Acronyms

- ABML-ID: Asphalt binder and mixture laboratory – implementation and delivery
- ABT: Asphalt Binder Tester
- BMD: Balanced mix design
- NHDOT: New Hampshire Department of Transportation
- CTindex*: Cracking index
- E*: Dynamic modulus
- FHWA: Federal Highway Administration
- FI: Flexibility Index
- FTIR: Fourier transform infrared spectroscopy
- HWT: Hamburg wheel tracker
- I-FIT: Illinois Flexibility Index Test
- MaineDOT: Maine Department of Transportation
- MATC: Mobile Asphalt Technology Center
- mm: millimeter
- Ndes: Design gyrations
- NRRI: Normalized rutting resistance index
- PG: Performance grade
- QA: Quality assurance
- RQL: Rejectable quality limit
- RSI: stress sweep rutting index
- Sapp: cyclic fatigue index parameter
- SIP: Stripping inflection point
- TFHRC: Turner-Fairbanks Highway Research Center
- VBE: Voids filled with effective binder
- VMA: Voids in the mineral aggregate
- VTrans: Vermont Agency of Transportation
Outline

- MATC Overview & Mission
- Ongoing MATC Support to Northeast
  - New Hampshire DOT
  - Connecticut DOT
- What can we do for you?
Mobile Asphalt Technology Center

MATC Mission:
Our mission is to introduce new and emerging asphalt materials and construction technologies to States and industry, which bridges the gap between research and implementation.

MATC Goal:
These technologies and practices are implemented by agencies and industry to provide longer-lasting, safer, better-performing, and more cost-effective asphalt pavements on our nation’s highways.

▸ MATC is on the move to serve the asphalt pavement community!
FHWA Asphalt Technology Deployment

- **Project Site Visits:** provide agencies and industry with first-hand exposure to new technologies (currently, 8 mixture tests, 4 materials tests, and 5 field tests)

- **Customized Training Workshops:** classroom and online training based on field test results and observations

- **Equipment Loan Program:** gain hands-on experience before making a resource commitment

- **Technical Guidance:** based on identified national trends to encourage agencies and industry to evaluate and improve their specifications and practices
Technologies Offered by FHWA MATC

**Mixture**
- AMPT suite of tests (cyclic fatigue, E*)
- Overlay test for reflective cracking
- Flexibility index test (I-FIT) for fracture resistance
- ITC (IDEAL-CT) for crack resistance
- IDEAL-RT for rutting resistance
- Hamburg wheel tracker

**Materials**
- X-Ray Fluorescence (XRF) Spectrometer
- ABT (true grade binder)
- FTIR for binder molecular analysis

**Field**
- Paver-mounted thermal profiler (PMTP)
- Pulse induction technology for in-place pavement thickness
- Pavement macrotexture measurements (3 methods)
- Dielectric profiling systems (DPS)
Ongoing MATC Support to the Northeast

- MATC project visits
  - ME: 2017
  - PA: 2017
  - VT: 2021
  - NH: 2023
  - CT: 2023
  - NJ: 2024

- BMD Testing Analysis
  - ME & VT

- Specification Review
  - RI, NH, & CT

- ABML-ID Project Involvement
  - MD, ME, & NH
New Hampshire DOT Site Visit
NH Project Background

- MATC setup at 150 New Hampshire Route 103, Warner, NH 03278
- Mixture/Asphalt Binder sampling and testing from test project as per test plan
  - I-89 “Winter Binder” mixture
- Field Testing Demonstrations
Mixture Testing Plan for I-89 Project

(1) The “Sample 1” testing protocol will be followed for the one sample I-93 Surface mixture evaluation.

(2) The IDEAL-CT w/Aging protocol will be to expose the loose mixture to 135°C for 8 hours prior to fabrication.
Volumetrics
(Production Samples)
Asphalt Content (%)

Asphalt Content by Ignition test results are corrected
Gradation

Combined Percent Passing (%)

Sieve Size Raised to 0.45

#200 #100 #8 1/2 #4 3/8 1/2 3/4 1

S1 S2 S3 S4 S5 S6 Upper Control Point Lower Control Point
Maximum Specific Gravity ($G_{mm}$)
Production AC (%) vs $G_{mm}$
Bulk Specific Gravity ($G_{mb}$)

![Graph showing Bulk Specific Gravity with Production Gmb and JMF data points.]

- **Production Gmb**
- **JMF**
Voids in Total Mix (VTM)

- Production VTM (%)
- USL
- LSL
- JMF

Samples

Voids in Total Mix (VTM)
Voids in Mineral Aggregates (VMA)

- Values are calculated based on Ignition test results.
Voids Filled with Asphalt (VFA)

Values are calculated based on Ignition test results

Samples
BMD Testing
IDEAL-CT Results

Reheated Avg. CT index - 67.7
Aging Avg. CT index - 40.2

Error Bars here represent Standard Deviation

Aging - 8hr at 135C
IDEAL-RT Results

<table>
<thead>
<tr>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
<th>S5</th>
<th>S6</th>
</tr>
</thead>
<tbody>
<tr>
<td>55.7</td>
<td>57.5</td>
<td>58.1</td>
<td>76.4</td>
<td>72.3</td>
<td>63.1</td>
</tr>
</tbody>
</table>

Avg. RT Index 63.9

Error Bars here represent Standard Deviation
Asphalt Binder Testing
X-Ray Fluorescence (XRF)

- Determines the Elemental Composition of Materials
- Potential Use
  - Detection of Recycled Engine Oil Bottoms (REOB), lime, and polyphosphoric acid (PPA) in asphalt
  - QC/QA of traffic paints and epoxies
  - Analysis of heavy metals in construction debris, aggregates, soils etc.

<table>
<thead>
<tr>
<th>Elements</th>
<th>REOB</th>
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<tbody>
<tr>
<td>Phosphorus</td>
<td>1.5-1.9%</td>
</tr>
<tr>
<td>Sulfur</td>
<td>1.5-1.9%</td>
</tr>
<tr>
<td>Calcium</td>
<td>7,200–10,900 ppm</td>
</tr>
<tr>
<td>Iron</td>
<td>370–1,800 ppm</td>
</tr>
<tr>
<td>Copper</td>
<td>700–1,500 ppm</td>
</tr>
<tr>
<td>Zinc</td>
<td>4,500–7,200 ppm</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>300–700 ppm</td>
</tr>
</tbody>
</table>

FHWA TechBrief: FHWA-HRT-18-043
## X-Ray Fluorescence (XRF)

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Calcium (ppm)</th>
<th>Molybdenum (ppm)</th>
<th>Zinc (ppm)</th>
<th>Copper (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH23127-Sample1 (PG64-28)</td>
<td>229</td>
<td>56</td>
<td>&lt;LOD</td>
<td>&lt;LOD</td>
</tr>
<tr>
<td>NH23127-Sample2 (PG64-28)</td>
<td>234</td>
<td>63</td>
<td>&lt;LOD</td>
<td>&lt;LOD</td>
</tr>
<tr>
<td>NH23127-Sample3 (PG64-28)</td>
<td>233</td>
<td>36</td>
<td>&lt;LOD</td>
<td>&lt;LOD</td>
</tr>
<tr>
<td>Average</td>
<td>232</td>
<td>52</td>
<td>&lt;LOD</td>
<td>&lt;LOD</td>
</tr>
<tr>
<td>REOB (%)</td>
<td>~0</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
Field Testing Demonstrations
Paver-Mounted Thermal Profiler

- High precision real time thermal profiler to detect pavement mat defects before compaction
- Used for identifying segregation and low-density issues
- Infrared sensors for measuring temperature uniformity of new asphalt surfaces
- Thermal profile imaging of mat surface done at 2 to 3 meters behind screed
Paver-Mounted Thermal Profiler

Bridge Deck

Paving Crew

203 ° F

274 ° F

298 ° F

347 ° F
Paver-Mounted Thermal Profiler

Distribution of Placement Temperatures

- Mean: 285 °F
- Median: 286 °F
- \( \sigma: 9.83 \) °F
Dielectric Profiling System (DPS)

- Uses ground penetrating radar technology to measure density.
- Unlike coring, DPS provides continuous measurements, resulting in nearly 100% coverage of the constructed layers.
  - Field cores and lab compacted specimens are still needed to calibrate the measured dielectric constant to the actual pavement density.
- Potential for complete enumeration of the pavement density.
Dielectric Profiling System (DPS)

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
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<tbody>
<tr>
<td>Mean</td>
<td>92.6</td>
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<tr>
<td>Standard Deviation</td>
<td>1.5</td>
</tr>
<tr>
<td>Min</td>
<td>70.2</td>
</tr>
<tr>
<td>Max</td>
<td>99</td>
</tr>
<tr>
<td>Sample Size</td>
<td>12,075</td>
</tr>
</tbody>
</table>
Dielectric Profiling System (DPS) - VETA
Pulse Induction Technology

- Nondestructive device to measure pavement thickness on either asphalt or concrete pavements
- Eliminates the need for taking cores
- Pulse Induction device requires preplacing a thin metal ‘target’ (plate) on the base before paving
- Distance between the plate and surface of the pavement is measured
Pulse Induction Technology

GPS - 43°22’53.5"N, 71°57’39.8"W
Location - Interstate 89 N, Warner, NH

Pavement Thickness, in.

Testing Location

- Pulse Induction (in)
- Measured Core Thickness
- Design Thickness

~2,000 ft
Laser Texture Scanner (LTS)

- Portable 3D Laser Texture Scanner
  - Rapid Measurements – within 90 seconds
  - 100 mm x 100 mm scan area
  - Laboratory and field applications
  - Mean Profile Depth (MPD)

- Materials
  - In-place (project site)
  - Field cores (project site)
  - Gyratory specimens (laboratory)

- Obtain six 6-inch cores from random locations for laboratory testing comparison against lab compacted specimens

Source: FHWA
Laser Texture Scanner (LTS)

Dense-graded HMA – MPD Typically ranges from 0.4 to 0.8 mm according to 2022 AASHTO Guide for Pavement Friction
Connecticut DOT
Site Visit
CT Project Background

- MATC setup at CTDOT Materials in Rocky Hill, CT
- Mixture/Asphalt Binder sampling and testing from test project as per test plan
  - Route 222 in Thomaston, CT
  - ½” Superpave 75 gyration w/ 64S-22.
- Field Testing Demonstrations
Mixture Testing Plan for Route 222 Project

CTDOT Surface Mixture

Sample 1
- AC, Gradation, & Volumetrics
- IDEAL-CT
- IDEAL-RT
- HWTT

Sample 2
- AC, Gradation, & Volumetrics
- IDEAL-CT
- IDEAL-RT
- IDEAL-CT 20-hr Aging

Sample 3
- AC, Gradation, & Volumetrics
- IDEAL-CT
- IDEAL-RT
- HWTT

Sample 4
- AC, Gradation, & Volumetrics
- IDEAL-CT
- IDEAL-RT
- IDEAL-CT 20-hr Aging

Sample 5
- AC, Gradation, & Volumetrics
- IDEAL-CT
- IDEAL-RT
- HWTT

Sample 6
- AC, Gradation, & Volumetrics
- IDEAL-CT
- IDEAL-RT
- IDEAL-CT 20-hr Aging
What can FHWA MATC do for you?

Unless otherwise noted, FHWA is the source for all images in this presentation.
Workshops
Quality in the Asphalt Paving Process 2-day Workshop

2-day Workshop on Asphalt Materials and Construction

▸ “Back to Basics” for asphalt

▸ Builds off observations from field visit, specification review, and test results for each state

▸ Scheduled within 6 – 9 months after conclusion of MATC site visit

▸ Agency and Industry participation (50/50)

▸ Goal: Identify key action items
FHWA BMD Case Studies Virtual Workshop

https://www.fhwa.dot.gov/pavement/asphalt/
Equipment Loan Program
Equipment Loan Program

Request form submitted via FHWA P&M Engineer in Division Office

- Dielectric Profiling System (DPS) units
- Paver-Mounted Thermal Profiler (PMTP) units
- Circular Track Meter (CTM)
- Laser Texture Scanner (LTS)
- Handheld XRF Spectrometer
- SmartJig for IDEAL-CT and IDEAL-RT testing
Equipment Loan Program

Equipment Loan includes:

- Pre-Loan virtual meeting
- Onsite training by MATC or Resource Center
- Mid-Loan period check-in
- Assistance with data extraction & analysis
- Post-Loan virtual briefing to go over results & describe your experience with the technology
- “Lessons Learned” document (for some loans)
- Return borrowed equipment to FHWA
Contact Us

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