IDOT HMA Update

59th Annual Bituminous Conference

Jim Trepanier
Engineer of HMA, Agg & Chem Tests
Illinois Dept. of Transportation

Illinois Department of Transportation
Topics

- I-FIT
  - 2018 & 2019 Round Robins
  - Implementation Task Force
  - Implementation Plan
- Asphalt Binder Performance Test
- PG Binder Usage
- AASHTO Proficiency Sample Program (PSP)
- Tack Coat
- Intelligent Compaction (IC)
2018 I-FIT Round Robin Approach

- Set A – Testing
  - Test I-FIT specimens cut from 160mm tall gyratory
- Set B – Testing
  - Test I-FIT specimens cut from 150mm tall gyratory
- Set C – Testing
  - Test I-FIT specimens cut from 115mm tall gyratories
## I-FIT Round Robin - 160mm Gyratory Height

<table>
<thead>
<tr>
<th>Test Group</th>
<th>Number of Test Sets</th>
<th>Avg. $G_i$ (J/m²)</th>
<th>Avg $G_i$ COV (%)</th>
<th>Avg. Slope (kN/mm)</th>
<th>Avg Slope COV (%)</th>
<th>Avg. FI</th>
<th>Individual Lab FI COV (%)</th>
<th>Population FI COV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDOT</td>
<td>10</td>
<td>2522.1</td>
<td>8.1</td>
<td>1.0</td>
<td>17.8</td>
<td>25.3</td>
<td>15.7</td>
<td>19.9</td>
</tr>
<tr>
<td>Private</td>
<td>17</td>
<td>2422.3</td>
<td>9.4</td>
<td>1.2</td>
<td>15.4</td>
<td>21.5</td>
<td>18.1</td>
<td>26.3</td>
</tr>
<tr>
<td>Other States and University</td>
<td>7</td>
<td>2461.3</td>
<td>4.3</td>
<td>1.0</td>
<td>9.2</td>
<td>24.9</td>
<td>10.0</td>
<td>22.1</td>
</tr>
<tr>
<td>Testquip Vertical</td>
<td>26</td>
<td>2453.5</td>
<td>8.1</td>
<td>1.2</td>
<td>15.5</td>
<td>22.7</td>
<td>16.8</td>
<td>26.1</td>
</tr>
<tr>
<td>Testquip Horizontal</td>
<td>2</td>
<td>2483.2</td>
<td>7.6</td>
<td>1.0</td>
<td>11.8</td>
<td>25.7</td>
<td>12.4</td>
<td>13.3</td>
</tr>
<tr>
<td>Instrotek</td>
<td>3</td>
<td>2453.2</td>
<td>5.5</td>
<td>1.0</td>
<td>9.9</td>
<td>25.1</td>
<td>12.5</td>
<td>16.0</td>
</tr>
<tr>
<td>IPC</td>
<td>1</td>
<td>2319.1</td>
<td>9.9</td>
<td>1.3</td>
<td>16.0</td>
<td>18.4</td>
<td>19.3</td>
<td>19.3</td>
</tr>
<tr>
<td>MTS</td>
<td>1</td>
<td>2351.8</td>
<td>16.8</td>
<td>0.9</td>
<td>27.0</td>
<td>27.3</td>
<td>10.3</td>
<td>10.3</td>
</tr>
<tr>
<td>Interlaken</td>
<td>1</td>
<td>2811.7</td>
<td>3.3</td>
<td>1.0</td>
<td>10.8</td>
<td>29.9</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td><strong>All Machines</strong></td>
<td><strong>34</strong></td>
<td><strong>2459.7</strong></td>
<td><strong>8.0</strong></td>
<td><strong>1.1</strong></td>
<td><strong>14.8</strong></td>
<td><strong>23.3</strong></td>
<td><strong>15.7</strong></td>
<td><strong>24.5</strong></td>
</tr>
</tbody>
</table>
Effect of Gyratory Height

![Bar chart showing the flexibility index for different gyratory heights: 160mm, 150mm, and 115mm.](chart.png)
Results showed no consistent trends with gyratory height

Testquip-Horizontal, MTS, & Interlaken produced consistently higher FI than Testquip-Vertical & Instrotek devices

Individual lab COV’s for FI were less than 16%
Provide final data needed for AASHTO to develop Precision Statement for TP-124

- **Needed:**
  - 3 mixes total
  - ≥ 30 labs ideal
  - A mix w/ 3 replicates per lab
  - Labs Compact, Cut & Test (115’s for Troxlers - 160 all others)
  - By January 2019 for consideration at AASHTO Mid-Year Mtg

- 2019 I-FIT RR completed December 7th
- Volumetric & Hamburg currently being tested
I-FIT Implementation Task Force Update
Current Requirements:
- New design is good for 3 years before reverification
- Uses same Agg Bulk Specific Gravities ($G_{sb}$) for 3 yrs
Perpetual Mix Designs

- New design verified by District Lab
- Mix Design updated annually w/ current $G_{sb}$'s
- ≥ 0.020 change in combined $G_{sb}$ triggers new design
- Change in ledge prior construction season requires 1 point design w/ Hamburg, IFIT & TSR
- Change in ledge during construction:
  - Use plant produced mix for Hamburg, IFIT, TSR.
  - Contractor makes needed adjustment – new $G_{sb}$ used for volumetric calculation going forward.
Perpetual Mix Designs

Benefits:

- Increase accuracy of calculated VMA ($G_{mb}$, AC, Combined $G_{sb}$)
- Reduction in cost & time of doing mix designs & design verifications
- Department focuses on as-produced (PFP, QCP, Hamburg, I-FIT)
### PG XX-28 for Overlays in D1 – D6

<table>
<thead>
<tr>
<th>Type of HMA Pavement</th>
<th>Layer</th>
<th>Illinois Design Number</th>
<th>Design ESALs (million)</th>
<th>PG Binder Grade&lt;br&gt;Traffic Loading Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>IL-4.75</td>
<td>Surface and Binder</td>
<td>50</td>
<td>≤ 10</td>
<td>SBS PG 70-22&lt;br&gt;SBS PG 76-22&lt;br&gt;SBS PG 76-22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 10</td>
<td></td>
<td>SBS PG 70-22&lt;br&gt;SBS PG 76-22&lt;br&gt;SBS PG 76-22</td>
</tr>
<tr>
<td>SMA Overlay of PCC or Composite Pavement</td>
<td>Surface and Binder</td>
<td>50</td>
<td>≤ 10</td>
<td>SBS PG 76-22&lt;br&gt;SBS PG 76-22&lt;br&gt;SBS PG 76-22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 10</td>
<td></td>
<td>SBS PG 76-22&lt;br&gt;SBS PG 76-22&lt;br&gt;SBS PG 76-22</td>
</tr>
<tr>
<td>SMA for Full-Depth Pavement and Overlays of Full-Depth Pavement</td>
<td>Surface and Binder</td>
<td>50</td>
<td>≤ 10</td>
<td>SBS PG 76-22&lt;br&gt;SBS PG 76-22&lt;br&gt;SBS PG 76-22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 10</td>
<td></td>
<td>SBS PG 76-22&lt;br&gt;SBS PG 76-22&lt;br&gt;SBS PG 76-22</td>
</tr>
<tr>
<td>Overlay of PCC or Composite Pavement</td>
<td>Surface or Binder</td>
<td>30</td>
<td>≤ 0.3</td>
<td>PG 58-22&lt;br&gt;PG 64-22&lt;br&gt;PG 64-22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 0.3 to 3</td>
<td></td>
<td>PG 64-22&lt;br&gt;SBS PG 70-22&lt;br&gt;SBS PG 76-22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 3 to 10</td>
<td></td>
<td>PG 64-22&lt;br&gt;SBS PG 70-22&lt;br&gt;SBS PG 76-22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 10</td>
<td></td>
<td>SBS PG 70-22&lt;br&gt;SBS PG 76-22&lt;br&gt;SBS PG 76-22</td>
</tr>
<tr>
<td><strong>Districts 1-6</strong></td>
<td>Surface and Top Binder</td>
<td>All</td>
<td>All Levels</td>
<td>SBS PG 64-28&lt;br&gt;SBS PG 70-28&lt;br&gt;SBS PG 76-28</td>
</tr>
<tr>
<td></td>
<td>Lower Binder</td>
<td>All</td>
<td>All Levels</td>
<td>PG 64-22&lt;br&gt;PG 64-22&lt;br&gt;PG 64-22</td>
</tr>
<tr>
<td><strong>Districts 7-9</strong></td>
<td>Surface and Top Binder</td>
<td>All</td>
<td>All Levels</td>
<td>SBS PG 64-22&lt;br&gt;SBS PG 70-22&lt;br&gt;SBS PG 76-22</td>
</tr>
<tr>
<td></td>
<td>Lower Binder</td>
<td>All</td>
<td>All Levels</td>
<td>PG 64-22&lt;br&gt;PG 64-22&lt;br&gt;PG 64-22</td>
</tr>
</tbody>
</table>
# ABR Limits

## FRAP/RAS Maximum Asphalt Binder Replacement (ABR) Percentage

<table>
<thead>
<tr>
<th>HMA Mixtures</th>
<th>FRAP/RAS Maximum ABR %</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Binder/Leveling Binder</td>
<td>Surface</td>
</tr>
<tr>
<td></td>
<td>w/o I-FIT</td>
<td>with I-FIT</td>
</tr>
<tr>
<td>Ndesign</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>50</td>
<td>55</td>
</tr>
<tr>
<td>50</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>70</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>90</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>SMA</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>IL-4.75</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Increase FI Thresholds for:

- SMA
- IL-4.75 for use as crack retarding binders
Explore FI Moving Average Concept

- Add a Production Testing Frequency
- Moving Average ≥ 8.0
- Establish Control Limits for Individual
- Would prevent Shutdown on failing Individual
- Need to wait until 2021 to determine District Testing Capability
I-FIT Implementation

2019: I-FIT on all Interstates
- Additional projects as approved by Central Office
- Spec include 5% higher ABR for I-FIT projects

2020: I-FIT on all HMA projects
- LTA protocol on all surface mixes
- Perpetual Mix Design & New FI Thresholds for SMA & Crack Retarding IL-4.75 binders
- Begin allowing Modified Asphalt Binders
Asphalt Binder Performance Test
ICT R27-196HS

Rheology/Chemical Based Procedure to Evaluate Additives/Modifiers used in Asphalt Binders for Performance Enhancements (Phase 2)
Research Objective

Develop advanced screening protocol w/ long-term aging & rheological/chemical characterization methods for modified binders.

• Evaluate the effect of modifiers on binder chemistry & performance
• Develop an efficient long term aging procedure for modified binders
• Validate & fine-tune preliminary thresholds
Identify and Collect Modifiers

• Working w/ Industry to identify & collect Modifiers & Additives available in IL
  • Up to 10 Modifiers/Additives Considered
  • Samples of Modifiers & Additives will be Characterized
• Asphalt Binders to be Collected & Tested
  • 64-22’s (Base Binders), 58-28, 52-34, 46-34
• Formulas, Mix Ratios & Blending Requirements Provided by Suppliers
Field Core Selection

- Objective of collecting cores is to determine impact of long-term binder aging & set baseline for developing LTA protocol
- Cores should represent typical surface mixtures used in the region
  - Avoid mixtures with RAP > 20% & RAS
  - Avoid poor performers
- Working w/ Tollway & Districts to identify field core locations & send cores & construction history to ICT
PG Binder Usage
Percent Polymer Used vs. Time

Percent Polymer Used

Year of Use
AASHTO Proficiency Sample Program (PSP)
Disputing Individual Test Results

- PFP Spec Rev. to allow Method 2 Dispute Resolution Provided:
  - Contractor Lab participates in AASHTO PSP & Scores Rating ≥ 3
  - Adjusted Split Sample exceed Precision Limits

- Requires all District QA Labs also participate in AASHTO PSP
AASHTO re:source Proficiency Sample Program (PSP)

- Intent:
  - Allow Contractors to dispute individual parameters in PFP
  - Compare individual labs results with large pool of results
  - Verify testing apparatus and operator under actual testing conditions
  - Opportunity to identify and correct problems
  - Allow Illinois to align results w/ the rest of the Country

- AASHTO provides results rating sheet
  - Good Rating = 3, 4, or 5, Low Rating = 2 or less
PSP Observations:

- All private & State labs received good scores on Gyratory Bulk Gravities ($G_{mb}$)

- Some labs on both sides had some issues w/ Max Gravities ($G_{mm}$) that warranted investigation, corrective action & retesting

- Illinois as a whole was light on the Gyratory Bulk Gravities ($G_{mb}$)
Hot-Applied Tack Coats w/ Wax
New Tack Coat Products

- 6 New Tack Product to Expedite Paving were evaluated through ICT Research
  - 4 Hot Applied Asphalt Binders w/ wax
  - 2 Quick Set Emulsions

- Evaluate Bond Strength of New Products
  - Bond Strength $\geq$ SS-1h
    - Lab Shear Test using ATREL Device Lab Specimens

- Products were found perform comparable to SS-1h
Hot-Applied Asphalt Tack Coat w/ Wax

- Work with Industry to develop a material specification
- Chemical Test Unit will evaluate and characterize the materials
- Develop an Experimental Feature Workplan
- Solicit Districts for projects in 2019
Intelligent Compaction

- **Field Project**
  - Veteran’s Parkway in Bloomington, IL

- **Lessons Learned**
  - Need IC Temperature and Location Verification each day of paving
  - Need new Manual of Test Procedures IC Document
  - Need Equipment Accuracy Table in QCP Special Provision
  - Need to Update Minimum Untrimmed Percent Coverage
Jim Trepanier
(217) 782-9607 Work
(217) 622-4790 Mobile
James.Trepanier@illinois.gov

Illinois Dept of, Transportation