings. Epoxy shall be applied to non cast-iron frames and rings only if and where recommended by the frame or ring manufacturer. Before applying epoxy to cast-iron frames and rings, the surfaces of the existing frame to receive the epoxy and the lower bearing surfaces and sides of the extension frames or rings shall be sand blasted or brushed clean with a mechanically-driven wire wheel to ensure adhesion of the epoxy to the surfaces. The prepared surfaces shall then be wiped with a rapid-evaporating degreasing agent. The extension frame or ring shall be placed in the existing casting and checked for fit. Any excess void space shall be noted and extra epoxy shall be applied at that location. The epoxy shall be applied according to the manufacturer's recommendations and the extension frame or ring shall be pressed firmly into the uncured epoxy to ensure uniform contact between the frame and epoxy. The grate or cover shall then be placed on the extension frame or ring in such a manner as not to change the position of the frames or rings.

603.11 Construction or Reconstruction of Sanitary Sewer Manholes.

Construction or reconstruction of sanitary sewer manholes shall include the following:

1. Paint the outside plastered surface of the manhole walls with one coat of asphalt cement seal coat conforming to Subsection 919.05.
2. Provide watertight manhole castings, unless existing castings are specified.

Sanitary sewer manholes that are not watertight will not be accepted. The completed work will be subject to the inspection and approval of the municipality concerned.

COMPENSATION

603.12 Method of Measurement.

Inlets, manholes, and castings, of the various kinds and types, will be measured by the unit. Separate payment will not be made for multiple extension frames or extension rings used to reach proposed grade at any single drainage structure.

Cleaning existing drainage structures will be measured by the number of units cleaned.

603.13 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
INLETS, TYPE ___	UNIT
INLETS, TYPE ___, USING EXISTING CASTING	UNIT
INLETS CONVERTED TO MANHOLES	UNIT
MANHOLES	UNIT
MANHOLES, ___ ' DIAMETER	UNIT
MANHOLES, USING EXISTING CASTING	UNIT
MANHOLES, SANITARY SEWER	UNIT
MANHOLES, SANITARY SEWER, USING EXISTING CASTING	UNIT
RECONSTRUCTED INLETS, TYPE ___, USING EXISTING CASTING	UNIT
RECONSTRUCTED INLETS, TYPE ___, USING NEW CASTING	UNIT
RECONSTRUCTED MANHOLES, USING EXISTING CASTING	UNIT
RECONSTRUCTED MANHOLES, USING NEW CASTING	UNIT
RECONSTRUCTED MANHOLES, SANITARY SEWER, USING EXISTING CASTING	UNIT
RECONSTRUCTED MANHOLES, SANITARY SEWER, USING NEW CASTING	UNIT
CAST IRON CURB PIECES	UNIT
INLET CASTINGS, TYPE ___	UNIT
MANHOLE CASTINGS	UNIT
MANHOLE COVERS	UNIT
NEW MANHOLE CASTINGS, SQUARE FRAME, CIRCULAR COVER	UNIT
BICYCLE SAFE GRATES	UNIT
RESET CASTINGS	UNIT
EXTENSION FRAMES FOR EXISTING INLETS, TYPE ___	UNIT
EXTENSION RINGS FOR EXISTING MANHOLES, TYPE ___	UNIT
CLEANING EXISTING DRAINAGE STRUCTURES	UNIT

Payment for rock excavation will be made according to Section 207.

Payment adjustments for strength will be made according to Subsection 914.02, Subpart F and will be applied to the lot for those Pay Items specified in that Subpart.

SECTION 604 - SLOPE GUTTERS{ XE "GUTTERS, SLOPE" }{ XE "SLOPE:GUTTERS" }

604.01 Description.

This work shall consist of the construction of portland cement concrete slope gutters.

MATERIALS

604.02 Materials.

Materials shall conform to the following Subsections:

Portland Cement Concrete 914
Curing Materials 905.03
Preformed Expansion Joint Filler 908.01

CONSTRUCTION

604.03 Excavation and Backfilling.

Excavation shall be according to Subsection 207.04. Backfilling shall be according to Subsection 207.06.

604.04 Preparation of Underlying Material.

The underlying material shall be shaped and compacted to a firm, even surface. Unstable material shall be removed and replaced with acceptable material that shall be compacted.

604.05 Concrete Slope Gutters.

Concrete slope gutters shall be constructed according to Section 405, except the gutters shall have a fine-hair-brush finish and shall be finished to an even, smooth surface at the specified grade. Forms shall be left in place at least 24 hours after finishing. Expansion joints shall be ½ inch, preformed, expansion-joint filler placed at intervals of 20 feet.

COMPENSATION

604.06 Method of Measurement.

Concrete slope gutters of the various thicknesses will be measured by the square yard.

604.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CONCRETE SLOPE GUTTERS, ___ " THICK	SQUARE YARD

SECTION 605 - CURBS{ XE "CURBS" }

605.01 Description.

{ XE "Concrete curbs" **}**This work shall consist of the construction of portland cement concrete curbs and granite curbs, the resetting of granite curbs, and the removal and disposal of existing concrete barrier curbs.

MATERIALS

605.02 Materials.

Portland cement concrete shall conform to Section 914, except that concrete curb at driveways shall attain a strength of not less than 3,000 pounds per square inch in three days. Other materials shall conform to the following Subsections:

Curing Materials	905.03
Preformed Expansion Joint Filler	908.01
Joint Sealer, Hot-Poured	908.02
Granite Curbs	910.06
Mortar and Grout	914.03
Reinforcement Steel	915.01

EQUIPMENT

605.03 Equipment.

A. Compaction. Compaction of underlying material shall be accomplished by equipment according to Subsection 203.04.

B. Forms. Forms shall be of wood, metal, or other suitable material and shall extend for the full depth of the concrete. All forms shall be true to line, free from warp, and of sufficient strength to resist the pressure of the concrete without deforming. Curved forms of proper radius shall be used on all radial sections and shall be of an acceptable design. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.

C. Finishing. Finishing equipment shall include floats, edgers, spades, tamps, and small vibrators.

CONSTRUCTION

605.04 Excavation and Backfilling.

Excavation shall be according to Subsection 202.04. Backfilling shall be according to Subsection 203.06.

605.05 Preparation of Underlying Material.

Excavation for curbs shall be made to the required depth, and to a width that permits the installation and bracing of the forms. The underlying material shall be shaped and compacted to a firm, even surface. Unstable material shall be removed and replaced with acceptable material that shall be compacted.

605.06 Granite Curbs.{ XE "Curbs:granite" }

Where concrete foundation is required, concrete as specified for manhole foundations shall be used.

Granite curbs shall be set with the top surface at the required grade. Joints shall be not more than ¼ inch wide for dressed, and ⅜ inch wide for quarry-split curbs. The joints shall be pointed with 1:1 by volume cement-sand mortar. Between granite curbs and adjacent concrete surface and concrete base course, expansion joints shall be provided and filled with ¼ inch, preformed, bituminous, joint filler and sealed with hot-poured joint sealer.

605.07 Concrete Curbs.{ XE "Curbs:concrete" }

A. Limitations. The limitations of placing shall be as specified in Subsection 501.11 and the following:

1. Placing of concrete shall be discontinued in time to allow finishing to be completed in daylight hours unless an artificial lighting system is provided.
2. Concrete curb shall not be constructed from November 1 to March 15 unless the roadway in which the curb is located is closed to traffic for a minimum of 30 curing days as specified in Subsection 501.17, Subpart B.

B. Mixing, Placing, and Finishing Concrete. Construction requirements shall conform to Section 405 and the following:

1. Where changes in the size or shape of curbs occur in a continuous section, the transition between sections shall be gradual.

2. Immediately before placing the concrete, the underlying material shall be thoroughly dampened, and the forms given a coating of light oil or other material which can prevent adherence of the concrete to the forms and which does not discolor the concrete. Where removed and used again, the forms shall be thoroughly cleaned and treated each time before using.
3. The concrete shall be placed immediately after mixing. The edges, sides, and faces shall be spaded or vibrated and the surface tamped to compact the concrete thoroughly and bring the mortar to the surface, after which the surface shall be finished smooth and even by means of a wooden float.
4. Sleeves for sign or delineator posts installed in barrier curbs shall be filled with sand and sealed with hot-poured joint sealer immediately after installation and shall be resealed if and when posts are installed.
5. Concrete curbs shall be constructed in sections having uniform lengths of 20 feet. The length of these sections may be reduced where necessary for closures, but no section less than 6 feet will be permitted. The forms on the face of all curb shall be removed as soon as the concrete holds its shape and the surface shall then be finished with a fine hair brush to a smooth and even finish. Plastering will not be permitted. The top edges of curb shall be rounded. Edges where expansion joint material has been placed shall be finished with an edging tool having a radius of not over ¼ inch.
6. As soon as the forms are removed, the concrete shall be covered with wet burlap if finishing prevents the immediate application of curing compound. The concrete shall remain covered until it is to be finished, at which time the wet burlap shall be removed from that amount of concrete that can be immediately finished. As soon as finishing is complete, curing compound shall be applied.
7. Any exposed surface or surfaces against which some rigid type of construction is to be made shall be left smooth and uniform so as to permit free movement of the curb.
8. All tool marks shall be removed with a wetted brush or wooden float, and the finished surface shall present a uniform appearance.
9. Care shall be taken to minimize damage to previously constructed areas. Any damage shall be repaired without additional compensation.

C. Joints. Expansion joints shall be provided opposite joints in abutting concrete surface course and at approximately equal distances of not more than 20 feet between joints. Joints shall be filled with preformed expansion joint filler, ½ inch thick, which shall be flush with the top and face. Between concrete curbs and concrete surface or base course, ½-inch, preformed, expansion-joint filler shall be installed and the joint shall be sealed with hot-poured joint sealer.

{ XE "Curbs:concrete:protection and curing" **}D. Protection and Curing.** Immediately after finishing the concrete according to Subpart B above, apply a Type 1-D, with fugitive dye, curing compound, or Type 2, white pigmented, for white concrete. Protection during cold weather and curing shall be performed according to Subsection 501.17, Subpart B.

The curb shall be protected until finally accepted. During this period, any damage caused by construction operations or cold weather shall be repaired without additional compensation.

E. Curb Placed on Concrete Base or Concrete Surface. When the curb is to be constructed upon concrete, all dirt, bituminous material, and other loose or adhering matter shall be removed from the surface. The curb shall be dowelled with steel dowels. The diameter of holes drilled in the concrete shall be not more than ¾ inch greater than the diameter of the dowels. The dowels shall be set in grout. Transverse joints in dowelled curb shall be installed directly over transverse joints and over definite cracks in the concrete. Additional joints shall be installed between slab joints and cracks so as to divide the curb into sections of approximately equal lengths of not more than 20 feet. The joints shall be constructed as specified in Subpart C above.

F. Curb Placed on Bridge Decks. Drilling of holes in the bridge deck outside the limits of the barrier curb to support the forms will not be permitted.

605.08 White Concrete Curbs.{ XE "White concrete curbs" }{ XE "Curbs:white concrete" }

White concrete curbs shall be constructed as specified for concrete curb in Subsection 605.07 and as follows:

1. Mixers and agitator trucks used for white concrete shall be used exclusively for that purpose during the time that the white concrete is being placed. The drums of such mixers and trucks shall be thoroughly washed, and all cement and concrete shall be removed before using the drums for mixing white concrete.
2. The fine hair brush finish is deleted from barrier curb if steel forms are used.

605.09 Precast Concrete and White Concrete Barrier Curbs.{ XE "Precast:barrier curb" }

Precast concrete barrier curbs may be substituted for cast-in-place concrete barrier curb and precast white concrete barrier curbs may be substituted for cast-in-place white concrete barrier curbs and the substitute curbs shall be constructed as specified for cast-in-place curb.

Reinforcement steel, if used for handling, shall have a minimum 2-inch cover of concrete. Handling devices shall be removable and the holes shall be filled with white concrete as required.

COMPENSATION

605.10 Method of Measurement.

Curbs of the various sizes and kinds will be measured by the linear foot along the face at the gutter line.

Curbs in transition areas will be measured under the larger size.

Reset granite curb will be measured by the linear foot along the face at the gutter line.

Reinforcement steel for concrete barrier curb, bridge and white concrete barrier curb, bridge of the various sizes will be measured by the pound. The weight of reinforcement steel will be computed as per the table shown under Subsection 915.01, Subpart H.

605.11 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
___"X___" CONCRETE BARRIER CURB	LINEAR FOOT
___"X___" CONCRETE BARRIER CURB, DOWELLED	LINEAR FOOT
___"X___" CONCRETE SLOPING CURB	LINEAR FOOT
___"X___" CONCRETE SLOPING CURB, DOWELLED	LINEAR FOOT
___"X___" CONCRETE VERTICAL CURB	LINEAR FOOT
___"X___" CONCRETE VERTICAL CURB, DOWELLED	LINEAR FOOT
___"X___" WHITE CONCRETE BARRIER CURB	LINEAR FOOT
___"X___" WHITE CONCRETE BARRIER CURB, DOWELLED	LINEAR FOOT
___"X___" WHITE CONCRETE BARRIER CURB, BRIDGE	LINEAR FOOT
___"X___" CONCRETE BARRIER CURB, BRIDGE	LINEAR FOOT
___"X___" WHITE CONCRETE SLOPING CURB	LINEAR FOOT
___"X___" WHITE CONCRETE SLOPING CURB DOWELLED	LINEAR FOOT
___"X___" WHITE CONCRETE VERTICAL CURB	LINEAR FOOT
___"X___" WHITE CONCRETE VERTICAL CURB, DOWELLED	LINEAR FOOT
___"X___" CONCRETE SLOPING CURB	LINEAR FOOT
___"X___" CONCRETE SLOPING CURB DOWELLED	LINEAR FOOT
___"X VARIABLE HEIGHT CONCRETE BARRIER CURB	LINEAR FOOT
___"X VARIABLE HEIGHT CONCRETE BARRIER CURB, DOWELLED	LINEAR FOOT
___"X VARIABLE HEIGHT CONCRETE VERTICAL CURB	LINEAR FOOT
___"X VARIABLE HEIGHT CONCRETE VERTICAL CURB, DOWELLED	LINEAR FOOT
___"X VARIABLE HEIGHT WHITE CONCRETE BARRIER CURB	LINEAR FOOT
___"X VARIABLE HEIGHT WHITE CONCRETE BARRIER CURB, DOWELLED	LINEAR FOOT
___"X VARIABLE HEIGHT WHITE CONCRETE VERTICAL CURB	LINEAR FOOT
___"X VARIABLE HEIGHT WHITE CONCRETE VERTICAL CURB, DOWELLED	LINEAR FOOT
GRANITE CURB	LINEAR FOOT
RESET GRANITE CURB	LINEAR FOOT
REINFORCEMENT STEEL	POUND

Payment adjustments for strength will be made according to Subsection 914.02, Subpart F and will be applied to the lot for those Pay Items specified in that Subpart.

SECTION 606 – HOT MIX ASPHALT CURB{ XE "CURBS:HOT MIX ASPHALT (HMA)" }{ XE "HOT MIX ASPHALT (HMA):CURB" }

606.01 Description.

This work shall consist of the construction of HMA curb.

MATERIALS

606.02 Materials.

{ XE "Reclaimed asphalt pavement (RAP):in HMA curb" **}**HMA shall conform to Section 903 and shall be ⅜ inch nominal size aggregate mix except that the composition of the mixture may include up to 20 percent of RAP. Other materials shall conform to the following Subsections:

Tack Coat:
- Cut-back Asphalt, Grade RC-70 or RC-T 904.02
- Emulsified Asphalt, Grade RS-1, SS-1, or SS-1h 904.03
- Cationic Emulsified Asphalt, Grade CSS-1 or CSS-1h 904.03

Traffic Paint 912.10

EQUIPMENT

606.03 Equipment.

The HMA curb machine shall be self-propelled automatic machine or a paver with attachments that produces curb that is uniform in texture, shape, and density. The weight of the machine shall be such that compaction is obtained without the machine riding above the surface on which curb is constructed.

CONSTRUCTION

606.04 Excavation and Backfilling.

Excavation shall be according to Subsection 202.04. Backfilling shall be according to Subsection 203.06.

606.05 Preparation.

When curb is constructed on a freshly laid HMA surface, the curb may be laid only after the surface has been cleaned. When curb is constructed on a cured or aged concrete base, HMA surface, or bituminous treated base, the surface shall be thoroughly swept and cleaned by compressed air. The surface shall be thoroughly dried and, immediately before placing of the HMA mixture, shall receive a tack coat according to Subsection 404.15. Tack coat application shall be prevented from spreading to areas outside of the area occupied by the curb.

606.06 Mixing and Placing.

The preparation and mixing of the HMA shall conform to Section 903 and shall be placed with an HMA curb machine.

Side forms are not required. Where the curb is to be placed on an existing surface that does not have a smooth grade, a method shall be used that provides the required curb line and grade.

When short sections of HMA curb with short radii are required, construction by means other than the automatic curb machine may be used as long as the resulting curb conforms to the curb as produced by the automatic machine.

606.07 Joints.

HMA curb construction shall be a continuous operation in one direction so as to eliminate curb joints. However, where conditions are such that this is not possible, the joints between successive days' work shall be carefully made in such a manner as to ensure a continuous bond between the old and new sections of the curb. Contact surfaces of previously constructed curb shall receive a thin, uniform coat of tack coat material just before placing the fresh curb material to the old joint.

606.08 Painting.

Painting with traffic paint, if required, shall only be on curb which is clean and dry and which has reached the ambient temperature.

COMPENSATION

606.09 Method of Measurement.

HMA curb of the various sizes will be measured by the linear foot along the face at the gutter line.

606.10 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
___" X___" HOT MIX ASPHALT CURB	LINEAR FOOT

SECTION 607 - SIDEWALKS AND DRIVEWAYS{ XE "DRIVEWAYS" }

607.01 Description.

{ XE "Hot mix asphalt (HMA):sidewalks" **}{** XE "Hot mix asphalt (HMA):driveways" **}**This work shall consist of the construction of HMA sidewalks and driveways and portland cement concrete sidewalks and driveways.

This work shall also consist of applying a color contrast and a slip resistant surface on portland cement concrete sidewalks for the delineation of public sidewalk curb ramps.

MATERIALS

607.02 Materials.

{ XE "Reclaimed asphalt pavement (RAP):in sidewalks and driveways" **}**HMA shall conform to Section 903 except that the composition of the mixture for the top layer may also include up to 20 percent of RAP. Portland cement concrete shall conform to Section 914 except that driveways shall attain a strength of not less than 3,000 pounds per square inch in three days. Other materials shall conform to the following Subsections:

Soil Aggregate	901.09
Prime Coat:	
Cut-back Asphalt, Grade MC-30 or MC-70	904.02
Tack Coat:	
Cut-back Asphalt, Grade RC-70 or RC-T	904.02
Emulsified Asphalt, Grade RS-1, SS-1, or SS-1h	904.03
Cationic Emulsified Asphalt, Grade CSS-1 or CSS-1h	904.03
Curing Materials	905.03
Preformed Expansion Joint Filler	908.01
Reinforcement Steel	915.03

Dense-graded aggregate for base course used with HMA sidewalk shall conform to Subsection 901.08.

Materials for public sidewalk delineation shall be safety red in color and shall be a moisture-cured polyurethane coating with self contained white rubber grit, or a preformed plastic marking tape. The materials shall be capable of adhering to existing or new portland cement concrete sidewalk. All applications of safety red shall be uniform in color.

The moisture-cured polyurethane shall be an abrasion, chemical, and UV resistant formula. When cured, the coating shall produce a slip resistant non-porous surface. The surface of the moisture-cured polyurethane shall exhibit the following minimum friction values when tested according to ASTM D 1894:

Static Coefficient of Friction (N/kg)	**Kinetic Coefficient of Friction (N/kg)**
35.0	32.0

The minimum final dry coat thickness for two coats or roller applied moisture-cured polyurethane shall be 40 mils.

The preformed marking tape shall be a durable, retroreflective, pliant, polymer material. The patterned material, without adhesive, shall have a minimum caliper of 20 mils at the thinnest portion of the cross-section. The surface of the public sidewalk delineation with the preformed marking tape shall exhibit a minimum slip resistant value of 55 BPN when tested according to ASTM E 303.

{ XE "SIDEWALK:CONSTRUCTION OF" **}**CONSTRUCTION

607.03 Excavation and Backfilling.

Excavation shall be according to Section 202. Immediately after removing the side forms, the spaces along the edges of sidewalks and driveways shall be backfilled with suitable material. This material shall be placed in layers not exceeding 5 inches in loose thickness and shall be compacted until firm.

607.04 Preparation of Underlying Materials.

The underlying material shall be shaped and compacted to a firm, even surface. Unstable material shall be removed and replaced with acceptable material that shall be compacted.

607.05 HMA Sidewalks and Driveways.

HMA sidewalks and driveways shall consist of a HMA surface on a base course.

1. **Base Course.** Either soil aggregate or dense-graded aggregate may be used for sidewalks, and HMA or dense-graded aggregate or both may be used for driveways and shall be constructed as follows:
    a. Soil aggregate base course or dense-graded aggregate base course shall be according to Section 301.
    b. HMA shall be according to Section 404.
2. **Surface Course.** HMA surface shall be constructed according to Section 404 except that rollers shall weigh at least ½ ton.

607.06 Concrete Sidewalks, Driveways, and Public Sidewalk Curb Ramp Delineation.

Concrete sidewalks and driveways shall be constructed according to Section 405 and the following:

1. **Mixing and Placing Concrete.** Immediately before placing the concrete, the underlying material shall be thoroughly dampened and the forms given a coating of light oil. Where removed and used again, the forms shall be thoroughly cleaned and oiled each time before using. Mechanical spreaders are not required.
2. **Finishing.** The concrete shall be struck off with a transverse template resting upon the side forms. After the concrete has been struck off to the required cross-section, it shall be finished with floats and straightedges until a smooth surface has been obtained.

    When the surface of the concrete is free from water and just before the concrete attains its initial set, the surface shall be gone over and finished with a wooden float and brushed with a wet, soft-haired brush. The surface of the concrete shall be so finished as to drain completely at all times. All edges shall be finished and rounded with an edging tool having a radius of ¼ inch.

    The surface shall be divided into blocks by use of a grooving tool. Grooves shall be so placed as to cause expansion joints to be placed at a groove line. The grooves shall be cut to a depth of not less than ½ inch. The edges of the grooves shall be finished with an edging tool having a radius of ¼ inch.
3. **Expansion Joints.** Expansion joints shall be ½ inch wide, placed at intervals of approximately 20 feet, and shall be filled with preformed expansion-joint filler. Expansion joints shall be formed around all appurtenances such as manholes and utility poles extending into or through the concrete. Preformed expansion joint filler, ¼ inch thick, shall be installed in these joints. Expansion joint filler shall be installed between concrete and any fixed structure, such as a building or bridge. The expansion joint material shall extend for the full depth.

    The top and ends of expansion joint material shall be cleaned of concrete, and the expansion joint material shall be so trimmed as to be slightly below the surface of the concrete.
4. **Protection and Curing.** Forms may be removed when removal does not damage the concrete. No pressure shall be exerted upon the concrete when removing forms. Protection during cold weather and curing shall be according to Subsection 501.17, Subpart B.

    Pedestrians will not be permitted upon concrete sidewalks or driveways until 24 hours after finishing concrete. Vehicles or loads shall not be permitted on any sidewalk, driveway, or median until the concrete has attained sufficient strength.

    Such barricades and protection devices as are necessary shall be constructed and placed to keep pedestrians and other traffic off the sidewalk or driveway.

    Any sidewalk or driveway damaged before Acceptance shall be repaired by removing concrete within groove limits and replacing it with concrete of the type and finish as is in the original construction. Damage caused by construction operations or cold weather shall be repaired without additional compensation.
5. **Public Sidewalk Curb Ramp Delineation{** XE "Sidewalk:curb ramp" **}{** XE "Curbs:curb ramp" **}.** Immediately before applying the marking material to the ramp surface, all dirt, oil, grease, and other foreign material shall be removed and the surface completely cleaned with a solvent according to the manufacturer's recommendations. The marking material shall be applied on thoroughly dry surfaces within the manufacturer's recommended ambient conditions for application.

    The moisture-cured polyurethane coating shall be applied by roller method, in two coats. Immediately after the application of the second coat, silicon carbide 60 grit shall be broadcast evenly over the moist surface coat at a rate of 0.07 pounds per square yard. The drying time between coats and drying time to fully cure the

coating shall be the times recommended by the manufacturer of the moisture-cured polyurethane. The coating shall not be subjected to loading or chemical exposure until fully cured.

Before applying preformed marking tape, a solvent based adhesive conforming to NJDEP volatile organic content requirements shall be applied to the curb ramp area. The preformed marking tape shall be field cut to the required dimensions and applied in one piece.

Equipment and procedures for applying curb ramp markings shall be such that the markings are not damaged, wrinkled, or distorted during installation.

All curb ramp markings determined to be damaged or not to be in conformance with these Specifications or the Plans shall be removed and replaced at no cost to the State.

COMPENSATION

607.07 Method of Measurement.

Sidewalks of the various kinds and thicknesses will not be measured and payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided for in Subsection 109.01.

Driveways of the various kinds and thicknesses will be measured by the square yard.

Public sidewalk curb ramp delineation will be measured by the square yard.

607.08 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
HOT MIX ASPHALT SIDEWALK, ___ " THICK	SQUARE YARD
CONCRETE SIDEWALK, ___ " THICK	SQUARE YARD
CONCRETE SIDEWALK, REINFORCED, ___ " THICK	SQUARE YARD
HOT MIX ASPHALT DRIVEWAY, ___ " THICK	SQUARE YARD
HOT MIX ASPHALT DRIVEWAY, VARIABLE THICKNESS	SQUARE YARD
CONCRETE DRIVEWAY, ___" THICK	SQUARE YARD
CONCRETE DRIVEWAY, REINFORCED, ___" THICK	SQUARE YARD
PUBLIC SIDEWALK CURB RAMP DELINEATION	SQUARE YARD

SECTION 608 - ISLANDS{ XE "ISLANDS" }

608.01 Description.

{ XE "Hot mix asphalt (HMA):islands" **}**This work shall consist of the construction of HMA islands and portland cement concrete islands.

MATERIALS

608.02 Materials.

{ XE "Reclaimed asphalt pavement (RAP):in islands" **}**HMA shall conform to Section 903 except that the composition of the mixture for the top layer may also include up to 20 percent of RAP. Portland cement concrete shall conform to Section 914.

Other materials shall conform to the following Subsections:

Prime Coat:
- Cut-back Asphalt, Grade MC-30 or MC-70 ..... 904.02

Tack Coat:
- Cut-back Asphalt, Grade RC-70 or RC-T 904.02
- Emulsified Asphalt, Grade RS-1, SS-1, or SS-1h 904.03
- Cationic Emulsified Asphalt, Grade CSS-1 or CSS-1h 904.03

Curing Materials 905.03
Preformed Expansion Joint Filler 908.01
Joint Sealer, Hot-poured 908.02

CONSTRUCTION

608.03 Preparation of Underlying Materials.

The underlying material shall be shaped and compacted to a firm, even surface. Unstable material shall be removed and replaced with acceptable material that shall be compacted.

608.04 HMA Islands.{ XE "Islands:hot mix asphalt (HMA)" }

HMA islands shall conform to the construction requirements for HMA sidewalk in Subsection 607.05.

608.05 Concrete Islands and White Concrete Islands.{ XE "Islands:white concrete" }{ XE "White concrete islands" }

Concrete islands and white concrete islands shall conform to the construction requirements for concrete sidewalk in Subsection 607.06 except as stated in this Subsection.

The concrete surface shall not be divided into blocks. Expansion joints shall not be provided except that when the island is constructed upon a concrete surface, expansion joints shall be installed directly over joints in the concrete surface and at approximately equal intervals of not more than 20 feet between the joints. Longitudinal expansion joints of the same width and type shall be provided between the island pavement and abutting curbs.

608.06 Sleeves.

Sleeves for sign or delineator posts shall be filled with sand and sealed with hot-poured joint sealer immediately after installation and shall be resealed if and when posts are installed.

COMPENSATION

608.07 Method of Measurement.

Islands of the various kinds and thicknesses will not be measured, and payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided for in Subsection 109.01.

608.08 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
HOT MIX ASPHALT ISLAND, ___ " THICK	SQUARE YARD
WHITE CONCRETE ISLAND, ___ " THICK	SQUARE YARD
CONCRETE ISLAND, ___" THICK	SQUARE YARD

SECTION 609 - RUBBLE MASONRY AND RUBBLE RIPRAP WALLS{ XE "RUBBLE:MASONRY" }{ XE "RUBBLE:RIPRAP WALLS" }{ XE "WALLS:RUBBLE MASONRY" }{ XE "WALLS:RUBBLE RIPRAP" }

609.01 Description.

This work shall consist of the construction of rubble masonry walls and rubble riprap walls.

MATERIALS

609.02 Materials.

Materials shall conform to the following Subsections:

Rubble Stones 901.17
Mortar and Grout 914.03

CONSTRUCTION

609.03 Excavation and Backfilling.

Excavation and backfilling shall conform to Section 206.

609.04 Rubble Walls.

Selected stones, rough squared and cut to the required pitch, shall be used at angles and ends of walls. The largest stones shall be used for the bottom courses of the wall and the size shall gradually decrease toward the top. The stones shall be laid so as to stagger joints and to bond together, with their bedding planes approximately horizontal. Not less than 25 percent of the face area shall be headers, uniformly distributed. The face stones shall have exposed faces parallel to the face of wall. The walls shall also conform to the following:

1. **Dry Rubble Masonry Walls{** XE "Rubble:masonry walls" **}.** Face joints shall be not more than 2 inches in width and other joints shall be not more than 4 inches in width. Spaces between stones shall be filled with spalls, neatly fitted into place, except that no spalls shall be used in the face.
2. **Mortar Rubble Masonry Walls.** The stones shall be laid in a bed of mortar and all spaces between stones shall be filled with mortar and packed with spalls except that no spalls shall be used in the face. All voids shall be filled with mortar. The face joints shall be not more than 1 inch wide and shall be pointed before the mortar has set.

609.05 Rubble Riprap Walls{ XE "Rubble:riprap walls" }.

Laying the stones in courses is not required. The larger stones shall be placed in the bottom of the wall and progressively smaller sizes shall be placed from the bottom to the top. The stones shall be of the size appropriate for the size of the wall and shall be placed so that there are a minimum of voids and a maximum stability of the wall.

COMPENSATION

609.06 Method of Measurement.

Rubble walls of the various kinds will be measured by the cubic yard.

609.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
DRY RUBBLE MASONRY WALLS	CUBIC YARD
MORTAR RUBBLE MASONRY WALLS	CUBIC YARD
RUBBLE RIPRAP WALLS	CUBIC YARD

SECTION 610 - CULVERTS AND HEADWALLS{ XE "CULVERTS" }{ XE "HEADWALLS" }

610.01 Description.

{ XE "Concrete culverts" **}{** XE "Concrete headwalls" **}**This work shall consist of the construction of portland cement concrete culverts of less than 5 foot span and the construction of portland cement concrete headwalls.

MATERIALS

610.02 Materials.

Portland cement concrete shall conform to Section 914. Other materials shall conform to the following Subsections:

Aggregate for Coarse Aggregate Bed	901.03
Curing Materials	905.03
Preformed Expansion Joint Filler	908.01
Reinforcement Steel	915.01

CONSTRUCTION

610.03 Excavation and Backfilling.

Excavation shall be according to Subsection 207.04. Backfilling shall be according to Subsection 207.06.

610.04 Mixing, Placing, Finishing, and Curing Concrete.

Mixing, placing, finishing, and curing of concrete, including placing of reinforcement steel shall be according to Section 501.

610.05 Precast Concrete Culverts and Precast Concrete Headwalls.{ XE "Precast:culverts" }{ XE "Precast:headwalls" }

{ XE "Culverts:precast concrete" **}{** XE "Headwalls:precast concrete" **}**Precast concrete culverts and precast concrete headwalls may be substituted for cast-in-place and shall be constructed as specified for cast-in-place. The dimensions of the precast culverts and precast headwalls shall be as shown for cast-in-place.

Precast structures shall be placed on a 6-inch bed of compacted coarse aggregate No. 57 in size.

Reinforcement steel, if required for handling, shall have a minimum 2 inches of cover. Handling devices shall be removable and the holes filled with concrete.

COMPENSATION

610.06 Method of Measurement.

Concrete culverts and headwalls will be measured by the cubic yard.

610.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CONCRETE CULVERTS	CUBIC YARD
CONCRETE HEADWALLS	CUBIC YARD

SECTION 611 - MONUMENTS{ XE "MONUMENTS AND MARKERS" }

611.01 Description.

This work shall consist of the construction of monuments with embedded brass markers, geodetic monuments, and monument boxes and the resetting of existing monuments and monument boxes.

MATERIALS

611.02 Materials.

Portland cement concrete shall conform to Section 914. Monument markers shall be brass conforming to ASTM B 19. Adjustable height monument boxes shall conform to Subsection 917.03.

CONSTRUCTION

611.03 Excavation and Backfilling.

Excavation shall be according to Subsection 207.04. Backfilling shall be according to Subsection 207.06.

611.04 Monuments.

Monuments shall be constructed according to Section 501 and shall be set at the required location and elevation and in such a manner as to ensure that the monuments are held firmly in place. The top surface of the monument shall be horizontal, and the disk shall be set in the true position.

Monuments shall be protected from disturbance and damage for the life of the Contract as specified in Subsection 107.16.

Monuments are to be set under the responsible charge of the Contractor's Land Surveyor according to the applicable provisions of the Map Filing Law NJSA 46.23-9.10 et seq., the applicable provisions of NJAC 13:40-5.1 et seq., and according to the tie and alignment data on tie sheets contained within the Plans, and within the ROW Plans.

611.05 Monument Boxes.

The monument box frame shall be set in concrete so that the top of the box is flush with the proposed final grade of the sidewalk, pavement surface, or ground line. The excavated area around the monument box shall be backfilled with concrete to hold the box firmly in place.

611.06 Resetting Monuments and Monument Boxes.{ XE "Monuments and markers:resetting monuments and monument boxes" }{ XE "Resetting monuments" }

{ XE "Monuments and markers:New Jersey Geodetic Control Survey monuments" **}**Monuments and monument boxes that are to be relocated or reset shall not be moved or disturbed until they have been properly referenced. The Contractor's Land Surveyor shall provide the signed and sealed documentation of the survey fieldwork and office survey work to the Engineer. The monuments shall be reset upon written approval from the Engineer. The Contractor's Land Surveyor shall verify and provide the final location of the new and reset monuments. Geodetic control monuments shall not be reset or relocated until written approval is received from the agency that established the monuments. New Jersey Geodetic Control Survey is the agency responsible for the New Jersey Geodetic Control monuments and the National Geodetic Survey monuments.

Where a monument is under the control or responsibility of a public entity other than NJDOT, that particular entity shall be directly contacted by the Contractor before resetting the said monument to advise of the need to reset its monument. The Contractor shall abide by the applicable requirements of that public entity before resetting the said monument. The Contractor shall provide the Resident Engineer with copies of all correspondence between such public entity, as well as, all written requirements or guidelines issued by that public entity before resetting any monument.

Care shall be taken in raising and resetting monument boxes and protecting them until the surface course is laid. Any damage done to the boxes shall be repaired without additional compensation.

Construction requirements shall be as specified above for new monuments.

Information regarding monuments of the New Jersey Geodetic Control Survey and the National Geodetic Survey may be obtained from the Geodetic Control Survey Unit, New Jersey Department of Transportation, P.O. Box 600, Trenton, New Jersey 08625.

COMPENSATION

611.07 Method of Measurement.

Monuments, geodetic monuments, monument boxes, reset monuments, and reset monument boxes will be measured by the number of units.

611.08 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
MONUMENTS	UNIT
GEODETIC MONUMENTS	UNIT
MONUMENT BOXES	UNIT
RESET MONUMENTS	UNIT
RESET MONUMENT BOXES	UNIT

SECTION 612 - BEAM GUIDE RAIL{ XE "BEAM GUIDE RAIL" }{ XE "GUIDE RAIL" \T "*SEE* BEAM GUIDE RAIL" }

612.01 Description.

This work shall consist of the installation, resetting, or modification of beam guide rail and the removal of beam guide rail and wire rope fence.

{ XE "BEAM GUIDE RAIL:MATERIALS" }MATERIALS

612.02 Materials.

Materials shall conform to the following Subsections:

{ XE "Beam guide rail:rail element" **}**Rail Element 902.01
Posts, Spacers, and Recycled/Synthetic Spacers 902.02
Rub Rail 902.03
Miscellaneous Hardware 902.04
Timber Posts, Timber Spacers and Routed Timber Spacers 918.01

Portland cement concrete for guide rail end treatment shall conform to Section 914.

CONSTRUCTION

612.03 Beam Guide Rail.

The installation of beam guide rail, single or dual-faced, shall be made in such a manner that no unprotected end is exposed to approaching traffic. The quantity of existing beam guide rail or wire rope fence removed shall not exceed that which can be replaced within the same work day. No previously protected area shall remain unprotected at the end of the work day. Where possible, new beam guide rail exposed to approaching traffic shall be installed before the removal of the existing system.

Beam guide rail posts shall be driven to the required position. Posts shall be plumb, properly spaced, and to the prescribed line and grade.

{ XE "Beam guide rail:posts and spacers" **}**Before driving the posts, the location of underground electrical conduits that may conflict with the posts shall be determined. Post spacing may be adjusted by 6 inches, as approved, to eliminate such conflicts. A functional test of the electrical system shall be made before and upon completion of driving the posts. The functional test shall be according to Subsection 701.16. Additional tests may be required if it is suspected that underground conduits have been damaged. Damage to the electrical conduit due to construction operations shall be located and repaired without additional compensation.

Beam guide rail elements shall be installed on the posts with spacers at every post. The top edge of the rail elements shall be in a straight line or smooth curve, parallel to or concentric with the traveled way. Where a vertical transition is required, the top edge of the rail elements shall form the chords of a smooth vertical curve. No punching, drilling, reaming, cutting, or welding of the rail elements will be permitted in the field.

Any damage to the galvanized coating during installation shall be repaired without additional compensation.

612.04 Beam Guide Rail End Treatment.{ XE "Beam guide rail:posts and spacers" }

End treatments consisting of slotted guide rail terminals, extruder terminals, controlled release terminals, controlled release terminal anchorages, anchorages for single-faced beam guide rail, and telescoping guide rail end terminals for dual-faced beam guide rail shall be constructed according to Subsection 612.03 except that timber posts shall be used where specified.

Slotted guide rail terminals shall be SRT-350 as manufactured by Syro, Inc.

Extruder terminals shall be ET-2000 Energy Absorbing Safety End Treatment as manufactured by Syro, Inc.

Telescoping guide rail end terminals shall be either Crash-cushion Attenuating Terminal (CAT) as manufactured by Syro, Inc., Girard, Ohio or Brakemaster System as manufactured by Energy Absorption Systems, Inc., Chicago, Illinois.

Excavation for timber post holes and concrete anchorages shall be according to Subsection 207.04. Backfilling shall be according to Subsection 207.06.

612.05 Rub Rail.{ XE "Rub rail" }{ XE "Beam guide rail:rub rail" }

When rub rail is required, the rub rail, consisting of a steel channel or a bent plate, shall be bolted to the beam guide rail posts.

612.06 Block Out Beam Guide Rail.{ XE "Beam guide rail:block out beam guide rail" }

Spacers, routed timber spacers and recycled/synthetic routed spacers, where required, shall be installed on existing beam guide rail between the steel posts and rail elements. Where required, beam guide rail shall be attached to existing structures. Sufficient beam guide rail posts shall be relocated to provide a smooth transition to the existing structures.

612.07 Reset Beam Guide Rail.{ XE "Beam guide rail:reset beam guide rail" }{ XE "Reset beam guide rail" \t "*See* Beam guide rail" }

Existing beam guide rail, single or dual-faced, scheduled for resetting and determined by the Resident Engineer to be suitable for reuse shall be carefully dismantled, stored, and protected. Existing posts and rail elements broken or damaged during removal because of carelessness, negligence, or the use of improper construction methods shall be replaced without additional compensation. Materials determined by the Resident Engineer to be unsuitable or surplus shall be removed and disposed of according to Subsection 201.10.

Where removal and storage are directed, the bolts, cables, and other hardware shall be removed from rails, posts, and other members. The components shall be sorted and stored at the locations specified. Rails shall be stacked and the cable shall be free from kinks and rewound on cable spools. Care shall be exercised in handling and storing of the materials to ensure maximum salvage value. Any beam guide rail components lost or missing in storage shall be replaced without additional compensation.

The existing beam guide rail shall be reset with salvaged materials and with new materials as necessary to conform with the requirements for new beam guide rail installations. New bolts, nuts, washers, and spacers shall be provided, as necessary. Payment will not be made for new posts or rail elements until all available existing posts and rail elements have been used.

Methods of resetting shall conform to the construction of new guide rail of the type being reset. Individual sections of guide rail shall be reset in the following sequence:

1. using existing posts and rail elements,
2. using new posts or rail elements at no cost to the State, and
3. using new posts or rail elements which will be paid for.

Wherever feasible, existing rail elements shall be used in guide rail section or portions thereof that are reset with existing posts, and new rail elements shall be used in guide rail sections or in portions thereof where new guide rail posts are used. When it is necessary to use existing and new rail elements in the same guide rail section, a continuous length of each shall be installed.

612.08 Beam Guide Rail on Bridges.{ XE "Beam guide rail:on bridges" }

Beam guide rail consisting of a steel rail element mounted on bridge structures shall utilize cast-in-place or epoxy-grouted anchors approved by the Department.

The holes in the deck for anchor bolts shall be core drilled with a core drill bit. Core drill bit sizes for anchor bolt holes shall conform to manufacturer's recommendations. Holes shall be spaced and located to clear existing deck reinforcement, deck joints, conduits, and junction boxes. Anchor bolts shall be fastened to the concrete according to the manufacturer's recommendations.

Precautions shall be taken so that concrete and existing utility conduits are not damaged during the drilling for anchor bolts. Any damage to the existing concrete shall be repaired without additional compensation.

Certification shall be furnished according to Subsection 106.04 that the 1⅛-inch diameter anchor bolt shall have a minimum pullout strength of 20 kips.

Welding shall conform to the ANSI/AASHTO/AWS D1.5 Bridge Welding Code with the exception that the welding of tubular structures shall be done according to the ANSI/AWS D1.1 Structural Welding Code.

612.09 Removal of Guide Rail{ XE "Beam guide rail:removal of" }.

Beam guide rail, wire rope fence, anchorages, terminal assemblies, and hardware scheduled for removal shall be as designated. Materials and debris shall be disposed of according to Subsection 201.10.

After posts are removed, the post holes shall be backfilled and compacted to the prescribed grade and the area shall be restored to that of the adjacent surface.

COMPENSATION

612.10 Method of Measurement.

Beam guide rail of the various kinds will be measured by the linear foot along the face of the rail excluding anchorages and end terminals. Dual-faced beam guide rail will be measured by the linear foot along the face of one rail excluding end terminals.

Slotted guide rail terminals, extruder terminals, controlled release terminals, controlled release terminal anchorages, beam guide rail anchorages, and telescoping guide rail end terminals will be measured by the number of units.

Beam guide rail posts of the various kinds will be measured by the number of units.

Beam guide rail element and rub rail will be measured by the linear foot along the face of the rail.

Block out beam guide rail will be measured by the linear foot.

Reset beam guide rail of the various kinds will be measured as specified for new beam guide rail.

Removal of guide rail will be measured by the linear foot.

612.11 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
BEAM GUIDE RAIL	LINEAR FOOT
BEAM GUIDE RAIL, BRIDGE	LINEAR FOOT
BEAM GUIDE RAIL, DUAL-FACED	LINEAR FOOT
SLOTTED GUIDE RAIL TERMINALS	UNIT
EXTRUDER TERMINALS	UNIT
CONTROLLED RELEASE TERMINALS	UNIT
CONTROLLED RELEASE TERMINAL ANCHORAGES	UNIT
BEAM GUIDE RAIL ANCHORAGES	UNIT
TELESCOPING GUIDE RAIL END TERMINALS	UNIT
BEAM GUIDE RAIL POSTS	UNIT
BEAM GUIDE RAIL POSTS, ___ ' LONG	UNIT
BEAM GUIDE RAIL ELEMENT	LINEAR FOOT
RUB RAIL	LINEAR FOOT
BLOCK OUT BEAM GUIDE RAIL	LINEAR FOOT
RESET BEAM GUIDE RAIL WITH EXISTING POSTS	LINEAR FOOT
RESET BEAM GUIDE RAIL, DUAL-FACED, WITH EXISTING POSTS	LINEAR FOOT
REMOVAL OF GUIDE RAIL	LINEAR FOOT

Separate payment will not be made for bridge attachments.

Separate payment will not be made for beam guide rail posts of the various kinds within the limits of new beam guide rail installations.

Separate payment will not be made for extra beam guide rail posts of the various kinds and rail elements at obstructions and bridge attachments within the limits of new beam guide rail installation.

Separate payment will not be made for new bolts, nuts, washers,or spacers within the limits of reset beam guide rail of the various kinds.

Payment adjustments for strength will be made according to Subsection 914.02, Subpart F and will be applied to the lot for those Pay Items specified in that Subpart.

Separate payment will not be made for replacing structural steel spacers with recycled/synthetic spacers within the limits of reset beam guide rail of the various kinds.

SECTION 613 - MISCELLANEOUS CONCRETE{ XE "MISCELLANEOUS CONCRETE ITEMS" }

613.01 Description.

This work shall consist of the construction of miscellaneous portland cement concrete items such as steps, pipe plugs, saddles, and encasements.

MATERIALS

613.02 Materials.

Materials shall conform to the following Subsections:

Portland Cement Concrete	914
Curing Materials	905.03
Preformed Expansion Joint Filler	908.01
Reinforcement Steel	915.01

CONSTRUCTION

613.03 Excavation and Backfilling.

Excavation and backfilling shall be according to Section 202, 206, or 207.

613.04 Mixing, Placing, Finishing, and Curing.

Mixing, placing, finishing, and curing of concrete including placing of reinforcement steel shall be according to Section 405.

613.05 Pipe Plugs{ XE "Pipe plugs" }.

The thickness of pipe plugs shall be equal to the inside diameter of the pipe or 2 feet, whichever is less.

COMPENSATION

613.06 Method of Measurement.

Miscellaneous concrete will be measured by the cubic yard.

613.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
MISCELLANEOUS CONCRETE	CUBIC YARD

Payment for rock excavation will be made according to Section 207.

SECTION 614 - FENCES{ XE "FENCES AND FENCE MATERIAL" }

614.01 Description.

This work shall consist of the construction of fence and gates, the removal and resetting of fence, and the repair of chain-link fence including the replacement of damaged fabric.

MATERIALS

614.02 Materials.

Materials shall conform to the following Subsections:

Chain-Link Fence	907.02
Chain-Link Farm-Type Fence	907.03
Snow Fence	907.04
Mortar and Grout	914.03
Coal Tar Epoxy-Polyamide Paint	912.04
Portland Cement Concrete	914

Where aluminum-coated fence or PVC-coated fence is not designated, either kind may be used.

Gates shall be of the same materials as the fence to which the gates are attached.

New fence fabric shall be of the same or equivalent type as existing fence. Fence fabric and incidental hardware shall conform to Section 907. All posts, fasteners, and other appurtenances for PVC-coated fence shall also be PVC-coated and shall match the fence fabric.

CONSTRUCTION

614.03 Preliminary Work.

Before beginning construction or placing of fences, site clearing shall be performed according to Section 201. Any rock protruding above the ground surface and in the line of fence shall be removed to ground surface level according to Section 202.

614.04 Chain-Link Fence.{ XE "Fences and fence material:chain-link" }{ XE "Chain-link fence" \t "*See* Fences and fence material" }

Fence and gates shall be erected according to the construction requirements recommended by the manufacturer and the following:

1. Terminal posts shall be set at the beginning and end of each continuous length of fence, at abrupt changes in vertical and horizontal alignment, and on each side of gate locations.
2. Aluminum surfaces to be placed in contact with concrete shall be given a coat of coal tar epoxy-polyamide paint.
3. Posts to be set in concrete shall be installed in dug or drilled holes. Posts not requiring a concrete foundation may be driven to the required depth if ground conditions permit, or the posts shall be installed in holes dug or drilled to allow sufficient room for proper backfilling. When solid rock is encountered, any posts not required to be set in concrete shall be installed by drilling the rock to the required depth and grouting the post placed therein with grout composed of one part cement to two parts sand.
4. Post holes for posts not requiring concrete foundations shall be backfilled with suitable material. Backfill shall be placed in layers not exceeding 4 inches, and each layer shall be thoroughly tamped. When backfilling and tamping are completed, the posts and anchors shall be held securely in proper position.
5. Pull shall not be applied to posts set in concrete foundations until the concrete has cured a minimum of 72 hours.

{ XE "Gates" **}**6. Gates shall be equipped with locks and two sets of keys.

7. Gates shall be the same height as the fence to which the gates are attached.

614.05 Removal and Resetting Fence.{ XE "Fences and fence material:resetting and repairing" }{ XE "Resetting fence" }

Existing fence materials that are found not to be usable or are damaged by construction operations shall be disposed of and replaced with new materials of the same or equivalent type, without additional compensation.

614.06 Repairing Chain-Link Fence.

New fabric shall be furnished and erected where required. Top rails and posts shall be straightened or replaced. Tension wire shall be replaced, and vertical cuts shall be mended.

Methods of construction shall be such that the repaired fence shall conform to the existing fence. Materials that are no longer usable shall be disposed of according to Subsection 201.10.

614.07 Temporary Fence.{ XE "Fences and fence material:temporary" }{ XE "Snow:fence" }{ XE "Fences and fence material:snow fence" }

Temporary chain-link fence and snow fence required to enclose hazardous construction areas and to complement the permanent fencing shall be erected before construction activity.

Plastic snow fence required to delineate ecologically sensitive areas shall also be erected before construction activity. Use of these sensitive areas for storage of materials, field offices, work access, etc., will not be permitted at any time. Ecologically sensitive areas damaged as a result of construction activities shall be restored as directed.

Temporary fence shall be constructed according to the requirements for permanent fence except used materials may be used.

Gates necessary for the construction operations may be installed at selected locations and shall be kept padlocked except when in actual use during working hours.

Temporary fence and all types of snow fence shall be maintained as directed during construction and shall be disposed of when no longer required on the Project.

COMPENSATION

614.08 Method of Measurement.

Chain-link fence of the various kinds and sizes will be measured by the linear foot along the bottom line of the fabric, deducting the width of gates.

Gates of the various kinds and sizes will be measured by the unit.

Reset fence and temporary fence will be measured by the linear foot, including gates.

Snow fence of the various types will be measured by the linear foot.

Repairing chain-link fence will be measured by the linear foot and computed on the basis of the total length of fence fabric repaired plus the pro-rated quantity of top rails and posts straightened or replaced, tension wire replaced, and vertical cuts mended according to the following:

Per linear foot of top rail replaced	1/5 linear foot
Per linear foot of top rail straightened	1/10 linear foot
Per unit of post replaced	10 linear feet
Per unit of post straightened	5 linear feet
Per linear foot of tension wire replaced	1/20 linear foot
Per linear foot of vertical cuts mended	1/20 linear foot

614.09 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CHAIN-LINK FENCE, ALUMINUM-COATED STEEL, ___ ' HIGH	LINEAR FOOT
CHAIN-LINK FENCE, PVC-COATED STEEL, ___ ' HIGH	LINEAR FOOT
CHAIN-LINK FENCE, ___ ' HIGH	LINEAR FOOT
CHAIN-LINK FARM-TYPE FENCE	LINEAR FOOT
GATES, CHAIN-LINK FENCE, ALUMINUM-COATED STEEL, ___ ' WIDE	UNIT
GATES, CHAIN-LINK FENCE, PVC-COATED STEEL, ___ ' WIDE	UNIT
GATES, CHAIN-LINK FENCE, ___ ' WIDE	UNIT
GATES, CHAIN-LINK FARM-TYPE FENCE, ___ ' WIDE	UNIT
RESET FENCE	LINEAR FOOT
REPAIRING CHAIN-LINK FENCE	LINEAR FOOT
TEMPORARY CHAIN-LINK FENCE, ___ ' HIGH	LINEAR FOOT
SNOW FENCE	LINEAR FOOT
SNOW FENCE, PLASTIC	LINEAR FOOT

Separate payment will not be made for chain link fence, Type NR, but all costs thereof will be paid for at the same linear foot price bid for the item it replaced.

Payment adjustments for strength will be made according to Subsection 914.02, Subpart F, and will be applied to the lot for those Pay Items specified in that Subpart.

SECTION 615 - METAL RAILING{ XE "METAL RAILING" }

615.01 Description.

This work shall consist of the construction of metal railing on steps, walls, or other similar appurtenances.

MATERIALS

615.02 Materials.

Materials shall conform to the following Subsections:

Metal Railing:
- Aluminum Alloy 911.01
- Structural Steel, Carbon 917.10

Aluminum-Pigmented Alkaline-Resistant Paint 912.01
Grout 914.03
Bolts and Bolting Material 917.01
Zinc Coating on Steel 917.12
Bearing Pad, Elastomeric 919.02
Caulking Compound 919.04

CONSTRUCTION

615.03 Construction Requirements.

Metal railing shall be constructed according to Section 508 and the following:

1. **Posts Perpendicular to Rails.** For railings in which the posts are to be perpendicular to the rails, standard or special fittings shall be used, or the joints may be welded. Aluminum posts shall be bolted to the concrete foundation with corrosion-resistant steel bolts. The plates shall be shimmed as required for railing alignment.
2. **Posts Vertical to Rails.** For railings in which the posts are vertical to the rails, the railing shall be erected by one of the following methods:
   a. **With Sleeves.** The railing shall be placed in the concrete foundation and the posts grouted in the metal sleeves. The sleeves shall be flush with the top of the concrete and accurately positioned for the required post spacing and true alignment of the railing. The space between the posts and sleeves shall be completely filled with non-shrink grout of suitable consistency. Temporary protection against the collection of water and other foreign materials in the sleeves shall be provided by filling the sleeves with sand to within 1 inch of the top and sealing with bituminous material. The sand and bituminous material shall be completely removed just before grouting and setting of the railing.
   b. **Without Sleeves.** The railing shall be securely supported in its final position and the foundation concrete shall be placed around the posts.

COMPENSATION

615.04 Method of Measurement.

Metal railing will be measured by the linear foot along the top of the rail.

615.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
METAL RAILING	LINEAR FOOT

SECTION 616 - SLOPE AND CHANNEL PROTECTION{ XE "SLOPE:PROTECTION" { XE "CHANNEL:PROTECTION" }}

616.01 Description.

This work shall consist of the construction of various kinds of slope and channel protection.

MATERIALS

616.02 Materials.

{ XE "Slope:protection:concrete bag" **}**Portland cement concrete shall conform to Section 914 except that water shall be omitted for concrete bag slope protection. Other materials shall conform to the following Subsections:

Riprap Stones	901.16
Emulsified Asphalt, Grade RS-1	904.03
Curing Materials	905.03
Preformed Expansion Joint Filler	908.01
Joint Sealer	908.02
Concrete Block for Slope Protection	910.03
Granite Paving Block	910.08
Mortar and Grout	914.03
Reinforcement Steel	915.03
Bags	919.01
Geotextiles	919.06

Coarse aggregate for riprap stone slope or channel protection shall conform to Subsection 901.04.

Fine aggregate for the base course used with concrete or granite block slope protection shall conform to Subsection 901.12.

According to the provisions of Subsection 901.16, the required d_{50} riprap stone size shall be stated in the appropriate riprap stone Pay Item listed below.

CONSTRUCTION

616.03 Preparation of Slopes or Channels.

Immediately before the construction of the slope or channel protection, the slopes or ground surface shall be trimmed conforming to the lines and grades and shall be thoroughly compacted by mechanical or vibrating tampers or rollers.

616.04 Concrete Slope Protection.{ XE "Slope:protection:concrete" }

Concrete slope protection shall be constructed by placing concrete on the prepared foundation according to Section 405 except that the concrete shall be of such consistency that it does not flow on the slope. Finishing shall be with a wood float followed by brushing with a wet, soft-hair brush to a neat and uniform surface.

Slope protection shall be scored for a depth of ½ inch on 6-foot centers, both ways. Scored edges shall be rounded to a ½-inch radius with an edging tool. A ½-inch, premolded, expansion-joint filler shall be used wherever the concrete abuts any portion of a structure.

Edge beams and key beams shall be placed monolithically with the slab.

Forms, which are of wood or metal, shall be removed after the concrete has set 24 hours. The concrete shall be cured according to Section 405.

616.05 Concrete Bag Slope Protection.{ XE "Concrete bag slope protection" }

Concrete bag slope protection shall be constructed by placing bags, filled approximately three-quarters full with dry concrete mix, on the prepared foundation. The filled bags shall be securely fastened with hog rings, by sewing or other methods. Leaking bags shall not be used.

The bags of concrete mix shall be bedded by hand on the surface with the fastened ends in the same direction and with the joints staggered. The bags shall be rammed and packed against each other and tamped on the surface in such a manner as to form close contact and secure a uniform surface. Bags of concrete ripped or broken in placing shall be removed and replaced before the placed bags are soaked with water. Immediately after the bags of concrete are placed and tamped, they shall be thoroughly soaked by sprinkling with water applied under low pressure.

616.06 Concrete Block and Granite Block Slope Protection.{ XE "Slope:protection:concrete block" }{ XE "Slope:protection:granite block" }

Concrete block and granite block slope protection shall be constructed by placing blocks on a 2-inch layer of aggregate base course.

The base course shall be dry, clean, and free of adhering matter and frost when the block is placed thereon. The mortar for the cushion course shall be 1:3, cement-sand mortar, thoroughly mixed without water in a mechanically operated batch mixer of a size suitable for the work. The dry mortar shall be placed on the base course in a uniform layer having a thickness of 2 inches. The layer shall not be placed more than 15 feet in advance of laying the blocks, and shall be covered with the blocks without delay.

The blocks shall be set in straight rows with the longitudinal joints staggered one-half the length of the block. The blocks in each row shall be of uniform width, and the joints at the surface shall be not less than ¼ inch and not more than ½ inch in width. The blocks shall be set plumb and fully bedded on the mortar cushion without crowding it into joints. Rammers or tampers shall be of the type and weight that do not break the blocks. The best face of the block shall be uppermost.

Blocks that do not have a firm bedding or which have been damaged shall be taken up, reset, and rerammed.

The surface shall be tested with a straightedge, and blocks found to be above or below the grade shall be taken up, reset, and rerammed. Fine aggregate, gravel, or other material shall not be placed in the joints. Blocks shall be laid not more than 15 feet in advance of ramming.

Joints shall be filled with grout where specified. The grout shall be mixed in a mechanically operated batch mixer as specified for mixing the cushion course, with only sufficient water to permit the grout to enter the joints to the full depth. The amount of water shall be kept constant in all batches. The mixing time shall not be less than 90 seconds, and the mixture shall be kept agitated until used. The joints shall be filled completely with grout so that an excess appears on the surface. The excess grout shall be swept or scraped into the joints. The grouting operation shall be repeated before initial set until the joints remain completely filled. The surface shall then be swept and all excess grout shall be removed before it has developed initial set. Grout shall not be applied when the temperature of the atmosphere or the blocks is below 40 ºF or during rainy weather.

616.07 Riprap Stone Slope or Channel Protection.{ XE "Slope:protection:riprap stone" }

Riprap stone slope or channel protection shall be constructed by placing riprap stones in close contact on prepared slopes or channel bottoms upon which has been placed a layer of coarse aggregate No. 57 in size and geotextile fabric.

The geotextile shall be positioned over the entire surface upon which the riprap is to be placed and extend a minimum of 1 foot out on each side. The extended edges of the geotextile fabric shall be buried under a minimum of 6 inches of soil. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 1 foot-6 inches in the direction of flow.

The coarse aggregate shall be laid on the geotextile in a manner that does not cause damage to or dislodge the geotextile.

The riprap stones shall be firmly bedded into the coarse aggregate also without damage to the geotextile fabric. Open spaces between the placed riprap shall be filled with smaller stones of the same type and quality as the riprap stones. These smaller stones shall be firmly rammed into place. The larger of these stones shall be used in the lower courses.

The finished surfaces of the riprap stone slope or channel protection shall be even.

COMPENSATION

616.08 Method of Measurement.

Slope or channel protection of the various kinds and thicknesses will be measured by the square yard.

616.09 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CONCRETE SLOPE PROTECTION, ___" THICK	SQUARE YARD
CONCRETE SLOPE PROTECTION, REINFORCED, ___ " THICK	SQUARE YARD
CONCRETE BAG SLOPE PROTECTION, ___ " THICK	SQUARE YARD
CONCRETE BLOCK SLOPE PROTECTION, ___ " THICK	SQUARE YARD
GRANITE BLOCK SLOPE PROTECTION, ___ " THICK	SQUARE YARD
RIPRAP STONE SLOPE PROTECTION, ___ " THICK (d_{50}=___")	SQUARE YARD
RIPRAP STONE CHANNEL PROTECTION, ___ " THICK (d_{50}=___")	SQUARE YARD

Separate payment will not be made for geotextiles and coarse aggregate placed under riprap stone slope or channel protection.

SECTION 617 - TRAFFIC CONTROL{ XE "TRAFFIC:CONTROL" }

617.01 Description.

{ XE "Maintaining and protecting traffic" **}**This work shall consist of the planning for and the carrying out of maintenance and protection of vehicular or pedestrian traffic and to provide for the safe and convenient passage of such traffic, within the scope of the Project. Maintenance and protection of traffic includes furnishing, assembling, placing, and relocating traffic control devices, including pavement markers, and removing them when they are no longer required.

MATERIALS

617.02 Materials.

Materials shall conform to the following Subsections:

Removable Pavement Marking Tape and Removable Black Line Masking Tape.....912.12
Temporary Pavement Markers 912.16

EQUIPMENT

617.03 Traffic Control Devices.{ XE "Traffic:control:devices" }{ XE "Maintaining and protecting traffic:traffic control devices and signs" }

Traffic control devices need not be new but must be in good condition as approved. Traffic control devices, other than those shown on the Plans, shall conform to the Manual on Uniform Traffic Control Devices.

Before beginning construction, traffic control devices shall be placed where shown on the Plans or directed by the Engineer. Traffic control devices shall be kept clean and maintained in good condition until no longer required for the Project, at which time they shall be disposed of.

Traffic control devices shall also be placed as directed to provide traffic control for personnel doing inspections, sampling, testing, or taking measurements required for the Project.

Traffic control devices shall conform to the following:

1. **Construction Signs.** Construction sign G20-1 shall be located at the limits of the Project as the first order of Work for construction signs for projects longer than 2 miles.

   The number and location of construction signs W99-2 with the legend **Give Us a Brake - Slow Down!** shall be as directed. A one-quarter full size detail is available upon written request to the appropriate Regional Construction Engineer listed in Subsection 101.04 of the Special Provisions.

   When construction signs conflict with existing signs, the existing signs shall be covered.

   When construction signs are no longer required, they shall be removed. If they are temporarily not required, such as overnight, they shall be either temporarily removed or covered. Signs covered from view of the traveling public shall be completely covered with lightweight opaque material securely fastened so that it does not blow in the wind. Burlap shall not be used.

2. **Construction Barriers.** Precast concrete curb used for construction barriers shall be concrete or white concrete conforming to Subsection 605.09. Construction barrier curb delivered to the job site shall be in new condition and maintained throughout the duration of the Project. The Engineer shall be the sole judge of the acceptability of the precast concrete curb. Precast concrete curb deemed unsatisfactory by the Engineer shall be replaced at no cost to the State.

   Construction barrier curb Type 4, Alternate Design A or B may be used interchangeably in any location where Type 4 has been specified, except that Alternate Design B, Joint Class D, shall be used as bridge parapets. Construction barrier curb Type 4, Alternate B, may be used in any location where Type 1 has been specified. There shall be no intermixing of construction barrier curb Types 1 and 4 in any one continuous run.

   Beam guide rail used for construction barrier shall be constructed according to Section 612 and shall be set at locations, and removed and reset at new locations as directed. Components that do not remain serviceable shall be replaced at no cost to the State. Beam guide rail scheduled for permanent installation shall not be used for construction barriers.

   All construction barriers shall be provided with retroreflective sheeting covered reflectors on the top and sides. The reflectors on the top of the construction barriers shall have a surface area of 6 inches wide by 1 foot high mounted on a plastic or 0.080 inch aluminum support. The top reflectors shall be located at 100-foot intervals on tangent sections, curves of radii greater than 1,910 feet, and at 50-foot intervals on curves of 1,910 feet or less.

The reflectors on the sides of the construction barriers shall have a surface area of 3 by 3 inches and shall be mounted perpendicular to the upper face, 3 inches from the top. A side reflector shall be attached at the lead end of each barrier segment. The side reflectors shall be flexible or hinge-mounted so as to return to their original position after being struck. Any side reflectors that fail to return to original perpendicular position shall be replaced.

The retroreflective sheeting shall be Type II or Type III-A as specified in Subsection 916.04 and cover the surface areas indicated for top and side reflectors. The retroreflective sheeting shall be yellow when the construction barrier is to the left of traffic and silver (white) when the construction barrier is to the right of traffic.

Reflectors that are lost or damaged shall be replaced at no cost to the State.

3. Illuminated Flashing Arrows. Illuminated flashing arrows shall be non-reflective, black, aluminum, or wooden boards equipped with battery-operated amber lights. The minimum mounting height shall be 7 feet above the traveled way from the bottom of the board. Boards shall be mounted on substantial, approved supports of such construction that they have good stability and do not topple, or they may be mounted on a small, two-wheeled, towing trailer. In no case shall they be mounted on a vehicle other than the specified trailer, unless that vehicle is equipped with a truck-mounted crash cushion of an approved design.

The 2 by 4 footboards shall be equipped with 4-inch low intensity lights, and the arrow panel message shall be comprehensible by a driver from a distance of ½ mile on a sunny day or a clear night. The lights shall flash in unison at a rate of 40 flashes per minute, and the flash duration shall be 50 percent of each flash cycle. Light intensity shall be not less than 7,000 candelas. The 2 by 4-footboards shall only be used during the hours from dusk to dawn.

The 4 by 8 footboards shall be equipped with 6-inch high intensity lights, and the arrow panel message shall be comprehensible by a driver from a distance of 1 mile on a sunny day or a clear night. The lights shall flash in unison at a rate of 30 flashes per minute, and the flash duration shall be 50 percent of each flash cycle. Each light shall have a minimum peak intensity of 8,800 candelas and shall be equipped with a photoelectric cell that shall automatically reduce the peak intensity to 1,500 candelas when ambient light level drops to 5 foot-candles. The 4 by 8 footboards may be used 24 hours a day as required.

The lighting system shall have solid state controls, polarity and surge protection, contained in a lockable control box.

Solar powered battery recharge arrow boards may be used in place of diesel powered battery recharge arrow boards in all non-moving operations. Their use is especially recommended in residential areas and other situations where the noise of the diesel powered battery recharge system would be objectionable.

When solar powered battery recharge arrow boards are used, a manufacturer's representative must be present before actual use on the Project to instruct personnel on the proper use and set-up of the solar powered battery recharge arrow boards.

Solar powered battery recharge arrow boards, which do not meet the above requirements for light intensity shall be reviewed and approved by the Department before use on Projects.

A list of solar powered battery recharge arrow boards approved for use on Projects will be provided in the Special Provisions.

{ XE "Variable message signs" }**4. Variable Message Signs.** Variable message signs shall be capable of displaying messages visible from distances of ½ mile under ideal day and night conditions and legible at distances of 900 feet under all weather conditions. A variable message sign unit shall be mounted on a two-wheeled trailer.

The trailer-mounted variable message sign units shall be structurally adequate to withstand sustained freeway travel speeds of 55 miles per hour with the sign panels in the travel position. The sign panels and the trailers shall be within legal height and width limits, and meet all State and Federal requirements for towed units, when in the travel position.

The complete message sign units shall be designed to operate in the ambient temperature range of -31 to 158 ºF. When in operation, the units shall be capable of withstanding wind gusts up to 80 miles per hour all stabilizing devices in place. The units shall not be affected by mobile radio transmissions.

All controls shall be located in lockable enclosures, which shall also be weather and shock resistant.

A variable message sign shall consist of the following:

a. Sign Panel Assembly. The sign panel assembly shall be of aluminum or stainless steel construction. The sign panel shall consist of three lines of individually changeable orange characters on a black background that are at a wavelength of 590 nanometers. Each line shall be capable of displaying eight characters equally spaced a minimum of 3 inches apart. Each

character shall be a minimum of 1 foot-5 inch in height and 1 foot in width. Each character shall be made up of a matrix of bulbs or the following:

(1) A cluster of 35 LED lamp pixels which have a minimum of four LEDs and maximum of six LEDs per pixel.
(2) A full LED matrix character board.
(3) A full LED matrix board.

The lamps for a bulb matrix sign shall be rugged, high performance, bayonet, or screw base units. Each lamp shall be a minimum of 20 watts with a life expectancy of at least 8,000 hours. The lamps shall have a minimum light output to meet visibility requirements. All wiring shall be suitable for outdoor use. Each connector point of the wiring harnesses shall be properly marked.

The sign panel shall be covered for increased legibility of the sign messages. A bulb matrix sign shall be covered by a sun screen which has fixed horizontal black louvers tilted at 15 to 20 degrees to the horizontal. An LED sign shall be covered with a clear polycarbonate ultraviolet inhibited material to prevent fading.

b. Controller. The controller shall be a fully self-contained, compact, solid state, modularized unit with at least 199 pre-programmed messages and with additional capability for storing an additional 199 user generated messages. The unit shall be furnished with the dual capability of message generation at the unit by an integral or plug-in type keyboard system, or by remote control by a digital cellular phone. The controller display shall show a miniaturized version of the message being displayed, or to be displayed, on the sign panel. For security purposes, password coding or key entry access shall be provided to lockout the keyboard. No message shall be displayed unless approved.

The antenna for cellular phone reception shall be mounted on top of the sign panel assembly to prevent theft or tampering.

The controller shall be designed so that it can accept a pre-programmed default message or indicator. In the event of power failure, the pre-programmed default message or indicator shall automatically be displayed and remain until such time that repairs can be made, or a minimum of 12 nighttime viewing hours. The default message or indicator can be a single or double flashing or pulsating light (i.e. any warning system that will indicate that the unit is on but not functioning properly).

A diesel and battery powered unit shall be equipped with a photocell to reduce the lamp intensity at night thereby eliminating glare to the motorist.

A designated representative of the Contractor, familiar with the operation and programming of the unit, shall be available on the Project.

c. Power Supply. A variable message sign shall be either diesel or battery powered with both having the capability of operating alternately on 120-volt AC commercial electrical service. The power supply shall conform to the following:

(1) Diesel-Powered. A diesel-powered variable message sign shall consist of an alternator power supply driven by an electrically-started diesel engine. The diesel-powered unit shall include a muffled exhaust system to minimize noise. The exhaust system shall include a United States Department of Forestry approved spark arrester.

The diesel-powered unit shall include a fuel tank of sufficient capacity to provide for a minimum of 72 hours of continuous operation without refueling.

The power supply shall be shock-mounted on a cradle to reduce vibration. The power supply shall be locked in a properly ventilated enclosure.

(2) Battery-Powered. A battery-powered variable message sign shall consist of banks of batteries recharged by a solar panel array. The number and size of the battery banks and solar panel array shall be sufficient to operate the sign panel for a period of 18 days without the array being exposed to sunlight. The solar panel array shall be capable of recharging the battery banks at a rate of four hours of sun for one 24-hour period of sign usage. The battery-powered unit shall incorporate an automatic intensity control feature to keep the LED lamp matrix intensity constant with a reduction in battery voltage.

The battery-powered unit shall be designed to also accept recharging from an internal or external diesel engine driven alternator power supply should there be a lack of proper sunlight.

A diesel generator shall be available on the site to charge the batteries in the event the batteries become sufficiently discharged, thereby making the variable message sign non-functional.

d. Structural Support System. The structural support system shall be designed to allow for the sign panel assembly, controller, and power supply to be assembled into a unit that is easily mountable on a trailer. The structural system shall support the sign panel assembly at the proper height and orientation required for visibility, as indicated in Part VI of the MUTCD.

The structural support system shall provide adequate support to allow for complete sign operation, including raising and lowering the sign panel at sustained wind speeds of 30 miles per hour. The raising and lowering mechanism can be either motor-driven or manually operated. If motor-driven, a manual back-up shall be provided in case of electrical failures.

5. Temporary Crash Cushions.

a. Inertial Barrier System. Temporary inertial barrier modules shall be made of frangible polyethylene material, as recommended by the manufacturer, except that the outer surface of the modules shall be a highway yellow color. The modules shall be designed to meet the safety performance recommendations of the NCHRP Report 350, and shall have FHWA approval.

b. Crushable Energy Absorbing System. Temporary crushable energy absorbing system shall be QuadGuard CZ, as designed and manufactured by Energy Absorption Systems, Inc., Chicago, Illinois. The manufacturer shall certify that the system has been crash tested according to NCHRP Report 350 and has passed the Test Level 3. The nose cover shall be a highway yellow color.

c. Non-redirective Energy Absorbing Terminal (N.E.A.T). Temporary crash cushion N.E.A.T. shall be as designed and manufactured by Energy Absorption Systems, Inc., Chicago, Illinois. The manufacturer shall certify that the system has been crash tested according to NCHRP 350 and has passed the Test Level 2. The nose cover shall be a highway yellow color with Chevron stripes.

This device shall be used on roadways where the posted speed limit is less than 40 miles per hour.

6. Traffic Control Trucks with Mounted Crash Cushions. The trucks shall weigh a minimum of 10 tons gross when in use for traffic control. The trucks shall be adaptable to mounting crash cushions at the rear and illuminated flashing arrows on the bed or on the rear of the trucks.

The crash cushions shall be lightweight systems designed by the manufacturer for installation at the back of the trucks. The crash cushions shall meet the safety performance recommendations of the NCHRP Report 350. The crash cushions shall consist of crushable yellow energy absorbing modules, hydraulic tilting systems, and backup structures designed for attaching the system to the trucks. The rear facing of the modules shall have 4-inch wide black strips on high retroreflective yellow sheeting in an inverted "V" pattern. The retroreflective sheeting shall be Type II or Type III-A as specified in Subsection 916.04. The crash cushions shall have standard trailer lighting systems including brake lights, taillights, and turn signals. All exposed steel shall be primed and painted yellow.

The illuminated flashing arrows shall be 4 by 8 foot boards conforming to Subheading 3 above.

The mounting of the crash cushions at the rear and the illuminated flashing arrows on the bed or on the rear of the trucks shall be according to the manufacturer's recommendations. The illuminated flashing arrows shall be fully visible, at all times, to vehicles approaching or following either a stationary or moving operation.

Crash cushions that are damaged or become inoperable shall be repaired or replaced. An adequate number of replacement parts to repair damaged units shall be available on the Project without additional compensation.

CONSTRUCTION

617.04 General.

When the construction involves improvement of an existing roadway, the roadway shall be kept open to traffic unless otherwise approved or shown on the Plans.

The portion of the Project that is opened to traffic shall be kept in such condition that traffic is adequately accommodated. Temporary approaches or crossings and intersections, and access to trails, roadways, businesses, parking lots, residences, garages, and farms shall be provided and maintained in a safe condition. The owners of adjoining properties shall be given a written notice at least three days before the beginning of any Work that interferes with the owners' normal passage.

{ XE "Damage to:newly constructed or existing pavements" **}**Equipment or machinery having crawler tracks or other treads that may mar or damage pavements shall not move over or operate from newly constructed or existing pavements unless precautions are taken to prevent such damage.

Any damage to newly constructed or existing pavements within the limits of the Project or adjacent thereto, which in the opinion of the Engineer was caused by the Contractor's operations, shall be repaired as directed, at the Contractor's expense, or the repairs will be made by the Department and the cost of such repairs will be deducted from any monies due or that may become due the Contractor.

Any restrictions of required traffic lane widths or diversion of traffic at any time are subject to approval.

Except as necessary during actual working hours, and then only with approval, equipment, materials, personnel, or employee vehicles shall not occupy any traveled way, shoulder, median, or sidewalk area within or adjacent to the Project that is open to traffic.

{ XE "Materials:storage" **}**If approved, State property adjacent to the traveled way and shoulders may be used for storage of equipment and materials provided the equipment and materials are placed behind barriers or crash cushions, or are stored more than 30 feet from the traveled way. The barriers and crash cushions must be approved before installation. Furnishing, placing, and removing the barriers and crash cushions shall be at no cost to the State.

Work that closes or alters the use of existing roadways shall not be undertaken until adequate temporary or permanent provisions for traffic have been approved.

Where it is necessary for pedestrians to cross or walk within the limits of the Project, temporary sidewalks shall be provided, maintained, and removed as directed.

{ XE "Maintaining and protecting traffic:construction above traffic" **}**Construction above vehicular or pedestrian traffic shall not be performed unless there is explicit provision made in the Special Provisions or specific written permission given. Subject to such provision or permission, necessary devices and means to protect such traffic from falling construction materials or other objects, and from painting operations shall be provided at no cost to the State during the time that construction is performed above traffic. The precautions to be taken for the protection of traffic are subject to approval.

Before beginning a seasonal shutdown or any other prolonged Work stoppage, or when Work is suspended according to Subsection 108.14 or 108.15, all excavated areas within the traveled way or adjacent thereto shall be brought to a grade compatible with the existing traveled way or to finished grade, as approved.

617.05 Nighttime Operations.{ XE "Nighttime operations" }

All operations that are performed during the non-daylight hours shall be properly illuminated to allow for the complete performance and inspection of the work. This work shall consist of furnishing, installing, operating, maintaining, moving, and removing portable light towers and equipment-mounted lighting fixtures for nighttime construction operations, for the duration of nighttime work on the Contract. Nighttime operations consist of work specifically scheduled to occur after sunset and before sunrise. Should the Contractor elect on its own to operate during these hours, the requirements of this Subsection shall apply and no additional compensation will be made. Before nighttime operations may begin the Contractor shall demonstrate to the Engineer that its nighttime operation meets the light level requirements.

1. **Light Levels and Illumination Requirements**. A minimum of 5 foot-candles shall be maintained throughout the entire area of operation. Area of operation is a work area that is a minimum of 50 feet ahead and behind the employee, where an employee is on or near the roadway.

   A minimum illuminance level of 5 foot-candles shall be provided during the setup and removal of lane or roadway closures installed in conjunction with nighttime construction operations.

Specific tasks should meet the minimum illumination levels shown in the following table:

Minimum Illumination Level	Description of Tasks	Areas of Illumination
5 foot-candles	Embankment, fill, and compaction Excavation - regular, lateral ditch, and channel Landscape, grassing, and sodding Maintenance of earthwork embankment Mechanical sweeping and cleaning Reworking shoulders Subgrade stabilization and construction	General illumination throughout area of operation
5 foot-candles	HMA milling * HMA paving operation *	General illumination throughout area of operation Minimum of 200 feet ahead and 200 feet behind equipment
5 foot-candles	HMA roller operation *	General illumination throughout area of operation Minimum of 100 feet ahead and 100 feet behind equipment
10 foot-candles	Barrier walls and traffic separators Base course construction HMA milling * HMA paving operation * HMA roller operation * Bridge decks Bridge painting Concrete pavement Drainage structures, culverts, and storm sewers Guide rail and fencing Highway signs and permanent installation Removal of pavement Other concrete structures Painting stripes and pavement markers Pot hole filling Repair of concrete pavement Resetting guide rail and fencing Sidewalks Surface treatment Waterproofing and sealing Any other operation not listed in this table	General illumination of tasks and around equipment Minimum of 25 feet ahead and 25 feet behind equipment Illumination shall be provided on the sides of the equipment.
20 foot-candles	Crack filling, sawcutting, and sealing joints Electrical work Highway street lighting Traffic signals Intelligent transportation systems	Illumination on task

* Both requirements of 5 foot-candles and 10 foot-candles for these operations must be met.

Light meter readings shall be taken horizontally to the roadway surface facing the light source.

If the Contractor fails to meet minimum illuminance levels at any time, the Contractor shall cease its nighttime operations until such time that required light levels are attained.

The uniformity of illuminance, defined as the ratio of the average illuminance to the minimum illuminance over the work areas, shall not exceed 5:1.

Construction operations shall be deemed to include all work operations by the Contractor's personnel, including layout and measurements ahead of the actual work.

2. Equipment. Materials and/or equipment shall be in good operating condition and in compliance with applicable OSHA, NEC, and NEMA codes.

The Contractor shall furnish, for use by the Engineer, two light meters capable of measuring the level of illuminance in lux. These light meters shall be supplied to the Engineer for use as necessary to check the adequacy of illumination throughout the nighttime operations. The light meters will become the property of the Contractor after Acceptance.

The Contractor shall provide suitable brackets and hardware to mount lighting fixtures and generators on machines and equipment. Mountings shall be designed so that lights can be aimed and positioned as necessary to reduce glare and to provide the required illuminance. Mounting brackets and fixtures shall not interfere with the equipment operator or any overhead structures and shall provide for secure connection of the fixtures with minimum vibration.

Portable and trailer-mounted light towers shall be sturdy and free-standing without the aid of guy wires or bracings. Towers shall be capable of being moved as necessary to keep pace with the construction operation. Portable towers and trailers shall be positioned to minimize the risk of being impacted by traffic on the roadway or by construction traffic or equipment.

Light towers mounted on paving and milling machines, rollers, and other paving equipment shall not exceed the height of vertical underclearances, such as trees, aerial utilities, or bridge underclearances. Lights shall be aimed and adjusted to provide uniform illumination with a uniformity ratio of 5:1. The hopper, auger, and screed areas of pavers shall be uniformly illuminated. The operator's controls on all machines shall be uniformly illuminated.

Conventional vehicle headlights shall not be permitted as the means of illumination while working. All moving equipment used for nighttime operations shall have a lighting system consisting of a minimum of two lights directed in each direction of travel of the equipment. Off-road equipment shall have high intensity retroreflective sheeting along the length of all four sides. On-road equipment shall have this sheeting at a minimum, along the length, excluding the cab, and across the back of the body of the vehicle. Trailers and trailer-mounted devices shall be equipped with sheeting on both sides and across the back. Sheeting shall be 2 inches wide with alternating red and white strips and meet current National Highway Transportation Safety Administration requirements for red and white conspicuity tape. All workers shall, during the hours of darkness, wear reflectorized garments as specified for traffic directors.

Existing street and highway lighting shall not eliminate the need for the Contractor to provide lighting. Consideration may be given to the amount of illumination provided by existing lights in determining the wattage and/or quantity of lights to be provided.

The Contractor shall provide sufficient fuel, spare lamps, generators, and qualified personnel to ensure that all required lights operate continuously during nighttime operations. Each generator shall have a fuel tank of sufficient capacity to permit operation of the lighting system for a minimum of 12 hours. In the event of any failure of the lighting system, the operation shall be discontinued until the required level of illumination is restored. Hydraulic generator systems shall be used in residential areas and areas designated to minimize noise pollution. If hydraulic generator systems are unavailable, other generator-powered systems may be used with the approval of the Engineer.

A supply of emergency flares shall be maintained by the Contractor for use in the event of emergency or unanticipated situations.

3. Glare Control. All lighting provided under this item shall be designed, installed, and operated to avoid glare that interferes with traffic on the roadway or that causes annoyance or discomfort for residences adjoining the roadway. The Contractor shall locate, aim, and adjust the lights to provide the required level of illuminance and uniformity in the work area without the creation of objectionable glare. The Engineer shall be the sole judge of when glare is unacceptable, either for traffic or for adjoining residences. The Contractor shall provide screening such as shields, visors, or louvers on lights as necessary to reduce objectionable levels of glare.

617.06 Detours.{ XE "Detours" }{ XE "Maintaining and protecting traffic:detours" }

Approval of the Engineer and consent of the local authorities having jurisdiction shall first be obtained for rerouting traffic over detours that are not shown on the Plans. All necessary arrangements shall be made with such authorities regarding the establishment, maintenance, and repair of such detours, the regulation and direction of traffic thereon, and signing. Adequate directional and detour signs, acceptable to the local authorities, shall be furnished and erected at the locations where such authorities may direct. All Work in connection with such detours shall be at no cost to the State.

Any detours used exclusively for hauling materials and equipment shall be constructed and maintained at no cost to the State.

617.07 Stage Construction.{ XE "Stage construction" }

{ XE "Maintaining and protecting traffic:new traffic patterns" **}{** XE "Closing roadways" **}{** XE "Dead-ended roadways" **}{** XE "Maintaining and protecting traffic:closing roadways" **}**The Engineer shall be notified one month in advance of a tentative date for establishing new traffic patterns. This date shall be finalized 14 calendar days before the establishment of the new traffic patterns resulting from stage construction, and 21 calendar days before the establishment of a detour for the closing of any roadways.

Existing roadways that are proposed to be dead-ended or abandoned shall not be closed to traffic until adequate temporary or permanent provisions for traffic have been approved.

617.08 Traffic Control Coordinator.{ XE "Traffic:control:coordinator" }

Before the start of construction operations, the Contractor shall assign a supervisory-level employee to be the traffic control coordinator. The Resident Engineer shall be notified as to the name and method of contacting the traffic control coordinator on a 24-hour basis.

The traffic control coordinator shall be a full-time position. The traffic control coordinator shall have successfully completed the Rutgers R2T2 Traffic Control Coordinator Program, or an equivalent course of training as approved by the Office of Capital Project Safety, and shall be delegated authority by the Contractor to implement and maintain all traffic control operations on behalf of the Contractor. The traffic control coordinator shall be approved by the Engineer based on a written request of the Contractor. The request shall set forth in detail the training and experience of the traffic control coordinator. The traffic control coordinator shall be assisted by additional members of the Contractor's work force as needed and as mutually agreed upon by the Engineer and the traffic control coordinator. The traffic control coordinator shall be equipped with a vehicle capable of traversing the entire project and a mobile communications system. When requested by the Engineer, the traffic control coordinator shall demonstrate competency to the Engineer; failure to demonstrate competency shall result in the immediate replacement with a competent person.

The traffic control coordinator shall perform daily inspections, including weekends and holidays, with some inspections at night, and take all corrective action to ensure compliance with the traffic control plan and other approved standards. The Engineer shall be advised of the schedule of these inspections and be given the opportunity to join in the inspection. In addition, the duties of the traffic control coordinator shall include, but shall not be limited to, the responsibility for ensuring the following:

1. Set-up and removal of all traffic control devices according to the Contract Documents.
2. Correction of deficiencies of traffic control devices within two hours of discovery or notification by the Engineer.
3. Repositioning traffic control devices displaced by traffic or construction equipment.
4. Covering or uncovering signs as appropriate.
5. Repairing or replacing damaged traffic control devices.
6. Replacing batteries, light bulbs, control panels, and other electrical components.
7. Keeping all traffic control devices clean.
8. Adding fuel and oil to power units for traffic control devices.
9. That all Contractor equipment and vehicles are properly stored and packed so as not to create a traffic hazard.
10. Properly storing traffic control devices when not in use.
11. That all excavations or drop-offs greater than 2 inches deep are eliminated, covered, or otherwise protected during non-working periods.

617.09 Traffic Control Plan (TCP).{ XE "Traffic:control:plan" }{ XE "Maintaining and protecting traffic:traffic control plan" }

The TCP provides for the treatment of conditions caused by or encountered during the Work on the Project. The Work shall be performed according to the TCP.

The TCP shall be a stand-alone document and shall not be reliant on any ancillary conditions or circumstances relative to the Project site. It is the Contractor's sole responsibility to implement the TCP. The TCP shall not be the original plan detail or a subsequent modification as proposed by the Contractor unless specifically adopted by the Contractor, in writing, and the Contractor provides detailed information as to how the original or modified original plan will support its operation with the Engineer's approval.

Thirty days before the start of Work, the Contractor shall submit a written TCP operations to the Engineer for acceptance. The Engineer will review and approve the TCP with reasonable promptness for conformance with the Contract Documents. The Engineer's approval of the TCP does not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents, unless the Contractor has informed the Engineer in writing of such deviation at the time of submission and the Engineer has given written approval to the specific deviation, nor does the Engineer's approval relieve the Contractor from responsibility for errors or omissions in the TCP. The TCP shall detail the means of traffic control for all aspects of the Contractor operations. The TCP shall be signed and bear the embossed seal of a Professional Engineer licensed to practice in the State. The TCP shall identify any contingencies or foreseen problems and address remedial actions. Subsequent changes to the TCP during the progress of the Work to accommodate actual or unforeseen project conditions shall be submitted and approved as specified above.

617.10 Traffic Directors.{ XE "Traffic:control:directors" }{ XE "Maintaining and protecting traffic:traffic control directors" }

A. Trained Flaggers. Trained flaggers shall be in good physical condition, including sight and hearing, mentally alert, and shall have a courteous but firm manner, neat appearance, and a sense of responsibility for the safety of the public. Trained flaggers shall wear an orange or fluorescent orange garment such as a shirt, jacket, or vest. This garment shall be reflectorized for nighttime operations with reflective material that shall be orange in color. When controlling traffic, trained flaggers shall be equipped with STOP/SLOW paddles, and shall follow the procedures stipulated for flaggers in the MUTCD.

Traffic directors as specified in this Subsection shall be an approved subcontractor or employees of the Contractor so indicated and on the Contractor's payroll. They shall not be police from any jurisdiction working on behalf of the Contractor while in uniform or in any other official status. All trained flaggers used as traffic directors shall be formally trained in flagging operations and proper use of the **STOP/SLOW** paddle. This training may consist of ATSSA, union, or trade association training, or training by an individual who has received formal training from a recognized program or agency in work zone traffic control. When requested by the Engineer, traffic directors and/or flaggers shall demonstrate competency to the traffic control coordinator; failure to demonstrate competency to the traffic control coordinator shall result in the immediate replacement with a competent person.

B. Traffic Safety Services. Traffic safety services shall consist of the assignment and use of police in conjunction with the Resident Engineer in the enforcement of the approved TCP, and applicable laws to provide a safe worksite for both construction personnel, and the traveling public.

Police providing traffic safety services shall be on-duty New Jersey State Police (NJSP) unless otherwise designated, at the Preconstruction Conference, to be on-duty police officers from the municipality or county within which the Work of the Project is to be accomplished. The term "municipal police" when used shall mean all police other than NJSP.

Police will be assigned during construction hours at locations and times designated by the Engineer. The Contractor agrees that it shall make no claims against the State for extra costs resulting from any delays or interruptions to its operations attributable to the actions or inactions of police in the performance of traffic safety services. The Contractor further agrees that it has incorporated in its Proposal any costs that may be incurred by the Contractor as a result of the actions or inactions of police in the performance of traffic safety services, and agrees to bear the risk of loss for any costs not included in its Proposal.

Police providing traffic safety services shall operate traffic signals when manual control of the signals is required, or shall maintain traffic flow at a signalized intersection when the signals are temporarily out of service.

The use of police on the Project will be as determined and directed by the Engineer. The Engineer's projections for anticipated usage of police shall consider the Contractor's operations provided that the Contractor notify the Engineer of planned operations at least 72 hours before projected usage. The Project progress schedule shall not constitute notice for usage of police traffic directors. Assignment of police to the Project will be on the basis of the Contractor's operations, and the needs of the worksite, and will be made solely by the Engineer with the advice of the NJSP.

The Contractor's failure to give complete, detailed, timely and proper notice of its operations shall not be cause for claims for extra costs by the Contractor, nor shall the number of police assigned to a project constitute a valid basis for a claim by the Contractor. The Contractor agrees that the TCP is a stand-alone document, and that the Contractor is solely responsible for the safety of the Project, the continuity of movement of traffic through the worksite, and the impact of traffic on its work.

The Contractor is advised that there may be emergency situations when police are not available, or when police do not arrive at the job site until after the scheduled arrival time or leave before the scheduled departure time. The Contractor agrees that it shall make no claims against the State for any costs associated with the failure of police to be on the job site at a scheduled time. The Contractor further agrees that it shall assume all risk of the possibility of such occurrences and shall factor the associated costs into its Proposal.

The Contractor shall be fully responsible for the set-up and maintenance of the TCP except as required by State law or as specifically set forth in the Contract. The use of police in the providing of traffic safety services is supplemental to the TCP and their presence shall not relieve the Contractor of its responsibility to maintain the TCP and safety on the Project.

The Contractor shall notify the Resident Engineer of any work cancellations at least 24 hours before the start of work with the sole exception of unforeseen weather cancellations that occur after the start of work or less than 24 hours before the start of work.

When police have been assigned to a project by the Resident Engineer, it is the Contractor's obligation to notify the Engineer of all cancellations of projected or scheduled operations. Police reporting for work will be reimbursed for a minimum of four hours. If projected work has been canceled, for whatever reason, including but not limited to foreseen weather conditions, and the Resident Engineer was not notified of the cancellations at least 24 hours before by the Contractor, except as noted above, the police will each be reimbursed for four hours of work. These payments will be made by the State through interagency transfer and the amount will be deducted from Contractor invoices.

617.11 Variable Message Signs.{ XE "Variable message signs" }

Variable message signs shall be located such that they provide motorists with clear, unobstructed visibility of the signs from distances of ½ mile and legibility of the sign messages at a minimum of 900 feet from all lanes of traffic. The variable message signs shall be physically located off of the traveled way or behind approved closure devices as directed. All messages shall be cycled so that two message cycles are displayed to a viewer beginning at a point 900 feet distant from the source with a total minimum viewing angle of 25 degrees and completing both message cycles when the same viewer is 250 feet distant from the source.

Battery-powered variable message signs shall be used in residential areas, and areas designated, to minimize noise pollution. If battery-powered variable message signs are unavailable, diesel-powered may be used with approval.

All control panel enclosures shall be kept locked when left unattended to prevent tampering with the displayed messages or general operation of the signs.

Malfunctioning variable message signs shall be repaired or replaced within 12 hours.

617.12 Temporary Crash Cushions.{ XE "Temporary:crash cushions" }

A. Inertial Barrier System. Temporary inertial barrier system modules shall be placed on relatively flat surfaces. The systems shall conform to the specified weights and module configurations. Each module shall be placed by outlining its location on the roadway surface with removable tape or other non-permanent marking, thereby marking the periphery of the modular base, and identifying its weight within the circumference. The module manufacturer's trained technician shall be on the Project at all times during the installation of the system.

Temporary inertial barrier modules may be placed on wooden or steel platforms to facilitate relocation. No part of a wooden platform shall be more than 4 inches in height or extend more than 8 inches beyond the modules. No part of a metal platform shall be more than 2 inches in height or extend more than 8 inches beyond the modules.

Loose sand, conforming to Subsection 901.10, Subpart C, shall be placed within each module to a depth recommended by the manufacturer. The sand shall have a dry density of 90 to 100 pounds per cubic foot and a three percent maximum allowable moisture content. Five to seven percent of sodium chloride (NaCl) by weight shall be added and evenly dispersed throughout the sand to prevent freezing. Calcium chloride ($CaCl_2$) shall not be submitted for sodium chloride.

A plastic lid shall be placed on the module in such a manner as to ensure that no weather elements come in contact with the sand. Four equidistant rivets or other fasteners, recommended by the manufacturer and

approved by the Department, shall be installed on the periphery of the lid to prevent high velocity escape upon impact.

When different manufacturers supply temporary inertial barrier system units for a Project, different modules shall not be intermixed within any inertial barrier system.

Modules which are lost, stolen, destroyed, or are determined to be unacceptable shall be replaced without additional compensation.

Temporary inertial barrier system units shall be kept clean and maintained in good condition. Damaged units shall be restored immediately according to Subsection 617.08. An adequate number of replacement parts to repair damaged module units shall be available on the Project without additional compensation. All debris resulting from damage to a system shall be removed and disposed of.

When no longer required for the Project, the inertial barrier system units shall be removed and disposed of.

B. Crushable Energy Absorbing System. Temporary QuadGuard shall be installed on relatively flat concrete or HMA foundation with steel backup structures according to the manufacturer's recommendations. The manufacturer's trained representative shall be present at all times during the installation.

Temporary QuadGuard components that are lost, destroyed, or are determined to be unacceptable shall be replaced without additional cost to the Department.

Temporary QuadGuard units that are damaged shall be restored immediately according to Subsection 617.08. An adequate number of replacement parts to repair the damaged units shall be available on the Project site at no additional cost to the Department.

When no longer required for the Project, the temporary QuadGuard components shall be removed and disposed of.

C. Non-redirective Energy Absorbing Terminal. Temporary crash cushion N.E.A.T. units shall be installed on relatively flat surface according to the manufacturer's recommendations. The manufacturer's trained representative shall be present at all times during the installation.

Temporary N.E.A.T. components that are lost, destroyed, or are determined to be unacceptable, shall be replaced without additional cost to the Department.

Temporary N.E.A.T. units that are damaged shall be restored immediately according to Subsection 617.08. An adequate number of replacement parts to repair the damaged units shall be available on the Project site at no additional cost to the Department.

When no longer required for the Project, the temporary N.E.A.T. units shall be removed.

617.13 Removable Black Line Masking Tape{ XE "Traffic:stripes:black line masking of" }.

The black line masking tape shall temporarily obscure the existing permanent traffic stripe on HMA surfaces. The existing traffic stripe shall be completely covered or masked by the application of the black line tape.

The black line masking tape shall be applied over dry existing traffic stripes according to the manufacturer's recommendations and when the weather is favorable as determined by the Engineer. Any portion of the black line masking tape that is loosened after placement over the existing traffic stripe, shall be replaced by the Contractor within two hours or as directed by the Engineer at no cost to the State.

Proper care shall be taken in completely unmasking the existing underlying traffic stripe without the use of heat, solvents, grinding, sanding, or water, when the black line masking tape is no longer required.

Existing permanent traffic stripes that become damaged during removal of the black line masking, including discoloration caused by the black masking tape, shall be replaced by the Contractor at no cost to the State.

617.14 Temporary Pavement Markers.{ XE "Temporary:pavement markers" }

Markers shall be applied using butyl adhesive pads to clean, dry pavement surfaces which are free of cracking, checking, spalling, or failure of underlying base material. If during installation, a marker will be placed on one of these defects or a joint, the affected marker shall be relocated longitudinally a minimum of 2 inches. Any marker that comes up from the pavement before the permanent traffic stripes shall be replaced by the Contractor at no cost to the State.

Temporary markers that have been placed in the same location as where the permanent stripes will be placed shall be removed before striping. These markers shall not be removed until the striping equipment is on site and the striping operation is ready to commence. Should there be a breakdown of the striping equipment and the traveled way is to be reopened, the removed markers shall be reapplied at no cost to the State before reopening the traveled way.

All temporary markers shall be removed when no longer required. Any pavement area that has been determined to be damaged as a result of the removal operation shall be repaired at no cost to the State by the method specified by the Engineer.

617.15 Removable Pavement Marking Tape.{ XE "Removable pavement marking tape" }

Removable pavement marking tape shall be applied at designated locations. The tape shall be white or yellow and shall be applied in single or double lines, as designated.

The surface upon which the tape is to be applied shall be prepared according to Subsection 618.05. Marking tape shall be applied on dry surfaces, when the surface temperature is between 50 and 150 ºF and when the ambient temperature is 50 ºF and rising, and when the weather is otherwise favorable as determined by the Engineer. The tape shall not be overlapped, and only butt splices shall be used.

To ensure maximum adhesion, the tape shall be tamped and a truck shall be driven slowly over the tape several times. The tape shall be removed when no longer required for traffic control.

Tape that has become damaged and is no longer serviceable shall be replaced and will not be measured for payment. Tape that is damaged by construction operations shall be replaced without additional compensation.

COMPENSATION

617.16 Method of Measurement.

The quantity of traffic control devices measured by the linear foot, unit, or unit basis is the maximum quantity required to be in service at one time according to traffic control requirements.

Breakaway barricades will be measured by the number of units.

Construction barriers of the various kinds and types will be measured by the linear foot.

Construction signs will be measured by square foot.

Construction identification signs of the various sizes will be measured by the unit.

Delineator guide posts, drums, traffic cones, and vertical panels will be measured by the number of units.

Temporary sidewalk will be measured by the square yard.

Traffic directors, flaggers will be measured by the hour.

Police providing traffic safety services are not employees of, nor are they to be paid by, the Contractor. Hours of police assigned to the Project will not be measured for payment except as noted above where reimbursement of the State is required. Police, if NJSP, are employees of the State. Police, if municipal police, are employees of the municipality in which the Project exists and serve as a vendor service to the State.

Variable message signs will be measured by the unit.

Temporary crash cushions, inertial barrier system will be measured by the number of units. A unit shall consist of a total inertial barrier system composed of the required number of modules.

Temporary crash cushions, crushable energy absorbing system, QuadGuard will be measured by the number of units. A unit shall consist of a total energy absorbing system composed of the required number of bays.

Temporary crash cushion, N.E.A.T. will be measured by the number of units. A unit shall consist of a total energy absorbing system and all components required to attach the system to construction barrier.

Traffic control trucks with mounted crash cushions will be measured by the number of units. A unit shall consist of the truck, crash cushion, and arrow board.

Temporary pavement markers will be measured by the number of units.

Removable pavement marking tape will be measured by the linear foot of 4-inch wide strips, deducting the gaps. Gaps will not be counted.

Removable black line masking tape will be measured by the linear foot for each 4-inch width of existing stripe that is to be covered. Gaps will not be counted.

617.17 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
BEAM GUIDE RAIL, CONSTRUCTION BARRIER	LINEAR FOOT
BREAKAWAY BARRICADES	UNIT
CONSTRUCTION SIGNS	SQUARE FOOT
CONSTRUCTION IDENTIFICATION SIGNS, ___ ' X ___ '	UNIT
DELINEATOR GUIDE POSTS	UNIT
DRUMS	UNIT
ILLUMINATED FLASHING ARROWS, ___ ' X ___ '	UNIT
PRECAST CONCRETE CURB, CONSTRUCTION BARRIER, TYPE ___	LINEAR FOOT
TEMPORARY SIDEWALK	SQUARE YARD
TRAFFIC CONES	UNIT
TRAFFIC DIRECTORS, FLAGGERS	HOUR

VARIABLE MESSAGE SIGNS	UNIT
VERTICAL PANELS	UNIT
TEMPORARY CRASH CUSHIONS, INERTIAL BARRIER SYSTEM, ___ MODULES	UNIT
TEMPORARY CRASH CUSHIONS, QUADGUARD, ___ BAYS, ___ "WIDE	UNIT
TEMPORARY CRASH CUSHIONS, N.E.A.T.	UNIT
TRAFFIC CONTROL TRUCKS WITH MOUNTED CRASH CUSHIONS	UNIT
TEMPORARY PAVEMENT MARKERS	UNIT
REMOVABLE PAVEMENT MARKING TAPE	LINEAR FOOT
REMOVABLE BLACK LINE MASKING TAPE	LINEAR FOOT

No payment will be made to the Contractor for traffic safety services.

Payment for traffic control devices that are on a unit or linear foot basis will be made at 50 percent of the Contract bid price upon delivery, placement, and approval with the balance prorated over the duration of the Contract.

Separate payment will not be made for relocating traffic control devices and the lighting systems used for nighttime operations as required or as directed, except for relocations of precast concrete curb construction barrier required by change of plan or because of a change in the staging of the project as directed by the Engineer. Payment for these approved relocations of precast concrete curb construction barrier will be made by Supplementary Agreement; however, if a Supplementary Agreement cannot be reached, payment will be made on a force account basis according to Subsection 109.03. No separate payment for reallocations or precast concrete curb construction barrier will be made for additional relocations due to changes in staging of the Project or for relocations made for the Contractor's convenience.

Separate payment will not be made for posts for construction signs.

Separate payment will not be made for lighting for nighttime operations, but all costs thereof shall be included in the prices bid for the various Pay Items scheduled in the Proposal.

Separate payment will not be made for traffic control coordinator but all costs thereof shall be included in the various Pay Items scheduled in the Proposal.

Separate payment will not be made for relocating temporary crash cushions as required or as directed.

Separate payment will not be made for moving the traffic control truck units during the various stages of construction.

Separate payment will not be made for escape ramps provided at the edges of pavement lifts or at excavations. All costs thereof shall be included in the prices bid for the various Pay Items scheduled in the Proposal.

SECTION 618 - TRAFFIC STRIPES AND MARKINGS{ XE "TRAFFIC:STRIPES" }

618.01 Description.

This work shall consist of applying white or yellow pavement stripes or markings and reflectors and castings to HMA or portland cement concrete surface.

Removal of traffic stripes and markings consists of the removal of white or yellow stripes or solid areas, letters, arrows, and other symbols from HMA and portland cement concrete surfaces.

MATERIALS

618.02 Materials.

Materials shall conform to the following Subsections:

EQUIPMENT

618.03 Equipment.

The epoxy striping unit shall be so designed, equipped, maintained, and operated that the material is properly applied in variable widths at a consistent temperature. The epoxy striping unit shall include a tachometer and a pressure gauge and calibrated holding vessel for each component. The holding vessels for the epoxy pigments and the hardener shall have thermometers for measuring the temperature of the vessel contents. The striping unit shall be equipped with a separate power unit for the pumps used in the mixing and distribution of the components. The following shall be furnished with each epoxy striping unit:

1. A calibration sheet that shows the number of the truck body, the capacity thereof, and an outage table in increments of not over ½ inch. This calibration sheet must be certified by the manufacturer or testing agency.
2. A metal rod for each holding vessel, with accurate divisions marked and consecutively numbered starting at the bottom. The rod shall be not less than 1 foot longer than the depth of the vessel.
3. Slip-proof steps with handrail to reach ground level.
4. Slip-proof catwalk with handrail, running along the top of the vessel.
5. Fire extinguisher in working order.

The equipment for applying thermoplastic material shall be capable of providing continuous mixing and agitation of the material. The parts of the equipment conveying the material between the main reservoir and the shaping die shall be so constructed to prevent accumulation and clogging. The mixing and conveying parts and the shaping dies or spray gun shall be capable of maintaining the material at optimum plastic temperature. The equipment shall be so constructed to ensure continuous uniformity in the dimensions of the entire stripe or marking. The kettle provided for the melting and heating of the thermoplastic material shall be equipped with an automatic thermostat control device and heated by a controlled heat-transfer liquid rather than by a direct flame. The heating kettle and applicator shall be equipped and arranged to meet the National Board of Fire Underwriters and State and Federal regulations. The parts of the equipment that come in contact with the material shall be easily accessible for cleaning and maintenance.

All equipment for applying traffic stripes or traffic markings shall be equipped with glass bead dispensers of a type that will mechanically and automatically dispense beads uniformly on wet stripes or markings at the rates specified.

Equipment for removing the various types of traffic stripes or traffic markings shall be designed with a vacuum system to remove all millings from the pavement surface and prevent airborne residue from escaping into the atmosphere.

CONSTRUCTION

618.04 Determination of Acceptability{ XE "Traffic:stripes:acceptability of" }.

The Contractor shall furnish for approval, 20 calendar days before placement, a complete schedule of operations for applying pavement markings, including the numbers and types of equipment, and procedures for the Project.

When long-life epoxy resin traffic stripes are required on the Project, the Contractor shall furnish the manufacturer's written instructions for proper use of the materials, including but not limited to, mixing ratios and application temperatures.

The Contractor shall arrange for and have each long-life material manufacturer's representative on the site for the first full day of applying either long-life traffic stripes or traffic markings to provide technical assistance.

The Contractor shall furnish a Mirolux-12 Retroreflectometer for the Engineer's use in determining the retroreflectance values of the various traffic stripes or traffic markings. This equipment is for the sole use of the Engineer and will become the property of the Contractor after Acceptance.

Before starting long-life epoxy resin traffic striping operations, the Contractor shall construct one or more test strips. Each test strip shall consist of approximately 500 linear feet of pavement with white and yellow striping (lane and edge lines) or markings similar to that required for the Project. The test strips shall demonstrate the capability of the proposed epoxy resin materials, equipment, and procedures to produce long-life epoxy resin traffic stripes that comply with the Specifications, including dimensions, appearance (stripes with uniform color and crisp, well defined edges), wet film thickness, drying time, and glass beads application and retention. A test strip will be required for each applicator unit used. Additional test strips may be required when major equipment repairs or adjustments are made or when the epoxy resin traffic stripes fail to comply with the Specifications. Permission to proceed with the striping operations will be given when the test strips are in compliance. Each test strip may remain in place and become part of the finished stripes subject to the requirements of Subsection 618.10.

618.05 Surface Preparation.

The Contractor shall remove, immediately before striping or marking the pavement surface, all dirt, oil, grease, existing types of traffic stripes or traffic markings, and other foreign material, including curing compound on new portland cement concrete, from the surface areas on which the various traffic stripes or traffic markings are to be placed. The pavement shall be cleaned 1 inch beyond the perimeter of where the stripe or marking is to be placed.

The Contractor shall apply a primer-sealer conforming to NJDEP volatile organic content (VOC) requirements to the areas of HMA surfaces, when recommended by the manufacturer, and to the areas of portland cement concrete surfaces where long-life thermoplastic traffic markings are to be placed.

618.06 Traffic Stripes or Traffic Markings.

The Contractor shall apply latex or alkyd traffic stripes or traffic markings to thoroughly dry surfaces and during dry weather when the ambient and surface temperatures are as specified for that particular material. Each of these types of traffic paint shall be applied at a maximum temperature of 140 ºF and at the thicknesses required as follows:

1. **Latex Traffic Paint.** The Contractor shall apply latex traffic stripes or traffic markings when the ambient and surface temperatures are above 45 ºF and rising. The latex traffic paint shall be applied in a wet film thickness of 6 ± 1 mil where traffic stripes are required for 14 days or less. The traffic paint shall be applied in a wet film thickness of 15 ± 1 mil where traffic stripes or traffic markings are to be visible to traffic 15 days and beyond, or when stripes or markings are to be placed on intermediate pavement layers to be opened to traffic due to stage construction.

   The Contractor shall apply glass beads, according to the gradation specified for latex traffic paint, to the wet paint in a uniform pattern and at the rate of 12 pounds per gallon of paint.

   When traffic stripes or traffic markings are required to remain visible beyond 14 days, the Contractor shall apply, before Acceptance and when directed, additional applications of latex traffic paint and glass beads. These applications shall be applied at least 15 days after the initial application and after any sawing or sealing of joints in the HMA overlay.

2. **Alkyd Traffic Paint.** The Contractor shall apply alkyd traffic stripes or traffic markings when the ambient and surface temperatures are between 35 and 45 ºF. The alkyd traffic paint shall be applied in a wet film thickness of 6 ± 1 mil where traffic stripes are required for 14 days or less. The traffic paint shall be applied in a wet film thickness of 11 ± 1 mil where traffic stripes or traffic markings are to be visible to traffic 15 days and beyond, or when stripes or markings are to be placed on intermediate pavement layers to be opened to traffic due to stage construction.

   The Contractor shall apply glass beads, according to the gradation specified for alkyd traffic paint, to the wet paint in a uniform pattern and at the rate of 6 pounds per gallon of paint.

   When traffic stripes or traffic markings are required to remain visible beyond 14 days, the Contractor shall apply, before Acceptance and when directed, additional applications at least 15 days after the initial application and after any sawing or sealing of joints in the HMA overlay.

618.07 Long-Life Epoxy Resin Traffic Stripes{ XE "Traffic:stripes:long-life epoxy resin" }.

The Contractor shall mix epoxy resin material with an automatic proportioning and mixing machine and hot-spray the compound at a temperature between 100 and 130 ºF onto thoroughly dry surfaces. The material shall only be placed during anticipated dry weather when the ambient temperature is a minimum of 45 ºF and the surface temperature is a minimum of 50 ºF. The temperature of the sprayed mixture shall be adjusted as required for prevailing conditions,

including the air and pavement surface temperatures, to achieve a no-track drying time of 30 minutes or less. The epoxy resin mixture shall be applied in a wet film thickness of 20 ± 1 mil.

Immediately after, or in conjunction with the epoxy resin application, the Contractor shall apply large glass beads and small glass beads to the wet compound. Each type of bead shall be applied in a uniform pattern and each at a rate of 12 pounds per gallon of epoxy resin material.

The Contractor shall remove all epoxy resin material that has been tracked or spilled in areas outside of the intended placement areas.

618.08 Long-Life Thermoplastic Traffic Markings{ XE "Traffic:markings:long-life thermoplastic" }.{ XE "Traffic:stripes:long-life thermoplastic" }{ XE "Traffic:markings" }

The Contractor shall apply either preformed or hot extruded thermoplastic traffic markings using equipment and procedures that produce markings that are straight and have sharp edges; that are the specified color, width, and thickness; that have uniform retroreflectivity; and that are properly bonded to the pavement. The thermoplastic material shall be applied as follows:

1. **Preformed Thermoplastic.** The Contractor shall place preformed thermoplastic traffic marking tape on thoroughly dry surfaces and during anticipated dry weather. The preformed thermoplastic tape shall be melted using the flame from a propane-type torch, according to the manufacturer's recommendations, to bond the traffic markings permanently in position.

   If required, the Contractor shall apply additional glass beads to the hot-wet material in a uniform pattern, to attain the minimum initial retroreflectance value specified in Subsection 618.10 for thermoplastic tape.

2. **Extruded Thermoplastic.** The Contractor shall heat the thermoplastic material uniformly and apply the melted material at a temperature between 400 and 425 ºF, to thoroughly dry surfaces and during anticipated dry weather, when the ambient and surface temperatures are a minimum of 50 ºF. The thermoplastic traffic markings shall be extruded on the HMA or portland cement concrete pavement in a thickness of 90 mils.

   Immediately after, or in conjunction with the thermoplastic application, the Contractor shall apply, by mechanical means, glass beads to the wet material in a uniform pattern and at a minimum rate of 10 pounds per 100 square feet of markings. Hand throwing of the beads will not be allowed.

618.09 Pavement Reflectors and Castings.

The Contractor shall lay out the locations of all pavement reflectors and castings before permanent installation to ensure their proper placement. Roadway grooves into which pavement reflectors and castings are to be bonded shall be cleaned in such a manner that at the time the castings are installed, the grooves shall be free of dirt, dust, oil, grease, moisture, curing compounds, loose or unsound layers, or other material which may interfere with proper bonding. Sand blasting shall be used when required. Casting leveling lugs shall rest on pavement surface and shall not drop below pavement surface. Pavement reflectors and castings shall not be placed on surfaces that show evidence of cracking, checking, spalling, or failure of underlying base material. Pavement reflectors and castings shall not be placed on joints. At longitudinal joints, the reflector and casting shall be located on one side of the joint, a minimum of 2 inches from the joint according to the following requirements:

1. Amber pavement reflectors and castings shall be located on the travel lane side of single yellow paint lines. There shall be a distance of 2 inches from the near edge of line to the near edge of the casting.
2. Amber pavement reflectors and castings shall be located between double yellow paint lines when there is no conflict with a longitudinal joint.
3. Amber or white pavement reflectors and castings shall be located along dashed white traffic stripes at the same longitudinal center axis of the stripes and concurrently located at the midpoint of the unpainted gap between each dashed white line. If a conflict develops between the specified center-to-center spacing and the gap midpoint location, the required center-to-center spacing shall prevail, with the concurrence of the Engineer and within a ten percent deviation.

4. White pavement reflectors and castings located along solid white paint lines delineating gore areas shall be placed along the solid white paint lines on the travel lane side of the solid white paint line and at a distance of 2 inches from the line, near edge to near edge.

If it is determined during the pre-installation layout operation, using typical reflector and casting spacing, that a pavement reflector and casting is to be placed at a point on a surface that shows evidence of cracking, checking, spalling, or failure of underlying material, or at a transverse joint the reflector and casting shall be relocated longitudinally. The distance the pavement reflector and casting may be relocated shall be approved and shall not exceed ten percent of typical reflector and casting spacing. If the relocation distance is determined to be greater than ten percent, the reflector and casting shall be deleted.

When pavement reflectors and castings are placed on bridge deck surfaces, the reinforcement steel in the bridge decks shall be located by use of a pachometer. The pavement reflectors and castings shall not be placed in any location that would expose the existing reinforcement steel. Any damage to the reinforcement steel or bridge deck shall be repaired at no cost to the State.

When using standard epoxy compound, pavement surface temperature and ambient air temperature at the time of application shall not be less than 50 ºF.

Pavement reflectors and castings shall not be installed unless the pavement surface is dry. Pavement reflectors and castings shall be installed by inserting the two keels on the casting into saw cuts in the roadway. Within two working days after the slots are saw cut, the marker castings shall be hand placed into the slots in such a manner as to ensure that the leveling lugs shall not drop below roadway surface, and the tips of the marker's snow plow deflecting surface are below the roadway surface. All castings which are not installed to a full depth and which leave a raised end exposed above the pavement shall be removed. The hole resulting from this faulty installation shall be filled, and a new reflector casting shall be installed within 2 feet of the faulty installation. A reflector and casting will be rejected if visible buildup of epoxy compound or reflector adhesive affects its optical performance.

618.10 Defective Stripes or Markings.

The Contractor shall replace long-life traffic stripes or traffic markings determined to be in nonconformance with the Specifications, or not placed at the locations or in the dimensions specified. The defective stripes or markings shall be removed according to Subsection 618.12.

The Contractor shall replace defective long-life epoxy resin traffic stripes based on the following:

1. The entire 10 foot broken line if the line to be replaced is determined to have a deficiency.
2. The entire length of striping determined to have a wet film thickness of less than 19 mils shall be restriped with 20 mils of new epoxy, based upon the calculated and measured yields.
3. The entire length of striping shall be replaced where improper curing or discoloration has occurred. Discoloration is defined as localized areas or patches of brown or grayish colored epoxy resin material. When improper curing or discoloration occurs intermittently in intervals of 100 feet or less throughout the striping, the entire length of striping shall be replaced from where it first occurs until where it no longer exists plus 5 feet on each end.
4. The entire length of striping that has failed to bond to the pavement, or has chipped or cracked, shall be replaced from where it first occurs to where it no longer exists. When more than 25 spots (combined or individual) of chipping, cracking or poor bonding has occurred within a 1,000 linear foot distance, the entire 1,000 linear feet shall be replaced.
5. The entire length of 1 mile of striping shall be replaced where the initial retroreflectance value of two of four readings for that 1 mile of 4-inch wide striping is less than 375 millicandelas per square feet per foot-candle for white or 250 millicandelas per square foot per footcandle for yellow when taken with a LTL2000 Retrometer.
6. The entire area of striping shall be replaced where the glass bead coverage or retention is deficient, based on yield determinations made during application and on visual comparisons of the production traffic stripes with those of the test strips.

The Contractor shall replace defective long-life thermoplastic traffic markings based on the following:

1. The entire area of marking determined to be less than the required thickness, to have an incorrect color or width, to have failed to bond to the pavement, or to have chipped or cracked shall be replaced. The minimum replacement area is an individual word or symbol, or entire length of longitudinal line from where the deficiency first occurs to where it no longer exists.

2. The entire area of marking shall be replaced where the initial retroreflectance value is less than 375 millicandelas per square foot per footcandle for white or 250 millicandelas per square foot per footcandle for yellow. Initial retroreflectance will be determined as follows:
   - Step 1: Visual night inspections will be made to identify traffic markings that appear to be below the specified minimum value.
   - Step 2: All retroreflectance measurements taken with a Mirolux-12 Retroreflectometer will be made on a clean, dry surface.
   - Step 3: a. For word markings, three random retroreflectance measurements will be made on each letter.
     b. For symbols, nine random retroreflectance measurements will be made over the symbol.
   - Step 4: All retroreflectance measurements within an area will be averaged to determine if the minimum retroreflectance requirements are met.

At no cost to the State, the Contractor shall remove all traffic paint where the striping or markings will not be directly under long-life material, replace long-life traffic stripes or traffic markings damaged due to any sawing or sealing of joints in the HMA overlay, and replace all existing pavement reflectors that have been marred by striping or marking material as a result of improperly located traffic stripes or traffic markings.

618.11 Opening to Traffic.{ XE "Traffic:stripes:opening to traffic" }

{ XE "Opening to traffic:after applying traffic stripes or markings" **}**The Contractor shall complete each application of all types of traffic stripes or traffic markings and allow them to thoroughly dry before opening to traffic.

Should ambient and surface temperatures be below the minimums specified for various materials, with approval, traffic stripes or traffic markings may be placed at temperatures as low as 35 ºF to open the traveled way to traffic. Placement of long-life epoxy resin or thermoplastic may be delayed for up to four days after paving.

As a minimum, center lines on undivided roadways and broken lines between lanes shall be delineated before the traveled way is opened. Unless directed, temporary pavement markers shall be used for the interim delineation until permanent stripes and markings are applied. The Engineer will determine when the traveled way is to be opened.

618.12 Removal of Traffic Stripes or Traffic Markings.{ XE "Traffic:markings:removal of" }{ XE "Traffic:stripes:removal of" }

The Contractor shall remove all types of traffic stripes or traffic markings by methods that do not damage the integrity of the underlying pavement or adjacent pavement areas, and that do not cause gouging, or create ridges or grooves in the pavement that may result in compromising vehicular control. Obliterating stripes or markings by painting over them will not be permitted.

Before starting removal operations, the Contractor shall demonstrate the proposed method to accomplish the removal of approximately 95 percent of the stripe or marking without the removal of more than 1/16 inch of pavement thickness. Area of removal includes the area of the stripe or marking plus 1 inch on all sides. Removal operations will not be permitted until the method of removal has been approved.

The Contractor shall replace all existing pavement reflectors that have been damaged by removal operations, at no cost to the State.

Debris from the removal of traffic stripes and markings shall be disposed of according to Subsection 201.10.

618.13 Rumble Strips{ XE "Rumble strips" }.

The shoulder areas, where rumble strips are to be constructed, shall be thoroughly cleaned before construction. Rumble strips shall not be constructed until the traffic striping has been completed.

The rumble strip shall be formed by cutting indentations perpendicular to the edge of the shoulder into the pavement without disturbing the pavement surrounding the indentation. The removed material shall be swept up and recycled. The method of recycling shall be submitted to the Engineer for approval before construction.

The cutting machine shall be equipped with an acceptable guide that extends in front of the machine and is clearly visible to the operator to obtain a prior alignment.

COMPENSATION

618.14 Method of Measurement.

Traffic stripes of the various types and materials will be measured by the linear foot for each 4-inch width of actual stripe. Gaps will not be counted.

Traffic markings of the various types and materials for diagonal gore lines, crosswalks, or stop lines will be measured by the linear foot for each 4-inch width of actual stripe.

Traffic markings of the various types and materials for words, arrows, or other pavement symbols will be measured by the square foot.

Removal of traffic stripes and markings will be measured by the linear foot for each 4-inch width of stripe or marking. Width in excess of 4 inches will be converted to equivalent linear feet of 4-inch width.

Pavement reflectors and castings of the different types will be measured by the number of units.

618.15 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
TRAFFIC STRIPES	LINEAR FOOT
TRAFFIC STRIPES, LONG-LIFE, EPOXY RESIN	LINEAR FOOT
TRAFFIC MARKINGS, LINES	LINEAR FOOT
TRAFFIC MARKINGS, SYMBOLS	SQUARE FOOT
TRAFFIC MARKINGS, LINES, LONG-LIFE, THERMOPLASTIC	LINEAR FOOT
TRAFFIC MARKINGS, SYMBOLS, LONG-LIFE, THERMOPLASTIC	SQUARE FOOT
REMOVAL OF TRAFFIC STRIPES AND MARKINGS	LINEAR FOOT
TWO-WAY PLOWABLE MONO-DIRECTIONAL WHITE PAVEMENT REFLECTORS AND CASTINGS	UNIT
TWO-WAY PLOWABLE BI-DIRECTIONAL WHITE PAVEMENT REFLECTORS AND CASTINGS	UNIT
TWO-WAY PLOWABLE MONO-DIRECTIONAL AMBER PAVEMENT REFLECTORS AND CASTINGS	UNIT
TWO-WAY PLOWABLE BI-DIRECTIONAL AMBER PAVEMENT REFLECTORS AND CASTINGS	UNIT
RUMBLE STRIP	LINEAR FOOT

Payment for latex or alkyd traffic stripes will be made under the Pay Item “Traffic Stripes.”

Payment for latex or alkyd traffic markings will be made under the Pay Item “Traffic Markings.”

SECTION 619 - SIGNS

619.01 Description.

This work shall consist of fabricating, furnishing, assembling, and erecting signs.

Materials and construction operations not specifically covered in the Plans and Specifications shall be according to the MUTCD, published by FHWA.

MATERIALS

619.02 Materials.

Materials shall conform to the following Subsections:

CONSTRUCTION

619.03 Regulatory and Warning Signs.{ XE "Signs:types:warning" }{ XE "Signs:types:regulatory" }

Regulatory and warning signs shall be fabricated of flat aluminum sheets and shall be covered with Type II or Type III-A retroreflective sheeting. Legends, borders, and accessories shall be Type B unless otherwise designated. Signs shall be fabricated according to Subsection 916.08.

Signs shall be installed according to the following:

1. **Positioning Signs.** The placement of signs shall be adjusted if they create interference in a sidewalk area. Sites at which the signs are to be erected shall be inspected immediately after grading of the area and before determining the sign post lengths.
2. **Mounting Signs.** All signs shall be mounted on breakaway steel "U" post sign supports except that the small signs located behind guide rails and other roadside barriers shall be mounted on steel "U" post sign supports without the breakaway feature assembly. Upon being notified that the signs have been installed, the Engineer will examine them at night. Should specular glare be apparent, the sign alignment shall be adjusted by shimming the sign. Signs mounted on two posts shall be shimmed either at all bolts on one of the posts, or at the proper upper or lower bolts on both posts. Signs mounted on a single post shall be shimmed at either the upper or lower bolts, whichever best minimizes the glare. In all cases, shims shall be installed between the back of the sign and the post. Shims shall be used wherever necessary to prevent sagging of the center of a sign and to permit secure tightening of all nuts and bolts.

619.04 Guide Signs.{ XE "Signs:types:guide" }

Guide signs fabricated of extruded aluminum sheets shall be covered with Type II, III-A, or VI retroreflective sheeting depending on the following:

1. Guide signs on steel "U" posts shall be fabricated of flat aluminum sheets and shall be covered with Type II or Type III-A retroreflective sheeting. Legends, borders, and accessories shall be Type B unless otherwise designated.
2. Guide signs on overheads and breakaway or non-breakaway posts shall be fabricated of extruded aluminum panels covered with Type VI retroreflective sheeting. Legends, borders, and accessories shall be Type A.

Breakaway couplings will be furnished upon written request. The request shall be made at least ten days before the time when needed for the Project and shall include the quantity for each type required.

Guide signs shall be installed according to the following:

1. **Positioning Signs.** Sign faces shall be so positioned in relation to a line normal to the adjacent edge of traveled way that the sign face is rotated about its edge, nearest the traveled way, through an angle of five degrees, in the direction of travel. All signs shall be level and at the heights indicated.
2. **Mounting Signs.** Signs mounted on breakaway, non-breakaway, or steel "U" post sign supports are designated as Type GA. Signs mounted on sign support structures are designated as Type GO or Type GOX. Type GO and Type GOX signs shall also include structural framing for lighting fixtures and for attaching sign panels to the supporting structures.

   Upon notification that the signs have been installed, the Engineer will examine them at night. Should specular reflection from any sign be apparent, alignment shall be adjusted. Signs mounted on breakaway and non-breakaway sign supports shall be adjusted by rotating the sign on the posts. Signs mounted on steel "U" post sign supports shall be adjusted as specified in Subheading 2 of the second paragraph of Subsection 619.03.

619.05 Cleaning Signs.

Before final inspection, all sign faces and support surfaces shall be cleaned of all foreign matter. Necessary measures shall be taken to provide that all signs, sign supports, and sign sites are in good condition and have a good appearance.

COMPENSATION

619.06 Method of Measurement.

Signs of the various sizes will be measured by square foot.

Guide signs of the various types will be measured by the square foot.

619.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SIGNS	SQUARE FOOT
GUIDE SIGNS, TYPE GA, STEEL "U" POST SUPPORTS	SQUARE FOOT
GUIDE SIGNS, TYPE GA, BREAKAWAY SUPPORTS	SQUARE FOOT
GUIDE SIGNS, TYPE GA, NON-BREAKAWAY SUPPORTS	SQUARE FOOT
GUIDE SIGN PANELS, TYPE GO	SQUARE FOOT
GUIDE SIGN PANELS, TYPE GOX	SQUARE FOOT

Separate payment will not be made for posts for signs.

Payment for sign support structures will be made according to Section 509.

Payment for sign illumination will be made according to Section 705.

Payment adjustments for strength will be made according to Subsection 914.02, Subpart F, and will be applied to the lot for those Pay Items specified in that Subpart.

SECTION 620 - DELINEATORS{ XE "DELINEATORS" }

620.01 Description.

This work shall consist of furnishing, assembling, and erecting flexible delineators.

MATERIALS

620.02 Materials.

Materials shall conform to the following:

Retroreflective Sheeting 916.04
Flexible Delineators..... 916.14

CONSTRUCTION

620.03 Ground Mounted Flexible Delineators.{ XE "Delineators:flexible" }{ XE "Delineators:flexible:ground mounted" }

Flexible delineator units shall be driven vertically into the ground to a minimum depth of 1 foot-6 inches. Units shall be installed so that the plane face of the center of the reflective area is at an angle of zero degrees with a perpendicular to the direction of traffic.

Retroreflective sheeting, Type IV-A shall be pre-applied to the front (surface facing traffic) of the unit by the manufacturer. The retroreflective sheeting shall cover a minimum area of 3 by 12 inches, beginning a maximum of 2 inches from the top of the post. The color shall be white when the delineator is located on the right side to the direction of traffic and shall be yellow when the delineator is located on the left side to the direction of traffic.

620.04 Guide Rail Mounted Flexible Delineators.{ XE "Delineators:flexible:guide rail mounted" }

Flexible delineators shall be mounted on the spacer of beam guide rail using either a "U" channel base on the I-beam spacer or a flat base attached to a wood, polymer, or other solid top spacer. The base shall be attached to the spacer using an adhesive recommended by the manufacturer of the base and panel. The first delineator shall be placed on the beam guide rail end treatment, positioned so that the reflector area is facing the direction of traffic, then subsequently every 81.9 feet (13 sections of guide rail) for tangent mainline roadway, and every 44.1 feet (seven sections of guide rail) for curved mainline roadways with radii less than 1,910 feet. If a parabolic flare in the beam guide rail exists, the second delineator shall be placed at the end of the flared section with subsequent delineators spaced as stated above. If the distance between the end of the beam guide rail is greater than 20 feet on curved mainline roadways, or 40 feet on tangent mainline roadways, a delineator shall be installed on the last post or end treatment.

Retroreflective sheeting, Type IV-A shall be applied to the upper portion of the flexible delineator panel. The retroreflective sheeting shall cover a minimum area of 4 ½ by 4 ½ inches (4 ½ by 9 inches for deceleration and acceleration lanes). The color shall be white when the delineator is located on the right side to the direction of traffic and shall be yellow when the delineator is located on the left side to the direction of traffic.

620.05 Barrier Curb Mounted Flexible Delineators.{ XE "Delineators:flexible:barrier curb mounted" }

The first flexible delineator shall be placed at the beginning of the concrete barrier curb section, positioned so that the reflector area is facing the direction of traffic, then subsequently every 80 feet. If the distance between the end of the concrete barrier curb and the adjacent delineator is greater than 40 feet, a delineator shall be installed on both sides of barrier curb openings.

Concrete barrier curb mounted flexible delineators shall be attached to the side of the barrier curb, 3 inches from the top of the barrier, using a method recommended by the manufacturer of the delineator unit.

Retroreflective sheeting, Type IV-A shall be applied to the upper portion of the flexible delineator panel facing traffic and perpendicular to the top of the concrete barrier curb. The retroreflective sheeting shall cover an area of 3 ½ by 3 ½ inches. The color shall be white when the delineator is located on the right side to the direction of traffic and shall be yellow when the delineator is located on the left side to the direction of traffic.

COMPENSATION

620.06 Method of Measurement.

Flexible delineators will be measured by the number of units.

620.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
FLEXIBLE DELINEATORS, GROUND MOUNTED	UNIT
FLEXIBLE DELINEATORS, GUIDE RAIL MOUNTED	UNIT
FLEXIBLE DELINEATORS, BARRIER CURB MOUNTED	UNIT

SECTION 621 - CRASH CUSHIONS{ XE "CRASH CUSHIONS" }

621.01 Description.

This work shall consists of furnishing and constructing crash cushions. Crash cushions shall be inertial barrier system crash cushions composed of sand-filled frangible impact modules, hi-dro cell clusters, or crushable energy absorbing system (QuadGuard) crash cushions with pads and backup structures.

MATERIALS{ XE "CRASH CUSHIONS:MATERIALS" }

621.02 Materials.

A. Inertial Barrier System. Inertial barrier system modules shall be made of frangible polyethylene material, as recommended by the manufacturer, except that the outer surface of the modules shall be a highway yellow color. Modules shall be designed to meet the safety performance recommendations of the National Cooperative Highway Research Program Report, Transportation Research Board, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 20418. Modules shall have FHWA approval.

B. Hi-Dro Cell Cluster. Hi-dro cell cluster units shall be as designed and manufactured by Energy Absorption Systems, Inc., Chicago, Illinois. The outer surface of the units shall be a highway yellow color.

C. QuadGuard. Crushable energy absorbing system shall be QuadGuard, as designed and manufactured by Energy Absorption Systems, Inc., Chicago, Illinois. The manufacturer shall certify that the system has been crash tested according to NCHRP 350 and has passed the Test Level 3. The nose cover shall be a highway yellow color.

Materials for concrete pads and concrete backup structures shall conform to Subsection 613.02.

CONSTRUCTION

621.03 Construction Requirements.

A. Inertial Barrier System. Inertial barrier systems shall conform to the specified weights and module configurations. Each module shall be placed by outlining its location on the roadway surface with paint, thereby marking the periphery of the modular base, and identifying its weight within the circumference. The module manufacturer's trained technician shall be on the Project at all times during the installation of the systems.

Loose sand, conforming to Subsection 901.10, Subpart C, shall be placed within each module to a depth recommended by the manufacturer. The sand shall have a dry density of 90 to 100 pounds per cubic foot, and a three percent maximum allowable moisture content. Five to seven percent of sodium chloride (NaCl) by weight shall be added and evenly dispersed throughout the sand to prevent freezing. Calcium chloride ($CaCl_2$) shall not be substituted for sodium chloride.

A plastic lid shall be placed on the module in such a manner as to ensure that no weather elements come in contact with the sand. Four equidistant rivets or other fasteners, recommended by the manufacturer and approved by the Department, shall be installed on the periphery of the lid to prevent high velocity escape upon impact.

When different manufacturers supply inertial barrier systems for a Project, different modules shall not be intermixed within any inertial barrier system.

Modules that are damaged during placement or due to construction operations after placement shall be replaced without additional compensation.

B. Hi-Dro Cell Cluster. Hi-dro cell cluster units shall be installed on concrete pads, and against concrete or steel backup structures according to the manufacturer's recommendations. The manufacturer's trained technician shall be on the Project at all times during the installation of the units.

Concrete pads and concrete backup structures shall be constructed according to Section 613.

After installation, the cell clusters shall be filled with a permanent type of antifreeze of such concentration so as to protect the water against freezing to a temperature of -20 ºF.

Hi-dro cell cluster units that are damaged during placement or due to construction operations after placement shall be replaced without additional compensation.

C. QuadGuard. QuadGuard shall be installed on a relatively flat concrete or HMA foundation pad with steel backup structures according to Section 613 and the manufacturer's recommendations. The manufacturer's trained representative shall be present at all times during the installation. QuadGuard units that are damaged during replacement or due to the construction operations after placement shall be replaced at no additional cost to the Department.

QuadGuard units that are damaged during placement or due to construction operations after placement shall be replaced without additional compensation.

COMPENSATION

621.04 Method of Measurement.

Inertial barrier system crash cushions will be measured by the number of units. A unit shall consist of a total inertial barrier system composed of the required number of modules.

Hi-dro cell cluster crash cushions will be measured by the number of units. A unit shall consist of a total cluster system composed of the required number of cells.

QuadGuard will be measured by the number of units. A unit shall consist of a total energy absorbing system composed of the required number of bays.

621.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CRASH CUSHIONS, INERTIAL BARRIER SYSTEM, ___ MODULES	UNIT
CRASH CUSHIONS, HI-DRO CELL CLUSTER, ___ CELLS	UNIT
CRASH CUSHIONS, QUADGUARD, ___ BAYS, ___"WIDE	UNIT

SECTION 622 - WATER, GAS, AND SANITARY SEWER LINES{ XE "WATER, GAS, AND SANITARY SEWER LINES" }

622.01 Description.

This work shall consist of the installation and relocation of fire hydrant assemblies, resetting fire hydrants and water and gas valve boxes, and the construction of water and sewer connections.

MATERIALS

622.02 Materials.

Materials for copper water service pipe, gate valves and boxes, tees, tapping sleeves and valves, and fire hydrant assemblies will be provided in the Special Provisions.

Portland cement concrete for pipe plugs, encasements, thrust blocks, or saddles shall conform to Section 914.

CONSTRUCTION

622.03 Construction Requirements.

Construction requirements will be provided in the Special Provisions and shall also conform to the following:

1. Excavation shall be according to Subsection 207.04.
2. Backfilling shall be according to Subsection 207.06.
3. Methods of construction shall be such that, when reset, water and gas valve boxes shall conform to the grade of the resurfaced or regraded area.
4. Care shall be exercised in resetting the valve boxes. After resetting, the valve boxes shall be protected until the final resurfacing course had been laid. Castings that are damaged by construction operations or vehicular traffic shall be replaced in kind and in a manner satisfactory to the utility company concerned at no cost to the State.
5. Fire hydrants shall be located in a manner to provide complete accessibility, and in such a manner that possibility of damage from vehicles or injury to pedestrians will be minimized. All hydrants shall stand plumb and be oriented with the pumper nozzles normal to the face of curb or gutter. All hydrants shall conform to the established grade with nozzles at least 1 foot-6 inches above ground. Hydrant barrel shall be adjusted where necessary to meet new grade.

COMPENSATION

622.04 Method of Measurement.

Fire hydrant assemblies and relocating fire hydrant assemblies will be measured by the number of units.

Reset fire hydrants will be measured by the number of units.

Reset valve boxes of the various kinds will be measured by the number of units.

Copper water service pipe of the various sizes will be measured by the linear foot.

Water service and sanitary sewer house connections will be measured by the number of units.

Tapping sleeves and valves, gate valves and boxes, and tees of the various sizes will be measured by the number of units.

622.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
FIRE HYDRANT ASSEMBLIES	UNIT
RELOCATE FIRE HYDRANT ASSEMBLIES	UNIT
RESET FIRE HYDRANTS	UNIT
RESET WATER VALVE BOXES	UNIT
RESET GAS VALVE BOXES	UNIT
___ " COPPER WATER SERVICE PIPE	LINEAR FOOT
WATER SERVICE CONNECTIONS	UNIT
SANITARY SEWER HOUSE CONNECTIONS	UNIT
___ " GATE VALVES AND BOXES	UNIT
___ " TAPPING SLEEVES AND VALVES	UNIT
___ "X ___ " TAPPING SLEEVES AND VALVES	UNIT
___ "X ___ " TEES	UNIT

Payment for rock excavation will be made according to Section 207.

Payment for pipe plugs, encasements, thrust blocks, or saddles will be made according to Section 613.

Payment for sewer or water pipe will be made according to Section 602.

Payment for sanitary sewer manholes or reconstructing sanitary sewer manholes will be made according to Section 603.

DIVISION 700 CONTENTS

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DIVISION 700 - ELECTRICAL

SECTION 701 - COMMON PROVISIONS{ XE "ELECTRICAL WORK:COMMON PROVISIONS" }

701.01 Description.

These provisions are common to the work of traffic signals, highway lighting, and sign lighting.

Materials and construction operations not specifically covered in the Plans and Specifications shall be according to the accepted standards of NEMA, UL, NEC, ITE, or ASTM.

Plans may be diagrammatic but shall be followed as closely as actual conditions permit.

MATERIALS AND ELECTRICAL EQUIPMENT

701.02 Materials and Equipment.

Portland cement concrete for foundations and junction boxes shall conform to Section 914. Other materials shall conform to the following Subsections:

Coarse Aggregate	901.03
Anchor Bolts	906.01
Bonding and Grounding Materials	906.02
Cable and Wire	906.03
Cable Racks	906.05
Conduits and Fittings	906.07
Electrical Tape	906.08
Multiple Lighting and Service Wire	906.13
Resin Splicing Kits	906.17
Paint:	
Black Graphite	912.03
Grout	914.03
Reinforcement Steel	915.01

Frames and covers for junction boxes shall conform to Subsection 917.03.

Electrical materials, equipment, and installations must also conform to the latest New Jersey Electrical Materials Specifications that are available by accessing the NJDOT website:

www.state.nj.us/transportation/cpm/CapitalProgramManagement/.

CONSTRUCTION

701.03 Existing Systems.{ XE "Electrical work:existing systems" }

The operation of existing electrical systems, within the limits of the Project, which are not scheduled to be modified or removed shall not be interfered with in any manner.

The modification of existing traffic signal or highway and sign lighting systems shall be accomplished with minimum interference to the operation of the facilities. Ten days before the commencement of work on an existing system, a scheme of the proposed construction method and the provisions planned to maintain traffic at the work site shall be submitted for approval.

Traffic directors shall be used according to Subsection 617.10.

It may be necessary to cut existing conduits, build new foundations, junction boxes, or other structures over existing conduits, install new conduits in existing junction boxes, or connect to existing conduits.

Existing foundations and junction boxes that are abandoned under the Contract shall be removed to a depth of 1 foot below grade. Should a foundation or junction box interfere with the installation of a new facility, it shall be completely removed. Backfilling shall be according to Subsection 203.06. The Engineer may direct compaction to be according to Subsection 203.10 except that the frequency may be increased. Debris shall be disposed of according to Subsection 201.10.

Where existing systems are to be modified, the existing above ground equipment and materials shall be salvaged and incorporated into the revised system, or salvaged for other use by the Department and become the property of the State. Material required to be salvaged shall be stored at or near the site of the work for disposal by the Contractor. The Contractor shall deliver the salvaged material to the nearest Department electrical maintenance yard, as directed. Adequate manpower shall be provided to unload the vehicle. Highway lighting poles, arms, and fixtures shall become the property of the Contractor when not incorporated into the revised system.

Existing equipment and materials specified for reuse, or to be reserved for the Department, which are disturbed, damaged, or removed from the Project in performing the work, shall be repaired or replaced with similar equipment and materials without additional compensation.

Relocation of any proposed foundation, junction box, or conduit, required because of the relocation or interference with an existing utility facility, shall be accomplished only after approval. Additional conduit or wire may be required because of these relocations, however, no additional compensation will be made for any delay caused by these field problems.

Location of existing traffic signal system and highway lighting system conduits, when not shown on the Plans, will be furnished upon written request.

Existing highway lighting facilities and their replacements shall be functional during normal hours of operation except as otherwise approved.

Existing pressure detectors and frames that are abandoned shall be removed and disposed of according to Subsection 201.10.

During the course of the construction, there may be locations where the Department, with its own or by other forces, may adjust or relocate existing traffic signal or highway lighting equipment under this Contract. Construction operations shall be arranged so as to permit the adjustment or relocation of these facilities.

Traffic directors, as defined in Subsection 617.10, must be employed to maintain traffic flow at a signalized intersection whenever the facility is temporarily extinguished.

Before the commencement of work on the existing traffic signal and/or highway lighting system(s), the Contractor shall arrange a meeting with the Department to inspect and verify the proper operation of the existing traffic signal and/or highway lighting system(s).

701.04 Working Drawings.{ XE "Electrical work:working drawings" }

Working drawings shall be furnished for all electrical materials and equipment not pre-approved, according to Subsection 105.04.

A copy of the pre-approved materials procedure is available, upon request, from the Unit of Traffic Signal and Safety Engineering, New Jersey Department of Transportation, 1035 Parkway Avenue, P.O. Box 613, Trenton, New Jersey 08625.

Approval of the working drawings for the precast foundations or junction boxes shall not be taken as an approval for the use in all locations.

Working drawings shall be sent directly to the Department's Unit of Traffic Signal and Safety Engineering. The number of copies sent shall be a minimum of seven. One additional copy each shall be submitted when an outside testing agency or outside authority is involved in the Project.

701.05 Construction Stakes, Lines, and Grades.{ XE "Electrical work:construction stakes" }

The furnishing of lines, grades, and bench marks shall be as specified in Subsection 105.11.

701.06 Excavation and Backfill.{ XE "Electrical work:excavation and backfill" }

Excavation and backfill for the construction of junction boxes, foundations, conduits, cables, and other appurtenances shall conform to Section 207. The excavation shall include all materials and structures encountered. The excavation shall also include the restoration of areas damaged, with the exception of topsoiling, seeding, and concrete sidewalk.

Trenching for conduit will be permitted only for such distances as can be installed and backfilled on the same day. Should a conduit installation not extend from junction box to junction box at the end of the workday, the conduit shall be capped.

The trench bottom for rigid nonmetallic conduit shall be prepared to eliminate lumps, ridges, and hollows. The conduit shall be placed on bedding material that has been tamped by a flat-faced mechanical tamper or a vibratory soil compactor.

The sides of the trench around the conduit shall be filled with bedding material (center filled if more than one conduit in the trench) to the top of the conduit, then additional bedding material shall be hand placed over the conduit, to a depth of 6 inches, and hand tamped. From this point backfilling shall conform to Section 207.

If the excavations do not furnish sufficient material of the quality required for backfilling, the material necessary to make up the deficiency shall be supplied and placed.

For the purpose of establishing the exact location of existing conduits, and to preserve and protect the conduit, the Engineer may direct the excavation of test pits according to Subsection 207.04.

701.07 Conduits.{ XE "Electrical work:conduits" }

Conduit installed above ground shall be rigid metallic conduit except as required by Section 705.

{ XE "Electrical work:conduits:jacking" **}**Rigid metallic conduit installed under existing roadways that are not to be disturbed or removed during construction shall be classified as Type CUR and shall be installed by the jacking method.

Excavations for jacking shall be kept a minimum of 2 feet from the edge of pavement.

{ XE "Electrical work:conduits:test pits" **}**In the event that obstructions are encountered during the course of jacking, permission shall be obtained to make earth excavations for test pits to clear the obstruction. A minimum of two attempts shall be made to install conduit by the jacking method and if unsuccessful, a final attempt shall be made changing the procedure and location (both horizontal and vertical), and if the final attempt fails, then permission may be given for the open cut method.

When the open cut method is used, the maximum trench width shall not exceed 6 inches.

After the conduit has been installed in the trench, the trench shall be filled with concrete to within 6 inches of the surface of the existing pavement. Backfill in the remaining trench shall conform to the materials composition of the existing pavement.

Rigid metallic conduit installed in earth under proposed or reconstructed sidewalks, pavements, driveways, bridges, or other obstructions, shall be classified as Type CUG. Rigid metallic conduit installed on utility poles shall be classified as Type CUG. Aluminum conduit shall not be utilized as Type CUG and shall not be embedded in concrete in bridge structures.

Rigid metallic conduit installations mounted on bridges and other structures shall be classified as type exposed and be provided with expansion joint fittings at all bridge expansion joints and all necessary mounting hardware.

At any location where conduits are installed in existing junction boxes, it may be necessary to cut additional holes in the junction boxes to admit the conduits.

Bonding bushings shall be threaded on the free ends of the conduit and locked in place with set screws.

Conduit installed in junction boxes shall be grouted in before the installation of wire or cables.

To facilitate the pulling of wire through the junction box, the conduits shall be installed in such a manner that the conduits in opposite walls of the box are in line with each other.

If the conduits cannot be installed with sufficient grade to provide drainage, T-drains shall be installed. T-drains shall consist of standard pipe tee and nipple for conduits.

All underground conduits entering meter cabinets and the wire entrance to the controller cabinet shall be thoroughly sealed with a compound.

The ends of all conduits, whether shop or field cut, shall be reamed to remove all burrs and rough edges. Cuts shall be made square and true so that the conduits butt or come together for the full circumference thereof. Slip joints or running threads will not be permitted for coupling metallic conduit. When a standard coupling cannot be utilized for coupling metallic conduit, a UL approved concrete-tight compression coupling with a permanent stop shall be used. Couplings utilizing set screws will not be permitted. Reducing couplings shall not be used except for expansion joints on bridges and if required to adapt a service conduit to the meter cabinet.

Ungalvanized threads on metallic conduit resulting from field cuts and all places where the galvanizing on the conduit or fittings have been damaged shall be coated with a compound, which is electrically conductive and prevents oxidation.

All ends of the conduits shall be threaded, in conformance with NEMA standards, and the free ends shall be provided with grounded-type insulated bushings. Conduits with a diameter of less than 1 inch may be provided with impact-resistant plastic, insulating bushings and bond lock nuts.

Metallic and nonmetallic conduit bends and elbows made in the field shall have a radius of not less than nine times the inside diameter of the conduit, and all such bends shall be made without crimping, denting, or otherwise damaging the conduit. Bends and elbows used in service conduits shall conform to the utility company requirements. Bends shall not exceed two 90-degree bends between pull boxes.

Field bends to rigid metallic conduit shall be made with an industry-accepted hydraulic conduit bender.

Field bends to rigid nonmetallic conduit shall be made with an industry-accepted flameless heater designed to distribute heat evenly over the section of conduit being bent. Internal supports shall be provided to prevent deforming of the conduit during the bending. Manufactured bends and elbows of identical material to the conduit may also be used.

All connections of rigid nonmetallic conduit shall be made according to the manufacturer's directions, using solvents recommended by the manufacturer. Where rigid nonmetallic conduit is to be connected to rigid metallic conduit or other existing conduit, a suitable manufactured adapter shall be used.

Repairs will not be permitted to any rigid nonmetallic conduit fitting. Broken, chipped, cracked, or impaired fittings shall be removed and replaced with new materials.

Damaged ends of rigid nonmetallic conduit may be cut off, and the remainder of the undamaged conduit utilized on the Project, provided at least a 9-foot length of material remains. Other repairs to rigid nonmetallic conduit will not be permitted.

Where two or more rigid nonmetallic conduits are to be installed in a common trench, impact-resistant plastic spacers shall be utilized. The spacers shall be installed a maximum of 8 feet on centers and shall provide a separation between conduits equal to at least 65 percent of the diameter of the conduit.

Immediately before the installation of cables, all conduit runs, including existing conduits, which are to be utilized, shall be carefully rodded, swabbed, or otherwise cleaned to ensure that the interior is free and clear of all obstructions.

Upon completion of any conduit run, and after the conduit has been cleaned, each conduit shall be gauged by pulling through a metal ball of a diameter not less than 85 percent of the nominal inside diameter of the conduit, to ascertain that the conduit is free of any obstruction or foreign material. If the ball fails to pass through the conduit, the defective conduit shall be repaired or replaced without additional compensation.

{ XE "Electrical work:conduits:fish and measuring tape" **}**A 130-pound average breaking strength fish and measuring tape, marked in either 3-foot or 1-foot increments, shall be installed in each conduit run. The Engineer may utilize the tape to verify the conduit length.

701.08 Foundations.{ XE "Electrical work:foundations" }

Concrete foundations shall be cast-in-place except as provided in Subsection 701.10 and shall be constructed according to Section 501.

Foundations shall rest on firm ground and shall be poured monolithically. Conduit and anchor bolts shall be placed in proper position and shall be held in place by means of a template until the concrete sets. Forms shall not be removed until the concrete has hardened properly and not less than 24 hours after the concrete has been placed. Exposed portions of foundations shall be neatly finished with a wood float followed by brushing with a wet, soft-haired brush. The tops of foundations shall be finished to an elevation of 1 inch above curb or sidewalk. Where curbs or sidewalks are not constructed or do not exist, the foundations shall be finished to an elevation of 2 inches above the surrounding lawn or earth.

Conduit installed in foundations shall be set plumb. The conduit shall terminate with a coupling flush with the top of the foundations and shall be provided with a close nipple. Conduit shall be provided with pipe caps during the placement of the concrete. When the finishing of the foundation is complete, the pipe caps shall be removed and insulated grounding bushings shall be installed. If the wiring is not immediately installed, the bushings shall be installed with push-penny plugs.

Anchor bolts installed in the foundation shall be set plumb.

For all foundations used with highway lighting, the top of the foundation shall be set at grade when installed with curb or sidewalk. Where curbs or sidewalks are not constructed or do not exist, the foundations shall be finished to an elevation of 1 inch above the surrounding lawn or earth.

701.09 Junction Boxes.{ XE "Junction boxes" }{ XE "Electrical work:junction boxes" }{ XE "Electrical work:junction boxes:precast" }

Concrete junction boxes shall be constructed according to Section 501 and the following:

1. Forms for rectangular concrete junction boxes shall not be removed until the concrete has hardened properly and not less than 24 hours after the concrete has been placed. All exposed portions of junction boxes shall be neatly finished with a wood float followed by brushing with a wet, soft-haired brush. The junction box covers shall meet the grade of sidewalks or other surrounding area.
2. Junction boxes shall also include four cable racks, a ground rod, and the coarse aggregate.

701.10 Precast Foundations and Junction Boxes.{ XE "Electrical work:foundations:precast" }

Precast foundations for lighting standards may be used, if approved, in areas where the slope is less than 1H:22V.

Precast junction boxes may be used, if approved, in areas where the junction box can be installed to conform to the surrounding grade.

If precast foundations or junction boxes are permitted, they shall be manufactured according to Subsections 701.08 and 701.09, except that forms may be removed after a stripping strength of 2,500 pounds per square inch has been achieved as determined by breaking two cylinders cured with the item, and not less than 12 hours after the concrete has been placed. Precast foundations and junction boxes shall be furnished according to Section 106.

701.11 Cable Rack Assembly.{ XE "Electrical work:cable rack assembly" }

Cable rack assembly shall consist of four cable racks, including inserts or fasteners, installed in existing rectangular junction boxes as directed.

701.12 Bonding and Grounding.{ XE "Bonding and grounding of traffic signals and other electrical equipment" }{ XE "Electrical work:bonding and grounding" }

Traffic signals, highway and signal lighting circuits, metallic conduits, above ground equipment, and all other electrical equipment shall be bonded and grounded according to the NEC and as may be required by the utility company.

A bonding wire shall be installed in all junction boxes and secured to all conduit bushings and to the ground rod.

An insulated, color-coded green, ground wire shall be installed continuously throughout the traffic signal system. It shall be secured to all ground rods, equipment enclosures, cabinets, traffic signal bases, and lighting bases.

For highway lighting systems, the ground wire may be either insulated or bare.

701.13 Cable and Wire.{ XE "Electrical work:cable" }{ XE "Electrical work:wire" }{ XE "Cable, electrical" }

Cable and wire shall be installed in the conduit system and properly trained through the junction boxes to permit racking and connection to lighting standard assemblies, traffic signal standards, controller cabinets, and to meter cabinet installations.

The circuit number of all cables and wires shall be identified by cable tags attached to each of the cables or wires in all the junction boxes and in the cabinets of the load centers or controller. The cable tags shall be secured to the cable or wire with nylon cable ties.

Where wiring is trained through existing junction boxes that are not equipped with cable racks, a cable rack assembly shall be furnished and installed. Bonding bushings and bonding wire shall also be provided on all metallic conduit ends within such junction boxes.

Wires and cables shall be pulled through conduits in such a manner as not to overstress or stretch any wire and precautions shall be taken not to score out, twist, or damage the protective covering or insulation. In the pulling of wire or cable into conduits, where the strain on the wire or cable is likely to prove excessive, wire lubricant shall be used. Without exception, all cables and wires in junction or pull boxes shall be provided with an adequate amount of slack formed around the interior of the box.

After cables have been installed and pending permanent splicing, the end of each section of cable in junction boxes and service panels or cabinets shall be carefully sealed, using rubber tape, and painted with a sealing type of waterproof compound. All cables in junction boxes shall be placed on cable racks while waiting to be permanently spliced.

One coil (minimum of 3 feet) of slack wire shall be provided in all standard bases to allow for the proper connection of all wiring.

In rectangular junction boxes, slack shall be provided as follows:

Rigid Metallic Conduit ..... 7 feet of slack
Rigid Nonmetallic Conduit ..... 9 feet of slack

The allowable slack shall be the average amount of slack; however, certain locations and conditions may require additional slack.

The slack shall be formed around the interior of the junction box. Conductors shall be secured to the cable racks using nylon cable ties having a minimum tensile holding strength of 120 pounds. In all circular junction boxes one coil (minimum 5 feet) of slack wire secured in a loop with nylon cable ties shall be provided and placed in the bottom of the box.

Loop detector leads shall provide for an allowable amount of slack of 7 feet in rectangular junction boxes and 5 feet in circular junction boxes.

All conductors in standard bases, junction boxes, meter cabinets, and controller cabinets shall be grouped and tagged with cable identification tags.

701.14 Electrical Installations.

Electrical installations shall conform to the requirements of the NEC and the utility company.

701.15 Connection with Utility Services.{ XE "Electrical work:connection with utility services" }

Underground conduits and electrical conductors shall be installed extending from a meter cabinet or junction box to a point on the service pole, and a sufficient length of conductors for extension to the overhead utility service shall be supplied according to the requirements of the utility company and subject to its approval. The extensions of the conductors from this point on the pole and connections with overhead utility service shall be made by the utility company.

The service conduit shall be located and installed according to the utility company requirements. The utility company shall be notified, and all required applications for inspection shall be completed. The location of the service conduit on the service pole and meter within the meter cabinet shall be verified with the utility company.

The meter socket shall be provided by the utility company or shall be supplied as required by the utility company's regulations. The dimensions of the socket and meter shall be verified to ensure proper installation in the cabinet and conformance with utility company requirements.

701.16 Testing.{ XE "Electrical work:testing circuits and system" }

When each wiring system is completed and before any connection is made to operating equipment, the following tests shall be performed on each circuit in the presence of the Engineer to determine whether the installations are in acceptable working order:

1. Tests for continuity.
2. Tests for ground.
3. Tests for insulation resistance shall be performed between circuit wires and from circuit wires to ground. Upon completion of the electrical system with fuses removed, or devices removed from the circuit, and before energizing, the insulation resistance shall not be less than 150 megohms between conductors or between conductor and ground on those circuits with a total single conductor length of 1,500 feet and over, no less than 175 megohms for those circuits with a single conductor length of less than 1,500 feet.

Tests shall be performed on the system as a whole. Circuits shall be complete, including all splicing from the control cabinet to all the devices it services.

Four copies of wire and wiring test results shall be furnished identifying the observed readings with their respective circuits. The test results shall be identified with the Project title, the date of the test, and the atmospheric conditions. The Contractor is responsible for recording data and preparing the report with test results.

Electrical circuits and component parts, with the exception of traffic signals, shall be energized for a minimum of ten consecutive periods of normal operation. Temporary service shall be provided if required to perform this part of the testing. Any defective material discovered during the test period shall be replaced.

In addition, traffic signal and system loop detectors shall be tested by checking the complete loop wire and detector lead for continuity using a suitable tester.

Before placing the sealant, an insulation resistance test shall be performed on the loop and lead wire to ensure that the resistance to ground is 10 megohms or greater. If the resistance to ground is less than 10 megohms, corrective measures as necessary shall be made until the desired readings are obtained.

An inductance test shall be performed to determine the inductance of the loop. A tabulation of all test results for all loops shall be submitted in writing. The Contractor shall provide a loop inductance meter to perform the inductance tests. If the loop inductance does not conform to the requirements shown on the plans, the number of turns of wire in the trench shall be adjusted, and the inductance of the loop shall be retested.

Traffic signal control equipment including, but not limited to, controllers, loop sensors, load switches, monitors, coordination units, telephone interconnect units, and interface modules shall be bench tested as a complete assembly according to the timing schedule for each location. The test, which shall provide the routinizing of all functions of the equipment, shall be considered complete only after 168 hours of continuous trouble-free operation. Approval is required of the test procedure and location. Equipment which does not pass the bench test shall be repaired or replaced and, when corrected, shall be scheduled for retesting.

701.17 Painting.{ XE "Electrical work:painting" }

Ungalvanized exposed steel for poles and structures installed on or in structures shall be painted with one shop coat of rust-inhibitive primer. In addition, all such steel shall be painted with a field coat of rust-inhibitive primer tinted to distinguish it from the shop or initial field coat, and a final coat of paint.

Methods of cleaning and painting shall be as specified for structural steel in Subsection 503.15. The final field coat, however, shall be Black Graphite paint, Foliage Green paint, or shall match the color of the adjacent concrete.

701.18 Topsoiling and Seeding.

Topsoiling and fertilizing and seeding shall be according to Sections 806 and 808.

COMPENSATION

701.19 Method of Measurement.

Conduit of the various kinds, types, and sizes will be measured by the linear foot including the lengths of conduit abandoned from all attempts made to bypass obstructions using proper jacking methods.

Cable and wire of the various kinds and gauges will be measured by the linear foot.

Cable rack assemblies installed in existing junction boxes will be measured by the number of units.

Junction boxes of the various kinds and sizes and foundations of the various kinds and types will be measured by the number of units.

Junction box frames and covers installed in bridge structures will be measured by the number of units.

701.20 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
___ " FLEXIBLE METAL CONDUIT	LINEAR FOOT
___ " RIGID METALLIC CONDUIT, TYPE ___	LINEAR FOOT
___ " RIGID NONMETALLIC CONDUIT	LINEAR FOOT
GROUND WIRE, NO. ___ AWG	LINEAR FOOT
MULTIPLE LIGHTING WIRE, NO. ___ AWG	LINEAR FOOT
SERVICE WIRE, NO. ___ AWG	LINEAR FOOT
CABLE RACK ASSEMBLIES	UNIT
FOUNDATIONS, TYPE ___	UNIT
JUNCTION BOX FOUNDATIONS	UNIT
___ " JUNCTION BOXES	UNIT
___ " X ___ " JUNCTION BOXES	UNIT
___ " X ___ " X ___ " JUNCTION BOXES	UNIT
JUNCTION BOX FRAMES AND COVERS	UNIT

Payment for traffic directors will be made according to Section 617.

Payment for clearing site will be made according to Section 201.

Payment for test pits will be made according to Section 207.

Payment for concrete sidewalks and driveways will be made according to Section 607.

Payment for topsoiling and fertilizing and seeding will be made according to Sections 806 and 808.

Separate payment will not be made for bonding wire installed in junction boxes, standard bases, meter cabinets, and equipment enclosures. All costs thereof shall be included in the price bid for ground wire.

Separate payment will not be made for multiple lighting wire installed in lighting arm and lighting standard assemblies, traffic signal assemblies, and sign lighting assemblies.

SECTION 702 - TRAFFIC SIGNALS{ XE "TRAFFIC:SIGNALS" }{ XE "ELECTRICAL WORK:TRAFFIC SIGNALS" }

702.01 Description.

This work shall consist of furnishing and installing completely wired traffic signal systems.

A complete traffic signal installation is generally composed of two systems, one underground and the other above ground.

The underground installation consists of conduits, junction boxes and foundations for standards, pedestals, push button stations, meter cabinets, traffic signal controllers, and the installation of detectors.

The above-ground installation consists of meter cabinets, traffic signal controllers, signal standards, mast arms, pedestals, signal heads, lamps, LED traffic signal modules, pedestrian push button assemblies, wire and wiring, bonding and grounding, connection to utility service, and testing.

Temporary traffic signals, where required, shall consist of furnishing, installing, maintaining, and repairing temporary traffic signal systems during the various stages of construction.

Interim traffic signals, where required, shall consist of furnishing, installing, maintaining, repairing, and modifying existing traffic signal systems during various stages of construction.

Terms used are according to NEMA Standard Publication No. TS-1, Section 1, entitled Traffic Control Systems.

MATERIALS AND ELECTRICAL EQUIPMENT

702.02 Materials and Equipment.

Materials and equipment shall conform to Section 701 and to the following Subsections:

Lamps	906.09
Loop Detector Lead	906.10
Loop Wire	906.11
Cabinets	906.12
Panel Boards and Circuit Breakers	906.14
Pedestals, Poles, Transformer Bases, and Mast Bracket Arms	906.15
Traffic Signal Cable	906.18

The following materials and equipment shall conform to the New Jersey Electrical Materials Specifications listed below:

Joint Sealant	EB-JS-1
Loop Detector Card	EB-LD-CARD
Optically Programmed Traffic Signal Head	EB-TS-2
Pedestrian Signal Head	EB-PS-1
Push Button Assembly	EB-PPB-1
Traffic Signal Head	EB-TS-1
Traffic Signal Controller:	
Eight-Phase	EB-TSC-ITB-8
Fiberoptic Two Color Turn Arrow	EB-TS-3
Optically Controlled Emergency Vehicle Detection System	EB-EOVD
Test Controller Unit for Two to Eight-Phase Solid State NEMA Type Traffic Signal Controllers	EB-TSC-CTU
Optically Programmed Adjustable Face Pedestrian Signal Heads	EB-PS-4
Fiberoptic Blankout Sign	EB-FOBS
Red LED Traffic Signal Module	EB-REDLED-TSM
Green LED Traffic Signal Module	EB-GRNLED-TSM
Green, Amber, and Red LED Turn Arrow Module	EB-LED-GARTAM
LED Bi-modal Turn Arrow Module	EB-LED-BTAM
Traffic Signal Head	EB-TS-1A

Other materials and equipment shall conform to the following:

{ XE "Electrical work:controllers" **}{** XE "Electrical work:traffic signals:assemblies" **}1. Controller Assembly.** Each actuated controller shall be furnished and installed with the following equipment which shall be connected to the back panel of the controller cabinet:

a. Single circuit solid state flasher.

b. Loop detector card. A maximum of one loop shall be connected to a sensor channel unless otherwise indicated on the plans. A minimum of eight loop detector cards shall be provided.

All equipment required to perform the required signal operation shall be furnished and installed. The controller shall be completely wired to the terminal blocks in the meter cabinet.

{ XE "Electrical work:meter cabinets" **}2. Meter Cabinets.** Meter cabinets shall consist of cabinets, meters, control and distribution facilities, the grounding of all equipment, internal wire and wiring to component parts, photoelectric control unit and wire, and wiring to the same. The metering facilities shall conform to all utility company requirements.

{ XE "Electrical work:pedestal assemblies" **}3. Pedestal Assemblies.** Pedestal assemblies shall consist of furnishing and installing a pedestal pole with base and slip-fitter cap, miscellaneous fittings and hardware, traffic or pedestrian signal heads or both and traffic signal cable from the terminal block of each face to the base of the standard.

PEDESTAL ASSEMBLIES (HEIGHT 8 FEET)

Type	No.of Std. Faces	No.of Ped. Faces	No.of Prog. Faces	No.of Spider Assemblies
P-1	1	0	0	0
P-2	2	0	0	1
P-3	3	0	0	1
P-4	4	0	0	1
P-1-W-1	1	1	0	1
P-2-W-1	2	1	0	1
P-3-W-1	3	1	0	1
P-1-W-2	1	2	0	1
P-2-W-2	2	2	0	1
PW-1	0	1	0	0
PW-2	0	2	0	1
PW-3	0	3	0	1
P-1-OP	0	0	1	0
P-2-OP	0	0	2	1

PEDESTAL ASSEMBLIES (HEIGHT MORE THAN 8 FEET)

Type	No.of Std. Faces	No.of Ped. Faces	No.of Prog. Faces	No.of Spider Assemblies
P-1-D	1	0	0	0
P-2-D	2	0	0	1
P-3-D	3	0	0	1
P-4-D	4	0	0	1
P-1-W-1-D	1	1	0	1
P-1-W-2-D	1	2	0	1

Pedestal assemblies designated with the letter “D” shall be furnished according to the height as shown on the Plans.

Use “J” assemblies when replacing signals on pedestal poles:

“J” ASSEMBLIES

Type	No. of Std. Faces	No.of Ped. Faces	No.of Prog. Faces	No.of Spider Assemblies
J-1	1	0	0	0
J-2	2	0	0	1
J-3	3	0	0	1
J-4	4	0	0	1
J-1-W	0	1	0	0
J-2-W	0	2	0	1
J-1-W-1	1	1	0	1

J-1-W-2	1	2	0	1
J-2-W-2	2	2	0	1

Pedestal assemblies designated with the letter "J" shall consist of furnishing and installing a traffic signal head on an existing traffic signal pedestal. The item shall include a slip-fitter, miscellaneous fittings, No. 14 traffic signal cable from the terminal block of the head to the base of the standard, and removal of an existing signal head.

{ XE "Electrical work:pedestrian signal assemblies" **}4. Pedestrian Signal Assemblies.** Pedestrian signal assemblies shall be of the following types:

a. Type W-1 shall consist of furnishing and installing one pedestrian signal head with pole clamp mounting, miscellaneous fittings, the drilling of the standard, installing the grommet and traffic signal cable from the terminal block of the face to the base of the standard.

b. Type W-1-OP shall consist of furnishing and installing one optically programmed pedestrian signal head with pole clamp mounting, miscellaneous fittings, the drilling of the standard, installing the grommet and traffic signal cable from the terminal block of the face to the base of the standard.

{ XE "Electrical work:push button assemblies" **}5. Push Button Assemblies.** Push button assemblies shall include the complete push button and housing, traffic signal cable from terminals of the push button to the base of the standard, and instruction sign. The signs shall be in conformance with the MUTCD. The legend for the sign shall be Push Button for Green Light except if WALK - DON'T WALK indications are used, the legend shall be Push Button for WALK Signal. Push buttons shall operate on logic ground.

6. Push Button Standard. Push button standard shall consist of a traffic signal pedestal complete with all mounting hardware and raintight pole cap.

{ XE "Traffic:signal cable" **}7. Traffic Signal Cable.** Traffic signal cable shall be multi-conductor cable conforming to Subsection 906.18 and shall consist of furnishing and installing the cable, all required splicing, cable tags, and providing slack cable in the standards, pedestals, meter cabinets and controller cabinets.

8. Traffic Signal Assemblies. Traffic signal assemblies shall consist of traffic signal arm, furnished and installed on a traffic signal standard complete with mast arm hanger and spider assemblies, or mounting bracket assembly, as required, safety chains, traffic signal heads, miscellaneous hardware and fittings, and traffic signal cable from the terminal block of each face to the base of the traffic signal standard. The red, green, bi-module turn arrow, and green, amber, and red turn-arrow LED modules shall be used for all related indications.

Free swinging traffic signal heads mounted at the end of a mast arm shall be aluminum.

Traffic signal assemblies designated with the letters "MA" shall consist of assemblies having a traffic signal arm of the aluminum mast arm type.

Traffic signal assemblies designated with the letters "MK" shall consist of assemblies having a traffic signal arm of the aluminum mast arm type that shall fit a 9-inch, outside diameter, pole top.

Traffic signal assemblies designated with the letters "TA" shall be assemblies having a traffic signal arm of the aluminum trombone type. A mast arm hanger and safety chains are not required.

Traffic signal assemblies designated with the letter "S" shall be assemblies having a traffic signal arm of the steel type. Signal mounting bracket assemblies shall be furnished with all steel mast arms.

Traffic signal assembly Type C-1 shall consist of one traffic signal head with pole clamp mounting furnished and installed on a traffic signal standard. The item shall also include miscellaneous fittings, the drilling of the standard, installing the grommet, and traffic signal cable from the terminal block of each face to the base of the standard.

Traffic signal assembly Type C-1-OP shall consist of one optically programmed traffic signal head with pole clamp mounting furnished and installed. The item shall also include miscellaneous fittings, the drilling of the standard, installing the required grommet, and traffic signal cable from the terminal block of each face to the base of the standard.

Traffic signal assembly Type MM-1 shall consist of a midmounted traffic signal head furnished and installed on a mast arm, complete mounting hardware, drilling the arm, grommet, midmount bracket assembly, safety chain, one traffic signal head, and traffic signal cable from the terminal block of each face to the base of the traffic signal standard.

Traffic signal assembly Type MM-1-OP shall consist of an optically programmed traffic signal head furnished and installed on a mast arm, complete mounting hardware, drilling the arm, grommet, midmount bracket assembly, safety chain, one optically programmed traffic signal head, and traffic signal cable from the terminal block of the face to the base of the traffic signal standard.

TRAFFIC SIGNAL ASSEMBLIES

Type	Nominal Arm Length (feet)	No. of Std. Faces	No. of Spider Assemblies	No. of Prog. Faces
15MA-1	15	1	0	0
15MA-2	15	2	1	0
15MA-3	15	3	1	0
15MA-4	15	4	1	0
20MA-1	20	1	0	0
20MA-2	20	2	1	0
20MA-3	20	3	1	0
20MA-4	20	4	1	0
25MA-1	25	1	0	0
25MA-2	25	2	1	0
25MA-3	25	3	1	0
25MA-4	25	4	1	0
30S-1	30	1	0	0
30S-2	30	2	0	0
35S-1	35	1	0	0
35S-2	35	2	0	0
40S-1	40	1	0	0
40S-2	40	2	0	0
45S-1	45	1	0	0
45S-2	45	2	0	0
50S-1	50	1	0	0
50S-2	50	2	0	0
55S-1	55	1	0	0
55S-2	55	2	0	0
60S-1	60	1	0	0
60S-2	60	2	0	0
65S-1	65	1	0	0
65S-2	65	2	0	0
15MA-1-OP	15	0	0	1
15MA-2-OP	15	0	1	2
15MA-1-1-OP	15	1	1	1
20MA-1-OP	20	0	0	1
20MA-2-OP	20	0	1	2
20MA-1-1-OP	20	1	1	1
25MA-1-OP	25	0	0	1
25MA-2-OP	25	0	1	2
25MA-1-1-OP	25	1	1	1
20MK-1	20	1	0	0
20MK-2	20	2	1	0
20MK-3	20	3	1	0
20MK-4	20	4	1	0
25MK-1	25	1	0	0
25MK-2	25	2	1	0
25MK-3	25	3	1	0
25MK-4	25	4	1	0
30S-1-OP	30	0	0	1
30S-2-OP	30	0	0	2
30S-1-1-OP	30	1	0	1

35S-1-OP	35	0	0	1
35S-2-OP	35	0	0	2
35S-1-1-OP	35	1	0	1
40S-1-OP	40	0	0	1
40S-2-OP	40	0	0	2
40S-1-1-OP	40	1	0	1
45S-1-OP	45	0	0	1
45S-2-OP	45	0	0	2
45S-1-1-OP	45	1	0	1
15TA-1	15	1	0	0
15TA-2	15	2	0	0
15TA-3	15	3	0	0
15TA-4	15	4	0	0
20TA-1	20	1	0	0
20TA-2	20	2	0	0
20TA-3	20	3	0	0
20TA-4	20	4	0	0
25TA-1	25	1	0	0
25TA-2	25	2	0	0
25TA-3	25	3	0	0
25TA-4	25	4	0	0
15TA-1-OP	15	0	0	1
15TA-2-OP	15	0	0	2
15TA-1-1-OP	15	1	0	1
15TA-2-1-OP	15	2	0	1
15TA-3-1-OP	15	3	0	1
15TA-1-2-OP	15	1	0	2
15TA-2-2-OP	15	2	0	2
15TA-1-3-OP	15	1	0	3
20TA-1-OP	20	0	0	1
20TA-2-OP	20	0	0	2
20TA-1-1-OP	20	1	0	1
20TA-2-1-OP	20	2	0	1
20TA-3-1-OP	20	3	0	1
20TA-1-2-OP	20	1	0	2
20TA-2-2-OP	20	2	0	2
20TA-1-3-OP	20	1	0	3
25TA-1-OP	25	0	0	1
25TA-2-OP	25	0	0	2
25TA-1-1-OP	25	1	0	1
25TA-2-1-OP	25	2	0	1
25TA-3-1-OP	25	3	0	1
25TA-1-2-OP	25	1	0	2
25TA-2-2-OP	25	2	0	2
25TA-1-3-OP	25	1	0	3

Use "H," "HC," and "HM" assemblies according to the following table when replacing signals on traffic signal mast arms and standards:

REPLACEMENT TRAFFIC SIGNAL ASSEMBLIES

Type	Nominal Arm Length (feet)	No. of Std. Faces	No. of Spider Assemblies	No. of Prog. Faces
H-1	NA	1	0	0
H-2	NA	2	1	0
H-3	NA	3	1	0
H-4	NA	4	1	0
H-1-OP	NA	0	0	1
HC-1	NA	1	0	0
HC-2	NA	2	0	0
HC-3	NA	3	0	0
HC-1-OP	NA	0	0	1
HM-1	NA	1	0	0
HM-2	NA	2	0	0
HM-3	NA	3	0	0
HM-4	NA	4	0	0
HM-1-OP	NA	0	0	1

Traffic signal assemblies designated with the letter "H" shall consist of furnishing and installing a traffic signal head on an existing traffic signal mast arm. The item shall include a mast arm hanger or mounting brackets, safety chain, miscellaneous fittings, No. 14 traffic signal cable from the terminal block of the signal head to the base of the standard, and removal of the existing traffic signal head assembly.

Traffic signal assemblies designated with the letters "HC" shall consist of furnishing and installing a traffic signal head on an existing traffic signal standard. The item shall include pole clamps, miscellaneous fittings, the drilling of the traffic signal standard if required, installing the grommet, No. 14 traffic signal cable from the terminal block of each face to the base of the standard, and removal of the existing traffic signal head assembly.

Traffic signal assemblies designated with the letters "HM" shall consist of furnishing and installing a mid-mounted traffic signal head on an existing traffic signal mast arm. The item shall include complete mounting hardware, drilling of the mast arm if required, installing the grommet, mid-mount bracket assembly, safety chain, No. 14 traffic signal cable from the terminal block of each face to the base of the standard, and removal of the existing traffic signal head assembly.

Traffic signal assemblies shall also consist of removing the lamp, lens, and reflector and furnishing and completely installing an LED module in all traffic signal heads, except the amber bulbs, and optically programmed signals.

Signs mounted on traffic signal mast arms shall utilize vertical mounted type, high-strength aluminum alloy, swing sign brackets with stainless steel components; heavy duty stainless steel straps adaptable to any pole diameter; and removable stainless steel damper springs. Swing sign brackets shall be adjustable for leveling.

9. Traffic Signal Standards. Aluminum traffic signal standards shall be installed complete with a separate bolt-on transformer base of one of the following types:

a. An 8-inch Type TB-30 base with through bolts shall be furnished with all traffic signal standards mounted on 11-inch bolt circles.

b. A 20-inch Type TB-20 base shall be furnished with all traffic signal standards mounted on 15-inch bolt circles.

c. A 24-inch Type TB-K base shall be furnished with all traffic signal standards mounted on 22-inch bolt circles.

A separate transformer base is not required for steel traffic signal standards.

Ground studs shall be furnished and installed in all transformer bases or in the standard. Ground wire shall be installed and shall extend to the ground rod.

Traffic signal standards, Type KE, shall be mounted on a new or existing K-pole. Traffic signal standards, Type S, shall be a pole of the steel type. Traffic signal standards, Type SC shall consist of a

modified steel traffic signal pole that shall have the capability of accommodating a 15 or 20 foot long lighting arm.

{ XE "Electrical work:loop detector and lead" **}10. Loop Detector.** Loop detector shall consist of cutting a loop trench, cleaning the loop trench, furnishing and installing the wire within the loop trench and, from the termination of the loop trench to the nearest junction box, splicing of wire to the loop detector leads, testing, drilling and repairing the curb, and furnishing and installing the sealant. The wire shall be loop wire as specified in Subsection 906.11.

11. Loop Detector Lead. Loop detector lead shall consist of furnishing and installing of wire specified in Subsection 906.10, connection of the wire to the terminals of the loop detector panel and splicing of the wire to the loop detector.

12. Traffic Controller Assembly Turn On. Traffic controller assembly turn on shall consist of supplying a technician, representing the controller manufacturer, at the site when each controller assembly is placed into operation and upon assumption of maintenance by the Department.

CONSTRUCTION

702.03 Construction Requirements.

The provisions of Section 701 shall apply.

When modifications are made to an existing traffic signal system, as-built prints shall be updated and maintained. The as-built prints shall be stored in the controller cabinet for each system for use by Department maintenance personnel.

Traffic signal standards shall be securely bolted to the foundations and shall be erected with sufficient rake as to assume a vertical position after all attachments and appurtenances are in place. Shims shall be installed to a maximum of ¼ inch.

Mounting fittings shall provide the proper clearance to aim and adjust the traffic control device. Fittings and mounting hardware not shown on the Plans shall conform to the recommendations of the manufacturer.

Factory installed wrapping shall remain on the poles and bracket arms for as long as recommended by the manufacturer. Every effort shall be made to install the standards and arms with the wrapping in place and every precaution shall be taken to maintain the standard and other equipment in their original factory appearance. In all cases, the ropes, slings or other equipment used to erect the standard and other equipment shall be carefully placed to prevent scratching or abrasions. All abrasions and scratches shall be refinished.

Traffic signal pedestals and meter cabinets shall be securely bolted to the foundations in a vertical position, using stainless steel hardware.

Pedestrian push button assemblies and instruction signs shall be accurately positioned on traffic signal standards, traffic signal pedestals, controller cabinets or meter cabinets. Pedestrian push-button assemblies shall be securely fastened with stainless steel vandal-resistant hardware.

Controller cabinets shall be securely fastened to foundations in a perpendicular position with stainless steel hardware. When a controller cabinet is temporarily installed on the top of a meter cabinet it shall be securely fastened in a perpendicular position using stainless steel hardware. The joint between the cabinets shall be sealed with a neoprene gasket and the wireway sealed as specified in Subsection 701.07.

Traffic signal faces shall be assembled using a wrench specifically designed for that purpose. All mounting fittings shall be specifically designed to function with the unit and provide the proper clearance to aim and adjust the signal face.

Ray directors of the specified cut-off angle shall be installed inside the signal visor. The entire ray director shall be dull black and shall be attached to the visor, after proper aiming, with stainless steel sheet metal screws.

Field adjustments of ray directors and optically programmed signal heads shall be made to limit the visibility of the signal indication. Programming of the indications is subject to approval.

Attachments of the visors, backplates or adaptors shall conform and readily fasten to existing mounting surfaces without affecting the water and light integrity of the signal head.

Traffic signal assemblies shall be wired as indicated. Each signal face shall be individually wired from the terminal block to the base of the pedestal or standard, using the specified colors for each signal section.

Wire used in traffic signal assemblies, from the face to the base of the standard, shall be traffic signal cable.

Each wire termination shall be made with an insulated locking spade terminal.

All terminations in meter cabinets or controller cabinets shall be attached to barrier type terminal blocks. All terminal blocks shall be identified. All spare wires shall be terminated and identified as such.

Where joints or splices are necessary they shall be made with a compression solderless connector and be secured mechanically and electrically with the proper tool. The conductors shall be thoroughly cleaned and with a minimum of the insulation removed. All joints and splices located in pole bases shall be insulated with insulating tape and shall

provide one and one-half times the insulation equivalent to that of the original conductor. The taped joints and splices shall be thoroughly coated with an electrical grade sealant and bonding compound.

Where joints or splices are necessary in junction boxes, they shall be as specified above and insulated with resin splicing kits.

Loop detector leads shall be installed continuously from the controller to the junction box nearest to the loop. Splices will not be permitted in the loop detector lead. The connection of the loop detector lead to the loop wire shall be made with a compression solderless connector and be secured mechanically and electrically, with a proper tool. The conductors shall be cleaned with a minimum of insulation removed. All joints and splices shall be insulated with a resin splicing kit.

{ XE "Electrical work:traffic signals:circuits" **}**Traffic signal circuits shall be color coded and wired as follows:

TWO CONDUCTOR CABLE

Function	Color	Number
Pedestrian Push Button	Black	1
Neutral	White	2

FIVE CONDUCTOR CABLE (Traffic Signal)

Face	Color	Number
Spare	Black	1
Neutral	White	2
Red	Red	3
Green	Green	4
Yellow	Orange	5

FIVE CONDUCTOR CABLE (One Pedestrian Signal)

Face	Color	Number
Spare	Black	1
Neutral	White	2
Don't Walk	Red	3
Walk	Green	4
Spare	Orange	5

FIVE CONDUCTOR CABLE (Two Pedestrian Signal)

Face	Color	Number
Walk (2)	Black	1
Neutral	White	2
Don't Walk	Red	3
Walk	Green	4
Don't Walk (2)	Orange	5

TEN CONDUCTOR CABLE (Traffic Signal)

Face	Color	Number
Green Arrow (spare)	Black	1
Neutral (1)	White	2
Red (1)	Red	3
Green (1)	Green	4
Yellow (1) or Yellow Arrow	Orange	5
Arrow Neutral (spare)	Blue	6
Neutral (2)	White-Black	7
Red (2)	Red-Black	8
Green (2)	Green-Black	9
Yellow (2)	Orange-Black	10

Where loop detectors are to be installed, it shall be necessary to saw cut in the roadway a channel of the dimensions and shape indicated by the Plans. An access channel shall be saw cut from each loop to the edge of the roadway. The

corners of the loops shall be cut diagonally to ensure a clean smooth radius. All cuts shall be accomplished in a single pass with circular pavement-cutting saw.

The channel shall be blown free of debris and moisture after the trench has been cut. If the loop wire is not immediately installed, a filler shall be installed to prevent the channel from collapsing.

The wire forming the loop shall be continuous throughout its length, and installed without splices or joints. The loop wire shall extend from the channel to the nearest junction box. At this point it shall be connected to the loop detector leads as previously specified.

The loop detector wire shall be installed in the following manner. After the channel is blown free of debris and moisture, the turns of wire shall be laid in the channel so that there are no kinks or curls, and no straining or stretching of the insulation around the corners of the channel or in the junction box. A piece of wood with rounded corners shall be used to seat the wire in the bottom of the channel. After the wire is placed, it shall be rechecked for slack, raised portions or tightness. If any of the foregoing are found, they shall be corrected.

The two wires, which form the lead-in wires, shall be twisted together in the loop channel and conduit to the nearest junction box.

After testing the loop, the channel shall be sealed with a joint sealant applied according to the manufacturer's instructions. The joint sealant shall not be placed in the channel at temperatures below 45 ºF or during precipitation of any kind. The channel shall be completely filled with the joint sealant and there shall be no air bubbles below the surface. Joint sealant that is accidentally applied to the roadway shall be removed. The joint sealant must be sufficiently hardened before traffic is permitted to move over the area.

At those locations where the saw cuts are in a roadway that slopes, the joint sealant shall be applied in a manner that prevents the joint sealant from running out of the trench and on to the roadway.

When the roadway in the area of the loop detectors is to be resurfaced, work shall be scheduled to install the loop detector immediately below the top layer of the surface course. The joint sealant must be hardened before the installation of the pavement.

If a loop is installed on a grade steeper than three percent, the joint sealant shall be sealant Type 1.

702.04 Temporary and Interim Traffic Signal Systems.{ XE "Temporary:traffic signal system" }{ XE "Electrical work:traffic signals:temporary traffic signal system" }{ XE "Electrical work:temporary traffic signal systems" }

Construction of the temporary and interim traffic signal system shall be according to Subsection 702.03, and with the following:

1. **Temporary Traffic Signal System.** This work shall consist of furnishing, installing, maintaining and repairing a temporary traffic signal system to provide the timing and operation as shown on the Plans or as directed. It shall include, but is not limited to, any temporary wiring, span and tether wire, signal heads, relamping, mast arms, poles, traffic signal cables, junction boxes, foundations, conduit, detectors, controllers and timing sequences, cabinets, associated highway lighting units, electric services, necessary hardware, and any other incidentals deemed required. Electric service for the temporary system shall be obtained from the utility company by the Contractor.

   As-built drawings of each signal change shall be kept by the Contractor and a copy shall be provided in each controller cabinet along with a Contractor Maintenance Traffic Signal Inspection Report (Form: EL-16C). Copies of each shall be provided to the Engineer before final payment for this item. The Contractor shall also be responsible for payment of electric current cost for new temporary electric service and removal of the temporary traffic signal system and for repair of all damage caused to the temporary signal by third parties including, but not limited to, vehicular knockdown. All material supplied by the Contractor for the temporary traffic signal system shall remain the property of the Contractor.

   If the Contractor chooses to install a temporary traffic signal system and the design is not provided in the Contract Documents, then the Contractor shall submit a temporary traffic signal plan, before installation, for review and approval. The plan shall include complete structural design calculations according to current AASHTO Standards, stamped by a Professional Engineer licensed to practice in the State.

   Maintenance responsibility of a temporary traffic signal system shall be from the time the Contractor commences work on the temporary traffic signal system until its removal. Should the Contractor cause any damage to the temporary traffic signal installation or should any portion of the temporary traffic signal system fail or malfunction for any reasons, it shall be the Contractor's responsibility to affect immediate repairs and return the traffic signal to normal signal operation. The Contractor shall make no claim against the State for the costs of repairs and/or maintenance if the traffic signal system is damaged by a third party or vehicular knockdown and repairs or maintenance is required as a result of this as outlined in Subsection 107.22. Work to repair the traffic signal must begin within a maximum

of two hours after the Contractor is notified of damage or malfunction by the Department, NJSP, or local authorities. Workmen assigned to such repair shall work continuously until the traffic signal resumes normal signal operation.

In addition, if the Contractor fails to respond to a failure or knockdown within two hours after notification, or does not begin work within the two hour limit specified, or does not continue to work until the traffic signal is back into normal signal operation, in the interests of safety, the State will respond with its own forces to restore normal signal operation. If the State responds with its own forces to affect repairs at the intersection(s), the Contractor agrees to pay the State a sum of $7,500 for costs of mobilizing its forces and equipment. In addition, the Contractor shall pay the State its actual cost of material used to affect the repair, and shall pay the actual costs of traffic protection to the agency providing the police, etc. This amount may be deducted from any money due and owing the Contractor by the Department. Any such emergency work performed by State forces will not in any way diminish the Contractors' liabilities as described hereunder.

All material, labor, equipment fees, energy costs, and all else necessary for the Contractor to maintain the traffic signal in operation shall be at the Contractors expense.

After the temporary traffic signal system is placed into operation, the Contractor shall be responsible for inspecting the temporary traffic signal system every two months. The Contractor Maintenance Traffic Signal Inspection Report shall be filled out at the time the temporary traffic signal system is placed into operation, for any modification to the temporary traffic signal system, and for the two-month inspection. One copy of the completed Contractor Maintenance Traffic Signal Inspection Report shall be provided to the Engineer and a second copy placed in each controller cabinet.

If the Contractor responds to a system failure or malfunction or vehicle knockdown, the Contractor shall fill out a Contractor Maintenance Emergency Call Record (Form: EL-11C). A copy shall be provided to the Engineer and a second copy placed in each controller cabinet after the form is filled out by the Contractor.

Copies of the as-built drawings, Contractor Maintenance Traffic Signal Inspection Reports, and Contractor Maintenance Emergency Call Records shall be placed in a plastic pocket mounted inside the cabinet door of each controller cabinet.

Before energization of the temporary traffic signal system the Contractor shall provide the Engineer with the names and telephone numbers of the Contractor's personnel to be contacted should a failure occur. These individuals shall be familiar with traffic signal construction and operation. The Contractor agrees to be fully liable for the proper installation and operation of the temporary traffic signal system and agree to defend, indemnify, and otherwise save harmless the State, it agencies, departments, bureaus, boards, officials, and employees for any and all claims, demands, suits, recoveries, judgments or actions at law whether for personal injury, property damage or liabilities of any other kind, including the cost of defense which arise from acts or omissions, whether negligent or not, of the Contractor or its agents, employees, servants, subcontractors, suppliers, or others working for the Contractor in the construction and/or maintenance of the traffic signal system.

2. **Interim Traffic Signal System.** This work shall consist of furnishing, installing, maintaining and repairing a modification to an existing traffic signal system to provide the timing and operation as shown on the Plans or as directed. It shall include, but is not limited to, any temporary wiring, signal heads, relamping, mast arms, cabinets, poles, traffic signal cables, span and tether wire, junction boxes, foundations, conduits, detectors, controllers and timing sequences, associated highway lighting units, electric services, necessary hardware, and any other incidentals deemed required.

Above-ground traffic signal equipment, which has been designated for removal, may be used in interim traffic signal systems as approved by the Engineer. As-built drawings of each signal change shall be kept by the Contractor and a copy shall be provided in each controller cabinet along with a Contractor maintenance traffic signal inspection report. Copies of each shall be provided to the Engineer before payment is fully made for the item. The Contractor shall also be responsible for obtaining and paying for electric current cost for new temporary electric service if required to maintain the traffic signal in operation during construction and for repair of all damage caused to the existing and/or replacement traffic signal system by third parties including but not limited to vehicular knockdown. Electric service for the modified system shall be obtained from the utility company by the Contractor.

This maintenance responsibility shall be from the time the Contractor first alters the existing traffic signal installation(s), in any manner, until the Contractor's work on the traffic signal is completed and the revised traffic signal installation(s) is fully operational, inspected and maintenance is assumed by the State according to Subsection 702.05. Should the Contractor cause any damage to any traffic signal installation, existing or installed as part of the Contract, or should any portion of the traffic signal system fail or

malfunction for any reason, it shall be the Contractor's responsibility to effect immediate repairs and return the traffic signal to normal signal operation. The Contractor shall make no claim against the State for the costs of repairs and/or maintenance if the traffic signal is damaged by a third party or vehicular knockdown and repairs and/or maintenance is required as result of this outlined in Subsection 107.22. Work to repair the traffic signal system must begin within two hours after the Contractor is notified of damage or malfunction by the Department, NJSP, or local authorities. Workmen assigned to such repair shall work continuously until the signal resumes normal operation.

In addition, if the Contractor fails to respond to a failure or knockdown within two hours after notification, or does not begin work within the two hours limit specified, or does not continue to work until the traffic signal is back into normal signal operation, in the interest of safety, the State will respond with its own forces to restore normal signal operation. If the State responds with its own forces to effect repair at the intersection(s), the Contractor agrees to pay the State a sum of $7,500 for costs of mobilizing its forces and equipment. In addition, the Contractor shall pay the State its actual cost of material used to affect the repair, and shall pay the actual costs of traffic protection to the agency providing the police, etc. This amount may be deducted from any money due and owing the Contractor by the Department. Any such emergency work performed by State forces will not in any way diminish the Contractor's liabilities as described hereunder.

All material, labor, equipment fees, energy costs, and all else necessary for the Contractor to maintain the traffic signal in operation shall be at the Contractor's expense.

After assumption of maintenance, the Contractor shall be responsible for inspecting the interim traffic signal system every two months. The Contractor Maintenance Traffic Signal Inspection Report shall be filled out at the time the interim traffic signal system is placed into operation, for any modification to the interim traffic signal system and for the two-month inspection. One copy of the completed Contractor maintenance traffic signal inspection report shall be provided to the Engineer and a second copy placed in each controller cabinet.

If the Contractor responds to a system failure or malfunction or vehicle knockdown, he shall fill out a Contractor Maintenance Emergency Call Record (Form: EL-11-C). One copy shall be provided to the Engineer and a second copy placed in each controller cabinet after the form is filled out by the Contractor.

Copies of the as-built drawings, Contractor Maintenance Traffic Signal Inspection Report, and Contractor Maintenance Emergency Call Record shall be placed in a plastic pocket mounted inside the cabinet door of each controller cabinet.

Before the work of modification of the existing traffic signal system begins, the Contractor shall provide the Engineer with the names and telephone numbers of the Contractor's personnel to be contacted should a failure occur. These individuals shall be familiar with traffic signal construction and operation. The Contractor agrees to be fully liable for the proper operation of the traffic signal system once the Contractor or its Contract forces modify it in any manner, and agrees to defend, indemnify and otherwise save harmless the State, its agencies, departments, bureaus, boards, officials and employees for any and all claims, demands, suits, recoveries, judgments or actions at law whether for personal injury, property damage of liabilities of any other kind, including the costs of defense which arise from acts or omissions, whether negligent or not, of the Contractor or its agents, employees, servants, subcontractors, suppliers or others working for the Contractor in the construction and/or maintenance of the traffic signal system.

Upon removal of the interim traffic signal system, above ground equipment and material shall be salvaged for use by the Department and shall become property of the State. Material required to be salvaged shall be stored at or near the work for disposal by the Contractor. The Contractor shall deliver the salvaged material to the nearest Department electrical maintenance yard as directed by the Engineer.

702.05 Assumption of Maintenance.{ XE "Electrical work:assumption of maintenance" }{ XE "Electrical work:traffic signals:assumption of maintenance" }

A traffic signal system at an intersection is to be considered as a separate entity, and maintenance and operational responsibility for the signal may be accepted by the Department before Completion. Thirty days before activation of the traffic signal system, the Resident Engineer shall be notified in order that the system may be inspected to ensure that it conforms to the Contract requirements. Maintenance assumption will be considered only after all testing has been completed, defects corrected, all indications are operational and properly aimed, cables tagged, controller fully operational performing all timing functions required, and all other items of work associated with the signal are completed.

Assumption of maintenance by the Department shall not be considered as Acceptance as described by the Subsection 105.23.

COMPENSATION

702.06 Method of Measurement.

Loop detectors will be measured by the linear foot of saw cut in which the wire is installed.

Loop detector leads and traffic signal cables will be measured by the linear foot.

Controller assemblies of the various phases and meter cabinets of the various types will be measured by the number of units.

Traffic controller assembly turn on will be measured by the number of units.

Pedestal, pedestrian, and traffic signal assemblies and standards of the various types will be measured by the number of units.

Push button assemblies and standards will be measured by the number of units.

Temporary traffic signal systems at the various locations will not be measured, and payment will be made on a lump sum basis.

Interim traffic signal systems at the various locations will not be measured and payment will be made on a lump sum basis.

702.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
LOOP DETECTOR	LINEAR FOOT
LOOP DETECTOR LEAD	LINEAR FOOT
CONTROLLER ASSEMBLIES, ___ PHASE	UNIT
METER CABINETS, TYPE ___	UNIT
TRAFFIC CONTROLLER ASSEMBLY TURN-ON	UNIT
PEDESTAL ASSEMBLIES, TYPE ___	UNIT
PEDESTRIAN SIGNAL ASSEMBLIES, TYPE ___	UNIT
PUSH BUTTON ASSEMBLIES	UNIT
PUSH BUTTON STANDARDS	UNIT
TRAFFIC SIGNAL ASSEMBLIES, TYPE ___	UNIT
TRAFFIC SIGNAL CABLE, ___ CONDUCTOR	LINEAR FOOT
TRAFFIC SIGNAL STANDARDS, TYPE ___	UNIT
TEMPORARY TRAFFIC SIGNAL SYSTEM LOCATION NUMBER___	LUMP SUM
INTERIM TRAFFIC SIGNAL SYSTEM LOCATION NUMBER___	LUMP SUM

Payment for junction boxes, conduits, ground wire and service wire will be made according to Section 701.

Payment for new traffic signal equipment, conduits, foundations and other materials used in the temporary system which are to become part of the permanent system will be made according to Section 701 or this Section, as appropriate.

Payment for swing sign brackets shall be included in the price bid for traffic signal assemblies.

SECTION 703 - HIGHWAY LIGHTING{ XE "HIGHWAY LIGHTING" }{ XE "ELECTRICAL WORK:HIGHWAY LIGHTING" }

703.01 Description.

This work shall consist of furnishing and installing complete multiple type highway lighting systems. The work shall also consist of furnishing, installing, and maintaining the temporary highway lighting system during the various stages of construction.

A complete highway lighting installation is generally composed of two systems, one underground and the other above ground.

The underground installation consists of conduits, junction boxes, and concrete foundations for lighting standards and meter cabinets.

The above ground installation consists of lighting standards and brackets, luminaires, lamps, meter cabinets, standard and bracket wire and wiring from luminaires to multiple lighting wires, multiple lighting wire and wiring from lighting standard bases to meter cabinet, connections, extension to utility service, grounding rods, bonding, and grounding.

MATERIALS AND ELECTRICAL EQUIPMENT

703.02 Materials and Equipment.

Materials and equipment shall conform to Section 701 and to the following Subsections:

Cable Connectors	906.04
Cast Boxes and Fittings	906.06
Lamps	906.09
Cabinets	906.12
Panel Boards and Circuit Breakers	906.14
Pedestals, Poles, Transformer Bases, and Mast Bracket Arms	906.15
Photoelectric Controls	906.16
Aluminum Alloys	911.01

The following materials and equipment shall conform to the New Jersey Electrical Materials Specifications listed below:

High Pressure Sodium Luminaires:	
Conventional Type	EB-LHPS-2
Offset Type	EB-LHPS-3
High Mast Type	EB-LHPS-4
Vertical Mounted Type	EB-LHPS-6
Offset Type	EB-LHPS-7
Underdeck Luminaires High Pressure Sodium:	
Wall Mounted Type	EB-UHPS-1
Pendant Type	EB-UHPS-2
Photoelectric Control Unit	EB-PEC-1
Storage Kit	EB-KIT
Cutoff Type	EB-CF

Other materials and equipment shall conform to the following:

1. **Cast Junction Boxes.** Cast junction boxes shall consist of furnishing and installing a cast junction box and cover, and mounting hardware and equipment bosses.
2. **Lighting Standard Assemblies.** Lighting standard assemblies shall consist of a lighting pole; transformer base; bracket arm; conventional type, vertical type, or cutoff type luminaire with lamp and ballast; cable connectors (fused and nonfused); and two No. 10 AWG color-coded wires extending from the ballast terminals of each fixture to the distribution wire in the adjacent junction box.

   Lighting standard assemblies designated with letters “SB” are units intended for mounting on structures. The transformer base is omitted, and a reinforced handhold is provided in the shaft.

   Lighting standard assemblies designated with the letter “T” shall have two bracket arms with luminaries mounted on the lighting standard.

   Lighting standard assemblies designated with the letters “CF” shall be provided with a cutoff type luminaires.

Lighting standard assemblies designated with the letter "V" shall be provided with a vertical type luminaires.

Lighting Standard Assemblies, Type L-E-S-SC shall consist of an offset type luminaire with an appropriate slip-fitter mounting adapter that shall have the capability of being installed on a traffic signal standard, "Type SC," cable connectors (fused and/or nonfused) and two No. 10 AWG color-coded wires extending from the ballast terminals of each fixture to the distribution wire in the base of the traffic signal or adjacent junction box.

LIGHTING STANDARD ASSEMBLIES

Type	Nominal Arm Length (feet)	Arms	Luminaires	Lamp Size
L-8-X	8	1	1	150W-HPS
L-8-SB-X	8	1	1	150W-HPS
L-8-T-X	8	2	2	150W-HPS
L-8-40-X	8	1	1	150W-HPS
L-8-40-SB-X	8	1	1	150W-HPS
L-8-40-T-X	8	2	2	150W-HPS
L-8-40-Y	8	1	1	250W-HPS
L-8-40-SB-Y	8	1	1	250W-HPS
L-8-40-T-Y	8	2	2	250W-HPS
L-8-CF-X	8	1	1	150W-HPS
L-8-SB-CF-X	8	1	1	150W-HPS
L-8-T-CF-X	8	2	2	150W-HPS
L-8-40-CF-X	8	1	1	150W-HPS
L-8-40-SB-CF-X	8	1	1	150W-HPS
L-8-40-T-CF-X	8	2	2	150W-HPS
L-8-40-CF-Y	8	1	1	250W-HPS
L-8-40-SB-CF-Y	8	1	1	250W-HPS
L-8-40-T-CF-Y	8	2	2	250W-HPS
L-15-X	15	1	1	150W-HPS
L-15-SB-X	15	1	1	150W-HPS
L-15-T-X	15	2	2	150W-HPS
L-15-40-X	15	1	1	150W-HPS
L-15-40-SB-X	15	1	1	150W-HPS
L-15-40-Y	15	1	1	250W-HPS
L-15-40-SB-Y	15	1	1	250W-HPS
L-15-CF-X	15	1	1	150W-HPS
L-15-SB-CF-X	15	1	1	150W-HPS
L-15-T-CF-X	15	2	2	150W-HPS
L-15-40-CF-X	15	1	1	150W-HPS
L-15-40-SB-CF-X	15	1	1	150W-HPS
L-15-40-CF-Y	15	1	1	250W-HPS
L-15-40-SB-CF-Y	15	1	1	250W-HPS
L-8-V-X	8	1	1	150W-HPS
L-8-SB-V-X	8	1	1	150W-HPS
L-8-T-V-X	8	2	2	150W-HPS
L-15-V-X	15	1	1	150W-HPS
L-15-SB-V-X	15	1	1	150W-HPS
L-15-T-V-X	15	2	2	150W-HPS
TL-100-8	0	0	8	400W-HPS
L-E-S-SC-X	0	0	1	150W-HPS

3. Lighting Arm Assemblies. Lighting arm assemblies designated with the letter "A" shall consist of a bracket arm on a traffic signal standard or existing standard, a luminaire, lamp, cable connectors (fused and nonfused), and two No. 10 AWG color-coded wires extending from the ballast terminals to the distribution wires in the adjacent junction box or the base of the standard.

Lighting arm assemblies designated with the letters "CF" shall be provided with a cutoff type luminaires.

Lighting arm assemblies designated with the letter "V" shall be provided with a vertical type luminaires.

Lighting arm assemblies designated with the letters "SA" shall consist of a steel bracket arm on a modified steel traffic signal standard, Type "SC," a luminaire, lamp, cable connectors (fused and/or nonfused), and two No. 10 AWG color-coded wires extending from the ballast terminals to the distribution wires in the adjacent junction box or the base of the standard.

LIGHTING ARM ASSEMBLIES

Type	Nominal Arm Length (feet)	Luminaires	Lamp Size
L-8A	8	1	150W-HPS
L-15A	15	1	150W-HPS
L-8A-CF	8	1	150W-HPS
L-15A-CF	15	1	150W-HPS
L-8A-V	8	1	150W-HPS
L-15SA	15	1	150W-HPS
L-20SA	20	1	150W-HPS
L-15SA-CF	15	1	150W-HPS
L-20SA-CF	20	1	150W-HPS
L-15SA-V	15	1	150W-HPS
L-20SA-V	20	1	150W-HPS
L-15A-V	15	1	150W-HPS

{ XE "Electrical work:highway lighting:lighting assemblies" **}4. Lighting Assemblies.** Lighting assemblies designated with the letter "R" shall consist of the replacement of an existing luminaire and wiring. The item shall include furnishing and installing a luminaire, lamp, ballast, cable connectors (fused and nonfused), and two No. 10 AWG color-coded wires extending from the ballast terminals to the cable connectors in the base of the standard.

Lighting assemblies Type L-R-E shall consist of the replacement of an existing luminaire and wiring and shall include furnishing and installing an offset type mounted luminaire, slip-fitter mounting adapter, lamp, ballast, cable connectors (fused and nonfused), and two No. 10 AWG color-coded wires extending from the ballast terminals to the cable connectors in the base of the standard.

Lighting assemblies designated with the letters "CF" shall be provided with a cutoff type luminaires.

Lighting assemblies designated with the letter "V" shall be provided with a vertical type luminaires.

LIGHTING ASSEMBLIES

Type	Nominal Arm Length (feet)	Arms	Luminaires	Lamp Size
L-R-X	0	0	1	150W-HPS
L-R-40-Y	0	0	1	250W-HPS
L-R-E-40-Z	0	0	1	400W-HPS
L-R-E-40-Y	0	0	1	250W-HPS
L-R-E-26-Y	0	0	1	250W-HPS
L-R-E-26-X	0	0	1	150W-HPS
L-R-U-X	0	0	1	150W-HPS
L-R-CF-X	0	0	1	150W-HPS
L-R-40-CF-X	0	0	1	150W-HPS
L-R-40-CF-Y	0	0	1	250W-HPS

L-R-40-X	0	0	1	150W-HPS
L-R-V-X	0	0	1	150W-HPS

5. Meter Cabinets. Meter cabinets shall consist of cabinets, meters, control and distribution facilities, the grounding of all equipment, internal wire and wiring to component parts, photoelectric control unit, and wire and wiring to the same. The metering facilities shall conform to all utility company requirements.

{ XE "Electrical work:highway lighting:underdeck lighting assemblies" **}6. Underdeck Lighting Assemblies.** Underdeck lighting assemblies shall consist of an underdeck luminaire, lamp, and two No. 10 AWG color-coded wires from the ballast terminals in the luminaire to the distribution cables in the adjacent junction box.

Underdeck lighting assemblies designated with the letter "W" or "P" are wall mounted and pendant mounted respectively.

Underdeck lighting assemblies Type L-R-U shall consist of the replacement of an existing luminaire and wiring and shall include furnishing and installing an underdeck luminaire, lamp, ballast, cable connectors, and two No. 10 AWG color-coded wires extending from the ballast terminals to the distribution wires in the adjacent junction box.

7. Wire. No. 10 AWG wire used in lighting arm and lighting standard assemblies, and underdeck lighting assemblies shall be multiple lighting and service wire.

703.03 Temporary Highway Lighting System{ XE "Highway lighting:temporary system" }.

Above ground highway lighting equipment, which has been designated for removal, may be used in the temporary highway lighting system.

Construction shall conform to Subsection 703.04. The Contractor shall obtain electrical service for the temporary system from the utility company. Upon removal of the temporary highway lighting system, above-ground equipment shall become the property the Contractor.

CONSTRUCTION

703.04 Construction Requirements.

The provisions of Section 701 shall apply.

The connection of the bonding wire to the bases of lighting standards shall be done by means of ground studs.

Lighting poles shall be securely bolted in a vertical position to foundations. Shims of ¼ inches maximum thickness shall be installed, if necessary. Brackets shall be securely attached to poles and shall be placed perpendicular to centerline of roadway. Luminaires shall be securely attached to ends of bracket arms and shall be accurately plumbed, with luminaire reflector properly and accurately placed.

Factory installed wrapping shall remain on the standards and brackets for as long as recommended by the manufacturer. Every effort shall be made to install the standards and brackets with the wrapping in place, and every precaution shall be taken to maintain the standard and other equipment in their original factory appearance. If the wrapping must be removed, the equipment must be maintained in its original factory appearance. In all cases, the ropes, slings or other equipment used to erect the standard, and other equipment shall be carefully placed to prevent scratching or abrasions. All abrasions and scratches shall be refinished.

Underground conduits entering meter cabinets or transformer enclosures shall be thoroughly sealed with a compound.

Lighting standard assemblies shall be tagged with the area, circuit, and applicable lamp number.

Sufficient color-coded, single-conductor multiple lighting wire shall be furnished and installed for lighting circuits. Conductors shall be run through the conduits properly trained through the junction boxes to permit racking and connection to lighting standard assemblies and to meter cabinet installations.

Lighting wire shall be color-coded utilizing plastic colored tape overlapped from duct edge to duct edge within each junction box. The only exception shall be white for neutral and green for ground wire which shall be color coded with continuous color compound for circuit identification.

The circuit number of all cables shall be identified by cable identification tags attached to each cable in all junction boxes and at the meter cabinets of the load centers. The tags shall be secured to the cable with nylon cable ties.

Where multiple lighting wiring is trained through existing junction boxes which are not equipped with cable racks, cable racks shall be furnished and installed.

Splices necessary to form continuous circuits, complete and ready for operation, shall be made. Splices on all cables and in all boxes shall be made by means of a "C" Type copper pressure connector, made secure mechanically and electrically, with the proper tool. The conductors shall be cleaned and with a minimum of insulation removed.

Splices in multiple lighting wire shall be made with resin type electrical splicing kits. Electrical splicing kits shall be of the in-line or tap type and shall be used as follows:

1. An in-line type splicing kit shall be utilized for joining a single conductor to another to form one continuous through conductor.
2. A tap or Wye type splicing kit shall be used where it is necessary to obtain a tap connection at a through conductor or where it is necessary to join together more than two conductors.

Precaution shall be taken to keep the conductors and splicing connector centered within the mold, so as to have an even amount of resin surrounding the splice.

Exposed rigid metallic conduits shall be installed parallel with or at right angles to the lines of the structure and shall be supported. Should any surface on which the conduit is installed be damaged, it shall be restored.

Concealed rigid metallic conduits shall be installed in as direct a line as possible and shall be rigidly supported.

When electrical boxes are fastened to masonry with any type of expansion fasteners, they shall be of sufficient size and strength to provide adequate support. Mounting bolts and anchors shall be stainless steel.

Conduits entering electrical boxes shall be secured to the box with lock nuts on the inside and outside if a boss is not provided.

Wire for underdeck lighting assemblies shall extend from the fixture to cast junction boxes.

Temporary highway lighting equipment shall be constructed and maintained according to the scheme provided under Subsection 701.03. The equipment includes, but is not limited to wire, overhead wiring, splices, lamps, ballasts, knockdowns or poles, foundations, and conduits. The Contractor shall be responsible for obtaining the electric service for the temporary system from the utility company and all incurring utility costs associated with the electric service including operating cost. Maintenance responsibility shall be for the term of the Contract. Maintenance of the existing highway lighting system not affected by modifications will remain the responsibility of the Department.

703.05 Assumption of Maintenance.{ XE "Electrical work:assumption of maintenance" }{ XE "Electrical work:highway lighting:assumption of maintenance" }

When all testing has been completed, defects corrected and all light units in the total system are operational, a request in writing may be made to the Department to assume maintenance responsibility for the lighting system before all other work of the Project is complete. After inspection and concurrence, and provided all work associated with the lighting system is complete, the Department may assume routine maintenance responsibility for the lighting.

Should the Engineer open a section of roadway to traffic and direct that highway lighting be made operational, the Department will assume maintenance responsibility of the selected portion of the lighting system provided all testing has been completed, defects corrected and associated circuit cables tagged.

Assumption of maintenance by the Department shall not be considered as Acceptance as described by Subsection 105.23.

COMPENSATION

703.06 Method of Measurement.

Cast junction boxes of the various sizes will be measured by the number of units.

Lighting assemblies, lighting arm assemblies, lighting standard assemblies, meter cabinets, and underdeck lighting assemblies, of the various types, will be measured by the number of units.

703.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
___ " X ___ " X ___ " CAST JUNCTION BOXES	UNIT
LIGHTING ASSEMBLIES, TYPE ___	UNIT
LIGHTING ARM ASSEMBLIES, TYPE ___	UNIT
LIGHTING STANDARD ASSEMBLIES, TYPE ___	UNIT
METER CABINETS, TYPE ___	UNIT
UNDERDECK LIGHTING ASSEMBLIES, TYPE ___	UNIT

Payment for junction boxes, foundations, conduit, multiple lighting wire, ground wire, and service wire will be made according to Section 701.

Payment for new highway lighting equipment, conduits, foundations and other materials used in the temporary system which are to be part of the permanent system will be made as stated above.

All costs for temporary highway lighting system shall be included in other Pay Items bid.

SECTION 704 - TOWER LIGHTING STANDARD ASSEMBLIES{ XE "TOWER LIGHTING STANDARD ASSEMBLIES" }

704.01 Description.

This work shall consist of furnishing and installing tower lighting standard assemblies complete with tower structure, anchor bolts, base plate, pole, head frame assembly, luminaire support ring, lowering device including the winch assembly, circuit breaker panel, power receptacles, terminal box, structural and power cables, secondary wiring, and eight luminaires.

MATERIALS

704.02 Materials.

A. Poles. Poles shall be round with a minimum of 18 sides or round taper, constructed from high-strength, low-alloy steel conforming to ASTM A 588 or from low carbon steel tubes, tapered for structural use conforming to ASTM A 595, Grade C.

Poles shall consist of a maximum of four individual tapered steel sections with each section a minimum of 20 feet long. Each section shall be free of circumferential welds or slip joints.

Pole anchor bolt clusters shall be designed to support a maximum of eight luminaires and the lowering device. Structural design shall conform to current AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Additional design criteria are as follows:

Weight of luminaire	approximately 80 pounds each
Maximum projected area	3.8 square feet per luminaire
V	80 miles per hour
Gust factor	1.3
CD (wind drag coefficient	1.0 (for luminaire).

Maximum horizontal deflection at the top of the assembled standard with fixtures attached due to a 40 mile per hour wind (V) shall not exceed 1.25 percent of the total shaft height.

Poles shall have a welded-on base plate, fabricated from high-strength, low-alloy steel conforming to ASTM A 588, drilled to fit onto the foundation anchor bolts. The base plate size and number of anchor bolts will be determined by the pole length and load.

Working drawings of the poles, bases, and anchor bolts, including design calculations, shall be submitted according to Subsection 105.04. The maximum overturning moment of the base shall be clearly identified in the computations.

Pole manufacturers shall have AISC shop certification for category No. 1.

B. Anchor Bolts for Tower Base. Anchor bolts shall be steel conforming to Subsection 917.01 and of sufficient size and strength to develop full bending moment of the shaft. Anchor bolts shall be steel with a minimum tensile strength of 55,000 pounds per square inch and shall conform to ASTM F 1554, Grade 36. The anchorage shall exceed the strength of the shaft. Each bolt shall have two hex nuts for plumbing the shaft and two hold down hex nuts. Bolts shall be threaded at the top and bottom. The threaded end and 6 inches of the embedded portion of the anchor rods and the nuts shall be hot-dip galvanized conforming to ASTM A 153, Class C.

Anchor bolts shall be preassembled in a cluster ready to be placed and leveled into foundation excavations.

C. Miscellaneous Pole Hardware. All other hardware, including nuts and bolts, shall be stainless steel conforming to ASTM F 593. Bolts heads and nuts shall be hexagonal.

D. Tower Luminaire Ring Lowering Device. Each pole shall be furnished with a luminaire ring lowering device that will permit periodic inspection and servicing, from the ground, of the luminaires and electrical and mechanical apparatus. The device shall be able to lower the complete assembly to a height of 5 feet or less above the pole base plate.

The lowering ring shall be made to accommodate eight fixtures, and the addition or deletion of fixtures shall not require the removal of the lowering ring.

Mounted at the top of the pole shaft shall be a detachable head assembly that remains fixed in position during the raising and lowering operation. The head assembly shall consist of three or more symmetrically-located fixed support arms which carry the weight of the lowering assembly. The fixed head assembly shall incorporate no moving parts except the necessary pulleys, rollers, or sheaves that guide the lowering cables and electrical cable during the lowering operations of the assembly.

The fixed head assembly shall be steel conforming to ASTM A 709, Grade 36 and shall be galvanized after fabrication. The luminaire lowering ring shall be high-strength steel, galvanized, and shall serve as the support for the luminaires as well as the wire raceway for all electrical connections to the luminaires and shall have adequate openings for access to wiring and for splicing. Pulleys, rollers, sheaves, and shafts shall be constructed of corrosion-resistant materials and shall not rely upon plating of the parent material for corrosion protection. Pulleys and sheaves attached to the head assembly shall have permanently lubricated bronze-impregnated bushings. The bearings shall be of corrosion-resistant material. Each cable sheave shall have a removable cable keeper covering the entire arc of cable contact to prevent the cable from jumping out of the sheaves.

All parts of the head assembly shall be protected with covers, screens, or shields to prevent entrance of dirt, moisture, ice accumulation, nesting of insects and birds, and other contaminants that may be harmful to the operation of the lowering device.

Miscellaneous fittings, fasteners, or hardware shall be stainless steel.

The entire luminaire lowering ring assembly shall be raised and lowered by three symmetrically-placed stainless steel, aircraft-type hoisting cables located inside the pole shaft extending through the head assembly support arms and attached to the lowering ring. Each of the hoisting cables shall be able to support the entire lowering device assembly. The lowering ring shall be equipped with an approved self-leveling device. Fastened to the underside of the ring shall be three spring-loaded guide arms with rollers to guide the ring assembly during raising and lowering operations. The pressure on the wheels shall be applied no more than 10 feet from the top of the tower. The spring shall be stainless steel, and the rollers shall be water-resistant, non-marking composition material with oil impregnated bronze bushings. The electrical power cable shall be 600-volt, Type SO, multiconductor No. 10 AWG cable with slack for field connection. The power cord shall be protected by a heat-resistant sleeve at the terminals where the cord enters the luminaire ring or raceway. Electrical disconnect shall not be permitted at the top of the pole. An approved device that prevents the twisting of the cable terminating plate during the raise-lower operation shall be used.

When the luminaire ring assembly is fully raised, it shall be held tightly in position against the head assembly to prevent either vertical or rotational movement even if stretch takes place in one or more lifting cables. The force holding the lowering ring to the head assembly shall be equal to a minimum of the weight of the lowering ring with eight luminaires plus 300 pounds.

If a latching device is utilized to position the ring assembly, the device shall provide positive indication, visible from the ground, that the ring assembly is latched or unlatched. The device shall be simple to operate and not require any additional cables. The device shall operate with a ground wind of up to 25 miles per hour and shall carry a two-year unconditional guarantee.

The entire assembly shall be adjusted and inspected by the manufacturer's field technician to ensure proper operation.

The raising and lowering device shall consist of an American Gear Manufacturers Association rated reducer with a 60 to 1 reduction to obtain self-locking in both raising and lowering operations. The vertical speed of travel of the lowering ring shall be a minimum of 13 feet per minute to a maximum of 20 feet per minute and shall be the same for raising and lowering. The raising and lowering of the luminaires will be done with a cable. The fleet angle shall not exceed 1.5 degrees. The drive shall be equipped with a torque-limiting safety clutch located between the load and the reducer. The raising and lowering mechanism shall be designed to provide the operator with a positive means of ascertaining that the raising operation is complete and the required force has been applied.

A winch assembly to control the ascent and descent of the luminaire support rings shall conform to the following:

1. The winch assembly shall be located in the base of the hollow light standard shaft, and shall be an enclosed, worm-gear housing, self-lubricating, and capable of raising and lowering the ring assembly as described above. The winch shall be the type that will remain locked in any position, so that the luminaire ring assembly cannot fall if the operator interrupts the raising or lowering operation.
2. The winch shall be driven with a hand drill that shall be provided with a mounting device that will hold the drill in place and prevent rotation of drill body. Two drills shall be provided which shall become the property of the Department. The drill shall have a remote control cable not less than 20 feet long allowing the operator to stand clear of the luminaire ring during lowering operation. It shall provide start-stop reverse motion of the drill motor. Drill motors shall be operated at 120

volts with a portable power transformer, with ground-fault protection supplied to match power source, provided at the base of each pole.

The distribution panel shall have a removable shield or cover made of corrosion-resistant material.

The electrical power circuit for the luminaires will be supplied by a flexible power cord with a twist lock disconnect receptacle in the base of the pole. The power circuit must be disconnected before the electrical motor can be energized. Two test cords shall be provided to test the luminaires when the luminaire ring is at ground level.

E. Luminaires. The luminaires for tower lighting poles shall be according to Subheading 2 of the third paragraph of Subsection 703.02.

CONSTRUCTION

704.03 Construction Requirements.

Tower lighting poles shall be factory assembled and delivered to the job site in one piece with no mechanical slip joints. Joining of tube sections shall be made with 100 percent transference butt welds (see drawings for typical detail).

All welding shall be performed by qualified welding operators using the procedures from Section 5, ANSI/AWS D1.1 Structural Welding Code.

All welding shall be done by the shielded metal-arc, gas shielded fluxcore, gas metal-arc, or submerged-arc process.

Circumferential seams and longitudinal seams within 6 inches of any circumferential weld shall be complete penetration. Base plate, circumferential weld joining base plate, and bottom tube section shall be complete penetration.

All other welds shall have 60 percent minimum weld joint penetration.

Weld quality shall conform to the current ANSI/AWS D1.1.

All full penetration welds shall be inspected with ultrasonics, and all other welds shall be visually inspected. If deemed necessary, the welds shall be radiographically tested as directed by the Engineer.

The surface of the poles shall not be blasted or finished.

Each pole base plate shall be permanently stamped or a weld beam plate attached with the manufacturers name, date, and pole design reference number.

704.04 Shipping.

The shipping of poles shall conform to Subsection 503.07.

Each shipment and its invoice shall have a list of all the parts on that specific shipment. All bolts, nuts, and other hardware shall be either boxed or bundled and identified by the packing list.

COMPENSATION

704.05 Method of Measurement.

Tower lighting standard assemblies of the various types shall be measured by the number of units.

704.06 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
TOWER LIGHTING STANDARD ASSEMBLIES, TYPE ___	UNIT

SECTION 705 - SIGN LIGHTING{ XE "SIGNS:LIGHTING" }{ XE "ELECTRICAL WORK:SIGN LIGHTING" }

705.01 Description.

This work shall consist of furnishing and installing complete wired multiple type sign lighting systems.

A complete sign illumination installation is generally composed of two systems, one underground and the other above ground.

The underground installation consists of conduits, junction boxes, and concrete foundations for meter cabinets.

The above ground installation consists of sign luminaires with lamp, meter cabinets, flexible and rigid conduit, fittings, wire, sign service cabinet with control equipment, conduit, and wire to the nearest junction box.

MATERIALS AND ELECTRICAL EQUIPMENT

705.02 Materials and Equipment.

Materials and equipment shall conform to Section 701 and to the following Subsections:

Cast Boxes and Fittings	906.06
Lamps	906.09
Cabinets	906.12
Panel Board and Circuit Breakers	906.14
Photoelectric Controls	906.16

The following materials and equipment shall conform to the New Jersey Electrical Materials Specifications listed below:

Photoelectric Control Unit	EB-PEC-1
Sign Luminaires	EB-SL-1

Other materials and equipment shall conform to the following:

1. **Sign Lighting Assemblies.** Sign lighting assemblies shall consist of fixtures, conduit, fittings, wire and wiring, sign service cabinet, hardware, bonding and grounding, painting, testing, sign tag indicating sign structure number and, if required, a photoelectric control unit and wire and wiring, and all other equipment and material necessary for sign illumination. Sign service cabinets shall consist of the cabinet and all control and distribution facilities, the grounding of all equipment, all internal wire and wiring to all component parts, and if required, a photoelectric control unit and wire and wiring.
2. **Meter Cabinets.** Meter cabinets shall consist of cabinets and meters, control and distribution facilities, grounding of all equipment, internal wire and wiring to component parts, photoelectric control unit, and wire and wiring to the same. The metering facilities shall conform to all utility company requirements.

CONSTRUCTION

705.03 Construction Requirements.

The provisions of Sections 701 and 703 shall apply.

Sign luminaires shall be placed perpendicular to the sign face and securely bolted to the sign support.

All underground conduits entering sign service cabinets, meter cabinets, or transformer enclosures shall be thoroughly sealed with a compound.

Sufficient color-coded, single conductor multiple lighting wire shall be furnished and installed for sign circuits. Conductors shall be run through the conduits, properly trained through the junction boxes to permit racking and connection to sign service cabinets and to meter cabinet installations.

Splices necessary to form continuous circuits, complete and ready for operation, shall be made. Splices on all cables shall conform to Subsection 703.04.

A minimum of two circuits shall be utilized for each sign panel, and fixtures shall be distributed alternately.

Wire for sign luminaires shall be No. 10 AWG and extend from the fixture to sign service cabinet.

Electrical outlet, junction, pull, and device boxes shall be furnished and installed where required to facilitate the pulling, supporting, or connecting of wires and cables.

Each conduit entering metal boxes, except threaded boxes, exposed to the weather, shall be securely fastened with two lock nuts, two flat washers, a lead washer, and bushing. Where boxes are aluminum, the lock nuts and flat washers shall be stainless steel. Ground bushings shall be the insulated bushing type. Bushing caps shall be furnished and remain in place until just before conductors are installed. Continuous ground shall be secured by bonding where required.

Exposed rigid metallic conduits shall be installed parallel with or at right angles to the lines of the structure and shall be supported. Concealed rigid metallic conduits shall be installed in as direct a line as possible and shall be rigidly supported.

Aluminum conduits to be installed exposed on tubular aluminum sign structures shall be supported with clamps or bands, with stainless steel saddles.

In the installation of boxes, cabinets, and conduits, there may be conditions that would result in the union of dissimilar metals, which under the atmospheric condition prevailing, are injurious to the installation, therefore the following shall be accomplished:

1. Aluminum conduit to steel conduit shall be separated by a stainless steel coupling.
2. Aluminum flexible conduit to steel coupling shall be separated by a stainless steel nipple and coupling.
3. Aluminum conduit to steel or cast iron boxes shall be separated by a short stainless steel nipple with stainless steel couplings.
4. Aluminum boxes or cabinets resting on or against concrete surfaces shall have the contact surfaces painted with bitumastic coating.

COMPENSATION

705.04 Method of Measurement.

Sign lighting assembly at each sign support structure will not be measured, and payment will be made on a lump sum basis.

Meter cabinets of the various types will be measured by the number of units.

705.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SIGN LIGHTING ASSEMBLY, STRUCTURE NO. ___	LUMP SUM
METER CABINETS, TYPE ___	UNIT

Payment for rigid metallic conduit, rigid nonmetallic conduit, flexible metal conduit, service wire, multiple lighting wire, ground wire, foundations, and junction boxes will be made according to Section 701.

SECTION 706 - INTELLIGENT TRANSPORTATION SERVICES FACILITIES{ XE "INTELLIGENT TRANSPORTATION SERVICES FACILITIES" }

706.01 Description.

This work shall consist of furnishing, installing and making operational Advanced Traffic Information Systems (ATIS), Advanced Traffic Management Systems (ATMS) and communications systems including the following subsystem components:

Road Weather Information Systems (RWIS)
Automatic Vehicle Classification Stations (AVC)
Weigh in Motion Stations (WIMS)
Speed Monitoring Stations
Highway Advisory Radio Systems (HAR)
Dynamic Message Signs
Computerized Traffic Signal Systems
Incident Management Systems
Traffic Surveillance Systems (CCTV)
Local Area Networks
Wide Area Networks
File Server and Workstation Computers
SONET Communications Equipment

MATERIALS AND ELECTRICAL EQUIPMENT

706.02 Materials and Equipment.

Materials and equipment shall conform to Sections 701 and 702.

The following materials and equipment shall conform to the New Jersey Electrical Materials Specifications listed below:

Cable Locator ..... EB-CBLR
CCTV Assembly (Remote Color Control) ..... EB-CCTV-COLOR
RS232 Dial-Up Modems (Low Speed) EB-DIALUP-1
Ramp Meter Blank-Out Signs (Fiber Optic) EB-FOBS-2
Patch Panels Fiber Optic Cable EB-FOC-PP-1
Single Mode, Loose Tube, Single Jacket Fiber Optic Cable. EB-FOC-SMLTSJ-1
Single Mode, Loose Tube, Termination (Fiber Optic Cable) EB-FOC-SMLTT-1
Fusion Splice and Splice Enclosure (Fiber Optic Cable) EB-FOC-SPLC-1
Connectors, Type ST (Fiber Optic Cable EB-FOC-ST-1
19-Inch Rack Base Mount (Field Terminal Cabinet) EB-FTC-1
19-Inch Rack Base Mount (Heater/AC) (Environmental Field Terminal Cabinet) EB-FTC-2
19-Inch Rack Base Mount (Video/Loop) (Video/Loop Field Cabinet) EB-FTC-3
VME Bus Computer (Field Terminal VME Bus Processor Assembly) ..... EB-FTERM-VME
HAR System EB-HAR-2
Long Distance Video Transmission System EB-LDV-1
RS232 Leased Line Modems (Low Speed Model 400) EB-LEASED-400
Long Haul Multiplexed Video (Single Mode Fiber Optic Cable Transmission System) ..... EB-LHVIDEO
Maintenance Weather Station EB-MAINT-WSTA-1
PVC Multiduct (Communications Conduit) EB-MULTI-1
Type F (Fiberglass Multiduct) (Communications Conduit) EB-MULTI-2
Type S (Galvanized Steel Multiduct) (Communications Conduit) EB-MULTI-3
Single Mode Fiber Optic Multiplexer ..... EB-SMF-MUX
Single Mode Fiber Modems ..... EB-SMFOMODS
Sonet (Single Mode Fiber Optic Long Haul SONET Multiplexer) ..... EB-SONET
Radar Detectors (Speed Station) ..... EB-SPEED
TOC Central Computer (Traffic Operations Center Computer Equipment) EB-TOCCE-1
TOC Large Direct View Monitor EB-TOCLSD-1
TOC Video Switcher/Control EB-TOCVCE-1
Traffic Controller Assembly Hardware (Eight-phase 170E Traffic Controller

Assembly)..... EB-TSC-170E
Software (Eight-phase 170E Intersection Software Program)..... EB-TSC-170E-ISOFT
Video Detectors..... EB-VIDEO
Remote Video Workstation EB-VIDWS2
Weather Station EB-WSTA-2
Closed Loop System On-Street Master EB-OSM-1
Closed Loop System Operator Console..... EB-OC-1
Closed Loop Traffic Signal Control System EB-CL-1
Closed Loop Traffic Signal Control System EB-CL-2
Eight Phase Traffic Signal Controller Assembly for a Closed Loop System EB-TSC-8CL
Closed Loop System Maintenance Console EB-MC-1
Closed Loop System Engineering Console EB-EC-1

706.03 Construction Requirements.

Construction requirements will be provided in the Special Provisions.

706.04 Method of Measurement.

Method of measurement will be included in the Special Provisions.

706.05 Basis of Payment.

Basis of payment will be provided in the Special Provisions.

DIVISION 800 CONTENTS

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DIVISION 800 - LANDSCAPING{ XE "LANDSCAPING" }

SECTION 801 - SELECTIVE THINNING{ XE "LANDSCAPING:SELECTIVE THINNING" }{ XE "SELECTIVE THINNING" }

801.01 Description.

This work shall consist of the removal of live and dead trees, both standing and fallen, shrubs, and other vegetation and debris designated for removal, to clean up unsightly areas, to produce irregular foliage lines, and to create a natural transition between the artificial edge of the woods left by the clearing of the site and the undisturbed woods.

MATERIALS

801.02 Materials.

Materials shall conform to the following Subsections:

Topsoil 909.10
Miscellaneous Materials 909.11

CONSTRUCTION

801.03 Construction Requirements.

{ XE "Stump removal" **}**All trees, shrubs, and other vegetation to be removed within the prescribed areas will be designated. Trees shall be carefully felled to prevent damage to adjacent vegetation, structures and property. Trees, stumps, and all debris shall be removed in a manner that does not unduly compact or disturb the soil.

In open areas, stumps shall be completely removed to 6 inches below the existing ground surface. The stump hole shall be backfilled with topsoil to eliminate depressions. In wooded areas and on 2H:1V slopes or greater, stumps shall be cut off at the existing ground surface. Live stumps shall be treated with herbicide immediately after cutting. If suckering occurs, the herbicide treatment shall be continued until no signs of growth recur.

Within the areas of selective thinning, trees that may have died subsequent to thinning and before Acceptance shall be removed. Such tree removal shall be considered as part of the work of selective thinning and shall be performed at no cost to the State.

Any damage to other vegetation or to structures or property shall be repaired without additional compensation. Damage to existing trees shall be repaired according to Subsection 803.02 and damage to existing grass areas shall be reconstructed according to Subsection 808.03.

All trees within the areas designated for selective thinning shall have all dead and undesirable limbs removed up to a height of 16 feet.

All cleared material, stumps, and debris resulting from selective thinning shall be disposed of according to Subsection 201.10.

COMPENSATION

801.04 Method of Measurement.

Selective thinning will be measured by the acre or by the square yard.

801.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SELECTIVE THINNING	ACRE
SELECTIVE THINNING	SQUARE YARD

SECTION 802 - SELECTIVE CLEARING{ XE "LANDSCAPING:SELECTIVE CLEARING" }{ XE "SELECTIVE CLEARING" }

802.01 Description.

This work shall consist of the removal of live and dead trees, both standing and fallen, shrubs and other vegetation, and debris to create bays in wooded areas, establishing new vegetation limits along roadsides and to open views.

MATERIALS

802.02 Materials.

Materials shall conform to the following Subsections:

Topsoil 909.10
Miscellaneous Materials 909.11

CONSTRUCTION

802.03 Construction Requirements.

All vegetation to remain within selective clearing limits will be designated. The Engineer shall be notified 24 hours before work is to begin.

{ XE "Stump removal" **}**Trees shall be carefully felled to prevent damage to adjacent vegetation, structures and property. Stumps of trees, shrubs, and vines shall be completely removed to 6 inches below the existing ground surface. If suckering occurs before Acceptance, herbicides shall be applied or mechanical operations performed to ensure that regrowth does not occur. Stump holes shall be backfilled with topsoil to eliminate depressions.

All cleared material, stumps, and debris resulting from selective clearing shall be disposed of according to Subsection 201.10.

Existing vegetation to remain, damaged by construction operations, shall be repaired by proper dressing, cutting, and tracing methods at no cost to the State.

COMPENSATION

802.04 Method of Measurement.

Selective clearing will be measured by the acre or by the square yard.

802.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SELECTIVE CLEARING	ACRE
SELECTIVE CLEARING	SQUARE YARD

SECTION 803 - TRIMMING EXISTING TREES{ XE "TREES:TRIMMING" }{ XE "LANDSCAPING:TREE TRIMMING" }

803.01 Description.

This work shall consist of the removal of all defective or undesirable limbs and the repair of all injuries or wounds on existing trees.

CONSTRUCTION

803.02 Construction Requirements.

All trees to be trimmed will be designated. All tree trimming work shall be supervised by a person competent in the work required, as determined by the Engineer.

All dead, dying, diseased, interfering, objectionable, and weak branches on the main trunk, as well as those within the leaf areas, shall be removed. Healthy low branches shall not be removed, unless directed.

All cuts shall be made sufficiently close to the trunk or parent limb, without cutting into the branch collar or leaving a protruding stub, so that closure can readily start. Clean cuts shall be made at all times.

Branches too heavy to handle shall be precut to prevent splitting or peeling the bark. Where necessary, to prevent tree or property damage, branches shall be lowered to the ground by ropes or equipment.

On trees known to be diseased, tools shall be disinfected with methyl alcohol at 70 percent (denatured wood alcohol diluted appropriately with water) or a commercial bleach after each cut where there is a danger of transmitting the disease on tools.

Old injuries shall be inspected. Those not closing properly and where the callus growth is not already completely established shall be traced.

In lifting the lower bottom branches of trees for underclearance, care shall be given to symmetrical appearance, and cuts shall not be made so large that they prevent normal sap flow.

All waste material and debris resulting from trimming existing trees shall be disposed of according to Subsection 201.10.

COMPENSATION

803.03 Method of Measurement.

Trimming existing trees will be measured by the number in each diameter category, measured 4½ feet above the ground.

803.04 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
TRIMMING EXISTING TREES, OVER ___ " TO ___ " DIAMETER	UNIT

SECTION 804 - TREE REMOVAL{ XE "LANDSCAPING:TREE REMOVAL" }{ XE "TREES:REMOVAL" }

804.01 Description.

This work shall consist of the removal of designated trees.

MATERIALS

804.02 Materials.

Topsoil shall conform to Subsection 909.10.

CONSTRUCTION

804.03 Construction Requirements.

Trees to be removed will be designated. Each tree designated for removal shall be completely removed except for the stump that is to be cut off 6 inches below the existing ground surface. Stump holes shall be backfilled with topsoil. If necessary, trees shall be felled in sections to prevent damage to adjacent vegetation, structures, utility wires, and property.

Any damage to other vegetation, structures, utility wires or other property shall be repaired at no cost to the State. Damage to existing trees to remain shall be repaired according to Subsection 803.02. Grass areas damaged as a result of tree removal shall be reconstructed according to Subsection 808.03.

All branches, limbs, trunks, and other debris resulting from tree removal shall be disposed of according to Subsection 201.10.

COMPENSATION

804.04 Method of Measurement.

Removal of trees will be measured by the number in each diameter category, measured 4½ feet above the ground.

804.05 Basis of Payment.

Payment will be made under

Pay Item	*Pay Unit*
TREE REMOVAL, OVER ___" TO ___ " DIAMETER	UNIT

SECTION 805 - PREPARATION OF EXISTING SOIL{ XE "LANDSCAPING:SOIL PREPARATION" }{ XE "SOIL PREPARATION" }{ XE "PREPARATION OF EXISTING SOIL" }

805.01 Description.

This work shall consist of the preparation of existing soil for seeding.

MATERIALS

805.02 Materials.

Topsoil shall conform to Subsection 909.10.

CONSTRUCTION

805.03 Construction Requirements.

The surface of the existing soil to be prepared shall first be cleared of all stumps, brush, weeds, and debris. It shall next be cultivated to a depth of 3 to 4 inches to prepare a seed bed. The entire area shall then be brought to a smooth grade, free from any depressions that would collect water. If necessary, additional topsoil shall be used to fill depressions. Where depressions exceed 8 inches in depth, subsoil shall be added and covered with 4 inches of topsoil.

All waste material and debris resulting from preparation of existing soil shall be disposed of according to Subsection 201.10.

COMPENSATION

805.04 Method of Measurement.

Preparation of existing soil will be measured by the acre or by the square yard.

805.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
PREPARATION OF EXISTING SOIL	ACRE
PREPARATION OF EXISTING SOIL	SQUARE YARD

Payment for topsoil will be made according to Section 813.

SECTION 806 - TOPSOILING{ XE "LANDSCAPING:TOPSOILING" }

806.01 Description.

This work shall consist of the preparation and placement of topsoil.

Borrow topsoil shall consist of the furnishing of topsoil required in excess of that obtained from stripping.

MATERIALS

806.02 Materials.

Topsoil shall conform to Subsection 909.10.

CONSTRUCTION

806.03 Construction Requirements.

Storage of topsoil shall conform to Subsection 202.03. The storage piles of topsoil and the areas from which stored topsoil has been removed, within the ROW limits of the Project, shall be fertilized and seeded according to Section 808.

Topsoil shall not be placed until the area to be topsoiled has been approved. All stones, 2 inches or larger in any dimension, and other debris such as wires, cables, tree roots, pieces of concrete, clods, and lumps shall be removed and the surface scarified to provide an improved bond between slope and topsoil. Slopes steeper than 2H:1V shall not be bladed smooth.

The topsoil shall be spread on a previously prepared surface in a uniform layer to produce the prescribed compacted thickness.

Topsoiled areas outside the limits of work shall be protected against damage caused by the delivery, handling, or storage of materials, by washouts due to drainage diversion, by workers, or by equipment. Any such damage shall be repaired by grading, fertilizing, seeding, and mulching at no cost to the State.

Where either embankment or excavation slopes become eroded during the Work and before Acceptance, repairs shall be made at no cost to the State.

COMPENSATION

806.04 Method of Measurement.

Topsoiling of the various thicknesses will be measured by the square yard. Reduction in quantity will not be made for areas designated for planting pits. Borrow topsoil will be measured by the cubic yard using the average end area method according to Section 109.01.

806.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
TOPSOILING, ___ " THICK	SQUARE YARD
BORROW TOPSOIL	CUBIC YARD

Separate payment will not be made for the preparation and placement of borrow topsoil. All costs thereof shall be included in the item Topsoiling, ___" thick.

SECTION 807 - TURF REPAIR STRIP{ XE "LANDSCAPING:TURF REPAIR STRIP" }{ XE "TURF REPAIR STRIP" }

807.01 Description.

This work shall consist of regrading and repairing the area immediately adjacent to the shoulder, including fertilizing and seeding, wood cellulose fiber mulching, and placing incidental topsoil.

MATERIALS

807.02 Materials.

Materials shall conform to the following Subsections:

CONSTRUCTION

807.03 Construction Requirements.

Soil and vegetation immediately adjacent to the surface course shall be removed by blading or other means, to facilitate resurfacing, and shall be windrowed adjacent to the shoulder. After resurfacing is completed, the soil shall be replaced according to Subsection 806.03, adding incidental topsoil as may be required. Fertilizing and seeding shall be according to Subsection 808.03. Wood cellulose fiber mulch then shall be applied at the minimum rate of 1,200 pounds per acre.

COMPENSATION

807.04 Method of Measurement.

Turf repair strip will be measured by the linear foot.

807.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
TURF REPAIR STRIP	LINEAR FOOT

SECTION 808 - FERTILIZING AND SEEDING{ XE "LANDSCAPING:FERTILIZING" }{ XE "LANDSCAPING:SEEDING" }{ XE "LANDSCAPING:SEEDING" }

808.01 Description.

This work shall consist of furnishing and placing pulverized limestone, fertilizer, and seed mixtures, and furnishing layout and straw mulching of wildflower seed beds.

MATERIALS

808.02 Materials.

Materials shall conform to the following Subsections:

CONSTRUCTION

808.03 Construction Requirements.

Fertilizing and seeding shall be carried out as soon as a unit or portion of the Project, such as a structure, an interchange, or a section of roadway has been completed for partial acceptance as provided under Subsection 105.21. Planting beds shall not be fertilized or seeded.

When the soil to be seeded has a pH value of less than 5.8, sufficient pulverized limestone shall be incorporated to increase the soil pH value to 6.5.

Recommended amounts (pounds per acre) of total oxides (calcium and magnesium) to raise the pH of a 4-inch layer of different soil textural classes to approximately 6.5 are as follows:

Soil (pH)	Loamy Sand	Sandy Loam	Loam	Silty Loam
5.7	300	600	900	1,200
5.3 - 5.6	600	1,035	1,500	1,800
4.9 - 5.2	900	1,500	2,100	2,400
4.5 - 4.8	1,200	1,800	2,700	3,000
4.1 - 4.4	1,500	2,100	3,300	3,600

The quantity of pulverized limestone required shall be in proportion to its magnesium and calcium oxide content.

The fertilizer for establishing turf shall be limited to one selection throughout the Project. Fertilizer shall be applied in the quantity necessary to yield 60 pounds of nitrogen per acre (30 pounds at the time of seeding and an additional application of 30 pounds approximately six months after seeding). The second application shall be made during March or September. The Engineer may adjust the six-month period depending upon the date of the initial seeding.

The placing of fertilizer and seed shall conform to the following:

{ XE "Landscaping:soil preparation" **}{** XE "Seed:soil preparation" **}1. Soil Preparation.** All areas to be seeded shall be cultivated to provide a reasonably firm but friable seedbed. The depth of cultivation shall be 3 to 4 inches. On slopes steeper than 3H:1V, the Engineer may direct the depth of cultivation to be reduced. All areas to be seeded shall meet the specified finish grades and shall be free of any weed or plant growth, stones of 2 inches or larger in any dimension, and other debris.

{ XE "Seed:optimum seeding seasons" **}2. Optimum Seeding Seasons.** Seeding should be completed from March 1 to May 15 and from August 15 to October 15.

When weather and soil conditions are suitable, the Engineer may permit seeding at other times for soil erosion control and sediment control.

The Engineer shall be notified 24 hours before the seeding operation.

{ XE "Seed:application" **}3. {** XE "Fertilizer:application" **}Application.** Turf seed mixtures shall be sown at the rate of 100 pounds per acre.

Seed and fertilizer may be placed by either of the following methods:

a. **Hydraulic Method.** The seed and fertilizer shall be mixed in water and then applied under pressure at the specified rates. Any area inadequately covered shall be retreated.

b. **Dry Method.** Mechanical seeders, seed drills, landscape seeders, cultipaker seeders, and fertilizer spreaders may be used when seed and fertilizer are applied in dry form. Fertilizer in dry form shall be spread separately at the rates specified.

Hand operated seeding devices may be used when seed and fertilizer are applied in dry form on areas that are inaccessible to mechanical seeders.

Finished seeded areas shall be smooth and shall conform to the prescribed lines and elevations. All seeded areas shall be mulched as specified in Section 811.

4. **Care During Construction.** Seeded areas shall be protected and maintained until Acceptance. Any damage to seeded areas caused by pedestrian or vehicular traffic or other causes, except for conditions as covered in Subsection 107.18, shall be repaired at no cost to the State.

When a satisfactory stand of grass, practically weed free and containing plants in reasonable proportion to the various kinds of seed in the grass seed mixture, is not established on areas of seeding, the deficient areas shall be mowed, refertilized, reseeded, and remulched at no cost to the State, until a satisfactory stand of grass is established.

5. **Wildflower Seeding**. Various wildflower seeding requirements are as follows:

a. **Seed Bed Preparation.** There will be no fertilizing and seeding of turf mixes in the wildflower seed bed areas. Existing vegetation within the areas proposed for seeding shall be sprayed during the active growing season with glyphosate at the manufacturer's recommended rates for total control of all plant material. A second application shall be applied ten days after the first application where necessary. The dead vegetation shall be mowed as close as possible to the existing ground, then disced to a depth of 1 to 2 inches.

b. **Seeding Seasons.** Wildflower seeding shall be done from August 15 to October 1 and from April 1 to May 31 inclusive.

c. **Bed Layout.** Bed outlines shall be staked at a maximum spacing of 25 feet using 2 by 2 by 36-inch wood stakes driven 1 foot into the ground. The staking shall define the limits for seed protection against mowing, overspray of herbicides, and other potential damage.

d. **Preparation of Seed Mixtures**. The Contractor shall obtain wildflower seed mixes according to Subsection 909.06. These mixes shall be combined with a carrier of clean, dry, salt-free sand in the presence of the Engineer at a volume ratio of two parts sand to one part wildflower seed mix, to aid even distribution.

e. **Seed Application.** The prepared mix, seed, and sand shall be broadcast evenly by use of a hand-operated, hand-held, cyclone spreader. The seeded area shall be lightly dragged with a piece of chain-link fence to mix the seed into the soil surface.

f. **Mulching.** Seeded areas shall be mulched immediately after the application of seed. The mulch shall consists of straw, uniformly spread in a layer 1 to 1½ inches thick, loose measurement, and shall be bound in place with a binder according to Subsection 811.03.

COMPENSATION

808.04 Method of Measurement.

Fertilizing and seeding of the various types will be measured by the square yard.

Wildflower seeding of the various types will be measured by the square yard.

808.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
FERTILIZING AND SEEDING, TYPE ___	SQUARE YARD
WILDFLOWER SEEDING	SQUARE YARD

Payment will not be made for areas of fertilizing and seeding disturbed by Construction Operations, beyond the prescribed grading limits in islands and medians, and between prescribed grading limits and the ROW line.

SECTION 809 - TOPSOIL STABILIZATION{ XE "LANDSCAPING:TOPSOIL STABILIZATION" }

809.01 Description.

This work shall consist of furnishing, placing, and stapling matting and blankets on soil surfaces that have been prepared and seeded.

MATERIALS

809.02 Materials.

Materials shall conform to the following Subsections:

{ XE "Topsoil:stabilization matting" **}**Topsoil Stabilization Matting 909.09
Miscellaneous Materials 909.11

CONSTRUCTION

809.03 Construction Requirements.

Before the matting is placed in position, the soil shall be smooth, soft, and free of depressions, clods, mounds, stones, or other debris that may prevent the matting from making complete contact with the soil. After the soil has been properly shaped, fertilized, and seeded, the matting shall be laid out flat and anchored securely with staples, so that the matting is in contact with the soil at all points.

When topsoil stabilization matting is required in swales or medians, the matting may be installed in multiple widths.

When jute matting is being laid, the higher end shall be turned under 6 inches and buried in a vertical position. Where laid end to end, the upper end of each downhill strip shall be buried 6 inches deep in vertical position with the uphill strip overlapping for a distance of 6 inches to form a smooth, shingle-like effect. Where laid parallel, the matting shall overlap from 3 to 6 inches.

When excelsior matting is being laid, the material shall be unrolled in the direction of the flow of water. Where laid end to end, the adjoining ends shall be butted snugly. Where laid parallel, the matting shall be butted snugly.

Erosion control mulch blanket may be substituted for excelsior matting; the method of construction shall be the same.

Bulging seams in matting material shall be cut and joints formed as described above.

Staples shall be placed along the outer edges of the matting and in a parallel row down the center of the strip. Staples shall be spaced 24 to 26 inches apart in the rows except along overlapping edges where they shall be 12 to 13 inches apart. Staples shall be driven at an angle of approximately 30 degrees from horizontal.

In addition to the above requirements, staples shall be placed 12 inches apart across the matting at 50-foot intervals and at critical locations such as at inlets, check slots, if required, overlapping joints, and ends. The staples shall be driven flush with the surface of the matting and care shall be taken so as not to form depressions or bulges in the surface of the matting. If any staples become loosened or raised, or if any matting becomes loose, torn, or undermined, satisfactory repairs shall be made immediately at no cost to the State.

COMPENSATION

809.04 Method of Measurement.

Topsoil stabilization matting will be measured by the square yard.

809.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
TOPSOIL STABILIZATION MATTING	SQUARE YARD

SECTION 810 - SODDING{ XE "SODDING" }{ XE "LANDSCAPING:SODDING" }

810.01 Description.

This work shall consist of furnishing and placing of topsoil and sod.

MATERIALS

810.02 Materials.

Materials shall conform to the following Subsections:

CONSTRUCTION

810.03 Construction Requirements.

Before placing the sod, 4 inches of topsoil shall be placed according to Subsection 806.03.

A 1-2-2 ratio fertilizer, applied at a rate necessary to yield 50 pounds of nitrogen per acre, and pulverized limestone, if necessary, shall be incorporated into the topsoil.

Sod shall be harvested and, within 36 hours, delivered and placed. Sod shall be laid with staggered joints and pressed closely together. The ends of sod strips shall be matched so that the ends and sides always lie flush with each other. Sod shall be pressed into the underlying soil by hand tamping and rolling. Then the sodded areas shall be thoroughly watered.

Watering shall be performed as necessary until a firm root mass is established. Each watering shall be performed until water infiltrates through the root zone and into the topsoil zone. Watering shall be performed in a manner that provides equal distribution and coverage to all areas sodded.

Sod shall not be transplanted when the moisture content (excessively wet or dry) may adversely affect its survival. If the upper ½ inch of topsoil is dry, the soil shall be lightly moistened immediately before laying the sod.

The finished surface shall be smooth, even, and to the prescribed lines and contour. Sod that is other than alive and healthy shall be replaced immediately without additional compensation.

On slopes, placing sod shall start at the bottom. At the top of slopes the upper edge of the sod strips shall be turned into the soil and covered with topsoil. On slopes steeper than 3H:1V, sod shall be held in place with pegs driven flush with the surface of the sod. The pegs shall be not more than 1 foot apart. No less than two pegs shall be used for each strip of sod.

With each delivery of sod, a delivery slip shall be submitted with the date of harvest and a New Jersey Department of Agriculture certification.

After a firm root mass is established and before the turf reaches the height of 3 inches, the area shall be mowed with a machine that does not produce ruts, contribute to soil compaction or, in any way, damage the sod. Mowing shall be performed as directed. At the time of Acceptance, all sod shall be alive, healthy, and established.

COMPENSATION

810.04 Method of Measurement.

Sodding will be measured by the square yard.

810.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SODDING	SQUARE YARD

Payment for mowing will be made according to Section 812.

Payment for watering will be made according to Section 813.

SECTION 811 - MULCHING{ XE "MULCHING" }{ XE "LANDSCAPING:MULCHING" }

811.01 Description.

This work shall consist of furnishing and spreading mulch, and the binding of straw mulch.

MATERIALS

811.02 Materials.

Materials shall conform to the following Subsections:

Binders.....909.01
Mulch.....909.04

CONSTRUCTION

811.03 Construction Requirements.

Seeded areas shall be mulched within seven days. Seeded areas shall be mulched with straw uniformly spread in a layer 1 to 1½ inches thick, loose measurement, and shall be bound in place with one of the following binders:

1. **Emulsified Asphalt.** Emulsified asphalt shall be applied at the rate of 240 gallons per acre.
2. **Fiber Mulch.** Fiber mulch shall be mixed with water and applied by hydraulic equipment. The fiber mulch shall be used as recommended by the manufacturer except that no less than 400 pounds of the dry product shall be used per acre. The mixture shall be evenly distributed over the straw mulch.
3. **Synthetic Plastic Emulsion.** Synthetic plastic emulsion shall be applied by hydraulic pressure equipment at a rate of 30 gallons (264 pounds) of undiluted material per acre. The synthetic binder shall be diluted in water at a ratio of 1:15. Application of synthetic binder shall not be made during rain or in freezing weather.
4. **Vegetable-Based Gels.** Vegetable-based gels shall be mixed with water and applied by hydraulic pressure equipment. The vegetable-based gels shall be used as recommended by the manufacturer except that no less than 40 pounds of the dry material shall be thoroughly mixed with 750 gallons of water per acre. Application of vegetable-based gels shall not be made during rain or in freezing weather.

When immediate protection of newly graded slopes is necessary at other than during optimum seeding seasons, straw mulch shall be applied with a temporary seed mixture.

Straw mulch shall be left in place and allowed to disintegrate.

If, before Acceptance, any straw mulch is displaced before the grass has made a growth of 1½ inches, the area shall be refertilized, reseeded, and remulched without additional compensation.

The specified plant pits of individual trees or shrubs, including the saucer to its outer edge and the entire beds, where material is planted in beds, shall be mulched with a 3 to 4-inch layer of wood chips, stone, gravel, or shredded hardwood bark, as directed. For Hemerocallis beds, the entire bed area shall be mulched with a 2-inch layer of wood mulch. In naturalized areas, each Hemerocallis plant shall be individually mulched with a 2-inch layer of wood mulch. For perennial beds, the entire area shall be mulched with a 2-inch layer of wood mulch. If, before Acceptance, any mulch is displaced, the planting area shall be remulched without additional compensation.

COMPENSATION

811.04 Method of Measurement.

Mulching of the various kinds will be measured by the square yard.

811.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
GRAVEL MULCHING	SQUARE YARD
STONE MULCHING	SQUARE YARD
STRAW MULCHING	SQUARE YARD
SHREDDED HARDWOOD BARK MULCH	SQUARE YARD
WOOD MULCHING	SQUARE YARD
WOOD MULCHING, 2" THICK	SQUARE YARD

SECTION 812 - MOWING{ XE "MOWING" }{ XE "LANDSCAPING:MOWING" }

812.01 Description.

This work shall consist of mowing grass areas and existing turf within the ROW. The mowing of existing turf shall consist of both machine and hand mowing and trimming of existing grass and weeds.

CONSTRUCTION

812.02 Construction Requirements.

New grass shall be mowed when it attains a height of 10 to 12 inches. Designated existing turf areas shall be mowed when the vegetation attains a height of 10 to 12 inches. The grass and other growth shall be mowed to a height of 3 to 4 inches. Hand mowing methods and light equipment shall be used in areas where the use of heavy equipment might be injurious to the turf or soil.

Before the commencement of any mowing operations, the Contractor shall pick-up and remove all litter and debris, including tires, cans, bottles, paper products, and general rubbish that is in the areas of existing turf to be mowed. The litter and debris shall be recycled or disposed of according to Subsection 201.10.When the cuttings resulting from the mowing operation are excessive, the cuttings shall be removed according to Subsection 201.10.

COMPENSATION

812.03 Method of Measurement.

Mowing of grass areas and existing turf will be measured by the acre or by the square yard each time the area is mowed.

812.04 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
MOWING	ACRE
MOWING	SQUARE YARD
MOWING EXISTING TURF	ACRE
MOWING EXISTING TURF	SQUARE YARD

SECTION 813 - PLANTING{ XE "PLANTING" }{ XE "LANDSCAPING:PLANTING" }

813.01 Description.

This work shall consist of furnishing, delivering, and installing trees, shrubs, seedlings, vines, ground cover plants, perennials, fibrous roots, bulbs, and wetland plants.

Planting shall be the initial planting.

{ XE "Replanting" **}**Replantings shall be those plantings required after the initial plantings have died or become unacceptable prior to acceptance of the plantings.

{ XE "Replacement planting" **}{** XE "Planting:replacements" **}**Replacement plantings shall be those required according to Subsection 109.14.

MATERIALS

813.02 Materials.

Materials shall conform to the following Subsections:

CONSTRUCTION

813.03 Construction Requirements.

Complete information shall be furnished, in writing, concerning the source of supply for all plant material. Plant material shall be available for inspection in the nursery before it is dug. Inspection before moving nursery material shall not be considered as approval. All plant materials shall comply with State and Federal laws controlling inspection for plant diseases and insect infestations, and all required certificates shall be submitted.

Plant material shall be carefully handled and packed to prevent injuries during transit. The roots of all plants shall be protected with wet straw, moss, or other suitable material until planted. If not planted on the day of delivery, all bare root material shall be heeled-in, watered, and kept shaded or covered until planted.

Work shall be coordinated to prevent delays in planting that may expose the roots of plant materials to the air, sun, or freezing conditions. Planting shall be according to standard nursery practice and the following:

{ XE "Planting:seasons" **}1. Planting Seasons.** Broad leaf and coniferous evergreen trees, shrubs, vines, and ground covers shall be planted from March 1 to May 1 and from August 15 to December 1. Deciduous trees, shrubs, vines, and perennials shall be planted from March 1 to May 1 and from October 15 to December 1. Narcissus shall be planted from October 15 to December 1. Hemerocallis shall be planted from March 1 to May 1.

2. **Layout.** Plant material locations and bed outlines shall be staked. The Engineer may adjust plant material locations to meet field conditions.

3. **Planting Beds.** Existing vegetation within proposed planting beds shall be sprayed during the growing season with glyphosate at the manufacturer's recommended rates. A second application shall be applied five days after the first application, where necessary. The dead vegetation shall be mowed as closely as possible to existing ground or turned into the soil.

   For Hemerocallis, planting beds shall be cultivated to a depth of 8 inches and graded smooth immediately before planting.

   For perennials, planting beds shall be cultivated to a depth of 4 inches and graded smooth immediately before planting.

   For Narcissus, bulbs shall be planted to a depth of 8 inches.

4. **Excavation for Plant Pits and Beds.** Before excavating for plant pits and beds, the areas shall conform to the prescribed lines and grades.

   All sod, weeds, roots, and other objectionable material unsuitable for backfill shall be immediately removed from the site and disposed of according to Subsection 201.10.

The minimum planting pit sizes for bare root plant materials shall be as follows:

Height of Plant (feet)	Diameter (inches)	Depth (inches)
1 to 4	25	16
over 4 to 5	27	17
over 5 to 6	28	18
over 6 to 8	30	19
over 8 to 10	33	20
over 10 to 12	36	22
over 12 to 14	44	26

Planting pits for balled and burlapped plant material shall be a minimum of two times the width of the root ball and shall be dug no deeper than the root ball as measured from the trunk flare to the bottom of the ball. Planting pits for containerized plant material shall be a minimum of two times the width of the container and shall be dug no deeper than the actual height of the root mass within the container. Side slopes of planting pits shall taper down from the rim of the plant pit to the outer edge of the bottom of the ball. If topsoil from the excavation of planting pits is of good quality, it shall be saved and reused.

Planting pits for seedlings, vines, ground covers, and perennials shall be not less than 12 inches in diameter and 12 inches deep.

Planting pits shall not remain open more than ten days in advance of planting on slopes steeper than 4H:1V.

In medians or other areas close to the roadway where a hazardous condition may result, planting pits shall not remain open beyond the close of the working day unless adequate precautions are taken to warn of their presence and protect the public from injury.

5. Setting Plants. All plants shall be set approximately plumb and at the same depth at which they were grown in the nursery.

For all planting during an extension of the spring planting season, the plant material shall be moved with roots balled; the trunk, branches, and foliage shall be sprayed with an antidesiccant which shall be mixed and applied according to the directions of the manufacturer; and the trees and shrubs shall be trimmed and thinned to reduce the amount of foliage and help balance the loss of roots due to transplanting.

Backfill and root placement for the various root conditions are as follows:

a. Bare Root Stock. Topsoil shall be placed in a small mound in the planting hole and the bare root plant shall be set on the mound and the roots properly spread out in a natural position. All broken or damaged roots shall be cleanly cut back to sound root growth. Backfill shall then be gradually worked around and over the root system and thoroughly and properly settled by firming or tamping. Thorough watering or puddling shall accompany backfilling. Earth saucers or water basins at least 4 inches in depth shall be formed about individual plants with a diameter equal to that of the plant pit.

b. Balled and Burlapped Stock. Balled and burlapped plants shall be placed carefully in the prepared pits on the required depth of tamped topsoil so as to rest in a firm, upright position. Plants shall be handled and moved only by the ball. Topsoil shall then be filled in around the plant ball to half the depth of the ball, then tamped and thoroughly watered. The burlap shall then be either cut away and removed from the upper half of the ball or loosened and folded back, after which the remainder of the backfill shall be placed. Earth saucers or water basins shall then be provided and the plant thoroughly watered.

c. Containerized Plant Material. Immediately before planting containerized plant material, the root-earth mass shall receive three vertical cuts, spaced equidistantly about the perimeter. Each cut, about ½ inch deep, shall begin at the top of the root-earth mass and continue to the bottom. Topsoil shall then be filled in around the root mass to half the depth, tamped and thoroughly watered, after which the remainder of the topsoil shall be placed. Earth saucers or water basins shall then be provided and the plant thoroughly watered.

6. Watering. The initial watering at the time of planting shall be at the rate of 15 gallons per square yard of plant pit area. All plants shall be watered once a week thereafter until the work is accepted.

Each watering, after the first, shall provide 5 gallons of water per square yard in the plant pit basin.

More than one watering per week may be required during planting operations or during periods of excessive dryness.

If the basin constructed around each plant does not function properly, it shall be repaired at no cost to the State. All damage to grass, plants, stakes, guys, mulch, or watering basins shall be repaired at no cost to the State.

7. **Tree Protection.** Tree protectors shall be installed to a height of 2 feet above the ground surface on all newly planted Malus and Crataegus species to prevent damage from bark consuming rodents.
8. **Pruning.** Deciduous trees and shrubs shall be pruned to remove one-third to one-half of the previous season's growth.

   Pruning shall be done before planting in such a manner as to preserve the natural character of each plant. All pruning shall be done by experienced personnel with properly conditioned equipment and in keeping with accepted horticultural practice.
9. **Mulching.** All beds shall be treated with a pre-emergence herbicide such as oryzalin, oxadiazon, or trifluralin. The herbicide shall be applied before the placing of any mulching materials. Planting beds in areas flatter than 4H:1V shall also be cultivated to a depth of 6 inches. All plant material shall be mulched according to Section 811. The beds shall be neatly edged.
10. **Planting.** At the time of acceptance of the planting, all planting areas shall be free of weeds and a minimum of 95 percent of the plants, as determined by the Engineer, shall be alive and healthy. Unacceptable plant material (five percent or less) shall be replanted during the next planting season. The date for beginning the plant establishment period for the replanted material is retroactive to the initial acceptance of the planting.

813.04 Restoration and Cleanup.

Where existing grass areas have been damaged during planting operations, the disturbed areas shall be restored according to Subsection 808.03 at no cost to the State.

All roots, sod, weeds, debris, spoil piles, containers, and other unsuitable material shall be disposed of according to Subsection 201.10.

813.05 Plant Establishment Period and Replacements.{ XE "Planting:establishment period" }{ XE "Replacement planting" }

The acceptability of the plant material furnished and planted as specified will be determined at the end of a period of establishment during which all possible means shall be employed to preserve the plants in a healthy growing condition. Planting will be determined as established one year from the date of acceptance of the planting. The dates of planting acceptance are June 1 for the spring planting and December 1 for the fall planting. Care during the establishment period shall include watering, weeding, spraying with insecticides or fungicides, pruning, and repairing and adjusting guys and stakes.

All plants that are not alive and healthy at the end of the plant establishment period shall be replaced in kind, quantity, and size with acceptable live, healthy plants installed as originally specified. The Engineer may permit substitute varieties of plants to be used.

Replacement planting shall conform to the requirements for initial planting except as follows:

1. Existing wood chips shall be removed and may be reused if salvageable and conforming to Subsection 909.04.
2. Backfilling may be made with excavated material that does not contain wood chips or other objectionable material.
3. Replacement plantings shall be made at no cost to the State.

Replacement of evergreen materials shall be made from March 1 to May 1 and from August 15 to December 1. Replacement of deciduous material shall be made from March 1 to May 1 and from October 15 to December 1.

All stakes, guys, and guy wires shall be removed two weeks before the conclusion of the one year plant establishment period.

At the conclusion of the one year plant establishment period, all weeds, debris, and damaged plant material shall be removed and disposed of according to Subsection 201.10. Holes resulting from the theft of plants shall be filled. All planting beds shall be treated with a pre-emergence herbicide.

COMPENSATION

813.06 Method of Measurement.

Planting of trees, shrubs, seedlings, vines, ground cover plants, perennials, fibrous roots, bulbs, and wetland plants, of the various kinds and sizes, will be measured by the unit. Watering will be measured in units of 1,000 gallons (MG). Water may be measured by means of meters, by actual measurement in tanks, tank trucks or other containers, or by computation based on weight.

813.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
_____ (GENUS, SPECIES, VARIETY, ROOT, AND SIZE)	UNIT
WATERING	THOUSAND-GALLON

Payment for plants rendered unacceptable by the random inspection of root system, as specified in Subsection 909.05, will be made at one-half the price bid.

Separate payment will not be made for topsoil or borrow topsoil. All costs thereof shall be included in the prices bid for the plant material.

SECTION 814 - NONVEGETATIVE SURFACES{ XE "NONVEGETATIVE SURFACES" }{ XE "LANDSCAPING:NONVEGETATIVE SURFACES" }

814.01 Description.

This work shall consist of the construction of nonvegetative surfaces of HMA.

MATERIALS

814.02 Materials.

HMA surface course shall conform to the requirements of Section 903 and shall be ⅜ inch nominal maximum size aggregate mix.

Color coating shall be formulated with a pure acrylic vehicle and shall be durable, weather resistant, and suitable for use on bituminous surfaces. The tint shall be lusterless brown matching color chip No. 30277 of FED-STD-595B, Colors Volume I, Table II.

CONSTRUCTION

814.03 Excavation.

Excavation shall be according to Section 202.

814.04 Preparation of Underlying Materials.

The underlying materials shall be shaped and compacted to a firm even surface. Unstable material shall be removed and replaced with acceptable material that shall be compacted.

814.05 Nonvegetative Surface, HMA.

Nonvegetative surface shall be constructed before the installation of the guide rail. Alternate methods of construction must be approved by the Engineer.

HMA surface course, 4 inches thick, shall be constructed according to the requirements of Section 404 except that air voids, surface, and thickness requirements will not apply. The material shall be placed and compacted in two lifts as directed and shall produce a surface free of roller marks and ridges. The finished surface shall be smooth, even, and graded to drain away from the guide rail. Areas not accessible to pavers and rollers shall be spread, raked, and luted by hand tools and compacted by vibratory drum compactors having a minimum centrifugal force of 180 pounds per inch of width of drive roll. Vibratory drum compactors shall be of the self propelled type and shall have one or two smooth steel drums and shall be capable of maintaining the frequency of vibration and amplitude specified by the manufacturer. Instruction plates indicating the recommended amplitude, vibrations per minute, and speed settings shall be provided by the manufacturer.

Nonvegetative surface damaged by guide rail installation shall be repaired with hot mix HMA. Hand tampers shall be used around posts and other obstacles where mechanical compactors are not accessible.

814.06 Color-Coated Nonvegetative Surface, HMA.

Color-coated nonvegetative surfaces shall be constructed according to the requirements of Subsection 814.05 and the following:

1. The final color shall be applied uniformly at a rate of 0.3 to 0.5 gallons per square yard, by spraying, brushing, or squeegeeing over the HMA surface course. The surface shall be clean and dry at the time of application. The coating shall be reapplied to any missed spots or areas to obtain a uniform coating.
2. Spilling of the color coating on adjacent surfaces shall be avoided.
3. Traffic will not permitted on the color-coated surface until it is dry.

COMPENSATION

814.07 Method of Measurement.

Nonvegetative surfaces will be measured by the square yard.

814.08 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
NONVEGETATIVE SURFACE, HOT MIX ASPHALT	SQUARE YARD
COLOR-COATED NONVEGETATIVE SURFACE, HOT MIX ASPHALT	SQUARE YARD

Payment for reset beam guide rail of the various kinds will be made according to Subsection 612.11.

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DIVISION 900 - MATERIALS

SECTION 901 - AGGREGATES{ XE "AGGREGATES" }

901.01 General.{ XE "Aggregates:general requirements" }

Aggregates from a single source and geological classification shall be used in any one construction item unless otherwise authorized.

Aggregates from different sources may be permitted if they are of the same geological classification and have similar specific gravities and color.

Gradations of aggregates in the various tables of this and other Sections are the percentages passing by weight.

901.02 Stockpiles.{ XE "Aggregates:stockpiles" }{ XE "Stockpiles" }

The area for each stockpile shall be of adequate size, reasonably uniform in cross-section, well drained, and cleared of foreign materials.

Stockpiles at portland cement concrete and HMA mixing plants shall be of sufficient size to provide for a minimum of one day's operations. The aggregate stockpiles shall be placed on a firm, hard surface such as a compacted aggregate or stabilized base, HMA or concrete surface, and shall be constructed by placing the aggregates in layers not more than 3 feet thick.

Aggregates from the haulway areas shall not be used. The piles shall be located so that there is no contamination by foreign material and no intermingling of aggregates from adjacent piles.

Aggregates from different sources, geological classifications, or of different gradings shall not be stockpiled near each other unless a bulkhead is placed between the different materials. Aggregates of different gradings and from different sources for use in blends shall be blended by proportion through the weigh hoppers. Aggregates found segregated or contaminated will be rejected for use. A rejected stockpile may be reconstructed for further evaluation. Aggregates shall be removed from stockpiles in a manner such as to prevent segregation.

Aggregates that require washing shall not be used sooner than 24 hours after washing, or until the surplus water has drained out and the material has a uniform moisture content.

Stockpiles of RAP to be used in HMA mixes shall not exceed 15 feet in height. Stockpiles shall be covered or otherwise protected to prevent buildup of moisture in the stockpile.

Steel-tracked equipment will not be permitted on the stockpiles.

901.03 Coarse Aggregate.{ XE "Aggregates:coarse" }{ XE "Coarse aggregate" }

Coarse aggregate shall be broken stone, washed gravel, blast furnace slag, and boiler slag conforming to Subsections 901.04, 901.05, 901.06, and 901.07, and shall be graded as shown in Subsection 901.20, Table 901-1.

901.04 Broken Stone.{ XE "Aggregates:broken stone" }

The broken stone shall be uniform in texture and quality, and shall conform to Subsections 901.01, 901.02, and 901.03 and to the following quality requirements:

	Maximum Percent
Weathered and decomposed stone	5
Broken stone other than that classification approved for use	5
Flat and elongated pieces for graded material No. 67 and larger (length greater than five times the thickness or width)	10
Absorption in cold water	
No. 8 and larger	1.7
Nos. 89 and 9	1.8
Sodium sulfate soundness, loss	
Ledge rock	10
Graded sizes	10
Adherent fines in coarse aggregates	
HMA	1.5
Portland cement concrete	1.0

The percent of wear (Los Angeles Test) shall be as follows for various uses:

	Maximum Percent
HMA surface course	40
HMA intermediate or base course	45
Concrete surface course and bridge decks	40
Concrete, other	50
Dense-graded aggregate base course	50

Types of rock permissible for use in concrete and white concrete shall be free from dirt and discoloring matter. The geologic classifications are as follows:

1. Argillite shall mean a thoroughly indurated and cohesive rock composed predominantly of silt size or smaller particles of clay, quartz, and feldspar or the fine-grained thermal recrystallization products of this assemblage (hornfels). It shall be bedded thickly enough so as not to break into thin pieces at planes of stratification.
2. Carbonate rock shall mean a thoroughly indurated and cohesive rock composed predominantly of calcite and dolomite, bedded thickly enough so as not to break into thin pieces at planes of stratification. Minerals insoluble in hot hydrochloric acid shall be discrete grains of quartz, clay, and mica.
3. Gneiss shall mean a metamorphic rock consisting principally of quartz and feldspar. It shall have a dense structure and shall not break into thin pieces at lines of stratification, and shall have a uniform distribution of minerals.
4. Granite shall mean an equigranular or porphyritic igneous rock consisting principally of quartz and feldspar. It shall be of medium or fine grain texture.
5. Quartzite shall mean a metamorphic rock composed principally of quartz. It shall be quarried so that only the nonarkosic, uniformly compacted quartzites are included in the graded products, and shall not be schistose in structure.
6. Trap rock shall mean either basalt or diabase. It shall have a uniform distribution of constituent minerals.

901.05 Washed Gravel.{ XE "Aggregates:washed gravel" }{ XE "Washed gravel" }

Washed gravel shall be either crushed or uncrushed as specified. The gravel shall conform to Subsections 901.01, 901.02, and 901.03, and to the following quality requirements:

	Percent
Sodium sulfate soundness, loss	10 maximum
Soft particles as determined by scratch hardness test	5 maximum
Absorption in cold water	
No. 8 size and larger	1.7 maximum
Nos. 89 and 9	1.8 maximum
Clay lumps, organic material, coal and other foreign or deleterious matter (Percent by weight or volume whichever is greater)	0.5 maximum
Chloride content	0.06 maximum
Crushed gravel material with at least one fractured face (Nicked gravel is not considered crushed)	60 minimum
Adherent fines in coarse aggregates	
HMA	1.5 maximum
Portland cement concrete	1.0 maximum

The percent of wear determined according to the Los Angeles Test shall be as specified for the various uses, except that the percent maximum loss for quartz gravel shall be 50 percent.

Quartz gravel shall mean a material composed of natural pebbles of which the overwhelming majority are coarsely crystalline quartz. The individual crystals within each pebble shall be intergrown into a tenacious, nonporous, interlocking texture that fractures as a single unit.

When the sodium sulfate soundness and scratch hardness tests total ten percent or more, a petrographic analysis will be made to determine the amount of unsound and weathered material. Unsound and weathered materials shall not be more than ten percent by weight.

901.06 Blast Furnace Slag.{ XE "Aggregates:blast furnace slag" }

Blast furnace slag shall be the air-cooled residue resulting from the production of pig iron and shall consist of tough, durable, angular fragments uniform in density, absorption, quality, and shall be free from flux stone, dirt, or other objectionable material. The slag shall conform to Subsections 901.01, 901.02, and 901.03, and to the following quality requirements:

Weight per cubic foot (loose measure), pounds	60 minimum
Percentage of wear (Los Angeles Test)	50 maximum
Sulfur, percentage by weight	2 maximum

901.07 Boiler Slag.{ XE "Aggregates:boiler slag" }

Boiler slag shall be the fused water-cooled residue from the combustion of pulverized or powdered coal used in electric generating plants, or from refuse incinerating plants, the color of which shall be black or nearly black. The gradation of boiler slag shall conform to size No. 10.

The boiler slag shall conform to Subsections 901.01, 901.02, and 901.03, and the following quality requirements:

Weight per cubic foot (loose measure), pounds	85minimum
Specific gravity (bulk)	2.80 minimum
Absorption in cold water, percent	1.2 maximum
Percentage of wear (Los Angeles Test)	50 maximum

901.08 Dense-Graded Aggregate.{ XE "Aggregates:dense-graded" }{ XE "Dense-graded aggregate" }

A. Gradation and Plasticity Requirements. Dense-graded aggregate shall consist of broken stone conforming to Subsection 901.04, crushed gravel conforming to Subsection 901.05, or blast furnace slag conforming to Subsection 901.06, except that at least 90 percent of all fragments shall contain at least one face resulting from fracture, and shall conform to the following requirements and gradation:

1. The moisture content of dense-graded aggregate immediately before placement shall be 6 ± 2 percent based on dry weight. If dense-graded aggregate is to be paid for on a weight basis, the moisture content shall not exceed eight percent when delivered to the Project.

Sieve Size	**Percent**
1½"	100
¾"	55 - 90
No. 4	25 - 60
No. 50	5 - 25
No. 200	3 - 12

2. When tested according to AASHTO T 90, the portion passing the No. 40 sieve shall be nonplastic.

{ XE "Aggregates:recycled concrete aggregate" **}B. Production from Recycled Concrete Aggregate.** Dense-graded aggregate may be produced from recycled concrete aggregate that shall conform to the gradation and plasticity requirements above and to the following:

1. Composition.

	Percent by Weight	
	Minimum	**Maximum**
Portland cement concrete	90 (Note 1)	
HMA		10 (Note 2)
Brick, mica, schist, and other friable material		4 (Note 2)
Reactive material		0
Wood		0.1 (Note 2)

Note 1: To meet the minimum requirement, broken stone, crushed gravel, or crushed vitreous china may be added. Broken stone shall conform to Subsection 901.04. Crushed gravel shall conform to Subsection 901.05, except that it need not be washed. Crushed vitreous china shall conform to the requirements for resistance to abrasion and soundness listed in this Section.

Note 2: The percent shall be determined by separating the material retained on the No. 4 sieve and expressing that amount as a percentage of the total weight of material retained on the No. 4 sieve.

2. Resistance to Abrasion. The loss shall not exceed 50 percent when tested according to AASHTO T 96 (Los Angeles Machine).

3. Soundness. The loss shall not exceed 15.0 percent when tested according to AASHTO T 104 by the use of sodium sulfate.
4. Before use, test results certifying compliance to the above requirements shall be submitted to and verified by the Department Laboratory.
5. A quality control plan shall also be submitted for approval and shall include the following:
    a. The assignment of quality control responsibility to specifically named individuals.
    b. Performance of regularly scheduled inspection procedures including inspection of the source concrete for the recycled concrete aggregate.
    c. Provisions for the prompt implementation of control and corrective measures.
    d. Provisions for liaison with the Engineer at all times.
    e. Performance of necessary quality control tests. The quality control procedure shall include performance of the following tests while stockpiles of recycled concrete aggregate are being produced:
        (1) Gradation. Testing according to AASHTO T 27 and T 11 shall be performed at least once a day.
        (2) Composition. Continuous visual inspection and removal of objectionable material to ensure compliance.
        (3) Soundness of aggregate according to AASHTO T 104 and resistance to degradation according to AASHTO T 96 shall be performed a minimum of once every two weeks.
6. Reporting of Recycled Materials Usage. The Contractor shall report to the Solid Waste Management District of origin, according to NJAC 7:26A, the tonnage of concrete aggregate being recycled. A copy of the reported information shall be provided to the Resident Engineer.

C. Production from Mixture with RAP. Dense-graded aggregate may also be produced by mixing RAP conforming to Subsection 901.10, Subpart B, with previously approved virgin dense-graded aggregate.

The method of mixing shall be such that the blended mixture will be homogeneous with regard to particle size and composition. The percentage of each of the above two components shall be determined by the Contractor and shall conform to the following:

1. Composition.

		Percent by Weight
	Minimum	**Maximum**
RAP and Virgin Dense-Graded Aggregate	(Note 2 & 3)	(Notes 2 & 3)
Portland Cement Concrete		5 (Note 2)
Brick, mica, schist, and other friable material		4 (Note 2)
Reactive material		0
Wood		0.1 (Note 2)

Note 2: Refer to Note 2 in B. above.

Note 3: The percentage of these two components shall be established by the Contractor. During production these percentages, as measured at the source, shall not vary by more than plus or minus 15 percent from the established value.

2. Plasticity and Gradation. This blended material shall be nonplastic when the portion passing the No. 40 sieve is tested according to AASHTO T 90, and shall conform to the following gradation when tested according to Section 990, NJDOT A-9:

Sieve Size	Blended Percent Passing
2"	100
1½"	85 - 100
¾"	55 - 90
No. 4	25 - 60
No. 50	3 – 25
No. 200	0 - 10

3. The above gradation shall apply only to mixes containing RAP. Mixes comprised of 100 percent virgin material shall conform to Subsection 901.08.
4. Before approval, test results certifying compliance with the above requirements shall be submitted to, and verified by, the Department Laboratory.
5. The supplier shall maintain an effective quality control program for gradation and composition.
6. Density control shall conform to Subsection 301.05. When AASHTO T 238 Method B and T 239 (nuclear gauge methods for measuring density and moisture content) are used to perform Compaction Acceptance Testing (Subsection 301.05, Subpart 2), a representative sample of five tests for each 5,000 square yards lot will be taken. For the purposes of the Q statistic, each test here is defined as the dry density determined from a field-measured wet density measurement and its corresponding laboratory-measured percent moisture value. This percent moisture value will be determined through the timely transport of a 1,000-gram sample of each field-tested specimen to a laboratory where it will be dried to a constant weight. The percent moisture will be calculated as a function of the weight difference before and after drying.

   For this test procedure only, the term "constant weight" is defined as that weight at which all the moisture (H_20) is driven off before any loss of volatile fractions from the asphalt binder.

   Moisture may be driven from the sample by low temperature oven drying or heating with a hot plate, providing the heating does not affect the gradation of the RAP in the sample.

901.09 Soil Aggregate.{ XE "Aggregates:soil aggregate" }{ XE "Soil aggregate" }

Soil aggregate shall be natural or prepared mixtures consisting predominately of hard durable particles or fragments of stone, slag, gravel, or sand, and containing some silt-clay or stone dust or remediated ID-27 petroleum contaminated soil aggregate (RPCSA) produced by a New Jersey Department of Environmental Protection (NJDEP) approved "Class B" recycling center operating pursuant to NJAC 7:26A.

A list of recycling centers, which have been approved as a source of RPCSA for NJDOT projects is available from the Department's Bureau of Materials.

Soil aggregate obtained from subaqueous sources and placed by methods other than hydraulically shall first be placed in a stockpile and drained, and shall not be placed in its final location until the Engineer has determined that the moisture content is not excessive.

Soil aggregate shall conform to the following:

A. Definitions of Constituent Materials. Stone shall be crushed or naturally angular particles of rock, a natural solid mineral matter occurring in large masses or fragments, which shall pass a 2-inch sieve and be retained on a No. 8 sieve. The stone shall conform to Subsection 901.04.

Slag shall be blast furnace slag conforming to Subsection 901.06.

Gravel shall be rounded particles of rock that shall pass a 4-inch sieve and be retained on No. 8 sieve.

Sand shall be granular material resulting from weathering processes, grinding or crushing of rock and shall pass a No. 8 sieve and be retained on the No. 200 sieve.

Stone dust shall be fine soil or mineral particles, or both, which shall pass the No. 200 sieve. Silt-clay shall be fine soil particles that shall pass the No. 200 sieve.

B. Composition of Soil Aggregate. The composite mixture of any type of soil aggregate specified herein shall be free from elements or chemicals which, in the presence of water, would produce detrimental effects to pavements, structures, or utility lines, and be free from organic matter, wood, garbage, metal, debris, or lumps of clay.

Designations I-1, I-2, I-3, I-4, I-9, I-10, I-11, I-12, and I-13 shall consist of bank-run sand and gravel, commercial sand and gravel combined, blast furnace slag, or stone, except blast furnace slag will not be permitted when in contact with concrete.

Designation I-5 shall be hard, durable gravel or stone mixed with sand, stone dust, or silt-clay so that it can be compacted into a hard, dense mass. The composite mixture shall contain, by weight, a total of not

more than 25 percent of shale, slate, schist, or soft and decomposed aggregate as determined by lithologic analysis.

{ XE "Aggregates:recycled concrete aggregate" **}**Designation I-5 may be produced from recycled concrete aggregate conforming to the composition and quality requirements specified for recycled concrete aggregate in Subsection 901.08, except that the crushed surface requirement shall not apply, and to the gradation requirements of Subsection 901.20, Table 901-2. When designation I-5 is produced from recycled concrete aggregate, the Contractor shall report to the solid waste management district of origin, according to NJAC 7:26A, the tonnage of concrete aggregate being recycled. A copy of the reported information shall be provided to the Resident Engineer.

Designations I-6, I-7, and I-8 shall consist of clean, free-draining sand, gravel or stone.

Designations I-1, I-2, I-3, I-4, I-5, I-9, and I-10 shall comply with the gradation requirements specified in Subsection 901.20, Table 901-2 after being tested for materials which break down as determined according to Section 990, NJDOT A-7.

C. Gradation. Soil aggregate shall be graded as shown in Subsection 901.20, Table 901-2 for the various designations. The gradation requirements shall apply to the material after it has been placed and compacted on the Project. Where compaction is not prescribed, the requirements for any given type shall apply to the material at the time it is placed.

{ XE "Soil aggregate:combining and mixing" **}D. Combining and Mixing.** If bank-run or other materials conforming to the requirements specified hereinabove are not available, materials that conform thereto may be produced by combining and mixing, and by washing if necessary. Materials may be combined and mixed on the grade only with approval. The blending on the grade shall be performed by a traveling high-speed rotor mixer capable of cutting and thoroughly mixing to a minimum depth of 6 inches.

901.10 Aggregates for Hot Mix Asphalt (HMA).{ XE "Aggregates:HMA" }{ XE "Hot mix asphalt (HMA):aggregates for" }

A. Coarse Aggregate. Coarse aggregate for HMA shall be broken stone or crushed gravel. Broken stone shall conform to Subsection 901.04 except that carbonate rock may be used for the surface course only in shoulder areas, parking areas, or driveways. Crushed gravel shall conform to Subsection 901.05 except that it need not be washed, and for surface course it shall contain not more than 30 percent of total carbonates as determined by Section 990, NJDOT A-4.

{ XE "Aggregates:reclaimed asphalt pavement (RAP)" **}B. RAP.** RAP shall pass a 2-inch sieve.

The bituminous material contained in the RAP shall be asphalt binder free from solvents or other contaminating substances.

{ XE "Reclaimed asphalt pavement (RAP):in HMA:aggregate" **}{** XE "Reclaimed asphalt pavement (RAP):in HMA" **}**When tested, the coarse aggregate contained in the RAP shall conform to the requirements of Subsection 901.04 for broken stone and to the requirements of Subsection 901.05 for gravel.

When tested, the fine aggregate contained in the RAP shall conform to the quality requirements in Subsection 901.10, Subpart C.

{ XE "Aggregates:fine aggregate" **}C. Fine Aggregate.** Fine aggregate for HMA surface course shall be stone sand or natural sand. For HMA surface course Mix I-4 HD, the fine aggregate shall be a blend containing a minimum of 50 percent stone sand and may contain a maximum of 100 percent stone sand.

Stone sand shall be manufactured from an aggregate source conforming to Subsection 901.04, however, not more than 15 percent based on the oven dry weight shall pass the No. 200 sieve. When the percent passing the No. 200 sieve exceeds 15 percent, use of the stone sand will be permitted if blended with another approved sand so that the combination contains no more than 15 percent passing the No. 200 sieve based on stockpile samples theoretically combined. Each sand source shall be fed into the plant through a separate cold feed hopper.

Natural sand shall consist of material composed of predominantly angular particles of quartz or other hard durable minerals conforming to the following quality and gradation requirements:

	Maximum Percent
Mica	2.0
Absorption, cold water	2.0
Sodium sulfate soundness, loss	5.0
Clay and clay lumps as determined by AASHTO T 88	5.0

Sieve Size	Percent
⅜"	100
No. 4	95 - 100
No. 8	80 - 100

Natural fine aggregates for the surface course shall be washed and graded products. After washing, not more than a total of five percent based on oven dry weight shall pass the No. 200 sieve.

Instead of the above requirements for gradation and washing, the appropriate provisions of ASTM C 33 may be substituted, except that not more than a total of five percent based on oven dry weight shall pass the No. 200 sieve.

D. Crushed Recycled Container Glass (CRCG). CRCG shall meet the following gradation:

Sieve	Percent Passing
⅜"	100

The source of the CRCG shall be from a plant approved by the Department. The maximum allowable percent of foreign materials contained in the CRCG shall be as shown in the table below:

Foreign Material	Maximum Allowable Percent by Weight Retained on the No. 4 Sieve
Paper	2.5
Metal	3.0
Plastic	0.3
Other	0.5

The percent shall be determined by separating the material retained on the No. 4 sieve and expressing that amount as a percentage of the total weight of material retained on the No. 4 sieve.

Container glass is defined as being derived from items, such as bottles, constructed from glass sufficiently thick so as to minimize thin sliver and flake-like fragments. Glass derived from thin walled items, such as test tubes and other laboratory glassware, is not considered to be container glass and shall constitute no more than 5 percent of the material.

A list of processing facilities that have been approved by the Department as a source of CRCG for use in HMA mixtures is available from the Department's Bureau of Materials Aggregate Section.

E. Ground Bituminous Shingle Material (GBSM). GBSM shall be derived from pre-consumer roofing shingles. The GBSM shall meet the following gradation:

Sieve Size	Percent Passing
¾"	100

The source of GBSM shall be approved by the Department**.**

A written certification of compliance shall be submitted for the GBSM according to Subsection 106.04. Test methods and results shall be submitted along with the certification.

The shingle material shall be ground pre-consumer roofing shingles complying with the following composition by weight:

	Weight
Petroleum asphalt	30-40%
Fibers	10% Maximum
Mineral matter	50-65%

The GBSM shall be added to the mixture through a feed system that shall individually proportion the GBSM, and be approved by the Regional Materials Engineer.

F. Remediated Petroleum Contaminated Soil Aggregate (RPCSA). A maximum of 20 percent of remediated ID-27 petroleum contaminated soil, produced by a NJDEP approved "Class B" recycling center operating pursuant to NJAC 7:26A, may be used as a coarse and/or fine aggregate in HMA base course, providing it complies with all quality requirements in subparts 901.10 A and C.

A list of recycling centers, which have been approved as a source of RPCSA for NJDOT projects is available from the Department's Bureau of Materials.

901.11 Aggregates for Bituminous Surface Treatment.{ XE "Aggregates:bituminous surface treatment" }

A. Coarse Aggregate. Coarse aggregate for cover material for bituminous surface treatment shall conform to Subsection 901.03.

B. Fine Aggregate. Fine aggregate for cover material for bituminous surface treatment shall be composed of natural sand, hard durable pebbles, crushed stone, or stone sand, to be mixed in such proportions that the material conforms to the grading requirements specified as follows:

Sieve Size	Percent
1"	100
No. 8	65 - 100
No. 50	10 - 30
No. 200	0 - 7

901.12 Aggregates for Portland Cement Concrete, Mortar, and Grout.{ XE "Aggregates:mortar and grout" }{ XE "Aggregates:portland cement concrete" }

Aggregates used in portland cement concrete shall be tested according to AASHTO T 303 Standard Test Method by a laboratory acceptable to the Engineer. Those aggregates that produce expansion of 0.1 percent or more in 14 days in solution shall be considered potentially reactive. The use of potentially reactive aggregate in portland cement concrete will be permitted only in conjunction with remedial agents, including fly ash; ground granulated blast furnace slag and low alkali cement.

A. Coarse Aggregate. Coarse aggregate shall be broken stone or washed gravel conforming to Subsection 901.04 or 901.05 respectively. Coarse aggregate shall be the size or sizes shown in Subsection 914.05, Tables 914-1 and 914-2. The coarse aggregate shall be washed at least 24 hours before use.

Broken stone and washed gravel for use in white concrete shall be free from dirt and discoloring matter and shall conform to Subsections 901.04 and 901.05 respectively. Broken stone shall be washed, and the gravel rewashed when so directed.

B. Fine Aggregate. Fine aggregate for any type or class of concrete and for mortar shall be a fine aggregate washed and processed material composed of quartz or other hard durable particles. The fine aggregate shall be predominantly angular in shape and be free of soft particles. The materials shall conform to Subsections 901.01, 901.02, and 901.03 and the following gradation and quality requirements:

Sieve Size	Percent
⅜"	100
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	10 - 30
No. 100	1 - 10
No. 200	0 - 3
No. 200 (white concrete-natural sand)	0 - 5
No. 200 (white concrete-stone sand)	0 - 7

The fine aggregate shall have not more than 45 percent retained between any two consecutive sieves, and its fineness modules shall be not less than 2.3 and not more than 3.1 for concrete, and shall be not less than 2.0 and not more than 3.1 for white concrete as defined in AASHTO M 6 and shall conform to the following quality requirements:

	Maximum Percent
Mica	2.0
Chloride content	0.06
Absorption, cold water	2.0
Sodium sulfate soundness, loss	5.0

Fine aggregate shall be tested for organic impurities and shall be rejected if it produces a color darker than the standard. The mortar-making properties of the fine aggregate shall be not less than 100 percent of those of standard Ottawa sand.

{ XE "Aggregates:white portland cement concrete" **}C. Fine Aggregate for White Concrete and Mortar.** Fine aggregate for white concrete and mortar shall conform to the applicable provisions of Subsection 901.12, Subpart B and to the following:

1. The fine aggregate shall be a crushed white marble or calcite or clean, washed natural sand, free from dirt and discoloring matter.
2. The fine aggregate or combination of fine aggregates shall have a reflectance value of not less than 40 percent.

D. Fine Aggregate for Grout. Fine aggregate for grout shall conform to the requirements in Subsection 901.12, Subpart B except that it shall be so graded that 100 percent of the material passes the No. 8 sieve and the mortar prepared from this material shall have a strength of not less than 75 percent of the strength of mortar prepared similarly with standard Ottawa sand.

E. Lightweight Aggregate. Lightweight aggregate shall be prepared by expanding or sintering material such as slate or shale by the rotary kiln process; shall be graded to size designation requirements of ¾" to No. 4 sieves of Table 1 of ASTM C 330. The lightweight aggregate shall be furnished by a producer with not less than five years experience with a record of successful production and use of such product. Certification for conformance with ASTM C 330 shall have been completed within two years of submission to the Engineer. In addition, the material shall conform to ASTM C 330 and the following requirements:

1. The loss of weight of the lightweight aggregate when tested according to AASHTO T 104 (as modified herein) using the sodium sulfate method, shall not exceed 10 percent after 5 immersion and drying cycles. The sample shall be of sufficient size to provide the following amounts of the various sieve sizes:

Sieve Size	**Weight**
1" to ¾"	2.20 pounds
¾" to ½"	1.65 pounds
½" to ⅜"	1.10 pounds
¾" to No. 4	0.66 pounds

2. The percent of abrasion loss, when tested according to AASHTO T 96, shall not exceed 40 percent.

901.13 Aggregates for Underdrains.{ XE "Aggregates:underdrains" }

Coarse aggregate shall be of broken stone, washed gravel, or blast furnace slag conforming to Subsection 901.04, 901.05, or 901.06 respectively. Soil aggregate shall conform to Subsection 901.09.

901.14 Mineral Filler.{ XE "Aggregates:mineral filler" }{ XE "Mineral filler" }

Mineral filler for HMA shall be broken stone conforming to Subsection 901.04, fly ash conforming to Subsection 919.07, or other inert mineral matter, free from lumps and foreign materials.

Mineral filler shall be of such quality that a HMA mixture containing the filler shall retain 70 percent of its initial strength after an immersion cycle of 14 days when prepared according to AASHTO T 167 and tested according to AASHTO T 165.

The mineral filler shall conform to the following grading requirements:

Sieve Size	**Percent**
No. 50	95 - 100
No. 200	70 - 100

901.15 Grit.{ XE "Grit" }{ XE "Aggregates:grit" }

Grit for spreading over the epoxy seal coat shall be a subangular natural 98 percent silica sand or boiler slag conforming to Subsection 901.07 except that boiler slag shall not be used for riding surfaces. The particle size shall be such that 90 percent of the total sample (by weight) falls between No. 4 and No. 30 sieves with 0 percent passing the No. 30 sieve.

901.16 Riprap Stones. .{ XE "Aggregates:riprap stones" }{ XE "Riprap stones" }

Riprap stones shall consist of a uniformly graded mixture of rock conforming to Subsection 901.04, such that 50 percent of the mixture by weight shall be equal to or larger than the designated median stone (d_{50}) size. The well-graded mixture shall be composed primarily of the larger stone sizes, but with a sufficient mixture of other sizes to fill the progressively smaller voids between the stones. The diameter of the largest stone size in such a mixture shall be 1.5 times the d_{50} size.

901.17 Rubble Stones.{ XE "Rubble:stones" }{ XE "Aggregates:rubble stones" }

Rubble stones shall consist of hard, durable rock meeting the geologic classifications in Subsection 901.04 or other hard durable rock. They shall be sound, free from weathered or decomposed pieces, shattered ends, and structural defects and conform to the following:

A. Rubble Masonry. The face stones for mortar rubble and dry rubble masonry walls shall be not less than 8 inches thick. The width shall be not less than 1.5 times the thickness and the length not more than three times the thickness and not less than 1.5 times the width.

B. Rubble Riprap. The rubble stones for rubble riprap walls shall be as specified above for rubble masonry walls except that they may be of random size within a range appropriate for the construction of walls of the cross-sectional design.

901.18 Sampling.{ XE "Aggregates:sampling" }{ XE "Samples for:aggregates" }

Sampling will be performed according to the following:

Aggregates:

Coarse, Size No.:

1	150 pounds for each 1,000 tons
2 & 24	100 pounds for each 1,000 tons
3 & 357	90 pounds for each 1,000 tons
4 & 467	70 pounds for each 1,000 tons
5, 56, & 57	50 pounds per each 500 tons
6, 67, & 68	30 pounds for each 500 tons
7 & 78	20 pounds for each 250 tons
8, 89, 9, & 10	10 pounds for each 250 tons
Dense-Graded	According toAASHTO T 2 for each 500 cubic yards
Fine	10 pounds for each 500 tons

Soil Designation:

I-1, I-2, I-3, I-4, I-5, I-6, I-7, I-8, I-9, & I-10	According to AASHTO T 2 for each 500 cubic yards
I-11, I-12, & I-13	According to AASHTO T 2 for each 500 cubic yards (see Note)
Borrow Excavation, Zone 3	According to AASHTO T 2 for each 2,000 cubic yards
Mineral Filler	1 quart from each source
Rubble Stones	Subject to test and inspection before shipment

Note: After initial 10,000 cubic yards have been sampled, then one sample for each 2,000 cubic yards except if any sample fails or is borderline, then revert to one sample for each 500 cubic yards.

901.19 Sampling and Testing Methods.{ XE "Aggregates:sampling" }{ XE "Aggregates:testing methods" }

Sampling and testing will be performed according to the following:

AASHTO

T 2	Sampling Aggregates
T 11	Amount of Material Finer than No. 200 Sieve in Aggregate
T 19	Unit Weight and Voids in Aggregate
T 21	Organic Impurities in Sands for Concrete
T 27	Sieve Analysis of Fine and Coarse Aggregates
T 37	Sieve Analysis of Mineral Filler
T 84	Specific Gravity and Absorption of Fine Aggregate
T 85	Specific Gravity and Absorption of Coarse Aggregate
T 89	Determining the Liquid Limit of Soils
T 90	Determining the Plastic Limit and Plasticity Index of Soils
T 96	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
T 104	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
T 112	Clay Lumps and Friable Particles in Aggregate
T 113	Lightweight Pieces in Aggregate
T 165	Effect of Water on Cohesion of Compacted Bituminous Mixtures

ASTM

D 4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

NJDOT

A-1	Mortar-Making Properties of Fine Aggregate
A-2	Determination of Reflectance Value of Aggregates
A-3	Determination of Percentage of Mica in Fine Aggregate
A-4	Determination of Percentage of Carbonates in Crushed Gravel by Petrographic Analysis
A-5	Determination of Percentage of Adherent Fines Present in Coarse Aggregate
A-6	Shale, Schist, Slate, and Soft and Decomposed Particles in Soil Aggregate
A-7	Rapidly Determining the Breakdown in Sizes of Soil Aggregate
A-8	Scratch Hardness Test for Coarse Aggregate Particles

901.20 Tables.

Tables referenced in the Specifications are as shown on the following pages:

Table 901-1 Standard Sizes of Coarse Aggregate { XE "Aggregates:soil aggregate:standard gradations table" }{ XE "Tables:aggregates:standard soil aggregate gradations" }

	Nominal Size	Amounts finer than each laboratory sieve (square openings), percentage by weight														
Size Number	Square Openings [1]	4	3½	3	2½	2	1½	1	¾	½	⅜	No. 4	No. 8	No. 16	No. 50	No. 100
1	3½ to 1½	100	90-100		25-60		0-15		0-5							
2	2½ to 1½			100	90-100	35-70	0-15		0-5							
24	2½ to ¾			100	90-100		25-60		0-10	0-5						
3	2 to 1				100	90-100	35-70	0-15		0-5						
357	2 to No. 4				100	95-100		35-70		10-30		0-5				
4	1½ to ¾					100	90-100	20-55	0-15		0-5					
467	1½ to No. 4					100	95-100		35-70		10-30	0-5				
5	1 to ½						100	90-100	20-55	0-10	0-5					
56	1 to ⅜						100	90-100	40-75	15-35	0-15	0-5				
57	1 to No. 4						100	95-100		25-60		0-10	0-5			
6	¾ to ⅜							100	90-100	20-55	0-15	0-5				
67	¾ to No. 4							100	90-100		20-55	0-10	0-5			
68	¾ to No. 8							100	90-100		30-65	5-25	0-10	0-5		
7	½ to No. 4								100	90-100	40-70	0-15	0-5			
78	½ to No. 8								100	90-100	40-75	5-25	0-10	0-5		
8	⅜ to No. 8									100	85-100	10-30	0-10	0-5		
89	⅜ to No. 16									100	90-100	20-55	5-30	0-10	0-5	
9	No. 4 to No. 16										100	85-100	10-40	0-10	0-5	
10	No. 4 to 0 [2]										100	85-100				10-30

(1) In inches, except where otherwise indicated.
(2) Screenings.

Table 901-2 Standard Soil Aggregate Gradations{ XE "Aggregates:soil aggregate:standard gradations table" }{ XE "Tables:aggregates:standard soil aggregate gradations" }

New Jersey Interagency Engineering Committee

Sieve Size	Gradation Designations, percentage by weight passing square mesh sieves												
	I-1	**I-2**	**I-3**	**I-4**	**I-5**	**I-6**	**I-7**	**I-8**	**I-9**	**I-10**	**I-11**	**I-12**	**I-13**
4"	100		100						100	100	100	100	100
2"	70-100	100		100	100				80-100	80-100	80-100		
1"				60-100		100	100						
¾"	50-95	65-100	60-100		70-100				60-100	60-100	60-100	70-100	
½"				40-100		80-100	80-100	100					
No. 4	30-60	40-75	30-100	25-100	30-80			95-100	40-100	40-100	40-100		30-100
No. 8				20-100		45-100	35-100						
No. 16				15-85		30-90	25-90	45-70	20-70	20-70			
No. 50	5-25	5-30	5-35	8-45	10-35	0-20	5-50	5-25	5-35	5-40	0-75	0-75	
No. 100						0-3	0-8		0-20	0-30			
No. 200	0-7	0-7	0-8	5-10	5-12		0-2	0-5	0-8	0-20	0-9	0-5	0-12

SECTION 902 - BEAM GUIDE RAIL{ XE "BEAM GUIDE RAIL" }

902.01 Rail Element.

{ XE "Steel:rail element for beam guide rail" **}{** XE "Beam guide rail:rail element" **}**Rail element shall be steel conforming to AASHTO M 180, Class A, Type I in Table 1. The weight of the zinc coating shall conform to AASHTO M 180, Class A, Type I in Table 2.

902.02 Posts and Spacers.{ XE "Beam guide rail:posts and spacers" }

{ XE "Steel:posts for beam guide rail" **}**Recycled/synthetic routed spacers shall be NCHRP 350 tested and FHWA approved. The Contractor shall furnish Working Drawings according to Subsection 105.04 and shall provide documentation of FHWA acceptance of the type of spacers provided. The approved manufacturers are found in the Material approved list. Steel spacers shall conform to ASTM A 36 and shall be galvanized according to AASHTO M 111. Steel pipe spacers shall be 152MM I.D. schedule 40 galvanized pipe.

Wood/timber spacers and posts shall conform to Subsection 918.01.

Steel posts shall be structural steel conforming to ASTM A 36 and shall be galvanized according to AASHTO M 111.

902.03 Rub Rail{ XE "Beam guide rail:rub rail" }.

Rub rail shall be steel channels or bent plate of structural steel conforming to ASTM A 36 and shall be galvanized according to AASHTO M 111.

902.04 Miscellaneous Hardware.

Guide rail end treatment cables shall conform to AASHTO M 30, Type I with Class A coating, and the swaged fitting shall be fabricated from forged steel conforming to AASHTO M 102.

Connections or splices, nuts, bolts, washers, and plates shall conform to AASHTO M 180 except as follows:

1. Nuts for guide rail end treatment shall conform to ASTM A 563, Grade A.
2. Plates and rods for guide rail end treatment shall be structural steel conforming to ASTM A 36.
3. Bolts, nuts, and washers for bridge guide rail, excluding base plate anchor bolts, shall conform to or exceed the requirements of ASTM A 307 unless otherwise designated as high-strength on the Plans. High-strength bolts, nuts, and washers shall conform to AASHTO M 164, Type I. Anchor bolts, nuts, and washers for base plate assemblies on bridge guide rail shall conform to or exceed the requirements of AASHTO M 164, Type I. Structural steel plates for guide rail on bridges shall conform to ASTM A 36.
4. Plates for guide rail on bridges and plates and rods for guide rail end treatment shall be galvanized according to AASHTO M 111.
5. Bolts and nuts may be mechanically galvanized according to AASHTO M 298, Class 50, Type 1.

902.05 Sampling and Testing Methods.{ XE "Beam guide rail:sampling and testing" }

{ XE "Samples for:beam guide rail" **}**Rails, posts, spacers, and miscellaneous hardware shall be subject to inspection before shipment.

902.06 Acceptance and Certification of Compliance.

Manufacturer's certification for all materials shall be submitted for each project according to Subsection 106.04 and shall include certification that the anchor bolt system, when tested for tension pull-out according to ASTM E 488 utilizing identical bolts, embedment depths, and concrete strengths as those specified on the Plans, does not fail by any mode listed in Section 10 of ASTM E 488 when loaded to 90 percent of the anchor bolt yield strength.

In addition, the Contractor or adhesive anchor manufacturer, in the presence of a Department inspector, shall perform proof loading on a percentage of the installed adhesive anchors as specified below at each location where the anchors have been placed (i.e., deck slab, sidewalk, parapet, etc.) no sooner than 24 hours after installation. All testing shall be performed in the presence of a Department inspector. Confined tension testing shall be according to ASTM E 488 to 90 percent of the yield strength of the anchor bolts without failure of the anchors. If the location of the anchor bolts precludes the proof loading of anchor bolts as prescribed in ASTM E 488, the Contractor shall propose an alternate testing method to be approved by the Engineer. All proof loading shall be to 90 percent of the anchor bolt yield strength. Calibration certificates shall be provided for the test equipment before testing.

A minimum of ten percent of the first 50 anchor bolts installed at each location shall be randomly selected and proof loaded to 90 percent of the yield strength of the anchor bolts before installing additional anchor bolts. Any spalls

or cracks caused by the testing shall be repaired. When these preliminary tests indicate that the anchor bolts are acceptable, the remaining anchor bolts shall be installed. The cube root of the remaining anchor bolts installed at each location shall also be randomly selected and proof loaded to 90 percent of the yield strength of the anchor bolts no sooner than 24 hours after installation without failures.

The adhesive anchor bolts will be considered acceptable based on satisfactory proof testing and certification as outlined above each location where they have been installed. Any failure to comply with these requirements will be considered cause for rejection of the adhesive anchor bolts supplied. If the adhesive anchor bolt system fails to meet the proof load requirements, the Contractor shall select and install approved and tested adhesive anchor bolts of alternate size, or alter the embedment depth, or reduce the spacing to supply satisfactory performance. If the adhesive anchor bolts fail to satisfy the proof load test and the results can be attributed to concrete compressive strengths less than 3,000 pounds per square inch, the Contractor shall increase the anchor bolt embedment depth or reduce the anchor bolt spacing to achieve satisfactory performance.

SECTION 903 – HOT MIX ASPHALT{ XE "HOT MIX ASPHALT (HMA)" }

903.01 Composition of Mixtures.{ XE "Hot mix asphalt (HMA):composition of mixtures" }

{ XE "Reclaimed asphalt pavement (RAP):in HMA" **}**Composition of the mixture for of HMA surface course shall be coarse aggregate, fine aggregate, and asphalt binder and may also include mineral filler and up to 15 percent RAP. Not more than a total of 1 percent by weight contamination from Crushed Recycled Container Glass (CRCG) will be permitted in the finished mix.

For projects with 25 percent or less RAP, the composition of the mixture for base or intermediate course shall be coarse aggregate, fine aggregate, and asphalt binder. It may also include mineral filler and up to 25 percent of RAP, and/or up to 5 percent ground bituminous shingle material, and/or up to ten percent CRCG for a combined total of up to 35 percent recycled materials. The coarse and fine aggregate portions of the HMA base course may contain RPCSA according to Subsection 901.10 F.

For projects with 26 to 50 percent RAP, the composition of the mixture for base or intermediate courses shall be coarse aggregate, fine aggregate, and asphalt binder and may also include mineral filler and a maximum of 50 percent by weight of recycled materials as follows:

Recycled Materials

Reclaimed Asphalt Pavement (RAP)		CRCG	Ground Bituminous Shingle Materials	Maximum Recycled
Percent	**Source**	**Percent**	**Percent**	**Percent**
0	--	0 to 10	0	10
0 to 25	Open System	0 to 10	0 to 5	35
26 to 50	Closed System	0 to 10	0	50

Closed system is defined as RAP obtained from removal of HMA overlay or milling performed on Project.

Open system is defined as RAP obtained from other sources both on and off the Project.

The maximum percent of RAP and GBSM shall not exceed 25 percent.

The grade of asphalt binder will be determined by the Department Laboratory for those projects that include the use of 26 to 50 percent of RAP.

When RAP is used, the supplier shall have in operation an ongoing daily quality control program to evaluate the RAP. As a minimum this program shall consist of the following:

1. An evaluation performed to ensure that the material complies with Subsection 901.10, Subpart B and compares favorably with the design submittal.
2. An evaluation of the RAP material performed using a solvent to qualitatively evaluate the aggregate components to determine compliance with Subsection 901.10, Subparts A and C. Quality control reports shall be made available to the Engineer.

When the RAP percentage exceeds 25 percent, a complete mix design including Marshall plugs shall be submitted.

Materials shall conform to the following Subsections:

Aggregates for HMA 901.10
Mineral Filler 901.14
Asphalt Binder 904.01

The several mineral constituents shall be combined in such proportions that the resulting mixture meets the grading requirements in Subsection 903.05, Table 903-1. In calculating the percentage of aggregates of the various sizes, the asphalt is excluded.

903.02 Formula for Job Mix.{ XE "Hot mix asphalt (HMA):job mix formula" }

A job mix formula for each mixture shall be submitted on forms supplied by the Department, which shall include a statement naming the source of each component and a report showing the results of the applicable tests specified in Subsection 903.05, Table 903-5.

The job mix formula for each mixture shall establish the percentage of dry weight of aggregate passing each required sieve size and an optimum percentage of asphalt binder based upon the weight of the total mix. The optimum percentage of asphalt binder shall be determined according to the Asphalt Institute Mix Design Methods for Asphalt Concrete, Manual Series Number 2 (MS-2) Marshall Method and shall produce a mixture that conforms to Subsection 903.05, Table 903-5. The job mix formula shall be within the master range specified in Subsection 903.05, Table 903-1, except that when the optimum percentage of asphalt binder is less than specified, the Engineer may approve the use of the optimum asphalt binder content. When plotted on a 0.45 power grading accumulation chart as used by the Department, the aggregate gradation for the job mix formula shall produce a grading curve with no abrupt changes and approximately parallel to the curve of the grading limits specified in Subsection 903.05, Table 903-1.

In addition, three Marshall specimens (for each mix specified) molded according to the composition, including asphalt content proposed in the job mix formula, shall be submitted with the mix design forms. The Engineer reserves the right to be present at the time of molding the Marshall specimens. The submitted specimens will be used to verify the properties of the job mix formula.

At the discretion of the Engineer, the submission of Marshall specimens for verification of the properties of the job mix formula will not be required if the previous year's approved design for a particular mix is submitted with written certification that the same source and character of materials are to be used. When a previous year's design is approved for use, the initial lot provision of Subsection 903.03 shall not apply and the first lot of the particular mix shall be lot No. 1 and is subject to reductions for nonconformance.

The job mix formula for each mixture shall be in effect until modification is approved.

{ XE "Reclaimed asphalt pavement (RAP):in job mix formula" **}**The job mix formula which includes RAP shall also include the following based on the weight of the total mixture:

Percentage of RAP
Percentage of asphalt binder in the RAP.
Percentage of new asphalt binder.
Total percentage of asphalt binder.
Percentage of each type of new aggregate.

For mixes containing RAP, the job mix formula shall also establish the target percentage of dry weight of aggregate passing each required sieve size and the target percentage of recoverable bitumen to be present in the recycled HMA mixture when discharged from the plant and when tested according to Section 990, NJDOT B-3 or AASHTO T 308.

The job mix formula containing up to 25 percent of RAP, may be established by modifying a previously approved mix design to allow for the introduction of RAP except that the Marshall design procedure and the specimens will not be required.

Mixtures containing up to ten percent crushed recycled container glass shall require a formula for job mix as outlined in this Subsection. The percentage of CRCG shall be included on the job mix formula.

Mixtures containing up to five percent GBSM shall require a formula for job mix as outlined in this Subsection. The percentage of GBSM shall be included on the job mix formula.

For mixes containing 26 to 50 percent of RAP, the job mix formula shall be determined according to the Asphalt Institute Mix Design Method MS-2, Marshall Method, and shall comply with Subsection 903.05, Table 903-5. The preparation of the mixture shall be modified to simulate the mixing process achieved by mixing RAP with new aggregates and new asphalt binder. To achieve a homogeneous mixture at the specified molding temperature, the new aggregates must be heated to a temperature considerably higher than conventional hot-mixes, and the mixing time must be extended.

For mixes containing 26 to 50 percent of RAP, the operation of the plant shall be controlled so that the proportions being included conform to the job mix formula within the tolerances established for manual batch plants.

When unsatisfactory results for any specified characteristic of the work make it necessary, a new job mix formula may be established for approval. In such instances, if corrective action is not taken, the Engineer reserves the right to require an appropriate adjustment.

Should a change in sources or properties of materials be made or significant changes in the properties of the RAP occur, the Engineer may require that a new job mix formula be established and approved before production can continue.

The producer shall perform quality control testing according to the approved quality control plan to keep the mix within the specified tolerances.

When two consecutive lot samples or three out of five consecutive lot samples of any mix or combination of mixes fail to conform to the job mix formula for the No. 8 sieve, No. 200 sieve, or the asphalt content, or the gradation for the remaining sieves falls outside the ranges listed in Subsection 903.05, Table 903-1, work will be stopped until corrective action is taken.

The temperature of the mixture at discharge from the plant or surge and storage bins shall be maintained at a minimum of 15 ºF above the minimum laydown temperature required to deliver material to the project to achieve optimum compaction. In no case shall the mixture temperature exceed 325 ºF.

The moisture content of the mixture at discharge from the plant shall not exceed one percent. Moisture determinations are based on the weight loss on heating for one hour in an oven at 280 ± 5 ºF of an approximately 1,500-gram sample of mixture. A minimum of one sample per lot but not less than two samples per day will be tested for moisture. Samples for moisture determinations will be obtained according to Section 990, NJDOT B-2 or ASTM D 3665.

The total mineral aggregate and bituminous material shall be so combined and mixed that at least 95 percent of the coarse aggregate particles are entirely coated with asphalt binder as determined by AASHTO T 195. At the option of the Engineer, random samples will be obtained from each of five trucks, and the adequacy of the mixing will be determined on the average of particle counts made on these five test portions. If the above requirement is not fully met, mixing time shall be increased as necessary to obtain the required degree of coating.

Resistance to plastic flow for HMA mixtures when combined in the proportions of the job mix formula shall conform to Subsection 903.05, Table 903-5 when tested according to AASHTO T 245 except reference to 1-inch maximum size aggregate is deleted and except that 75 blows of the compaction hammer are to be used on specimens for Mix I-2, I-4 HD, I-4, and I-5 HD.

903.03 Sampling and Testing.{ XE "Hot mix asphalt (HMA):sampling and testing" }

A. Drum Mix Plants. Five random samples will be taken from each lot of approximately 3,000 tons of each type of mix. When a lot of HMA is necessarily less than 3,000 tons, samples will be taken at random for each type of mix at the rate of one sample for each 600 tons or fraction thereof.

At the drum mix plants, the HMA will be sampled and tested for compliance.

To determine the quantity of bitumen and the gradation of the aggregate in HMA mixtures for acceptance testing purposes; composition testing at the rate specified, will be performed each day for each type mixture according to Section 990, NJDOT B-3 or AASHTO T 308.The producer's quality control technician shall be present during periods of mix production for the purposes of quality control testing and assisting the Department's representative to ensure compliance.

B. Fully Automated Batch Plants. Under the supervision of the Engineer, five random samples shall be taken from each lot of approximately 3,000 tons of each type of mix. When a lot of HMA is necessarily less than 3,000 tons, samples shall be taken at random for each type of mix at the rate of one sample for each 600 tons or fraction thereof.

Acceptance testing for gradation and asphalt binder will be performed using bin samples and printed weigh tickets according to Section 990, NJDOT B-5 or AASHTO T 308.

{ XE "Samples for:HMA" **}C. General Sampling and Testing Requirements.** Acceptance testing of HMA will be performed in a timely manner. Sampling will be performed according to AASHTO T 168, and Section 990, NJDOT B-2.

The Department will not perform the composition control testing or other routine test functions in the absence of or instead of the plant laboratory technician.

Acceptance testing does not preclude the Engineer from requiring disposal of any batch or shipment without further testing which is rendered unfit for its intended use due to contamination, segregation, improper temperature, or incomplete coating of the aggregate. For other than improper temperature, visual inspection of the material by the Engineer is considered sufficient grounds for such rejection.

When materials are rejected for any of the above reasons, except for improper temperature, samples will be taken for testing. Should such testing indicate that the material was erroneously rejected, payment will be made for the rejected material.

HMA mixtures processed through a surge or storage system will be inspected visually to ensure that they are essentially free of lumps of cold material. Any batch or shipment of material found to be so contaminated will be rejected and shall be disposed of.

D. Conformance to Job Mix Formula. Conformance to the job mix formula will be determined on the basis of extraction or ignition oven samples taken and tested at the mixing plant for drum mix plants and will be determined by plant print-out tickets and hot bin samples for fully automated batch plants.

The average of test results for the five samples or less for a lot shall conform to the job mix formula within the applicable tolerances of Subsection 903.05, Tables 903-2 and 903-3. Also the range of test results samples from a lot shall be within the applicable tolerances of Subsection 903.05, Table 903-4. Payment for any lot that does not comply with these requirements will be reduced according to Subsection 903.05, Table 903-6. The Engineer may order the removal of any material subject to the maximum reduction shown in Subsection 903.05, Table 903-6.

On each day of production at least one sample shall be obtained of the new aggregate from each cold feed bin, the RAP from its cold feed, and the mineral filler. These samples shall then be tested to determine aggregate grading, and for RAP used in mixes containing 26 to 50 percent of RAP, the percent asphalt, and moisture content. The results of these tests will be theoretically combined and plotted on control charts supplied by the Engineer.

E. Conformance to Control Stability Requirements. Control stability will be determined on the basis of samples taken and tested at the mixing plant. Conformance to the control stability requirements specified in Subsection 903.05, Table 903-5 will be determined from the average of five stability determinations for each lot of material. The material for the stability determinations will be obtained according to Section 990, NJDOT B-2 or ASTM D 3665 at the mixing plant at the same time that the random samples are taken for measurement of conformance to the job mix formula and tested for resistance to plastic flow. Payment for any lot that does not comply with the specified stability requirements will be reduced according to Subsection 903.05, Table 903-7. The Engineer may order the removal of any material subject to the maximum reduction shown in Subsection 903.05, Table 903-7.

F. Initial Production Lot. Reductions for nonconformance to job mix formula and control stability requirements will not be applied to the initial lot each year for each type of mix, also these reductions will not be applied to the initial lot when a new job mix formula is approved in which a change of aggregate producer has caused the maximum specific gravity to change by more than 0.04 as determined by the Engineer. The above waiver does not apply when the average result of the job mix formula conformance samples of the initial lot varies outside those limits for the No. 8 or No. 200 sieve or asphalt content shown in Subsection 903.05, Table 903-1 or the control stability shown in Subsection 903.05, Table 903-5. In this case, the entire initial lot is subject to nonpayment. For the purpose of applying this requirement, if the job mix formula for a top course mix has its asphalt content at the lower limit of Subsection 903.05, Table 903-1, then the lower limit shall be decreased by 0.45 percent.

The initial lot each year is defined as the plant's first day's production, or a minimum of 1,000 tons, in a calendar year. In the event the first day's production does not reach 600 tons, the initial lot is to be extended until the 600-ton level is reached or the Project is completed. Every truck will be visually checked before the first sample being taken. The first sample shall be taken in the first 100 to 200 tons. The remaining samples shall be taken at a rate of one sample every 600 tons, starting at 600 tons. The random sampling numbers may be adjusted to suit production at the discretion of the Engineer.

G. Plants Producing for Multiple Projects. When a plant is producing HMA mixtures for two or more Department Projects at the same time, only one common set of lots for stability and job mix formula will be established and the samples taken for each lot shall apply to each Project on which a part of that lot was used.

903.04 Bituminous Concrete Patch.{ XE "Bituminous concrete patch" }

Bituminous concrete for patching may be used either as a hot mixture direct from a mixing plant or cold from a stockpile at temperatures as low as 15 ºF. In addition, all mixtures shall be sufficiently workable to allow spreading and raking for a period of at least six months when stockpiled and shall be sufficiently stable after compaction to carry traffic without undue marking or displacement.

{ XE "Bituminous concrete patch:materials" **}1. Materials.** Materials shall conform to the following Subsections:

Aggregates for Bituminous Concrete 901.10
Mineral Filler 901.14
Cut-back Asphalt, Grade MC-250 or MC-800 (Note) 904.02
Inverted Emulsified Asphalt, Grade IEMC-250 or IEMC-800 ..... 904.04

Note: Grades MC-250 and MC-800 shall contain an anti-stripping additive.

{ XE "Bituminous concrete patch:composition of mixture" **}2. Composition of Mixture.** The bituminous concrete patch shall be composed of aggregates and bituminous materials combined in such proportions that the resulting composite blend meets the following:

Sieve Size	Total Percent
½"	100
⅜"	80 - 100
No. 4	55 - 75
No. 8	30 - 60
No. 50	10 - 30
No. 200	4 - 10
Residual Bitumen Content	5.5 - 7.5

In calculating the percentages of aggregates of the various sizes, the bituminous material is excluded.

Material passing the No. 200 sieve may consist of fine particles of the aggregate or mineral filler, or both. Material passing the No. 40 sieve shall be nonplastic when tested according to AASHTO T 90. Composition of mixture shall be determined according to Section 990, NJDOT B-3 except that the material shall be dried at 280 ºF for a period of three hours before beginning the extraction procedure.

3. **Preparation of Mixture.** The aggregate shall be surface dry at the time of mixing, however, its temperature shall not exceed 250 ºF. The temperature of the bituminous material shall not exceed 170 ºF. The temperature of the components and the mixing time shall be such that a minimum of 90 percent of the aggregate is coated when tested according to Section 990, NJDOT B-7.

903.05 Tables. { XE "Hot mix asphalt (HMA):tables" }

Tables referenced in the Specifications are as follows:

Table 903-1 Hot Mix Asphalt Mixtures

New Jersey Interagency Engineering Committee

*Standard Hot Mix Asphalt Mixture Design Table{ XE "*Hot mix asphalt (HMA)*:*mix design table*" }*

{ XE "Tables:HMA:mix designation and nominal maximum size of aggregate" **}Mix Designation and Nominal Maximum Size of Aggregate**

	Base Course			Surface Course		
Mix	**I-1**	**I-2**	**I-4 HD**	**I-4**	**I-5**	**I-5 HD**
Size, inches	1"	1½"	¾"	¾"	⅜"	½"
Sieve Size	Grading of total aggregate (coarse plus fine, plus filler if required). Amounts finer than each laboratory sieve (square opening) weight percent.					
2"	--	100				
1 ½"	100	90-100				
1"	90-100	80-100	100	100		
¾"	60-80	65-95 (NA)	95-100	98-100		100
½"	--	50-85	75-95	88-98	100	72-98
⅜"	15-40	40-75 (NA)	65-85	65-88	80-100	60-82
No. 4	0-10	25-60	35-65	35-65	55-75	40-56
No. 8	--	20-45	25-36	25-46	30-56	28-37
No. 16	--	--	15-35	18-40	20-45	19-24
No. 30	--	--	10-30	12-30	15-35	13-19
No. 50	--	8-30	8-25	10-25	10-30	8-16
No. 100	--	--	--	--	--	5-10
No. 200	--	4-7.5	4-7.5	4-7.5	4-8	3-6
Asphalt Binder, Percent by Weight of Total Mixture						
	2.5-3.1	4-6	4.8-7	5-7	5-7	5-6

Material passing the No. 200 sieve may consist of fine particles of the aggregate or mineral filler, or both. Material passing the No. 40 sieve shall be nonplastic when tested according to AASHTO T 90.

Maximum aggregate size requirements - the maximum size of coarse aggregate for any given mix on a project shall be no more than one-half of the proposed lift thickness on the Project. (For example: If the proposed lift thickness for an I-2 mix is 2 inches, the mix used must be 100 percent passing the 1-inch sieve even though the overall specification allows 80-100 percent passing the 1-inch sieve.)

Mix I-1 is not subject to the design requirements specified elsewhere.

(NA) Denotes not applicable for NJDOT Mix.

Mix Descriptions:

1. I-1 is a permeable base course that should be used in a minimum lift of 3 inches.
2. I-2 is a dense-graded base course that may be used in full depth construction or as the bottom course in an overlay.
3. I-4 HD (heavy duty) is a ¾-inch nominal maximum size surface course mix intended to be used on heavy traffic roadways.
4. I-4 is a ¾-inch nominal maximum size surface course mix for medium to heavy traffic roadways.
5. I-5 is a ⅜-inch nominal maximum size surface course mix for low to medium traffic roadways.
6. I-5 HD (heavy duty) is a ½-inch nominal maximum size surface course mix intended to be used for thin lifts (less than 1½ inch) on heavy traffic roadways.

Table 903-2 Tolerances from Job Mix Formula
for Average of Five Samples{ XE "Tables:HMA:tolerances from job mix formula for average of five samples" }

Gradation Mix No.	**I-2**	**I-4 HD**	**I-4**	**I-5**	**I-5 HD**
Sieve Size	**Tolerance Percentage (Plus or Minus)**				
All Plants					
No. 8	4.5	4.0	4.0	4.0	4.0
No. 200	1.4	1.4	1.4	1.4	1.4
HMA (Drum Mix Plant)	0.45	0.45	0.45	0.45	0.45
HMA (Fully Automated Batch Plants) (Note 1)	0.15	0.15	0.15	0.15	0.15

Note 1: If the Fully Automated Batch Plant is tested according to the requirements for a drum plant, the drum plant tolerances shall apply.

Table 903-3 Tolerances from Job Mix Formula for Average of N Samples from a Short Lot{ XE "Tables:HMA:tolerances from job mix formula for average of N samples from a short lot" }

Gradation Mix No.		I-2	I-4 HD	I-4	I-5	I-5 HD
Number of Samples	Sieve Size All Plants	Tolerance Percentage (Plus or Minus)				
4	No. 8	5.0	4.5	4.5	4.5	4.5
4	No. 200	1.6	1.6	1.6	1.6	1.6
HMA (Drum Mix Plants)		0.50	0.50	0.50	0.50	0.50
HMA (Fully Automated Batch Plants)		0.15	0.15	0.15	0.15	0.15
3	No. 8	6.0	5.0	5.0	5.0	5.0
3	No. 200	1.8	1.8	1.8	1.8	1.8
HMA (Drum Mix Plants)		0.60	0.60	0.60	0.60	0.60
HMA (Fully Automated Batch Plants)		0.20	0.20	0.20	0.20	0.20
2	No. 8	7.0	6.5	6.5	6.5	6.5
2	No. 200	2.2	2.2	2.2	2.2	2.2
HMA (Drum Mix Plants)		0.70	0.70	0.70	0.70	0.70
HMA (Fully Automated Batch Plants)		0.25	0.25	0.25	0.25	0.25

Table 903-4 Tolerances for Range of Five Samples or Less{ XE "Tables:HMA:tolerances for range of five samples or less" }

Gradation Mix No.	I-2	I-4 HD	I-4	I-5	I-5 HD
Sieve Size - All Plants	Tolerance Percentage				
No. 8	16.0	13.0	13.0	13.0	13.0
No. 200	4.8	4.8	4.8	4.8	4.8
HMA (Drum Mix Plant)	1.5	1.5	1.5	1.5	1.5
HMA (Fully Automated Batch Plants)	0.4	0.4	0.4	0.4	0.4

For any one characteristic, the range is the absolute difference between the smallest and largest value in the lot.

Table 903-5 Design and Control{ XE "Tables:HMA:design and control" }

Gradation Mix No.	I-2	I-4 HD	I-4	I-5	I-5 HD
Criteria	Test Limits				
Design Stability, minimum lbs	1,500	1,800	1,500	1,200	1,800
Control Stability, minimum lbs	1,200	1,500	1,200	900	1,500
Flow Value, 0.01"	6-18	6-16	6-16	6-16	6-16
Design Voids in mineral aggregate, minimum %	12	13	14	16	15
Design Air Voids (Note 1), %	3-5	3-5	3-5	3-5	3-5
Control Air Voids average of 5 cores (Notes 1 and 2), %	2-8	2-8	2-8	2-8	2-8

Note 1: As determined from the values for the maximum specific gravity of the mix and the bulk specific gravity of the compacted mixture. Maximum specific gravity of the mix will be determined according to AASHTO T 209 except that minimum sample size may be waived to use a 4-inch diameter specimen. Bulk specific gravity of the compacted mixture will be determined according to AASHTO T 166.

Note 2: As determined by the Engineer from drilled pavement cores taken at the direction of the Department. The air voids will be determined based on the bulk specific gravity tests performed on each core individually, and the maximum specific gravity tests performed in the Department's Laboratory according to Section 990, NJDOT B-9.

Table 903-6 Reduction per Lot Due to Nonconformance to Job Mix Formula and Range in the Characteristics of Asphalt Content or Aggregate Passing No. 8or No. 200 Sieve. (see Note 1){ XE "Tables:HMA:reduction per lot due to nonconformance to job mix formula and range in the characteristics of asphalt content or aggregate passing no. 8 or no. 200 sieve" }

Deviation of average of five samples or less from a lot beyond applicable tolerances in Tables 903-2 and 903-3 above. (Percent of tolerance in Table 903-2 above for the applicable type plant)	Reduction Per Lot
1 to 50	2%
51 to 100	5%
Over 100	10%

Deviation of sample range beyond applicable tolerance in Table 903-4 above. (Percent of tolerance in Table 903-4 above for the applicable type plant)	Reduction Per Lot
Greater than 0	5%

Note 1: Where more than one reduction due to nonconformance to job mix formula is applicable to a lot, only the greatest single reduction will be used.

Table 903-7 Reduction Per Lot Due to Nonconformance to Stability Requirements{ XE "Tables:HMA:reduction per lot due to nonconformance to stability requirements" }

Deviation of five sample average below control stability of Table 903-5. (pounds)	Reduction Per Lot
1 to 150	2%
151 to 300	5%
Over 300	10%

SECTION 904 – BITUMINOUS MATERIALS{ XE "BITUMINOUS MATERIALS" }

904.01 Asphalt Binder.{ XE "Asphalt binder" }{ XE "Bituminous materials:asphalt binder" }

Asphalt binder shall conform to AASHTO MP-1, "Standard Specifications for Performance Graded Asphalt Binder." Grade 64-22 shall be used except that an asphalt of softer grade may be directed to be used when the mixture contains RAP and except where otherwise specified.

When specified, PG 76-22 asphalt binder shall be storage-stable, pre-blended, homogeneous, polymer modified asphalt binder using Styrene-Butadiene (SB) or Styrene-Butadiene-Styrene (SBS) formulations with the rolling thin film oven test (RTFOT) residue having a minimum Elastic Recovery (ASTM D 6084) of 50 percent when tested for 60 minutes at 77 ºF and 2 inches/minute elongation. A written certification of compliance shall be furnished for the polymer modified asphalt binder and shall be submitted according to Subsection 106.04.

904.02 Cut-back Asphalts.{ XE "Cut-back asphalts" }{ XE "Bituminous materials:cut-back asphalts" }

Cut-back asphalt of the rapid curing (RC) types shall conform to AASHTO M 81. Grade RC-T shall conform to AASHTO M 81 and the following:

	Minimum	Maximum
Water, % by weight		0.0
Viscosity, Furol at 104 ºF, seconds		40.0
Distillation, % by volume of total distillate to 680 ºF		
to 320 ºF	35.0	
to 374 ºF	55.0	
to 437 ºF	75.0	
to 500 ºF	85.0	
to 600 ºF	90.0	
Asphalt residue from distillation to 680 ºF, % by volume, by difference	45.0	
Tests on residue from distillation		
Penetration at 77 ºF, 100 grams, 5 seconds	80.0	140.0
Ductility at 77 ºF, cms	100	

Cut-back asphalt of the medium curing (MC) types shall conform to AASHTO M 82.

{ XE "Bituminous materials:cut-back asphalts:limitations for use" **}**Except when used as a penetrating prime coat, the use and storage of cut-back asphalts shall conform to NJAC 7:27-16 *et seq.* which includes the following limitations:

1. Shall be used only from October 15 through April 15.
2. When used for repairs, shall be a cold mix, stockpile material.
3. There shall be no emissions of volatile organic substances (VOS) under conditions of normal use.

904.03 Emulsified Asphalts.{ XE "Emulsified asphalts" }{ XE "Bituminous materials:emulsified asphalts" }

Emulsified asphalts of the rapid setting (RS), medium setting (MS), and slow setting (SS) types shall conform to AASHTO M 140. Cationic emulsified asphalts of the rapid setting (CRS), medium setting (CMS), and slow setting (CSS) types shall conform to AASHTO M 208.

904.04 Inverted Emulsified Asphalts.{ XE "Inverted emulsified asphalts" }{ XE "Bituminous materials:inverted emulsified asphalts" }

Inverted emulsified asphalt of the medium curing (IEMC) type shall be prepared using a suitable grade of medium curing cut-back asphalt conforming to Subsection 904.02, with the necessary water and emulsifier required. The inverted asphalt emulsion shall not be mixable with water in any proportion, shall remain homogeneous after 15 hours at 0 ºF, and shall conform to the following:

	IEMC-250	IEMC-800
Kinematic viscosity at 140 ºF (60 ºC), centistokes	250-500	800-1200
Settlement, 7 days, % maximum	1	1
Distillation, by weight		
Asphalt content, % minimum	65	67
Water, %	3-12	3-12
Solvent (by difference), % minimum	15	12
Residue from distillation, Absolute viscosity at 140 ºF (60 ºC), poises	300-1200	30-120
Ductility at 77 ºF (25 ºC), cm min	100	100
Solubility in trichloroethylene	98	98

by weight, % minimum

Inverted emulsified asphalts shall contain not more than eight percent VOS, by volume, and shall be used for mixed-in-place construction. Other limitation requirements and the use and storage of inverted emulsified asphalts shall conform to Subsection 904.02.

904.05 Sampling and Testing Methods.{ XE "Bituminous materials:sampling and testing methods" }

Sampling and testing will be performed according to the following:

AASHTO

{ XE "Samples for:bituminous materials" }T 40	Sampling Bituminous Materials
T 44	Solubility of Bituminous Materials
T 47	Loss on Heating of Oil and Asphaltic Compounds
T 48	Flash and Fire Points by Cleveland Open Cup
T 49	Penetration of Bituminous Materials
T 51	Ductility of Bituminous Materials
T 53	Softening Point of Bitumen (Ring and Ball Apparatus)
T 55	Water in Petroleum Products and Bituminous Materials by Distillation
T 59	Testing Emulsified Asphalt
T 78	Distillation of Cut-Back Asphaltic (Bituminous) Products
T 111	Inorganic Matter or Ash in Bituminous Material
T 179	Effect of Heat and Air on Asphalt Materials (Thin-Film Oven Test)
T 201	Kinematic Viscosity of Asphalts (Bitumens)
T 202	Viscosity of Asphalts by Vacuum Capillary Viscometer
T 240	Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)

ASTM

D 6084	Test Method for Elastic Recovery of Bituminous Materials by Ductilometer

NJDOT

B-1	Determination of Asphalt Content of Inverted Emulsified Asphalt

904.06 Temperature-Volume Correction Factors.{ XE "Temperature-volume correction factors" }{ XE "Bituminous materials:temperature-volume correction factors" }

Temperature-volume correction factors that shall be used to convert the volume of bituminous materials, measured at the temperature at the point of use, to the volume at 60 ºF are found in the following tables:

Table 904-1 Temperature-Volume Correction Factors for Bituminous Materials{ XE "Tables:bituminous materials:temperature-volume correction factors for biuminous materials" }

Asphalt Binder, All Grades.
Cut-Back Asphalt, Grades RC-800, RC-3000, MC-800, and MC-3000.
Inverted Emulsified Asphalt, Grade IEMC-800.

Temp (ºF)	Factor	Temp (ºF)	Factor	Temp (ºF)	Factor	Temp (ºF)	Factor
40	1.0070	85	0.9913	130	0.9758	175	0.9604
41	1.0067	86	0.9909	131	0.9754	176	0.9601
42	1.0063	87	0.9906	132	0.9751	177	0.9597
43	1.0060	88	0.9902	133	0.9747	178	0.9594
44	1.0056	89	0.9899	134	0.9744	179	0.9590
45	1.0053	90	0.9896	135	0.9740	180	0.9587
46	1.0049	91	0.9892	136	0.9737	181	0.9584
47	1.0046	92	0.9889	137	0.9734	182	0.9580
48	1.0042	93	0.9885	138	0.9730	183	0.9577
49	1.0038	94	0.9882	139	0.9727	184	0.9574
50	1.0035	95	0.9878	140	0.9723	185	0.9570
51	1.0031	96	0.9875	141	0.9720	186	0.9567
52	1.0028	97	0.9871	142	0.9716	187	0.9563
53	1.0024	98	0.9868	143	0.9713	188	0.9560
54	1.0021	99	0.9864	144	0.9710	189	0.9557
55	1.0017	100	0.9861	145	0.9706	190	0.9553
56	1.0014	101	0.9857	146	0.9703	191	0.9550
57	1.0010	102	0.9854	147	0.9699	192	0.9547
58	1.0007	103	0.9851	148	0.9696	193	0.9543
59	1.0003	104	0.9847	149	0.9693	194	0.9540
60	1.0000	105	0.9844	150	0.9689	195	0.9536
61	0.9997	106	0.9840	151	0.9686	196	0.9533
62	0.9993	107	0.9837	152	0.9682	197	0.9530
63	0.9990	108	0.9833	153	0.9679	198	0.9526
64	0.9986	109	0.9830	154	0.9675	199	0.9523
65	0.9983	110	0.9826	155	0.9672	200	0.9520
66	0.9979	111	0.9823	156	0.9669	201	0.9516
67	0.9976	112	0.9819	157	0.9665	202	0.9513
68	0.9972	113	0.9815	158	0.9662	203	0.9509
69	0.9969	114	0.9813	159	0.9658	204	0.9506
70	0.9965	115	0.9809	160	0.9655	205	0.9503
71	0.9962	116	0.9806	161	0.9652	206	0.9499
72	0.9958	117	0.9802	162	0.9648	207	0.9496
73	0.9955	118	0.9799	163	0.9645	208	0.9493
74	0.9951	119	0.9795	164	0.9641	209	0.9489
75	0.9948	120	0.9792	165	0.9638	210	0.9486
76	0.9944	121	0.9788	166	0.9635	211	0.9483
77	0.9941	122	0.9785	167	0.9631	212	0.9479
78	0.9937	123	0.9782	168	0.9628	213	0.9476
79	0.9934	124	0.9782	169	0.9624	214	0.9472
80	0.9930	125	0.9775	170	0.9621	215	0.9469
81	0.9927	126	0.9771	171	0.9618	216	0.9466
82	0.9923	127	0.9768	172	0.9614	217	0.9462
83	0.9920	128	0.9764	173	0.9611	218	0.9459
84	0.9916	129	0.9761	174	0.9607	219	0.9456

Table 904-1 (Continued) { XE "Tables:bituminous materials:temperature-volume correction factors for biuminous materials" }

Temp (ºF)	Factor	Temp (ºF)	Factor	Temp (ºF)	Factor	Temp (ºF)	Factor
220	0.9452	265	0.9302	310	0.9154	355	0.9008
221	0.9449	266	0.9299	311	0.9151	356	0.9005
222	0.9446	267	0.9296	312	0.9148	357	0.9002
223	0.9442	268	0.9293	313	0.9145	358	0.8998
224	0.9439	269	0.9289	314	0.9141	359	0.8995
225	0.9436	270	0.9286	315	0.9138	360	0.8992
226	0.9432	271	0.9293	316	0.9135	361	0.8989
227	0.9429	272	0.9279	317	0.9132	362	0.8986
228	0.9426	273	0.9276	318	0.9128	363	0.8982
229	0.9422	274	0.9273	319	0.9125	364	0.8979
230	0.9419	275	0.9269	320	0.9122	365	0.8976
231	0.9416	276	0.9266	321	0.9118	366	0.8973
232	0.9412	277	0.9263	322	0.9115	367	0.8969
233	0.9409	278	0.9259	323	0.9112	368	0.8966
234	0.9405	279	0.9256	324	0.9109	169	0.8963
235	0.9402	280	0.9253	325	0.9105	370	0.8960
236	0.9399	281	0.9250	326	0.9102	371	0.8957
237	0.9395	282	0.9246	327	0.9099	372	0.8953
238	0.9392	283	0.9243	328	0.9096	373	0.8950
239	0.9389	284	0.9240	329	0.9092	374	0.8947
240	0.9385	285	0.9236	330	0.9089	375	0.8944
241	0.9382	286	0.9233	331	0.9086	376	0.8941
242	0.9379	287	0.9230	332	0.9083	377	0.8937
243	0.9375	288	0.9227	333	0.9079	378	0.8934
244	0.9372	289	0.9223	334	0.9076	379	0.8931
245	0.9369	290	0.9220	335	0.9073	380	0.8928
246	0.9365	291	0.9217	336	0.9070	381	0.8924
247	0.9362	292	0.9213	337	0.9066	382	0.8921
248	0.9359	293	0.9210	338	0.9063	383	0.8918
249	0.9356	294	0.9207	339	0.9060	384	0.8915
250	0.9352	295	0.9204	340	0.9057	385	0.8912
251	0.9349	296	0.9200	341	0.9053	386	0.8906
252	0.9346	297	0.9197	342	0.9050	387	0.8905
253	0.9342	298	0.9194	343	0.9047	388	0.8902
254	0.9339	299	0.9190	344	0.9044	389	0.8899
255	0.9336	300	0.9187	345	0.904	390	0.8896
256	0.9332	301	0.9184	346	0.9037	391	0.8892
257	0.9329	302	0.9181	347	0.9034	392	0.8889
258	0.9326	303	0.9177	348	0.9031	393	0.8886
259	0.9322	304	0.9174	349	0.9028	394	0.8883
260	0.9319	305	0.9171	350	0.9024	395	0.8880
261	0.9316	306	0.9167	351	0.9021	396	0.8876
262	0.9312	307	0.9164	352	0.9018	397	0.8873
263	0.9309	308	0.9161	353	0.9015	398	0.8870
264	0.9306	309	0.9158	354	0.9011	399	0.8867
						400	0.8864

Table 904-2 Temperature-Volume Correction Factors
For Bituminous Materials{ XE "Tables:bituminous materials:temperature-volume correction factors for biuminous materials" }

Cut-Back Asphalt, Grades RC-T, RC-70, RC-250, MC-30, and MC-250.
Inverted Emulsified Asphalt, Grade IEMC-250.

Temp (ºF)	Factor	Temp (ºF)	Factor	Temp (ºF)	Factor	Temp (ºF)	Factor
40	1.0080	85	0.9901	130	0.9725	175	0.9551
41	1.0076	86	0.9897	131	0.9710	176	0.9547
42	1.0072	87	0.9893	132	0.9717	177	0.9543
43	1.0080	88	0.9889	133	0.9713	178	0.9539
44	1.0064	89	0.9885	134	0.9709	179	0.9536
45	1.0060	90	0.9881	135	0.9705	180	0.9532
46	1.0056	91	0.9877	136	0.9701	181	0.9528
47	1.0052	92	0.9873	137	0.9697	182	0.9524
48	1.0048	93	0.9869	138	0.9693	183	0.9520
49	1.0044	94	0.9865	139	0.9690	184	0.9517
50	1.0040	95	0.9861	140	0.9686	185	0.9513
51	1.0036	96	0.9857	141	0.9682	186	0.9509
52	1.0032	97	0.9854	142	0.9678	187	0.9505
53	1.0028	98	0.9850	143	0.9674	188	0.9501
54	1.0024	99	0.9846	144	0.9670	189	0.9498
55	1.0020	100	0.9842	145	0.9666	190	0.9494
56	1.0016	101	0.9838	146	0.9662	191	0.9490
57	1.0012	102	0.9834	147	0.9659	192	0.9486
58	1.0008	103	0.9830	148	0.9655	193	0.9482
59	1.0004	104	0.9826	149	0.9651	194	0.9478
60	1.0000	105	0.9822	150	0.9647	195	0.9475
61	0.9996	106	0.9818	151	0.9643	196	0.9471
62	0.9993	107	0.9814	152	0.9639	197	0.9467
63	0.9988	108	0.9810	153	0.9635	198	0.9463
64	0.9984	109	0.9806	154	0.9632	199	0.9460
65	0.9980	110	0.9803	155	0.9628	200	0.9456
66	0.9976	111	0.9799	156	0.9624	201	0.9452
67	0.9972	112	0.9795	157	0.9620	202	0.9448
68	0.9968	113	0.9791	158	0.9616	203	0.9443
69	0.9964	114	0.9787	159	0.9612	204	0.9441
70	0.9960	115	0.9783	160	0.9609	205	0.9437
71	0.9956	116	0.9879	161	0.9605	206	0.9433
72	0.9952	117	0.9875	162	0.9601	207	0.9429
73	0.9948	118	0.9771	163	0.9597	208	0.9425
74	0.9944	119	0.9767	164	0.9593	209	0.9422
75	0.9940	120	0.9763	165	0.9589	210	0.9418
76	0.9936	121	0.9760	166	0.9585	211	0.9414
77	0.9932	122	0.9756	167	0.9582	212	0.9410
78	0.9929	123	0.9752	168	0.9578	213	0.9407
79	0.9925	124	0.9748	169	0.9574	214	0.9403
80	0.9921	125	0.9744	170	0.9570	215	0.9399
81	0.9917	126	0.9740	171	0.9660	216	0.9395
82	0.9913	127	0.9736	172	0.9562	217	0.9391
83	0.9909	128	0.9732	173	0.9559	218	0.9388
84	0.9905	129	0.9728	174	0.9555	219	0.9384

Table 904-2 (Continued) { XE "Tables:bituminous materials:temperature-volume correction factors for biuminous materials" }

Temp (ºF)	Factor	Temp (ºF)	Factor	Temp (ºF)	Factor	Temp (ºF)	Factor
220	0.9380	265	0.9212	310	0.9154	355	0.9008
221	0.9376	266	0.9208	311	0.9151	356	0.9005
222	0.9373	267	0.9205	312	0.9148	357	0.9002
223	0.9369	268	0.9201	313	0.9145	358	0.8998
224	0.9365	269	0.9197	314	0.9141	359	0.8995
225	0.9361	270	0.9194	315	0.9138	360	0.8992
226	0.9358	271	0.9190	316	0.9135	361	0.8989
227	0.9354	272	0.9186	317	0.9132	362	0.8986
228	0.9350	273	0.9182	318	0.9128	363	0.8982
229	0.9346	274	0.9179	319	0.9125	364	0.8979
230	0.9343	275	0.9175	320	0.9122	365	0.8976
231	0.9339	276	0.9171	321	0.9118	366	0.8973
232	0.9335	277	0.9168	322	0.9115	367	0.8969
233	0.9331	278	0.9164	323	0.9112	368	0.8966
234	0.9328	279	0.9160	324	0.9109	169	0.8963
235	0.9324	280	0.9157	325	0.9105	370	0.8960
236	0.9320	281	0.9153	326	0.9102	371	0.8957
237	0.9316	282	0.9149	327	0.9099	372	0.8953
238	0.9313	283	0.9146	328	0.9096	373	0.8950
239	0.9309	284	0.9142	329	0.9092	374	0.8947
240	0.9305	285	0.9138	330	0.9089	375	0.8944
241	0.9301	286	0.9135	331	0.9086	376	0.8941
242	0.9298	287	0.9131	332	0.9083	377	0.8937
243	0.9294	288	0.9127	333	0.9079	378	0.8934
244	0.9290	289	0.9124	334	0.9076	379	0.8931
245	0.9286	290	0.9120	335	0.9073	380	0.8928
246	0.9293	291	0.9116	336	0.9070	381	0.8924
247	0.9279	292	0.9113	337	0.9066	382	0.8921
248	0.9275	293	0.9109	338	0.9063	383	0.8918
249	0.9272	294	0.9105	339	0.9060	384	0.8915
250	0.9268	295	0.9102	340	0.9057	385	0.8912
251	0.9264	296	0.9098	341	0.9053	386	0.8906
252	0.9260	297	0.9094	342	0.9050	387	0.8905
253	0.9257	298	0.9091	343	0.9047	388	0.8902
254	0.9353	299	0.9087	344	0.9044	389	0.8899
255	0.9349	300	0.9187	345	0.9040	390	0.8896
256	0.9245	301	0.9080	346	0.9037	391	0.8892
257	0.9242	302	0.9181	347	0.9034	392	0.8889
258	0.9238	303	0.9177	348	0.9031	393	0.8886
259	0.9234	304	0.9174	349	0.9028	394	0.8883
260	0.9231	305	0.9171	350	0.9024	395	0.8880
261	0.9227	306	0.9167	351	0.9021	396	0.8876
262	0.9223	307	0.9164	352	0.9018	397	0.8873
263	0.9219	308	0.9161	353	0.9015	398	0.8870
264	0.9216	309	0.9158	354	0.9011	399	0.8867
						400	0.8864

Table 904-3 Temperature-Volume Correction Factors for Bituminous Materials{ XE "Tables:bituminous materials:temperature-volume correction factors for biuminous materials" }

Emulsified Asphalt, All Grades.

Temp (ºF)	Factor	Temp (ºF)	Factor	Temp (ºF)	Factor	Temp (ºF)	Factor
40	1.0050	75	0.9953	110	0.9876	145	0.9792
41	1.0048	76	0.9960	111	0.9874	146	0.9790
42	1.0045	77	0.9958	112	0.9872	147	0.9787
43	1.0043	78	0.9955	113	0.9869	148	0.9785
44	1.0040	79	0.9953	114	0.9867	149	0.9782
45	1.0038	80	0.9950	115	0.9864	150	0.9780
46	1.0035	81	0.9948	116	0.9862	151	0.9778
47	1.0033	82	0.9945	117	0.9860	152	0.9775
48	1.0030	83	0.9943	118	0.9857	153	0.9773
49	1.0028	84	0.9940	119	0.9855	154	0.9770
50	1.0025	85	0.9938	120	0.9852	155	0.9768
51	1.0023	86	0.9935	121	0.9850	156	0.9766
52	1.0020	87	0.9933	122	0.9847	157	0.9763
53	1.0018	88	0.9930	123	0.9845	158	0.9761
54	1.0015	89	0.9928	124	0.9843	159	0.9758
55	1.0013	90	0.9925	125	0.9840	160	0.9756
56	1.0010	91	0.9923	126	0.9838	161	0.9754
57	1.0008	92	0.9920	127	0.9835	162	0.9751
58	1.0005	93	0.9918	128	0.9833	163	0.9749
59	1.0003	94	0.9915	129	0.9830	164	0.9747
60	1.0000	95	0.9913	130	0.9828	165	0.9744
61	0.9998	96	0.9910	131	0.9826	166	0.9742
62	0.9995	97	0.9908	132	0.9823	167	0.9739
63	0.9993	98	0.9905	133	0.9821	168	0.9737
64	0.9990	99	0.9903	134	0.9818	169	0.9735
65	0.9988	100	0.9901	135	0.9816	170	0.9732
66	0.9985	101	0.9899	136	0.9814	171	0.9730
67	0.9983	102	0.9896	137	0.9811	172	0.9728
68	0.9980	103	0.9884	138	0.9809	173	0.9725
69	0.9978	104	0.9891	139	0.9806	174	0.9723
70	0.9975	105	0.9889	140	0.9804	175	0.9721
71	0.9973	106	0.9886	141	0.9802	176	0.9718
72	0.9970	107	0.9884	142	0.9799	177	0.9716
73	0.9968	108	0.9881	143	0.9797	178	0.9713
74	0.9965	109	0.9879	144	0.9794	179	0.9711

SECTION 905 - CONCRETE ADMIXTURES AND CURING MATERIALS{ XE "CONCRETE (PORTLAND CEMENT):CURING MATERIALS" }{ XE "CONCRETE (PORTLAND CEMENT):ADMIXTURES" }

905.01 Air-Entraining Admixtures.{ XE "Air-entraining admixtures" }{ XE "Admixtures:air-entraining" }

Air-entraining admixtures for portland cement concrete shall conform to AASHTO M 154 except that the tests for bleeding and volume change will not be required.

Before the admixture is approved for use, the test results and certification shall be furnished according to Subsection 905.02.

The Department will test for uniformity through the use of infrared spectrophotometry, pH values, specific gravity and solids content.

All bulk storage tanks shall be inside a heated area with an ambient temperature of not less than 32 ºF. Air-entraining admixture that has been allowed to freeze shall not be reused until agitated and retested.

905.02 Chemical Admixtures.{ XE "Chemical admixtures" }{ XE "Admixtures:chemical" }

Chemical admixtures for portland cement concrete shall conform to AASHTO M 194 except that the use of such admixtures shall not introduce more than one percent of air-entrainment. Chlorides shall not be added in the admixture for prestressed concrete.

The chemical admixtures shall be the following types:

Type A - Water-reducing admixtures
Type B - Retarding admixtures
Type C - Accelerating admixtures
Type D - Water-reducing and retarding admixtures
Type E - Water-reducing and accelerating admixtures
Type F - Water-reducing, high range admixtures

If chemical admixtures are used, they shall contain no calcium chlorides or any other intentionally added chlorides that may initiate or promote corrosion of the reinforcement steel.

Admixtures will be approved by the Department's Bureau of Materials. Certification may be required periodically from the manufacturer stating that the material is identical with that originally approved and has in no way been changed or altered.

The Department will test for uniformity through the use of infrared spectrophotometry, pH values, specific gravity and solids content.

All bulk storage tanks for chemical admixtures shall be located inside a heated area with an ambient temperature of not less than 32 ºF. Chemical admixtures that have been allowed to freeze shall not be reused until agitated and retested.

Corrosion inhibitor admixtures shall be defined as materials that when added to concrete have the ability to reduce the potential of corrosion of embedded steel. Corrosion inhibitor admixtures shall be the following:

1. Calcium Nitrite Based. Calcium nitrite when mixed into the concrete will become an integral part of the concrete matrix and promote a corrosion barrier around the embedded steel. The following guidelines shall be followed in the use of calcium nitrite:
    a. Precautions shall be taken to ensure that the calcium nitrite does not contact other admixtures before entering the concrete mix. Air entraining, water reducing and retarding admixtures, according to the manufacturers' recommendations, shall be compatible with the calcium nitrite solution. The calcium nitrite solution shall be thoroughly mixed into the concrete before other admixtures have been incorporated into the concrete mix.
    b. The Contractor shall strictly adhere to the manufacturer's written recommendations regarding the use of the calcium nitrite admixture. This shall include storage, transportation and method of mixing. The manufacturer of the calcium nitrite admixture shall provide a representative to assist the Contractor and the Engineer on the first full day of production of members that contain the calcium nitrite admixture, and shall be available on request during subsequent construction.
    c. Testing for the presence of the calcium nitrite admixture in the concrete shall conform to Section 990 Method of Tests, M-4 for plastic concrete testing and M-5 for hardened concrete testing. The test kit that is required to perform the plastic test shall be provided to the Department Laboratory by the Contractor.
    d. 30 ± 2 percent by weight of solution of calcium nitrite shall be contained in the admixture. A high range water reducing chemical admixture shall be included in the design mix.

e. The calcium nitrite shall be added at a rate of 3 gallons per cubic yard of concrete.

The list of the approved manufacturers shall be provided in the Special Provisions.

905.03 Curing Materials.{ XE "Curing materials:burlap" }{ XE "Burlap cloth" }

Curing materials for Portland cement concrete shall conform to the following:

1. Burlap cloth made from jute or kenaf shall conform to AASHTO M 182, Class 4.

{ XE "Curing materials:liquid membrane-forming compounds" **}**2. Liquid membrane-forming compounds shall conform to AASHTO M 148, Type 1-D, clear or translucent with fugitive dye, or Type 2, white pigmented.

{ XE "Curing materials:white polyethylene sheeting" **}{** XE "Polyethylene sheeting" **}**3. White polyethylene sheeting shall conform to AASHTO M 171 for white opaque polyethylene film.

{ XE "Curing materials:white burlap-polyethylene sheeting" **}**4. White burlap-polyethylene sheeting shall conform to AASHTO M 171.

{ XE "Waterproof paper" **}{** XE "Curing materials:waterproof paper" **}**5. Waterproof paper shall conform to AASHTO M 171.

6. Hay or straw shall conform to Subsection 919.13 and when used for insulation in cold weather, it shall be dry and shall not be reused unless otherwise approved.

905.04 Sampling and Testing Methods. { XE "Curing materials:sampling" }

Sampling and testing will be performed according to the following:

{ XE "Samples for:admixtures" **}**1. Admixtures:

a.	Air-entraining	1 gallon from each source
b.	Chemical	1 gallon from each source

{ XE "Samples for:curing materials" **}**2. Curing Materials:

a.	Burlap	1 square yard from each source
b.	Liquid Compound	1 quart from each lot
c.	Polyethylene Sheeting	1-foot strip (cut across full width) from each source
d.	Waterproof Paper	1-foot strip (cut across full width) from each source

905.05 Certification of Compliance.

Manufacturer's certification for polyethylene sheeting shall be submitted according to Subsection 106.04.

SECTION 906 - ELECTRICAL MATERIALS{ XE "ELECTRICAL MATERIALS" }

906.01 Anchor Bolts.{ XE "Electrical materials:anchor bolts" }

Anchor bolts shall conform to ASTM A 576, and the top 6 inches shall be galvanized according to ASTM A 153.

906.02 Bonding and Grounding Materials.{ XE "Electrical materials:bonding and grounding" }{ XE "Bonding and grounding of traffic equipment" }

{ XE "Electrical materials:bushings" **}**Bushings for rigid metallic conduit with a diameter of 1 inch or more shall be constructed of hot-dip galvanized or electro-galvanized malleable iron, with a bakelite, nylon, or some type of heat-resistant plastic, molded, and locked into the bushing. The lug shall be constructed of aluminum, bronze, copper, or other corrosion-resistant metal. The set screws, lug mounting, and binding screws shall be stainless steel. Threadless bushings may be utilized at specific locations where the conduit is not threaded.

Insulating bushings for rigid metallic conduit with a diameter of less than 1 inch shall be constructed of molded high-impact thermoset plastic with a high dielectric and mechanical strength.

The conduit shall be bonded with bonding lock nuts.

Bushings made of materials that support combustion shall not be used.

{ XE "Electrical materials:ground wire" **}**Ground wire may be bare or insulated. The conductor shall be seven-strand, soft-drawn copper conforming to ASTM B 8. Bare conductors shall be tinned. Insulated conductors shall be covered with an insulation that meets or exceeds the requirements of UL Type THW.

{ XE "Electrical materials:ground rods" **}**Ground rods shall be ⅝ inch in diameter and 12 feet long, composed of steel core with copper covering, thoroughly welded so that an interlocking crystalline union is secured between the two metals. The minimum thickness of the copper on the cylindrical portion of the rod shall average not less than 0.010 inch.

906.03 Cable and Wire.{ XE "Electrical materials:cable and wire" }{ XE "Cable, electrical" }

The manufacturer shall furnish the Engineer and the Contractor all splicing and terminating information necessary for proper installation of the cables and wires.

All conductors shall be of stranded copper, and they shall conform to the standard rules of the American Institute of Electrical Engineers and of the National Board of Fire Underwriters. No conductors shall be smaller than No. 14 AWG or Brown and Sharp Gage.

All conductors shall be soft annealed copper wire according to ASTM B 3 for tin-coated conductors or ASTM B 8 for bare copper conductors.

All conductors shall have Class B concentric stranding.

906.04 Cable Connectors.{ XE "Electrical materials:cable connectors" }

Cable connectors shall be fused for use on line wires and nonfused on neutral wires. The connectors shall be a waterproof inline type connector and shall be composed of a line side and a load side housing, each made of water-resistant synthetic rubber. Each housing shall include a section to form a watertight seal around the cable, an interior arrangement to receive and retain the copper fuse contacts, and a watertight seal section at the point of disconnection.

The contacts shall be spring loaded, designed for a maximum current of 30 amperes at 600 volts and shall have a 90 percent minimum conductivity. The contacts shall be suitable for gripping a cartridge-type midget fuse. The fuse shall be 13/32 inch in diameter and 1½ inches in length and shall be rated at 5 amperes. The contacts shall be fully annealed and compressed onto the cable. The cable diameter shall determine the size of each housing. Each side of the housing shall be permanently marked load side or line side.

906.05 Cable Racks.{ XE "Electrical materials:cable racks" }

Cable racks shall be a molded polycarbonate cable rack. The cable rack shall have a dielectric strength of less than 2 microamps at 100,000 volts. The polycarbonate used in the construction of the rack shall be fire retardant with an SE-1 rating. The cable rack shall be 3 inches wide and 3 feet long in ground-installed junction boxes or 1 foot in structures. The cable rack shall contain three saddle arms with a capacity of 2 inches.

As an alternative, steel cable racks may be used and shall consist of a steel channel, welded steel supports, a clip, and porcelain insulator for each support. All steel components shall be hot-dip galvanized. The cable rack shall be approximately 2 feet long in ground installed boxes with three supports and 7 inches long in junction boxes located on structures with one support. Support holes on the channel shall be spaced approximately 1½ inches on centers. The cable supports shall be designed with an interlocking feature at the rear of the support to prevent tilting and, when installed, to extend approximately 4 inches from the rack. The porcelain insulator required on each support shall be constructed with a hook bottom groove to prevent slipping.

906.06 Cast Boxes and Fittings.{ XE "Electrical materials:cast boxes and fittings" }

Cast boxes shall be provided with suitable cover of like material held in place with stainless steel fasteners and sealed with a weatherproof neoprene gasket.

Cast boxes shall be provided with mounting lugs. All mounting hardware shall be stainless steel. Cast iron boxes shall conform to Subsection 917.03. All surfaces of cast iron boxes and covers shall be hot-dip galvanized.

Aluminum boxes and covers shall conform to Subsection 911.01.

Junction boxes for underdeck lighting shall be cast iron of approved design, suited and adapted to the specific location and the number of conduits, nipples, etc. connected thereto. Boxes shall be flush-type when installed in a structure or surface-mounted-type in all surface applications. The cover shall have a neoprene gasket and shall be secured with stainless steel screws. Where required, the box shall have busses to provide at least five full threads or a UL-approved watertight rigid conduit hub at each entry point of the conduit.

Pull boxes and pull fittings exposed on sign structures shall be cast aluminum. Boxes shall be of approved design, suited and adapted to the specific location and the number and arrangement of conduits, etc. connecting herewith. Boxes shall have external lugs for mounting and internal mounting buttons for mounting equipment.

906.07 Conduits and Fittings.{ XE "Electrical materials:conduits and fittings" }

Conduits and fittings on sign structures that are exposed shall be aluminum conforming to UL standards for rigid metallic conduit. Fittings and accessories for aluminum conduit shall be made of aluminum or stainless steel.

Conduits and fittings used as a raceway for the installation of wires and cables shall conform to the following:

1. **Rigid Nonmetallic Conduit.** Rigid nonmetallic conduit shall be polyvinyl chloride conduit and shall be made from virgin polyvinyl resins conforming to ASTM D 1784, Type I, Grade 1. The conduit shall exceed all the property requirements including impact strength, chemical resistance, and flammability as listed in UL 651 and NEMA TC 2. The rigid nonmetallic conduit shall be Type II, Schedule 40 suitable for direct burial. Fittings shall also be made from high-impact polyvinyl chloride. They shall be of the socket type and be joined to the conduit using polyvinyl chloride solvent cement. Fittings including couplings shall conform to NEMA TC 3.

   Solvent cement used for joining polyvinyl chloride conduit shall be a heavy-bodied cement complying with ASTM D 2564 and shall be applied with a natural bristle or nylon brush.

2. **Rigid Metallic Conduit.** Rigid metallic conduit and fittings shall be steel and shall conform to UL 6, UL 514B, and ANSI C80.1.

   Steel conduit shall be manufactured from a milled steel tubing with a wall thickness similar to Schedule 40 pipe. The conduit shall be hot-dip galvanized inside and out, throughout its entire length, including the threads. Minimum weight of galvanized coating shall be one ounce per square foot. The couplings supplied shall be electro-galvanized.

   Manufactured rigid metallic conduit sweep elbows shall conform to UL 6 and to Subsection 906.02.

   Aluminum conduit and fittings shall be fabricated from a copper-free, corrosion-resistant aluminum alloy, conforming to Federal Specification WW-C-540A, ASTM B 429, ASME Specification SB-241, and Subsection 911.01.

3. **Flexible Metal Conduit.** Flexible metal conduit shall consist of a spirally wound steel core covered with a polyvinyl chloride jacket. It shall be manufactured according to Federal Specification A-A-55810 and shall comply with the National Electrical Code for liquidtight, flexible, metal conduit. Associated fittings shall be of like material and provide positive grounding and a liquidtight seal.

   Flexible metal conduit for use on sign structures shall have an aluminum core with a neoprene jacket.

906.08 Electrical Tape.{ XE "Electrical materials:electrical tape" }

Friction tape shall be the self-sticking, rubber-impregnated, woven cotton fabric type.

Insulating tape shall be self-bonding and designed for use with cross-linked polyethylene or rubber-insulated wire and cable. When installed, it shall provide a permanent electrical and watertight seal.

Jacket tape shall be a conformable vinyl, plastic electrical tape that is flame retardant, water resistant, and cold weather pliable. It shall be heavy-duty with a minimum tensile strength of 20 pounds per inch, a minimum adhesion of 20 ounces per inch, and a minimum thickness of 8.5 mils.

906.09 Lamps.{ XE "Electrical materials:lamps" }{ XE "Lamps" }

{ XE "Electrical materials:lamps:traffic signal" **}A. Traffic Signal**. Traffic signal lamps shall be 120/125 volts and clear. The 135-watt lamp shall be rated for 6,000 hours of life, and the 60-watt lamp shall be rated for

8,000 hours of life. The lamps shall meet or exceed the beam candlepower requirements of the Institute of Transportation Engineers signal lamp standard. The lamps shall also comply with the following:

Indication Size	Wattage	Rated Initial Lumens	Center Length
8 inch	60	595	2 7/16 inches
12 inch	135	1750	3 inches
Pedestrian	60	595	2 7/16 inches

{ XE "Electrical materials:lamps:highway lighting" **}B. Highway Lighting.** High pressure sodium lamps shall have electrical, physical, and photometric characteristics that conform to ANSI Standards. The lamps shall also be rated for 24,000 hours of average life (based on ten hours per start) and be equipped with borosilicate glass, have a mogul base, a universal burning position, and shall be of the following ANSI designation, initial lumen rating, and nominal lamp voltage:

Wattage	Wattage Designation	Lumens	Voltage
150	SC-150	16,000	55
250	VA-250	27,500	100
400	WA-400	50,000	100

Mercury vapor lamps shall have electrical, physical, and photometric characteristics that conform to ANSI Standards. The lamps shall also be rated for 24,000 hours of average life (based on ten hours per start), be equipped with borosilicate glass, have a mogul base, a universal burning position, and shall be of the following ANSI designation, and initial lumen rating in the vertical burning position:

Designation	Wattage	Lumens
H 37-5KC/W	250	11,400
H 33-1GL/W	400	22,000

{ XE "Electrical materials:lamps:sign lighting" **}C. Sign Lighting.** Lamps for sign luminaires shall be 250-watt, phosphor-coated mercury lamps conforming to ANSI H 37-KC-R250/DX.

906.10 Loop Detector Lead.{ XE "Electrical materials:loop detector lead" }

Loop detector lead shall conform to Subsection 906.03 and to the New Jersey Electrical Materials Specification EBM-LDL. Only one type of loop detector lead will be permitted on the Project.

906.11 Loop Wire.{ XE "Electrical materials:loop wire" }

{ XE "Electrical materials:single conductor signal wire" **}**The loop wire shall be thermoplastic single conductor wire with a ¼-inch PVC tube or ¼-inch, high-density, polyethylene tube extruded over the loop detector wire, shall be manufactured in conformance with ICEA Publication No. S-61-402/NEMA Publication No. WC5, and shall conform to the following:

1. The conductor shall be No. 14 AWG soft-drawn copper wire with 19-wire (Class C) stranding or seven-wire (Class B) stranding conforming to ASTM B 3 and ASTM B 8.
2. The insulation shall conform to UL Type THHN/THWN and shall be rated for 600 volts.
3. The extruded polyvinyl chloride tubing shall be UL listed FR-1 rated at 221 ºF, with a minimum wall thickness of 30 mils. It shall be chemical resistant and oil resistant with a moisture absorption of less than one percent. The high density polyethylene tubing shall be UL listed with a minimum wall thickness of 30 mils.

906.12 Cabinets.{ XE "Electrical materials:cabinets" }

Cabinets shall be aluminum alloy conforming to Subsection 911.01.

{ XE "Electrical materials:meter cabinets" **}{** XE "Meter cabinets" **}**The door of all meter and control equipment cabinets, other than traffic signal cabinets, shall be labeled with a permanent reflective metallic sign indicating the voltage and the word **DANGER**. The sign shall be applied on a 0.040-inch minimum thickness aluminum alloy sheet. The lettering shall be approximately 1½ inches high and shall be red on a white background. The sign shall be installed with four stainless steel vandal proof screws.

A weatherproof print of the system field wiring shall be sealed in plastic and attached to the inside of the door of each meter cabinet, control equipment, and controller cabinet.

906.13 Multiple Lighting and Service Wire.{ XE "Electrical materials:multiple lighting wire" }{ XE "Electrical materials:service wire" }

Multiple lighting and service wire shall conform to Subsection 906.03 and to the following:

1. Wire shall conform to current ICEA-NEMA Standards Publication for Cross-linked-thermosetting-polyethylene-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy, ICEA Publication No. S-66-524/NEMA Publication No. WC 7 and UL Type RHW-USE.
2. Insulation shall be a heat-resistant, moisture-resistant submarine compound conforming to current ICEA Publication No. S-66-524/NEMA Publication No. WC 7, except the thickness of insulation for all conductors shall be that required for 600 volts rated circuit voltage according to Table 3-1 for cross-linked-thermosetting-polyethylene-insulated power cables, Column A.

906.14 Panel Boards and Circuit Breakers.{ XE "Electrical materials:panel boards" }{ XE "Electrical materials:circuit breakers" }

A. Traffic Signals. Panelboards shall be single-phase, three-wire, 120/240-volt, with 70-ampere main-rated busses, conforming to Federal Specification W-P-115C, Type 1, Class 2. Circuit breakers shall be UL listed and shall comply with NEMA Standards. They shall conform to Federal Specification W-C-375B, Class 10A.

B. Highway and Sign Lighting. Panelboards and circuit breakers shall conform to the following:

1. Panelboards for 120/240-volt installations shall be single-phase, three-wire with 100-ampere main-rated busses, conforming to Federal Specification W-P-115C, Type 1, Class 1. Circuit breakers shall be UL listed and shall comply with NEMA Standards. They shall conform to Federal Specification W-C-375B for Class 10A or Class 10B.
2. Panelboards for 240/480-volt installations shall be single-phase, three-wire and shall have main busses, rated as designated, and shall conform to Federal Specification W-P-115C, Type 1, Class 1. Circuit breakers shall be UL listed and shall comply with NEMA Standards. They shall conform to Federal Specification W-C-375B for Class 13B.
3. Panelboards for 480-volt installations shall be the size and type indicated and shall conform to Federal Specification W-P-115C, Type 1, Class 1. Circuit breakers shall be UL listed and comply with NEMA Standards. They shall be manually operated, molded-case units conforming to Federal Specification W-C-375B for Class 13B.

906.15 Pedestals, Poles, Transformer Bases, and Mast Bracket Arms.{ XE "Electrical materials:pedestals" }{ XE "Electrical materials:poles" }{ XE "Electrical materials:transformer bases" }{ XE "Electrical materials:mast bracket arms" }

Pedestals, poles, transformer bases, and mast bracket arms for traffic signal and highway lighting shall be fabricated with materials according to the appropriate ASTM Standard. The items shall also be manufactured in conformance with the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. All welds shall be made by welders certified as prescribed in Section IX of the ASME Boiler and Pressure Vessel Code. Copies of the certifications shall be presented upon request. The items shall be manufactured under a quality control program that conforms to the General Requirements for a Quality Program of the American Society for Quality Control.

Aluminum poles, lighting, bracket arms, and traffic signal mast arms shall have a rotary, sand-polish finish giving a nonreflecting outer surface. The external surfaces of the transformer bases and shoe bases shall have a satin-type finish. Steel poles and steel traffic signal arms shall be hot-dip galvanized according to ASTM A 123.

Where wire or cable passes through a hole or runs along a surface at any point, through or on the complete assembly, such holes and surfaces shall be deburred and void of any sharp edges or protuberances that may in any way damage the wire or cable. Rubber grommets shall be provided and installed in the entrance hole to the shaft and mast arms where mid-mounted traffic signals are installed.

All hardware, bolts, nuts, and washers used in the installation of the aluminum traffic signal standards shall be stainless steel. Hardware used for steel traffic signal standards shall conform to Specifications for Steel Bars, Carbon, Hot Wrought, Special Quality Mechanical Properties, Grade 90, and shall be galvanized according to ASTM A 153. Bolts shall conform to ASTM F 738M. Leveling nuts shall conform to ASTM F 836M.

Standards and mast bracket arms shall be tested by the manufacturer to ensure compliance with specified material and strength requirements. The testing shall also ensure that the items have been manufactured in conformance with the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. Five copies of the certification stipulating that the items meet the strength and material requirements shall be submitted.

All aluminum poles and mast bracket arms shall be factory wrapped to protect them during shipment.

Fabrication operations for aluminum alloy structures not specifically covered in these Specifications shall be according to Section 10, ANSI/AWS D1.2 for Class 1 structures.

906.16 Photoelectric Controls.{ XE "Electrical materials:photoelectric controls" }

Photoelectric controls shall be rated for the control or lighting circuit voltage indicated. Mounting hardware shall be provided to allow the unit to be installed in whatever type of location is indicated, and the mounting shall conform to the EEI-NEMA Standards for physical and electrical interchangeability of light sensitive control devices.

906.17 Resin Splicing Kits.{ XE "Electrical materials:resin splicing kits" }

A. Traffic Signals. Resin splicing kits shall be of a type having a soft plastic sealing packet. The resin splicing kits shall meet or exceed the conductor's insulation voltage rating.

B. Highway Lighting. Resin splicing kits shall be of a type having a rigid molded plastic casing. The casing shall be capable of being split laterally to allow insertion of the conductors. The resin splicing kits shall meet or exceed the conductor's insulation voltage rating and be suitable for use with the insulation material.

906.18 Traffic Signal Cable.{ XE "Electrical materials:traffic signal cable" }

Traffic signal cable shall conform to Subsection 906.03 and to the New Jersey Electrical Materials Specification EBMC-TS-CABLE. Only one type of traffic signal cable will be permitted on the Project.

906.19 Sampling and Testing Methods.{ XE "Electrical materials:sampling and testing" }

{ XE "Samples for:electrical materials" **}**Electrical materials, components, and assemblies shall be subject to job site inspection.

906.20 Certification of Compliance.

Manufacturer's certification for all materials, components, and assemblies shall be submitted according to Subsection 106.04.

SECTION 907 - FENCE{ XE "FENCES AND FENCE MATERIAL" }

907.01 Barbed Wire.{ XE "Fences and fence material:barbed wire" }

Barbed wire shall conform to ASTM A 121.

907.02 Chain-Link Fence.{ XE "Fences and fence material:chain-link" }

Chain-link fence shall conform to AASHTO M 181 and the following:

1. Carriage bolts with elastic stop nuts shall be zinc coated by the electroplating process and shall be Type SC-1 conforming to ASTM B 633.
2. PVC coated fabric shall also be zinc coated with the weight as specified for extruded type.
3. Gate fabric shall be the same material used in the adjacent fence.
4. Gate locking devices, stops, and keepers may be ductile iron, galvanized malleable iron, or steel except plunger bars may be tubular or bar steel.
5. Posts, rails, wire fabric ties, stretcher bars, and railing and post sleeves for chain-link fence on bridges shall be Alloy 6061-T6.
6. Aluminum-coated steel posts shall be used with aluminum-coated steel fabric.
7. Aluminum alloy or aluminum-coated steel rails, ties, bands, bars, rods, and other fittings and hardware shall be used with aluminum-coated steel fabric.
8. Color for the PVC coated fabric, posts, fasteners, and other appurtenances shall be brown, as matching color chip number 20059 of FED-STD 595B.
9. Materials for chain-link fence fabric, vinyl clad shall comply with RR-F-191/1D, Type IV. Fabric shall be composed of individual wire pickets helically wound and interwoven from number 9 gauge galvanized coated steel wire to form a continuous chain-link fabric having a 2-inch mesh. Top and bottom selvages shall have a knuckle finish.

   Vinyl coating shall be plasticized polyvinyl chloride (PVC) with suitable non-migratory low temperature plasticizer.

   Color shall be stabilized and shall withstand a minimum weather-ometer exposure test of 1,000 hours without visible fading or discoloration.

   The vinyl covered wire shall withstand an accelerated aging test of a minimum of 2,000 hours at 145 ºF without any cracking or peeling. The vinyl clad chain-link fabric shall withstand a mandrel bend test (10 x 0.0 on wire at –58 ºF) without cracking.

   The vinyl coating shall be of a self-extruding character and have a compression cut-through of 1,800 psi (Bell Laboratory Test). The vinyl covering shall, in addition, resist attack from prolonged exposure to:

   a. sea water at 100 ºF.
   b. salt solutions: $CaCl_2$, NH_4CL, NH_4NO_3, NACl, $CuCl_2$, $CuSO_4$, $ZnCl_2$, $SNCl_2$, KCl, and others.
   c. alkalis: sodium, magnesium, calcium, barium, ammonium, and hydroxide.
      acids: dilute sulfuric, nitric, hydrochloric, acetic, boric, carbonic, and citric.
   d. petroleum products, mineral oils, and fats.
   e. fungus inducing atmospheres.

   Top and bottom tension wire shall be 6 gauge vinyl clad wire conforming to the requirements specified herein for vinyl clad fabric.

   All fittings and appurtenances shall be pressed steel coated with matching vinyl (PVC) by the thermal-fusion bond process.

   Line, corner and terminal posts, and brace rails shall be resin clad with epoxy modified polyvinyl chloride, continuously chemically bonded to heated standard weight ASTM A 53, Schedule 40 steel pipe. The coating shall have a thickness of not less than 10 mils.

   The resin shall have a minimum adhesion of 3,500 psi to the steel substrate, have a compressive strength of 12,000 psi, and shall withstand an impact test of a 8-pound steel ball from 6 feet height. The resin shall be non-flammable and self-extinguishing, and shall withstand minimum outdoor weathering of 20,000 hours south of the 30^{th} parallel. The protective resin shall exhibit a chemical resistance (minimum of two years) at 73 ºF to 50 percent sulfuric acid, 50 percent hydrochloric acid, 25 percent acetic acid, 10 percent nitric acid, saturated sodium hydroxide, gasoline, fuel oil, toluene, sodium chloride, and calcium chloride.

   All materials shall be uniform in quality and temper. Exterior and interior surfaces shall be clean, smooth, and free from slivers, laminations, grooves, cracks, or other defects.

When handling vinyl clad materials in the shop and in the field, every precaution shall be taken to avoid scoring or marring of the surfaces. Any such scoring or marring, sufficient in the opinion of the Engineer to give an objectionable appearance, shall be cause for rejection of the material.

Chain-link fence fabric, rails, posts, and appurtenances shall be produced by methods recognized as good commercial practice. Roughness, blisters, spots, bruises, and discoloration shall be noted. These other obvious defects, if present to any considerable extent, shall provide a basis for rejection.

907.03 Chain-Link Farm-Type Fence.{ XE "Fences and fence material:chain-link:farm-type" }

The materials for chain-link farm-type fence shall conform to AASHTO M 181.

907.04 Snow Fence.{ XE "Fences and fence material:snow fence" }{ XE "Snow:fence" }

The materials for snow fence shall conform to the following:

1. Wires for snow fence shall be stay-cable type, with a diameter of not less than 12½ gauge. All wires making up the stay-cables shall be galvanized snow fence wire.
2. Wooden pickets for snow fence shall be made from cedar, spruce, maple, or other satisfactory species of wood and shall be unpainted. The pickets shall be free from knots greater than one-half the diameter of the width of the pickets supplied.
3. Fabric for plastic snow fence shall be made from high density polyethylene. The fabric shall have a minimum tensile strength of 5,000 pounds per square inch when tested according to ASTM D 648. The fabric shall be blaze orange in color and be ultraviolet stabilized.
4. Posts shall be made of high carbon steel and be a flanged leg channel section or flanged leg U-bar section having a uniform thickness of metal of not less than ⅛ inch or shall be other section of equal strength. The posts shall weigh not less than 2 pounds per linear foot, exclusive of ground plate and shall be so designed that the posts can be driven easily into the ground. Each post shall be equipped with not less than eleven riveted lugs. Posts shall not be equipped with punched or welded lugs. Posts shall be galvanized.

907.05 Sampling and Testing Methods.{ XE "Samples for:fence" }{ XE "Fences and fence material:sampling and testing" }

Sampling and testing will be performed according to AASHTO M 181.

907.06 Certification of Compliance.

Mill certification for fence materials shall be submitted according to Subsection 106.04.

SECTION 908 - JOINT MATERIALS{ XE "JOINT MATERIALS" }

908.01 Preformed Expansion Joint Filler.{ XE "Joint materials:preformed expansion joint filler" }

Preformed fillers for joints shall conform to AASHTO M 33, AASHTO M 153 Type II, and AASHTO M 213 and shall be punched to admit the dowels. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint. When the use of more than one piece is authorized for a joint, the abutting ends shall be fastened securely, and held accurately to shape by stapling or other positive fastening.

The use of preformed, closed-cell, polyethylene foam backer rod joint filler shall conform to ASTM D 3204, Type I and shall be limited to vertical applications only.

908.02 Joint Sealers.{ XE "Joint materials:joint sealers" }

Hot-poured joint sealer for joints and cracks in both HMA and portland concrete surface course shall be a low modulus rubberized asphalt conforming to Subsections 908.06, 908.07, and AASHTO M 301 with one of the following:

Cone penetration, Non-Immersed:	Shall be between 90 – 150
Flow:	Shall be 3.0 mm maximum
Resilience:	Recovery shall be a maximum 60%
Bond Test:	Shall conform at 200% extension

Cold-poured joint sealant shall be silicone type conforming to ASTM D 5893 except that ultimate elongation shall be a minimum of 1,200 percent.

The use of low-modulus silicon rubber or polyethylene base sealers shall be limited to vertical applications and shall conform to ASTM D 5893 with a minimum ultimate elongation of 600 percent. A primer shall be used in the application when recommended by the manufacturer.

Backer material (backer rod) used in conjunction with cold and hot-applied joint shall conform to ASTM D 5249, Type 1. The width of the backer rod shall be at least 25 percent greater than the width of the pavement joint or crack. The backer rod shall be clean, free of dirt, oil, and moisture.

908.03 Preformed Elastomeric Joint Sealer (Compression Type).{ XE "Joint materials:preformed elastomeric joint sealer" }{ XE "Tables:preformed elastomeric joint sealer" }

A. Requirements. Sealers shall be preformed and manufactured from vulcanized elastomeric compound using polychloroprene (neoprene) as the only base polymer. The material shall conform to the physical properties in Tables 908-1 and 908-2 below.

Table 908-1 Tests for Identification

Property	ASTM Test Procedure	Physical Requirements
Tensile strength, minimum psi (kg/cm^2)	D 412	2,000 (141)
Elongation at break, minimum %	D 412	250
Hardness, Type A durometer (Test made with durometer in durometer stand)	D 2240	55 ± 5
Permanent set at break, maximum %	D 412	10
Oven or heat aging, 70 hours at 212 ºF	D 573	
Tensile strength, change maximum %		+10 to -20
Elongation, change maximum %		-20
Hardness, Type A durometer, points change		0 to +10
Ozone resistance 20% strain, 300 pphm in air, 70 hours at 104 ºF(40 ºC) (Wipe with solvent to remove surface contamination)	D 1149	No Cracks
Oil swell, ASTM oil No. 3, 70 hours at 212 ºF, Weight change, maximum %	D 471	+45

Table 908-2 Tests for Qualification

Property	Section 990 Test Procedure	Physical Requirements
High temperature recovery 70 hours at 212 ºF, ± 1.8 ºF, under Z% of nominal width	NJDOT J-2	85% minimum (no cracking or sticking)
Low temperature recovery 72 hours at 14 ºF under 50% of nominal width	NJDOT J-2	88% minimum (no cracking or sticking)
Low temperature recovery 22 hours -20 ºF under 50% of nominal width	NJDOT J-2	83% minimum (no cracking or sticking)
Pressure deflection at 80% of nominal width and at 73 ± 1.1 ºF minimum contact unit pressure	NJDOT J-2	3.5 psi

The limit of safe compressibility, an inherent characteristic of each sealer, is the borderline between closure of essentially all of the air voids and the beginning of solids compression and is indicated on the pressure-deflection curve by rapid and considerable increase of pressure.

At the limit of safe compressibility, the ratio of the sealer width to its nominal width multiplied by 100 shall be less than or equal to a value "Z." "Z" (percent) is the maximum permitted degree of sealer compression used in the joint sealing design and shall be calculated as follows:

$$Z\ (\text{percent}) = \frac{\text{Minimum Sealer Width}}{\text{Nominal Sealer Width}} \times 100$$

The value of "Z" (percent) shall be not more than 50.

The ratio of compression sealer height to width shall never be less than one. The accepted width and height of a sealer shall be not less than nominal; the height of a sealer may be in excess of nominal but by not more than ¼ inch. The dimensional tolerances shall be determined on the basis of the limit of safe compressibility of sealers.

The minimum contact unit pressure at 80 percent of nominal width for all sizes of bridge sealers shall be not less than 3.5 pounds per square inch on the return side of the third successive test run or cycle of the pressure deflection test. The amounts of contact unit pressure (psi) are based on the actual measured length (6 inches) and height (h) of the sealer's test sample; they shall be established on the basis of three successive test runs or cycles, performed on the compression testing machine conforming to ASTM E 4. The contact unit pressure shall be calculated as follows:

$$\text{Unit Pressure (psi)} = \frac{\text{Total Force}}{\text{Actual Contact Area}} = \frac{\text{Total Force}}{6.0 \times \text{Height (inches)}}$$

If splicing of a sealer is unavoidable, the sealer at the splice point shall have no significant misalignment at its sides or top. A misalignment at the bottom not to exceed half of the bottom wall thickness will be permitted.

At the sealer's place of manufacture, each sealer splice shall be subjected to the 180-degree bend test described in Section 990, NJDOT J-2. The same test will be performed at random at stockpile locations or construction sites.

{ XE "Samples for:joint materials" **}B. Sampling.** A lot shall consist of a quantity represented by not more than one day's production of each cross-section and size of sealer.

Samples will be taken at random from each lot at least three weeks in advance of the product's delivery to the Project.

In instances of stockpiling, samples will be taken at random from every lot.

The minimum lengths of samples for testing purposes shall be according to Table 908-3. In all tests, the material to be tested shall be furnished from standard production.

The supplier may elect to have the sealer sampled and inspected according to one of the following:

1. **Sampling of Stockpiles.** The supplier will be permitted to stockpile only upon receipt of written approval. A representative from the Department will sample each lot and size for acceptance testing and the sample will be marked for identification with the representative's seal. Shipment to the Project will be permitted only after approval. The Department shall be notified by the supplier of the lot number and quantity shipped to the Project so that an inventory can be maintained.
2. **At the Project Site.** The Contractor shall notify the Engineer when the sealer has arrived at the Project. Shipment shall be made to allow at least three weeks for sampling and testing prior to the sealer being incorporated into the Project. The supplier shall ensure that each lot and size shipped includes sufficient length for testing according to Table 908-3.
3. **Manufacturer's Submission.** The manufacturer shall submit, for each lot and size of material, the required length, plus an extra 4 inches, for testing according to Table 908-3 below. The sealer from which the sample is taken shall be marked to indicate from which end the test piece was cut. The extra 4 inches of the submitted sample is to be cut from the marked end of the sample and, after approval by the Department Laboratory, will be taken to the Project site and matched to the end of the length sent to the Project. Upon verification that the cut ends match, the material will be approved for use.

Table 908-3 Minimum Lengths of Samples for Testing{ XE "Tables:joint materials:preformed elastomeric joint sealer:minimum lengths of samples for testing" }

Sealer Size Width	Minimum Length
Less than 2"	84"
Less than 3" to 2" inclusive	66"
Less than 4" to 3" inclusive	50"
4" and larger	42"

C. Acceptance Testing. The acceptance testing of the preformed elastomeric joint sealer is based on the following:

1. Preformed elastomeric compression sealers shall not be installed before approval.
2. In new construction, field splicing of sealers will not be permitted. For reconstruction projects, field splices may be permitted. In such case, splicing shall be accomplished through vulcanization or as specified below for factory bonding.
3. If shop splicing of sealer is unavoidable, splicing shall be accomplished either through factory vulcanization or through cold- cured factory bonding using a high-strength rapid-bonding adhesive.

D. Certification. Manufacturer's name or trademark and lot number shall be marked on the joint sealer itself to identify each shipment and shall be accompanied by the manufacturer's certification indicating conformance to the test requirements including the value of "Z" (percent) and 180-degree bend tests results. The certification shall be furnished according to Subsection 106.04, except that the sample shall be submitted directly to the Department Laboratory with a copy of the certification.

908.04 Reinforced Elastomeric Expansion Dam.{ XE "Joint materials:reinforced elastomeric expansion dam" }{ XE "Tables:joint materials:reinforced elastomeric expansion dam" }

A. Scope. This specification covers the material requirements for preformed elastomeric sealing products to be used in bridge deck expansion joints with the base polymer being as stipulated below. The requirements for other components of an expansion dam are also provided.

B. Elastomeric Sealer Requirements. Sealers shall be preformed and manufactured from vulcanized elastomeric compound using polychloroprene (neoprene) as the only base polymer. The material shall conform to the physical properties prescribed in Table 908-4 below.

Table 908-4 Tests for Identification

Property	ASTM Test Procedure	Physical Requirements
Tensile strength, minimum psi (kg/cm^2)	D 412	2,000 (141)
Elongation at break, minimum %	D 412	350
Hardness, Type A durometer (Test made with durometer in durometer stand)	D 2240	55 ± 5
Permanent set at break, maximum %	D 412	10
Oven or heat aging, 70 hours at 212 ºF	D 573	
Tensile strength, change maximum %		+10 to -20
Elongation, change maximum %		-20
Hardness, Type A durometer, points change		0 to +10
Ozone resistance 20% strain, 300 pphm in air, 70 hours at 104 ºF(40º) (Wipe with solvent to remove surface contamination)	D 1149	No Cracks
Oil swell, ASTM oil No. 3, 70 hours at 212 ºF, Weight change, maximum %	D 471	+45

C. Metal Components and Sealant. Reinforcement metal embedded in the elastomeric dam shall be steel. The sealant, which shall be furnished by the elastomeric dam manufacturer, shall conform to Federal Specification TT-S-00230C(2). Any filler material used to fill the voids and cavities between the dam and the bridge deck blockout for water tight purposes shall be furnished as recommended by the dam manufacturer.

D. Shop Splicing. If shop splicing of a sealer is unavoidable, the sealer at the splice point shall have no significant misalignment at its sides or top.

E. Sampling. A lot shall consist of a quantity represented by not more than one day's production of each cross-section and size of elastomeric sealer component of an expansion dam.

Samples will be taken at random from each lot at least three weeks in advance of the product's delivery to the Project.

In instances of stockpiling, samples will be taken at random from every lot. The minimum lengths of samples for testing purposes shall be 2 feet. In all tests, the material to be tested shall be furnished from standard production.

A 1-quart sample of sealant to be used with the expansion dam shall be submitted along with the elastomeric sealer specimens.

F. Acceptance Testing. Reinforced elastomeric expansion dams shall not be installed before securing approval of the material from the Department Laboratory.

The acceptance testing of the preformed elastomeric sealer component is based on the following:

1. Field splicing of sealers will not be permitted unless such splicing is designated.
2. If splicing of sealer is so designated, splicing shall be accomplished either through vulcanization or through cold-cured bonding using a high-strength rapid-bonding adhesive.

G. Certification. Manufacturer's name or trademark and lot number shall be marked on the joint sealer itself to identify each shipment and shall be accompanied by the manufacturer's certification indicating conformance to the test requirements including the 180-degree bend test results.

The certification shall be furnished according to Subsection 106.04 except that the samples shall be submitted directly to the Department Laboratory with a copy of the certification.

908.05 Strip Seal Expansion Dam{ XE "Joint materials:strip seal expansion dam" }.

A. Bolt Down Type Strip Seal.

1. Scope. This specification covers the material requirements for bolt down type strip seal deck joint systems consisting of fabric reinforced expansion sealers held in place with either retainer plates or steel reinforced elastomeric retainer blocks.

2. **Elastomeric Sealer Requirements.** Sealers shall be preformed and manufactured from vulcanized elastomeric compound using polychloroprene as the only base polymer. The material shall conform to the physical properties and requirements prescribed in Subsection 908.04.

3. **Metal, Sealant, and Fabric.** The elastomeric material shall be integrally molded to fabric reinforcement. Fabric used for reinforcement in a seal element shall be a non-wicking fabric conforming to the requirements of ASTM D 578.

   The sealant, which shall be furnished by the elastomeric dam manufacturer, shall conform to Federal Specification TT-S-00230C(2). Any filler material used to fill the voids and cavities between the dam and the bridge deck blockout for water tight purposes shall be furnished as recommended by the dam manufacturer.

   Structural steel shall conform to the requirements of ASTM A 36 galvanized according to AASHTO M 111.

   Nuts and washers shall conform to the requirements of ASTM A 307 and A 36, respectively, and shall be galvanized according to AASHTO M 111.

   Stainless steel threaded studs shall conform to the requirements of ASTM A 276, Type 304. Stainless steel nuts and washers shall conform to the requirements of ASTM A 320, Grade B.

   Anchor bolts shall conform to the requirements of ASTM A 36 and shall be hot-dip galvanized after fabrication, including threading, according to the requirements of ASTM A 153.

4. **Sampling, Acceptance, and Certification.** Sampling shall be according to Subsection 908.04, Subpart E. Acceptance shall be according to Subsection 908.04, Subpart F. Certification shall be according to Subsection 908.04, Subpart G.

{ XE "Tables:joint materials:strip seal expansion dam" **}B. Glandular Type Strip Seal**.

1. **Scope.** This specification covers the material requirements for glandular type strip seal deck joint systems consisting of a molded neoprene rubber gland seal mechanically locked in the cavities of two parallel steel rail sections. In addition, the system consists of accompanying steel plates and concrete anchors consisting of studs, steel plates, and/or reinforcement steel which are welded to the steel rail sections.

   The product shall be capable of accommodating the full range of movement as prescribed on the plans and shall provide a watertight seal in all positions within the movement range.

2. **Neoprene Rubber Gland Requirements.** The sealing gland shall be an extruded synthetic rubber utilizing polychloroprene (neoprene) as the only base polymer. The sealing gland shall have locking lugs that interlock physically with the two steel rail sections.

   The material shall conform to the following physical properties:

Table 908-5 Tests for Identification

Property	ASTM Test Procedure	Physical Requirements
Tensile strength, minimum psi (kg/cm^2)	D 412	2,000 (141)
Elongation at break, minimum %	D 412	250
Hardness, Type A durometer	D 2240	60 ± 5
Oven aging, 70 hours at 212 ºF	D 573	
Tensile strength loss, maximum %		20
Elongation loss, maximum %		20
Hardness, Type A durometer, points change		0 to +1
Ozone resistance 20% strain, 300 pphm in air, 70 hours at 104 ºF (40 ºC)	D 1149	No Cracks
Oil swell, ASTM oil No. 3, 70 hours at 212 ºF, Weight change, maximum %	D 471	+45

   a. **Tension and Elongation Test.** A 2-foot long specimen shall be subjected to a tension test to failure.

      Under an applied tension force, the neoprene gland shall be capable of stretching across a gap between extrusions of at least 9½ inches and shall be capable of withstanding a force equal to 90 pounds per inch disengaging from the grooves at any

point along the length of the specimen or exhibiting signs of failure such as tearing or rupturing.

3. **Metal Components and Adhesive.** Steel rail sections shall conform to AASHTO M 270, Grade 36 or Grade 50W. Steel for plates, shapes, and other structural steel used in the deck joint system shall conform to AASHTO M 270, Grade 36. The entire joint system shall be hot-dip galvanized after fabrication according to AASHTO M 111.

   End-welded studs shall conform to the requirements of Subsection 503.10.

   Steel anchors shall be deformed bars conforming to ASTM A 615 - 96a, Grade 60.

   The lubricant/adhesive used for installing and bonding the neoprene strip seal gland in the cavity of the parallel steel rail sections shall be a one-part, moisture-curing polyurethane and hydrocarbon solvent having the following physical properties:

   Average weight per gallon ..... 8 pounds ± 10 percent
   Solids content by weight ..... 65 percent
   Material shall be fluid from ..... 5 to 120 ºF
   Film strength (ASTM D 412) ..... 2,000 pounds per square inch (minimum)
   Elongation ..... 250 percent (minimum)

4. **Sampling, Acceptance, and Certification.** Sampling shall be according to Subsection 908.04, Subpart E.

   Acceptance testing of the strip seal gland shall be according to Subsection 908.04, Subpart F.

   Certification of the strip seal deck joint system shall be according to Subsection 908.04, Subpart G. In addition, the manufacturer shall certify that the specimen used in the tension and elongation test is representative of the product which will be used on the Project with respect to its size, material components, dimensional tolerances, and overall workmanship.

908.06 Sampling and Testing Methods.{ XE "Joint materials:sampling and testing" }

Sampling and testing will be performed according to the following:

Preformed expansion joint filler ..... 3-foot length from each lot
Joint sealers:
  Hot-poured rubber asphalt ..... 10 pounds from each lot
  Cold-applied ..... 1 quart from each lot
Preformed elastomeric joint sealer ..... Subsection 908.03
Reinforced elastomeric expansion dam ..... Subsection 908.04
Strip Seal Expansion dam ..... Subsection 908.05

908.07 Certification of Compliance.

Manufacturer's certification for joint sealer shall be submitted according to Subsection 106.04. Manufacturer's certification for preformed elastomeric joint sealer, reinforced elastomeric expansion dam, and strip seal expansion dam shall be submitted according to Subsections 908.03, 908.04, and 908.05, respectively.

SECTION 909 - LANDSCAPING MATERIALS{ XE "LANDSCAPING MATERIALS" }

909.01 Binders.{ XE "Landscaping materials:binders" }

Binders for mulch shall be one of the following:

1. Emulsified asphalt, Grades CSS-1, CSS-1h, SS-1, or SS-1h conforming to Subsection 904.03.
2. Fiber mulch made from wood or plant fibers containing no growth or germination inhibiting materials.
3. Synthetic plastic emulsion shall be miscible with all normally available water when diluted to any proportions. After drying, the synthetic plastic binder shall no longer be soluble or dispersible in water but shall remain tacky until the grass seed has germinated. The plastic binder shall be physiologically harmless and shall not have phytotoxic or crop-damaging properties.
4. Vegetable based gels which can be classified as naturally occurring powder-based hydrophilic additives formulated to provide gels, which, when applied under curing conditions shall form membrane networks of water insoluble polymers. The vegetable gel shall be physiologically harmless and shall not have phytotoxic or crop-damaging properties.

909.02 Fertilizer.{ XE "Landscaping materials:fertilizer" }{ XE "Fertilizer" }

Fertilizer for establishing turf shall have a commercial designation of 10-20-10 or any 1-2-1 ratio fertilizer containing a minimum five percent nitrogen, ten percent available phosphoric acid, and five percent soluble potash.

If the fertilizer is to be applied with mechanical spreader in the dry form, a minimum of 75 percent shall pass a No. 8 sieve and a minimum of 75 percent shall be retained on a No. 16 sieve, and the maximum free moisture content shall be two percent.

Fertilizer for establishing sod shall be any 1-2-2 ratio fertilizer containing a minimum of five percent nitrogen, ten percent available phosphoric acid, and ten percent soluble potash.

Each delivery of fertilizer shall be accompanied by a delivery slip showing the weight and a certified chemical analysis of the composition of the fertilizer.

909.03 Limestone, Pulverized.{ XE "Landscaping materials:limestone, pulverized" }{ XE "Limestone, pulverized" }

Pulverized limestone shall be composed of not less than 85 percent calcium and magnesium carbonates to not less than 40 percent calcium and magnesium oxides.

Each delivery of pulverized limestone shall be accompanied by a delivery slip indicating its weight and certified analysis of its chemical composition and gradation, including calcium and magnesium oxide equivalents, which shall be furnished at the time of delivery.

909.04 Mulch.{ XE "Landscaping materials:mulch" }{ XE "Mulch" }

Straw shall be stalks of oats, wheat, rye, or barley relatively free from seeds, noxious weeds, and other foreign material.

Wood cellulose fiber shall consist of wood cellulose fibers having no growth or germination inhibiting materials.

Shredded wood mulch shall be produced by a shredding machine that produces a wood particle varying in size from ⅝ to 3 inches.

Wood chip mulch shall be produced by a wood chipping machine which produces a wood particle varying in size from ⅝ to 3 inches.

Shredded wood mulch and wood chip mulch shall not be decomposed and shall be clean and hard and shall not contain leaves, twigs, wood shavings, dirt, stones, toxic material, or other foreign material. The source of the material shall not be wood pallets, chemically treated wood, or materials from building demolition. The pH shall be above 3.0.

Selected wood chips produced from clearing operations that are reasonably in conformance with the above are acceptable.

Samples of shredded or wood chip mulch shall be submitted for approval before delivery to the Project. Visual inspection of each shipment of shredded or wood chip mulch will be made upon delivery to the Project.

Shredded hardwood bark mulch shall be derived from the bark of hardwood trees and shall be twice shredded to a fine texture. It shall not contain leaves, twigs, wood shavings, dirt, stones, weed seeds, toxic material, or other foreign material.

Each shipment of shredded or wood chip mulch and shredded hardwood bark mulch shall be accompanied by a delivery slip, furnished at the time of delivery, and a certification. This certification shall include a statement to the effect that the material was not derived from wood pallets, chemically treated wood, or material from building demolition.

Stone shall be coarse aggregate, approximately size No. 4, conforming to Subsection 901.04. Sample shall be submitted for approval of size and color.

Gravel shall be uncrushed washed gravel, approximately size No. 4, conforming to Subsection 901.05. Sample shall be submitted for approval of size and color.

909.05 Plant Materials.{ XE "Landscaping materials:plant materials" }{ XE "Plant materials,landscape" }

Plant materials shall be trees, shrubs, vines, seedlings, ground covers, and plants of all descriptions conforming to the American Standard for Nursery Stock sponsored by the American Association of Nurserymen, Inc. Hortus III shall be the authority for all plant names. They shall be healthy and vigorous, with well-developed branch and root systems, and shall be free from disfiguring knots and gall, sun scald injuries, bark abrasions and other objectionable disfigurements. Plant materials that are weak and thin or which have been cut back from larger grades to meet certain specified requirements will not be accepted. Bulbs, corms, and tubers shall be firm and free of rot disease. All plant materials shall conform to State and Federal laws relating to inspection for diseases and infestation, and inspection certificates shall be filed with the Engineer.

Alternates for unavailable plant materials may be permitted according to the following conditions:

The Contractor shall supply written verification to the Resident Engineer and NJDOT Landscape & Urban Design that an attempt was made to locate the contract item at a minimum of six different nursery sources that would normally supply the item and found that item to be unavailable for planting before the project completion date. All substitutions shall be submitted for approval.

Plant materials shall also conform to the following:

{ XE "Tables:landscape:ball sizes of nursery grown plant material" **}1. Ball Sizes for Nursery Grown Plant Material.** The ball sizes of nursery grown trees and shrubs shall conform to the following tables:

{ XE "Tables:landscape:ball sizes of nursery grown plant material" **}Shade Trees**

Caliper (inches)	Minimum Diameter (inches)
½ - ¾	12
¾ - 1	14
1 - 1 ¼	16
1 ¼ - 1 ½	18
1 ½ - 1 ¾	20
1 ¾ - 2	22
2 - 2 ½	24
2 ½ - 3	28
3 - 3 ½	32
3 ½ - 4	38
4 - 4 ½	42
4 ½ - 5	48
5 - 5 ½	54

Deciduous Shrubs

Height (feet)	Minimum Diameter (inches)
1 - 1 ½	8
1 ½ - 2	9
2 - 3	10
3 - 4	12
4 - 5	14
5 - 6	16
6 - 7	18
7 - 8	20
8 - 9	22
9 - 10	24
10 - 11	26

{ XE "Tables:landscape:ball sizes of nursery grown plant material" }**Small Trees**

Height (feet)	Minimum Diameter (inches)
1½ - 2	10
2 - 3	12
3 - 4	13
4 - 5	15
5 - 6	16
6 – 7	18
7 – 8	20
8 – 9	22
9 – 10	24
10 - 12	26

Caliper (inches)	Minimum Diameter (inches)
¾ - 1	16
1 - 1 ½	18
1 ½ - 1 ¾	20
1 ¾ - 2	22
2 - 2 ½	24
2 ½ - 3	28
3 - 3 ½	32
3 ½ - 4	38
4 - 4 ½	42
4 ½ - 5	48
5 - 5 ½	54

{ XE "Tables:landscape:ball sizes of nursery grown plant material" }**Columnar Conifers**

Regular Growing Type

Height (feet)	Minimum Diameter (inches)
1 - 1½	10
1 ½ - 2	10
2 - 3	12
3 - 4	13
4 - 5	14
5 - 6	16
6 - 7	18
7 - 8	20
8 - 9	22
9 - 10	24
10 - 12	27
12 - 14	30
14 - 16	33
16 - 18	36
18 - 20	40

Rapid Growing Type

Height (feet)	Minimum Diameter (inches)
1 - 2	8
2 - 3	9
3 - 4	11
4 - 5	12
5 - 6	14
6 - 7	16

{ XE "Tables:landscape:ball sizes of nursery grown plant material"
}Conifers and Broadleaf Evergreens

Spreading, Semi-Spreading, and Globe or Dwarf Type		Conical and Broad Upright Type	
Height (feet)	**Minimum Diameter (inches)**	**Height (feet)**	**Minimum Diameter (inches)**
¾ - 1	8	1 ½ - 2	10
1 - 1 ¼	9	2 - 3	12
1 ¼ - 1 ½	10	3 - 4	14
1 ½ - 2	10	4 - 5	16
2 - 2 ½	12	5 - 6	20
2 ½ - 3	14	6 - 7	22
3 - 3 ½	16	7 - 8	24
3 ½ - 4	18	8 - 9	27
4 - 5	21	9 - 10	30
5 - 6	24	10 - 12	34
6 - 7	28	12 - 14	38
7 - 8	32	14 - 16	42
8 - 9	36	16 - 18	46
		18 - 20	50

{ XE "Tables:landscape:ball sizes of nursery grown plant material" **}Container Plants**

Container	Minimum Diameter (inches)	Minimum Depth (inches)
4"	4	4
#1	7	7
#2	8	9
#3	10	10
#5	11	10
#7	12	14
#10	15	15
#15	17	15

For Hemerocallis, plants shall be received in #SP5 containers according to the Supplier's practice for each individual cultivar, and shall conform to the American Standard for Nursery Stock sponsored by the American Association of Nurserymen, Inc. An established plant shall be a 1-2 fan division with a heavy root system transplanted to and grown in the same container for a sufficient period of time so that new fibrous roots to have developed so that the root mass will retain its shape and hold together when removed from the container.

For perennials, plants shall be received in #1 containers according to the Supplier's practice for each individual cultivar, and shall conform to the American Standard for Nursery Stock sponsored by the American Association of Nurserymen, Inc. An established plant shall be a single species plant transplanted into and grown in the same container for a sufficient period of time so that new fibrous roots to have developed so that the root mass will retain its shape and hold together when removed from the container.

For Narcissus, bulbs shall be received as DNII or RDII, minimum (large size grade according to American Standard for Nursery Stock).

{ XE "Trees:and shrubs" **}2. Ball Sizes for Collected Trees and Shrubs.** The ball sizes of collected trees and shrubs shall be equal to that specified for the next larger size for nursery grown trees and shrubs.

All trees grown in plantations or reforestation plantations, or trees that have been grown without the benefit of root pruning, shall be considered collected material and shall be balled accordingly.

3. Ball Depths. Balls shall be of sufficient depth to encompass the fibrous and feeding root system necessary for the full recovery of the plant and shall conform to the following requirements:

Diameter of ball, inches	Up to 20	Over 20 to 30	Over 30 to 48
Minimum depth of ball, percentage of diameter	75	67	60

These dimensions may vary according to site and type of plant material as provided in the American Standard for Nursery Stock**.**

4. Collected Plant Material. Collected or salvaged plant material shall be confined to specific items as indicated.

{ XE "Inspection:of plant materials" **}5. Inspection.** Plant materials may be inspected where they are growing. Certain items selected will be marked with a seal furnished by the Department. The plant materials will be inspected upon arrival at the site of the Project. Notice shall be given not less than 24 hours before the material is to be on the Project. Materials arriving with broken seals, broken or loose balls, insufficient protection, or which have been damaged in transit will not be accepted. Random inspection of the root system of the plant material may be made by the Engineer by breaking open the earth balls. Necessary assistance shall be given when inspections are made.

6. Shipment. All bare root materials shall be completely dormant when they are dug. Immediately before shipment, plant materials shall be dug with care to prevent injury to fibrous roots. Plant material marked B&B shall be balled and burlapped.

The following plant material shall be drum laced or machine dug with wire baskets:

a. Shade trees - 1¼ inch caliper and larger.
b. Small trees - 1½ inch caliper and larger.
c. Columnar conifers - 6 feet and taller.
d. Spreading, semi-spreading, and globe or dwarf type conifers - 3 feet – 6 inches in diameter and larger.
e. Conical and broad upright type conifers - 5 feet and taller.
f. Spreading, semi-spreading, and globe or dwarf type broadleaf evergreens - 3 feet – 6 inches spread and larger.
g. Conical and broad upright type broadleaf evergreens - 3 feet – 6 inches and taller.

Materials used for burlapping and tying shall be biodegradable. Nonbiodegradable materials such as plastic or nylon shall not be used.

Material that is shipped in open vehicles shall be thoroughly protected from drying out due to exposure to the wind and sun. Material shipped in enclosed vans or boxcars shall be adequately ventilated. Each shipment shall be accompanied by an invoice giving the date and origin of shipment, the botanical names, sizes, grades, and the quantities of plants. A copy of the invoice shall be furnished at the time of delivery.

For Hemerocallis and perennials, containers shall be accompanied by a delivery ticket and a certification by the Supplier listing the botanical name and type of the Hemerocallis or perennial delivered. The Inspector shall verify the variety before use on location.

For Narcissus, bulbs shall be accompanied by a delivery ticket and a certification by the bulb house of the types of Narcissus delivered. The Inspector shall verify the variety before use on location.

909.06 Seed Mixtures.{ XE "Landscaping materials:seed mixtures" }{ XE "Seed:mixtures" }

{ XE "Grass seed mixtures" **}A. Grass Seed.** Grass seed mixtures shall be as follows:

{ XE "Tables:landscape:grass seed mixture" }Type A Grass Seed Mixture

Kind of Seed	Minimum Purity, Percent	Minimum Germination, Percent	Percent of Total Weight of Mixture
Kentucky Bluegrass	85	75	20
Red Fescues (Creeping or Chewings)	95	80	35
Kentucky 31	95	80	20
Redtop	92	85	10
Perennial Ryegrass	98	85	10
White Clover	97	90	5

{ XE "Tables:landscape:grass seed mixture" }Type A-3 Grass Seed Mixture

Kind of Seed	Minimum Purity, Percent	Minimum Germination, Percent	Percent of Total Weight of Mixture
Tall Fescue	95	80	60
Kentucky Bluegrass	85	75	10
Chewing Fescue	95	85	20
Perennial Ryegrass	98	85	10

{ XE "Tables:landscape:grass seed mixture" }Type A-4 Grass Seed Mixture

Kind of Seed	Percent of Total Weight of Mixture
Spreading Fescue	30
Chewing or Hard Fescue	30
Kentucky Bluegrass	30
Perennial Rye	10

All grass seed in the above mixture shall be certified seed.

The Department has royalty free license to use the proprietary seed mixtures Fortress and Banner. Seed producers shall be notified when seed purchased is to be used on a Department Project and is not to be subject to royalties.

{ XE "Tables:landscape:grass seed mixture" }Type B Grass Seed Mixture

Kind of Seed	Minimum Purity, Percent	Minimum Germination, Percent	Percent of Total Weight of Mixture
Redtop	92	85	10
Red Fescues (Creeping or Chewings)	95	80	40
Blackwells Switchgrass	95	85	10
Red Canary Grass	96	80	10
Weeping Love Grass	95	85	10
Perennial Ryegrass	98	85	5
Kentucky 31	95	80	15

{ XE "Tables:landscape:grass seed mixture" }Type D Grass Seed Mixture

Kind of Seed	Minimum Purity, Percent	Minimum Germination, Percent	Percent of Total Weight of Mixture
Kentucky Bluegrass	85	75	50
Red Fescues (Creeping or Chewings)	95	85	35
Redtop	92	85	5
Perennial Ryegrass	95	80	10

{ XE "Tables:landscape:grass seed mixture" }Type F Grass Seed Mixture

Kind of Seed	Minimum Purity, Percent	Minimum Germination, Percent
Perennial Ryegrass	95	90

B. Wildflower Seed. Wildflower shall be as follows:

Wildflower Seed Mixture

Kind of Seed	By Weight Per Acre
Coreopsis Lanceolata	40 ozs.
Rudbeckia Hirta	40 ozs.
Echinacea Purpurea	79 ozs.
Festuca Ovina	64 ozs.
	Total =223 ozs.

C. Shipment. Each shipment of grass seed mixture shall be accompanied by a certified weight slip and an analysis of the composition, purity, and germination of the seed mixture, certified by the seed house, and furnished at the time of delivery.

D. Sampling and Testing. Sampling and testing shall be done according to the New Jersey State Seed Law (Revision of 1963), PL 1963, c.29 (C.4:8-17.13 *et seq.*) and with the Rules and Regulations for Testing Seeds adopted by the Association of Official Seed Analysis.

909.07 Composted Sewerage Sludge.{ XE "Landscaping materials:composted sewerage sludge" }{ XE "Composted sewerage sludge" }

Composted sewerage sludge shall consist of a stabilized, screened mixture of wood chips and sewerage sludge processed according to NJDEP Interim Guidelines on General Conditions for the Processing and Distribution of Sewerage Sludge Compost. Composted sewerage sludge shall be obtained from facilities operating in compliance with a New Jersey Pollutant Discharge Elimination System Permit or under an approved NJDEP Memorandum of Agreement. The compost product must be registered with the New Jersey Department of Agriculture in conformance with the New Jersey Commercial Fertilizer and Soil Conditioner Act of 1970.

The average water content of the stabilized composted sludge shall not exceed 55 percent by weight. The composted sewerage sludge shall have a minimum organic content of 50 percent, by weight, and pH of not less than 6.0.

Shipments of composted sewerage sludge shall be accompanied by delivery slips with the certified weight and the name of the producer or supplier.

909.08 Sod.{ XE "Landscaping materials:sod" }{ XE "Sod" }

Sod shall be machine cut at a uniform soil thickness of ⅝ ± ¼ inch at the time of cutting. Measurement for thickness shall exclude top growth and thatch. Individual strips of sod shall be of a uniform width. Broken strips and torn or uneven strips may be rejected. Standard size strips of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically from the upper ten percent of the strip.

Sod shall be Kentucky Bluegrass blend or Kentucky Bluegrass-fescue blend, inspected and certified by the New Jersey Department of Agriculture.

909.09 Topsoil Stabilization Matting.{ XE "Landscaping materials:topsoil stabilization matting" }{ XE "Topsoil:stabilization matting" }

Topsoil stabilization matting shall be one of the following:

1. Excelsior mat shall be wood excelsior, 48 ± 1 inch in width and weighing 0.8 pounds per square yard plus or minus five percent. The excelsior material shall be covered on both sides with a biodegradable netting to facilitate handling and to increase strength.
2 Jute mat shall be cloth of a uniform plain weave of undyed and unbleached single jute yarn, 48 ± 1 inch in width and weighing an average of 1.2 pounds per linear yard of cloth with a tolerance of plus or minus five percent, with approximately 78 warp ends per width of cloth and 41 weft ends per linear yard of cloth. The yarn shall be of a loosely twisted construction having an average twist of not less than 1.6 turns per inch and shall not vary in thickness by more than one-half its normal diameter.
3. Erosion control mulch blanket shall be a machine produced mat of organic, biodegradable mulch material, such as straw, coconut fiber, or other approved materials. The blanket shall be covered on both sides with a ½ by ½-inch polypropylene mesh netting. The mesh shall contain a photo-degradable accelerator which will cause breakdown of the mesh within six months. The blanket shall be sewn together with cotton thread. The minimum weight of the blanket shall be 0.5 pounds per square yard.

909.10 Topsoil.{ XE "Landscaping materials:topsoil" }{ XE "Topsoil" }

Topsoil shall not contain stones, lumps, roots, or similar objects larger than 2 inches in any dimension and shall have not less than a 5.8 pH value. When the topsoil has less than a 5.8 pH value, it shall be increased by applying pulverized limestone at a rate necessary to attain a 6.5 pH value. When the topsoil has greater than a 7.0 pH value, it shall be decreased to attain a 6.8 pH value. The method to decrease the soil pH shall be submitted for approval before work.

A. Unacceptable Topsoil Sources. Material stripped from the following sources shall not be considered suitable for use as topsoil:

1. Soils having less than 4.1 pH value, or greater than 3.0 pH value.
2. Chemically contaminated soils.
3. Areas from which the original surface has been stripped and/or covered over such as borrow pits, open mines, demolition sites, dumps, and sanitary landfills.
4. Wet excavation.

Topsoil furnished from sources outside the limits of the Project shall have a minimum organic content of not less than 2.75 percent by weight. When the organic content is less than 2.75 percent, it shall be increased by adding peat or composted sewerage sludge, conforming to Subsection 909.07, at a rate necessary to attain this minimum organic content. The organic content of soils will be determined according to AASHTO T 194 except that the sample is to be taken from oven-dried soil passing a No. 10 sieve. The organic content of all topsoil used for planting shall conform to the requirements specified above.

{ XE "Tables:landscape:topsoil gradation" **}B. Gradation of Topsoil Sources.** The gradation of the topsoil furnished from sources outside the limits of the Project will be determined using the Bouyoucos Hydrometer Analysis conforming to AASHTO T 88. The gradation of the topsoil shall be within the following:

1. Not more than 20 percent of the material submitted from an off-site sample shall be retained on a No. 10 sieve.
2. If more than one-half of the sand is smaller than 20 mils:

Sand (80 mils to 2 mils)	.....
Silt (2 mils to 0.2 mils)	.....
Clay (0.2 mils and smaller)	.....

3. If more than one-half of the sand is larger than 20 mils:

		Percent
Sand (80 mils to 2 mils) .....40 - 80	or	40 - 75
Silt (2 mils to 0.2 mils).....0 - 30	or	0 - 30
Clay (0.2 mils and smaller) .....15 - 30	or	0 - 30

Material outside these ranges is not suitable for use as topsoil.

909.11 Miscellaneous Materials.{ XE "Landscaping materials:miscellaneous materials" }

Antidesiccant shall be of the polyvinyl type.

Cedar posts shall be of white cedar and shall have a diameter of not less than 2 nor more than 3 inches at the thinner end.

Wooden posts shall be nominal size 2 by 2 inches, of solid, reasonably knot-free lumber, and may be permitted as an alternate for white cedar posts. The length of either post shall be one-half the height of the plant to be supported, plus a minimum of 2 feet for setting in the ground. The maximum overall length of any post shall be 8 feet.

{ XE "Guy wire" **}**Guy wire shall be 14 gauge steel wire.

{ XE "Herbicides" **}**Herbicides shall be Banvel CST, WeedOne CB, and Compadre. The application of the herbicides shall conform to NJAC 7:301 *et seq*.

Hose shall be ½-inch corded rubber or plastic hose.

{ XE "Peat" **}**Peat (known as sedge or reed peat) shall consist of partially decomposed plant residues resulting from anaerobic activity in water-saturated areas. Peat shall not contain gravel, debris or toxic compounds. The average water content of the peat shall not exceed 65 percent, by weight. Peat shall have a minimum organic content of 75 percent, by weight. The inorganic material shall consist only of sand, silt, and clay. Peat with less than a 4.0 pH value will not be accepted. The pH (hydrogen ion concentration), organic content, and moisture content will be determined according to Section 990, NJDOT M-1. Samples of peat will be taken by the Department at the source and must be approved before any deliveries are made. All shipments of peat shall be accompanied by delivery slips, with certified weight and name of supplier indicated, which shall be furnished at the time of delivery.

Pegs for fastening sod on slopes shall be of wood lath, not less than 9 inches long, or of similar pieces of wood.

Staples for anchoring topsoil stabilization matting shall be made of 12-inch lengths of No. 25 plain iron wire.

{ XE "Trees:protectors" **}**Tree protectors shall be one of the following:

1. Plastic, wrap-around-the-trunk type, dark brown, dark gray, or dark green in color.
2. Wire mesh, ¼ by ¼-inch mesh, forming a 6-inch diameter cylinder around the trunk, with the abutting edges fastened together with wire.

{ XE "Wood guy stakes" **}**Wood guy stakes shall be nominal size 2 by 4-inch lumber with a minimum length of 2 feet of solid and reasonably knot-free wood or 2½-inch diameter minimum length of 2 feet of white cedar. The diameter of the cedar stakes shall be measured at the thinner end. The stakes shall be pointed on the thinner end. All guy stakes shall be notched 4 inches from the top for fastening the wire guys.

909.12 Sampling and Testing Methods.{ XE "Landscaping materials:sampling and testing" }{ XE "Samples for:landscaping materials" }

Sampling and testing will be performed according to the following:

Binder, Asphalt Cement	Subsection 904.05
Composted sewerage sludge	Subject to job site inspection and according to Subsection 909.07
Fertilizer	Subsection 909.02
Limestone, Pulverized	1 quart from each source and according to Subsection 909.03
Miscellaneous:	
Herbicides	Subject to job site inspection and according to Subsection 909.11
Peat	Subject to job site inspection and according to Subsection 909.11
Mulch:	
Gravel	Subject to job site inspection and according to Subsection 909.04
Stone	Subject to job site inspection and according to Subsection 909.04
Straw	Subject to job site inspection
Wood cellulose fiber	Subject to job site inspection
Wood chips	Subsection 909.04
Plant materials	Subsection 909.05
Seed mixtures	Subsection 909.06
Sod	Subject to job site inspection
Topsoil	10 pounds from each source

SECTION 910 - MASONRY UNITS{ XE "MASONRY UNITS" }

910.01 Clay or Shale Brick.{ XE "Masonry units:clay or shale brick" }{ XE "Clay or shale brick" }

Clay or shale brick shall conform to AASHTO M 114, Grade MW, with the following modifications:

1. The length of the brick shall be not less than 7.40 and not more than 7.88 inches, the width shall be not less than 3.50 and not more than 3.88 inches, and the depth shall be not less than 2.10 and not more than 2.38 inches.
2. The maximum water absorption, by five-hour boiling, shall be 14 percent based on the average of five bricks, and 16 percent for individual bricks.

910.02 Concrete Block for Inlets and Manholes.{ XE "Masonry units:concrete block" }{ XE "Concrete block:for inlets and manholes" }

Concrete block for inlets and manholes shall be solid, precast segmental concrete masonry units. Portland cement shall conform to ASTM C 150. Other materials shall conform to the following Subsections:

Aggregates for portland cement concrete, mortar, and grout.....901.12
Water 919.15

The blocks shall be either rectangular in shape, or curved blocks with the inside and outside surfaces curved to the required radii, whichever is appropriate for the shape of the structure. The length shall be not less than 1 foot and not more than 1 foot-6 inches. The height shall be not less than 5 inches and not more than 8 inches. The width shall be not less than 6 inches.

For the reduction of cross-sectional area of the cones or tops of manholes, blocks may be of special shapes and heights. Blocks of special shapes and heights may be used in the top courses of all structures so that the head castings shall be set at the required elevation on a mortar bed not more than ½ inch thick without cutting the blocks.

All blocks shall have an interlocking-type joint at the ends so as to form a strong, rigid structure and shall be sound and free from cracks or other defects.

At the place of manufacture, the blocks shall be stocked in such a manner as to facilitate inspection and sampling of the units.

910.03 Concrete Block for Slope Protection.{ XE "Concrete block:for slope protection" }

Concrete block for slope protection shall be solid concrete units, 1 foot-4 inches long, 8 inches wide, and 4 inches thick, with a tolerance of plus or minus ⅜ inch. All faces shall be true to shape, true in relation to each other, and each shall have a dense uniform surface. The block shall be made from materials specified in Subsection 910.02.

Compressive strength and absorption tests shall be made on three blocks. The blocks tested shall have a minimum compressive strength of 2,500 pounds per square inch at 28-day age and the maximum water absorption for any individual specimen shall not exceed eight percent.

At the place of manufacture, the blocks shall be stocked in such a manner as to facilitate inspection and sampling of the units.

910.04 Concrete Brick.{ XE "Concrete brick" }{ XE "Masonry units:concrete brick" }

Concrete brick shall conform to Subsection 910.02, except that the sizes and shapes shall be as specified in Subsection 910.01.

910.05 Concrete Crib Members.{ XE "Masonry units:concrete crib members" }{ XE "Concrete crib members" }

The concrete shall conform to Section 914 and the following:

1. All members shall be protected against the loss of moisture after casting. Live steam shall be employed as a means of applying moisture and controlled heat to freshly cast concrete members. Waterproof covering and framework shall be furnished to enclose crib members, in order that curing temperatures can be controlled.
2. Live steam shall be introduced into the kiln or enclosure through a series of steam jets that are to be evenly spaced. In no case shall the steam impinge directly on the concrete or forms.
3. After the concrete is placed in the forms, live steam may be introduced into the kiln or enclosure provided that the temperature within the kiln or enclosure shall not exceed 100 °F for the first three hours. Thereafter, the application of live steam shall be controlled so that the temperature does not rise faster than 1 °F per minute, and shall be kept controlled at 130 °F for not less than ten hours. After these curing periods, the steam may be shut off; however, the enclosure shall remain closed for one hour before removing members from forms. Recording thermometers shall be provided to record curing temperatures

in kiln or enclosure. The crib members shall be reinforced with No. 10 deformed steel bars conforming to Subsection 915.01, Subpart A. A plastic or galvanized metal chair shall be used to provide minimum concrete cover of 1 inch. A tolerance of plus or minus ¼ inch will be allowed in the overall dimensions of crib members.

4. Any devices cast in the units for handling purposes shall be of corrosion resistant material, except that aluminum will not be permitted. They shall be located on the rear face of the members and shall be removable flush with the face after erection.
5. Two concrete test cylinders, similarly cured, shall be tested after the curing procedure specified. Should the test indicate that the precast units have not achieved at least 65 percent of the specified 28-day strength, curing of the units shall continue until 65 percent of the 28-day strength is surpassed.

910.06 Granite Curbs.{ XE "Masonry units:granite curbs" }{ XE "Granite:curbs" }

Granite curbs shall be new or used and shall be medium grained with uniform texture and distribution of minerals, unstratified, unlaminated, and free from seams and evidence of weathering. The granite shall comply with the geologic classification and quality requirements of Subsection 901.04.

Used material shall be free of bituminous or cement grout coatings or other foreign materials. Curb stones shall be from one quarry and of the same color and texture.

Quarry-split stone for curbs shall have the top face machine-finished or dressed to an even surface without depressions or projections of more than ⅜ inch below or above the plane of the face. Edges shall be straight and even, and the ends shall be cut square for the entire depth of exposed curb face. Curb stones shall be so dressed that joints can be made not more than ⅜ inch wide from top to gutter line and not more than 1 inch wide below the gutter line.

Dressed stone for curbs shall be dressed to an even, smooth finish on the top face, on the front face for the entire depth of the exposed curb face, on the back face to a depth of 2 inches, and on the ends to a depth of 1 inch. The projections and depressions on the various faces shall not be greater than the following:

	Depression (inches)	Projection (inches)
Top	¼	¼
Front, dressed part	¼	¼
Front, undressed part	1½	½
Back, dressed part	½	½
Back, undressed part	1½	1½
Ends, dressed part	¼	¼
Ends, rough-dressed part	½	¼
Ends, undressed part	1½	¼

The rough-dressed part of end faces shall extend 1 inch below the gutter line. The back edge of the top shall be parallel to the front face. The top and front faces shall be sloped, and the front edge shall be rounded. The stones shall have the width specified at the top, and the bottom width shall be not less than 1 and not more than 3 inches greater than the top width. The stones shall be furnished in lengths of not less than 4 and not more than 8 feet.

Straight-cut stone may be used for curved curb having a radius of not less than 50 feet but shall be dressed to true radius after being set in place. For smaller radii the stone shall be cut to the required radius, and the ends shall be cut so that the joints can be made not more than ¼ inch wide for full depth.

910.07 Granite Facing for Pier Shafts.{ XE "Masonry units:granite facing for pier shafts" }{ XE "Granite:facing for pier shafts" }

Granite facing for pier shafts shall be of a quality, color, and texture matching as closely as possible the color range of the granite commonly known as Chelmsford White or Chelmsford Gray. The granite shall be sound, durable, and free from flaws, discoloration, and structural defects. A reasonable variation in color and texture and occasional irregular distribution of the component minerals of the granite, termed waves, or knots will be permitted, if, in the judgment of the Engineer, they do not impair the architectural qualities or affect the structural properties of the granite. The granite shall come from quarries that have ample production capacity both as to quantity and quality. Certification shall be submitted according to Subsection 106.04. Evidence that the granite proposed for use has satisfactorily withstood long exposure in environments similar to that at the location of the Project shall be included in the certificates.

Duplicate samples shall be submitted and shall be 1 by 1 foot to indicate the range of color, texture, and surface finish of the granite to be furnished. After approval of such samples, one set of samples will be returned for guidance. All granite used in the Project shall match these samples.

All granite furnished shall be capable of withstanding a crushing stress of 20,000 pounds per square inch on 2½-inch diameter cores tested air-dry. The number of cores to be furnished for such tests shall be as specified in the Special Provisions.

910.08 Granite Paving Block.{ XE "Masonry units:granite paving block" }{ XE "Granite:paving block" }

Granite paving block shall be new or used granite block of good quality. Blocks shall be free of all bituminous and cement grout coatings and other foreign matter.

910.09 Sampling and Testing Methods.{ XE "Masonry units:sampling and testing" }

Sampling and testing will be performed according to the following:

{ XE "Samples for:brick and block" **}{** XE "Samples for:crib members" **}{** XE "Samples for:granite" **}**Brick	Ten units from 10,000 units
Block	ASTM C 140 (see Note 1)
Crib Members	Subject to inspection before shipment
Granite:	
Curbs	2-foot end section from each source
Facing	Subsection 910.07

Note 1: Concrete block for inlets and manholes shall have compressive strength and absorption requirements conforming to ASTM C 139.

SECTION 911 - NON-FERROUS METALS{ XE "NON-FERROUS METALS" }

911.01 Aluminum Alloys.{ XE "Aluminum alloys" }

Aluminum alloys shall conform to the following:

Component	ASTM	ASTM Alloy and Temper
Castings, Sand	B 26	356.0-F or 356.0-T6
Die Castings, Permanent Mold	B 108	356.0-T6
Extruded Bars, Rods, Shapes, and Pipe	B 221	6061-T6
Pipe	B 241	6061-T6
Plates and Sheets	B 209	6061-T6
Rolled Shapes, Rods, and Bars	B 211	6061-T6
Shim Material Made of Sheet or Plate	B 209	1100-0
Tube, Drawn	B 210	6061-T6
Tube, Extruded	B 221	6061-T6
Washers, Made of Sheet, Alloy Clad	B 209	2024-T3

Bolts, nuts, set screws, and pins shall be made from rods conforming to ASTM B 211, Alloy 2024-T4 with No. 205 Alumilite Finish. Bolt heads and nuts shall be American National Standard, Regular Series, hexagonal, semi-finished, conforming to ANSI B18.2.1 to B18.2.2. Threads shall be American National Standard, Coarse Series, Class 2 Fit, conforming to ANSI B1.13M. The finished bolts and nuts shall be heat treated to a T4 temper and given an anodic coating thickness of not less than 0.0002 inches and shall be chromate sealed.

911.02 Bearing and Expansion Plates.{ XE "Bearing and expansion plates" }

Cast bronze bearing and expansion plates shall conform to AASHTO M 107, Alloy UNS No. C91100. Rolled copper-alloy bearing and expansion plates shall conform to AASHTO M 108, Alloy UNS No. C51000, C51100, or C65500.

911.03 Flashing for Construction and Expansion Joints.{ XE "Flashing" }

Copper for flashing shall weigh 16 ounces per square foot and shall conform to ASTM B 152, Type UNS No. C11000.

Nickel-copper alloy sheeting for flashing shall conform to ASTM B 127. The sheeting shall be cold-rolled deep-drawing and spinning quality.

911.04 Sampling and Testing Methods.

{ XE "Samples for:aluminum alloys" **}{** XE "Samples for:bearing and expansion plates" **}{** XE "Samples for:copper flashing" **}{** XE "Samples for:metals, non-ferrous" **}**Samples for and testing will be performed according to the following:

Aluminum alloys	Applicable ASTM test methods
Bearing and expansion plates	One unit from each source
Copper flashing	1 square foot from each source

911.05 Certification of Compliance.

Mill certification for copper flashing shall be submitted according to Subsection 106.04.

SECTION 912 - PAINTS, COATINGS, AND MARKINGS{ XE "PAINT" }

912.01 Aluminum-Pigmented Alkaline-Resistant Paint.{ XE "Paint:aluminum-pigmented alkaline-resistant paint" }

Aluminum-pigmented alkaline-resistant paint shall conform to the requirements of Federal Specification TT-C-498C.

912.02 Aluminum Paint, Finish Coat.{ XE "Paint:aluminum, finish coat" }

Aluminum paint shall conform to the requirements of AASHTO M 69, Type II.

912.03 Graphite Paint, Finish Coat, Black{ XE "Paint:graphite, finish coat, black" }.

Graphite paint, black shall be a ready-mixed, linseed oil, black graphite paint intended for outside use on either wood or metal and shall conform to the following:

1. **Pigment.** The pigment shall consist of graphite of only the natural crystalline flake variety, siliceous matter, and gas carbon black or lampblack. The pigment on analysis shall show not less than 40 or more than 60 percent graphitic carbon. The gas carbon black or lampblack shall be not less than five and not more than ten percent of the total pigment. Ground coal and powdered shale are not permitted.

Suggested Weight Formula	**Percent**
Pigment	
Natural crystalline flake graphite (containing about 55 percent graphitic carbon) (Note 1)	95
Gas carbon black	5
Total	100
Note 1: Infrared spectra on file with the Department Laboratory.	
Vehicle	
Boiled linseed oil	85
Drier	5
Mineral spirits	10
Total	100
Paint	
Pigment	40
Vehicle	60
Total	100
Weight per gallon of paint, 10 pounds	
Volume Analysis	
One gallon of paint contains:	**Gallon**
Dry graphite	0.195
Dry carbon black	0.013
Total pigments	0.208
Linseed oil	0.654
Total nonvolatile	0.862
Mineral spirits and drier	0.138
Total paint	1.000

Other volume characteristics of paint:	**Percent**
Pigment in paint	21
Oil in paint	65
Pigment in nonvolatile	24

The above volume figures shall mean that 1 gallon of this paint when delivered shall contain 0.862 gallons total nonvolatile or film-forming materials, and in the dry film there shall be approximately 24 percent by volume of pigment and 76 percent by volume of oil. For the above reasons, paint is to be supplied by volume.

2. Liquid in Ready-Mixed Paint. Liquid in the ready-mixed paint shall contain not less than 85 percent linseed oil, the balance to be combined drier and thinner. The thinner shall be turpentine, volatile mineral spirits, or any mixture thereof.

{ XE "Paint:ready-mixed paint" **}3. Ready-Mixed Paint.** Ready-mixed paint shall consist of the pigment and the liquid described above. It shall be well ground, shall not settle badly or cake in the container, shall be readily broken up with a paddle to a smooth, uniform paint of good brushing consistency, and shall dry within 24 hours to a full oil gloss, without running or sagging. The weight per gallon shall be not less than 9 ½ pounds.

The paint shall consist of:

	Minimum	**Maximum**
Pigment, percent	35	42
Liquid, percent (containing at least 85 percent linseed oil)	58	65
Water, percent	--	0.5
Coarse particles and skins, percent (total residue retained on No. 325 sieve based on pigment)	--	5.0

When the two coats of graphite paint are specified, the first coat shall contain no carbon black or lampblack pigment.

912.04 Coal Tar Epoxy-Polyamide Paint (Black or Dark Red).{ XE "Paint:coal tar epoxy polyamide black (or dark red)" }

Coal tar epoxy-polyamide paint shall conform to SSPC-Paint 16. This specification covers a two-component coal tar-epoxy black (or dark red) paint that employs a coal-reacting polyamide resin and an aromatic tertiary polyamide catalyst as curing agent.

912.05 Masonry Paint.{ XE "Paint:masonry" }

Paint for application on exposed concrete surfaces shall conform to Federal Specification A-A-3120.

912.06 Epoxy Bonding Coat.{ XE "Paint:epoxy bonding coat" }

Epoxy bonding coat shall be a two-component, epoxy-resin, bonding system for application to portland cement concrete. The coating shall conform to ASTM C 881, Type 1. Color shall be clear or gray to match the color of the adjacent concrete.

912.07 Epoxy Waterproofing Seal Coat.{ XE "Paint:epoxy waterproofing seal coat" }

Epoxy waterproofing seal coat shall be a two-component, epoxy-resin, waterproofing system for application to portland cement concrete. The coating shall conform to ASTM C 881, Type 3. Color shall be gray to match the color of the adjacent concrete.

912.08 Green Enamel Paint.{ XE "Paint:green enamel" }

Green enamel paint shall conform to Federal Specification A-A-2962, Class A, gloss, synthetic (for exterior and interior surfaces). The tint shall match color chip No. 14062 of FED-STD-595B.

912.09 Lime-Yellow Enamel Paint.{ XE "Paint:lime-yellow enamel" }

Lime-yellow enamel paint shall conform to Federal Specification A-A-2962, Class A, and shall match color chip No. 13670 of FED-STD-595B.

912.10 Pavement Stripes or Markings.

{ XE "Paint:traffic paint" **}{** XE "Traffic:paint" **}A. Traffic Paint.**

1. **Latex.** Latex traffic paint for traffic stripes or traffic markings shall be a white or a yellow ready-mixed pigmented binder that is emulsified in water and capable of anchoring reflective glass beads that are separately applied. In addition, the paint shall not contain any of the materials listed in the EPA Code of Regulations (CFR) 40, Section 261.24, Table 1.

Manufacturers of latex paint shall have produced, to the satisfaction of the Department's Bureau of Materials, a fast-drying traffic paint that meets the following requirements:

a. Composition. The exact composition of the latex paint shall be left to the discretion of the manufacturer, provided that the finished product meets the requirements as stipulated hereinafter.

b. Pigment. The pigment portion shall be a combination of prime and extender pigments as required to produce either a white or yellow traffic paint meeting the color and other requirements of the finished product for white or yellow, as specified elsewhere in this specification.

The prime pigment for white paint shall be titanium dioxide conforming to ASTM D 476, Type IV, with a minimum titanium dioxide content of 94 percent and shall be used at a minimum rate of 1 pound per gallon.

The prime pigment for yellow paint shall be a non-toxic organic pigment yellow, No. 75 or equal pre-approved by the Department Laboratory, with excellent exterior and color permanence. The prime pigment shall also contain a minimum 0.2 pounds per gallon of titanium dioxide conforming to ASTM D 476, Type IV, 94 percent purity.

The percent pigment by weight of the finished product shall not be less than 60 nor more than 62 percent.

c. Vehicle. The non-volatile vehicle shall not be less than 42 percent by weight, and shall be pre-approved by the Department Laboratory and meet the dry through (early washout) requirements specified hereinafter.

d. Physical Properties.

(1) Color. The color shall match FED-STD-595B, No. 33538 for yellow and No. 37886 for white.

(2) Organic Volatiles. The volatile organic content (VOC) of the finished paint shall contain less than 2 pounds per gallon of volatile organic matter of total non-volatile paint material as required by NJSA 7:27-23.

(3) Volume of Solids. The finished paint shall not be less than 61 percent solids by volume.

(4) Total Solids. The finished paint shall not be less than 77.5 percent total non-volatiles by weight, when tested according to ASTM D 2369.

(5) Liter Weight. The weight of the finished paint shall be 14 ± 0.2 pounds per gallon for each color.

(6) Grind. The grind shall not be less than 2 Hegman when tested in accordance with ASTM D 1210.

(7) Field No-Tracking Time. The paint shall dry to a no-tracking condition under traffic in 120 seconds maximum when the ambient temperature is77 ºF, and when applied in a wet film thickness of 15 ± 1 mil, at 140 ºF, and with 12 pounds per gallon of glass beads for latex traffic paint conforming to Subsection 912.11.

(8) Viscosity. The consistency of the paint shall be not less than 70 nor more than 95 Krebs Units at 77 ºF, when tested according to ASTM D 562.

(9) Flexibility. The paint shall show no cracking or flaking when tested according to ASTM D 522.

(10) Dry Opacity. The minimum contrast ratio shall be 0.95 when tested according to ASTM D 2805.

(11) Daylight Reflectance. The daylight directional reflectance shall not be less than 85 percent for the white paint and not less than 54 percent for the yellow (relative to magnesium oxide), when tested according to ASTM E 1347.

(12) Abrasion Resistance. The abrasion resistance shall be such that no less than 55 gallons of sand shall be required for removal of the paint film when tested according to ASTM D 968.

(13) Dilution Test. The paint shall be capable of dilution with water at all levels without curdling or precipitation such that the wet paint can be readily cleaned up with only water.

(14) Dry Through (Early Washout). The "dry through" time of a 15 mil wet film placed immediately in a humidity chamber maintained at 72.5 ± 2.5 ºF and 90 ± 5 percent relative humidity shall be less than or equal to the Department Laboratory reference film when tested according to ASTM D 1640, except that the pressure exerted shall be the minimum needed to maintain contact with the thumb and film.

(15) Shelf Life. All paint furnished shall have a minimum shelf life of nine months at temperatures above 35 ºF. When tested, the paint shall conform to the physical requirements specified herein. In addition, the paint shall show no skinning, gelling or hardening on the surface, nor hard settling upon storage in the sealed containers, that will affect the performance of the product.

(16) Packaging. The paint shall be packaged in 5-gallon kits or 55-gallon drums, complying with the Code of Federal Regulations, Revised 1-70. The 5-gallon kits shall be new metal, 37A80, "Single Trip Container" Lug Type, 24 gauge thick steel for both body and head sheet. The 55-gallon drums shall be new metal, 17H, 18 gauge thick metal for body and bottom head sheet, and have welded side seams. The drums shall be of the open end type. All containers, after being filled, shall be closed with tight fitting covers that will ensure leak-proof seals. The removable top head sheet thickness shall be 14 gauge; 16 gauge is authorized provided there are one or more corrugations in the cover near the periphery.

The 5-gallon kits and the 55-gallon drums shall be coated on the inside of the body and head sheets with a lacquer type rust inhibiting coating, free of pin holes, scratches, or other defects that may allow contamination of the paint from corrosion of the container.

The label or stencil shall show the name of the manufacturer, a designation of the contents, the lot or batch number, the date of manufacture, and the volumetric contents in liters. All containers shall be labeled according to the current code of Federal Regulations and shall contain all information necessary to comply with NJSA 34:5A-1, NJ Worker and Community Right to Know Act.

e. Inspection and Testing. The manufacturer shall provide access for the Department Technician to obtain two one-quart production samples of the paint for each production batch. Each sample shall be accompanied by an analysis report showing compliance with specification requirements for the following physical tests:

(1) Viscosity.
(2) Weight per gallon.
(3) Grind.

Testing shall be performed on production batches by the manufacturer and witnessed by the Department Technician. Compliance with the above requirements must be met before batches are sampled for testing by the Department Laboratory.

The Department also reserves the right to randomly sample raw materials during the manufacturing process.

Only Department Laboratory approved material conforming to all the requirements of this specification shall be shipped. Any specification deviation will result in rejection of the entire batch. Paint not approved, but shipped, shall be picked up entirely at the manufacturer's expense.

B. Epoxy Resin. Epoxy resin compound shall be specifically formulated for use as a long-life pavement striping material and for hot-spray application at elevated temperatures. The types and amounts of epoxy resins and curing agents shall be at the discretion of the manufacturer, provided that the physical properties and composition specified in this Subpart are satisfied.

Long-life epoxy resin traffic stripes placed on the Project with material that fails to comply with the following requirements shall be removed and replaced according to Subsection 618.10:

1. Physical Properties of the Mixed Compound.

{ XE "Paint:samples" **}a. Samples.** All samples shall be mixed at the ratio specified by the manufacturer and tested at an ambient temperature of 73 ± 5 °F unless otherwise specified.

b. Color. The white and yellow epoxy resin compound, when applied in a wet film thickness of 20 ± 1 mil and allowed to cure, shall meet the following initial color requirements:

Color	1		2		3		4		Reflectance Limits Y (%)	
	x	y	x	y	x	y	x	y	Min.	Max.
White	0.302	0.344	0.325	0.344	0.302	0.320	0.325	0.320	80.0	
Yellow	0.5425	0.4718	0.4752	0.4718	0.5425	0.4245	0.4752	0.4245	50.0	60.0

c. Yellowness Index. When tested according to ASTM E 313 (with glass beads), the white epoxy resin should exhibit the following color stability:

Maximum Yellowness Index before QUV: 10.00

Maximum Yellowness Index after 72 hours QUV: 20.00

d. Directional Reflectance. The white epoxy resin compound (without glass beads) shall have a daylight directional reflectance of not less than 80 percent relative to a magnesium oxide standard when tested according to ASTM E 1347.

The yellow epoxy resin compound, without glass beads, shall have a daylight directional reflectance of not less than 50 percent relative to a magnesium oxide standard when tested according to ASTM E 1347.

e. Drying Time. The epoxy resin compounds, when mixed in the proper ratio and applied according to the thickness requirements specified above and immediately dressed with glass beads at the rates specified in Subsection 618.07, shall exhibit a no-track drying time of 15 minutes or less when tested according to ASTM D 711.

f. Abrasion Resistance. When the epoxy resin material is tested according to ASTM C 501 with a CS-17 wheel under a load of 1,000 grams for 1,000 cycles, the abrasive wear index shall be no greater than 80. The abrasive wear index is the weight in milligrams that is abraded from the sample under the specified test conditions.

g. Hardness. After the epoxy resin material has cured for not less than 72 hours and not more than 96 hours at 70 °F, Shore D hardness of the material shall be not less than 75 nor more than 100 when tested according to ASTM D 2240.

2. Epoxy Composition. The epoxy resin material shall be a two-component (Component A and Component B), 100 percent solids type system formulated and designed to provide a simple volumetric mixing ratio (e.g., two volumes of Component A to one volume of Component B) according to the following:

	Percent By Weight	
Pigment Composition	**Minimum**	**Maximum**
White:		
Titanium Dioxide Rustile (94% minimum purity) (ASTM D 476, Type III)	18.0	25.0
Epoxy Resin	75.0	82.0
Yellow:		
Organic Non-Lead Yellow	7.0	8.0
Epoxy Resin	77.0	79.0
Titanium Dioxide (ASTM D 476, Type III)	14.0	17.0

The entire pigment composition shall consist of titanium dioxide. No extender pigments shall be permitted, except in non-lead formula.

The epoxy resin shall be as follows:

a. Epoxy Content (Component A). The epoxy content of the epoxy resin shall be tested according to ASTM D 1652 and calculated as the weight per epoxy equivalent (WPE) for both white and yellow. The epoxy content shall be determined on a pigment free basis and shall meet the target value provided by the manufacturer's certification and approved by the Department's Bureau of Materials.

A tolerance of plus or minus 50 will be applied to the target value to establish the acceptance range.

b. Amine Value (Component B). The amine value of the curing agent shall be determined according to ASTM D 2074. The total amine value shall meet a target value provided by the manufacturer and approved by the Department's Bureau of Materials. A tolerance of plus or minus 50 will be applied to the target value to establish the acceptance range. If the manufacturer specifies an alternate test method for determining the amine value, the alternate shall be subject to approval by the Department's Bureau of Materials.

c. Toxicity. Upon heating to application temperature, the material shall not exude fumes that are toxic or injurious to persons or property.

{ XE "Paint:sampling and testing" **}3.Sampling and Certified Analysis**. The epoxy manufacturer shall furnish certified test results that each batch of epoxy resin material used on the Project complies with these specifications. In addition, all epoxy components shall be pre-approved for use on the Project. Samples of the epoxy components shall be submitted to the Department Laboratory at least 30 days before the needed approval date.

To verify that the epoxy resin material subsequently used on the Project is of an identical formulation as those pre-approved, epoxy components shall be sampled at the Project and submitted to the Department Laboratory. These sample components shall match their respective infrared spectrums in the pre-approved file in the Department Laboratory.

{ XE "Paint:shipping requirements" **}4. Containers and Shipment**. The epoxy resin material shall be shipped in appropriate containers supplied by the Contractor and shall be plainly marked with the following information:

a. Manufacturer's Name and Address.
b. Name of Product.
c. Lot/Batch Number.
d. Color.
e. Net Weight and Volume of Contents.
f. Date of Manufacture.
g. Date of Expiration.
h. Statement of Contents (As Appropriate):
   Component A - Pigment and Epoxy Resin.
   Component B - Catalyst.
i. Mixing Proportions and Instructions.
j. Safety Information.

C. Thermoplastic. Thermoplastic for long-life traffic markings shall be of either preformed or hot extruded material. The thermoplastic shall conform to the requirements of AASHTO M 249, except as follows:

1. Preformed material shall be 90 mils thick and conform to only those portions of AASHTO M 249 not associated with material in a liquid state.
2. For white, the composition of the mixture shall be as follows:

Component	**Percent by weight**
Resin/Binder	22-26 percent minimum
Glass Beads (pre-mix)	30 percent minimum
WhitePigment	10 percent minimum
Calcium Carbonate and Inert Fillers (shall not contain silica other than as glass beads)	34-38 percent maximum

3. For yellow non-lead formulas, the composition of the mixture shall be as follows:

Component	**Percent by weight**
Resin/Binder	22-26 percent minimum
Glass Beads (pre-mix)	30 percent minimum
Yellow Pigment	2 percent minimum
Calcium Carbonate and Inert Fillers (shall not contain silica other than as glass beads)	42-46 percent maximum

The yellow material's combined totals of lead, cadmium, mercury, and hexavalent chromium shall not exceed 100 parts per million.

The thermoplastic manufacturer shall certify, according to Subsection 106.04, that the material will meet the requirements specified.

912.11 Glass Beads.{ XE "Glass beads for reflectorizing traffic paint" }{ XE "Traffic:paint:glass beads for reflectorizing" }

All glass beads shall be transparent, clean, colorless glass; smooth and spherically shaped; and free of milkiness, pits, or air bubbles. All glass beads shall conform to the following when tested according to Section 990, NJDOT P-1, and with other appropriate methods:

1. **Spherical Particles (Rounds).** Glass beads shall contain a minimum of 80 percent rounds per screen for the two highest sieve quantities. There shall be no more than three percent sharp angular particles per screen. The remaining sieve fractions shall contain not less than 75 percent rounds.
2. **Gradation.** The beads shall meet the specified grading requirements for the following pavement stripe or marking materials when tested according to ASTM D 1214:

a. Traffic Paint.

6 mil Thickness

Sieve Size	Percent Retained By Weight
No. 16	0
No. 20	0 - 2
No. 30	5 - 28
No. 50	35 - 65
No. 100	15 - 40
Pan	0 - 5

15 mil Thickness

Sieve Size	Percent Retained By Weight
No. 12	0
No. 14	0 - 5
No. 16	5 - 20
No. 18	40 - 80
No. 20	10 - 40
No. 25	0 - 5
Pan	0 - 2

b. Epoxy Resin.

Large Beads

Sieve Size	Percent Retained By Weight
No. 10	0
No. 12	0 - 5
No. 14	5 - 20
No. 16	40 - 80
No. 18	10 - 40
No. 20	0 - 5
Pan	0 - 2

Small Beads

Sieve Size	Percent Retained By Weight
No. 20	0 - 5
No. 30	5 - 20
No. 50	30 - 75
No. 80	9 - 32
No. 100	0 - 5
Pan	0 – 2

c. Thermoplastic.

Sieve Size	Percent Retained By Weight
No. 20	0 - 5
No. 30	5 - 20
No. 50	30 - 75
No. 80	9 - 32
No. 100	0 - 5
Pan	0 - 2

3. **Coating.** The beads shall be coated with a silane adherence coating meeting the requirements of Section 990, NJDOT P-1, except that pre-mix beads for thermoplastic shall be uncoated and conform to AASHTO M 247, Type 1. Drop-on beads for thermoplastic shall also be moisture resistant coated.
4. **Index of Refraction.** The beads, when tested by the liquid immersion method, shall show an index of refraction within the range of 1.50 to 1.52.
5. **Chemical Stability.** Beads that show any tendency toward decomposition, including surface etching, when exposed to atmospheric conditions, moisture, dilute acids or alkalines, or paint film constituents, shall be rejected.
6. **Packaging.** The beads shall be packaged in 50-pound moisture-resistant bags conforming to the packaging and marking requirements of AASHTO M 247.

912.12 Removable Pavement Marking Tape and Removable Black Line Masking Tape.

A. Removable Pavement Marking Tape{ XE "Traffic:markings:removable pavement marking tape" **}.** The removable pavement marking tape shall be a mixture of polymeric materials, glass beads, and all pigments bonded to a nonmetallic backing material. The tape shall be reflectorized with a layer of glass beads bonded to the top surface. The underside of the tape shall be precoated with a pressure sensitive adhesive which bonds the tape to the roadway surface so as to be able to withstand traffic immediately after application.

Daylight color of the white tape shall be no darker than color No. 37778 of FED-STD-595B. Daylight color of the yellow tape shall conform to the FHWA color tolerance chart for highway yellow.

The tape shall have the following initial minimum reflectance values at 86.0 degrees entrance angle when measured according to FED-STD-370:

Observation Angle	Specific Luminance	
(Degrees)	White	Yellow
0.2	1770	1310
0.5	1270	820

Specific luminance is measured in millicandelas per square foot per foot-candles.

The test distance shall be 50 feet, and the sample size shall be a 24 by 30-inch rectangle. The angular aperture of both the photoreceptor and the light projector shall be six minutes of arc. The reference axis shall be taken perpendicular to the test sample.

The tape shall be capable of being removed manually, intact or in large pieces, at temperatures above 40 °F without the use of solvents, burning, grinding, or blasting. Only tape that has previously received the approval of the Department Bureau of Materials shall be used. Certification of Compliance shall be furnished according to Subsection 106.04.

B. Removable Black Line Masking Tape{ XE "Traffic:stripes:removable black line masking tape" **}.** Black line masking tape shall be a non-retroreflective, pliant polymer material that is black in color. Once installed, the tape shall not produce a sheen under any day, night, dry, or wet conditions. The finish of the masking tape shall be such that the underlying existing stripes cannot reflect through under any circumstances. The surface of the black line masking tape shall be slip resistant and shall provide minimum skid resistance of 30 BPN when tested according to ASTM E 303. The underside of the black line masking tape shall be pre-coated with a pressure sensitive adhesive.

Certification of Compliance shall be furnished according to Subsection 106.04. Only tape that has previously received the approval of the Department Laboratory shall be used.

912.13 Inorganic Zinc Coating System.

Requirements for inorganic zinc coating systems will be provided in the Special Provisions.

912.14 Epoxy Mastic Coating System.

Requirements for epoxy mastic coating systems will be provided in the Special Provisions.

912.15 Organic Zinc Coating System.

Requirements for organic zinc coating systems will be provided in the Special Provisions.

912.16 Temporary Pavement Markers{ XE "Temporary:pavement markers" }.

Temporary pavement markers shall be molded of ABS (acrylonitrile butadiene styrene), acrylic (methylmethacrylate), polycarbonate, or high impact polystyrene, and shall be ultra-violet stabilized. The markers shall have a maximum width of 4 inches perpendicular to traffic and a maximum height of ¾ inch. The markers shall be able to support a minimum of 10,100 pounds.

The temporary pavement markers shall contain either mono-directional white or bi-directional yellow retroreflective material. Plastic reflector lenses used for the retroreflective material shall be molded of methylmethacrylate conforming to ASTM D 788, PMMA0131V0 or PMMA0231V0. The retroreflective material shall meet retroreflectance values, specific intensity, in millicandelas per foot-candles as follows:

Observation Angle (Degrees)	Entrance Angle (Degrees)	White (mcd/foot-candles)	Yellow (mcd/foot-candles)
0.2	0.0	2.0	1.4
0.2	20	1.0	0.7

The temporary pavement markers shall be of the same color as the retroreflective material it contains.

The manufacturer shall certify, according to Subsection 106.04, that the material meets the requirements specified.

912.17 Pavement Reflectors and Castings.

Pavement reflectors and castings shall consist of iron castings with a two-way snow-plowable replaceable prismatic reflector. The pavement reflectors and castings shall conform to the following:

1. **Castings.** Castings shall be ductile iron conforming to ASTM A 536, hardened to 52-54 RC, and shall be marked with the manufacturer's name and model number. Castings shall be between 9.25 and 10 inches long, between 5.5 and 5.85 inches wide, and between 1.70 and 1.92 inches high. When installed, the height shall be between 0.25 and 0.41 inch above the road surface. The casting shall weigh approximately 5.5 pounds. The surface of the keel and web of the casting shall be free of scale, dirt, oil, grease, or other contaminant that may reduce the bond of the casting to the epoxy adhesive.
2. **Reflectors.** Reflectors shall consist of an acrylic or high-strength polymer shell filled with a tightly-adhering potting compound. The shell shall contain one or two prismatic reflective lenses to reflect incident light from opposite directions. The lenses shall be hermetically sealed and permanently bonded to the reflector base. The reflector shall be attached with an approved adhesive to the casting. The reflector shall conform to the following design requirements:

   Dimensions (nominal) ..... 4 by 2 by 0.48 inch
   Slope of reflecting surface ..... between 30 and 35 degrees
   Area of each reflecting surface ..... between 1.44 and 1.87 square inches
   Approximate thickness of applied adhesive bead ..... 0.375 inch

   Thin untempered glass shall be bonded to the front surface of the prismatic retroreflective lens face to provide an extremely hard and durable abrasion resistant surface. The shell shall be molded of methyl methacrylate conforming to Federal Specification L-P-380C, Type I, Class 3. The outer surface of the shell shall be smooth except that it may be marked with the manufacturer's identification.

   The color of the reflective elements when illuminated by an automobile headlight shall be white or amber conforming to the following:

   a. **Optical Performance and Testing Procedure.** Horizontal entrance angle shall mean the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the reflector. Observation angle shall mean the angle at the reflector between the observer's line of sight and the direction of the light incident on the reflector. Specific intensity shall mean candelas of the returned light at the chosen observation and entrance angle for each lux of illuminance at the reflector on a plane perpendicular to the incident light.

      A random number of reflectors shall be tested. The reflector shall be placed with the center of the reflecting face 5 feet from a uniformly bright light source having an effective diameter of 0.2 inch.

The photocell shall be an annular ring with an inside diameter of 0.37 inch and an outside diameter of 0.47 inch. The photocell shall be shielded to eliminate stray light. The distance from the light source center to the photocell center shall be 0.21 inch. If a test distance other than 5 feet is used, the source and receiver distances shall be modified in the same proportion as the test distance.

A 1-inch diameter flat pad shall be formed of No. 10 coarse steel wool conforming to Federal Specification A-A-1043A. The steel wool pad shall be placed on the reflector lens, and a load of 50 pounds shall be applied while rubbing the entire lens surface 100 times. After the lens surface has been abraded, the specific intensity of each crystal reflecting surface at 0.2-degree observation angle shall not be less than the following when the incident light is parallel to the base of the reflector:

Horizontal Entrance Angle	Specific Intensity (mcd/foot-candles)
0 degrees	3.0 to 4.0
20 degrees	1.2 to 1.6

For amber reflectors, the specific intensity shall be 60 percent of the value for white. Failure of more than four percent of the reflecting faces will be cause for rejection of the lot.

Off-color reflection will be cause for rejection.

b. Physical Requirements. A random sample of three reflectors shall be selected for testing. Each reflector shall be placed, top side up, on a steel plate not less than ½ inch thick. The reflector shall be capable of supporting a load of 1,200 pounds when applied slowly to the top center of the reflector through a 1-inch diameter, 1-inch high metal plug centered on top of the reflector. Failure shall consist of one or more of the following:

(1) Breakage or significant deformation of the reflector at a load of less than 1,200 pounds.
(2) Significant delamination between the thin protective coat and the surface of the acrylic shell at a load of less than 1,200 pounds.
(3) Scratched hard-coat surface of the reflector.
(4) Reflector without hard coat.

3. Reflector to Casting Adhesive. The reflector adhesive used in the bonding of the prismatic retroreflector to the casting shall be an approved functional equivalent recommended by the manufacturer and having the following generic formulation:

Material	Percent by Weight
Aliphatic Petroleum Distillate (Hexane)	36.0
Kaolin Clay	32.1
Synthetic Rubber	13.1
Hydrocarbon Resin	7.8
Rosin Ester	7.1
Calcium Carbonate	3.3
Antioxidant	0.6
	100.0

4. Reflector Installation to Casting. The bottom of the reflector shall be clean and dry to permit attachment of the reflector to the primed surface of the casting. The adhesive shall be applied in a ⅜-inch bead, the length of the reflector. The reflector shall then be firmly pressed onto the casting by manual or mechanical means. The presence of any or all defects shall be cause for rejection of an individual reflector and casting or, if applicable, of a shipment.

5. Epoxy Compound - Standard Set. Standard set epoxy shall be a two-component epoxy formulated for use in bonding snow-plowable pavement markers to portland cement concrete and HMA and conforming to the following:

	Parts By Weight
Component A	
Epoxy Resin	100.00
Titanium Dioxide	7.68
No. 13 Talc	36.64
Component B	
N-Aminoethyl Piperazine	25.10
Nonyl Phenol	50.03
Talc	69.28
Malacco Black	0.23

The epoxy adhesive shall be mixed by an automatic proportioning and mixing machine; Components A and B shall have a ratio of 1:1 by volume. The mixing operation and placing of the reflectors and castings shall be done rapidly. A mixed batch of epoxy adhesive shall not be used if it becomes so viscous that it cannot be extruded readily from under the casting when light pressure is applied. The adhesive shall be maintained at 60 °F to 80 °F before mixing. If required, heating of the epoxy shall be by application of indirect heat. The adhesive shall not be heated above 120 °F.

Certification of Compliance shall be furnished according to Subsection 106.04.

912.18 Sampling and Testing Methods.{ XE "Samples for:paint" }{ XE "Samples for:epoxy components" }{ XE "Samples for:glass beads" }{ XE "Paint:sampling and testing" }

Samples and a certified analysis of any ingredients to be used or any paint manufactured shall be furnished by the manufacturer within ten days after request is made. The Engineer may require the manufacturer of the paint to certify the use of the specific materials and components in the quantities specified herein where such materials or components are not readily identifiable in the finished paint**.**

Sampling and testing will be performed according to the above requirement and the following:

Paint:

Driers	1 pint from each lot
Pigments	1 pint from each lot
Ready-mixed	Two 1-pint cans from each lot
Resin	1 pint from each lot
Stabilizers	1 pint from each lot
Thinner	1 quart from each lot
Varnish	1 pint from each lot
Vehicles	1 quartfrom each lot
Epoxy components	Sufficient quantities from each component to make 1 gallon
Glass beads	1 quartfrom each lot

SECTION 913 - PIPE{ XE "PIPE MATERIALS" }

913.01 Aluminum Alloy Structural Plate for Pipe, Pipe Arches, and Arches.{ XE "Pipe materials:aluminum alloy structural plate" }

Aluminum alloy structural plate pipe and the bolts and nuts shall conform to AASHTO M 219.

913.02 Ductile Iron Culvert Pipe.{ XE "Pipe materials:ductile iron culvert" }

Ductile iron culvert pipe shall conform to ASTM A 716 or shall be ductile iron pipe conforming to ANSI/AWWA C151/A21.51 with push-on joint and Table 913-1 below:

Table 913-1 Ductile Iron Culvert Pipe{ XE "Tables:pipe:ductile iron culvert pipe" }

Nominal Diameter (Inches)	Inside Thickness (Class)	Nominal Thickness (Inches)	Nominal Mass (pounds per foot)
12	2	0.37	48.7
14	1	0.36	55.5
16	1	0.37	65.3
18	1	0.38	75.4
20	1	0.39	86.0
24	2	0.44	115.7
30	5	0.59	186.3
36	5	0.68	256.7
42	6	0.83	361.4
48	6	0.93	461.7
54	6	1.05	584.3

913.03 Ductile Iron Water Pipe.{ XE "Pipe materials:ductile iron water" }

Ductile iron water pipe shall conform to ANSI/AWWA C151/A21.51 as prescribed in the Special Provisions. All threaded flanges shall conform to ANSI/AWWA C115/A21.15, and all fittings shall conform to ANSI/AWWA C110/A21.10, C153/A21.53. Field welding of ductile iron pipe is not permitted. All required welding of a ductile iron pipe assembly shall be performed in the fabrication shop.

913.04 Concrete Pipe.{ XE "Pipe materials:concrete" }

Concrete pipe shall conform to the AASHTO Specifications cited below except that the concrete shall be made from portland cement conforming to ASTM C 150 and other materials conforming to the following Subsections:

Aggregates for Portland Cement Concrete 901.12
Water 919.15

Reinforced concrete culvert, storm drain, and sewer pipe shall conform to AASHTO M 170.

Reinforced concrete culvert pipe shall be Class III, Wall B unless otherwise designated.

Elliptical reinforcing will not be permitted in circular pipe.

Reinforced concrete arch culvert, storm drain, and sewer pipe shall conform to AASHTO M 206.

Reinforced concrete elliptical culvert, storm drain, and sewer pipe shall conform to AASHTO M 207.

Perforated concrete pipe shall conform to AASHTO M 175.

Porous concrete pipe shall conform to AASHTO M 176.

913.05 Corrugated Aluminum Alloy Culvert Pipe and Pipe Arches.{ XE "Pipe materials:corrugated aluminum alloy" }{ XE "Pipe materials:corrugated aluminum alloy:culvert" }

Corrugated aluminum alloy culvert pipe and pipe arches shall conform to ASTM B 745. Types I and II, and the following:

1. **Type I.** Corrugated aluminum alloy culvert pipe and pipe arches shall be fabricated from 16 gauge (0.064 inch) sheet metal except where other thicknesses are designated.

   Only helical corrugations will be permitted except that annular corrugations shall be used where designated.

   The pipe shall be field jointed with locking bands conforming to ASTM B 745 except that coupling bands with projections (dimples) are not permitted.
2. **Type II.** The sheet metal thickness shall conform to that of the equivalent size of Type I pipe.

913.06 Corrugated Aluminum Alloy Underdrain Pipe.{ XE "Pipe materials:corrugated aluminum alloy:underdrain" }

Corrugated aluminum alloy underdrain pipe shall conform to ASTM B 745, Type III.

The sheet metal thickness for the various sizes as listed below shall be as follows:

Pipe Diameter	Gauge Thickness
6"	18 (0.048")
8"	18 (0.048")

913.07 Corrugated Steel Culvert Pipe and Pipe Arches.{ XE "Pipe materials:corrugated steel:culvert" }

Corrugated steel culvert pipe and pipe arches shall conform to ASTM A 760, Types I and II.

Special sections, such as elbows and flared end sections, shall be of the same thickness as the conduit to which they are joined and shall conform to ASTM A 760 and the following:

1. **Type I.** Corrugated steel culvert pipe and pipe arches shall be fabricated from 14 gauge (0.079 inch thick) sheet metal except where other thicknesses are designated.

   Only helical corrugations will be permitted for Type I pipe except that annular corrugations shall be used where designated.

   The pipe shall be field jointed with locking bands conforming to ASTM A 760 except that coupling bands with projections (dimples) are not permitted.

   Corrugated steel culvert pipe and coupling bands, elbows, and flared end sections shall have a polymeric coating as specified in AASHTO M 246, Grade 36/11 (interior 0.010 inches and exterior 0.003 inches).

   For testing coated pipe, a section of pipe of the specified diameter and length shall be furnished upon request.
2. **Type II.** The sheet metal thickness shall conform to that of the equivalent size of Type I pipe.

   Corrugated steel culvert pipe and coupling bands, elbows, and flared end sections shall have a polymeric coating as specified in AASHTO M 246, Grade 36/11 (interior 0.010 inches and exterior 0.003 inches).

For testing coated pipe, a section of pipe of the specified diameter and length shall be furnished upon request.

913.08 Corrugated Steel Sewer Pipe and Pipe Arches.{ XE "Pipe materials:corrugated steel:sewer" }

Corrugated steel sewer pipe and pipe arches shall conform to AASHTO M 190, Type D.

913.09 Corrugated Steel Underdrain Pipe.{ XE "Pipe materials:corrugated steel:underdrain" }

Corrugated steel underdrain pipe shall conform to ASTM A 760, Type III.

The sheet metal thickness for the various sizes as listed below shall be as follows:

Pipe Diameter	**Gauge Thickness**
6"	18 (0.052")
8" and larger	16 (0.064")

Corrugated steel underdrain pipe shall be bituminous coated or polymeric coated. When polymeric coating is used, the pipe and coupling bands shall conform to AASHTO M 246, Grade 36/11 (interior 0.010 inches and exterior 0.003 inches). When bituminous coating is used, pipe and coupling bands shall conform to AASHTO M 190, Type A.

913.10 Fiberglass Pipe.{ XE "Pipe materials:fiberglass" }

Fiberglass pipe and fittings shall conform to ASTM D 2996 Designation Code RTRP-11AE-5112. Pipe and fittings with Class C or Class F liners are acceptable. The finish color shall be concrete gray.

913.11 Plastic Drainage Pipe.{ XE "Pipe materials:plastic drainage" }

{ XE "Pipe materials:PVC (polyvinyl chloride)" **}**Corrugated polyethylene drainage pipe shall conform to AASHTO M 252. Polyvinyl chloride (PVC) drainage pipe shall conform to ASTM D 2729.

913.12 Semicircular Steel Pipe for Underdrains.{ XE "Pipe materials:semicircular steel" }

Semicircular steel pipe for underdrains shall conform to ASTM A 760, Type IIIA. Pipe and connecting bands shall be bituminous coated or polymeric coated. Bituminous coating shall be according to AASHTO M 190, Type A. Polymeric coating shall be according to AASHTO M 246, Grade 36/11 (interior 0.010 inches and exterior 0.003 inches).

913.13 Steel Alloy Pipe for Bridge Storm Drains.{ XE "Pipe materials:steel alloy" }

Steel alloy pipe and fittings shall be of alloy steel conforming to the chemical analysis of ASTM A 53, Grade B or ASTM A 500. Ductile iron pipe conforming to ASTM A 377 (ANSI/AWWA C151/A21.51) may be furnished as an alternate. The pipe and fittings for both the steel alloy pipe and ductile iron pipe alternate shall be zinc-coated (galvanized) according to ASTM A 123. Steel pipe and fitting shall be connected by welding before galvanizing.

Ductile iron pipe fittings shall conform to ASTM A 48, Class 30. Pipe bends shall be of the long radius type. Pipe joints shall be formed using groove-type couplings consisting of a housing clamp keyed into a groove cut around the full pipe circumference. A gasket of molded or extruded butyl or EPDM shall be provided to create a sealed joint. Bolts shall be of track type conforming to ASTM A 183 with oval necks and heavy hexagon standard nuts. The assembly shall be galvanized according to Subsection 503.15, Subpart A.

913.14 Structural Steel Plate for Pipe, Pipe Arches, and Arches.{ XE "Pipe materials:structural steel plate" }

Conduits, bolts, and nuts for connecting plates shall conform to ASTM A 761.

913.15 Vitrified Clay Pipe.{ XE "Pipe materials:vitrified clay" }

Clay pipe shall be standard strength, extra strength, standard strength perforated, or extra strength perforated and shall conform to ASTM C 700.

913.16 Sampling and Testing Methods.{ XE "Pipe materials:sampling and testing" }

Sampling and testing will be performed according to the appropriate AASHTO and ASTM methods and the following:

{ XE "Samples for:pipe" **}**Corrugated steel culvert pipe and pipe arches..... Subsection 913.07

913.17 Certification of Compliance.

Manufacturer's certification for all pipe shall be submitted according to Subsection 106.04.

SECTION 914 - PORTLAND CEMENT CONCRETE, MORTAR, AND GROUT{ XE "PORTLAND CEMENT CONCRETE, MORTAR, AND GROUT" \T "*SEE* LISTINGS FOR CONCRETE, MORTAR, AND GROUT" }{ XE "MORTAR" }{ XE "CONCRETE (PORTLAND CEMENT)" }

914.01 Composition of Portland Cement Concrete.

Portland cement concrete shall be composed of portland cement, coarse aggregate, fine aggregate, admixtures, and water. Portland cement concrete except white concrete may include fly ash. Portland cement concrete for bridge structures, retaining walls, and culverts may include a maximum of 15 percent by weight of Class F fly ash conforming to AASHTO M 295.

{ XE "Concrete (portland cement):materials" **}**Materials shall conform to the following Subsections:

Aggregates	901.12
Admixtures:	
Air-Entraining	905.01
Chemical	905.02
Fly Ash	919.07
Portland Cement	919.11
Water	919.15
Ground Granulated Blast Furnace Slag	919.18

Chemical admixtures conforming to the requirements of Subsection 905.02 may be used in the mix design of structural concrete items.

914.02 Portland Cement Concrete Design, Control, and Acceptance Testing Requirements.{ XE "Concrete (portland cement):design" }{ XE "Concrete (portland cement):acceptance testing requirements" }

A. General Requirements. The coarse aggregate size, slump, and entrained air for each item and class of concrete shall be as specified in Subsection 914.05, Tables 914-1 and 914-2. The concrete shall be designed to conform to Subsection 914.05, Table 914-3. Any of the coarse aggregate sizes in Subsection 914.05, Tables 914-1 and 914-2 may be used for a particular type of construction. Coarse aggregate size Nos. 357 and 467 shall be produced by weight proportioning directly into the mixer from size Nos. 3 and 57 and size Nos. 4 and 67 respectively. Conformance to gradation will be determined on the basis of separate tests on the component sizes before proportioning. If the size selected creates a clearance problem with reinforcement steel, a smaller size aggregate shall be used.

{ XE "Concrete (portland cement):acceptance testing requirements:proportioning and verification" **}B. Proportioning and Verification.** At least 45 days before the start of concrete placement, trial batches of concrete shall be prepared of the same materials and proportions proposed for use on the Project.

The designs shall be computed and set up according to ACI Standard 211.1 or 211.2, as applicable. Each mix design shall be submitted on portland cement concrete mix design forms furnished by the Department giving the sources of materials and test data.

Department personnel shall be present at the time of verification batching to confirm that the proportions and ingredients batched are according to the proposed mix designs. At least six 4 by 8-inch compression test cylinders shall be prepared from each batch and cured according to AASHTO T 23 or AASHTO T 126. Within two to five days after molding, the cylinders shall be delivered to the Department Laboratory where testing will be performed for seven-day and 28-day compressive strengths.

The use of chemical admixtures shall be according to the admixture manufacturer's recommendation for the given design mix and anticipated field conditions, including the admixture dosage rate(s) and the location (plant or placement site) where it is to be introduced into the mixture. The admixture manufacturer's technical representative shall be on the Project site for the first full day's production of mix containing a chemical admixture to recommend methods and operations based on prevailing climatic and job conditions.

At least one trial mix shall be designed to equal or exceed the required verification strengths listed in Subsection 914.05, Table 914-3 for each class of concrete included on the Project. A single mix design may satisfy the requirements for more than one class of concrete, and any mix design failing to meet a specific verification requirement may later be approved for use on the Project if the field strengths and degree of quality control warrant.

At the Department's option, verification may be done on an annual basis for a concrete plant rather than on a project-to-project basis provided the properties and proportions of the materials do not change. If the job

is the continuation of Work in progress during the previous construction season and written verification is submitted that the same source and character of materials are to be used, the Engineer may waive the requirement for the design and verification of previously approved mixes.

Concrete furnished on the Project shall conform to the approved mix design. If another previously approved mix design is to be used, the Engineer shall be notified at least one day before such change.

Change in the sources, types, or proportions of materials shall not be made until approved and the requirements for verification specified herein have been satisfied. The Engineer may waive this requirement if the materials, other than portland cement, or proportions are not appreciably different from those used with a previously approved mix design.

The requirement to verify a new design as a result of a change in the source of portland cement may be waived only by the Engineer.

{ XE "Concrete (portland cement):design:early strength" **}**Classes A, B, and C concrete may be designed to achieve early strength requirements by increasing the cement content. Alternatively, an existing approved mix design may serve as a high-early-strength mix. Additional verification tests for high-early-strength mixes are not required but will be performed if requested. Before actual loading is applied in the field, the requirements of Subsections 405.19 and 501.24 shall be met.

If fly ash is added, its weight shall not exceed 15 percent of the minimum cement content and shall not be greater than 125 percent of the weight of cement replaced.

If fly ash is added to control alkali-silica reactivity, the minimum amount required shall not be less than 15 percent of the total cementitious material. If AASHTO T 303 Standard Test Method results in an expansion greater than 0.40 percent, the minimum addition of fly ash shall be 20 percent. Fly ash may replace no more than 15 percent of the portland cement; the remaining fly ash will replace fine aggregate.

If ground granulated blast furnace slag is used to control alkali-silica reactivity, the amount required shall not be less than 25 percent of the total cementitious material.

The combined weight of fly ash, ground granulated blast furnace slag, and cement content shall be used to determine compliance with the cement factor and water-cement ratio requirements listed in Subsection 914.05, Table 914-3.

If it is the opinion of the Engineer that the mix properties are such that concrete of unacceptable quality is likely to be produced, the Work may be ordered stopped until the cause has been determined and the necessary corrective action has been taken. The corrective action may range from a minor adjustment of proportions to the establishment of a new mix design.

If the concrete producer has satisfactorily met applicable design, control, and acceptance testing requirements at the batch plant and has provided automatic recordation of the various batched weights which comply with specified design criteria, slump, and air content, the concrete will be presumed to be in compliance with Department standards at the time of delivery. This presumption shall not waive or alter any other requirements or otherwise affect the Engineer's ability to impose pay-adjustments.

{ XE "Concrete (portland cement):acceptance testing requirements:slump and air entrainment" **}C. Acceptance Testing Procedures for Slump and Air Entrainment.** The Engineer will perform sampling and testing for slump and air entrainment except for precast, prestressed concrete items for which sampling and testing for slump and air entrainment shall be performed by the Contractor.

Slump and air-entrainment tests are at the rate specified for strength tests in Subsection 914.05, Table 914-4 and will be performed on the same samples of material from which the compressive tests cylinders have been molded. While these tests are being performed, discharge from the truck is to be halted. Discharge from other trucks not scheduled for test may proceed.

For slump or air entrainment or both, if the measured value is outside the ranges specified in Subsection 914.05, Table 914-1 or 914-2, a second test will be performed on a different portion of material from the same load. If the average of the two test results for either slump or air entrainment exceeds the upper limit, the load of concrete will be rejected and removed from the Project site. If the average of the two test results for either slump or air-entrainment falls below the lower specification limit, a single addition of mix water (or the approved Type F admixture for those mixes containing a water-reducing, high range admixture) and/or air-entraining agent will be permitted provided that this additional step can be accomplished without exceeding the time or revolution limits specified in Subsection 405.08. When an air-entraining agent is added, it shall be diluted with water before addition to the drum.

Following any permitted additions, the drum shall be rotated at the recommended mixing speed for a minimum of ten and a maximum of 20 revolutions, the original test results shall be disregarded, and a single test for both slump and air-entrainment performed. Further additions of mix water or admixtures will not be

permitted. If the measured values for slump and air-content are not within the ranges specified in Subsection 914.05, Tables 914-1 and 914-2, the load of concrete will be rejected and removed from the Project.

Each truck load of concrete containing fly ash will be tested for slump and air entrainment.

{ XE "Concrete (portland cement):acceptance testing requirements:strength" }**D. General Acceptance Testing Requirements for Strength.** The Engineer will perform sampling and testing for strength except for precast, prestressed concrete items for which sampling and testing for strength shall be performed by the Contractor.

A sufficient number of curing facilities for the storage and curing of concrete test cylinders on the Project site for the 24 hours required by AASHTO T 23 shall be provided for the sole use of the Engineer. The curing facilities shall be provided with a minimum-maximum thermometer and shall be securable with lock and key. During the period of May 1 through October 31, the Contractor shall provide water tanks or tubs of sufficient capacity and rigidity to hold the cylinders in an upright position, fully submerged and without contact between cylinders. During the remaining months of the year, or as directed by the Engineer, securable insulated or heated boxes, of similar capacity and rigidity shall be provided. During the initial 24 hours, the Contractor is solely responsible for ensuring that the test specimens are undisturbed and maintained within the specified temperature range. If, within ten days of the Engineer's request, the facilities are not provided, the Contractor shall not place any concrete.

An initial strength test result is defined in Subsection 914.05, Table 914-4. The required rate of sampling and the acceptance testing criteria of Subsection 914.05, Table 914-4 must be met. If either of the cylinders comprising a test shows definite evidence (other than low strength) of improper sampling, molding, handling, curing, or testing, it is to be discarded and the strength of the remaining cylinder then is considered the test result. If the difference in compressive strength between two cylinders comprising a test equals or exceeds 600 pounds per square inch, the lower value is to be disregarded and the higher value is taken as the test result. If both cylinders comprising a test must be discarded, the lot will be evaluated on the basis of the reduced number of tests. If a batch of concrete from which compression cylinders have been prepared is rejected because it fails to meet the slump or air-entrainment requirements of this Subsection, the cylinders obtained from that batch will be discarded.

If additional unscheduled compression cylinders are taken, as permitted by Subsection 106.03, they are to be included with the regularly scheduled compression cylinders and the lot will be evaluated on the basis of the increased number of tests.

{ XE "Concrete (portland cement):acceptance testing requirements:strength:pay-adjustment items" }**E.Acceptance Testing for Strength for Pay-Adjustment Items.** The list of concrete Pay Items, if any, which are subject to pay–adjustment, and the base prices may be found in the Special Provisions.

The amount of pay-adjustment in dollars is the product of the item base price times the lot quantity times the percent pay-adjustment. The percent pay-adjustment is given by Equation No. 1.

Equation No. 1:

$$PPA = 2.0 - 0.2\,PD$$

Where: PPA = Percent Pay-Adjustment
PD = Percent Defective (Estimate of percent of lot below the class design strength by the use of Equation No. 2 and Subsection 914.05, Table 914-5)

Equation No. 2:

$$Q = (ALS - CDS) / S$$

Where: Q = Quality index for pay-adjustment computations
ALS = Average lot strength in pounds per square inch
CDS = Class design strength in pounds per square inch
S = Standard deviation of the strength test results in pounds per square inch for the lot as computed by Equation No. 3

Equation No. 3:

$$S = \sqrt{\frac{\Sigma(Xi - ALS)^2}{N - 1}}$$

Where: Σ = Summation
Xi = Individual test result (Average strength of a test cylinder pair)
N = Number of test results for the lot

When only a single test result is available, the standard deviation "S" is assumed to equal 300 psi.

When it is necessary to estimate the percentage of material below the retest limit to check the rejection criteria in Subsection 914.05, Table 914-4, Equation No. 4 is used with Subsection 914.05, Table 914-5. All other terms are previously defined.

Equation No. 4:

$$Q_{reject} = (ALS - \text{Retest Limit}) / S$$

Provided that no individual test result falls below the retest limit listed in Subsection 914.05, Table 914-4, the acceptability of a lot is based upon the estimated percentage of concrete having a 28-day compressive strength less than the class design strength specified in Subsection 914.05, Table 914-3. To be eligible for 100 percent payment, a lot must have no more than ten percent of the material below the class design strength.

For lots with percent defective levels less than ten percent, Equation No. 1 provides positive pay-adjustments to the Contract price. For lots having percent defective levels greater than ten percent but not exceeding the rejection limit in Subsection 914.05, Table 914-4, Equation No. 1 assesses negative pay-adjustments to the Contract price.

Whenever an initial test result falls below the retest limit in Subsection 914.05, Table 914-4, the concrete will be re-evaluated by coring or other suitable means. When this provision is applied to Class P concrete, each beam or pile in the steam bed will be evaluated separately.

When re-evaluation is accomplished by a method other than coring, the results will be used only to determine what further action is to be taken. If any of the non-core tests results are below the class design strength, the Engineer has the option to core. If this option is waived, the Contractor may elect to core, at no cost to the State and within 60 days after being presented with this option, or to accept the pay-adjustment computed from the initial cylinder tests. If the Contractor elects to core, the coring shall be performed as directed and the Department will test the cores. If none of the non-core test results is below the class design strength, the Engineer may elect either to core or to accept the lot at 100 percent payment.

When cores are taken, final disposition of the lot is based on the core results. Pay-adjustment will be computed using the core test results provided that the estimated percentage of material below the retest limit does not exceed the maximum allowable percentage in Subsection 914.05, Table 914-4. If the maximum allowable percentage is exceeded, the Engineer may:

1. Require the Contractor to remove and replace the defective lot at no cost to the State,
2. Allow the Contractor to leave the defective lot in place and receive a percent pay-adjustment (PPA) of minus 50 percent, or
3. Allow the Contractor to submit a plan, for approval, for corrective action to be performed at no cost to the State. If the plan for corrective action is not approved, either option 1 or 2 above may be applied.

{ XE "Concrete (portland cement):acceptance testing requirements:strength:non-pay-adjustment items" **}F. Acceptance Testing for Strength for Non-Pay-Adjustment Items.** This Subpart applies to all concrete items in Subsection 914.05, Tables 914-1 and 914-2 that are not subject to pay-adjustment and other requirements according to Subpart E above and that are not accepted on the basis of Certificates of Compliance. The lot is eligible for 100 percent payment provided that all initial test results equal or exceed the retest limit for non-pay-adjustment items in Subsection 914.05, Table 914-4. Whenever one or more individual test results fall below the retest limit, the lot will be re-evaluated by coring or other suitable means and is subject to pay-adjustment and all other provisions according to Subpart E above except that, for the following Pay Items, the amount of pay-adjustment is the product of the unit bid price times the estimated

percentage of concrete, as indicated below, in decimal equivalent contained in the item times the lot quantity times the percent pay-adjustment given by Equation No. 1:

Pay Item	Estimated Percentage of Concrete
INLETS, TYPE ___	30
INLETS, TYPE ___, USING EXISTING CASTING	30
INLETS, TYPE B-___	40
INLETS, TYPE B-___, USING EXISTING CASTING	40
INLETS, TYPE ___ MODIFIED	40
INLETS, TYPE ___ MODIFIED, USING EXISTING CASTING	40
INLETS, TYPE ES	50
INLET CASTINGS, TYPE ES	40
MANHOLES	30
MANHOLES, ___ ' DIAMETER	30
MANHOLES, USING EXISTING CASTING	30
MANHOLES, SANITARY SEWER	30
MANHOLES, SANITARY SEWER, USING EXISTING CASTING	30
GRANITE CURB	25
RESET GRANITE CURB	25
BEAM GUIDE RAIL ANCHORAGES	25
CHAIN-LINK FENCE, ___ ' HIGH	25
CHAIN-LINK FENCE, ALUMINUM-COATED STEEL, ___ ' HIGH	25
CHAIN-LINK FENCE, PVC-COATED STEEL, ___ ' HIGH	25
CHAIN-LINK FARM-TYPE FENCE	25
GATES, CHAIN-LINK FENCE, ___ ' WIDE	25
GATES, CHAIN-LINK FENCE, ALUMINUM-COATED STEEL, ___ ' WIDE	25
GATES, CHAIN-LINK FENCE, PVC-COATED STEEL, ___ ' WIDE	25
GATES, CHAIN-LINK FARM-TYPE FENCE, ___ ' WIDE	25
RESET FENCE	25
TEMPORARY CHAIN-LINK FENCE, ___ ' HIGH	25
GUIDE SIGNS, TYPE GA, BREAKAWAY SUPPORTS	20
GUIDE SIGNS, TYPE GA, NON-BREAKAWAY SUPPORTS	20

The amount of pay-adjustment for items not listed above is the product of the unit bid price times the lot quantity times the percent pay-adjustment given by Equation No. 1.

914.03 Mortar and Grout.

{ XE "Grout" **}{** XE "Grout:non-shrink type" **}**Mortar and grout shall consist of one part portland cement to two parts fine aggregate unless otherwise specified. Water shall be added to form the proper consistency. Mortar and grout shall not be tempered or used after it has begun to set.

Materials shall conform to the following Subsections:

Aggregates.....901.12
Portland Cement.....919.11
Water.....919.15

Where nonmetallic or non-shrink grout is specified, the grout shall conform to ASTM C 1107, Type A, B, or C with the following amendments:

1. The grout shall be of a plastic consistency.
2. The color of the hardened grout, where visible, shall match the color of the adjacent hardened concrete.
3. One day strength tests shall be included as part of the performance requirements of ASTM C 1107.

The grout shall have a minimum working life of 30 minutes from the time the water is added and shall contain not more than 0.05 percent chlorides or 5.0 percent sulfates by weight.

The grout shall not contain any corrosion-promoting agents.

Epoxy and other types of nonmetallic or non-shrink grout may be used.

914.04 Sampling and Testing Methods.{ XE "Concrete (portland cement):sampling and testing" }{ XE "Samples for:portland cement concrete" }

Sampling and testing will be performed according to the following:

AASHTO

T 22	Compressive Strength of Cylindrical Concrete Specimens (Including the Annex providing for use of neoprene caps)
T 23	Making and Curing Concrete Test Specimens in the Field
T 24	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
T 119	Slump of Hydraulic Cement Concrete
T 121	Weight Per Cubic Foot, Yield and Air Content (Gravimetric) of Concrete
T 126	Making and Curing Concrete Test Specimens in the Laboratory
T 141	Sampling Fresh Mixed Concrete
T 152	Air Content of Freshly Mixed Concrete by the Pressure Method
T 196	Air Content of Freshly Mixed Concrete by the Volumetric Method

ASTM

C 567	Unit Weight of Structural Lightweight Concrete
C 311	Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete. (see Note)

Note: The Department may modify the sampling rate for individual and composite samples.

NJDOT

C-1	Determination of Yield of Concrete Produced by Continuous-Mixing-Type Truck Mixers

Note: Wherever the reference to 4 by 8-inch (diameter by height) compression test cylinders appears in these Specifications, the use of 6 by 12-inch (diameter by height) test cylinders will be required for mix designs containing coarse aggregate sizes exceeding a nominal maximum size of 1 inch.

914.05 Tables.{ XE "Concrete (portland cement):tables" }

Tables referenced in the Specifications are shown in the following pages:

Table 914-1 Requirements for Roadway Concrete Items{ XE "Tables:portland cement concrete:requirements for roadway concrete items" }

	Concrete Class	Slump (inch)	Percent Air Entrainment for Coarse Aggregate Size Numbers				
			357	467	57	67	8
Cast-in-Place Items							
Surface Course, Bridge Approach Slabs, Bridge Approach Transition Slabs	B	2±1	5.0±1.5	5.0±1.5	6.0±1.5	6.0±1.5	7.0±1.5
Base Course	C	2±1	5.0±1.5	5.0±1.5	6.0±1.5	6.0±1.5	7.0±1.5
Inlet and Manhole Walls, Headwalls, Miscellaneous Concrete	C	3±1	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Inlet and Manhole Top Slabs, Sidewalks, Driveways, Islands	B	3±1	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Slope Gutters, Vertical Curb, Sloping Curb, Barrier Curb and Base	B	4±1	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Concrete and White Concrete Vertical, Sloping and Barrier Curb, Concrete and White Concrete Islands	B	4±1	----	----	7.0±2.0	7.0±2.0	8.0±2.0
Foundations for:							
Inlets and Manholes	C	3±1	6.5 max	6.5 max	7.5 max	7.5 max	8.5 max
Electrical Items	C	3±1	----	----	7.5 max	7.5 max	8.5 max
Signs	B	3±1	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Junction Boxes	C	3±1	----	----	7.5 max	7.5 max	8.5 max

Table 914-1 (Continued) { XE "Tables:portland cement concrete:requirements for roadway concrete items" }

	Concrete Class	Slump (inch)	Percent Air Entrainment for Coarse Aggregate Size Numbers				
			357	467	57	67	8
Cast-in-Place Items (continued)							
Footings for Fence Posts, Guide Rail End Treatment	C	3±1	----	----	7.5 max	7.5 max	8.5 max
Culverts`	A	3±1	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Monuments	A	3±1	----	----	7.5 max	7.5 max	8.5 max
Slope Protection	C	2±1	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Precast Items							
Culverts	A	3±1	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Inlets and Manholes, Junction Boxes, Headwalls, Reinforced Concrete End Sections (See Note 2)	B	3±1	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Concrete/White Concrete Barrier Curb	B	3±1	----	----	7.0±2.0	7.0±2.0	8.0±2.0

Note 1: According to the provisions of Subsection 501.03, a Type F water-reducing, high range admixture will be permitted according to Subsection 905.02 and Subsection 914.02, Subparts B and C. When a Type F admixture is used, the table Slump and Air Content values for the given concrete item shall be changed as follows:
Slump: 6 ± 2 inches
Air Content: Increase both the target value and tolerance percentages by 0.5.

Note 2: For the items in this category, the slump may be reduced to zero (dry cast) provided that adequate consolidation, acceptable to the Engineer, is achieved.

Table 914-2 Requirements for Structural Concrete Items{ XE "Tables:portland cement concrete:requirements for structural concrete items" }

	Concrete Class	Slump (inch)	Percent Air Entrainment for Coarse Aggregate Size Numbers					
			357	**4**	**467**	**57**	**67**	**8**
Cast-in-Place Items								
Unreinforced Footings	B	3±1	6.5 max	6.5 max	6.5 max	7.5 max	7.5 max	8.5 max
Reinforced Footings	B	3±1	----	----	6.5 max	7.5 max	7.5 max	8.5 max
Abutments, Walls Solid Shaft Piers, Pylons	B	3±1	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Concrete/White Concrete Barrier Curb, Bridge	B	4±1	----	----	----	7.0±2.0	7.0±2.0	8.0±2.0
Piles	B	3±1	----	----	----	7.5 max	7.5 max	8.5 max
Columns and Caps for Piers, Arch Spans, Rigid Frarnes, Culverts	A	3±1	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Decks, Sidewalks, Concrete Patch, Parapets, Curbs	A	3±1	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Seal (Tremie) Concrete	S	7±2	----	----	----	7.5 max	7.5 max	8.5 max
Prestressed Items								
Beams	P, P-1,& P-2	2±1	----	----	----	5.0±1.5	5.0±1.5	5.0±1.5
Piles	P	2±1	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5

Table 914-2 (Continued) { XE "Tables:portland cement concrete:requirements for structural concrete items" }

	Concrete Class	Slump (inch)	Percent Air Entrainment for Coarse Aggregate Size Numbers					
			357	4	467	57	67	8
Precast Items								
Crib Wall Members	A	3±1	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Piles	B	3±1	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Culverts	P	3±1	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Modular Bin Units	P	2±1	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Noise Barriers	P	2±1	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Slip-Form Items			----	----	----			
Parapet	A	1±½	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5

Note 1: According to the provisions of Subsection 501.03, a Type F water-reducing, high range admixture will be permitted according to Subsection 905.02 and Subsection 914.02, Subparts B and C. When a Type F admixture is used, the table Slump and Air Content values for the given concrete item shall be changed as follows:

Slump: 6 ± 2 inches

Air Content: increase both the target value and tolerance percentages by 0.5.

Table 914-3 Mix Design Requirements{ XE "Tables:portland cement concrete:mix design requirements" }

	Class of Concrete						
	A	**B**	**C**	**S**	**P**	**P-1**	**P-2**
Class Design Strength (28 days, psi)	4600	3700	3200	2000	5500	6000	6500
Verification Strength (28 days, psi)	5000	4500	4000	--	6000	6500	7000
Max. Water/Cement Ratio Or See Note 2							
lb/lb	0.443	0.488	0.532	0.577	Note 1	Note 1	Note 1
gal/bag	5.0	5.5	6.0	6.5	Note 1	Note 1	Note 1
Minimum Cement Content							
lb/cy	611	564	517	658	Note 1	Note 1	Note 1
bags/cy	6.5	6.0	5.5	7.0	Note 1	Note 1	Note 1

Note 1: According to PCI Manual, except as indicated in Note 2.
Note 2: The maximum water/cement ratio for all classes of concrete, when a Type F, water-reducing, high range admixture is used according to Tables 914-1 and 914-2, shall be 0.40 lb/lb (4.5 gal/bag)

Table 914-4 Lot Sizes, Sampling Rates, Retest, and Rejection Limits{ XE "Tables:portland cement concrete:lots sizes, sampling rates, retest, and rejection limits" }

	Class of Concrete						
	A	**B**	**C**	**S**	**P**	**P-1**	**P-2**
Lot Size, Maximum	One Day's Production				One Day's Production of a Single Steam Bed		
Pay-Adjustment Items							
Initial Sampling Rate	6/Lot	5/Lot	4/Lot	--	6/Lot	6/Lot	6/Lot
Retest Limit, psi	4000	3000	3000	2000	5000	5500	6000
Retest Sampling Rate, minimum	6/Lot	6/Lot	6/Lot	6/Lot	6/Unit or Load Test		
Rejection Limit, percent	10	10	20	20	5	5	5
Non-Pay-Adjustment Items							
Initial Sampling Rate	3/Lot	2/Lot	1/Lot	1/Lot	--	--	--
Retest Limit, psi	4400	3600	3100	2000	--	--	--

The lot sizes are maximums and, at the option of the Engineer, any lot may be subdivided into two or more smaller lots. When such a subdivision is made, the specified sampling rate applies to each of the smaller lots.

An initial strength test result is defined as the average strength of two 4 by 8-inch compression test cylinders, cured for 28 days, and tested in the Department Laboratory except for Classes P, P-1, and P-2 cylinders that may be tested at the fabricator's plant under the supervision of the Engineer.

A retest result is defined as the strength of an individual test result obtained by coring or other suitable means. If retest is performed by coring, each retest result is defined as the corresponding nominal core strength divided by 0.85.

The specified sampling rates shall apply except that no more than one test per truckload or batch of concrete will be required. At the option of the Engineer, lots consisting of fewer than three truckloads or batches, or containing 20 cubic yards or less, may be accepted without strength tests.

No lot shall include more than one class of concrete nor include concrete of the same class having different specified levels of slump or air entrainment.

For prestressed concrete, if more than one bed is used or if more than 80 cubic yards of concrete are used, the production shall be subdivided as equally as possible into two or more lots.

Retest limit for non-pay-adjustment roadway and structural items requiring the use of Class B, white concrete, shall be 3,000 pounds per square inch.

Table 914-5 Estimation of Lot Percent Defective{ XE "Tables:portland cement concrete:estimation of lot percent defective" }

Variability-Known Procedure **Standard Deviation Method**

Sample Size
1

Q	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.0	50.00	48.98	47.96	46.94	45.92	44.90	43.88	42.86	41.84	40.82
0.1	39.80	38.78	37.76	36.73	35.71	34.69	33.67	32.65	31.63	30.61
0.2	29.59	28.57	27.55	26.53	25.51	24.49	23.47	22.45	21.43	20.41
0.3	19.39	18.37	17.35	16.33	15.31	14.29	13.27	12.24	11.22	10.20
0.4	9.18	8.16	7.14	6.12	5.10	4.08	3.06	2.04	1.02	0.00

Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

This empirically derived table is suitable only for use with this Specification.

Table 914-5 (Continued) { XE "Tables:portland cement concrete:estimation of lot percent defective" }

Variability-Unknown Procedure — Standard Deviation Method

Sample Size 2

Q	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.66	49.33	48.99	48.66	48.32	47.99	47.65	47.32	46.98
0.1	46.64	46.31	45.97	45.64	45.30	44.97	44.63	44.30	43.96	43.62
0.2	43.29	42.95	42.62	42.28	41.95	41.61	41.28	40.94	40.60	40.27
0.3	39.93	39.60	39.26	38.93	38.59	38.26	37.92	37.58	37.25	36.91
0.4	36.58	36.24	35.91	35.57	35.23	34.90	34.56	34.23	33.89	33.56
0.5	33.22	32.89	32.55	32.21	31.88	31.54	31.21	30.87	30.54	30.20
0.6	29.87	29.53	29.19	28.86	28.52	28.19	27.85	27.52	27.18	26.85
0.7	26.51	26.17	25.84	25.50	25.17	24.83	24.50	24.16	23.83	23.49
0.8	23.15	22.82	22.48	22.15	21.81	21.48	21.14	20.81	20.47	20.13
0.9	19.80	19.46	19.13	18.79	18.46	18.12	17.79	17.45	17.11	16.78
1.0	16.44	16.11	15.77	15.44	15.10	14.77	14.43	14.09	13.76	13.42
1.1	13.09	12.75	12.42	12.08	11.75	11.41	11.07	10.74	10.40	10.07
1.2	9.73	9.40	9.06	8.72	8.39	8.05	7.72	7.38	7.05	6.71
1.3	6.38	6.04	5.70	5.37	5.03	4.70	4.36	4.03	3.69	3.36
1.4	3.02	2.68	2.35	2.01	1.68	1.34	1.01	0.67	0.34	0.00

Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

This empirically derived table is suitable only for use with this Specification.

Table 914-5 (Continued) { XE "Tables:portland cement concrete:estimation of lot percent defective" }

Variability-Unknown Procedure **Standard Deviation Method**

Sample Size
3

Q	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.72	49.45	49.17	48.90	48.62	48.35	48.07	47.79	47.52
0.1	47.24	46.96	46.69	46.41	46.13	45.85	45.58	45.30	45.02	44.74
0.2	44.46	44.18	43.90	43.62	43.34	43.05	42.77	42.49	42.20	41.92
0.3	41.63	41.35	41.06	40.77	40.49	40.20	39.91	39.62	39.33	39.03
0.4	38.74	38.45	38.15	37.85	37.56	37.26	36.96	36.66	36.35	36.05
0.5	35.75	35.44	35.13	34.82	34.51	34.20	33.88	33.57	33.25	32.93
0.6	32.61	32.28	31.96	31.63	31.30	30.97	30.63	30.30	29.96	29.61
0.7	29.27	28.92	28.57	28.22	27.86	27.50	27.13	26.76	26.39	26.02
0.8	25.64	25.25	24.86	24.47	24.07	23.67	23.26	22.84	22.42	21.99
0.9	21.55	21.11	20.66	20.19	19.73	19.25	18.75	18.25	17.74	17.21
1.0	16.67	16.11	15.53	14.93	14.31	13.66	12.98	12.27	11.51	10.71
1.1	9.84	8.89	7.82	6.60	5.08	2.87	0.00	0.00	0.00	0.00

Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table 914-5 (Continued) { XE "Tables:portland cement concrete:estimation of lot percent defective" }

Variability-Unknown Procedure **Standard Deviation Method**

Sample Size
4

Q	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.67	49.33	49.00	48.67	48.33	48.00	47.67	47.33	47.00
0.1	46.67	46.33	46.00	45.67	45.33	45.00	44.67	44.33	44.00	43.67
0.2	43.33	43.00	42.67	42.33	42.00	41.67	41.33	41.00	40.67	40.33
0.3	40.00	39.67	39.33	39.00	38.67	38.33	38.00	37.67	37.33	37.00
0.4	36.67	36.33	36.00	35.67	35.33	35.00	34.67	34.33	34.00	33.67
0.5	33.33	33.00	32.67	32.33	32.00	31.67	31.33	31.00	30.67	30.33
0.6	30.00	29.67	29.33	29.00	28.67	28.33	28.00	27.67	27.33	27.00
0.7	26.67	26.33	26.00	25.67	25.33	25.00	24.67	24.33	24.00	23.67
0.8	23.33	23.00	22.67	22.33	22.00	21.67	21.33	21.00	20.67	20.33
0.9	20.00	19.67	19.33	19.00	18.67	18.33	18.00	17.67	17.33	17.00
1.0	16.67	16.33	16.00	15.67	15.33	15.00	14.67	14.33	14.00	13.67
1.1	13.33	13.00	12.67	12.33	12.00	11.67	11.33	11.00	10.67	10.33
1.2	10.00	9.67	9.33	9.00	8.67	8.33	8.00	7.67	7.33	7.00
1.3	6.67	6.33	6.00	5.67	5.33	5.00	4.67	4.33	4.00	3.67
1.4	3.33	3.00	2.67	2.33	2.00	1.67	1.33	1.00	0.67	0.33
1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table 914-5 (Continued) { XE "Tables:portland cement concrete:estimation of lot percent defective" }

Variability-Unknown Procedure **Standard Deviation Method**

Sample Size
5

Q	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.64	49.29	48.93	48.58	48.22	47.86	47.51	47.15	46.80
0.1	46.44	46.09	45.73	45.38	45.02	44.67	44.31	43.96	43.60	43.25
0.2	42.90	42.54	42.19	41.84	41.48	41.13	40.78	40.43	40.08	39.72
0.3	39.37	39.02	38.67	38.32	37.97	37.62	37.28	36.93	36.58	36.23
0.4	35.88	35.54	35.19	34.85	34.50	34.16	33.81	33.47	33.12	32.78
0.5	32.44	32.10	31.76	31.42	31.08	30.74	30.40	30.06	29.73	29.39
0.6	29.05	28.72	28.39	28.05	27.72	27.39	27.06	26.73	26.40	26.07
0.7	25.74	25.41	25.09	24.76	24.44	24.11	23.79	23.47	23.15	22.83
0.8	22.51	22.19	21.87	21.56	21.24	20.93	20.62	20.31	20.00	19.69
0.9	19.38	19.07	18.77	18.46	18.16	17.86	17.55	17.25	16.96	16.66
1.0	16.36	16.07	15.78	15.48	15.19	14.91	14.62	14.33	14.05	13.76
1.1	13.48	13.20	12.93	12.65	12.37	12.10	11.83	11.56	11.29	11.02
1.2	10.76	10.50	10.23	9.97	9.72	9.46	9.21	8.96	8.71	8.46
1.3	8.21	7.97	7.73	7.49	7.25	7.02	6.79	6.56	6.33	6.10
1.4	5.88	5.66	5.44	5.23	5.02	4.81	4.60	4.39	4.19	3.99
1.5	3.80	3.61	3.42	3.23	3.05	2.87	2.69	2.52	2.35	2.19
1.6	2.03	1.87	1.72	1.57	1.42	1.28	1.15	1.02	0.89	0.77
1.7	0.66	0.55	0.45	0.36	0.27	0.19	0.12	0.06	0.02	0.00

Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of “Q,” the Quality Index. For values of “Q” greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of “Q” less than zero, the table value must be subtracted from 100.

Table 914-5 (Continued) { XE "Tables:portland cement concrete:estimation of lot percent defective" }

Variability-Unknown Procedure **Standard Deviation Method**

Sample Size
6

Q	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.63	49.27	48.90	48.53	48.16	47.80	47.43	47.06	46.70
0.1	46.33	45.96	45.60	45.23	44.86	44.50	44.13	43.77	43.40	43.04
0.2	42.68	42.31	41.95	41.59	41.22	40.86	40.50	40.14	39.78	39.42
0.3	39.06	38.70	38.34	37.98	37.62	37.27	36.91	36.55	36.20	35.84
0.4	35.49	35.14	34.79	34.43	34.08	33.73	33.38	33.04	32.69	32.34
0.5	32.00	31.65	31.31	30.96	30.62	30.28	29.94	29.60	29.26	28.93
0.6	28.59	28.25	27.92	27.59	27.26	26.92	26.60	26.27	25.94	25.61
0.7	25.29	24.96	24.64	24.32	24.00	23.68	23.37	23.05	22.74	22.42
0.8	22.11	21.80	21.49	21.18	20.88	20.57	20.27	19.97	19.67	19.37
0.9	19.07	18.78	18.49	18.19	17.90	17.61	17.33	17.04	16.76	16.48
1.0	16.20	15.92	15.64	15.37	15.09	14.82	14.55	14.29	14.02	13.76
1.1	13.50	13.24	12.98	12.72	12.47	12.22	11.97	11.72	11.47	11.23
1.2	10.99	10.75	10.51	10.28	10.04	9.81	9.58	9.36	9.13	8.91
1.3	8.69	8.48	8.26	8.05	7.84	7.63	7.42	7.22	7.02	6.82
1.4	6.63	6.43	6.24	6.05	5.87	5.68	5.50	5.33	5.15	4.98
1.5	4.81	4.64	4.47	4.31	4.15	4.00	3.84	3.69	3.54	3.40
1.6	3.25	3.11	2.97	2.84	2.71	2.58	2.45	2.33	2.21	2.09
1.7	1.98	1.87	1.76	1.66	1.55	1.45	1.36	1.27	1.18	1.09
1.8	1.01	0.93	0.85	0.78	0.71	0.64	0.57	0.51	0.46	0.40
1.9	0.35	0.30	0.26	0.22	0.18	0.15	0.12	0.09	0.07	0.05
2.0	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table 914-5 (Continued)
{ XE "Tables:portland cement concrete:estimation of lot percent defective" }
Variability-Unknown Procedure Standard Deviation Method

Sample Size
7

Q	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.63	49.25	48.88	48.50	48.13	47.75	47.38	47.01	46.63
0.1	46.26	45.89	45.51	45.14	44.77	44.40	44.03	43.65	43.28	42.91
0.2	42.54	42.17	41.80	41.44	41.07	40.70	40.33	39.97	39.60	39.23
0.3	38.87	38.50	38.14	37.78	37.42	37.05	36.69	36.33	35.98	35.62
0.4	35.26	34.90	34.55	34.19	33.84	33.49	33.13	32.78	32.43	32.08
0.5	31.74	31.39	31.04	30.70	30.36	30.01	29.67	29.33	28.99	28.66
0.6	28.32	27.98	27.65	27.32	26.99	26.66	26.33	26.00	25.68	25.35
0.7	25.03	24.71	24.39	24.07	23.75	23.44	23.12	22.81	22.50	22.19
0.8	21.88	21.58	21.27	20.97	20.67	20.37	20.07	19.78	19.48	19.19
0.9	18.90	18.61	18.33	18.04	17.76	17.48	17.20	16.92	16.65	16.37
1.0	16.10	15.83	15.56	15.30	15.03	14.77	14.51	14.26	14.00	13.75
1.1	13.49	13.25	13.00	12.75	12.51	12.27	12.03	11.79	11.56	11.33
1.2	11.10	10.87	10.65	10.42	10.20	9.98	9.77	9.55	9.34	9.13
1.3	8.93	8.72	8.52	8.32	8.12	7.92	7.73	7.54	7.35	7.17
1.4	6.98	6.80	6.62	6.45	6.27	6.10	5.93	5.77	5.60	5.44
1.5	5.28	5.13	4.97	4.82	4.67	4.52	4.38	4.24	4.10	3.96
1.6	3.83	3.69	3.57	3.44	3.31	3.19	3.07	2.95	2.84	2.73
1.7	2.62	2.51	2.41	2.30	2.20	2.11	2.01	1.92	1.83	1.74
1.8	1.65	1.57	1.49	1.41	1.34	1.26	1.19	1.12	1.06	0.99
1.9	0.93	0.87	0.81	0.76	0.70	0.65	0.60	0.56	0.51	0.47
2.0	0.43	0.39	0.36	0.32	0.29	0.26	0.23	0.21	0.18	0.16
2.1	0.14	0.12	0.10	0.08	0.07	0.06	0.05	0.04	0.03	0.02
2.2	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table 914-5 (Continued)

Variability-Unknown Procedure — Standard Deviation Method

Sample Size
8

Q	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.62	49.24	48.86	48.49	48.11	47.73	47.35	46.97	46.59
0.1	46.22	45.84	45.46	45.08	44.71	44.33	43.96	43.58	43.21	42.83
0.2	42.46	42.08	41.71	41.34	40.97	40.59	40.22	39.85	39.48	39.11
0.3	38.75	38.38	38.01	37.65	37.28	36.92	36.55	36.19	35.83	35.47
0.4	35.11	34.75	34.39	34.04	33.68	33.33	32.97	32.62	32.27	31.92
0.5	31.57	31.22	30.87	30.53	30.18	29.84	29.50	29.16	28.82	28.48
0.6	28.15	27.81	27.48	27.15	26.82	26.49	26.16	25.83	25.51	25.19
0.7	24.86	24.54	24.23	23.91	23.59	23.28	22.97	22.66	22.35	22.04
0.8	21.74	21.44	21.14	20.84	20.54	20.24	19.95	19.66	19.37	19.08
0.9	18.79	18.51	18.23	17.95	17.67	17.39	17.12	16.85	16.57	16.31
1.0	16.04	15.78	15.51	15.25	15.00	14.74	14.49	14.24	13.99	13.74
1.1	13.49	13.25	13.01	12.77	12.54	12.30	12.07	11.84	11.61	11.39
1.2	11.17	10.94	10.73	10.51	10.30	10.09	9.88	9.67	9.47	9.26
1.3	9.06	8.87	8.67	8.48	8.29	8.10	7.91	7.73	7.55	7.37
1.4	7.19	7.02	6.85	6.68	6.51	6.35	6.19	6.03	5.87	5.71
1.5	5.56	5.41	5.26	5.12	4.97	4.83	4.69	4.56	4.42	4.29
1.6	4.16	4.03	3.91	3.79	3.67	3.55	3.43	3.32	3.21	3.10
1.7	2.99	2.89	2.79	2.69	2.59	2.49	2.40	2.31	2.22	2.13
1.8	2.04	1.96	1.88	1.80	1.72	1.65	1.58	1.51	1.44	1.37
1.9	1.31	1.24	1.18	1.12	1.07	1.01	0.96	0.91	0.86	0.81
2.0	0.76	0.72	0.67	0.63	0.59	0.55	0.52	0.48	0.45	0.42
2.1	0.39	0.36	0.33	0.30	0.28	0.26	0.23	0.21	0.19	0.17
2.2	0.16	0.14	0.13	0.11	0.10	0.09	0.08	0.07	0.06	0.05
2.3	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.00

Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q" the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table 914-5 (Continued) { XE "Tables:portland cement concrete:estimation of lot percent defective" }

Variability-Unknown Procedure — Standard Deviation Method

Sample Size 9

Q	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.62	49.24	48.85	48.47	48.09	47.71	47.33	46.95	46.57
0.1	46.18	45.80	45.42	45.04	44.66	44.29	43.91	43.53	43.15	42.77
0.2	42.40	42.02	41.64	41.27	40.89	40.52	40.15	39.77	39.40	39.03
0.3	38.66	38.29	37.92	37.55	37.19	36.82	36.46	36.09	35.73	35.37
0.4	35.00	34.64	34.29	33.93	33.57	33.21	32.86	32.51	32.15	31.80
0.5	31.45	31.10	30.76	30.41	30.07	29.72	29.38	29.04	28.70	28.36
0.6	28.03	27.69	27.36	27.03	26.70	26.37	26.04	25.72	25.39	25.07
0.7	24.75	24.43	24.11	23.80	23.49	23.17	22.86	22.56	22.25	21.94
0.8	21.64	21.34	21.04	20.75	20.45	20.16	19.87	19.58	19.29	19.00
0.9	18.72	18.44	18.16	17.88	17.61	17.33	17.06	16.79	16.53	16.26
1.0	16.00	15.74	15.48	15.23	14.97	14.72	14.47	14.22	13.98	13.73
1.1	13.49	13.26	13.02	12.79	12.55	12.32	12.10	11.87	11.65	11.43
1.2	11.21	10.99	10.78	10.57	10.36	10.15	9.95	9.75	9.55	9.35
1.3	9.16	8.96	8.77	8.59	8.40	8.22	8.04	7.86	7.68	7.51
1.4	7.33	7.17	7.00	6.83	6.67	6.51	6.35	6.20	6.04	5.89
1.5	5.74	5.60	5.45	5.31	5.17	5.03	4.90	4.77	4.64	4.51
1.6	4.38	4.26	4.14	4.02	3.90	3.78	3.67	3.56	3.45	3.34
1.7	3.24	3.14	3.03	2.94	2.84	2.75	2.65	2.56	2.47	2.39
1.8	2.30	2.22	2.14	2.06	1.98	1.91	1.84	1.76	1.70	1.63
1.9	1.56	1.50	1.44	1.37	1.32	1.26	1.20	1.15	1.10	1.05
2.0	1.00	0.95	0.90	0.86	0.82	0.77	0.73	0.70	0.66	0.62
2.1	0.59	0.55	0.52	0.49	0.46	0.43	0.41	0.38	0.36	0.33
2.2	0.31	0.29	0.27	0.25	0.23	0.21	0.20	0.18	0.17	0.15
2.3	0.14	0.13	0.11	0.10	0.09	0.08	0.08	0.07	0.06	0.05
2.4	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.01	0.01
2.5	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q," the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Table 914-5 (Continued)
{ XE "Tables:portland cement concrete:estimation of lot percent defective" }
Variability-Unknown Procedure **Standard Deviation Method**

Sample Size
10

Q	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.62	49.23	48.85	48.46	48.08	47.70	47.31	46.93	46.54
0.1	46.16	45.78	45.40	45.01	44.63	44.25	43.87	43.49	43.11	42.73
0.2	42.35	41.97	41.60	41.22	40.84	40.47	40.09	39.72	39.34	38.97
0.3	38.60	38.23	37.86	37.49	37.12	36.75	36.38	36.02	35.65	35.29
0.4	34.93	34.57	34.21	33.85	33.49	33.13	32.78	32.42	32.07	31.72
0.5	31.37	31.02	30.67	30.32	29.98	29.64	29.29	28.95	28.61	28.28
0.6	27.94	27.60	27.27	26.94	26.61	26.28	25.96	25.63	25.31	24.99
0.7	24.67	24.35	24.03	23.72	23.41	23.10	22.79	22.48	22.18	21.87
0.8	21.57	21.27	20.98	20.68	20.39	20.10	19.81	19.52	19.23	18.95
0.9	18.67	18.39	18.11	17.84	17.56	17.29	17.03	16.76	16.49	16.23
1.0	15.97	15.72	15.46	15.21	14.96	14.71	14.46	14.22	13.97	13.73
1.1	13.50	13.26	13.03	12.80	12.57	12.34	12.12	11.90	11.68	11.46
1.2	11.24	11.03	10.82	10.61	10.41	10.21	10.00	9.81	9.61	9.42
1.3	9.22	9.03	8.85	8.66	8.48	8.30	8.12	7.95	7.77	7.60
1.4	7.44	7.27	7.10	6.94	6.78	6.63	6.47	6.32	6.17	6.02
1.5	5.87	5.73	5.59	5.45	5.31	5.18	5.05	4.92	4.79	4.66
1.6	4.54	4.41	4.30	4.18	4.06	3.95	3.84	3.73	3.62	3.52
1.7	3.41	3.31	3.21	3.11	3.02	2.93	2.83	2.74	2.66	2.57
1.8	2.49	2.40	2.32	2.25	2.17	2.09	2.02	1.95	1.88	1.81
1.9	1.75	1.68	1.62	1.56	1.50	1.44	1.38	1.33	1.27	1.22
2.0	1.17	1.12	1.07	1.03	0.98	0.94	0.90	0.86	0.82	0.78
2.1	0.74	0.71	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46
2.2	0.44	0.41	0.39	0.37	0.34	0.32	0.30	0.29	0.27	0.25
2.3	0.23	0.22	0.20	0.19	0.18	0.16	0.15	0.14	0.13	0.12
2.4	0.11	0.10	0.09	0.08	0.08	0.07	0.06	0.06	0.05	0.05
2.5	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01
2.6	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00

Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of “Q,” the Quality Index. For values of “Q” greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of “Q” less than zero, the table value must be subtracted from 100.

SECTION 915 - REINFORCEMENT STEEL{ XE "REINFORCEMENT STEEL" }{ XE "STEEL:REINFORCEMENT" }

915.01 Reinforcement Steel for Structures.

A. Deformed Bars. Reinforcement steel shall have deformed bars conforming to AASHTO M 31, except that all bars shall have the tensile requirements of Grade 60. Detailing dimensions for hooks and bends shall be according to the Manual of Standard Practice for Detailing Reinforced Concrete Structures (SP-66) for Grade 60. Production bending of Grade 60 bars shall be by the cold method with motive powered machines in the shop or in the field.

B. Deformed Bars, Zinc-Coated (Galvanized). Reinforcement steel shall be deformed bars conforming to Subpart A above. Galvanizing shall conform to ASTM A 767. Coating Class I shall be furnished. Fabrication shall be before galvanizing.

C. Deformed Bars, Epoxy-coated. Reinforcement steel shall be deformed bars conforming to Subpart A above. Epoxy coating shall conform to AASHTO M 284 except that the thickness of the cured coating shall be 10 ± 2 mils.

D. Spiral Reinforcement. Spiral reinforcement shall be plain round hot-rolled steel bars conforming to AASHTO M 31, except that the steel bars shall be Grade 60.

E. Structural Shapes, Plates, and Bars. Structural shapes, plates, and bars used for reinforcement or other miscellaneous embedded metal work shall conform to the requirements for structural steel specified in Subsection 917.10 and shall be galvanized according to AASHTO M 111.

F. Welded Steel Wire and Welded Deformed Steel Wire Fabric Reinforcement. Welded steel wire fabric shall conform to AASHTO M 55. When permitted as an alternate to zinc coated (galvanized) or epoxy-coated reinforcement steel bars, the welded steel wire fabric reinforcement shall be zinc coated (galvanized) according to ASTM A 641, Table 2, Class C or epoxy-coated according to ASTM A 884, Class A, respectively. Otherwise, the application of a corrosion protection coating will not be required in the use of welded steel wire fabric reinforcement.

Welded deformed steel wire fabric reinforcement shall conform to AASHTO M 221. When permitted as an alternate to zinc coated (galvanized) or epoxy-coated reinforcement steel bars, the welded deformed steel wire fabric reinforcement shall be zinc coated (galvanized) according to ASTM A 641, Table 1, Class C or epoxy-coated according to ASTM A 884, Class A, respectively. Otherwise, the application of a corrosion protection coating is not required in the use of welded steel wire fabric reinforcement.

G. Tolerances. Fabricating tolerances for deformed reinforced steel bars shall be according to Figures 3 and 4 of the CRSI Manual of Standard Practices unless otherwise specified.

H. Weight. The weight of steel bar reinforcement, as applicable to Subparts A, B, C, and D above, will be computed from the cutting lists according to the following:

Designation	Nominal Mass Pounds per foot
10	0.376
13	0.668
16	1.043
19	1.502
22	2.044
25	2.670
29	3.400
32	4.303
36	5.313

915.02 Prestressing Reinforcement.{ XE "Prestressing reinforcement" }{ XE "Reinforcement steel:prestressing reinforcement" }

A. High-Tensile-Strength Steel Wire, Seven-Wire Strand, and Alloy Bars. Prestressing reinforcement shall be high-tensile-strength steel wire, high-tensile-strength seven-wire strand or high-tensile-strength alloy bars.

High-tensile-strength steel wire shall conform to AASHTO M 204.

High-tensile-strength seven-wire strand shall conform to AASHTO M 203, Grade 270, with Supplement I requirements for low relaxation strands.

High-tensile-strength alloy bars shall conform to ASTM A 722. Bars with greater minimum ultimate strength but otherwise produced and tested according to ASTM A 722 may be used provided they have no properties which make them less satisfactory than the specified material.

B. Testing Prestressing Reinforcement. All wire, strand, or bars to be shipped to the site shall be assigned a lot number and tagged for identification purposes. Anchorage assemblies to be shipped shall be identified in the same manner. All samples submitted shall be representative of the lot to be furnished and, in the case of wire or strand, shall be taken from the same master roll. The manufacturer shall furnish samples selected from each lot. If ordered, the selection of samples shall be made at the manufacturer's plant.

C. Grit Impregnated Epoxy-Coated Prestressing Steel. Grit impregnated epoxy-coated prestressing steel stands shall conform to the requirements of ASTM A 882 except as provided in Subsection 502.05. The Supplementary Requirements listed in Supplement I of the above ASTM Specification shall apply.

915.03 Reinforcement Steel for Concrete Base and Concrete Surface Courses.

Reinforcement steel may be either deformed steel bars or cold-drawn steel wire conforming to the following:

1. **Tolerances.** Fabricating tolerances for deformed reinforcement steel bars shall be according to Figures 3 and 4 of the CRSI Manual of Standard Practices unless otherwise specified.
2. **Bar Mats.** Bar mats shall be rolled cold-drawn steel wire or deformed steel bars from new billet steel conforming to AASHTO M 31, except that all bars shall have the tensile strength requirement of Grade 40 or Grade 60. The bars shall be size No. 10. Fabrication of bar mats using deformed steel bars shall be according to ASTM A 184. Bar mats fabricated using rolled cold-drawn steel wire shall be according to ASTM A 82.
3. **Welded Steel Wire Fabric.** Welded steel wire fabric shall conform to AASHTO M 55.

   Wire fabric shall be not less than 5 feet in width and shall be shipped in sheets and not in rolls. Fabric for slope protection, gutters, and miscellaneous items may be shipped in rolls. Sheets shall be bent in the shop.
4. **Joint Tie Bolt Assembly.** The bar used shall conform to Subsection 915.01, Subpart A and shall be of the plain type. The tensile strength of the assembly shall be not less than 15,000 pounds. The tie bolt assemblies shall be equipped with an approved fastener for installation of the assembly in the steel pavement form. The fastener shall hold the assembly in the designated position during the placing and finishing of the concrete and subsequent removal of the forms without damage to the concrete or the tie bolt assembly.
5. **Dowels.** Dowels for transverse joints shall be carbon steel dowels, part of the length of which shall be encased in stainless steel or monel metal tubing, infused with chromium, or solid stainless steel dowels. The carbon steel dowels may be of any grade of carbon steel.
6. **Tie Bars.** Tie bars shall conform to Subsection 915.01, Subpart A.

915.04 Sampling and Testing Methods.{ XE "Samples for:reinforcement steel" }

Sampling and testing will be performed according to the following:

Plain and deformed bars ..... Four 2 foot-6 inch pieces from each heat
Post-tensioning:
Bars (threaded) .....One 6-foot piece (between threads) from each lot
Cable with fittings ..... One 6-foot piece (between fittings) from each reel
Petensioning:
Bars.....One 6-foot piece from each lot
Cable..... Two 4-foot pieces with flame cut ends and one 1-foot piece with sawcut ends from each heat
Welded wire fabric ..... One 2 square feet piece from each source
Anchorages .....Two assemblies (complete with plates) of each size or type

915.05 Certification of Compliance.

Certifications are required for reinforcement bars, pretensioning bars, welded wire fabric, and galvanizing and shall be submitted according to Subsection 106.04.

SECTION 916 - SIGN MATERIALS{ XE "SIGNS:MATERIALS" }

916.01 Aluminum.{ XE "Signs:materials:aluminum" }

Flat sheets (signs) and plates shall conform to ASTM B 209, Alloy 5052-H38 or Alloy 6061-T6. Thicknesses for the various sizes and shapes shall be as follows:

1. Regulatory, Warning, and Guide Signs.

Square and Diamond Shaped Signs:
- 30" by 30" or less ..... 0.080"
- More than 30" by 30" ..... 0.125"

Rectangular Signs:
- 30" or less (horizontal dimension) ..... 0.080"
- More than 30" (horizontal dimension) ..... 0.125"

Other Shaped Signs:
- 30" or less (longest horizontal dimension) ..... 0.080"
- More than 30" (longest horizontal dimension) ..... 0.125"

2. Distance and Destination Signs.

All sizes ..... 0.100"

Signs Mounted on Breakaway Barricades:
- All sizes ..... 0.024"

Weld filler wire shall be AWS classification ER5356 or ER5556.

Other aluminum items shall conform to the following:

Aluminum Items	ASTM	ASTM Alloy Temper
Bars and Rods	B 221	6063-T6
Delineator Sheets	B 209	5052-H38
Washers, Alclad	B 209	M2024-T4
Flange Splicing Material	B 209	6061-T6
Shims	B 209	1100-O
Letters, Numerals, Symbols	B 209	5052-H38
Posts, Truss Chords, Truss Bracing Members	B 221	6061-T6
Post and Chord Caps	B 26	356.0-T6
Post Clips	B 26	356.0-T6
Structural Shapes	B 308	6061-T6
Nuts, 5/16 inch and larger	B 211	6061-T6
Tamperproof Type, ¼ inch and under	B 211	2017-T4
Rivets (shall be of the size and length recommended by the manufacturer)	B 316	5052-0
Bolts (finished bolts shall have at least 0.002" chromated sealed anodic coating)	B 211	2024-T4

916.02 Aluminum Extruded Sign Panels.{ XE "Signs:materials:aluminum extruded sign panels" }

Sign panels shall be made of extruded aluminum sections conforming to ASTM B 221, Alloy 6063-T6. The sections shall be 1 foot wide, bolted together with a minimum section modulus of 0.605 inches cubed per foot for 2-inch thick panels.

Sign panel sections shall be joined to each other through flanges with ⅜-inch bolts and the maximum span between vertical supports shall be 18 feet. Sign panels shall be joined to the supporting structure.

Trim moldings shall be of the same color and material as the sign face.

Aluminum extruded sign panels are not permitted for use with steel “U” post sign supports.

916.03 Paints.{ XE "Signs:materials:paints" }

Transparent screen process paints and necessary thinners for application to signs utilizing white or silver reflective backgrounds shall be recommended by the manufacturer of the retroreflective sheeting. Color shall be visually determined according to ASTM D 1535 by comparison with the Federal Highway Administration Interstate Highway Color Charts using the Munsell notation.

916.04 Retroreflective Sheeting.{ XE "Signs:materials:retroreflective sheeting" }{ XE "Retroreflective sheeting" }

As stated herein, the terms reflective sheeting and retroreflective sheeting are synonymous.

Retroreflective sheeting, Types I through V shall be silver-white or colored, flexible, weather resistant material, and shall have a smooth, uniform retroreflective outer surface. The sheeting shall conform to the following:

1. **Definitions.**
   - **a. Retroreflection.** Retroreflection is defined as the reflection in which radiation is returned in directions close to the direction from which it came; this property being maintained over wide variations of the direction of the incident radiation.
   - **b. Retroreflective Element.** One optical unit that by refraction or reflection or both, produces the phenomenon of retroreflection.
   - **c. Retroreflective Sheeting.** A preassembled thin film that consists of a continuous layer of small retroreflective elements close to the transparent surface.
   - **d. Entrance Angle.** An entrance angle is the angle between the reference axis of the retroreflector and the axis of the incident light (illuminance axis).
   - **e. Observation Angle.** An observation angle is the angle between the observation axis and the axis of the incident light.
2. **Retroreflective Sheeting.**
   - **a. Type I.** Type I retroreflective sheeting shall consist of spherical lens elements adhered to a synthetic resin and enclosed by a flexible, transparent sheeting having a smooth flat outer surface. It shall conform to the retroreflectance requirements of Table 916-1.
   - **b. Type II.** Type II retroreflective sheeting shall consist of spherical lens elements adhered to a synthetic resin and encapsulated by a flexible transparent sheeting having a smooth flat outer surface. It shall conform to the retroreflectance requirements of Table 916-2.
   - **c. Type III-A.** Type III-A retroreflective sheeting shall be a high intensity retroreflective sheeting. It shall consist of cube corner (microprism) retroreflective elements encapsulated by a transparent, flexible, smooth-surfaced, tough and weather resistant polymeric film. It shall conform to the retroreflectance requirements of Table 916-3.
   - **d. Type III-B.** Type III B retroreflective sheeting shall be a high intensity retroreflective sheeting. It shall consist of cube corner (microprism) retroreflective elements encapsulated by a transparent, flexible, smooth-surfaced, tough and weather resistant polymeric film. It shall have a precoated pressure sensitive adhesive, suitable for adhering to plastic surfaces, with a paper release liner for ease of application. It shall conform to the retroreflectance requirements of Table 916-4.
   - **e. Type IV-A.** Type IV-A retroreflective sheeting shall be a super high intensity retroreflective sheeting. It shall consist of prismatic elements having high retroreflectance values at wide compounded angles. It shall have a smooth surface and a precoated pressure-sensitive adhesive backing protected by a removable liner. It shall conform to the retroreflectance requirements of Table 916-5.
   - **f. Type IV-B.** Type IV-B retroflective sheeting shall be a super high intensity retroreflective sheeting. It shall consist of prismatic elements formed in a transparent fluorescent orange synthetic resin, sealed and backed with a precoated pressure-sensitive adhesive protected by a removable liner. It shall conform to the retroreflectance requirements of Table 916-6.
   - **g. Type V.** Type V retroreflective sheeting shall be an elastomeric sheeting without adhesive. This sheeting shall be of a vinyl microscopic retroreflective element material conforming to the retroreflectance requirements of Table 916-7.
   - **h. Type VI.** Type VI retroreflective sheeting shall consist of wide angle prismatic sheeting. Sheeting shall be installed according to the manufacturer's recommendation. Sheeting requiring directional orientation must have datum marks visible from the face. The sheeting shall be precoated with pressure sensitive adhesive backing protected by a removable liner. It shall conform to the retroreflectance requirements of Table 916-8.
3. **General Requirements.**
   - **a. Retroreflectance.** Retroreflective sheeting, Types I through VI shall have the minimum specific intensity per unit area (SIA) requirements of Tables 916-1 through 916-8, for the types specified. The SIA shall be expressed as candela per foot-candle per square foot of sheeting. The measurements shall be conducted according to FED-STD-370 or ASTM E 810.

The test results/analysis shall be provided by the manufacturer according to Subheading 4 below.

b. Rainfall Performance. The SIA values of the retroreflective sheeting totally wet by rain shall not be less than 90 percent of the values shown in Tables 916-1 through 916-8 for the types specified. The measurements shall be conducted according to AASHTO M 268.

The test results/analysis shall be provided by the manufacturer according to Subheading 4 below.

c. Color. The colors of the retroreflective sheeting, except for Type IV-B, shall be designated according to the MUTCD Section 2A-11. Colors shall conform to the AASHTO Manual for Signing and Pavement Marking of the National System of Interstate and Defense Highways. Colors shall be visually determined according to ASTM D 1535 by comparison with the FHWA Interstate Highway Color Tolerance Charts using the Munsell notations. When directed by the Engineer, the manufacturer shall provide results of the instrumental test using color coordinates as described in AASHTO M 268.

The daytime fluorescent orange color of the Type IV-B retroflective sheeting shall be determined according to ASTM E 991. The nighttime fluorescent orange color shall be determined according to ASTM E 811.

In addition, the color shall be equally distinguishable in daylight and at night under artificial headlight lumination. The color shall have a consistent chromaticity across all signs of the same color. Noticeable deviation from the shades that would affect the required performance shall be a cause for rejection of any sheeting or completed sign at any time before Acceptance. For Type VI sheeting that is directional, the datum mark (arrow) imprinted on the face of the sheeting shall be the datum mark for test purposes.

d. Specular Gloss. The retroreflective sheeting shall have an 85-degree specular gloss of not less than 40 for Type I sheeting and not less than 50 for Types II through VI when tested according to ASTM D 523.

The test results/analysis shall be provided by the manufacturer according to Subheading 4 below.

e. Accelerated Weathering. When processed and applied according to the recommended procedures, the reflective material shall be weather resistant and, following cleaning, shall show no appreciable discoloration, cracking, scaling, crazing, blistering, edge lifting, curling, or dimensional change. The sheeting shall be certified by the manufacturer to retain not less than the percent of the minimum coefficient of retroreflection specified in Table 916-8, when exposed to xenon arc weatherometer according to ASTM G 23, Type E or EH weatherometer with the humidifier off, or for Type IV-B, ASTM G 26, Type B, Method A.

The test results/analysis shall be provided by the manufacturer according to Subheading 4 below.

f. Colorfastness. One of the accelerated weathered specimens shall be tested for colorfastness. The specimen shall be wetted with a mild detergent and water solution and then compared with a similarly treated unexposed specimen under natural sky (north sky) daylight or artificial light having a color temperature of 7,500 K. The colorfastness shall be evaluated as follows:

Excellent: No appreciable change in color.
Good: Perceptible but no appreciable change in color.
Fair: Appreciable change in color.

Appreciable change in color is defined as the change that is immediately noticeable in comparison with the exposed specimen. The retroreflective sheeting to be used must have either a "good" or an "excellent" rating.

g. Adhesion. The retroreflective sheeting shall be precoated with a pressure sensitive adhesive backing or a tack free heat activated adhesive backing, either of which shall be applied to properly prepared surfaces without the necessity of additional adhesive coats on the retroreflective sheeting or application surface.

The protective liner attached to the adhesive shall be easily removed by peeling, without soaking in water or other solutions, and shall not break, tear, or remove adhesive from the backing. The liner shall be easily removed following accelerated storage for four hours at 160 °F under a pressure of 2.5 pounds per square inch. The specimens for Types I through VI shall

be tested according to AASHTO M 268, Section 7.7, and the test results shall be furnished by the manufacturer according to Subheading 4 below.

Additionally, retroreflective sheeting shall show no sign of cracking or delamination when subjected to the impact resistance test described in AASHTO M 268. The manufacturer shall furnish the test results according to Subparagraph 4 below.

h. Flexibility. The retroreflective sheeting shall have sufficient strength and flexibility so that it can be handled, processed, and applied according to the recommendations of the sheeting manufacturer without appreciable stretching, tearing or other damage.

When tested according to FED-STD-141C NOT 2, Methods 6224 and 6115, the Type I retroreflective sheeting, with the liner removed, shall have a tensile strength or not less than 5 pounds per inch of width. Elongation shall not be less than ten percent. The machine speed shall be 1 foot per minute.

Following liner removal, the retroreflective sheeting shall be sufficiently flexible to show no cracking when slowly bent in a time of one second around a ⅛-inch mandrel with the adhesive contacting the mandrel.

Retroreflective sheeting for cones, drums, and delineator guide posts shall conform to the above except that after being conditioned for 24 hours at 53 °F, the sheeting shall be sufficiently flexible to show no cracking when slowly bent in one second's time around a ⅛ inch mandrel with the adhesive contacting the mandrel.

i. Shrinkage. Following the liner removal, the retroreflective sheeting specimen shall not shrink in any direction more than 1/32 inch in ten minutes and ⅛ inch in 24 hours. The test shall be conducted on a 9 by 9-inch conditioned (72 °F, 50 percent relative humidity for 24 hours) specimen with the liner, according to AASHTO M 268.

j. Storage. The retroreflective sheeting, as supplied, shall be of good appearance, free from ragged edges and cracks, and be suitable for use for a minimum period of one year.

4. Certification of Compliance. The manufacturer shall perform all the specified standard tests and provide results and an analysis of the test results. The manufacturer shall also submit a certification of compliance according to Subsection 106.04.

916.05 Legends, Borders, and Accessories.{ XE "Signs:materials:legends, borders, and accessories" }

The legend for each sign shall consist of letters, numerals, shields, and other symbols. The border on each sign shall be of the same type and manufacture as the system used for the legend. Border widths shall be as stated.

All letters and numerals shall meet the requirements established by the FHWA in the Standard Alphabets for Highway Signs and the Standard Lower-Case Alphabets for Highways.

Legends, borders, and accessories shall conform to the following:

1. Type A Demountable. The demountable sign letters, digits, arrows, borders, and alphabet accessories shall be reflectorized and shall consist of Type VI wide angle prismatic retroreflective sheeting applied to ⅜-inch cutout aluminum plates conforming to ASTM B 209, Alloy 6061-T6.

All shields and symbols to be mounted to sign types GO, GOX, and GA on breakaway tubular posts shall consist of Type VI wide angle prismatic retroreflective sheeting applied to 3/16-inch cutout aluminum plates conforming to ASTM B 209, Alloy 6061-T6.

All cutout letters, numerals, border sections, and other symbols shall be predrilled with ⅛-inch mounting holes to accept mounting with aluminum rivets. The number of the holes required per character or symbol shall be determined by the manufacturer to ensure secure mounting to the sign face.

All letters shall be modified "E" series.

2. Type B Direct and Permanently Applied Retroreflective Sheeting Copy. The retroreflective sheeting for cut-out letters, numerals, symbols, borders, and route markers shall conform to Subsection 916.04, pressure-sensitive or heat activated, silver-white.

Permanently applied legend and border, complying with the above, of the designated sizes shall be used exclusively for those signs for which any of the following letter sizes are specified:

a. Upper case letters and digits when used in conjunction with lower case letters 6 inches or less in height
b. All letters and digits 6 inches in height.
c. When the background is Type III-A sheeting, Type III-A sheeting shall be used for copy.
d. When the background is Type I sheeting, Type I sheeting shall be used for copy.
e. When the background is Type II sheeting, Type II sheeting shall be used for copy.

f. When the background is Type III-A sheeting, Type III-A sheeting shall be used for copy.

916.06 Steel.{ XE "Signs:materials:steel" }

Steel structural shapes and plates, posts, chords, and bracing members shall all conform to ASTM A 36. Post and chord caps shall conform to ASTM A 27, Grade 70-36. Steel posts and U-shaped rail shall conform to ASTM A 499 with length of post and minimum pounds per foot as specified.

Tubular posts, chords, and bracing members shall conform to ASTM A 53, Grade B, Type S or E pipe. All steel components, excluding hardware, shall be galvanized according to ASTM A 123.

Bolts, nuts, and washers shall conform to ASTM A 307 and shall be galvanized by the hot-dip process according to ASTM A 153.

916.07 Stainless Steel.

{ XE "Signs:materials:stainless steel nuts and bolts" **}**Stainless steel nuts shall conform to ASTM A 194, Grade 8F, except that the nuts shall be lock nuts with semi-finished hex nuts equivalent to American Standard Heavy Series.

Stainless steel bolts, washers, and screws shall conform to ASTM A 193, austenitic steel.

916.08 Fabrication.{ XE "Signs:materials:fabrication" }

The name of the fabricators of the signs and supports shall be furnished before fabrication is started and, if requested, information shall be furnished as to the fabricator's qualifications and experience.

Fabrication shall conform to the following:

1. **Working Drawings.** Working drawings shall be submitted according to Subsection 105.04.
2. **Flat Sheet Signs.** Flat sheet signs shall be fabricated of a single piece of sheet aluminum without joints and without supporting frame.
3. **Multiple Panel Signs**. Multiple panel signs shall be made of extruded sections as specified in Subsection 916.02.

   All panels shall be flat and straight within commercial tolerances established by the aluminum industry.
4. **Cutting Metals**. Materials ½ inch thick or less may be sheared, blanked, sawed, or milled. Materials over ½ inch thick shall be sawed or milled. Cut edges shall be true and smooth and free from excessive burrs or ragged breaks.

   Re-entrant cuts shall be filleted by drilling before cutting.

   Flame cutting will not be permitted for aluminum.
5. **Bolt Holes in Metals**. Bolt holes either shall be drilled to finished size or may be blanked to finish size provided the diameter of the blanked hole is at least twice the thickness of the metal being blanked.

   Bolt holes for one-post signs shall be ⅜-inch diameter and shall be located as shown in the FHWA Manual of Standard Highway Signs.

   Bolt holes for two-post signs shall be located as shown on the drawings.
6. **Welding**. Welding shall conform to Section 509.
7. **Sign Surface Preparation**. All fabrication, including cutting and punching of holes and excluding mounting holes for demountable letters, numerals, symbols, and borders, shall be completed before surface preparation. Before painting or application of reflective sheeting to the aluminum, the sheets shall be treated according to the following procedures:

   a. **Degreasing**. Preliminary cleaning shall be done by using either of the following degreasing methods:

      (1) **Vapor Degreasing**. Sheets shall be totally immersed in a saturated vapor of trichlorethylene or perchlorethylene. Trademark printing shall be removed with lacquer thinner or by a controlled alkaline cleaning system.

      (2) **Alkaline Degreasing**. Sheets shall be totally immersed in a tank containing a controlled alkaline solution. The instructions of the solution's manufacturer concerning time, temperature, and concentration shall be followed. Immersion time depends upon the amount of dirt and the solution strength. All evidence of the trademark printing shall be removed. Sheets shall be thoroughly rinsed by a high pressure spray of clear cold water and allowed to dry completely.

   b. **Etching**. Preliminary cleaning shall be followed by a surface etch using either of the following etching methods:

      (1) **Acid Etching**. Sheets shall be totally immersed in a six to eight percent phosphoric acid solution of 100 °F, or an approved commercially available acid etching solution. The

sheets shall be thoroughly rinsed using a high pressure spray of cold water and allowed to dry completely.

(2) Alkaline Etching. Sheets shall be totally immersed in a controlled alkaline solution. The instructions of the manufacturer concerning time, temperature, and concentration shall be followed. Smut shall be removed with an acidic chromium compound, such as a chromic acid solution, and rinsed thoroughly. Sheets shall be allowed to dry completely.

c. Chromate Conversion Coating. The chromate conversion coating shall be applied to the sheets according to the manufacturer's instructions. The coating shall conform to ASTM B 449, Class 2 and shall range in color from silvery iridescent to pale yellow. The coating should be 10 to 35 milligrams per square foot with a median of 25 milligrams per square foot as the optimum coating weight. The coating shall be within the prescribed weight limits, tightly adhered to the sheet, coherent within itself and show no dusting of the coated surface.

d. Handling. Aluminum sheets shall not be handled except by a clean device or clean canvas gloves between all cleaning, etching, and coating operations and the application of paint or retroreflective sheeting. There shall be no opportunity for the sheets to come in contact with grease, oil, or other contaminants after the surface preparation processes and the application of paint or retroreflective sheeting.

8. Shop Painting and Reflectorization.

a. Application. Retroreflective sheeting shall be applied to properly treated base panels with mechanical equipment in a manner specified by the manufacturer. Heat-activated adhesive coated sheeting shall be pre-perforated.

Sign faces comprising two or more pieces or panels of retroreflective sheeting shall be carefully matched for color at the time of sign fabrication to provide uniform appearance and brilliance, both day and night.

At splices, pressure-sensitive adhesive coated sheeting shall be overlapped not more than 3/16 inch or butted. When butted, the gaps shall not exceed 1/32 inch. Only butt splices will be permitted on signs screen processed with transparent color. Sheeting applied to extruded sections shall extend over top edges and down side legs a minimum of 1/16 inch; except that where Type VI sheeting is used, it shall be cut at the top edges according to the manufacturer's recommendation.

After aging 48 hours at 75 °F, adhesion of retroreflective sheeting to sign surface shall be strong enough to resist stripping from the panel when tested with a stiff putty knife, and shall meet other requirements as specified for retroreflective sheeting in Subsection 916.04.

b. Green Enamel Paint for Traffic Sign Exterior. Green enamel paint to be used for traffic sign background on exterior surfaces shall be a medium oil air-drying alkyd type. The enamel shall have been prequalified as an acceptable coating. The enamel shall be suitable for spray application to aluminum treated according to Subsection 916.03 or primed plywood and shall dry to a smooth uniform film, free from defects.

The enamel shall meet the following physical requirements:

	Minimum	Maximum
Gloss, specular -60 degrees after 48 hours dry, %	80	
Drying Time:		
Set to touch, hours		1
Dry to handle, hours		4
Dry hard, hours		181
Fineness of Grind, Hegman	7	
Consistency, Stormer KU	60	70

Color of the dried enamel shall match the color chip that is available from the Department's sign shop. The backs of aluminum signs shall not be painted.

c. Screen Process Printing. All legends and borders on signs except demountable or cut-out legends and border, shall be applied by screen process printing after the sheeting is attached to the sign base material. All screening shall be done as recommended by the manufacturer of the retroreflective sheeting. Transparent screen process paint, after application to the retroreflective sheeting and thoroughly dry shall conform to ASTM D 1535 and shall match the FHWA Interstate Highway Color Charts using Munsell notation when compared in natural daylight. Any noticeable deviation from the shades shall be cause for rejection of the sign.

The application of a finishing clear or clear coat shall be applied after screen printing, if required by the manufacturer. Application of the coating shall be according to the sheeting manufacturer's recommendation.

Black legend and border may be applied, other than by screen printing, to those signs requiring this color. The materials and application technique shall be as recommended by the retroreflective manufacturer or approved**.**

9. **Packaging, Storage, and Shipping.** Packaging, storage, and shipping of signs produced using Type I through Type VI sheeting shall be according to the sheeting manufacturer's recommendations. All other signs shall be packaged in such manner that they are protected during shipment and storage. The packaging shall be adequate to prevent damage to any part of the sign, including any demountable legends or borders. Before packaging, all signs shall be free of moisture and all paints shall be thoroughly dry. Adhesive tapes shall not be applied to any sign surfaces. All packaged signs shall be kept entirely dry.

   All assembled or partially assembled signs, other than flat sheet signs, shall have sufficient braces securely attached to prevent buckling or warping from the time of assembling to attaching on permanent supports.

916.09 Breakaway Sign Supports.{ XE "Signs:supports:breakaway" }

Aluminum alloy shall conform to ASTM B 209, ASTM B 210, ASTM B 221, or ASTM B 308.

Nuts and bolts of aluminum alloy shall conform to ASTM B 316.

Posts for mounting signs shall be fabricated of one piece seamless aluminum tubing of uniform wall thickness. Posts shall be tire-wrapped to protect the finish during shipment and handling.

Spring pins shall conform to ASTM A 276, Type 304 or 420 with a minimum strength of 5,000 pounds in double shear.

Hex studs and nuts used in the breakaway coupling assembly shall conform to ASTM A 320, Grade 17, with a minimum yield strength of 105,000 psi. Hex nuts in the assembly shall conform to ASTM A 194, Grade 2H.

Load concentrating washers shall conform to ASTM A 564, Type 630, Condition H 1025, with a minimum yield strength of 145,000 psi.

Washer retainers shall conform to ASTM A 1011, Grade 40 or ASTM A 569.

Anchor bolts shall conform to ASTM A 307. Galvanizing of anchor bolts, nuts, washers, and leveling plates shall conform to ASTM A 123.

Breakaway shock absorber cable shall have a plain button on one end. Stainless steel wire rope shall conform to Military Specification MIL-W-87161. The wire rope shall have a diameter of ¼ inch with a minimum breaking strength of 4,700 pounds and shall be 1 by 19 construction.

Cutting pins shall conform to ASTM A 564, Type 630, Condition H 1025 with a minimum yield strength of 145,000 psi.

Hex studs with nuts and washer retainer shall have a zinc coating electrodeposited according to ASTM B 633, after which a chromate dip shall be applied. The coating shall be Type GS that shall have a minimum thickness of 0.0010 inches with a maximum plus tolerance of 0.0005 inches. The maximum tolerance can be exceeded provided all attaching parts can be freely assembled.

Mechanical testing of the shock absorber assemblies shall conform to AASHTO T 244.

The shock absorber assembly shall be tested in tension. The tube shall not fail through its cross-section separating the tube from the cable. The cutting pins shall begin and progress to slice through the walls of the tube before a maximum load of 4,500 pounds is applied.

Equivalent material may be accepted in place of specified material. Approval is based on written submission of reasons for the material substitution, accompanied by test data supplied by a testing agency indicating the chemical analysis of the equivalent material and its conformance to the mechanical specifications of the specified material.

916.10 Breakaway Steel "U" Post Sign Supports.{ XE "Signs:supports:\"U\" posts" }

Signs shall be secured to the steel "U" post by means of 18-8 stainless steel 5/16 x 18 UNC hexagonal headed bolts and nuts conforming to ASTM A 320, Grade B8, Class 1. Sign mounting bolts shall extend beyond the end of each nut but not more than ¾ inches when fully tightened.

The steel "U" posts shall be straight and have a smooth finish, free of burrs.

The list of the approved manufacturers will be provided in the Special Provisions.

916.11 Non-Breakaway Sign Supports.{ XE "Signs:supports:non-breakaway" }

Material requirements shall conform to that specified above for breakaway sign supports and to the following:

1. Stainless steel hardware shall conform to ASTM A 320 (AISI Type 304).
2. The underside of the post bases shall be coated with an aluminum-pigmented alkaline-resistant paint coating conforming to Subsection 912.02.
3. The castings for post caps may be permanent mold castings conforming to ASTM B 26, ASTM Alloy 356.0-T6. Each casting shall be 100 percent visually inspected for surface defects and irregularities. The castings shall be of uniform quality and conditions, free from cracks and shall not contain any other defects such as blowholes, porous places, hard spots, and shrinkage defects which due to their nature, degree, or extent, detrimentally affect the suitability of the castings for their intended use. Castings exhibiting these surface discontinuities are subject to rejection as a result of visual inspection.
4. Galvanizing of anchor bolts, nuts, washers, and leveling plates shall conform to ASTM A 123.

916.12 Overhead Sign Supports.{ XE "Signs:supports:overhead" }

Overhead sign supports shall be fabricated according to Section 509.

Brackets shall be provided for mounting signs (including future signs) of the type to be supported by the structures. They shall be adjustable to permit mounting the sign faces at any angle between a truly vertical position and three degrees from vertical. This angle shall be obtained by rotating the front lower edge of the sign forward of the top edge. All brackets shall be of lengths equal to the heights of the signs being supported.

All steel fabricated components other than stainless steel parts, including clamps and brackets, shall be galvanized according to Subsection 917.12.

916.13 Timber Sign Supports.{ XE "Signs:supports:timber" }

Timber posts shall conform to Subsection 918.01.

916.14 Flexible Delineators.{ XE "Signs:supports:flexible delineators" }{ XE "Delineators:flexible" }

Flexible delineator units shall be made of a fiberglass reinforced, thermosetting, high polymer resin, an extruded polycarbonite resin, or other materials, which are resistant to ultraviolet and infrared radiation, and which meet the following minimum physical and performance requirements:

1. **Dimensions.**

{ XE "Delineators:flexible:ground mounted" **}a. Ground Mounted**. The unit for ground mounted flexible delineators shall have a minimum width of 3 inches and a minimum thickness of ⅛ inch. The length of each unit shall be variable such that the top of the reflective area is positioned 4 feet above the near roadway edge.

{ XE "Delineators:flexible:guide rail mounted" **}b. Guide Rail Mounted**. The unit for beam guide rail mounted flexible delineators shall have a minimum width of 3 inches and a minimum thickness of 100 mils. Each unit shall have a variable height such that the top of the reflective area is 32 ± 2 inches (40 ± 2 inches for deceleration and acceleration lanes) above the near roadway edge.

The base of each unit shall be designed to mount over the I-beam spacer, or to the top of a wood, polymer, or other type of spacer, of the beam guide rail.

{ XE "Delineators:flexible:barrier curb mounted" **}c. Barrier Curb Mounted**. The unit for concrete barrier curb mounted flexible delineators shall be the same as for beam guide rail mounted units except that the panel shall be 3 ½ by 3 ½ inches with a minimum thickness of 100 mils. The base shall form a "T" shape with the panel.

2. **Composition**. Units for flexible delineators shall contain a minimum of 40 percent consumer recycled material in their construction. For ground mounted flexible delineators, the portion of the unit above ground shall be one component, or shall be bonded together if it consists of two or more components. The shape of the ground mounted unit shall be conducive to protection of the applied retroreflective sheeting from abrasion.

The base and panel for beam guide rail or concrete barrier curb flexible delineators shall be designed to withstand repeated impacts, after which, the panel returns to its functioning position (90 degrees from the plane of the roadway surface).

3. **Color**. Flexible delineators shall be white or opaque in color.
4. **Impact Resistance**. Flexible delineator units shall be self-erecting to within 10 degrees of original upright position within 15 minutes of impact on five separate occasions by a vehicle traveling at 55 miles per hour. Tests shall be conducted at zero degrees, 22 degrees, and 45 degrees, variance of the long cross-sectional axis of the unit to the perpendicular of vehicle direction. The same unit(s) shall be used for all angle impact tests, total impacts per unit equaling 15. The re-erected unit shall retain the original cross-section, show no evidence of shredding or splintering, and shall retain 80 percent of its original retroreflective sheeting.
5. **Heat Resistance**. A unit shall be conditioned in an oven for two hours at 140 ± 3 °F. After removal from the oven, the unit shall be bent backwards at 90 degrees from the upright, simulating a field hit. The unit shall, without cracking, recover to its original position within ten seconds for each of three bends. Testing shall be complete within two minutes. Color shall remain unchanged.
6. **Cold Resistance**. The same unit(s) tested for heat resistance shall be tested for cold resistance. The unit shall be conditioned for 24 hours at -0 °F, then subjected to the same testing as for heat resistance. The unit shall conform to the same recovery and color retention standards as for heat resistance.
7. **Weather Resistance**. A unit shall be exposed to 1,000 hours of weathering according to ASTM G 26 with no significant discoloration.
8. **Installation**. The unit for ground mounted flexible delineators shall be capable of being driven by hand into the ground by only one person to proper depth without damage to the unit. The unit shall remain in the position in which it is installed. All special fittings, attachments, or special tools shall be compatible with that type of flexible delineator. The unit's manufacturer shall provide installation instructions and make available all special tools required for installation.
9. **Depth Indicator Mark**. A depth indicator mark shall be located on the front (reflective) face of the drivable ground mounted flexible delineators at a height of 1 foot-6 inches from the bottom end of the unit with a weather resistant marking material so as to not wash off or weather away before unit installation.
10. **Mowability**. Ground mounted flexible delineator units shall be capable of being mowed over in both directions a total of 20 times (ten each direction) by a standard Department flail mower equipped with a front-mounted deflector and adjusted to a minimum mowing height of 3 inches, without damage. Mowable, drivable, flexible delineator units must fold parallel and flat to the ground so as to not deflect upward and into the flail mower mechanism passing above and over the delineator unit causing any damage thereto.
11. **Sampling Rate**. Five samples per lot size of approximately 10,000 to 20,000 units will be chosen at random by the Engineer for testing at the Department Laboratory.

916.15 Sampling and Testing Methods.{ XE "Samples for:sign materials" }{ XE "Samples for:sign support materials" }{ XE "Signs:materials:sampling and testing" }

Sampling and testing will be performed according to the following:

Aluminum alloys	Subsection 911.04
Letters, demountable	Three units from each source
Paint	Subsection 912.18
Retroreflective sheeting	Two 1 by 1 foot sheets for each type and color
Steel	Subsection 917.13
Stainless steel	ASTM A 193
Shock absorber	One unit from each source

Five samples per lot size of approximately 10,000 to 20,000 flexible delineator posts will be chosen at random by the Engineer for testing at the Department Laboratory.

916.16 Certification of Compliance.

Mill certifications shall be furnished for the chemical and physical properties of all metals and shall be submitted according to Subsection 106.04.

916.17 Tables.

Tables referenced in the Specifications are as follows:

Table 916-1 Type I Sheeting Retroreflectance Requirements
Minimum SIA (Specific Intensity per unit Area), cd/f-c/ft^2 { XE "Sheeting retroreflectance" } { XE "Tables:signs:type I sheeting retroreflectance requirements" }

Color	Silver/ White	Yellow	Orange	Green	Red	Blue	Brown
Observation Angle, Degrees	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5
Entrance Angle							
-4 Degrees	70 - 30	50 - 25	25 - 13.5	9 - 4.5	14.5 - 7.5	4 - 2	0.6 - 0.25
15 Degrees	45 - 22	35 - 18	14 – 8	6 - 3.2	9.5 - 5	2.8 - 1.3	0.6 - 0.25
30 Degrees	30 - 15	22 - 13	5 - 4	3.5 - 2.2	6 - 3	1.7 - 0.8	0.3 - 0.2
45 Degrees	7.5 - 5	7.5 - 4	1 - 0.8	1 - 1	2 - 1	0.5 - 0.2	0.2 - 0.1

Table 916-2 Type II Sheeting Retroreflectance Requirements
Minimum SIA (Specific Intensity per unit Area), cd/f-c/ft^2 { XE "Tables:signs:type II sheeting retroreflectance requirements" }

Color	Silver/ White	Yellow	Orange	Green	Red
Observation Angle, Degrees	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5
Entrance Angle					
-4 Degrees	250 - 95	170 - 62	100 - 30	45 - 15	45 - 15
30 Degrees	150 - 65	100 - 45	60 - 25	25 - 10	25 - 10
50 Degrees	35 - 22	23 - 15	14 - 9	6 - 1.5	6 - 4

Table 916-3 Type III-A Sheeting Retroreflectance Requirements
Minimum SIA (Specific Intensity per unit Area), cd/f-c/ft^2 { XE "Tables:signs:type III-A sheeting retroreflectance requirements" }

Color	Silver/ White	Yellow	Orange	Green	Red	Blue
Observation Angle, Degrees	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5
Entrance Angle						
-4 Degrees	250 - 95	170 - 62	100 - 30	45 - 15	45 - 15	20 - 7.5
30 Degrees	150 - 55	100 - 45	60 - 22	25 - 10	25 - 10	10 - 5

Table 916-4 Type III-B Sheeting Retroreflectance Requirements
Minimum SIA (Specific Intensity per unit Area), cd/f-c/ft^2{ XE "Tables:signs:type III-B sheeting retroreflectance requirements" }

Color	Silver/White	Orange
Observation Angle, Degrees	0.1 - 0.2 - 0.5	0.1 - 0.2 - 0.5
Entrance Angle		
-4 Degrees	400 - 300 - 205	150 - 120 - 60
30 Degrees	160 – 160 - 68	75 - 65 - 26

Table 916-5 Type IV-A Sheeting Retroreflectance Requirements
Minimum SIA (Specific Intensity per unit Area), cd/f-c/ft^2{ XE "Tables:signs:type IV-A sheeting retroreflectance requirements" }

Color	Silver/ White	Yellow	Orange	Green	Red	Blue
Observation Angle, Degrees	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5
Entrance Angle						
-4 Degrees	800 - 200	470 - 110	450 - 120	120 - 28	120 - 28	55 - 13
30 Degrees	400 - 100	270 - 51	250 - 70	72 - 13	72 - 13	32 - 0
50/60 Degrees	35 - 30	16 - 16	16 - 16			

Table 916-6 Type IV-B Sheeting Retroreflectance Requirements
Minimum SIA (Specific Intensity per unit Area), cd/f-c/ft^2{ XE "Tables:signs:type IV-B sheeting retroreflectance requirements" }

Color	Orange
Observation Angle, Degrees	0.2 - 0.5
Entrance Angle	
-4 Degrees	200 - 80
30 Degrees	120 - 50
50 Degrees	50 - 20

Table 916-7 Type V Sheeting Retroreflectance Requirements
Minimum SIA (Specific Intensity per unit Area), cd/f-c/ft^2{ XE "Tables:signs:type V sheeting retroreflectance requirements" }

Color	Silver/ White	Yellow	Orange	Green	Red	Blue
Observation Angle, Degrees	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5

Entrance Angle						
-4 Degrees	250 - 200	170 - 136	70 - 56	30 - 24	35 - 28	20 - 18
30 Degrees	95 - 60	64 - 40	26 - 17	11 - 7.2	13 - 8.4	7.6 - 4.8

Table 916-8 Type VI Sheeting Retroreflectance Requirements
Minimum SIA (Specific Intensity per unit Area), cd/f-c/ft^2{ XE "Tables:signs:type VI sheeting retroreflective requirements" }

Color	Silver/ White	Yellow	Green	Red	Blue
Observation Angle, Degrees	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5	0.2 - 0.5
Entrance Angle					
-4 Degrees	430 - 250	350 - 200	45 - 25	100 - 65	20 - 10
30 Degrees	235 - 170	190 - 140	24 - 19	55 - 35	11 - 7

Table 916-9 Accelerated Weathering Photometric Requirements{ XE "Tables:signs:accelerated weathering photometric requirements" }

Type	Hours	Minimum Coefficient of Retroreflection (RA)
I	1000	65% of Table 916-1
II	1000 (Note 1)	65% of Table 916-2
III-A	1000 (Note 1)	80% of Table 916-3
III-B	1000 (Note 1)	80% of Table 916-4
IV-A	2200 (Note 2)	80% of Table 916-5
IV-B	1500	50% of Table 916-6
V	250	50% of Table 916-7
VI	1000	80% of Table 916-8

Note 1: When the color orange is specified, the artificial weathering will be for 500 hours.
Note 2: When the color orange is specified, the artificial weathering will be for 1,000 hours.

SECTION 917 - STRUCTURAL STEEL AND OTHER FERROUS METALS{ XE "STEEL" }

917.01 Bolts and Bolting Material.{ XE "Steel:bolts" }

Ordinary steel bolts shall conform to ASTM A 307. Ordinary steel nuts shall conform to ASTM A 563. Galvanizing, when specified for ordinary bolts and washers, shall be according to ASTM A 153. Undercut type expansion anchors shall conform to ASTM A 193, Grade B7.

Corrosion-resistant steel bolts and anchor clamps shall be of stainless steel, containing approximately 18 percent chromium and eight percent nickel, conforming to ASTM A 276, Type 304. Stainless steel undercut type expansion anchors shall conform to ASTM A 193, Grade B8 – Class 2.

For the erection of sign support structures, anchor bolts shall conform to ASTM F 1554, Grade 36.

High-strength steel bolts, including suitable nuts and plain hardened washers, shall conform to either AASHTO M 164 or AASHTO M 253 and also the following supplementary criteria:

1. **Scope**. Additional requirements for field or shop installation of AASHTO M 164 high-strength bolts are listed in Subheading 4.d below. These additional requirements supplement Section 11 of the AASHTO LRFD Bridge Construction Specifications. If designed with the AASHTO Standard Specifications for Highway Bridges, Section 11 of Division II of the AASHTO Standard Specifications for Highway Bridges is supplemented. For the surface treatment of high-strength steel bolt assemblies, the requirements of the AASHTO LRFD Bridge Construction Specifications shall govern. If designed with the AASHTO Standard Specifications for Highway Bridges, Section 11 of Division II of the AASHTO Standard Specifications for Highway Bridges shall govern, with the exception that the AASHTO M 164 high-strength bolt assemblies shall be hot-dipped galvanized only.
2. **Specifications.**
   a. All nuts shall meet the requirements of AASHTO M 292 as applicable or AASHTO M 291 and the revisions below.
   b. All washers shall meet the requirements of ASTM F 436 and the revisions shown.
3. **Manufacturing.**
   a. Bolts. Hardness for bolt diameters M16 to M36, inclusive, shall be as noted:

Bolt Size	**Hardness Number** Rockwell C	
	Minimum	**Maximum**
¼ to 1½ inches (for ASTM A 325)	23	34
¼ to 1½ inches (for ASTM A 490)	33	39

   b. Nuts.
      (1) Nuts to be galvanized (hot-dip) shall be heat treated Grade 2H, DH, or DH3.
      (2) Plain (ungalvanized) nuts shall be Grades 2, C, D, or C3 with a minimum Rockwell hardness of 89 HRB (or Brinell hardness 180 HB), or heat treated Grades 2H, DH, or DH3. (The hardness requirements for Grades 2, C, D, and C3 exceed the current AASHTO/ASTM requirements).
      (3) Nuts that are to be galvanized shall be tapped oversize the minimum amount required for proper assembly. The amount of over tap in the nut shall be such that the nut will assemble freely on the bolt in the coated condition and shall meet the mechanical requirements of AASHTO M 291 and the rotational-capacity test herein (the over tapping requirements of AASHTO M 291, Paragraph 7.8 shall be considered maximum values instead of minimum, as currently shown). Galvanized bolts and nuts are to be treated as an assembly and shipped together.
      (4) Galvanized nuts shall be lubricated with a lubricant containing a dye of any color that contrasts with the color of the galvanizing. Galvanized bolts and nuts shall be shipped and stored in plastic bags in wood or metal containers.
   c. Marking. All bolts, nuts, and washers shall be marked according to the appropriate AASHTO/ASTM specifications. The manufacturer's control numbers on the test reports must match the lot numbers marked on the shipping containers. If this criterion is not met, the lot in question shall be rejected.

4. Testing.

a. Bolts.

(1) Proof load tests (ASTM F 606, Method 1) are required. Minimum frequency of tests shall be as specified in AASHTO M 164, Paragraph 9.2.4.

(2) Wedge tests on full size bolts (ASTM F 606, Paragraph 3.5) are required. If bolts are to be galvanized, tests shall be performed after galvanizing. Minimum number of tests shall be as specified in AASHTO M 164, Paragraph 9.2.4.

(3) If galvanized bolts are supplied, the thickness of the zinc coating shall be measured. Measurements shall be taken on the wrench flats or top of bolt head.

b. Nuts.

(1) Proof load tests (ASTM F 606, Paragraph 4.2) are required. Minimum number of tests shall be as specified in AASHTO M 291, Paragraph 8.3 or AASHTO M 292 Paragraph 7.1.2.1. If nuts are to be galvanized, tests shall be performed after galvanizing, overtapping, and lubricating.

(2) If galvanized nuts are supplied, the thickness of the zinc- coating shall be measured. Measurements shall be taken on the wrench flats.

c. Washers.

(1) If galvanized washers are supplied, hardness testing shall be performed after galvanizing. (Coating shall be removed before taking hardness measurements).

(2) If galvanized washers are supplied, the thickness of the zinc coating shall be measured.

d. Assemblies. According to Subsection 11.5.6 of the AASHTO LRFD Bridge Construction Specifications, rotational-capacity tests are required and shall be performed on all plain or galvanized (after galvanizing) bolt, nut, and washer assemblies. If the project has been designed according to the AASHTO Standard Specifications for Highway Bridges, the criteria for rotational-capacity tests of Subsection 11.5.6 of Division II of the AASHTO Standard Specifications for Highway Bridges shall govern. According to the rotational-capacity tests guidelines, the test shall also be performed at the job site and by the manufacturer or distributor before shipping. Washers are required as part of the test even though they may not be required as part of the installation procedure. The following shall apply:

(1) Except as modified herein, the rotational-capacity test shall be performed according to the requirements of AASHTO M 164. Additional guidance concerning rotational-capacity tests for both long and short bolts is included in Section 990, NJDOT S-1 and S-2.

(2) Each combination of bolt production lot, nut lot, and washer lot shall be tested as an assembly. Where washers are not required by the installation procedures, they need not be included in the lot identification.

(3) A rotational-capacity lot number shall be assigned to each combination of lots tested.

(4) The minimum frequency of testing shall be two assemblies per rotational-capacity lot.

(5) The bolt, nut, and washer assembly shall be assembled in a Skidmore-Wilhelm calibrator or an acceptable equivalent device. This requirement supersedes the current AASHTO M 164 requirement that the test be performed in a steel joint. For bolts that are too short to be assembled in the Skidmore-Wilhelm calibrator, see (9) below.

(6) The minimum rotation, from a snug tight condition (ten percent of the specified proof load), shall be:

Rotation	**Bolt Length**
240 degrees (⅔ turn)	≤ 4 diameters
360 degrees (1 turn)	> 4 diameters and ≤ 8 diameters
480 degrees (1-⅓ turns)	> 8 diameters

These values differ from the AASHTO M 164 specifications.

(7) The tension reached at the above rotation shall be equal to or greater than 1.15 times the required installation tension. The installation tension and the tension for the turn test are shown:

Bolt Size	⅜	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½
Req. Install Tension, kips	12	19	28	39	51	56	71	85	103
Turn Test Tension, kips	14	22	32	45	59	64	82	98	118

(8) After the required installation tension listed above has been exceeded, one reading of tension and torque shall be taken and recorded. The torque value shall conform to the following:

$$\text{Torque} \leq 0.25\,PD$$

Where: Torque = measured torque in foot-pounds.
P = measured bolt tension in pounds.
D = bolt diameter in feet.

(9) Bolts that are too short to test in a Skidmore-Wilhelm calibrator may be tested in a steel joint. The tension requirement of (7) above need not apply. The maximum torque requirement of (8) above shall be computed using a value of P equal to the turn test tension shown in the table in (7) above.

e. Reporting.

(1) The results of all tests (including zinc coating thickness) required herein and in the appropriate AASHTO specifications shall be recorded on the appropriate document.

(2) Location where tests are performed and date of tests shall be reported on the appropriate document.

f. Witnessing. The tests need not be witnessed by an inspection agency; however, the manufacturer or distributor that performs the tests shall certify that the results recorded are accurate.

5. Documentation.

a. Mill Test Report(s) (MTR).

(1) MTR shall be furnished for all mill steel used in the manufacture of the bolts, nuts, or washers.

(2) MTR shall indicate the place where the material was melted and manufactured.

b. Manufacturer Certified Test Report(s) (MCTR).

(1) The manufacturer of the bolts, nuts, and washers shall furnish test reports (MCTR) for the item furnished.

(2) Each MCTR shall show the relevant information required according to Subheading 4.e above.

(3) The manufacturer performing the rotational-capacity test shall include on the MCTR:

(a) The lot number of each of the items tested.
(b) The rotational-capacity lot number as required in Subheading 4.d.(3) above.
(c) The results of the tests required in Subheading 4.d above.
(d) The pertinent information required in Subheading 4.e.(2) above.
(e) A statement that MCTR for the items are in conformance to this specification and the appropriate AASHTO specifications.
(f) The location where the bolt assembly components were manufactured.

c. Distributor Certified Test Report(s) (DCTR).

(1) The DCTR shall include MCTR above for the various bolt assembly components.

(2) The rotation-capacity test may be performed by a distributor (instead of a manufacturer) and reported on the DCTR.

(3) The DCTR shall show the results of the tests required in Subheading 4.d above.

(4) The DCTR shall also show the pertinent information required in Subheading 4.e.(2) above.

(5) The DCTR shall show the rotational-capacity lot number as required in Subheading 4.d.(3) above.
(6) The DCTR shall certify that the MCTR is in conformance to this specification and the appropriate AASHTO specifications.

6. Shipping.
a. Bolts, nuts, and washers (where required) from each rotational-capacity lot shall be shipped in the same container. If there is only one production lot number for each size of nut and washer, the nuts and washers may be shipped in separate containers. Each container shall be permanently marked with the rotational-capacity lot number such that identification will be possible at any stage before installation.
b. The appropriate MTR, MCTR, or DCTR shall be supplied to the Contractor or Owner as required by the contract documents.

7. Installation. In addition to the Specifications stated in Section 11 of the AASHTO LRFD Bridge Construction Specifications or, if the project has been designed to the AASHTO Standard Specifications for Highway Bridges, to the Specifications stated in Division II Section 11 of the AASHTO Standard Specifications for Highway Bridges, when high-strength bolts are installed in the field or shop, the following requirements shall apply:
a. Bolts shall be installed according to the appropriate AASHTO Specifications. During installation, regardless of the tightening method used, particular care should be exercised so that the snug tight condition, as defined therein, is achieved.
b. The rotational-capacity test described in Subheading 4.d above shall be performed on each rotational-capacity lot before the start of bolt installation. Hardened steel washers are required as part of the test although they may not be required in the actual installation procedures.
c. A Skidmore-Wilhelm calibrator, or an acceptable equivalent tension measuring device, shall be required at each job site during erection. Periodic testing (at least once each working day when the calibrated wrench method is used) shall be performed to assure compliance with the installation test procedures required in the appropriate AASHTO Specifications for turn-of-nut tightening, calibrated wrench tightening, installation of alternate design bolts, and direct tension indicator tightening. Bolts that are too short for the Skidmore-Wilhelm calibrator may be tested using direct tension indicators (DTIS). The DTIS must be calibrated in the Skidmore-Wilhelm calibrator using longer bolts.
d. Lubrication.
(1) Galvanized nuts shall be checked to verify that a visible lubricant is on the threads.
(2) Black bolts shall be "oily" to the touch when delivered and installed.
(3) Weathered or rusted bolts or nuts not satisfying the requirements of b. or c. above shall be cleaned and relubricated before installation. Recleaned or relubricated bolt, nut, and washer assemblies shall be retested according to b. above before installation.
e. Bolt, nut, and washer (when required) combinations as installed shall be from the same rotational-capacity lot.

917.02 Flooring.{ XE "Steel:flooring" }

Steel for grid flooring shall conform to AASHTO M 270, Grade 36 and shall be galvanized according to AASHTO M 111. Formed steel flooring shall conform to ASTM A 1011, Grade 30.

917.03 Castings, Materials, and Components for Drainage Structures.{ XE "Steel:castings" }

All inlet and manhole castings, grates, extension rings, extension frames, and covers, shall be capable of withstanding the HL-93 live load vehicle when tested as a complete, assembled unit and shall conform to the following:

Metal shall conform to the following:

{ XE "Castings:gray iron" **}{** XE "Gray iron castings" **}**1. Gray iron castings shall conform to AASHTO M 105 and AASHTO M 306 for Class 30B and Class 35B and shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blowholes, and other defects in composition affecting their strength and value for the service intended.

The castings shall be sandblasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean, and uniform surface.

2. Carbon steel extension frames and rings for inlets and manholes shall be galvanized according to AASHTO M 111 when specified. Welding of fabricated steel shapes and structures shall conform to AWS D1.1. No

punching, drilling, reaming, welding, or cutting will be allowed in the field. Any damage to the galvanized coating during and prior to installation shall be repaired without additional compensation.

3. Structural steel shapes used in the fabrication of drainage structures and components shall conform to Subsection 917.07.
4. Ductile iron castings shall conform to ASTM A 536, Grade 65-45-12 or Grade 80-55-06.
5. Type "E" inlet casting, design A (one part casting) or design B (two part casting), may be used interchangeably in any location where Type E inlet has been specified. The Contractor shall ensure that when using alternate B casting the two casting segments are securely fastened together according to the manufacturer's recommendations.
6. Extension rings, extension frames, castings, or other drainage structure components made of non-metal materials shall conform to Subsection 919.21.

917.04 Permanent Steel Bridge Deck Forms.{ XE "Steel:bridge deck forms" }

Permanent steel bridge deck forms and accessories shall conform to ASTM A 653, Grades 33, 37, 40, 49, or 80. Galvanizing shall conform to ASTM A 653, coating designation 700.

917.05 Rivets.{ XE "Steel:rivets" }

Structural rivet steel shall conform to ASTM A 502, Grade 1. High-strength structural rivet steel shall conform to ASTM A 502, Grade 2.

917.06 Steel Bearings.{ XE "Steel:bearings" }

Bearing pins shall be either annealed carbon steel forging conforming to AASHTO M 102, Class C or cold-finished carbon steel shafting conforming to AASHTO M 169, UNS G10160 to G10300 (Grades 1016 to 1030) inclusive. Structural steel bearings for prestressed concrete beams shall be hot-dip galvanized according to Subsection 917.12 except that bearing areas of pins and surfaces upon which pins bear shall be excluded from this requirement.

917.07 Steel Castings.{ XE "Steel:castings" }{ XE "Castings:steel" }

Carbon steel castings shall conform to AASHTO M 103, Grades 65-35 or 70-36. Carbon steel forgings shall conform to AASHTO M 102, Class D. High-strength steel castings shall conform to ASTM A 148.

917.08 Steel Forging.{ XE "Steel:forging" }

Steel forgings shall conform to AASHTO M 102, Class C. The forgings shall be thoroughly annealed before being machined.

917.09 Steel Piling.{ XE "Steel:piling" }

Steel H-piles shall conform to AASHTO M 270, Grade 36, with the exception that steel H-piles for use in a marine environment shall conform to AASHTO M 270, Grade 50. When used in a marine environment, Grade 50 material shall be coated with a 16-mil application of coal tar epoxy according to SSPC Paint Specification No. 16.

Steel sheet piling shall conform to AASHTO M 202 or AASHTO M 270, Grade 50, with the exception that steel sheet piling for use in a marine environment shall conform to AASHTO M 270, Grade 50. When used in a marine environment, the Grade 50 material shall be coated with a 16-mil application of coal tar epoxy according to SSPC Paint Specification No. 16.

Steel shells for cast-in-place piles shall conform to ASTM A 252, Grade 2. If the thickness is not prescribed, the shells shall be of such thickness and shall be reinforced so that they show no sign of distortion when driven. They shall be watertight and shall withstand collapsing forces until filled with concrete.

Certified copies of mill test results shall be furnished. Joints shall be butt jointed and arc welded. All shells shall be equipped with heavy steel points having a diameter not less than the outside diameter of the pile tip. The design of the metal shells shall be submitted and approved before the shells are driven.

Closure plate for steel pipe piling shall be equal to the pile outside diameter with a tolerance of plus or minus 1/16 inch and shall be ¾-inch minimum thickness. The plate shall be welded all around.

Splices for steel pipe piling shall be of the internal type and full penetration butt welds shall be made all around.

917.10 Structural Steel.{ XE "Steel:structural" }

Carbon structural steel shall conform to AASHTO M 270, Grade 36, 50, or 50W or ASTM Grade HPS70W. ASTM Grade HPS70W shall be fabricated according to the criteria of the AASHTO Guide Specifications for Highway Bridge Fabrication with HPS70W steel. Use of the Thermo-Mechanical-Controlled-Process (TCMP)

manufacturedHPS70W steel is permitted. Supplementary requirement S83 for non-fracture critical material or S84 for fracture critical material is mandatory for materials designated "T" as main load carrying member components subject to tensile stress. Zone 2 of Table S1.1 shall govern the toughness requirements.

Corrosion resistant (Weathering) steel shall conform to the requirements of AASHTO M 270 Grade 50W or ASTM A 709, Grade HPS70W. The criteria for the above supplementary requirements, S83 or S84, shall be applied.

High strength bolts for use with unpainted corrosion resistant (Weathering) steel shall conform to AASHTO M 164, Type 3. All other bolts and fasteners, which will remain in the finished structure, shall be of material having the same weathering characteristics as the corrosion resistant base metal.

High-strength low-alloy structural steel with a 50,000 psi minimum yield point for thicknesses 4 inches and under shall conform to AASHTO M 270, Grade 50W. Supplementary requirement S83 for non-fracture critical material or S84 for fracture critical material is mandatory for materials designated "T" as main load carrying member components subject to tensile stress. Zone 2 of Table S1.1 shall govern the toughness requirements.

High-strength low-alloy steel of structural quality shall conform to AASHTO M 270, Grade 50. Supplementary requirement S83 for non-fracture critical material or S84 for fracture critical material is mandatory for materials designated "T" as main load carrying member components subject to tensile stress. Zone 2 of Table S1.1 shall govern the toughness requirements.

High-yield-strength, quenched and tempered alloy steel plate, suitable for welding shall conform to AASHTO M 270, Grades 100/100W. Supplementary requirement S83 for non-fracture critical material or S84 for fracture critical material is mandatory for materials designated "T" as main load carrying member components subject to tensile stress. Zone 2 of Table S1.1 shall govern the toughness requirements.

Tie rods, plate washers, and turnbuckles shall conform to AASHTO M 270, Grade 36.

Steel tubes shall be steel pipe conforming to the requirements of current ASTM A 53, Type S or Type E, Grade B, and shall be hot-dip galvanized after fabrication, including welding, according to Subsection 917.12.

Plates, shapes, and shims shall be made of structural steel conforming to AASHTO M 270, Grade 36 and shall be hot-dip galvanized after fabrication, including welding, according to Subsection 917.12.

917.11 Transverse Ties.{ XE "Steel:transverse ties" }

Transverse ties for prestressed concrete voided slab and box beams shall be high-tensile strength steel rod bars conforming to AASHTO M 275 or ½-inch diameter, 270,000 psi strands, or equivalent. Bars shall be blast cleaned (SSPC-SP 6) and coated with a two-component, self priming, chemically cured, catalyzed coal tar epoxy coating conforming to Subsection 912.04. As an alternate, bars may be epoxy-coated according to AASHTO M 284 or galvanized according to AASHTO M 111. The minimum thickness of the cured epoxy coating per AASHTO M 284 shall be 10 ± 2 mils.

End anchorages (nuts, washers, and anchor plates) to be used with high-tensile strength steel rod bars shall be shown on the working drawings and approved by the Engineer. End anchorages shall be compatible with the tie rod system and shall be galvanized according to AASHTO M 111.

Anchorages and end fittings for ½-inch diameter strands and the corrosion protection method for the end fittings shall be shown on the working drawings and shall be approved by the Engineer.

917.12 Zinc Coating on Steel.{ XE "Steel:zinc coating (galvanizing)" }{ XE "Zinc coating (galvanizing)" }

Zinc coating (hot-dip galvanizing), applied on iron and steel products, shall conform to AASHTO M 111.

Zinc coating (hot-dip galvanizing), applied on iron and steel hardware, shall conform to ASTM A 153.

Tubular steel sign support structures shall utilize the dry process. No kettle flux shall be allowed in the galvanizing kettle.

917.13 Bolts and Studs for Noise Barriers.

Bolts and studs for noise barriers shall conform to ASTM F 593, Alloy 304, Condition A. Nuts for bolts and threaded stainless steel rod shall conform to ASTM F 594, Alloy 304, Condition A. Washers shall be stainless steel conforming to ASTM A 167, Type 304, No. 4 finish. Threaded stainless steel rod shall conform to ASTM A 276, Type 304, Condition A.

917.14 Sampling and Testing Methods.{ XE "Steel:sampling and testing" }{ XE "Samples for:ferrous metals" }{ XE "Samples for:structural steel" }

Sampling and testing will be performed according to the following:

Bolts, nuts, washers, and miscellaneous ..... Subject to inspection and testing before shipment

hardware	
Castings:	
Carbon	Subject to inspection and testing before shipment
Gray Iron	Two bars for each 200 kips
Steel for flooring, deck forms, rivets, bearings, castings, forgings, pilings, and structures	Subject to inspection before shipment
Steel, structural	Subject to inspection and testing at point of fabrication

917.15 Certification of Compliance.

Mill certifications are required, except for castings, and shall be submitted according to Subsection 106.04.

SECTION 918 - TIMBER AND TIMBER PRESERVATIVES{ XE "TIMBER" }

918.01 Sawn Timber Posts, Timber Spacers, and Routed Timber Spacers.

Sawn timber posts, timber spacers, and routed timber spacers shall be of Southern pine or Douglas fir with extreme fiber stress in bending in excess of 1,200 pounds per square inch, as assigned according to Southern Pine Inspection Bureau or West Coast Lumber Inspection Bureau grading rules. The timber posts, timber spacers, and routed timber spacers may be rough sawn or dressed. Treatment shall be according to AASHTO M 133 and AWPA Standards C2 and C14, as summarized in Subsection 918.06.

918.02 Round Timber Piling.{ XE "Timber:bearing piles" }

Round timber piling shall be southern pine or Douglas fir conforming to AASHTO M 168 and ASTM D 25, except that untreated piles having smooth, tight bark need not be peeled. Treatment shall be according to AASHTO M 133 and AWPA Standards C3 and C14 as summarized in Subsection 918.06.

918.03 Dimension Lumber for Sheet Piling.{ XE "Timber:sheet piling" }

Sheet piling shall be southern pine or Douglas fir No. 2 or better, dressed on four sides and shall be tongue and grooved or grooved for splines. Treatment shall be according to AASHTO M 133 and AWPA Standards C2, C14, and C18, as summarized in Subsection 918.06.

918.04 Timber Connectors and Hardware.{ XE "Timber:connectors" }{ XE "Timber:hardware for" }

Timber connectors and hardware shall be galvanized and shall conform to Division II, Section 16 of the AASHTO Specifications for Highway Bridges.

918.05 Dimension Lumber, Timber, Glued-Laminated Timber, and Decking for Structures.{ XE "Timber:for structures" }

Dimension lumber, timber, glued-laminated timber, and decking for structures shall conform to AASHTO M 168 with the following modifications:

1. Dimension lumber and timber shall be southern pine or Douglas fir of structural grade and shall conform to the grading rules of the Southern Pine Inspection Bureau or the Western Lumber Inspection Bureau. Grading must be performed by an agency approved by the Board of Review of the American Lumber Standards Committee. Southern pine shall be designated and graded as No. 2 if 1½ to 3½ inches thick and as No. 1 if 4½ inches or thicker. Douglas fir shall be designated and graded as Dense No. 1.

   Pacific coast Douglas fir may be used instead of southern yellow pine. Pacific coast Douglas fir shall be stress graded, conforming to the Standard Grading Rules of the West Coast Lumber Inspection Bureau. Timber for decking shall be designated Commercial DEX, and all other Douglas fir shall be Dense No. 1. Timber shall be dressed square edged S4S.

   Pacific coast Douglas fir shall be treated with creosote, AWPA Standard No. P13, by the full-cell process to a retention of not less than 12 pounds of preservative per cubic foot of timber for timber 5 inches and thicker, and 20 pounds of preservative per cubic foot of timber or to refusal but not less than 12 pounds per cubic foot for timber less than 5 inches thick, according to AWPA Standard No. C2.

2. Timber for decking subjected to vehicular traffic shall be graded as Dense Commercial if southern pine and Select if Douglas fir. Timber for bridge decking shall be dressed square edged S4S.
3. Timber for decking used exclusively by pedestrians shall be Commercial grade and shall be dressed square edged S4S.
4. Treatment shall be according to AASHTO M 133 and AWPA Standards C2, C14, C18, and C28 as summarized in Subsection 918.06, except that timber railing systems and decking used by pedestrians shall not be preserved with creosote. In addition, timber decking, which is covered with membrane waterproofing and asphalt cement overlay, shall not be preserved with creosote.
5. Solid sawn timber for noise barriers shall be of Douglas fir-larch (Western Wood Products Association) and be graded as No. 1 or better or shall be southern pine (The Southern Pine Inspection Bureau) and graded as No. 2 or better. Hardwood may be used for solid sawn timber if it is at least of the same strength as the softwood and is approved by the Engineer. Heartwood may be used, but no heartwood center (pith) will be allowed.

   Glulam shall be classified 22F-E5 DF/DF (Douglas fir) or 20F-E3 SP/SP (Southern pine) (AITC Table 1). The adhesive in glulam production shall comply with "wet condition" as specified in PS56. Lumber used in the production of glulam shall be within a range of seven to 16 percent moisture content at the time of laminating. The moisture gradient within a single glulam member shall be limited to a five percent range as specified by PS56.

   All timber materials shall receive a preservative treatment consisting of five percent pentachlorophenol AWPA P-9, Type A in oil, according to AWPA Standards C14 and C28, current at time of bid, to a minimum retention of 0.5 pounds per cubic foot before gluing. Where feasible, all cuts and holes shall be fabricated before preservative treatment. After treatment, the maximum moisture content shall not exceed 19 percent.

918.06 Timber Treatment.{ XE "Timber:preservatives" }

Timber preservative treatment for various wood species and usage requirements shall be according to AASHTO M 133 and AWPA Standards C1, C2, C3, C14, C18, and C28 as summarized in the following tables:

{ XE "Timber:posts" **}1. Timber Posts (Soil and Fresh Water Contact).** Timber posts of southern pine for use in soil or fresh water contact shall be treated with creosote, CCA, or pentachlorophenol (penta) to the minimum retention levels listed below. Posts of Douglas fir for use in soil or fresh water contact shall be treated with creosote or ACZA to the minimum retention levels listed below. Posts of oak, maple, and black/red gum for use in soil or fresh water contact shall be treated with creosote to the minimum retention levels listed below.

Timber Posts/Usage	**AWPA Standards**	**Wood Species/Treatment Process Minimum Retention (lbs/cu.ft.)**			
		Southern Pine		*Douglas Fir*	
	Creosote	*CCA/Penta*		*Creosote*	*ACZA*
1. Round, half-round, and quarter-round posts	C14	10	0.50	10	0.50
2. Posts sawn four sides	C14	12	0.60	12	0.60

Timber Posts/Usage	AWPA Standards	Wood Species/Treatment Process Minimum Retention (lbs/cu.ft.)		
		Oak Creosote	*Maple Creosote*	*Black/Red Gum Creosote*
3. Oak, maple, and black/red gum posts, under 5 inch thick	C2	7	10	8
4. Oak, maple, and black/red gum posts	C2	6	10	8

2. Round Timber Piles. Round timber piles of southern pine for use in soil or fresh water contact shall be treated with creosote or CCA to the minimum retention levels listed below. Round timber piles of southern pine for use in a marine environment, including foundation piles in a marine environment, shall be treated with CCA to the minimum retention levels listed below. Round timber piles of Douglas fir for use in soil or fresh water contact shall be treated with creosote or ACZA to the minimum retention levels listed below. Round timber piles of Douglas fir for use in a marine environment, including foundation piles in a marine environment, shall be treated with ACZA to the minimum retention levels shown.

Round Timber Piles/Usage	AWPA Standards	Wood Species/Treatment Process Minimum Retention by ASSAY (lbs/cu.ft.)			
		Southern Pine		*Douglas Fir*	
		Creosote	*CCA*	*Creosote*	*ACZA*
1. Soil contact and fresh water contact	C3, C14	12	0.80	17	1.00
2. Marine environment (salt water contact)	C3, C14	N/A	2.5 (Zone 1) 1.5 (Zone 2)	N/A	2.5

3. Timber Sheet Piling and Timber for Structures. Sheet piling and structural timber of southern pine for use in soil or fresh water contact shall be treated with creosote, CCA, or pentachlorophenol (penta) to the minimum retention levels listed below. Sheet piling and structural timber of southern pine for use in a marine environment shall be treated with CCA to the minimum retention levels listed below. Sheet piling and structural timber of Douglas fir for use in soil or fresh water contact shall be treated with creosote or ACZA to the minimum retention levels listed below. Sheet piling and structural timber of Douglas fir for use in a marine environment shall be treated with ACZA to the minimum retention levels shown.

Timber Sheet Piling and Structural Timber/Usage	AWPA Standards	Wood Species/Treatment Process Minimum Retention (lbs/cu.ft.)			
		Southern Pine		*Douglas Fir*	
		Creosote	*CCA/Penta*	*Creosote*	*ACZA*
1. Above ground, soil contact, and fresh water contact	C2, C14	12	0.60	12	0.60
		Creosote	*CCA*	*Creosote*	*ACZA*
2. Marine environment (salt water contact or salt water splash)	C2, C14, C18	N/A	2.5	N/A	2.5

4. Glued-Laminated Timber (Above Ground and Soil Contact). Glued-laminated structural timber of southern pine or Douglas fir for use above ground and in soil contact shall be treated with creosote or pentachlorophenol (penta) to the minimum retention levels shown. Glued-laminated timber shall be treated before gluing.

Glued-Laminated Structural Timber/Usage	**AWPA Standards**	**Wood Species/Treatment Process Minimum Retention (lbs/cu.ft.)**			
		Southern Pine		*Douglas Fir*	
		Creosote	*Penta*	*Creosote*	*Penta*
Above ground and soil contact	C14, C28	12	0.60	12	0.60

Glued-laminated timber shall not be used in marine environment or in salt water splash zones.

918.07 Sampling and Testing Methods.{ XE "Timber:sampling and testing" }{ XE "Samples for:timber" }

Sampling and testing will be performed according to the following:

Timber posts, piles, and connectors ..... Subject to inspection before shipment
Timber for structures ..... Subject to inspection and testing prior to shipment
Timber preservatives ..... AASHTO M 133

SECTION 919 - MISCELLANEOUS{ XE "MISCELLANEOUS" }

919.01 Bags.{ XE "Bags" }

Bags for concrete bag slope protection shall conform to AASHTO M 182, Class 1. The bags shall measure approximately 18 by 29½ inches when closed and tied, and shall be capable of holding 1 cubic foot of concrete without ripping, tearing, bursting or loss of concrete during handling and placing on the slope.

919.02 Bearing Pads.

{ XE "Bearing pads:elastomeric" **}{** XE "Bearing pads:preformed fabric" **}A. Elastomeric Bearing Pads.** Elastomeric bearing pads for bridge beams shall conform to Division II, Section 18, AASHTO Standard Specifications for Highway Bridges. Grade 60 shall be used. Elastomeric bearing pads for bridge railing posts shall conform to Division II, Section 18, AASHTO Standard Specifications for Highway Bridges. Grade 70 shall be used.

The manufacturer shall provide certified reports on the lot from which each shipment is made, based on tests made in the manufacturer's own laboratory or by a testing agency.

B. Preformed Fabric Pads. Preformed fabric pads shall be composed of multiple layers of 8-ounce duck impregnated and bound with high quality natural rubber or of equivalent and equally suitable materials compressed into resilient pads of uniform thickness. The number of plies shall be such as to produce a thickness of ⅛ inch after compression and vulcanizing. The finished pads shall withstand compression loads perpendicular to the plane of the laminations of not less than 10,000 pounds per square inch without detrimental reduction in thickness or extension.

919.03 Calcium Chloride.{ XE "Calcium chloride" }

Calcium chloride shall conform to AASHTO M 144 except that the alkali and impurity requirements need not apply.

919.04 Caulking Compound.{ XE "Caulking compound" }

Aluminum-impregnated caulking compound shall conform to Federal Specification TT-C-598, consistency Grade 1.

919.05 Waterproofing.{ XE "Waterproofing" }

{ XE "Asphalt seal coat" **}**Asphalt seal coat shall conform to ASTM D 449, Type I for use below ground level and to ASTM D 449, Type II or III for use above ground level. Primer shall conform to ASTM D 41.

{ XE "Bituminized cotton fabric" **}**Bituminized cotton fabric shall conform to ASTM D 173.

{ XE "Tar seal coat" **}**Tar seal coat shall conform to ASTM D 450, Type II. Primer shall conform to ASTM D 43.

Membrane waterproofing shall be a HMA material reinforced with a synthetic fabric capable of withstanding puncture and severe stress. Membrane shall be cold applied and capable of providing a good bond to both the primed surface and to itself on overlap areas.

Membrane waterproofing shall conform to the following:

Physical Property	Test Method	Requirement
Thickness		60 ± 5 mils minimum
Tensile Strength of Reinforcement Only	ASTM D 882-A	50 lbs/in width minimum
Elongation of Compound Only	ASTM D 882-A	300% minimum
Water Absorption	ASTM D 517	1% maximum by weight
Permeance	ASTM E 96-B	0.05 perms maximum
Pliability	ASTM D 146	No cracks at 180-degree (-25 ºF, 1" mandrel) bend
Puncture Resistance	ASTM E 154	40 lbs minimum
Compound Softening Point	ASTM D 36	220 ºF
Peel Adhesion	ASTM D 903	4 lbs/in minimum

919.06 Geotextiles.{ XE "Geotextiles" }

Fibers used in the manufacture of geotextiles and threads used in sewing geotextiles shall be long-chain, polymeric filaments or yarns consisting of at least 85 percent, by weight, polyolefins, polyesters, or polyamides. The fibers shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including selvages.

Geotextile rolls shall be furnished with wrapping and, before placement, shall be stored for protection against moisture and extended ultraviolet ray exposure. Geotextiles to be placed above ground or exposed to ultraviolet rays shall be inert to commonly encountered chemicals and be ultraviolet stabilized. Each roll shall be labeled to provide product identification.

Geotextiles shall meet the specified requirements for the following uses when tested according to the methods listed:

1. Underdrains.

Physical Property	Test Method	Requirements
Grab Strength, lbs	ASTM D 4632	80 minimum
Puncture Strength, lbs	ASTM D 4833	25 minimum
Burst Strength, psi	ASTM D 3786	130 minimum
Trapezoidal Tear, lbs	ASTM D 4533	25 minimum
Seam Strength, lbs	ASTM D 4632	70 minimum
Ultraviolet Degradation, Retained Strength	ASTM D 4355	70% at 150 hours
Apparent Opening Size	ASTM D 4751	0.297 mm maximum
Permeability, cm/sec	ASTM D 4491	0.01 minimum

2. Roadway Stabilization, Riprap Filter, Retaining Structure Filter.

Physical Property	Test Methods	Requirements
Grab Strength, lbs	ASTM D 4632	200 minimum
Puncture Strength, lbs	ASTM D 4833	80 minimum
Burst Strength, psi	ASTM D 3786	.5 minimum
Trapezoidal Tear, lbs	ASTM D 4533	50 minimum
Seam Strength, lbs	ASTM D 4632	180 minimum
Ultraviolet Degradation, Retained Strength	ASTM D 4355	70% at 150 hours
Apparent Opening Size	ASTM D 4751	0.6 mm maximum
Permeability, No. 30	ASTM D 4491	0.001 minimum

3. Silt Fence, Inlet Filter.

Physical Property	Test Methods	Requirements
Weight, oz./sq yd	ASTM D 3776	2.5
Thickness, mil	ASTM D 1977	10
Grab Strength, lbs	ASTM D 4632	100 minimum
Elongation to Break, %	ASTM D 4632	10
Burst Strength, psi	ASTM D 3786	190 minimum
Trapezoidal Tear, lbs	ASTM D 4533	50 minimum
Permittivity Factor, per second	ASTM D 4491	0.01

919.07 Fly Ash.{ XE "Fly ash" }

Fly ash for portland cement concrete shall conform to ASTM C 618, Class C or Class F except that the loss on ignition shall not be more than three percent. When Class C fly ash is used, the magnesium oxide shall not exceed 2.5 percent. Fly ash used to control alkali-silica reactivity shall be Class F and shall contain not more than 1.5 percent available alkali according to ASTM C 618, Table 1A. Before each source of fly ash is approved, certified results of tests conducted by a testing agency shall be submitted to and verified by the Department. Accompanying the certification shall be a statement from the supplier listing the source and type of coal, the methods used to burn, collect, and store the fly ash, and the quality control measures employed.

Conformance to the requirements for loss on ignition and fineness shall be determined by the supplier for each truck load of fly ash delivered to the mixing site. The test values determined shall be included on the delivery ticket. The Engineer may require that the fly ash not be used until the Department has performed tests for loss on ignition and fineness.

Fly ash for other uses shall conform to ASTM C 593 except that the loss on ignition shall be not more than ten percent, and the combined content of silica and aluminum oxide shall be a minimum of 50 percent.

919.08 Gaskets.{ XE "Gaskets for pipe" }

Hemp or oakum gaskets shall be closely twisted and shall be of the size and type required for the pipe. Gaskets shall be in one piece of sufficient length to pass around the pipe and lap.

When used for watertight flexible joints, rubber gaskets, and flexible plastic gaskets shall conform to AASHTO M 198.

919.09 Hydrated Lime.{ XE "Hydrated lime" }

Hydrated lime shall conform to ASTM C 207, Type N.

919.10 Concrete Deck Overlay Protective Systems{ XE "Latex emulsion admixture" }{ XE "Admixtures:latex emulsion" }

A. Latex Emulsion Admixture. Latex emulsion admixture shall be a nonhazardous, film-forming, polymeric emulsion in water to which all stabilizers have been added at the point of manufacture. It shall be homogeneous and uniform in composition.

The latex shall be a styrene-butadiene polymeric emulsion stabilized with anionic, nonionic, and polyorgano-siloxane fluid surfactant in which the anionic surfactant is a sodium alkyl sulfate.

Latex modifiers shall be prequalified by a testing agency and shall conform to the requirements listed in the prequalification test program for styrene-butadiene latex emulsions of the FHWA Report No. FHWA-RD-78-35. A certified copy of the test properties shall be furnished according to Subsection 106.04.

Before submitting a mix design according to Subsection 518.06, Subpart A.2., a sample of the latex emulsion admixture shall be submitted to the Department Laboratory and tested for conformity to the following requirements:

Polymer (solids), percent	46 - 50
Butadiene, percent of polymer	32 - 36
Styrene, percent of polymer	64 - 68
pH	9.0 - 11.0

The percent of solids will be determined according to Section 990, NJDOT M-2. Other properties will be determined according to the procedure in the above referenced FHWA Report.

B. Silica Fume Admixture. Before submitting a mix design according to Subpart B of Subsection 518.06, a sample of the silica fume admixture shall be submitted to the Department Laboratory and tested for conformity against the requirements of the latest AASHTO M 307 and shall be accompanied by a copy of manufacturer's recommendations. Silica fume admixture shall be approved by the Engineer before its use on the Project. Only one brand of silica fume admixture shall be used for the entire duration of the project. Silica fume admixture may be supplied either in dry or in slurry form. If the slurry form is used, it shall be homogeneous and agitated to prevent separation.

Silica fume concrete shall consist of a homogeneous mixture of portland cement, silica fume admixture, fine aggregate, coarse aggregate, concrete admixtures (Type F or Type G high range water reducing admixture and air entraining admixture), and water.

919.11 Portland Cement.{ XE "Portland cement" }

Portland cement shall conform to the following:

Masonry Cement	ASTM C 91

Portland Cement, Type I, II, and Type III (see Note 1) ..... ASTM C 150
White Portland Cement, Type I and III (see Note 2) ..... ASTM C 150

Note 1: Type III may be used only for prestressed or precast items.

Note 2: Shall not contain more than 0.55 percent by weight of ferric oxide (Fe_2O_3).

Portland cement, Type II, which has been pre-blended with a maximum of 15 percent fly ash, by weight, and conforming to ASTM C 595 may be used. When blended portland cement is used, no additional fly ash shall be added.

Different brands of cement, the same brand of cement from different mills or different types of cement shall not be mixed.

Suitable means shall be provided for storing and protecting the cement against dampness. Cement which for any reason has become partially set or which contains lumps of caked cement will be rejected. The temperature of the cement at the time of delivery to the mixer shall not exceed 160 °F.

919.12 Quick-Setting Patch Materials.{ XE "Quick-setting patch materials" }{ XE "Patch materials:quick-setting" }

The material shall be packaged and ready for mixing just before use according to the manufacturer's instructions. The required water demand for the patching material classification type that is to be used shall be stated in the manufacturer's written instructions. It shall be concrete gray in color and contain no calcium chloride or admixture containing calcium chloride, or other ingredient in sufficient quantity to cause corrosion to steel reinforcement. It shall be quick-setting for use as a concrete patching compound where fast setting, rapid strength gain, non-shrink, and high bond strength characteristics are needed.

The material shall be classified into the following types:

Type I: Suitable for use above water. As much as 15 pounds of size No. 8 coarse aggregate, per bag, may be added to increase yield. This is provided that the product properties are not adversely affected.

Type IA: Type 1A products shall be those products that are classified as Type 1, that have manufacturer specified mix proportions and have more than 15 pounds, per bag, of No. 8 coarse aggregate and/or sand. The mix proportions shall be approved by the Bureau of Materials at least 90 days before the start of placement. The manufacturer's mixing proportions shall include the type and size of aggregate and the proportion of patching materials, aggregate/sand and water that is required. Mix proportioning verification trial batching, that is based on the manufacturer's pre-approved proportions and consist of the same materials that are proposed for use on the project, shall be prepared by the Contractor at least 10 days before the start of placement. The trial batching shall also be verified by the Department to meet the physical properties that are listed herein.

Type II: Suitable for use underwater.

Type III: Suitable for use above water at air temperatures below 32 °F.

Type IV: Suitable for use above water and for use in hot weather (95 ± 5 °F).

Type V: Suitable for vertical and overhead repairs that are not formed and poured.

Should liquid activator, other additives, adhesive, or bonding agents be integral to the performance of the patch material, they shall be provided so that one package of additive, activator, adhesive or bonding agent is required for one package of patch material.

The material when tested according to Section 990, NJDOT M-3 shall meet the following requirements:

1. **Bond Strength.**
   7-day.....1,000 psi minimum
   28-day.....2,000 psi minimum
2. **Expansion/Shrinkage.**
   Cured in Water ..... +0.20% maximum
   Cured in Air..... -0.20% maximum
   Difference..... 0.30% maximum
3. **Durability.** Patching material must retain 90 percent of the 28-day compressive strength after 50 freeze-thaw cycles.
4. **Permeability.** The chloride content of the patching material must not exceed 2.5 pounds per cubic yard at or below the 2-inch level.

5. **Compressive Strength (psi).** Patching material is classified as follows:

	3 hours	1 day	7 days	28 days
Type I and IA	2,000	3,000	4,000	4,500
Type II	--	2,000	4,000	4,500
Type III	2,000	3,000	4,000	4,500
Type IV	2,000	3,000	4,000	4,500
Type V	--	1,000	2,000	3,000

6. **Time of Set.**

	Not Less Than	Not More Than
Type I and IA	5 minutes	--
Type II	5 minutes	20 minutes
Type III	5 minutes	--
Type IV	5 minutes	--
Type V	5 minutes	--

919.13 Hay and Straw.{ XE "Hay" }{ XE "Straw" }{ XE "Salt hay" }

Salt hay shall be of salt meadow grasses. Hay shall be timothy, redtop, or native grasses. Straw shall be stalks of oats, wheat, rye, or barley relatively free from seeds, noxious weeds, and other foreign matter, free from decayed matter and from organic matter soluble in water.

919.14 Sodium Chloride (Rock Salt){ XE "Sodium chloride (rock salt)" }

Sodium chloride shall conform to ASTM D 632, Type I with the following exceptions:

1. Sodium chloride shall be in the form of rock salt containing, at the time of delivery, not more than 1.0 percent moisture as determined by drying at 230 ± 9 °F (110 ± 5 °C) to constant weight.
2. Evaporated solar or other salt shall not be furnished instead of rock salt.

919.15 Water.{ XE "Water" }

Water used in mixing or curing shall be clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. Water will be tested according to and shall meet the requirements of AASHTO T 26. Water known to be of potable quality may be used without test. Where the source of water is relatively shallow, the intake shall be so enclosed as to exclude silt, mud, grass, or other foreign materials.

919.16 Waterstops.{ XE "Waterstops" }

Metallic waterstops shall be sheet copper conforming to Subsection 911.03.

Nonmetallic waterstops shall be synthetic rubber or polyvinyl chloride conforming to Division II, Section 8, AASHTO Standard Specifications for Highway bridges.

919.17 Epoxy Bedding and Bonding Compound.{ XE "Epoxy bedding and bonding compound" }

Epoxy bedding and bonding compound shall be a two-part, non-sag gel, rapid-setting epoxy adhesive conforming to the requirements of Appendix C, NJDOT Research Report No. 86-013-7778. Copies of the report may be obtained from Bureau of Research. The epoxy shall be used at the ambient temperature range of 40 to 100 °F.

919.18 Ground, Granulated Blast Furnace Slag.

Ground, granulated blast furnace slag for use as a cementitious material in portland cement concrete shall conform to the requirements of AASHTO M 302, Grade 120. Grade 100 may be used only with the written permission of the Engineer.

Ground, granulated blast furnace slag may be used as a replacement for portland cement conforming to ASTM C 150 or white portland cement as specified in Subsection 919.11 up to a maximum replacement level of 30 percent by weight. Replacement of portland cement greater than 30 percent will not be allowed.

Certification will be required indicating that the ground, granulated blast furnace slag meets the requirements AASHTO M 302, Grade 120 at seven days, and the results for 28 days shall be provided within the time requirements of this standard.

When ground, granulated blast furnace slag is used, its use shall continue throughout the Project so as not to create color inconsistencies in the finished concrete.

919.19 Sampling and Testing Methods.{ XE "Samples for:bearing pads" }{ XE "Samples for:calcium chorlide" }{ XE "Samples for:sodium chorlide" }{ XE "Samples for:latex emulsion" }{ XE "Samples for:portland cement" }{ XE "Samples for:water" }

Sampling and testing will be performed according to the following:

Bearing Pads	1 square foot from each lot
Chlorides:	
Calcium	1 quart from each lot
Sodium	1 quart for chemical analysis from each lot and one large bag for gradation
Latex Emulsion	Subsection 919.10
Masonry Cement	ASTM C 91
Portland Cement	ASTM C 150
Water	1 gallon from each source

919.20 Certification of Compliance.

Manufacturer's certifications are required for bearing pads, portland cement, and membrane waterproofing and shall be submitted according to Subsection 106.04.

919.21 Non-Metal Castings, Materials, and Components for Drainage Structures.

Extension frames and extension rings for inlets and manholes made of composite polymers or other non-metal materials shall be from the qualified products list maintained by the New Jersey Department of Transportation's Bureau of Quality Management Services, New Technologies and Products Section. Any product or material selected from this list must be accompanied by certification of compliance conforming with Subsection 106.04. In addition the certification of compliance shall certify that the product or material is identical to that which was evaluated and approved by the New Technologies and Product Section, as defined by the manufacturer's specifications on file with the Bureau of Materials and with the New Technologies and Products Section.

Bureau of Quality Management Services
New Technologies and Products Section
1035 Parkway Avenue
PO Box 600
Trenton, NJ 08625

SECTION 920 – SUPERPAVE HOT MIX ASPHALT (HMA) { XE "SUPERPAVE HOT MIX ASPHALT (HMA)" }{ XE "SUPERPAVE HOT MIX ASPHALT (HMA):MATERIALS" }

920.01 Composition of Mixtures.

Composition of the mixture for Superpave HMA surface course shall be coarse aggregate, fine aggregate, and asphalt binder, and may also include mineral filler and up to 15 percent RAP. Not more than a total of one percent by weight contamination from Crushed Recycled Container Glass (CRCG) will be permitted in the finished mix.

The composition of the mixture for base or intermediate course shall be coarse aggregate, fine aggregate, and asphalt binder, and may also include mineral filler and up to 25 percent of RAP, and/or up to five percent ground bituminous shingle material, and/or up to ten percent CRCG. The combined total for recycled material shall not exceed 35 percent.

When RAP is used, the supplier shall have in operation an ongoing daily quality control program to evaluate the RAP. As a minimum this program shall consist of the following:

1. An evaluation performed to ensure that the material complies with Subsection 901.10, Subpart B and compares favorably with the design submittal.
2. An evaluation of the RAP material performed using a solvent or an ignition oven to qualitatively evaluate the aggregate components to determine compliance with Subsection 901.10, Subparts A and C. Quality control reports shall be made available to the Engineer.

Materials shall conform to the following Subsections:

Aggregates for Superpave Hot Mix Asphalt 901.10
Mineral Filler 901.14
Asphalt Binder 904.01

The several mineral constituents shall be combined in such proportions that the resulting mixture meets the grading requirements in Subsection 920.04 Table 920-1. In calculating the percentage of aggregates of the various sizes, the asphalt binder is excluded.

Aggregates shall conform to the requirements in Subsection 901.10 and the following:

The combined coarse aggregate in the mixture shall comply with the requirements in Table 920-5 and the combined fine aggregate in the mixture shall comply with the requirements in Table 920-6. RAP for Superpave HMA shall be processed through screening and crushing operations and shall be 100 percent passing the maximum aggregate size for the mixture.

920.02 Formula for Job Mix.{ XE "Superpave hot mix asphalt (HMA):formula for job mix" }

A job mix formula for each mixture shall be submitted on forms supplied by the Department, which shall include a statement naming the source of each component and a report showing the results meet the criteria specified in Subsection 920.04 Table 920-2 and Table 920-3.

The job mix formula for each mixture shall establish the percentage of dry weight of aggregate passing each required sieve size and an optimum percentage of asphalt binder based upon the weight of the total mix. The optimum percentage of asphalt binder shall be determined according to AASHTO MP2 and PP28. The job mix formula shall be within the master range specified in Subsection 920.04, Table 920-1.

For each mix design, three gyratory specimens and one loose sample corresponding to the composition of the job mix formula, including the design asphalt content, shall be submitted with the mix design forms. These will be used for verification of the properties of the job mix formula. The specimens shall be compacted to the design number of gyrations (N_{des}). To be acceptable all three gyratory specimens must comply with all of the requirements in Table 920-1 and 920-4. The Engineer reserves the right to be present at the time of molding the gyratory specimens.

At the discretion of the Engineer, the submission of gyratory specimens for verification of the properties of the job mix formula will not be required if the previous year's approved design for a particular mix is submitted with written certification that the same source and character of materials are to be used. When a previous year's design is approved for use, the initial lot provision of Subsection 920.03 shall not apply and the first lot of the particular mix shall not be a reduced size lot.

The job mix formula shall provide a mixture that meets a minimum Tensile Strength Ratio (TSR) of 80% when tested according to AASHTO T 283.

The job mix formula for each mixture shall be in effect until modification is approved.

{ XE "Reclaimed asphalt pavement (RAP):in superpave hot mix asphalt (HMA)" **}**The job mix formula which includes RAP shall also include the following based on the weight of the total mixture:

Percentage of RAP

Percentage of asphalt binder in the RAP.
Percentage of new asphalt binder.
Total percentage of asphalt binder.
Percentage of each type of new aggregate.

For mixes containing RAP, the job mix formula shall also establish the target percentage of dry weight of aggregate passing each required sieve size and the target percentage of recoverable bitumen to be present in the recycled Superpave HMA mixture when discharged from the plant and when tested according to Section 990, NJDOT B-3 or AASHTO T 308.

The job mix formula containing up to 25 percent of RAP may be established by modifying a previously approved mix design to allow for the introduction of reclaimed asphalt pavement.

Mixtures containing up to ten percent CRCG shall require a formula for job mix as outlined in this Subsection. The percentage of CRCG shall be included on the job mix formula.

Mixtures containing up to five percent Ground Bituminous Shingle Material (GBSM) shall require a formula for job mix as outlined in this subsection. The percentage of GBSM shall be included on the job mix formula.

When unsatisfactory results for any specified characteristic of the work make it necessary, a new job mix formula may be established for approval. In such instances, if corrective action is not taken, the Engineer reserves the right to require an appropriate adjustment.

Should a change in sources or properties of new materials be made or significant changes in the properties of the RAP occur, the Engineer may require that a new job mix formula be established and approved before production can continue.

920.03 Sampling and Testing { XE "Superpave hot mix asphalt (HMA):sampling and testing" }

A. General Sampling and Testing Requirements. Acceptance testing of Superpave HMA will be performed in a timely manner. Sampling will be performed according to AASHTO T 168, NJDOT Section 990, NJDOT B-2, and/or ASTM D 3665.

The producer's quality control technician shall be present during periods of mix production for the sole purpose of quality control testing and to assist the Department's representative in order to ensure compliance. The Department will not perform the quality control testing or other routine test functions in the absence of or instead of the plant laboratory technician.

Acceptance testing does not preclude the Engineer from requiring disposal of any batch or shipment without further testing which is rendered unfit for its intended use due to contamination, segregation, improper temperature, or incomplete coating of the aggregate. For other than improper temperature, visual inspection of the material by the Engineer is considered sufficient grounds for such rejection.

When materials are rejected for any of the above reasons, except for improper temperature, samples will be taken for testing. Should such testing indicate that the material was erroneously rejected, payment will be made for the rejected material.

HMA mixtures processed through a surge or storage system will be inspected visually to ensure that they are essentially free of lumps of cold material. Any batch or shipment of material found to be so contaminated will be rejected and shall be disposed of.

B. Drum Mix Plants. Five stratified random samples for acceptance will be taken from each lot of approximately 3,000 tons of each type of mix. When a lot of Superpave HMA is necessarily less than 3,000 tons, samples will be taken at random for each type of mix at the rate of one sample for each 600 tons or fraction thereof and will be treated as a short lot.

To determine the quantity of binder and the gradation of the aggregate to determine volumetric properties for quality control testing purposes, extractions or ignition testing at the sampling rate specified shall be performed each day for each type mixture according to Section 990, NJDOT B-3 or AASHTO T 308.

C. Fully Automated Batch Plants. When using bin analysis, five stratified random samples shall be taken from each lot, under the supervision of the Engineer, otherwise sampling is done according to the requirements for drum mix plants. A lot is approximately 3,000 tons of each type of mix. When a lot of Superpave HMA is necessarily less than 3,000 tons, samples shall be taken at random for each type of mix at the rate of one sample for each 600 tons or fraction thereof and will be treated as a short lot.

Quality control testing for gradation and volumetric properties shall be performed using bin samples and printed weigh tickets according to Section 990, NJDOT B-5 or according to the requirements for drum mix plants.

D. Quality Control and Acceptance Requirements. The quality control technician at the asphalt plant shall perform sampling and testing according to the approved quality control plan for the plant, to keep

the mix within the limits specified in Tables 920-1 and 920-4. Volumetric properties, dust to binder ratio, and compaction requirements (N_{ini}, N_{des}, N_{max}) for quality control samples shall be determined on the basis of extraction, ignition oven, or hot bin analysis, and air voids as determined by bulk specific gravity according to AASHTO T 166 and maximum specific gravity according to AASHTO T 209. The quality control technician shall use the results to control production.

Coarse aggregate, fine aggregate, mineral filler and RAP shall be sampled and tested according to the approved quality control plan for the plant.

Volumetric properties at N_{des}, dust to binder ratio and compaction at N_{ini} will be determined for acceptance from samples taken, compacted and tested at the mixing plant. The number of sublots tested for N_{max} is at the Engineer's discretion. The material will be compacted to the number of design gyrations (N_{des}) as required in Table 920-2, using equipment according to AASHTO T 312.

The bulk specific gravity of the compacted sample will be determined according to AASHTO T 166.

Maximum specific gravity shall be tested as needed to control production and at least once per day's production by the producer's quality control technician on loose material, according to AASHTO T 209.

The Superpave HMA mixture shall conform to all of the requirements listed in Subsection 920.04 Table 920-4, and to the gradation requirements in Table 920-1. If two samples in a lot do not conform to these requirements, corrective action shall be initiated immediately.

The temperature of the mixture at discharge from the plant or surge and storage bins shall be maintained at a minimum of 15°F above the minimum laydown temperature required to deliver material to the project to achieve optimum compaction. In no case shall the mixture temperature exceed 325 °F for unmodified asphalt binders or exceed the mixing range specified by the manufacturer for modified binders.

The moisture content of the mixture at discharge from the plant shall not exceed 1.0 percent. Moisture determinations are based on the weight loss on heating for one hour in an oven at 280 ± 5°F of an approximately 3.5 lb. sample of mixture. A minimum of one sample per lot will be tested for moisture. Samples for moisture determinations will be obtained according to Section 990, NJDOT B-2 or ASTM D 3665.

The total mineral aggregate and asphalt cement material shall be so combined and mixed that at least 95 percent of the coarse aggregate particles are entirely coated with asphalt binder as determined by AASHTO T 195. At the option of the Engineer, random samples will be obtained from each of five trucks, and the adequacy of the mixing will be determined on the average of particle counts made on these five test portions. If the above requirement is not fully met plant operations shall be modified as necessary to obtain the required degree of coating.

E. Initial Production Lot. The initial lot each year is defined as the plant's first day's production, or a minimum of 1,200 tons, in a calendar year. In the event the first day's production does not reach 1,200 tons, the initial lot is to be extended until the 1,200-ton level is reached or the Project is completed. Every truck will be visually checked before the first sample being taken. The first sample shall be taken in the first 100 to 200 tons. The remaining samples shall be taken at a rate of one sample every 600 tons, starting at 600 tons.

F. Plants Producing for Multiple Projects. When a plant is producing Superpave HMA mixtures for two or more Department Projects at the same time, only one common set of lots will be established and the samples taken for each lot shall apply to each Project on which a part of that lot was used.

G. Testing of Cores for Air Voids Acceptance. Superpave HMA cores shall meet the air voids requirements of Subsection 406.12. Acceptance of cores will be determined from the values for the maximum specific gravity of the mix and the bulk specific gravity of the compacted mixture. Maximum specific gravity of the mix will be determined according to Section 990, NJDOT B-9 and AASHTO T 209 except that minimum sample size may be waived in order to use a 6-inch diameter core sample. Bulk specific gravity of the compacted mixture will be performed on each core and determined according to AASHTO T 166.

920.04 Tables.

Tables referenced in the Specifications are as follows:

Table 920-1 Superpave HMA Mixtures
Nominal Maximum Size of Aggregate - Grading Of Total Aggregate{ XE "Tables:superpave HMA:nominal maximum size of aggregate-grading of total aggregate" }

Sieve Size	Nominal Maximum Aggregate Size – Control Point (Percent Passing)									
	37.5 mm		25 mm		19 mm		12.5 mm		9.5 mm	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
2"	100	--	--	--	--	--	--	--	--	--
1½"	90	100	100	--	--	--	--	--	--	--
1"	--	90	90	100	100	--	--	--	--	--
¾"	--	--	--	90	90	100	100	--	--	--
½"	--	--	--	--	--	90	90	100	100	--
3/8"	--	--	--	--	--	--	--	90	90	100
No. 4	--	--	--	--	--	--	--	--	--	90
No. 8	15	41	19	45	23	49	28	58	32	67
No. 200	0	6	1	7	2	8	2	10	2	10

Material passing the 200 sieve may consist of fine particles of the aggregate or mineral filler, or both. Material passing the No. 40 sieve shall be non-plastic when tested according to AASHTO T 90.

Aggregate size requirements: Layer thickness should be greater than or equal to three times the nominal maximum aggregate size for the mixture. (For example, the minimum proposed lift thickness for a 12.5-millimeter mix should be 1½.")

Table 920-2 Gyratory Compaction Effort for Superpave HMA Mixtures{ XE "Tables:superpave HMA:gyratory compaction effort" }

Compaction Level	ESALs[(1)] (millions)	N_{ini}	N_{des}	N_{max}
L	<0.3	6	50	75
M	0.3 to < 3	7	75	115
H	3 to < 30	8	100	160
V	≥ 30	9	125	205

Design ESALs (Design Equivalent (80kN) Single-Axle Loads) are anticipated project traffic level expected on the design lane over a 20-year period.

Table 920-3 Superpave HMA Requirements for Design{ XE "Tables:superpave HMA:requirements for design" }

Compaction Levels	Required Density (% of Theoretical Max. Specific Gravity)			Voids in Mineral Aggregate (VMA), % (minimum) Nominal Max. Aggregate Size, mm					Voids Filled With Asphalt (VFA) %	Dust-to-Binder Ratio
	N_{ini}	N_{des}	N_{max}	37.5	25.0	19.0	12.5	9.5		
L	≤91.5	96.0[(3)]	≤ 98.0	11.0	12.0	13.0	14.0	15.0	70 – 80	0.6 - 1.2
M	≤ 90.5	96.0[(3)]	≤ 98.0	11.0	12.0	13.0	14.0	15.0	65 – 78	0.6 – 1.2
H	≤ 89.0	96.0[(3)]	≤ 98.0	11.0	12.0	13.0	14.0	15.0	65 –75[(1)]	0.6 - 1.2
V	≤ 89.0	96.0[(3)]	≤ 98.0	11.0	12.0	13.0	14.0	15.0	65 –75[(1,2)]	0.6 - 1.2

Note 1: For 37.5 mm nominal maximum size mixtures the specified lower limit of the VFA shall be 64 percent for all design traffic levels.

Note 2: For 9.5 mm nominal maximum size mixtures the specified VFA range shall be 73 percent to 76 percent for design traffic level V.

Note 3: As determined from the values for the maximum specific gravity of the mix and the bulk specific gravity of the compacted mixture. Maximum specific gravity of the mix will be determined

according to AASHTO T 209. Bulk specific gravity of the compacted mixture shall be determined according to AASHTO T 166.

Table 920-4 Superpave Hot Mix Asphalt Requirements for Control{ XE "Tables:superpave HMA: requirements for control" }

Compaction Levels	Required Density (% of Theoretical Max. Specific Gravity)			Voids in Mineral Aggregate (VMA), % (minimum) Nominal Max. Aggregate Size, mm					Dust-to-Binder Ratio
	N_{ini}	N_{des}	N_{max}	37.5	25.0	19.0	12.5	9.5	
L	≤91.5	95.0 – 97.0[(1)]	≤ 98.0	11.0	12.0	13.0	14.0	15.0	0.6 - 1.3
M	≤ 90.5	95.0 – 97.0[(1)]	≤ 98.0	11.0	12.0	13.0	14.0	15.0	0.6 – 1.3
H	≤ 89.0	95.0 – 97.0[(1)]	≤ 98.0	11.0	12.0	13.0	14.0	15.0	0.6 - 1.3
V	≤ 89.0	95.0 – 97.0[(1)]	≤ 98.0	11.0	12.0	13.0	14.0	15.0	0.6 - 1.3

Note 1: As determined from the values for the maximum specific gravity of the mix and the bulk specific gravity of the compacted mixture. Maximum specific gravity of the mix will be determined according to AASHTO T 209. Bulk specific gravity of the compacted mixture shall be determined according to AASHTO T 166.

Note 2: For 37.5 mm nominal maximum size mixtures the specified lower limit of the VFA shall be 64 percent for all design traffic levels.

Note 3: For 9.5 mm nominal maximum size mixtures the specified VFA range shall be 73 percent to 76 percent for design traffic level V.

Table 920-5 Additional Coarse Aggregate Requirements for Superpave HMA { XE "Tables:superpave HMA:additional coarse aggregate requirements" }

Mix Compaction Level	Coarse Aggregate Angularity % (minimum)		Flat & Elongated[(2)] % (maximum)
	Surface/Intermediate	Base	
L	95/90[(1)]	80/75	10
M,H	95/90	80/75	10
V	100/100	100/100	10

Note 1: 95/90 denotes that 95 percent of the coarse aggregate has one or more fractured faces and 90 percent has two or more fractured faces, according to ASTM D 5821.

Note 2: Criterion based upon a 5:1 maximum to minimum ratio according to ASTM D 4791.

Table 920-6 Additional Fine Aggregate Requirements for Superpave HMA { XE "Tables:superpave HMA:additional fine aggregate requirements" }

Mix Compaction Level	Fine Aggregate Angularity % Air Voids (minimum) [(1)]		Clay Content Sand Equivalent[(2)] % (maximum)
	Surface/Intermediate	Base	
L	40	40	45
M,H	45	40	45
V	45	45	50

Note 1: According to AASHTO T 304, Method A.

Note 2: According to AASHTO T 176

SECTION 990 - METHODS OF TESTS

This Section consists of the following NJDOT Methods of Tests that have been adopted and are used by the Department.

A-1 MORTAR-MAKING PROPERTIES OF FINE AGGREGATE{ XE "METHODS OF TESTS FOR:MORTAR-MAKING PROPERTIES OF FINE AGGREGATE (A-1)" }

A. Scope.

This method of test is used to determine the mortar-making properties of fine aggregate by tensile strength at the age of seven days when compared to Standard Ottawa mortar.

Subsequent samples of fine aggregate that fail to meet the minimum strength for seven days will be tested for both seven and 28 days.

B. Procedure.

The Standard Ottawa mortar will be prepared according to AASHTO T 162 and tested according to AASHTO T 132.

The fine aggregate sample mortar will be prepared and tested according to the paragraph above by replacing the Standard Ottawa sand with the same weight of fine aggregate sample and using sufficient mixing water to produce the same consistency as obtained with the Standard Ottawa mortar.

C. Report.

The strength of the fine aggregate sample will be reported as a percentage of the Standard Ottawa mortar at age of seven days.

A-2 DETERMINATION OF REFLECTANCE VALUE OF AGGREGATES{ XE "METHODS OF TESTS FOR:DETERMINATION OF REFLECTANCE VALUE OF AGGREGATES (A-2)" }

A. Scope.

This method of test is used to determine the daylight 45 degree - 0 degree, luminous directional reflectance of fine and coarse aggregate.

B. Apparatus.

The apparatus will conform to ASTM E 1347 and to the following:

1. The receptacle for testing fine aggregate will be a flat-bottomed dish with a diameter of 3 to 4 inches and a minimum depth of ½ inch.
2. The receptacle for testing the coarse aggregate will be of sufficient size to hold several kilograms of aggregate and will be at least 5 inches deep.

C. Procedure.

1. **Fine Aggregate**. Fill flat-bottomed dish to overflowing with representative sample. Strike off excess material until the fine aggregate is even with the top edge of the receptacle. Place a flat, clean, ⅛ inchglass plate, approximately 4 inches square, on the reflectance standard and standardize the reflectometer. Select the standard that is closest to the sample being tested. Place glass plate and reflectometer on sample and take a reading. Repeat this procedure two times, using a different area selected from the total sample.
2. **Coarse Aggregate**. Fill flat-bottomed pan to a depth of about 4 inches with sample to be tested. Level material with a metal scoop. Standardize the reflectometer on reflectance standard as described above. Select the standard that is closest to sample being tested. Place glass plate and reflectometer on prepared sample and determine reflectance. Take two additional readings at different locations on the surface of the material.

D. Report.

Reflectance value will be an average of three readings reported to the nearest one percent.

A-3 DETERMINATION OF PERCENTAGE OF MICA IN FINE AGGREGATE{ XE "METHODS OF TESTS FOR:DETERMINATION OF PERCENTAGE OF MICA IN FINE AGGREGATE (A-3)" }

A. Scope.

This method of test is used to determine the mica content of fine aggregate.

B. Apparatus.

The apparatus will consist of the following:

1. Square opening No. 10 and No. 200 sieves conforming to ASTM E 11.
2. Balances for fine aggregate having a minimum capacity of 500 grams, sensitive to 0.1 gram or less. The analytical balances used in the mica determination will have a capacity of not more than 200 grams, sensitive to 0.1 milligram.
3. Ionizing brush, 3-inch length, equipped with a polonium ionizer built in the ferrule of the brush that is an alpha emitter and immediately neutralizes any surface in close proximity freeing it of static electricity.
4. Microscope, wide field, low power magnification 20X, working distance 71 mm (2.795 inches), field area 12.6 mm(0.496 inches).
5. Rubber-edged scraping blade with metal stem rubber edge approximately 4 inches in length.
6. Roundometer as described in ASTM D 1155.

C. Selection of Sample.

Sample as received in the Laboratory will be taken from representative sample of field stockpile. Fine aggregate will be graded in conformance with current standard gradation specifications for the fine aggregate under test. A representative air-dried sample will be split to approximately 25 grams. The sample shall be representative of material passed through a No. 10 mesh sieve and retained on a No. 200 mesh sieve. The 25-gram sample will then be kept in a friction top can until ready for test. This sample will be further reduced to two representative 1-gram samples, both of which will be tested for mica content.

D. Procedure.

Weigh two 1-gram samples from the 25-gram sample on an analytical balance. Brush surface of vibrating glass panel with ionizing brush. Adjust the height of slope of the glass panel to 1 ¾ inches. Set the vibrator amplitude control at such a position that flat particles on the upper half of the panel will move slowly up the slope, while the fine aggregate rolls down. Pour the sample slowly onto the vibrating glass panel at such a rate that no bunching occurs. While the flat particles are moving toward the upper end of the panel, scrape mica particles into a suitable receiver. Repeat this procedure until microscopic examination of each separation shows that 95 percent or more of the mica has been removed. Weigh the collected mica. Both 1-gram samples are to be tested.

If mica adheres to the glass panel during the test, indicating static electricity, clean the panel and brush with the ionizing brush.

E. Calculation.

$$\text{Percent of Mica} = \frac{\text{Weight of Mica in Grams}}{\text{Weight of Sample}} \times 100$$

F. Report.

Report results of the test to the nearest 0.1 percent. The average of the results of the two samples tested will be reported.

A-4 DETERMINATION OF PERCENTAGE OF CARBONATES IN CRUSHED GRAVEL BY PETROGRAPHIC ANALYSIS{ XE "METHODS OF TESTS FOR:DETERMINATION OF PERCENTAGE OF CARBONATES IN CRUSHED GRAVEL BY PETROGRAPHIC ANALYSIS (A-4)" }

A. Scope.

This method of test is used for the visual determination of rock types and deleterious material in coarse aggregates.

B. Apparatus.

The apparatus will be as follows:

1. Binocular microscope.
2. Dilute hydrochloric acid.
3. Scale accurate to plus or minus 0.1 gram.
4. Geology or mason hammer, or other cracking implement, and a steel striking plate.
5. Penknife, screwdriver, or similar scratching device.

C. Petrographer.

The examiner will have a degree in geology or will be a trained technician with a general background in geology and a specific background in petrology.

D. Sample Preparation.

A sample of approximately 35 pounds will be split and screened to produce a representative sample of 300 grams of plus No. 4 material for aggregate sizes No. 3 through No. 5, 1,000 grams of plus No. 4 material for aggregate sizes No. 56 through No. 68, and 500 grams of plus No. 8 material for aggregate sizes No. 7 through No. 9. The samples will then be washed to remove any coating that would make particle examination difficult.

E. Procedure.

The prepared sample will be divided into rock types as defined in ASTM C 294. This will be done by visual examination with the aid of the binocular microscope, dilute HCl, and cracking and scratching implements. The resulting groups will be weighed to the nearest gram and calculated as a percent of the whole.

Deleterious material samples will be examined for weathered and leached, porous, friable, fractured, altered, or otherwise unsound particles. Pieces affected by such conditions to the degree that their performance may be impaired will be sorted out, weighed, and calculated as a percent of the whole.

Since this is a subjective determination, the following guidelines will be used in determining if particles are weathered and unsound:

1. Can be broken into several pieces by a light hammer tap.
2. Show more than superficial oxidation or alteration of feldspars.
3. Are visibly porous.
4. Show numerous microfractures or cleavage planes.
5. Are of abnormal coloration.

Particles that are as outlined above should be considered worthy of close examination.

F. Report.

Report will contain the percentage by weight of individual rock types, as defined in ASTM C 294, and percentage by weight of deleterious material that will be reported as weathered and unsound.

A-5 DETERMINATION OF PERCENTAGE OF ADHERENT FINES PRESENT IN COARSE AGGREGATE{ XE "METHODS OF TESTS FOR:DETERMINATION OF PERCENTAGE OF ADHERENT FINES PRESENT IN COARSE AGGREGATE (A-5)" }

A. Scope.

This method of test is used to determine the percentage of adherent fines present in coarse aggregates.

B. Apparatus.

The apparatus will be according to AASHTO T 11.

C. Sample.

The sample for the test will conform to AASHTO T 11.

D. Procedure.

The test sample will be dried to constant mass at a temperature of 230 ± 9 °F (110 ± 5 ºC) and weighed to the nearest 0.1 percent. The sample will be sieved, for a period not to exceed one minute, over a No. 16 sieve. The material passing the No. 16 sieve will be considered nonadherent fines. The remaining material will then be tested according to AASHTO T 11 and that material determined to be finer than the No. 200 sieve will be considered adherent fines.

E. Report.

The report will include the amount of nonadherent fines computed as a percentage of the total mass of the sample and the amount of adherent fines computed as a percentage of the total mass of the sample.

A-6 SHALE, SCHIST, SLATE, AND SOFT AND DECOMPOSED PARTICLES IN SOIL AGGREGATE{ XE "METHODS OF TESTS FOR:SHALE, SCHIST, SLATE AND SOFT AND DECOMPOSED PARTICLES IN SOIL AGGREGATE (A-6)" }

A. Scope.

This method of test is used to determine the percentage of shale, schist, slate, and soft and decomposed particles in soil aggregate.

B. Apparatus.

The apparatus will be according to AASHTO T 27 and the following:

1. The drying oven will be of the forced convection type capable of maintaining a temperature of 230 ± 9 °F (110 ± 5 °C).
2. The brass rod will be according to A-8.
3. The reading glass will be 4X, mounted on a suitable stand.

C. Sample.

Sample for test will weigh, after drying, not less than 2,500 grams nor more than 3,500 grams obtained by use of a sample splitter or the quartering method.

D. Procedure.

1. Gradation. The sample will be separated by use of 2-inch, ¾-inch, ⅜-inch, and No. 200 sieves, and the particle size distribution determined according to AASHTO T 27.
2. Determination of Shale, Schist, Slate, and Soft and Decomposed Particles. The portions of the sample passing the 2-inch sieve and retained on the ¾-inch sieve, and passing the ¾-inch sieve and retained on the ⅜-inch sieve will be examined for shale, schist, slate, and soft and decomposed particles by:
    a. The scratch hardness test according to A-8.
    b. Lithological examination.
    c. Combination of scratch hardness test and lithological examination.

3. Separation and Weighing. Particles determined to be shale, schist, slate, and soft and decomposed particles according to Subpart D.2 above will be separated from their respective sample fractions and weighed.

E. Calculation and Report.

The report will include the following:

1. The percent of particle distribution as determined in Subpart D.1 above for the entire sample.
2. Percentage of shale, schist, slate, and soft and decomposed particles for each size larger than the ⅜-inch sieve as determined by the above procedure.
3. Total weighted percent of shale, schist, slate, and soft and decomposed particles for the entire sample. For the purpose of calculating the test results, the material finer than the 9.5-millimeter sieve will be considered to contain the same percentage of shale, schist, slate, and soft and decomposed particles as the next larger size.

A-7 RAPIDLY DETERMINING THE BREAKDOWN IN SIZES OF SOIL AGGREGATE{ XE "METHODS OF TESTS FOR:RAPIDLY DETERMINIG THE BREAKDOWN IN SIZES OF SOIL AGGREGATE (A-7)" }

A. Scope.

This method of test is used to determine rapidly the approximate amount of soil aggregate that may be expected to break down to finer sizes under field compaction and exposure to weathering.

B. Apparatus.

1. The apparatus for determining moisture density relationship and aggregate breakdown will conform to AASHTO T 99, Method C.
2. The apparatus for performing the mechanical analysis will conform to AASHTO T 27.

C. Preparation of Sample.

1. A sample of approximately 150 pounds will be air dried and thoroughly mixed.
2. A mechanical analysis will be run on two samples of approximately 12 pounds each, obtained from the above sample by quartering. These two gradations will be averaged and the average reported as the original gradation of the material.
3. A sample will be prepared to have the same gradation as the original determined in Subpart C.2 above.
4. The maximum density at optimum moisture content will be determined from a representative portion of the prepared sample by using AASHTO T 99, Method C including the replacement option, for material retained on the ¾-inch sieve.

D. Procedure.

1. Another sample will be compacted from the remaining material at the optimum moisture content determined in Subpart C.4 above.
2. A mechanical analysis will be performed on the prepared sample after compaction.

E. Report.

The report will include the following:

1. Average of two gradations determined in Subpart C.2 above.
2. Gradation of the prepared sample after compaction in Subpart D.2 above.
3. Specified gradation for the material.
4. Maximum density at optimum moisture of the prepared sample determined in Subpart C.4 above.

A-8 SCRATCH HARDNESS TEST FOR COARSE AGGREGATE PARTICLES{ XE "METHODS OF TESTS FOR:SCRATCH HARDNESS TEST FOR COARSE AGGREGATE PARTICLES (A-8)" }

A. Scope.

This method of test is used to determine the quantity of soft particles in coarse aggregates on the basis of scratch hardness. It is intended to be used to identify materials that are soft including those which are so poorly bonded that the separate particles in the piece are easily detached from the mass. The test is not intended to identify other types of deleterious materials that may be designated separately in the Specifications.

The scratch hardness test should be made on a freshly broken surface of the aggregate particle. If the particle contains more than one type of rock and is partly hard and partly soft, it should be classified as soft only if the soft portion is one-third or more the volume of the particle.

The scratch hardness test may be made on the exposed surface of a particle provided consideration is given to softening of the surface due to weathering. A particle with a thin, soft, and weathered surface and a hard core should normally be classified as "soft."

B. Apparatus.

Apparatus will be a brass rod, 1/16 inch (1.6 mm) in diameter, with a rounded point, mounted in a device so that a load of 2 ± 0.1 pounds (8.9 ± 0.4 N) is applied to the specimen tested. The brass rod will be of suitable hardness so that when filed to a sharp point, it will scratch a copper penny (US Lincoln design), but fail to scratch a nickel (US Jefferson design). For use in the field, the brass rod of the specified size and hardness may be mounted into the wooden shaft of an ordinary lead pencil. A suitable design for the scratch hardness apparatus is on file in the Department Laboratory.

C. Preparation of Sample.

Coarse aggregate for the test will consist of material from which the sizes finer than the ⅜-inch (9.5 mm) sieve have been removed. The sample tested will be of such size that it will yield not less than the amounts of the different sizes prescribed in Table 1, which will be available in amounts of ten percent or more.

Table 1 - Minimum Size of Sample to be Tested (Square Opening Sieves)

Sieve Size		Sample Mass
Millimeters	**Inches**	**(grams)**
9.5 to 12.5	⅜ to ½	200
12.5 to 19.0	½ to ¾	600
19.0 to 25.0	¾ to 1	1500
25.0 to 37.5	1 to 1½	4500
37.5 to 50.0	1½ to 2	12000

Should the sample contain less than ten percent of any of the sizes prescribed in Table 1, that size will not be tested but, for the purpose of calculating test results, it will be considered as containing the same percentage of soft particles as the average of the next larger and the next smaller size or, if one of these sizes is absent, it will be considered to have the same loss as the next larger or next smaller size, whichever is present.

The requirements in Table 1, cover aggregates composed of a mixture of different types of rock. When the aggregate is composed of only one type of rock, the weight of the sample tested may be reduced to an amount considered appropriate by the Engineer.

D. Procedure.

Subject each particle of aggregate under test to a scratching motion of the brass rod, using a pressure of 2 pounds (8.9 N). Particles are considered to be soft if, during the scratching process, a groove is made in them without deposition of metal from the brass rod, or if separate particles are detached from the rock mass.

E. Calculation and Report.

The report will include the following:

1. Mass and number of particles of each size of each sample tested with the brass rod.
2. Mass and number of particles of each size of each sample classified as soft in the test.
3. Percentage of test sample classified as soft by mass and by number of particles.

4. Weighted average percentage of soft particles calculated from percentages in Subpart E.3 above and based on the grading of the sample of aggregate received for examination or, preferably, the average grading of the material from that portion of the supply of which the sample is representative. In these calculations, sizes finer than the ⅜-inch (9.5 mm) sieve will not be included.

A-9 DETERMINATION OF GRADATION OF DENSE-GRADED AGGREGATE CONTAINING RAP{ XE "METHODS OF TESTS FOR:DETERMINATION OF GRADATION OF DENSE-GRADED AGGREGATE CONTAINING RAP (A-9)" }

A. Scope.

This method of test is used to rapidly determine the gradation of RAP.

B. Apparatus.

The apparatus will be according to AASHTO T 27.

C. Sample.

The sample will be obtained and reduced according to AASHTO T 2 except that the material need not be dried before splitting.

D. Procedure.

A minimum 5,000-gram sample of RAP will be sieved without drying (wet-sieved) through the following sieves: 2," 1½," ¾," and No. 4. The material passing the No. 4 sieve will be separated, reduced to 500 grams, spread out in a pan, and put in an oven preheated to 175 ± 5 °F (80 ± 3 °C) for approximately 1.5 hours. The material will be removed from the oven at 15 minute intervals, weighed, and remixed to promote even and thorough drying.

If the dense-graded aggregate (DGA) is 100 percent RAP after drying to a constant weight, the minus No. 4 material is graded.

If the DGA is a blend of RAP and virgin DGA, the minus No. 4 material will be washed, dried using the above procedure, and graded.

The gradation results of the plus No. 4 and minus No. 4 portions of the material will be combined mathematically for a final gradation.

E. Report.

The report will include the mathematically combined gradation results reported as a total percent passing the required sieves.

B-1 DETERMINATION OF ASPHALT CONTENT OF INVERTED EMULSIFIED ASPHALT{ XE "METHODS OF TESTS FOR:DETERMINATION OF ASPHALT CONTENT OF INVERTED EMULSIFIED ASPHALT (B-1)" }

A. Scope.

This method of test is used to determine the asphalt content of inverted emulsified asphalt.

The inverted emulsified asphalt first will be dehydrated and then distilled according to AASHTO T 78.

B. Apparatus.

The apparatus will consist of a 1-liter glass beaker and distillation apparatus according to AASHTO T 78.

C. Procedure.

Weigh 200 grams of the material into the tared 1-liter glass beaker. Heat, with constant stirring, to a temperature of 350 °F. This temperature will be attained within 20 to 30 minutes. Weigh the residue.

Weigh 150 grams of the dehydrated material into a tared flask and distill according to the method prescribed above. Weigh the residue in the 8-ounce tin box and also the emptied distillation flask. When the dehydration does not yield sufficient residue for 150 grams distillation charge, or when the residue foams excessively in the flask on distillation, an approximate charge of 125 grams may be used.

The asphalt content, percent by weight, will be calculated according to the following formula:

$$\text{Percent Asphalt Content} = \frac{A \times (B + C)}{D}$$

Where: A = Percent of residue in beaker after open evaporation to 350 °F.
B = Weight in grams of residue in 8-ounce tin box.
C = Weight in grams of residue in distillation flask.
D = Weight in grams of residue from open evaporation taken for distillation test. This weight is normally 150 grams as specified above.

B-2 METHOD OF SAMPLING HMA MIXTURES{ XE "METHODS OF TESTS FOR:METHOD OF SAMPLING HMA MIXTURES (B-2)" }

A. Scope.

This method is used at the plant to sample HMA mixtures for Marshall stability tests and acceptance extraction tests.

B. Apparatus.

The apparatus will be as follows:

1. Table of random numbers.
2. Scoop to make furrow and to dig material from the furrow in the pile of HMA mixture.

C. Procedure.

The samples for extraction and stability testing will be taken from trucks, at the plant, by the Department's plant inspector.

The rates of sampling will be applied to the plant's production for all Department Projects rather than for individual Projects.

The plant's production will be divided into successive parts or lots of the size specified for the mixture being sampled. Five samples to be tested for stability and five samples to be used for extraction testing will be taken from each lot.

The Department's plant inspector will assign consecutive lot numbers for each type of mix at the plant. The producer will include the assigned lot identification number on each weigh ticket.

A table of random numbers will be used by the Department to make random selection as to which ton of mix and thus from which truckload each sample will be taken.

The following method will be used to obtain samples from the designated truckloads of material:

1. From one of the conical piles of mixture within the truck, a furrow 3 to 6 inches in depth will be dug extending from the top to the bottom of the pile. The furrow will be prepared within either the front or the rear half of the truck. A coin will be flipped to determine which half of the truck is to be used:

HEADS - front half, **TAILS** - rear half.

The furrow will follow the slope of the pile and be formed as near to its center as possible. Sampling in areas between piles will be avoided because of possible segregation.

Scoops of approximately equal volumes of material will be dug from the furrow, representing the top third, center third, and bottom third of the pile. The sample will be a minimum of 28 pounds in weight.

The sample removed from the truck will be reduced as follows:

1. **Marshall Specimen**. From the container of material, the Department's representative will take a sample to be molded into one specimen for the Marshall stability test, taking care to ensure that the temperature of the mixture does not fall below that specified for molding.

   During the production of the first lot of each mix supplied and for each succeeding fourth lot (1, 5, 9, etc.), the Department's representative will mold three Marshall specimens in addition to those molded for stability tests. The specimens will be submitted to the Department Laboratory for verification of the mix properties.
2. **Extraction Sample**. Following the removal of material for the Marshall specimen the remaining material will be remixed. The Department's representative will then take a 1,000-plus gram sample from the remixed material for the acceptance test. From the remaining material, a comparison sample of approximately 5 pounds will be wrapped, sealed and labeled.

In the event of a situation whereby the test results will not be valid because of human or mechanical failure, the comparison sample will be tested and used in place of the initial acceptance sample.

The comparison sample is to be stored at the plant so it will be available for selection by Department personnel if required.

Before and after each remixing and quartering, all tools shall be cleaned to prevent build-up of asphalt and fines. The cleaning during the remixing and quartering operations will be accomplished without solvents.

All samples forwarded for comparison testing must be identified as to their lot number and position in the lot's sampling sequence. For this purpose, an identification code, consisting of a number followed by a letter, will be used with each sample. The number portion of the code will be the number of the lot from which the sample was taken. The

letter portion will indicate where the sample fits into the lot's sampling sequence. The letter "A" will be used to indicate the first sample of the lot, the letter "B" for the second sample, the letter "C" for the third, and so forth. When several samples (extractions and/or stability) come from the same truckload of mix, each of these samples will have the same identification code (number and letter).

B-3 LABORATORY ANALYSIS OF HMA { XE "METHODS OF TESTS FOR:LABORATORY ANALYSIS OF HMA (B-3)" }

Quantitative Extraction of Bitumen

A. Scope.

This method of test is used for the quantitative determination of bitumen in paving mixtures and pavement samples. The bitumen content is calculated by difference from the weight of the extracted aggregate, moisture content and weight of ash in extract. As an alternate, AASHTO T 164, Method A, may be used except that the moisture content will be determined according to Subsection 903.02 as required, and the use of a steam bath for the ash determination is not required. A balance conforming to AASHTO M 231, Class C may be used to determine the weight of the ash.

B. Apparatus.

The apparatus will consist of the following:

1. Oven, capable of maintaining temperature at 280 ± 5 °F.
2. Pan, 12-inch diameter.
3. Balance, capable of weighing 2,000 grams to an accuracy of 0.2 gram.
4. Hot plate, electric, 3.6 kilowatts, low, medium, and high setting.
5. Small mouth graduate, 1,000-ml capacity.
6. Test tube, 100-ml capacity.
7. Desiccator.
8. Analytical balance.
9. Centrifugal extraction apparatus, consisting of a bowl (minimum capacity 1,300 g) and an apparatus in which the bowl may be revolved up to a speed of 60 revolutions per second. The apparatus will be provided with a container for catching the solvent thrown from the bowl and a drain for removing the solvent. The apparatus will be provided with explosion-proof features installed in a hood to provide ventilation.
10. Filter rings, to fit the rim of the bowl.
11. Reagent, inhibited solvent -trichloroethylene.
12. Centrifuge, capable of rotating 100 ml test tubes at 1,500 rpm.
13. Torque wrench calibrated in newton meters with a minimum capacity of 110 inch-pounds.

C. Procedure.

Random weight samples of 1,000-plus grams are to be used for extraction. If the sample has cooled to ambient temperature, it will be heated at 280 °F for a minimum of 30 minutes. Samples taken at the batch plant that are still hot may be processed immediately.

The sample will be weighed to the nearest 0.1 gram and transferred into the bowl.

The sample will be covered in the bowl with solvent and sufficient time allowed for the solvent to disintegrate the sample (not over one hour). The bowl containing the sample and the solvent will be placed in the extraction apparatus. The filter ring will be dried, weighed, and fitted around the edge of the bowl. The cover will be clamped on the bowl tightly with a torque wrench to 110 inch-pounds. A beaker will be placed under the drain to collect the extract.

The centrifuge will be revolved until the solvent ceases to flow from the drain. The machine will be allowed to stop, 200 to 250 ml of solvent will be added, and this procedure repeated twice more. The extract and the washings will be collected in a suitable graduate. Sufficient solvent additions will be used, as required, to produce an extract that is clear and not darker than a light straw color.

The filter ring will be removed from the bowl and dried. As much as possible of the mineral matter adhering to the ring will be removed and added to the aggregate. The ring and contents of the bowl will be dried to constant weight in an oven at 280 °F.

The volume of the total extract in the graduate will be recorded. The extract will be agitated thoroughly and 75 ml immediately measured out and poured into a previously weighed test tube. The test tube will be placed in a centrifuge and revolved at 1,500 rpm for 60 minutes. The extract will be decanted and approximately 25 ml of clean

solvent added to the test tube. The residue will be dislodged and stirred with a spatula. The test tube will be filled with solvent, cleaning the spatula, and placed back in the centrifuge for 30 minutes. The rinsing process will be repeated a second time and the test tube placed back in the centrifuge for 30 minutes. The test tube will be decanted and placed in an oven until dry, then cooled in a desiccator and weighed. A minimum of one determination of fines in the extract will be done on each lot of material.

Centrifuge fines in the extract will be calculated as follows:

$$\text{Weight of fines in extract} = \frac{AB}{75}$$

Where: A = Total amount of extract.
B = Amount of material in tube.

Convert to ash as follows:

$$Y = 1.0338\,X + 1.0488$$

Where: Y = Weight of ash in extract.
X = Weight of centrifuge fines in extract.

Calculate percentage of bitumen in the sample as follows:

$$\text{Percent Asphalt Binder} = \frac{(W1 + W2) - (W3 + W4 + W5)}{W1} \times 100$$

Where: W1 = Weight of sample.
W2 = Weight of ring.
W3 = Weight of aggregate.
W4 = Weight of ring after centrifuging.
W5 = Weight of fines in extract.

A minimum of one sample per lot but not less than two samples per day will be tested for moisture. The amount of moisture in the mixture can be compensated for by using the equation listed in AASHTO T 164, Method A, or by mathematically calculating the sample dry weight by dividing the wet weight by one plus the moisture content. The most recent moisture content for each mix will be used. Samples for moisture determination will be obtained.

The percentage of bitumen will be determined to the nearest 0.01 of a percent. This will be rounded to the nearest 0.05 percent. The rounding procedure will be according to ASTM E 29.

Mechanical Analysis of Extracted Aggregate

A. Scope.

This method is used to determine the particle size distribution of fine and coarse aggregates extracted from HMA mixtures, using sieves with square openings. As an alternate, AASHTO T 30 may be used.

B. Apparatus.

The apparatus will be as follows:

1. Balance or scale sensitive to within 0.2 gram.
2. Sieves with square openings, mounted on substantial frames constructed in a manner that will prevent loss of material during sieving. Suitable sieve sizes will be selected to furnish the information required by the specifications covering the material to be tested. The woven wire cloth sieves will conform to the specifications for sieves for testing purposes in AASHTO M 92.

C. Sample.

The sample will consist of the entire amount of mineral aggregate from which the HMA material has been extracted.

D. Procedure.

The test sample will be dried to a constant weight and weighed. The weight of mineral matter contained in the extracted bitumen will be determined and this weight added to the weight of the sample under test.

After being dried and weighed, the test sample will be placed over proper sieves decreasing in size down to the No. 10 or No. 8 sieve with a catch pan under them. The sieving operation will be conducted by means of lateral and vertical motion of the sieve, accompanied by jarring action so as to keep the sample moving continuously over the surface of the sieve. In no case will fragments in the sample be turned or manipulated through the sieve by hand. Sieving will be continued until not more than one percent by weight of the residue passes any sieve during one minute.

The fine aggregate in the catch pan will be weighed and recorded. The aggregate will then be placed in a large pan and covered with water that contains a wetting agent (Joy, Calgon, or other suitable product) and agitated vigorously and the wash water immediately poured over a nest of two sieves consisting of a 2.00-millimeter or 1.18-millimeter sieve superimposed over a No. 200 sieve.

The agitation will be sufficiently vigorous to result in a complete separation from the coarse particles of all particles finer than the No. 200 sieve, and bring them into suspension in order that they may be removed by decantation of the wash water. Care will be taken to avoid decantation of the coarse particles. The operation will be repeated until the wash water is clear.

All materials retained on the nested sieves will be returned to the container. The washed aggregate will be dried to constant weight at a temperature 230 ± 9 °F (110 ± 5 ºC) and weighed to the nearest 0.1 percent.

If the amount of material passing the No. 200 sieve fails to meet the minimum requirement for the sample under test, the coarse aggregate of the sample must also be washed over a No. 200 sieve. The minute amount of fines washed from the coarse aggregate will then be added to the passing No. 200 material washed from the fine aggregate portion of the sample.

The dried material will then be placed over a set of proper sieves including the No. 200 sieve. It will be agitated mechanically for ten minutes.

The weight of material passing each sieve and retained on the next and the amount passing the No. 200 sieve will be recorded. The weight of dry material passing the No. 200 sieve by dry sieving will be added to the weight of mineral matter in the extract in the ring, and the weight removed by washing to obtain the total passing the No. 200 sieve.

E. Report.

The results of the sieve analysis will be reported as follows:

1. The total percentage passing each sieve will be determined to the nearest 0.1 percent when reported on the work sheet and daily inspection report. When recorded on the lot data report, results for the No. 8 sieve will be rounded to the nearest 0.5 percent. The No. 200 sieve will be reported to the nearest 0.1 percent and all other sieves will be reported to the nearest whole percent.
2. The rounding procedure will be according to ASTM E 29.

B-4 MEASURING THICKNESS OF HMA FROM CORES{ XE "METHODS OF TESTS FOR:MEASURING THICKNESS OF HMA FROM CORES (B-4)" }

A. Scope.

This method consists of placing the drilled HMA core in a measuring device and recording the individual lift thickness of the specified courses.

B. Apparatus.

The apparatus will consist of a calipering device that will measure the axial lengths of individual lifts before separation. A drawing of this device is on file at the Department Laboratory.

The apparatus is so designed that the specimen will be held with its axis in a horizontal position by two metal roller bearings sufficiently rigid and stable to maintain alignment without distortion or deflection.

The apparatus will provide for the accommodation of specimens of different nominal lengths over a range of at least ½ to 12 inches.

A suitable gauge will be provided to calibrate and check the zero reference point of the apparatus.

C. Procedure.

The specimens will be placed in the measuring apparatus with the smooth end of the core, that is, the end that represents the upper surface of a pavement core, firmly against the hardened-steel reference pin.

Four equidistant measurements, approximately 90 degrees apart, will be taken around the periphery of the specimens using the sliding index attached to the scale to indicate to each reading the division of the various lifts. Each of these four measurements for each lift will be read directly to 0.001 of an inch. The four measurements will be averaged and recorded to the nearest 0.01 of an inch.

If, during the course of the measuring operation, it is discovered that one or more of the measuring points is not representative of the plane of the core because of a small projection or depression, the specimen will be rotated slightly about its axis and the measurement taken at the nearest discernible point.

D. Report.

The first (top) lift average thickness will be reported to the nearest 0.01 of an inch as the difference between the zero reference point and the demarcation point of the first lift.

The second lift average thickness will be reported to the nearest 0.01 of an inch as the difference between the zero reference point and the demarcation point of the second lift minus the measurement of the first lift.

Additional lift thicknesses will be reported as the difference between the zero reference point and the demarcation point of the subsequent lifts minus the total measurement of all previous lifts.

B-5 DETERMINING CONFORMANCE OF HMA MIXTURE FOR FULLY AUTOMATED PLANTS USING HOT BIN SAMPLES AND BATCH WEIGHT PRINTOUTS{ XE "METHODS OF TESTS FOR:DETERMINING CONFORMANCE OF HMA MIXTURE FOR FULLY AUTOMATED PLANTS (B-5)" }

A. Scope.

This method is used to determine the gradation and asphalt content of a HMA mixture by use of bin samples and printout ticket.

B. Apparatus.

Apparatus for coarse and fine aggregate will conform to AASHTO T 27 and apparatus for mineral filler will conform to AASHTO T 37.

C. Procedure.

Under the supervision of the Engineer, random samples of not less than 25 pounds shall be taken by the producer from each hot bin for each 600 tons batched. The bin samples shall be taken during the loading of the truck from which the Marshall samples are selected. When mineral filler is used, a minimum of one filler sample shall be taken per lot.

The minimum sample weight for testing shall be 25 pounds for bins No. 5 and No. 4, 10 pounds for bin No. 3, and 2 pounds for bin No. 2. Minimum test sample weight for bin No. 1 shall be 500 grams, and for mineral filler 100 grams.

Test samples from bins No. 2, 3, 4, and 5, after being weighed, will be placed over proper sieves decreasing in size down to the No. 8 with a catch pan underneath. The sieving operation will be conducted by means of a mechanical sieve shaker. The material passing the No. 8 sieve will be washed and graded using the procedure hereinafter described for bin No. 1.

The bin No. 1 material will be weighed and recorded, then washed through a No. 200 mesh sieve. The sample will be carefully agitated during this washing operation resulting in the minus No. 200 material being removed by the washing medium.

The washed material will be thoroughly dried and weighed, then placed over the proper sieves, decreasing in size down to the No. 200 sieve with a catch pan underneath. It will be agitated mechanically for five minutes.

The amount of material passing each sieve and retained on the next and the amount passing the No. 200 sieve will be recorded. The weight of dry material passing the No. 200 sieve and the weight removed by washing will be added together to obtain the total passing the No. 200 sieve.

The mineral filler sample is to be washed over a No. 200 sieve using inhibited solvent trichloroethylene or according to AASHTO T 37.

D. Report.

The percent of material from each bin will be determined by dividing the recorded delivery ticket weights for each bin by the total aggregate weight of the load.

The mix gradation will be determined by computing the percentage of material passing each sieve for each bin, and multiplying the percentage by each bin percentage determined above and then summing the products.

The asphalt content will be determined by dividing the recorded delivery ticket asphalt cement weight for the load by the total load weight. Percentages will be reported to the nearest 0.01 percent on the work sheet and the daily inspection report and rounded to the nearest 0.05 percent when reported on the lot data report.

Bin percentages and bin gradations will be determined to the nearest 0.1 percent when reported on the work sheet and daily inspection report. When recorded on the lot data report, results for the No. 8 sieve will be rounded to the nearest 0.5 percent. Results for the No. 200 sieve will be reported to the nearest 0.1 percent and all other sieves will be reported to the nearest whole percent.

The rounding procedure will be according to ASTM E 29.

B-6 DETERMINATION OF PERCENT OF AIR VOIDS IN OPEN-GRADED MIX{ XE "METHODS OF TESTS FOR:DETERMINATION OF PERCENT OF AIR VOIDS IN OPEN-GRADED MIX (B-6)" }

A. Scope.

The method is used to determine the percent of air voids in open-graded HMA mix design specimens.

B. Apparatus.

Apparatus will be according to AASHTO T 167 for molding, weighing, and curing specimens and according to AASHTO T 209 for determining maximum specific gravity. Apparatus will include a device to measure the specimens to 0.001 of an inch.

C. Procedure.

Mold six specimens using the materials and formula for the particular mix being evaluated.

The specimens will be molded at 255 °F using a pressure of 2,000 pounds per square inch.

After removal from the mold, specimens will be oven cured for 24 hours at 140 °F and, thereafter, brought to test temperature of 77 °F by storing in the air bath at this temperature for not less than five hours before testing.

Weigh each specimen in air. Report in grams to the nearest 0.1 gram.

Measure the height and diameter of each specimen at four approximately equidistant locations and average respectively. Report to the nearest 0.001 inch.

Calculate the volume of each specimen based on the average height and diameter and convert to cubic centimeters.

Calculate the bulk specific gravity of the specimens using the formula:

$$\text{Bulk Specific Gravity} = \frac{\text{Density gm/cm}^3}{0.99707 \text{ gm/cm}^3}$$

Where: Density = mass divided by volume, and 0.99707 g/cm^3 is the density of water at 77 °F (25 °C).

Determine the maximum specific gravity of the specimens according to AASHTO T 209.

Calculate the percent of air voids using the formula:

$$\text{Percent Air Voids} = \frac{\text{Maximum Specific Gravity - Bulk Specific Gravity}}{\text{Maximum Specific Gravity}} \times 100$$

D. Report.

Report the average air voids of the specimens to the nearest 0.1 percent.

B-7 COATING OF HMA PATCH{ XE "METHODS OF TESTS FOR:COATING OF HMA PATCH (B-7)" }

A. Scope.

This method of test is used to determine the retention of a bituminous film on aggregates used in HMA patch in the presence of water.

B. Apparatus.

A glass container with a tight cover of sufficient size to hold a 200-gram test sample of HMA patch material.

C. Procedure.

A sample of approximately 200 grams of HMA patch will be placed in the glass container, completely covered with distilled water and allowed to stand for 24 ours at room temperature. After the 24-hour period, the container will be shaken vigorously by hand for five minutes. The water will then be poured from the container and the sample will be removed and placed on a flat surface. The sample will be allowed to air dry before a visual examination is made to estimate the coated areas.

D. Report.

Report the estimated coated area as above 90 percent or below 90 percent.

Any thin, brownish, translucent areas are to be considered fully coated.

B-8 BULK SPECIFIC GRAVITY OF COMPACTED HMA MIXTURES{ XE "METHODS OF TESTS FOR:BULK SPECIFIC GRAVITY OF COMPACTED HMA MIXTURES (B-8)" }

A. Scope.

This method of test is used to determine the bulk specific gravity of specimens of compacted HMA mixtures as defined in AASHTO M 132. The bulk specific gravity of the compacted HMA mixtures may be used in calculating the unit weight of the mixture.

B. Test Specimens.

Test specimens may be taken either from laboratory-molded HMA mixtures or from field samples of HMA mixtures.

The recommended thickness of specimens should be at least one and one-half times the maximum size of the aggregate.

Field samples will be taken with a core drill, diamond or carborundum saw, or by other suitable means. Care will be taken to avoid distortion, bending, or cracking of specimens during and after removal. Specimens will be stored in a safe, cool place.

Specimens may be separated from other pavement layers by sawing or other suitable means.

Specimens will be free of foreign materials such as tack coat, foundation material, soil, paper, or foil.

C. Apparatus.

Apparatus will be as follows:

1. Balance will conform to AASHTO M 231 for the class of balance required for the weight of the principal sample being tested. The balance will be equipped with suitable suspension apparatus and holder to permit weighing the specimen while suspended from the center of scale pan of balance. The holder should be immersed to a depth sufficient to cover it and the test sample during weighing. Wire suspending the holder should be the smallest practical size to minimize any possible effects of a variable immersed length.
2. Water bath for immersing the specimen in water while suspended under the balance will be equipped with an overflow outlet for maintaining a constant water level.

D. Procedure.

Dry the specimen by allowing it to remain undisturbed at room temperature, 77 ± 10 °F (25 ± 5.5 ºC), for at least 12 hours. A fan may be used to aid drying if needed. After the specimen is dry or cooled to room temperature, record the dry mass under "A." Immerse each specimen in water at 77 ± 10 °F (25 ± 5.5 ºC) until all visible bubbling has ceased

and record the immersed mass under "C." Remove the specimen from the water, surface dry by blotting with a damp towel, and determine the surface-dry mass under "B." If desired, the sequence of testing operations may be changed to expedite the test results. For example, first the weight of the immersed mass under "C" can be determined, then the surface-dry mass under "B" and finally the dry mass under "A."

E. Calculation.

Calculate the bulk specific gravity of the specimen as follows:

$$\text{Bulk Specific Gravity} = \frac{A}{B - C}$$

Where: A = Mass in grams of sample in air.
B = Mass in grams of surface-dry specimen in air.
C = Mass in grams of sample in water.

F. Report.

The bulk specific gravity will be reported to the nearest 0.001.

B-9 PROCEDURE FOR SELECTION OF CORES TO BE TESTED FOR MAXIMUM SPECIFIC GRAVITY TO BE USED IN DETERMINATION OF AIR VOIDS ACCEPTANCE{ XE "METHODS OF TESTS FOR:PROCEDURE FOR SELECTION OF CORES TO BE TESTED FOR DETERMINATION OF AIR VOIDS ACCEPTANCE (B-9)" }

A. Scope.

This method is used to randomly select the core samples on which the maximum specific gravity will be determined according to AASHTO T 209 for use in the calculation of air voids for acceptance of a lot, and the procedure to be followed in the event of a possible failing lot.

B. Procedure.

One core sample will be randomly selected from a five-core sample lot using the computer-generated random number selection program. Maximum specific gravity will be determined for the core selected. Bulk specific gravities will be performed on each core.

If the percent air voids for each core in the lot is within the acceptance range of the specification, plus 0.5 percent on the lower end and –0.5 percent on the upper end, the maximum specific gravity of the tested core sample will be applied to the remaining core samples of the same lot.

If the air voids percentage falls out of the acceptance range as noted above for the randomly selected and tested core sample, the maximum specific gravity will be determined for each of the core samples of that lot.

C. Calculation.

Calculate the air voids for each core as follows:

$$\text{Air Voids} = \frac{A - B}{A} \times 100$$

Where: A = Maximum Specific Gravity
B = Bulk Specific Gravity

D. Report.

The air voids will be reported to the nearest 0.1 percent.

C-1 DETERMINATION OF YIELD OF CONCRETE PRODUCED BY CONTINUOUS-MIXING-TYPE TRUCK MIXERS{ XE "METHODS OF TESTS FOR:DETERMINATION OF YIELD OF CONCRETE PRODUCED BY CONTINUOUS-MIXING-TYPE TRUCK MIXERS (C-1)" }

A. Scope.

This method is used to determine the yield of concrete that is proportioned volumetrically in a continuous-mixing-type truck mixer.

B. Apparatus.

The apparatus will consist of a ¼-cubic yard container having dimensions of 36 by 36 by 9 inches. The container will be constructed of materials that do not become deformed when filled with concrete.

C. Procedure.

Set all controls of the mixer unit at the settings approved for the mix design being checked. Activate the mixer and discharge sufficient material to fill the mixing auger assembly and discharge chute. Then deactivate the mixing unit. Reset cement meter to zero and reactivate the mixer and discharge material into the ¼ cubic yard container until it is level-struck full, making provision for the material settling into all corners. Record the count as shown on the cement meter.

D. Calculation.

Calculate the cement count that is equivalent to the amount of cement specified in the mix design for ¼ cubic yard. Calculate the yield by dividing the actual cement count by the specified count and multiplying by 100. The result will be 100 ± 2 percent.

J-1 BRITTLENESS OF LIQUID JOINT FILLER{ XE "METHODS OF TESTS FOR:BRITTLENESS OF LIQUID JOINT FILLER (J-1)" }

A. Scope.

This method of test is used to determine the brittleness of liquid joint filler.

B. Apparatus.

The apparatus will be as follows:

1. The apparatus used to form the specimen required is shown in Figure 1 below. This forms a 1½ by 2½ inch specimen of the material for test on 26 gauge black iron.
2. A 1-inch mandrel.

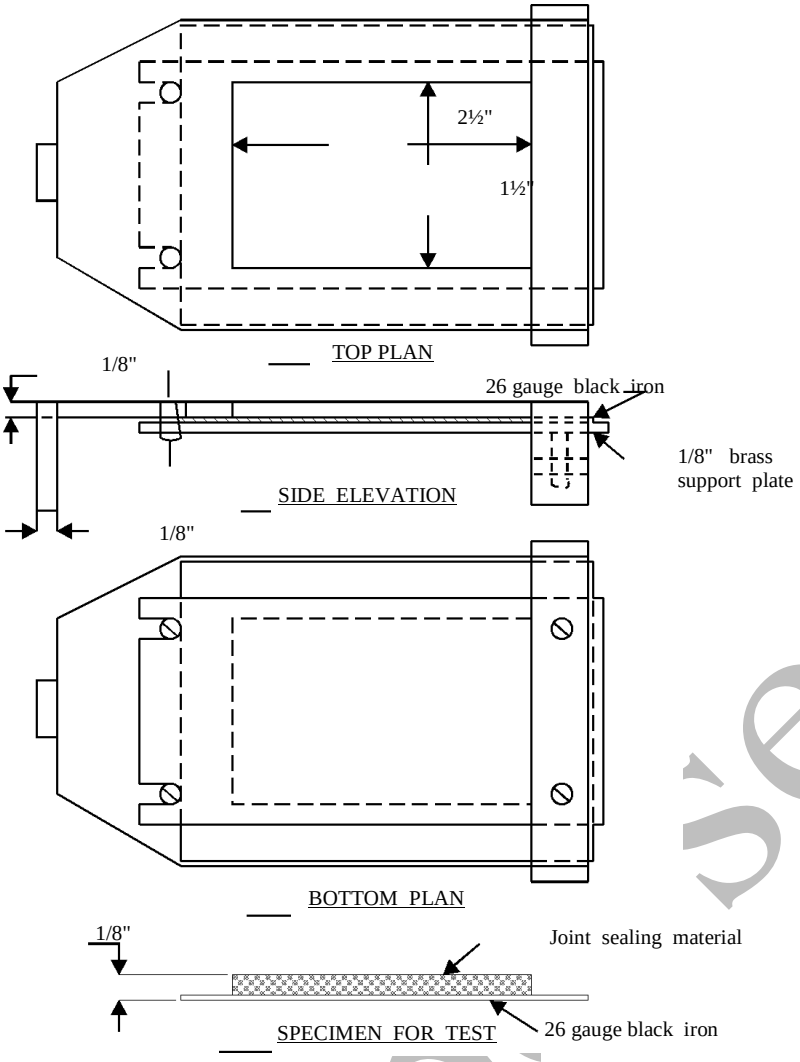

Figure 1

C. Preparation of Sample.

The sample of material to be tested will be heated on a hot plate to 300 °F and maintained at this temperature while being uniformly and homogeneously mixed by stirring.

D. Procedure.

After being heated and mixed as specified above, the material will be poured into the opening shown in Figure 1 until the opening is slightly more than filled. After being poured, the material will be allowed to cool for a period of 30 minutes after which excess material will be cut off with a broad putty knife until the surface of the material is flush with the top of the mold. After being cut off, the material on the iron sheet will be removed from the mold without disturbing the specimen in any way. The specimen on the iron sheet and the mandrel will then be placed in a suitable container that will be maintained at a temperature of 8 ± 1 ºF for a period of two hours. The specimen on the iron sheet will then be bent over the mandrel in three seconds. When making the bend, the black iron sheet with the specimen resting upon it will be placed and centered on the mandrel along the 1½-inch dimension. During the bending, the specimen will be maintained at the temperature specified above.

E. Report.

Five specimens will be poured for each sample tested. If the material shows any sign of a crack, it will be considered as not complying with the requirements of the Specifications.

J-2 ELASTOMERIC JOINT SEALERS{ XE "METHODS OF TESTS FOR:ELASTOMERIC JOINT SEALERS (J-2)" }

High Temperature Recovery Test

A. Scope.

This method of test is used to indicate the preformed elastomeric compression sealer's potential long-term resiliency at high temperatures in actual field application.

B. Apparatus.

The compression set clamp assembly described in ASTM D 395, Method B, will be used with the exceptions specified herein.

If a dial gauge is used, it will have a ¼-inch diameter foot and will be mounted on a platform. If a dial caliper is used, it will be graduated in thousandths of an inch, made of stainless steel, hardened throughout, and carefully calibrated.

C. Preparation of Sample.

A 6-inch length of the preformed elastrometric compression sealer specimen will be cut from the actual extruded sealer. In this test the internal surfaces will remain as received from production while the outside surfaces only may be dusted off with talc to prevent them from sticking to the steel compression plates.

D. Procedure.

A new specimen will be used for each test. Each specimen will be deflected between parallel plates to "Z" percent of the nominal width. Each width measurement will be taken in the center of a 6-inch length. The width measurements will be made at both the top and bottom longitudinal edges of the specimen. For this purpose each edge will be placed at the center of the foot of the gauge or at the measuring tips of caliper jaws. The position of the foot or jaw will be carefully marked on the specimen before the first reading is made.

Before compression, the specimen will be placed in such a horizontal position that the plane through both edges of the top surface of the sealer is perpendicular to the compression plates. As the specimen is being compressed, the top surface of the joint sealer will fold inward toward the center of the specimen. The compressed width will be measured on the centers of all four sides of the clamp assembly with a carefully calibrated internal dial caliper.

The clamp assembly with the compressed specimen will be exposed for 70 hours in an oven maintained at 212 ± 2 °F. The clamp assembly will not be preheated. When the aging period in the oven is completed, the clamp assembly will be removed and the test specimen immediately unclamped. The test specimen is to be cooled at room temperature (73 ± 4 °F) on a wooden surface for one hour before measuring the heat-aged recovery width. This measurement is to be made at the same location as the original width. The recovery is to be calculated as described herein.

E. Calculations.

Recovery, expressed as a percentage of the original width and in relation to the corresponding recovered width, will be calculated separately for the top and the bottom measurements. For the determination of physical requirements, the smaller of the two recovery percentages will be used. Recovery is to be calculated as follows:

$$\text{Percent Recovery} = \frac{\text{Recovered Width}}{\text{Original Width}} \times 100$$

Low Temperature Recovery Test

A. Scope.

This method of test is used to determine the preformed elastomeric compression sealer's potential long-term resiliency at low temperatures in actual field application.

B. Apparatus.

Compression set clamp assembly described in ASTM D 395, Method B, will be used with the exceptions specified further herein.

If a dial gauge is used, it will have a ¼ inch diameter foot and will be mounted on a platform. If a dial caliper is used, it will be graduated in thousandths of an inch, made of stainless steel hardened throughout, and carefully calibrated.

C. Preparation of Sample.

A 6 inch length of preformed elastomeric compression sealer specimen will be cut from the actual extruded sealer. In this test the internal and the outside surfaces may be dusted with talc to prevent adhesion.

D. Procedure.

A new specimen will be used for each test. Each specimen will be deflected between parallel plates to 50 percent of the nominal width. Each width measurement will be taken in the center of a 6 inch length. The width measurements will be made at both the top and bottom longitudinal edges of the specimen. For this purpose each edge will be placed at the center of the foot of the gauge or at the measuring tips of caliper jaws. The position of the foot or jaw will be carefully marked on the specimen before the first reading is made.

Before compression, the specimen will be placed in a horizontal position so that the plane through both edges of the top surface of the sealer is perpendicular to the compression plates. As the specimen is being compressed, the top surface of the joint sealer will fold inward toward the center of the specimen. The compressed width will be measured on the center of all four sides of the clamp assembly.

The clamp assembly with compressed specimen will be exposed in a frost-free refrigerated box for the time and at the temperature specified in Subsection 908.03, Table 908-2. To achieve the frost-free condition, a sufficient amount of a desiccant such as calcium chloride will be placed in the box. When the cold aging period is completed, the test specimen will be unclamped at the test temperature and allowed to recover for two hours in a free state at the test temperature. The recovery width will then be measured with the specimen still at the test temperature. The recovery is to be calculated as described further herein. The measurements will be made at the locations at which the original widths were determined.

E. Calculations.

Recovery, expressed as a percentage of the original width and in relation to the corresponding recovered width, will be calculated separately for the top and the bottom measurements. For the determination of physical requirements, the smaller of the two recovery percentages will be used. Recovery is to be calculated as follows:

$$\text{Percent Recovery} = \frac{\text{Recovered Width}}{\text{Original Width}} \times 100$$

Pressure Deflection Test

A. Scope.

This method of test is used to determine the performance limits of the preformed elastomeric compression sealer, its pressure-deflection curb, and possible minimal unit contact pressure at 80 percent of sealer's nominal width.

B. Preparation of Sample.

A 6-inch length of the preformed elastomeric compression sealer specimen will be cut from the extruded sealer.

The internal and outside surfaces of the specimens may be dusted with talc to prevent adhesion.

C. Procedure.

The pressure deflection test will be performed according to ASTM D 575, Method A. The sealer will be deflected in this test at a rate of approximately 0.2 inch per minute. The test will be performed in a reasonably dust-free enclosure at constant room temperature (73 ± 4 °F).

A new specimen will be used for each test. The specimen will be placed between the platens of the testing machine in the horizontal position in such a way that a plane through both edges of the top surface of the sealer will be perpendicular to the platens, which must be larger than the specimen.

The test specimen will be at zero percent deflection. It will then be deflected at the prescribed rate until the limit of safe compressibility is established as described in Section 908. The specimen will then be immediately released at the same rate back to the initial zero percent deflection. The pressure-deflection cycle or test run will be successfully repeated two additional times (total three times) as stated above, and up to the limits of deflection established in the first run.

The zero percent deflection is at zero pascals of pressure. The pressure exerted by the sample, its deflection, the time schedule at the beginning and the end of the test run, and the rate of speed will be read and recorded continuously from the beginning to the end of the test.

Bend Test

A. Scope.

This method of test is used to determine adequacy of the preformed elastomeric compression sealer's splices exposed to actual field conditions.

B. Procedure.

The sealer splice will be bent on all four sides perpendicular to vertical and horizontal axis around a round-shaped object having a diameter equal to two to three times the nominal width of the sealer and hold in such position for at least two minutes. The test will be conducted at room temperature. No splice separation will be detectable.

M-1 DETERMINING pH OF PEAT{ XE "METHODS OF TESTS FOR:DETERMINING PH OF PEAT (M-1)" }

A. Scope.

This method of test is used to determine the pH (hydrogen-ion concentration) of peat by means of a pH meter and the moisture content and organic content of peat by the Ignition Loss method.

B. Determination of pH (Hydrogen-ion Concentration).

Weigh 20 grams of peat into a 250-ml beaker. Add sufficient distilled water to make a slurry and stir the suspension several times at regular intervals for about one hour.

Using a pH meter, measure the pH of the peat suspension by immersing both the glass electrode and calomel electrode attachments deep into the thoroughly stirred suspension and reading the meter needle on the dial.

C. Determination of Moisture Content.

Weigh 200 grams of peat in a tared dish and dry in the oven to constant weight at 230 ± 9 °F (105 ± 5 ºC).

$$\text{Percent Moisture} = \frac{\text{Loss of Weight of Sample}}{200} \times 100$$

D. Determination of Organic Content.

Weigh 1 gram of the oven-dried peat into a porcelain crucible and ignite to constant weight.

Percent Organic Content = Loss of Weight of Sample x 100

M-2 PERCENT SOLIDS IN LATEX EMULSION ADMIXTURE{ XE "METHODS OF TESTS FOR:PERCENT SOLIDS IN LATEX EMULSION ADMIXTURE (M-2)" }

A. Scope.

This method of test is used to determine the percentage of solids in a latex emulsion admixture used in latex modified concrete.

B. Procedure.

All samples to be tested must be at room temperature. Weigh three aluminum cups and record the weight of each. Mix each sample by inverting the container five to ten times. Weigh approximately 1 gram of latex to the nearest milligram into each preweighed aluminum cup. Place all three samples in the oven to dry for 120 minutes at 285 ± 2 °F. Remove the samples from the oven and place immediately in a desiccator until cool. Reweigh each sample out of the desiccator to the nearest milligram and record.

Every sample must be tested in triplicate.

C. Calculation.

$$\text{Total Solids in Percent} = \frac{C - A}{B - A} \times 100$$

Where: A = Weight of empty aluminum cup.
B = Weight of aluminum cup and wet sample.
C = Weight of aluminum cup and dried sample.

D. Report.

If the results for the three samples are within two percent, average the three results to obtain the percent solids.

If the results for the three samples are not within two percent, but two results are within one percent, the average of the two results within one percent is reported as the percent solids and the third determination is discarded.

If the results for the three samples are not within two percent and no two results are within one percent, all the values will be discarded and the test procedure will be repeated.

M-3 QUICK-SETTING PATCH MATERIALS{ XE "METHODS OF TESTS FOR:QUICK-SETTING PATCH MATERIALS (M-3)" }

A. Preparation of Samples.

All samples are to be prepared according to manufacturer's recommendations. If several design mixes are given, the material will be tested in the worst condition (having the most water), which would be consistent with its intended use as a patching material.

B. Tests.

Materials will be tested according to the following:

1. **Time of Set.** Run Proctor according to ASTM C 403 except cardboard molds may be used.
2. **Strength Development.** Two cubes per test according to ASTM C 109, except for the Type 1A classification. Specimens shall be 4 by 8-inch cylinders according to ASTM C 192. All specimens will be air cured, except in the case of magnesium phosphate materials.
3. **Bond Strength - Arizona Shear Method.** Prepare four 4 by 8-inch composite cylinders consisting of a base cylinder of hardened conventional concrete and an upper portion of patching material.

   The base concrete will be made from 4 by 8-inch cylinders having a minimum compressive strength of 5,000 psi. These cylinders will be cut into equal halves along a 30-degree angle with the vertical axis. After being cut, the base cylinders will be etched with a 50 percent solution of hydrochloric acid and placed in 4 by 8-inch cylinder molds with cut face up.

   When preparing the composite cylinders, brush a small amount of the patching material into the saw-cut surface of the base cylinder and fill the remaining half of the cylinder mold with patching material using the standard consolidation procedures defined in AASHTO T 126. Remove the cylinders from the mold after 24 hours. Test two specimens at seven days and two specimens at twenty-eight days according to the procedure listed in AASHTO T 22.
4. **Expansion-Shrinkage.** Change in volume and length will be monitored from batching until the materials have reached equilibrium. Prepare four 2 by 2 by 10-inch autoclave bars according to ASTM C 157. Cure in room at 70.4 to 76.4 °F and 50 percent relative humidity for 24 hours. Record initial reading for 24 hours, then place two bars in water bath in moisture room, leave the other bars in the initial curing conditions and take a reading on each bar every 24 hours until stability has been attained.
5. **Durability.** Prepare four 4 by 8-inch cylinders for each material. Test two cylinders according to ASTM C 192 for 28-day compressive strength. The remaining two cylinders will be tested as follows:
   a. Cure for 24 hours in room at 70.4 to 76.4 °F and 50 percent relative humidity, followed by six-day cure in a lime water solution.
   b. Following the seven-day cure period, begin 50 cycle freeze-thaw test. Each cycle will consist of 16 hours freeze (air) and eight hours thaw (solution). The solution will be proportioned by weight of 96 percent water, 3.2 percent sodium chloride, and 0.8 percent calcium chloride.
   c. At the end of the 50 cycles, perform compressive test and report the results as a percentage of the 28-day compressive strength result.

      After every tenth cycle, cylinders will be examined visually and their condition recorded according to ASTM C 672.
6. **Permeability.**
   a. Prepare one 4 by 8-inch cylinder and cure 24 hours at 70.4 to 76.4 °F and 50 percent relative humidity. Saw cut the cylinder into two 4 by 4-inch cylinders.
   b. Seal all sides and the bottom with hot paraffin leaving the saw-cut surface exposed.
   c. Place cylinders in durability solution for seven days.
   d. Measure the amount of chlorides at the 1-inch, 2-inch, and 3-inch levels, from the top surface, according to AASHTO T 260.

If the material is to be used at temperatures lower than 70 °F, the Engineer may test the time of set and compressive strength at the lower temperatures.

M-4 CALCIUM NITRITE PRESENCE IN PLASTIC CONCRETE{ XE "METHODS OF TESTS FOR:CALCIUM NITRITE PRESENCE IN PLASTIC CONCRETE (M-4)" }

A. Scope.

This Method of Test is used to determine the presence of calcium nitrite in the plastic concrete state. A freshly mixed concrete sample shall be tested. Quantofix test strips, for high range nitrite shall be utilized. The equipment to perform this test shall be provided to the State by the Contractor. This will include provision of such equipment for the field laboratory testing operation.

For each day's production, a minimum of one test shall be performed unless directed otherwise.

B. Apparatus.

THE FOLLOWING EQUIPMENT SHALL BE PROVIDED:

1. Quantofix Test Strips for high range nitrite #91322.
2. 10cc disposable syringes with Leur-Lok tip #309604.
3. Disposable filters 1 inch/0.45 micron #SLHA02510.
4. Wide-mouth Container.
5. Clean Measuring Cup.

C. Procedure.

1. Using the apparatus list above, add field concrete to pre-measured 0.5 gallons of water in a wide mouth container. Use the water in the container to rinse out the measuring cup.
2. Shake the container 2-5 minutes until contents are well mixed. As indicated in Column 2 of the following Table, the stated quantity of concrete, in millimeters, should be obtained in the container.
3. Using the syringe, uptake approximately 10ml of extraction water from the container. Attach a disposable filter to the end of the syringe.
4. Filter the extraction water into a clean cup.
5. Dip the test strip into the clear, filtered extraction water and compare the color to the chart on the side of the test strip container.

Use the following chart to determine amount of concrete to be extracted, and expected readings on test strips:

Amount of Calcium Nitrite Added, liters/cu. meters	Volume of Concrete to be Extracted, ml	Expected Reading on Test Strip
9.9	225	0.3
12.4	180	0.3
14.8	150	0.3
17.3	130	0.3
19.8	225	0.6
22.3	200	0.6
24.8	180	0.6

M-5 CALCIUM NITRITE PRESENCE IN HARDENED CONCRETE{ XE "METHODS OF TESTS FOR:CALCIUM NITRITE PRESENCE IN HARDENED CONCRETE (M-5)" }

A. Scope.

This method of test is used to determine the concentration of calcium nitrite in the hardened concrete. A concrete sample shall be pulverized, and a representative portion shall be extracted with water. The test shall be used, at the direction of the Department, only as a retest provision.

An alternative to the following procedure is specified by the Environmental Protection Agency (EPA Method No. 353.3 - Storet No. Total 00630 - Spectrophotometric, Cadmium Reduction). The sample shall be filtered and the filtrate diluted to a known volume, an aliquot is treated with sulfanilic acid, which is diazotized by the nitrite. The diazotized sulfanilic acid is then coupled with N-(1-naphthyl) ethylenediamine to produce a purple color which is measured by a spectrophotometer from 520 to 530 nanometer.

B. Apparatus.

The following equipment shall be provided to facilitate the testing:

1. Analytical balance, accurate to ± 0.1 milligram.
2. U.S. Standard sieve series, 50 mesh.
3. Magnetic stirrer and stirring bars.
4. Erlenmeyer flask, 500-ml.
5. Pipets, 2.00-ml, 5.00-ml, 10.00-ml, 20.00-ml, and 50.00-ml.
6. Volumetric flasks 100-ml, 500-ml, 1,000-ml.
7. Graduated cylinders, 50-ml, 200-ml.
8. Funnels.
9. Weighing paper, Schleicher and Schnell, S&S No. B-2.
10. Filter paper, Whatman No. 44.
11. Spectrophotometer with scanning capability.

C. Reagents.

1. **Sulfanilic Acid, 0.6 Percent Solution, ACS Reagent Grade.** Dissolve 2.27 liters of sulfanilic acid in 70 ml of hot distilled water, cool the solution, add 20 ml of concentrated hydrochloride acid, and dilute to 100 ml with distilled water, and mix.
2. **Hydrochloric Acid, 1N, Concentrated, ACS Reagent Grade.** Dilute 8.6 ml of concentrated HC1 to 100 ml and mix.
3. **N-(1-Naphthyl)-Ethylenediamine Dihydrochloride Solution, Fisher Scientific Co. Cat. No. 21.** Dissolve 0.60 grams of this reagent in 50 ml of distilled water acidified with 1.0 ml of concentrated HC1. Dilute to 100 ml and mix. Keep solution in a refrigerator and prepare freshly every week.
4. **Sodium Nitrite, Crystals, ACS Reagent Grade.**
    a. **PRIMARY STANDARD SOLUTION**. Dissolve approximately, but accurately, 10.6 grams of sodium nitrite in distilled water and dilute to 1 liter using a volumetric flask.
    b. **SECONDARY STANDARD SOLUTION**. Dilute the primary standard solution 50/500 using a 50-ml pipet and 500-ml volumetric flask.
5. **Phenolphthalein Indicator Solution, 1 Percent, ACS Reagent Grade.** Dissolve 1 gram of phenolphthalein in 100-ml Graduate Cylinder of 95 Percent ethyl alcohol.
6. **Ethyl Alcohol, ACS Reagent Grade.**

D. Procedure

1. **Preparation of Standard Calibration Curve for Nitrite Ion.** Using the appropriate pipets and three 500-ml volumetric flasks, dilute the secondary sodium nitrite standard solution 5/500, 10/500, and 20/500. Pipe 10 ml of each of the above solutions into separate 100-ml volumetric flasks. Add approximately 50 mils. of distilled water to each volumetric flask. To a fourth 100-ml volumetric flask labeled "Blank" add 60 mils. of water. To each 100-ml flask:
    a. Pipet 2.00 ml of sulfanilic acid reagent, mix and allow to stand five minutes.
    b. Pipet 2.00 ml of N-(1-Naphthyl) ethylenediamine dichloride reagent, dilute to volume, mix, and allow to stand ten minutes.

    Using the spectrophotometer, measure the absorbance of the three standard solutions as follows:

a. Zero the spectrophotometer over the range of 600 to 500 nanometers using the reagent blank in the sample cell.
b. Measure the absorbance of the nitrite standard solutions by placing each solution in the sample cell and scanning the UV spectra from 600 to 500 nanometers. Record the absorbance at the apex of the UV curve between 520 and 530 nanometers.

Using regular graph paper, plot ug/ml nitrate vs. Absorbance.

2. **Sample Extraction and Nitrite Determination.** Pulverize the whole concrete sample to obtain a homogeneous and representative sample. Pass the powder through a 50-mesh screen. Using weighing paper (S&S, No. B-2) and the analytical balance, weigh a 2-gram sample to the nearest milligram. Quantitatively transfer the sample to a 500-milliliter Erlenmeyer flask. Add (graduate) 200 ml of distilled water an a magnetic stirring bar. Place the Erlenmeyer flask on a magnetic stirring base and stir for 30 minutes. Stop and allow to settle. Filter through Whatman No. 44 paper. Collect the filtrate in a 500-ml volumetric flask. To the Erlenmeyer flask containing the residual sample, add 200 ml of distilled water and re-extract by stirring ten minutes. Stop and allow to settle. Refilter using the Whatman #No. 44 filter as indicated above. Collect the filtrate in the same 500-ml volumetric flask. Repeat extraction and filtration using 100 ml of distilled water. Dilute to volume (500 ml), if necessary, and mix. From the 500-ml volumetric flask transfer (pipet) a 10.00-ml aliquot into a 100-ml volumetric flask. Add 50 ml of distilled water. Add a few drops of phenolphthalein indicator and neutralize by dropwise addition of 1 Nhydrochloric acid. Pipet 2.00 ml of sulfanilic acid reagent, mix, and allow solution to stand five minutes. Pipet 2.00 ml of N(-1naphthyl) ethylenediamine dihydrochloride reagent. Dilute to volume, mix, and allow solution to stand ten minutes. Scan an aliquot of the sample solution from 600 to 500 nanometers and record the maximum absorbance between 520 to 530 nanometers.

E. Calculations.

Read the ug/milliliter nitrite equivalent to the absorbance from the standard calibration curve. Calculate the percent NO_2 in the sample as follows:

$$\frac{NO_2 \text{ Dilution } (\mu g/ml), \text{ Sample } \times \text{ Aliquot } \times 500}{\text{Sample Wt. (g)} \times 10^6} \times 100 = \% NO_2$$

The aliquots pipeted from the 500-ml extraction filtrate should be adjusted such that the absorbance is within the range of 0.10 to 0.80.

The percent NO_2 as calculated above does not take into account the percent recovery factor of the nitrite. For a particular set of lab concrete standards containing 390 kilograms per cubic meter cement with two percent s/s $Ca(NO_2)_2$ 96 percent recovery of the theoretical nitrite was obtained.

F. Report.

The following data and certification for the corrosion inhibitor admixture shall be submitted. Test results shall meet or exceed the Physical Requirements (Table 1) of ASTM C 494 for any type of admixture.

P-1 GLASS BEADS{ XE "METHODS OF TESTS FOR:GLASS BEADS (P-1)" }

A. Scope.

These methods of tests are used to determine the suitability of glass beads for reflectorizing traffic paint.

B. Sampling.

Bags selected at random are split by a sample splitter to about 3 pounds (1 quart). The number of bags selected will be the nearest cube root of the number of bags in the lot or shipment. Each sample will again be split to such a size that a combined sample of approximately 3 pounds (1 quart) will be obtained for the tests. For determining the percent spheres, grading, and daylight 45 degrees - 0 degree reflectance, the combined sample is split to such amounts as required for the particular tests.

C. Spherical Particles.

The percentage of spherical particles will be determined according to ASTM D 1155, Procedure B.

D. Index of Refraction.

1. **General**. When immersed in liquids, all transparent or translucent objects yield images under a microscope that are bounded by dark shadow outlines or halos. As the index of refraction of the solid nears that of the liquid, the dark shadow outlines decrease in prominence and disappear when both object and liquid have the same refractive index.
2. **Liquid Immersion Method at 25 ºC.** The crushed particles of glass beads are placed on a clean glass slide and covered with a small fragment of cover glass. (Small pieces of cover glass are advantageous because less sample and liquid are required and the crystals are more easily found.) A drop of liquid of known refractive index is introduced and the specimen examined under the microscope.

   When the solid possesses a higher index than that of the liquid, the contours are usually dark and well defined with a halo or band of light within the back bands. As the microscope tube is raised, this band of light will appear to move inward, i.e., toward the center of the solid. If, on the other hand, the solid possesses a lower index of refraction, the black contours are relatively weak, with the bright halo outside the black bands. Upon raising the microscope objectives, the band of light or bright halo appears to move outward or away from the center.

   If a solid of unknown index is immersed in a series of liquids of known refractive index, one after another, until the black contours bounding the image just disappear when the solid is immersed in one of the liquids, the index of that particular liquid is the index sought of the solid.

E. Grading.

Approximately 100 grams of glass beads are separated by mechanical sieving into a series of standard sieves and the following determinations are made:

1. Percent passing Nos. 16, 20, 30, 50, and 100 mesh sieves.
2. Percent retained on Nos. 16, 20, 30, 50, and 100 mesh sieves.

F. Chemical Stability.

Samples of beads will show no tendency toward decomposition or surface etching when subjected to each of the following tests:

1. **Resistance to Hot Water Attack**. Twenty-five grams of beads are run with 250 ml of distilled water and subjected to 90 hours continuous running in a Soxhlet Extraction Apparatus.
2. **Resistance to Attack Comparable to that of Normal Soil Acidity (pH 5 to pH 6).** Twenty-five grams of beads are soaked for 90 hours in 500 ml of buffered solution (pH 5 to pH 6) at room temperature. The solution is then decanted and the beads rinsed with 100 ml of distilled water.
3. **Resistance of Lime Water Attack (Encountered on Portland Cement Concrete Highways).** Twenty-five grams of beads are boiled for two hours in 1,000 ml of saturated lime water solution. Solution is then decanted and beads are rinsed with 100 ml of distilled water.
4. **Resistance to Attack by Salt Solution (Encountered in Winter with Treated Sands, etc).** Twenty-five grams of beads are boiled for three hours in 500 ml of a 1.0 normal solution of calcium chloride. Solution is then decanted and beads are rinsed with 100 ml of distilled water.

G. Coating.

The embedment coating on the beads will be tested in the following manner:

1. Set drying oven to 60 ºC. Turn on the ultraviolet light (7,000 nanowatts per centimeter squared).
2. Weigh 10 grams of beads to be evaluated and place into an aluminum weighing dish.
3. Place a 2-inch diameter filter paper into a Buchner funnel and attach to a suction flask.
4. Put the beads into the Buchner funnel and saturate the sample with dansyl chloride solution (98 percent) using a medicine dropper. Let the solution and sample stand for 30 seconds.
5. Place the saturated beads into an aluminum dish and dry in the oven at 60 ºC for 15 to 20 minutes. The beads will be yellow and agglomerated. Do not let the solution char.
6. Remove the sample from the oven and place the glass beads in the Buchner funnel with new filter paper. Rinse the beads with 100 ml of acetone. Use the suction during this step. All yellow must be removed from the beads.
7. Remove the beads from the funnel and place into a new aluminum tray. Allow the beads to dry in the oven for five to ten minutes until free flowing.
8. Remove the beads from the oven and place on glass filter paper. If the beads are agglomerated, break them up with a spatula.
9. Inspect the treated sample under the ultraviolet light in a darkened room.

   Embedment coated beads will emit a yellow-green fluorescence. Color comparison samples are available from the Department. If no fluorescence is observed, the test should be rerun using a new 10-gram sample of beads and a fresh solution of dansyl chloride. If there is no fluorescence observed on the second sample of beads, the material is not properly coated and the lot is rejected. If the second sample does fluoresce, the lot is accepted.

S-1
PROCEDURE FOR PERFORMING ROTATIONAL-CAPACITY TEST ON LONG BOLTS IN TENSION CALIBRATOR

{ XE "METHODS OF TESTS FOR:PROCEDURE FOR PERFORMING ROTATIONAL-CAPACITY TEST ON LONG BOLTS IN TENSION CALIBRATOR (S-1)" }

A. Equipment Required.

1. Calibrated bolt tension measuring device of size required for bolts to be tested.
2. Calibrated torque wrench.
3. Spacers and/or washers with hole size no larger than 1/16 inch greater than bolt to be tested.
4. Steel section to mount bolt calibrator. Flange of girder or cross frame accessible from the ground is satisfactory.

B. Procedure.

1. Install nut on bolt and measure protrusion of bolt when three to five full threads of the bolt are located between the bearing face of the nut and the bolt head. Measure the bolt length, the distance from the end of the threaded shank to the underside of the bolt head.
2. Install the bolt into the tension calibrator and install the required number of shim plates and/or washer (one washer under the nut must always be used) to produce the thread protrusion measured in Step 1.
3. Tighten bolt using a hand wrench to the snug tension listed below, -0, +2 kips.

Bolt Size	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½
Snug Tension, kips	1	2	3	4	5	6	7	9	10

4. Match mark a corner of the nut and the face plate of the bolt calibrator.
5. Using the calibrated manual torque wrench, tighten the bolt to at least the tension listed below and record the torque required to reach the tension and the value of the bolt tension. Torque must be measured with the nut in motion.

Bolt Size	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½
Tension, kips	12	19	28	39	51	56	71	85	103

6. Further tighten the bolt to the rotation listed below. The rotation is measured from the initial marking in Step 4. Record the bolt tension. Assemblies that fail before this rotation either by stripping or fracture fail the test.

Rotation	**Bolt Length**
240 degrees (⅔ turn)	≤ 4 diameters
360 degrees (1 turn)	> 4 diameters and ≤ 8 diameters
480 degrees (1-⅓ turns)	> 8 diameters

7. The bolt tension measured in Step 6 after the required rotation must equal or exceed the values in the table shown below. Assemblies that do not meet this tension fail the test.

Bolt Size	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½
Tension, kips	14	22	32	45	59	64	82	98	118

8. Loosen and remove nut, and examine the threads on the nut and bolt. No signs of thread shear failure, stripping, or torsional failure of the bolt should be evident. Assemblies that have evidence of stripping fail the test.
9. Calculate and record the value of 0.25 times the tension in kips measured in Step 5 times the bolt diameter in inches. The torque measured and recorded in Step 5 must be equal to or less than this calculated value. Assemblies with torque values exceeding this calculated value fail the test.

S-2
PROCEDURE FOR PERFORMING ROTATIONAL-CAPACITY TEST ON BOLTS TOO SHORT TO FIT TENSION CALIBRATOR{ XE "METHODS OF TESTS FOR:PROCEDURE FOR PERFORMING ROTATIONAL-CAPACITY TEST ON BOLTS TOO SHORT TO FIT TENSION CALIBRATOR (S-2)" }

A. Equipment Required.

1. Calibrated torque wrench and spud wrench or equivalent.
2. Spacers and/or washers with hole size no larger than 1/16 inch greater than bolt to be tested.
3. Steel section with normal size hole to install bolt. Any available splice hole can be used with a plate thickness that will provide the number of threads under the nut required in Step 1 below.

B. Procedure.

1. Install nut on bolt and measure protrusion of bolt when three to five full threads of the bolt are located between the bearing face of the nut and the bolt head. Measure the bolt length, the distance from the end of the threaded shank to the underside of the bolt head.
2. Install the bolt into the hole and install the required number of shim plates and/or washer (one washer under the nut must always be used) to produce the thread protrusion measured in Step 1.
3. Snug the bolt using a hand wrench. The snug condition should be the normal effort applied to a 12-inch long wrench. The applied torque should not exceed 20 percent of the torque determined in Step 5.
4. Match mark a corner of the nut and the plate.
5. Tighten the bolt by turning the nut using the torque wrench to the rotation listed below. A second wrench must be used to prevent rotation of the bolt head during tightening. Record the torque required to reach this rotation. Torque must be measured with the nut in motion.

Rotation	**Bolt Length**
120 degrees (⅓ turn)	≤ 4 diameters
180 degrees (½ turn)	> 4 diameters and ≤ 8 diameters
240 degrees (⅔ turn)	> 8 diameters

The measured torque should not exceed the values listed below. Assemblies that exceed the listed torques fail the test.

Bolt Size	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½
Torque, ft-lb	150	290	500	820	1,230	1,500	2,140	2,810	3,690

6. Tighten the bolt further to the rotation required below. The rotation is measured from the initial marking in Step 4. Assemblies that fail before this rotation either by stripping or fracture fail the test.

Rotation	**Bolt Length**
240 degrees (⅔ turn)	≤ 4 diameters
360 degrees (1 turn)	> 4 diameters and ≤ 8 diameters
480 degrees (1-⅓ turns)	> 8 diameters

7. Loosen and remove nut, and examine thread on the nut and bolt. No signs of thread shear failure, stripping, or torsional failure of the bolt should be evident. Assemblies that have evidence of stripping fail the test.

Anchor bolts, rock anchors, and hardware shall conform to ASTM A 36 and shall be galvanized after fabrication, including threading, according to ASTM A 153.

Dowels used to anchor prestressed concrete voided slabs and box beams to abutments and piers shall conform to ASTM A 36 and shall be galvanized according to ASTM A 153. Threading of dowels is not required.

Welded steel shear connectors shall conform to Division II, Section 11 of the AASHTO Standard Specifications for Highway Bridges or Section 11 of the AASHTO LRFD Bridge Construction Specifications.

Stainless steel bolts, nuts, and washers shall conform to ASTM A 320, Class 1, Grade B8 (AISI Type 304).

For overhead and cantilever sign support structures, bolts, nuts, and washers for steel to steel chord splices shall conform to AASHTO M 164 and be hot-dip galvanized as per ASTM A 153.

As an alternate, bolts, nuts, and washers conforming to AASHTO M 164 may be substituted for bolts, nuts, and washers of the same diameter, length, and thickness conforming to ASTM A 307.

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