OVERVIEW OF VDOT REFLECTIVE CRACKING MITIGATION RESEARCH

Hari Nair, Ph.D., P.E
Senior Research Scientist

VIRGINIA PAVEMENT RESEARCH AND INNOVATION SYMPOSIUM
JUNE 18-19, 2019
Outline

• Introduction
• Reflective Cracking Mitigation Techniques
• VTRC/VDOT Research
  - Field Trials and Performance
• Summary
Introduction

Reflective cracking over jointed concrete is a major problem in Virginia.

Result of horizontal and vertical movements at the joints and cracks in the underlying PCC
- Thermal and moisture changes

Reflective cracks allow water into the pavement
- Contributes to premature deterioration
- Reduce ride quality
Introduction

The key to delaying reflective cracking is to reduce the stresses and strains produced in the asphalt overlays.

State DOT’s are using several treatment strategies to mitigate reflective cracking

Most of the reflective cracking mitigation methods only delay or reduce the severity of the cracks
Reflective Cracking Mitigation Techniques

1. Asphalt mixes with higher cracking resistance
   - High polymer mixtures (~7.5% SBS)
   - Ground Tire Rubber Modified (GTR) Mixtures

2. Crack-relief Mechanism (e.g.: Fabric Interlayers, SAMI, Chip Seal etc.)

3. Saw and Seal

4. In Place Recycling (e.g.: CIR+ AC Overlay)

5. Fractured Slab Processes (e.g.: Rubblization + AC overlay)

6. Thicker Overlays
Saw and Seal

Saw and seal method involves making saw cuts in the overlaying asphalt, (above the concrete joints) and sealing them with a compressible rubberized low modulus material.

Economical option for controlling reflective cracking
VDOT Field Project: Saw and Seal

Saw/sealing performance on IS 395

<table>
<thead>
<tr>
<th>Year</th>
<th>Critical Condition Index (CCI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>Before CCI</td>
</tr>
<tr>
<td>2012</td>
<td>100</td>
</tr>
<tr>
<td>2013</td>
<td>90</td>
</tr>
<tr>
<td>2014</td>
<td>80</td>
</tr>
<tr>
<td>2015</td>
<td>70</td>
</tr>
<tr>
<td>2016</td>
<td>60</td>
</tr>
<tr>
<td>2017</td>
<td>50</td>
</tr>
<tr>
<td>2018</td>
<td>40</td>
</tr>
</tbody>
</table>

- **Excellent**: 90 and above
- **Good**: 70-89
- **Fair**: 60-69
- **Poor**: 50-59
In Place Recycling

Cold In-Place Recycling (CIR) + AC overlay

- Suitable if the composite pavement has a substantial HMA thickness built up over the years with overlays

VDOT Projects

1. US-60 in Henrico County
   - Originally constructed in 1967 with 8 inches of JRCP
   - Average of 7” of existing asphalt
   - The last rehabilitation prior to the CIR was done in 2000
   - CIR to a depth of 5 inches (after 2” mill)
   - HMA overlay (2” SMA-12.5 and 2” SMA- 19.0)
Cold In-Place Recycling (CIR)+ AC overlay

US-60 in Henrico County

Data Credit: Bipad Saha, P.E, CO Materials Division
Cold In-Place Recycling (CIR)+ AC overlay

VDOT Projects

2. SR-35 in Prince George County

-Originally constructed in 1969 with 8” of JRCP
-Average of 7” of existing asphalt
-The last rehabilitation prior to the CIR was done in 2001
-CIR to a depth of 5 inches (after 2” mill)
-HMA overlay (2” SM-12.5E and 2” IM- 19.0A )
Cold In-Place Recycling (CIR)+ AC overlay

SR-35 in Prince George County

Before CCI

Data Credit: Bipad Saha, P.E, CO Materials Division
Crack-relief Mechanism

Paving Fabric Interlayers

Interlayers can be used for stress absorption, reinforcement, and to provide a waterproof barrier.

Performance was reported to depend on many factors including the installation procedures and condition of the existing pavement.

The technologies continue to advance with more interlayer choices than in the past.
Route 143 NB & SB, York County
Paving Grid Type III (HaTelit G100) on milled asphalt pavement over jointed concrete, with 1.5” overlay of SM-9.5D.

Tack Coat: PG 64-22
Application rate of 0.13 gallon/yd^2
US Route 17 SB, York county

Paving Grid Type III (HaTelit G100) directly on existing asphalt pavement over jointed concrete, with 2” overlay of SM-12.5D.

Tack Coat: PG 64-22 - application rate of 0.11 gallon/yd^2
US 460 Wakefield
1.12 mile long, 2” overlay

Polygrid PT1012
Length: 328 ft.
Width: 5 ft.
Rte. 30, York County

- Concrete patching
- Joint seal
- SM 4.75 (1”)
- Fabric placement
- Overlay (1.5”)

[Images of road construction activities]
Asphalt mixes with higher cracking resistance

Use of highly modified (HP) binders (~7.5% SBS)

<table>
<thead>
<tr>
<th>Site #</th>
<th>District</th>
<th>Route</th>
<th>Direction</th>
<th>CCI (2017)</th>
<th>CCI (2018)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Richmond</td>
<td>I-95</td>
<td>SB</td>
<td>99</td>
<td>97</td>
</tr>
<tr>
<td>2</td>
<td>Nova</td>
<td>I-95</td>
<td>NB</td>
<td>97</td>
<td>89</td>
</tr>
<tr>
<td>3</td>
<td>Nova</td>
<td>I-95</td>
<td>SB</td>
<td>93</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>Nova</td>
<td>I-95</td>
<td>SB</td>
<td>98</td>
<td>97</td>
</tr>
<tr>
<td>5</td>
<td>Nova</td>
<td>I-495</td>
<td>NB</td>
<td>97</td>
<td>92</td>
</tr>
</tbody>
</table>

Ongoing VTRC project. Contact: Jhony Habbouche, Ph.D., EIT, jhony.habbouche@vdot.virginia.gov
Slab-fracturing technologies

Rubblization and other slab-fracturing technologies have proven to be cost effective.

They may not be feasible in all situations.
## Terminal Boulevard (SR 406) Concrete Rubblization

<table>
<thead>
<tr>
<th>Mainline</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0” SM-12.5E</td>
</tr>
<tr>
<td>4.0” IM-19.0E (two lifts of 2”)</td>
</tr>
<tr>
<td>8” Rubblized Existing Concrete (CRCP)</td>
</tr>
<tr>
<td>12.0” Existing Cement Treated Sub-Base</td>
</tr>
</tbody>
</table>
Terminal Boulevard (SR 406)
Deflection results from FWD testing at EB lane 1

(D0= deflection at loading plate, D72= deflection at 72” from loading plate)
## Terminal Boulevard (SR 406)

<table>
<thead>
<tr>
<th></th>
<th>Year</th>
<th>Mile points</th>
<th>IRI (in/mile) Average</th>
<th>Rut depth (inch), Average</th>
<th>CCI Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>EB</td>
<td>2018</td>
<td>0-1.33</td>
<td>97</td>
<td>0.13</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>2017</td>
<td>0-1.33</td>
<td>95</td>
<td>0.09</td>
<td>99</td>
</tr>
<tr>
<td>WB</td>
<td>2018</td>
<td>1.33-0.052</td>
<td>107</td>
<td>0.17</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2017</td>
<td>1.33-0.048</td>
<td>99</td>
<td>0.09</td>
<td>-</td>
</tr>
</tbody>
</table>
US 460 Appomattox By-Pass
Concrete Rubblization

SM 12.5D-1.5”
IM 19.0D- 2”
BM 25.0D+0.8 - 4” HMHB
Rubbled Existing Concrete (9-inch JPCP)
On-going/Future work

1. Asphalt Rubber Gap Graded Mixture (AR-GGM12.5) Overlays
   - IS 85 SB, Dinwiddie County, Richmond District
   - Existing Jointed Concrete Pavements (JCP)

2. GTR Modified Asphalt Surface Mixture (Dry Process), GTR-SM 12.5 (64E-22)
   - US 60 EB & WB, New Kent County
   - GTR Modified SM-12.5E
   - Bottom Layer: Glass Fiber Reinforced Surface Treatment (Fibermat)
   - Existing Jointed Concrete Pavements (JCP)

Project Champions: Sameer Shetty, P.E and Tommy Schinkel, P.E – Richmond District
Accelerated Pavement Testing

Reflective Cracking Study

<table>
<thead>
<tr>
<th>Lane 6</th>
<th>Lane 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>3” SMA</td>
<td>3” SMA</td>
</tr>
<tr>
<td>8” jointed concrete</td>
<td>8” jointed concrete</td>
</tr>
<tr>
<td>6” Compacted Aggregate (21B)</td>
<td>6” Compacted Aggregate (21B)</td>
</tr>
<tr>
<td>Compacted Subgrade (CBR 7.5)</td>
<td>Compacted Subgrade (CBR 7.5)</td>
</tr>
</tbody>
</table>

3” SMA-12.5 with PG64E-22 binder (control)
3” SMA-12.5 (control) + fiber reinforcing additive
Summary

Reflection cracking is a serious challenge associated with pavement rehabilitation.

Saw and Seal and Recycling Techniques were found to be effective.

- Project selection is important

Choosing the right fabric, proper installation and dust free surface are very important for a successful Interlayer project.

- Performing well to date (1~2 Year)

More field performance data is needed to assess highly modified (HP) binder mixtures and rubblized pavements.

- Performing well to date (1~2 Year)
ACKNOWLEDGEMENT

VDOT Central Office Materials
VDOT Central Office Maintenance
VDOT Districts
FHWA
VAA / Industry
Thank you!

Hari Nair, Ph.D., P.E
Senior Research Scientist
Harikrishnan.nair@vdot.virginia.gov