LTPP SPS-10: Warm Mix Asphalt (WMA) Overlays of AC Pavements

FHWA Asphalt Mixture ETG
April 8, 2015
Fall River, Massachusetts

Jim Musselman
Florida DOT
Background

• Need to investigate long-term performance of WMA
  – Higher potential for rutting?
  – Increased risk of moisture damage?
• Compare WMA to HMA
• Compare various WMA technologies
• Investigate inclusion of RAP in various quantities
## Experimental Design

<table>
<thead>
<tr>
<th>WMA Technology</th>
<th>Wet</th>
<th>Dry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Test Sections on Project</td>
<td>Freeze</td>
<td>No Freeze</td>
</tr>
<tr>
<td>HMA (Control)</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>WMA (Foaming Process)</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>WMA (Chemical Additive)</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

16 Projects
SPS-10 Requirements

• Asphalt overlay of existing asphalt pavements
• Overlay thickness from 2” – 4”
  – Test Sections ~ 800’ long
  – 500’ plus transition and sampling areas
• Dense-graded mix
• RAP content 10 - 25% (binder replacement)
• 1 HMA control test section
• 2 WMA test sections
  – Foaming Process
  – Chemical Additive
Experimental Layer Requirements

• Mix design and asphalt binder grade selection based on Agency’s standard practice
• Overlay thickness selected by Agency’s standard practice
• Uniformity between HMA and WMA
  – Same binder source/grade
  – Same aggregate source/gradations
  – Mix design/JMF
Tests on Experimental Layer

• Dynamic Modulus – Small-scale AMPT (TP 79)
  – 0, 6, 12 and 18 months after construction

• 38 mm diameter x 110 mm height specimens
  – Re-cored horizontally from 6” diameter core
  – OTHERWISE in accordance with AASHTO TP79
Tests on Experimental Layer (cont.)

• Binder Testing – DSR, BBR, MSCR
  – Tank Binder
  – Extracted binder at 0, 6, 12 and 18 months

• Hamburg Wheel Tracker
  – Initial time period only

• Basic Mix Characterization
  – $G_{mb}$, $G_{mm}$, $P_b$, $G_{se}$, $G_b$, aggregate gradation
Tests on Existing Asphalt Layers

- Dynamic Modulus – Small-scale AMPT (TP 79)
- Binder Testing – DSR, BBR, MSCR
- Hamburg Wheel Tracker
- Basic Mix Characterization
  - $G_{mb}$, $G_{mm}$, $P_b$, $G_{se}$, $G_b$, aggregate gradation

All tests performed at initial time period only
ETG Recommendations

• Supplementary Tests for Agencies:
  – Based on NCHRP Research Digest 370
  – “Guidelines for Project Selection and Materials Sampling, Conditioning, and Testing in WMA Research Studies”
## Supplementary Tests

### Rutting

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Number (AMPT)</td>
<td>AASHTO TP 79</td>
</tr>
<tr>
<td>Hamburg Test</td>
<td>AASHTO T 324 (Note: Prepare specimens at air voids content of 7±1% and conduct test at standard conditions: 50°C under water.)</td>
</tr>
<tr>
<td>APA</td>
<td>AASHTO T 340</td>
</tr>
</tbody>
</table>

### Modulus

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Modulus (AMPT)</td>
<td>AASHTO PP 61</td>
</tr>
</tbody>
</table>

### Fatigue Cracking

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beam Fatigue</td>
<td>AASHTO T 321</td>
</tr>
<tr>
<td>Simplified Viscoelastic Continuum Damage (S-VECD)</td>
<td>AASHTO TP 107</td>
</tr>
<tr>
<td>Superpave Indirect Tension Test (IDT)</td>
<td>University of Florida</td>
</tr>
<tr>
<td>Semi-Circular Bending Test at Intermediate Temperatures</td>
<td>Louisiana Transportation Research Center (LTRC)</td>
</tr>
</tbody>
</table>

### Thermal (Low Temperature) Cracking

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDT Creep Compliance and Strength</td>
<td>AASHTO T 322</td>
</tr>
<tr>
<td>Semi-Circular Bending Test</td>
<td>AASHTO TP 105</td>
</tr>
<tr>
<td>Disk Shaped Compact Tension – DC(T) Test</td>
<td>ASTM D7313</td>
</tr>
</tbody>
</table>
## Supplementary Tests

### Durability

<table>
<thead>
<tr>
<th>Test</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture Sensitivity</td>
<td>AASHTO T 283 (Note: 1 Freeze/Thaw cycle)</td>
</tr>
<tr>
<td>Hamburg Test</td>
<td>AASHTO T 324 (Note: Prepare specimens at air voids content of 7±1% and conduct test at standard conditions: 50°C under water.)</td>
</tr>
</tbody>
</table>

### Other

<table>
<thead>
<tr>
<th>Test</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>$G_{mm}$</td>
<td>AASHTO T 209</td>
</tr>
<tr>
<td>Volumetric Properties</td>
<td>AASHTO R 35</td>
</tr>
<tr>
<td>Gyratory Compaction to $N_{design}$</td>
<td>AASHTO T 312</td>
</tr>
</tbody>
</table>

Additional information on these recommended tests can be found at the following location:

Current Status

• 27 States/Provinces plan to nominate a project
• To date, 18 projects have been nominated:
  – 13 projects accepted
  – 3 projects rejected
  – 2 projects being evaluated
Accepted Project Nominations

- Arizona (2)
- Ontario (2)
- Florida
- Georgia
- Nevada
- New Mexico
- Oklahoma
- Oregon
- Texas
- Washington
- Manitoba
Plans to Nominate

- Alabama
- Arkansas
- Delaware
- District of Columbia
- Kansas
- Louisiana
- Michigan
- Minnesota
- Nebraska
- North Carolina
- Rhode Island
- South Carolina
- Vermont
- Virginia
- Quebec
- Saskatchewan
Supplemental Sections

- Agencies can build additional test sections that will be monitored as part of the LTPP program
  - Varying levels of RAP
  - Additional WMA technologies
  - Layer thickness variation
  - Open or gap graded mixtures
  - Varying aggregate sources/absorption levels
  - Other variables of interest to Agency
ETG Recommendations

• Supplementary Test Sections:
  – Variable Density Levels
  – WMA produced at HMA temperatures
  – Other WMA technologies
  – High Recycle Binder Ratio (>0.25) Mixes
Southern Region

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Southern Region

• New Mexico - I-40 (October 2014)
  – WMA with chemical additive (Cecabase)
  – WMA with chemical additive (Cecabase) and PG 70-28+ binder (standard binder is PG 70-28 binder)

• Oklahoma - SR-66 (April 2015)
  – Stone matrix asphalt with chemical WMA additive
    • No fibers, RAP, or RAS
  – PG 64-22 binder with 10% - 25% RAP/RAS
    • standard binder is PG 70-28
  – PG 58-28 binder with 10% - 25% RAP/RAS
Southern Region

• Georgia – US-84 (Summer 2015)
  – 1.5” overlay (standard overlay is 2”)
• Texas - US-277 (February 2015)
  – No Supplemental Sections
• Florida – SR-77 Jackson County (Spring 2016)
  – Chemical at HMA temperature
  – Foaming with >35% RAP
  – Chemical with >35% RAP
Western Region

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Western Region

• Arizona: (Both projects will have the same supplemental test sections):
  – 1 foaming section with increased RAP,
  – 1 chemical section with increased RAP,
  – 1 HMA with increased RAP.

• Nevada:
  – 1 organic WMA section,
  – 1 foaming additive,
  – 1 foaming additive with TBR (terminal blend rubber),
  – HMA with TBR
Western Region

• Oregon:
  – 1 foaming section produced at hot mix temperatures,
  – 1 HMA section with increased RAP

• Washington:
  – 1 HMA section with ½” NMAS and 60 gyration mix
  – 1 foaming section with ½” NMAS and 60 gyration mix,
  – 1 HMA section with 3/8” NMAS and 100 gyration mix,
  – 1 HMA with 3/8” NMAS and 60 gyration mix
North Central Region

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North Central Region

• Manitoba:
  – WMA Chemical Additive & Foaming Process test section (Evotherm and Water),
  – WMA Foaming Process test section (water).
North Atlantic Region

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North Atlantic Region

• Ontario:
  – WMA Chemical Additive test section (Rediset),
  – WMA Organic Additive test section (SonneWarmix).
Summary

• 13 of the 16 projects have been selected
  – 5 Western Region
  – 5 Southern Region
  – 2 North Atlantic Region
  – 1 North Central Region

• Majority will be constructed 2015
  – Time’s running out if you need something

• Most states are adding supplemental sections
Contacts

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Jack Springer, FHWA-LTPP Jack.springer@dot.gov
International Society of the Sweater Vest
Thank You... Questions?