New and Emerging HMA Technologies and Proven Pavement Preservation

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Presentation Outline

- MnROAD – NCAT partnership
- Northern Experiment
- Southern Experiment
- Future Opportunities
First of All
Thank you!
Investment into Pavement Research

Minnesota Highway System

2000
Average RSL = 13.7 years

Percent Roadway Miles

Remaining Service Life (years)

MnROAD

NCAT at Auburn University
Investment into Pavement Research

Minnesota Highway System

2013
Average RSL = 9.4 years

2000
Average RSL = 13.7 years

Roadway Miles

Remaining Service Life (years)
MnROAD & NCAT Background

MnROAD
- Entering 3rd Phase / 23 Years of Customer Service
- 7 miles of Interstate and 2.5 Low Volume Road
- HMA / PCC / Composite Pavements

NCAT
- Entering 7th 3-year Cycle / 16 Years of Customer Service
- 1.7 mile Test Track
- HMA

Commonalities
- Built and Operational
- Knowledgeable Dedicated Staff
- History of Positive Results
MnROAD & NCAT Partnership

• Development
  – Informal in the past
  – June 2014 @ MnROAD
  – October 2014 @ NCAT
  – FP² / NCPP Participation

• Partnership Benefits
  – Individual Strengths of Each Other
  – Operations / Data Sharing / Analysis
  – North/South Environmental Zones
  – Greater National Appeal
Common Activates

Common Performance Monitoring
  • Dedicated Pathways Van
    • Cracking/Rutting/Ride
  • Deflection (FWD), .....

Traffic Monitoring

Sensor Monitoring

Database
  • Utilize the MnROAD common database with NCAT

Communication
  • Joint Planning Meeting with Sponsor's
  • Website
  • Reporting
  • National Presentations
Partnership Vision for Nationwide Impact

To facilitate high value pavement research that addresses national needs using full-scale pavement testing facilities in both warm and cold climates on flexible, rigid, and composite pavement structures.
National Research Initiatives

National Pavement Preservation Study
Development of a National Cracking Test
2015 HMA Performance Test
Research Sponsors

[Map of the United States showing states with the research sponsors highlighted]
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.
• We need tests that are practical for both mix design verification and quality control testing purposes.
• We need tests that accommodate recycled materials, new and future additives, and combinations.
<table>
<thead>
<tr>
<th>MIX DESCRIPTION</th>
<th>RAP</th>
<th>RAS</th>
<th>CELL</th>
<th>BINDER</th>
<th>Aggregate Size</th>
<th>POLY</th>
<th>CRACK POTENTIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Temp Mix</td>
<td>~30</td>
<td>5</td>
<td>16</td>
<td>PG 64S-22</td>
<td>12.5mm</td>
<td>No</td>
<td>High</td>
</tr>
<tr>
<td>High Temp Mix</td>
<td>&lt;20</td>
<td>3</td>
<td>17</td>
<td>PG 64S-22</td>
<td>12.5mm</td>
<td>No</td>
<td>High</td>
</tr>
<tr>
<td>High Temp Mix</td>
<td>&lt;20</td>
<td>0</td>
<td>18</td>
<td>PG 64S-22</td>
<td>12.5mm</td>
<td>No</td>
<td>Med/High</td>
</tr>
<tr>
<td>High Temp Mix + regressed voids (3.0)</td>
<td>&lt;20</td>
<td>0</td>
<td>19</td>
<td>PG 64S-22</td>
<td>12.5mm</td>
<td>No</td>
<td>Med/High</td>
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<tr>
<td>Soft Binder Mix</td>
<td>&gt;30</td>
<td>0</td>
<td>20</td>
<td>PG 52S-34</td>
<td>12.5mm</td>
<td>No</td>
<td>Med</td>
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<tr>
<td>Typical Low-Temp Mix</td>
<td>&lt;20</td>
<td>0</td>
<td>21</td>
<td>PG 58H-34</td>
<td>12.5mm</td>
<td>Yes</td>
<td>Low</td>
</tr>
<tr>
<td>Typical Low-Temp Mix + limestone</td>
<td>&lt;20</td>
<td>0</td>
<td>22</td>
<td>PG 58H-34</td>
<td>12.5mm</td>
<td>Yes</td>
<td>Low/Med</td>
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<tr>
<td>HiMA Mix</td>
<td>&lt;15</td>
<td>0</td>
<td>23</td>
<td>PG 64E-34</td>
<td>12.5mm</td>
<td>Yes</td>
<td>Low</td>
</tr>
</tbody>
</table>
DCT Fracture Energy Results
Illinois Flexibility Index Test (IFIT)
RDM appears to be a valid approach to measure density

- Working to develop methods to assist construction
- Significantly higher density within mat as compared to confined and unconfined joints
- Relationship is unique, dielectric affected by aggregate type:
  - Granite ~5
  - Limestone ~7
2015 Pavement Preservation Research Sponsors

FP²

MnROAD

National Center for Asphalt Technology at Auburn University
Pavement Preservation Goals

Partnership

• MnROAD (North) / NCAT (South)
  • Offsite Low and High Volume Road Installations
• 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
Northern Pavement Preservation

Mille Lac County

US-169
High Volume Road
4 mile section

Rum River Bridge
RP 189.9

County Road 8
Low Volume Road
2.5 mile section

County Road 146
RP 185.3
Pre-Treatment Condition

US-169
Northbound Lanes
Pre-Treatment Condition

County State Aid Highway (CSAH-8) EB and WB Lanes
Treatment Condition (February 2017)
Open Graded Friction Coarse “OGFC”

MnROAD – Low Volume Road

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

August 2016 – Hardrives Contractor
<table>
<thead>
<tr>
<th>Treatment/Combination</th>
<th>LR-159</th>
<th>PaveTrack</th>
<th>US-280</th>
<th>MnROAD</th>
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<tbody>
<tr>
<td>Fog Seal</td>
<td>-1</td>
<td>E4B,E5A</td>
<td>12</td>
<td>X</td>
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<tr>
<td>Rejuvenating fog seal</td>
<td>1</td>
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<td>11</td>
<td>X</td>
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<tr>
<td>FiberMat chip seal</td>
<td>2</td>
<td></td>
<td>25</td>
<td>X</td>
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<tr>
<td>Crack sealing only</td>
<td>5</td>
<td>S2</td>
<td>8</td>
<td>X</td>
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<tr>
<td>Chip seal</td>
<td>6</td>
<td>S11A</td>
<td>16</td>
<td>X</td>
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<td>Chip seal w/ crack sealing</td>
<td>7</td>
<td></td>
<td>14</td>
<td>X</td>
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<tr>
<td>Triple layer chip seal</td>
<td>8</td>
<td></td>
<td>26</td>
<td>X</td>
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<tr>
<td>Double layer chip seal</td>
<td>9</td>
<td></td>
<td>27</td>
<td>X</td>
</tr>
<tr>
<td>Cape seal (micro surface over chip seal)</td>
<td>10</td>
<td></td>
<td>23</td>
<td>X</td>
</tr>
<tr>
<td>Single layer micro surface</td>
<td>11</td>
<td>S9B,N6A</td>
<td>18</td>
<td>X</td>
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<tr>
<td>Single layer micro surface w/ crack sealing</td>
<td>12</td>
<td></td>
<td>22</td>
<td>X</td>
</tr>
<tr>
<td>Double layer micro surface</td>
<td>13</td>
<td>7,28</td>
<td></td>
<td>X</td>
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<tr>
<td>FiberMat Cape seal</td>
<td>14</td>
<td></td>
<td>24</td>
<td>X</td>
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<tr>
<td>Scrub Cape seal</td>
<td>15</td>
<td></td>
<td>21</td>
<td>X</td>
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<tr>
<td>Scrub seal</td>
<td>16</td>
<td>S10B</td>
<td>15</td>
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<td>HMA FiberMat Cape seal (Thinlay on FiberMat chip seal)</td>
<td>18</td>
<td>S10A</td>
<td>36</td>
<td>X</td>
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<tr>
<td>Thinlay</td>
<td>19</td>
<td>S9A</td>
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<td>Thinlay on Foamed Cold Central Plant Recycle</td>
<td>20</td>
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<td>Polymer Thinlay</td>
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<tr>
<td>Bonded Ultra Thinlay</td>
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<td>45</td>
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<td>50% FRAP Thinlay</td>
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<td></td>
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<tr>
<td>5% PCMAS Thinlay</td>
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<tr>
<td>HiMA Thinlay</td>
<td>25</td>
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<tr>
<td>HMA Scrub Cape Seal (ABR Thinlay on Scrub Seal)</td>
<td>N10B,N11A</td>
<td></td>
<td>35</td>
<td>X</td>
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<tr>
<td>Lightweight Aggregate Chip Seal</td>
<td>W2</td>
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<td>Asphalt Rubber Chip Seals</td>
<td>E6</td>
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<td>Epoxy High Friction Surface Treatments</td>
<td>W8,W9</td>
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<td>Asphalt Based High Friction Surfaces</td>
<td>W3,W7</td>
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<td>Micro Surface with Fibers</td>
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<td>HiMA Micro Surface</td>
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<tr>
<td>Bonded OG FC</td>
<td>30</td>
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<tr>
<td>OGFC w/ Trackless Tack</td>
<td>31</td>
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<tr>
<td>OGFC w/ PG67-22 Tack</td>
<td>32</td>
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<tr>
<td>OGFC w/ UltraFuse Tack</td>
<td>33</td>
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<td></td>
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<tr>
<td>OGFC w/ eTack</td>
<td>34</td>
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<tr>
<td>HMA Cape Seal (ABR Thinlay on Chip Seal)</td>
<td>37</td>
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<tr>
<td>Friction Micro Surface on ABR Thinlay</td>
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<tr>
<td>ABR Thinlay</td>
<td>39</td>
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<td>X</td>
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<td>ABR Thinlay on Emulsion Cold Central Plant Recycle</td>
<td>41</td>
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<td>ABR Thinlay on Emulsion Cold In-Place Recycle</td>
<td>43</td>
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<tr>
<td>ABR Thinlay on Foamed Cold In-Place Recycle</td>
<td>44</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lee Road 159 Control Section
Benefit of Crack Sealing

760k ESALS
Track Thinlay

>11 million ESALS...
US-280 Conventional vs FiberMat Cape

1.2 million ESALs
Benefits of Preservation

![Graph showing the benefits of preservation over age in years. The graph compares treated and untreated asphalt, with a clear reduction in cracking percentage over time for treated asphalt.]
QC/QA Preservation Testing
Cracking Group Tests
Design and Construction Testing

Peak Load

Balanced Mix Design

Fracture Energy

MnROAD

National Center for Asphalt Technology
# Southern Cracking Group Sections

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Rutting (mm)</th>
<th>Δ IRI (in/mi.)</th>
<th>Δ MTD (mm)</th>
<th>Cracking (% of lane)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1</td>
<td>20% RAP (Control)</td>
<td>3</td>
<td>3</td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td>N2</td>
<td>Control w/ High Density</td>
<td>3</td>
<td>6</td>
<td>0.9</td>
<td>0</td>
</tr>
<tr>
<td>N5</td>
<td>Low AC, Low Density</td>
<td>1</td>
<td>3</td>
<td>0.7</td>
<td>0.1</td>
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<tr>
<td>N8</td>
<td>20% RAP 5% RAS</td>
<td>2</td>
<td>12</td>
<td>1.0</td>
<td>0.2</td>
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<tr>
<td>S5</td>
<td>35% RAP PG 58-28</td>
<td>2</td>
<td>0</td>
<td>0.8</td>
<td>0</td>
</tr>
<tr>
<td>S6</td>
<td>Control w HiMA</td>
<td>2</td>
<td>4</td>
<td>0.9</td>
<td>0</td>
</tr>
<tr>
<td>S13</td>
<td>AZ Rubber Mix</td>
<td>4</td>
<td>6</td>
<td>0.4</td>
<td>0</td>
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End-of-Cycle Track Conference

- High RAP/RAS balanced mix designs
- Nationwide pavement preservation
- Preventing reflective distresses
- Optimized structural design
- Implementation

Pavement Test Track Conference
March 27-29, 2018
The Hotel at Auburn University and Dixon Conference Center
www.ncat.us
2018 Pavement Research Partnership

- $100k/year for Cracking Group (CG)
  - Traffic continuation at MnROAD\textsubscript{8} and NCAT\textsubscript{8}
  - Design, QC, unaged, aged array of test results
  - Support for implementation of suitable test(s)
- $50k/year for Preservation Group (PG)
  - Data collection, management, analysis
  - Life extending & condition improving benefits
  - Specifications, best practices, testing protocols

\textit{MnROAD}

\textit{NCAT at Auburn University}
Thank You