Construction Task Force Update
FHWA Mix ETG

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Discussion Points

• High RAM Projects and Performance Testing
• Joint Density in-Progress Research
• Solicit Mix ETG for future task force activities
High RAM Projects

• 2014
  – STH 77 Ashland CTY WI. Part of WisDOT High RAM Pilot Program

• 2015
  – Three projects in NC WI and Central MN. One state road and two county highways.

• % Binder Replacement ~40%.

• Incorporate performance testing in mix design and production testing.
Selected Performance Tests

**Thermal Cracking**
- DC(t)
  - LT (-18 or -24°C)

**Fatigue**
- Semi-Circular Bend (LSU and UIUC)
  - IT (15°C)-LSU 25°C - UIUC

**Rutting**
- Hamburg
  - HT (50°C)

**Long Term Aging – Loose Mix Aging 12 hours @ 135°C**
- SCB and DCT
- Recovered binder grade and ΔTc
### High RAM General Approach

#### Materials Selection

<table>
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<tbody>
<tr>
<td><em>Obtain millings from project.</em></td>
<td><em>Apply Blending Charts: Target Plan Grade.</em></td>
<td><em>Same process as conventional mix design.</em></td>
</tr>
<tr>
<td><em>Extract/RAM binder and determine true PG.</em></td>
<td><em>Select virgin binder grade: PG 58-28, PG 52-34, PG 58-40</em></td>
<td><em>Target %AV of 3.5% of 4.0% used.</em></td>
</tr>
<tr>
<td><em>Average LT grade of RAP ~-24°C</em></td>
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## High RAM General Approach

### Mix Design and Performance Testing

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
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</table>
| 4. Verify Binder Properties | - Extraction and recovery on mix design pill.  
- Grading based on as-recovered and as-recovered + PAV. Include $\Delta T_c$  
- Have also used binder from loose mix aging. |
| 5. Evaluate Hamburg | - Verify the mix has adequate stability.  
- Reasons for instability could be grade dumping or use of more asphalt binder. |
| 6. Cracking Resistance | - 12 hours at 135°C – Loose Mix Aging  
- Mixture: SCB @ 15°C, DCT @ PG LT +10°C, Fracture Energy > 400 J/m² |
Testing Plan

• Mix Design
• Construction
  – 1\textsuperscript{st} 600 ton of production
  – Every 10k ton after.
• Future Evaluation
  – Field performance surveys.
  – Coring and analysis of mixture modulus (TB), cracking tests and recovered binder properties.
Example – STH 77 Comparison to Control Mix

• At a minimum our expectation was that the high RAM mix would perform as well as conventional mixes placed in WI.
• Primary distress in WI is cracking, comparison will focus on
  – Recovered binder grading
  – DCT testing
  – Sensitivity to aging
## Comparison of Mix Designs

<table>
<thead>
<tr>
<th>Property</th>
<th>Control Mix – 12.5mm</th>
<th>High RAM 12.5mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Binder Replacement</td>
<td>24.5%</td>
<td>36.7%</td>
</tr>
<tr>
<td>Design Air Void</td>
<td>4.0%</td>
<td>3.5%</td>
</tr>
<tr>
<td>VMA</td>
<td>15.1%</td>
<td>14.9%</td>
</tr>
<tr>
<td>Vbe</td>
<td>12.7%</td>
<td>13.3%</td>
</tr>
<tr>
<td>Dust to Binder Ratio</td>
<td>0.90</td>
<td>1.0</td>
</tr>
<tr>
<td>Asphalt Binder Grade</td>
<td>PG 58-34</td>
<td>PG 58-40</td>
</tr>
<tr>
<td>MSCR Jnr 3.2 kPa @ 58°C</td>
<td>3.0</td>
<td>1.1</td>
</tr>
<tr>
<td>MSCR %R 2.3 kPa @ 58°C</td>
<td>0</td>
<td>43.5%</td>
</tr>
</tbody>
</table>
Binder recovered from mixes subjected to loose mix aging at 135°C

- High RAM mix is softer after 12 hours loose mix aging, mixes behave the same at 24 hour aging.
- Differences in R (2.8 vs. 3.0) and cross over frequency (61 rad/s vs. 12 rad/s) observed for high RAM mix.
DCT Results @ -24C

Load vs. CMOD(fit) – 12 hr Loose Mix Aging

<table>
<thead>
<tr>
<th>Mix</th>
<th>Gf: 12 Hr Loose Mix Aging (J/m²)</th>
<th>Gf: 24 Hour Loose Mix Aging (J/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High RAM</td>
<td>634.3</td>
<td>70.8</td>
</tr>
<tr>
<td>Control</td>
<td>296.1</td>
<td>20.4</td>
</tr>
<tr>
<td>High RAM</td>
<td>587.5</td>
<td>127.9</td>
</tr>
<tr>
<td>Control</td>
<td>360.4</td>
<td>5.0</td>
</tr>
</tbody>
</table>
• High RAM Section was 4 miles long.
• Control is 9 miles.
• Overall pavement is performing well.

• Very few transverse cracks.
• Small crack width
• No difference in performance between sections.
Final Remarks

• Performance testing has evolved from a research tool to part of conventional practice in our lab.
• We have found it beneficial to adjusting mix designs or materials selection.
• With this set of projects there is an opportunity to compare actual field performance to laboratory test results.
• Possibility to compare lab conditioning vs. field aging.
Future Research Activities

1. Effect of Laboratory Aging
   • Understand effect of aging on performance tests.
   • Compare lab aged vs. field aged materials.
   • Loose mix aging vs. PAV.

2. Comparison of High RAM to Standard Mixes
   • Establish baseline for performance properties.
   • Compare rates of aging.

3. Contribute to identifying performance based limits.
Performance Testing Challenges

- Test procedure harmonization: conditioning, sample geometry, etc.
  - Example: WisDOT vs. MnDOT DCT, Notch depth/width for different cracking tests.
- Repeatability within lab and between lab.
  - ASTM working group for SCB, cracking test study with Rutgers.
- Aging: Protocol and relation to field.
- Selecting tests and performance criteria
  - Use “standard” mixes as a baseline.
Laboratory vs. Field Aging, (Reinke, 2015 ETG)

12 Hr. Loose Mix @ 135°C

\[ y = 1.4934x - 0.0519 \]
\[ R^2 = 0.9818 \]

As binder becomes more m-controlled (neg. Tc), this aging protocol under-represents 8 years field aging in Minnesota.
Laboratory vs. Field Aging (Reinke, ETG 2015)

24 Hr. Loose Mix @ 135°C

ΔTc of Binder recovered from top 1/2 of core

ΔTc of Binder recovered from 24 hr., 135°C aged loose mix

y = 0.8497x + 0.6405
R² = 0.9971

Aging protocol over-predicts 8 years field aging in Minnesota. Over prediction becomes worse as Tc becomes more negative.
Longitudinal Joint Density Research

• WisDOT Funded **0092-15-09**
  – Asphalt Mixture New Specifications Implementation – Field Compaction and Density Validation (end June 2016)

• Two specific initiatives that require additional field research and evaluation
  – Special provision for Thin Layer Overlays
  – Evaluate density measurements of longitudinal joints to assess construction and compaction

• Mathy is also collecting joint density data on projects in WI, MN, IA, and MI.
Open Discussion

• Task Group gave updates on two items:
  – Performance testing on lab and field produced mix. Future opportunity to compare lab measures to field performance.
  – Longitudinal Joint Density work that will be complete in 2016.

• Suggestions from the ETG for other activities?
Thank you

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