



STATE OF NEW JERSEY
DEPARTMENT OF TRANSPORTATION

Scoping & Design – Project Level Data Collection & Analysis

By Robert J. Blight

Principal Engineer

Pavement Management & Technology

Goals

- Share process
- Provide knowledge
- Identify key data
- Feedback



Reliable and cost-effective design of a project requires the collection and detailed analysis of key data from the existing pavement.



Analysis of key data, from simple to complex, will allow the pavement engineer to identify specific problems and their causes.



Basic Steps of Project Level Data Collection

- Review of existing data
- Perform field review
- Additional Data Collection
 - Constraints
- Analysis



Review Existing Data

- PMS data
 - Surface Distress (SDI)
 - Ride Quality (IRI)
 - Rutting (inches)
 - Skid Resistance (SN)
- Historical data
 - HPMA, SLD, Video, Falcon
 - Structural Adequacy
- Other pavement projects
- Project Limits

NJDOT PavView - [Roadway Measured Data]

File Edit View Insert Format Records Tools Window Help

Tahoma 8 B I U

ROADWAY MEASURED DATA

Collection Cycle Year: 2008

Route	Direction	Milepost From	Milepost To:	Pvmt Type	AADT	Skid Date	Skid Value	Profiler Date	Left IRI	Right IRI	Avg IRI	Avg Rut	Max Lft Rut	Max Rt Rut	NDI	LDI	SDI	SDI Ovrdr
001	N	7.3	7.4	CO	43,161	4/12/2005	50	5/5/2008	166	198	182	0.3	0.9	0.6	0.82	1.85	0.30	
001	N	7.4	7.5	CO	43,161	4/12/2005	52	5/5/2008	173	157	165	0.3	0.7	0.7	0.77	1.98	0.30	
001	N	7.5	7.6	CO	43,161	4/12/2005	52	5/5/2008	148	185	166	0.2	0.7	0.5	0.77	2.10	0.32	
001	N	7.6	7.7	CO	43,161	4/12/2005	58	5/5/2008	156	194	175	0.3	0.7	0.6	0.77	2.02	0.31	
001	N	7.7	7.8	CO	43,161	4/12/2005	58	5/5/2008	127	158	143	0.3	0.6	0.4	0.77	2.05	0.32	
001	N	7.8	7.9	CO	43,161	4/12/2005	48	5/5/2008	149	144	147	0.3	1.1	0.7	0.77	1.91	0.29	
001	N	7.9	8.0	CO	43,161	4/12/2005	49	5/5/2008	164	147	155	0.2	0.6	0.4	3.56	3.93	2.80	
001	N	8.0	8.1	CO	43,161													

Generate Report Export To Excel Return To Selection Screen

Review Existing PMS Data

2008 ENGINEERING REVIEWED PAVEMENT PROJECTS LIST - MINIMUM 1/2 MILE Sorted By Project Benefit

Notes:

- (1) Selection criteria: SDI < 2.0, based on 2007 PMS data. Minimum project length is 0.5 mile.
- (2) Allowable gap in consecutive segments meeting selection criteria and included in the same project = 0.2 mile.
- (3) AADT = Average Annual Daily Traffic. IRI = International Roughness Index. Normalized IRI = IRI converted to 0 - 5 scale. SDI = Surface Distress Index. FPR = Final Pavement Rating
- (4) Cost estimated as \$300,000 per lane mile. $Benefit = 0.9(5.0 - Avg\ FPR) + 0.1(Traffic\ Factor)$ and $Traffic\ Factor = (5/60000)(Avg\ AADT)$, with $Max = 5.0$
- (5) For undivided routes (Dir = B): IRI, Normalized IRI, SDI, and FPR shown represent the most critical set of values considering both directions of travel.

Proj #	Benefit Rank	Proj ID	Rte	Dir	MP Start	MP End	Len	Lane Miles	Avg AADT	Avg IRI	Avg Normalized IRI	Avg SDI	Avg FPR	Avg Ld Distress Percent	Benefit	Cost Estimate (Millions)	Planned Work in Proximity to Project			
																	MP Start	MP End	Constr Year	Description
1	1	U045	030	B	12.4	13.1	0.7	2.8	31938	256	1.69	0.15	0.15	98	4.494	\$0.84				
	25	U046	030	B	13.8	16.3	2.5	10.0	15904	231	1.91	0.77	0.49	73	4.124	\$3.00				
	11	U047	030	B	16.9	18.0	1.1	4.1	15416	221	2.01	0.38	0.38	93	4.219	\$1.23				
2	2	D045R	009	N	128.0	129.8	1.8	4.7	39059	134	2.97	0.44	0.44	100	4.426	\$1.41				
		D045AR	009	S	128.0	129.8	1.8	4.6							\$1.38					
3	3	D018	001	S	22.3	22.9	0.6	1.8	37630	162	2.60	0.48	0.48	100	4.378	\$0.54				
4	5	U109	047	B	59.8	61.5	1.7	3.4	12376	223	1.97	0.28	0.28	88	4.302	\$1.02				
	329	U110	047	B	61.8	62.3	0.5	1.0	12376	222	2.02	1.66	1.54	0	3.167	\$0.30				
5	6	D039	009	N	111.9	112.4	0.5	1.0	18756	143	2.97	0.40	0.40	100	4.293	\$0.30				
	272	D049	009	S	111.7	112.2	0.5	1.0	18756	119	3.18	1.48	1.48	0	3.320	\$0.30				
6	7	D286	202	S	11.5	12.6	1.1	2.2	14702	128	3.11	0.38	0.38	100	4.285	\$0.66				
7	8	D072	018	N	11.4	13.2	1.8	3.6	17512	201	2.25	0.40	0.40	81	4.282	\$1.08				
	28	D077	018	S	5.3	13.2	7.9	15.7	21762	137	2.93	0.63	0.63	97	4.114	\$4.71				
8	9	D016	001	S	9.0	9.5	0.5	1.5	38071	111	3.27	0.60	0.60	87	4.276	\$0.45	6.76	10.86		Congestion Management. Concept Development
	79	D002	001	N	9.7	11.0	1.3	3.9	38071	170	2.52	1.06	1.06	0	3.864	\$1.17	6.76	10.86		Congestion Management. Concept Development
9	10	D104	023	S	9.3	9.8	0.5	1.5	29832	177	2.45	0.57	0.57	98	4.240	\$0.45				
10	235	U217	206	B	107.7	109.3	1.6	3.5	17880	215	2.05	1.40	1.30	94	3.404	\$1.05				
	133	U218	206	B	110.0	111.4	1.4	4.0	24478	167	2.56	1.04	1.04	90	3.670	\$1.20				
	294	U219	206	B	114.7	115.3	0.6	1.2	17798	163	2.83	1.59	1.45	94	3.270	\$0.36				
	12	U220	206	B	116.5	117.6	1.1	3.8	29280	161	2.64	0.45	0.45	99	4.215	\$1.14				
11	14	D126	034	S	12.0	12.5	0.5	1.0	8962	110	3.30	0.41	0.41	100	4.203	\$0.30				
	34	U069	034	B	12.5	13.1	0.6	1.3	15840	135	2.96	0.53	0.53	92	4.086	\$0.39	12.80	13.60		Colts Neck Intersect-Operational Improvements. Concept Development
12	15	D031R	003	W	6.2	8.0	1.8	6.3	74482	140	2.89	0.90	0.90	0	4.187	\$1.89	4.00	6.20		Preliminary Design. Rt-3 Bridge over Passaic River
	76	D029R	003	E	6.2	10.8	4.6	14.7	71963	155	2.73	1.28	1.25	0	3.871	\$4.41	4.00	6.20		Preliminary Design. Rt-3 Bridge over Passaic River
13	16	D071	015	N	9.9	10.4	0.5	1.0	19450	233	1.96	0.53	0.53	97	4.186	\$0.30				
14	17	D247R	124	E	11.5	12.4	0.5	1.8	8222	276	1.58	0.61	0.43	94	4.184	\$0.54	11.11	11.47		2008 Maintenance Resurfacing Schedule- MRRC #N303
	50	D248	124	W	11.9	12.4	0.5	1.0	8222	217	2.04	0.65	0.65	92	3.982	\$0.30				
15	18	U076	035	B	20.5	21.0	0.5	2.0	20150	172	2.52	0.45	0.45	100	4.177	\$0.60				

Review of Simple Data

State of New Jersey
Department of Transportation

Straight Line Diagrams

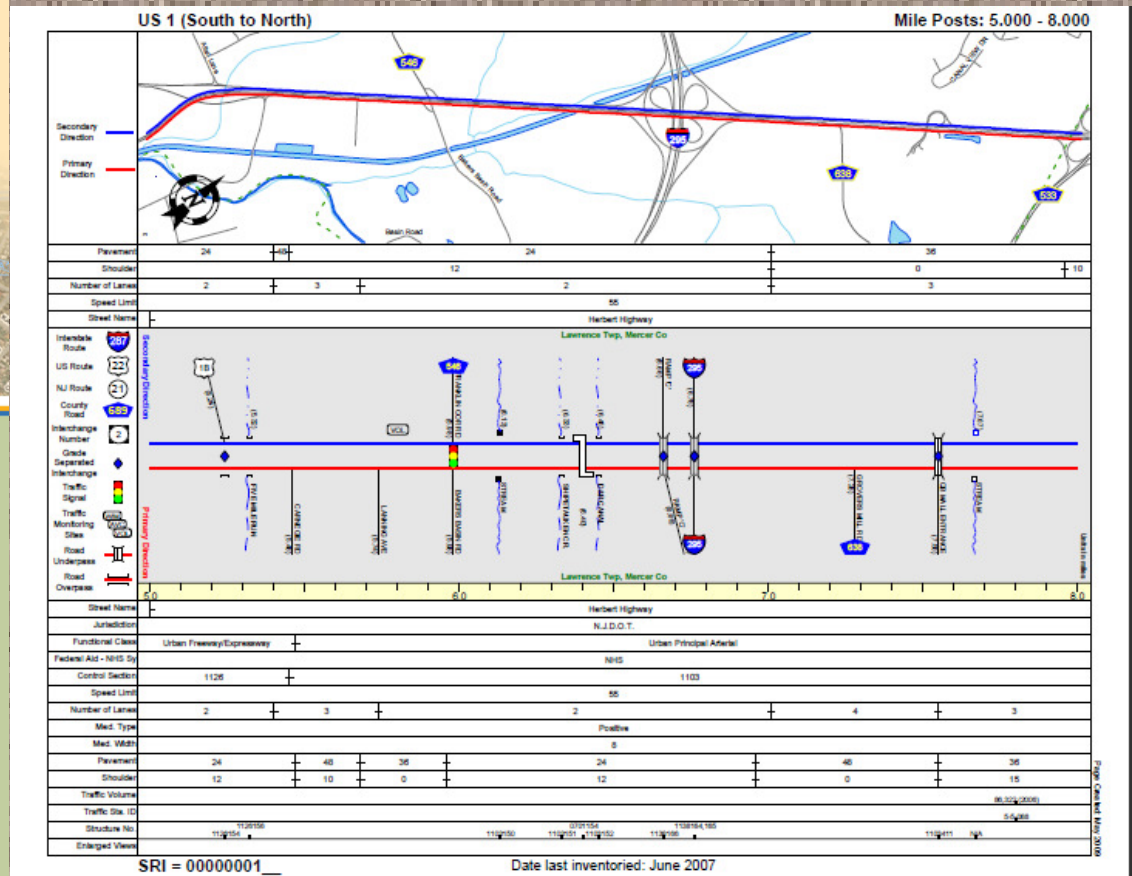
Prepared by:
The Division of Traffic Engineering and Safety
Bureau of Transportation Data Development

In Cooperation with:
The US Department of Transportation
Federal Highway Administration

Diagrams Depicting Statewide:

- State, Interstate, and Toll Authority Highways
- National Highway System Routes
- Surface Transportation Program Routes
- County Numbered Series Routes
- State Highway Interchange Diagrams

2009



Review Existing Data - Video

New Jersey Road Inventory Video Log


File View Options Help

Photo Information

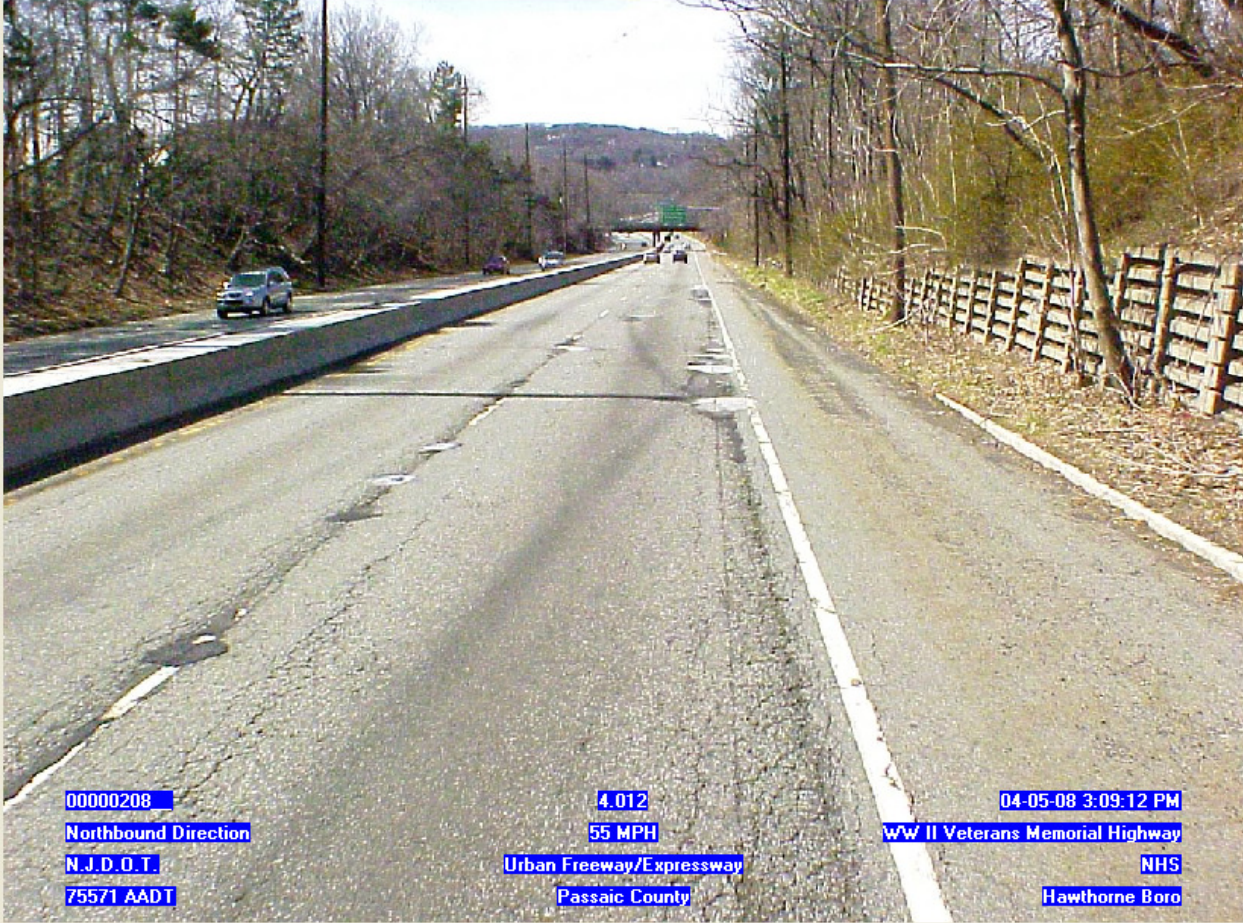
SRI	00000208
Milepost	4.012
Date	04-05-08
Time	3:09:12 PM
Street Name	WW II Veterans M
Jurisdiction	N.J.D.O.T.
Functional Class	Urban Freeway/Ex
Federal Aid	NHS
Speed Limit	55
Traffic Volume	75571
County	Passaic
Municipality	Hawthorne Boro

View Image

Direction



Northbound Direction



00000208 4.012 04-05-08 3:09:12 PM
Northbound Direction 55 MPH WW II Veterans Memorial Highway
N.J.D.O.T. Urban Freeway/Expressway NHS
75571 AADT Passaic County Hawthorne Boro

Playback **Camera**

0 5.035 10.07 Right Camera

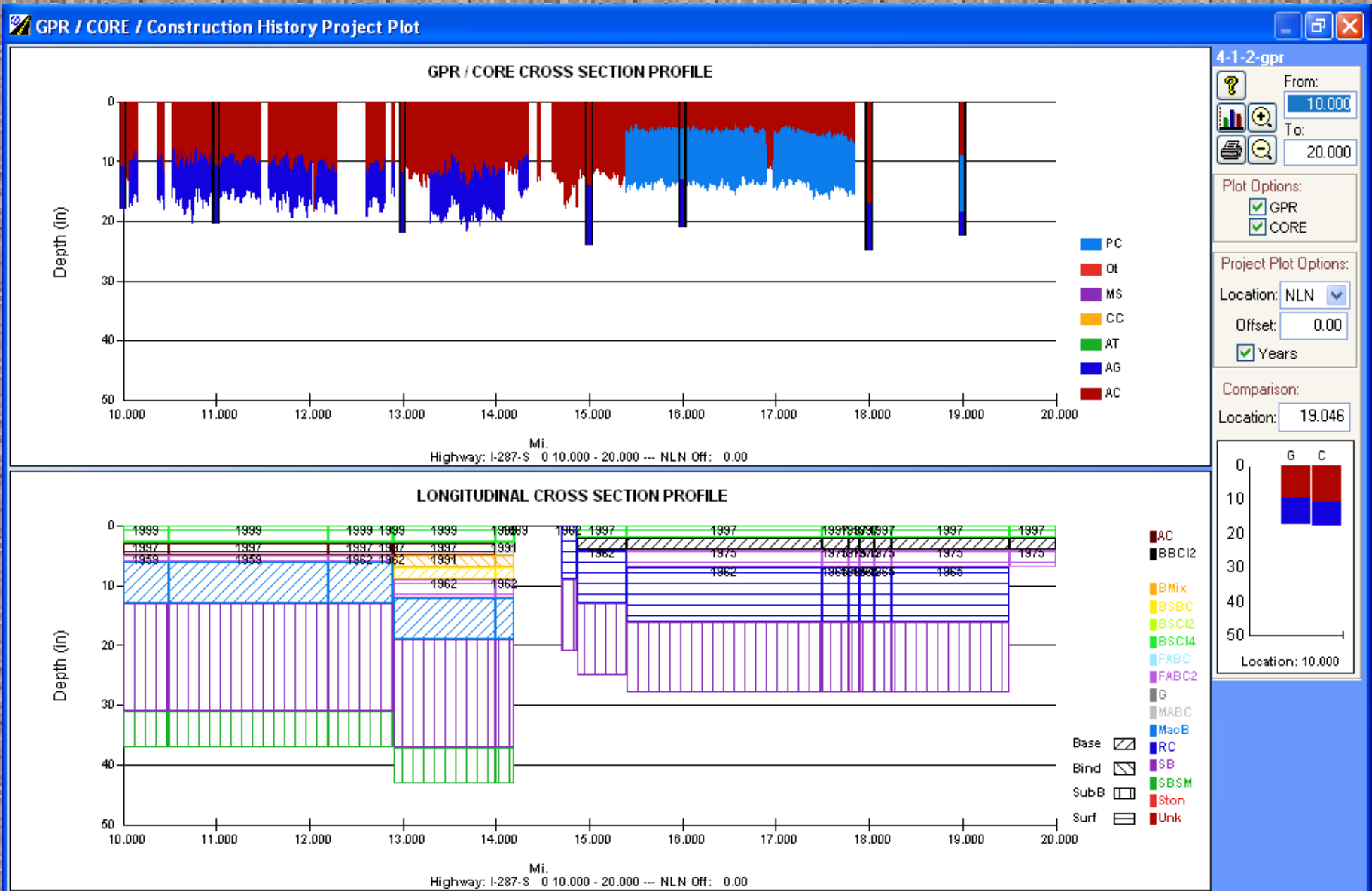
Stop \\NJDOTSLD01\SLD IMAGES\00000208_NJ208\RAK08034R.jpg

start Microsoft PowerPoint ... Untitled - Mechanistic... Help New Jersey Road Inv... 7:44 AM

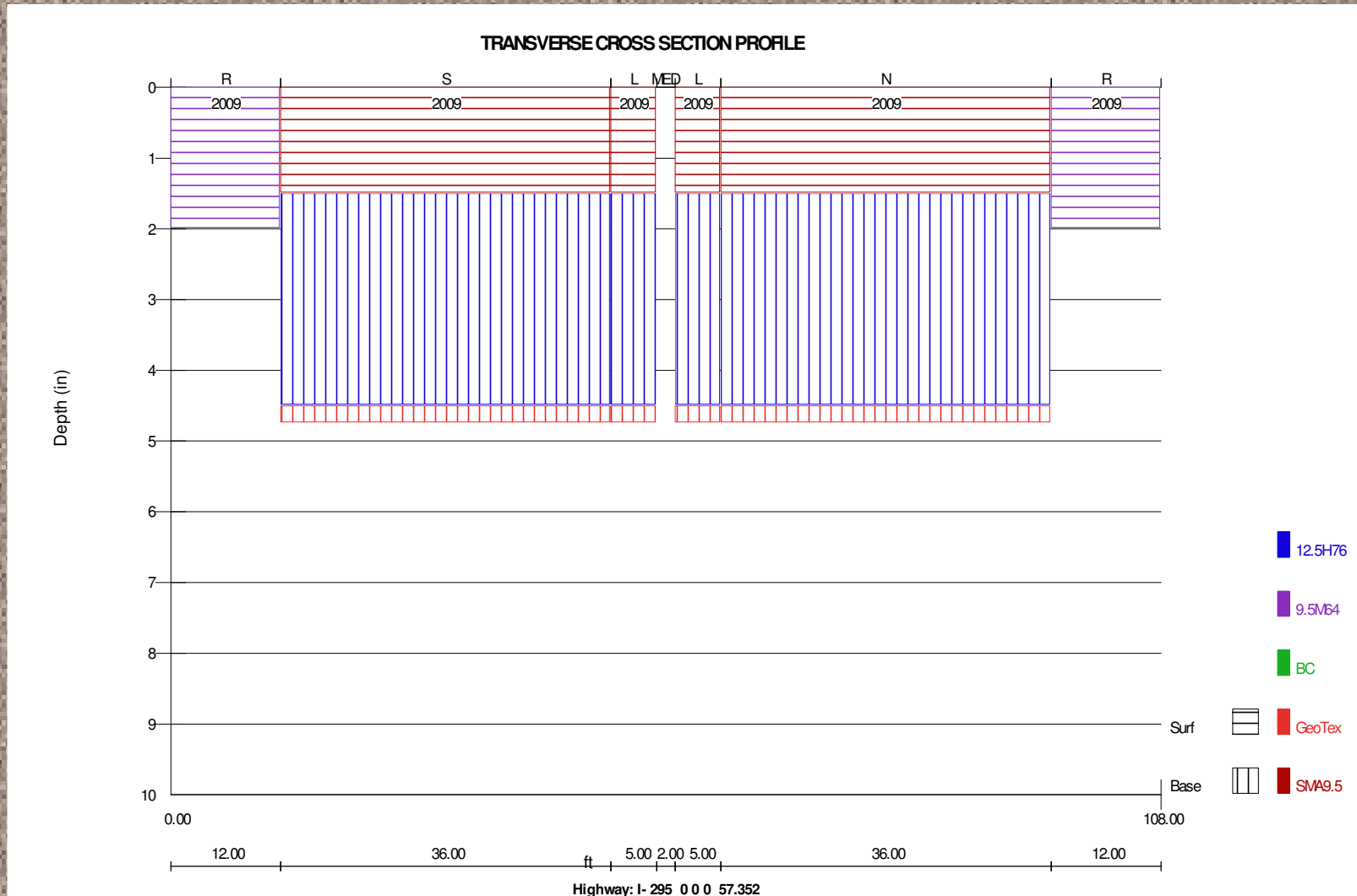
Review Existing Data - Video



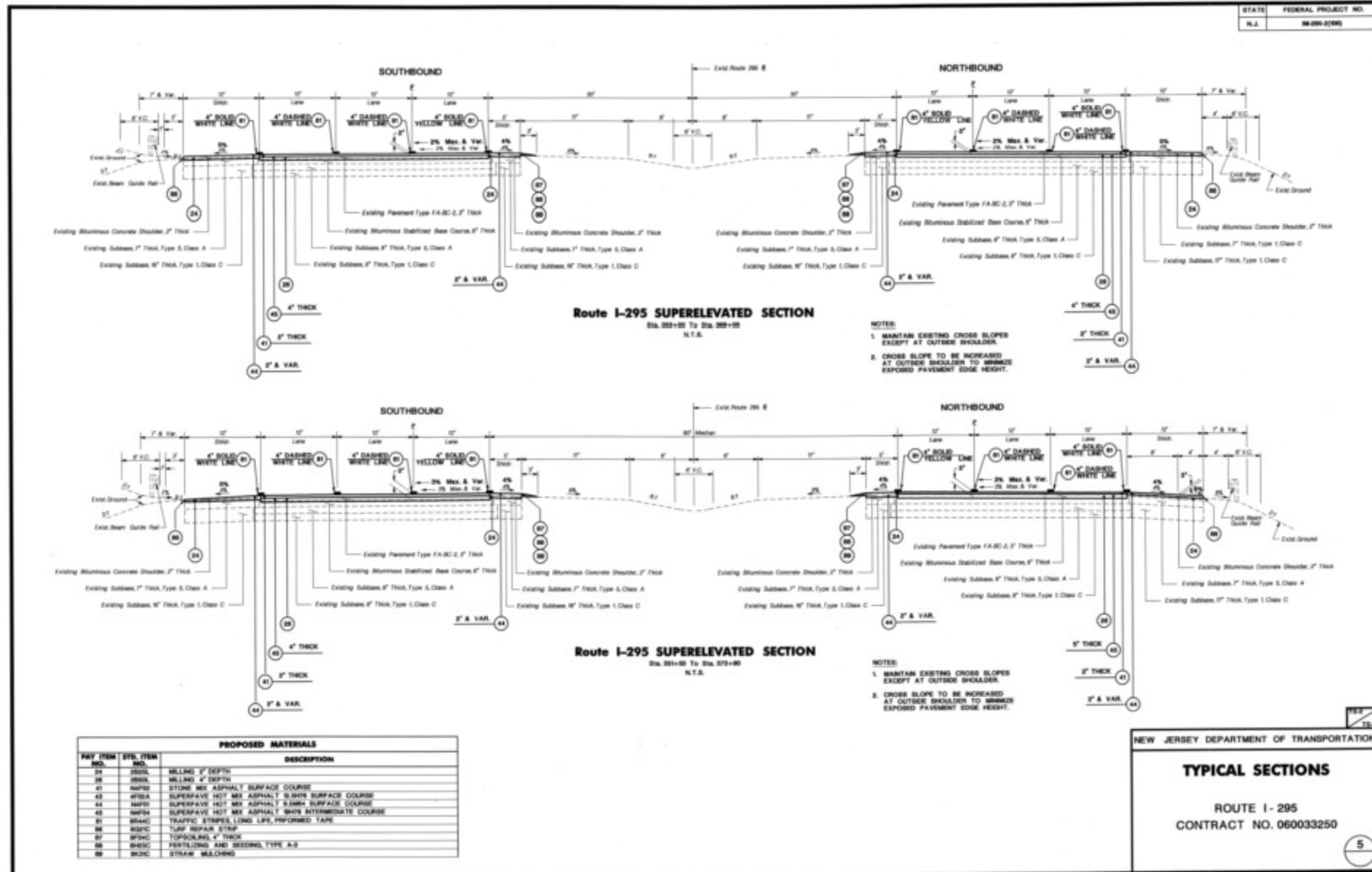
Existing Coring/GPR/As-built Data



Existing As-built Information



Existing As-builts (Falcon SVP)

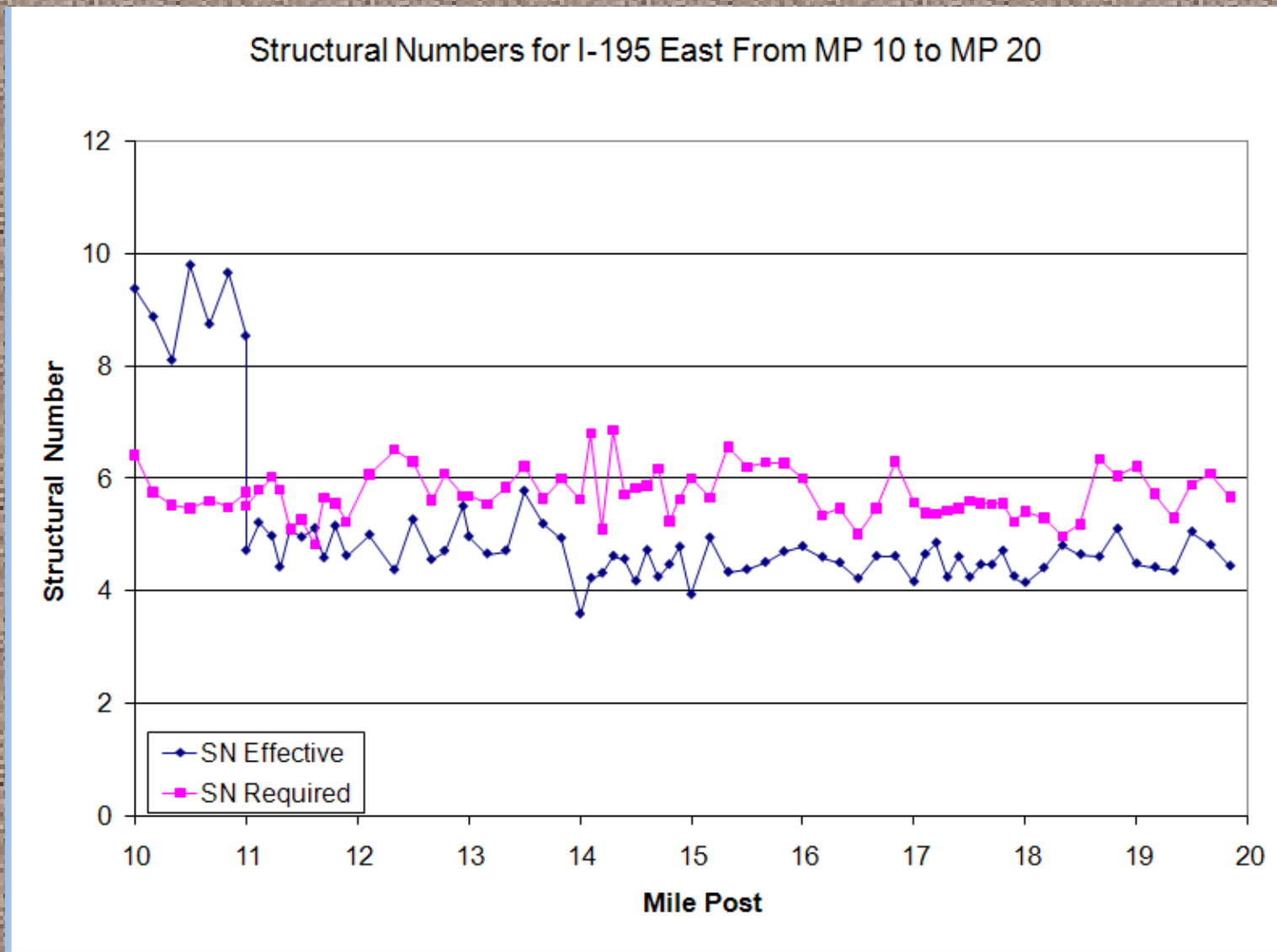


Existing Core Data

Core Photo at: I- 295 0 ON 0 60.000



Existing Structural Data



Review Existing Projects

- This must be checked and rechecked throughout the process
- Past, present & future projects
- Conflicts
- Limits of the project
- Possibly combine with other project
- Pavement project files reviewed to review past designs

CPM Project Reporting System

File Options Tools Help

UPC Group: **UPC: 073080**

Program Manager: [Dropdown]

Project Manager: [Dropdown]

Project Name: Rt 287 N of the Ramapo River to the vic of Fr [Dropdown]

County: [Dropdown]

DPPD Bureau Manager: [Dropdown]

DPPD Lead Engineer: [Dropdown]

Production Manager: [Dropdown]

[Click to Select Project](#)

UPC	Prog Mgr	Proj Mgr	Title
073080	Manera, Steve	McElmoyl, Larry	Rt 28

General | Organization | Proj. Dates | Budget Info | Baseline | MPO Issues | FMIS Data

UPC: 073080 **Rt 287 N of the Ramapo River to the vic of Franklin Ave**

Project Name: Rt 287 N of the Ramapo River to the vic of Franklin Ave

Contract No: 058073080 [Print in Blue Book?](#) Archived?

Project in DPPD?

Job Numbers: FD: [Dropdown] FD: 0235515

Project Phase: 9 - Construction

Description:
The proposed project is to mill 2 1/2 inches and resurface with 4 1/2 inches in the NB and SB directions, including ramps, from MP 58.5 to MP 59.69, with HMA. The shoulders will be milled an average of 1 inch and resurfaced with 2 inches of HMA. Guiderail will be upgraded to standard.

Reason for Project:
This segment of highway exhibits high severity block and longitudinal cracking, moderate to high severity fatigue cracking, longitudinal raveling, and patching. The primary scope of this project is to preserve the integrity of the Interstate system by maintaining the structural capacity of the pavement, improving the riding quality of the pavement and upgrading the skid resistance.

Oversight: Alternative CPCS DB Number: 07308

Classification: 4C - Resurfacing \$5,000,001 to \$10,000,000

Progress: Archive Progress?

Last Updated - 06/03/09
06/03/09 - Awarded on May 28, 2009
03/20/09 - Advertisement set for 04/02/09, Bidding 04/23/09, Pending Federal Approval.
12/29/08 - All comments have been resolved. Will move forward to Pre-PS&E.
11/25/08 - Comments being resolved.

Construction Status:

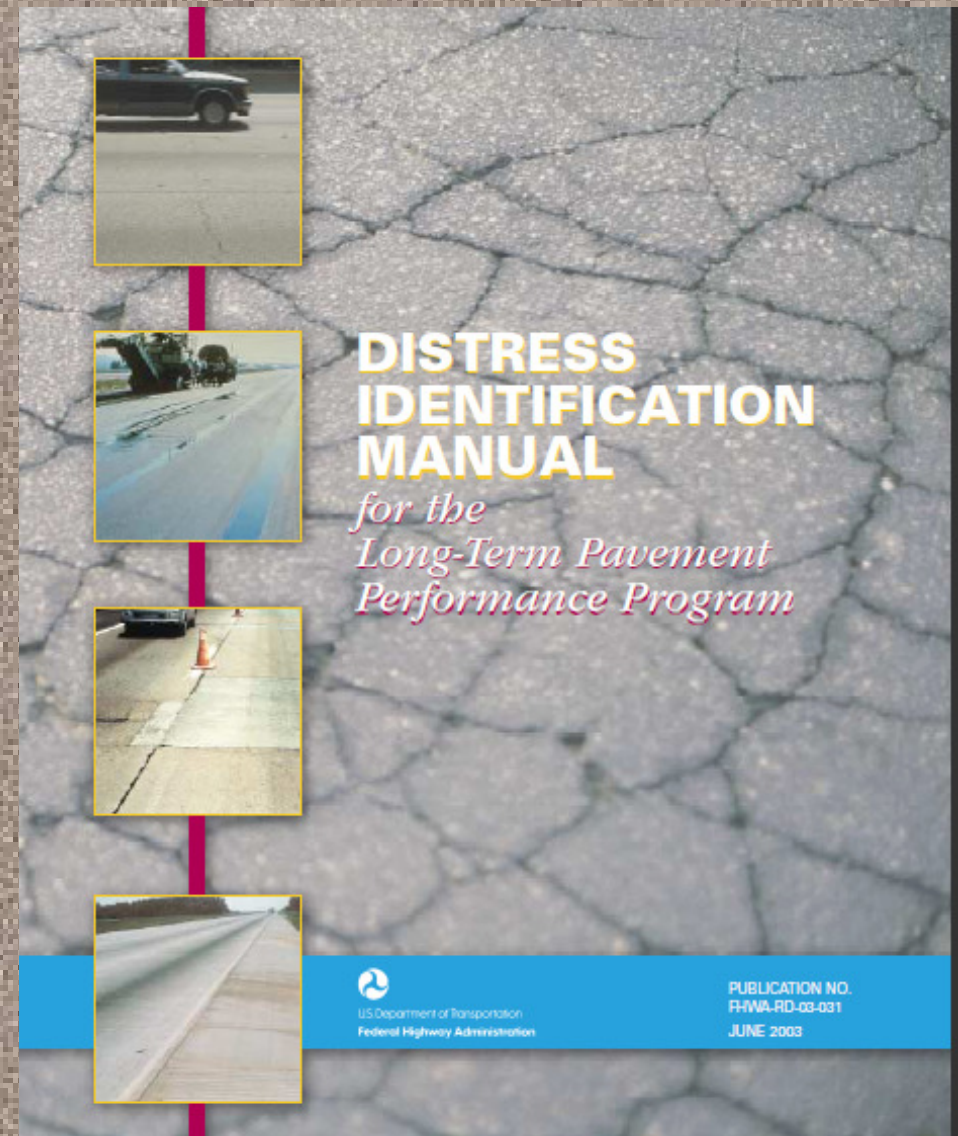
Future Improvements in Process

- GIS Mapping
- Project Tracking System
 - Rutgers-CAIT Pavement Resource Program
 - Advanced Infrastructure Design, Inc.



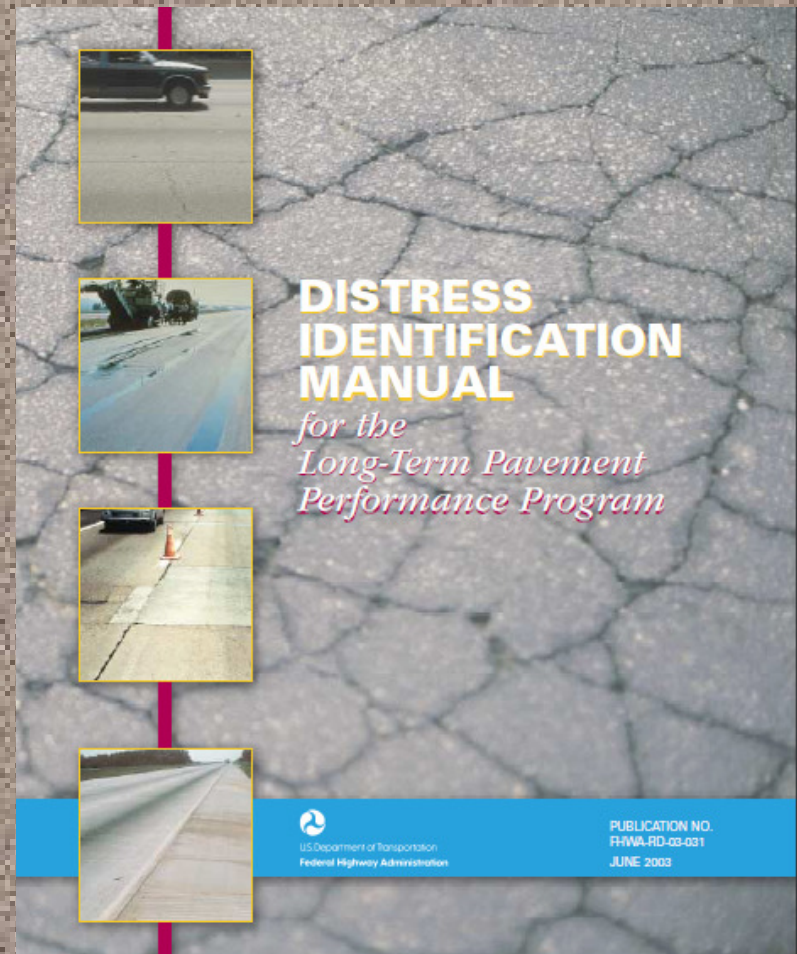
Field Review

- Distress Survey (video and field)
- Ramp conditions
- Shoulders
- Drainage (inlets)
- Geometric constraints
 - Bridge under-clearance
 - ROW impacts (driveways)
 - Barrier curb
 - Floodway/Floodplain
 - Curb, inlets, manholes, guide rail



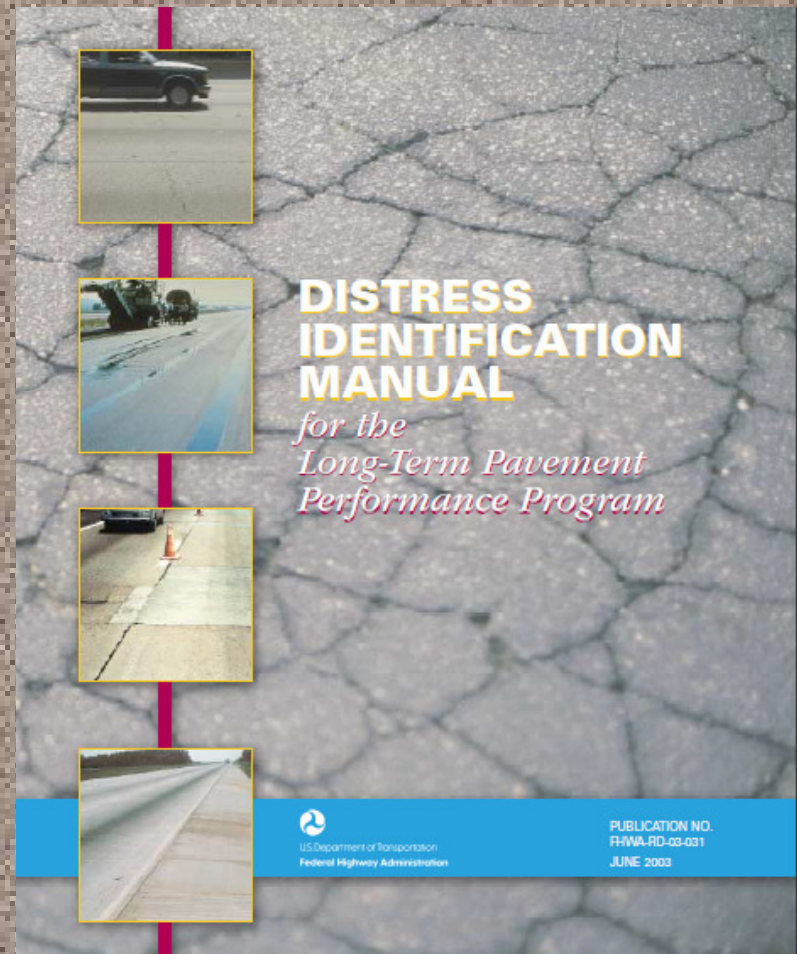
Distress Survey

- Routine Pavement Management and Pavement Design activity
- For project level design
 - Identify major distress types
 - Most harmful and most prevalent



Distress Survey

- Use data to evaluate options and/or trigger further investigation



General Categorization of Flexible & Composite Pavement Distress

General Description	Distress Type ^{1, 2, 3}	Major Contributing Factors
Cracking	Fatigue Cracking	Load
	Long. Cracking (wheelpath)	Load
	Reflection Cracking	Load, materials, climate, construction
	Transverse Cracking	Materials, climate
	Block Cracking	Materials, climate, construction
Surface deformation	Rutting	Load, materials
	Shoving	Load
Surface defects	Raveling	Materials, climate, construction
	Bleeding	Materials, climate, construction
Miscellaneous distress	Lane-to-Shoulder Drop-off	Materials, climate, construction
	Pumping	Load, materials, climate, construction
Patching and potholes	Patch Deterioration	Load, materials, climate, construction
	Potholes	Load

1. Note that the severity of the distresses listed is typically aggravated by harsh climatic conditions and a lack of adequate drainage.
2. Most of the distresses listed influence the functionality of the pavement which is typically characterized by smoothness and surface friction.
3. Some distresses such as reflection cracking and rutting have multiple causes.

Raveling



Raveling

- Improper compaction
- Lack of density
- High fines in mix
- Low asphalt content
- Oxidized asphalt



Rutting



Rutting

- Poor compaction
- Improper density
- Lateral movement of the asphalt layers
- Weak subgrade



Block Cracking



Block Cracking

- Materials (PG grade of binder)
- Climate (frost action)
- Construction (poor subbase or embankment)
- Traffic load (heavy trucks)



Wheel Path Fatigue Cracking



Fatigue Cracking

- Traffic Load
- Structurally deficient



Reflective Cracking



Reflective Cracking

- Load
- Materials
- Climate
- Construction



Reflective Cracking

- Joint Repair



Disintegrating Concrete

- Poorly compacted asphalt
- High voids (not enough AC binder)
- Water intrusion (cracks or pores)
- Deicing chemicals
- Traffic load



Concrete Pavement Distress

General Description	Distress Type ^{1, 2, 3}	Major Contributing Factors
Cracking	Corner breaks	Load
	Longitudinal cracking	Load, materials, climate, construction
	Transverse cracking	Load
Joint deficiencies	Transverse joint seal damage	Materials, climate, construction
	Longitudinal joint seal damage	Materials, climate, construction
	Spalling of longitudinal joints	Materials, climate, construction
	Spalling of transverse joints	Materials, climate, construction
PCC durability	Durability cracking	Materials, climate, construction
	ASR	Materials, climate, construction
Surface defects	Map cracking	Materials, climate, construction
	Scaling	Materials, climate, construction
	Polished aggregate	Materials, climate, construction
	Popouts	Materials, climate, construction
Miscellaneous distress	Blowups	Materials, climate, construction
	Faulting of transverse joints and cracks	Load, materials, climate, construction
	Lane-to-shoulder dropoff	Materials, climate, construction
	Lane-to-shoulder separation	Materials, climate, construction
	Patch deterioration	Load, materials, climate, construction
	Water bleeding and pumping	Load, materials, climate, construction

- Note that the severity of the distresses listed is typically aggravated by harsh climatic conditions and a lack of adequate drainage.
- Most of the distresses listed influence the functionality of the pavement which is typically characterized by smoothness and surface friction.
- Some distresses such as longitudinal cracking have multiple causes.

Popouts



Joint Spalling



Joint Faulting



Transverse Crack



High Severity Cracks

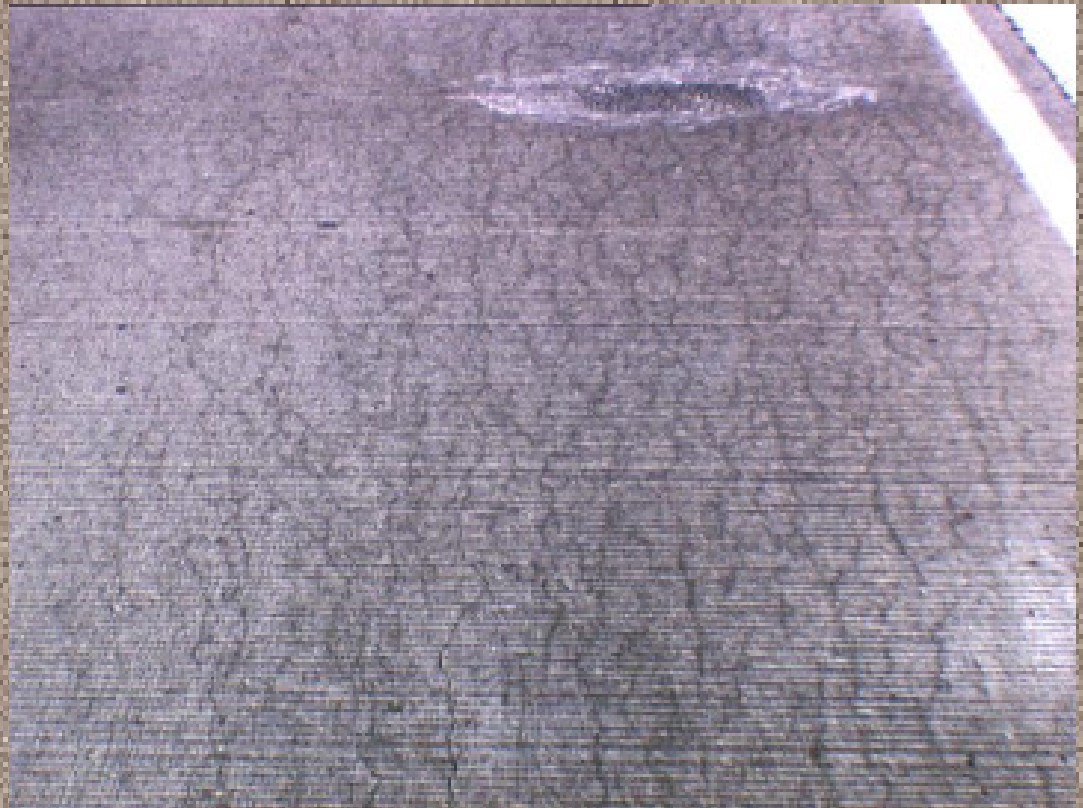


High Severity Cracks/Faulting/Spalling



Alkali-Silica Reacting Concrete

- Disintegrating Concrete
- Caused by reaction between aggregate, cement paste and water



Shoulder Condition – Edge Cracking



Shoulder Condition



Shoulder Condition



Ramp Condition



Ramp Condition



Drainage



Drainage



Drainage



Unusual Condition



Unusual Condition



Unusual Condition - Geometric



Additional Data Collection

- Traffic Data
- Ground Penetrating Radar (GPR)
- Falling Weight Deflectometer (FWD)
- Coring
- Dynamic Cone Penetrometer (DCP)
- Soil Borings
- Unusual Conditions

Pavement Data Collection Resources

- NJDOT Pavement Management
- Operations Engineering
- Rutgers-CAIT PRP
- Pavement Engineering Task Order Consultants
 - Advanced Infrastructure Design, Inc.
 - Michael Baker Jr., Inc.

Traffic Data Collection

- DPD typically provides
 - Volumes (ADT)
 - Percent Trucks (Total & Heavy)
 - Directional Distribution
 - ESAL Factors on website at the following link
 - http://www.state.nj.us/transportation/refdata/roadway/wim_files/ESAL_Design_Factors.pdf

GPR Ground-Coupled Antennas

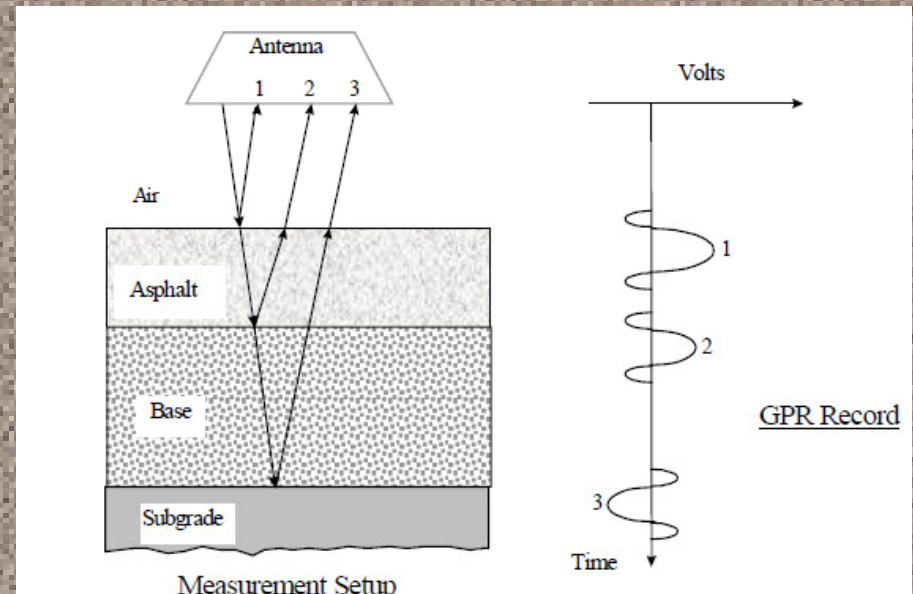


GPR Air-Coupled Antennas

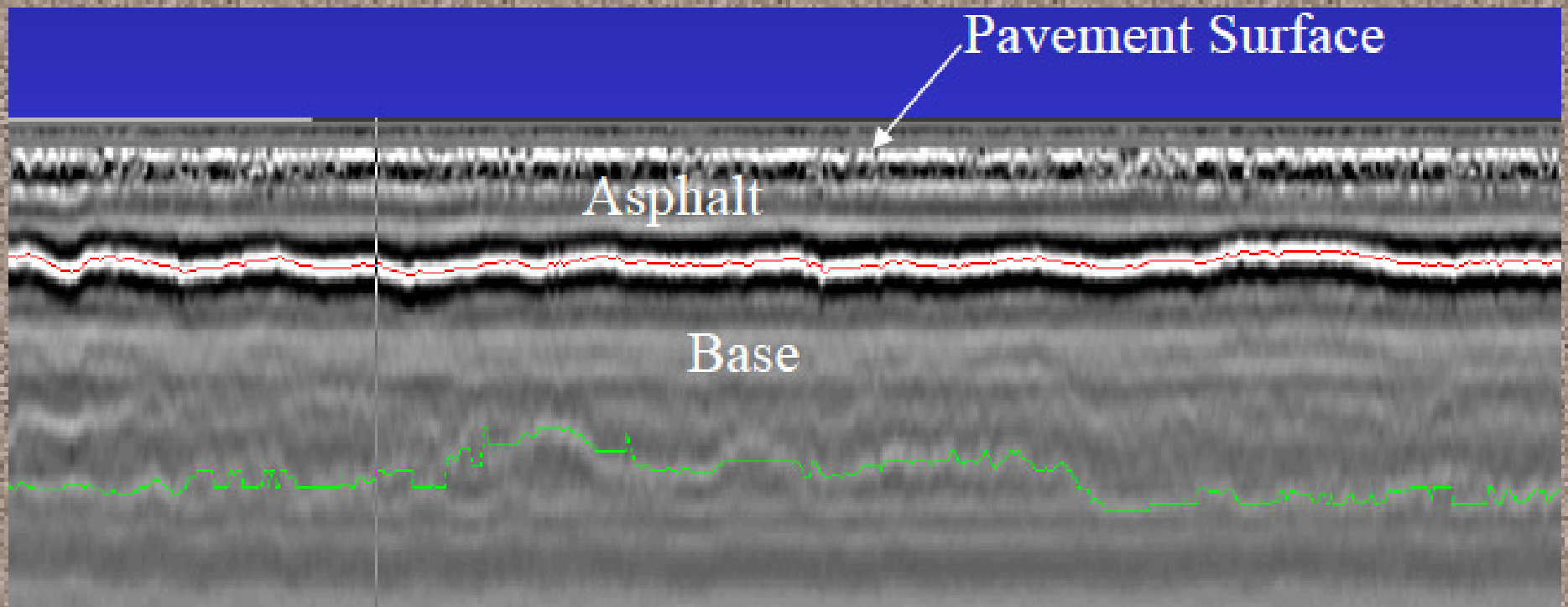


How GPR Works

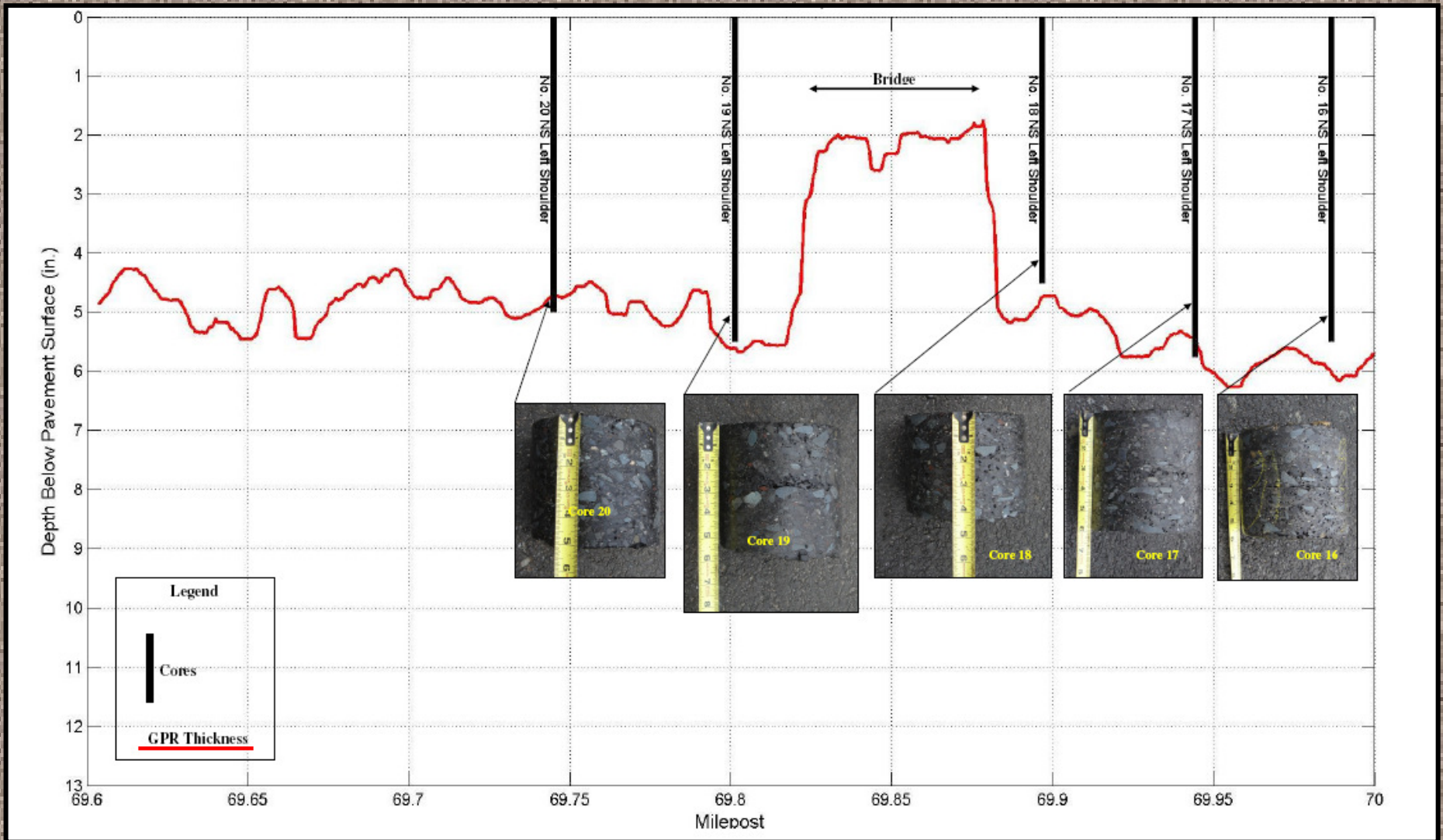
- Antenna sends electromagnetic pulses
- Pulses reflect back with amplitudes and arrival times
- Measured data relates to dielectric constants
- Verified /calibrated with core samples



Processed Graphic Data of GPR



GPR Plotted With Cores



What GPR gives you

- Layer Material
- Continuous Layer Thickness
- Void detection (large)
- Anomalies that need further investigation



Falling Weight Deflectometer (FWD)



Figure 9.22: FWD Impulse Loading Mechanism (foreground) and Sensors (background)



Figure 9.23: FWD



Figure 9.24: [Dynatest](#) 8000 FWD



Figure 9.25: [KUAB](#) FWD

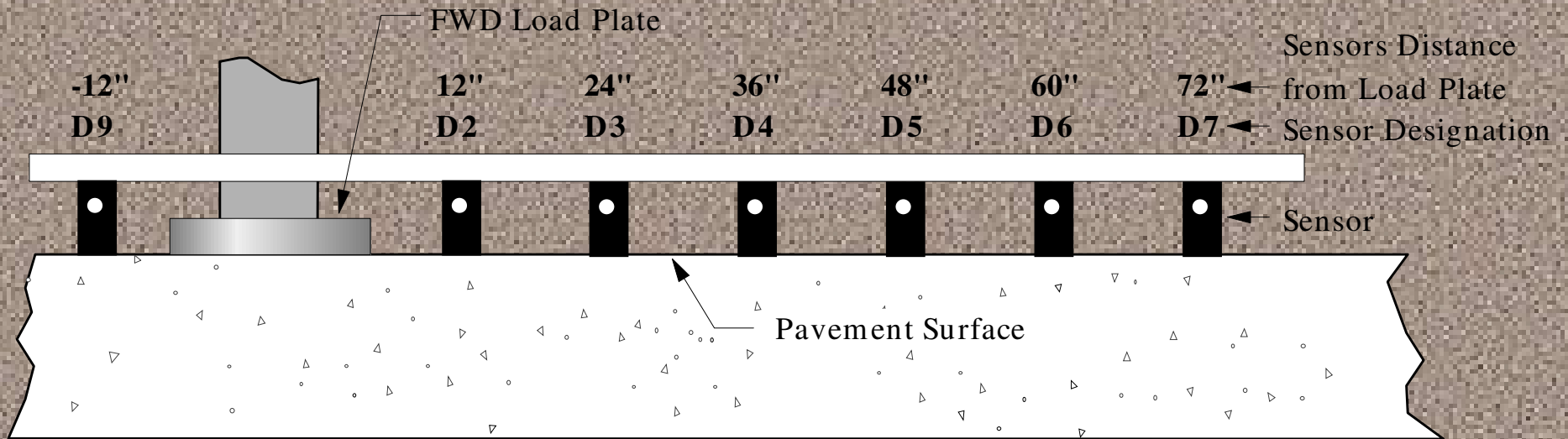


Figure 9.26: [JILS](#) FWD

NJDOT Heavy Weight Deflectometer (HWD)



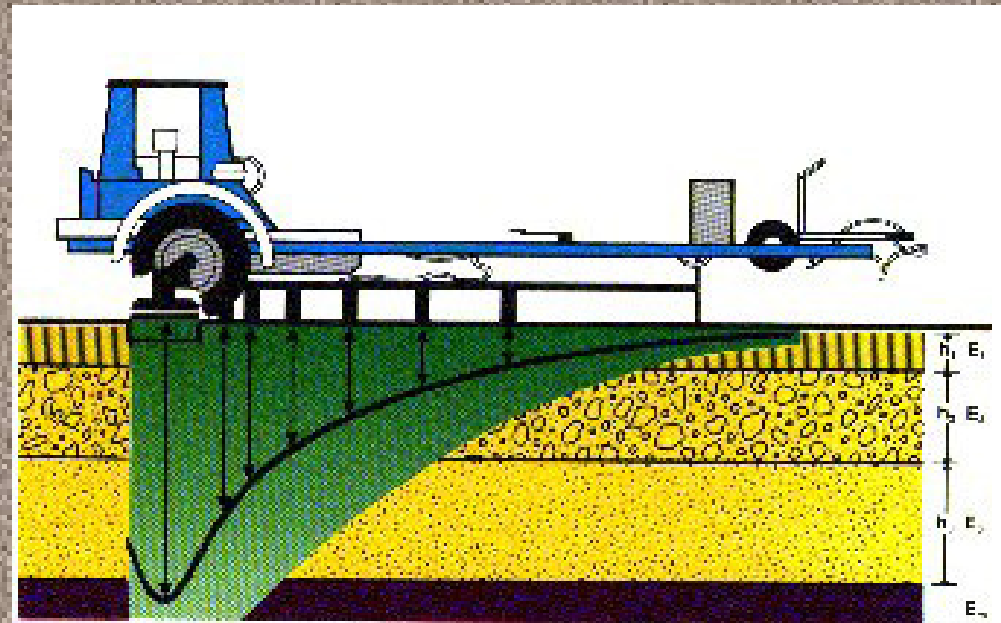
Typical FWD Load Plate and Geophone(s) Set-up



Note: Sensor D8 is located 12 inches to the right of the load plate.

How FWD Works

- FWD is an impulse deflection device
- Lift weight to given height and drops
- Weight strikes specially designed plate and transmits impulse force to the pavement
- Pavement deflections are measured



What FWD gives you

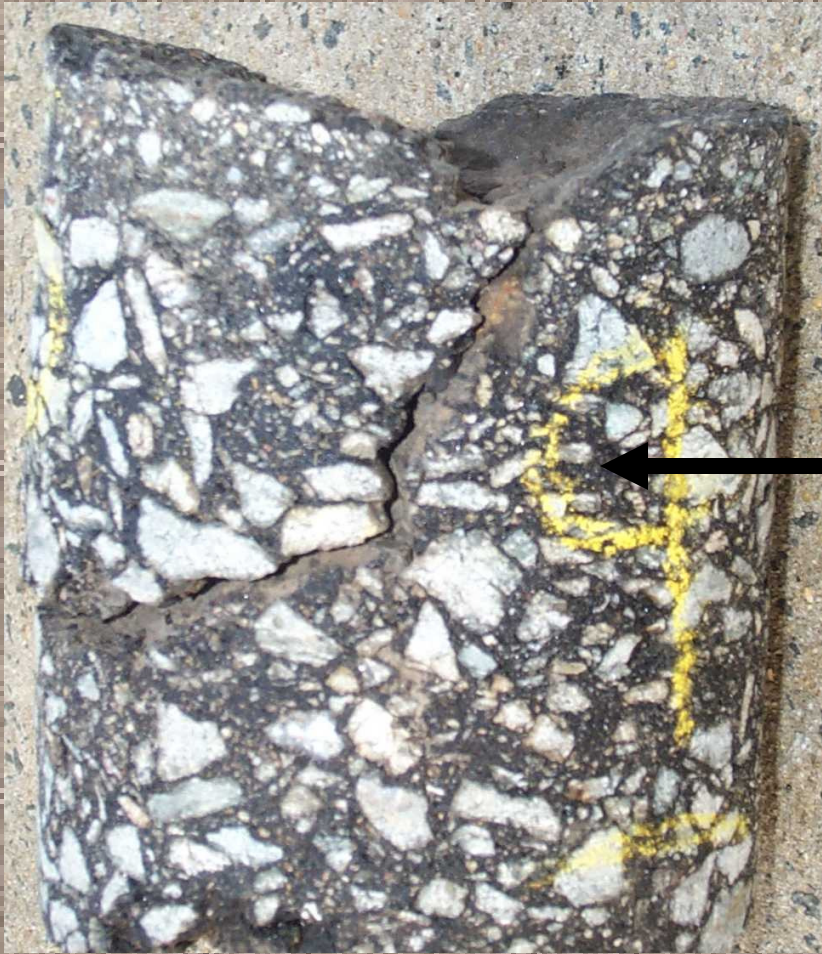
- Asphalt pavement
 - Elastic modulus of Structural Layers (at non-distressed locations)
 - Structural adequacy (at non-distressed locations)
- Concrete pavement
 - Modulus of concrete
 - Modulus of reaction for subgrade
 - Joint load transfer
 - Deflection at joint
 - Void detection
 - Structural adequacy

Coring

- Thickness
- Material determination
- Crack depth
- Debonding of layers
- Stripping
- Rutting
- Samples for testing



Top-Down Fatigue Cracking Verified by Coring



DCP

- Unbound layer strength
- Changes in unbound layers



Analysis & Design Next Week!



What's the problem?



Russian Federal Freeway



Unusual Conditions!



Excelent!!!!



Thank you. Questions?

Contact Info.:

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Management & Technology

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