Void Reducing Asphalt Membrane for Extending Longitudinal Joint Life of Asphalt Pavements

Ohio Transportation Engineering Conference
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Longitudinal Construction Joints

• How hard is it to find longitudinal construction joints in this condition?
• Look at the condition of the rest of the pavement.
Why do longitudinal construction joints fail?

The first paving pass creates an unconfined edge.
Rollers can’t compact the unconfined edge to the same density as the interior of the mat.
Longitudinal Joint Construction Failure

- Air and water intrude into the HMA at the construction joint and damages the pavement over time
- Premature construction joint failure triggers maintenance or reconstruction
Longitudinal Joint Improvement Plan

- Early 2000 timeframe
- Illinois DOT recognized need for better joint performance
- Failure mechanism – permeability
- **Concept** – fill a portion of the voids with an asphalt product from **bottom up**, a **Void Reducing Asphalt Membrane (VRAM)**

Falling head permeameter
• **VRAM material criteria**
  - Capable of migrating upward from heat of mix and compaction to reduce permeability at the joint
    - 50% to 75% of voids in overlay height filled over the width of the application
  - Create a bond to the underlying pavement and a bond between paving passes
  - Impart crack resistance at the joint

Placed **under** the intended area for an overlay longitudinal construction joint
Void Reducing Asphalt Membrane

- VRAM construction criteria
  - Fill voids in an overlay in an area 12” to 18” wide at the longitudinal joint
  - Non-lateral flow at placement
  - Minimize time from placement to start of paving
  - Fast release to traffic for moving construction zone
  - Non-tracking, no pick up from construction operation or traffic

Placed under the intended area for an overlay longitudinal construction joint
IDOT test sections placed in 2002-2003
VRAM = hot-applied, modified binder
Manual placement using melting kettle (~200 gal)
VRAM Test Section Performance

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• US 51 Decatur, IL 2002
  – VRAM was placed in test sections under the intended area for an overlay construction joint, either 12” or 18” wide and with thickness up to 5/32”
VRAM Field Performance

US 51 Decatur, IL

12 Years after placement

No VRAM

VRAM
<table>
<thead>
<tr>
<th>Test</th>
<th>Test Requirement</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic shear @ 82°C (unaged), G*/sin δ, kPa</td>
<td>1.00 min.</td>
<td>AASHTO T 315</td>
</tr>
<tr>
<td>Creep stiffness @ -18°C (unaged), Stiffness (S), MPa m-value</td>
<td>300 max. 0.300 min.</td>
<td>AASHTO T 313</td>
</tr>
<tr>
<td>Ash, %</td>
<td>6.0 max.</td>
<td>AASHTO T 111</td>
</tr>
<tr>
<td>Elastic Recovery, 100 mm elongation, cut immediately, 25°C, %</td>
<td>58 min.</td>
<td>ASTM D 6084 (Procedure A)</td>
</tr>
<tr>
<td>Separation of Polymer, Difference in °C of the softening point (ring and ball)</td>
<td>3 max.</td>
<td>ITP Separation of Polymer from Asphalt Binder&quot;</td>
</tr>
</tbody>
</table>
• The VRAM shall be suitable for construction traffic to drive on without pick up or tracking of the VRAM within 30 minutes of placement.

• The VRAM shall be applied at a width of not less or greater than 1.5” of the width specified in the plans. The VRAM shall not flow more than 2” from the initial placement width.

• When VRAM is specified, the longitudinal joint density testing, one foot on either side of the joint, will be waived.
## Application Rate Table (2016 IDOT)

<table>
<thead>
<tr>
<th>Overlay Thickness $^{2/}$, in (mm)</th>
<th>LJS Width, “W” in (mm)</th>
<th>lb / lineal ft (kg/lineal m)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-SMA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (25)</td>
<td>18 (457)</td>
<td>1.15 (1.71)</td>
</tr>
<tr>
<td>1 ¼ (32)</td>
<td>18 (457)</td>
<td>1.31 (1.95)</td>
</tr>
<tr>
<td>1 ½ (37.5)</td>
<td>18 (457)</td>
<td>1.47 (2.19)</td>
</tr>
<tr>
<td>1 ¾ (44)</td>
<td>18 (457)</td>
<td>1.63 (2.43)</td>
</tr>
<tr>
<td>2 (50)</td>
<td>18 (457)</td>
<td>1.80 (2.68)</td>
</tr>
<tr>
<td><strong>SMA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 ½ (37.5)</td>
<td>12 (305)</td>
<td>0.83 (1.24)</td>
</tr>
<tr>
<td>1 ¾ (44)</td>
<td>12 (305)</td>
<td>0.92 (1.37)</td>
</tr>
<tr>
<td>2 (50)</td>
<td>12 (305)</td>
<td>1.00 (1.49)</td>
</tr>
</tbody>
</table>

\[ \approx 1 \text{ gal/}\text{yd}^2 \]
How can VRAM be applied?

Drag Box

Push Cart
How can VRAM be applied?

- Inline spray bar (parallel to direction of travel) on heated, agitated distributor
  - Multiple spray nozzles used to build thickness
  - Depending on nozzle angle, a bell curve distribution or uniform thickness can be applied
Where can VRAM be used?

VRAM applied on top of:
• New asphalt pavement
• Aged asphalt pavement
  – Address distresses before VRAM placement
• Milled asphalt surface
• PCC pavement
  – Address distresses before VRAM placement
Where has VRAM been used?

- Interstate
- Urban
- Rural
- State
• 12” width application, 1 lb/ft VRAM
• 2” SMA overlay
Milled surface with new 1 ½” 9.5mm surface
18” width application, 1.47 lb/ft VRAM
IDOT District 5 I-74

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- 18” application at 1.47 lb/ft placed on binder course
- 1 ½” 9.5mm surface
• 1 ½” 9.5mm HMA
• 18” VRAM application width at 1.47 lb/ft
Dewey-Fisher Rd, Champaign Co, IL

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Width of VRAM

Shadow on mix over VRAM
Features

• During construction
  – Upward migration
  – Non-tracking
  – Resist Flow

• Imparts crack resistance at joint

• Reduces water and air permeability

• Bonds to existing pavement
VRAM Summary

- Proactive approach to reduce joint permeability
- 18” or 12” VRAM width depending on mix type
- Weight/ft based on mix thickness
  - Target 50% to 75% migration of VRAM into HMA
- Multiple methods for placement of VRAM
Questions?

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