National Pavement Advancements
MnROAD/NCAT Partnership

Safer, Smarter, Sustainable Pavements through Innovative Research

Ben Worel
October 13, 2016

National Pavement Preservation Conference 2016
History of MnROAD

- MnROAD Owned and Operated by Minnesota DOT
  - Mainline and Low Volume Road
- 22-Years of Long Term Customer Service
  - Minnesota Department of Transportation
  - Minnesota Local Road Research Board
  - Pooled Funds Efforts (States) / Industry
  - SHRP II / FHWA
  - National Road Research Alliance (NRRA)
- Major Experiments
  - Phase I (1994-2006)
  - Phase II (2007-2016)
  - Phase III (Currently Planning → NRRA Directed)
MnROAD Operations

• Research Development
• Construction
• Performance Monitoring
  – Cracking / Rutting / Ride
  – Deflection (FWD), ..... 
• Sensors
  – Static (Environmental)
  – Dynamic (Traffic Loading)
• MnROAD Database
• Technology Transfer/Samples
• Traffic Loadings
MnROAD Project Benefits

• Phase-1
  – **9:1** B/C Ratio
  Highlights → Seasonal Load Restrictions; Low Temp Cracking

• Phase-2
  – **5:1** B/C Ratio
  Highlights → Surface Characteristics (HMA/PCC), Pervious Pavements, Implements Husbandry, Stabilized Full Depth Reclamation, Lightly Surface Roadways, Chip Seal Video, Whitetopping, Thin PCC, Optimal Timing of Preventive Maintenance, Low Temperature Cracking II, Quiet Rumble Strips, Drainable/Stabile Bases
MnROAD Pavement Preservation Benefits

- Crack Sealing
- Chip Seals
- Microsurfacing
- Transverse Crack Repairs
MnROAD Pavement Preservation Benefits

- Partial Depth Patches
  - Installed 2011 (22 materials/93 joints)
  - [http://www.lrrb.org/media/reports/201616.pdf](http://www.lrrb.org/media/reports/201616.pdf)

- Diamond Grinding
  - 2008 National Pooled Fund

- Full Depth PCC Repairs

- Dowel Bar Retrofits
National Research Initiatives

Pooled Fund - TPF-5(267)

National Pavement Preservation Study
Development of a National Cracking Test
National HMA Cracking Performance Test

• **Partnerships** (Utilize both MnROAD / NCAT Test Tracks)
  – Top Down / Reflection / LTC cracking Efforts
  – Range of cracking potential mixes
  – Battery of testing of many different existing tests Nationally

• **Goals (We need....)**
  – Tests and criteria that relate to performance.
  – Practical for both mix design verification and quality control testing purposes.
  – Accommodate recycled materials, new and future additives, and combinations.
### MnROAD HMA Mix Designs – 2016

<table>
<thead>
<tr>
<th>MIX DESCRIPTION</th>
<th>RAP</th>
<th>RAS</th>
<th>CELL</th>
<th>BINDER</th>
<th>Aggregate Size</th>
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National Pavement Preservation Study

• Partnership
  – MnROAD (North) / NCAT (South)
    • Offsite Low and High Volume Road Installations
    • Asphalt Focus (no Concrete, yet)
  – FP² / National Center for Pavement Preservation
  – Government / Academia / Industry involvement

• Goals
  – National Study (Climatic zones)
  – Provide consistently collected data / analysis
  – Quantify the life extending benefits
National Pavement Preservation Study

Mille Lac County

US-169
High Volume Road
4 mile section

County Road 8
Low Volume Road
2.5 mile section

Rum River Bridge
RP 189.9

MnROAD
National Pavement Preservation Study

Northern High Traffic Preservation on US-169
PreTreatment Condition
US-169
Northbound Lanes
PreTreatment Condition

CSAH-8

East and Westbound Lanes
Construction Documentation

• Setup (Truck Station)
  – Equipment
  – Get working
• Calibration (Truck Station)
  – Emulsion Rates
  – Aggregates Rates
  – Mix Designs
• Verification (Field)
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Crack Sealing / Mastic Details

- Crack Sealing
  - Hot Poured, Crafco 522 = 3725 spec.
  - Overbanded, routed both transverse, and a few longitudinal cracks.

- Mastic
  - Crafco Mastic One
  - Applied to bad longitudinal joint on US 169, and transverse cupped cracks on CSAH 8.
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Chip Seal Details

Single, FA 2.5
- 0.33 g/sy at application temp
- 23 lbs/sy

Double, FA 2.5 covered by FA2
- FA2.5 at 0.29 g/sy and 17 lbs/sy
- FA2 at 0.29 g/sy and 15 lbs/sy

Triple, CA 70, FA2.5, FA2
- CA70 at 0.30 g/sy and 25 lbs/sy
- FA 2.5 at 0.41 g/sy and 21 lbs/sy
- FA2 at 0.30 g/sy and 15 lbs/sy
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Scrub Seals

Northern
Low Traffic
Preservation
CSAHI-8
Scrub Sealing Details

Pull a broom system, behind the distributor to scrub the emulsion into cracks

- Uses a rejuvenating emulsion
  - PASS CR from Asphalt Materials Inc.

- Scrub and scrub covered by microsurfacing
  - FA 2.5 at 0.30 g/sy and 20.5 lbs/sy

- Scrub covered by 4.75 mm thinlay on milled HMA
  - FA 2.5 at 0.36 g/sy and 20.5 lbs/sy
1. Crack Seal / Transverse Mastic
2. Single Chip Seal (FA2.5) over Crack Seal / Transverse Mastic
3. Single Chip Seal (FA 2.5)
4. **Microsurfacing (Type-III) over Single Chip Seal (FA 2.5)**
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Microsurfacing Details

- Type II on US 169
- Type III on CSAH 8 (3 Cells)
- Emulsion CQS-1hP
  - CQS-1P did not pass ISSA mix specifications
- Single (19.2 lbs/sy $\rightarrow$ 13.6% emulsion)
- Double (16 lbs/sy (each) $\rightarrow$ 13.5% emulsion)
- Micro over surface treatment (25 lbs/sy $\rightarrow$ 12.5% emulsion)
Microsurfacing QA/QC Innovation

- Field Test Method
- Simple test to Verify
  - Water Content
  - Asphalt Content
  - Aggregate Percent
  - Aggregate Gradation
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Thinlay Details

- 0.75” Mill and Fill
- 4.75 mm HMA
  - Virgin
  - ABR (asphalt binder replacement)
    - 12% fine frac RAP and 3% RAS
  - ARB with Delta S rejuvenator
  - HiMA binder 64E-34 (US 169 only)
  - UTBWC
  - On CSAH 8, chip seal, scrub seal and fibermat chip seal, all under ABR HMA
1. Crack Seal / Transverse Mastic
2. Single Chip Seal (FA2.5) over Crack Seal / Transverse Mastic
3. Single Chip Seal (FA 2.5)
4. Microsurfacing (Type-III) over Single Chip Seal (FA 2.5)
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28. Ultra Thin Bonded Wearing Coarse
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30. Control
Fog Seal Details

• Conventional fog seal
  • CSS-1H, diluted 1:1, shot at 0.10 g/sy
  • Black Diamond Dust

• Rejuvenating fog seal
  • PASS QB (CMS-1P), target 0.10 g/sy
  • Black Diamond Dust
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28. **Ultra Thin Bonded Wearing Coarse**
29. Thinlay Overlay (4.75 mm with RAP and RAS) Delta S
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UTBWC Details

- Ultra Thin Bonder Wearing Course
- Gap Graded Mix
- Spray Paver
- Polymer Modified Quick Break Tack
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</tr>
<tr>
<td>3</td>
<td>Single Chip Seal (FA 2.5)</td>
</tr>
<tr>
<td>4</td>
<td>Microsurfacing (Type-III) over Single Chip Seal (FA 2.5)</td>
</tr>
<tr>
<td>5</td>
<td>Double Chip Seal (FA 2 over FA 2.5)</td>
</tr>
<tr>
<td>6</td>
<td>Triple Chip Seal (FA 2 over FA 2.5 over CA-70)</td>
</tr>
<tr>
<td>7</td>
<td>Fibermat Chip Seal (FA 2.5)</td>
</tr>
<tr>
<td>8</td>
<td>Microsurfacing (Type III) over Fibermat Chip Seal (FA 2.5)</td>
</tr>
<tr>
<td>9</td>
<td>Microsurfacing (Type III) over Scrub Seal (FA 2.5)</td>
</tr>
<tr>
<td>10</td>
<td>Scrub Seal (FA2.5)</td>
</tr>
<tr>
<td>11</td>
<td>Microsurfacing (Type II) over crack seal and Transverse Mastic</td>
</tr>
<tr>
<td>12</td>
<td>Microsurfacing (Type II)</td>
</tr>
<tr>
<td>13</td>
<td>Double Microsurfacing (Type II over Type II)</td>
</tr>
<tr>
<td>14</td>
<td>Conventional Fog Seal with black diamond dust</td>
</tr>
<tr>
<td>15</td>
<td>Rejuvenating Fog Seal with black diamond dust</td>
</tr>
<tr>
<td>16</td>
<td>Thinlay Overlay (ABR over fibermat (FA 2.5))</td>
</tr>
<tr>
<td>17</td>
<td>Thinlay Overlay (ABR over Scrub Seal (FA 2.5))</td>
</tr>
<tr>
<td>18</td>
<td>Thinlay Overlay (ABR over Chip Seal (FA 2.5))</td>
</tr>
<tr>
<td>19</td>
<td>Control</td>
</tr>
<tr>
<td>20</td>
<td>Control</td>
</tr>
<tr>
<td>21</td>
<td>Control  END OF EB CELLS</td>
</tr>
<tr>
<td>22</td>
<td>Control  FIRST WB CELL</td>
</tr>
<tr>
<td>23</td>
<td>Thinlay Overlay (4.75 mm)</td>
</tr>
<tr>
<td>24</td>
<td>Thinlay Overlay (4.75 mm with RAP and RAS)</td>
</tr>
<tr>
<td>25</td>
<td>Control</td>
</tr>
<tr>
<td>26</td>
<td>Control</td>
</tr>
<tr>
<td>27</td>
<td>Control</td>
</tr>
<tr>
<td>28</td>
<td>Ultra Thin Bonded Wearing Coarse</td>
</tr>
<tr>
<td>29</td>
<td>Thinlay Overlay (4.75 mm with RAP and RAS) Delta S</td>
</tr>
<tr>
<td>30</td>
<td>Control</td>
</tr>
</tbody>
</table>
Open Graded Friction Coarse “OGFC”

OGFC/PCC
- conventional tack
OGFC/PCC
- ultrafuse tack
OGFC/HMA
- ultrafuse tack
OGFC/HMA
- conventional tack

August 2016 – Harddrives Contractor
Thank You

Contractors and Material Suppliers

- Vance Brothers
- Brockwhite
- Crafco
- Colas
- Etyner
- Astech Corp

- Hardrives
- Roadtech
- East Alabama Paving
- Collaborative Aggregates
- Asphalt Materials
- Martin Marietta Materials
Commitment Requirements

• Short Term (till 2018)
  • Results as they become available
  • Document Performance

• Long Term (after 2018)
  • Expect long term commitment needed (10-15 years)
  • Data to support the life extending /condition benefits
Thank You

MnROAD/NCAT Sponsor Meeting
Minneapolis – October 26-27, 2016