Void Reducing Asphalt Membrane (VRAM) - Improving Longitudinal Joint Performance

County Engineer’s Workshop
Bellaire, MI
2/14/18
Longitudinal Construction Joints

- Longitudinal construction joints
  - Commonly, the first area requiring maintenance on a pavement

- Issues
  - Can’t achieve the same density at the joint as in the mat
  - Water and air intrusion accelerates damage
• Methods to improve joint performance
  – Joint density requirements (typically target voids at 4” from joint to within 2% of center mat voids)
  – Echelon paving
  – Notched wedge joint
  – Cut off lower density edge
  – Mill and inlay

• All the above are “mechanical” solutions
Effect of In-Place Voids on Service Life*

*Washington State DOT Study
Effect of Air Voids on Pavement Service Life

- For 7% air voids, assuming 15 year service life at 100%
- For 9% air voids, 94% of service life = 14 yr service life (1 yr reduction)
- For 10% air voids, 82% of service life = 12 yr service life (3 yr reduction)
- For 11% air voids, 64% of service life = 9.6 yr service life (5 yr reduction)

Regardless of method, the joint isn’t the same air voids as the center of mat. The joint will deteriorate and ultimately fail first.
Void Reducing Asphalt Membrane (VRAM)

- Thick application of hot-applied, polymer-modified asphalt (~ 1 gal/sq yd for 1 ½” overlay)
- Application of 12” or 18” band applied before paving in the location of the new longitudinal joint
- Fills voids and reduces water intrusion at joint from the bottom up
- Protects underlying pavement layers
- Materials approach to improving joint performance
VRAM Application

Innovation – Quality - Service

Placed by pressure distributor with mechanical agitation in tank

OR

Manual strike off box fed from melting kettle
• Material criteria
  – Migrates upward from heat of mix and compaction to reduce permeability at the joint
  – Creates a bond to the underlying pavement and a bond between paving passes
  – Imparts crack resistance at the joint

• Construction criteria
  – Fills voids in the overlay in an area 12” to 18” wide at the longitudinal joint
  – Resists lateral flow at placement
  – Provides non-tracking, no pick up from construction operation or traffic
  – Permits rapid start of paving after application
  – Allows quick release to traffic for moving construction zone
VRAM Experimental Test Sections Placed in 2002 – 2003

Illinois DOT

- District 7 US-51 Elwin
- District 1 US-50 Richton Park
- District 2 IL-26 Cedarville
IDOT D7 Elwin US-51 after 15 Years

Innovation – Quality – Service

VRAM Joint transition to control

VRAM section
All pictures were taken in 2017

Transition from Control Section to VRAM Section
IDOT D1 US 50 Richton Park after 14 years

Innovation – Quality - Service

VRAM Test Section

Control Section
<table>
<thead>
<tr>
<th>Test</th>
<th>Test Requirement</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic shear @ 88°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.</td>
<td>AASHTO T 313</td>
</tr>
<tr>
<td></td>
<td>0.300 min.</td>
<td></td>
</tr>
<tr>
<td>Ash, %</td>
<td>1.0 – 4.0</td>
<td>AASHTO T 111</td>
</tr>
<tr>
<td>Elastic Recovery, 100 mm elongation, cut immediately, 25°C, %</td>
<td>70 min.</td>
<td>AASHTO T301</td>
</tr>
<tr>
<td>Separation of Polymer, Difference in °C of the softening point (ring and ball)</td>
<td>3 max.</td>
<td>ASTM D7173, AASHTO T53</td>
</tr>
</tbody>
</table>
VRAM shall be

• … suitable for construction traffic to drive on without pick up or tracking within 30 minutes of placement.

• … be applied 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.

• Density testing, one foot on either side of the joint, will be waived.
## Application Rate and Width Table

<table>
<thead>
<tr>
<th>Overlay thickness, in</th>
<th>VRAM width, in</th>
<th>VRAM Application Rate, lb/ft*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SMA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 ½</td>
<td>12</td>
<td>0.83</td>
</tr>
<tr>
<td>1 ¾</td>
<td>12</td>
<td>0.92</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>1.00 (= 1.05 gal/yd²)</td>
</tr>
<tr>
<td><strong>HMA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>18</td>
<td>1.15</td>
</tr>
<tr>
<td>1 ¼</td>
<td>18</td>
<td>1.31</td>
</tr>
<tr>
<td>1 ½</td>
<td>18</td>
<td>1.47</td>
</tr>
<tr>
<td>1 ¾</td>
<td>18</td>
<td>1.63</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>1.80 (=1.26 gal/yd²)</td>
</tr>
</tbody>
</table>

* Rates based on coarse-graded HMA
Example

- HMA @ 5.5% AC, @ 1.5” thick/square yard = 9 lb of AC
- VRAM @ 1.47 lb/ft – 18” equates to 8.8 lb AC/square yard
- Total AC in HMA + VRAM = 10.3%
- For 10-13% air voids @ joint, VRAM would occupy 2/3 of overlay height
Current States with VRAM Experience

• Illinois
• Ohio
• Iowa
• Indiana
• Michigan
• Missouri
Types of Roads using VRAM

**Interstate:** ODOT I-77

**State:** Indiana SR-26

**Urban:** Indianapolis DPW 56th St

**County:** Champaign Co, IL Dewey-Fisher Road
VRAM Summary

• Application rate based on volumetrics (tailored to specific mix types)
• Provides a **material solution** to reducing air voids at the longitudinal joint
• Multiple field projects indicate **improved long term field performance**
• Reduces need for joint maintenance and **increases the life of the pavement**
• Provides **improved cracking resistance**
Questions?