Image source: NAPA

Image source: ACPA

U.S. Department of Transportation
Federal Highway Administration

TOPS

Targeted Overlay Pavement Solutions

A solution for extending the life of an existing pavement investment.

Every Day Counts
Innovation for a Nation on the Move

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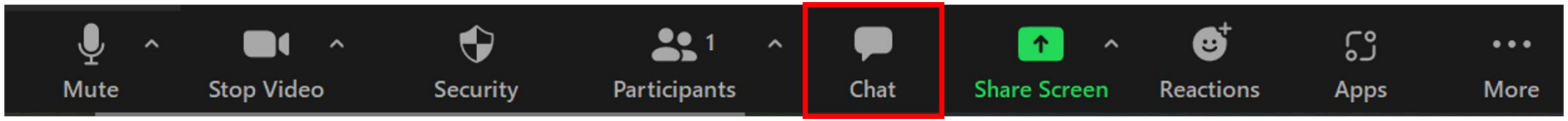

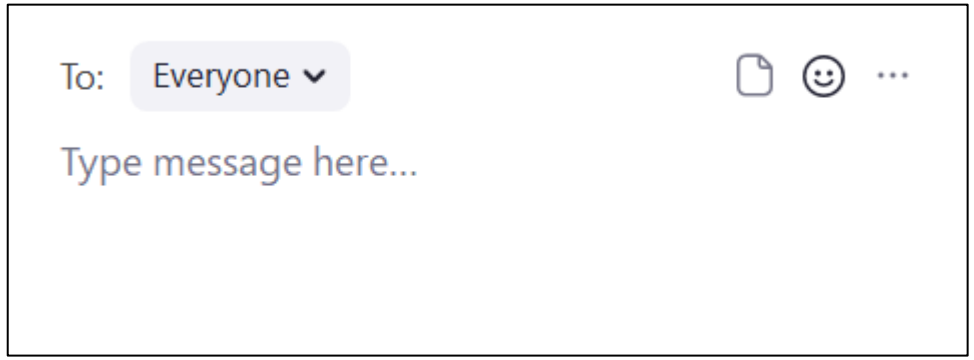

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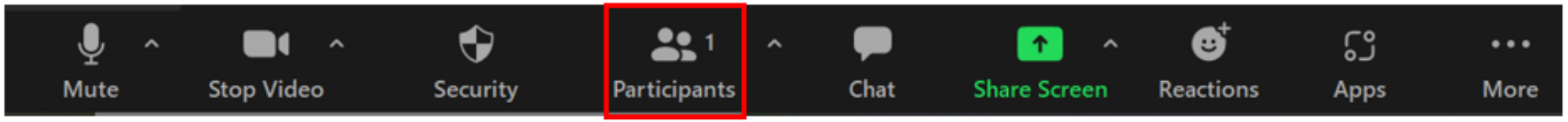

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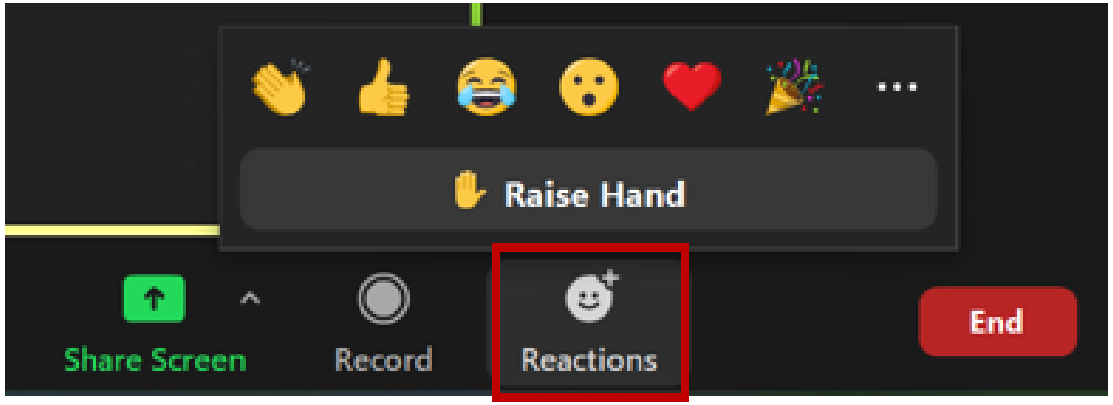

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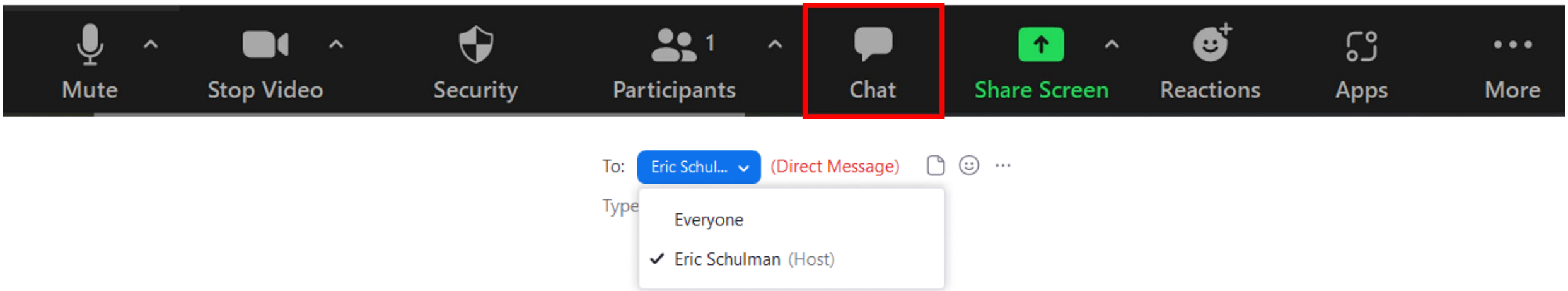


- Email eric.schulman@weris-inc.com and johan.vanrensburg@weris-inc.com

Webinar Overview

- Introduction to EDC-6 TOPS: Tim Aschenbrener, FHWA
- Concrete over Concrete – Unbonded (COC-U) Overview: Jerry Voigt, FHWA Consultant
- COC-U Agency Experience: Clark Morrison, North Carolina DOT
- Q & A

FHWA TOPS EDC-6 Team

Tim Aschenbrener
FHWA Headquarters

Bob Conway
FHWA Resource Center

Derek Nener-Plante
FHWA Resource Center

Background

- Over 25% of all State DOT infrastructure funds go to pavements overlays.
- State DOT manage 2.8 million miles of pavements.

- *Information source: FHWA at https://www.fhwa.dot.gov/innovation/everydaycounts/edc_6/targeted_overlay_pavement.cfm*

Image source: Iowa State University

How is this different from typical overlays?

TOPS matches treatments to high-priority, high-need locations.

Image source: Georgia DOT

TOPS EDC Mission

Image source: iStock

Extend pavement life, increase load-carrying capacity, and improve safety, mobility, and user satisfaction in a cost-effective and sustainable manner by delivering targeted pavement overlay solutions to Federal, State, and local transportation agencies.

EDC-6 Goals

- Increase the number of participating agencies that demonstrate, assess, or institutionalize an additional TOPS technology not previously institutionalized.
- Build awareness and expand TOPS usage
  - Identify a champion at each State agency
  - Share information at conferences/workshops
  - Train people (webinars/peer exchanges)

What's in the TOPS toolbox? (1 of 2)

Asphalt overlay products:

- High-Performance Thin Overlay (HPTO)
- Crack Attenuating Mixture (CAM)
- Highly Modified Asphalt (HiMA)
- Enhanced friction overlay
- Stone matrix asphalt (SMA)
- Asphalt Rubber Gap-Graded (ARGG)
- Open-Graded Friction Course (OGFC)
- Ultra-thin bonded wearing course (UTBWC)

What's in the TOPS toolbox? (2 of 2)

Concrete overlay products:

- Concrete on Asphalt – Bonded (COA-B)
- Concrete on Asphalt – Unbonded (COA-U)
- Concrete on Concrete – Bonded (COC-B)
- Concrete on Concrete – Unbonded (COC-U)

TOPS Potential Benefits

- Improved Safety
- Improved Performance
- Retained Investments
- Cost Savings
- Environmentally Sound

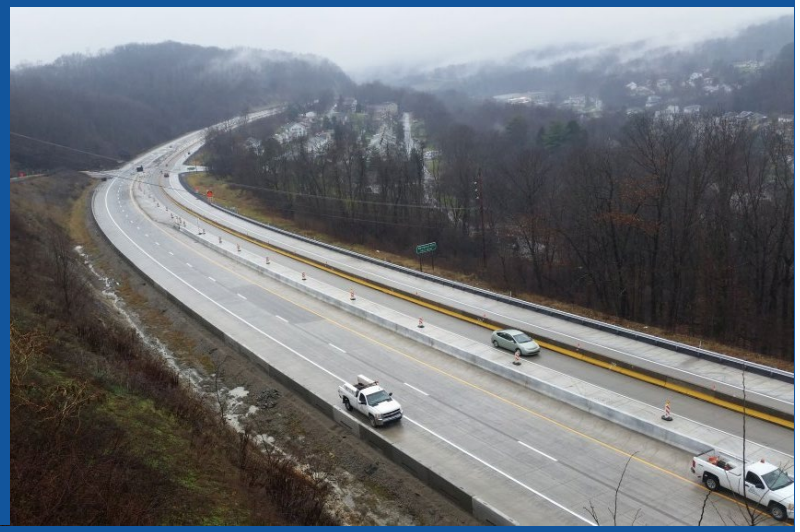


Image source: American Concrete Pavement Association

COC-U

Concrete Overlay on Concrete - Unbonded

Acronyms

- AASHTO – American Association of State Highway and Transportation Officials
- ASTM – American Society for Testing and Materials
- FWD – Falling Weight Deflectometer
- GPR – Ground Penetrating Radar
- LiDAR – Light Detection and Ranging
- NDT – Non-Destructive Testing

Overview

- What is a COC-U and How Do They Work
- The Information You Need to Develop a Project
- Basics for a Set of Plans
- Important Material & Construction Factors
- How You Can Get Started & Resources

Concrete on Concrete Unbonded (1 of 2)

Counts on Separating the Layers

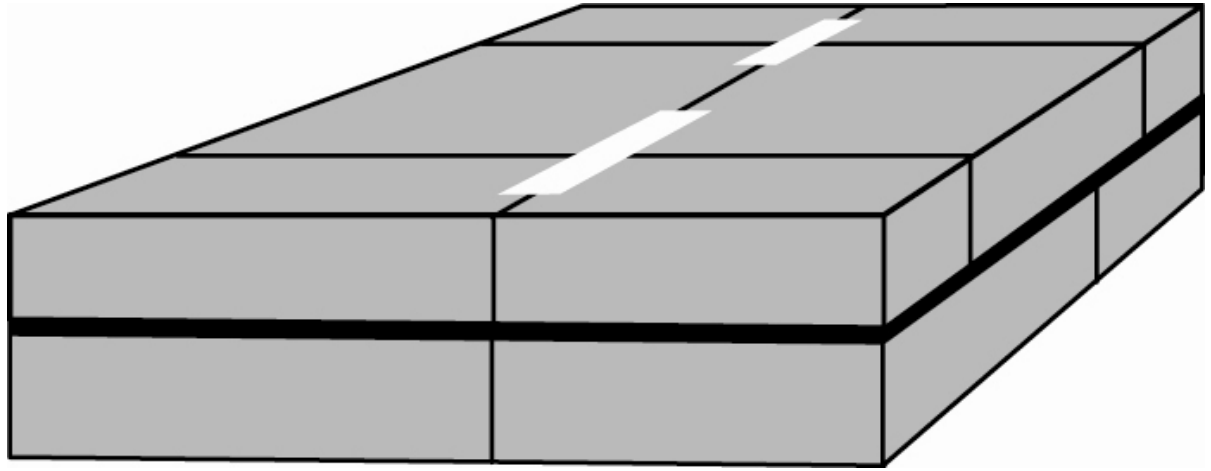


Image source: Iowa State University

Separation Means Minimal Bond & Minimal Keying

Overlay and Existing Pavement Are Not Monolithic

Concrete on Concrete Unbonded (2 of 2)

Overlay and existing pavement act independently under loading

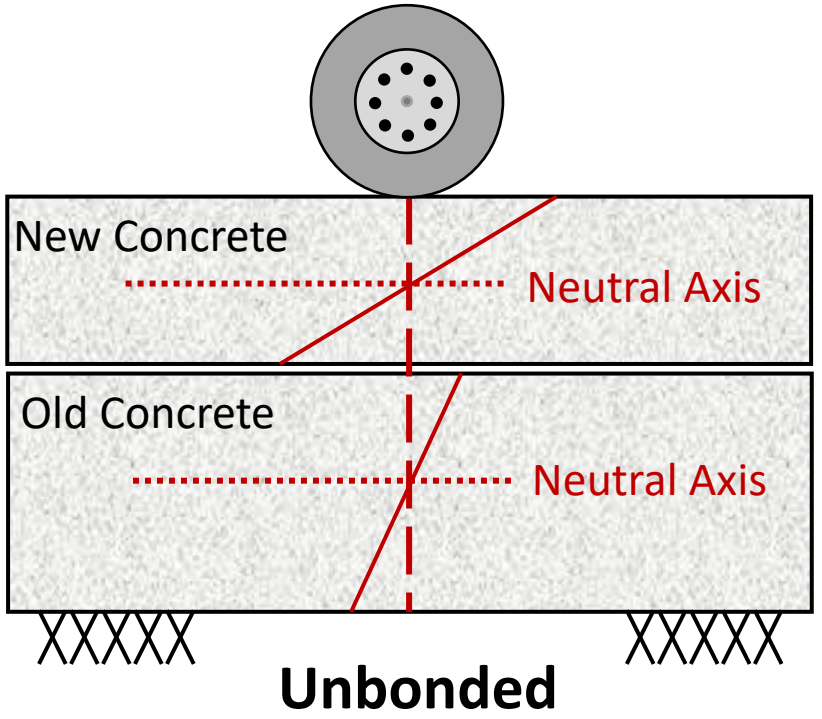


Image source: Iowa State University

Potential Candidate Projects

Jointed Pavement

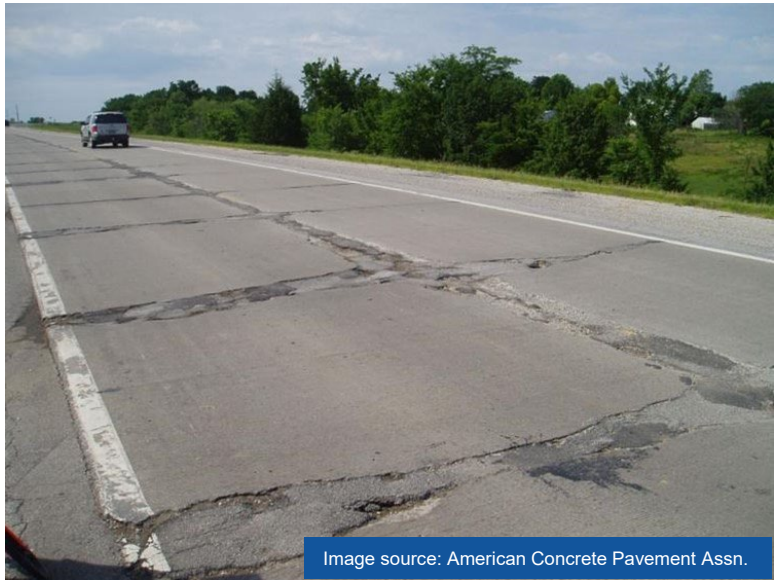


Image source: American Concrete Pavement Assn.

Continuously-Reinforced Pavement

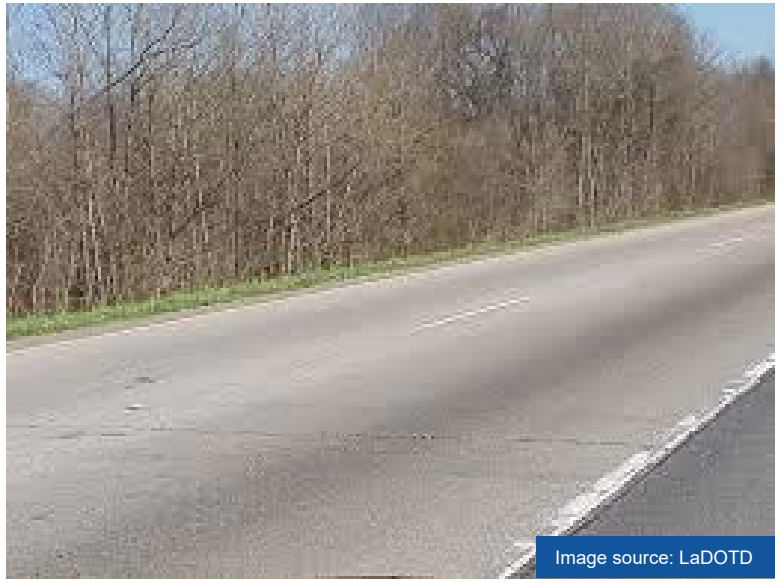


Image source: LaDOTD

Composite Pavement

Image source: FHWA

To Identify a Candidate – You Have to Answer These Questions

- Can the existing concrete provide a uniform subbase to overlay?
- If not, what pre-overlay repairs may be necessary to obtain that uniformity?
- What separation layer (fabric or asphalt) will help prevent the overlay from keying into the existing surface?
- Can a COC-U work within any vertical constraints?

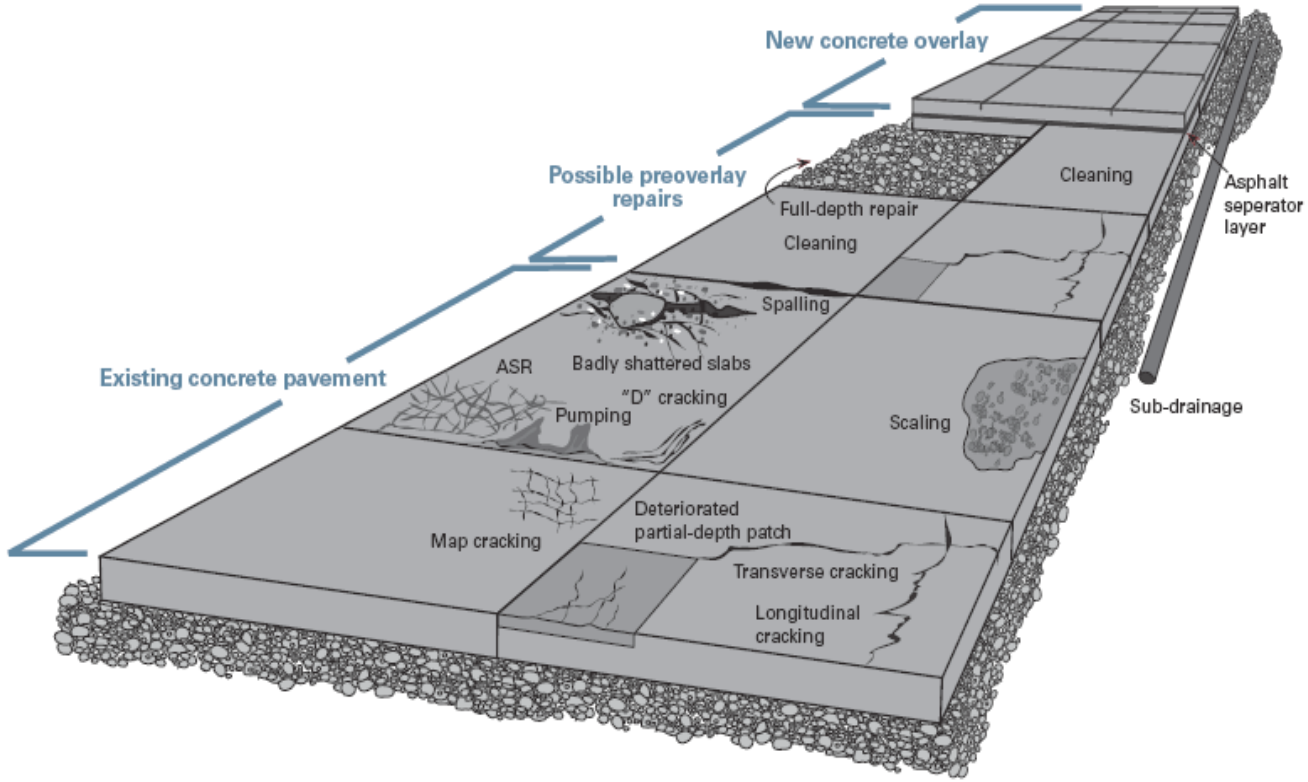


Image source: Iowa State University

Information Needed for Identifying Candidate

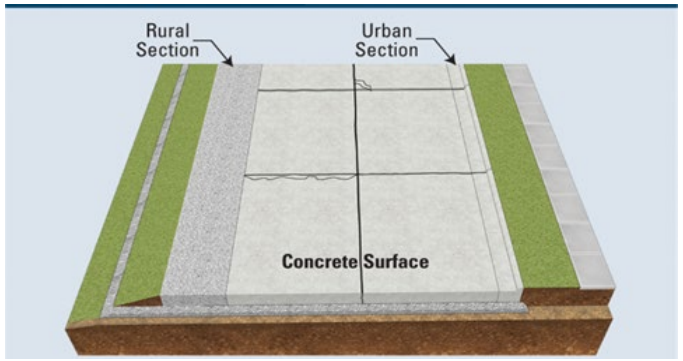
1. Existing pavement type and condition
2. Preliminary determination of typical section layers and thicknesses
3. An on-site review and evaluation
4. Assessment of profile grade adjustment and vertical constraints
5. Validation of the existing pavement condition by coring and material testing
6. Final determination on feasibility of the COC-U overlay option

1. Existing Pavement Type and Condition

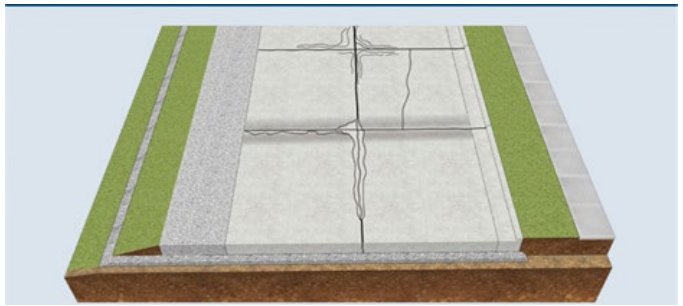
Starts as simple as assessing pavement condition rating by engineering judgement

Then...

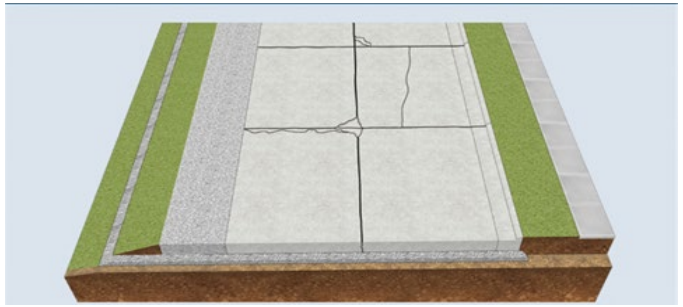
Enhance with data



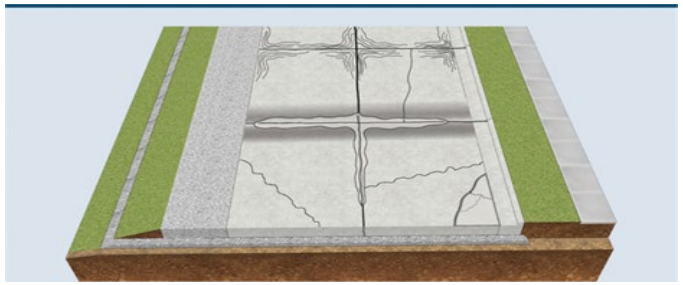
Good – Structurally sound with little to no cracking.



Poor – Full-depth joint deterioration, working cracks, spot structural failures, faulting, and/or material-related distresses.



Fair – Structurally sound with minor surface distresses such as random cracking, periodic partial-depth joint spalling, and shadowing.



Deteriorated – Significant surface deterioration and structural distresses, including joint deterioration from freeze-thaw damage or material-related distress at 50% or more of the joints.

Image source: Iowa State University

2. Existing Pavement Typical Section

- Review historical documents, as-built plans, construction data.
- Check for:
  - Surface pavement layers and thicknesses
  - Dowel & tie bars
  - Base/subbase layers and thicknesses
  - Subgrade soil type

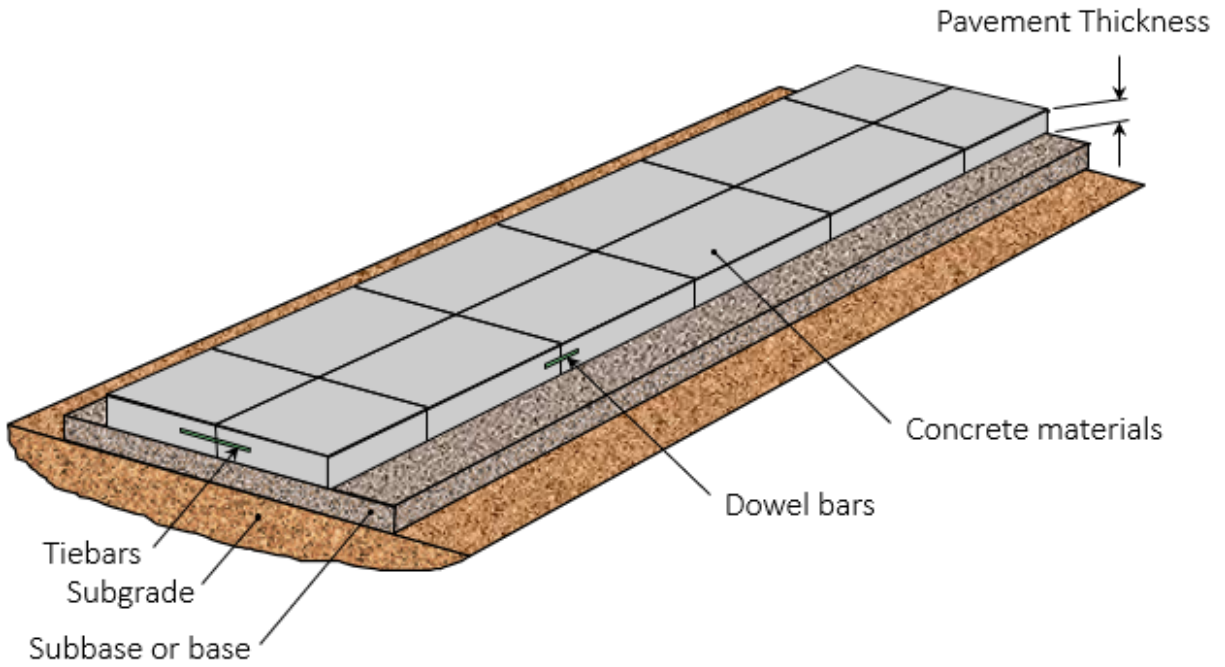


Image source: American Concrete Pavement Assn.

3. On-Site Review and Evaluation

Refine the pavement assessment initiated in Steps 1 and 2

- Measure distress types and quantities
- Review the profile grade for dips indicative of subgrade and/or drainage issues
- Assess condition of any inlets/edge drains
- Note drainage-related structural failures.
- Identify locations for investigative coring
- Estimate extent of pre-overlay repairs

No surface repair needed

Pre-overlay repair needed

Image source: Iowa State University

4. Consider Profile Grade Adjustments

- COC-U will raise your pavement grade
- Consider in feasibility assessment
- Plan ahead by:
    1. Creating preliminary COC-U thickness design
    2. Consider type of separation layer (fabric vs. asphalt)
    3. Identify all locations of vertical clearance constraints
    4. Consider options to work within the constraints

TYPES OF VERTICAL CONSTRAINTS/ISSUES

- Bridges
- Guardrails, parapet walls, cable & median barriers
- Curb and gutter sections
- Storm sewer inlets
- Intersecting roadways & driveways
- Drainage conduits and culverts
- Safety slopes and ditches

5. Validate Existing Pavement Condition

- Use Coring, NDT and Material Testing
  - Core for thickness & layer integrity
  - FWD for pavement integrity/uniformity
  - GPR for known problem areas
  - If composite pavement, check potential for asphalt stripping (ASTM D4867)
- Can vary level of review by functional class
  - Low-Volume Rural or Urban
  - Arterial or Urban Intersection
  - Secondary (State Route)
  - Primary (US Route/Interstate)

LESS

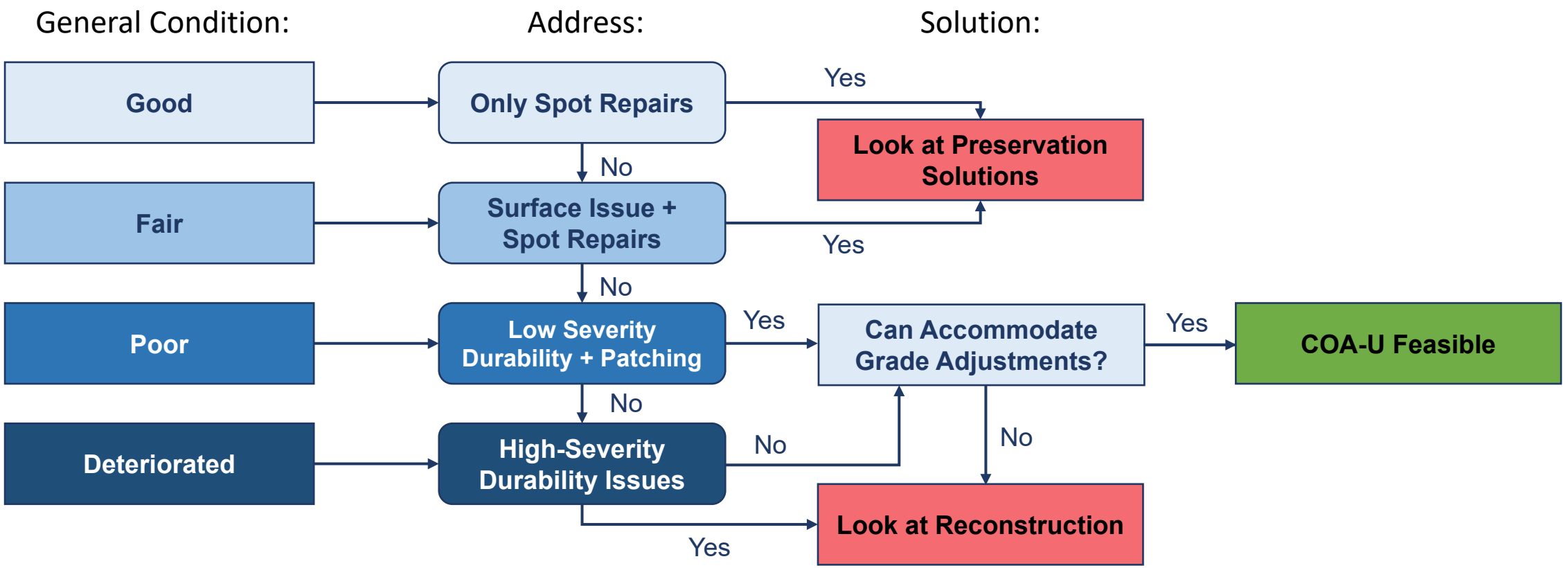
MORE

Image source: Voigt

...BUT CORING IS NECESSARY!

Use of ASTM standard is not a Federal requirement

6. Conclude Feasibility of a COC-U

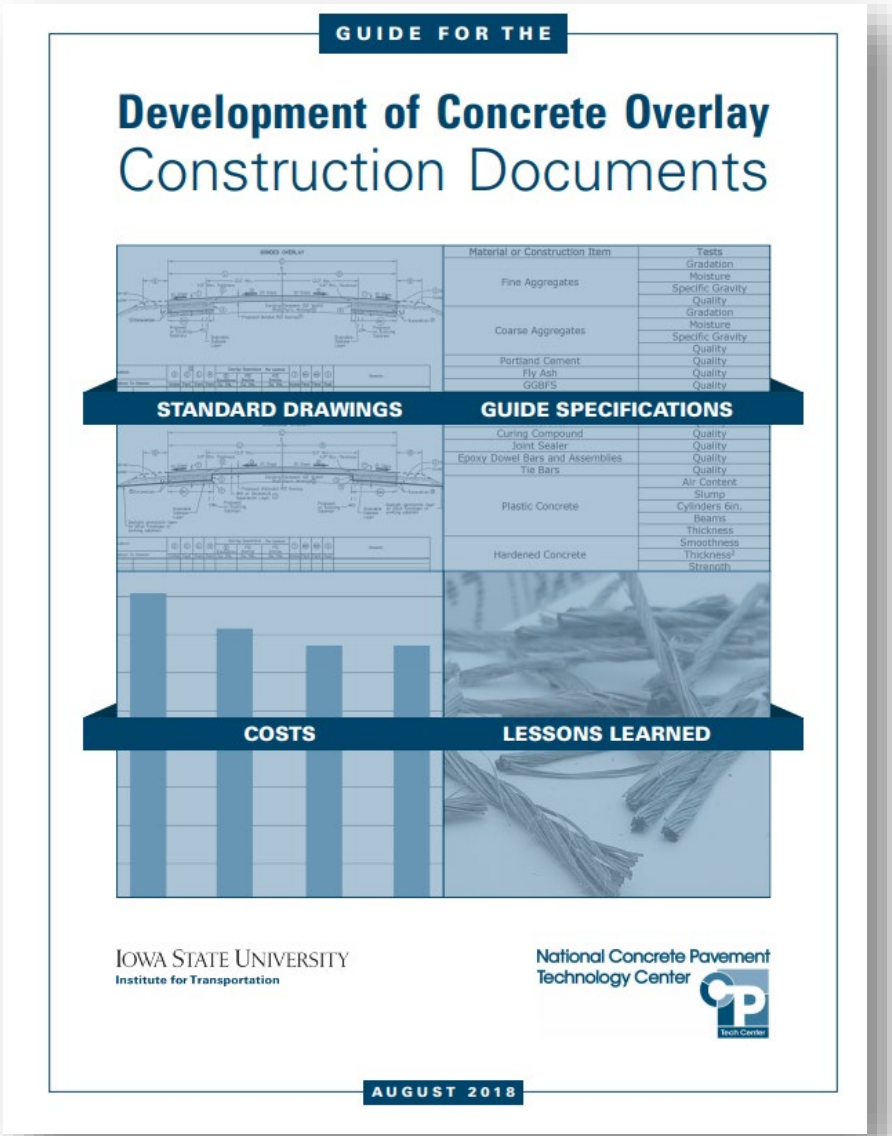


Design Issues & Plans

Image source: Voigt

For Best Practice in Preparing Plans Consider Using This Guide

Includes example drawing sheets, construction details, guide specifications, and cost estimating



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COC-U Plan & Spec Development: Information Needed

- Location
- Geometrics
- Maintenance of traffic requirements
- Existing & proposed profile(s)
- Special Details:
  - Pre-Overlay repair directions
  - Jointing
  - Separation interlayer
  - Transition and adjustment details for addressing profile elevation at bridges, curb & gutter, side slopes, etc.

Include digital design data when available:

- Design model
- Elevations
- LiDAR scans of existing pavement

COC-U Plans – Pre-Overlay Repairs

- Combination of repairs to address the suitability of existing pavement as base
- Likely to require specs/notes for:
  - Full-depth patching
  - Crack filling with sand or flowable mortar to level up surface
  - Shoulder excavation if widening roadway
  - Milling high spots (when overlaying a composite pavement or using fabric interlayer)
- Last requirement is surface sweeping or blowing ahead of interlayer placement.

COC-U Specs – Separation Interlayer (1 of 3)

- This is very important
- Goal is to allow pavements to act independently
- Two basic options:
  - Geotextile fabric interlayer
  - Nominal 1-in asphalt layer

Image source: American Concrete Pavement Assn.

An Interlayer Creates a Smoother Slip Plane

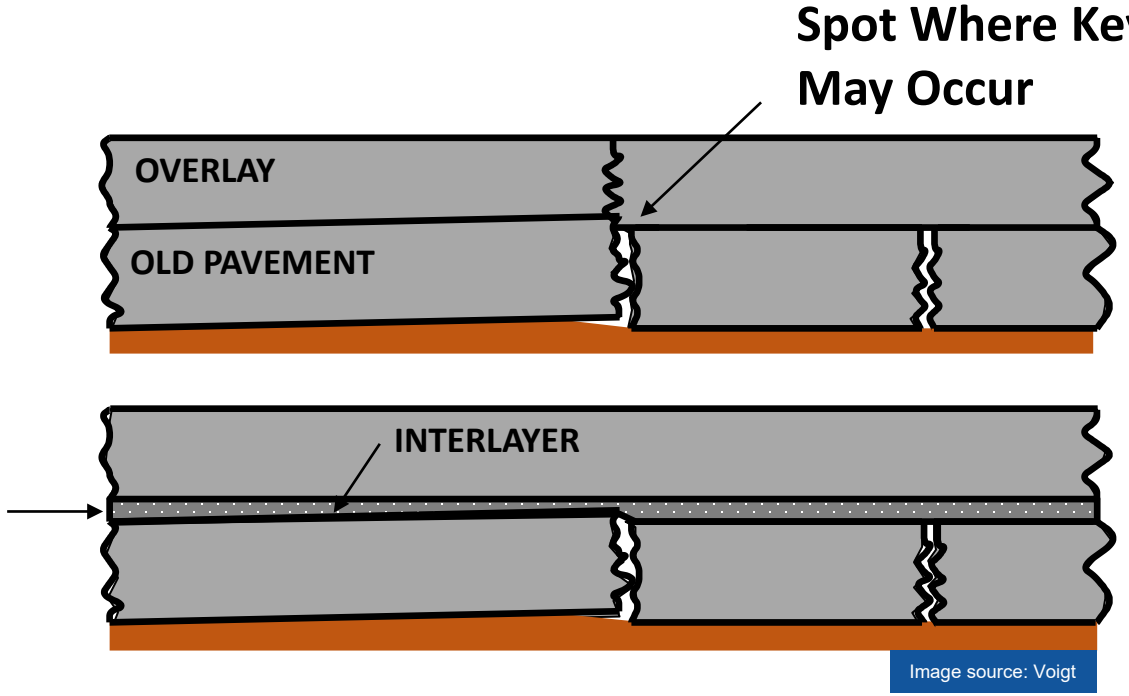


Image source: Voigt

COC-U Specs – Separation Interlayer (2 of 3)

- Use the recommended material specs!
- Specify fabric by thickness and weight; color optional
- Specify asphalt layer material with:
  - Aggregate gradation appropriate for 1- inch nominal mat
  - Typical density/air void requirements
  - Anti-stripping agent (lime)
  - Consider open-graded asphalt if concerned with drainage or heavy truck traffic unique to project

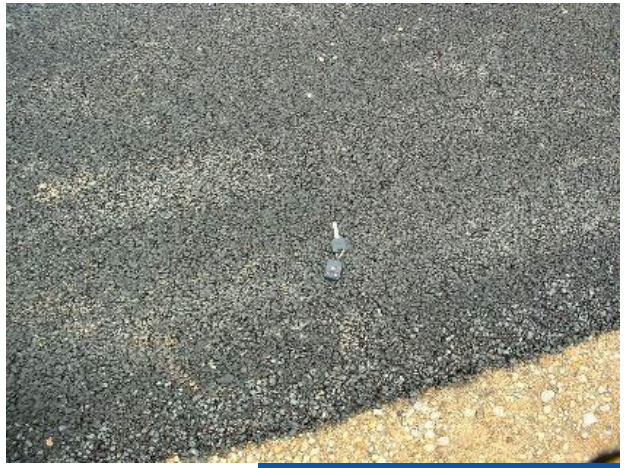


Image source: Iowa State University

COC-U Specs – Separation Interlayer (3 of 3)

For fabric interlayer specify:

- Non-woven fabric
- < 5 inch thick overlay – 13 ounces/square yard @130 mils thick
- ≥ 5 inch thick overlay – 15 ounces/square yard @170 mils thick

Images source: Voigt

COC-U Specs – Jointing (1 of 2)

- Use same details as in conventional concrete pavement for:
  - Cut-depth = T/4 min. to T/3 max.
  - Joint width = Min. 1/8 inch (wider if sealing not filling)
  - Sealant reservoir = as applied in your state
  - Dowel bars in transverse COC-U joints
  - Tie bars in longitudinal COC-U joints

- Some states have had issues with stripping of asphalt interlayers – sealing/filling joints recommended if using this type of interlayer

COC-U Specs – Jointing (2 of 2)

- Apply these special considerations for transverse joints
- Spacing:
  - For ≤6 inch thick overlays maximum spacing is 1.5 times thickness
  - For >6 inch thick overlays maximum spacing is 2.0 times thickness
  - In either case do not exceed 15 feet
- Transverse Joint Locations:
  - Mismatch if feasible
  - Match isolation/expansion joints in overlay if such joints are present in existing pavement

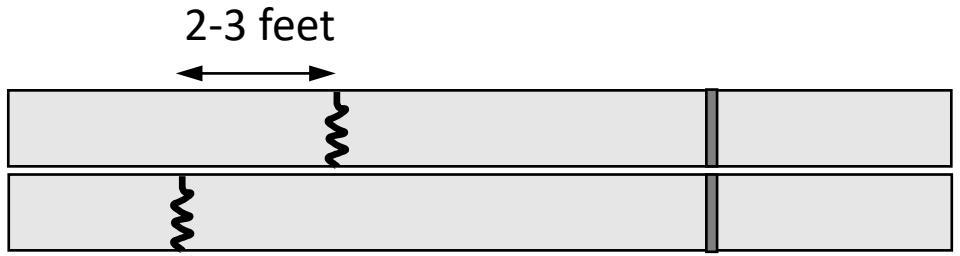
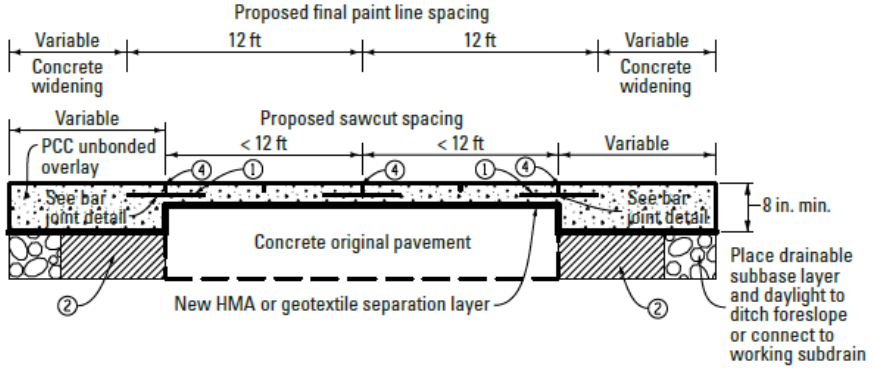


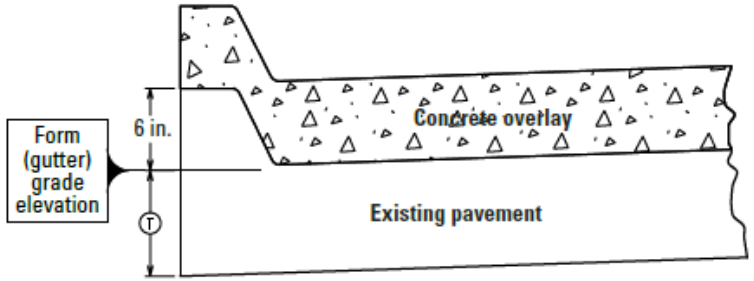
Image source: Voigt

COC-U Specs – Helpful Details

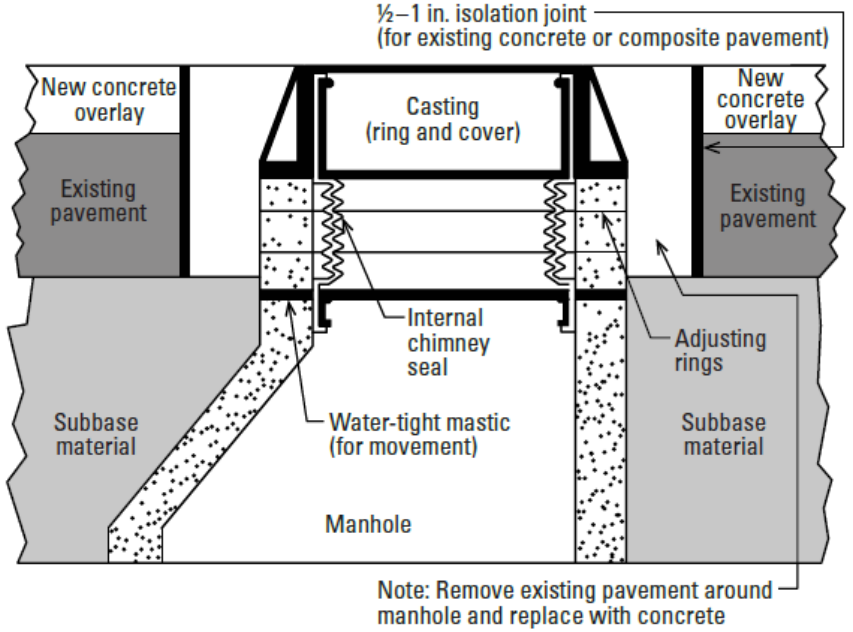
Widening



Curbs



Inlets/Manholes



Images source: Iowa State University

Materials

Image source: Voigt

Concrete Constituents for COC-U

- Cementitious Materials
- Aggregates
- Water
- Admixtures

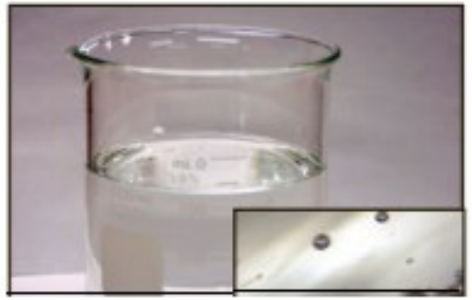
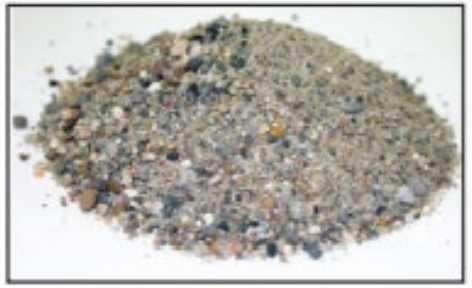





Image source: Iowa State University

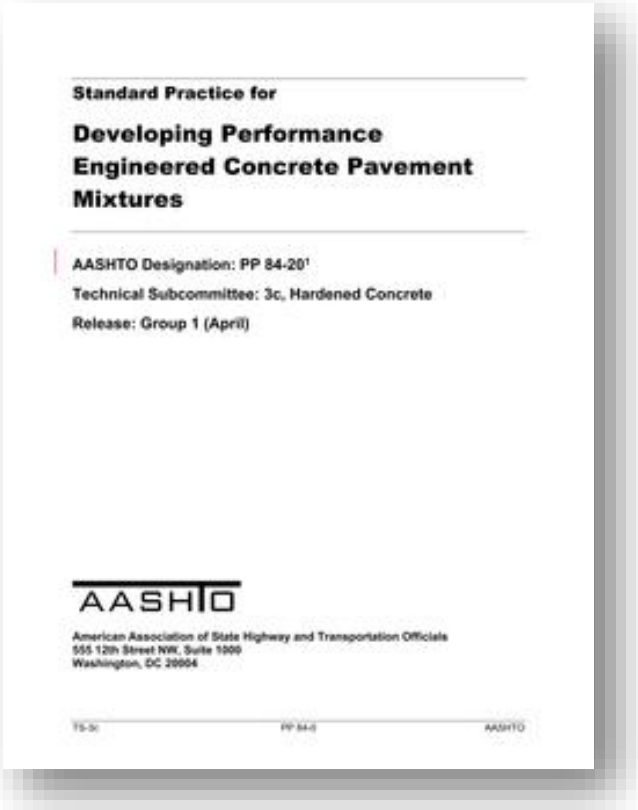
Cementitious Materials Options for COC-U

- Typically use Type I and Type II cements (ASTM C150)
- Also blended (ASTM C595) or hydraulic cements (ASTM C1157)
- Commonly used SCMs:
  - Class C or F fly ash
  - Slag cement
- No fibers generally used in COC-U mixtures
- Most accelerated construction needs can be accomplished through careful planning/staging – Use accelerated mixtures only where needed!

Use of ASTM standard is not a Federal requirement

Performance Engineered Mixtures (PEM)

- Material technology for COC-U
- Focuses on important long-term performance criteria:
  - cold weather resistance
  - wet freeze-thaw
  - workability
  - shrinkage
  - strength
  - aggregate stability
  - fluid transport


Standard Practice for

Developing Performance Engineered Concrete Pavement Mixtures

AASHTO Designation: PP 84-20[1]

Technical Subcommittee: 3c, Hardened Concrete

Release: Group 1 (April)

AASHTO

American Association of State Highway and Transportation Officials
555 12th Street NW, Suite 1000
Washington, DC 20004

AASHTO R101 (PP 84) specification

Use of AASHTO standard is not a Federal requirement

Construction Issues

Image source: Voigt

Overlay Placement for COC-U

- Placing a COC-U is typical of other concrete paving
- Slipform construction steps are similar
- Using best practices increases odds of great results
  - Placement, texturing, curing, joint sawing and opening to traffic

- Three suggestions to pay special attention to:
  - Preparation of existing pavement
  - Installing/securing interlayer (fabric)
  - Securing dowel baskets

Preparation – Repair Subgrade Issues (1 of 2)

- DO NOT consider this like a full pavement preservation approach
- Address inadequate support issues and poor drainage conditions
- Might include:
  - Subcuts and patching with suitable materials (likely)
  - Regrading ditches (likely)
  - Installing underdrain systems (rare)

Images source: Voigt

Preparation – Repair Subgrade Issues (2 of 2)

- Use full-depth patching to:
  - Replace pavement at subcuts
  - Replace structurally unsound and/or moving slabs
- Target a compressive strength of 3,000 psi at 28 days for patching mix
- Use tie bars at patch longitudinal joints
- Dowels in transverse joints not typically needed/used

Images source: Voigt

Preparation – Repair Deteriorated Joints

Address badly deteriorated (spalled) joints in COC-U by:

- Removing all loose material in the joints and blowing clean with compressed air (approximately 150 psi).
- Fill voids flush with surface using:
  - Flowable mortar mixture.
  - Asphalt milling fines or HMA

Spalls Filled with Flowable Mortar

Image source: Iowa State University

Installing/Securing Fabric (1 of 6)

- Sequence the geotextile placement intentionally:
  - Not too late (interrupts paving operation)
  - Not too early (exposes geotextile to damage)
- Sweep the pavement surface clean just ahead of installation

Example of Prepared Surface

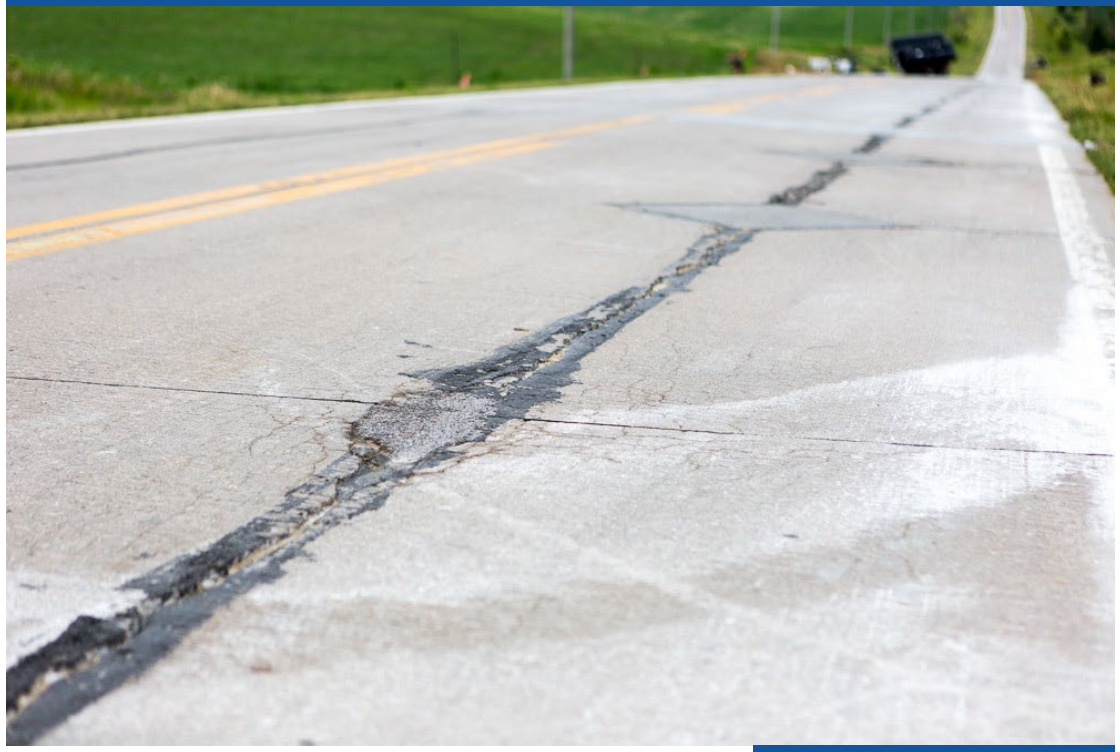


Image source: Propex Geosolutions

Installing/Securing Fabric (2 of 6)

- Align the geotextile carefully to pavement edge
- Terminate in underdrain trench/drainage inlet (if in design)
- Avoid wrinkles while unrolling

Images source: Propex Geosolutions

Installing/Securing Fabric (3 of 6)

- Provide 6 to 10 inches of overlap between sections
- Secure the fabric to the existing pavement using either geotextile adhesive or power nails

Image source: Propex Geosolutions

Installing/Securing Fabric (4 of 6)

- Spray adhesive application
- Wrinkles should be cut out and fixed before paving over

Image source: Propex Geosolutions

Image source: Iowa State University

Installing/Securing Fabric (5 of 6)

- Geotextile interlayer survives construction traffic well
- Avoid sudden changes in acceleration
- Avoid sharp or sudden turns

Image source: Propex Geosolutions

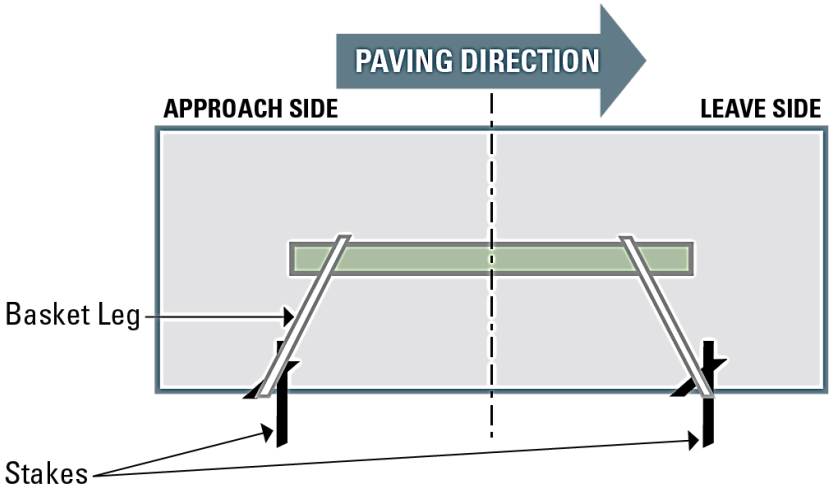
Installing/Securing Fabric (6 of 6)

- Instruct haulers how to dump to avoid damaging geotextile
- May need breaking off and truck in neutral if using certain spreaders

Image source: Propex Geosolutions

Placing/Securing Dowel Baskets

- Anchor securely to the existing pavement
- Always place anchors on leave side of basket wire on both sides
- Use anchors that extend through the asphalt interlayer (if used)



Images source: American Concrete Pavement Assn.

How Do You Get Started? Next Steps

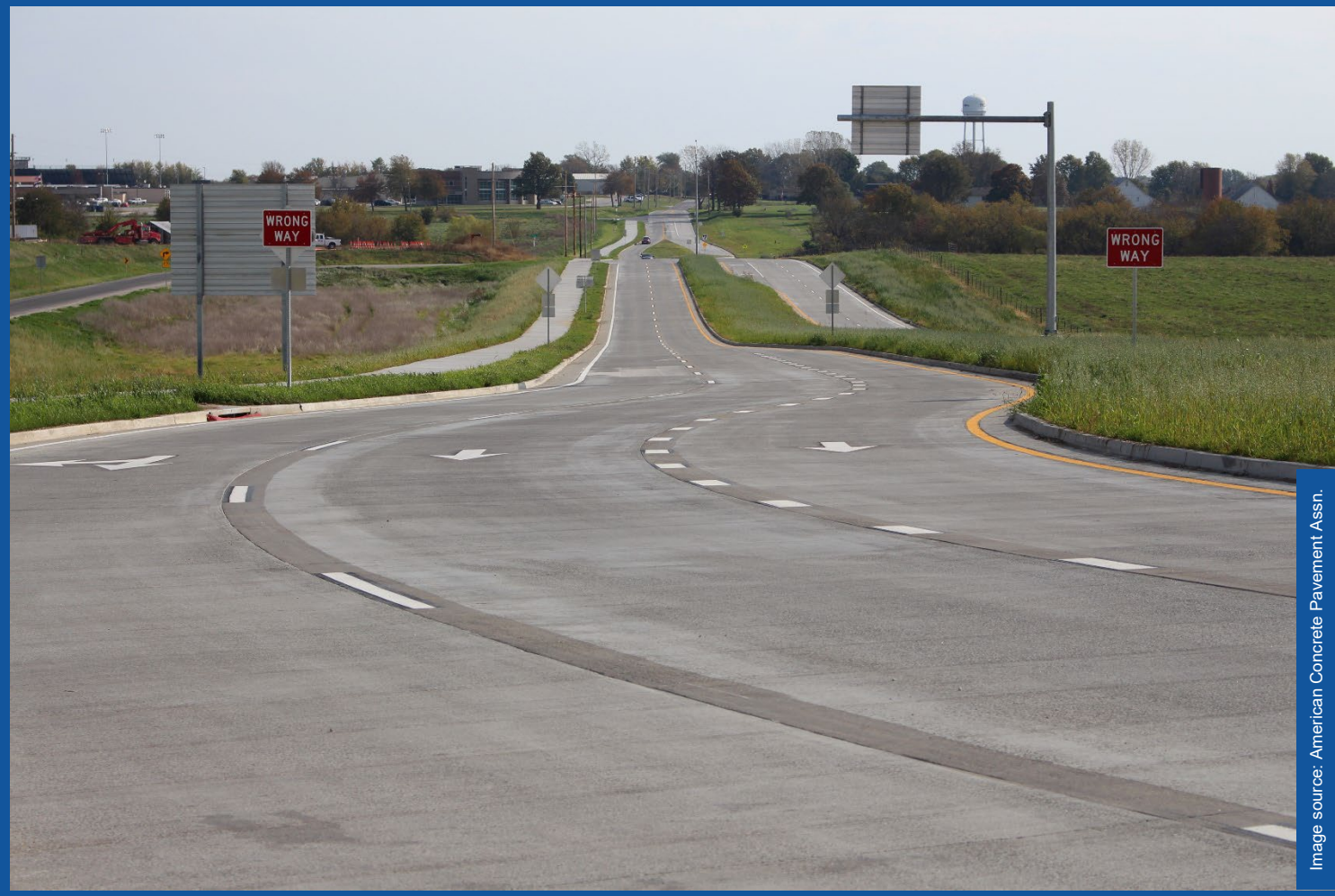


Image source: American Concrete Pavement Assn.

Getting Started (1 of 5)

1

Start with simple projects:

A project with no complicated staging or tight completion requirements

Makes it easy to get started on your procedures and work out your specifications/details

Getting Started (2 of 5)

2

Evaluate performance:

- Build a few projects per year
- Establish a process for annual field reviews and collection of performance data

Allow first projects to build your confidence in the technology

Getting Started (3 of 5)

3

Build your technical competency using available help:

- Use the technical manuals and training materials
- Reach out to peer agencies to gain from their experience
- Consult FHWA for help

Take advantage of the experience around you remembering this is ready-to-implement EDC technology!

Getting Started (4 of 5)

4

Integrate concrete overlays into your “Mix of Fixes” over time:

- Collect local cost and performance data from your overlay projects
- Build a database with your data and include data from peer organizations to get started

Make sure COC-U is an option in your software for project scoping and update that system with your data over time

Getting Started (5 of 5)

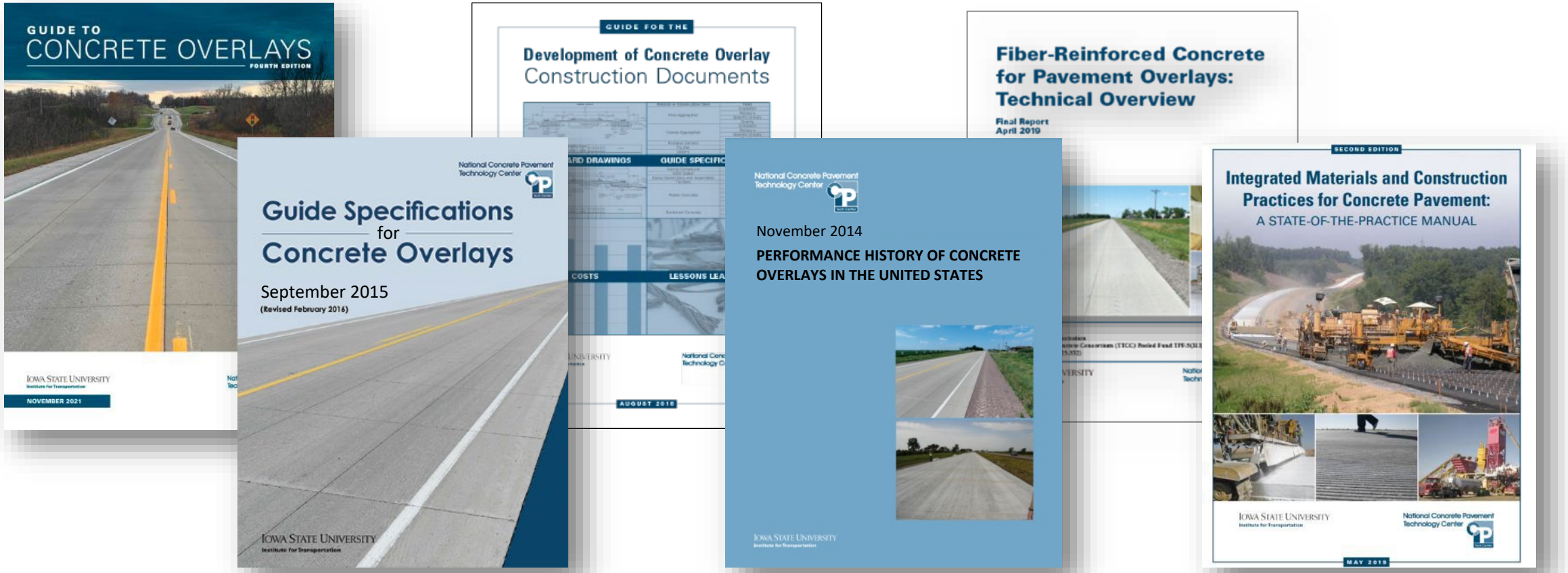
5

Collaborate/reach out to peers as you learn:

- Exchange technical info/support with FHWA
- Share your knowledge at consortiums and peer exchanges

Pay it forward by sharing what you learn from your COC-U solutions!

Remember These Technical Resources!



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About the Presenter

- **Clark Morrison** is the State Pavement Design Engineer for the North Carolina Department of Transportation. He has been with NCDOT for 24 years.
- He received his B.S. in Civil Engineering from the University of Arizona, his M.S. in Civil Engineering from the University of Texas at Austin, and his Ph.D. in Civil Engineering from Virginia Tech.
- He is currently a Member of TRB Standing Committee on Structural Testing and Evaluation and is the Chair of the AASHTOWare Pavement ME Design Task Force.

NORTH CAROLINA
Department of Transportation









Unbonded Concrete Overlays on I-85 in North Carolina

Clark S. Morrison, PE

November 8, 2022

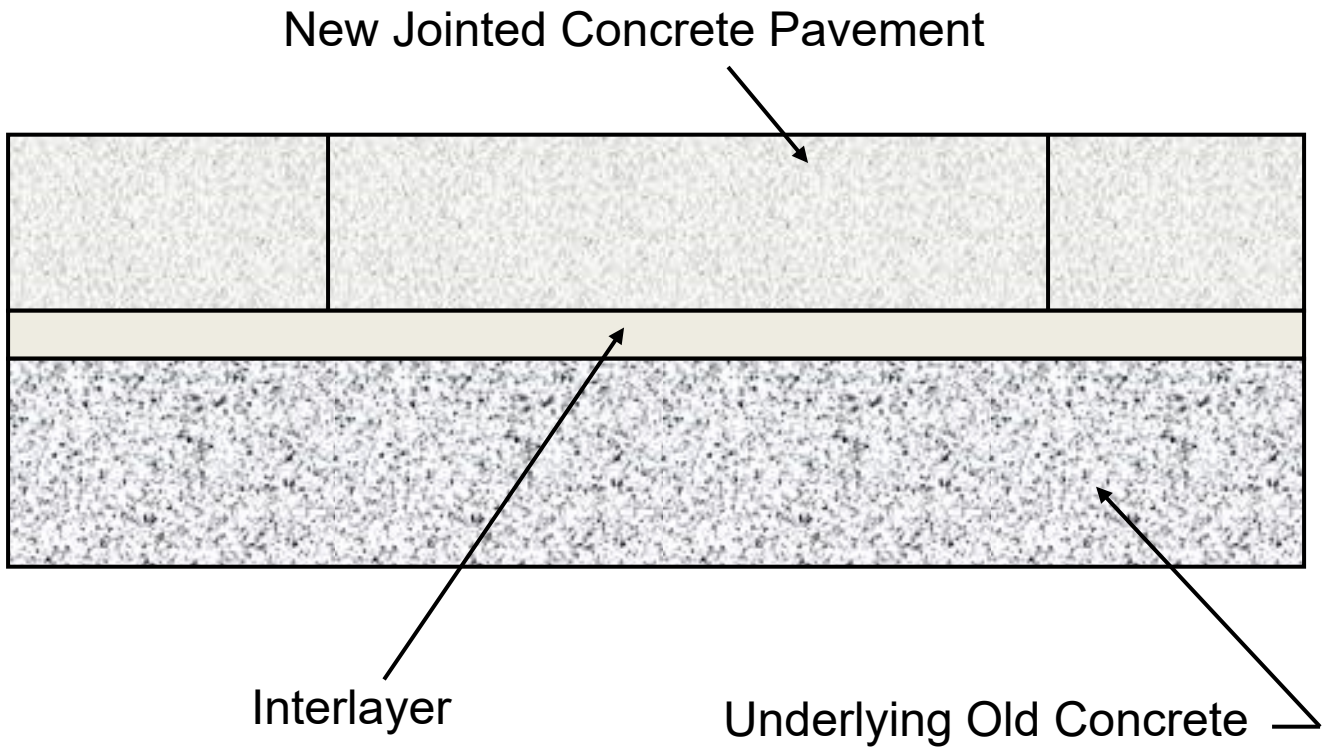
Order

- Preliminaries
- I-2508, Granville County
- I-2810, Vance County
- I-0914, Vance and Warren Counties

Definitions

- Unbonded Concrete Overlay: A Concrete Pavement built over an existing concrete pavement and with an interlayer used to prevent bonding.
- Interlayer: Typically either asphalt surface course, an asphalt stabilized drainage layer, or a nonwoven geosynthetic.

Layout of Unbonded Overlay



Project Selection

- Can be used over extensively deteriorated jointed or continuously reinforced concrete.
- Extensive pre-overlay repair typically not required, but punchouts in CRCP and shattered slabs in JCP require repair to avoid localized failures.
- Grade will change by about a foot, so overhead clearance and tie-ins to existing bridges are considerations.
- Maintenance of traffic is important. Because of grade change, it is best if you can give the contractor all lanes of one direction to work with.

TIP: I-2508 BA (1 of 6)

Let: 1997

Division: 5

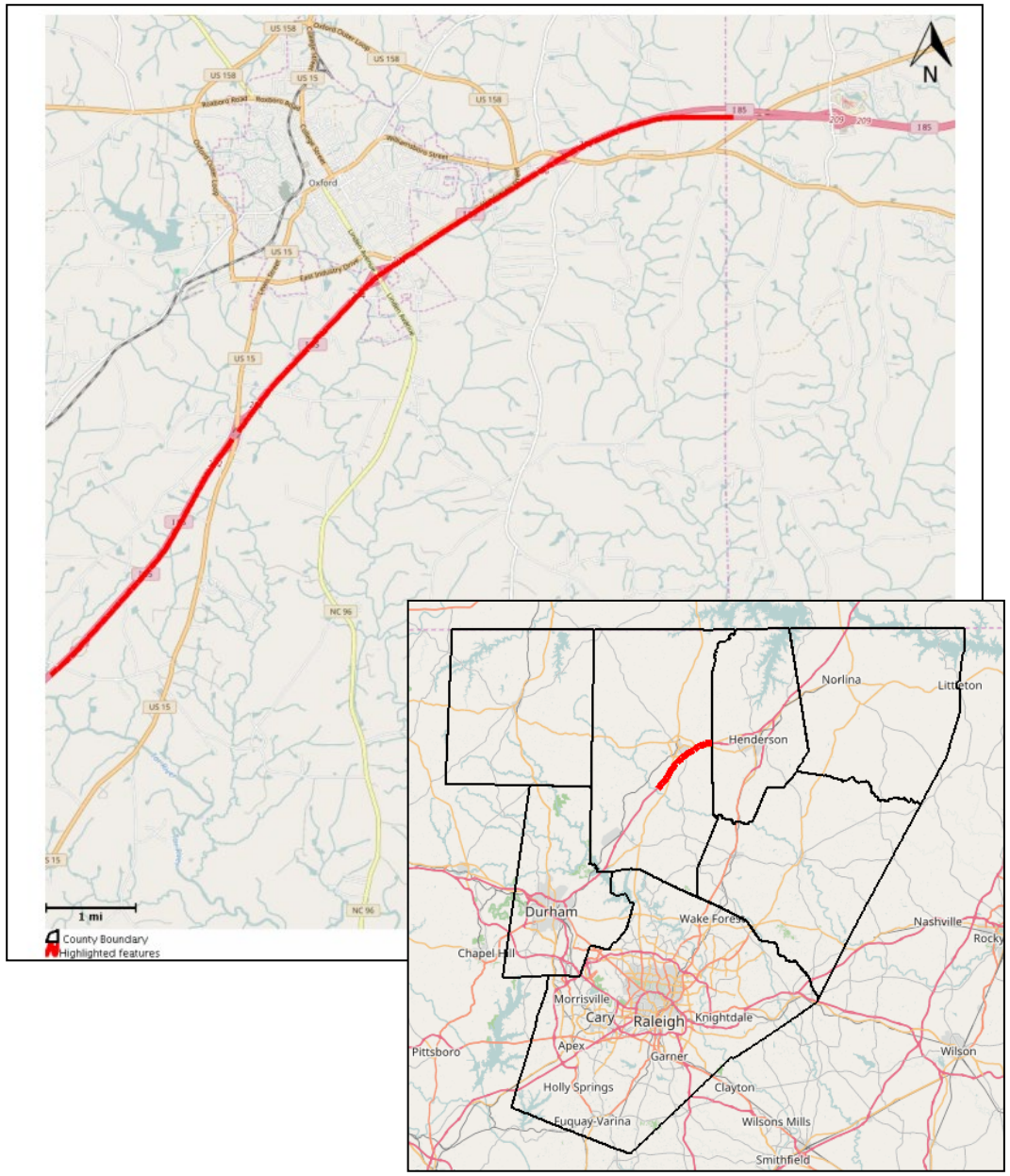
County: Granville & Vance

Route: I-85 NB

Description:
Unbonded overlay project consisting of pavement and bridge rehabilitation on I-85 from south of US 15 interchange to Vance county line.

Project length = 10.333 miles.

Existing Pavement: 8” CRCP over 4” ABC Built in 1971 (26 years old)



TIP: I-2508 BA *(2 of 6)*

Preconstruction Condition

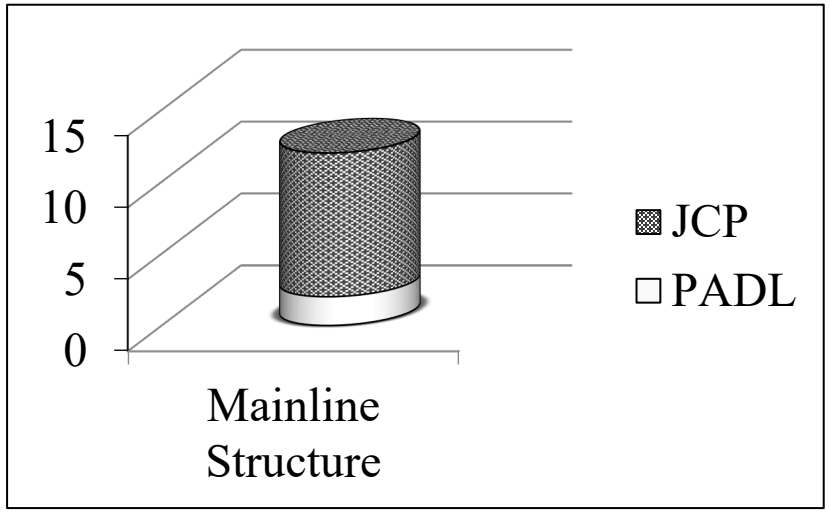
TIP: I-2508 BA *(3 of 6)*

Pavement Structure – Main Line:

Unbonded Concrete Overlay – Jointed with Dowels ……10”

PADL……..2”

Total: 12”



Pavement Structure – Shoulders:

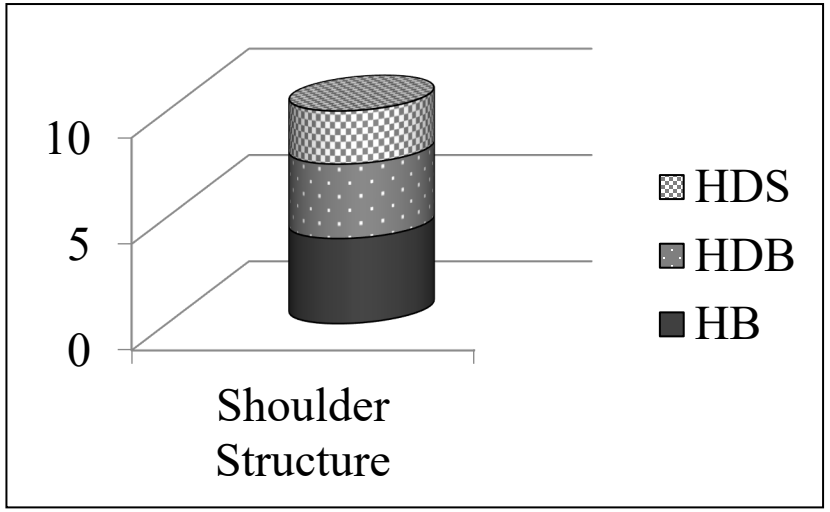
HDS…..……2.5”

HDB……..3.5”

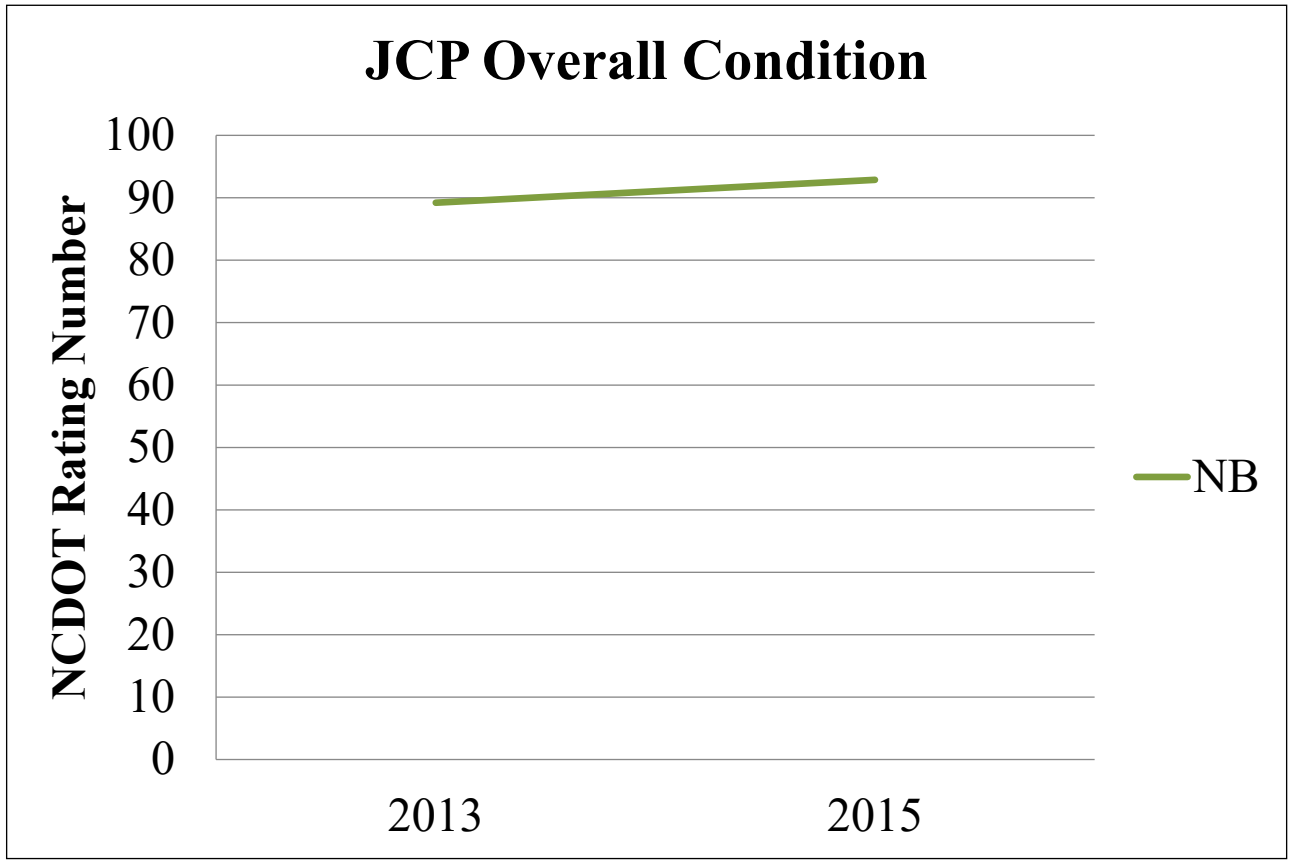
HB…..……4”

PADL……2”

Total: 12”



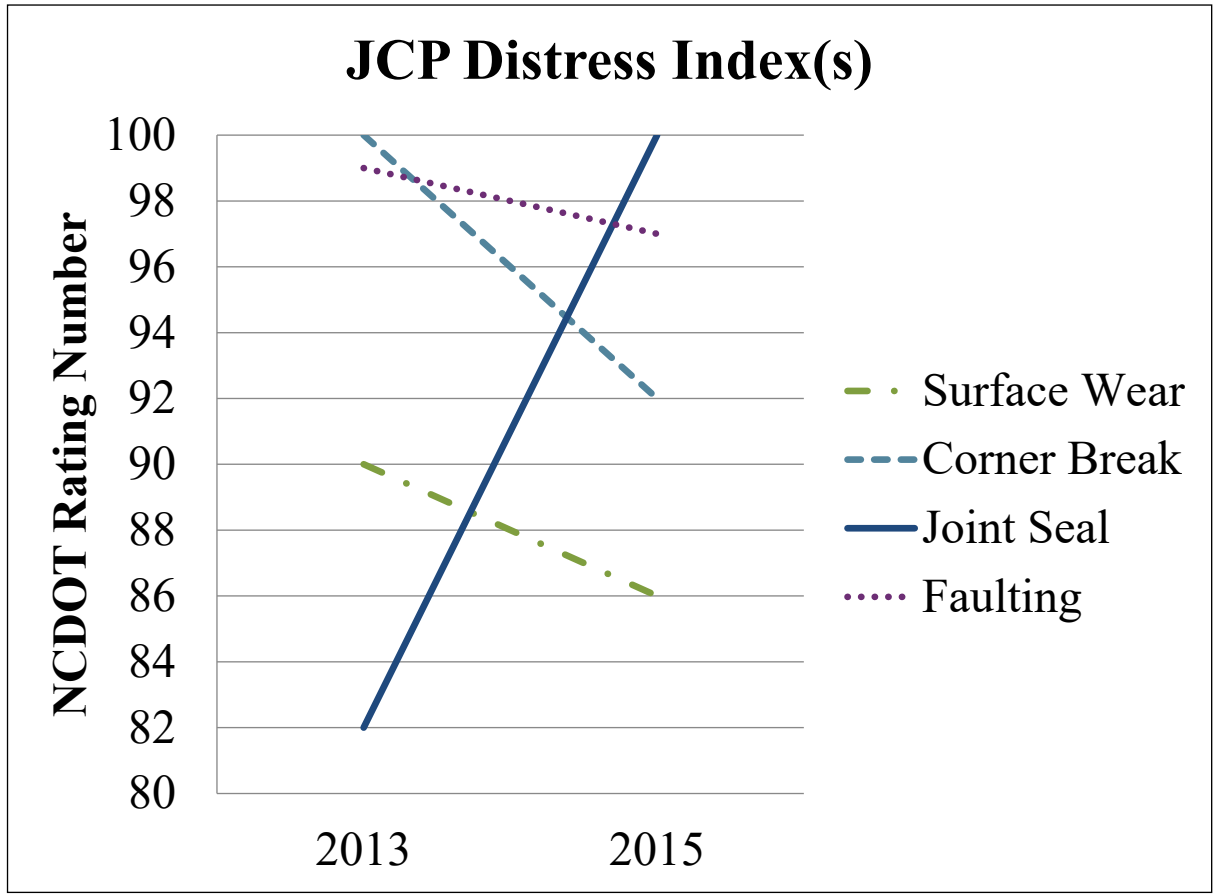
TIP: I-2508 BA *(4 of 6)*



*NCDOT did not calculate a rating number for CRC Pavements, only for JCP Pavements.

Route	NCDOT Rating: 2013	NCDOT Rating: 2015
I-85 NB	89	93

TIP: I-2508 BA *(5 of 6)*



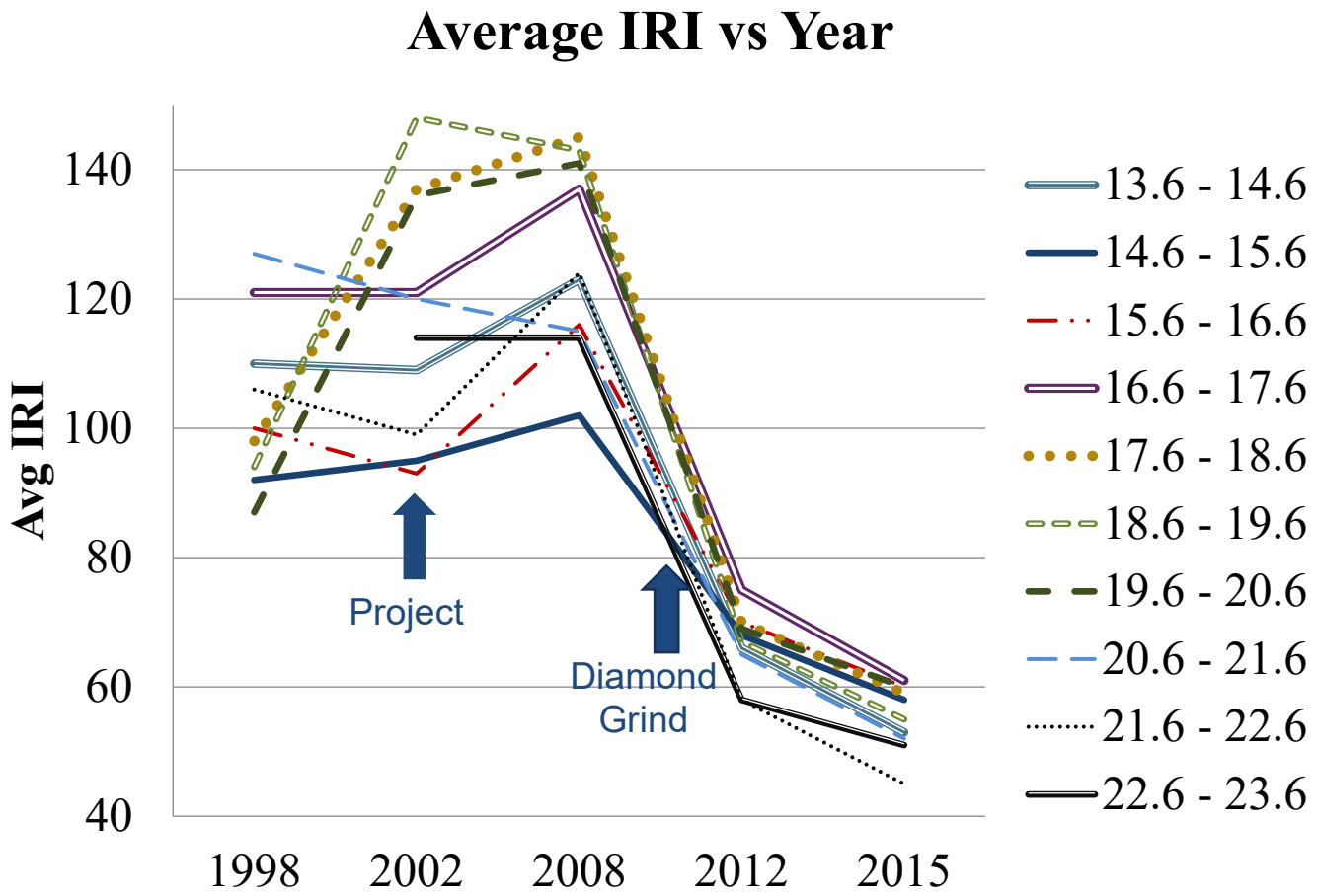
Distress Type	NCDOT Rating: 2013	NCDOT Rating: 2015
Surface Wear	90	86
Corner Break	100	92
Joint Seal	82	100
Faulting	99	97

*NCDOT did not calculate a rating number for CRC Pavements, only for JCP Pavements.

**JCP Distress Index is a 0 – 100 scale, with 100 being no notable distress present.

***4377 Slabs surveyed in 2013. 4477 Slabs surveyed in 2015.

TIP: I-2508 BA *(6 of 6)*



Mile Segment	Average IRI: 1998	Average IRI: 2002	Average IRI: 2008	Average IRI: 2012	Average IRI: 2015
13.6-14.6	110	109	123	66	53
14.6-15.6	92	95	102	68	58
15.6-16.6	100	93	116	70	60
16.6-17.6	121	121	137	75	61
17.6-18.6	98	137	145	70	59
18.6-19.6	94	148	143	67	55
19.6-20.6	87	136	141	69	60
20.6-21.6	127	120	115	65	52
21.6-22.6	106	99	124	58	45
22.6-23.6	-	114	114	58	51

*IRI measurement taken every 0.1 mile then averaged over each mile segment.

TIP: I-2508 BB *(1 of 8)*

Let: 1998

Division: 5

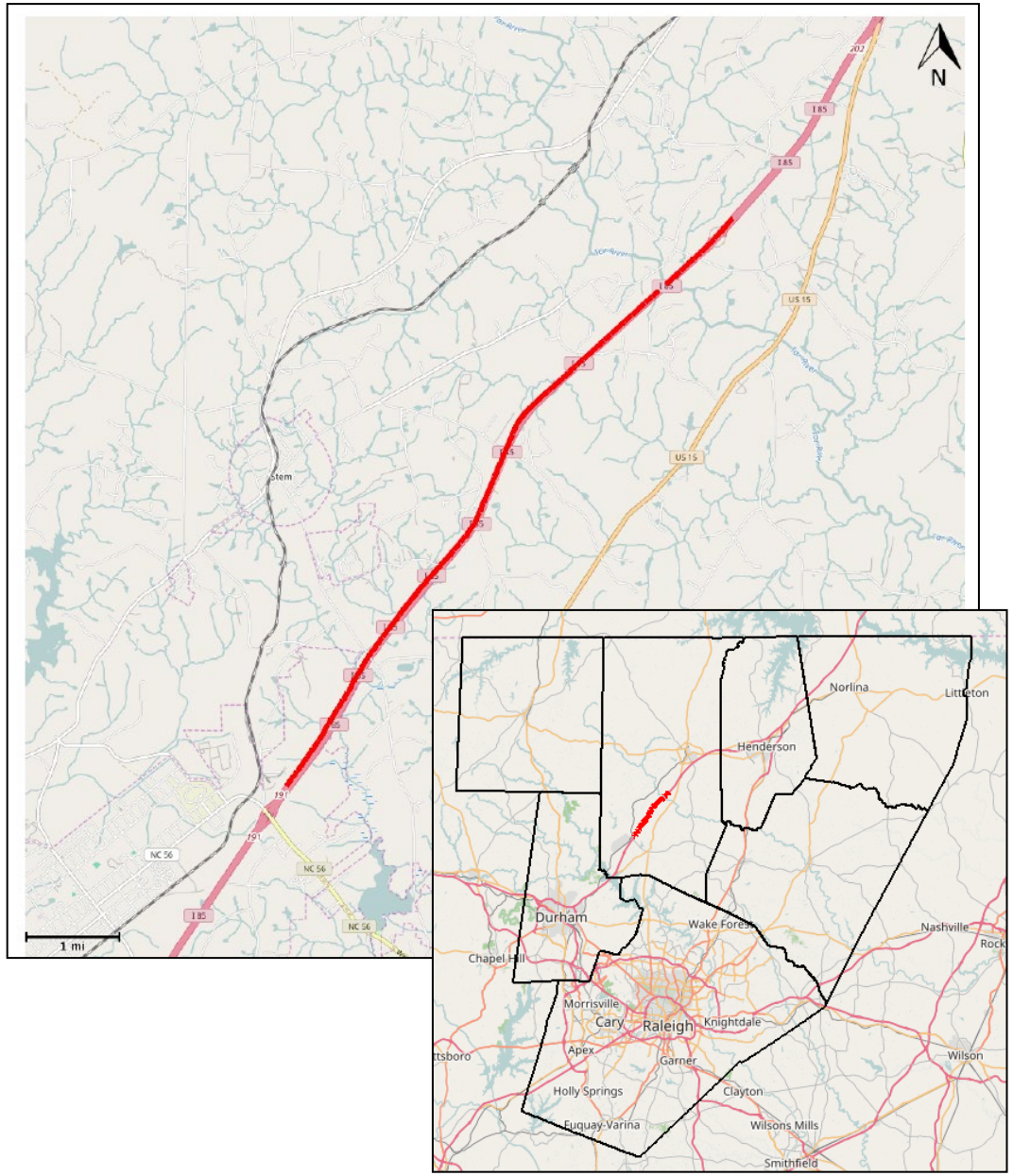
County: Granville

Route: I-85 SB

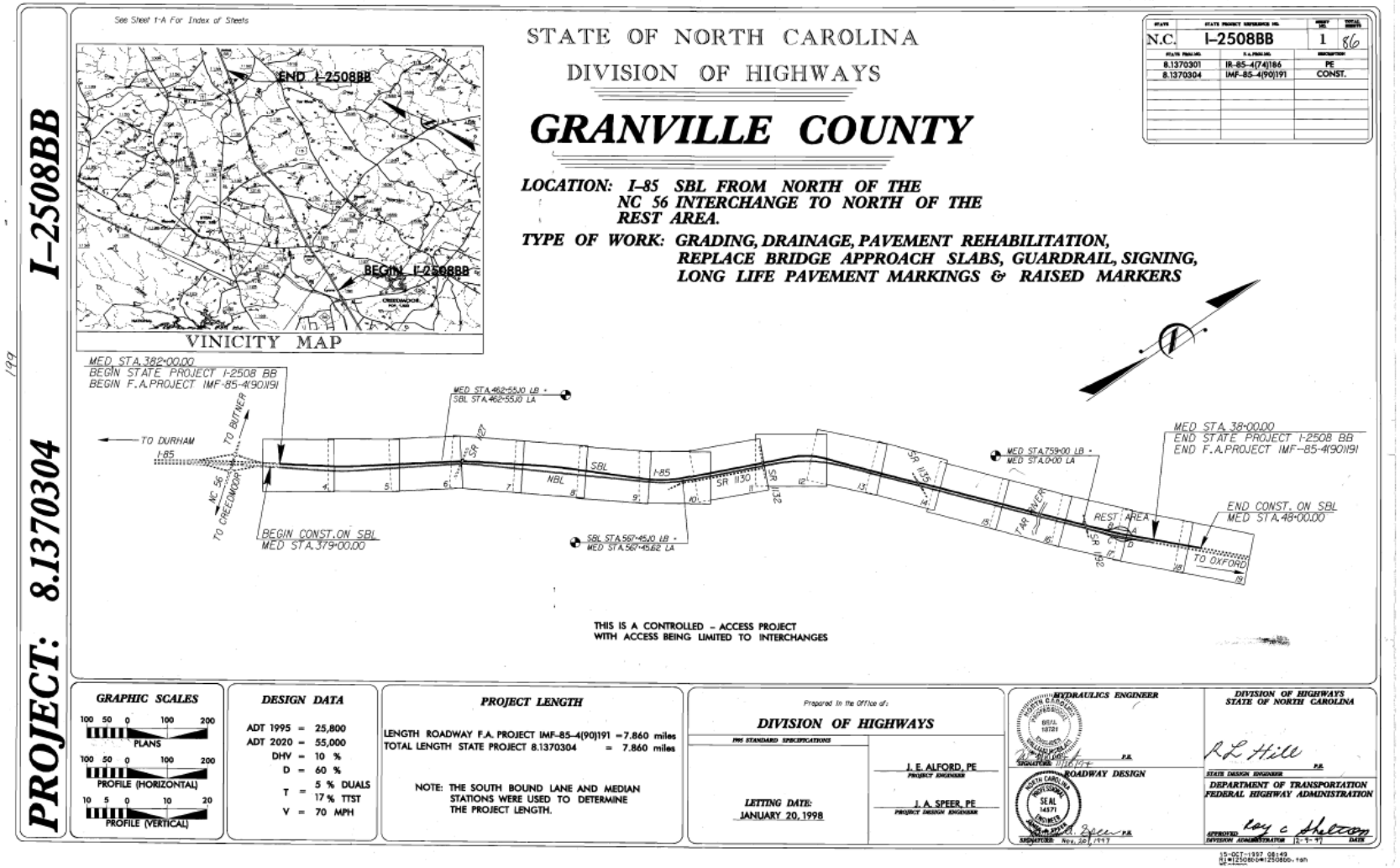
Description:
Unbonded overlay project consisting of pavement rehabilitation on I-85 SBL from North of the NC 56 Interchange to North of the Rest Area.

Project length = 7.86 miles.

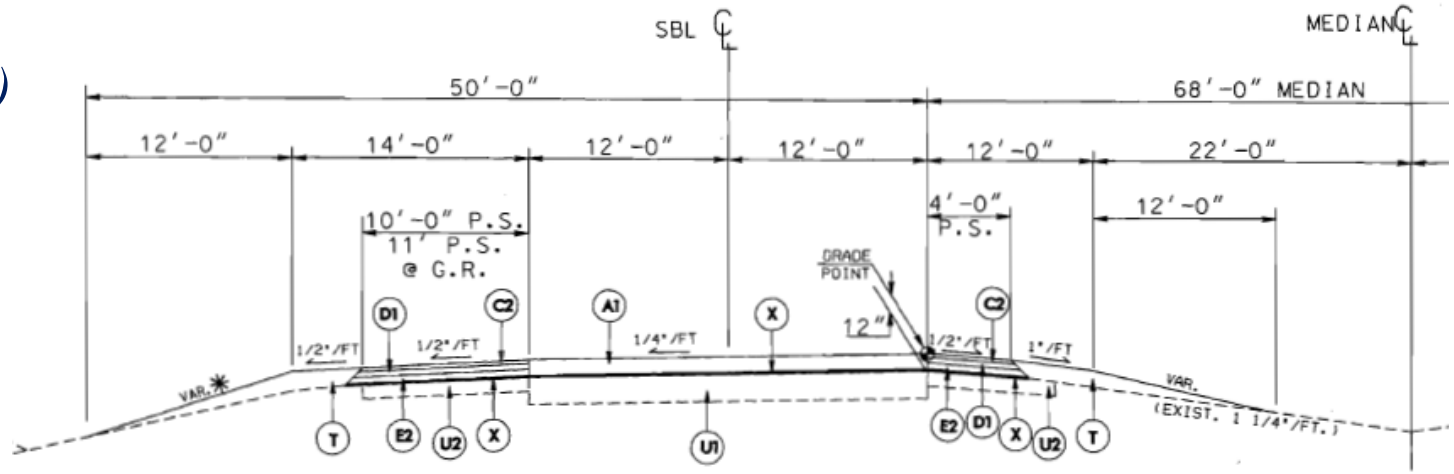
Existing Pavement: 8” CRCP over 4” ABC Built in 1970 (28 years old)



TIP: I-2508 BB *(2 of 8)*



TIP: I-2508 BB *(3 of 8)*



PAVEMENT SCHEDULE

Step #	Description
A1	10" PORTLAND CEMENT CONCRETE PAVEMENT, THROUGH LANES (WITH DOWELS)
A2	10" PORTLAND CEMENT CONCRETE PAVEMENT, MISC. AREAS, SUCH AS RAMP TAPERS AND GORE AREAS (WITHOUT DOWELS)
A3	12" PORTLAND CEMENT CONCRETE PAVEMENT, THROUGH LANES (WITH DOWELS)
A4	12" PORTLAND CEMENT CONCRETE PAVEMENT, MISC. AREAS, SUCH AS RAMP TAPERS AND GORE AREAS (WITHOUT DOWELS)
C1	PROP. APPROX. 1 ¼" ASPHALT CONC. SURFACE COURSE, TYPE HDS, AT AN AVERAGE RATE OF 140 LBS. PER SQ. YD.
C2	PROP. APPROX. 2 ½" ASPHALT CONC. SURFACE COURSE, TYPE HDS, AT AN AVERAGE RATE OF 140 LBS. PER SQ. YD. IN EACH OF TWO LAYERS
C3	PROP. VAR. DEPTH ASPHALT CONC. SURFACE COURSE, TYPE HDS, AT AN AVERAGE RATE OF 112 LBS. PER SQ. YD. PER 1" DEPTH TO BE PLACED IN LAYERS NOT LESS THAN 1 ¼" OR GREATER THAN 1 ¾" DEPTH
D1	PROP. APPROX. 3 ½" ASPHALT CONC. BINDER COURSE, TYPE HDB, AT AN AVERAGE RATE OF 392 LBS. PER SQ. YD.

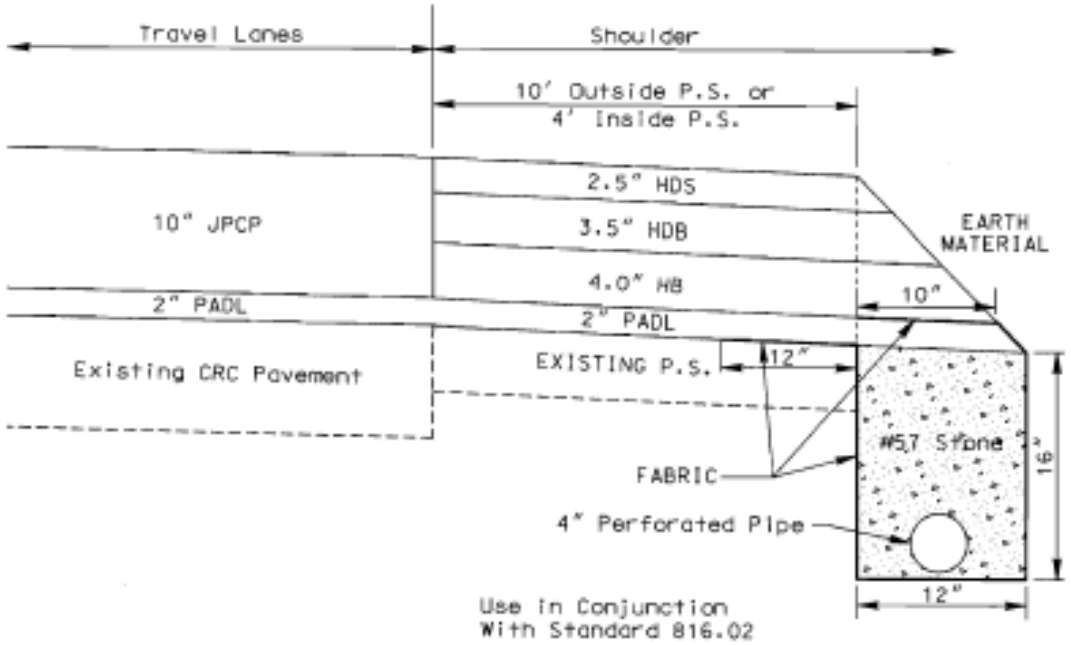
Step #	Description
D2	PROP. VAR. DEPTH ASPHALT CONC. BINDER COURSE, TYPE HDB, AT AN AVERAGE RATE OF 112 LBS. PER SQ. YD. PER 1" DEPTH TO BE PLACED IN LAYERS NOT LESS THAN 1 ¾" OR GREATER THAN 3 ½" DEPTH
E1	PROP. APPROX. 3" ASPHALT CONC. BASE COURSE, TYPE HB, AT AN AVERAGE RATE OF 330 LBS. PER SQ. YD.
E2	PROP. APPROX. 4" ASPHALT CONC. BASE COURSE, TYPE HB, AT AN AVERAGE RATE OF 440 LBS. PER SQ. YD.
E3	PROP. APPROX. 4 ½" ASPHALT CONC. BASE COURSE, TYPE HB, AT AN AVERAGE RATE OF 495 LBS. PER SQ. YD.
E4	PROP. APPROX. 5" ASPHALT CONC. BASE COURSE, TYPE HB, AT AN AVERAGE RATE OF 550 LBS. PER SQ. YD.
E5	PROP. VAR. DEPTH ASPHALT CONC. BASE COURSE, TYPE HB, AT AN AVERAGE RATE OF 110 LBS. PER SQ. YD. PER 1" DEPTH TO BE PLACED IN LAYERS NOT GREATER THAN 5 ½" OR LESS THAN 3" DEPTH
K	SUBGRADE TO BE STABILIZED TO A DEPTH OF 8" WITH LIME AT AN APPROX. RATE OF 20 LBS. PER SQ. YD. (QUICKLINE METHOD), AT LOCATIONS DIRECTED BY THE ENGINEER

Step #	Description
L	SUBGRADE TO BE STABILIZED WITH 200 TO 400 LBS. PER SQ. YD. OF STABILIZER AGGREGATE MIXED WITH THE TOP 3" PF SUBGRADE SOIL AT LOCATIONS DIRECTED BY THE ENGINEER
T	EARTH MATERIAL
U1	EXISTING CONCRETE PAVEMENT
U2	EXISTING ASPHALT PAVEMENT
V1	MILLING EXISTING CONCRETE PAVEMENT, 0" TO 1 ¼" DEPTH
V2	MILLING EXISTING ASPHALT PAVEMENT, 0" TO 1 ¼" DEPTH
W	VAR. DEPTH ASPHALT PAVEMENT (VAR. 0" TO 9 ½"), SEE PAVEMENT TRANSISTION DETAILS
X	PROP. APPROX. 2" PERMEABLE ASPHALT DRAINAGE LAYER – TYPE P-78M

TIP: I-2508 BB *(4 of 8)*

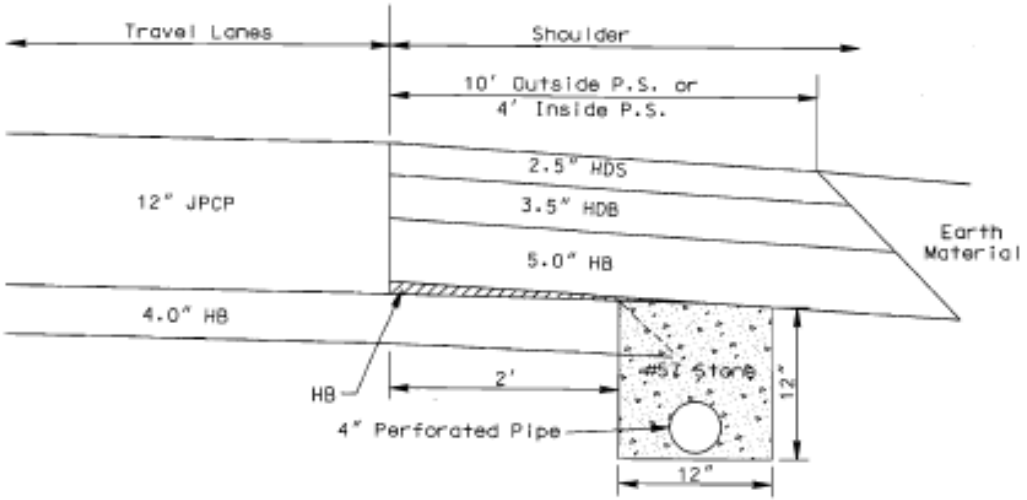
SHOULDER DRAIN DETAIL 1

Shoulder Drain Placement Detail (Resurfacing)
< Use with Typical No. 1 >



SHOULDER DRAIN DETAIL 2

Shoulder Drain Placement Detail (Grade Changes)
< Use With Typical No. 2 >



See Standard 816.02
For Shoulder Drain Detail

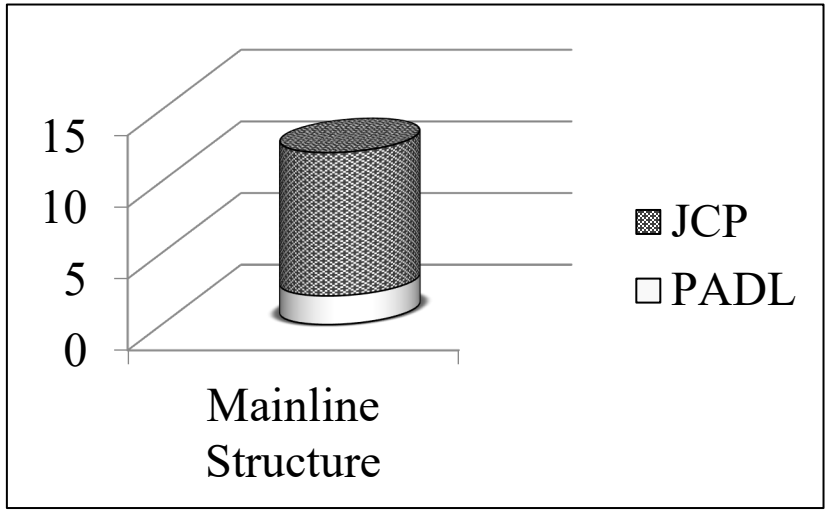
TIP: I-2508 BB *(5 of 8)*

Pavement Structure – Main Line:

Unbonded Concrete Overlay –
Jointed Dowels ……10”

PADL……..2”

Total: 12”



Pavement Structure – Shoulders:

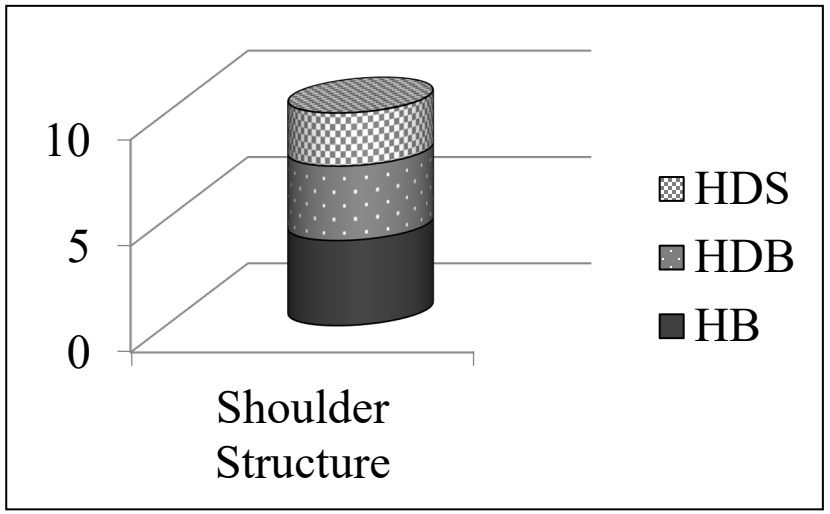
HDS……2.5”

HDB……3.5”

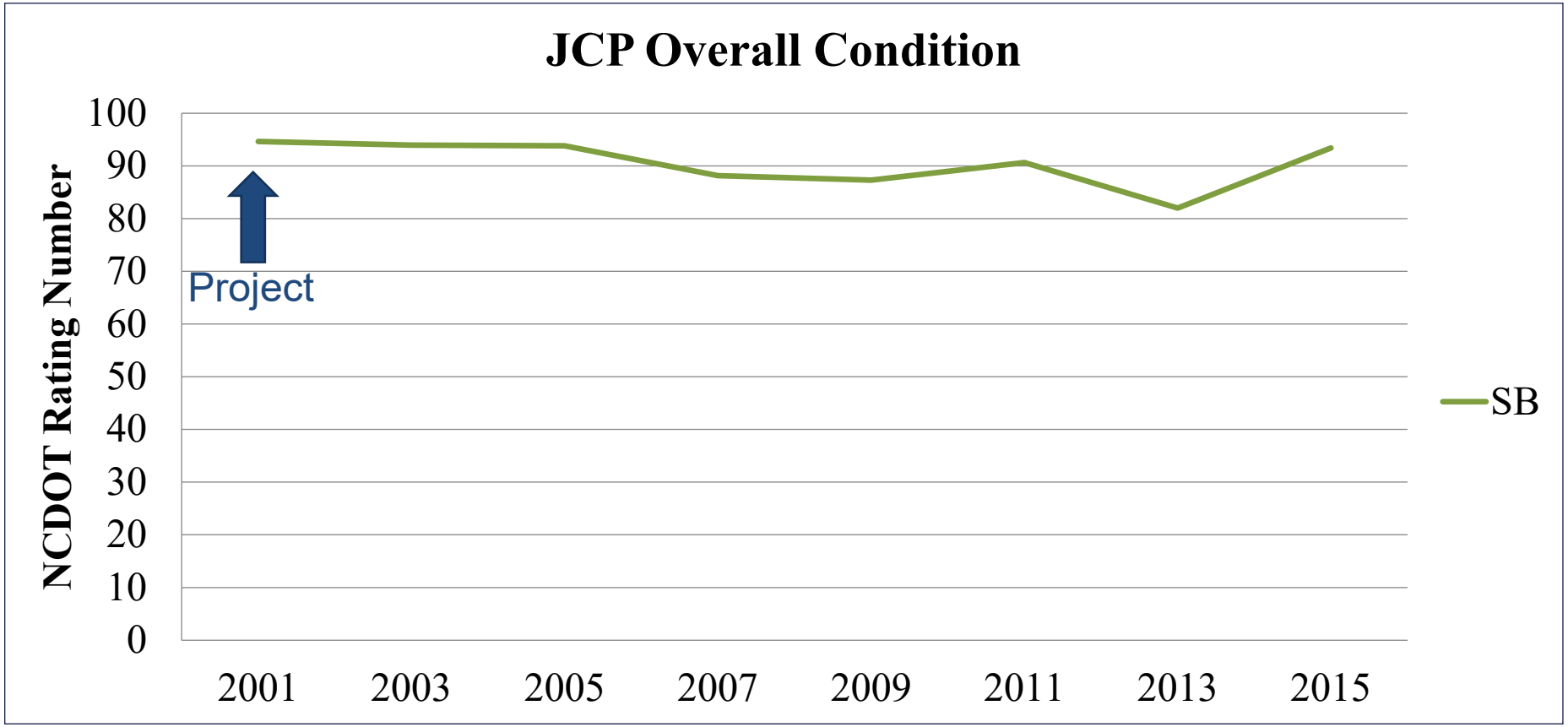
HB……4”

PADL……..2”

Total: 12”



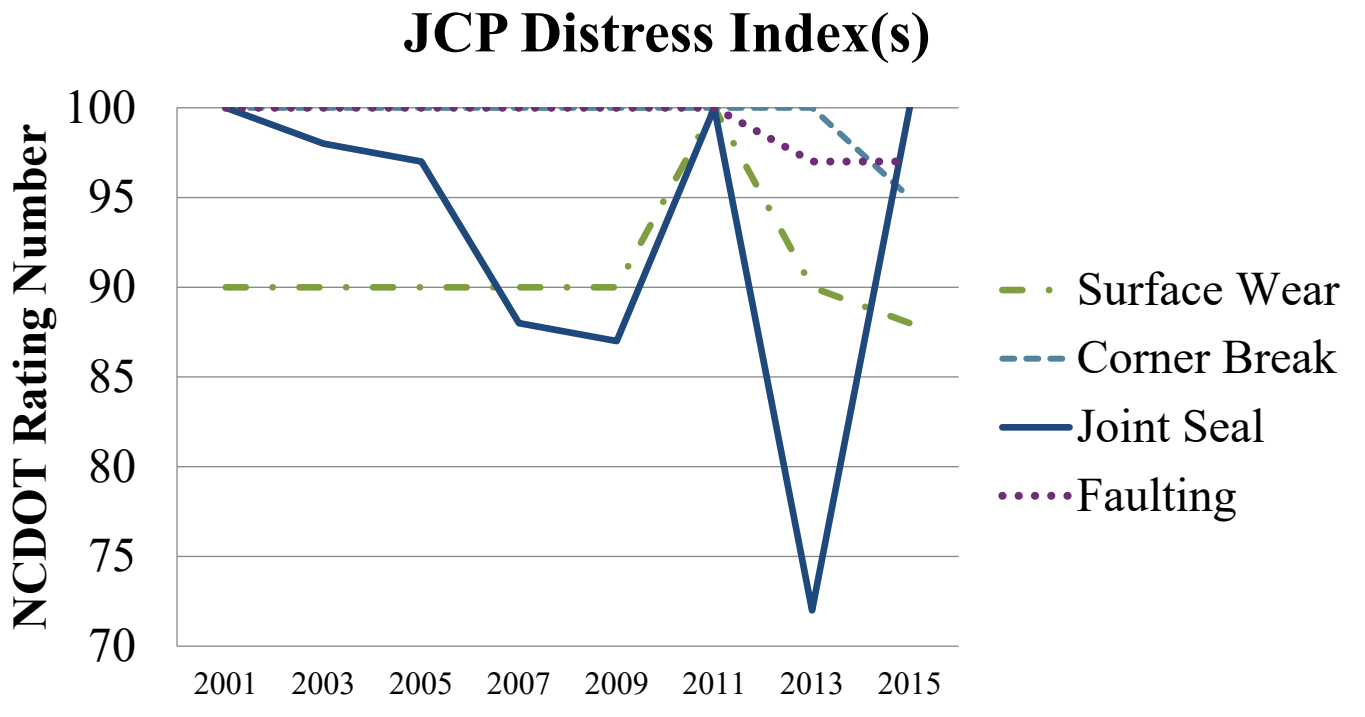
TIP: I-2508 BB *(6 of 8)*



*NCDOT did not calculate a rating number for CRC Pavements, only for JCP Pavements.

Route	NCDOT Rating: 2001	NCDOT Rating: 2003	NCDOT Rating: 2005	NCDOT Rating: 2007	NCDOT Rating: 2009	NCDOT Rating: 2011	NCDOT Rating: 2013	NCDOT Rating: 2015
I-85 SB	95	94	94	88	87	91	82	93

TIP: I-2508 BB *(7 of 8)*



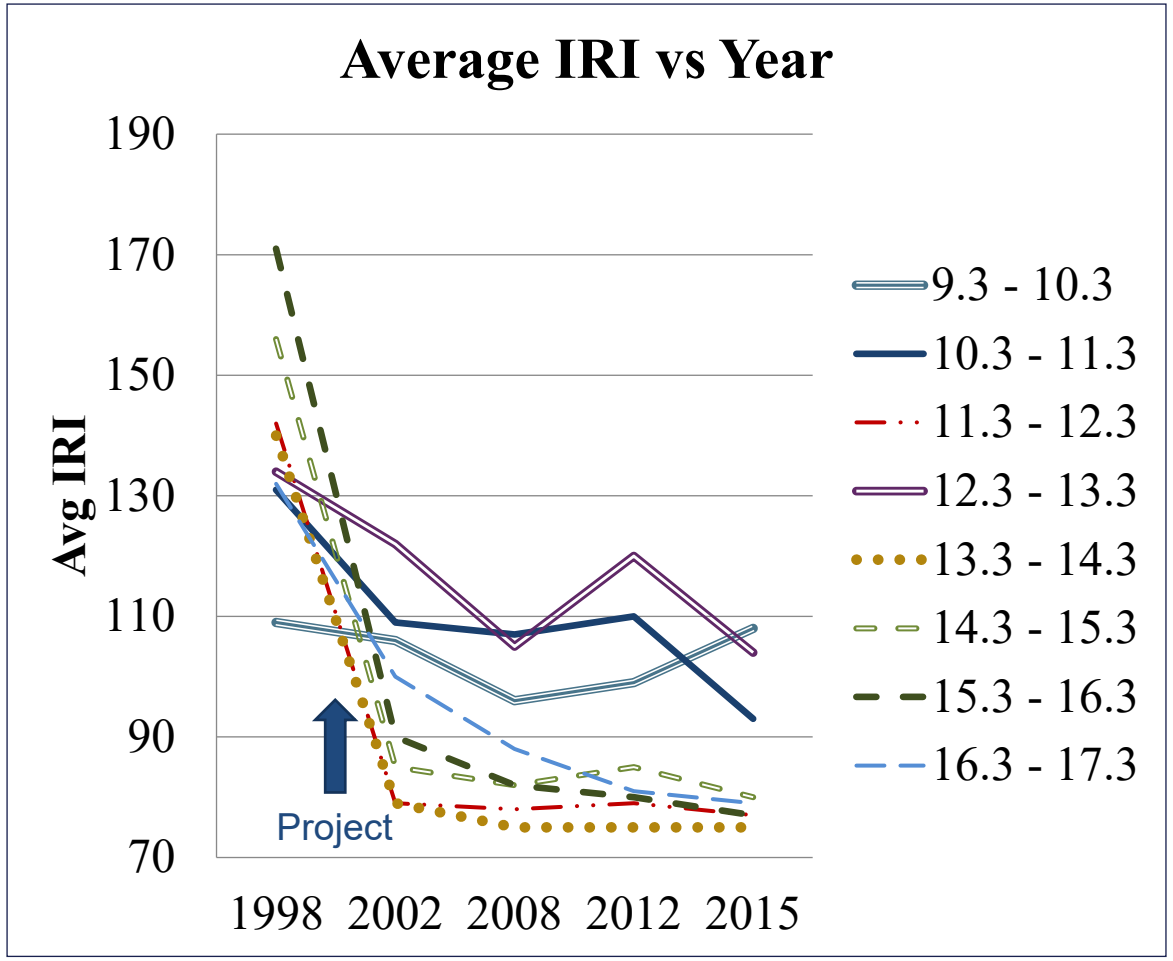
*NCDOT did not calculate a rating number for CRC Pavements, only for JCP Pavements.

**JCP Distress Index is a 0 – 100 scale, with 100 being no notable distress present.

***280 Slabs surveyed annually 2001 – 2011. 1800 Slabs surveyed annually 2012 – 2015.

Distress Type	NCDOT Rating: 2001	NCDOT Rating: 2003	NCDOT Rating: 2005	NCDOT Rating: 2007	NCDOT Rating: 2009	NCDOT Rating: 2011	NCDOT Rating: 2013	NCDOT Rating: 2015
Surface Wear	90	90	90	90	90	100	90	88
Corner Break	100	100	100	100	100	100	100	95
Joint Seal	100	98	97	88	87	100	72	100
Faulting	100	100	100	100	100	100	97	97

TIP: I-2508 BB *(8 of 8)*



Mile Segment	Average IRI: 1998	Average IRI: 2002	Average IRI: 2008	Average IRI: 2012	Average IRI: 2015
9.3-10.3	109	106	96	99	108
10.3-11.3	131	109	107	110	93
11.3-12.3	142	79	78	79	77
12.3-13.3	134	122	105	120	104
13.3-14.3	140	79	75	75	75
14.3-15.3	156	85	82	85	80
15.3-16.3	171	90	82	80	77
16.3-17.3	132	100	88	81	79

*IRI measurement taken every 0.1 mile then averaged over each mile segment

TIP: I-2508 BC *(1 of 8)*

Let: 2000

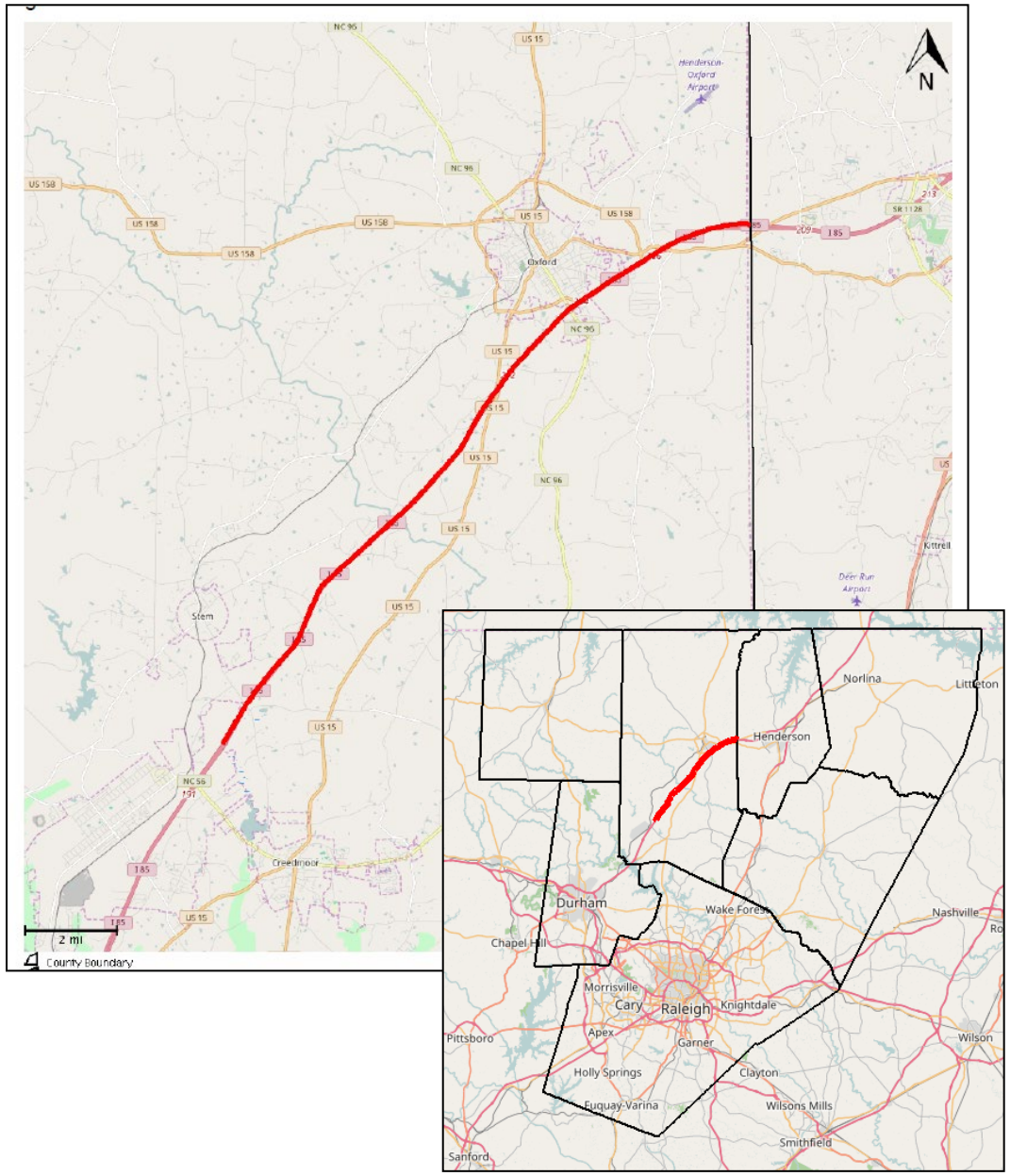
Division: 5

County: Granville & Vance

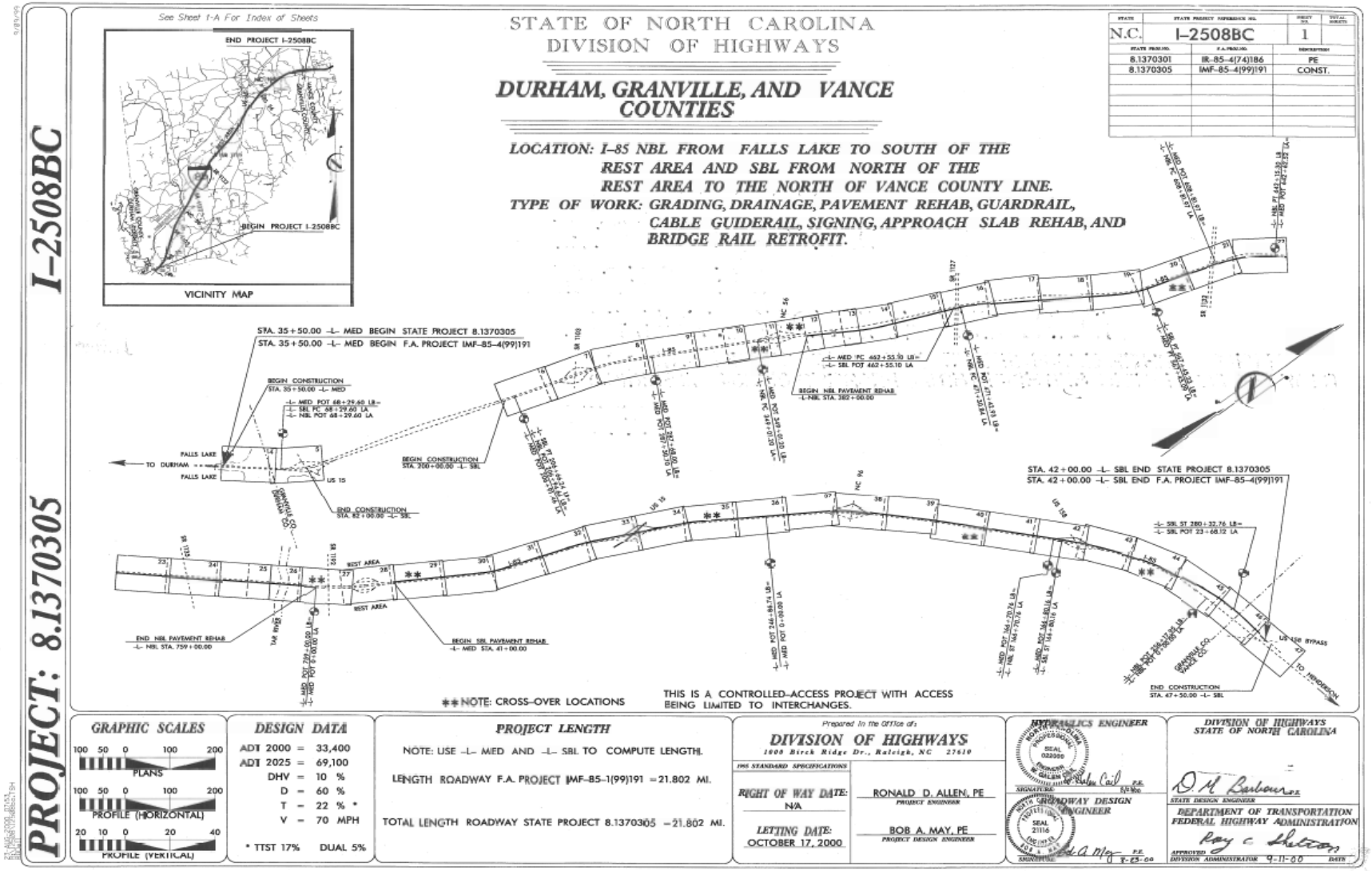
Route: I-85

Description:
Unbonded overlay project consisting of pavement rehabilitation on I-85 NBL from Falls Lake to south of the rest area and SBL from north of the rest area to the north of Vance county line. Project length = 17.2 miles

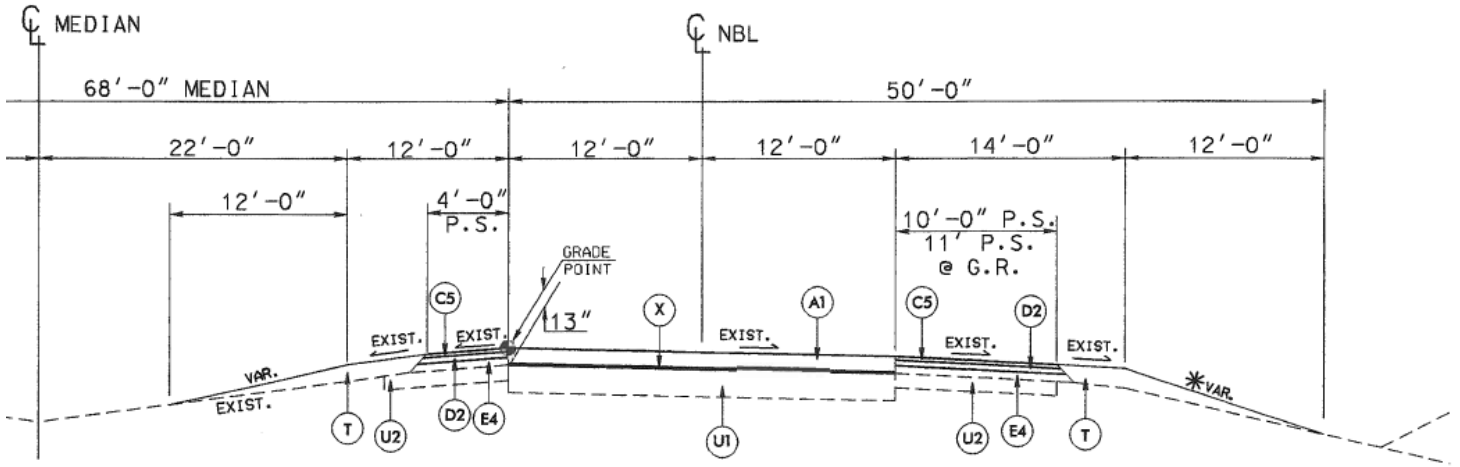
Existing Pavement: 8” CRCP over 4” ABC Built in 1971 (26 years old)



TIP: I-2508 BC *(2 of 8)*



TIP: I-2508 BC *(3 of 8)*



PAVEMENT SCHEDULE

Step #	Description	Step #	Description	Step #	Description
A1	11” CONCRETE W/ DOWELS	C6	VAR. SURFACE COURSE, TYPE S12.5C	E5	VAR. BASE COURSE, TYPE B25.0C
A2	11” CONCRETE W/O DOWELS	D1	3.5” INTERMEDIATE COURSE, TYPE I19.0C	J1	9” ABC
A3	12” CONCRETE W/ DOWELS	D2	4” INTERMEDIATE COURSE, TYPE I19.0C	T	EARTH MATERIAL
C1	1.25” SURFACE COURSE, TYPE S9.5C	D3	VAR. INTERMEDIATE COURSE, TYPE I19.0C	U1	EXIST. CONCRETE PAVEMENT
C2	2.5” SURFACE COURSE, TYPE S9.5C	E1	4” BASE COURSE, TYPE B25.0C	U2	EXIST. ASPHALT PAVEMENT
C3	VAR. SURFACE COURSE, TYPE S9.5C	E2	5” BASE COURSE, TYPE B25.0C	V	MILLING ASPHALT
C4	1.25” SURFACE COURSE, TYPE S12.5C	E3	5.5” BASE COURSE, TYPE B25.0C	V1	MILLING CONCRETE
C5	3” SURFACE COURSE, TYPE S12.5C	E4	6” BASE COURSE, TYPE B25.0C	X	2” PADL, TYPE P-78M

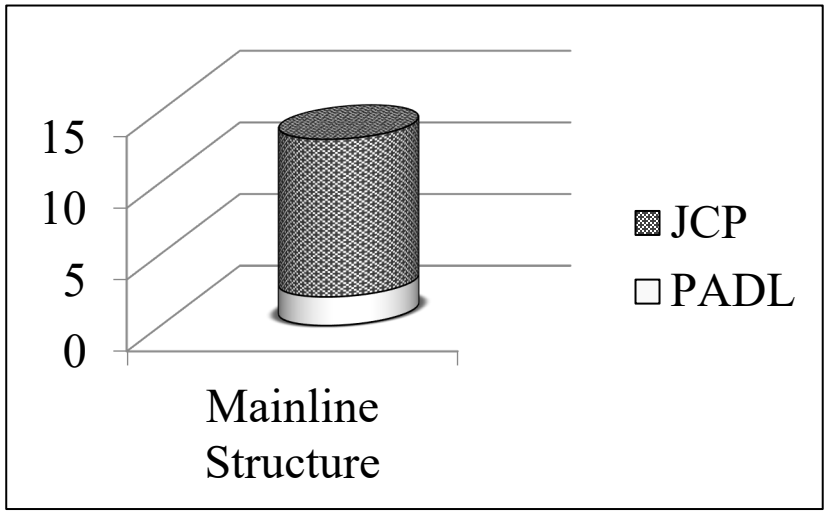
TIP: I-2508 BC *(4 of 8)*

Pavement Structure – Main Line:

Unbonded Concrete Overlay –
Jointed Dowels ……11”

PADL……..2”

Total: 13”



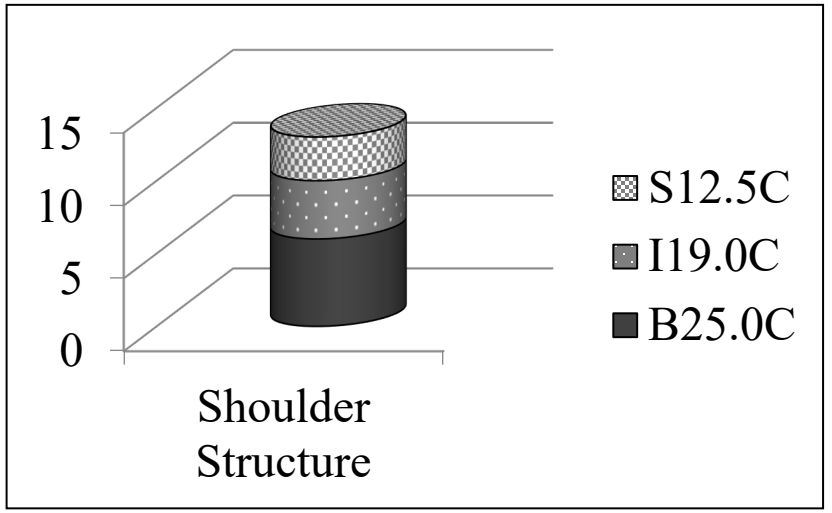
Pavement Structure – Shoulders:

S12.5C…..……3”

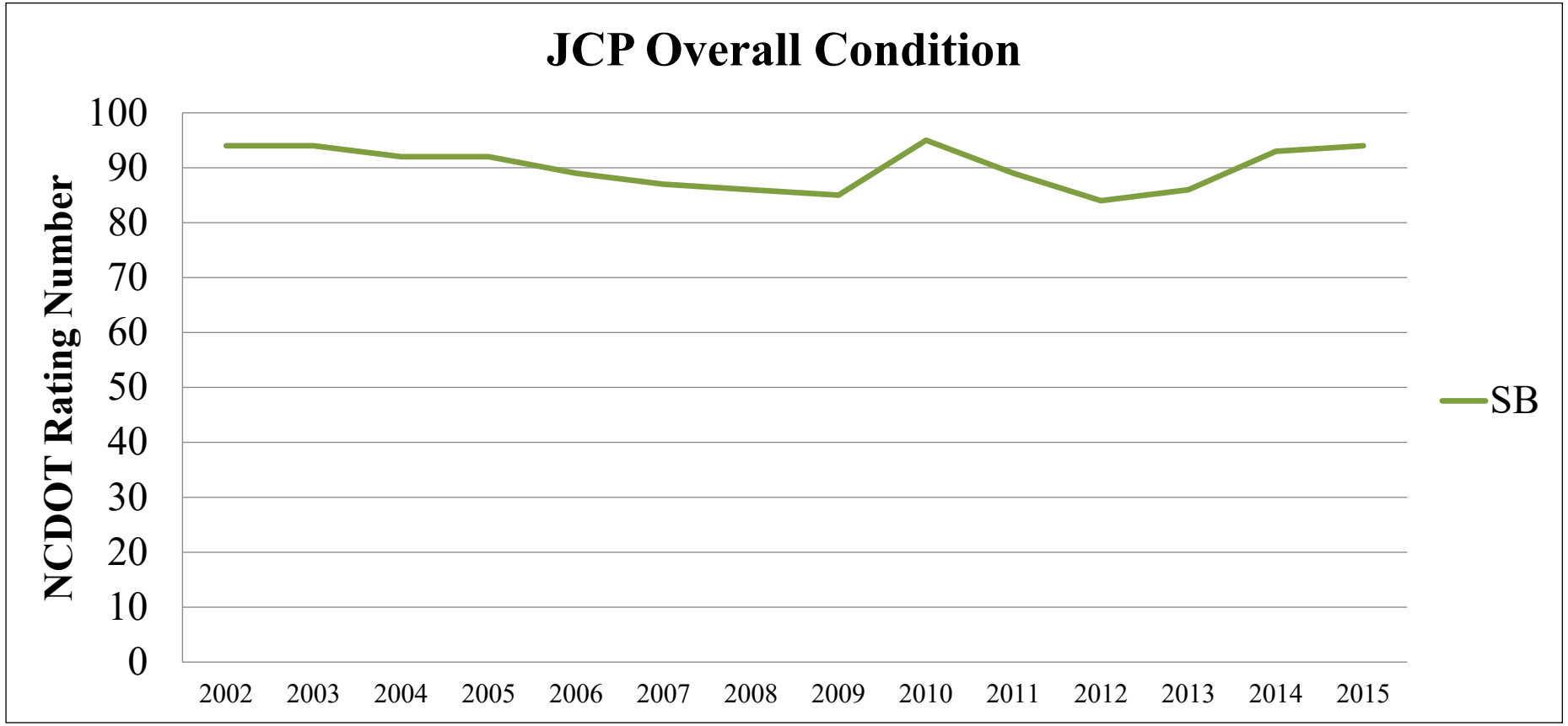
I19.0C……..4”

B25.0C…..……6”

Total: 13”



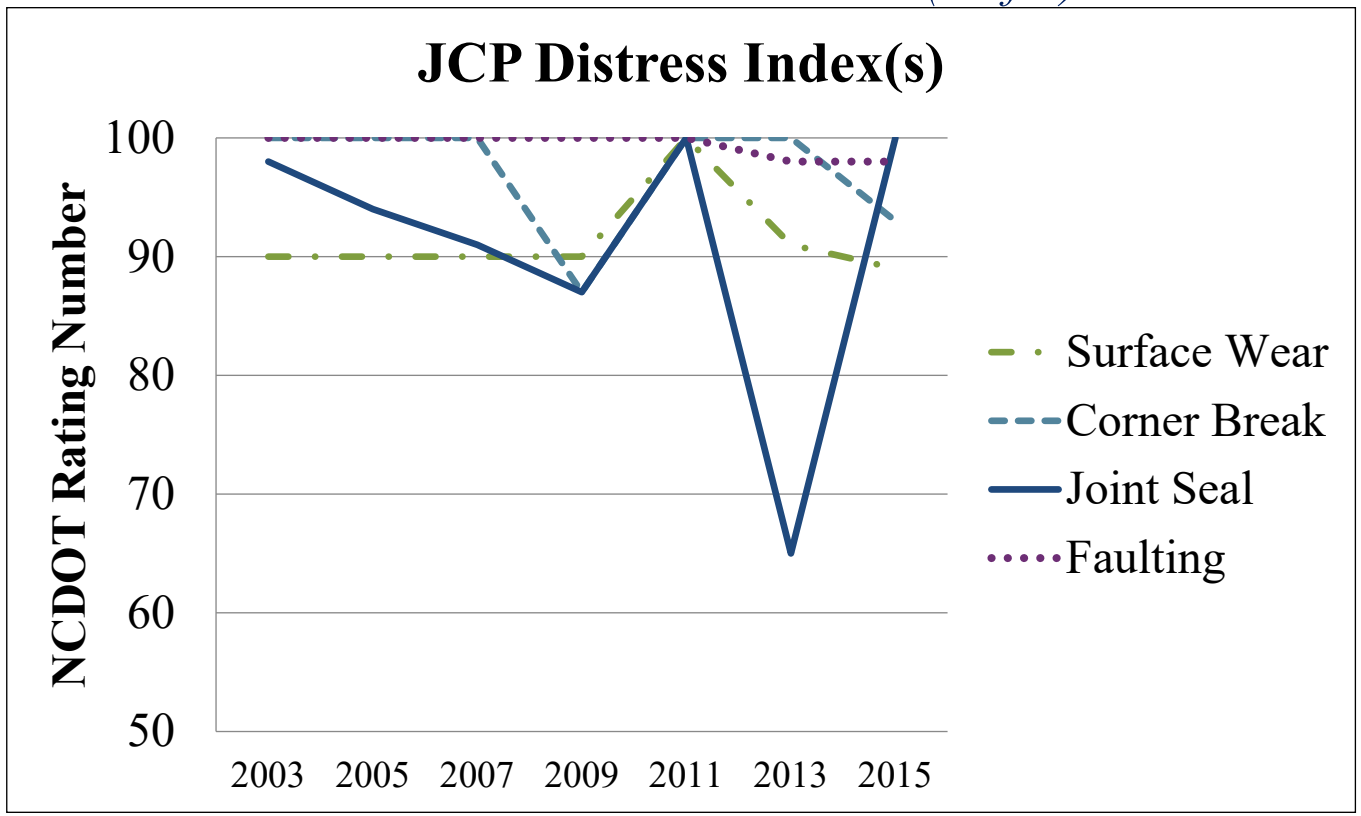
TIP: I-2508 BC *(5 of 8)*



*NCDOT did not calculate a rating number for CRC Pavements, only for JCP Pavements.

Route	NCDOT Rating: 2002	NCDOT Rating: 2003	NCDOT Rating: 2004	NCDOT Rating: 2005	NCDOT Rating: 2006	NCDOT Rating: 2007	NCDOT Rating: 2008	NCDOT Rating: 2009	NCDOT Rating: 2010	NCDOT Rating: 2011	NCDOT Rating: 2012	NCDOT Rating: 2013	NCDOT Rating: 2014	NCDOT Rating: 2015
I-85 SB	94	94	92	92	89	87	86	85	95	89	84	86	93	94

TIP: I-2508 BC *(6 of 8)*



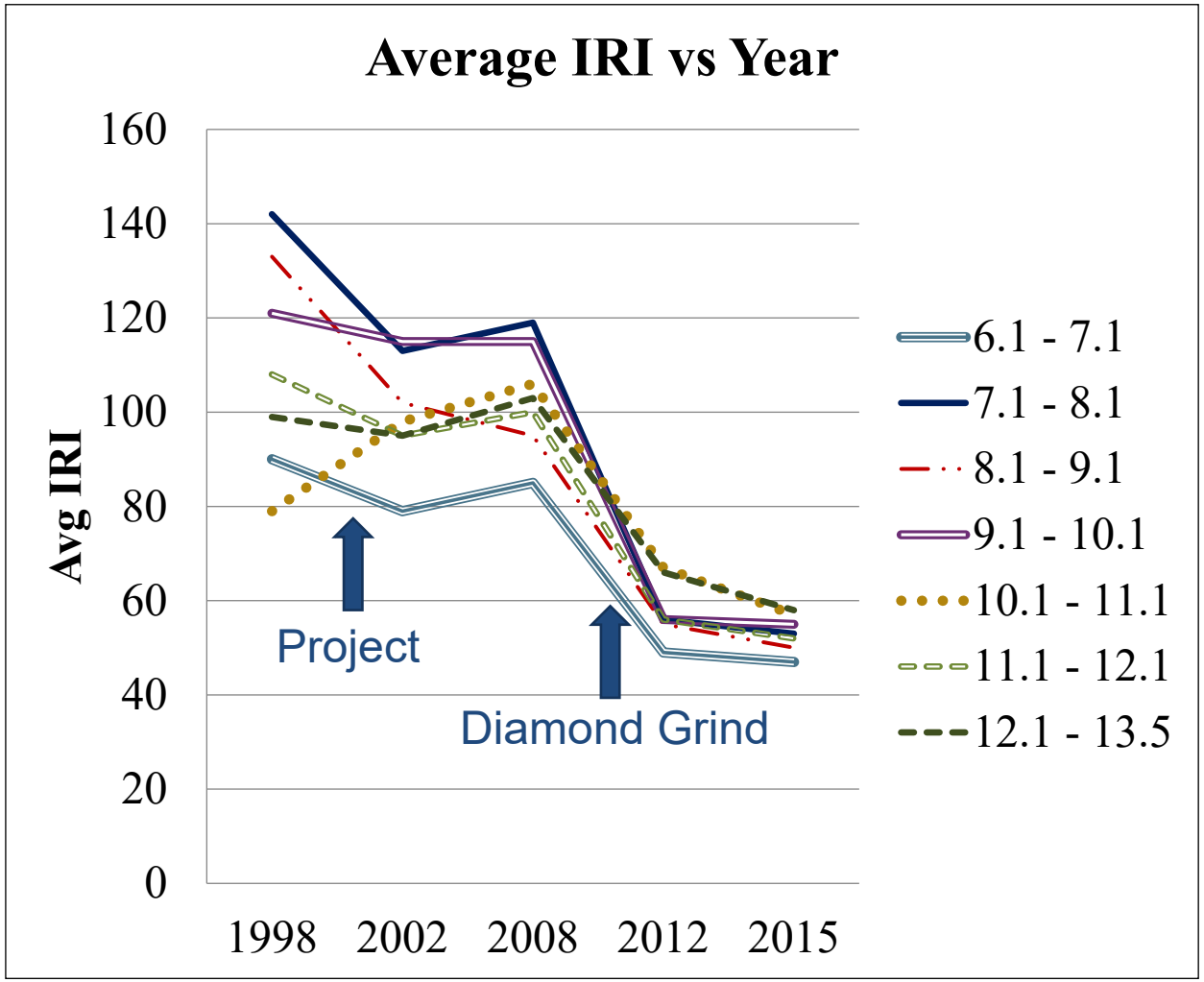
*NCDOT did not calculate a rating number for CRC Pavements, only for JCP Pavements.

**JCP Distress Index is a 0 – 100 scale, with 100 being no notable distress present.

***200 Slabs surveyed annually 2002 - 2011. 2300 Slabs surveyed annually 2012 – 2015.

Distress Type	NCDOT Rating: 2003	NCDOT Rating: 2005	NCDOT Rating: 2007	NCDOT Rating: 2009	NCDOT Rating: 2011	NCDOT Rating: 2013	NCDOT Rating: 2015
Surface Wear	90	90	90	90	100	91	89
Corner Break	100	100	100	87	100	100	93
Joint Seal	98	94	91	87	100	65	100
Faulting	100	100	100	100	100	98	98

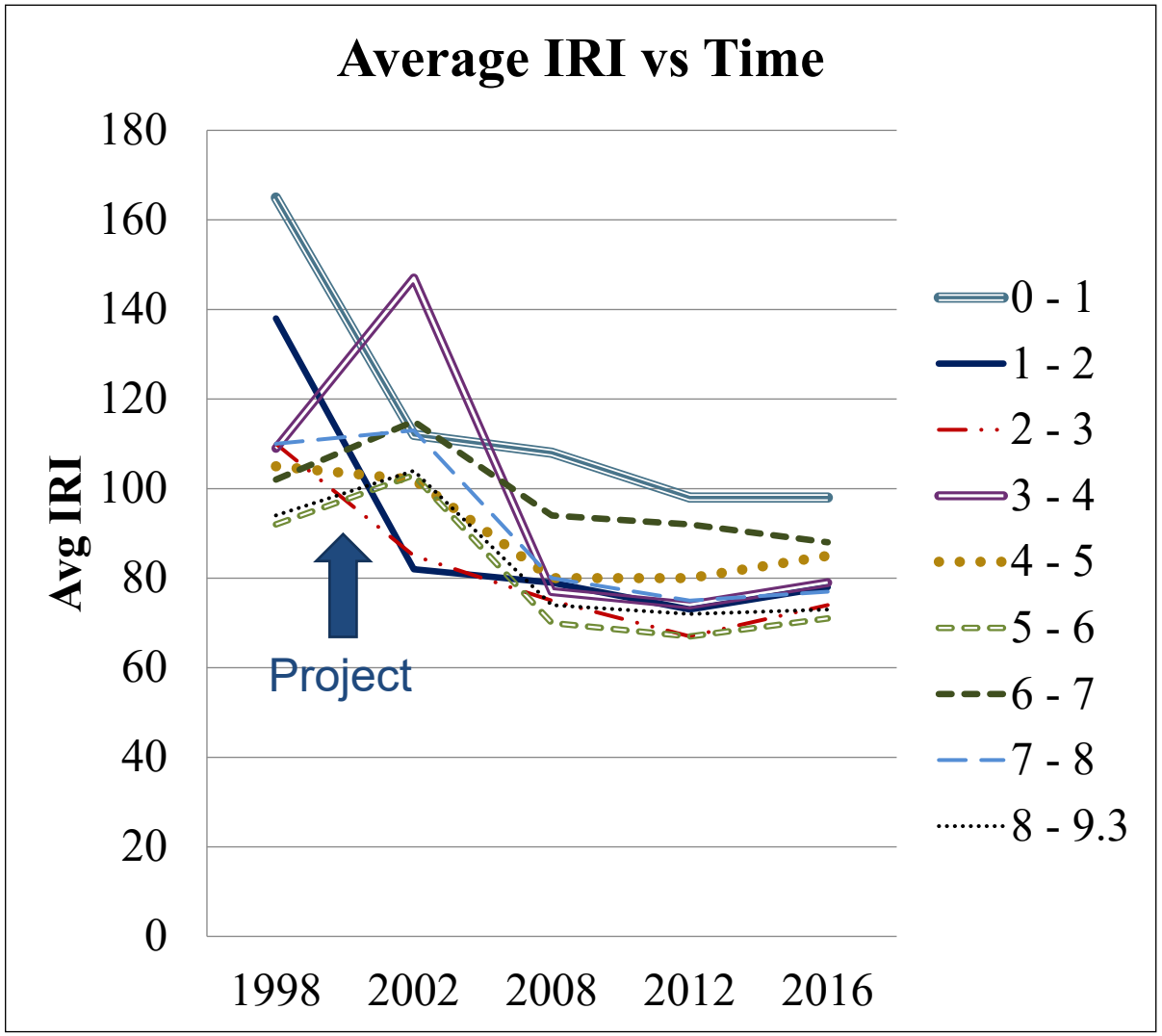
TIP: I-2508 BC NB *(7 of 8)*



Mile Segment	Average IRI: 1998	Average IRI: 2002	Average IRI: 2008	Average IRI: 2012	Average IRI: 2015
6.1-7.1	90	79	85	49	47
7.1-8.1	142	113	119	56	53
8.1-9.1	133	102	95	55	50
9.1-10.1	121	115	115	56	55
10.1-11.1	79	98	106	67	57
11.1-12.1	108	95	100	56	52
12.1-13.5	99	95	103	66	58

*IRI measurement taken every 0.1 mile then averaged over each mile segment.

TIP: I-2508 BC SB *(8 of 8)*



Mile Segment	Average IRI: 1998	Average IRI: 2002	Average IRI: 2008	Average IRI: 2012	Average IRI: 2016
0-1	165	112	108	98	98
1-2	138	82	79	73	78
2-3	110	85	75	67	74
3-4	109	147	77	74	79
4-5	105	102	80	80	85
5-6	92	103	70	67	71
6-7	102	115	94	92	88
7-8	110	113	80	75	77
8-9.3	94	104	74	72	73

*IRI measurement taken every 0.1 mile then averaged over each mile segment.

TIP: I-2810 *(1 of 8)*

Let: 2007

Year Complete: 2010

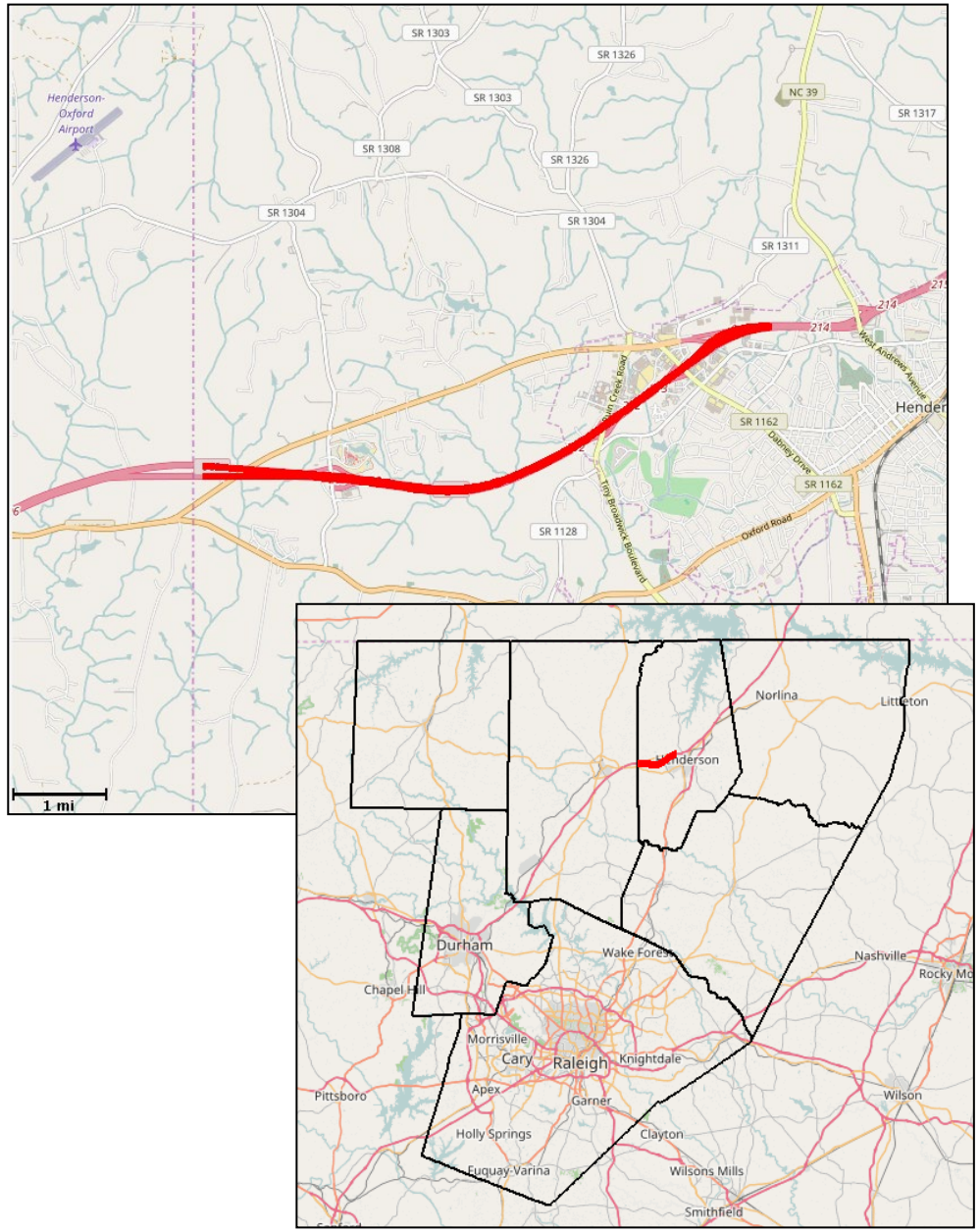
Division: 5

County: Vance

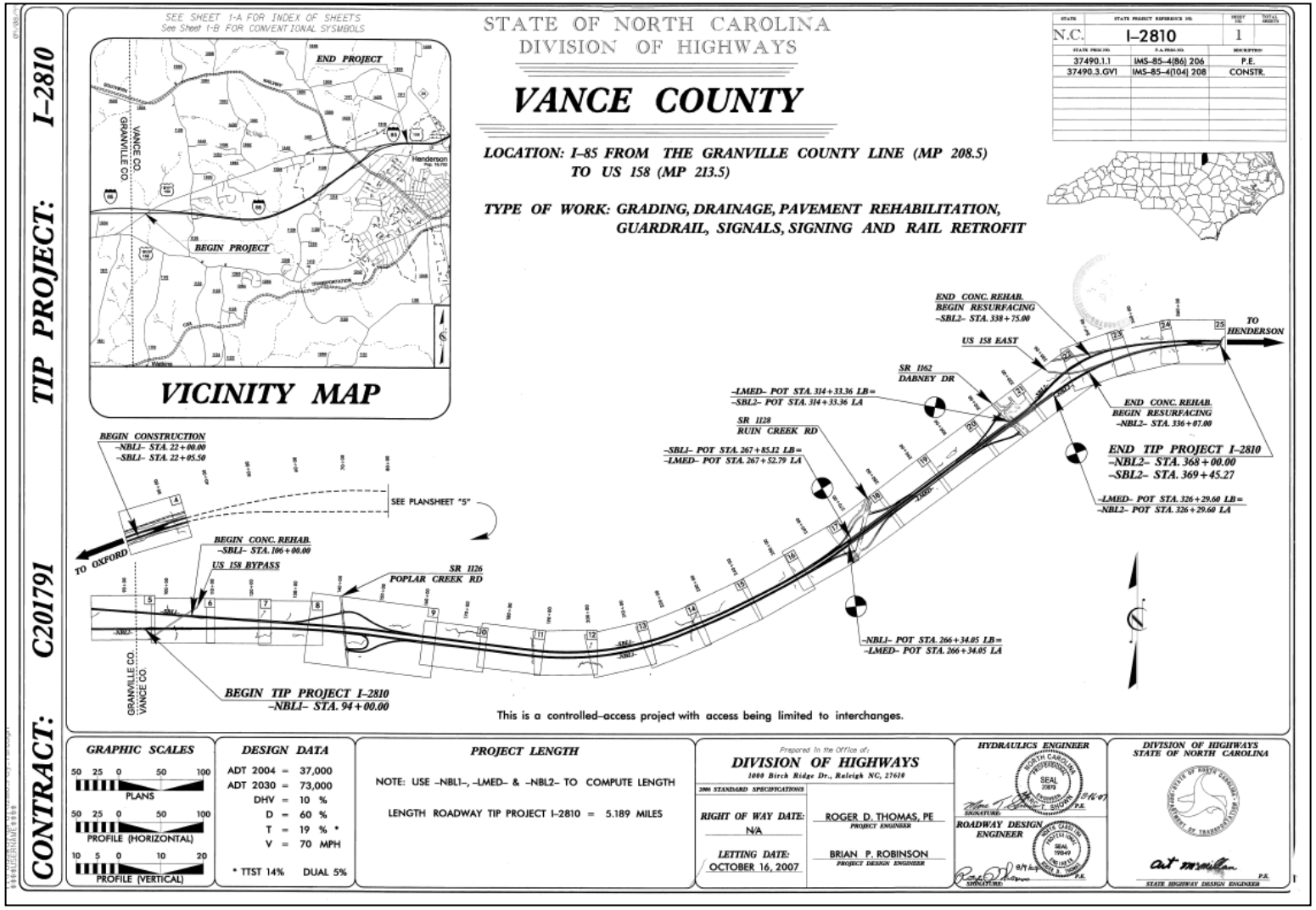
Route: I-85 NB & SB

Description:
Unbonded overlay project consisting of pavement and bridge rehabilitation on I-85 from the Granville county line (MP 208.5) to US 158 Bypass (MP 213.5) in Vance county.

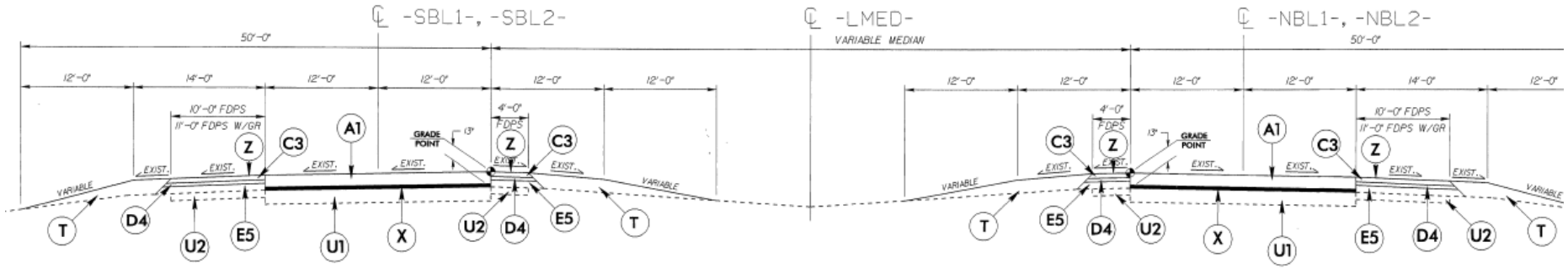
Existing Pavement: 8” CRCP over 4” ABC Built in 1971 (36 years old)



TIP: I-2810 *(2 of 8)*



TIP: I-2810 *(3 of 8)*



PAVEMENT SCHEDULE

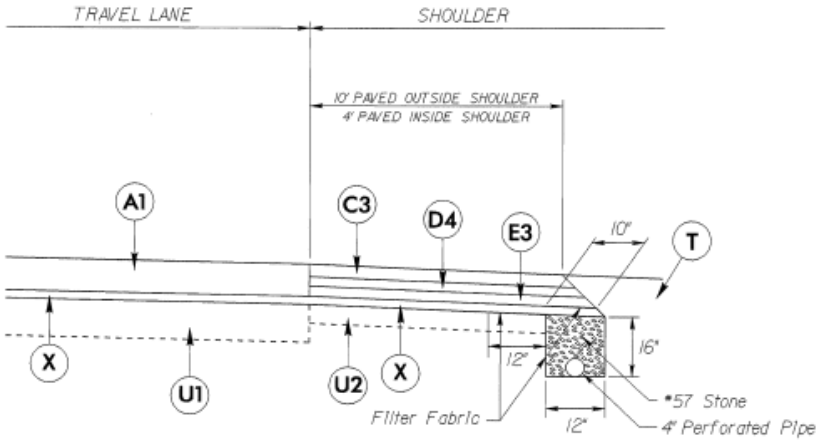
Step #	Description
A1	11.0" CONCRETE W/ DOWELS
A2	11.0" CONCRETE W/O DOWELS
A3	13.0" CONCRETE W/ DOWELS
C1	3.0" SURFACE COURSE, TYPE S9.5B
C2	3.0" SURFACE COURSE, TYPE S9.5C
C3	4.0" SURFACE COURSE, TYPE S12.5C
C4	VAR. SURFACE COURSE, TYPE S9.5B

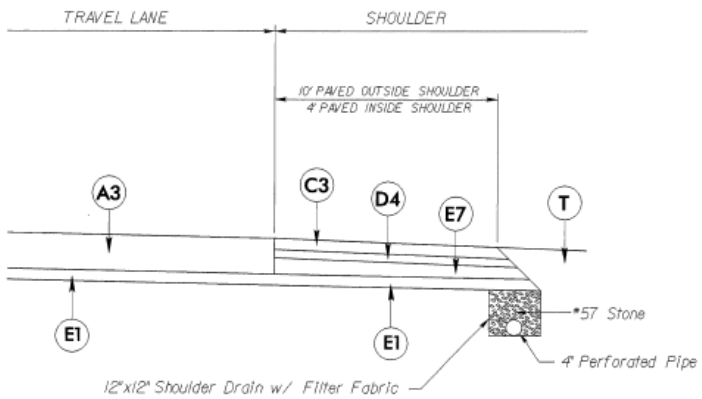
Step #	Description
D1	2.5" INTER. COURSE, TYPE I19.0B
D2	3.0" INTER. COURSE, TYPE I19.0B
D3	4.0" INTER. COURSE, TYPE I19.0B
D4	3.0" INTER. COURSE, TYPE I19.0C
D5	VAR. INTER. COURSE, TYPE I19.0B
E1	4.0" BASE COURSE, TYPE B25.0B
E2	4.5" BASE COURSE, TYPE B25.0B

Step #	Description
E3	4.0" BASE COURSE, TYPE B25.0C
E4	5.0" BASE COURSE, TYPE B25.0C
E5	6.0" BASE COURSE, TYPE B25.0C
E6	VAR. BASE COURSE, TYPE B25.0B
E7	VAR. BASE COURSE, TYPE B25.0C
T	EARTH MATERIAL
U1	EXISTING CONCRETE PAVEMENT

Step #	Description
U2	EXISTING ASPHALT PAVEMENT
V	MILLING EXISTING ASPHALT
X	2.0" PADL, TYPE P-78M
Y	5/8" ULTRA-THIN WEARING COURSE, TYPE B
Z	MILLED RUMBLE STRIPS

TIP: I-2810 *(4 of 8)*





PAVEMENT SCHEDULE

Step #	Description
A1	11.0” CONCRETE W/ DOWELS
A3	13.0” CONCRETE W/ DOWELS
C3	4.0” SURFACE COURSE TYPE S12.5C
D4	3.0” INTER. COURSE TYPE I19.0C
E1	4.0” BASE COURSE B25.0B
E3	4.0” BASE COURSE B25.0C
E7	VAR. BASE COURSE B25.0C
T	EARTH MATERIAL
U1	EXISTING CONCRETE PAVEMENT
U2	EXISTING ASPHALT PAVEMENT
X	2.0” PADL, TYPE P-78M

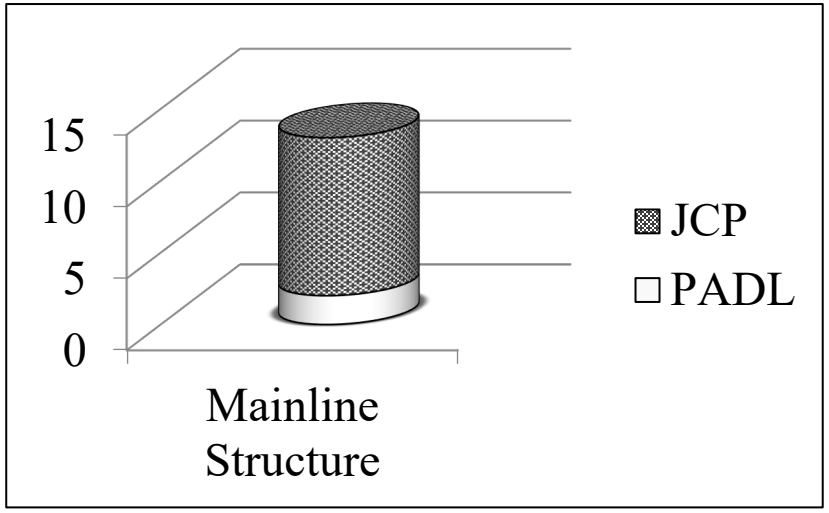
TIP: I-2810 *(5 of 8)*

Pavement Structure – Main Line:

Unbonded Concrete Overlay – Jointed Dowels ……11”

PADL……..2”

Total: 13”



Pavement Structure – Shoulders:

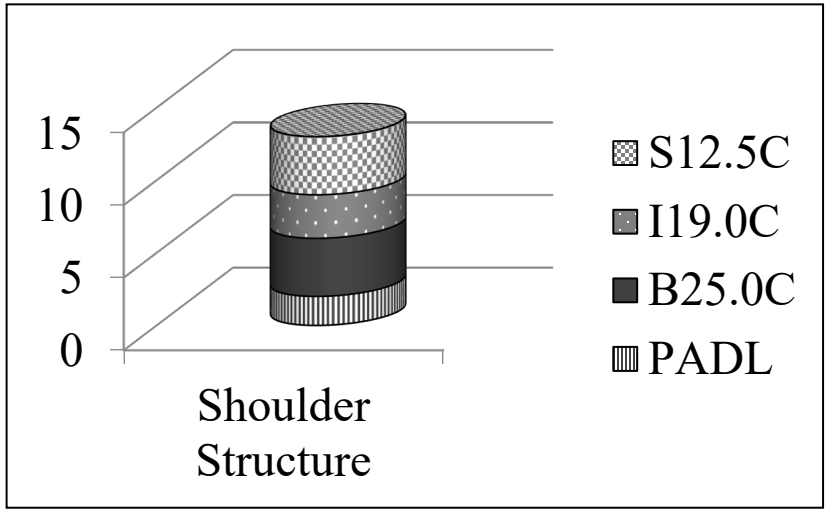
S12.5C……4”

I19.0C……..3”

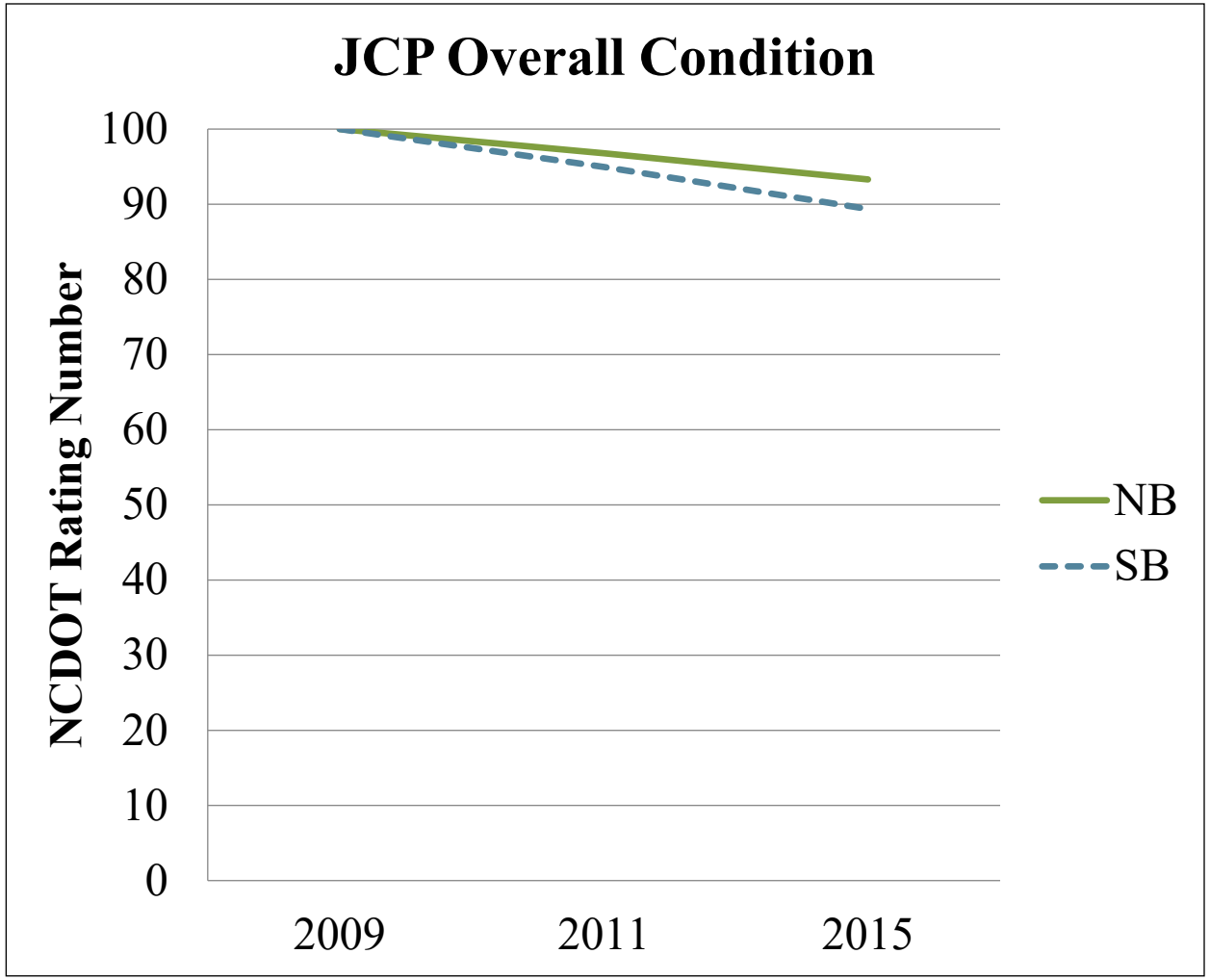
B25.0C……4”

PADL……..2”

Total: 13”



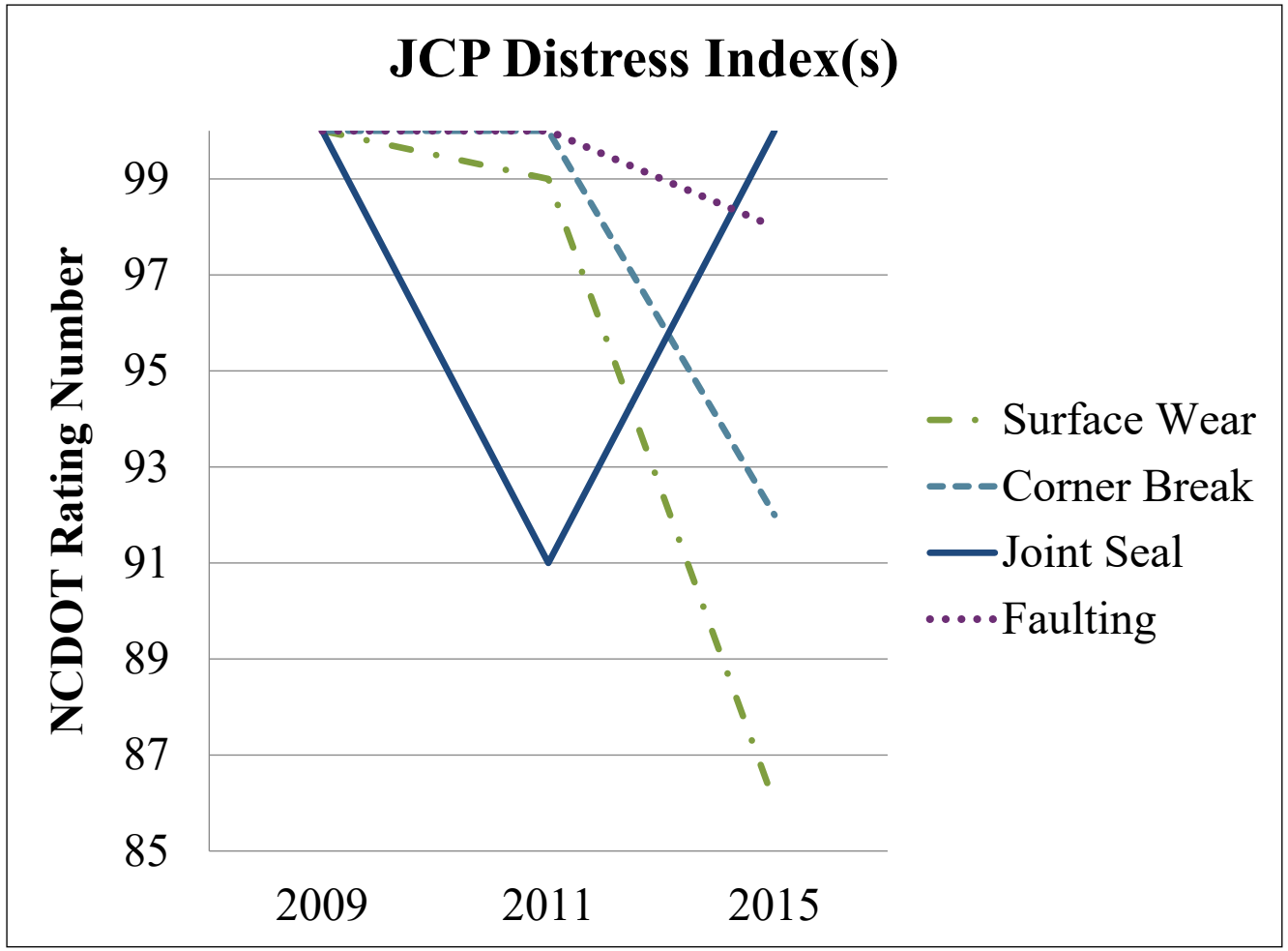
TIP: I-2810 *(6 of 8)*



*NCDOT did not calculate a rating number for CRC Pavements, only for JCP Pavements.

Route	NCDOT Rating: 2009	NCDOT Rating: 2011	NCDOT Rating: 2015
I-85 NB	100	97	93
I-85 SB	100	95	89

TIP: I-2810 *(7 of 8)*



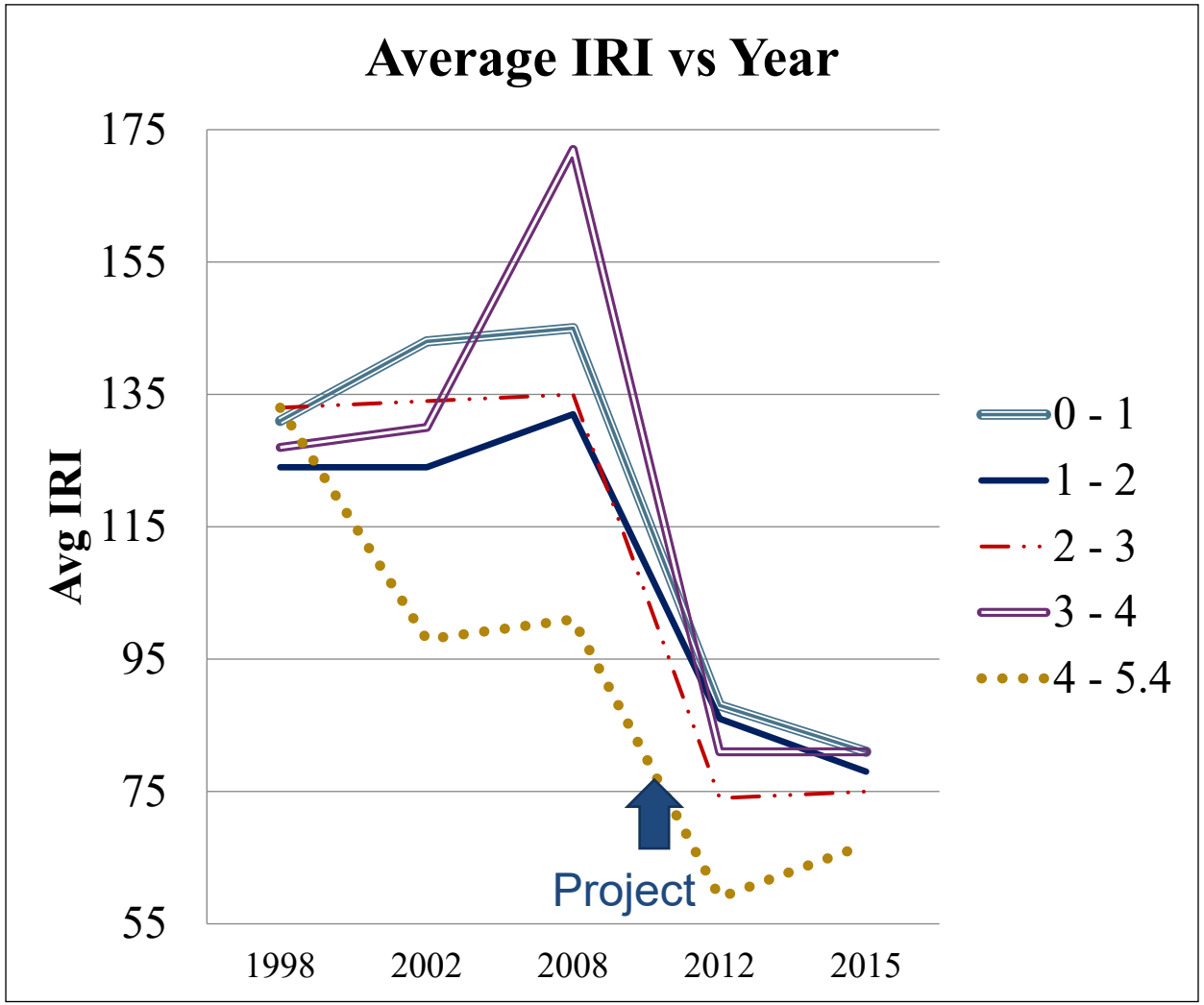
Distress Type	NCDOT Rating: 2009	NCDOT Rating: 2011	NCDOT Rating: 2015
Surface Wear	100	99	86
Corner Break	100	100	92
Joint Seal	100	91	100
Faulting	100	100	98

*NCDOT did not calculate a rating number for CRC Pavements, only for JCP Pavements.

**JCP Distress Index is a 0 – 100 scale, with 100 being no notable distress present.

***355 Slabs surveyed annually in 2009 and 2011. 1600 Slabs surveyed in 2015.

TIP: I-2810 *(8 of 8)*



Mile Segment	Average IRI: 1998	Average IRI: 2002	Average IRI: 2008	Average IRI: 2012	Average IRI: 2015
0-1	131	143	145	88	81
1-2	124	124	132	86	78
2-3	133	134	135	74	75
3-4	127	130	172	81	81
4-5.4	133	98	101	59	67

*IRI measurement taken every 0.1 mile then averaged over each mile segment

TIP: I-0914 BA & BB *(1 of 20)*

Let: 3/17/2015

Complete: 12/28/2020

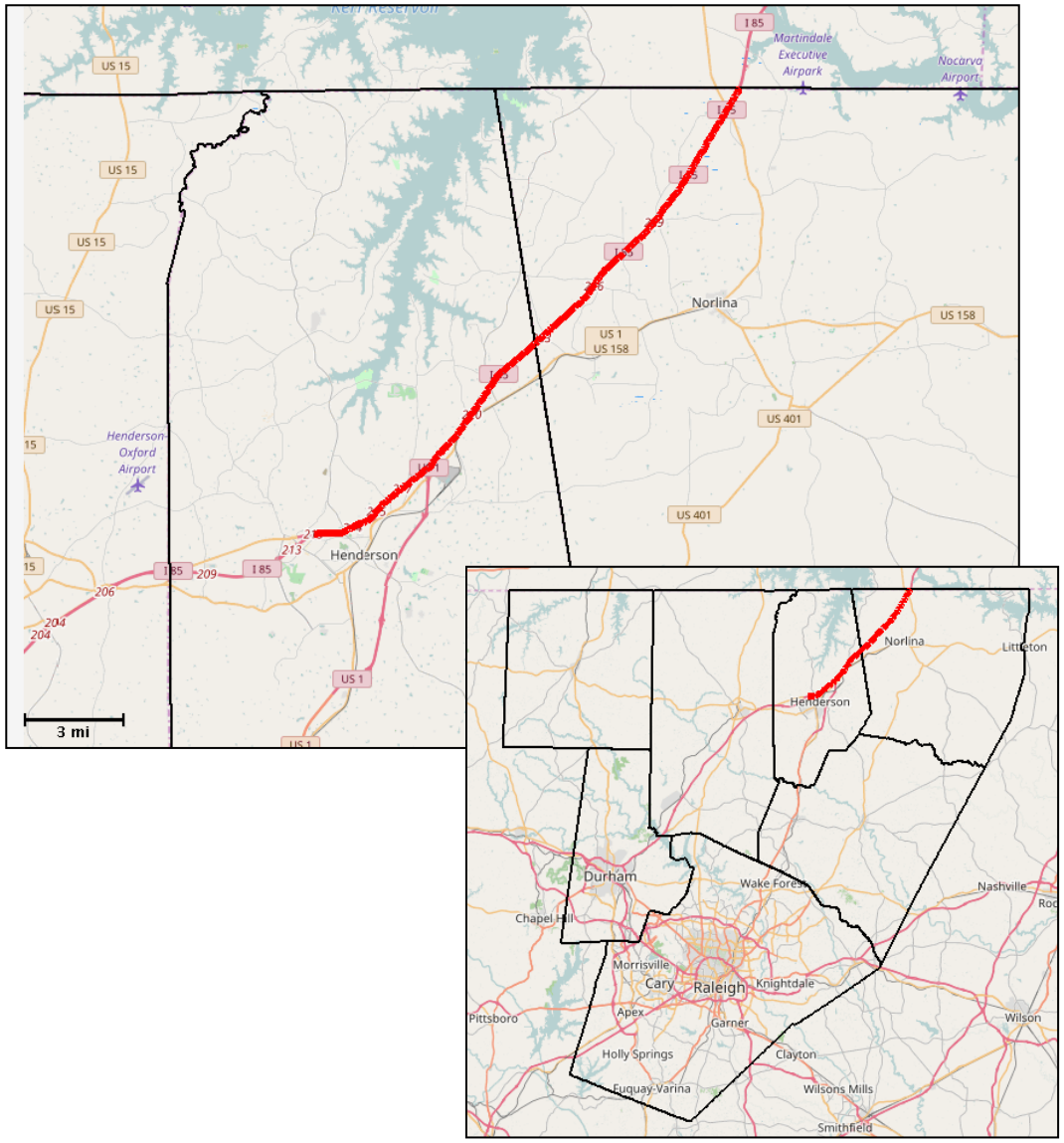
Division: 5

County: Vance & Warren

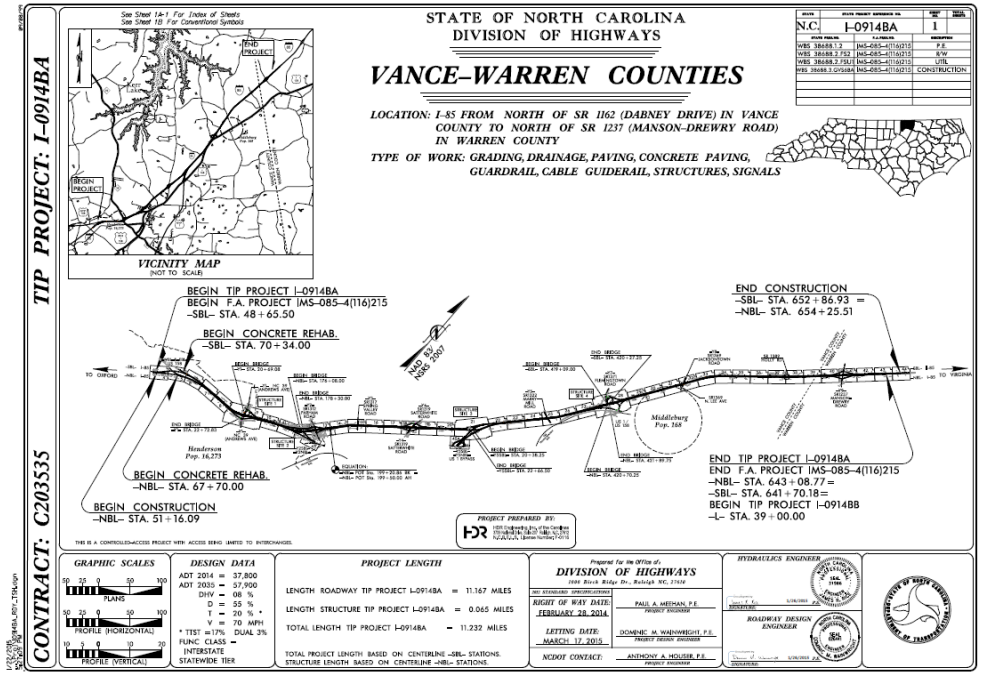
Route: I-85

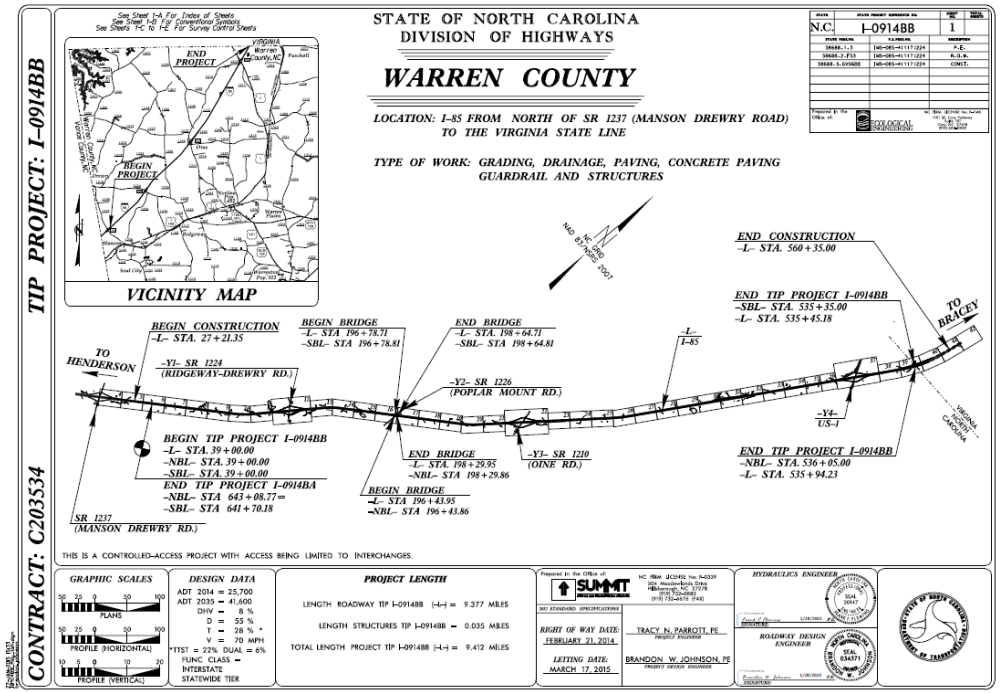
Description:
Unbonded overlay project consisting of pavement rehabilitation on I-85 from US 158 in Vance county to Virginia State line.

Project length = 17.2 miles



TIP: I-0914 BA & BB *(2 of 20)*

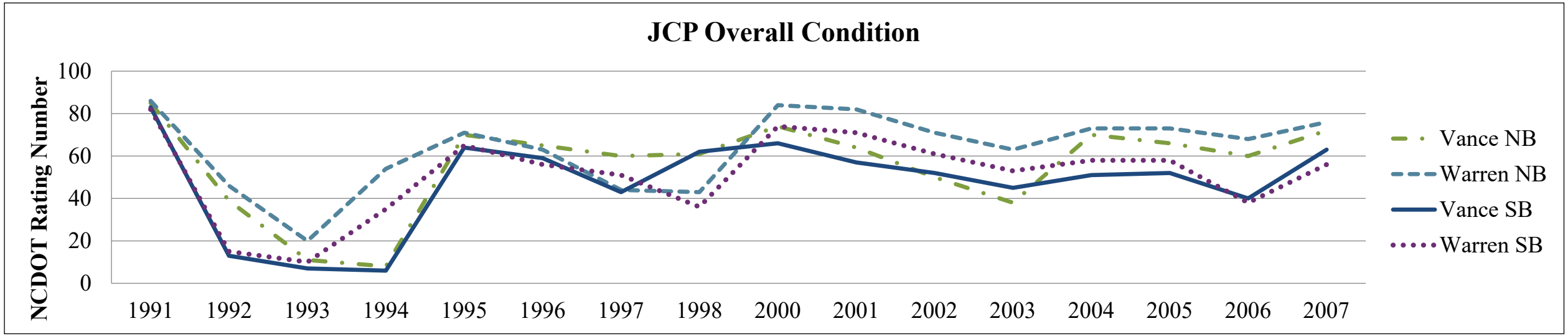




I-0914 BA & BB Project History *(3 of 20)*

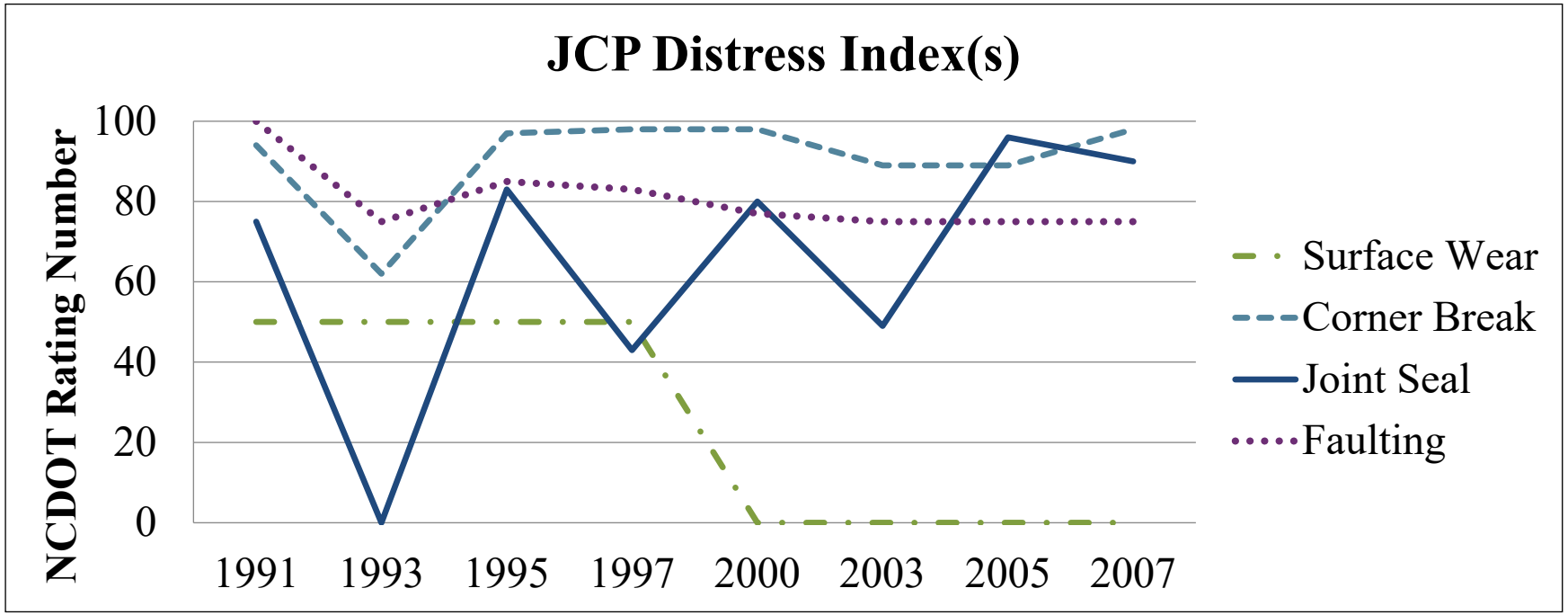
- Original Pavement constructed in 1960, 9” JCP on 4” ABC (54 years old)

TIP: I-0914 BA & BB *(4 of 20)*



Route	NCDOT Rating: 1991	NCDOT Rating: 1992	NCDOT Rating: 1993	NCDOT Rating: 1994	NCDOT Rating: 1995	NCDOT Rating: 1996	NCDOT Rating: 1997	NCDOT Rating: 1998	NCDOT Rating: 2000	NCDOT Rating: 2001	NCDOT Rating: 2002	NCDOT Rating: 2003	NCDOT Rating: 2004	NCDOT Rating: 2005	NCDOT Rating: 2006	NCDOT Rating: 2007
Vance NB	85	39	11	8	70	65	60	61	74	64	50	38	70	66	60	72
Warren NB	86	46	20	54	71	63	44	43	84	82	71	63	73	73	68	76
Vance SB	83	13	7	6	64	59	43	62	66	57	52	45	51	52	40	63
Warren SB	82	15	10	35	65	56	51	36	74	71	61	53	58	58	38	56

TIP: I-0914 NB *(5 of 20)*

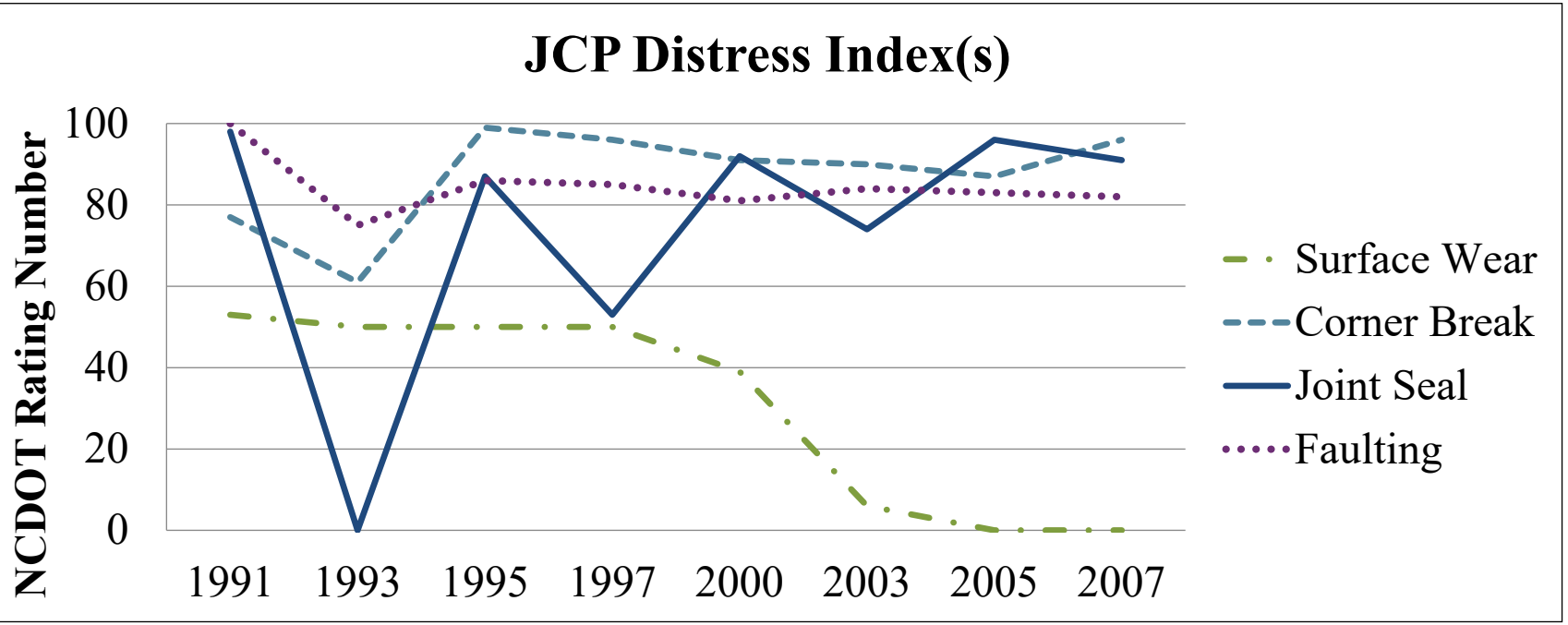


*JCP Distress Index is a 0 – 100 scale, with 100 being no notable distress present.

**640 Slabs surveyed annually 1991 - 2007.

Distress Type	NCDOT Rating: 1991	NCDOT Rating: 1993	NCDOT Rating: 1995	NCDOT Rating: 1997	NCDOT Rating: 2000	NCDOT Rating: 2003	NCDOT Rating: 2005	NCDOT Rating: 2007
Surface Wear	50	50	50	50	0	0	0	0
Corner Break	94	62	97	98	98	89	89	98
Joint Seal	75	0	83	43	80	49	96	90
Faulting	100	75	85	83	77	75	75	75

TIP: I-0914 SB *(6 of 20)*



*JCP Distress Index is a 0 – 100 scale, with 100 being no notable distress present.

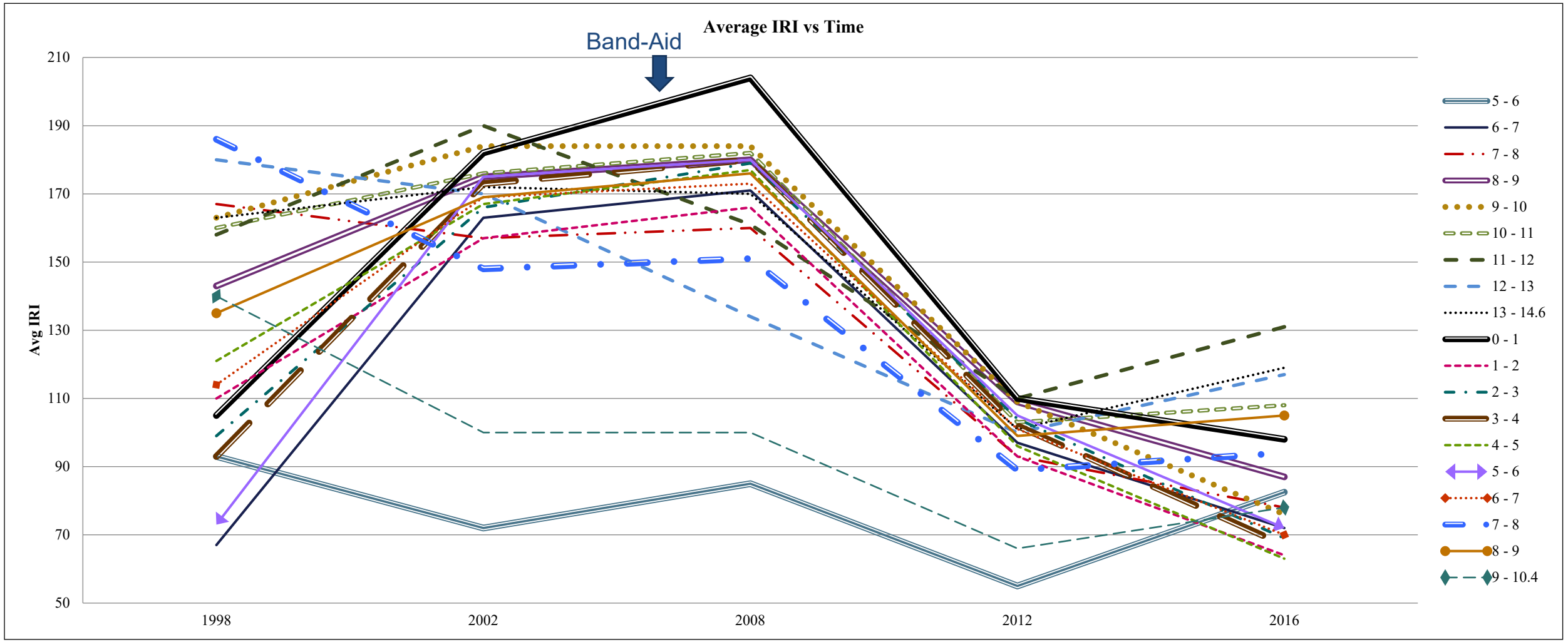
**640 Slabs surveyed annually 1991 - 2007.

Distress Type	NCDOT Rating: 1991	NCDOT Rating: 1993	NCDOT Rating: 1995	NCDOT Rating: 1997	NCDOT Rating: 2000	NCDOT Rating: 2003	NCDOT Rating: 2005	NCDOT Rating: 2007
Surface Wear	53	50	50	50	39	6	0	0
Corner Break	77	61	99	96	91	90	87	96
Joint Seal	98	0	87	53	92	74	96	91
Faulting	100	75	86	85	81	84	83	82

I-0914 BA & BB Project History *(7 of 20)*

- Original Pavement constructed in 1960, 9” JCP on 4” ABC (54 years old)
- Band-Aid project in 2007: Asphalt patches of worst slabs, Ultra-Thin Bonded Wearing Course Overlay

TIP: I-0914 NB *(8 of 20)*

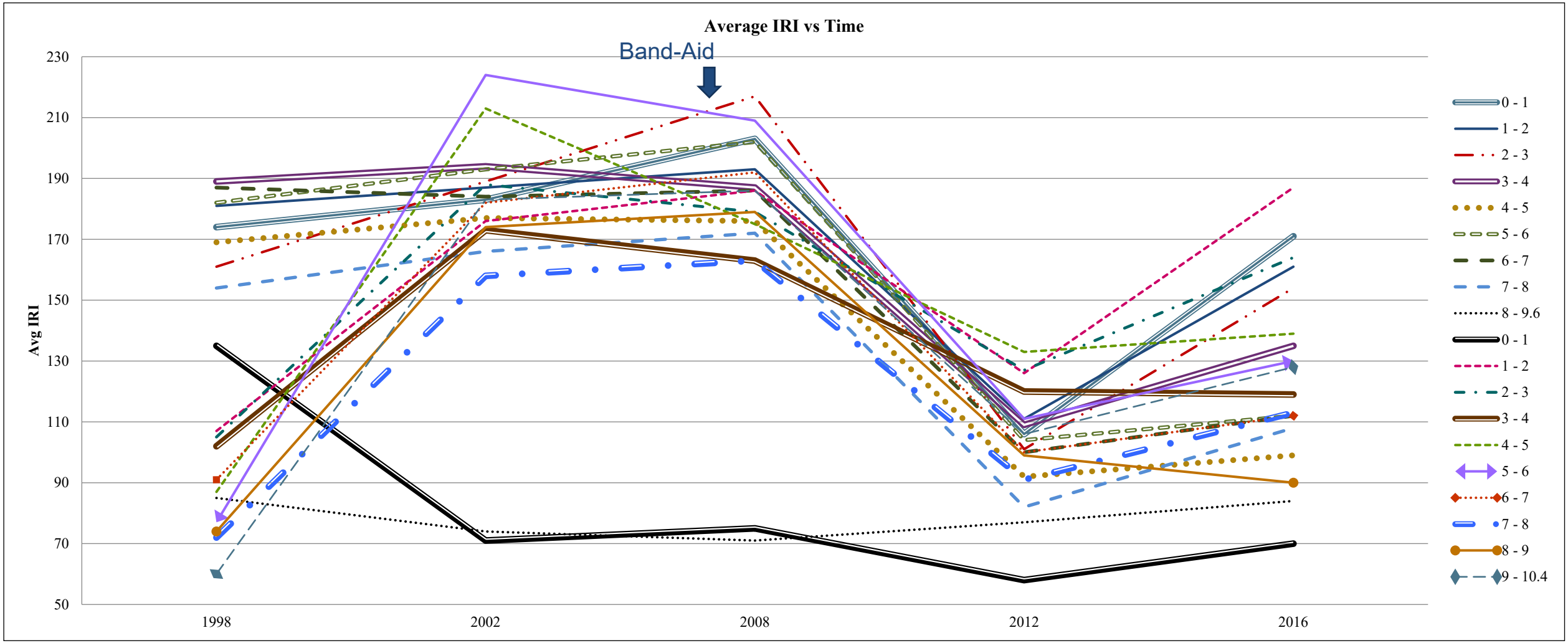


*IRI measurement taken every 0.1 mile then averaged over each mile segment.

TIP: I-0914 NB *(9 of 20)*

Mile Segment	Average IRI: 1998	Average IRI: 2002	Average IRI: 2008	Average IRI: 2012	Average IRI: 2016
5-6	93	72	85	55	82.5
6-7	67	163	171	97	72
7-8	167	157	160	93	78
8-9	143	175	180	109	87
9-10	163	184	184	109	76
10-11	160	176	182	103	108
11-12	158	190	161	110	131
12-13	180	170	134	100	117
13-14.6	163	172	170	101	119
0-1	105	182	204	110	98
1-2	110	157	166	93	64
2-3	99	166	179	104	69
3-4	93	173	180	102	67
4-5	121	167	177	96	63
5-6	73	175	180	105	72
6-7	114	169	173	101	70
7-8	186	148	151	89	94
8-9	135	169	176	99	105
9-10.4	140	100	100	66	78

TIP: I-0914 SB *(10 of 20)*



*IRI measurement taken every 0.1 mile then averaged over each mile segment.

TIP: I-0914 SB (11 of 20)

Mile Segment	Average IRI: 1998	Average IRI: 2002	Average IRI: 2008	Average IRI: 2012	Average IRI: 2016
0-1	174	183	203	106	171
1-2	181	187	193	111	161
2-3	161	189	217	101	154
3-4	189	194	187	109	135
4-5	169	177	176	92	99
5-6	182	193	202	104	112
6-7	187	184	186	100	112
7-8	154	166	172	82	108
8-9.6	85	74	71	77	84
0-1	135	71	75	58	70
1-2	107	176	186	126	187
2-3	105	188	179	127	164
3-4	102	173	163	120	119
4-5	87	213	175	133	139
5-6	77	224	209	111	130
6-7	91	182	192	100	112
7-8	72	158	163	91	113
8-9	74	174	179	99	90
9-10.4	60	183	186	106	128

Reflection Cracking in UTBWC *(12 of 20)*

Distress in UTBWC *(13 of 20)*

I-0914 BA & BB Project History *(14 of 20)*

- Original Pavement constructed in 1960, 9” JCP on 4” ABC (54 years old)
- Band-Aid project in 2007: Asphalt patches of worst slabs, Ultra-Thin Bonded Wearing Course Overlay
- In 2013 during design of I-0914, concern with asphalt patches:
  - Would they provide uniform support?
  - Do they need to be removed and replaced with concrete?
  - If so, can we find them under the UTBWC?
- Patches located with GPR
  - 189 lane-width patches
  - Length ranged from 9.5’ to 883’, 80% less than 70’ long

I-0914 BA & BB Project History *(15 of 20)*

- Project Review and Workshop held through the Concrete Overlay Technical Assistance Program (FHWA and CP Tech Center) in 2013.
- Recommended leaving asphalt patches in place unless there was severe distress apparent in the UTBWC surface. Repair could be either asphalt or concrete.
- FWD testing done on asphalt patches and concrete slabs
  - Deflections on Concrete: 4.29 to 12.63 mils
  - Deflections on Asphalt Patches: 8.67 to 10.51 mils
- Asphalt patches were left in place

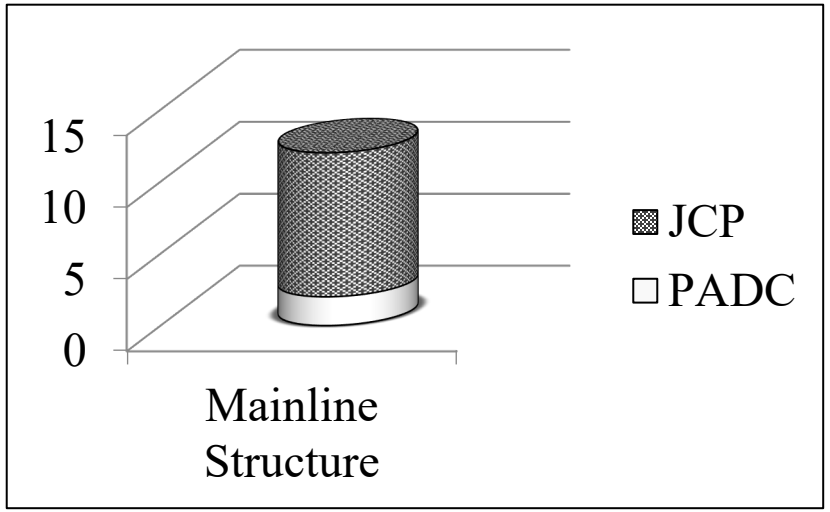
TIP: I-0914 BA & BB *(16 of 20)*

Pavement Structure – Main Line:

Unbonded Concrete Overlay – Jointed Dowels …..……10”

PADC……..…..2”

Total: 12”



Pavement Structure – Shoulders:

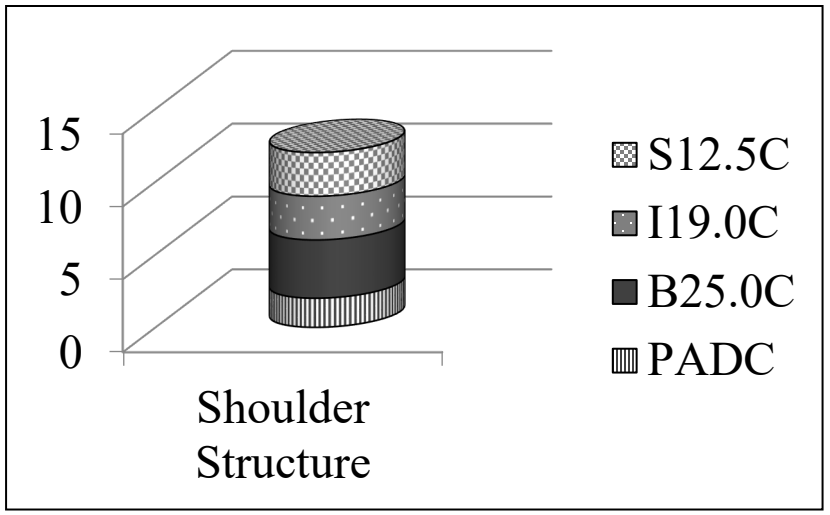
S12.5C…..……..…3”

I19.0C…….……..…..3”

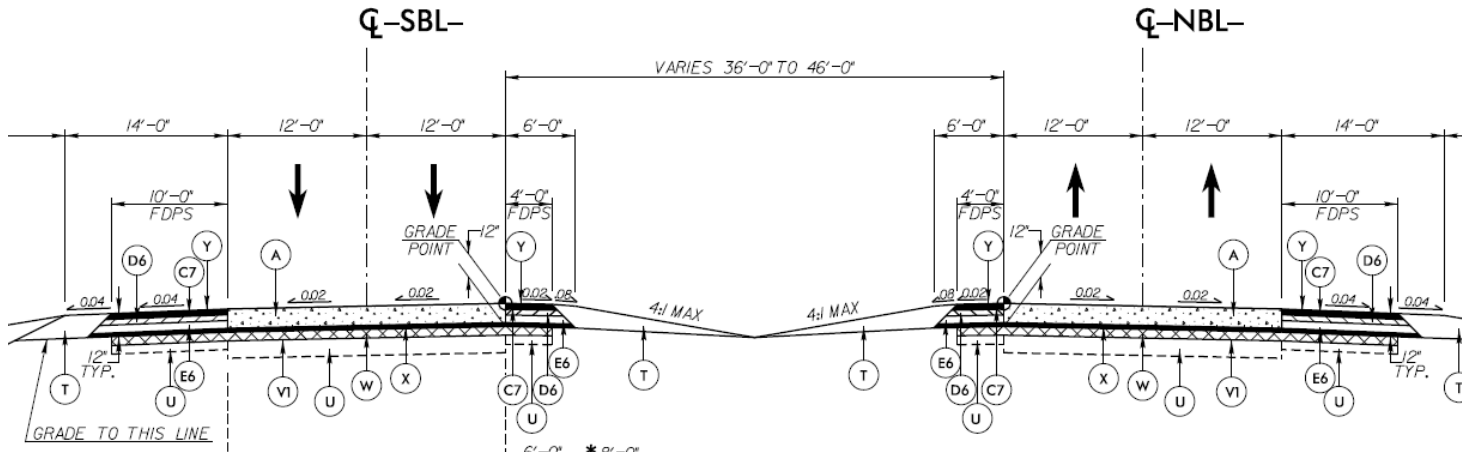
B25.0C…..……4”

PADC……..2”

Total: 12”



TIP: I-0914 BA & BB *(17 of 20)*



PAVEMENT SCHEDULE

Step #	Description	Step #	Description	Step #	Description	Step #	Description
A1	10” CONCRETE W/ DOWELS	C9	VARIABLE DEPTH S4.75A	E3	5” B25.0B	R2	CONCRETE SBG
C1	1.5” S9.5B	D2	3” |19.0B	E4	5.5” B25.0B	R3	SPECIAL CONCRETE SBG
C2	2” S9.5B	D3	4” |19.0B	E5	VARIABLE DEPTH B25.0B	S	4” CONCRETE SIDEWALK
C3	3” S9.5B	D4	VARIABLE DEPTH |19.0B	E6	4” B25.0C	T	EARTH MATERIAL
C4	VARIABLE DEPTH S9.5B	D5	2.5” |19.0C	E7	4.5” B25.0C	U	EXISTING PAVEMENT
C5	1.5” S9.5C	D6	3” |19.0C	E8	5” B25.0C	V1	5/8” MILLING
C6	2” S9.5C	D7	3.5” |19.0C	E9	5.5” B25.0C	V2	3” MILLING
C7	3” S9.5C	E1	4” B25.0B	E10	9” B25.0C	W	WEDGING
C8	VARIABLE DEPTH SA-1	E2	4.5” B25.0B	R1	2’-6” CONCRETE C&G	X	2” PADC
						Y	MILLED RUMBLE STRIPS

TIP: I-0914 BA & BB *(18 of 20)*

TIP: I-0914 BA & BB *(19 of 20)*

TIP: I-0914 BA & BB *(20 of 20)*

Conclusion

- Unbonded concrete overlays have performed well on the I-85 corridor and are a cost-effective pavement choice.

Thanks to:

- Matt Hilderbran
- Boyd Tharrington
- Greg Dean

Q & A

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