New Composite Pavement Systems

Virginia Concrete Conference
March 3, 2017

Kurt Smith
Applied Pavement Technology, Inc.
Outline

1. What are Composite Pavements?
2. SHRP2 Project R21
3. HMA/PCC Composite Projects
4. SHRP2 R21 Implementation
5. VDOT R21 Composite Pavement
6. Summary
1. What Are Composite Pavements Systems?

• Multi-lift pavement structures designed for long life, rapid renewal, and optimized performance
  – New hot-mix asphalt on portland cement concrete (HMA/PCC)
  – Two-Lift concrete paving (PCC/PCC placed wet-on-wet)
• New construction (not overlays)
Composite Pavement Systems—HMA/PCC

- High-quality, new HMA surface
  - SMA, PMA, WMA, etc.
  - Optimized for design conditions
- New PCC structural layer (JPC, CRC)

1 to 3 in (typical)
Composite Pavement Systems—PCC/PCC

• Thin PCC surface layer
  – Quality aggregates
  – Optimized for conditions (friction, noise)

• Thicker PCC structural layer
  – Local/recycled aggregates

2 to 3 in (typical)

New PCC Surface (thin)
New PCC Lower Layer (JPC, CRC)

Hot Mix Asphalt (SMA, PMA, Superpave, etc.)
Benefits/Advantages of Composite Systems

• Optimized pavement surface (friction, noise)
• Renewable
• Long service life
• Sustainability considerations
  – Use of local/recycled aggregates
  – Reduced transport costs
  – Reduced cement contents (bottom layer)
  – Durability & long life
  – Reduced carbon footprint
• Cost competitive
2. **SHRP2 Project R21**

- Research study, 2007-2011
- Activities:
  - Review of European practices
  - Field demonstration
  - Analytical studies
- Developed improved guidance on design and construction of composite systems
R21 Research Approach for Composite Pavements

• Constructed HMA/PCC projects
  – MnROAD
  – Univ. of Calif. Pavement Research Center (ALF testing)
  – IL Tollway (north of Chicago)
• Constructed PCC/PCC projects
  – MnROAD
• Studied existing projects in U.S. and Europe
• Extensive analysis of HMA/PCC and PCC/PCC behavior and performance
Pavement Design Guidelines

- Proposed revisions to:
  - AASHTOWare Pavement ME Design™ software
  - AASHTO MEPDG Manual of Practice

Technical Guidelines

- Construction Guidelines
- Materials Guidelines
- Quality Management
3. HMA/PCC Composite Projects

- Extensive use in Europe (e.g., Germany, Netherlands)
- Strong use throughout North America (e.g., AZ, OH, IL, TX, ONT)
- PCC Layer = Structural (load-carrying) capacity
- HMA = Functional capacity (smoothness, friction, noise)
- Renewable surface
Germany A93

• 1.2-inch SMA / 10.3 inch JPC
• Major freeway pavement
• 15-ft joints in JPC
• HMA surface sawed & sealed above transverse and longitudinal joints
• Excellent performance
White Road
Columbus, Ohio

- 3-inch HMA / 8-inch RCC
- Local road
- Low to medium traffic levels
- 45-ft Joints in RCC
- HMA surface sawed & sealed
- Easy maintenance for utility cuts
- Good performance
PCC Temperature and Humidity

HMA placed

<table>
<thead>
<tr>
<th>Date</th>
<th>Temperature, °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/16</td>
<td>50 - 120</td>
</tr>
<tr>
<td>5/17</td>
<td>50 - 120</td>
</tr>
<tr>
<td>5/18</td>
<td>50 - 120</td>
</tr>
<tr>
<td>5/19</td>
<td>50 - 120</td>
</tr>
<tr>
<td>5/20</td>
<td>50 - 120</td>
</tr>
<tr>
<td>5/21</td>
<td>50 - 120</td>
</tr>
<tr>
<td>5/22</td>
<td>50 - 120</td>
</tr>
<tr>
<td>5/23</td>
<td>50 - 120</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Relative Humidity, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/16</td>
<td>86 - 100</td>
</tr>
<tr>
<td>5/17</td>
<td>86 - 100</td>
</tr>
<tr>
<td>5/18</td>
<td>86 - 100</td>
</tr>
<tr>
<td>5/19</td>
<td>86 - 100</td>
</tr>
<tr>
<td>5/20</td>
<td>86 - 100</td>
</tr>
<tr>
<td>5/21</td>
<td>86 - 100</td>
</tr>
<tr>
<td>5/22</td>
<td>86 - 100</td>
</tr>
<tr>
<td>5/23</td>
<td>86 - 100</td>
</tr>
</tbody>
</table>

- **4.8-in Temp**
- **9.8-in Temp**
- **4.8-in RH**
- **9.8-in RH**
Potential Concern: Reflective Cracking

• Major issue for HMA/PCC

• Solutions
  – Saw and seal joints
  – Use other mitigation techniques
  – Avoid jointed pavements!

CRCP

Reflection Cracking

Sawed/Sealed Joint
4. **SHRP2 R21 Implementation**

- Part of larger effort to promote findings from SHRP2 research
- Administered by FHWA
- Goal: Support and promote adoption of composite pavement systems
  - HMA/PCC
  - PCC/PCC
- Support period: 2014 to 2018
• FHWA provides incentive funding under SHRP2 R21 project for lead adopters of composite paving technology

• Lead Agencies:
  – Tennessee (October 2015) (PCC/PCC)
  – California (January 2017) (PCC/PCC)
  – Texas (April/May 2017) (PCC/PCC)
  – Virginia (Summer 2017) (HMA/PCC)
5. VDOT R21 Composite Pavement

• Project Description
  – US 60 WB (Henrico County)
  – 2-lane divided suburban highway
    ➢ Open ditch
    ➢ Minor cut/fill
  – 1.22 miles long
  – Traffic: 14,000 ADT (6% trucks)
Project Location

US 60 WB
(I-295 bridge to ~Whiteside Rd.)
Existing Pavement

- 8 inch CRCP/6 inch CTA
- Built in 1979
- 2015 Distress Ratings:
  - CDR = 31
  - CPR = 42
Why Composite? VDOT Experience

SMA/Jointed

SMA/CRC
New Pavement Structure

- 2-inch SMA surface
- 8-inch CRCP base slab
- Underdrains
- 30-year design and 5.3 million ESALs
Current Status

• Advertise March/ April  2017
• Construction July-October 2017
6. Summary

- Composite pavement structures
  - PCC/PCC & HMA/PCC
  - New design (not overlays!)
- Characteristics:
  - Long life
  - Optimized surface characteristics
  - Sustainability benefits
  - Cost competitive
- Several recent and current U.S. projects
- VDOT HMA/PCC composite in Summer 2017
Questions?

Kurt Smith
ksmith@appliedpavement.com

Shabbir Hossain
Shabbir.Hossain@VDOT.Virginia.gov