Pavement Forensics Analysis Part II
Case Histories from Texas

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Sunday, March 28, 2010
Objectives of Forensic Studies

- What is the cause of the problem
- What should the DOT do now
- How can the problem be avoided in the future
TxDOT’s Forensics Process

- TxDOT District contact Jeff Seiders (Head: Materials and Test Div)
- Jeff appoints a team of TxDOT and University personnel
- Study conducted (typically 1 week to 3 months duration)
- Short report and presentation to District requesting help
- Place report in TxDOT on-line data base
  - Over 100 reports in data base
  - Contact person Dar Hao Chen, TxDOT
Presentation Outline

- Tools used in field and lab
- Case studies
  - SH 6  rapid failure during construction
  - US 287  poor performance
- Products of Forensics Studies
  - Pave IR Thermal Segregation in HMA
  - Sulfate detection and 3 D Swell
  - Prime coat Bonding Test
  - Measuring Organic content of Soils
GPR Profile of 2 miles of highway

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TxDOT’s Falling Weight Deflectometer
TxDOT’s Falling Weight Deflectometer
Case 1  SH 6 Frontage Road
Bryan District

• Failure during construction
• 20 inches of Grade 1 base
• Underseal + 2 inches of Type D dense graded HMA
• Both base and HMA passed specs on density and thickness
• Is it HMA, base, subgrade or bonding problem??
Project Nuclear Density data
Base Material

SH6 Percent Compaction

- Frequency
- Cumulative %

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SH 6 FWD data
max deflection vs distance

A  Test locations  B

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Cores from SH 6 Project
No bonding issues
Lab Results on HMA Field Cores
No problems in performance tests

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<th>Target</th>
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<td>&gt;300</td>
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<td>(overlay tester cycles to failure)</td>
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DCP data from low deflection area

Test Location 1  0.5 miles
FWD  11 mils
Very Difficult to test
Min E from DCP  90 ksi
DCP data from high deflection area

Test Location 2  1.89 miles
FWD 50 mils
Min base E = 30 ksi

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Conclusions and Actions

- Problem with compaction of base
- Density measurements did not catch problem
  - One test per 3000 cu yd
  - Base substantially less than OMC when test run
  - “Contractor compacted base on dry side”
- HMA was fine, bonding fine
- 1 mile of project rebuilt

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Case 2  US 287
Amarillo District

- New Construction
- 2 inches Type D HMA, 4 inches Type B over 10 inches Fly Ash treated base
- 3 years old
- Concern about quality of FA base

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No Structural Problems from GPR or FWD
Issues in Middle of HMA layer from GPR
Cores from Uncracked, minor and major cracks
Air Void Distribution from CT scan
Conclusions

- Not a base problem
- Cause related to lack of bond between Type D and B layers
- HMA placed in Jan/Feb – cold weather paving could be a contributing factor
Products from Forensics Studies

- Thermal Segregation in Hot Mix
  - Pave IR system

- Sulfate Heave
  - Test Procedures
  - 3D swell

- Bonding of HMA to bases

- Detecting high organic contents
Day 1 of Placement Operation many problem areas

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Day 2 Operation
Representative Results after Contractor Modified Operation

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Incentives to Use Pave-IR

- Currently the Minimum Surface Temperature Prior to Paving Must be 50F - 70F
- Currently Contractors are Required to Run Thermal and Density Profiles on Every Sublot and Failing Result – Waive QCQA Bonus
- Density Profiles Also Required Every Time Paver Stops and When Visual or Thermal Segregation is Identified.
- If Contractor uses Pave-IR System they can pave when Surface Temperature is 32F and Pavement is Dry and they do not have to Run Segregation or Density Profiles and are Not Subject to Waiving QCQA Bonus for Failing Thermal or Density Profile.
- Must Show Less than 25F Segregation when Pave-IR System is Used
Overall Goal of Pave-IR

- Improve Paving Quality By Having 100% Sampling for Thermal Segregation
- Passive Inspection?
- Contractors Can Fix Paving Problem is they See the Problem
- Contractors Are Allowed More Latitude if They Can Demonstrate They Have a Good Paving Practice
Sunday, March 28, 2010
Sulfate Heave (1997)
US 67 South of Dallas
Blow ups in stabilized subgrade layer

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Spectrophotometer/Colorimeter
Cost $400   Lab Test  Tx Method 145E

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Search for Alternative Stabilizers

Phase 1  Swell Tests

- Molded in gyratory compactor
- 3 day dry back
- Wrapped in wet paper towel and rubber membrane
- Placed in chest on porous stone in water bath
- Monitor 3-D swell
- Target < 6% or less than control

Phase 2  Wet/Dry Strength Tests

Sunday, March 28, 2010
Debonding problems leading to rapid pavement failure
Direct Tensile Bond Test
ASTM C-1583
Tests Performed on Grade 5 Surface Treatment

**MC-30 Prime, Grade 5 ST**
Mean Tensile Strength = 133 lb,  
Std Dev = 28 lb

**No Prime, Grade 5 ST**
Mean Tensile Strength = 49 lb,  
Std Dev = 12 lb

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Pull-Off Strength, lbs

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<th>Material</th>
<th>Average Strength</th>
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<tr>
<td>AE P</td>
<td>113</td>
</tr>
<tr>
<td>MC-30</td>
<td>82</td>
</tr>
<tr>
<td>EC-30</td>
<td>30</td>
</tr>
<tr>
<td>Covered Prime*</td>
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Failed in ST

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Disappearing Stabilizer often high organic content related

- Initial strength gain
- No long term strength
- Can be strength loss
- Rough roads

DCP Results

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Project 5540: Mitigating the Effects of Organics in Stabilized Soils

- Understanding the reactions - Organics with lime and clays
- Establish risk areas
  - 0-1% low risk
  - 1-2% moderate risk
  - >2% high risk
- Provide test methods to measure soluble organic content in soils
UV-Vis Equipment

- UV-Vis Spectrophotometer
- Computer and Software
- Sodium Hydroxide + Sodium Pyrophosphate
- Polycarbonate Cuvette
- Syringe filter
- 10 ml Syringe
- 50 ml Polypropylene Centrifuge tube
- 1N Hydrochloric Acid

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