FHWA Initiatives for Improved Asphalt Pavement Performance

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Senior Asphalt Pavement Engineer
Federal Highway Administration – HQ
Office of Preconstruction, Construction and Pavements
Agenda

FHWA
- Who we are, what we do in pavements
- Initiatives for pavement performance
- Improved pavement density initiative

MATC
- Program Goals
- Activities
- Deploying technology that supports performance
<table>
<thead>
<tr>
<th>Acronyms</th>
<th>Definitions</th>
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<tbody>
<tr>
<td>ACEC: American Council of Engineering Consultants</td>
<td>AMPT: Asphalt Mixture Performance Tester</td>
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<td>BMD: Balanced Mix Design</td>
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<td>DO: FHWA Division Office</td>
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<td>DPS: Dielectric Profiling System</td>
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<td>FAST Act: Fixing America’s Surface Transportation Act</td>
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<td>FLH: FHWA Federal Lands Highway</td>
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<td>FTIR: Fourier Transform Infrared Spectroscopy</td>
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<td>HICP: FHWA Office of Preconstruction, Construction, and Pavements</td>
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<td>I-FiT: Illinois Fatigue Test</td>
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<td>ITC: Ideal Test for Cracking</td>
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<td>LPA: Local Public Agency</td>
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<td>MIT SCAN-T3: Non-Destructive Thickness Measuring Gauge System for Asphalt/Concrete Pavements</td>
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<td>NCAT: National Center for Asphalt Technology</td>
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<td>NMAS: Nominal Maximum Aggregate Size</td>
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<td>NCHRP: National Cooperative Highway Research Program</td>
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<td>NDE: Nondestructive Evaluation</td>
<td>PEMD: Performance Engineered Mixture Design</td>
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<td>PEP: Performance Engineered Pavements</td>
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<td>PG: Performance Grade</td>
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<td>PRS: Performance-Related Specifications</td>
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<td>QA: Quality Assurance</td>
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<td>R&amp;D: Research &amp; Development</td>
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<td>RC: FHWA Resource Center</td>
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<td>SAPA: State Asphalt Pavement Associations</td>
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<td>Sapp: Apparent Fatigue Damage parameter</td>
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<td>SSR: Stress Sweep Rutting</td>
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<td>TFHRC: Turner-Fairbank Highway Research Center</td>
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<td>t/NMAS: Ratio of Lift Thickness to Nominal Maximum Aggregate Size</td>
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<td>XRF: X-Ray Florescence</td>
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Pavement and Materials: Who we are

- **Richard Duval**: program coordination for Performance Engineered Mixtures and Design and Performance Related Specifications
- **Tim Aschenbrener**: asphalt pavements, Asphalt QA, increased density, asphalt recycling
- **Dr. Leslie Myers McCarthy**: flexible pavements, asphalt materials, Mobile Asphalt Technology Center
- **Mike Praul**: concrete pavements and materials, concrete QA, Mobile Concrete Technology Center
- **Sam Tyson**: long-life concrete pavement strategies, concrete repair strategies, concrete recycling and industrial byproducts, concrete overlays
Pavement and Materials: What we do

- All things Asphalt Materials
- All things Concrete Materials
- Technologies for pavements and materials
- Movement toward Performance Engineered Mixture Design- Asphalt and Concrete
- Accelerated Implementation and Deployment of Pavement Technologies Program (under FAST Act)
Performance Engineered Pavements

- Vision: incorporate the goal of long term performance into the structural pavement design, construction and materials acceptance
Motivation for PEP

- Increase in premature deterioration
- MAP-21 and FAST ACT legislation focus on performance
  - Transportation Performance Management
- Desire by public agencies and industry to move toward performance
  - Optimize mixture designs for traffic, climate, environment
  - Improved durability
  - Sustainability - recycled materials, reducing footprint, etc.
  - Innovative materials
- SHRP-Superpave original program intent – focus on performance and not fully realized
- Testing technology advancements
- Changes in agency and industry skills and personnel levels
Performance Engineered Pavements
Quality Assurance Continuum

Structural Pavement Design

PEMD

QA

PRS

PBS
Programmatic Focus

- Performance Engineered Mixture Design (PEMD)

Source: FHWA

Source: FHWA
Performance-Engineered Mixture Design (PEMD)

- Design and field control of mixtures around engineering properties related to performance
- Move toward index-based testing approaches and then to a more fundamental-engineering properties approach
- Mix designs accepted on passing performance indices in combination with volumetric targets (Go/No-Go)
- Two indices:
  - $S_{app}$ – fatigue resistance
  - Permanent strain – rutting resistance
- Upcoming NCHRP 20-07 report to detail steps to implement a performance test
  - AMPT cyclic fatigue is well on its way in many of these steps
PEP Next Steps

- FHWA encourages performance engineering in mixture designs and durability testing into the mixture design evaluation, verification, and acceptance process
- Performance engineering and durability testing should be tailored to the expected traffic and environment that pavement will be exposed
- Evaluate performance tests available to address local failure mechanisms, local materials, climate, and traffic
- Performance testing on pilot projects
- Project selection guidelines for performance testing specification
- Incorporate performance testing into the QA Program
Highlights of FHWA Density Initiative

For more information contact:

Tim Aschenbrener
(720) 963-3247
Timothy.Aschenbrener@dot.gov
Reasons for Obtaining Density

Cracking
- To improve fatigue cracking resistance
- To improve thermal cracking resistance

Rutting
- To minimize/prevent further consolidation
- To provide shear strength and resistance to rutting

Moisture Damage
- To ensure the mixture is waterproof (impermeable)

Aging
- To minimize oxidation of the asphalt binder

Density is important, but not a cure-all
“A 1% decrease in air voids was estimated to:
• **improve fatigue** performance by 8.2 and 43.8%
• **improve the rutting** resistance by 7.3 to 66.3%
• **extend the service life** by conservatively 10%”
Enhanced Durability of Asphalt Pavements through Increased In-Place Pavement Density

Demonstration Projects
- Phase 1 (10 states)
- Phase 2 (9 states)
- Phase 3 (10 states)

Mobile Asphalt Technology Center (3)
# FHWA Demonstration Project Status

<table>
<thead>
<tr>
<th>Phase</th>
<th>Year</th>
<th>States</th>
<th>Constructed</th>
<th>State Reports Completed</th>
<th>FHWA Summary Report</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2016</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>July 2017</td>
<td>Literature Review</td>
</tr>
<tr>
<td>2</td>
<td>2017-2018</td>
<td>8</td>
<td>8 (2 re-do’s)</td>
<td>7</td>
<td>July 2019</td>
<td>Identification of Highly Effective Specifications</td>
</tr>
<tr>
<td>3</td>
<td>2018-2019</td>
<td>11</td>
<td>11</td>
<td>8</td>
<td></td>
<td>Contractor Techniques &amp; SHA Changes</td>
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Updated: July 16, 2019
Summary Reports

Phase 1

- NCAT Report 17-05
- July 2017

Phase 2

- FHWA Report HIF-19-052
- NCAT Report 19-02
- July 2019

Report Phase 1:
- http://eng.auburn.edu/research/centers/ncat/files/technical-reports/rep17-05.pdf

Report Phase 2:

FHWA density website:
What Changes Were Made to Increase Density?

**Contractor Changes**
- More passes / more rollers / type / location
  - “Roll until you meet density requirements”
  - Some were using 1 roller
  - Pneumatic / Oscillation / Combination
  - Echelon

**Agency Changes**
- Adjusting optimum asphalt content
- Larger t/NMAS
- Smaller NMAS
- Innovative materials / techniques

Courtesy Miguel Montoya
Density: Key Findings to Date

- Level of field compactive effort varies greatly
- No extraordinary field compactive effort needed
  - Specification (quality measure, limits, incentives, etc.)
  - Smaller NMAS
  - Larger t/NMAS
  - Adequate binder content
- All Together:
  - Mixture design with appropriate asphalt content
  - Performance testing
  - Acceptance
  - In-place density
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  o Acceptance
  o In-place density
Pavement and Materials: How we do it
Mobile Asphalt Technology Center (MATC)

Program Goal

Innovative technologies and practices are implemented by agencies and industry to provide durable, safe, and sustainable asphalt pavements on our nation’s highways.
MATC Team

Leslie Myers McCarthy
Federal Program Manager

Project Manager
Asphalt Design, Production, Field Operations, Quality Control / Testing

Marketing
Communications & Events

Project Engineer
Data Analysis Performance Testing

Senior Laboratory Technician
Electro/Mechanical Mixture Design / Testing

Subject Matter Experts
Materials and Construction Specifications

Materials Lab Technician
Lab Operations / Materials Testing

Field Technician
Field Operations / Field Testing
MATC Objectives

- Demonstrate emerging technologies & maintain focus on customer needs
  - Tiered technical assistance and troubleshooting
  - Specification review and development
  - Equipment loan program

- Deploy technology from TFHRC, Every Day Counts, other research & development (R&D)
  - Workshop activities that yield measurable outcomes

- Leverage the asset for whole Pavements program & increase MATC’s impact
  - Integrated more fully with FHWA R&D, Resource Center, Federal Lands Highway, and Division Offices
MATC Mission Approach

- **Project Site Visits**
  - Independent party with a national perspective

- **Customized Training Workshops**
  - Test results and observations facilitates implementation

- **Technical Guidance**
  - Topical guidance documents based on national trends

- **Equipment Loan Program**
  - Loan equipment to partners to gain hands-on experience
MATC can serve as conduit to deploy initiatives and tools from many pavement-related areas.
MATC Activities

Core Activities of MATC

- Support performance engineered pavements (PEP)
- Demonstrating test methods
- On-site support (States, FLH)
- Equipment training
- Case examples developed from innovation trials
- Specification review (QA, materials, construction)
- Equipment loan program
- FHWA DO Rotational

Deployment

- Quality in Asphalt Paving Workshop: multiday, focused on flexible pavement
- Recorded video briefs: topical to MATC equipment

Level of troubleshooting

- On-site: within scope of standard or agency spec.
- In-depth: direct to FHWA ABML-ID

Post-installed pavement

- Density, sustainability, M&P option selection
- Surface characteristics (macrotexture, etc.)
- Monitoring performance (handheld, other tech.)
# Technologies offered by MATC

<table>
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<tr>
<th><strong>Mixture Tests</strong></th>
<th><strong>Materials Tests</strong></th>
<th><strong>Field Tests</strong></th>
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<tbody>
<tr>
<td>AMPT suite of tests ($</td>
<td>E^*</td>
<td>$, cyclic fatigue, SSR) for PRS</td>
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<tr>
<td>Overlay Test for reflective cracking</td>
<td>ABT (true grade of binder)</td>
<td>MIT SCAN-T3 for in-place pavement thickness</td>
</tr>
<tr>
<td>Flexibility index test (I-FIT) for fracture resistance</td>
<td>* FTIR looks at molecules in binder (lime, polymers,...)</td>
<td>Circular Track Meter for measuring mean profile depth in field and in lab*</td>
</tr>
<tr>
<td>ITC (IDEAL-CT) for crack resistance</td>
<td>* Binder performance testing</td>
<td>Dielectric profiling system (DPS) for in-place density</td>
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**Other support activities:**
- PaveME Design analysis
- HMA materials spec review
- Construction density spec review (mat and joints)

* FlexMAT & FlexPAVE

* Done at TFHRC

Sand patch test for macrotexture
Past Visits and 2020 Requests... so far
Typical Site Visit by MATC

**Planning Call**
with DOT and FHWA Div.

**Logistics**
with DOT and Contractor

**Kickoff Meeting**
with DOT, Contractor, and FHWA Div. on-site

**Open House**
with DOT, SAPA members, LPAs, ACEC, etc.

**On-Site Testing**
at Plant and Field sites

**Closeout Meeting**
with DOT, Contractor, and FHWA Div. on-site

**Final Close-out Webinar & Report**
with DOT, Contractor, SAPA, and FHWA Div.

Start 1-hr call webinar
During 60 days emails
First week on-site 2-hr meeting & call-in
2nd week on-site 2-hr presentations (plus web access), 2-hr tour at MATC
2.5 – 3 weeks at MATC and at paving site
End of last week at MATC 1-hr meeting

Onsite Time: 3 weeks

**Total Time:**
5 mos.

Within 60 days after site visit 1.5-hr webinar
Contact Us

Ideas on Technologies or Practices to Deploy? Trends that you’ve observed? Let us know!

Leslie Myers McCarthy, Ph.D., P.E.
(202) 981-2875

FHWA-MATC@dot.gov