Longitudinal Joint Experience

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Owner/President S.T.A.T.E. Testing, LLC

2017 Illinois Bituminous Paving Conference

December 12, 2017
Industry Accomplishments

- Rutting
  - Moving from Marshall to Superpave, Volumetrics
- Tackling segregation
  - MTD, lower Va, smaller NMAS
- Stripping
  - T283, Hamburg
- Cracking
  - DCT, IFIT, Recovered PG Grading
Longitudinal Joints

WEAK LINK
Weak Link....
Water Intrusion Into Pavement
Maintenance Expensive and Disruptive
How do we fix this issue?

**Preventing** Longitudinal Joint failure is MUCH cheaper than maintaining a joint throughout the life of the pavement
Many agencies are getting involved
WHRP Longitudinal Joint Study

- Researched in-place data for:
  - **Joint Type** (vertical, notched wedged etc.)
  - **Joint Method** (rolling on, overhang or back from joint)
Longitudinal Joint Type

- Echelon
- Notched Wedge
- Normal Vertical
- Safety Edge
- Milled
WisDOT Joint Data

- 1400 data sets
- 28 projects
- No joint density > 93%
WHRP Study
Recommendations

• Joint Type:
  • Notched Wedge / Mill out wedge

• Joint Method:
  • Unconfined: Stay back from edge with Roller
    (WI uses fine graded mixes)
  • Confined: Type of rolling pattern did not make a difference
Further research should include the evaluation of various joint sealers. New products include a void reducing asphalt membrane that is applied before paving to fill the void spaces in the longitudinal joint from the bottom up. Appendix G is the Illinois Department of Transportation (IDOT) Void Reducing Asphalt Membrane specification.

Also, in lieu of a monetary penalty, the research team recommends requiring the application of a top-applied joint sealer, at the contractor’s expense, when the contractor does not achieve compaction of the longitudinal joint.

Heated joints resulted in higher densities for all joint types where data was available. Heated joints increased densities by 0.7, 1.2 and 1.5% for milled, vertical, and notched wedge, respectively.
Make it better??
The following is the sequence for milling and paving:

1. Mill the first lane 6" wider than the centerline.
2. Clean and prepare surface as per Article 406.05 of the Standard Specifications prior to placement of the HMA surface.
3. Pave the first lane 6" wider than the centerline to the longitudinal vertical face of the adjacent lane.
4. Mill the adjacent lane to the existing centerline, removing the additional 6" width of the initial mat.
5. Clean and prepare the surface as per Article 406.05 of the Standard Specifications prior to the placement of the HMA surface. The HMA Tack Coat shall be sprayed the full width of the lane and also lapped onto the adjacent lane a distance not to exceed 4". In addition, the vertical face of the adjacent mat shall be thoroughly tacked by means of a dedicated spray nozzle, mounted at a 45 degree angle, aimed toward the face.
6. Placement of this HMA Surface shall require the use of a joint-matching device in lieu of a longitudinal averaging ski. The compacted height of this lane shall be either exactly flush, or no more than 1/32" higher, to the adjacent lane to ensure the joint has sufficient material for adequate compaction. During placement, the side plate of the screed shall not exceed 1/2" overlap onto the adjacent lane.
D-4 Pave Wide Mill Wide

"Darker" (black) color is uncompacted HMA on top of 12" LJS and shoulder (little compactive effort applied due to condition of existing shoulder base).

"Lighter" (grey) color is compacted HMA.

This 6" of HMA was joint trimmed prior to return.
Concerns:

1. Urban Areas
   • Time factor
   • Perception

2. Permeability
   • Isn’t fully addressed
Agree to Disagree

Mill off unconfined joint?

Hey – Teddy Brosevelt!

Why not LJS?
Need to prevent Permeability

• Increase density (obviously)
• Brother from a Different Mother:
  • Longitudinal Joint Seal (LJS) – IDOT
  • Void Reducing Asphalt Material (VRAM) - Tollway
  • J-Band = Joint Band – Heritage proprietary
Illinois Department of Transportation

Memorandum

To: Regional Engineers  Attn: Program Development Engineers
From: Brian Pfeifer
Subject: Special Provision for HMA – Longitudinal Joint Sealant
Date: March 31, 2017

This special provision was developed to improve the performance of centerline and lane-to-lane joints for full-depth HMA pavements and HMA overlays.

The designer must specify which lifts of the HMA shall receive the sealant on the plans.

- Full-Depth HMA Pavements – under the surface lift and under the top binder lift
- HMA Overlays (both standard paving grade and 2.75 in.)
Illinois Department of Transportation
Bureau of Materials

QUALIFIED PRODUCER LIST OF CERTIFIED SOURCES FOR LONGITUDINAL JOINT SEALANT

September 15, 2017
This list supersedes the August 26, 2016 list.

Effective: March 1, 2016
Revised: January 17, 2017

To learn more about the certification procedure click on the bookmark to the left, “Procedure for Certifying a New Longitudinal Joint Sealant”.

<table>
<thead>
<tr>
<th>Source</th>
<th>Location</th>
<th>Source Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Materials, Inc.</td>
<td>Indianapolis, IN</td>
<td>423-01</td>
</tr>
<tr>
<td>Emulsicoat, Inc.</td>
<td>Urbana, IL</td>
<td>2260-03</td>
</tr>
<tr>
<td></td>
<td>(Saline Court)</td>
<td></td>
</tr>
<tr>
<td>Tri-State Asphalt</td>
<td>Morris, IL</td>
<td>3900-01</td>
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</table>
Application Rates:
### Bid Tabs on I-55 in 2016

Please Note:
- These are large quantities
- LJS is at 12” (for SMA) & 15% less
- LJS should be 18” for dense graded

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#### Summary of Contractor Bids

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Unit Price</th>
</tr>
</thead>
<tbody>
<tr>
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<td>LONG JOINT SEALANT</td>
<td>3069</td>
<td>426,297.00</td>
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<td></td>
<td></td>
<td>4813</td>
<td>738,914.80</td>
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<td></td>
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<td>1560</td>
<td>568,396.00</td>
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**60Y65**

ILLINOIS DEPARTMENT OF TRANSPORTATION

UNIT PRICE TABULATION OF BIDS

CONTRACT NUMBER: 60Y65

COUNTY: WILL  DUPAGE  COOK

SUMMARY OF CONTRACTOR BIDS

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Unit Price</th>
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<tr>
<td></td>
<td></td>
<td>1.3000</td>
<td>738,914.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.0000</td>
<td>568,396.00</td>
</tr>
</tbody>
</table>
Long Term Experience 14 Years Later

Route 26 Conventional Joint

Route 26 with Joint Sealant
No Maintenance After 14 Years

Route 50 Conventional

Route 50 J-Band
Distributors Improving
DuPage County

- Wanted improved longitudinal joint performance
- Started specifying alternative methods in 2013
  - Echelon Paving
  - Infra-red Joint Heater
  - J-Band
- Performance testing on joint cores
Tested Right ON the Joint!
DuPage County

• Joint treatment types tested:
  • J-Band (Bid @ $2.80 per foot)
  • Echelon (Incidental)
  • Infra-red Joint Heater (Incidental)
• 4 x 150mm cores directly over the joint
• Performance test results (DCT & I-FIT)
### 2016 DuPage North - Gary Avenue

<table>
<thead>
<tr>
<th>Mix Type</th>
<th>Vir AC</th>
<th>Section Type</th>
<th>DCT (J/m²)</th>
<th>I-FIT (FI)</th>
<th>Ave Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>N70E</td>
<td>SBS PG70-28</td>
<td>J-Band</td>
<td>675.5</td>
<td>41.0</td>
<td>98.9¹</td>
</tr>
<tr>
<td>N70E</td>
<td>SBS PG70-28</td>
<td>Echelon</td>
<td>485.5</td>
<td>14.7</td>
<td>94.1</td>
</tr>
<tr>
<td>N70E</td>
<td>SBS PG70-28</td>
<td>Joint Heater</td>
<td>418.5</td>
<td>12.3</td>
<td>90.4</td>
</tr>
</tbody>
</table>

¹ - Gmm calculated from cores

**Results!**
# 2016 DuPage South - Hobson Road

<table>
<thead>
<tr>
<th>Mix Type</th>
<th>Vir AC</th>
<th>Section Type</th>
<th>DCT (J/m²)</th>
<th>I-FIT (Fl)</th>
<th>Ave Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>N70E</td>
<td>SBS PG70-28</td>
<td>J-Band</td>
<td>395.5</td>
<td>48.5</td>
<td>95.7¹</td>
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<tr>
<td>N70E</td>
<td>SBS PG70-28</td>
<td>Echelon</td>
<td>418.5</td>
<td>10.7</td>
<td>93.3</td>
</tr>
<tr>
<td>N70E</td>
<td>SBS PG70-28</td>
<td>Joint Heater</td>
<td>340.0</td>
<td>11.0</td>
<td>92.8</td>
</tr>
</tbody>
</table>

1 - Gmm calculated from cores
Conclusions DuPage County.

LJS and Echelon are the only approved methods going forward.
I-88 Tollway Trials

• Tollway Trials and Innovations
  • RAP fractionation
  • Warm mix mandate
  • RAS implementation
  • GTR trials and use
  • And a whole lot of other ones!

• LJS in 2015
Evaluation and Performance of:

Joint-Band, a Void Reducing Asphalt Material (VRAM)

Introduction

One type of failure associated with Hot Mix Asphalt (HMA) and Warm Mix Asphalt (WMA) pavements occurs at the longitudinal joints. During placement one or both of the edges of the mat will be unconfined and density at these edges will be lower than across the rest of the mat because there is nothing to hold that edge. This typically makes the outside of the mat less dense and more permeable. This edge will most likely be cold when the adjacent lane is placed, and depending on how well it was constructed, the resulting longitudinal joint may also be permeable. Water may infiltrate either through the mat or the joint and, during freeze/thaw, may cause the joint to deteriorate.
I-88 Field Trials

- Migration
- Hamburg
- Single Edge Notch Disk
- Torque Test

### Table 1

<table>
<thead>
<tr>
<th>Core No.</th>
<th>Overall Core Thickness (cm)</th>
<th>Average Migration from Interface (cm)</th>
<th>Migration %</th>
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<tbody>
<tr>
<td>Joint</td>
<td>1.0</td>
<td>4.0</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td>2.3</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>2.5</td>
<td>56</td>
</tr>
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### Table 2

<table>
<thead>
<tr>
<th>Core No.</th>
<th>Type</th>
<th>No. Passes</th>
<th>Rut Depth (mm)</th>
<th>Average Rut Depth (mm)</th>
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</thead>
<tbody>
<tr>
<td>14-15</td>
<td>Control</td>
<td>20,000</td>
<td>7.29</td>
<td>8.56</td>
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<tr>
<td>19-20</td>
<td>Control</td>
<td>20,000</td>
<td>9.83</td>
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### Table 3

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Diameter (mm)</th>
<th>Thickness (mm)</th>
<th>Notch depth (mm)</th>
<th>Ligament Length (mm)</th>
<th>Max Load (kN)</th>
<th>Fracture Energy (J/m²)</th>
<th>Fracture Energy (J/m²)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>150.0</td>
<td>65.5</td>
<td>14.5</td>
<td>55.0</td>
<td>12.8</td>
<td>1470.6</td>
<td>1470.6</td>
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<tr>
<td>2</td>
<td>150.0</td>
<td>69.0</td>
<td>13.0</td>
<td>56.0</td>
<td>12.8</td>
<td>1415.5</td>
<td>1415.5</td>
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<tr>
<td>3</td>
<td>150.0</td>
<td>60.5</td>
<td>14.5</td>
<td>46.0</td>
<td>9.1</td>
<td>1482.2</td>
<td>1482.2</td>
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<tr>
<td>4</td>
<td>150.0</td>
<td>59.0</td>
<td>12.5</td>
<td>46.5</td>
<td>8.9</td>
<td>1328.0</td>
<td>1328.0</td>
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</table>

<table>
<thead>
<tr>
<th>Specimen</th>
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</tr>
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<tbody>
<tr>
<td>1A</td>
<td>150.0</td>
<td>65.5</td>
<td>14.5</td>
<td>51.0</td>
<td>10.9</td>
<td>1359.5</td>
<td>1359.5</td>
</tr>
<tr>
<td>2A</td>
<td>150.0</td>
<td>65.5</td>
<td>14.5</td>
<td>51.0</td>
<td>11.2</td>
<td>1397.2</td>
<td>1397.2</td>
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<tr>
<td>3A</td>
<td>150.0</td>
<td>64.5</td>
<td>14.0</td>
<td>50.5</td>
<td>10.07</td>
<td>1069.8</td>
<td>1069.8</td>
</tr>
<tr>
<td>4A</td>
<td>150.0</td>
<td>66.5</td>
<td>13.5</td>
<td>53.0</td>
<td>10.57</td>
<td>1373.9</td>
<td>1373.9</td>
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</tbody>
</table>

Specimens 1-4 contained J-Band between SMA surface and underlying asphalt layer. Specimens 1A-4A taken as controls in sections without J-Band material.
Learning Experience

• Flushing observed after application on SMA
• Application rate reduced in current IDOT specification
Hamburg Results

<table>
<thead>
<tr>
<th>Core No.</th>
<th>Type</th>
<th>No. Passes</th>
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<td>Control</td>
<td>20,000</td>
<td>9.83</td>
<td></td>
</tr>
<tr>
<td>4-5</td>
<td>J-Band</td>
<td>20,000</td>
<td>9.55</td>
<td>7.21</td>
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<tr>
<td>9-10</td>
<td>J-Band</td>
<td>20,000</td>
<td>4.87</td>
<td></td>
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</table>

Flushed areas did not show increased rutting potential
CDOT All Aboard!
CDOT Arterial Resurfacing Program 2016

- Contract divided into four quadrants of City
- Each required joint treatment on one street
- Trials used IDOT Longitudinal Joint Treatment
- Two completed in 2016
- Two completed in 2017
LJS Constructibility

- Sets up in a few minutes
- Does not pick up under traffic. (Note tire tracks but no pickup)
### DCT Results – CDOT

<table>
<thead>
<tr>
<th>Location</th>
<th>Core Numbers</th>
<th>HMA Mixture Type</th>
<th>% ABR</th>
<th>RAS</th>
<th>Virgin Asphalt Grade</th>
<th>DCT Value (J/m²)</th>
<th>J-Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belmont EB</td>
<td>1 &amp; 2</td>
<td>N70 D</td>
<td>19</td>
<td>N</td>
<td>PG 58-28</td>
<td>584.6</td>
<td>Y</td>
</tr>
<tr>
<td>Belmont WB</td>
<td>3 &amp; 4</td>
<td>N70 D</td>
<td>19</td>
<td>N</td>
<td>PG 58-28</td>
<td>628.2</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>606.4</strong></td>
<td>Y</td>
</tr>
<tr>
<td>Irving Park Rd WB</td>
<td>5 &amp; 6</td>
<td>N70 E</td>
<td>19</td>
<td>N</td>
<td>* PG 70-28</td>
<td>385.6</td>
<td>N</td>
</tr>
<tr>
<td>Irving Park Rd EB</td>
<td>7 &amp; 8</td>
<td>N70 E</td>
<td>19</td>
<td>N</td>
<td>* PG 70-28</td>
<td>418.0</td>
<td>N</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>401.8</strong></td>
<td>N</td>
</tr>
</tbody>
</table>

*PG 70-28 is SBS polymerized

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**ROCK STAR** Results!
DCT Results at Joint

- DCT higher for lower quality mix with a neat PG58-28 AC than mix with SBS polymer PG70-28

- Filling voids with the LJS has a greater effect on the mix properties at joint than polymer AC.
CDOT Field Experience

• Experience positive

• Will be using on more projects
City-wide Term Contracts (3 year term, 4 set areas, mixes, etc.) included 79,000 LF for the quantity per contract area. Bigane Paving low bidder on all four contracts. Unit price was $3.00 to $3.50 /LF on each contract.
Bid opening was late fall 2017
- North 183,285ft; $2.00/ft
- Central 161,780ft; $2.00/ft
- South 140,178ft; $2.00/ft
- Far South 201,172ft; $1.95/ft

Started paving this year (Cold temps/No Issues)
Will finish balance in 2018
ALL locations get LJS!!
Conclusion

• Variety of approaches to improve performance at joint – most don’t work
• My recommendation is ....

LJS
Questions?