STH 77 Project Objectives

• Design High PBR Mixes Using RAP
  – Meet project specifications

• Primum non nocere
  – First, do no harm.

• Meet performance objectives
  – No rutting
  – No cracking
    • (minimize) thermal and
    • fatigue

Project Overview:
• 13 Miles
• 9 Miles Standard - E3 Mixture
• 4 Miles High RAM SPV- E3 Mixture
• 4” Total Thickness
• 60K Ton Total (16K High RAM)
• Table 460.2 Modified – Target AV = 3.5%
• WMA Additive Used
Location: Clam Lake to Sth 13

• Total Project Length – 13.69 miles
  – 3” pavement depth
  – 1.25” Leveling Layer 12.5mm E3 PG 58-34P
  – 1.75” Upper Layer 12.5mm E3 PG 58-34P

• High Recycle Length – 4.08 miles (West End)
  – 4” total pavement depth
  – 2.25” Lower Layer 19mm E3 High Recycle
  – 1.75” Upper Layer 12.5mm E3 High Recycle
Hamburg Results – Stripping Inflection Point (SIP)

Effects of Sample Conditioning

Sample conditioning effect

<table>
<thead>
<tr>
<th>Condition</th>
<th>Average SIP</th>
<th>RSlope</th>
<th>SSlope</th>
<th>Rut Depth @ 5000 passes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2hr Conditioning</td>
<td>5450 passes</td>
<td>6.4</td>
<td></td>
<td>5.9mm</td>
</tr>
<tr>
<td>4hr Conditioning</td>
<td>8050 passes</td>
<td>5.2</td>
<td></td>
<td>3.4mm</td>
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</tbody>
</table>
DCT - Disc Shaped Compact test

- Low temperature cracking
- 400 J/m² the desired minimum
- Run at 10C above the design required minimum
  - Dsn PG: -34 C
  - Test Temp: -24 C
SCB – Semi-Circular Bend Test at intermediate temperature

- Wheel path fatigue cracking
- Following the Louisiana Procedure
- 3 different notch depths
  - 25.4, 31.8 and 38.1 mm
- No set limit, collecting information for specification development
Northern Climate requires that we balance rutting resistance with cracking performance at both intermediate and low temperatures.

- Rut depth < 12.5mm
- Minimum Cracking Resistance
  - Inter. Temp - SCB: Jc > 0.4 kJ/m²
  - Low Temp - DCT: FE > 400 J/m²
- Target is upper left quadrant.
**Intermediate Temperature (SCB)**
- SCB conditions greatly affect comparison to national threshold value.
- Important to consider climate in temp. selection.

**Low Temperature (DCT)**
- At -24°C fracture energy exceeds specification minimum.
- Mix performance is indicator that a thermal cracking resistant mix can be designed using the current SPV.
<table>
<thead>
<tr>
<th>Lab</th>
<th>Sample</th>
<th>Notch (mm)</th>
<th>Max Load (kN)</th>
<th>Disp. @ max load (mm)</th>
<th>Fracture Energy</th>
<th>Friction Reducer</th>
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</thead>
<tbody>
<tr>
<td>MTE</td>
<td>1</td>
<td>26.93</td>
<td>1.45</td>
<td>0.96</td>
<td>0.75</td>
<td>Teflon</td>
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<tr>
<td>Brovold</td>
<td>2</td>
<td>25.35</td>
<td>1.25</td>
<td>1.11</td>
<td>0.79</td>
<td>Teflon</td>
</tr>
<tr>
<td>Brovold</td>
<td>1</td>
<td>25.40</td>
<td>1.95</td>
<td>1.09</td>
<td>1.23</td>
<td>No Teflon</td>
</tr>
</tbody>
</table>
STH 77 Results

Temperature (C) vs. Jc:
- Dissipated Energy Jc (blue line)
- Elastic Jc (red line)
- Total Jc (green line)
STH 77 Results

![Bar chart showing Jc values for Plastic 5C, Elastic 5C, Total 5C, Plastic 15C, Elastic 15C, and Total 15C. The chart compares 12 Hr Aged and 24 Hour Aged conditions.](chart.png)
More Results

- 70-28 WF
- 70-28 SB
- 70-28 AB
- 58-40 RAP 15C

Total Jc

- 5 Day/12 Hour Aging
- 10 Day/24 Hour Aging
More Results

Elastic Jc

<table>
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<tr>
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<th>5 Day/ 12 Hr Aging</th>
<th>10 Day/24 Hour Aging</th>
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<td>70-28 WF</td>
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Planned Activities

- ASTM Collaboration Site: [WK48574](#) - New Standard Evaluation of Asphalt Mixture Crack Propagation using the Semi-Circular Bend Test (SCB) at Intermediate Temperature
- Continued Ruggedness Testing – round 4
- ASTM ILS Study – 10labs
- ASTM/AASHTO Specification

- Black Space beginning considered