Strength Testing of Tack Coats

2015 SEAUPG Annual Meeting

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West Virginia DOH Materials
Thursday November 19th, 2015

The Discussion
- WV's Observations
- 2013 WVDOH Asphalt Specification Changes
- Developing and Supporting the “Bond Spec”
- The last few years
- Tack Coat Applications Studies
- 2016 – Looking into the future

WV's Observations - 2012
- Stagnant Funding
- Available Pavement Funding is Decreasing
- Asphalt Design Thicknesses Decreasing
- Poor Tack Efforts
- Failures
- Slippage
- Delamination
- Cracking
- Reduced Pavement Life

2012 WVDOH Specification Changes
- Management Ultimatum
- Interstate Projects
- Asphalt “Super” Specification
- Square Yard Payment
- Thickness Cores
- Percent Within Limits
- %AC
- Gradation Control
- Density (Mat and Joint cores)
- Bond Strength Cores

Developing and Supporting the New Bond Strength Specification
- How to best test the bond
- WVDOH Literature Review
- WVU Research

Literature Review
- Three main types of bond strength testing devices
- Tension Device
- Direct Shear Device
Demo from Road Science
- Visited MCS&T in Feb of 2013
- Field Bond Device
- 2" core

Direct Shear Devices
- Measures the force required to break a double layered sample.
- Key Research Studies
  - West et al. (2005) - NCAT Bond Strength Device (20 psi normal)
  - McGhee and Clark (2009) - VDOT Shear Device
  - Kim et al. (2011) Layer Parallel Direct Shear
  - Tian et al. (2012) - Florida DOT Shear Test
  - Mohammad et al. (2012) - Louisiana Interlayer Shear Strength Tester (ULSST) (100 psi normal)

Key Findings
- Direct Shear testing is most common
- Marshall Stabilometer
- Temperature affects bond strength
- Most researchers use shop fabricated loading heads
- ALDOTMP was the most thorough test method
- Lab samples exhibit higher bond strengths

Choosing our Requirements
- NCAT Report No. 12-04
  - Evaluated failed sections
  - Found a window of 87 to 100 psi between failure and acceptable results
  - Recommended 100 psi
- WVU Research aligned

Our Specification and Shear Device
- Spec was based off ALDOT-430
- Device was modeled off of the NCAT and LPDS devices
- Holds a 6 inch core
- Shear gap of ¼"
- 100 psi Minimum
- No Normal force
- Utilizes the Marshall Stabilometer
- Clamps to secure sample tightly
- Lightweight aluminum design

Building our Shear Device
- Proof of Concept Device
Looking Back 2013
- MP 401.07.23 Guide to Determining Interface Bond Shear Strength of Multilayered Asphalt Pavement Specimens
- 2013-present → Shadow spec
- No bid item for a tack coat
- No Penalty for “Good Tacking Effort”

Looking Back - 2013
- 6 Interstate/APD Projects
- 2 PWL Shadow Spec testing
- 4 Full PWL testing
- Total Cores = 180

Looking Back - 2014
- Began using Fine milling
- 4 Interstate Projects
- Total Cores = 231

Looking Back - 2015
- No changes to Specifications
- 10 Interstate/APD Projects
- Total Cores = 385
- Total of 796 cores
Sample Integration
- 2500 Ton Lots
- 500 Ton Sub-lots
- Lot-by-Lot payment
- PWL

Results
- Compiled results for 800 cores

2013 Distribution of Bond Strength
- Bond Strength (PSI)
- Frequency

Bond Strength Distribution
- Percent of Total

Bond Strength Distribution
- Percent of Total
Results
- Percentage above NCAT recommendations

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>87+</td>
<td>57%</td>
<td>58%</td>
<td>68%</td>
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<tr>
<td>100+</td>
<td>45%</td>
<td>56%</td>
<td>56%</td>
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</table>

Milled Surface Bond Strength Distribution

Tack Application Study
- 2013
  - Single project
  - 3 Application rates
- 2015
  - Held a Tack Coat best practices workshop
    - 120 50/50 industry/state
    - 3 Application rates studies

Tack Coat Workshops

Outcomes From 30 Workshops
- FHWA Best Practices Tech Brief (Dec. 2015)
- AASHTO SOM Specification Was Submitted
- Increasing Application Rates
- DOT Specification Revisions
- Verifying Calibration of Distributor
- Treat Tack as Separate Pay Item vs. Incidental Item

Jason Dietz (FHWA)
Tack Application Study

- Project 1 – I-79
- 6 Application Rates
- 36 Bond Cores

<table>
<thead>
<tr>
<th>Applied Gal/SY</th>
<th>Calculated Gal/SY</th>
<th>Film Thickness Mil</th>
<th>Bond Strength PSI</th>
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<tbody>
<tr>
<td>0.06</td>
<td>0.031</td>
<td>9.0</td>
<td>139</td>
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<tr>
<td>0.08</td>
<td>0.037</td>
<td>10.2</td>
<td>135</td>
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<td>0.12</td>
<td>0.051</td>
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<td>0.14</td>
<td>0.060</td>
<td>7.8</td>
<td>178</td>
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WVDOH TABLE 48-11

<table>
<thead>
<tr>
<th>Condition of Existing Pavement</th>
<th>Application Rate (gal/sq yd)</th>
<th>(L/min)</th>
<th>Uniload</th>
<th>Dilated (1:1)</th>
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<tbody>
<tr>
<td>New HMA</td>
<td>0.08 – 0.06</td>
<td>(0.36 – 0.45)</td>
<td>0.04 – 0.10</td>
<td>(0.18 – 0.27)</td>
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<tr>
<td>Outlaid HMA</td>
<td>0.05 – 0.10</td>
<td>(0.59 – 0.96)</td>
<td>0.13 – 0.20</td>
<td>(0.32 – 0.45)</td>
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<tr>
<td>Milled Surface</td>
<td>0.10 – 0.11</td>
<td>(0.90 – 1.22)</td>
<td>0.20 – 0.27</td>
<td>(0.45 – 0.69)</td>
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<tr>
<td>PC Concrete</td>
<td>0.07 – 0.10</td>
<td>(0.13 – 0.20)</td>
<td>0.22 – 0.45</td>
<td>(0.65 – 1.0)</td>
</tr>
</tbody>
</table>

App Rate 0.08\% 0.05\% 0.02\%
Actual 0.065\% 0.021\% 0.023\%
Film Thick 6mil 10mil 22mil
Tack Application Study

Project 1 - Bond Testing

\[ y = 10.835x + 105.23 \]

\[ R^2 = 0.8442 \]

<table>
<thead>
<tr>
<th>Calculated Application Rate Gal/SY</th>
<th>Project 2 - US Route 119</th>
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<tr>
<td>0.04</td>
<td>0.048</td>
</tr>
<tr>
<td>0.05</td>
<td>0.048</td>
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<tr>
<td>0.07</td>
<td>0.087</td>
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<td>0.048</td>
<td>9.0</td>
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<tr>
<td>0.05</td>
<td>0.048</td>
<td>8.8</td>
<td><strong>---</strong></td>
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<tr>
<td>0.07</td>
<td>0.087</td>
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</table>

Project 3 - US Route 60 through downtown Charleston

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<tr>
<th>Applied Gal/SY</th>
<th>Calculated Gal/SY</th>
<th>Film Thickness Mil</th>
<th>Bond Strength PSI</th>
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<td>0.09</td>
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Looking into the Future – Changes???

- 2016
  - Continued Research
  - Tack Application rates
  - Further bond testing
  - Calibrations of Tack Trucks
  - Coring major jobs prior to bid to determine weak interfaces to avoid delamination
- 2017
  - Begin using bond testing as a pay deduction
  - Make tack a separate pay item
Speaking of Bonding

I believe we have BONDED long enough! Let's BREAK!!

Questions?