North Carolina I-795 Pavement Evaluation

May 20, 2009

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I-795 Pavement Evaluation Agenda

I. Overview
II. Significant Factors Affecting Pavement Performance
III. Information/Data
IV. Significant Causal Factors for Premature Distresses
V. Pavement Condition

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Overview

- FHWA Division Request
- NC DOT Source of all Information/Data except Ground Penetrating Radar (GPR)

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Significant Factors Affecting Pavement Performance

- Structural Design
- Traffic Loading
- Individual Material Layer Thicknesses
- Delamination Between Material Layers
- Material Characteristics (air voids, asphalt content, aggregate grading, moisture, density, stiffness . . .)

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Data/Information

Construction: materials acceptance test results, inspectors notes, asphalt mix type

Forensic (after construction): hot mix asphalt (density, asphalt content, gradation, layer thickness, air voids), GPR, falling weight deflectometer (FWD), 2008 visual surface distress at time of FWD testing, dynamic cone penetrometer (DCP), shear, observations, weigh in motion (WIM)

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Factors Where Construction and Forensic are Consistent

- Subgrade: FWD
- Aggregate Base Course: FWD, GPR, DCP
- Asphalt Mix (asphalt content, gradation, depth): GPR, forensic tests
- Traffic Loading: WIM, traffic counts
- Original structural design in accordance with NC DOT procedures

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Significant Causal Factors for Premature Distresses

Asphalt Mix Air Voids: forensic tests, observations (moisture)

- Delamination between Material Layers: GPR, FWD, shear, coring operation

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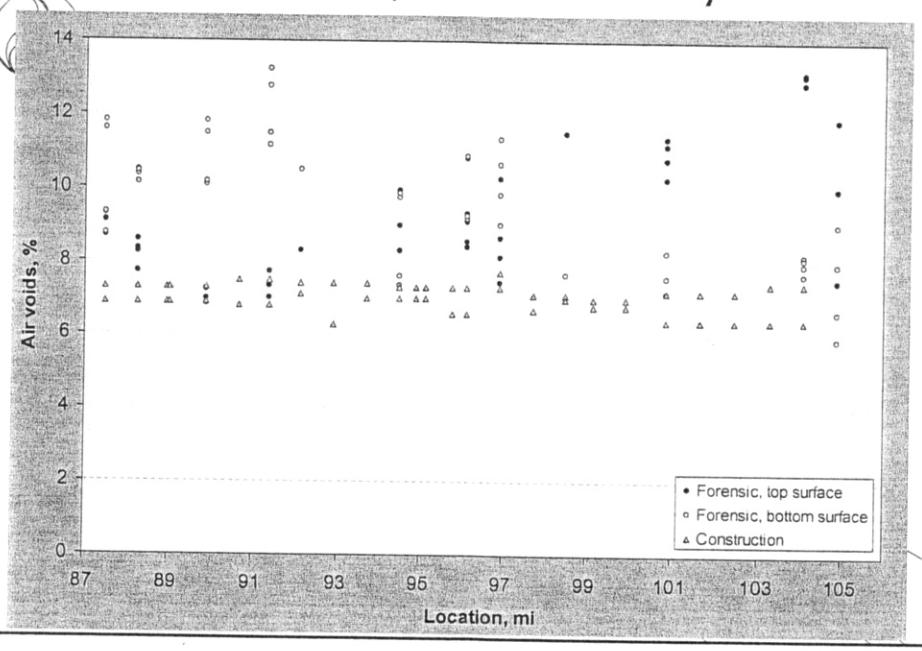
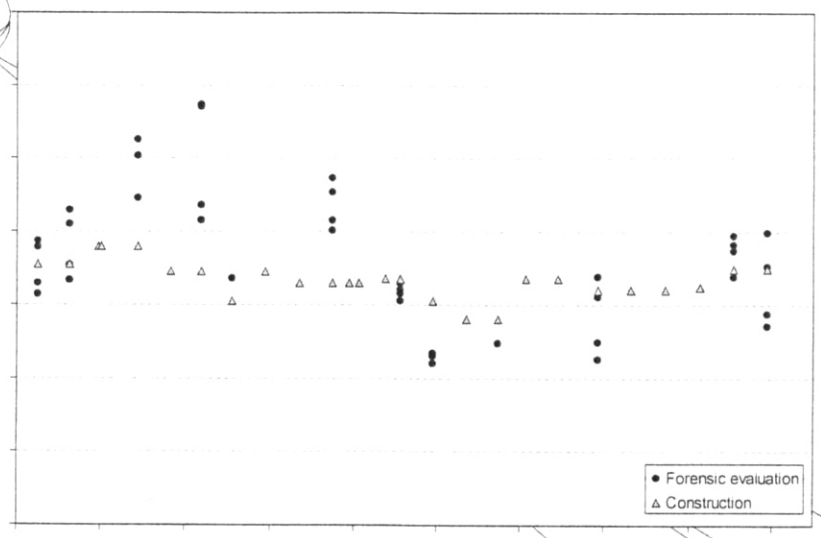
AC air voids, NB surface layers



AC air voids, NB intermediate layer



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Density analysis results

	Layer	Mean density, %		Std. deviation, %		F-test of variances	t-test of means
		Construction	Forensic	Construction	Forensic		
NB	Surface, top	93.1	90.7	0.35	1.75	Fail	Fail
NB	Surface, bottom	92.7	90.3	0.31	1.50	Fail	Fail
NB	Intermediate	93.2	92.6	0.42	1.68	Fail	Pass
SB	Surface, top	93.3	90.3	0.89	1.48	Pass	Fail
SB	Surface, bottom	93.2	91.4	0.55	1.42	Fail	Fail
SB	Intermediate	93.1	92.7	0.51	1.04	Pass	Pass

Construction density: correlation by NC DOT field Division

Forensic density: Corelock test method (ASTM D 6752)

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	HMA Layer		Mean Density %		Std. Deviation %	
		PWL %	Const	Forensic	Const	Forensic
NB Control Strip, QC, cores	Surface,T	27		90.6		1.83
	Surface,B	77		92.9		1.19
	Inter.	82		93.5		1.60
NB FWD, cores	Surface,T	24		90.7		1.75
	Surface,B	13		90.3		1.50
	Inter.	64		92.6		1.68
NB Const, nuclear gauge	Surface,T	100	93.1		0.35	
	Surface,B	100	92.7		0.31	
	Inter.	100	93.2		0.42	

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Description of information in previous slide

- Forensic = information collected after project completion.
- Const = construction acceptance test results by the contractor (nuclear gauge) in close proximity to the FWD locations.
- FWD = density sample (cores) locations at same sites as FWD test sites. Sampling occurred in 2008. Sample locations were selected in a "reasonably random" manner. Corelok density test method used.
- Control strip QC = samples (cores) taken in 2008 from density control strips, samples taken with both contractor and NC DOT present. Test results are from contractor lab (results compare to NC DOT) using the visual test method for core drying. This test method resulted in highest density test results. Samples from control strips are not a "reasonably random" sampling method.
- PWL – percent within limits – in general a PWL of greater than 90% is selected as the target for 100% pay.
- Analysis: In general it is reasonable to expect the control strip density test results to have a higher PWL than the FWD locations due to lack of randomness of the sampling method. Both sets of forensic test results in both NB and SB data sets for the HMA top surface layer indicate the density is less than expected.

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Significant Causal Factors for Premature Distresses

- Other Factors not fully Assessed:
  - Clay in HMA, pin holes and/or pop outs (prevalent)
  - Tack coat/HMA surface before next HMA lift
  - Stripping of HMA
  - History of similar pavement designs
  - HMA performance history from HMA plants

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Pavement Condition

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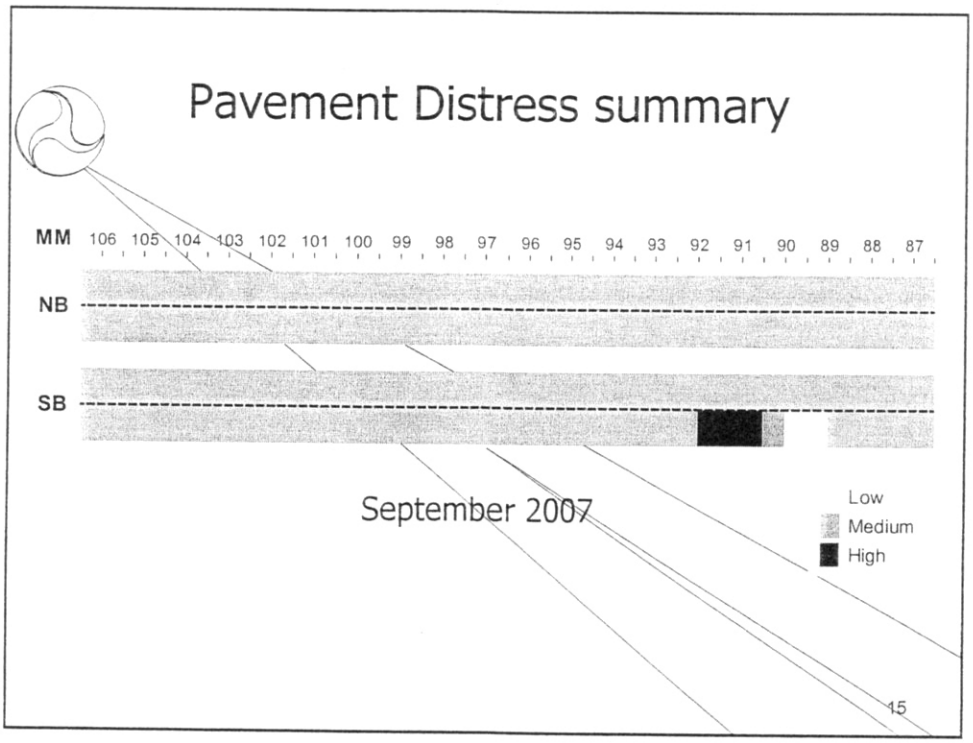
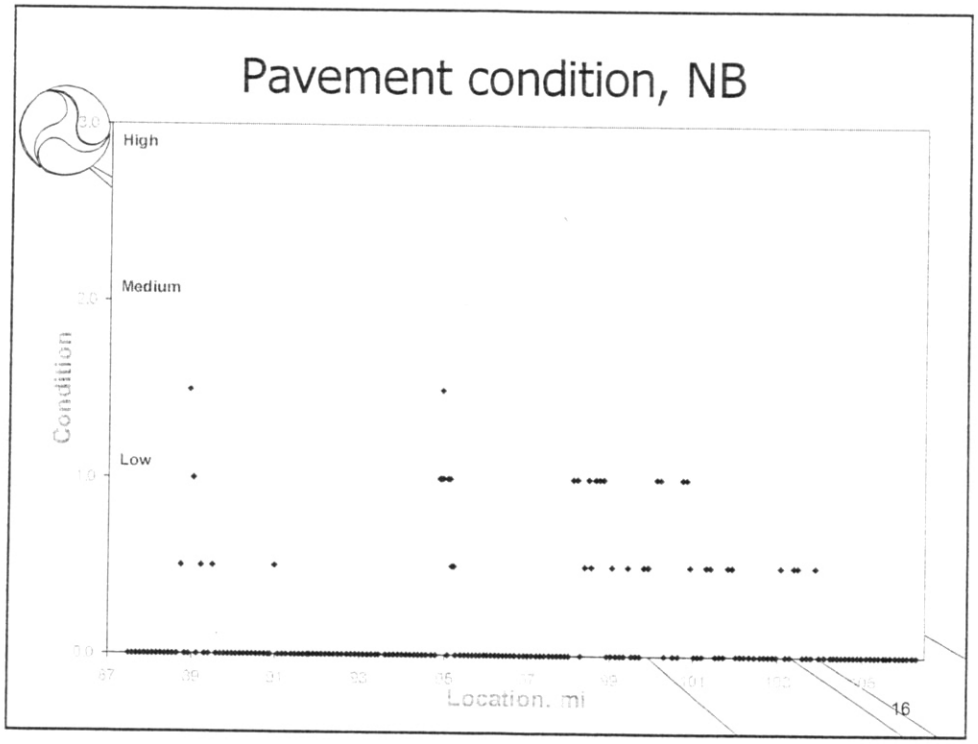
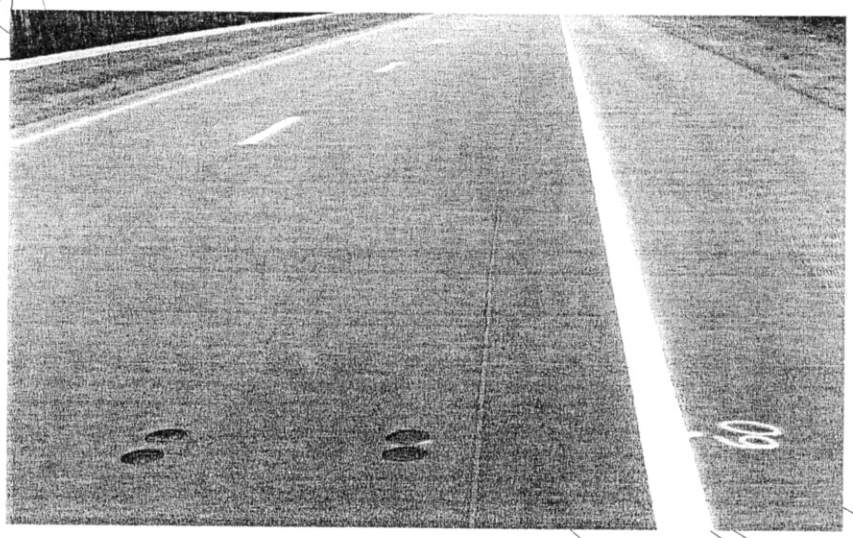

Pavement Distress summary
MM 106 105 104 103 102 101 100 99 98 97 96 95 94 93 92 91 90 89 88 87
NB
SB
September 2007
Low
Medium
High
15


Pavement condition, NB
High
Medium
Low
Condition
Location, mi
16

NB distress



No distress – MM 92.89 NB Core condition: Fully intact

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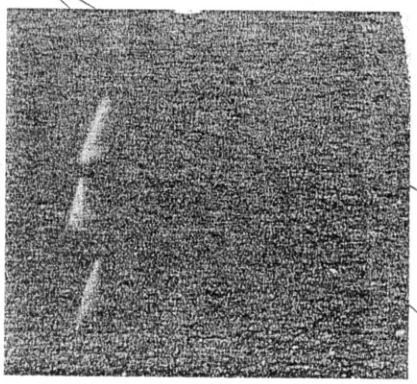
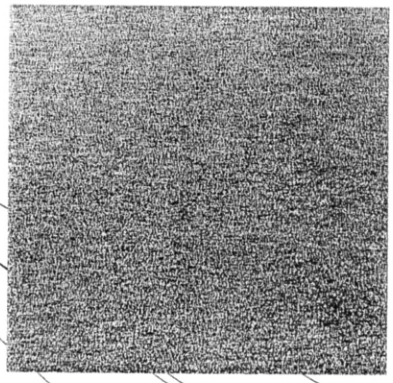
NB distress





Low severity – MM 94.89 NB
Core condition: Top layer debonded

Low severity – MM 99.91 NB
Core condition: **Fully intact**

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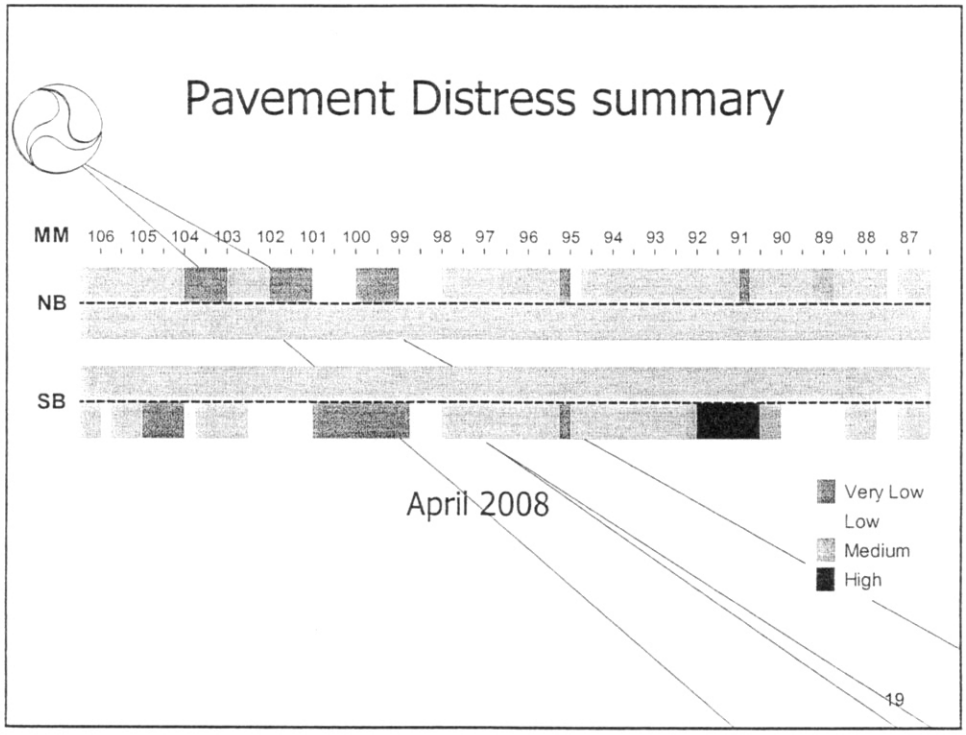
Pavement Distress summary
MM 106 105 104 103 102 101 100 99 98 97 96 95 94 93 92 91 90 89 88 87
NB
SB
April 2008
Very Low
Low
Medium
High
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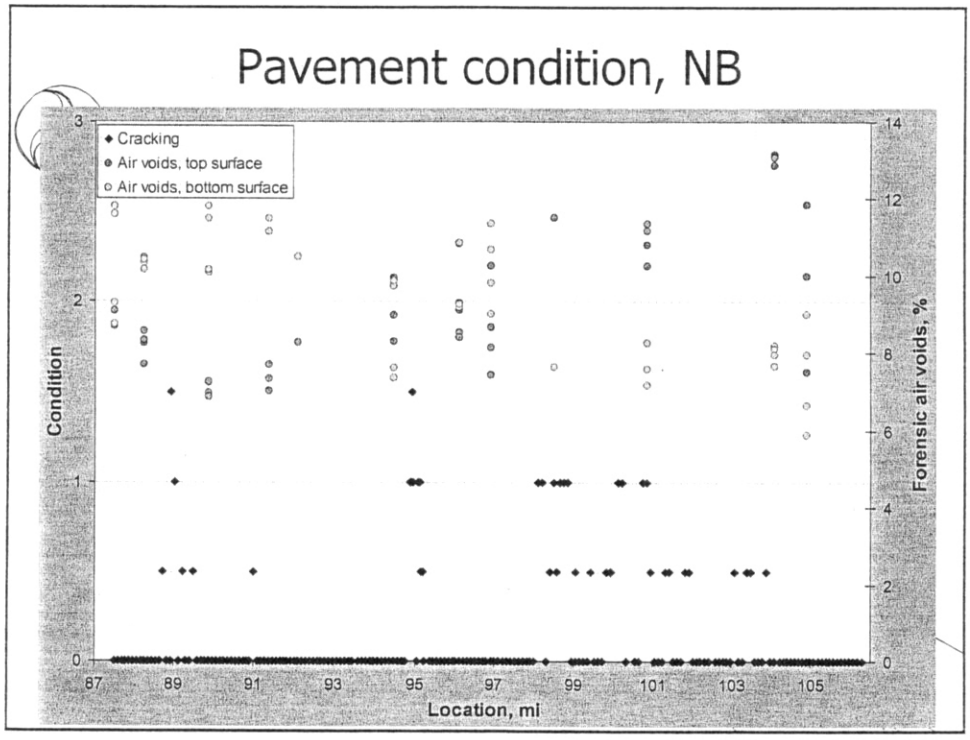
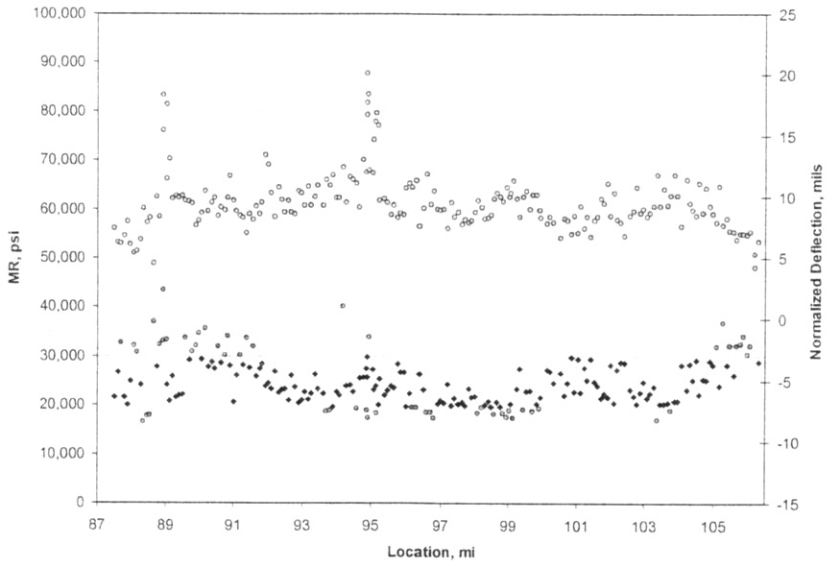

Pavement condition, NB
Cracking
Air voids, top surface
Air voids, bottom surface
Condition
Forensic air voids, %
Location, mi
0
1
2
3
0
2
4
6
8
10
12
14
87
89
91
93
95
97
99
101
103
105

FWD testing results, NB



Summary of pavement condition

- HMA surface air voids are high throughout the project
- Debonding is associated with medium- and high-severity distresses
- Low-severity distresses occurred in some of the fully intact areas
- Some areas with debonding has not yet developed distress

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Conclusion on Density

- Could not determine the exact cause of the difference between the construction QC/QA field density test results and the forensic field density test results. Adequate HMA Gmm and Gmb verification testing program needs to be provided. NC DOT ensure the verification samples are randomly taken and NC DOT taking possession and storage of the samples through the testing process. Alternative Gmb test methods should be explored that adequately characterize the HMA quality.

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