NEW JERSEY
DEPARTMENT OF TRANSPORTATION

1998
SUPPLEMENTAL SPECIFICATIONS

TO THE

1996
STANDARD SPECIFICATIONS
FOR
ROAD AND BRIDGE
CONSTRUCTION

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DIVISION 100 - GENERAL PROVISIONS

SECTION 101 - GENERAL INFORMATION

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 which 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, prior to 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 vertical to horizontal dimensions.

101.02 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
AREA	American Railway Engineering 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
EEI	Edison Electrical Institute
EPA	Environmental Protection Agency of the United States Government
FHWA	Federal Highway Administration
FSS	Federal Specifications and Standards, General Services
ICEA	Insulated Cable Engineers Association
IMSA	International Municipal Signal Association
ISO	International Organization for Standardization
ITE	Institute of Transportation Engineers
MUTCD	Manual on Uniform Traffic Control Devices
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NIST	National Institute for Standards and Technology
NJAC	New Jersey Administrative Code

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
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.

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

ACCEPTANCE. The term "Acceptance" means the formal written acceptance of the Project by the Commissioner of Transportation which has been completed in all respects in accordance with the Contract Documents.

ACCEPTANCE TESTING. Testing conducted by the Engineer to measure the degree of compliance to the Contract Documents.

ADDENDA (Addenda or Addendum used interchangeably). The term "Addenda" means the written or graphic documents and computer disk issued prior to the opening of bids which clarify, correct, or change the Contract Documents.

ADVERTISEMENT. The public announcement, as required by law, inviting bids for work to be performed or materials to be furnished.

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.

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.

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 6.1 meters 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 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.

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.

CALENDAR DAY. Each and every day shown on the calendar.

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. The Board is comprised of three members appointed by the Commissioner of Transportation 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 cost of using the Board in an attempt to resolve a dispute is shared equally by the Department and the Contractor. 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. A claim may be reviewed by the Board only after it has been reviewed by the Department Claims Committee.

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 4 °C. The forecast of the daily temperature data that is required to calculate this average daily temperature shall be procured from the closest local NOAA monitoring station in the State as specified in the Project 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	Audobon	Cape May 1 NW
Canoe Brook	Belleplain St. Forest	Long Branch 2 S
Charlotterburg	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

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.

COMPLETION. The term "Completion" means Completion of the Work. Completion shall occur when:

1. the Work has been satisfactorily completed in all respects in accordance with 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.

COMPUTER DISK. The term "Computer Disk" means a diskette furnished by the Department which 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 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 90-millimeter high-density floppy disk drive and a hard drive
3. Hewlett Packard laser inkjet printer, or 100 percent compatible, connected to the PC's parallel port, PRN
4. minimum of 400k available memory (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 which 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 spread sheet program on the Computer Disk which 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.

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 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 prior to the performance of Work on Pay Items.

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

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.

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, Addenda, or other information mailed or otherwise transmitted to the prospective bidders prior to 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.

Note: 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 Bond.

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 in lieu of the number of working 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.

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.

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 which provides an opening to carry water under a roadway.

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.

DAYS. Unless otherwise designated, days as used in the Contract Documents means calendar days.

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.

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.

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.

Note: In order 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".

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.

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.

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.

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 right-of-way (see Figure 101-1 on page 13).

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
	Thanksgiving Day
Memorial Day	Christmas Day
Independence Day	

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.

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.

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.

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, said paved sections including both the shoulders and the traveled way.

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 on page 13). 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.

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.

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.

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 who is 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.

PRECONSTRUCTION CONFERENCE. The initial Project meeting conducted by the Regional Construction Engineer, normally held after Award of the Contract and prior to 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.

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.

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.

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.

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.

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.

RESIDENT ENGINEER. The term "Resident Engineer" means the field representative of the Engineer having direct supervision of the administration of the Contract.

RIGHT-OF-WAY (R.O.W.). 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 on page 13).

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 on page 13).

ROADSIDE. A general term including:

1. The areas between the outside edges of the shoulders and the right-of-way 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.

ROADWAY. The portion of the highway, street, or road within the limits of construction (see Figure 101-1 on page 13).

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 on page 13).

SIDEWALK. That portion of the roadway primarily constructed for the use of pedestrians (see Figure 101-1 on page 13).

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 Addendum or other information giving interpretations or revisions to them which, prior to the receipt of bids, are transmitted to prospective Bidders.

1. *Standard Specifications.* The term "Standard Specifications" means the 1996 Standard Specifications for Road and Bridge Construction of the New Jersey Department of Transportation, which has been approved for general application and repetitive use.
2. *Supplemental Specifications.* Approved additions and revisions to the Standard Specifications.
3. *Special Provisions.* Revisions to the Standard and Supplemental Specifications applicable to an individual project

STATE. The "State" means the State of New Jersey.

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.

STRAIGHTEDGE. An accurate, 3.048-meter square-edged straightedge used in testing variations in the surface to verify specified tolerances.

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.

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.

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 on page 13).

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.

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.

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.

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.

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.

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.

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.

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.

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.

TRAVELED WAY. The portion of the roadway for the movement of vehicles exclusive of shoulders and auxiliary lanes (see Figure 101-1 on page 13).

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.

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.

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.

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.

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.

101.04 Inquiries Regarding the Project.

Inquiries prior to 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.

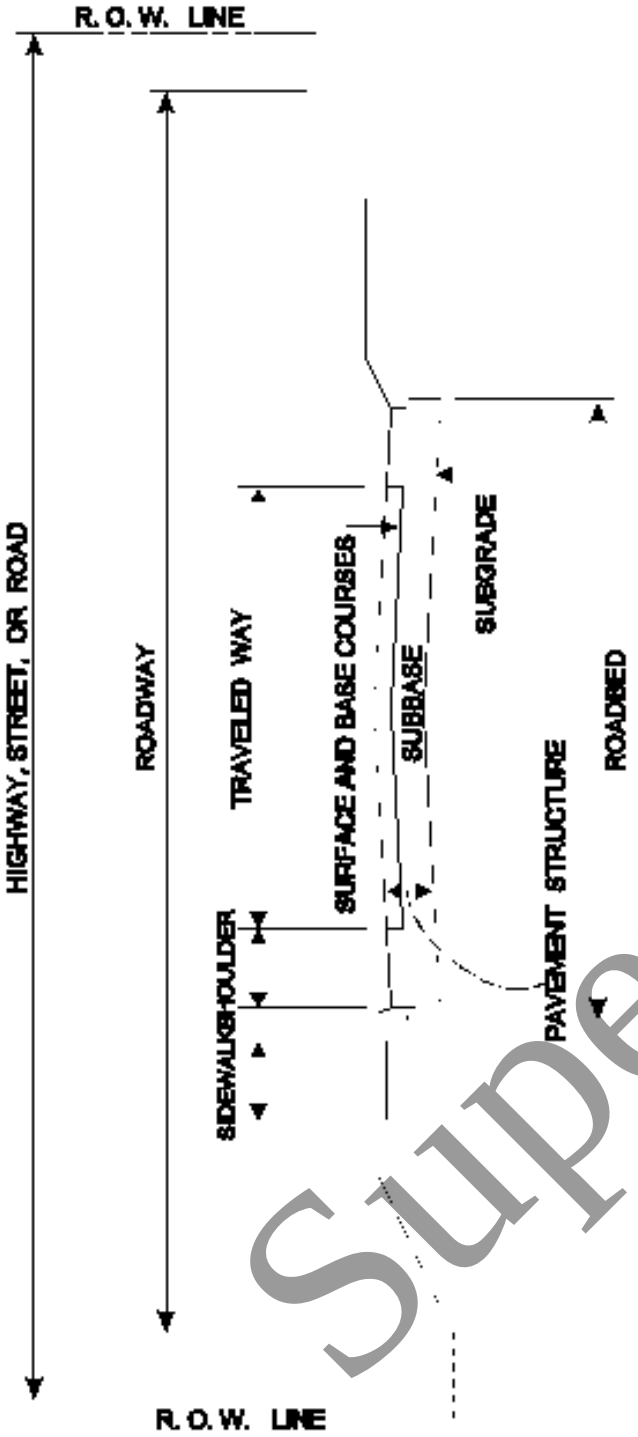

Figure 101-1

SECTION 102 - BIDDING REQUIREMENTS AND CONDITIONS

102.01 Prequalification of Prospective Bidders.

Proposals will be received only from Bidders who, prior to 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 in accordance with Regulations Covering the Classification of Prospective Bidders issued in accordance with 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.

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 which, 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.

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 Form 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.

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 in accordance with 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.

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.

The Bidder shall examine carefully the site of the proposed Project and the Contract Documents before submitting a Proposal. 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:

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.

   Boring logs, if borings are taken, are part 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 (Telephone: 609-530-8584).

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 in order 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. **Right-of-Way Availability.** The Bidder shall consider the effect on its work schedule of any delays in right-of-way 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 prior to 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. Plans for such structures are available for review or purchase upon written request at 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 (Telephone: 609-530-5587, Fax : 609-530-6626). The State assumes no responsibility for the correctness of the Plans. Any information obtained from the existing Plans shall be verified by the Bidder prior to 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.

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.

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.

been received prior to the opening of bids, the bid envelope will be returned to the Bidder unopened.

102.14 Public Opening of Proposals.

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.

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 which 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 prior to 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.

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

103.01 Consideration of Proposals.

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

or for its removal. Where modifications to the proposal or for its removal. Where modifications to the proposal are approved in order 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 in accordance with 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 which 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, 100 micrometers 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 80 micrometers 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 of New Jersey.

Proposals will not be considered that change the following:

a. The type, thicknesses, or joint designs of a concrete, a bituminous, or a stabilized surface or base course.

b. The types and thicknesses of the unbound materials underlying a concrete, a bituminous, or a stabilized surface 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, andunderclearance.

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 therefor 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, in accordance with the Specifications.
   b. The cost of the revised Work as determined from the aforementioned changes will be paid in accordance with 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.

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 in accordance with 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

105.01 Authority of the Engineer.

The Engineer will decide all questions which may arise as to the quality and acceptability of the Work and as to the rate of progress of the Work, all questions which 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.

All costs for providing the working drawings outlined below shall be included in the prices bid for the various Pay Items scheduled in the Proposal.

Working drawings shall be 594 by 841 millimeters (A1) which shall have 540 millimeter by 775 millimeter drawing area within the border, or 210 by 297 millimeters (A4). Seven copies shall be submitted to the Design Unit for review, and one copy shall be submitted to the Resident Engineer, except that for railroad carrying structures, four additional copies are required to be submitted to the Design Unit. One additional copy each shall be submitted when an outside testing agency or an outside authority is involved in the Project. Working drawings requiring corrections or changes will indicate **REVISE AND RESUBMIT** and be returned directly to the Contractor by the Design Unit with a copy to the Resident Engineer. Once changes have been made, the drawings shall be resubmitted as above. The above submittal procedure will simultaneously facilitate both approval 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
3. Municipality and County
4. Contractor's name
5. Fabricator's name (if applicable).
6. Federal Project Number or Data ProcessingD.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 A1 working drawing shall contain three blank blocks placed directly above the title block. One block, designated for design unit approval, shall be used for the stamped markings **NO EXCEPTIONS** and **REVISE AND RESUBMIT,** and **APPROVED**. Calculation cover sheets shall also contain a block for a 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 A4 sheets shall be accompanied by a cover sheet which shall contain the above blocks, and the blocks shall not appear on the A4 working drawing/calculation sheets. The specific format and direction for submission of working drawings will be supplied after award.

The original tracings for each A1 working drawing or the cover sheet for A4 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 for the following shall be on A1, 80 micrometers minimum thickness, polyester film, such as Mylar or Herculene, and shall be done in ink, drafting lead, or similar writing material so as to produce clear and legible A1 prints which shall be submitted as working drawings:

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 deckjoints.

10. Bridge storm drains.
11. Sign support structures.
12. Prefabricated modular walls.
13. Mechanical stabilized earth (MSE) walls.
14. Alternate retaining wall designs.
15. Concrete crib walls.
16. Noise barriers.
17. Cofferdams.
18. Temporary sheeting.
19. Sheeting left in place.
20. Electrical items for movable bridges.
21. Bridge railings and fencing anchorages

Any calculations for the above shall be submitted on A4 paper.

All calculations shall bear an actual embossed seal of a Professional Engineer licensed to practice in the State of New Jersey.

Working drawings or calculations and the cover sheet, if required, for the following shall be on A4 or A1 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. Temporary shielding.
4. Cofferdams with temporary sheeting.
5. Temporary structures.
6. Temporary sheeting.

The above lists of items requiring working drawings indicate those items for which working drawings will be reviewed. All items may not be present on the Project.

Material specification designations shall be noted on the working drawings. 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 297 by 420 millimeters (A3) prints may be made.

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

105.05 Conformity with Contract Documents.

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

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.

Utility agreements and orders relating to the Project, if available, may be inspected at the Department's Bureau of Utilities and Right-of-Way located at 1035 Parkway Avenue, E & O Building, Trenton, New Jersey (Telephone: 609-530-5683).

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.

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:

1. **Railroad Traffic and Property.** Where the Project includes Work across, over, under, or adjacent to railroad tracks or railroad right-of-way, the Contractor shall safeguard the traffic, tracks, and appurtenances, and other property of the railroad which 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 in accordance with Section 617.

   All Work done within the railroad right-of-way 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 interest 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 which 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 right-of-way 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 right-of-way, or other Work which 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 right-of-way 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 right-of-way 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 in accordance with 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.

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.

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 make all necessary computations to establish the exact position of all the Work from the control points which 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 prior to 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.

2	50 mm	Sof-gauze bandages
2		Oval eye pads
1	1300 mm	Triangular bandage
1	13 by 4500 mm	Hypo-allergenic first-aid tape
10		Antiseptic wipes
1	3.5 g	Burn cream, foil pack
1	227 g	First-aid cream
1	100 caplets	Tylenol Extra-Strength caplets
1		Scissors
1		Tweezer
1		First-aid guide
1	15 mL	Ophthalmic irrigation solution
1		Contents cards
10		Disposable gloves
10	0.33 mL	Ammonia inhalants

(12) The hardware and software requirements of the microcomputer system, if required, will be provided in the Special Provisions.

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 42 square meters and shall be divided into two communicating rooms, one with a floor area of not less than 28 square meters and one with a floor area of not less than 14 square meters, 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 28 square meters 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 70 square meters and shall be divided into four communicating rooms, one with a floor area of not less than 28 square meters and three with a floor area of not less than 14 square meters 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 84 square meters and shall be divided into four communicating rooms, two with a floor area of not less than 28 square meters each and two with a floor area of not less than 14 square meters 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 98 square meters and shall be divided into five communicating rooms, two with a floor area of not less than 28 square meters each and three with a floor area of not less than 14 square meters each, and equipped with tables and chairs for the use of 28 personnel.

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 14 square meters 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 28 square meters and shall be equipped with tables and chairs for the use of eight personnel.

In lieu 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 offices shall consist of furnishing the office complete with furniture, equipment, electricity, water, heating, air-conditioning, 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, providing

lavatory supplies, janitorial and waste disposal services weekly, and snow removal services. Maintenance of the field office shall also include the monthly rent. The fax machine and related equipment shall be repaired or replaced within 48 hours of becoming inoperable or defective.

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

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 in accordance with Subsection 108.16.

Payment for telephone service will be made based on the actual cost as evidenced by paid bills from the telephone company. An estimated amount to cover these reimbursements will be included in the Proposal.

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.

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 prior to 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.

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, 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 in accordance with 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 3 800 cubic meters or more, a list of trucks and their motor vehicle classifications shall be furnished prior to 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 bituminous concrete from automated batch plants, a list of trucks including the certified tare weights and maximum allowable load for each shall be furnished prior to 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 meter load for each shall be furnished prior to 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.

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 which otherwise meet the Specifications.

105.19 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.

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.

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 bituminous concrete patch in accordance with Section 402 in order to maintain sections of traveled way and shoulders in a smooth riding condition at all times including seasonal shutdowns. Payment for bituminous concrete patch will be made in accordance with Section 402 except for those areas which 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.

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.

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.

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 in accordance with 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 prior to 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

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 to be in compliance with the Contract, the Engineer will promptly issue a Certificate of Completion stating that, to the best of its knowledge, information, and belief, and on the basis of observations and inspections, the Work has been completed in accordance with 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 which 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

106.01 Source of Supply and Quality Requirements.

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 which have been approved by the Engineer shall be used. All Hot Mix Asphalt (HMA) facilities manufacturing HMA for Department projects shall have an approved Quality Control Program Plan in accordance with the requirements outlined in the report entitled "Hot Mix Asphalt Quality Control Program Plan" prepared by the NJDOT and NJAPA; a current copy of which can be obtained from the Regional Materials Engineer. Failure to follow these requirements shall 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.

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

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 inclosure 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 prior to 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.

Prior to 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.

NJSA 54:32B-9 provides that any sale or service to the State of New Jersey, 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.

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.

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.

It is the public policy of the State of New Jersey 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 Programs have been developed. The Affirmative Action and Minority or Disadvantaged Business Enterprises 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 for any delay occasioned thereby.

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 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.

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 by 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 0.8 kilometer.

All toilet facilities shall be in compliance with OSHA Regulation 1926.51(c) with the exception that the State of New Jersey 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.

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.

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 Material Safety Data Sheets (MSDS) for products in use at the Project. These Material Safety Data Sheets shall be made available to the Engineer upon request.

107.11 Public Convenience and Safety.

The Contractor shall at all times so conduct the Work as 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.

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 right-of-way shall be performed in accordance with Subsections 105.09 and 105.10.

107.19 Independent Contractor.

The relationship of the Contractor to the State is that of an independent contractor, and said Contractor, in accordance with 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.

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.

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 3 below. Excepted from this assumption of risks are only those risks which 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:

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 nonexecution 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 bear the responsibility of seeking insurance reimbursement for this risk of loss or damage. It shall be the Contractor's responsibility to obtain insurance covering the risks described herein, and the cost of this insurance shall be distributed throughout the bid and not paid as a specific Contract line item. However, 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 risks for failure to take such actions shall be assumed by the Contractor.

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. **Risk 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 prior to completion of removal of such property from the construction site or the State's premises, or the vicinity thereof.

The Contractor shall indemnify and save harmless the State against all claims described in Subheadings 2 and 3 above, and for all expense incurred by the State in the

defense, settlement, or satisfaction thereof including expenses of attorneys. 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 which 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.

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:

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 of New Jersey, 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 which 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 in accordance with the requirements

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.

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 45 meters 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.

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.

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 in accordance with 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 in accordance with NJSA 4:24-39 *et seq.*

SECTION 108 - 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 which 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.

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 Form A approved by the State.

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 in accordance with 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.

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.

After review of the application, the consent of or rejection by the Commissioner of the subcontracting will be provided to the Contractor in writing. Prior to the receipt of the written consent from the Commissioner, Work shall not be performed on the Project under the subcontract.

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 the Work to be subcontracted is $200,000 or more, subcontracting will be permitted only to subcontractors prequalified with the Department. Moreover, where one subcontractor has pending, and as yet uncompleted, work on more than one Department project, the aggregate value of which exceeds $200,000, such subcontract must be prequalified with the Department. However, if a subcontractor has satisfactorily completed work for the Department and has a performance rating of average or above, compared to all contractors on file with the Department, such subcontractor will be permitted to perform work on Department projects up to an aggregate value of $400,000 without prequalification. For such a subcontractor, prequalification is required when the value of work of a single

Department project or the aggregate value of work on more than one Department project exceeds $400,000.

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 which require electricians will be permitted only to subcontractors who are licensed electricians in the State regardless of the value of the subcontract.

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, prior to 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.

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 prior to 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 prior to execution of the Contract by the Commissioner unless proof of insurance has been provided in accordance with 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 prior to 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 in accordance with the Contract Documents prior to 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 prior to 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.

At or prior to 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 in order 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 prior to 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.

accomplishes the Work. When the use of certain methods and equipment is specified, the specified methods and equipment shall be used unless otherwise authorized in accordance with Subsection 106.12.

108.08 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 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 which 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.

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 on a calendar day basis, it shall consist of the number of calendar days stated in the Contract counting from the date set forth in the Notice to Proceed in accordance with Subsection 108.03, including all Saturdays, Sundays, holidays, and non-work days.

When the Contract Time is a specified completion date, that is the date on which the Contract shall reach Completion.

108.11 Extensions and Reductions of Contract Time.

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 which 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 which 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 right-of-way, 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 fourth paragraph) (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 fourth paragraph) 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 fourth paragraph).

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 in accordance with 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**

CONCRETE IN SUPERSTRUCTURE, DECK SLABS	$ 4.20 per cubic meter
CONCRETE IN SUPERSTRUCTURE, SIDEWALKS	$ 2.10 per cubic meter
CONCRETE IN SUPERSTRUCTURE, PARAPETS	$ 1.05 per linear meter
REINFORCEMENT STEEL IN STRUCTURES	$ 0.02 per kilogram
REINFORCEMENT STEEL IN STRUCTURES, EPOXY COATED	$ 0.02 per kilogram
BITUMINOUS CONCRETE SIDEWALK,___ MM THICK	$ 0.77 per square meter
CONCRETE SIDEWALK,___ MM THICK	$ 0.77 per square meter
CONCRETE SIDEWALK, REINFORCED,__ MM THICK	$ 0.77 per square meter
BITUMINOUS CONCRETE ISLAND,___ MM THICK	$ 0.77 per square meter
WHITE CONCRETE ISLAND,___ MM THICK	$ 0.77 per square meter
CONCRETE ISLAND,___ MM THICK	$ 0.77 per square meter
EPOXY WATERPROOFING SEAL COAT	$ 0.77 per square meter
SAW CUT GROOVED DECK SURFACE	$ 0.08 per square meter
FOUNDATION EXCAVATION	$ 0.42 per cubic meter
BRIDGE EXCAVATION	$ 0.42 per cubic meter
CONCRETE DECK OVERLAY PROTECTIVE SYSTEM, TYPE LATEX MODIFIED CONCRETE	$ 4.20 per cubic meter
CONCRETE DECK OVERLAY PROTECTIVE SYSTEM, TYPE SILICA FUME CONCRETE	$ 4.20 per cubic meter

Note: When calculating the cost of measurement, pay quantities are rounded off to the nearest whole number.

109.02 Scope of Payment.

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 which 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.

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 Work that is paid on a Force Account basis is performed by forces other than the Contractor's organization, the Contractor shall reach an agreement with such other forces as to the distribution of payments made by the State for such Work. Additional payment therefor 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 which 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 in accordance with 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 Nielsen/DATAQUEST, Inc. of Palo Alto, California.

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 in accordance with 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 prior to 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 FOB).
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 FOB).
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

by payment under the next partial payment. If retainages are 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.

The Contractor may elect to deposit negotiable bonds of the State of New Jersey 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 of New Jersey which is an authorized depository of the State of New Jersey 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 of Transportation 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 in accordance with the terms and conditions of the escrow agreement.

109.09 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. Retainages are 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.

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 in accordance with 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 in accordance with Subsection 109.11. In addition, the provision of Subsection 109.01 shall also govern.

The Resident Engineer may from time to time, prior to 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 prior to 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 retainages 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 retainages, 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 retainages, but the Contractor shall have no claim of any kind for additional compensation as a result of the Engineer's decision to withhold retainages or other monies pending issuance of the proposed Final Certificate.

109.11 Final Payment and Claims.

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.

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.

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.

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 which 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 which 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 Reivew Board, as provided

et seq. The Contractor shall dispose of the material and debris in accordance with 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 megagrams.

Installing 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 a 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.

Ground water 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.

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	MEGAGRAM
RECYCLING OF CONTAMINATED SOIL	MEGAGRAM
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

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 in accordance with 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 relaid 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.

SECTION 202 - 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 within the excavated material, and the construction of rumble strips in the shoulder.

202.02 Classification.

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 0.8 cubic meter in volume and rock in ledge formations which 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.

202.08 Removal of Concrete Base, Concrete Surface Courses, and Joints.

Equipment which involves the use of a ball, weight, or punch shall not be used in the breaking or removal of concrete within 1.5 meters of a transverse joint or within 1 meter of any structure or pavement which 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 overlaying bituminous 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 underlaying 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 in accordance with Subsection 203.09. Payment for the replacement material will be made as provided for in its respective Section.

Joint areas shall be replaced with bituminous-stabilized base course conforming to Section 304. Compaction of the bituminous-stabilized base course shall be in accordance with Subsection 404.16 except that areas not accessible to rollers conforming to Subsection 404.09 shall be compacted by a vibratory drum compactor. The vibratory drum compactors shall be of the self-propelled type, having one or two smooth drums and a minimum centrifugal force of 31 kilonewtons per meter 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.

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.

Broken concrete and any overlaying bituminous 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 0.06 cubic meter. The broken concrete shall not be placed within 600 millimeters of the final subgrade or less than 1 meter above the highest seasonal high ground water table as defined by the NJDEP or within 600 millimeters of any underground utility. Compaction shall be in accordance with Subsection 203.09. If such use is not possible, the broken concrete shall be disposed of in accordance with Subsection 202.12.

202.09 Milling of Bituminous Concrete.

Milling of bituminous concrete consists of the removal of bituminous concrete surface and base courses to the prescribed depth, profile, and cross slope and shall conform to the following:

1. **Equipment.** The milling machine shall be a self-propelled planing, grinding, or cutting machine, with variable operating speeds, capable of removing bituminous concrete 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 6-meter 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.

2. **Construction Requirements.** A test strip of approximately 400 square meters shall be constructed within the proposed limits of milling prior to 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.

Prior to 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 2 000 square meters, 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, in accordance with Subsection 212.07, Subpart A.

The milling equipment shall be operated in such a manner as to produce milled material which passes a 63- millimeter sieve. The area of milling shall be cleared of all debris and power broomed to remove fine particles prior to 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 in accordance with 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 milled areas which are opened to traffic have not been milled to a flush surface by the end of the work day, the longitudinal edges of the milled area exceeding 50 millimeters high shall be sloped and a smooth transition shall be provided at the transverse edges.

Bituminous concrete below the specified level of milling that becomes dislodged or delaminated shall be removed and replaced with bituminous concrete in accordance with Section 404 at no cost to the State.

The surface of the milled area shall be swept clean prior to being opened to traffic and prior to the subsequent construction or resurfacing stage. Sweepings shall be disposed of in accordance with 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 25 millimeters in 60 meters from a line parallel to the center of the traveled way and shall not exceed 10 millimeters in depth. The milling shall provide a skid resistance not less than that of the original surface prior to 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 bituminous concrete is removed to its full depth.

The shoulder areas, where rumble strips are to be constructed, shall be thoroughly cleaned prior to construction. Rumble strips shall not be constructed until the traffic striping is 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 prior to 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 in order to obtain a prior alignment.

202.10 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.

In order 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 in order 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 in accordance with Subsection 202.12 for excess material.

202.11 Partial Wet Excavation.

Partial wet excavation shall be in accordance with 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.

Excess excavated earth may be permitted to be used to widen or flatten slopes of embankment, or to fade embankments into cuts, or used as approved at other locations, or disposed of.

Excess rock excavation may be permitted to be used along slopes adjacent to streams for slope protection in accordance with Subsection 616.07.

Excess broken concrete and bituminous concrete may be permitted to be reused in the construction of embankments in accordance with Subsections 202.04 and 202.08.

Excess material other than earth or rock not reused as specified above shall be recycled or disposed of in accordance with 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 right-of-way and out of sight, during all seasons, of any State highway.

Prior to 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. Written permission of the property owner(s) on whose property the material is to be placed shall be obtained by the Contractor 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.

Regulated waste shall be disposed of in accordance with Subsection 201.10.

COMPENSATION

202.14 Method of Measurement.

Stripping will be measured by the hectare. Roadway excavation of the various kinds will be measured by the cubic meter except roadway excavation, unclassified 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 meter.

Presplitting will be measured by the square meter.

Removal of concrete base or concrete surface course and the removal of only the bituminous concrete overlay will be measured by the square meter.

Joint removal, including adjacent concrete courses, for the width designated will be measured by the square meter. 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 meter.

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 bituminous concrete 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 meter parallel to the edge of the shoulder.

202.15 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
STRIPPING	HECTARE
ROADWAY EXCAVATION, EARTH	CUBIC METER
ROADWAY EXCAVATION, ROCK	CUBIC METER
ROADWAY EXCAVATION, UNCLASSIFIED	CUBIC METER
ROADWAY EXCAVATION, REGULATED WASTE	CUBIC METER
WET EXCAVATION	CUBIC METER
PRESPLITTING	SQUARE METER
REMOVAL OF BITUMINOUS CONCRETE OVERLAY	SQUARE METER
REMOVAL OF CONCRETE BASE COURSE AND CONCRETE SURFACE COURSES	SQUARE METER
JOINT REMOVAL	SQUARE METER
MILLING, ___ MM DEPTH	SQUARE METER
MILLING, ___ MM AVERAGE DEPTH	SQUARE METER
MILLING, ___ MM VARIABLE DEPTH	SQUARE METER
MILLING, VARIABLE DEPTH	SQUARE METER
PROFILE MILLING	SQUARE METER
RUMBLE STRIP	LINEAR METER

Payment for temporary soil erosion and sediment control measures will be made in accordance with Section 212.

Separate payment will not be made for bituminous-stabilized 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

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.

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, prior to 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 prior to 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.

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 Materials	Designation
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

VERTICAL WICK DRAINS	LINEAR METER
PORE PRESSURE MEASURING DEVICES, TYPE___	UNIT
CONTROL STAKES	UNIT
SETTLEMENT PLATFORMS	UNIT
PNEUMATIC-TIRED ROLLING, 45-MEGAGRAM	HOUR

Payment for the removal of unusual obstruction difficulties which have prevented the formation of a satisfactory pattern of vertical drains will be made in accordance with Subsection 104.02.

Payment for removal of unstable material will be made in accordance with Section 202 for unclassified material.

Payment for the refilling of the excavated areas or depressions caused by the rolling operation of the 45-megagram pneumatic-tired roller will be made in accordance with Section 204 for the zone used.

Payment for temporary soil erosion and sediment control measures will be made in accordance with Section 212.

Separate payment will not be made for embankment.

SECTION 204 - BORROW EXCAVATION

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 Sulphate Test (NJDOT A-3)…… 20% maximum, dry.

Unit Weight (ASTM C-29, rodding method)…….. 1200 kg/m^3 maximum, as delivered moisture

Sieve Size	**Percentage by Weight Passing**
50 mm	100
19.0 mm	50 - 100
4.75 mm	5 - 90
300 µm	0 - 55
75 µm	0 - 20

CONSTRUCTION

204.03 Construction Requirements.

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 1:3 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 in accordance with Section 212.

Placement and compaction with borrow excavation shall be in accordance with 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 in accordance with AASHTO T 180, Method D, including the replacement option. The maximum thickness of any layer shall be 300 millimeters, loose measurement. A minimum of two field density tests will be taken in accordance with 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 100 square meters of embankment.

Material which 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 200 millimeters 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 4.5 megagrams. The number of passes of the dynamic compactor per layer shall be in accordance with Subsection 203.09. Blast furnace slag and/or cinders shall not be permitted within 300 millimeters of any concrete structure.

COMPENSATION

204.04 Method of Measurement.

Borrow excavation of the various zones and kinds will be measured by the cubic meter, 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.

Lightweight fill will be measured by the cubic meter.

204.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
BORROW EXCAVATION, ZONE___	CUBIC METER
BORROW EXCAVATION, BRIDGE FOUNDATION	CUBIC METER

206.10 Backfilling.

Backfilling shall be in accordance with 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 21 megapascals from an additional two cylinders cast during placement.

206.11 Excess or Unusable Material.

Excess material shall be used in accordance with Section 203, or, if not required for embankments, the material shall be disposed of in accordance with Subsection 202.12.

Unusable material shall be disposed of in accordance with 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 in order 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 meter.

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 METER
FOUNDATION EXCAVATION	CUBIC METER
BRIDGE EXCAVATION	CUBIC METER
COFFERDAMS	LUMP SUM

Payment for borrow excavation, Zone 3, will be made in accordance with Section 204.

Payment for concrete seals will be made in accordance with 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. Twenty-five 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 in accordance with 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

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 0.4 cubic meters 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.

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 9.5-millimeter sieve and not more than ten percent of which shall pass a 75-micrometer sieve.

Material for bedding for corrugated aluminum alloy culvert pipe shall consist of granular soil with the following gradation:

Sieve Size	Percent
25.0 mm	100
4.75 µm	80 - 100
75 µm	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.

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, in accordance with Subsection 105.09. Test pits shall be backfilled in accordance with 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.

SECTION 212 - 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.

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 which has a knot strength of 0.75 kilonewton and straight break strength of 1.3 kilonewtons.

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 (D50) size in the range of 150 to 225 millimeters 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 200 millimeters 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.

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.

Prior to 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 in accordance with 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 in order to control sediment and provide filtration of water prior to it being released into adjacent streams or other watercourses. Soil being stockpiled shall be placed in well-drained areas no closer than 15 meters from streams, wetlands, floodplains, and other watercourses, unless otherwise directed. The stockpiles shall be seeded and mulched in accordance with 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 in accordance with 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, in accordance with 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.

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 ten working days prior to 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

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.

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 900 millimeters to provide for a 600-millimeter high fence after 300 millimeters of fabric is buried in the existing soil. Sections of fabric shall be overlapped a minimum of 450 millimeters 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 which shall be buried in the soil. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 450 millimeters in the direction of flow.

H. Floating Turbidity Barriers. Floating turbidity barriers, consisting of 0.25-millimeter 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 15 meters from the point of discharge of drainage pipes, or from construction operations affecting the waterways. The barriers shall extend across the entire waterway 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 which shall be buried in the soil. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 450 millimeters in the direction of flow.

J. Dewatering Basin. Dewatering basins shall be constructed within the right-of-way of the Project and outside of any undisturbed wetland area, and areas not affected by roadway construction, as a dewatering containment measure in order to control sediment and provide filtration of water.

The dewatering basins shall be sized by the Contractor 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.

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.

In order 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 100 millimeters thick and 30 meters long where practical, and of sufficient width to serve the intended purpose. The broken stone shall be 65 millimeters 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.

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 in accordance with 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 meter.

Haybale check dams with temporary stone outlets will be measured by the linear meter.

Temporary stone check dams will be measured by the cubic meter.

Temporary slope drains will be measured by the linear meter.

Inlet filters will be measured by the number of each.

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 number of each.

Floating turbidity barriers will be measured by the linear meter.

Temporary stone outlet sediment traps of the various sizes will be measured by the number of each.

Dewatering basins will be measured by the unit.

Construction driveway will be measured by the megagram.

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 meter.

Embankment, temporary erosion control, required for the construction of temporary berms and ditches, will be measured by the cubic meter.

Temporary riprap for ditches and channels will be measured by the cubic meter. Geotextile for ditches and channels will be measured by the square meter.

Haybales required as directed and for maintenance replacement of bales for the various soil erosion and sediment controls will be measured by the number of each.

212.10 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SILT FENCE	LINEAR METER
HEAVY DUTY SILT FENCE	LINEAR METER
HAYBALE CHECK DAM WITH TEMPORARY STONE OUTLET	LINEAR METER
TEMPORARY STONE CHECK DAM	CUBIC METER
TEMPORARY SLOPE DRAIN	LINEAR METER
INLET FILTERS	UNIT
INLET PROTECTION, HAYBALE BARRIERS	UNIT
INLET SEDIMENT TRAPS	UNIT
FLOATING TURBIDITY BARRIER	LINEAR METER
TEMPORARY STONE OUTLET SEDIMENT TRAPS, ___ BY ___ M	UNIT
DEWATERING BASINS	UNIT
CONSTRUCTION DRIVEWAY	MEGAGRAM
ROADWAY EXCAVATION, TEMPORARY EROSION CONTROL	CUBIC METER
EMBANKMENT, TEMPORARY EROSION CONTROL	CUBIC METER
TEMPORARY RIPRAP	CUBIC METER
GEOTEXTILE	SQUARE METER
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 its 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 in accordance with Section 302.

Payment for topsoil stabilization matting will be made in accordance with 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.

Tack Coat:
Cut-back Asphalt, Grades RC-70 or RC-T……..…904.02
Emulsified Asphalt, Grades RS-1, SS-1, or SS-lh…….….904.03
Cationic Emulsified Asphalt, Grades CSS-1 or CSS-1h……..904.03

305.03 Composition of the Mixture.
Bituminous-stabilized base course shall be Mix I-2 and the mixture shall be stone mix.

EQUIPMENT

305.04 Equipment.
The equipment shall be as specified in Subsection 404.04 except that the infrared joint heater will not be required.

CONSTRUCTION

305.05 Weather Limitations.
The limitations shall be as specified in Subsection 404.12.

305.06 Preparation of Subgrade or Base Course.
The preparation of subgrade or base course shall be in accordance with Section 208 or 209, and each shall be checked and approved far enough in advance of spreading the bituminous base mixture to permit one day's paving operations.

305.07 Conditioning of Existing Surface.
The conditioning of the existing surface shall be as specified in Subsection 404.13. When previously constructed layers of the bituminous-stabilized base course become coated with dust, dirt, or other foreign material which would inhibit proper bond to subsequent layers, the layers shall be given an application of tack coat material.

305.08 Transportation and Delivery of Mixture.
The transportation and delivery of the mixture shall be as specified in Subsection 404.14.

305.09 Spreading and Finishing.
The spreading and finishing of the mixture shall be as specified in Subsection 404.15. The base course shall be constructed in layers not more than 75 millimeters compacted thickness except 100-millimeter layers may be constructed in those areas where the total combined thickness of surface course and bituminous-stabilized base is 175 millimeters or greater.

305.10 Compaction and Air Voids.
Compaction and air voids requirements of the base course shall be as specified in Subsections 404.16 and 404.18.

305.11 Surface and Thickness.
The surface will be tested using a Straightedge at 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 10 millimeters. All humps or depressions exceeding 10 millimeters shall be corrected by removing defective work and replacing it with new material.

The thickness requirements shall be as specified in Subsection 404.20.

305.12 Maintenance Under Traffic.

Maintenance shall be in accordance with Subsection 105.19.

COMPENSATION

305.13 Method of Measurement.

Bituminous-stabilized base course will be measured as specified for bituminous concrete surface course in Subsection 404.23.

305.14 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
BITUMINOUS-STABILIZED BASE COURSE, MIX I-2	MEGAGRAM

Payment for tack coat and prime coat will be made in accordance with Section 404.

SECTION 306 - CONCRETE BASE COURSE

306.01 Description.

This work shall consist of the construction of portland cement concrete base course, with or without reinforcement.

MATERIALS

306.02 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

306.03 Equipment.

The equipment shall conform to Subsection 405.03 except a slip-form paver, conforming to the requirements specified below, will be permitted.

CONSTRUCTION

306.04 Construction Requirements.

The surface upon which the concrete base course is to be constructed shall be prepared in accordance with Section 209.

The term "QL" shall also be calculated for the bituminous concrete surface course of each lot independently using the core thickness values for that course and a minimum thickness acceptance testing limit of 32 millimeters. 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 32 millimeters, 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 25 millimeters thick if that mixture is bituminous concrete Mix I-5 and 38 millimeters thick if that mixture is bituminous concrete Mix I-4.

The overlaid or replaced lot is only that material placed up to the specified total thickness of the combined bituminous 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.

404.21 Core Samples.

Upon completion of the bituminous concrete paving, the Contractor shall obtain cores from the finished pavement at random locations as directed, in accordance with this Section and Sections 903 and 990. The Engineer will request the random core locations through the Department's Bureau of Materials.

The cores shall be 150 millimeters in nominal diameter, and 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. Each core shall be identified by number, painted on the side of the sample and accompanied by the appropriated 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 and compacted with patching material. The finished patch shall be at least 6 millimeters above the surrounding pavement surface to allow for additional compaction by traffic.

404.22 Opening to Traffic.

The Resident Engineer will determine when the bituminous surface is to be opened to traffic or construction equipment. Traffic or construction equipment will not be permitted on the bituminous surface until 12 hours after its placement except when approved for maintaining traffic in accordance with Subsection 617.04.

Opening to traffic as provided above shall not relieve responsibility for the work in accordance with Section 107.

COMPENSATION

404.23 Method of Measurement.

Bituminous concrete surface course will be measured by the megagram 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 bituminous 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 in accordance with 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.

The Engineer will compute, from cores of the bituminous concrete mixtures placed on the Project, the average weight per square meter per millimeter of thickness of each of the various types of bituminous concrete mixtures. The computed average weight will be calculated from the average bulk specific gravity on at least ten percent of the drilled cores, but not less than three cores, as determined in accordance with Section 990, NJDOT 19B.

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 average weight as established above, the lot area and the average thickness from lot cores except that where the definite distribution of weight to lots is known, the weight indicated on the weigh tickets will be used in lieu of the computed lot weight. The determination of computed lot weight may require conversion between megagrams and square meters.

When bituminous concrete 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.

Tack coat and prime coat will be measured by the liter in accordance with Subsection 109.01 except that the volume of diluted emulsions will be reduced by 50 percent.

Sealing of cracks in bituminous concrete surface course will be measured by the linear meter.

Treatment of cracks and joints in concrete surface course will be measured by the linear meter.

Sawing and sealing joints and cracks in bituminous concrete overlays will be measured by the linear meter. Sawing joints and cracks in base course will be measured by the linear meter.

Core samples, Bituminous will be measured by the number of each.

Asphalt price adjustment for asphalt cement will be determined on a monthly basis by the following formula:

$$A = (MA - BA) \times MG$$

Where: A = Asphalt Price Adjustment

MA = Monthly Asphalt Price Index
BA = Basic Asphalt Price Index
MG = Megagrams of New Asphalt Cement (see Note)

Note: The weight of asphalt cement eligible for price adjustment will be determined by multiplying the percentage of new asphalt cement in the approved job mix formula by the weight of bituminous concrete.

Asphalt price adjustment for tack coat and prime coat will be determined on a monthly basis by the following formula:

$$A = (B) \times (I) \times (C) \times (M) \times (L)$$

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%
L = Liters 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 median of quotations from suppliers serving the area in which the Project is located, and will be determined by the Department each month. Median is defined as the middle number in a given sequence, or the average of the two middle numbers when the sequence has an even number of numbers.

For that part of the State north of and including Route 195, the asphalt price index will be based on quotations from Coastal, Chevron, and Citgo Materials Company. For that part of the State south of Route 195, the index will be based on quotations from Coastal, Sun, Chevron, and Citgo Materials Company.

The basic asphalt price index will be the most recent monthly asphalt price index prior to receipt of bids.

Should a monthly asphalt price index increase 50 percent or more over the basic asphalt price index, no additional concrete shall be furnished for the Project without written approval from the appropriate Executive Director of Regional Operations.

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.

404.24 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
BITUMINOUS CONCRETE SURFACE COURSE MIX___	MEGAGRAM
SEALING OF CRACKS IN BITUMINOUS SURFACE COURSE	LINEAR METER
TREATMENT OF CRACKS AND JOINTS IN CONCRETE SURFACE COURSE	LINEAR METER
SAWING AND SEALING JOINTS IN BITUMINOUS CONCRETE OVERLAY	LINEAR METER
SAWING JOINTS IN BASE COURSE	LINEAR METER
TACK COAT	LITER
PRIME COAT	LITER
CORE SAMPLES, BITUMINOUS	UNIT
ASPHALT PRICE ADJUSTMENT	LUMP SUM

Payment reductions due to nonconformance to job mix formula requirements will be made in accordance with 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 in accordance with Table 903-7 and will be applied to the in-place lot weight determined from weigh tickets.

Payment reductions due to nonconformance to air voids requirements will be made in accordance with Subsection 404.18 and will be applied to the lot weight determined in accordance with Subsection 404.23.

Payment reductions due to nonconformance to thickness requirements will be made in accordance with Table 404-5 and will be applied to the lot weight determined in accordance with Subsection 404.23.

Payment reductions due to nonconformance to surface requirements for new construction, reconstruction, or dualization projects will be in accordance with Table 404-3

In lieu 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 prior to 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.

e. As an alternative, at either a one-stop or two-stop batching plant, when the mixing water is less than 38 ºC, 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.

f. At either a one-stop or two-stop batching plant, when the temperature of the mixing water exceeds 38 ºC, the loading sequence shall be the mixing water, then the aggregates, and then the cement.

g. 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.

Prior to 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 30 ºC 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.

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 which 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 42.6 kilograms 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 prior to 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

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 3.6-meter intervals, and result in a uniformly grooved surface finish.

Grooves shall be rectangular in shape and conform to the following dimensions:

Width…….2.5 to 4 millimeters
Depth……..6 to 10 millimeters

Grooves shall be placed at 38 ± 1.5 millimeters center-to-center of groove. This spacing dimension may be increased up to 75 millimeters 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 prior to actual grooving and shall be approved. The cutting of grooves over an area which 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 75 millimeters in width.

Grooves shall terminate within the following limits:

Table 405-3 Saw Cut Grooved Area Limits

Location	Closest Allowable Distance	Farthest Allowable Distance
Drainage Structure	300 mm	400 mm
Vertical Face (curb or parapet), or Face of Railing (no curb)	300 mm	400 mm
Joint System	150 mm	825 mm (see Note)

Note: This distance is a variable which is dependent upon equipment size, in this case, predicated on a 600-millimeter 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 225 millimeters tolerance.

A plan of action shall be submitted for approval, seven days prior to 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.

Prior to 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.

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 6 millimeters from the specified thickness.

Conformance to thickness requirements will be determined based on the following:

1. **Procedure.** A lot consists of approximately 12 000 square meters 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 in accordance with 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 13 millimeters, the lot may be required to be removed and replaced at no cost to the State.

$$\text{Percent Reduction} = \frac{300 \times \text{Specified Thickness - Average Thickness}}{\text{Specified Thickness}}$$

    b. When more than two individual cores are deficient by more than 6 millimeters, 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 meter.

Joint ties will be measured by the number of each.

Sealing of cracks and joints in concrete surface course will be measured by the linear meter.

Core samples, Concrete will be measured by the number of each.

Transverse concrete grooving will be measured by the square meter 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 meter of surface area actually grooved.

405.25 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CONCRETE SURFACE COURSE,___ MM THICK	SQUARE METER
CONCRETE SURFACE COURSE, REINFORCED, ___ MM THICK	SQUARE METER
BRIDGE APPROACH SLABS,___ MM THICK	SQUARE METER
BRIDGE APPROACH TRANSITION SLABS, ___ MM AVERAGE THICKNESS	SQUARE METER
TRANSVERSE EXPANSION JOINT, TYPE___	LINEAR METER
LONGITUDINAL JOINT TIES	UNIT
TRANSVERSE JOINT TIES	UNIT
SEALING OF CRACKS AND JOINTS IN CONCRETE SURFACE COURSE	LINEAR METER
CORE SAMPLES,CONCRETE	UNIT
TRANSVERSE CONCRETE GROOVING	SQUARE METER
SAW CUT GROOVED BRIDGE APPROACH AND TRANSITION SLABS	SQUARE METER

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.

Payment reductions due to nonconformance to surface requirements will be made in accordance with Table 405-2 and will be applied to the lot quantity as determined in accordance with Subsection 405.15, Subpart B.

Payment reductions due to the average thickness being less than the specified thickness will be made in accordance with Subheading 2.a. of the second paragraph of Subsection 405.23, and will be applied to the lot area as determined in accordance with Subheading 1 of the second paragraph of Subsection 405.23.

Payment reductions due to more than two individual cores being deficient by more than 6 millimeters will be made in accordance with Subheading 2.b. of the second paragraph of Subsection 405.23, and will be applied to the lot area as determined in accordance with Subheading 1 of the second paragraph of Subsection 405.23.

Note: All payment reductions made in accordance with the above are cumulative.

Payment for the preparation of the underlayer will be made in accordance with Section 209.

DIVISION 500 - BRIDGES AND STRUCTURES

SECTION 501 - CONCRETE STRUCTURES

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. Also, this work shall 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 1 meter. 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, apron 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 culverts and that are not specifically covered in the Plans and these Specifications, shall conform to the AASHTO Standard Specifications for Highway Bridges, ACI Manual of Concrete Practice, and the PCI Manual MNL-116.

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, as an alternate to the two-course construction, the Contractor may construct "Concrete in Superstructure, Deck Slabs with Corrosion Inhibitor Admixture" as a full depth deck slab. If this alternate is selected, the full depth deck slab shall be constructed to the same minimum thickness, as indicated in the Plans, 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 in the Plans and Specifications shall conform to the AASHTO Standard Specifications for Highway Bridges.

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	901.16
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
Strip Seal Expansion Dam	908.05
Epoxy Bonding Coat	912.11
Epoxy Waterproofing Seal Coat	912.12
Reinforcement Steel for Structures	915.01
Prestressing Reinforcement	915.02
Bolts and Bolting Materials	917.01
Permanent Steel Bridge Deck Forms	917.04
Structural Steel	917.10
Bearing Pads	919.02
Waterproofing	919.05
Latex Emulsion Admixture	919.10
Silica Fume Admixture	919.10
Waterstops	919.16

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.

Certification shall be furnished in accordance with Subsection 106.04 that the epoxy resin system, that is to be 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, in accordance with 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 615M-96a, Grade 420. Welded deformed steel wire fabric conforming to AASHTO M 221M (ASTM A 497) and having a diameter of at least 9.5 millimeters 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 19.1-millimeter diameter high tensile strength steel bars conforming to AASHTO M 275M (ASTM A 722) or 13-millimeter, Grade 1860 polystrands conforming to AASHTO M 203M (ASTM A 416). No splices will be allowed in the 13-millimeter diameter polystrands, if used. Bars shall be galvanized in accordance with 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 in accordance with AASHTO M 111. Anchorages and end fittings for the 13-millimeter 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.

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, the use of chemical admixtures shall be in accordance with the manufacturer's product specifications. In accordance with 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 that is to be used shall be a dosage rate that is in accordance with the manufacturer's product specifications.

EQUIPMENT

501.04 Equipment.

Equipment shall be in accordance with Subsection 405.03.

Equipment for the second course deck slab construction shall be in accordance with 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 in accordance with 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 prior to 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 30 meters, 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 2.0 megapascals to enssure 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 in accordance with Subsection 105.04.

Prior to fabrication of precast concrete culverts, the Contractor shall submit complete working drawings and erection plans in accordance with 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.

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.

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 13-millimeter 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 25 millimeters 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.** Prior to 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 for use 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 1 meter 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 in accordance with 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 2.5 kilopascals 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 250 megapascals.

      Deflection under the weight of the forms, the plastic concrete, and reinforcement shall not exceed 55.6 percent of the form span or 15 millimeters, whichever is less, but in no case shall this loading be less than 6 kilopascals 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 50 millimeters measured parallel to the form flutes.

      Physical design properties shall be computed in accordance with 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 25-millimeter 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 in accordance with 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 in order to maintain required concrete cover of reinforcement steel at all locations.

b. Construction. All forms shall be installed in accordance with 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 25 millimeters 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 in accordance with the ANSI/AASHTO/AWS D1.5 Bridge Welding Code pertaining to fillet welds, except that 3-millimeter 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 6-millimeter weep holes shall be field drilled at not less than 300 millimeters 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.

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 in order 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, in accordance with 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 in order 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 as are required for the safe and convenient conduct of the Resident Engineer's inspection procedures shall be provided.

e. Quantities. Additional reinforcement steel required by the use of the permanent steel forms shall be provided without additional compensation.

501.08 Reinforcement Steel.

A. Order Lists. Before ordering material, working drawings, order lists, and bending diagrams shall be submitted in accordance with 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 prior to 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 in accordance with AASHTO M 284/M 284M.

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 in accordance with the requirements of ASTM A780. 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 in accordance with 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 540 to 650 ºC, 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 225 millimeters 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 300 millimeters 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 200 mm and less than 600 mm. specified cover.	± 10 mm but cover shall not be reduced by more than 10 percent of the
b.	where "d" is greater than or equal to 600 mm. than 10 percent of the specified cover.	± 15 mm but cover shall not be reduced by more
Note:	"d" equals specified effective design depth.	
2.	Longitudinal location of bends and ends of bars.	± 50 mm except at discontinuous ends of members, the tolerance shall be ± 15 mm.
3.	Bar spacing, except where inserts etc. might require some shifting of bars, where spacing is:	
a.	equal to or less than 300 mm.	± 10 mm
b.	greater than 300 mm.	± 15 mm
4.	Deck slabs, cover for reinforcement.	+ 6 mm, - 3 mm

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 in accordance with the requirements of AASHTO M 232.

Mechanical connectors used for galvanized bar reinforcement shall be galvanized in accordance with the requirements of AASHTO M 232, prior to installation.

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/M 284M. 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, in accordance with 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 construction plans, 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. In accordance with ASTM A 767/A 767M, the average coating weight of a minimum of three tests shall be 0.484 kilogram per square meter.

Prior to 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 prior to 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 563M.

Material galvanized in accordance with 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 prior to 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/A 767M 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.

In order 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 2 580 square millimeters.

Field repair will be allowed only when the total number of repairable damaged areas in any 3-meter 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 2 580 square millimeters will be rejected.

The galvanized coating shall be repaired in accordance with 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 100 micrometers shall be achieved.

501.09 Handling, Measuring, and Batching Materials.

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.

At least 30 days prior to 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 10 ºC or more than 32 ºC. When the ambient temperature reaches 24 ºC, 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 29 ºC, immediate steps shall be taken to cool either the mixing water or the aggregates, or both, in accordance with the plan of action. In no case shall concrete be placed when its temperature in the plastic state at the completion of mixing exceeds 32 ºC.

Cold and hot weather concreting shall be in accordance with the following:

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 4 and 27 ºC.

   In accordance with Subsection 101.03, cold weather conditions shall be determined by review of forecasted temperatures.

2. **Hot Weather Concreting.** When the ambient temperature reaches 24 ºC, 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 in accordance with 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.

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 prior to 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 in order 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 which may have formed on concrete previously placed or 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:

1. **Chutes and Troughs.** Concrete shall not be dumped or dropped for a distance greater than 1.5 meters, 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.

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 8 cubic meters.

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.

   When a tremie is used, it shall consist of a tube not less than 250 millimeters 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.

   When concrete is placed with a bottom-dump bucket, the bucket shall have a capacity of not less than 0.4 cubic meters 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 seal placed shall not be lower than 150 millimeters below the theoretical elevation, nor shall any individual peaks

project more than 225 millimeters 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 225-millimeter tolerance shall be cut down to within the permissible height above the theoretical top of seal.

At least 30 calendar days prior to 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.

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.

5. **Deck Slabs.** At least 20 calendar days prior to 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 3 meters 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 in accordance with 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 23 cubic meters per hour for deck slabs of 140 cubic meters or less. When the deck slab is in excess of 140 cubic meters of concrete, the minimum rate of placement shall be approximately 30 cubic meters 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 150 millimeters or less in thickness shall be 15 cubic meters per hour.

Unless provisions are made by the Contractor to reduce the atmospheric evaporation rate below 0.75 kilograms per square meter per hour, placement of the concrete shall not begin. Additionally, placement of the concrete shall be discontinued when the air temperature begins to exceed 30 ºC or when the evaporation rate begins to exceed 0.75 kilograms per square meter per hour. The evaporation rate will be as determined with the use of 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 0.75 kilogram per square meter per hour. If fog misting is used, the fog misting equipment shall be capable of delivering 8 to 11 liters of water per minute at 13 megapascals to 17 megapascals using a 40-degree to 50-degree wide-angle nozzle.. The fog nozzle shall be held 1.8 meters 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 prior to 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 prior to 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.

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 in order 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 65 millimeters 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.

Prior to 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 prior to 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 3 meters 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 750 millimeters wide, but it need not apply to safety curbs, 750 millimeters 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.

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 in accordance with 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.

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 15 millimeters in diameter and 6 millimeters 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 3 meters 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 construction plans.

Parapet joints shall be saw cut to the width and height as shown on the construction plans and shall be saw cut within four hours of the slip-forming operation.

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. In order to provide sufficient mortar for such joints, a layer of portland cement mortar, 25 to 50 millimeters 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 25 millimeters past the troweled "V" notch groove. Saw cutting shall be performed within four hours of slip-forming, to prevent shrinkage cracking.

9. Expansion Joints.

a. 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.

b. Filled Joints. Expansion joints shall be constructed similarly to open joints.

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 975 grams per square meter, 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 as recommended by the manufacturer shall be observed. Joints shall be cleaned and shall be free of oil, curing compound and all other foreign materials immediately prior to 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 the use of 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.

c. Steel Joints. The plates, angles or other structural shapes shall be shaped at the working to conform to the section of the concrete slab. Fabrication and painting shall conform to Section 503. When specified, the material shall be galvanized in lieu 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 ambient temperatures.

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 in accordance with the manufacturer's recommendations. In the case 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.

e. Reinforced Elastomeric Expansion Dam. The expansion dam shall be bolted to the bridge deck, 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 in accordance with 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.

Expansion type anchor bolts are not permitted, but threaded anchor bolts may be used by coring and grouting to vertical surfaces and to the bridge deck on rehabilitation projects. Stainless steel,

automatic, end-welded, threaded studs, or stainless steel anchor bolts that have been placed before the concrete is placed may be used to secure the expansion dam 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 prior to placing sealant.

Before installation, the expansion dam 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 immediately removed.

Upon completion of installation, all anchor bolts shall be checked andretightened 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 dam shall not be closer than 3 millimeters or more than 6 millimeters from the top of the finished 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.

f. Strip Seal Expansion Dam, Bolt Down Type. The expansion dam 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 all information pertinent to the installation procedure, shall be submitted in accordance with 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.

Prior to fabrication, the Contractor shall verify all existing or as built 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 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 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 1.4 meters 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 3 millimeters or more than 6 millimeters 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.

No expansion type anchor bolts are permitted but threaded anchor bolts may be used by coring and grouting to vertical surfaces and to the bridge deck on rehabilitation projects. 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 studs 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 prior to placing sealant.

Before installation, the expansion dam 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 (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 installation, all anchor bolts shall be checked andretightened to the proper torque.

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.

When the strip seal is installed in an anchor block, two installation devices shall be supplied to the State.

g. 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.

Prior to fabrication, detailed working drawings of the strip seal expansion joint systems shall be submitted for approval in accordance with 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 -23 to 43º C in order 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 in accordance with the temperature erection chart and attached to the superstructure prior to 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 as outlined in ASTM A 780. Closed cell foam backer rod shall be placed in the seal cavity of the steel retainer rails by the Contractor prior to 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 prior to 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.

10. Anchor Bolts.

a. Bearings. Anchor bolts in abutments and piers for bearings shall either be cast-in-place, cast in 75-millimeter 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. 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 25 millimeters 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 in accordance with 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 unless drilled and grouted (e.g., adhesive type anchor bolts) or otherwise approved for use by the Engineer 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 in accordance with 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 28 megapascals unless otherwise indicated on the construction plans.

Shop drawings for adhesive anchoring systems shall be submitted in accordance with 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 in accordance with 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 3 millimeters larger, than the bolt diameter unless otherwise instructed by manufacturers 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 100-millimeter 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 in order 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 prior to 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 structural design requirements for precast reinforced concrete box culvert sections including headwalls, cutoff walls, aprons, wingwalls, and footings shall be in accordance with Section 3 of the NJDOT Design Manual for Bridges and Structures.

Precast concrete units shall be designed with a minimum design compressive strength of $f_c' = 35$ megapascals.

The cover of concrete over the circumferential reinforcement shall be 40 millimeters except on the top slab where it shall be 50 millimeters.

Reinforcement bars shall be tied at all intersections except where the spacing is less than 300 millimeters in each direction in which case alternate intersections shall be tied.

The wall thickness for the precast culvert shall be a minimum of 205 millimeters. The top and bottom slab thickness shall be a minimum of 255 millimeters.

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 600 millimeters, the top mat of reinforcement in the roof slab shall be epoxy coated and shall be tied with epoxy coated ties.

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 in accordance with 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 38-millimeter 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 in accordance with Subsection 105.04 and shall be signed and sealed by a Professional Engineer licensed in the State.

b. Fabrication Requirements. The fabricator of precast concrete culvert units shall be PCI certified in the applicable category and be pre-approved prior to award of Contract by the Department. The fabricator shall provide an Engineer's office in accordance with Subsection 502.03, Supbart 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 10 °C

and shall be delayed for a period of three hours when the air temperature is 10 °C 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 32 and 66 ºC 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 28 megapascals 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 6.9 kilopascals to 3.5 megapascals less than the class design strength for the specified concrete class, (i.e. for Class P concrete, this range will be between 35 megapascals to 38 megapascals.). The pay adjustment will be in accordance with Section 914. Concrete will be rejected if the averaged single value is greater than an amount that is 3.5 megapascals 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 in accordance with 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 35 megapascals. 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 35 megapascals.

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 600

millimeters. It shall extend 300 millimeters on each side of the precast box culvert. The coarse aggregate layer shall be compacted in accordance with Subsection 203.09.

Prior to backfilling, a 600-millimeter wide strip of filter fabric shall be placed over the top and side transverse joints. The filter fabric shall be in accordance with Subsection 919.06.

If precast concrete culvert units are used in parallel for multicell installations, the parallel units shall be placed a maximum of 150 millimeters apart, and the 150-millimeter space between the units shall be filled with nonshrink grout. As an alternate, the 150-millimeter space may be filled and compacted with Zone 2 or crushed stone conforming to coarse aggregate size No. 57. If crushed stone is used, an 800-millimeter 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 38-millimeter diameter preformed hole located in each corner of the box units (a minimum total of four longitudinal ties) and stressed to a tension of 133 kilonewtons 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 25 millimeters 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 is as follows

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, prior to use. The surface shall be scrubbed with wire broom and shall be kept wet until new concrete is placed. Immediately prior to 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 0.30 liter per square meter 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 in accordance with 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 Subheading 5 of the third paragraph of Subsection 501.12. The following criteria shall be followed in the use of the Corrosion Inhibitor Admixture:

a. At least 45 calendar days prior to 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 completed applicable product testing as stated below and results of a Trial Concrete Mix Program.

The design mix shall incorporate the following conditions:

(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 Subsection 914.05 Table 914.03. In accordance with the manufacturer's product specifications, chemical admixtures, in accordance with Subsection 905.02, may be added to the concrete mix. The corrosion inhibitor admixture shall be thoroughly mixed before chemical admixtures are added.

The Trial Concrete Mix Program shall incorporate the following conditions:

(1). To demonstrate the workability of the concrete containing the corrosion inhibitor admixture, a minimum of 4.6 cubic meters of the concrete mix shall be placed at the Project site in a location that is acceptable to the Engineer. This location shall not be a structural element that is to remain in place.

(2). The provisions of Section 501 or Section 502 concerning placement, curing and finishing of the concrete shall be followed.

(3). 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 design mix and trial concrete mix program are accepted by the Engineer. A representative from the admixture supplier shall be present during the initiation of the trial concrete mix program and during the actual initial placement of the concrete.

c. The following corrosion inhibitor admixture products may be used:

(1). The use of the calcium nitrite admixture shall conform to the following quality control conditions.

(a). 30 +/- 2 percent of calcium nitrite shall be contained in the admixture. A high range water reducing chemical admixture shall be included in the design mix.

(b). The calcium nitrite shall be added at a rate of 14.83 liters per cubic meter of concrete, as per the manufacturer's recommendations.

(c). As part of the design mix approval, completed results of the testing outlined in Tests M4 and M5 of Section 990 shall be submitted.

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 914 millimeters 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 in strict accordance with 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.

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. In order 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 back of abutments have been placed up to 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.

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 25 millimeters 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 in accordance with 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.

The surface of the deck slab shall be finished in accordance with 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:

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 15 millimeters long. There shall be approximately 65000 blades per square meter.

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 fullwidth 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 300 millimeters of curbs.

2. **Saw Cutting.** Saw cutting will be permitted when the deck concrete has attained a strength of at least 28 megapascals 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 prior to 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 28 megapascals 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 prior to 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 3.6-meter intervals, yielding a uniformly grooved surface finish. Grooves shall be rectangular in shape and shall conform to the following dimensions:

   Width.....2.5 to 4 mm
   Depth.....6 to 10 mm

   Grooves shall be spaced at 40 ± 2 millimeters center-to-center of groove. This spacing dimension may be increased up to 75 millimeters at the end of each consecutive, multi-bladed, saw cut pass as necessary to accommodate the distance limits required at the joint system in accordance with Table 501-1 below. The required dimension shall be determined prior to 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 75 millimeters of width.

   Grooves shall terminate within the limits prescribed in Table 501-1 below.

Table 501-1 Saw Cut Grooved Area Limits

Location	Closest Allowable Distance	Farthest Allowable Distance
Drainage Structure	300 mm	380 mm
Vertical Face (curb or parapet), or Face of Railing (no curb)	300 mm	380 mm
Joint System	150 mm	(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 225-millimeter tolerance up to a maximum distance of 825 millimeters.

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.

Prior to 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.

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 3 millimeters in 3 meters.

Deck slabs which are required to be struck and finished with a self-propelled finishing machine shall be so constructed that, when tested in accordance with Subpart C below, the measured length of lot exceeding the specified 3 millimeters in 3 meters 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 3-millimeter 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 3 millimeters tolerance shall not exceed 13.9 percent as specified in Subpart E, Table 501-2, Subschedule B2 below.

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 the use of 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 1.5-meter 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.

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 meters 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 3 millimeters in 3 meters, 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 915 millimeters 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 in accordance with 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.

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 3 millimeters in 3 meters 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 3 millimeters in 3 meters surface tolerance.

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

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 6 millimeters in 3 meters.

501.17 Curing and Protecting Concrete.

A. Curing Concrete Under Normal Conditions. Concrete decks, curbs, and tops of sidewalks for both one-course and two-course concrete deck slab construction shall be cured in accordance with Subheading 4 of the sixth paragraph of Subsection 405.14 with the exception that the minimum wet cure period shall not

be less than seven calendar days. In accordance with the provisions of Subheading 3 of the sixth paragraph of Subsection 405.14, the wet burlap shall be covered with white polyethylene sheeting. In two-course deck slab construction, the Contractor shall prepare the entire deck surface area in accordance with Subheading 6 of Subpart C of Subsection 518.06 prior to placing the second course.

Other concrete structures and concrete surfaces to receive an epoxy coating, rubbed finish or to be covered with another material shall be cured in accordance with Subheadings 2, 3, 4, and 5 of the sixth paragraph of Subsection 405.14.

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 in accordance with 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 the use of 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 4 ºC, 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 4 ºC, 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 16 ºC for a period of seven calendar days after placing and then, at a temperature not lower than 4 ºC 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 6 ºC per 12-hour period.

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 21 plus 6 or minus 11 ºC.

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 21 plus 6 or minus 11 ºC. 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 6 ºC per hour. Maximum concrete temperatures shall not be greater than 38 ºC.

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.

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 in accordance with Subsection 501.14. Immediately prior to 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 which are open, but which 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 4 ºC.

   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 1 liter per square meter and shall be allowed to cure thoroughly before the subsequent coats of hot bitumen are applied.

Not less than 1 liter per square meter shall be used for each coating or between layers of fabric on horizontal surfaces, and not less than 1.5 liters per square meter 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 121 ºC or more than 163 ºC and, for tar, shall be not less than 93 ºC or more than 121 ºC.

At the point where waterproofing begins and upon the prime coat, a section, 50 millimeters 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 50 millimeters of this strip of fabric and the adjoining surface area equal to 50 millimeters 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 50 millimeters. Side laps shall be not less than 50 millimeters and end laps not less than 300 millimeters.

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.

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 4 to 29 ºC 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 250 micrometers. 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 600 millimeters of fill and where bituminous concrete 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 prior to 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 0.5 liters per square meter. The sealer shall be mixed and applied in strict accordance with 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 50 millimeters 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 3 kilograms per square meter 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 bituminous concrete 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.

Cast stone lettering panels shall be erected in place. The finished product shall conform to Federal Specification SS-S-721C. 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.

Prior to 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 the use of 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 prior to 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 2 millimeters above the adjacent surfaces.

501.24 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 in accordance with 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 28 megapascals 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 prior to 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.

Concrete seal in cofferdams will be measured by the cubic meter.

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 in accordance with 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 meter along the centerline including the vertical face of curbs and tops of sidewalks and brush curbs.

Rock anchors will be measured by the linear meter.

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 meter 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 meter.

Pressure injection of concrete cracks will be measured by the linear meter.

501.26 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CONCRETE IN STRUCTURES, CULVERTS	CUBIC METER
CONCRETE IN STRUCTURES, FOOTINGS	CUBIC METER
CONCRETE IN STRUCTURES, RETAINING WALLS	CUBIC METER
CONCRETE IN SUBSTRUCTURES, ABUTMENT WALLS	CUBIC METER
CONCRETE IN SUBSTRUCTURES, PIER COLUMNS AND CAPS	CUBIC METER
CONCRETE IN SUBSTRUCTURES, PIER SHAFTS	CUBIC METER
CONCRETE IN SUPERSTRUCTURE, DECK SLABS	CUBIC METER
CONCRETE IN SUPERSTRUCTURE, SIDEWALKS	CUBIC METER
CONCRETE IN SUPERSTRUCTURE, PARAPETS	LINEAR METER
CONCRETE SEAL IN COFFERDAMS	CUBIC METER
REINFORCEMENT STEEL IN STRUCTURES	KILOGRAM
REINFORCEMENT STEEL IN STRUCTURES, EPOXY COATED	KILOGRAM
EPOXY WATERPROOFING SEAL COAT	SQUARE METER
WATERPROOFING	SQUARE METER
___ BY ___ MM PREFORMED ELASTOMERIC JOINT SEALER	LINEAR METER
___ BY ___ MM REINFORCED ELASTOMERIC EXPANSION DAM	LINEAR METER
STRIP SEAL EXPANSION DAM	LINEAR METER
ROCK ANCHORS	LINEAR METER

SAW CUT GROOVED DECK SURFACE	SQUARE METER
REINFORCED CONCRETE BOX CULVERT, PRECAST	LINEAR METER
PRESSURE INJECTION, CONCRETE CRACKS	LINEAR METER
REINFORCEMENT STEEL IN STRUCTURES, GALVANIZED	KILOGRAM
CONCRETE IN SUPERSTRUCTURE, DECK SLABS WITH CORROSION INHIBITOR ADMIXTURE	CUBIC METER

Payment reductions due to nonconformance with surface requirements will be made in accordance with 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 in accordance with Subsection 914.02, Subpart E and will be applied to the lot volume for concrete in deck slabs.

Note: All payment reductions or adjustments made in accordance with the above are cumulative.

Payment adjustments for strength will be made in accordance with 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 in accordance with 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 prior to 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

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 Division II, Section 10 of the AASHTO Standard Specifications for Highway Bridges except as herein amended.

Materials, test methods, methods of manufacture, or any other item not specifically covered in the Plans and Specifications shall be in accordance with 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, in accordance with 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.....912.12
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.

Prior to 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 1.5 millimeters.

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 non-petroleum based.

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 prior to award of Contract. This certification shall be in accordance with 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 prior to 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 at the prestressing plant for the exclusive use of the Engineer. The office shall have a minimum area of 20 square meters. It shall be adequately heated and cooled to maintain a temperature between 20 and 27 ºC. The doors and windows shall be equipped with adequate locks, and the keys shall be in the possession of the Engineer. The cost for telephone 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.
4. One plan table.

CONSTRUCTION

502.04 Working Drawings.

Working drawings shall be furnished in accordance with 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 prior to 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 prior to 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 15 working days prior to the actual production placement of concrete and 15 working days prior to 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 in accordance with 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 in accordance with the contract documents shall be subject to rejection.

A permanent identification marking 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 ,spacings not to exceed 3 meters.

Horizontal and vertical spacers shall be provided, if required, to hold the wires in place in the enclosures.

All reinforcement including prestressing reinforcement, reinforcing bars, and welded wire fabric shall be free of frost, loose rust, grease, dirt, oil, paint mill scale, corrosion, 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 prior to installing the prestressing reinforcement. Enclosures shall be strong enough to maintain their shapes under such forces that come upon them. They shall be 6 millimeters 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 13 millimeters, minus 6 millimeters.
2. Spacing of Reinforcement, excluding stirrups: Plus or minus 25 millimeters except where inserts, etc., might require some shifting of the bars.
3. Spacing of Stirrup Reinforcement:

Stirrup Spacing (mm)	**Tolerance (mm)**
Spacing ≤ 150	Plus or minus 25
150 < Spacing ≤ 600	Plus or minus 50

4. Projection above top of beams: Plus or minus 13 millimeters.

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.

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, prior to 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 in accordance with 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.

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 28 megapascals for Class P, 31 megapascals for Class P-1, and 34 megapascals 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 prior to 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 125 millimeters 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 17.5 megapascals 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 in accordance with 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 in accordance with 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 10 ºC or lower and shall be delayed for a period of three hours when the air temperature is 10 ºC 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 32 and 65 ºC for a period of 12 hours.

When the ambient air temperature is below 10 ºC, 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 10 and 21 ºC until the end of the waiting period.

When the ambient air temperature is above 38 ºC, 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 28 megapascals for Class P, 31 megapascals for Class P-1, and 34 megapascals 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 28 megapascals for Class P, 31 megapascals for Class P-1, and 34 megapascals 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 in accordance with 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.

502.13 Grouting of Bonded Steel.

Grouting shall conform to Division II, Section 10 of the 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 rod bars or 13-millimeter diameter, 1 860-megapascal strands conforming to Subsection 917.11. If used, no splices will be allowed in the 13-millimeter diameter strands. Anchorage details and design calculations signed and sealed by a Professional Engineer licensed in the State of New Jersey shall be submitted to the Engineer for approval. Transverse ties shall be installed through 75 millimeter 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 construction plans. The 13 millimeter diameter tie strands, if used, shall be tensioned to the force indicated on the construction 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 25 millimeters 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.) prior to 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 prior to 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 6 millimeters below the keyway bottom. No further work shall be done to the keyway prior to the Engineer's inspection and approval of the sealing operations. The ends of the keyway shall also be sealed to prevent grout loss.

Immediately prior to placing grout, the keyway surfaces shall be thoroughly wetted with clear water. Nopuddling 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 5 and 30 ºC. When ambient temperature is expected to fall below 5 ºC, measures shall

be provided to maintain the concrete surface temperature between 5 and 30 ºC. The Contractor shall supply and place suitable curing blankets over the grout after placement. The blankets shall be placed as soon as possible after the grout has been finished but no later than one hour after grout placement. The curing blankets shall remain on the grouted keyways for a minimum of 48 hours. Curing blankets shall be in accordance with 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 prior to being placed in storage.

Units shall be surface dry prior to removal from beds when air temperatures are below 5 ºC. When the air temperature is below 0 ºC, thermal blankets shall be applied to the beams, and the concrete surface temperature shall be maintained above 0 ºC.

Portions of prestressed concrete beams as delineated on the construction 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 in strict accordance with 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 28 ºC.

The Engineer shall be given two working days notice prior to 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 prior to 28 days following casting, the additional test cylinders must attain a strength of at least 1.4 megapascals 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 prior to the start of erection, prior to 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 prior to erection unless otherwise approved.

Anchor bolts for masonry plates of structural steel bearings shall be set in accordance with 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 meter.

502.17 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
PRETENSIONED PRESTRESSED CONCRETE BEAMS, ___ MM	LINEAR METER
PRESTRESSED CONCRETE BOX BEAMS, (TYPE___), ___ BY ___ MM	LINEAR METER
PRESTRESSED CONCRETE SLAB BEAMS, (TYPE___), ___ BY ___ MM	LINEAR METER

Payment for cast-in-place concrete and reinforcement steel for diaphragms will be made in accordance with Section 501.

Payment adjustments for strength will be made in accordance with 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.

SECTION 503 - STEEL STRUCTURES

503.01 Description.

This work shall consist of the furnishing, fabrication, erection and painting of bridges, structures, and associated elements which are composed of structural steel and miscellaneous metals.

Materials and construction operations not specifically covered in the Plans and Specifications shall be in accordance with Division II of the AASHTO Standard Specifications for Highway Bridges.

MATERIALS

503.02 Materials.

Materials shall conform to the following Subsections:

Bearing and Expansion Plates.....911.02
Paint.....912.01

Inorganic Zinc Coating System.....912.24
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

Steel bridge member components, designated "T", shall conform to the toughness requirements specified in Subsection 917.10.

In the manufacture of High Load Multi-Rotational Bearing assemblies, the following shall apply:

1. **Steel.** Steel that is to be used in the bearing assemblies shall conform to AASHTO M 270/M 270M, Grades 250, 345, or 345W, except for steel that is used for guide bars and shear restriction pins and sleeves. The guide bars and shear restriction mechanisms shall be in accordance with the manufacturer's specifications and as approved by the Engineer.
2. **Elastomeric Disc.** For the following two type bearing assemblies, the elastomeric disc element shall conform to the following:
   a. **Pot Bearings.** The elastomeric disc shall conform, as applicable, to AASHTO Division II, Section 18. 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, conforming to AASHTO Division II Section 18, shall be used.
3. **Sliding Surfaces.** PTFE sliding surfaces shall conform to the material requirements of AASHTO Section 18.8 Division II. 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. Use heat cured, high temperature epoxy capable of withstanding temperatures of -217 ºC to +260 ºC shall be used when bonding the PTFE to its steel substrate. This shall conform to AASHTO Division II, Section 18 requirements.
4. **Sealing Rings.** The sealing rings shall be of metal and shall conform to the following requirements:
   a. Flat brass rings, ASTM B36 half hard.
   b. Round cross-section wings, Federal Specifications QQB626, Composition 22, half hard.
5. **Bronze Elements.** Bronze elements shall be in conformance with AASHTO Section 18.6.1, Division II.
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 2 millimeters.
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.

In the manufacture of Seismic Isolation Bearings assemblies, 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 (70 ºC for seven days)
Maximum permissible change in tensile strength: -25percent
Maximum permissible change in ultimate elongation:25 percent
Maximum permissible change in durometer hardness:+10 points

(2) Compression Set.
ASTM D 395 Method B (70 ºC for 22 hours)
Maximum permissible set: 25percent

(3) Low Temperature Properties.
ASTM D 2137 Method A (Brittleness Test at -25 ºC): no failure
ASTM D 1229 (Compression Set at 26 ºC for seven days at 25 percent compression): maximum permissible set: 65 percent.
ASTM D 2240 (Low Temperature Stiffness. Conditioned for 22 hours at -25 ºC): 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% strain between 38 degrees C +/- 1 degree C 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 2.14 micromillimeter. The failure type shall be 100% 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 15.5 megapascals and the minimum ultimate elongation shall be 550 percent.

(7) Shear Modulus at 50% Shear Strain of Elastomer: The shear modulus of the elastomer at 50% shear strain shall be determined by ASTM D 4014. The tangent modulus shall be 0.689 megapascals +/- 10%.

c. Steel reinforcement and load plates shall be made from rolled carbon steel conforming to ASTM A 36/A 36M or A 570/A 570M.

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 the material requirements of AASHTO Division II Section 18.

3 The list of suppliers shall be provided in the Special Provisions.

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 in accordance with a fracture control plan as defined by AASHTO or AREA.

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. Mill and Shop Inspection.** The Department shall be notified, in writing, 15 calendar days in advance of the date of beginning of work at the mill and shop, so that arrangements for inspection may be made.

Any materials rolled or work done prior to 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 shall be submitted, in accordance with Subsection 106.04, showing chemical and physical properties of the materials to be used. 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.

c. Fracture Control Plan. Steel bridge members or member components designated as Fracture Critical Members (FCM's) shall conform to the provisions of the 1978 AASHTO Guide Specifications for Fracture Critical Non-Redundant Steel Bridge Members as modified by interim specifications 1981 and 1983.

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 be determined 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 2 millimeters. 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% of the predicted value;
      (2) The slope of the loading curve (K) shall be greater than or equal to 90% of the predicted value; and
      (3) The average value of energy dissipated per cycle (EDC) shall be equal to or greater than 90% 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 in accordance with these specifications.
   d. The following criteria shall be furnished in order 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, in accordance with the AASHTO Guide Specifications for Seismic Isolation Design.

(6.) Adherence to the design and construction requirements of the AASHTO Standard Specifications for Highway Bridges Division I, Sections 14 and Division II, Section 18.

CONSTRUCTION

503.04 Working Drawings.

Working drawings shall be furnished in accordance with Subsection 105.04.

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 AWS 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, in accordance with 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.

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.

503.05 Fabrication and Welding.

Fabrication of steel structures including, but not limited to, bolt holes, finishing and shaping, bolts and bolted connections, pins and rollers, shop assembling, tests, marking, and shipping shall conform to Division II, Articles 10.1 through 10.37 of the AASHTO Standard Specifications for Highway Bridges.

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.

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 50 millimeters, 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 25 millimeters. The edge blocks shall be centered on the weld with a snug fit against the plate being radiographed, allowing no more than a 1.6-millimeter gap. Edge blocks shall be made of radiographically clean steel and the surface shall have a finish of ANSI 3 micrometers 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 prior to 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.

Fabrication of High Load Multi-Rotational Bearing Assemblies.

1. Section 18 - Bearings of the AASHTO Standard Specifications for Highway Bridges, Division 2 shall be followed for the fabrication of multi-rotational bearing assemblies.
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, prior to 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 consists 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 1335 kilonewtons.
   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 AASHTO, Division II, Section 18.
   c. Proof Load Test. One bearing from each production "lot" of fixed and expansion bearings shall be tested. Perform the test as specified in AASHTO, Division II, Section 18.
   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.

Fabrication of Seismic Isolation Bearing assemblies:

1. The tolerance on isolator dimensions shall be as follows:

Dimension	Tolerance
Thickness of Top & Bottom Cover Rubber	1.5 millimeters
External Dimensions	6.5 millimeters
Flatness of Exterior Top and Bottom Surfaces of Completed Isolator	1.5 millimeters from mean surface
Variation from Plane Parallel to the Theoretical Surface:	
Top	slope relative to the bottom of no more than 0.005 radians
Sides	6.5 millimeters
Overall Isolator Height	6.5 millimeters

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 2 millimeters shall be rejected.
3. Exposed steel surfaces, if any, shall be protected from rust by painting in accordance with the requirements of 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 Division II of the AASHTO Standard Specifications for Highway Bridges.
6. Gross bearing dimensions shall have a tolerance of +/- 2 millimeters. Out of flatness tolerance shall not exceed 1.5 millimeters per meter.
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 in accordance with Section 18 of Division II of the AASHTO Standard Specifications for Highway Bridges.
9. Preloaded frictional elements shall be constructed such that a 0.65 millimeters deflection in the preload element results in less than 10% change in the design frictional resistance.
10. Preload to the frictional element shall not be produced by utilizing an elastomeric material.

503.06 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 prior to 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 7.5 meters. 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 in the State of New Jersey 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 Division II, Section 11 of the AASHTO Standard Specifications for Highway Bridges, and to the following:

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 prior to 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 in order 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 weldingshall 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 in accordance with 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 in accordance with 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 15 ºC. 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.

503.09 High-Strength Bolts.

The installation of high-strength bolts shall be in accordance with Division II of the AASHTO Standard Specifications for Highway Bridges.

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 prior to 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.

503.12 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 two field coats of paint may be applied in the shop or on the site prior to 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 3 by 25-millimeter fillet welds through the holes in each valley. The lapped edges of adjacent plates shall be welded together with a bead, 75 millimeters 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.

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 prior to 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 912.24. 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 912.26.

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.

Cleaning and painting of structural steel shall conform to the following:

1. **Surface Preparation.** Where oil and grease are present, these shall be removed in accordance with the SSPC Surface Preparation Specification using No. 1 solvent cleaning (SSPC-SP 1). This cleaning shall be performed prior to 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 the use of 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 2-1/2) if sand or grit is used. The blast cleaning shall leave an anchor profile, from 38 to 64 micrometers 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 in accordance with 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 38 to 64-micrometer 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, prior to 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 in accordance with 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 coating solids that might have settled to the bottom of the container are thoroughly dispersed.
   b. The zinc-rich primer mixture shall be strained through a 250 to 600-micrometer 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 in accordance with the manufacturer's recommendations.
3. **Conditions for Painting.** Conditions for painting shall be in accordance with 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 5 ºC, or when the temperature is expected to fall below 5 ºC before the paint is dried. The minimum temperature shall be 10 ºC 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 8 meters per second, 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 3 ºC 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 (5.5 megapascals minimum).

4. Paint Application. Paint application shall be in accordance with 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 prior to priming. Succeeding coats shall not be applied until each coat is approved. The minimum drying time between coats shall be in accordance with Subsection 912.24. 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 in accordance with the manufacturer's written recommendations.

b. Prior to 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, prior to the application of the succeeding coat.

f. Surfaces of steel which will be in contact with or embedded in concrete, and 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 50 millimeters 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 prior to the blasting and coating of the girders or beams. The parts shall be blasted separately, primed, then reassembled and the bolts fullytorqued.

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 in accordance with 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 in accordance with 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 115 millimeters 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.....64 to 102 micrometers
For the intermediate coat..... 89 to 127 micrometers
For the finish coat.....51 to 76 micrometers
For the three-coat system..... 204 to 305 micrometers

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 25 to 64 micrometers. All other contact surfaces and surfaces to be in contact with concrete shall be within the normal primer dry film thickness range of 64 to 102 micrometers.

The dry film thickness for each coat will be determined by the use of a magnetic dry film thickness gage. The gage shall be calibrated and used in accordance with SSPC-PA 2. A Tooke film thickness gage shall be used in accordance with 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 204 micrometers 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.....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.

7. Stenciling. The following information shall be stenciled on the outside web of both fascia beams, on both ends of the structure, and in accordance with 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 50-millimeter 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 50 millimeters above the lower flange and not more than 1 meter 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 prior to 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, in accordance with 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 prior to, 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. If commercially available, the following equipment shall measure and provide readouts in metric units:

1. NACE, Maryland, and/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 in accordance with ASTM D 2092, Method A or Method D, 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 in accordance with Subsection 917.12. The average thickness of coating shall be at least 127 micrometers, but in no case less than 102 micrometers. 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 steel exposed to view, all outside surfaces, including all welds and the bottom surface of the bottom flange of the fascia stringers, shall be blast cleaned in accordance with SSPC-SP 6 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 in accordance with 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.

   Prior to final acceptance of the structure, any rust stains on the substructure concrete shall be removed by the use of a concrete rust stain remover in accordance with the recommendations of the manufacturer. Flushing with water shall follow all applications of rust removing material.

3. **Cleaning and Painting of AASHTO M 270/M 270M, Grade 345W Structural Steel.** Cleaning and painting of AASHTO M 270/ M 270M, Grade 345W structural steel is required for the following:
   - **a. Cap Girders.** The exterior surfaces of the top and the sides, including the brackets.
   - **b. Structural Steel Adjacent to Deck Joints.** All structural steel for a distance of three times the depth of the stringers from the deck joint, with the exception of steel designated to be galvanized, and the exterior face of the fascia stringers.

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-C-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 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 kilogram 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 kg/m³
Aluminum, cast or rolled	2 770
Bronze or copper alloy	8 590
Copper sheet	8 940
Iron, cast	7 130
Iron, malleable	7 530
Steel, cast or rolled, including alloy, copper bearing, and stainless	7 850
Zinc	7 210

The weight of rolled shapes and of plates, up to and including 1 meter 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 1 meter 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/M 160M.

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:

Metric Bolts

Metric Bolt	Diameter of Bolt, mm	Weight in kg per 100 bolts	Metric Bolt	Diameter of Bolt, mm	Weight in kg per 100 bolts
M12	12	7.5	M24	24	44.7
M16	16	14.1	M27	27	63
M20	20	27.3	M30	30	80.7
M22	22	35.5	M36	36	139.4

The weight of shop and field fillet welds is based on the following:

Size of Weld, mm	Weight in kg/m	Size of Weld, mm	Weight in kg/m
6.4	0.30	15.9	1.19
7.9	0.37	19.1	1.64
9.5	0.52	22.2	2.23
11.1	0.67	25.4	2.98
12.7	0.82		

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 meter.

Shear connectors will be measured by the number of units.

503.18 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
STRUCTURAL STEEL	LUMP SUM
STRUCTURAL STEEL	KILOGRAM
STEEL BEARINGS FOR PRESTRESSED CONCRETE	LUMP SUM
STRUCTURAL STEEL DECK JOINTS	LUMP SUM
STEEL GRID FLOORING	SQUARE METER
FORMED STEEL FLOORING FOR PEDESTRIAN BRIDGES	SQUARE METER
SHEAR CONNECTORS	UNIT
SHEAR CONNECTORS, GALVANIZED	UNIT

SECTION 504 - TIMBER STRUCTURES

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 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 in accordance with 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 cubic meters 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	CUBIC METER
TREATED TIMBER STRUCTURES, BRIDGE DECKING	CUBIC METER
TREATED TIMBER STRUCTURES, SHEETING	CUBIC METER
TREATED TIMBER STRUCTURES, WALES	CUBIC METER
UNTREATED TIMBER STRUCTURES	CUBIC METER

SECTION 505 - LOAD BEARING PILES

505.01 Description.

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.

MATERIALS

505.02 Materials.

Portland cement concrete shall conform to Section 914. Other materials shall conform to the following Subsections:

Reinforcement Steel for Structures.....915.01
Steel Castings for H-Pile Tips (Medium Strength).....917.07
Steel Piling.....917.09
Timber Bearing Piles.....918.02

Timber Preservatives.....918.06

EQUIPMENT

505.03 Equipment.

A. Types of Hammers. Piles shall be driven with steam, air, diesel, vibratory, or drop hammer. The type and size of hammer used shall be capable of driving the pile to its design capacity without damage to the pile.

Steam, air, and diesel hammers shall develop a minimum of 8.1 kilojoules energy per blow. Drop hammers shall have a minimum weight of 900 kilograms and a maximum drop of 2.5 meters.

B. Impact Pile Drivers. The 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 with the use of the Empirical Pile Formula (ENR), the pile design capacity shall be considered achieved when between two to four blows per 25 millimeters is reached.

   When the installation of other type piles is planned, and the pile driving equipment is to be analyzed with the use of the Empirical Pile Formula (ENR), the pile design capacity shall be considered achieved when between eight and twelve blows per 25 millimeters is reached.
2. The weight of the pile to be driven for steam or air hammers should be no more than two times the weight of the ram used to drive it; for diesel hammers, no more than four times the weight of the ram driving it.
3. Diesel hammers shall be equipped with gauges and charts for the determination of the actual driving energy produced under any driving conditions.
4. When the pile driving equipment is to be analyzed with the use of wave equation analysis (WEAP), the Engineer shall use the number of required hammer blows per 25 millimeter and the pile stresses at the required ultimate pile capacity to evaluate the driving equipment. For the driving equipment to be acceptable, the number of required hammer blows indicated by the wave equation analysis at the ultimate pile resistance shall be between three and ten blows per 25 millimeters.

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 6 and 13 millimeters. 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 1 meter, or as directed by the Engineer, of penetration.

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 leads that are straight and constructed in such a manner as to afford freedom of movement to the hammer. The leads shall be held in position by guys or braces to ensure support to the pile during driving. Except where piles are driven through water, followers shall not be used unless approved.

Pile driving leads which support the pile and the hammer in proper position throughout the driving operation shall be used. 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 insure concentric impact for each blow. 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

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 700 kilopascals at two 19 millimeter 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 in accordance with 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. Any reduction of hammer cushion thickness exceeding 25 percent of the original thickness shall be replaced by the Contractor before driving is permitted to continue.
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 prior to driving shall not be less than 100 millimeters. 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. 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.
2. **Prebored Holes.** The diameter of auger may vary as follows:
   a. For round piles, not less than 50 millimeters nor more than the average nominal diameter of piles.
   b. For steel H-piles, 100 to 150 millimeters 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.** Prior to 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 a wave equation analysis is to be used to determine the pile capacity, 20 working days prior to delivery of the equipment to the work site, a completed "pile and driving equipment data form" and a complete wave equation analysis, signed and sealed by a licensed Professional Engineer registered in the State, shall be submitted to the Resident Engineer. This submission shall be for each pile type and hammer combination with summary and recommendations showing that the proposed hammer will perform adequately. A "pile and driving equipment data form" can be obtained by contacting the Manager, Geotechnical Engineering Unit at telephone number 609-530-3730.

505.05 Order List of Piles.

Piles shall be furnished in accordance with 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 are based on the lengths which are assumed to remain in the completed structure. Without added compensation, the lengths shall be

increased to provide for fresh heading and for additional lengths as may be necessary to suit the method of operation.

505.06 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 40 millimeters per meter from the vertical or from the batter and shall not be out of the required position by more than 150 millimeters after driving. Piles for trestle bents shall be driven with variation of not more than 40 millimeters per meter from the vertical or batter and shall not be out of the required position at the top of the pile by more than 50 millimeters 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 6 millimeters has been achieved.
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 lengths for test piles 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 in order 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, dimensions, and at the designated locations shall be furnished and driven. Order lengths for test piles will be directed. They shall be driven to such tip elevation or minimum bearing value as may be directed. Test piles shall be driven with the same type of equipment that is used for driving permanent (production) piles. Test piles shall be driven to the bearing capacity and tip elevation that is shown on the Plans or is specified in the Special Provisions. The bearing capacity of test piles will be determined by the Engineer through the use of one or a combination of the following methods, as indicated in the Special Provisions:

1. **Pile Load Test (Static).** Load tests shall be made where prescribed or directed. When diesel or other types of hammers requiring calibration are to be used, load tests shall be made even though no load tests are scheduled. Load tests will not be required when the hammer is to be used only for driving piles to refusal, rock or a fixed tip elevation or when the hammer is of a type and model that has been

previously calibrated for similar type, size, and length of pile and foundation material. Calibration data must be obtained from acceptable sources.

The pile load test shall be performed in accordance with ASTM D 1143 except as may be modified in the Special Provisions. Detailed plans of the loading apparatus and methods to be used shall be submitted. The apparatus shall be so constructed as to allow the various increments of the load to be placed gradually without causing vibration to the test piles. If the approved method requires the use of anchor piles, such piles shall be of the same type and diameter as the permanent piles and shall be driven in the location of permanent piles when practical. 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.

The total test load shall be applied in four equal increments. Each increment of load shall remain in place until the settlement over a period of two hours is less than 0.25 millimeter. The full test load shall be maintained until the settlement over a 48-hour period does not exceed 0.25 millimeter. The full test load shall be removed in four decrements with a six-hour period between decrements. Following the removal of all loading, rebound readings shall be taken for a period of not less than 12 hours. Upon completion of each load test, all records shall be submitted for approval.

After the completion of loading 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 specified the ultimate bearing capacity of a pile will be determined by using a wave equation analysis.
4. **Pile Load Tests (Dynamic).** 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 the use of pile analyzer instruments. The dynamic testing shall conform to ASTM D 4945. Monitoring of test piles shall be performed during the full length of driving and, if restrike is required, during restriking. A further analysis of the PDA test results will be performed by using the Case Pile Wave Analysis Program (CAPWAP).

   The Contractor shall engage the services of a specialty subcontractor, who is experienced in dynamic monitoring of piles. 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 specialty subcontractor shall submit and provide interpretation of test data to the Engineer, who will use this data to approve the Contractor's driving procedure and pile tip elevation. This data shall be provided to the project Designer and to the Engineer within 48 hours of the completion of the pile driving.

   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, the Contractor shall reduce the driving energy transmitted to the pile by using additional cushions or reducing the energy output of the hammer in order to maintain acceptable stresses in the piles. 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 redriving 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 redrive begins by applying at least 20 blows to another pile. The maximum amount of penetration required during redrive shall be 150 millimeters or the maximum total number of hammer blows required shall be 50, whichever comes first. After redriving, the Engineer will determine whether additional pile penetration and testing is required or not.

Production piles shall not be driven or jetted until the PDA/CAPWAP test pile results are reviewed and the driving criteria and production pile order lengths are provided by the Engineer.

505.08 Defective Piles.

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 600 millimeters 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.

All piles pushed up 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.

Timber piles shall be stored, handled, and cut off as prescribed in 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.

The inspection of steel shells, reinforcement, and placing of concrete shall be in accordance with Division II, Section 4 of the AASHTO Standard Specifications for Highway Bridges.

505.11 Manufacture of Precast Concrete Piles.

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 4 ºC, 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.

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.

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.

Tops of foundation piles shall be embedded in the concrete footing at least 300 millimeters except that at locations of tremie concrete, the piles shall project at least 150 millimeters above the top of the seal concrete. Piles shall be cut off level at the designated elevation. 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 230 millimeters. 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. Steel shells or concrete casings for cast-in-place concrete piles shall be cut off at the designated elevation before being filled with concrete.

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.

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 one meter 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.

Test piles will be measured by the linear meter. The length of test piles, when driven, will be measured as the total length of test piles as designated or as ordered by the Engineer or if the penetration for any one test pile is greater than the length of the pile indicated or directed, the extension length ordered by the Engineer will be included in the linear meter of piling furnished and splices for such piles will be paid for as extra work. If the Contractor orders shorter test piles than directed and extensions are required, the cut-off length after driving and splices will not be considered for measurement and payment. Cast-in-place pipe or shell test piles will be measured in linear meter from the tip elevation to the cut-off elevation. The part cutoff will not be measured as driven piles and will be measured and paid as cutoff.

Production piles, piles of the various kinds and size, including buildups or extensions, as ordered by the Engineer will be measured by the linear meter. The part cutoff after driving will not be measured as driven piles and will be measured by linear meter and paid as cutoff. If the Contractor orders shorter piles than directed by the Engineer and extensions are required, the cutoff length after driving and splices will not be considered for measurement and payment.

The quantity of cast-in-place pipe or shell concrete piles to be paid for will be the actual number of linear meter of steel pipe or shell piles, driven, cast and left in place in the completed and accepted work. Measurement will be made from the tip of steel pipe or shell to the cutoff elevation. No separate measurement will be made for reinforcing steel, excavation, drilling, cleaning holes, drilling fluids, sealing materials, concrete, required casing 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 shall 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 shall be only those splices actually made and as required to drive the piles in excess of the order length furnished by the Department.

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 24 meters.

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 linear meter 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.

Cutoffs will be measured by the linear meter as determined by subtracting the total length of pile remaining in each of the furnished structures from the lesser of either the total

length of pile ordered by the Engineer for each structure or the total length of pile delivered to the project for each structure excluding the length of test 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 anchors and test piles for load tests incorporated into the permanent structure.

Pile load tests (Dynamic or PDA Monitoring) will be measured per unit when specified by contract documents. Restriking and a CAPWAP analysis of a dynamic load test will not be measured and will be included in the Pile Load Tests (Dynamic), Item. When 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. 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 METER
TEST PILES	LINEAR METER
CAST-IN-PLACE CONCRETE PILES, ___ MM DIAMETER	LINEAR METER
PRECAST CONCRETE PILES, ___ BY ___ MM	LINEAR METER
PRESTRESSED CONCRETE PILES	LINEAR METER
STEEL H-PILES, HP ___ MM BY ___ KG/M	LINEAR METER
UNTREATED TIMBER PILES, ___ MM DIAMETER	LINEAR METER
TREATED TIMBER PILES, ___ MM DIAMETER	LINEAR METER
SPLICES, FOR STEEL H-PILES	UNIT
PILE LOAD TESTS (STATIC)	UNIT
PILE LOAD TESTS (DYNAMIC)	UNIT
FURNISHING EQUIPMENT FOR DRIVING PILES	LUMP SUM
PILE SHOES	UNIT

Payment of 75 percent of the lump sum price bid 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 pile cut-offs not used in the Project will be made in an amount equal to the actual per linear meter material cost of piles furnished, provided that such cost does not exceed 85 percent of the bid price for the Pay Item. An invoice or bill of sale shall be furnished to show the linear meter price paid for the materials delivered to the site.

Payment for pile cut-offs will not be made for pile lengths which were included for material payments under the provisions of Subsection 109.06.

Payment adjustments for strength will be made in accordance with Subsection 914.02, Subpart E and will be applied to the lot meters for cast-in-place, precast, or prestressed concrete piles.

SECTION 506 - BULKHEADS, FENDER SYSTEMS,

AND DOLPHINS

506.01 Description.

This work shall consist of the construction of concrete, steel, and timber bulkheads, fender systems, and dolphins.

MATERIALS

506.02 Materials.

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:

Coal Tar Epoxy-Polyamide Paint	912.09
Bolts and Bolting Material	917.01
Steel Piling	917.09
Structural Steel for Tie Rods, Plate Washers, and Turnbuckles	917.10
Zinc Coating on Steel	917.12
Timber Bearing Piles	918.02
Timber Sheet Piles	918.03
Timber for Structures	918.05
Timber Preservatives	918.06

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 prior to the installation. All galvanized surfaces to receive coal tar epoxy-polyamide paint shall be cleaned in accordance with 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 and 505.

CONSTRUCTION

506.04 Timber Structures.

The methods of construction for timber structures shall conform to Division II, Section 16 of the AASHTO Standard Specifications for Highway Bridges and to the following amendments and additions:

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 following:

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.
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 prior to 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 3 square meters per liter, but in no case shall the dry film thickness of the two coats total less than 410 micrometers 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 meter of projected area exclusive of indentation of pile section.

Tie rods will be measured by the kilogram 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 METER

STEEL SHEET PILING	SQUARE METER
TREATED TIMBER SHEET PILING	SQUARE METER
TIE RODS	KILOGRAM

Payment for timber wales, caps, and other structural members used in bulkhead and fender system construction will be made in accordance with Section 504.

Payment for piles used in bulkhead and fender system construction will be made in accordance with Section 505.

SECTION 507 - 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.....901.13
Curing Materials.....905.03
Epoxy Bonding Coat.....912.11
Reinforcement Steel for Structures.....915.01
Portland Cement.....919.11
Water.....919.15

CONSTRUCTION

507.03 Preparation and Cleaning.

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 20 millimeters 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 14 kilograms 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 13 millimeters in depth. Areas which 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 prior to application of the mortar.

507.04 Applying Mortar.

Prior to 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.

Test panels shall be at least 750 by 750 millimeters 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 75 millimeters 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 150-millimeter 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 prior to testing.

At least five 75-millimeter diameter cores or 75-millimeter 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 in accordance with AASHTO T 24.

For acceptance purposes, the average 28-day core strengths, as a minimum, shall be equal to f'_c = 24 megapascals 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 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 300 millimeters square and 75 millimeters 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 23 megapascals minimum. If 23 square meters 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 100 millimeters in depth, a layer of mesh shall be used for each 75-millimeter depth of mortar. However, in no case shall wire mesh be placed behind existing reinforcement. For concrete encased steel members, steel rods, 10-millimeter nominal diameter, shall be attached to the steel member by wiring through existing holes provided for the purpose. Welded wire fabric, WWF 51 by 51 - MW65 by MW65, galvanized, then shall be securely fastened to the anchors with wires, spaced not more than 0.5 meters 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 in order 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 meeting the requirements of Subsection 201.04 shall be provided.

COMPENSATION

507.05 Method of Measurement.

Pneumatically applied mortar will be measured by the square meter.

507.06 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
PNEUMATICALLY APPLIED MORTAR	SQUARE METER

SECTION 508 - METAL BRIDGE RAILING AND 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..... 912.02
Zinc Chromate Primer.....912.07
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 709/709 M, Grade 345, and all other shapes and plates shall conform to ASTM A 709/709 M, Grade 250.

CONSTRUCTION

508.03 Working Drawings.

Working drawings shall be furnished in accordance with 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 prior to 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 which 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 30 millimeters wide and of the required thickness. The strips, when placed, shall project 3 millimeters 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 6 millimeters 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 in accordance with Section 503 with the exception that the welding of tubular structures shall be done in accordance with 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 prior to 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 13-millimeter 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 13 millimeters thick or less may be sheared, sawed, or milled. Material over 13 millimeters 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 prior to cutting.
2. Rivet or bolt holes shall be drilled or subpunched 5 millimeters 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 the use of 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 3-millimeter 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 in accordance with this Section and Section 614.

COMPENSATION

508.08 Method of Measurement.

Chain-link fence of the various sizes will be measured by the linear meter.

Metal railing of the various kinds and sizes will be measured by the linear meter.

508.09 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CHAIN-LINK-FENCE ALUMINUM-COATED STEEL, BRIDGE, _____M HIGH	LINEAR METER
CHAIN-LINK-FENCE, PVC COATED STEEL BRIDGE, _____ M High	LINEAR METER
CHAIN-LINK-FENCE, BRIDGE _____ M HIGH	LINEAR METER
CHAIN-LINK-FENCE ALUMINUM COATED STEEL, BRIDGE ____ M HIGH, CURVED TOP	LINEAR METER
CHAIN-LINK-FENCE, PVC COATED STEEL, BRIDGE _____ M HIGH, CURVED TOP	LINEAR METER
CHAIN-LINK-FENCE, BRIDGE, ____ M HIGH CURVED TOP	LINEAR METER
METAL RAILING (___ RAIL, ALUMINUM)	LINEAR METER
METAL RAILING (___ RAIL, STEEL)	LINEAR METER
4-BAR OPEN STEEL BRIDGE RAILING	LINEAR METER

SECTION 509 - SIGN SUPPORT STRUCTURES

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 in accordance with the current AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

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

All sign support structures shall be constructed of steel members, and shall consist of steel pipe conforming to ASTM A 53, Type S, Grade B, with the exception that API 5L, Grade B may be used when the specified wall thickness is greater than 13 millimeters, and of plates, shapes, and shims conforming to ASTM A 36/A 36M (AASHTO M 270/M 270M), Grade 250.

Nuts, washers, chord, post, and tower shaft caps, and the upper 375 millimeters of the anchor bolts shall be galvanized in accordance with ASTM A 153. Bolts shall be threaded at each end before galvanizing and shall be furnished with double nuts at the upper end, a leveling nut, and single nuts at the lower end. Threaded length shall be as shown on the Plans.

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 in accordance with 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 prior to fabrication.

509.04 Steel Structures.

Welding and fabrication shall be performed by an AISC certified plant and shall be done in accordance with the AWS D1.1, Structural Welding code. All quality control and quality assurance inspectors shall be AWS Certified Welding Inspectors (CWI), qualified in accordance with 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% 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 in accordance with Subsection 917.12. 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 prior to execution.

Galvanizing of each truss unit shall be by a single dip process.

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.

Where weldments are to be galvanized after welding, a type or brand of filler metal which will deposit weld metal with a silicon content less than 0.4 percent shall be used to avoid possible disintegration of the weld during the galvanizing process.

509.05 Aluminum Alloy Members

Welding and fabrication for aluminum members shall be in accordance with 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.

Radiographic inspection will be taken at the frequency of 25 percent of the number of welds. When a failure rate of ten percent or more is obtained, a frequency of 100 percent of the number of welds will be taken. If the failure rate falls below ten percent, the 25 percent frequency will be re-established.

Welders shall be qualified in accordance with the ANSI/AWS D1.2 Structural Welding Code - Aluminum.

509.06 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.

Inspection and acceptance of aluminum alloy members will be performed in accordance with Part III, Subpart F of the Department's Operation Bulletin No. 14-A. Copies may be obtained from the Department Laboratory upon written request. Inspection of weldments at the site of fabrication will be performed by the Department or by a testing agency designated by the Department.

Prior to 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.

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 prior to 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.

Structural components shall be handled with care to prevent damage and shall be stored in accordance with Subsection 509.09. Detailed written instructions and drawings for the erection of all structures shall be supplied prior to 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 splice plates shall be connected in accordance with the criteria stated in Subsection 11.5.6. - Connections Using High Strength Bolts, Division II of the AASHTO Standard Specifications for Road and Bridge Construction.

   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 (2) 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 tighten to the same calibrated increment.

   b. To sequentially tighten the bolt assembly to a snug tight condition, two (2) 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. To facilitate the fully compacted connection, in the presence of the Engineer, a calibrated torque dial wrench shall be used to provide the "final turn" of the bolt assembly. As per the AASHTO Division II requirements, the calibrated torque wrench shall be set to provide a tension not less than five (5) percent in excess of the minimum tension specified in the Plans.

   e. To maintain the connection, the bolt nut shall be tack welded. The welded area shall be repaired galvanized in accordance with Subsection 503.14.

   f. 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 (Telephone: 313-462-1454) 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 the use of 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 prior to 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 the use of 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.

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). The nuts shall be tighten with the use of a hydraulic torque wrench, equivalent to the Hytorc (Telephone 215-361-7175) XLT-Series Square Drive Wrench.

The hydraulic torque wrench shall be set to provide a tension as indicated in the Plans.

After the posts or tower shafts are erected and all nuts have been tighten 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. (Telephone 215-537-8700) may be used to maintain the connection, or the bolt nuts may be tack welded. If tack welding is done, the welded area shall be repair galvanized in accordance with Subsection 503.14. The Engineer shall approve the selected method. The leveling nuts shall also then be brought to a snug tight condition.

The space between the top of the pedestal and the bottom of the post or tower shaft base plate shall be filled with grout as specified in Subsections 509.09(B) and 509.09(F).

Prior to 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 in order 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 (2) stainless steel u-bolts, to the NJDOT Bureau of Materials, that are to be used for the mounting of the VMS boards. They shall be submitted two (2) weeks prior to 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 prior to the foundation construction and prior to fabrication of the structure.

509.09 General.

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 prior to shipment for final shop assembly to verify camber, alignment and contact of splice mating surfaces.
2. Splice mating surfaces may be ground or milled in order to achieve the desired surface contact. However, ASTM A6/A 6M requirements for permissible variation (under specified thickness) shall be maintained. Galvanizing damaged by grinding or milling shall be repaired in accordance with Subsection 503.14.
3. Truss and posts shall be assembled and bolts torqued to the required value specified in the plans. The fabricator shall verify that the following surface contact is achieved by means of plastigage and/or feeler gage:

   Minimum 75% of the surface area of the chord splice from the outer edge of the bolt circle to the inner edge of the flange shall be in full contact. The remaining 25% area may be less than full contact but no greater than 1.6 millimeter apart. The surface area from the outer edge of the bolt circle to the outer edge of the flange shall not have a gap in any location greater than 3.2 millimeter.

B. Concrete Pedestals. Excavation and backfill shall be performed in accordance with 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. This space shall be filled with non-shrink grout after the structure has been adjusted to the lines and grades.

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 1 meter from the face of the pedestal and 450 millimeters 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 50 millimeters 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. The grout course shall be placed after the truss and sign panels are erected so as to fill the spaces between the top of the concrete pedestal and the post or tower shaft base plate. The exposed portions of the top surface of the grout course shall be sloped down away from the post or tower shaft base plate.

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 prior to 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 in accordance with Section 206.

Payment for concrete and reinforcement steel will be made in accordance with Section 501.

Payment for load bearing piles will be made in accordance with Section 505.

Payment for sheeting will be made in accordance with Section 513.

SECTION 510 - 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 in accordance with ASTM A 123.

Channel supports, rods, bolts, nuts, washers, inserts, and other hardware required for the permanent installation shall be hot-dip galvanized in accordance with ASTM A 123 or A 153.

Gas or water mains shall conform to the following:

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 6 meter 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 3.77-millimeter galvanized fish wires placed therein.

Structural steel shapes and plates for utility supports shall be furnished and erected in accordance with 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 1.5 meters 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.

Prior to 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 in accordance with 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 in accordance with 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 in accordance with 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 in accordance with the provisions in the Special Provisions.

COMPENSATION

510.04 Method of Measurement.

Utility conduits and mains will be measured by the linear meter 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 METER
TELEPHONE CONDUITS	LINEAR METER
___ MM GAS MAINS	LINEAR METER
___ MM WATER MAINS	LINEAR METER

SECTION 511 - STRUCTURAL PLATE PIPE

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 in accordance with Subsection 105.04.

511.04 Excavation, Bedding, and Backfill.

Excavation, bedding, and backfilling shall be in accordance with 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 in accordance with 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 600 millimeters.

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 meter 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 50 millimeters 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 310 millimeters. 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 3 millimeters.

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 in accordance with 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 meter 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*
___ MM STRUCTURAL PLATE PIPE,___ MM THICK	LINEAR METER
___ BY ___ MM STRUCTURAL PLATE PIPE ARCH, ___ MM THICK	LINEAR METER
___ BY ___ MM STRUCTURAL PLATE ARCH, ___ MM THICK	LINEAR METER

Payment for excavation will be made in accordance with Section 206.

SECTION 512 - TEMPORARY STRUCTURES

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 shall be furnished in accordance with Subsection 105.04. Design calculations shall be included and shall be signed by a Professional Engineer licensed in the State of New Jersey.

512.04 Capacity.

Design loadings shall conform to the New Jersey Department of Transportation Metric 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

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 shall be furnished in accordance with Subsection 105.04. Design calculations shall be included and shall be signed by a Professional Engineer licensed in the State of New Jersey.

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 in accordance with 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 1 meter minimum below finish ground.

Safety provisions shall be in accordance with Subsection 107.11.

Materials which obstruct the installation shall be excavated and removed in accordance with Section 202.

COMPENSATION

513.05 Method of Measurement.

Temporary sheeting will be measured by the square meter.

Sheeting left in place will be measured by the square meter.

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 meters 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 METER
SHEETING LEFT IN PLACE	SQUARE METER

SECTION 514 - PAINTING EXISTING BRIDGES

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 system(s):

Epoxy Mastic Coating System

Organic Zinc Coating System

Only one of the above coating systems shall be used on each bridge in a Contract. Both systems shall not be combined for use on the same bridge in a Contract.

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:

Paint	912.01
Epoxy Mastic Coating System	912.25
Organic Zinc Coating System	912.26

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 912.25. However, except 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 912.26. 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 700-kilopascal 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, in accordance with 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, in accordance with the manufacturer's recommendations. Compressed air shall be in accordance with 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 in accordance withmanent metal deck forms for concrete decks and bridge deck grid flooring shall not be painted.

The Contractor's progress schedule, submitted in accordance with 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/or 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 912.03.

All components/materials which are not scheduled for blast cleaning and painting shall be adequately protected during those operations. All blast damage or paint overspray to 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, prior to 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. Prior to hand/power tool cleaning, all visible oil, grease, and salts shall be removed by solvent cleaning in

accordance with SSPC-SP 1. All existing surfaces shall then be cleaned by a high pressure water washing (5.5 megapascals minimum) which shall include a corrosion inhibitor. All existing paint left on the surface after hand/power tool cleaning shall be adequately roughened prior to paint application. Existing surfaces to be prepared by hand or power tool cleaning, or a combination of both, shall be in accordance with 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 in accordance with Subsection 514.13.

Prior to 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 in accordance with SSPC-SP 1.

Prior to 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 in accordance with these Specifications.

Existing surfaces to be prepared by commercial blast cleaning shall be in accordance with 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 in accordance with 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 2-1/2) 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.

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, in accordance with Subpart A.2. above, is specified in the Special Provisions, all existing surfaces shall be hand/power tool cleaned in accordance with Subpart A.1 above. All commercial blast cleaned surfaces shall leave an anchor profile from 38 to 76 micrometers deep.

C. Organic Zinc Coating System. All existing surfaces shall be near-white blast cleaned in accordance with Subpart A.2. above. Near-white blast cleaned surfaces shall leave an anchor profile from 38 to 64 micrometers deep.

514.06 Painting Galvanized Surfaces.

Galvanized surfaces and galvanized surfaces made bare by the cleaning operations shall be treated before painting in accordance with ASTM D 2092, Method A or Method D. 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 in accordance with 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 9 meters per second, 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 3 ºC 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 (5 500 kilopascals minimum).
5. The Contractor shall provide a suitable facility for the storage of paint that will be in accordance with 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 10 ºC or when the relative humidity is above 90 percent. The urethane coating shall not be applied when the temperature is below 4 ºC 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 in accordance with Subsection 514.05, Subpart A.1 and applied in accordance with the manufacturer's recommendations.

C. Organic Zinc Coating System. The organic zinc or epoxy coating shall not be applied when the temperature is below 10 ºC 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 4 ºC 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 the use of a magnetic dry film thickness gauge. The gauge shall be calibrated and used in accordance with SSPC-PA 2. A Tooke film thickness gauge shall be used in accordance with 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.....127 micrometers
Prime coat.....76 micrometers
Finish coat.....51 micrometers

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.....76 micrometers
Intermediate coat.....89 micrometers
Finish coat.....51 micrometers

514.09 Mixing the Coatings.

A. General. Coatings shall be mixed in accordance with 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 250 to 600-micrometer 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 in accordance with 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 4 to 43 ºC. The enclosure shall be equipped with a recording thermometer.

514.11 Paint Application.

A. General. Paint application shall be in accordance with 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 prior to any contamination, formation of rust, or any other deterioration of the prepared surface.
2. The minimum curing time between coats shall be in accordance with Subsection 912.25 for the Epoxy Mastic Coating System and Subsection 912.26 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 be in accordance with the manufacturer's written recommendations.
3. Prior to 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 in accordance with 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 be in accordance with 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 115 millimeters 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 in accordance with 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 50-millimeter 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 50 millimeters above the lower flange and not more than 1 meter from the abutment. In the case of a bascule bridge, stencil information should be placed 1 meter 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, in accordance with 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 in accordance with 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. In accordance with 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 Steel Structures Painting Council (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 in accordance with Subsections 107.10, 107.28 and the following:

1. Blast Cleaning Requirements

a. Pollution Control System. Prior to 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 which 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 licensed Professional Engineer, registered in the State of New Jersey. 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 to prevent a traffic and/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.

In accordance with 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 in order to meet the capture, containment, collection, and disposal requirements. The cost thereof shall reflect the type of containment and equipment selected in order 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.

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.

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 in accordance with 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 of New Jersey, 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, CN 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.

Prior to 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 in accordance with 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 in accordance with NJDEP regulations NJSA 58:00-23.11 *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 in accordance with 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 and/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 and/or licenses required as part of this plan prior to 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.

Prior to 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/or 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 450 megagrams 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 50 micrograms per cubic meter 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 in accordance with 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 the use of 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 (Telephone: 202-523-6138).

Compliance Assistance Resources - Enforcement

US Department of Labor/OSHA
Marlton Area Office, Marlton Executive Park, Building 2, Suite 120, 701 Route 73 South, Marltor, NJ 08053
Telephone: 609-757-5181
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
Telephone: 732-750-3270
Counties Served: Hunterdor, Somerset, Middlesex, and Union.

US Department of Labor/OSHA, Parsippany Area Office, 299 Cherry Hill Road, Suite 304, Parsippany, NJ 07054
Telephone: 973-263-1003
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
Telephone: 201-288-1700
Counties Served: Bergen and Passaic.

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
Telephone: 609-292-3922

State of New Jersey, Dept. of Health, P.O. Box 360, Trenton, NJ 08625-0360
Telephone: 609-633-6454

National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, Ohio 45226
Telephone: 800-35-NIOSH
For concerns regarding engineering controls contact the Engineering Control Technology of NIOSH.

(2) Lead Health and Safety Plan (LHASP). When over 450 megagrams of blast cleaning is required, 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 prior to 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. Prior to 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 in order to meet the capture, containment, collection, and disposal requirements. The cost thereof shall reflect the type of containment and equipment selected in order 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 in accordance with 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 Safety and Health 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 prior to, 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 prior to 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 operatedpsych	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 withautoflash,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 minus1 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 meter 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	MEGAGRAM
HAND/POWER TOOL CLEANING	LUMP SUM
HAND/POWER TOOL CLEANING	SQUARE MATER
COMMERCIAL BLAST CLEANING	SQUARE METER
NEAR-WHITE BLAST CLEANING	MEGAGRAM
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".

SECTION 515 - GRANITE MASONRY

515.01 Description.

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:

Granite Facing for Pier Shafts	910.07
Mortar	914.03
Bolts and Bolting Material	917.01

CONSTRUCTION

515.03 Working Drawings.

Working drawings shall be furnished in accordance with 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 1.2 and 2.4 meters and shall be of such heights as comply with the heights of courses, including bed joints. Thicknesses not less than 200 millimeters nor more than 300 millimeters, 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 75-millimeter maximum projection on straight stones and a 100-millimeter 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 6 millimeters from the theoretical true arris. Snipped corners over 10 millimeters 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 300 millimeters 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 50 millimeters 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 75 millimeters and a distance of more than 150 millimeters from the arris line.

Lewis holes will be permitted in all stones weighing over 45 kilograms except that Lewis holes or other holes will not be permitted in exposed surfaces without approval.

Holes for anchor clamps shall be at least 100 millimeters from any face of the stone and shall be of such size as to allow at least 5 millimeters 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 20 millimeters in thickness with a tolerance of plus or minus 6 millimeters.

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 25 millimeters, 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 meters, 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 METER

SECTION 516 - CONCRETE CRIB WALLS

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 in accordance with Subpart A of Subsection 405.03.

CONSTRUCTION

516.03 Working Drawings.

Working drawings shall be furnished in accordance with 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 in accordance with 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 150 millimeters 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 in accordance with 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 meter 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 meter.

516.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CONCRETE CRIBBING	CUBIC METER
BROKEN STONE FILL FOR CRIB WALL	CUBIC METER

Payment for foundation excavation and coarse aggregate layer will be made in accordance with Section 206.

Payment for porous fill will be made in accordance with Section 203.

SECTION 517 - 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 in accordance with 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.

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 meter.

517.06 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
INLET FRAMES AND GRATES	UNIT
SCUPPERS	UNIT
___ MM STEEL ALLOY PIPE	LINEAR METER

SECTION 518 - 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.

B. Membrane Waterproofing. This work shall consist of the placing of a waterproofing membrane on the surface of the existing bridge deck prior to placing an overlay of bituminous concrete.

C. Concrete Deck Overlay Protective System. This work shall consist of the construction of a concrete deck overlay protective system in accordance with Subsection 518.06 A.

D. Scarification. This work shall consist of scarifying existing concrete bridge decks prior to repair of concrete deck or placing of concrete deck overlay protective systems.

MATERIALS

518.02 Materials.

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 13 millimeters in size, not exceed ½ the thickness of section to be placed and be broken stone or crushed gravel.

Other materials shall conform to the following Subsections:

Coarse Aggregate.....901.13
Epoxy Bonding Coat.....912.24
Reinforcement Steel, Deformed Bars.....915.01
Latex Emulsion Admixture.....919.10
Silica Fume Admixture.....919.10
Quick-Setting Patch Materials.....919.12

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 in accordance with the descriptions provided in Subsection 919.12. The provisions of Section 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, in accordance with 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 in accordance with ASTM C 531, is 25 percent greater or less than the coefficient of the LMC mix to be used in the overlay.

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 in accordance with Subsection 106.04 prior to 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 901.13, Item (A). Coarse Aggregate shall be size number 8 with a maximum 13 millimeter size, not exceed ½ the thickness of section to be placed and be broken stone or crushed gravel.
2. Fine Aggregate. Fine aggregate shall comply with the requirements of Subsection 901.13, Item (B).
3. Concrete Admixtures. Admixtures shall comply with the requirements of Section 905, and AASHTO MI94.
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 8 to 11 liters of water per minute at 13 megapascals to 17 megapascals 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 prior to 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 in accordance with 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 minus 1 degree to plus 38 degree C 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.

B. Scarification. The equipment shall be self-propelled and capable of scarifying a minimum of 830 square meters per day across the cutting path in one pass to a minimum depth of 6 millimeters. 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 14-kilogram class, and triple-headed tampers fitted with star drills not less than 50 millimeters 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 0.1 cubic meter. The mixer shall be approved by the Engineer prior to use.
2. At least 2 (two) batching boxes of 0.1 cubic meter capacity each shall be approved at the site for the proportioning of sand and cement.

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 4.6 cubic meters of concrete.
2. Mixers should be calibrated to accurately proportion the specific mix. Where placements involve more than 76 cubic meters, calibration of cement and latex should be checked at 76 cubic meter intervals. The yield will be required to be within a tolerance of 1.0 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 0.19 cubic meter container that is 0.914 m x 0.914 m x 0.228 m 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 7 bags/cubic meter of cement.

CONSTRUCTION

518.04 Repair of Concrete Deck.

Repairs of concrete deck are classified as follows:

1. Type A Repair shall consist of removing all delaminated and/or deteriorated deck concrete from 20 millimeters 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 and/or deteriorated deck concrete to a minimum depth of 25 millimeters 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, in the use of 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 (3) 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.

   Prior to 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.

   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 4 ºC for a minimum of 72 hours prior to 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 bituminous concrete 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.

   Prior to the start of the survey, the Contractor shall furnish a properly connected half-cell meter equivalent to an M.C. Miller Co. (Telephone: 201-728-3800) Model IA electronic potential meter with an intermediate electrode extension, a 762-millimeter PVC extension, 30 meters of 1.59-millimeter diameter wire, 470 milliliters of distilled water, a 100 by 150 by 25-millimeter sponge, and two alligator clips. The Contractor shall retain ownership of the meter and accessories upon completion of the Project.

2. **Construction Procedures.** Repair areas shall be saw cut to a 20-millimeter depth prior to scarification, if scheduled, and prior to 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 6 millimeters and not more than 25 millimeters, 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 14-kilogram class (15 kilograms 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 7-kilogram class (9 kilograms 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 in accordance with a Type B Repair. A minimum of 25 millimeters 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 in accordance with 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 prior to placing the Class A concrete. The epoxy bonding coat shall not be allowed to completely dry prior to the placement of the Class A concrete. In order 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 28 megapascals from two cylinders cast during placement. When Class A concrete is used, the repair areas shall be cured in accordance with 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 prior to 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 in accordance with 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 in accordance with the provisions of 518.06 C.12 for a 72 hour period. An air cure period will not be required.

518.05 Membrane Waterproofing.

A. Deck Preparation. Repair of concrete deck shall be performed in accordance with Subsection 518.04. The repairs shall be completed and accepted prior to 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. In accordance with AASHTO T23, 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 thdemoldec cylinders are to be air cured.

At least 45 calendar days prior to 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 28 megapascals 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 in accordance with the proposed mix design. At least three tests (six cylinders) for compression testing shall be prepared, cured, and delivered in accordance with 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.

1. **Latex Modified Concrete**. Certification shall be furnished, in accordance with 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:

DESIGN MIX CRITERIA

Cement, bags per cubic meter (42.7 kilogram bag)	9.16
Latex emulsion admixture, liters per bag	13.2
Water, liters per bag	10.2 max
Air content, percent of plastic mix according to AASHTO T 152	6.5 max
Slump, millimeters (see note 2)	75 to 150 max
Percent fine aggregate in accordancwithcen of total aggregate, by weight	55 to 70
Weight ratio range (dry basis):	
cement	1.0
sand	2.5 to 3.1
coarse aggregate	1.4 to 2.0
Design Strength @ 28 Days	Class A, Table 914-3
Verification Strength @ 28 Days	Class A, Table 914-3

NOTE 1. 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.

NOTE 2. The slump will be measured four to five minutes after discharge from the mixer. LMC shall not be placed during this waiting period.

NOTE 3. 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, in accordance with 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

Minimum Cement Content (Kg/m^3)	387 +/- 6
Silica Fume Content	7% +/- 0.5% of total cementitious content
Water/Cementitious Ratio (See Note 1)	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 (See Note 2) (MM).....152 +/- 50
Design Strength @ 28 Days .....Class A, Table 914-3
Verification Strength @ 28 Days .....Class A, Table 914-3

Note 1: This 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.

Note 2: 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 and/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 (thirty) resolutions. 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 (one hundred sixty).

Certification shall be furnished, in accordance with 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. In accordance with 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 prior to the planned start of the overlay placement, a Report to include laboratory data to document completed results of permeability testing shall be submitted. The permeability samples used for this testing shall be cylindrical samples with a 100 millimeter diameter and at least 100 millimeters 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 results of the AASHTO T 277 testing shall be correlated with the results of a 90 day ponding test that shall be performed in accordance with AASHTO T 259. The completed results of the 90 day ponding test shall also be included in the Report.

The Contractor shall also submit six (6) 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 in accordance with Subsection 405.07.

   Admixtures shall be stored in enclosures which can protect them from freezing or from prolonged exposure to temperatures in excess of 30 degrees C. 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 10 degrees C, 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 in accordance with the requirements of Subsection 901.02.
5. **Construction Plan**. At least 30 days prior to 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 in accordance with the equipment and manufacturers' recommendations.
6. **Surface Preparation**. The following procedure shall be followed in preparing surfaces that are to receive the concrete overlay:
   a. Prior to 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 prior to 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 34 megapascals 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. Immediately prior to placing the overlay, the cleared surface shall be thoroughly wetted for a period of not less than one hour. 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 3 millimeter) 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 0.9 meters to 1.2 meters 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 0.028 cubic meter 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. Noretempering 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 prior to placing the concrete overlay.

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 prior to 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 150 millimeters 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 and/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 5 millimeters 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.

11. Weather and Temperature Restrictions. The concrete overlay shall not be placed at air temperatures lower than 10 degrees C. It can be placed at 10 degrees C and rising, provided that the air temperature is forecast to remain above 10 degrees C for the first 12 hours of the curing period.

If it is probable that the air temperature could fall below 2 degrees C at any time during the planned placement or wet cure period, at least 30 calendar days prior to 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 0.75 kilograms per square meter 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 30 degrees C or when the evaporation rate begins to exceed 0.75 kilograms per square meter per hour. The evaporation rate will be as determined with the use of 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 0.75 kilograms per square meter per hour. If fog misting is used, the fog misting equipment shall be capable of delivering 8 to 11 liters of water per minute at 13 megapascals to 17 megapascals using a 40 degree to 50 degree wide-angle nozzle.. The fog nozzle shall be held 1.8 meters 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 prior to the concrete placement, 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 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 prior to 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.

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 300 millimeters and have been presoaked for a minimum of 24 hours and shall be drained of excess water prior to 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. Within one hour of covering with the wet burlap, a layer of white polyethylene sheeting, 150 micrometers minimum thickness, shall be placed on top of the wet burlap.

The burlap shall be kept wet for a continuous period of seven (7) calendar days 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 seven calendar days.

The Contractor shall inform the Engineer of the intended curing procedure 30 days prior to the overlay placement.

13. Saw Cut Grooving. After completion of the minimum total curing time of fourteen (14) calendar days, the overlay shall be grooved in accordance with Subsection 501.15, Item 3, provided that the concrete has attained a strength of at least 28 megapascals 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 in accordance with Subsection 501.16.
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 28 megapascals. In the event that the 28 day cylinders fail to produce a compressive strength of 28 megapascals, 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 7 degrees C and 29 degrees C for the specified curing period. Any time in which the curing temperature falls between 0 degrees C and 7 degrees C 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 (7) 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 10 millimeters 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 10 millimeters 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 in accordance with the latest ASTM C856 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 prior to beginning corrective action operations.

518.07 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 in accordance with 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 meter.

Membrane waterproofing will be measured by the square meter.

Concrete deck overlay protective systems will not be measured. The quantity of these overlays will be 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 meter.

518.09 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
REPAIR OF CONCRETE DECK, TYPE___	SQUARE METER
MEMBRANE WATERPROOFING	SQUARE METER
CONCRETE DECK OVERLAY PROTECTION SYSTEM, TYPE_____	CUBIC METER
SCARIFICATION	SQUARE METER

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, Type _____", at the bid price for concrete that meets or exceeds these Project Specifications, including the minimum 28 megapascal compressive strength at 28 days. Failure to meet this strength requirement will result in the deficient lot being reclassified as a pay adjustment and subject to the provisions of Section 914.02, Subpart F.

No separate payment will be made for the overlay material that is brushed onto the deck surface prior to 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, Type ____".

Payment for reinforcement steel will be made in accordance with Section 501.

At bridge deck repair areas outlined as either Type B or Type C Repair on the construction 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 in accordance with the construction details regardless of original designation or preparatory work for another repair type.

SECTION 519 - PREFABRICATED MODULAR WALLS

519.01 Description.

This work shall consist of the construction of prefabricated modular walls manufactured by approved licensees in an approved concrete plant. 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 system that are acceptable for use in a Project, shall be provided in the Special Provisions.

MATERIALS

519.02 Materials.

Materials shall conform to Subsection 501.02 and the following:

1. Prefabricated modular units shall be Class P, 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 10 ºC or lower, and shall be delayed for a period of three hours when the air temperature is 10 ºC 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 63 ±5 ºC 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 28 megapascals or greater, the precast units shall be cured further until the required strength is achieved.

2. Filler for horizontal joint for footings shall conform to Subsection 908.01.
3. Filler for front face horizontal joints between units shall be closed-cell polyethylene foam backer rod conforming to AASHTO M 153, Type 1.
4. Filter fabric placed inside the units over all vertical joints in the front face shall be 300 millimeters wide and conform to Subsection 919.06.
5. The pervious structure backfill material within the units shall conform to porous fill, designation I-9.
6. Coarse aggregate layer shall be material obtained from an approved commercial source and processed into stone size ASTM C 33, size No. 67.
7. Weep holes, where shown on the Plans, 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 100-millimeter clay pipe, polyvinyl chloride, transite, or unreinforced concrete drain pipe.
8. Underdrains, where shown on the Plans, shall conform to Section 601.

CONSTRUCTION

519.03 Construction.

A. Fabrication. 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.

The name of manufacturer, name of project, date of manufacture, mark numbers, and type of unit in accordance with the approved erection drawings shall be clearly marked in the inside face of each unit.

B. Inspection and Rejection. The quality of materials, the process of manufacture, and the finished units shall be subject to inspection by the Engineer prior to 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 5 millimeters.

b. Deviation from square when measured on diagonal: 8 millimeters for units up to 3 meters wide, 20 millimeters for larger units.

3. Honeycombed or open texture not properly repaired.
4. Defects which would affect the structural integrity of the unit.

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.

D. Installation. The foundation bed for the structure shall be approved by the Engineer before erection is started. Prior to 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 and/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 14 megapascals before placement of wall modules. The completed footing surface shall be constructed in accordance with grades and cross slopes shown on Plans. When tested with a Straightedge, the surface shall not vary more than 3 millimeters in 3 meters.

The units shall be installed in accordance with 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.

Porous fill shall be used behind all units and shall be free from organic or otherwise deleterious material. Unless otherwise noted on the working drawings, backfill material, in the structure volume behind the wall, shall conform to Section 203.

Prefabricated modular wall units shall be filled one course at a time, with pervious structure backfill. Units 1.2 meters or less in height shall be filled in one layer and then thoroughly compacted with a vibratory tamping device. Units which are more than 1.2 meters in height shall be filled in two approximately equal layers and thoroughly compacted after each layer is placed.

Backfill shall be compacted to 95 percent of maximum density as determined by AASHTO T 99, Method C.

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 2 meters.

All units above the first course shall interlock with the lower courses. Vertical joint openings on the wall's front face shall not exceed 20 millimeters. The front face vertical joints shall have 300-millimeter wide strips of filter fabric behind each joint starting 600 millimeters below grade.

The overall vertical tolerance of wall (plumbness from top to bottom) shall not exceed 13 millimeters per 3 meters of wall height.

519.04 Working Drawings.

The Contractor shall submit working drawings and design calculations, signed and sealed by a Professional Engineer licensed in the State of New Jersey, to the Engineer for approval in accordance with Subsection 105.04. Design parameters shall be verified and be consistent with those parameters that are in place at the time of Advertisement. The working drawing submission shall include, but not be limited to, the descriptive plan sheet presentations that are listed in Subsection 105.04 of the Special Provisions.

COMPENSATION

519.05 Method of Measurement.

The method of measurement shall be in accordance with Subsection 521.03.

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 in accordance with Subsection 521.04.

SECTION 520 - MECHANICALLY STABILIZED EARTH (MSE) WALLS

520.01 Description.

This work shall consist of the complete construction of a mechanically stabilized earth (MSE) wall structure composed of precast concrete facing panels, concrete leveling pad, steel reinforcement strips, joint materials, fasteners, select granular backfill materials, and all other appurtenant items of construction within the common structure volume as shown on the Plans or specified herein.

The manufacturer shall provide the design and engineering for each structure and the services of an on-site technical representative to assist and instruct during construction of the leveling pad and installation of the first two-panel courses, as a minimum. 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 select granular backfill, and construct the coping, traffic barrier, or noise barrier.

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.

Concrete for precast concrete facing panels shall conform to Class P in accordance with Section 914.

Dowels shall be of steel conforming to ASTM A 36/A 36M, galvanized in accordance with ASTM A 123, or PVC rod meeting the requirements of ASTM D 1784, Type 1, Grade 1.

Soil reinforcement strips shall conform to ASTM A 572/A 572M, Grade 450. Soil reinforcement welded wire mesh shall conform to ASTM A 185. The minimum size welded wire shall be MD 130.

Steel reinforcement strips, wire mesh, and similar materials shall be hot-dip galvanized in accordance with AASHTO M 111 (ASTM A 123), except in marine environments and areas where stray electrical currents are resent in the soil. For those conditions the reinforcement strips, mesh, and similar materials shall be epoxy coated. Epoxy coated reinforcement strips shall be in conformance with AASHTO M 284/M 284M (ASTM D 3963/D 3963M). Epoxy coated wire mesh shall be in conformance with ASTM A 884, Class B. For acceptance purposes of the epoxy coating, at least 90 percent of all recorded film thickness measurements shall equal or exceed 460 micrometers after cure.

High-strength bolts shall conform to ASTM A 325M.

Plate and bars for steel strap connections shall conform to ASTM A 36/A 36M. Bolts shall conform to ASTM A 307.

Coil inserts for attachments shall be fabricated from cold drawn steel wire conforming to AISI C1035. Coil bolts shall be ductile iron conforming to ASTM A 570/A 570M, Grade 345.

Tie strips shall conform to ASTM A 570/A 570M, Grade 345.

All material for attachments shall be galvanized in accordance with ASTM A 123, except for threaded devices which shall be galvanized in accordance with 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 912.09.

Reinforcement steel shall be Grade 420 conforming to Section 915.

Bearing pads shall be preformed fabric pads conforming to Subsection 919.02, Subpart B.

Filter fabric shall conform with Subsection 919.06.

Impervious membrane material shall be a flexible chlorinated polyethylene (CPE) sheeting conforming to ASTM D 4068, Grade 1. All seams in the membrane shall be sealed or overlapped to prevent leakage.

Select granular backfill material used in the MSE structure volume shall be borrow excavation material reasonably free from organic and otherwise deleterious materials and shall conform to the following gradation limits as determined by AASHTO T 27.

Sieve Size	**Percent Passing**
150 mm	100
75 mm	70 - 100
4.75 mm	30 - 80
425µm	0 - 25
75µm	0 - 10

The frequency of sampling of select granular backfill necessary to ensure gradation limits shall be performed at least once for every 1 500 cubic meters 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, kilohms per meter	Greater than 500	ASTM G 57 (LAB)
pH	4.5 < pH < 9.5	Soil survey 8 CLA.
Organic Content	1.00% Maximum	AASHTO T 267

Soils with resistivities of less than 500 kilohms per meter, but greater than 200 kilohms per meter, may be accepted if they meet the following additional requirements

Property	**Standard**	**Test Procedure**
Chloride	Less than 100ppm	ASTM D 512, ASTMD 4327
Sulfates	Less than 200ppm	ASTM D 516, ASTM D 4327

The frequency of sampling of select granular backfill necessary to ensure electrochemical limits shall be performed at least once for every 800 cubic meters of material placed with a minimum of two samples per structure or whenever the appearance or behavior of the material changes and as directed.

Select granular backfill tested for durability shall exhibit a magnesium sulfate soundness loss of less than 30 percent after four cycles.

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 the Specifications shall also be furnished.

Coarse aggregate stone pocket material shall be obtained from an approved commercial source. Stone shall conform to ASTM C 33, size No. 67.

Concrete for leveling pad where required shall be Class B concrete conforming to the requirements of applicable portions of Section 914, for unreinforced footings.

CONSTRUCTION

520.03 Methods of Construction.

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 prior to casting of the panels.

Prior to 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.

The panels shall be placed without interruption and shall be consolidated by the use of 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. Clear form oil of the same manufacture shall be used throughout the casting operation.

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. 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 Prestressed Concrete Products.

If steam curing 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 10 ºC or lower and shall be delayed for a period of threehours when the air temperature is 10 ºC 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 63 ± 6 ºC 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 28 megapascals or greater, the precast units shall be cured further until the required strength is achieved.

Forms may be removed as soon as their removal will not cause distortion of the hardened concrete.

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. The panels shall meet the acceptance criteria in Section 914.

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. The rear face shall have a uniform surface finish free of open pockets of aggregates or surface distortions in excess of 6 millimeters.

All units shall be manufactured within the following tolerances:

1. All dimensions within 5 millimeters.
2. Deviation from vertical, 3 millimeters per 1.5 meters.

Units shall be rejected because of failure to meet any of the requirements specified above. In addition, any or all of the following defects shall be sufficient cause for rejection:

1. Defects that indicate imperfect molding.
2. Defects indicating honeycombed or open texture concrete.
3. Defects in the physical characteristics of the concrete, such as:
    a. Stained front face due to excess form oil or other reasons.
    b. Signs of aggregate segregation.
    c. Broken or cracked corners.
    d. Tie strips bent or damaged.
    e. Lifting inserts not usable.
    f. Exposed reinforcing steel.
    g. Cracks at the PVC pipe or pin.
    h. Insufficient concrete compressive strength.
    i. Panel thickness in excess of 5 millimeters from that shown on the plans.

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.

The name of manufacturer, name of project, date of manufacture, the production lot number, and the piece-mark shall be clearly scribed on the rear face of each panel.

All units shall be handled, stored, and shipped 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.

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 prior to erection to determine any damage which may have occurred during storage.

A 600 by 600-millimeter stone pocket, filter fabric, and a 200-millimeter corrugated steel underdrain pipe (CSUP) shall be placed as shown on the Plans.

Unclassified excavation shall be in accordance with the requirements of Section 206 and in conformity with the limits and construction stages shown on the Plans.

The foundation for the structure shall be graded level for a width exceeding the length of reinforced strips or mesh for a minimum of 600 millimeters. Prior to wall construction, the foundation bed, if not in rock, shall be compacted with a smooth wheel vibratory roller. Any foundation soils found to be unsuitable shall be removed and replaced with a layer or coarse aggregate material compacted in accordance with Section 203.

At each panel foundation level, an unreinforced concrete leveling footing shall be provided. 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.

Footing elevations shall be as shown on the Plans, within a tolerance of plus 3 millimeters, minus 6 millimeters.

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. Panels shall be placed in successive horizontal lifts as placement of the select granular

backfill proceeds, in accordance with the recommendations of the panel manufacturer and the sequence shown on the Plans. As the select fill material is placed behind a panel, the panels shall be maintained vertical by means of temporary wooden wedges placed in the joint at the junction of the two adjacent panels on the external side of the wall. Wedges shall not remain in place below three panel heights during erection and shall be removed upon completion of erection.

External bracing shall be required for the initial lift. Vertical tolerance (plumbness) and horizontal alignment tolerance shall not exceed 20 millimeters, when measured along a straightedge. The maximum allowable offset in any panel joint shall be 20 millimeters.

The overall vertical tolerance of the wall (plumbness from top to bottom) shall not exceed 13 millimeters per 3 meters of wall height.

Reinforcing strips or mesh shall be placed normal to the face of the wall, unless otherwise shown on the Plans or directed. Prior to placement of reinforcing strips or mesh, select granular backfill shall be compacted in accordance with requirements for backfill placement.

Backfill placement shall follow erection of each course of panels. Select granular 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 select granular 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.

The select granular backfill shall be compacted to 95 percent of the maximum density as determined by AASHTO T 99, Method C.

The moisture content of the select granular backfill prior to and during compaction shall be uniformly distributed throughout each layer. Select granular backfill materials shall have a placement moisture content less than or equal to the optimum moisture content. 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. The optimum moisture content shall be determined in accordance with AASHTO T 99, Method C.

Select granular backfill material placed within 300 millimeters of any drainage structure or utility line which is included in the reinforced earthen volume shall not have any particle greater than 75 millimeters in maximum dimension.

The maximum lift thickness of select granular backfill material shall not exceed 250 millimeters loose measurement. The Contractor shall decrease this lift thickness to obtain the specified density.

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 1.5-meter zone directly behind the facing panels. No sheepsfoot rollers shall be used.

Within the 1.5-meter zone, 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.

When there is evidence of wall displacement or disturbance, compaction shall be accomplished by use of a smooth drum static roller.

The compaction equipment shall be capable of providing uniform density throughout the depth of the layer of the select granular material being compacted with no disturbance to the vertical or horizontal alignments of the previously placed panels.

The density requirements specified herein for compaction of the select granular backfill material shall be performed on each layer placed in accordance with Subsection 203.10, using AASHTO T 238, Method B, and AASHTO T 239.

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.

For MSE walls supporting roadways that may be chemically deiced, to intercept any flows that may contain the deicing chemicals, an impervious membrane shall be placed below the pavement and just above the first row of reinforcements. The membrane shall be sloped to drain away from the wall facing. Refer to Subsection 520.02 for the type of material to be used.

In addition, the Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

520.04 Working Drawings.

The Contractor shall submit detailed working drawings including design calculations, signed and sealed by a Professional Engineer licensed in the State of New Jersey, 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 in accordance with the requirements specified under Subsection 105.04. The working drawing submission shall include, but not be limited to, the descriptive plan presentations that are listed in Subsection 105.04 of the Special Provisions.

COMPENSATION

520.05 Method of Measurement.

The method of measurement shall be in accordance with Subsection 521.03

520.60 Basis of Payment.

Payment will be made in accordance with Subsection 521.04.

SECTION 521 - ALTERNATE RETAINING WALL 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 104.12, 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.

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.

COMPENSATION

521.03 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 in 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 meter. 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.

521.04 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
RETAINING WALL, LOCATION NO. _____	SQUARE METER

SECTION 522 - 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 in lieu of the proposed precast posts and panels. However, the design calculations and detailed drawings shall be submitted in accordance with 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 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 600 by 600 by 100-millimeter 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 600 by 600 by 100-millimeter test panel. The test panels shall be prepared in accordance with Subsection 522.05, Subpart B utilizing the specified integral color to produce one 600 by 600 by 100-millimeter test panel.

Curing materials and methods of construction for curing integrally colored concrete shall be in accordance with 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 901.13. The maximum size of coarse aggregate shall not be larger than No. 67 as listed in Table 901-1 of Subsection 901.21, and it shall be washed. Adherent fines shall not exceed 1.0 percent. Total adherent and nonadherent 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-230, 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 325M and shall be galvanized in accordance with ASTM A 153. All hardware shall conform to A 36/A 36M and shall be galvanized in accordance with AASHTO M 111.

CONSTRUCTION

522.03 Working Drawings.

Working drawings shall be furnished in accordance with 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.

Prior to 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 prior to 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 in accordance with the Specifications.

522.05 Precast Concrete 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. Prior to the start of normal noise barrier fabrication and prior to 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 600 by 600 by 100-millimeter 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 prior to 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 prior to 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 450 millimeters 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):
   - 3 meters or under.....± 3 millimeters
   - Over 3 meters.....+ 3 millimeters, - 5 millimeters
   - Thickness.....± 3 millimeters
   - Out of square.....6 millimeters
2. After casting tolerances:
   - Bowing and warpage: 1/360 panel dimension with a maximum of 19 millimeters; differential bowing or camber between adjacent members of the same design shall not exceed 10 millimeters.
3. Position of cast-in items:
   - Recessed handling inserts.....± 10 millimeters
   - Reinforcement.....± 13 millimeters
   - Threaded inserts.....± 6 millimeters

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 in accordance with Subsection 501.14. The remainder of the exposed surfaces of the posts and panels on the roadway side shall be formed using the form liner type as specified in Subsection 522.02.

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 610

millimeter asphalt rake with every other tine removed. This tool is used to rake up the outer face to a depth of about 25 millimeters 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.

Prior to 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 the use of a "hotmelt" system. No glue, caulking orunfusec 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 prior to 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 10 degrees C or lower and shall be delayed for a period of three hours when the air temperature is 10 degrees C 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 63 +/- 6 degrees C 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 34 megapascals 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 21 megapascals.

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 6.9 kilopascals to 3.5 megapascals less than the class design strength for the specified concrete class, (i.e. for Class P concrete, this range will be between 38 megapascals to 35 megapascals). The pay adjustment will be in accordance with Section 914. Concrete will be rejected if the averaged single value is greater than the amount that is 3.5 megapascals 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	None	
Content	1.4 megapascals, minimum	ASTM D 4541
Adhesion to Concrete	(Average of five tests)	Elcometer Test
Gloss Flat	No visible	ASTM G 23
Weather-O-Meter	Degradation	Atlas Test
Carbon Arc	500 hours	
Solids by Weight	57 ± 2 percent	
Viscosity	70 to 75 Krebbs Units	ASTM D 562

The Contractor shall submit a Certificate of Compliance in accordance with 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.** Prior to 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.

   Prior to 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 prior to 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 in strict accordance with 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.

Prior to 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 19-liter plastic pails or open head 208-liter 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 7 and 32 ºC. The Concrete shall be completely dry. Stain shall not be applied unless weather conditions will permit complete drying of material prior to 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 in accordance with 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 breakoff 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.

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 in accordance with 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 32 millimeters. The width of open edge joints on the face panel may vary from 13 to 19 millimeters, 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 6 millimeters over the full length of the panel. The outside edge of the inner ply shall not be scant by more than 10 millimeters 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 13 millimeters.

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 in order 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 in order to provide an tight fit.

"Cross banding" at the middle layer of the 48-millimeter 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 4.6 meters 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.

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. Prior to 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 Right-of-Way 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 25 millimeters in any direction. The actual diameter of the hole constructed may be larger, but may not be more than 25 millimeters 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 prior to 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 200 millimeters 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 150 millimeters 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 13 millimeters 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 13 millimeters 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 6 millimeters 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.

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 2 millimeters.

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 in accordance with ASTM A153.

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.

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 13-millimeter 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 meters 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 METER
NOISE BARRIER, BRIDGE	SQUARE METER
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 prior to 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”.

DIVISION 600 - INCIDENTAL CONSTRUCTION

SECTION 601 - 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…….901.14
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 in accordance with Subsection 207.04. Backfilling shall be in accordance with Subsection 207.06.

601.04 Laying of Pipe

Laying of pipe shall be in accordance with 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 which have been damaged shall be painted with two coats of hot bituminous material conforming to AASHTO M 190.
3. All areas of polymer coating which have been damaged shall be repaired in accordance with the manufacturer's recommendations.

Dead ends of pipe underdrains shall be plugged with concrete in accordance with Subsection 613.05 or closed with a pipe cap.

COMPENSATION

601.05 Method of Measurement.

Subbase outlet drains will be measured by the linear meter. For each stone pocket, 0.5 meter of subbase outlet drain will be allowed.

Pipe for subbase outlet drains will be measured by the linear meter.

Underdrains of the various types will be measured by the linear meter.

601.06 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SUBBASE OUTLET DRAIN	LINEAR METER
___ MM CORRUGATED STEEL UNDERDRAIN PIPE	LINEAR METER
___ MM CORRUGATED ALUMINUM ALLOY UNDERDRAIN PIPE	LINEAR METER
UNDERDRAIN, TYPE ___	LINEAR METER

Payment for rock excavation will be made in accordance with Section 207.

Separate payment will not be made for pipe plugs.

SECTION 602 - PIPES

602.01 Description.

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.

Materials shall conform to the following Subsections:

Ductile Iron Culvert Pipe……913.02
Ductile Iron Water Pipe……913.03
Concrete Pipe……913.04
Corrugated Aluminum Alloy Culvert Pipe and Pipe Arches……913.05
Corrugated Steel Culvert Pipe and Pipe Arches……913.07
Corrugated Steel Sewer Pipe and Pipe Arches……913.08
Mortar and Grout……914.03
Gaskets……919.08

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.

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

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 in accordance with 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 which are damaged during jacking shall be replaced without additional compensation.

As each succeeding reinforced concrete pipe section is placed against the preceding jacked pipe, 13-millimeter 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 which 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 in order 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 in accordance with 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 which do not meet exactly shall be accomplished by forming a smooth concrete collar or plug, at least 150 millimeters 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 150 millimeters 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.

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 in accordance with Subsection 201.10.

602.08 Relaid Pipe.

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.

Construction operations for cured-in-place pipe shall be performed in accordance with local, State, or Federal safety requirements. The Contractor shall submit copies of the manufacturer's recommended method of installation to the Engineer.

Prior to entering manholes for inspection and cleaning operations, an investigation shall be conducted in accordance with 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 in accordance with 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 prior to the installation of the tube.

The Contractor shall designate the location where the tube is to become vacuum impregnated with resin prior to installation the tube shall be installed in the existing pipe through a manhole or other access point by means of an inversion process in accordance with 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 in accordance with 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 in accordance with 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 meter except for the distance between inner faces of inlet and manhole walls. Pipes with sloped or skewed ends will be measured along the invert.

Note: Corrugated aluminum alloy culvert pipe which is designated to be heavier than 1.52 millimeters thick will be measured with the quantity of 1.52-millimeter thick pipe. Corrugated steel culvert pipe which is designated to be heavier than 2.01 millimeters will be measured with the quantity of 2.01-millimeter pipe.

Reinforced concrete culvert pipe, of the various sizes, installed by the jacking and tunneling methods, will be measured by the linear meter.

End sections of the various sizes and kinds will be measured by the number of each.

Cleaning existing pipe of the various sizes will be measured by the linear meter.

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 meter 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*
___ MM DUCTILE IRON CULVERT PIPE	LINEAR METER
___ MM DUCTILE IRON WATER PIPE, CLASS___	LINEAR METER
___ MM CORRUGATED ALUMINUM ALLOY CULVERT PIPE	LINEAR METER
___ MM CORRUGATED STEEL CULVERT PIPE	LINEAR METER
___ MM CORRUGATED METAL CULVERT PIPE	LINEAR METER
___ MM REINFORCED CONCRETE CULVERT PIPE	LINEAR METER
___ MM REINFORCED CONCRETE CULVERT PIPE, CLASS___	LINEAR METER
___ MM REINFORCED CONCRETE CULVERT PIPE, JACKING AND TUNNELING METHODS	LINEAR METER
___ MM CORRUGATED ALUMINUM ALLOY END SECTIONS	UNIT
___ MM CORRUGATED STEEL END SECTIONS	UNIT
___ MM CORRUGATED METAL END SECTIONS	UNIT
___ MM REINFORCED CONCRETE END SECTIONS	UNIT
___ MM CORRUGATED STEEL SEWER PIPE	LINEAR METER
___ MM REINFORCED CONCRETE SEWER PIPE, CLASS___	LINEAR METER
___ BY ___ MM CORRUGATED ALUMINUM ALLOY CULVERT PIPE ARCH	LINEAR METER
___ BY ___ MM CORRUGATED STEEL CULVERT PIPE ARCH	LINEAR METER
___ BY ___ MM CORRUGATED METAL CULVERT PIPE ARCH	LINEAR METER
___ BY ___ MM REINFORCED CONCRETE CULVERT PIPE ARCH, CLASS___	LINEAR METER
___ BY ___ MM CORRUGATED ALUMINUM ALLOY END SECTIONS	UNIT
___ BY ___ MM CORRUGATED STEEL END SECTIONS	UNIT
___ BY ___ MM CORRUGATED METAL END SECTIONS	UNIT

___ BY ___ MM REINFORCED CONCRETE END SECTIONS	UNIT
___ BY ___ MM CORRUGATED STEEL SEWER PIPE ARCH	LINEAR METER
___ BY ___ MM REINFORCED CONCRETE SEWER PIPE ARCH, CLASS___	LINEAR METER
___ BY ___ MM REINFORCED CONCRETE ELLIPTICAL CULVERT PIPE, CLASS___	LINEAR METER
CLEANING EXISTING PIPE,___ TO ___ MM DIAMETER	LINEAR METER
CLEANING EXISTING PIPE, OVER___ TO ___ MM DIAMETER	LINEAR METER
CLEANING EXISTING PIPE,___ MM DIAMETER	LINEAR METER
RELAID (SIZE AND KIND) PIPE	LINEAR METER
____MM CURED-IN-PLACE PIPE, ___MM THICK	LINEAR METER

Payment for rock excavation will be made in accordance with Section 207.

Payment for concrete for pipe encasements or saddles or for permanent pipe plugs will be made in accordance with 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

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 in accordance with Subsection 207.04. Backfilling shall be in accordance with Subsection 207.06.

603.04 Concrete Construction.

Concrete construction shall be in accordance with 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 10 millimeters wide. The outside wall shall be plastered with a minimum thickness of 13 millimeters of mortar troweled to a smooth finish.

When the working day temperature is below 4 ºC, mortar shall be prepared by heating the mixing water and sand to produce mortar between 10 and 38 ºC. Masonry shall be maintained above 0 ºC for 24 hours by the use of 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 which require changes in pipe location, size, or type. Modifications to precast concrete inlets and manholes which 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. Prior to 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 prior to the placement of concrete for the adjacent curb.

Soil erosion and sediment control shall be in accordance with Section 212.

603.09 Castings and Fittings.

Cast iron 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 in order 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.

Existing inlet and manhole castings shall be disposed of unless they are to be used on the Project.

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 17 megapascals before the casting is exposed to traffic. Adjustment of grades and elevations in excess of 300 millimeters 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. Cast Iron Extension Frames and Rings. Cast iron extension frames for inlets and extension rings for manholes shall be used to raise existing structures to proposed grades and elevations. Before applying epoxy, 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 such as 1, 1, 1-trichloroethane. 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 in accordance with 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 frame or ring. 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.

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.

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 coal-tar seal coat conforming to Subsection 919.05.
2. Provide watertight manhole castings, unless existing castings are specified.

Sanitary sewer manholes which 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 number of each.

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, ___ MM 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

CAST IRON EXTENSION FRAMES FOR EXISTING INLETS	UNIT
CAST IRON EXTENSION RINGS FOR EXISTING MANHOLES	UNIT
CLEANING EXISTING DRAINAGE STRUCTURES	UNIT

Payment for rock excavation will be made in accordance with Section 207.

Payment adjustments for strength will be made in accordance with Subsection 914.02, Subpart F and will be applied to the lot for those Pay Items specified in that Subpart.

SECTION 604 - SLOPE GUTTERS

604.01 Description.

This work shall consist of the construction of portland cement concrete slope gutters.

MATERIALS

604.02 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

CONSTRUCTION

604.03 Excavation and Backfilling.

Excavation shall be in accordance with Subsection 207.04. Backfilling shall be in accordance with 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 which shall be compacted.

604.05 Concrete Slope Gutters.

Concrete slope gutters shall be constructed in accordance with 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 13 millimeters, preformed expansion joint filler placed at intervals of 6 meters.

COMPENSATION

604.06 Method of Measurement.

Concrete slope gutters of the various thicknesses will be measured by the square meter.

604.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CONCRETE SLOPE GUTTERS,___ MM THICK	SQUARE METER

SECTION 605 - CURBS

605.01 Description.

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.

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 6 meters between joints. Joints shall be filled with preformed expansion joint filler, 13 millimeters thick, which shall be flush with the top and face. Between concrete curbs and concrete surface or base course, 13-millimeter, preformed expansion joint filler shall be installed and the joint shall be sealed with hot-poured joint sealer.

D. Protection and Curing. Immediately after finishing the concrete in accordance with 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 in accordance with 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 19 millimeters 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 6 meters. 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.

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 prior to 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.

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 50 millimeter 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 meter along the face at the gutter line.

Note: Curbs in transition areas will be measured under the larger size.

Reset granite curb will be measured by the linear meter along the face at the gutter line.

Reinforcement steel for concrete barrier curb, white concrete barrier curb, and bridge of the various sizes will be measured by the kilogram. 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*
___ BY ___ MM CONCRETE BARRIER CURB	LINEAR METER
___ BY ___ MM CONCRETE BARRIER CURB, DOWELLED	LINEAR METER
___ BY ___ MM CONCRETE SLOPING CURB	LINEAR METER
___ BY ___ MM CONCRETE SLOPING CURB, DOWELLED	LINEAR METER
___ BY ___ MM CONCRETE VERTICAL CURB	LINEAR METER
___ BY ___ MM CONCRETE VERTICAL CURB, DOWELLED	LINEAR METER
___ BY ___ MM WHITE CONCRETE BARRIER CURB	LINEAR METER
BY ___ MM WHITE CONCRETE BARRIER CURB, DOWELLED	LINEAR METER
___ BY ___ MM WHITE CONCRETE BARRIER CURB, BRIDGE	LINEAR METER
___BY ___ MM CONCRETE BARRIER CURB, BRIDGE	LINEAR METER
___ BY ___ MM WHITE CONCRETE SLOPING CURB	LINEAR METER
____BY ___ MM WHITE CONCRETE SLOPING CURB DOWELLED	LINEAR METER
___ BY ___ MM WHITE CONCRETE VERTICAL CURB	LINEAR METER
____ BY ___ MM WHITE CONCRETE VERTICAL CURB, DOWELLED	LINEAR METER
___BY ___ MM CONCRETE SLOPING CURB	LINEAR METER
____BY ___ MM CONCRETE SLOPING CURB DOWELLED	LINEAR METER
BY ___ MM CONCRETE VERTICAL CURB	LINEAR METER
BY ___ MM CONCRETE VERTICAL CURB, DOWELLED	LINEAR METER
___ MM BY VARIABLE HEIGHT CONCRETE BARRIER CURB	LINEAR METER
___ MM BY VARIABLE HEIGHT CONCRETE BARRIER CURB, DOWELLED	LINEAR METER
___ MM BY VARIABLE HEIGHT CONCRETE VERTICAL CURB	LINEAR METER
___ MM BY VARIABLE HEIGHT CONCRETE VERTICAL CURB, DOWELLED	LINEAR METER
___ MM BY VARIABLE HEIGHT WHITE CONCRETE BARRIER CURB	LINEAR METER
___ MM BY VARIABLE HEIGHT WHITE CONCRETE BARRIER CURB, DOWELLED	LINEAR METER
___ MM BY VARIABLE HEIGHT WHITE CONCRETE VERTICAL CURB	LINEAR METER
___ MM BY VARIABLE HEIGHT WHITE CONCRETE VERTICAL CURB, DOWELLED	LINEAR METER

GRANITE CURB	LINEAR METER
RESET GRANITE CURB	LINEAR METER
REINFORCEMENT STEEL	KILOGRAM

Payment adjustments for strength will be made in accordance with Subsection 914.02, Subpart F and will be applied to the lot for those Pay Items specified in that Subpart.

SECTION 606 - BITUMINOUS CONCRETE CURB

606.01 Description.

This work shall consist of the construction of bituminous concrete curb.

MATERIALS

606.02 Materials.

Bituminous concrete shall conform to Section 903 and shall be Mix I-5 except that the composition of the mixture may include up to 20 percent of reclaimed asphalt pavement. 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……..	912.21

EQUIPMENT

606.03 Equipment.

The bituminous 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 in accordance with Subsection 202.04. Backfilling shall be in accordance with Subsection 203.06.

606.05 Preparation.

When curb is constructed on a freshly laid bituminous surface, the curb may be laid only after the surface has been cleaned. When curb is constructed on a cured or aged concrete base, bituminous surface, or bituminous treated base, the surface shall be thoroughly swept and cleaned by compressed air. The surface shall be thoroughly dried and, immediately prior to placing of the bituminous mixture, shall receive a tack coat in accordance with Subsection 404.13. 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 bituminous concrete shall conform to Section 903 and shall be placed with a bituminous 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 bituminous concrete 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.

Bituminous concrete 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 prior to 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.

Bituminous concrete curb of the various sizes will be measured by the linear meter along the face at the gutter line.

606.10 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
___ BY ___ MM BITUMINOUS CONCRETE CURB	LINEAR METER

SECTION 607 - SIDEWALKS AND DRIVEWAYS

607.01 Description.

This work shall consist of the construction of bituminous concrete 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.

Bituminous concrete shall conform to Section 903 except that the composition of the mixture for the top layer may also include up to 20 percent of reclaimed asphalt pavement. Portland cement concrete shall conform to Section 914 except that driveways shall attain a strength of not less than 21 megapascals 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 bituminous concrete 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 in accordance with ASTM D 1814:

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 1 millimeter.

The preformed marking tape shall be a durable, retroreflective, pliant, polymer material. The patterned material, without adhesive, shall have a minimum caliper of 0.508 millimeter 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 in accordance with ASTM E 303

CONSTRUCTION

607.03 Excavation and Backfilling.

Excavation shall be in accordance with 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 125 millimeters 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 which shall be compacted.

607.05 Bituminous Concrete Sidewalks and Driveways.

Bituminous concrete sidewalks and driveways shall consist of a bituminous concrete surface on a base course.

1. **Base Course.** Either soil aggregate or dense-graded aggregate may be used for sidewalks, and bituminous concrete 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 in accordance with Section 301.
    b. Bituminous concrete shall be in accordance with Section 305.
2. **Surface Course.** Bituminous concrete surface shall be constructed in accordance with Section 404 except that rollers shall weigh at least 450 kilograms.

607.06 Concrete Sidewalks, Driveways, and Public Sidewalk Curb Ramp Delineation.

Concrete sidewalks and driveways shall be constructed in accordance with 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 6 millimeters.

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 13 millimeters. The edges of the grooves shall be finished with an edging tool having a radius of 6 millimeters.

3. **Expansion Joints.** Expansion joints shall be 13 millimeters wide, placed at intervals of approximately 6 meters, 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, 6 millimeters 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 in accordance with 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 prior to 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**. Immediately prior to 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 in accordance with 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 38 grams per square meter. 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.

Prior to 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 meter.

Public sidewalk curb ramp delineation will be measured by the square meter

607.08 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
BITUMINOUS CONCRETE SIDEWALK,___ MM THICK	SQUARE METER
CONCRETE SIDEWALK,___ MM THICK	SQUARE METER
CONCRETE SIDEWALK, REINFORCED,___ MM THICK	SQUARE METER
BITUMINOUS CONCRETE DRIVEWAY,___ MM THICK	SQUARE METER
BITUMINOUS CONCRETE DRIVEWAY, VARIABLE THICKNESS	SQUARE METER
CONCRETE DRIVEWAY, ___ MM THICK	SQUARE METER
CONCRETE DRIVEWAY, REINFORCED,___ MM THICK	SQUARE METER
PUBLIC SIDEWALK CURB RAMP DELINEATION	SQUARE METER

SECTION 608 - ISLANDS

608.01 Description.

This work shall consist of the construction of bituminous concrete islands and portland cement concrete islands.

MATERIALS

608.02 Materials.

Bituminous concrete shall conform to Section 903 except that the composition of the mixture for the top layer may also include up to 20 percent of reclaimed asphalt pavement. 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 which shall be compacted.

608.04 Bituminous Concrete Islands.

Bituminous concrete islands shall conform to the construction requirements for bituminous concrete sidewalk in Subsection 607.05.

608.05 Concrete Islands and 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 6 meters 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*
BITUMINOUS CONCRETE ISLAND,___ MM THICK	SQUARE METER
WHITE CONCRETE ISLAND,___ MM THICK	SQUARE METER
CONCRETE ISLAND, _____MM THICK	SQUARE METER

SECTION 609 - RUBBLE MASONRY AND RUBBLE RIPRAP WALLS

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……...901.18
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.** Face joints shall be not more than 50 millimeters in width and other joints shall be not more than 100 millimeters 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 25 millimeters wide and shall be pointed before the mortar has set.

609.05 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 meter.

609.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
DRY RUBBLE MASONRY WALLS	CUBIC METER
MORTAR RUBBLE MASONRY WALLS	CUBIC METER
RUBBLE RIPRAP WALLS	CUBIC METER

SECTION 610 - CULVERTS AND HEADWALLS

610.01 Description.

This work shall consist of the construction of portland cement concrete culverts of less than 1.5-meter 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 in accordance with Subsection 207.04. Backfilling shall be in accordance with 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 in accordance with Section 501.

610.05 Precast Concrete Culverts and Precast Concrete Headwalls.

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 150-millimeter bed of compacted coarse aggregate No. 57 in size.

Reinforcement steel, if required for handling, shall have a minimum 50 millimeters 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 meter.

610.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CONCRETE CULVERTS	CUBIC METER
CONCRETE HEADWALLS	CUBIC METER

SECTION 611 - MONUMENTS

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 in accordance with Subsection 207.04. Backfilling shall be in accordance with Subsection 207.06.

611.04 Monuments.

Monuments shall be constructed in accordance with 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.

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.

Monuments and monument boxes that are to be relocated or reset shall not be moved or disturbed until they have been properly referenced. After having been referenced, they shall be reset. 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.

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, CN 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

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.

MATERIALS

612.02 Materials.

Materials shall conform to the following Subsections:

Rail Element…….902.01
Posts and Spacers…….902.02
Rub Rail……902.03
Miscellaneous Hardware……..902.04
Timber Posts…….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 prior to 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.

Prior to driving the posts, the location of underground electrical conduits which may conflict with the posts shall be determined. Post spacing may be adjusted by 150 millimeters or double spacers may be used, as approved, to eliminate such conflicts. A functional test of the electrical system shall be made prior to and upon completion of driving the posts. The functional test shall be in accordance with 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 and back-up plates at the intermediate posts. 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.

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 in accordance with 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 (Telephone:1-800-321-2755)

or Brakemaster System as manufactured by Energy Absorption Systems, Inc., Chicago, Illinois (Telephone: 312-467-6750).

Excavation for timber post holes and concrete anchorages shall be in accordance with Subsection 207.04. Backfilling shall be in accordance with Subsection 207.06.

612.05 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.

Spacers and back-up plates, 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.

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 in accordance with 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, spacers, and back-up plates 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.

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 in accordance with 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 in accordance with Subsection 106.04 that the 29-millimeter diameter anchor bolt shall have a minimum pullout strength of 89 kilonewtons.

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 in accordance with the ANSI/AWS D1.1 Structural Welding Code.

612.09 Removal of Guide Rail.

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 in accordance with 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 meter along the face of the rail excluding anchorages and end terminals. Dual-faced beam guide rail will be measured by the linear meter 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 meter along the face of the rail.

Block out beam guide rail will be measured by the linear meter.

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 meter.

612.11 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
BEAM GUIDE RAIL	LINEAR METER
BEAM GUIDE RAIL, BRIDGE	LINEAR METER
BEAM GUIDE RAIL, DUAL-FACED	LINEAR METER
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, ___ MM LONG	UNIT
BEAM GUIDE RAIL ELEMENT	LINEAR METER
RUB RAIL	LINEAR METER
BLOCK OUT BEAM GUIDE RAIL	LINEAR METER
RESET BEAM GUIDE RAIL WITH EXISTING POSTS	LINEAR METER
RESET BEAM GUIDE RAIL, DUAL-FACED,	

WITH EXISTING POSTS	LINEAR METER
REMOVAL OF GUIDE RAIL	LINEAR METER

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, spacers, or back-up plates within the limits of reset beam guide rail of the various kinds.

Payment adjustments for strength will be made in accordance with Subsection 914.02, Subpart F and will be applied to the lot for those Pay Items specified in that Subpart.

SECTION 613 - MISCELLANEOUS CONCRETE

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.

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
Reinforcement Steel	915.01

CONSTRUCTION

613.03 Excavation and Backfilling.

Excavation and backfilling shall be in accordance with Section 202, 206, or 207.

613.04 Mixing, Placing, Finishing, and Curling.

Mixing, placing, finishing, and curing of concrete including placing of reinforcement steel shall be in accordance with Section 405.

613.05 Pipe Plugs.

The thickness of pipe plugs shall be equal to the inside diameter of the pipe or 600 millimeters, whichever is less.

COMPENSATION

613.06 Method of Measurement.

Miscellaneous concrete will be measured by the cubic meter.

613.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
MISCELLANEOUS CONCRETE	CUBIC METER

Payment for rock excavation will be made in accordance with Section 207.

SECTION 614 - FENCES

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
Zinc Chromate Primer	912.07
Mortar and Grout	914.03

Portland cement concrete for fence post foundations shall conform to Section 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.

CONSTRUCTION

614.03 Preliminary Work.

Before beginning construction or placing of fences, site clearing shall be performed in accordance with Section 201. Any rock protruding above the ground surface and in the line of fence shall be removed to ground surface level in accordance with Section 202.

614.04 Chain-Link Fence.

Fence and gates shall be erected in accordance with 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 zinc chromate primer.
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 100 millimeters, 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.
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.

Existing fence materials which 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 which are no longer usable shall be disposed of in accordance with Subsection 201.10.

614.07 Temporary Fence.

Temporary chain-link fence and snow fence required to enclose hazardous construction areas and to complement the permanent fencing shall be erected prior to construction activity.

Plastic snow fence required to delineate ecologically sensitive areas shall also be erected prior to 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 in accordance with 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 meter along the bottom line of the fabric, deducting the width of gates.

Gates of the various kinds and sizes will be measured by the number of each.

Reset fence and temporary fence will be measured by the linear meter, including gates.

Snow fence of the various types will be measured by the linear meter.

Repairing chain-link fence will be measured by the linear meter 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 in accordance with the following:

Per linear meter of top rail replaced……0.2 linear meter
Per linear meter of top rail straightened……0.1 linear meter
Per unit of post replaced……...3 linear meters
Per unit of post straightened…… 1.5 linear meters
Per linear meter of tension wire replaced……0.05 linear meter
Per linear meter of vertical cuts mended……..0.05 linear meter

614.09 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CHAIN-LINK FENCE, ALUMINUM-COATED STEEL, ___ M HIGH	LINEAR METER
CHAIN-LINK FENCE, PVC-COATED STEEL, ___ M HIGH	LINEAR METER

CHAIN-LINK FENCE, ___ M HIGH	LINEAR METER
CHAIN-LINK FARM-TYPE FENCE	LINEAR METER
GATES, CHAIN-LINK FENCE, ALUMINUM-COATED STEEL, ___ M WIDE	UNIT
GATES, CHAIN-LINK FENCE, PVC-COATED STEEL, ___ M WIDE	UNIT
GATES, CHAIN-LINK FENCE, ___ M WIDE	UNIT
GATES, CHAIN-LINK FARM-TYPE FENCE, ___ M WIDE	UNIT
RESET FENCE	LINEAR METER
REPAIRING CHAIN-LINK FENCE	LINEAR METER
TEMPORARY CHAIN-LINK FENCE, ___ M HIGH	LINEAR METER
SNOW FENCE	LINEAR METER
SNOW FENCE, PLASTIC	LINEAR METER

Separate payment will not be made for chain link fence, Type NR, but all costs thereof will be paid for at the same linear meter price bid for the item it replaced.

Payment adjustments for strength will be made in accordance with Subsection 914.02, Subpart F, and will be applied to the lot for those Pay Items specified in that Subpart.

SECTION 615 - 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	912.02
Zinc Chromate Primer	912.07
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 in accordance with 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 25 millimeters of the top and sealing with bituminous material. The sand and bituminous material shall be completely removed just prior to 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 meter along the top of the rail.

615.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
METAL RAILING	LINEAR METER

SECTION 616 - SLOPE AND CHANNEL PROTECTION

616.01 Description.

This work shall consist of the construction of various kinds of slope and channel protection.

MATERIALS

616.02 Materials.

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	901.17
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 901.13.

In accordance with the provisions of Subsection 901.17, the required D50 riprap stone size shall be stated in the appropriate riprap stone Pay Item listed above.

CONSTRUCTION

616.03 Preparation of Slopes or Channels.

Immediately prior to 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 the use of mechanical or vibrating tampers or rollers.

616.04 Concrete Slope Protection.

Concrete slope protection shall be constructed by placing concrete on the prepared foundation in accordance with 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 15 millimeters on 2 meter centers, both ways. Scored edges shall be rounded to a 15-millimeter radius with an edging tool. A 13-millimeter 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 in accordance with Section 405.

616.05 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.

Concrete block and granite block slope protection shall be constructed by placing blocks on a 50-millimeter 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 50 millimeters. The layer shall not be placed more than 4.5 meters 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 6 millimeters and not more than 13 millimeters 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 which 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 4.5 meters 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 4 ºC or during rainy weather.

616.07 Riprap Stone Slope or Channel Protection.

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 300 millimeters out on each side. The extended edges of the geotextile fabric shall be buried under a minimum of 150 millimeters of soil. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 450 millimeters in the direction of flow.

The coarse aggregate shall be laid on the geotextile in a manner which 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 meter.

616.09 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
CONCRETE SLOPE PROTECTION, ___ MM THICK	SQUARE METER
CONCRETE SLOPE PROTECTION, REINFORCED, ___ MM THICK	SQUARE METER
CONCRETE BAG SLOPE PROTECTION, ___ MM THICK	SQUARE METER
CONCRETE BLOCK SLOPE PROTECTION, ___ MM THICK	SQUARE METER
GRANITE BLOCK SLOPE PROTECTION, ___ MM THICK	SQUARE METER
RIPRAP STONE SLOPE PROTECTION, ___ MM THICK (D50=___MM)	SQUARE METER
RIPRAP STONE CHANNEL PROTECTION, ___ MM THICK (D50=___MM)	SQUARE METER

Separate payment will not be made for geotextiles and coarse aggregate placed under riprap stone slope or channel protection.

SECTION 617 - TRAFFIC CONTROL

617.01 Description.

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……912.23
Temporary Pavement Markers……912.27

EQUIPMENT

617.03 Traffic Control Devices.

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.

Prior to 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 3 kilometers.

   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 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 barrier 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 in accordance with 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 barrier.

All construction barriers shall be provided with reflectors. The reflectors for precast concrete curb Types 1 and 4, and also for beam guide rail, shall consist of 150-millimeter wide by 300-millimeter high retroreflective sheeting, Type II or Type III-A, as specified in Subsection 916.04. The reflectors shall be mounted on a plastic or 2-millimeter aluminum support attached to the top of the construction barrier at 30-meter intervals, except that on curves with radii less than 580 meters, the interval shall be 15 meters. On the flared portion of the construction barrier, the reflectors shall be omitted when other traffic control devices are used to delineate travel paths.

Construction barrier curb Types 1 and 4 shall be provided with additional reflectors. The reflectors shall have a reflective area of 75 by 75 millimeters, mounted perpendicular to the upper face of the construction barrier curb and attached 75 millimeters from the top of the barrier curb. One reflector shall be attached at the lead end of each barrier segment. The reflectors shall be flexible or hinge-mounted so as to return to their original position after being struck. Any reflectors which fail to return to original position shall be replaced.

Retroreflective sheeting on reflectors 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 which 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 2.2 meters 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 600 by 1200-millimeter boards shall be equipped with 100-millimeter low intensity lights, and the arrow panel message shall be comprehensible by a driver from a distance of 0.8 kilometer 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 7000 candelas. The 0.6 by 1.2-meter boards shall only be used during the hours from dusk to dawn.

The 1 200 by 2 400-millimeter boards shall be equipped with 150-millimeter high intensity lights, and the arrow panel message shall be comprehensible by a driver from a distance of 1.6 kilometers 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 8800 candelas and shall be equipped with a photoelectric cell that shall automatically reduce the peak intensity to 1500

candelas when ambient light level drops to 54 lux. The 1200 by 2400 millimeter boards 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 prior to 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 prior to use on Projects.

A list of solar powered battery recharge arrow boards approved for use on Projects will be provided in the Special Provisions.

4. Variable Message Signs. Variable message signs shall be capable of displaying messages visible from distances of 0.8 kilometers under ideal day and night conditions and legible at distances of 275 meters 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 90 kilometers 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 -35 to 70 ºC. When in operation, the units shall be capable of withstanding wind gusts up to 130 kilometers per hour with 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 which are at a wavelength of 590 nanometers. Each line shall be capable of displaying eight characters equally spaced a minimum of 75 millimeters apart. Each character shall be a minimum of 430 millimeters in height and 300 millimeters 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 through the use of an integral or plug-in type keyboard system, or by remote control through the use of 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 which will indicate that the unit is on but not functioning properly).

A diesel and battery powered unit shall be equipped with a photocell in order 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 in order 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 48 kilometers 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 National Cooperative Highway Research Program Report, 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 in accordance with the NCHRP 350 report 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.) Temporaray 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 in accordance with the NCHRP 350 report 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 65 kilometers per hour.

6. Traffic Control Trucks with Mounted Crash Cushions. The trucks shall weigh a minimum of 9 megagrams 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 National Cooperative Highway Research Program Report. 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 100-millimeter 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 1 200 by 2 400-millimeter boards conforming to Subheading 3 above.

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 which 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 prior to the beginning of any Work which interferes with the owners' normal passage.

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.

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 10 meters from the traveled way. The barriers and crash cushions must be approved prior to installation. Furnishing, placing, and removing the barriers and crash cushions shall be at no cost to the State.

Work which 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.

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.

Prior to beginning a seasonal shutdown or any other prolonged Work stoppage, or when Work is suspended in accordance with 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.

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 50 lux shall be maintained throughout the entire area of operation. Area of operation is a work area that is a minimum of 20 meters ahead and behind the employee, where an employee is on or near the roadway.

   A minimum illuminance level of 50 lux 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
50 lux	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
50 lux	Bituminous concrete milling * Bituminous concrete paving operation *	General illumination throughout area of operation Minimum of 60 meters ahead and 60 meters behind equipment
50 lux	Bituminous concrete roller operation *	General illumination throughout area of operation Minimum of 30 meters ahead and 30 meters behind equipment

100 lux	Barrier walls and traffic separators Base course construction Bituminous concrete milling * Bituminous concrete paving operation * Bituminous concrete 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 8 meters ahead and 8 meters behind equipment Illumination shall be provided on the sides of the equipment
200 lux	Crack filling, sawcutting, and sealing joints Electrical work Highway street lighting Traffic signals Intelligent transportation systems	Illumination on task

* Both requirements of 50 lux and 100 lux 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. The equipment shall also have a minimum of 0.05 square meter high intensity retroreflective sheeting toward the extremities of each side of the equipment. A minimum of 0.1 square meter of the sheeting shall be visible from each direction. 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.

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.

The Engineer shall be notified one month in advance of a tentative date for establishing new traffic patterns. This date shall be finalized ten working days prior to the establishment of the new traffic patterns resulting from stage construction, and 15 working days prior to 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.

Prior to 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 a course of training approved by the Department, which is American Traffic Safety Services Association's (ATSSA) Traffic Control for Worksite Traffic Supervisors (WTS) Training Course or equivalent as approved by the Resident Engineer, 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 replacement at once 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 in accordance with 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 50 millimeters deep are eliminated, covered, or otherwise protected during non-working periods.

617.09 Traffic Control Plan.

The traffic control plan provides for the treatment of conditions caused by or encountered during the Work on the Project. The Work shall be performed in accordance with the traffic control plan.

The traffic control plan shall be a stand-alone document and shall not be reliant on any ancillary conditions or circumstances relative to the Project site or circumstances. It is the Contractor's sole responsibility to implement the traffic control plan. The traffic control plan 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 prior to the start of Work, the Contractor will submit a written traffic control plan for operations to the Engineer for acceptance. The Engineer will review and approve the traffic control plan with reasonable promptness, but only for conformance with the design concept of the Project, and with the information given in the Contract Documents. The Engineer's approval of the traffic control plan 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 traffic control plans. The traffic control plan shall detail the means of traffic control for all aspects of the Contractor operations. The traffic control plan shall be signed and bear the raised seal of a Professional Engineer licensed to practice in the State. The traffic control plan shall identify any contingencies or foreseen problems and address remedial actions. Subsequent changes to the traffic control plan 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.

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 their competency to the traffic control coordinator; any failing to demonstrate competency shall be replaced at once with a competent person at the direction of the traffic control coordinator.

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 in order 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) or, if so designated in the Special Provisions, they shall 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 which 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 prior to 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 New Jersey 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 which 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.

Variable message signs shall be located such that they provide motorists with clear, unobstructed visibility of the signs from distances of 0.8 kilometers and legibility of the sign messages at a minimum of 275 meters 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 275 meters distant from the source with a total minimum viewing angle of 25 degrees and completing both message cycles when the same viewer is 75 meters 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 in order 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.

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 100 millimeters in height or extend more than 200 millimeters beyond the

modules. No part of a metal platform shall be more than 50 millimeters in height or extend more than 200 millimeters 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 1.4 to 1.6 megagrams per cubic meter and a three percent maximum allowable moisture content. A minimum of five percent sodium chloride shall be thoroughly mixed with the sand to prevent freezing.

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 in accordance with 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 bituminous concrete foundation with steel backup structures in accordance with 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 in accordance with 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 in accordance with 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 in accordance with 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 Traffic Control Trucks with Mounted Crash Cushions.

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 in accordance with 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 which 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.

617.14 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 50 millimeters. Any marker that comes up from the pavement prior to 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 prior to 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 prior to 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.

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 in accordance with Subsection 618.05. Marking tape shall be applied on dry surfaces, when the surface temperature is between 10 and 66 ºC and when the ambient temperature is 10 ºC 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 meter, number of each, or unit basis is the maximum quantity required to be in service at one time in accordance with traffic control requirements.

Barricades of the various types will be measured by the linear meter.

Breakaway barricades will be measured by the number of units.

Construction barriers of the various kinds and types will be measured by the linear meter.

Construction signs will be measured by square meter.

Construction identification signs of the various sizes will be measured by the number of each.

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 meter.

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 number of each.

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 meter of 100-millimeter wide strips, deducting the gaps. Gaps will not be counted.

617.17 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
BARRICADES, TYPE___	LINEAR METER
BEAM GUIDE RAIL, CONSTRUCTION BARRIER	LINEAR METER
BREAKAWAY BARRICADES	UNIT
CONSTRUCTION SIGNS	SQUARE METER
CONSTRUCTION IDENTIFICATION SIGNS, ___ BY ___ MM	UNIT
DELINEATOR GUIDE POSTS	UNIT
DRUMS	UNIT
ILLUMINATED FLASHING ARROWS,___ BY ___ MM	UNIT
PRECAST CONCRETE CURB, CONSTRUCTION BARRIER, TYPE___	LINEAR METER
TEMPORARY SIDEWALK	SQUARE METER
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 METER

No payment will be made to the Contractor for traffic safety services.

Payment for traffic control devices which are on a unit or linear meter 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 in accordance with 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

618.01 Description.

This work shall consist of applying white or yellow pavement stripes or markings and reflectors and castings to bituminous concrete 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 bituminous concrete and portland cement concrete surfaces.

MATERIALS

618.02 Materials.

Materials shall conform to the following Subsections:

Pavement Stripes or Markings……912.21
Glass Beads……912.22
Pavement Reflectors and Castings……912.28

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 which shows the number of the truck body, the capacity thereof, and an outage table in increments of not over 15 millimeters. 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 300 millimeters 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 in order 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 which 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.

The Contractor shall furnish for approval, 20 calendar days prior to 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 in order 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 150 meters 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 prior to 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 25 millimeters 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 bituminous concrete 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 60 ºC 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 7 ºC and rising. The latex traffic paint shall be applied in a wet film thickness of 150 ± 25 micrometers where traffic stripes are required for 14 days or less. The traffic paint shall be applied in a wet film thickness of 380 ± 25 micrometers 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 1.4 kilograms per liter of paint.

   When traffic stripes or traffic markings are required to remain visible beyond 14 days, the Contractor shall apply, prior to 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 bituminous concrete overlay.
2. **Alkyd Traffic Paint.** The Contractor shall apply alkyd traffic stripes or traffic markings when the ambient and surface temperatures are between 2 and 7 ºC. The alkyd traffic paint shall be applied in a wet film thickness of 150 ± 25 micrometers where traffic stripes are required for 14 days or less. The traffic paint shall be applied in a wet film thickness of 280 ± 25 micrometers 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 0.7 kilogram per liter of paint.

When traffic stripes or traffic markings are required to remain visible beyond 14 days, the Contractor shall apply, prior to Acceptance and when directed, additional applications at least 15 days after the initial application and after any sawing or sealing of joints in the bituminous concrete overlay.

618.07 Long-Life Epoxy Resin Traffic Stripes.

The Contractor shall mix epoxy resin material with an automatic proportioning and mixing machine and hot-spray the compound at a temperature between 38 and 55 ºC onto thoroughly dry surfaces. The material shall only be placed during anticipated dry weather when the ambient temperature is a minimum of 7 ºC and the surface temperature is a minimum of 10 ºC. 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 500± 25 micrometers.

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 1.4 kilograms per liter 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.

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 205 and 220 ºC, to thoroughly dry surfaces and during anticipated dry weather, when the ambient and surface temperatures are a minimum of 10 ºC. The thermoplastic traffic markings shall be extruded on the bituminous or portland cement concrete pavement in a thickness of 2.3 millimeters.

   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 0.5 kilogram per square meter 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 50 millimeters from the joint in accordance with 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 50 millimeters 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 50 millimeters 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 which 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 10 ºC.

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 600 millimeters 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 3 meter broken line if the line shall be replaced is determined to have a deficiency.
2. The entire length of striping determined to have a wet film thickness of less than 480 micrometers shall be restriped with 500 micrometers 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 30 meters 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 1.5 meters 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 300-meter distance, the entire 300 meters shall be replaced.
5. The entire length of 1 kilometer of striping shall be replaced where the initial retroreflectance value of two of four readings for that 1 kilometer of 100-millimeter wide striping is less than 375 millicandelas per square meter per lux for white or 250 millicandelas per square meter per lux for yellow when taken with a Mirolux-12 retroreflectometer.
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 meter per lux for white or 250 millicandelas per square meter per lux for yellow. Initial retroreflectance will be determined as follows:

   Step 1: Visual night inspections will be made to identify traffic markings which 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 bituminous concrete 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.

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 2 ºC in order 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.

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 2 millimeters of pavement thickness. Area of removal includes the area of the stripe or marking plus 25 millimeters 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 in accordance with Subsection 201.10.

COMPENSATION

618.13 Method of Measurement.

Traffic stripes of the various types and materials will be measured by the linear meter for each 100-millimeter 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 meter for each 100-millimeter 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 meter.

Removal of traffic stripes and markings will be measured by the linear meter for each 100-millimeter width of stripe or marking. Width in excess of 100 millimeters will be converted to equivalent linear meters of 100-millimeter width.

Pavement reflectors and castings of the different types will be measured by the number of units.

618.14 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
TRAFFIC STRIPES	LINEAR METER
TRAFFIC STRIPES, LONG-LIFE, EPOXY RESIN	LINEAR METER
TRAFFIC MARKINGS, LINES	LINEAR METER
TRAFFIC MARKINGS, SYMBOLS	SQUARE METER
TRAFFIC MARKINGS, LINES, LONG-LIFE, THERMOPLASTIC	LINEAR METER
TRAFFIC MARKINGS, SYMBOLS, LONG-LIFE, THERMOPLASTIC	SQUARE METER
REMOVAL OF TRAFFIC STRIPES AND MARKINGS	LINEAR METER
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

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".

Payment for temporary pavement markers will be made in accordance with Section 617.

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 in accordance with the MUTCD, published by FHWA.

MATERIALS

619.02 Materials.

Materials shall conform to the following Subsections:

Zinc Chromate Prime……912.07
Mortar and Grout……914.03
Reinforcement Steel……915.01
Aluminum……916.01
Aluminum Extruded Sign Panels……916.02
Paints……916.03
Retroreflective Sheeting……916.04
Legends, Borders, and Accessories……916.05
Steel……916.06
Stainless Steel……916.07
Fabrication……916.08
Breakaway Sign Supports……916.09

"U" Post Sign Supports……916.10
Non-Breakaway Sign Supports……... 916.11
Overhead Sign Supports…….. 916.12

Portland cement concrete for sign post footings shall conform to Section 914.

CONSTRUCTION

619.03 Regulatory and Warning Signs.

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 in accordance with Subsection 916.08.

Signs shall be installed in accordance with 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 prior to determining the sign post lengths.
2. **Mounting Signs.** Signs shall be mounted on "U" post sign supports. 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.

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 “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 prior to the time when needed for the Project and shall include the quantity for each type required.

Guide signs shall be installed in accordance with 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 "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 "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 meter.

Guide signs of the various types will be measured by the square meter.

619.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SIGNS	SQUARE METER
GUIDE SIGNS, TYPE GA, "U" POST SUPPORTS	SQUARE METER
GUIDE SIGNS, TYPE GA, BREAKAWAY SUPPORTS	SQUARE METER
GUIDE SIGNS, TYPE GA, NON-BREAKAWAY SUPPORTS	SQUARE METER
GUIDE SIGN PANELS, TYPE GO	SQUARE METER
GUIDE SIGN PANELS, TYPE GOX	SQUARE METER

Separate payment will not be made for posts for signs.

Payment for sign support structures will be made in accordance with Section 509.

Payment for sign illumination will be made in accordance with Section 705.

Payment adjustments for strength will be made in accordance with Subsection 914.02, Subpart F, and will be applied to the lot for those Pay Items specified in that Subpart.

SECTION 620 - 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.

Flexible delineator units shall be driven vertically into the ground to a minimum depth of 450 millimeters. 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 75 by 300 millimeters, beginning a maximum of 50 millimeters 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.

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 25 meters (13 sections of guide rail) for tangent mainline roadway, and every 13.5 meters (seven sections of guide rail) for curved mainline roadways with radii less than 580 meters. 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 6 meters on curved mainline roadways, or 12 meters 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 115 by 115 millimeters (115 by 230 millimeters 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.

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 24 meters. If the distance between the end of the concrete barrier curb and the adjacent delineator is greater than 12 meters, 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, 75 millimeters 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 90 by 90 millimeters. 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

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

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 in accordance with the NCHRP 350 report 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 1.4 to 1.6 megagrams per cubic meter, and a three percent maximum allowable moisture content. A minimum of five percent sodium chloride shall be added to the sand to prevent freezing.

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 which 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 in accordance with 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 -29 ºC.

Hi-dro cell cluster units which 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 bituminous concrete foundation pad with steel backup structures in accordance with Section 613 and the manufacturer's recommendations. The manufacturer's trained representative shall be present at all times during the installation. QuadGuard units which are damaged during replacement or due to the construction operations after placement shall be replaced at no additional cost to the Department..

QuadGuard units which 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

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 in accordance with Subsection 207.04.
2. Backfilling shall be in accordance with 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 which 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 450 millimeters 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 meter.

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
___ MM COPPER WATER SERVICE PIPE	LINEAR METER
WATER SERVICE CONNECTIONS	UNIT
SANITARY SEWER HOUSE CONNECTIONS	UNIT
___ MM GATE VALVES AND BOXES	UNIT
___ MM TAPPING SLEEVES AND VALVES	UNIT
___ BY ___ MM TAPPING SLEEVES AND VALVES	UNIT
___ BY ___ MM TEES	UNIT

Payment for rock excavation will be made in accordance with Section 207.

Payment for pipe plugs, encasements, thrust blocks, or saddles will be made in accordance with Section 613.

Payment for sewer or water pipe will be made in accordance with Section 602.

Payment for sanitary sewer manholes or reconstructing sanitary sewer manholes will be made in accordance with Section 603.

DIVISION 700 - ELECTRICAL

SECTION 701 - 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 in accordance with 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	912.04
Rust-lnhibitive Primer	912.05
Foliage Green Urethane Finish Coat	912.24
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 which are available by accessing the NJDOT Bulletin Board Service at (609) 530-5151.

CONSTRUCTION

701.03 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 prior to 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 in accordance with 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 which are abandoned under the Contract shall be removed to a depth of 300 millimeters below grade. Should a foundation or junction box interfere with the installation of a new facility, it shall be completely removed. Backfilling shall be in accordance with Subsection 203.09. The Engineer may direct compaction to be in accordance with Subsection 203.10 except that the frequency may be increased. Debris shall be disposed of in accordance with 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 which are abandoned shall be removed and disposed of in accordance with 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.

Prior to 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.

Working drawings shall be furnished for all electrical materials and equipment not pre-approved, in accordance with Subsection 105.04.

A copy of the pre-approved materials procedure is available, upon request, from the Office of Traffic Signal and Safety Engineering, New Jersey Department of Transportation, 1035 Parkway Ave., 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 Office 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.

The furnishing of lines, grades, and bench marks shall be as specified in Subsection 105.11.

701.06 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 150 millimeters, 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 in order to preserve and protect the conduit, the Engineer may direct the excavation of test pits in accordance with Subsection 207.04.

701.07 Conduits.

Conduit installed above ground shall be rigid metallic conduit except as required by Section 705.

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 600 millimeters from the edge of pavement.

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 150 millimeters.

After the conduit has been installed in the trench, the trench shall be filled with concrete to within 150 millimeters 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, 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 prior to 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 25 millimeters 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.

701.17 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 in accordance with Sections 806 and 808.

COMPENSATION

701.19 Method of Measurement.

Conduit of the various kinds, types, and sizes will be measured by the linear meter including the lengths of conduit abandoned from all attempts made to bypass obstructions using proper jacking methods.

Ground wire installed in conduit will be measured by the linear meter.

Wire of the various kinds and gauges, including slack, will be measured by the linear meter.

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 each.

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*
___ MM FLEXIBLE METAL CONDUIT	LINEAR METER
___ MM RIGID METALLIC CONDUIT, TYPE___	LINEAR METER
___ MM RIGID NONMETALLIC CONDUIT	LINEAR METER
GROUND WIRE, NO.___ AWG	LINEAR METER
MULTIPLE LIGHTING WIRE, NO.___ AWG	LINEAR METER
SERVICE WIRE, NO.___ AWG	LINEAR METER
CABLE RACK ASSEMBLIES	UNIT
FOUNDATIONS, TYPE___	UNIT
JUNCTION BOX FOUNDATIONS	UNIT
___ MM JUNCTION BOXES	UNIT
___ BY ___ MM JUNCTION BOXES	UNIT
___ BY ___ BY ___ MM JUNCTION BOXES	UNIT
JUNCTION BOX FRAMES AND COVERS	UNIT

Payment for traffic directors will be made in accordance with Section 617.

Payment for clearing site will be made in accordance with Section 201.

Payment for test pits will be made in accordance with Section 207.

Payment for concrete sidewalks and driveways will be made in accordance with Section 607.

Payment for topsoiling and fertilizing and seeding will be made in accordance with Sections 806 and 808.

Separate payment will not be made for ground wire installed in junction boxes, standard bases, meter cabinets, and equipment enclosures.

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

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 and meter cabinets, 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 in accordance with 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……906.19

The following materials and equipment shall conform to the New Jersey Electrical Materials Specifications listed below:

Joint Sealant……..….. EBM-JS-1
Loop Detector Card……..BM-LD-CARD
Optically Programmed Traffic Signal Head…….. EBM-TS-2
Pedestrian Signal Head…….. EBM-PS-1
Push Button Assembly……..EBM-PPB-1
Traffic Signal Head……EBM-TS-1
Traffic Signal Controller:
Eight-Phase…… EBM-TSC-ITB-8
Fiberoptic Two Color Turn Arrow……..EBM-TS-3
Optically Controlled Emergency Vehicle Detection System…EBM-EOVD
Test Controller Unit for Two to Eight-Phase Solid State
NEMA Type Traffic Signal Controllers……EBM-TSC-CTU
Optically Programmed Adjustable Face

Pedestrian Signal Heads……EBM-PS-4
Fiberoptic Blankout Sign……EBM-FOBS
Red LED Traffic Signal Module……EBM-REDLED-TSM
Green LED Traffic Signal Module……EBM-GRNLED-TSM
Green, Amber, and Red LED
Turn Arrow Module……EBM-LED-GARTAM
LED Bi-modal Turn Arrow Module……EBM-LED-BTAM

Other materials and equipment shall conform to the following:

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.
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.
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 signal head and traffic signal cable from the terminal block of each face to the base of the standard.

PEDESTAL ASSEMBLIES (HEIGHT 2.5 METERS)

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 2.5 METERS)

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 in accordance with 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.

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.
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.
7. **Traffic Signal Cable.** Traffic signal cable shall be multi-conductor cable conforming to Subsection 906.19 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.

    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 which shall fit a 229-millimeter, 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	NominalArm Length (Meters)	No.of Std. Faces	No.of Spider Assemblies	No.of Prog. Faces
4.6MA-1	4.6	1	0	0
4.6MA-2	4.6	2	1	0
4.6MA-3	4.6	3	1	0
4.6MA-4	4.6	4	1	0
6.1MA-1	6.1	1	0	0
6.1MA-2	6.1	2	1	0
6.1MA-3	6.1	3	1	0
6.1MA-4	6.1	4	1	0
7.6MA-1	7.6	1	0	0
7.6MA-2	7.6	2	1	0
7.6MA-3	7.6	3	1	0
7.6MA-4	7.6	4	1	0
9.1S-1	9.1	1	0	0
9.1S-2	9.1	2	0	0
10.7S-1	10.7	1	0	0
10.7S-2	10.7	2	0	0
12.2S-1	12.2	1	0	0
12.2S-2	12.2	2	0	0

Use "H" assemblies according to the following table when replacing signals on mast arms:

REPLACEMENT TRAFFIC SIGNAL ASSEMBLIES

Type	Nominal Arm Length (Meters)	No. ofStd. 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
H-1-1-OP	NA	1	1	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, 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.

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

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. A 203-millimeter Type TB-30 base with through bolts shall be furnished with all traffic signal standards mounted on 279-millimeter bolt circles.
   b. A 508-millimeter Type TB-20 base shall be furnished with all traffic signal standards mounted on 381-millimeter bolt circles.
   c. A 610-millimeter Type TB-K base shall be furnished with all traffic signal standards mounted on 559-millimeter 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.
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 6 millimeters.

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 the top of meter cabinets and foundations, with stainless steel hardware, in a perpendicular position. When a controller cabinet is installed on the top of a meter cabinet, 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.

channel at temperatures below 7 ºC 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 which 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.

Construction of the temporary and interim traffic signal system shall be in accordance with 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 wood-pole temporary traffic signal system, complete design calculations by a New Jersey licensed Professional Engineer shall be required to be submitted for review and approval as part of this item.

This maintenance responsibility 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 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 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 effect 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 his 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 in accordance with 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 effect 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 his 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.

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 prior to Completion. Thirty days prior to 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 meter of saw cut in which the wire is installed.

Loop detector leads and traffic signal cables will be measured by the linear meter.

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 be measured by the number of units.

702.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
LOOP DETECTOR	LINEAR METER
LOOP DETECTOR LEAD	LINEAR METER
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 METER
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 in accordance with 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 in accordance with Section 701 or this Section, as appropriate.

SECTION 703 - 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……. EBM-LHPS-2
Offset Type……... EBM-LHPS-3
High Mast Type……. EBM-LHPS-4
Vertical Mounted Type…….. EBM-LHPS-6
Offset Type……. EBM-LHPS-7
Underdeck Luminaires High Pressure Sodium:
Wall Mounted Type……. EBM-UHPS-1
Pendant Type……... EBM-UHPS-2
Photoelectric Control Unit…… EBM-PEC-1
Storage Kit……. EBM-KIT
Cutoff Type…….. EBM-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/or nonfused), and two color-coded No. 10 AWG 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 designed 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	Nominal Arm Length (meters)	Arms	Luminaires	Lamp Size
L-2.4-X	2.4	1	1	150W-HPS
L-2.4-SB-X	2.4	1	1	150W-HPS
L-2.4-T-X	2.4	2	2	150W-HPS
L-2.4-12.2-X	2.4	1	1	150W-HPS
L-2.4-12.2-SB-X	2.4	1	1	150W-HPS
L-2.4-12.2-T-X	2.4	2	2	150W-HPS

LIGHTING STANDARD ASSEMBLIES

Type	Nominal Arm Length (meters)	Arms	Luminaires	Lamp Size
L-2.4-12.2-Y	2.4	1	1	250W-HPS
L-2.4-12.2-SB-Y	2.4	1	1	250W-HPS
L-2.4-12.2-T-Y	2.4	2	2	250W-HPS
L-2.4-CF-X	2.4	1	1	150W-HPS
L-2.4-SB-CF-X	2.4	1	1	150W-HPS
L-2.4-T-CF-X	2.4	2	2	150W-HPS
L-2.4-12.2-CF-X	2.4	1	1	150W-HPS
L-2.4-12.2-SB-CF-X	2.4	1	1	150W-HPS
L-2.4-12.2-T-CF-X	2.4	2	2	150W-HPS
L-2.4-12.2-CF-Y	2.4	1	1	250W-HPS
L-2.4-12.2-SB-CF-Y	2.4	1	1	250W-HPS
L-2.4-12.2-T-CF-Y	2.4	2	2	250W-HPS
L-4.6-X	4.6	1	1	150W-HPS
L-4.6-SB-X	4.6	1	1	150W-HPS
L-4.6-T-X	4.6	2	2	150W-HPS
L-4.6-12.2-X	4.6	1	1	150W-HPS
L-4.6-12.2-SB-X	4.6	1	1	150W-HPS
L-4.6-12.2-Y	4.6	1	1	250W-HPS
L-4.6-12.2-SB-Y	4.6	1	1	250W-HPS
L-4.6-CF-X	4.6	1	1	150W-HPS
L-4.6-SB-CF-X	4.6	1	1	150W-HPS
L-4.6-T-CF-X	4.6	2	2	150W-HPS
L-4.6-12.2-CF-X	4.6	1	1	150W-HPS
L-4.6-12.2-SB-CF-X	4.6	1	1	150W-HPS
L-4.6-12.2-CF-Y	4.6	1	1	250W-HPS
L-4.6-12.2-SB-CF-Y	4.6	1	1	250W-HPS
L-2.4-V-X	2.4	1	1	150W-HPS
L-2.4-SB-V-X	2.4	1	1	150W-HPS
L-2.4-T-V-X	2.4	2	2	150W-HPS
L-4.6-V-X	4.6	1	1	150W-HPS
L-4.6-SB-V-X	4.6	1	1	150W-HPS
L-4.6-T-V-X	4.6	2	2	150W-HPS
TL-30.5-8	0	0	8	400W-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 lumimaires.

LIGHTING ARM ASSEMBLIES

Type	Nominal Arm Length (meters)	Luminaires	Lamp Size
L-2.4A	2.4	1	150W-HPS
L-4.6A	4.6	1	150W-HPS
L-2.4A-CF	2.4	1	150W-HPS
L-4.6A-CF	4.6	1	150W-HPS
L-2.4A-V	2.4	1	150W-HPS
L-4.6A-V	4.6	1	150W-HPS

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 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 typelumimaires.

LIGHTING ASSEMBLIES

Type	Nominal Arm Length (meters)	Arms	Luminaires	Lamp Size
L-R-X	0	0	1	150W-HPS
L-R-12.2-Y	0	0	1	250W-HPS
L-R-E-12.2-Z	0	0	1	400W-HPS
L-R-E-12.2-Y	0	0	1	250W-HPS
L-R-E-7.9-Y	0	0	1	250W-HPS
L-R-E-7.9-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-12.2-CF-X	0	0	1	150W-HPS
L-R-12.2-CF-Y	0	0	1	250W-HPS
L-R-12.2-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.
6. **Underdeck Lighting Assemblies.** Underdeck lighting assemblies shall consist of an underdeck luminaire, lamp, and two color-coded No. 10 AWG wires from the 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.

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. Electrical service for the temporary system shall be obtained 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 6 millimeters 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 conforming to the NEC.

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 ~~i~~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 in order 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 in accordance with 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.

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 each.

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*
___ BY ___ BY ___ MM 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 in accordance with 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

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/A 588M 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 6 meters 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 36 kilograms each
Maximum projected area…….. 0.35 square meter per luminaire
V ……... 129 kilometers 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 64-kilometer 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/A 588M, 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 in accordance with 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 380 megapascals and shall conform to ASTM A 709/A 709M, Grade 250 and ASTM A 307. 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 150 millimeters of the embedded portion of the anchor rods and the nuts shall be hot-dip galvanized conforming to ASTM A 153.

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 738M. Bolts heads and nuts shall be hexagonal.

D. Tower Luminaire Ring Lowering Device. Each pole shall be furnished with a luminaire ring lowering device which 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 1.5 meters 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 which 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 which 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/A 709M, Grade 250 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 which 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 3 meters 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 which 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 135 kilograms.

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 40 kilometers 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 4 meters per minute to a maximum of 6 meters 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 which 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 which 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 6 meters 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 in accordance with 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 150 millimeters 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 each.

704.06 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
TOWER LIGHTING STANDARD ASSEMBLIES, TYPE___	UNIT

SECTION 705 - 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…… EBM-PEC-1
Sign Luminaires……... EBM-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 conforming to the requirements of the NEC.

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 which 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 each.

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 in accordance with Section 701.

SECTION 706 - 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 Section 701 and Section 702.

The following materials and equipment shall conform to the New Jersey Electrical Materials Specifications listed below:

Cable Locator……EBM-CBLR
CCTV Assembly (Remote Color Control)…… EBM-CCTV-COLOR
RS232 Dial-Up Modems (Low Speed)…….. EBM-DIALUP-1
Ramp Meter Blank-Out Signs (Fiber Optic)...…….…..EBM-FOBS-2
Patch Panels Fiber Optic Cable.....…….…EBM-FOC-PP-1
Single Mode, Loose Tube, Single Jacket Fiber Optic Cable…….……...EBM-FOC-SMLTSJ-1
Single Mode, Loose Tube, Termination (Fiber Optic Cable).....……EBM-FOC-SMLTT-1
Fusion Splice and Splice Enclosure (Fiber Optic Cable).....……EBM-FOC-SPLC-1
Connectors, Type ST (Fiber Optic Cable).....…….EBM-FOC-ST-1
483 Millimeter Rack Base Mount (Field Terminal Cabinet).....……EBM-FTC-1
483 Millimeter Rack Base Mount (Heater/AC) (Environmental Field Terminal Cabinet).....……EBM-FTC-2
483 Millimeter Rack Base Mount (Video/Loop) (Video/Loop Field Cabinet).....……EBM-FTC-3
VME Bus Computer (Field Terminal VME Bus Processor Assembly).....……EBM-FTERM-VME
HAR System.....……EBM-HAR-2
Long Distance Video Transmission System….……EBM-LDV-1
RS232 Leased Line Modems (low Speed Model 400).....……EBM-LEASED-400
Long Haul Multiplexed Video (Single Mode Fiber Optic Cable Transmission System).....……EBM-LHVIDEO
Maintenance Weather Station.....…….…EBM-MAINT-WSTA-1
PVC Multiduc (Communications Conduit)…….…….. EBM-MULTI-1
Type F (Fiberglass Multiduct) (Communications Conduit).....……EBM-MULTI-2
Type S (Galvanized Steel Multiduct) (Communications Conduit).....……EBM-MULTI-3
Single Mode Fiber OpticMultiplexer.....……...….. EBM-SMF-MUX
Single Mode Fiber Modems.....……...…EBM-SMFOMODS
Sonet (Single Mode Fiber Optic Long Haul SONET Multiplexer).....……....…EBM-SONET
Radar Detectors (Speed Station).....……...…EBM-SPEED
TOC Central Computer (Traffic Operations Center Computer Equipment).....……....…EBM-TOCCE-1
TOC Large Direct View Monitor.....…….....….EBM-TOCLSD-1
TOC Video Switcher/Control.....…….....….EBM-TOCVCE-1
Traffic Controller Assembly Hardware (Eight phase 170E Traffic Controller Assembly).....……...…EBM-TSC-170E

Software (Eight phase 170E Intersection Software Program).....EBM-TSC-170E-ISOFT
Video Detectors.....EBM-VIDEO
Remote Video Workstation.....EBM-VIDWS2
Weather Station.....EBM-WSTA-2
Closed Loop System On-Street Master.....EBM-OSM-1
Closed Loop System Operator Console.....EBM-OC-1
Closed Loop Traffic Signal Control System.....EBM-CL-1
Closed Loop Traffic Signal Control System.....EBM-CL-2
Eight Phase Traffic Signal Controller Assembly for a Closed Loop System.....EBM-TSC-8CL
Closed Loop System Maintenance Console.....EBM-MC-1
Closed Loop System Engineering Console.....EBM-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.

SECTION 808 - FERTILIZING AND SEEDING

808.01 Description.

This work shall consist of furnishing and placing of pulverized limestone, fertilizer, seed mixtures and straw mulching and the preparation and layout of wildflower seed beds.

MATERIALS

808.02 Materials.

Materials shall conform to the following Subsections:

Fertilizer……909.02
Limestone, Pulverized……..909.03
Seed Mixtures……...909.06
Binders……..909.01
Straw Mulching……909.04
Wildflower Seed Mixtures……909.06

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 (kilograms per hectare) of total oxides (calcium and magnesium) to raise the pH of a 100-millimeter layer of different soil textural classes to approximately 6.5 are as follows:

Soil (pH)	Loamy Sand	Sandy Loam	Loam	Silty Loam
5.7	0.3	0.7	1.0	1.3
5.3 - 5.6	0.7	1.2	1.7	2.0
4.9 - 5.2	1.0	1.7	2.4	2.7
4.5 - 4.8	1.3	2.0	3.0	3.4
4.1 - 4.4	1.7	2.4	3.7	4.0

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 70 kilograms of nitrogen per hectare (35 kilograms at the time of seeding and an additional application of 35 kilograms 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:

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 75 to 100 millimeters. On slopes steeper than 1:3, 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 50 millimeters or larger in any dimension, and other debris.

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 prior to the seeding operation.

3. **Application.** Seed mixtures shall be sown at the rate of 110 kilograms per hectare.

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 which 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 25 mm to 50 mm.

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 7.5 meters using 50 mm by 50 mm by 910 mm long wood stakes driven 300 mm 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 in accordance with 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 25 mm to 40 mm thick; loose measurement, and shall be bound in place with a binder in accordance with Subsection 811.03.

COMPENSATION

808.04 Method of Measurement.

Fertilizing and seeding of the various types will be measured by the square meter.

Wildflower seeding of the various types will be measured by the square meter.

808.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
FERTILIZING AND SEEDING, TYPE___	SQUARE METER
WILDFLOWER SEEDING	SQUARE METER

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 right-of-way line.

SECTION 809 - TOPSOIL STABILIZATION

809.01 Description.

This work shall consist of furnishing, placing, and stapling matting and blankets on soil surfaces which have been prepared and seeded.

MATERIALS

809.02 Materials.

Materials shall conform to the following Subsections:

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 which 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 150 millimeters and buried in a vertical position. Where laid end to end, the upper end of each downhill strip shall be buried 150 millimeters deep in vertical position with the uphill strip overlapping for a distance of 150 millimeters to form a smooth, shingle-like effect. Where laid parallel, the matting shall overlap from 75 to 150 millimeters.

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 600 to 650 millimeters apart in the rows except along overlapping edges where they shall be 300 to 325 millimeters apart. Staples shall be driven at an angle of approximately 30 degrees from horizontal.

In addition to the above requirements, staples shall be placed 300 millimeters apart across the matting at 15-meter 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 meter.

809.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
TOPSOIL STABILIZATION MATTING	SQUARE METER

SECTION 810 - 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:

Fertilizer……909.02
Limestone, Pulverized……..909.03
Sod……909.08
Topsoil……..909.10
Pegs……..909.11

CONSTRUCTION

810.03 Construction Requirements.

Prior to placing the sod, 100 millimeters of topsoil shall be placed in accordance with Subsection 806.03.

A 1-2-2 ratio fertilizer, applied at a rate necessary to yield 60 kilograms of nitrogen per hectare, 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 10 millimeters of topsoil is dry, the soil shall be lightly moistened immediately prior to 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 1:3, sod shall be held in place with pegs driven flush with the surface of the sod. The pegs shall be not more than 300 millimeters 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 75 millimeters, 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 meter.

810.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
SODDING	SQUARE METER

Payment for mowing will be made in accordance with Section 812.

Payment for watering will be made in accordance with Section 813.

SECTION 811 - MULCHING

811.01 Description.

This work shall consist of furnishing and spreading mulch and binding 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 25 to 40 millimeters 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 2.0 cubic meters per hectare.
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 450 kilograms of the dry product shall be used per hectare. 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 280 liters (300 kilograms) of undiluted material per hectare. 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 45 kilograms of the dry material shall be thoroughly mixed with 7000 liters of water per hectare. 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, prior to Acceptance, any straw mulch is displaced before the grass has made a growth of 40 millimeters, 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 75 to 100-millimeter layer of wood chips, stone, or gravel, as directed. If, prior to 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 meter.

811.05 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
GRAVEL MULCHING	SQUARE METER
STONE MULCHING	SQUARE METER
STRAW MULCHING	SQUARE METER

Separate payment will not be made for wood mulching. All costs thereof shall be included in the prices bid for the plant material.

SECTION 812 - MOWING

812.01 Description.

This work shall consist of mowing grass areas within the right-of-way.

CONSTRUCTION

812.02 Construction Requirements.

Grass shall be mowed when it attains a height of 250 to 300 millimeters. The grass and other growth shall be mowed to a height of 75 to 100 millimeters. 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.

When the cuttings resulting from the mowing operation are excessive, the cuttings shall be removed in accordance with Subsection 201.10.

COMPENSATION

812.03 Method of Measurement.

Mowing will be measured by the hectare each time the area is mowed.

812.04 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
MOWING	HECTARE

SECTION 813 - PLANTING

813.01 Description.

This work shall consist of furnishing, delivering, and planting trees, shrubs, seedlings, vines, and ground cover plants.

Planting shall be the initial planting.

Replantings shall be those plantings required after the initial plantings have died or become unacceptable prior to acceptance of the plantings.

Replacement plantings shall be those required in accordance with Subsection 109.14.

MATERIALS

813.02 Materials.

Materials shall conform to the following Subsections:

Limestone, Pulverized……..909.03
Mulch……909.04
Plant Materials……..909.05
Topsoil……..909.10
Miscellaneous Materials……909.11
Water……919.15

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 prior to 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 in accordance with standard nursery practice and the following:

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.
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.
4. **Excavation for Plant Pits and Beds.** Prior to 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 in accordance with Subsection 201.10.

   The minimum planting pit sizes for bare root plant materials shall be as follows:

Height of Plant (meters)	Diameter (millimeters)	Depth (millimeters)
0.3 to 1.2	625	400
over 1.2 to 1.5	675	425
over 1.5 to 1.8	700	450
over 1.8 to 2.4	750	475
over 2.4 to 3.0	825	500
over 3.0 to 3.6	900	550
over 3.6 to 4.2	1100	650

   Planting pits for B & B plant materials shall provide a space for not less than 150 millimeters of backfill below and around the ball. Planting pits for containerized plant material shall provide space for not less than 100 millimeters of topsoil below and around the root-earth mass. 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 300 millimeters in diameter and 300 millimeters deep.

   Planting pits shall not remain open more than ten days in advance of planting on slopes steeper than 1:4.

   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 the plant pit to the required depth. Bare root plants shall then be placed in the center of the plant pit and the roots properly spread out in a natural position. All broken or damaged roots shall be cleanly cut back to sound root growth. Topsoil shall then be carefully worked around and over the roots and thoroughly and properly settled by firming or tamping.

Thorough watering or puddling shall accompany backfilling. Earth saucers or water basins at least 100 millimeters 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 prior to planting containerized plant material, the root-earth mass shall receive three vertical cuts, spaced equidistantly about the perimeter. Each cut, about 10 millimeters 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 70 liters per square meter 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 25 liters of water per square meter 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 600 millimeters 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 prior to the placing of any mulching materials. Planting beds in areas flatter than 1:4 shall also be cultivated to a depth of 150 millimeters. All plant material shall be mulched in accordance with 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 in accordance with 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 in accordance with Subsection 201.10.

813.05 Plant Establishment Period and Replacements.

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 may 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 which 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 prior to 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 in accordance with 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 ground covers, seedlings, shrubs, trees, or vines, of the various kinds and sizes, will be measured by the number of each.

813.07 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
_____ (GENUS, SPECIES, VARIETY, ROOT, AND SIZE)	UNIT

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 and watering. All costs thereof shall be included in the prices bid for the plant material.

SECTION 814 - NONVEGETATIVE SURFACES

814.01 Description.

This work shall consist of the construction of nonvegetative surfaces of bituminous concrete.

MATERIALS

814.02 Materials.

Bituminous concrete surface course shall conform to the requirements of Section 903 and shall be Mix I-5.

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-595A, Colors Volume I, Table II.

CONSTRUCTION

814.03 Excavation.

Excavation shall be in accordance with 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 which shall be compacted.

814.05 Nonvegetative Surface, Bituminous Concrete.

Nonvegetative surface shall be constructed prior to the installation of the guide rail. Alternate methods of construction must be approved by the Engineer.

Bituminous concrete surface course, 100 millimeters thick, shall be constructed in accordance with 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 3.2 megagrams per meter 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 bituminous concrete. Hand tampers shall be used around posts and other obstacles where mechanical compactors are not accessible.

814.06 Color-Coated Nonvegetative Surface, Bituminous Concrete.

Color-coated nonvegetative surfaces shall be constructed in accordance with the requirements of Subsection 814.05 and the following:

1. The final color shall be applied uniformly at a rate of 1.0 to 2.0 liters per square meter, by spraying, brushing, or squeegeeing over the bituminous concrete 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 meter.

814.08 Basis of Payment.

Payment will be made under:

Pay Item	*Pay Unit*
NONVEGETATIVE SURFACE, BITUMINOUS CONCRETE	SQUARE METER
COLOR-COATED NONVEGETATIVE SURFACE, BITUMINOUS CONCRETE	SQUARE METER

Payment for reset beam guide rail of the various kinds will be made in accordance with Section 612.

DIVISION 900 - MATERIALS

SECTION 901 - AGGREGATES

901.01 General.

Aggregates from a single source 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.

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 bituminous concrete 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, bituminous or concrete surface, and shall be constructed by placing the aggregates in layers not more than 1 meter 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 and 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 which 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 reclaimed asphalt pavement to be used in bituminous concrete mixes shall not exceed 5 meters 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.

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 901.21, Table 901-1. Field welding of ductile iron pipe is not permitted. All required welding of a ductile iron pipe assembly shall be performed in the fabricator’s shop.

901.04 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 or elongated pieces for graded material No. 57 and larger (length greater than four times maximum thickness or width)	7
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	
Bituminous concrete	1.5
Portland cement concrete	1.0

The percent of wear (Los Angeles Test) shall be as follows for various uses:

	Maximum Percent
Bituminous concrete surface course	40
Bituminous-stabilized 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.

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:

1. **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 50-millimeter sieve and be retained on a 2.36-millimeter 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 which shall pass a 100-millimeter sieve and be retained on 2.36-millimeter sieve.

   Sand shall be granular material resulting from weathering processes, grinding or crushing of rock and shall pass a 2.36-millimeter sieve and be retained on the 75-micrometer sieve.

   Stone dust shall be fine soil or mineral particles, or both, which shall pass the 75-micrometer sieve. Silt-clay shall be fine soil particles which shall pass the 75-micrometer sieve.

2. **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.

   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 901.21, 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, in accordance with NJAC 7:26A, the metric weight 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 901.21, Table 901-2 after being tested for materials which break down as determined in accordance with Section 990, NJDOT A-8.

3. **Gradation.** Soil aggregate shall be graded as shown in Subsection 901.21, 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.

4. **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 150 millimeters.

901.10 Aggregates for Bituminous Concrete.

A. Coarse Aggregate. Coarse aggregate for bituminous concrete surface course (total retained on 2.36-millimeter sieve) shall be broken stone or crushed gravel. Broken stone shall conform to Subsection 901.04 except that carbonate rock will be permitted provided it has been classified as being acceptable in accordance with the Department's operations bulletin entitled "Classification and Approval of Carbonate Rock for Use as Coarse Aggregate in Top Layer of Bituminous Concrete" which is available through the Bureau of Materials upon request. Crushed gravel shall conform to Subsection 901.05 except that it need not be washed, and it may contain any percentage of total carbonates.

B. Reclaimed Asphalt Pavement (RAP). Reclaimed asphalt pavement shall pass a 50-millimeter sieve.

The bituminous material contained in the RAP shall be asphalt cement free from solvents or other contaminating substances.

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 Subpart C.

C. Fine Aggregate. Fine aggregate for bituminous concrete surface course shall be stone sand or natural sand. For bituminous concrete 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 75-micrometer sieve. When the percent passing the 75-micrometer 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 75-micrometer 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
9.5 mm	100
4.75 mm	95 - 100
2.36 mm	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 75-micrometer sieve.

In lieu 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 75-micrometer sieve.

D. Crushed Recycled Container Glass. Crushed recycled container glass (CRCG) shall meet the following gradation:

Sieve	Percent Passing
9.5 mm	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 4.75-millimeter Sieve
Paper	2.5
Metal	3.0
Plastic	0.3
Other	0.5

Note 1: The percent shall be determined by separating the material retained on the 4.75-millimeter sieve and expressing that amount as a percentage of the total weight of material retained on the 4.75-millimeter sieve.

A list of processing facilities which have been approved by the Department as a source of CRCG for use in bituminous mixes is available from the Department's Bureau of Materials (Telephone: 609-292-4908).

901.11 Aggregates for Bituminous-Stabilized Base Course.

Course aggregate for bituminous-stabilized base course (total retained on 2.36-millimeter sieve) shall be broken stone or crushed gravel conforming to Subsection 901.04 or 901.05 respectively except that the gravel need not be washed.

Crushed gravel conforming to Subsection 901.05 may be used for stone mix except that the gravel need not be washed.

Soil aggregate may be used for gravel mix and shall contain, by weight, a total of not more than 25 percent of shale, slate, schist, and soft and decomposed aggregate as determined by lithologic analysis.

Any aggregate blended with soil aggregate of a gravel or stone mix shall conform to Subsection 901.04, 901.05, or 901.10.

The soil aggregates shall be free of vegetable matter, lumps or balls of clay, adherent films of clay, or other matter that may prevent thorough coating with bituminous material. The portion passing the 425-micrometer sieve shall be nonplastic.

901.12 Aggregates for 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 below:

Sieve Size	Percent
25.0 mm	100
2.36 mm	65 - 100
300 µm	10 - 30
75 µm	0 - 7

901.13 Aggregates for Portland Cement Concrete, Mortar, and Grout.

A. Coarse Aggregate. Coarse aggregate shall be broken stone or washed gravel conforming to Subsection 901.04 or 901.05 respectively, except that carbonate rock shall not be used for concrete surface courses or bridge decks. 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.

Aggregates used in portland cement concrete shall be tested in accordance with AASHTO TP 14 by a laboratory acceptable to the Engineer. Those aggregates which 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 and ground granulated blast furnace slab.

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. Sand manufactured from a carbonate rock as defined in Subsection 901.04 will not be permitted in concrete surface courses and bridge deck wearing surfaces. The fine aggregate shall be predominantly angular in shape

SECTION 902 - BEAM GUIDE RAIL

902.01 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.

Posts and spacers shall be structural steel conforming to AASHTO M 183/M 183M and shall be galvanized in accordance with AASHTO M 111.

902.03 Rub Rail.

Rub rail shall be steel channels or bent plate of structural steel conforming to AASHTO M 183/M 183M and shall be galvanized in accordance with 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 563M, Property Class 5.
2. Plates and rods for guide rail end treatment shall be structural steel conforming to AASHTO M 183/M 183M.
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 (ASTM A/325/ 325M, Type I) or ASTM A 449/A 449M. 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 (ASTM A/325/ 325M, Type I) Structural steel plates for guide rail on bridges shall conform to AASHTO M 183/M 183M (ASTM A/36/ A36M).
4. Plates for guide rail on bridges and plates and rods for guide rail end treatment shall be galvanized in accordance with AASHTO M 111.
5. Bolts and nuts may be mechanically galvanized in accordance with AASHTO M 298, Class 50, Type 1.

902.05 Sampling and Testing Methods.

Rails, posts, spacers, and miscellaneous hardware shall be subject to inspection prior to shipment.

902.06 Acceptance and Certification of Compliance.

Manufacturer's certification for all materials shall be submitted for each project in accordance with Subsection 106.04 and shall include certification that the anchor bolt system, when tested for tension pull-out in accordance with 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 and/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 in accordance with 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 prior to 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 prior to 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 or alternate size, embedment depth, or reduced 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 21 megapascals, the Contractor shall increase the anchor bolt embedment depth or reduce the anchor bolt spacing to achieve satisfactory performance.

SECTION 903 - BITUMINOUS CONCRETE

903.01 Composition of Mixtures.

Composition of the mixture for of bituminous concrete surface course shall be coarse aggregate, fine aggregate, mineral filler, and asphalt cement and may also include up to ten percent reclaimed asphalt pavement (RAP). The percentage of RAP will be provided in the Special Provisions.

For projects with 25 percent or less RAP, the composition of the mixture for bituminous-stabilized base course shall be coarse aggregate, fine aggregate, mineral filler, and asphalt cement and may also include up to 25 percent of RAP or up to ten percent crushed recycled container glass for a combined total of up to 35 percent recycled materials.

For projects with 26 to 50 percent RAP, the composition of the mixture for bituminous-stabilized base course shall be coarse aggregate, fine aggregate, mineral filler, and asphalt cement and may also include a maximum of 50 percent by weight of recycled materials as follows:

Recycled Materials

Reclaimed Asphalt Pavement (RAP)		Crushed Recycled Container Glass	Maximum Recycled
Percent	**Source**	**Percent**	**Percent**
0	--	0 to 10	10
0 to 25	Open System	0 to 10	35
26 to 50	Closed System	0 to 10	50

Note: Closed system is defined as RAP obtained from removal of bituminous concrete overlay or milling performed on Project. Open system is defined as RAP obtained from other sources both on and off the Project.

The grade of asphalt cement will be determined by the Department Laboratory for those projects which include the use of 26 to 50 percent of RAP.

If cores have been taken by the Department, the data may be obtained from the Department.

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 21 percent, a complete mix design including Marshall plugs shall be submitted.

Materials shall conform to the following Subsections:

Aggregates for Bituminous Concrete……901.10
Aggregates for Bituminous-Stabilized Base Course…… 901.11
Mineral Filler……901.15
Asphalt Cement……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 bituminous material is excluded.

903.02 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 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 cement based upon the weight of the total mix. The optimum percentage of asphalt cement shall be determined in accordance with 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 cement is less than specified, the Engineer may approve the use of the optimum asphalt 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.

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 cement in the RAP.
Percentage of new asphalt cement.
Total percentage of asphalt cement.
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 (bituminous material) to be present in the recycled bituminous mixture when discharged from the plant and when tested in accordance with Section 990, NJDOT B-4.

The job mix formula containing up to 20 percent of RAP, may be established by modifying a previously approved mix design to allow for the introduction of reclaimed asphalt pavement 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.

For mixes containing 21 to 50 percent of RAP, the job mix formula shall be determined in accordance with 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 cement. In order 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.

The recommended procedure for the preparation of the mixture containing 26 to 50 percent of RAP may be obtained from the Department Laboratory upon written request.

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 of new materials be made or significant changes in the properties of the RAP used in mixes containing 26 to 50 percent of RAP occur, the Engineer may require that a new job mix formula be established and approved before production can continue.

Quality control testing shall be performed by the producer 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 2.36-millimeter sieve, 75-micrometer 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 8 ºC above the laydown temperature. In no case shall the mixture temperature exceed 163 ºC.

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 138 ± 3 ºC 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 in accordance with Section 990, NJDOT B-3.

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 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 bituminous mixtures when combined in the proportions of the job mix formula shall conform to Subsection 903.05, Table 903-5 when tested in accordance with AASHTO T 245 except reference to 25-millimeter 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.

A. Drum Mix Plants. Five random samples will be taken from each lot of approximately 3000 megagrams of each type of mix. When a lot of bituminous concrete is necessarily less than 3000 megagrams, samples will be taken at random for each type of mix at the rate of one sample for each 600 megagrams or fraction thereof.

At the drum mix plants, the bituminous mixture will be sampled and tested for compliance.

To determine the quantity of bitumen and the gradation of the aggregate in bituminous concrete mixtures for acceptance testing purposes, extractions at the sampling rate specified will be performed each day for each type mixture in accordance with Section 990, NJDOT B-4.

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.

B. Fully Automated Batch Plants. Under the supervision of the Engineer, five random samples shall be taken from each lot of approximately 3 000 megagrams of each type of mix. When a lot of bituminous concrete is necessarily less than 3 000 megagrams, samples shall be taken at random for each type of mix at the rate of one sample for each 600 megagrams or fraction thereof.

Acceptance testing for gradation and asphalt content will be performed using bin samples and printed weigh tickets in accordance with Section 990, NJDOT B-6.

If, at any time, the automatic proportioning or recording devices become inoperative or inaccurate, sampling and acceptance testing will be performed in accordance with the requirements for drum mix plants.

If RAP is added to the system prior to the hot bins, sampling and acceptance testing will be performed in accordance with the requirements for drum mix plants.

C. General Sampling and Testing Requirements. Acceptance testing of bituminous concrete will be performed in a timely manner.

The Department will not perform the composition control testing or other routine test functions in the absence of or in lieu 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.

Bituminous 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 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 which does not comply with these requirements will be reduced in accordance with 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 recoverable bitumen, 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 in accordance with Section 990, NJDOT B-3 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 which does not comply with the specified

stability requirements will be reduced in accordance with 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 2.36-millimeter or 75-micrometer 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 production, up to 900 megagrams, for the first day in a calendar year. In the event the first day's production does not reach 600 megagrams, the initial lot is to be extended until the 600 megagrams level is reached or the Project is completed.

G. Plants Producing for Multiple Projects. When a plant is producing bituminous concrete or bituminous-stabilized base course 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.

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 -9 ºC. 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.

1. Materials. Materials shall conform to the following Subsections:

Aggregates for Bituminous Concrete (Note 1)……901.11
Mineral Filler……901.15
Cut-back Asphalt, Grade MC-250 or MC-800 (Note 2)…… 904.02
Inverted Emulsified Asphalt, Grade IEMC-250 or IEMC-800……904.04

Note 1: Aggregates for bituminous-stabilized base course.
Note 2: Grades MC-250 and MC-800 shall contain an anti-stripping additive.

2. Composition of Mixture. The bituminous concrete shall be composed of aggregates and bituminous materials combined in such proportions that the resulting composite blend meets the following:

Sieve Size	**Total Percent**
12.5 mm	100
9.5 mm	80 - 100
4.75 mm	55 - 75
2.36 mm	30 - 60
300 µm	10 - 30
75 µm	4 - 10
Residual Bitumen Content	5.5 - 7.5

In calculating the percentages of aggregates of the various sizes, the bituminous material is excluded.

Note: Material passing the 75-micrometer sieve may consist of fine particles of the aggregate or mineral filler, or both. Material passing the 425-micrometer sieve shall be nonplastic when tested in accordance with AASHTO T 90. Composition of mixture shall be determined in accordance with Section 990, NJDOT B-4 except that the material shall be dried at 140 ºC for a period of three hours prior to 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 121 ºC. The temperature of the bituminous material shall not exceed 77 ºC. 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 in accordance with Section 990, NJDOT B-8.

903.05 Tables.

Tables referenced in the Specifications are as follows:

Table 903-1 Bituminous Concrete Mixtures

New Jersey Interagency Engineering Committee

Standard Bituminous Concrete Mixture Design Table

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, mm	25.0	37.5	19.0	19.0	9.5	12.5
Sieve Size	Grading of total aggregate (coarse plus fine, plus filler if required). Amounts finer than each laboratory sieve (square opening) weight percent.					
50 mm	--	100				
37.5 mm	100	90-100				
25.0 mm	90-100	80-100	100	100		
19.0 mm	60-80	65-95 (NA)	95-100	98-100		100
12.5 mm	--	50-85	75-95	88-98	100	72-98
9.5 mm	15-40	40-75 (NA)	65-85	65-88	80-100	60-82
4.75 mm	0-10	25-60	35-65	35-65	55-75	40-56
2.36 mm	--	20-45	25-36	25-46	30-56	28-37
1.18 mm	--	--	15-35	18-40	20-45	19-24
600 µm	--	--	10-30	12-30	15-35	13-19
300 µm	--	8-30	8-25	10-25	10-30	8-16
150 µm	--	--	--	--	--	5-10
75 µm	--	4-7.5	4-7.5	4-7.5	4-8	3-6
	Asphalt Cement, Percent by Weight of Total Mixture					
	2.5-3.1	4-6	4.8-7	5-7	5-7	5-6

Note 1: Material passing the 75-micrometer sieve may consist of fine particles of the aggregate or mineral filler, or both. Material passing the 425-micrometer sieve shall be nonplastic when tested in accordance with AASHTO T 90.

Note 2: 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 50 millimeters, the mix used must be 100 percent passing the 25.0-millimeter sieve even though the overall specification allows 80-100 percent passing the 25.0-millimeter sieve.)

Note 3: Mix I-1 is not subject to the design requirements specified elsewhere.

Note 4: (NA) Denotes not applicable for NJDOT Mix.

Note 5: Mix Descriptions:

1. I-1 is a permeable base course which should be used in a minimum lift of 75 millimeters.
2. I-2 is a dense-graded base course which may be used in full depth construction or as the bottom course in an overlay.
3. I-4 HD (heavy duty) is a 19.0-millimeter nominal maximum size surface course mix intended to be used on heavy traffic roadways.
4. I-4 is a 19.0-millimeter nominal maximum size surface course mix for medium to heavy traffic roadways.
5. I-5 is a 9.5-millimeter nominal maximum size surface course mix for low to medium traffic roadways.
6 I-5 HD (heavy duty) is a 12.5-millimeter nominal maximum size surface course mix intended to be used for thin lifts (less than 37.5 millimeters) on heavy traffic roadways.

Table 903-2 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 All Plants	**Tolerance Percentage (Plus or Minus)**				
2.36 mm	4.5	4.0	4.0	4.0	4.0
75 µm	1.4	1.4	1.4	1.4	1.4
Asphalt (Drum Mix Plant)	0.45	0.45	0.45	0.45	0.45
Asphalt (Fully Automated Batch Plants)	0.15	0.15	0.15	0.15	0.15

Table 903-3 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	2.36 mm	5.0	4.5	4.5	4.5	4.5
4	75 µm	1.6	1.6	1.6	1.6	1.6
Asphalt (Drum Mix Plants)		0.50	0.50	0.50	0.50	0.50
Asphalt (Fully Automated Batch Plants)		0.15	0.15	0.15	0.15	0.15
3	2.36 mm	6.0	5.0	5.0	5.0	5.0
3	75 µm	1.8	1.8	1.8	1.8	1.8
Asphalt (Drum Mix Plants)		0.60	0.60	0.60	0.60	0.60
Asphalt (Fully Automated Batch Plants)		0.20	0.20	0.20	0.20	0.20
2	2.36 mm	7.0	6.5	6.5	6.5	6.5
2	75 µm	2.2	2.2	2.2	2.2	2.2
Asphalt (Drum Mix Plants)		0.70	0.70	0.70	0.70	0.70
Asphalt (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

Gradation Mix No.	I-2	I-4 HD	I-4	I-5	I-5 HD
Sieve Size - All Plants	**Tolerance Percentage**				
2.36 mm	16.0	13.0	13.0	13.0	13.0
75 µm	4.8	4.8	4.8	4.8	4.8
Asphalt (Drum Mix Plant)	1.5	1.5	1.5	1.5	1.5
Asphalt (Fully Automated Batch Plants)	0.4	0.4	0.4	0.4	0.4

Note: 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

Gradation Mix No.	I-2	I-4 HD	I-4	I-5	I-5 HD

Criteria	Stone	Gravel	Test Limits			
Design Stability, minimum kN	6.7	4.9	8.0	6.7	5.3	8.0
Control Stability, minimum kN	5.3	3.6	6.7	5.3	4.0	6.7
Flow Value, 0.25 mm	6-18	6-18	6-16	6-16	6-16	6-16
Design Voids in mineral aggregate, minimum %	12	12	13	14	16	15
Design Air Voids (Note 1), %	3-5	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	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 in accordance with AASHTO T 209 except that minimum sample size may be waived in order to use a 100-millimeter diameter specimen. Bulk specific gravity of the compacted mixture will be determined in accordance with Section 990, NJDOT B-9.

Note 2: As determined by the Engineer from drilled pavement cores taken by the Department. The air voids will be determined based on the bulk specific gravity and maximum specific gravity tests performed on each core individually.

Table 903-6 Reduction per Lot Due to Nonconformance to Job Mix Formula and Range in the Characteristics of Asphalt Content or Aggregate Passing 2.36-mm or 75-µm Sieve. (see Note 1)

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

Deviation of five sample average below control stability of Table 903-5. (kilonewtons)	Reduction Per Lot
1 to 0.70	2%
0.71 to 1.30	5%
Over 1.30	10%

SECTION 904 - BITUMINOUS MATERIALS

904.01 Asphalt Cement.

Asphalt cement shall conform to AASHTO MP-1, "Standard Specifications for Performance Graded Asphalt Binder". Grade 64-22 shall be used except that an asphalt of lower grade may be directed to be used when conditions are such as to cause rapid cooling of the mixture or when the mixture contains reclaimed asphalt pavement.

904.02 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:

Table 904-3 Temperature-Volume Correction Factors for Bituminous Materials

Emulsified Asphalt, All Grades.

Temp (°C)	Factor	Temp (°C)	Factor	Temp (°C)	Factor
5	1.004 8	31	0.993 1	57	0.981 7
6	1.004 3	32	0.992 6	58	0.981 3
7	1.003 9	33	0.992 2	59	0.980 8
8	1.003 4	34	0.991 7	60	0.980 4
9	1.003 0	35	0.991 3	61	0.980 0
10	1.002 5	36	0.990 8	62	0.979 5
11	1.002 1	37	0.990 4	63	0.979 1
12	1.001 6	38	0.990 0	64	0.978 7
13	1.001 2	39	0.989 4	65	0.978 2
14	1.000 7	40	0.989 1	66	0.977 8
15	1.000 3	41	0.988 7	67	0.977 4
16	0.999 8	42	0.988 2	68	0.976 9
17	0.999 4	43	0.987 8	69	0.976 5
18	0.998 9	44	0.987 4	70	0.976 1
19	0.998 5	45	0.986 9	71	0.975 6
20	0.998 0	46	0.986 5	72	0.975 2
21	0.997 6	47	0.986 1	73	0.974 8
22	0.997 1	48	0.985 6	74	0.974 4
23	0.996 7	49	0.985 2	75	0.973 9
24	0.996 2	50	0.984 7	76	0.973 5
25	0.995 8	51	0.984 3	77	0.973 1
26	0.995 3	52	0.983 9	78	0.972 7
27	0.994 9	53	0.983 4	79	0.972 3
28	0.994 4	54	0.983 0	80	0.971 8
29	0.994 0	55	0.982 6	81	0.971 4
30	0.993 5	56	0.982 1		

SECTION 905 - CONCRETE ADMIXTURES AND CURING MATERIALS

905.01 Air-Entraining Admixtures.

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 in accordance with 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 0 ºC. Air-entraining admixture that has been allowed to freeze shall not be reused until agitated and retested.

905.02 Chemical Admixtures.

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 chlorides.

Before the admixture is approved for use, the results of tests conducted by a testing agency, which is inspected at regular intervals by the Cement and Concrete Reference Laboratory, shall be submitted and verified by the Department. 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 0 °C. 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. The calcium nitrite based corrosion inhibitor 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:

1. 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/or retarding admixtures, as per the manufacturers' recommendations, shall be compatible with the calcium nitrite solution. The calcium nitrite solution shall be added immediately after all other admixtures have been incorporated into the concrete mix. However, the calcium nitrite shall be thoroughly mixed before the addition of the other admixtures.
2. The Contractor shall strictly adhere to the manufacturer's written recommendations regarding the use of the admixture including storage, transportation and method of mixing. The manufacturer of the calcium nitrite solution shall provide a representative to assist the Contractor and the Engineer

on the first full days of production of members and to be available on request during subsequent construction.

3. Testing for the presence of the calcium nitrite admixture in the concrete shall conform to Section 990 - Method of Tests, Subpart M-4 for plastic concrete testing and Subpart 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.

905.03 Curing Materials.

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.
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.
3. White polyethylene sheeting shall conform to AASHTO M 171 for white opaque polyethylene film.
4. White burlap-polyethylene sheeting shall conform to AASHTO M 171.
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.

Sampling and testing will be performed in accordance with the following:

1. Admixtures:		
	a. Air-entraining	4 liters from each source
	b. Chemical	4 liters from each source
2. Curing Materials:		
	a. Burlap	1 square meter from each source
	b. Liquid Compound	1 liter from each lot
	c. Polyethylene Sheeting	300-millimeter strip (cut across full width) from each source
	d. Waterproof Paper	300-millimeter strip (cut across full width) from eachsource

905.05 Certification of Compliance.

Manufacturer's certification for polyethylene sheeting shall be submitted in accordance with Subsection 106.04.

SECTION 906 - ELECTRICAL MATERIALS

906.01 Anchor Bolts.

Anchor bolts shall conform to ASTM A 576, and the top 150 millimeters shall be galvanized in accordance with ASTM A 153.

906.02 Bonding and Grounding Materials.

Bushings for rigid metallic conduit with a diameter of 27 millimeters 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 27 millimeters 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 which support combustion shall not be used.

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.

Ground rods shall be 16 millimeters in diameter and 3.7 meters 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 250 micrometers.

906.03 Cable and Wire.

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 in accordance with 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.

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 10 millimeters in diameter and 38 millimeters 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.

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 75 millimeters wide and 800 millimeters long in ground-installed junction boxes or 300 millimeters in structures. The cable rack shall contain three saddle arms with a capacity of 50 millimeters.

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 600 millimeters long in ground installed boxes with three supports and 175 millimeters long in junction boxes located on structures with one support. Support holes on the channel shall be spaced approximately 38 millimeters 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 100 millimeters 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.

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.

Conduits and fittings exposed on sign structures shall be aluminum conduit 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 514, and ASA C-80.1.

   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 300 grams per square meter. 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 metal core covered with a polyvinyl chloride jacket. It shall be manufactured in accordance with Federal Specification WW-C-566C 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 shall have a steel core.

Flexible metal conduit for use on sign structures shall have an aluminum core with a neoprene jacket.

906.08 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 which is flame retardant, water resistant, and cold weather pliable. It shall be heavy-duty with a minimum tensile strength of 3.5 newtons per millimeter, a minimum adhesion of 0.22 newton per millimeter, and a minimum thickness of 220 micrometers.

906.09 Lamps.

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
200 mm	60	595	62 mm
300 mm	135	1750	75 mm
Pedestrian	60	595	62 mm

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:

Designation	Wattage	Lumens	Voltage
S 55	150	16000	55
S 50	250	27500	100
S 51	400	50000	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 be of the following ANSI designation, initial lumen rating in vertical burning position:

Designation	Wattage	Lumens

H 37-5KC/W	250	11400
H 33-1GL/W	400	22000

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.

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.

The loop wire shall be thermoplastic single conductor wire with a 6.4-millimeter PVC tube or 6.4-millimeter, 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 105 ºC, with a minimum wall thickness of 760 micrometers. 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 1 millimeter.

906.12 Cabinets.

Cabinets shall be aluminum alloy conforming to Subsection 911.01.

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 1-millimeter minimum thickness aluminum alloy sheet. The lettering shall be approximately 40 millimeters 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.

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 in accordance with Table 3-1 for cross-linked-thermosetting-polyethylene-insulated power cables, Column A.

906.14 Panel Boards and 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. Panelboard 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.

Pedestals, poles, transformer bases, and mast bracket arms for traffic signal and highway lighting shall be fabricated with materials in accordance with 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 which conforms to the General Requirements for a Quality Program of 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 in accordance with 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 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 620, and shall be galvanized in accordance with 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 assure 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 in accordance with Section 10, ANSI/AWS D1.2 for Class 1 structures.

906.16 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.

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 Single Conductor Signal Wire.

Single conductor signal wire shall conform to Subsection 906.03 and to the following:

1. Single wire shall conform to the requirements of the ICEA-NEMA Standards Publication for Therm-plastic-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy, ICEA Publication No. S-61-402/NEMA Publication No. WC 5. All wires shall be single conductor and shall conform to UL Type THW or, as an alternate, Type THWN.
2. The insulation shall consist of polyvinyl chloride compound extruded concentrically over the conductor conforming to ICEA Publication No. S-61-402/NEMA Publication No. WC 5, Part 3.8, polyvinyl chloride 75 ºC.

All traffic signal wire shall be color coded with continuous color compound for circuit identification in conformance with ICEA Publication No S-61-402/NEMA Publication No. WC 5, Part 5.

906.19 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.

906.20 Sampling and Testing Methods.

Electrical materials, components, and assemblies shall be subject to job site inspection.

906.21 Certification of Compliance.

Manufacturer's certification for all materials, components, and assemblies shall be submitted in accordance with Subsection 106.04.

SECTION 907 - FENCE

907.01 Barbed Wire.

Barbed wire shall conform to ASTM A 121.

907.02 Chain-Link Fence.

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.

of withstanding a force equal to 16 kilonewtons per meter without 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/M 270M, Grade 250 or Grade 345W. Steel for plates, shapes, and other structural steel used in the deck joint system shall conform to AASHTO M 270/M 270M, Grade 250. The entire joint system shall be hot-dip galvanized after fabrication in accordance with AASHTO M 111 (ASTM A 123).

End-welded studs shall conform to the requirements of Subsection 503.10.

Steel anchors shall be deformed bars conforming to ASTM A 615/A 615M-96a, Grade 420.

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 liter	0.96 kilogram ± 10 percent
Solids content by weight	65 percent
Material shall be fluid from	-15 to +49 ºC
Film strength (ASTM D 412)	14 megapascals (minimum)
Elongation	250 percent (minimum)

4. **Sampling, Acceptance, and Certification.** Sampling shall be in accordance with Subsection 908.04, Subpart E.

Acceptance testing of the strip seal gland shall be in accordance with Subsection 908.04, Subpart F.

Certification of the strip seal deck joint system shall be in accordance with 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.

Sampling and testing will be performed in accordance with the following:

Preformed expansion joint filler…… 1-meter length from each lot
Joint sealers:
Hot-poured rubber asphalt…… 4.6 kilograms from each lot
Cold-applied…… 1 liter 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 in accordance with Subsection 106.04. Manufacturer's certification for preformed elastomeric joint sealer,

reinforced elastomeric expansion dam, and strip seal expansion dam shall be submitted in accordance with Subsections 908.03, 908.04, and 908.05, respectively.

SECTION 909 - LANDSCAPING MATERIALS

909.01 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 havephytotoxic 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.

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 2.36-millimeter sieve and a minimum of 75 percent shall be retained on a 1.18-millimeter 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.

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,

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	95	85	35
Chewings)	92	85	5
Redtop	95	80	10
Perennial Ryegrass			

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	Kilograms Per Hectare
Coreopsis Lanceolata	2.75
Rudbeckia Hirta	2.75
Echinacea Purpurea	5.50
Festuca Ovina	4.50
Total =	15.50

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 in accordance with 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.

Composted sewerage sludge shall consist of a stabilized, screened mixture of wood chips and sewerage sludge processed in accordance with 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.

Sod shall be machine cut at a uniform soil thickness of 16 ± 6 millimeters 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.

Topsoil stabilization matting shall be one of the following:

1. Excelsior mat shall be wood excelsior, 1.2 meters ± 25 millimeters in width and weighing 0.43 kilograms per square meter 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, 1.2 meters ± 25 millimeters in width and weighing an average of 0.60 kilograms per linear meter of cloth with a tolerance of plus or minus five percent, with approximately 78 warp ends per width of cloth and 45 weft ends per linear meter of cloth. The yarn shall be of a loosely twisted construction having an average twist of not less than 63 turns per meter 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 13 by 13-millimeter 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 0.27 kilograms per square meter.

909.10 Topsoil.

Topsoil shall not contain stones, lumps, roots, or similar objects larger than 50 millimeters 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.

Material stripped from the following sources shall not be considered suitable for use as topsoil:

1. Soils having less than 4.1 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 in accordance with AASHTO T 194 except that the sample is to be taken from oven-dried soil passing a 2.00-millimeter sieve.

SECTION 910 - MASONRY UNITS

910.01 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 188 millimeters and not more than 200 millimeters, the width shall be not less than 89 millimeters and not more than 99 millimeters, and the depth shall be not less than 55 millimeters and not more than 60 millimeters.
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.

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……..901.13
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 300 millimeters and not more than 450 millimeters. The height shall be not less than 125 millimeters and not more than 200 millimeters. The width shall be not less than 150 millimeters.

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 13 millimeters 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.

Concrete block for slope protection shall be solid concrete units, 400 millimeters long, 200 millimeters wide, and 100 millimeters thick, with a tolerance of plus or minus 10 millimeters. 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 17 megapascals 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.

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.

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 which 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 38 ºC for the first three hours. Thereafter, the application of live steam shall be controlled so that the temperature does not rise faster than 0.5 ºC per minute, and shall be kept controlled at 54 ºC 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 10 millimeter 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 25 millimeters. A tolerance of plus or minus 6 millimeters 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.

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 10 millimeters 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 10 millimeters wide from top to gutter line and not more than 25 millimeters 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

reflector from the metal casting. The removed sample reflector shall have a minimum 90 percent adhesion. If more than one reflector fails to meet the requirement, the lot shall be rejected, and no resample will be allowed. If only one pavement reflector and casting fails to meet the requirement, a resample will be allowed if requested.

b. Twenty-five reflectors and castings will also constitute a resample. All 25 reflectors and castings shall be subject to the adhesion test. If more than five reflectors and castings fail the retest, the entire shipment or lot shall be rejected and no further sampling will be allowed.

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 bituminous concrete surface course 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-AminoethylPiperazine	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 15 ºC before mixing. If required, heating of the epoxy shall be by application of indirect heat. The adhesive shall not be heated above 48 ºC.

Certification of Compliance shall be furnished in accordance with Subsection 106.04.

912.29 Sampling and Testing Methods.

Sampling and testing will be performed in accordance with Subsection 912.01 and the following:

Paint:	
Driers	0.5 liter from each lot
Pigments	0.5 liter from each lot
Ready-mixed	Two 0.5-liter cans from each lot
Resin	0.5 liter from each lot
Stabilizers	0.5 liter from each lot
Thinners	1 liter from each lot
Varnish	0.5 liter from each lot
Vehicles	1 liter from each lot
Epoxy components	Sufficient quantities from each component to make 4 liters
Glass beads	1 liter from each lot

SECTION 913 - PIPE

913.01 Aluminum Alloy Structural Plate for Pipe, Pipe Arches, and Arches.

Aluminum alloy structural plate pipe and the bolts and nuts shall conform to AASHTO M 219/M 219M.

913.02 Ductile Iron Culvert Pipe.

Ductile iron culvert pipe shall conform to AASHTO M 64 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

Nominal Diameter (millimeters)	Inside Thickness (Class)	Nominal Thickness (millimeters)	Nominal Mass (kilograms per meter)
300	2	9.5	72.5
350	1	9.0	82.6
400	1	9.5	97.2
450	1	9.5	112.2
500	1	10.0	128.0
600	2	11.0	172.2
750	5	15.0	277.2
900	5	17.0	382.0
1050	6	21.0	537.8
1200	6	23.5	687.1
1350	6	26.5	869.5

913.03 Ductile Iron Water Pipe.

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 hall be performed in the fabrication shop.

913.04 Concrete Pipe.

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……901.13
Water……919.15

Reinforced concrete culvert, storm drain, and sewer pipe shall conform to AASHTO M 170M.

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 206M.

Reinforced concrete elliptical culvert, storm drain, and sewer pipe shall conform to AASHTO M 207M.

Perforated concrete pipe shall conform to AASHTO M 175M.

Porous concrete pipe shall conform to AASHTO M 176M.

913.05 Corrugated Aluminum Alloy Culvert Pipe and Pipe Arches.

Corrugated aluminum alloy culvert pipe and pipe arches shall conform to AASHTO M 196/M 196M. Types I and II, and the following:

1. **Type I.** Corrugated aluminum alloy culvert pipe and pipe arches shall be fabricated from 1.52-millimeter 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 AASHTO M 196/M 196M 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.

Corrugated aluminum alloy underdrain pipe shall conform to AASHTO M 196/M 196M, Type III.

The sheet metal thickness for the various sizes as listed below shall be as follows:

Pipe Diameter	**Metal Thickness**
150 mm	1.22 mm
200 mm and larger	1.22 mm

913.07 Corrugated Steel Culvert Pipe and Pipe Arches.

Corrugated steel culvert pipe and pipe arches shall conform to AASHTO M 36/M 36M, 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 AASHTO M 36/M 36M and the following:

1. **Type I.** Corrugated steel culvert pipe and pipe arches shall be fabricated from 2.01-millimeter 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 AASHTO M 36/M 36M 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/M 246M, Grade 250/75 (interior 250 micrometers and exterior 75 micrometers).

   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/M 246M, Grade 250/75 (interior 250 micrometers and exterior 75 micrometers).

   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.

Corrugated steel sewer pipe and pipe arches shall conform to AASHTO M 190, Type D.

913.09 Corrugated Steel Underdrain Pipe.

Corrugated steel underdrain pipe shall conform to AASHTO M 36/M 36M, Type IIA.

The sheet metal thickness for the various sizes as listed below shall be as follows:

Pipe Diameter	Metal Thickness
150 mm	1.32 mm
200 mm and larger	1.63 mm

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/M 246M, Grade 250/75 (interior 250 micrometers and exterior 75 micrometers). When bituminous coating is used, pipe and coupling bands shall conform to AASHTO M 190, Type A.

913.10 Fiberglass Pipe.

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.

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.

Semicircular steel pipe for underdrains shall conform to AASHTO M 36/M 36M, Type IIIA. Pipe and connecting bands shall be bituminous coated or polymeric coated. Bituminous coating shall be in accordance with AASHTO M 190, Type A. Polymeric coating shall be in accordance with AASHTO M 246/M 246M, Grade 250/75 (interior 250 micrometers and exterior 75 micrometers).

913.13 Steel Alloy Pipe for Bridge Storm Drains.

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) in accordance with ASTM A 123. Steel pipe and fitting shall be connected by welding prior to 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 in accordance with Subsection 503.15, Subpart A.

913.14 Structural Steel Plate for Pipe, Pipe Arches, and Arches.

Conduits, bolts, and nuts for connecting plates shall conform to AASHTO M 167/M 167M.

913.15 Vitrified Clay Pipe.

Clay pipe shall be standard strength, extra strength, standard strength perforated, or extra strength perforated and shall conform to AASHTO M 65.

913.16 Sampling and Testing Methods.

Sampling and testing will be performed in accordance with the appropriate AASHTO and ASTM methods and the following:

Corrugated steel culvert pipe and pipe arches……. Subsection 913.07

913.17 Certification of Compliance.

Manufacturer's certification for all pipe shall be submitted in accordance with Subsection 106.04.

SECTION 914 - PORTLAND CEMENT CONCRETE, MORTAR, AND GROUT

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 (ASTM C 618).

Materials shall conform to the following Subsections:

Aggregates……..901.13
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.

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 prior to proportioning. If the size selected creates a clearance problem with reinforcement steel, a smaller size aggregate shall be used.

B. Proportioning and Verification. At least 45 days prior to 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 in accordance with 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 in accordance with the proposed mix designs. At least six 150 by 300-millimeter compression test cylinders shall be prepared from each batch and cured in accordance with 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 in accordance with 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 in order 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 prior to 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.

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 TP 14 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.

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 prior to 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.

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. If curing facilities are not provided as required, the Engineer will instruct the Contractor to provide such facilities. 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

Table 914-1 Requirements for Roadway Concrete Items

	Concrete Class	Slump (mm)	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	50±25	5.0±1.5	5.0±1.5	6.0±1.5	6.0±1.5	7.0±1.5
Base Course	C	50±25	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	75±25	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Inlet and Manhole Top Slabs, Sidewalks, Driveways, Islands	B	75±25	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Slope Gutters, Vertical Curb, Sloping Curb, Barrier Curb and Base	B	100±25	----	----	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	100±25	----	----	7.0±2.0	7.0±2.0	8.0±2.0
Foundations for:							
Inlets and Manholes	C	75±25	6.5 max	6.5 max	7.5 max	7.5 max	8.5 max
Electrical Items	C	75±25	----	----	7.5 max	7.5 max	8.5 max
Signs	B	75±25	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Footings for Fence Posts, Guide Rail End Treatment	C	75±25	----	----	7.5 max	7.5 max	8.5 max

Table 914-1 (Continued)

	Concrete Class	Slump (mm)	Percent Air Entrainment for Coarse Aggregate Size Numbers				
			357	467	57	67	8
Cast-in-Place Items (continued)							
Culverts	A	75±25	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Monuments	A	75±25	----	----	7.5 max	7.5 max	8.5 max
Slope Protection	C	50±25	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Precast Items							
Culverts	A	75±25	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Inlets and Manholes, Junction Boxes, Headwalls, Reinforced Concrete End Sections (See noted 2)	B	75±25	----	----	6.0±1.5	6.0±1.5	7.0±1.5
White Concrete Barrier Curb	B	75±25	----	----	7.0±2.0	7.0±2.0	8.0±2.0

Note 1: Except for surface and base course, bridge approach slabs, and transition slabs, a Type F water-reducing, high range admixture will be permitted in accordance with Subsection 905.02 and Subsection 914.02, Subparts B and C. When a Type V admixture is used, the table Slump and Air Content values for the given concrete item shall be changed as follows:

Slump: 150 ± 50 millimeters
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

	Concrete Class	Slump (mm)	Percent Air Entrainment for Coarse Aggregate Size Numbers					
			357	4	467	57	67	8
Cast-in-Place Items								
Unreinforced Footings	B	75±25	6.5 max	6.5 max	6.5 max	7.5 max	7.5 max	8.5 max
Reinforced Footings	B	75±25	----	----	6.5 max	7.5 max	7.5 max	8.5 max
Abutments, Walls Solid Shaft Piers, Pylons	B	75±25	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
White Concrete Barrier Curb, Bridge	B	100±25	----	----	----	7.0±2.0	7.0±2.0	8.0±2.0
Piles	B	75±25	----	----	----	7.5 max	7.5 max	8.5 max
Columns and Caps for Piers, Arch Spans, Rigid Frarnes, Culverts	A	75±25	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Decks, Sidewalks, Concrete Patch, Parapets, Curbs	A	75±25	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Seal (Tremie) Concrete	S	175±50	----	----	----	7.5 max	7.5 max	8.5 max
Prestressed Items								
Beams	P, P-1,& P-2	50±25	----	----	----	5.0±1.5	5.0±1.5	5.0±1.5
Piles	P	50±25	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5

Table 914-2 (Continued)

	Concrete Class	Slump (mm)	Percent Air Entrainment for Coarse Aggregate Size Numbers					
			357	4	467	57	67	8
Precast Items								
Crib Wall Members	A	75±25	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Piles	B		----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Culverts	P	75±25	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Modular Bin Units	P	50±25	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Noise Barriers	P	50±25	----	----	----	6.0±1.5	6.0±1.5	7.0±1.5
Slip-Form Items			----	----	----			
Parapet	A	25±13	__----	__----	----	6.0±1.5	6.0±1.5	7.0±1.5

Note 1: Except for bridge decks, a Type F water-reducing, high range admixture will be permitted in accordance with 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: 150 ± 50 millimeters

Air Content: increase both the target value and tolerance percentages by 0.5.

Table 914-5 (Continued)

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

Note 1: 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

915.01 Reinforcement Steel for Structures.

A. Deformed Bars. Reinforcement steel shall have deformed bars conforming to AASHTO M 31M, except that all bars shall have the tensile requirements of Grade 420. Detailing dimensions for hooks and bends shall be in accordance with the Manual of Standard Practice for Detailing Reinforced Concrete Structures (ACI 315) for Grade 420. Production bending of Grade 420 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/A 767M. 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/M 284M except that the thickness of the cured coating shall be 250 ± 50 micrometers.

D. Spiral Reinforcement. Spiral reinforcement shall be plain round hot-rolled steel bars conforming to AASHTO M 31M, except that the steel bars shall be Grade 420.

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 in accordance with AASHTO M 111.

F. Welded Steel Wire and Welded Deformed Steel Wire Fabric Reinforcement. Welded steel wire fabric shall conform to AASHTO M 55M/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) in accordance with ASTM A 641M, Table 2, Class C or epoxy coated in accordance with ASTM A 884/A 884M, 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 221M/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) in accordance with ASTM A 641M, Table 1, Class C or epoxy coated in accordance with ASTM A 884/A 884M, 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 in accordance with 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 in accordance with the following:

Designation	Nominal Mass kg/m
10	0.560
13	0.994
16	1.552
19	2.235
22	3.042
25	3.973
29	5.060
32	6.404
36	7.907

915.02 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 204M/ M 204.

High-tensile-strength seven-wire strand shall conform to AASHTO M 203, 1860 megapascals, 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 in accordance with 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.

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 in accordance with 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 31M, except that all bars shall have the tensile strength requirement of Grade 300 or Grade 420. The bars shall be size No. 10. Fabrication of bar mats using deformed steel bars shall be in accordance with ASTM A 184/A 184M. Bar mats fabricated using rolled cold-drawn steel wire shall be in accordance with ASTM A 82.

3. Welded Steel Wire Fabric. Welded steel wire fabric shall conform to AASHTO M 55M/M 55.

Wire fabric shall be not less than 1.5 meters 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 67 kilonewtons. 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.

Sampling and testing will be performed in accordance with the following:

Plain and deformed bars…….. Four 750-millimeter pieces from each heat
Post-tensioning:
Bars (threaded)…….. One 1.8-meter piece (between threads) from each lot
Cable with fittings…… One 1.8-meter piece (between fittings) from each reel
Petensioning:
Bars…….. One 1.8-meter piece from each lot
Cable…….. Two 1.2-meter and one 305-mm pieces with flame cut ends from each heat
Welded wire fabric…….. One 0.2-square meter 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 in accordance with Subsection 106.04.

SECTION 916 - SIGN MATERIALS

916.01 Aluminum.

Flat sheets (signs) and plates shall conform to ASTM B 209M, 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:
750 by 750 mm or less……. 2.0 mm
More than 750 by 750 mm……. 3.2 mm

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 shall consist of wide angle prismatic retroreflective sheeting with datum orientation marks visible from the face. The sheeting shall be precoated with a pressure sensitive adhesive backing protected by a removable liner.

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 lux per square meter of sheeting. The measurements shall be conducted in accordance with the Federal Test Method Standard 370, Photometric Measurements of Retroreflective Materials and Retroreflective Devices, or ASTM E 810, Standard Test Method for Coefficient of Retroreflectance.

The test results/analysis shall be provided by the manufacturer in accordance with 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 in accordance with AASHTO M 268.

The test results/analysis shall be provided by the manufacturer in accordance with Subheading 4 below.

c. Color. The colors of the retroreflective sheeting, except for Type IV-B, shall be designated in accordance with the Manual on Uniform Traffic Control Devices (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 in accordance with ASTM E 991. The nighttime fluorescent orange color shall be determined in accordance with 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. The datum mark (arrow) imprinted on the face of the Type VI 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 in accordance with ASTM D 523.

The test results/analysis shall be provided by the manufacturer in accordance with Subheading 4 below.

e. **Accelerated Weathering.** When processed and applied in accordance with 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 in accordance with 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 in accordance with 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 7500 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 70 °C under a pressure of 17.2 kilopascals. The specimens for Types I through VI shall be tested in accordance with AASHTO M 268, Section 7.7, and the test results shall be furnished by the manufacturer in accordance with 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 in accordance with 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 in accordance with 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 0.87 newton per millimeter of width. Elongation shall not be less than ten percent. The machine speed shall be 305 millimeters per minute.

Following liner removal, the retroreflective sheeting shall be sufficiently flexible to show no cracking when slowly bent in one second's time around a 3.2-millimeter 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 -12 °C, the sheeting shall be sufficiently flexible to show no cracking when slowly bent in one second's time around a 3.2-millimeter 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 0.8 millimeter in ten minutes and 3.2 millimeters in 24 hours. The test shall be conducted on a 225 by 225-millimeter conditioned (22 °C, 50 percent relative humidity for 24 hours) specimen with the liner, in accordance with 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 in accordance with Subsection 106.04.

916.05 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 10 millimeter cutout aluminum plates conforming to ASTM B 209M, 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 5 millimeter cutout aluminum plates conforming to ASTM B 209M, Alloy 6061-T6.

All cutout letters, numerals, border sections, and other symbols shall be predrilled with 3-millimeter 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 150 millimeters or less in height
b. All letters and digits 150 millimeters 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.

Steel structural shapes and plates, posts, chords, and bracing members shall all conform to ASTM A 36/A 36M. Post and chord caps shall conform to ASTM A 27/A 27M, Grade 70-36. Steel posts and U-shaped rail shall conform to ASTM A 499 with length of post and minimum kilograms per meter 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 in accordance with 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.

Stainless steel nuts shall conform to ASTM A 194/A 194M, 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/A 193M, austenitic steel.

916.08 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 in accordance with 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 13 millimeters thick or less may be sheared, blanked, sawed, or milled. Materials over 13 millimeters 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 prior to 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 10-millimeter 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 prior to surface preparation. Prior to painting or application of reflective sheeting to the aluminum, the sheets shall be treated in strict accordance with 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 38 °C, 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 108 to 377 milligrams per square meter with a median of 269 milligrams per square meter 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 5 millimeters or butted. When butted, the gaps shall not exceed 0.8 millimeter. 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 2 millimeters; except that where Type VI sheeting is used, it shall be cut at the top edges in accordance with the manufacturer's recommendation.

After aging 48 hours at 24 °C, 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 in accordance with 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		18
Fineness of Grind, Hegman		7
Consistency, Stormer KU 60		70

Color of the dried enamel shall match the color chip which 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.

Aluminum alloy shall conform to ASTM B 209M, ASTM B 210M, ASTM B 221M, or ASTM B 308/B 308M.

Nuts and bolts of aluminum alloy shall conform to ASTM B 316/B 316M.

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 22 kilonewtons in double shear.

Hex studs and nuts used in the breakaway coupling assembly shall conform to ASTM A 320/A 320M, Grade 17, with a minimum yield strength of 725 megapascals. Hex nuts in the assembly shall conform to ASTM A 194/A 194M, Grade 2H.

Load concentrating washers shall conform to ASTM A 564/A 564M, Type 630, Condition H 1025, with a minimum yield strength of 1 000 megapascals.

Washer retainers shall conform to ASTM A 570/A 570M, Grade 275 or ASTM A 569/A 569M.

Anchor bolts shall conform to ASTM A 307. Galvanizing of anchor bolts (top 150 millimeters), 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-5693C. The wire rope shall have a diameter of 6 millimeters with a minimum breaking strength of 20.9 kilonewtons and shall be 1 by 19 construction.

Cutting pins shall conform to ASTM A 564/A 564M, Type 630, Condition H 1025 with a minimum yield strength of 1000 megapascals.

Hex studs with nuts and washer retainer shall have a zinc coating electrodeposited in accordance with ASTM B 633, after which a chromate dip shall be applied. The coating shall be Type GS which shall have a minimum thickness of 25 micrometers with a maximum plus tolerance of 13 micrometers. 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 20 kilonewtons 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 "U" Post Sign Supports.

A. One Piece Steel "U" Posts. One piece steel "U" posts shall be fabricated from hot-rolled steel conforming to ASTM A 499 or ASTM A 663/A 663M, Grade 80 with a minimum of 0.20 percent copper.

Minor variations will be permitted in the shape of the posts to conform to a manufacturer's standard if such variations do not in any way reduce the minimum requirements herein specified. All posts members shall have flat ribs on the side of the post farthest from the flanges. All post members shall be of no smaller size than that indicated for each sign size or type designated and shall meet the corresponding minimum requirements. The weight per meter shall be that of each individual member comprising the post or post assembly. The term post shall also be construed to mean post member. The minimum requirements are as follows:

Post Requirements

Weight, kg/m	Face Width, mm	Depth, mm	Area, mm^2	Section Modulus Axis Parallel to Sign Face Single Post, mm^3
3.72	79	40	475	5080
5.95	89	44	800	9177

All posts exceeding the above requirements shall be suitably proportioned to present a pleasing appearance when supporting their respective signs, as judged by the Engineer. All posts shall be of adequate length to meet the requirements for erection. All posts shall be entirely galvanized after

Table 916-8 Type VI Sheeting Retroreflectance Requirements

Color	Silver/ White		Yellow		Green		Red		Blue	
Observation Angle, Degrees / Entrance Angle	0.2	0.5	0.2	0.5	0.2	0.5	0.2	0.5	0.2	0.5
-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

Type	Hours	Minimum Coefficient of Retroreflection (RA)
I	1000	65% of Table 916-1
II	1000 (A)	65% of Table 916-2
III-A	1000 (A)	80% of Table 916-3
III-B	1000 (A)	80% of Table 916-4
IV-A	2200 (B)	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 A: When the color orange is specified, the artificial weathering will be for 500 hours.

Note B: When the color orange is specified, the artificial weathering will be for 1000 hours.

SECTION 917 - STRUCTURAL STEEL AND OTHER FERROUS METALS

917.01 Bolts and Bolting Material.

Ordinary steel metric bolts shall conform to ASTM A 307. Ordinary steel metric nuts shall conform to ASTM A 563M. Galvanizing, when specified for ordinary bolts and washers, shall be in accordance with ASTM A 153.

Corrosion-resistant metric 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.

For the erection of sign support structures, anchor bolts shall conform to ASTM F 1554, Grade 250.

High-strength metric steel bolts, including suitable nuts and plain hardened washers, shall conform to either AASHTO M 164M (ASTM A 325M) or AASHTO M 253M (ASTM A 490M) and also the following supplementary criteria:

1. **Scope**. Additional requirements for field or shop installation of AASHTO M 164M (ASTM A 325M) high-strength bolts are listed in Subheading 4.d below. These additional requirements supplement the AASHTO Standard Specifications for Highway Bridges, Division II, Article 11. For the surface treatment of high-strength metric steel bolt assemblies, the AASHTO Division II, Article 11 requirements shall govern, with the exception that the AASHTO M 164M

(ASTM A 325M) high-strength bolt assemblies shall be hot-dipped galvanized only.

2. Specifications

a. All nuts shall meet the requirements of AASHTO M 292/M 292M (ASTM A 194/A 194M) as applicable or AASHTO M 291M (ASTM A 563M) and the revisions below.

b. All washers shall meet the requirements of ASTM F 436M and the revisions below.

3. Manufacturing.

a. Bolts. Hardness for bolt diameters M16 to M36, inclusive, shall be as noted below:

Bolt Size	**Hardness Number** Rockwell C	
	Minimum	**Maximum**
M16 to M36 (for ASTM A 325M)	23	34
M16 to M36 (for ASTM A 490M)	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 291M (ASTM A 563M) and the rotational-capacity test herein (the over tapping requirements of AASHTO M 291M (ASTM A 563M), 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 in accordance with the appropriate AASHTO/ASTM specifications. The manufacturer's control numbers on the test reports must match the lot number marked on the shipping containers. If this criteria is not met, the lot in question shall be rejected.

4. Testing.

a. Bolts.

(1) Proof load tests (ASTM F 606M, Method 1) are required. Minimum frequency of tests shall be as specified in AASHTO M 164M (ASTM A 325M), Paragraph 9.2.4.

(2) Wedge tests on full size bolts (ASTM F 606M, 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 164M (ASTM A 325M), 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 606M, Paragraph 4.2) are required. Minimum number of tests shall be as specified in AASHTO M 291M (ASTM A 563M), Paragraph 8.3 or AASHTO M 292/M 292M (ASTM A 194/A 194M) 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 prior to taking hardness measurements).

(2) If galvanized washers are supplied, the thickness of the zinc coating shall be measured.

d. Assemblies. In accordance with the AASHTO Standard Specifications for Highway Bridges, Division II, Article 11.5.6.4.2, rotational-capacity tests are required and shall be performed on all plain or galvanized (after galvanizing) bolt, nut, and washer assemblies. The rotational-capacity tests, in accordance with these guidelines, shall also be performed at the job site and by the manufacturer or distributor prior to 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 in accordance with the requirements of AASHTO M 164M (ASTM A 325M). Additional guidance concerning rotational-capacity tests for both long and short bolts is included in Appendices A and B at the end of this Subsection.

(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 (Note: This requirement supersedes the current AASHTO M 164M (ASTM A 325M) requirement that the test be performed in a steel joint). For bolts which 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 (2/3 turn)	≤ 4 diameters
360 degrees (1 turn)	> 4 diameters and ≤ 8 diameters
480 degrees (1-1/3 turns)	> 8 diameters

Note: These values differ from the AASHTO M 164M (ASTM A 325M) 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 below:

Bolt Size	M16	M20	M22	M24	M27	M30	M36
Req. Install Tension, kN	94.2	147	182	212	275	337	490
Turn Test Tension, kN	108	169	209	244	316	388	564

(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 newton meters.
P = measured bolt tension in newtons.
D = bolt diameter in meters.

(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 in accordance with 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 (in lieu 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 prior to installation.
b. The appropriate MTR, MCTR, or DCTR shall be supplied to the Contractor or Owner as required by the contract documents.

7. Installation. The following requirements for installation apply in addition to the specifications in AASHTO Standard Specifications for Highway Bridges, Division II, Article 11, when high-strength bolts are installed in the field or shop:

a. Bolts shall be installed in accordance with AASHTO Standard Specifications for Highway Bridges, Division II, Article 11.5.6.4.

During installation, regardless of the tightening method used, particular care should be exercised so that the snug tight condition as defined in Article 11.5.6.4 is achieved.

b. The rotational-capacity test described in Subheading 4.d above shall be performed on each rotational-capacity lot prior to 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 AASHTO Standard Specifications for Highway Bridges, Division II, Article 11.5.6.4.4 through 11.5.6.4.7, 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 prior to installation. Recleaned or relubricated bolt, nut, and washer assemblies shall be retested in accordance with b. above prior to installation.

e. Bolt, nut, and washer (when required) combinations as installed shall be from the same rotational-capacity lot.

APPENDIX A
PROCEDURE FOR PERFORMING ROTATIONAL-CAPACITY TEST ON LONG BOLTS IN TENSION CALIBRATOR

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 1.6 millimeters 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, +9 kilonewtons.

Bolt Size	M16	M20	M22	M24	M27	M30	M36
Snug Tension, kN	9	15	18	21	27	34	49

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	M16	M20	M22	M24	M27	M30	M36
Tension, kN	94.2	147	182	212	275	337	490

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 which fail prior to this rotation either by stripping or fracture fail the test.

Rotation	**Bolt Length**
240 degrees (2/3 turn)	≤ 4 diameters
360 degrees (1 turn)	> 4 diameters and ≤ 8 diameters
480 degrees (1-1/3 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 which do not meet this tension fail the test.

Bolt Size	M16	M20	M22	M24	M27	M30	M36
Tension, kN	108	169	209	244	316	388	564

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 which have evidence of stripping fail the test.
9. Calculate and record the value of 0.25 times the tension in newtons measured in Step 5 times the bolt diameter in meters. 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.

APPENDIX B
PROCEDURE FOR PERFORMING ROTATIONAL-CAPACITY TEST ON BOLTS TOO SHORT TO FIT TENSION CALIBRATOR

A. Equipment Required.

1. Calibrated torque wrench and spud wrench or equivalent.
2. Spacers and/or washers with hole size no larger than 1.6 millimeters 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 300-millimeter 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 (1/3 turn)	≤ 4 diameters
180 degrees (1/2 turn)	> 4 diameters and ≤ 8 diameters
240 degrees (2/3 turn)	> 8 diameters

The measured torque should not exceed the values listed below. Assemblies which exceed the listed torques fail the test.

Bolt Size	M16	M20	M22	M24	M27	M30	M36
Torque, N-m	404	808	1 081	1 423	1 852	2 423	4 214

6. Tighten the bolt further to the rotation required below. The rotation is measured from the initial marking in Step 4. Assemblies which fail prior to this rotation either by stripping or fracture fail the test.

Rotation	**Bolt Length**
240 degrees (2/3 turn)	≤ 4 diameters

360 degrees (1 turn)	> 4 diameters and ≤ 8 diameters
480 degrees (1-1/3 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 which have evidence of stripping fail the test.

Anchor bolts, rock anchors, and hardware shall conform to AASHTO M 183/M 183M and shall be galvanized after fabrication, including threading, in accordance with ASTM A 153.

Dowels used to anchor prestressed concrete voided slabs and box beams to abutments and piers shall conform to AASHTO M 183/M 183M and shall be galvanized in accordance with ASTM A 153. Threading of dowels is not required.

Welded stud shear connectors shall conform to AASHTO Standard Specifications for Highway Bridges, Division II, Section 11.

Stainless steel bolts, nuts, and washers shall conform to ASTM A 320/A 320M, 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 164M (ASTM A 325M) and be hot-dip galvanized as per ASTM A 153.

As an alternate, bolts, nuts, and washers conforming to AASHTO M 164M (ASTM A 325M) may be substituted for bolts, nuts, and washers of the same diameter, length, and thickness conforming to ASTM A 307.

917.02 Flooring.

Steel for grid flooring shall conform to AASHTO M 270/M 270M, Grade 250 and shall be galvanized in accordance with AASHTO M 111. Formed steel flooring shall conform to ASTM A 570/A 570M, Grade 205.

917.03 Castings for Drainage Structures.

Metal shall conform to the following:

1. Gray iron castings shall conform to AASHTO M 105, Class 30B, 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 castings shall conform to AASHTO M 103/M 103M. Grade shall be optional.
3. Ductile iron castings shall conform to ASTM A 536, Grade 65-45-12.
4. Structural steel shall conform to AASHTO M 183/M 183M.

Galvanizing, where specified for these units, shall conform to AASHTO M 111.

917.04 Permanent Steel Bridge Deck Forms.

Permanent steel bridge deck forms and accessories shall conform to ASTM A 446/A 446M, Grades A through E. Galvanizing shall conform to ASTM A 525M, coating designation Z700.

917.05 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.

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 in accordance with 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.

Medium-strength carbon steel castings shall conform to AASHTO M 103/M 103M, Grade 450-240. High-strength steel castings shall conform to ASTM A 148/A 148M.

917.08 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.

Steel H-piles shall conform to AASHTO M 270/M 270M, Grade 250, with the exception that steel H-piles for use in a marine environment shall conform to AASHTO M 270/M 270M, Grade 345 and shall be coated with a 406-micrometer application of coal tar epoxy in accordance with SSPC Paint Specification No. 16.

Steel sheet piling shall conform to AASHTO M 202/M 202M or AASHTO M 270/M 270M, Grade 345, with the exception that steel sheet piling for use in a marine environment shall conform to AASHTO M 270/M 270M, Grade 345 and shall be coated with a 406-micrometer application of coal tar epoxy in accordance with 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 1.6 millimeters and shall be 19 millimeters 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.

Carbon structural steel shall conform to AASHTO M 270/M 270M, Grade 250. 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 structural columbium-vanadium steel shall conform to ASTM A 572/A 572M. Supplementary requirement S5 of AASHTO M 183/M 183M is mandatory for materials designated "T" as main load carrying member components subject to tensile stress. Zone 2 of Table S1, AASHTO M 183/M 183M shall govern the toughness requirements.

High strength low-alloy structural steel shall conform to ASTM A 242/A242 M. Supplementary requirement S5 of AASHTO M 183/M 183 M is mandatory for materials designated "T" as main load carrying member components subject to tensile stress. Zone 2 of Table S1 of AASHTO M 183/M 183 M shall govern the toughness requirements.

High-strength low-alloy structural steel with a 345-megapascal minimum yield point for thicknesses 100 millimeters and under shall conform to AASHTO M 270/M 270M, Grade 345W. 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/M 270M, Grade 345. 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/M 270M, Grades 690/690W. 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/M 270M, Grade 250.

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, in accordance with Subsection 917.12.

Plates, shapes, and shims shall be made of structural steel conforming to AASHTO M 270/M 270M, Grade 250 and shall be hot-dip galvanized after fabrication, including welding, in accordance with Subsection 917.12.

917.11 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 (ASTM A 722) or 13-millimeter diameter, 1 860-megapascal 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 912.09. As an alternate, bars may be epoxy coated in accordance with AASHTO M 284/M 284M or galvanized in accordance with AASHTO M 111. The minimum thickness of the cured epoxy coating per AASHTO M 284/M 284M shall be 250 ± 50 micrometers.

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 in accordance with AASHTO M 111.

Anchorages and end fittings for 13-millimeter 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.

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.

Sampling and testing will be performed in accordance with the following:

Bolts, nuts, washers, and miscellaneous hardware	Subject to inspection and testing prior to shipment
Castings:	
Carbon	Subject to inspection and testing prior to shipment
Gray Iron	Two bars for each 100 megagrams
Steel for flooring, deck forms, rivets, bearings, castings, forgings, pilings, and structures	Subject to inspection prior to 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 in accordance with Subsection 106.04.

SECTION 918 - TIMBER AND TIMBER PRESERVATIVES

918.01 Sawn Timber Posts.

Sawn timber posts shall be of southern pine or Douglas fir with extreme fiber stress in bending in excess of 8.4 megapascals, as assigned in accordance with Southern Pine Inspection Bureau or West Coast Lumber Inspection Bureau grading rules. The post may be rough sawn or dressed. Treatment shall be in accordance with AASHTO M 133 and AWPA Standards C2 and C14, as summarized in Subsection 918.06.

918.02 Round Timber Piling.

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 in accordance with AASHTO M 133 and AWPA Standards C3 and C14 as summarized in Subsection 918.06.

918.03 Dimension Lumber for 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 in accordance with AASHTO M 133 and AWPA Standards C2, C14, and C18, as summarized in Subsection 918.06.

918.04 Timber Connectors and Hardware.

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.

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 38 to 89 millimeters thick and as No. 1 if 114 millimeters or thicker. Douglas fir shall be designated and graded as Dense No. 1.

   Pacific coast Douglas fir may be used in lieu 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 192 kilograms of preservative per cubic meter of timber for timber 127 millimeters and thicker, and 320 kilograms of preservative per cubic meter of timber or to refusal but not less than 192 kilograms per cubic meter for timber less than 127 millimeters thick, in accordance with 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 in accordance with 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 bituminous 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, in accordance with AWPA Standards C14 and C28, current at time of bid, to a minimum retention of 9.61 kilograms per cubic meter before gluing. Where feasible, all cuts and holes shall

be fabricated prior to preservative treatment. After treatment, the maximum moisture content shall not exceed 19 percent.

918.06 Timber Treatment.

Timber preservative treatment for various wood species and usage requirements shall be in accordance with AASHTO M 133 and AWPA Standards C1, C2, C3, C14, C18, and C28 as summarized in the tables below:

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 (kg/m^3)**			
		Southern Pine		*Douglas Fir*	
		Creosote	*CCA/Penta*	*Creosote*	*ACZA*
1. Round, half-round, and quarter-round posts	C14	160	8	160	8
2. Posts sawn four sides	C14	190	10	190	10

Ultraviolet Degradation, Retained Strength	ASTM D 4355	70% at 150 hours
Apparent Opening Size	ASTM D 4751	0.6 mm maximum
Permeability, cm/sec	ASTM D 4491	0.001 **minimum**

3. Silt Fence, Inlet Filter.

Physical Property	**Test Methods**	**Requirements**
Weight, g/m^2	ASTM D 1910	85
Thickness,Tm	ASTM D 1977	254
Grab Strength, N	ASTM D 4632	445 minimum
Elongation to Break, %	ASTM D 4632	10
Burst Strength,MPa	ASTM D 3786	1.3 minimum
Trapezoidal Tear, N	ASTM D 4533	223 minimum
Permittivity Factor, per second	ASTM D 4491	0.01

919.07 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 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 in accordance with 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.

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.

Hydrated lime shall conform to ASTM C 207, Type N.

919.10 Concrete Deck Overlay Protective Systems

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-79-35. A

certified copy of the test properties shall be furnished in accordance with Subsection 106.04.

Prior to submitting a mix design in accordance with 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 in accordance with Section 990, NJDOT M-2. Other properties will be determined in accordance with the procedure in the above referenced FHWA Report.

B. Silica Fume Admixture. Prior to submitting a mix design in accordance with 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 or ASTM C 1240 and shall be accompanied by a copy of manufacturer's recommendations. Silica fume admixture shall be approved by the Engineer prior to 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.

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 71 ºC.

919.12 Quick-Setting Patch Materials.

The material shall be packaged and ready for mixing just prior to use in accordance with 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 6.8 kilograms 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 6.8 kilograms, 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 prior to 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 prior to 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 0°C.

Type IV: Suitable for use above water and for use in hot weather (35 ± 3°C).

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 in accordance with Section 990, NJDOT M-3 shall meet the following requirements:

1. **Bond Strength.**
   7-day……7 MPa minimum
   28-day……14 MPa 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 1.5 kilograms per cubic meter at or below the 50-millimeter level.

5. Compressive Strength (MPa). Patching material is classified as follows:

	3 hours	1 day	7 days	28 days
Type I and IA	14	21	28	31
Type II	--	14	28	31
Type III	14	21	28	31
Type IV	14	21	28	31
Type V	-	7	14	21

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.

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)

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 110 ± 5 °C to constant weight.
2. Evaporated solar or other salt shall not be furnished in lieu of rock salt.

919.15 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 in accordance with 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.

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.

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 4 to 38.

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.

Sampling and testing will be performed in accordance with the following:

Bearing Pads…… 0.1 square meter from each lot
Chlorides:
Calcium…… 1 liter from each lot
Sodium…… 1 liter 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…… 4 liters 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 in accordance with Subsection 106.04.

SECTION 990 - METHODS OF TESTS

This Section consists of the following NJDOT Methods of Tests which have been adopted and are used by the Department.

A-1 MORTAR-MAKING PROPERTIES OF FINE AGGREGATE

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.

Note: Subsequent samples of fine aggregate which 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 in accordance with AASHTO T 162 and tested in accordance with AASHTO T 132.

The fine aggregate sample mortar will be prepared and tested in accordance with 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

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 75 to 100 millimeters and a minimum depth of 13 millimeters.
2. The receptacle for testing the coarse aggregate will be of sufficient size to hold several kilograms of aggregate and will be at least 130 millimeters 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, 3.2-millimeter glass plate, approximately 100 millimeters 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 100 millimeters 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 SOUNDNESS OF AGGREGATES BY USE OF SODIUM SULFATE

A. Scope.

This method of test is used to determine the resistance of aggregates to disintegration by a saturated solution of sodium sulfate.

B. Apparatus.

The apparatus will consist of the following:

1. Square opening sieves conforming to ASTM E 11:
   Fine Series: 4.75 millimeters, 2.36 millimeters, 1.18 millimeters, 600 micrometers, 300 micrometers, and 150 micrometers.
   Coarse Series: 63 millimeters, 50 millimeters, 37.5 millimeters, 25.0 millimeters, 19.0 millimeters, 12.5 millimeters, and 9.5 millimeters.
2. Containers for immersing the aggregate samples in the sulfate solution as described in this method will be perforated. The perforations will allow free access and drainage of the solution without loss of the aggregates. The containers for fine aggregate will be 125-micrometer mesh sieves of sufficient size to hold a minimum of 100 grams, and allow proper solution cover. The volume of the

solution will be such that a minimum of 13 millimeters of solution rises above the top surfaces of the aggregates.

3. Balances for fine aggregates will have a minimum capacity of 500 grams, sensitive to 0.1 gram or less. Balances for coarse aggregates will have a minimum capacity of 5000 grams, sensitive to 1 gram or less.
4. Drying oven will be capable of maintaining a constant temperature of 110 ± 5 C with a minimum evaporation rate of 25 grams per hour.
5. Saturated solution of sodium sulfate using USP (US Pharmaceutical) or equal grade of the salt will be used. The temperature of the solution will be 21 ± 1 ºC and will have a specific gravity range of 1.151 to 1.174 at 21 ± 1 ºC. Contaminated solutions will be discarded.

C. Samples.

Fine aggregate will be passed through a 4.75-millimeter sieve. The sample will be of sufficient size to provide not less than 100 grams of the following sizes. Each of the following sizes will be used for testing the fine aggregate:

Passing	**Retained On**
4.75 mm	2.36 mm
2.36 mm	1.18 mm
1.18 mm	600 µm
600 µm	300 µm
300 µm	150 µm

Coarse aggregate will be considered that which is larger than retained on a 4.75-millimeter sieve.

The sample will be of sufficient size to provide the following amounts of the various sizes:

Sieve Size	**Weight**
50 to 37.5 mm	2000 g
37.5 to 25.0 mm	1500 g
25.0 to 19.0 mm	1000 g
19.0 to 12.5 mm	750 g
12.5 to 9.5 mm	500 g
9.5 to 4.75 mm	300 g

If the samples contain less than five percent of any of the sizes specified for fine and coarse aggregate above, that size will not be tested, but will be considered to have the same loss as the average of the next smaller and the next larger size, or the same loss as the next smaller or the next larger size, whichever is applicable. Each sieve size tested will be shaken to refusal prior to cycling.

For testing coarse aggregates, three consecutive sieve sizes will be tested to determine the amount of loss. The sizes are to be determined by the gradation of the sample.

The preparation of the sample and procedure for testing will conform to ASTM C 88 except that any referral to a previous section of the test will be interpreted as referring to the same section of this test method.

The process of alternate immersion and drying will be repeated for five cycles.

D. Quantitative Examination.

The quantitative examination will be made as follows:

1. After completion of the final cycle, and after the sample has cooled, the sample will be washed until free of sodium sulfate solution, as determined by the reaction of the wash water with barium chloride.
2. After the removal of the sodium sulfate solution, each fraction of the sample will be dried to constant weight at 110 ± 5 µC, weighed, and, except in the case of

ledge rock, sieved over the same size sieve on which it was retained before the cycling procedure. The amount retained on this sieve, after the sample is shaken to refusal, will be weighed and the weight recorded.

In the case of ledge rock, the loss in weight will be determined by subtracting the final weight of all fragments which have not split into three or more pieces from the original weight of the test sample.

Note: A piece of aggregate is defined as any fragment that weighs at least ten percent of the oven dry weight of the fragment from which it was broken.

E. Report.

The report will show the total weighted average loss calculated from the percentage loss for each sieve fraction based on the original grading of the sample.

In the case of ledge rock, the loss will be determined as outlined above.

A-4 DETERMINATION OF PERCENTAGE OF MICA IN FINE AGGREGATE

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 2.0-millimeter and 75-micrometer 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, 75-millimeter length, equipped with a polonium ionizer built in the ferrule of the brush which 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 millimeters, field area 12.6 millimeters.
5. Rubber-edged scraping blade with metal stem rubber edge approximately 100 millimeters 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 2.0-millimeter mesh sieve and retained on a 75-micrometer 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.

M-3 QUICK-SETTING PATCH MATERIALS

A. Preparation of Samples.

All samples are to be prepared in accordance with 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 in accordance with ASTM C 109, except for the Type 1A classification. Specimens shall be 100 by 200 millimeter 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 101.6 by 203.2-millimeter 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 101.6 by 203.2-millimeter cylinders having a minimum compressive strength of 35 megapascals. 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 101.6 by 203.2-millimeter 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 one day and two specimens at seven days in accordance with 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 50.8 by 50.8 by 254-millimeter autoclave bars according to ASTM C 157. Cure in room at 21 to 25 °C 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 101.6 by 203.2-millimeter 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 21 to 25 °C 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.

   Note: After every tenth cycle, cylinders will be examined visually and their condition recorded in accordance with ASTM C 672.
6. **Permeability.**

a. Prepare one 101.6 by 203.2-millimeter cylinder and cure 24 hours at 21 to 25 °C and 50 percent relative humidity. Saw cut the cylinder into two 101.6 by 101.6-millimeter 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 25, 50, and 75-millimeter levels, from the top surface, in accordance with AASHTO T 260.

Note: If the material is to be used at temperatures lower than 21 C, the Engineer may test the time of set and compressive strength at the lower temperatures.

M-4 CALCIUM NITRITE PRESENCE IN PLASTIC CONCRETE

A. SCOPE

This method of test is used to determine the presence of calcium nitrite in the plastic concrete state. A freshly-mixed sample shall be tested utilizing a Hach low range nitrite test cure manufactured by the Hach Company of Loveland, Colorado, or equivalent. The equipment to perform this test shall be provided to the State by the Contractor.

B. PROCEDURE

Place a sample of the freshly-mixed concrete into a clean container. Add water, shake and allow the contents to completely settle. Use only the remaining water from the concrete sample for the following test. Rinse the empty low range test cube with the remaining water to be tested. Fill to the cube mark with the water sample. Use clippers to open one Nitriver$^{(R)}$3 nitrite reagent powder pillow. Add the contents from the pillow to the cube. Cap the cube and shake vigorously for one minute. Wait for 10 minutes to allow time for the color development. Match the color of the sample to the color on the test cube to obtain the milligram/liter nitrite nitrogen (N_2O as N).

M-5 CALCIUM NITRITE PRESENCE IN HARDENED CONCRETE

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.

Note: 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 nanometers.

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 milliliter.
5. Pipets, 2.00 milliliter, 5.00 milliliter, 10.00 milliliter, 20.00 milliliter, and 50.00 milliliter.
6. Volumetric Flasks 100 milliliter, 500 milliliter, 1000 milliliter.
7. Graduated Cylinders, 50 milliliter, 200 milliliter.
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% Solution, ACS Reagent Grade.** Dissolve 2.27 liters of sulfanilic acid in 70 milliliter of hot distilled water, cool the solution, add 20 milliliter of concentrated hydrochloride acid, and dilute to 100 milliliter with distilled water and mix.
2. **Hydrochloric Acid, 1N, Concentrated, ACS Reagent Grade.** Dilute 8.6 milliliter of Conc. HC1 to 100 milliliter and mix.
3. **N-(1-Naphthyl)-Ethylenediamine Dihydrochloride Solution, Fisher Scientific Co. Cat. # 21.** Dissolve 0.60 g of this reagent in 50 milliliter of distilled water acidified with 1.0 milliliter of Conc. HC1. Dilute to 100 milliliter 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 liters of sodium nitrite in distilled water and dilute to one liter using a volumetric flask.
   b. SECONDARY STANDARD SOLUTION. Dilute the primary standard solution 50/500 using a 50 milliliter pipet and 500 milliliter volumetric flask.
5. **Phenolphthalein Indicator Solution, 1%, ACS Reagent Grade.** Dissolve 1 gram of phenolphthalein in 100 milliliter (Graduate) of 95% 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 milliliter volumetric flasks, dilute the secondary sodium nitrite standard solution 5/500, 10/500, and 20/500. Pipe 10 milliliter of each of the above solutions into separate 100 milliliter volumetric flasks. Add approximately 50 mils. of distilled water to each volumetric flask. To a fourth 100 milliliter volumetric flask labelled "Blank" add 60 mils. of water. To each 100 milliliter flask:
   a. Pipet 2.00 milliliter of sulfanilic acid reagent, mix and allow to stand 5 minutes.
   b. Pipet 2.00 milliliter of N-(1-Naphthyl) ethylenediamine dichloride reagent, dilute to volume, mix, and allow to stand 10 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 nanometer 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 nm. Record the absorbance at the apex of the UV curve between 520 and 530 nanometer.

Using regular graph paper, ploug/milliliter nitrate vsAbsorbance.

2. **Sample Extraction and Nitrite Determination.** Pulverize the whole concrete sample in order 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 milliliter 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 #44 paper. Collect the filtrate in a 500 milliliter volumetric flask. To the Erlenmeyer flask containing the residual sample, add 200 milliliter of distilled water and re-extract by stirring 10 minutes. Stop and allow to settle. Refilter using the same filter as in Step 5. Collect the filtrate in the same 500 milliliter volumetric flask. Repeat extraction and filtration using 100 milliliter of distilled water. Dilute to volume (500 milliliter), if necessary, and mix. From the 500 milliliter volumetric flask transfer (pipet) a 10.00 milliliter aliquot into a 100 milliliter volumetric flask. Add 50 milliliter of distilled water. Add a few drops of phenolphthalein indicator and neutralize by dropwise addition of 1 Nhydrochloric acid. Pipet 2.00 milliliter of sulfanilic acid reagent, mix, and allow solution to stand 5 minutes. Pipet 2.00 milliliter of N(-1naphthyl) ethylenediamine dihydrochloride reagent. Dilute to volume, mix and allow solution to stand 10 minutes. Scan an aliquot of the sample solution from 600 to 500 nm and record the maximum absorbance between 520 to 530 nanometel.

E. Calculations.

Read the ug/milliliter nitrite equivalent to the absorbance from the standard calibration curve. Calculate the % NO_2 - in the sample as follows:

$$\frac{(\mu g/\text{milliliter } NO_2\text{ - , Sample From Standard Curve} \times \frac{\text{Dilution Aliquot}}{500}) \times 100\%}{(\text{Sample Wt., Grams}) \times (10^6)} = \_\_\_\_\_ \%NO_2$$

Note: The aliquots pipeted from the 500 milliliter extraction filtrate should be adjusted such that thabsorbance is within the range of 0.10 to 0.80.

Note: The % NO_2 - as calculated above does not take into account the % recovery factor of the nitrite. For a particular set of lab concrete standards containing 390 kilograms per cubic meter cement with 2% s/s $Ca(NO_2)_2$ 96% recovery of the theoretical nitrite was obtained.

G. 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 C494 Standard Specification for Chemical Admixtures for Concrete for any type of admixture.

P-1 DETERMINING WATER RESISTANCE OF TRAFFIC PAINT

A. Scope.

This method of test is used to determine the water resistance of traffic paint.

B. Apparatus.

The apparatus will consist of 100 by 200-millimeter glass panels and suitable solvent.

C. Procedure.

The glass panels used in this test will be thoroughly cleaned with a suitable solvent to remove the presence of any grease, then with hot soapy water, rinsed with clear warm water, and allowed to dry before the paint is applied.

The paint will be applied to the panels in a wet film thickness of 380 micrometers. Allow the paint film to dry in a horizontal position at room temperature (24 ± 3 ºC) for two hours, protecting it against accumulation of dust, then immerse the glass panel in distilled water at room temperature for 18 hours. Allow to air dry for two hours and then examine.

The paint will show no softening or blistering.

P-2 GLASS BEADS

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 1.4 kilograms (1 liter). 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 1.4 kilograms (1 liter) 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 in accordance with 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 which 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 °C.** 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 1.18-millimeter, 850-micrometer, 600-micrometer, 300-micrometer, and 150-micrometer mesh sieves.
2. Percent retained on 1.18-millimeter, 850-micrometer, 600-micrometer, 300-micrometer, and 150-micrometer 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 milliliters 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 milliliters of buffered solution (pH 5 to pH 6) at room temperature. The solution is then decanted and the beads rinsed with 100 milliliters 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 milliliters of saturated lime water solution. Solution is then decanted and beads are rinsed with 100 milliliters 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 milliliters of a 1.0 normal solution of calcium chloride. Solution is then decanted and beads are rinsed with 100 milliliters 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 (7000 nanowatts per centimeter squared).
2. Weigh 10 grams of beads to be evaluated and place into an aluminum weighing dish.
3. Place a 50-millimeter 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 milliliters 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.