MATC
MOBILE ASPHALT TECHNOLOGY CENTER

FHWA Work with Macrotexture & Friction in Association with Sustainability in SEAUPG States

2024 SEAUPG Annual Meeting & Exhibits
Mobile, Alabama
November 19-21

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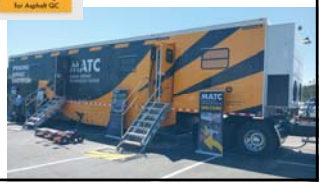
FHWA
Mobile Asphalt Technology Center



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MATC Team

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SME: Nam Tran
Subject Matter Expert
Asphalt Materials Data Analysis

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FHWA's Response to Critical Issues

Since 1988…

Per Program

- 175 site visits
- 250 workshops delivered
- ~ 2,000 people trained annually
- Paving contractors & industry groups
- Local & tribal governments

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FHWA 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.

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Why Do We Do What We Do?

- Implement new & under-utilized asphalt technologies
- Demonstrate benefits of performance specifications in both agency quality assurance (QA) programs & industry quality control (QC) applications
- Encourage advancements for highway agency asphalt programs
  - Specification review
  - Technical assistance
  - Training
  - Troubleshooting

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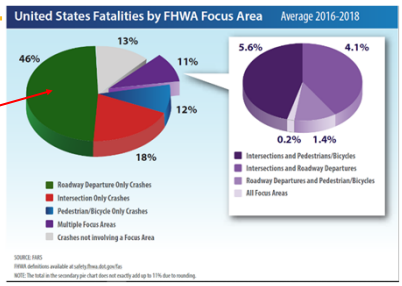
U.S. Fatalities

- Roadway departure only crashes over-represented in annual fatalities



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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 Documents:** based on identified national trends to encourage agencies and industry to evaluate and improve their specifications and practices

Image Source: FHWA

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Technical Advisory on Surface Texture

Surface Texture for Asphalt and Concrete Pavements T-5040.36

Issued June 17, 2005

- Technical Advisory
  - (1) issues information on state-of-the-practice for providing surface texture/friction on pavements and
  - (2) issues guidance for selecting techniques that will provide adequate wet pavement friction
- Not aware of any State DOT with dense graded asphalt mix specification requirements for macrotexture

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Technologies Demonstrated by FHWA MATC

Mixture

- Cracking & durability
  - I-FIT
  - IDEAL-CT
  - Overlay Test
  - Cyclic Fatigue
- Rutting & plastic deformation
  - IDEAL-RT
  - SSR
  - HWTT
- Moisture Damage
  - HWTT

Binder

- X-Ray Fluorescence (XRF) Spectrometer for element analysis
- FTIR for binder molecular analysis
- Binder characterization testing

Field

- Paver-Mounted Thermal Profiler (PMTP) for mat temperature
- Pulse Induction Technology (PIT) for mat thickness
- Pavement surface texture measurements (3 methods)
- Dielectric Profiling System (DPS) for mat density correlation

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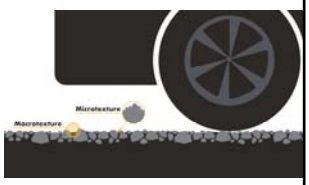
Asphalt Pavement Macrotexture

- **Significant focus on adding life (durability) to dense-graded mixes over the past several years**
  - Concern that macrotexture may be compromised
- **Macrotexture – mix surface voids, driven by aggregate gradation**
  - Provides voids/channel to evacuate water – more critical at higher speeds
  - Provides friction from hysteresis – hysteresis increases with speed – more critical at higher speeds
  - FHWA is investigating macrotexture testing procedures that could be used in mix design, mix verification, and field verification



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Slide 8

M(0 I changed "Guidance" to "Documents" bec we aren't allowed to say guidance
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Sand Patch Method

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Circular Texture Meter (CTM)

- Changes in Pavement Macrotexture
- Have Been Used to Identify Segregation, Skid Resistance, Pavement Noise
- CTM – Laser-Based Device to Measure Mean Profile Depth (MPD) of a Pavement
- Displacement Sensor mounted on an Arm Rotates Clockwise at a Fixed Elevation from Surface to Measure Vertical Macrotexture Depth
- Does Not Account for Concave Recesses in the Pavement Surface
- Correlates Well with Sand Patch Test

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Laser Texture Scanner (LTS) in Lab or Field

- Lightweight, portable, rapid, 3D scanner
- Utilizes a 100-mm laser line and travels 100 mm to collect a square area
- Measures macrotexture on freshly compacted mats in field and on cores or gyratory specimens in lab

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Objectives of MATC Efforts

- FHWA developing macrotexture test procedure for use in mix design, verification, and field validation.
- Compare macrotexture data of lab-compacted specimens at both N_{design} and 7% air voids, to field cores from just-constructed pavements.
- Variety of asphalt mixtures included from around the US, with different binders, mix design approaches, and design gyration levels.
- Initial steps exploring the addition of macrotexture as a variable in the design of asphalt mixtures.
- Consideration of safety at the design phase for dense graded mixtures advances towards a more sustainable pavement.
- Also potential for macrotexture to be an added goal in a balanced mixture design.

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Comparison of Laboratory vs. Field Macrotexture Results

- Seven (7) various mixtures tested from different parts of the country
  - 6 geographically-different states
  - 2 mix design methodologies
  - 3 nominal maximum aggregate sizes (NMAS)
  - 3 gradation types
  - 2 N_{design} levels of gyration
  - 5 asphalt binder grades
  - 6 asphalt content percentages
- Both production mix and roadway cores were sampled for each mixture
- NMAS and gradation type were expected to have the most influence on surface macrotexture

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Mixture Types Included in Laboratory and Field Macrotexture Testing

State Agency Mix Design	NMAS (mm)	PCS Control Point (%)	%Passing PCS (%)	Design Gyrations (N_{des})	Asphalt Content (%)
ND Superpave – PG64-28 Fine-Graded DGA	12.5	39	49	75	5.0
FL Superpave – PG76-22 Fine-Graded DGA	12.5	39	**	75	5.1
AZ Marshall – PG70-28 Fine-Graded DGA	19.0	47	57	75	5.1

**Florida DOT specification requires this mix designed to be fine-graded

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Mixture Types Included in Laboratory and Field Macrotexture Testing

State Agency Mix Design	NMAS (mm)	PCS Control Point (%)	%Passing PCS (%)	Design Gyrations (N_{des})	Asphalt Content (%)
MS Superpave – PG67-22 Coarse-Graded DGA	9.5	47	41	65	5.8
OH Marshall – PG70-22 Coarse-Graded DGA	9.5	47	36	75	6.3
OH_HRAP Marshall – PG70-22 Coarse-Graded DGA	9.5	47	37	75	6.0
VT Superpave – PG70-28 Gap-Graded SMA	12.5	39	17	65	6.1

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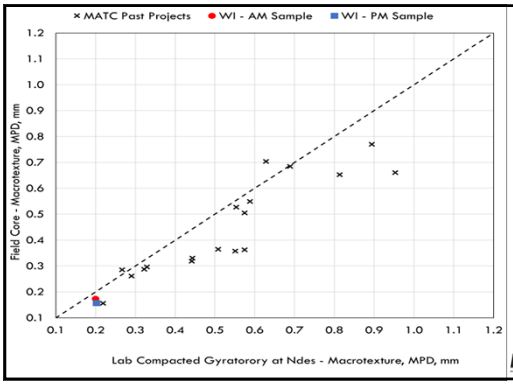
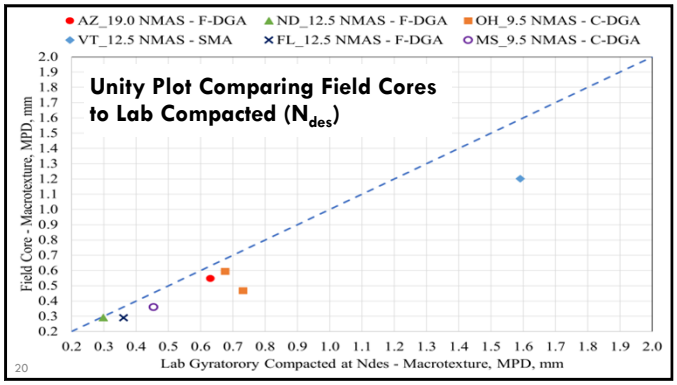


MATC Projects as of Sept. 2024



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Potential Ties for Macrotexture into Balanced Mixture Design

- Advantages of providing adequate macrotexture can include reduced crash rates in wet weather, especially on high-speed roads.
- Changes in macrotexture can help identify mixture non-uniformity, which can lead to raveling and cracking.
- For agencies where friction is an important parameter for the performance of their asphalt pavements it is desirable to make it part of mixture design criteria.
- The LTS has the potential to provide rapid evaluation of mixtures during the design phase making it a potential tool to use in a Balanced Mix Design (BMD) system.
- Although most are focused on using BMD to address cracking and rutting, there are some that are evaluating macrotexture and friction as part of the program.
- The rapid measurement and the ability of the LTS tool to replicate field macrotexture on laboratory specimens creates an opportunity for this to be combined with BMD.

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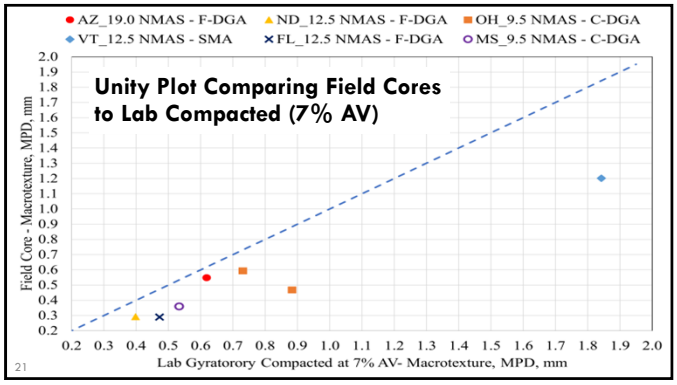

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Overall Observations and Future Steps

- In almost all cases, the macrotexture measurements taken on lab compacted samples were higher than field core measurements.
- As expected, the SMA mix had a higher macrotexture than the dense graded mixes.
- Macrotexture measurements from four states exhibited MPD values that were slightly below (< 0.4 mm) the typical values listed in the AASHTO Guide for Pavement Friction.
- These observations indicated the potential for macrotexture to be considered in the conducting of a BMD approach to mixture design.
- However, more formal research is necessary to address various gaps, such as:
  - Controlled experiment to better assess the relationship between laboratory and field macrotexture
  - Study the influence of gradation, NMAS, density of compaction, binder content and binder type on macrotexture
  - Study the effect of aggregate characteristics on the measured MPD value
  - Harmonize testing protocol for measurement of macrotexture both in the laboratory and field
  - Develop a simple laboratory method for measurement of pavement macrotexture in Balanced Mix Design without compromising other performance requirements.

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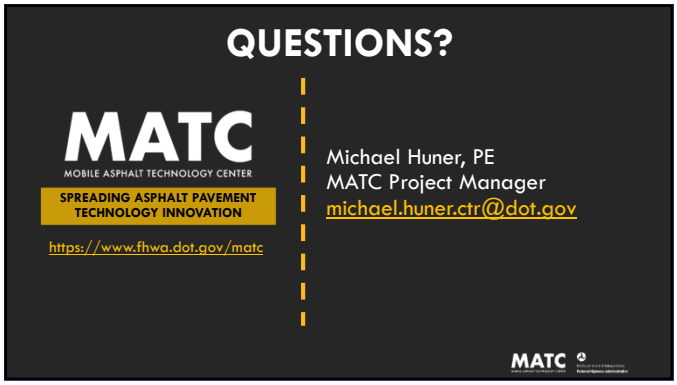
QUESTIONS?
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