Wisconsin Annual Asphalt Conference

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Overview of the FHWA Mobile Asphalt Technology Center: Field Technologies On the Go

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U.S. Department of Transportation

Federal Highway Administration

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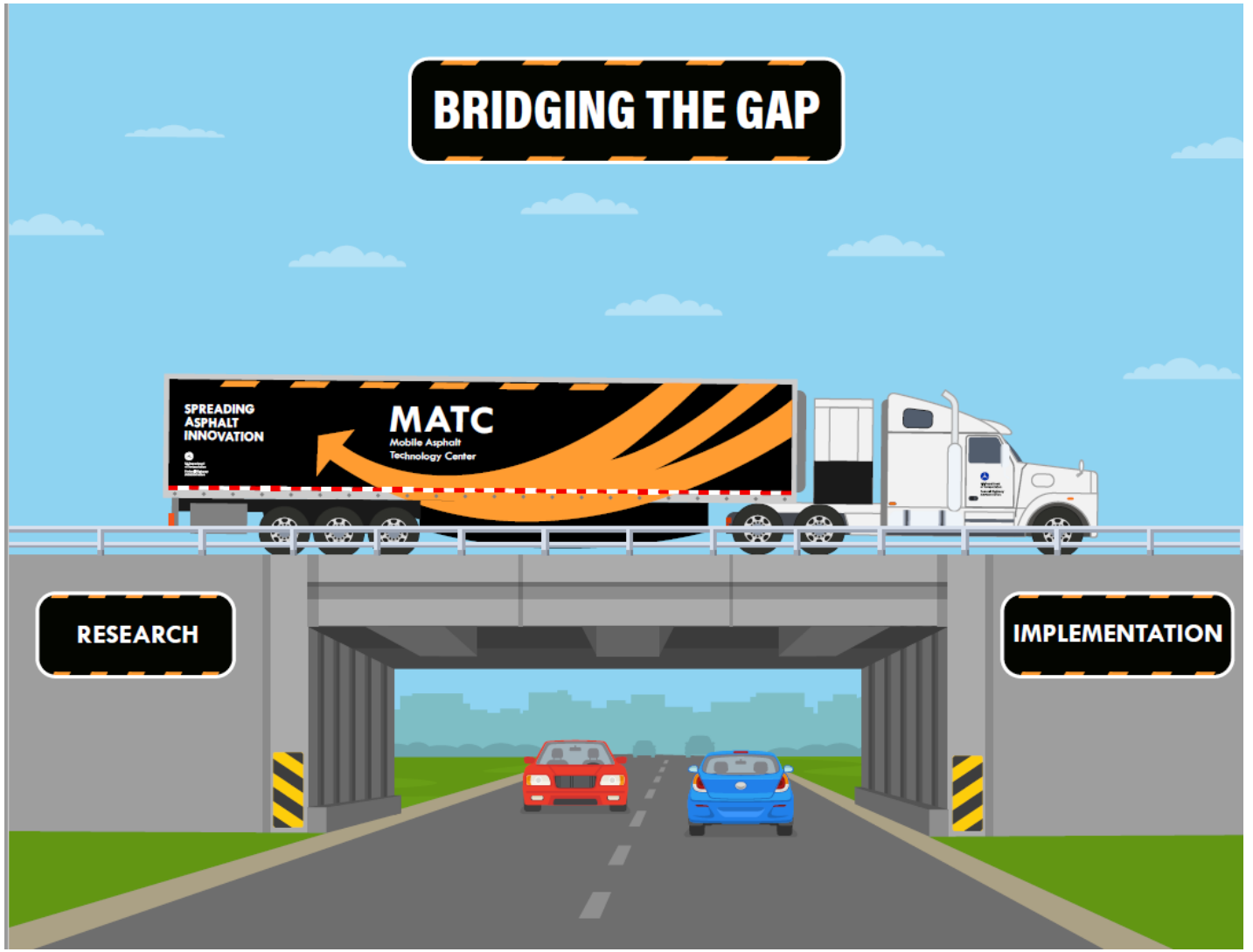
ACRONYMS

- AASHTO: American Association of State Highway and Transportation Officials
- AMPT: Asphalt Mixture Performance Tester
- ASTM: American Society for Testing and Materials
- BMD: Balanced Mix Design
- DPS: Dielectric Profiling System
- |E*|: Dynamic modulus of asphalt
- FHWA: Federal Highway Administration
- FTIR: Fourier Transform Infrared Spectroscopy
- I-FiT: Illinois Fatigue Test
- LTS: Laser Texture Scanner
- MATC: Mobile Asphalt Technology Center
- MPD: Mean Profile Depth
- NDE: Nondestructive Evaluation
- PMTP: Paver Mounted Thermal Profiler
- QA: Quality Assurance
- SSR: Stress Sweep Rutting
- TFHRC: Turner-Fairbank Highway Research Center
- XRF: X-Ray Florescence

FHWA Mobile Asphalt Technology Center (MATC)

- Site Visits
- Equipment Loan Program
- Training Workshops
- Data Sharing
- Agency Specification Reviews
- Technician Tips & Tricks Videos
- Virtual Lunch-n-Learns
- InfoSheets



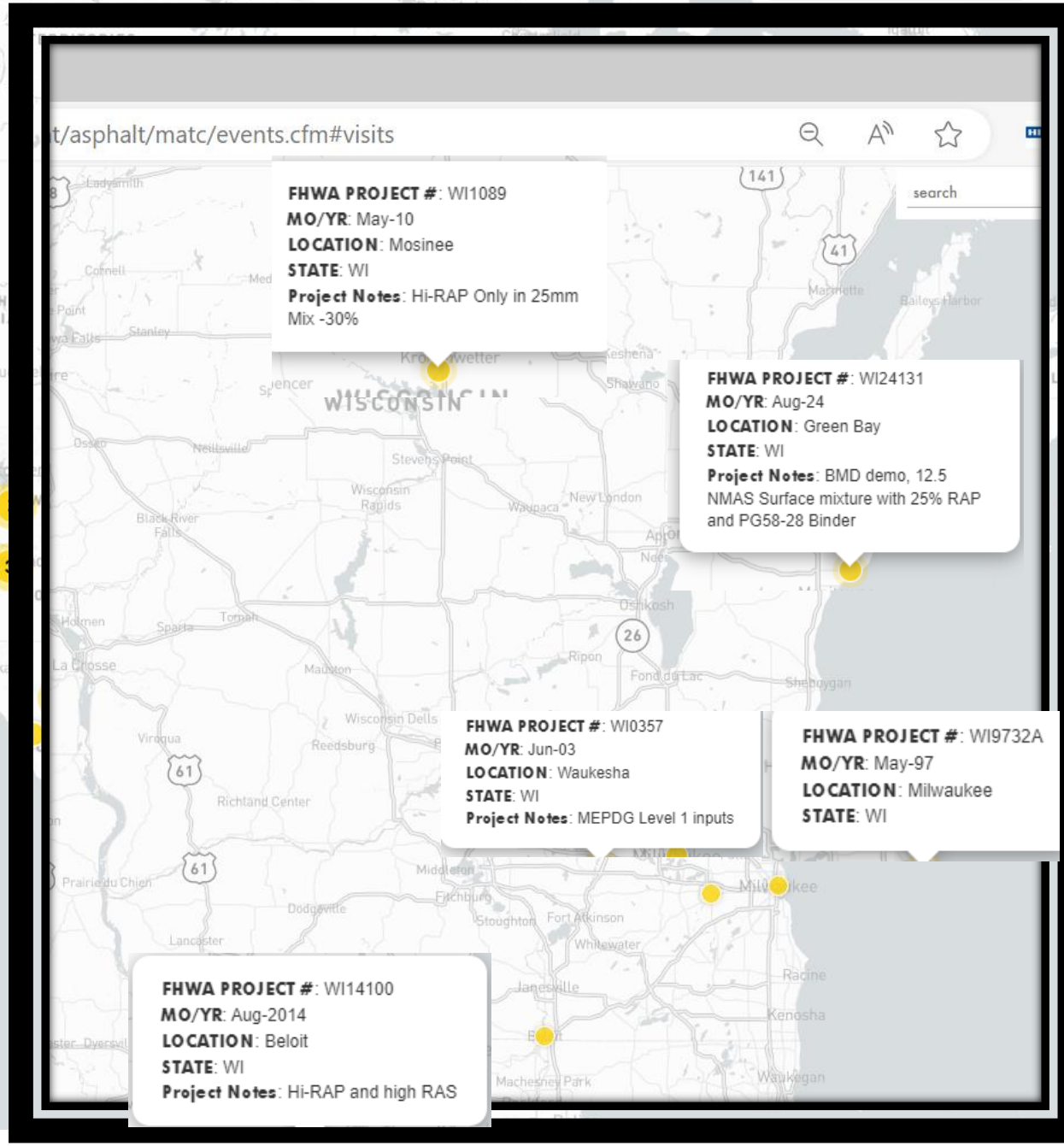
MATC

Site Visits Since 1988

Wisconsin

- Interactive Map
- Searchable:

RAP	Reclaimed asphalt pavement
RAS	Recycled asphalt shingles
SMA	Stone matrix aggregate mix design
FC	Friction course
WMA	Warm mix asphalt
Hi-RAP	High percentage of RAP (30% plus)
PMA	Polymer modified asphalt
AR	Asphalt rubber
ARB	Asphalt rubber base
PRS	Performance related specification project



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MATC Team

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Low Carbon Transportation Materials Specification Review

James Barker
Laboratory Technician
Electro/Mechanical
Mixture Design/Testing

SME: Nam Tran
Subject Matter Expert
Asphalt Materials Data Analysis

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

Image Source: FHWA

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Technologies Demonstrated by MATC

Mixture Tests	Materials Tests	Field Tests
IDEAL-CT for crack resistance	X-Ray Fluorescence (XRF) Spectrometer for binder's or markings' chemical elements	Paver-mounted thermal profiler for real-time mat temperatures
Overlay Test for reflective cracking	* FTIR looks at molecules in binder (lime, polymers,…)	Pulse induction test for in-place pavement thickness
Flexibility index test (I-FIT) for fracture resistance	* Binder characterization testing (delta T_c, delta T_f)	Circular Track Meter for measuring mean profile depth
* Hamburg Wheel Track Tester		Dielectric profiling system (DPS) for in-place density
IDEAL-RT for rutting resistance		Laser-based measurement of mean profile depth
AMPT suite of tests (|E*|, cyclic fatigue, SSR)	* *Done at FHWA TFHRC labs*	

<u>Other support activities</u>:

PaveME Design analysis

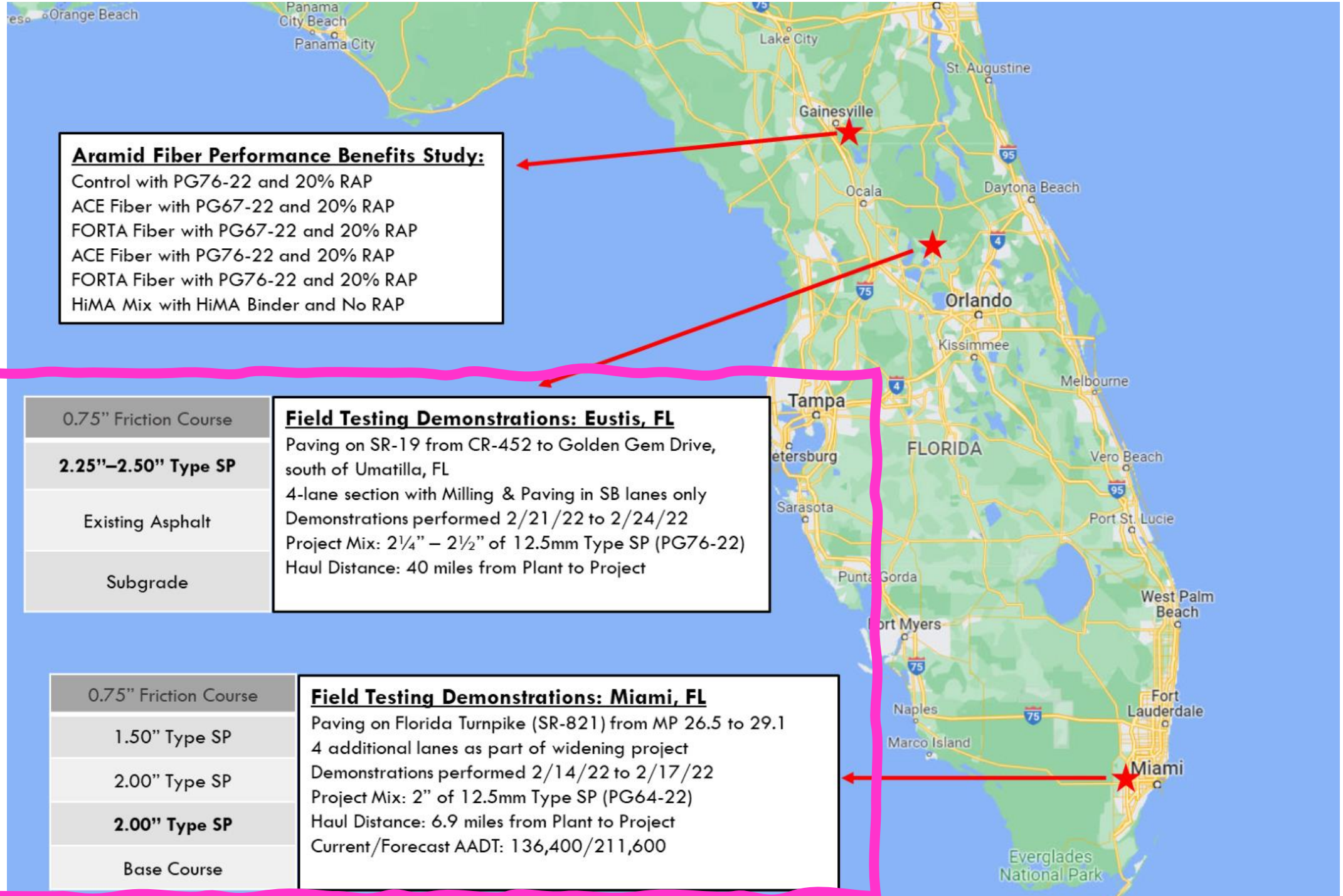
* FlexMAT & FlexPAVE for mix design performance comparisons

Asphalt pavement spec review

Construction density spec review (mat and joints)

Example of Typical MATC Site Visit

Feb 2022



Deployment of Field Technologies to Assist Asphalt Pavement Constructability

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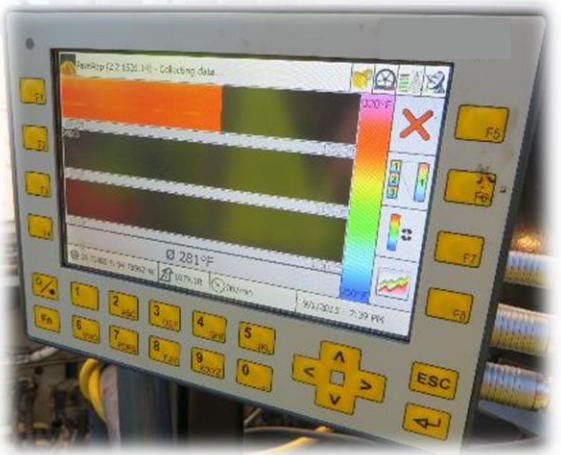
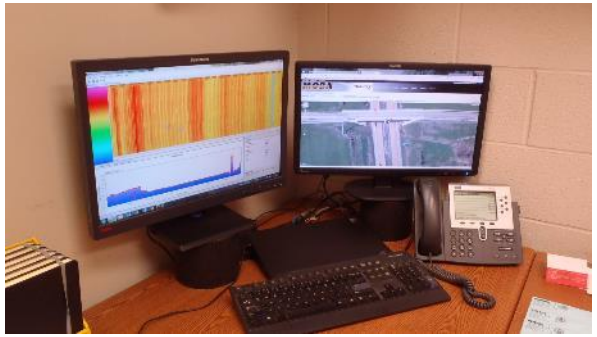
Paver-Mounted Thermal Profiler (PMTP)

Imaging of Mat Surface: 2 to 3 meters behind screed

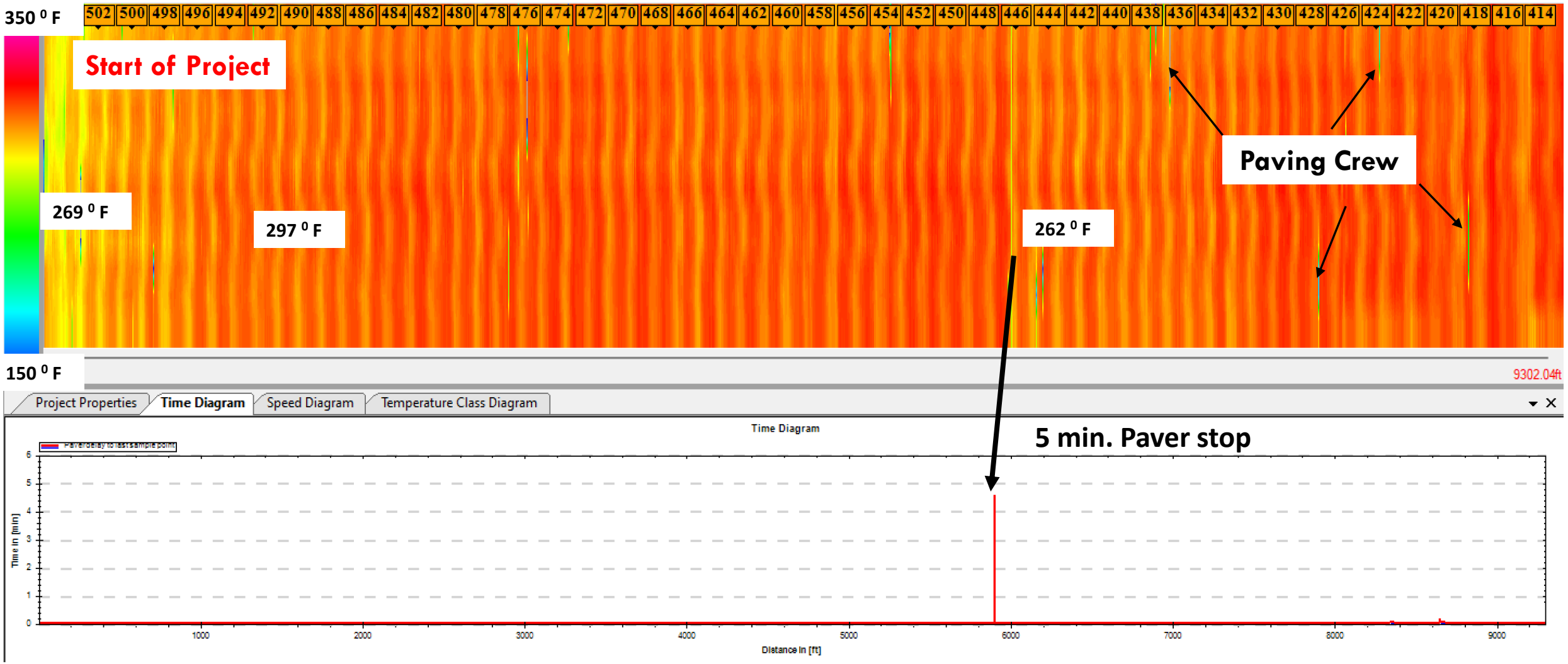




All images source: Travis Walbeck

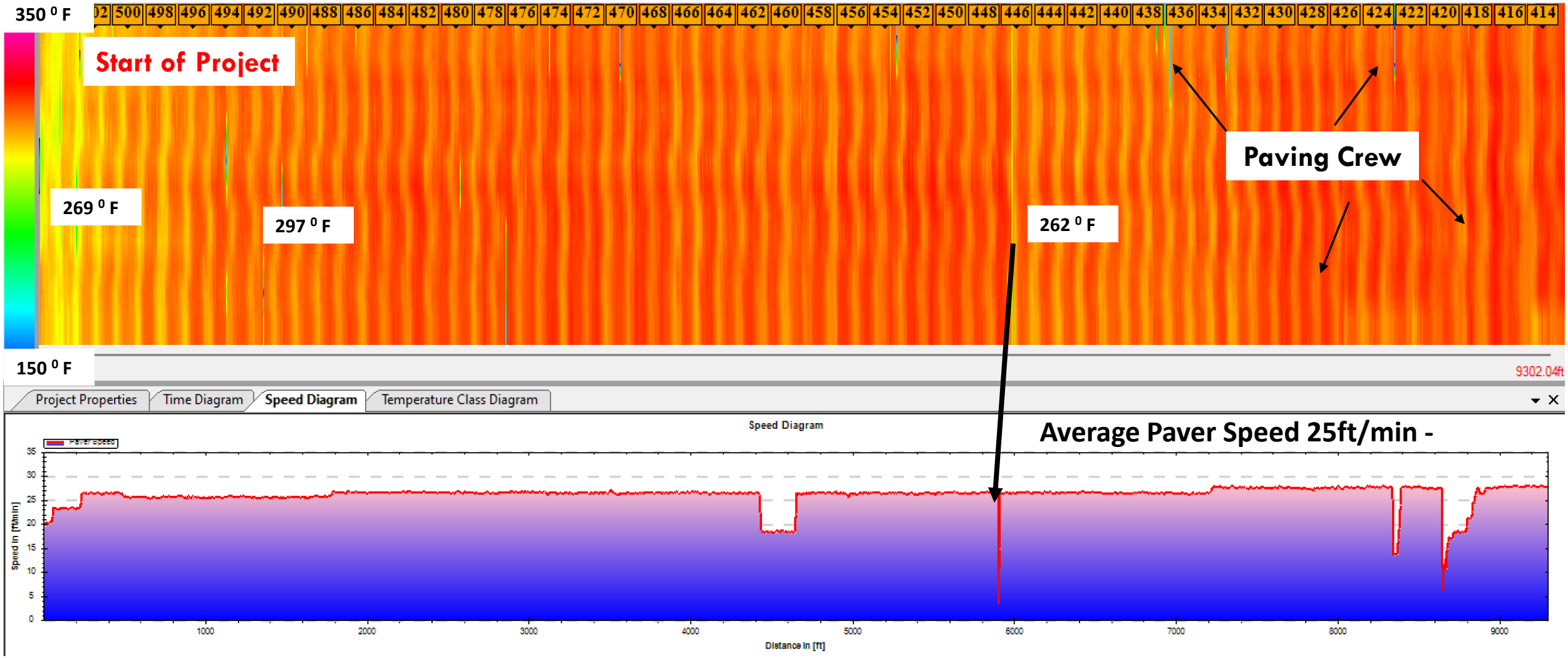
Paver-Mounted Thermal Profiler

Paving Date : 8-9-24



Paver-Mounted Thermal Profiler

Paving Date : 8-9-24



Paver-Mounted Thermal Profiler

Thermal Profile Results Summary (8-9-24)				
Number of Profiles	**Moderate 25.0°F < differential <= 50.0°F**		**Severe differential > 50.0°F**	
62	Number	Percent	Number	Percent
	1	2	0	0

Use of PMTP Devices Nationally

Benefits

+ Identify cold spots, segregation, thermal streaks
+ Identify low density areas
+ Control paver delays
+ Adjust speed between trucks

Current Limitations

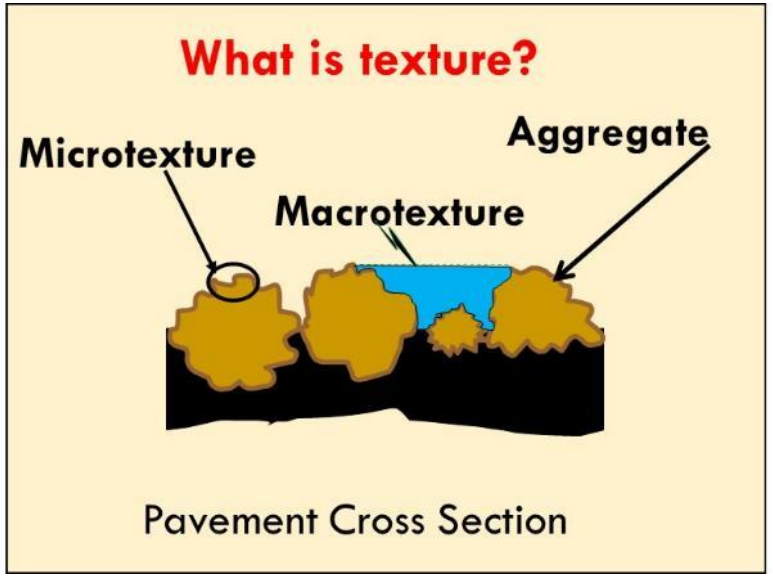
- Installation on contractor's equipment
- No existing direct correlation between severe thermal segregation & pavement density

Implementation in 12 states & Eastern Federal Lands

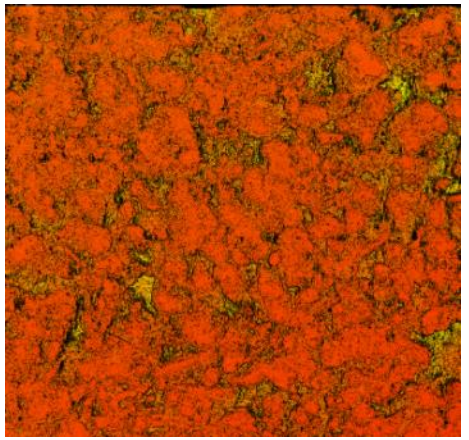
- Alabama, Alaska, Illinois, Maine, Minnesota, Missouri, New Jersey, North Carolina, North Dakota, Texas, Virginia, & West Virginia

Macrotexture Testing

Laser Texture Scanner: Use 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



Laser Texture Scanning

Benefits

+ Easy to use & nondestructive
+ High accuracy
+ Takes 90 seconds to run
+ Good for QC use
+ Can be used in lab during mix design & production

Current Limitations

- Standards still under development
- Surface must be dry, if used on field mat
- Sensitive to shiny mixes so spray needed to dull reflectance
- Not a direct correlation to friction

Current under consideration for implementation

- California, Illinois, Kentucky, North Carolina, Ohio, Washington

In-Place Asphalt Thickness Testing

Pulse Induction Technology

Nondestructive Pavement Measurement

- Quality control and agency acceptance
- AASHTO test method (AASHTO T 359-18)
- ASTM test method in the works
- *Not Federal requirements*

Step 1

Place the target

Step 2

Pave over it

Step 3

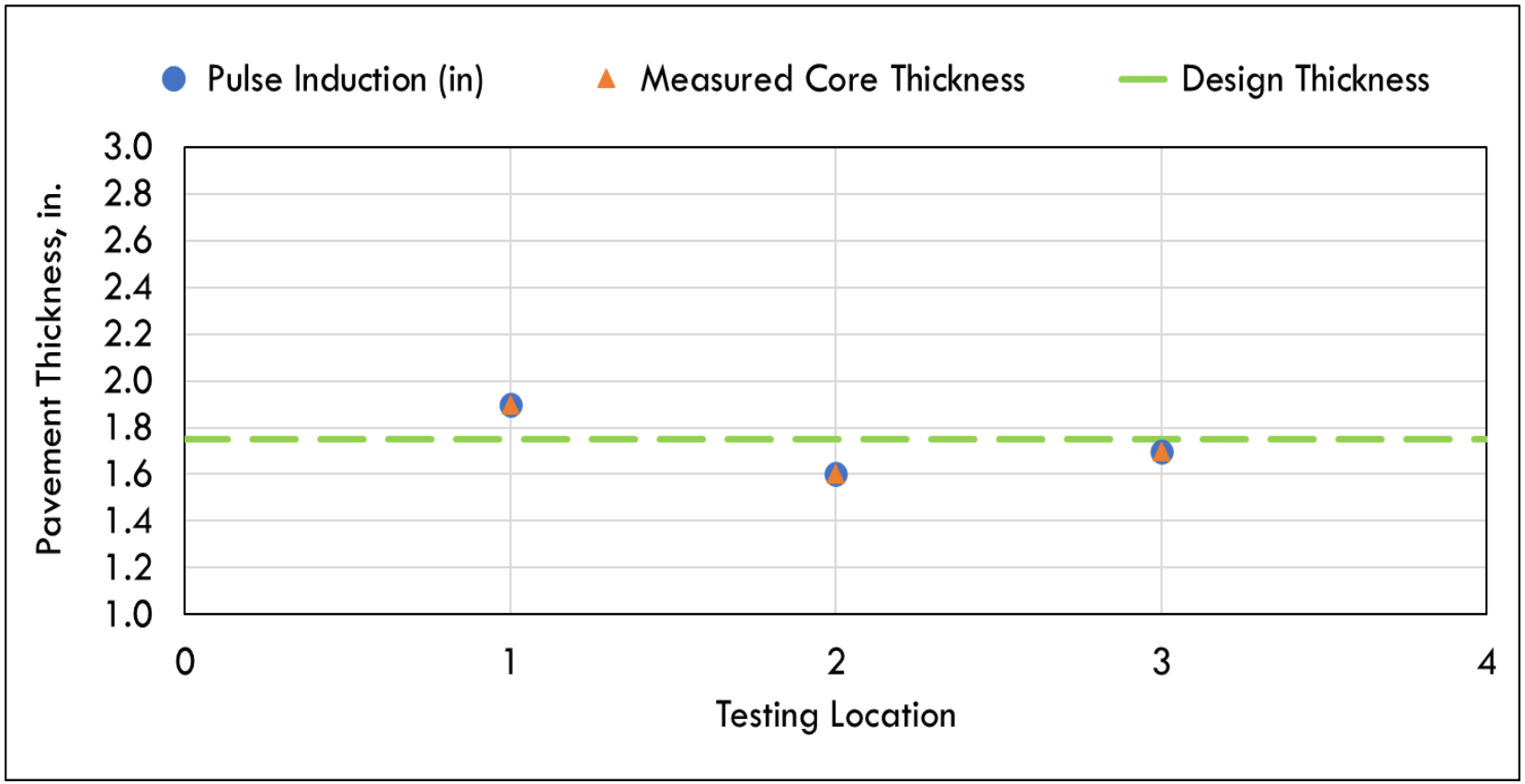
Find targets; measure thickness

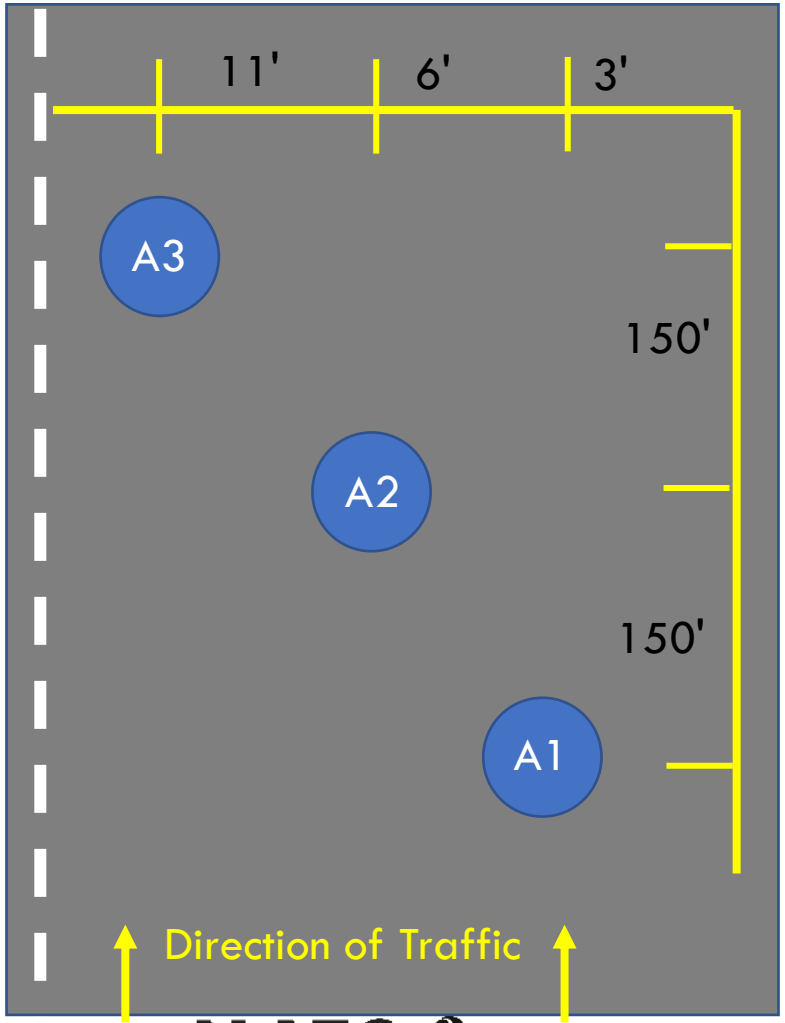
Optional Step

Core & confirm thickness

Pulse Induction Technology

GPS - 44°09'13.0"N, 87°35'35.6"W
Location - Hwy-310, Manitowoc, WI





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Pulse Induction Technology

Benefits

+ Easy to use
+ High accuracy
+ Non-destructive
+ Almost real time (rapid)
+ Good for QC use e.g., test strips, informing paver adjustments

Current Limitations

- Presence of existing rebar in existing layers
- Presence of excessive moisture on surface
- Windrow paving
- Surface irregularities (inadequate removal of scabs, unlevel existing surface)

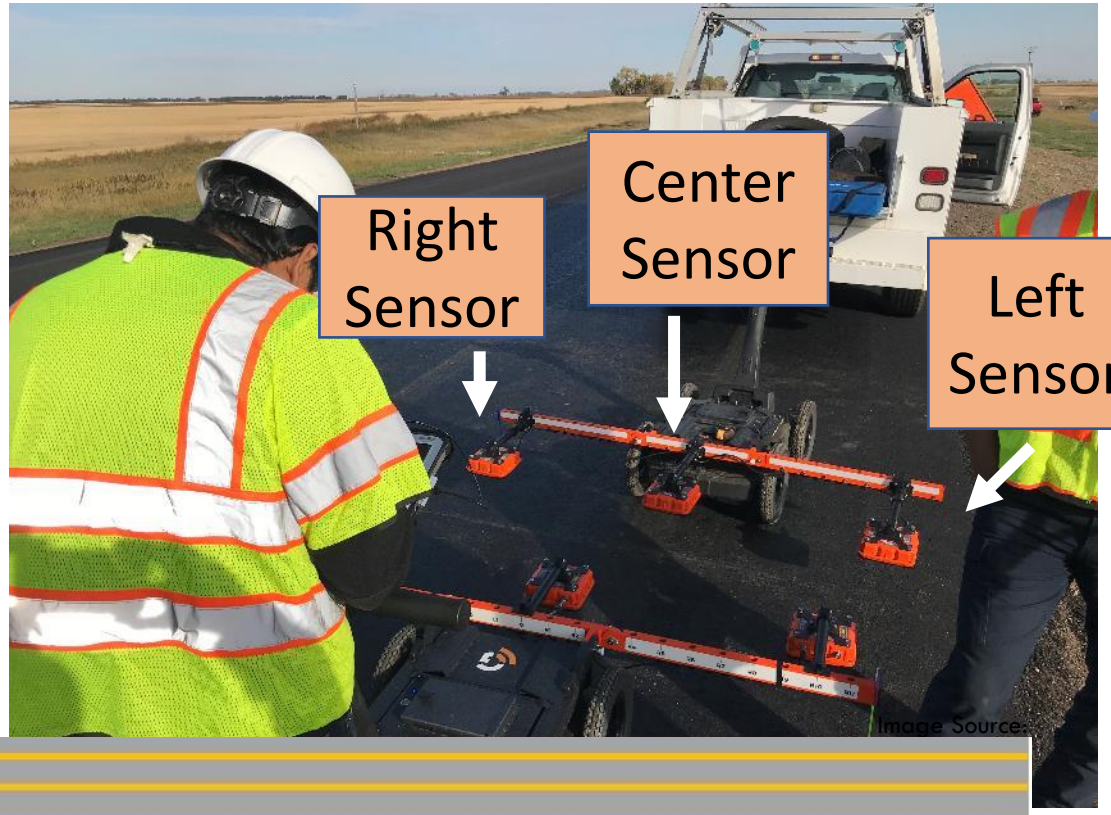
Current practice

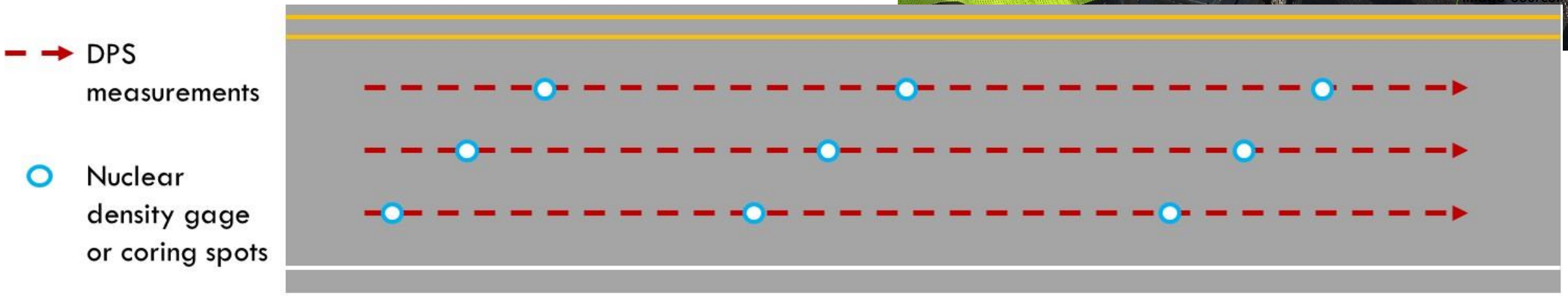
- Iowa, Minnesota, Pennsylvania, Washington, Wisconsin

In-Place Asphalt Density & Mat Uniformity Testing

Dielectric Profiling Systems (DPS)

- Coring and nuclear density gauge only used for spot checks on predetermined, random locations
- DPS provides continuous density profile along testing path
- Reduce turnaround times



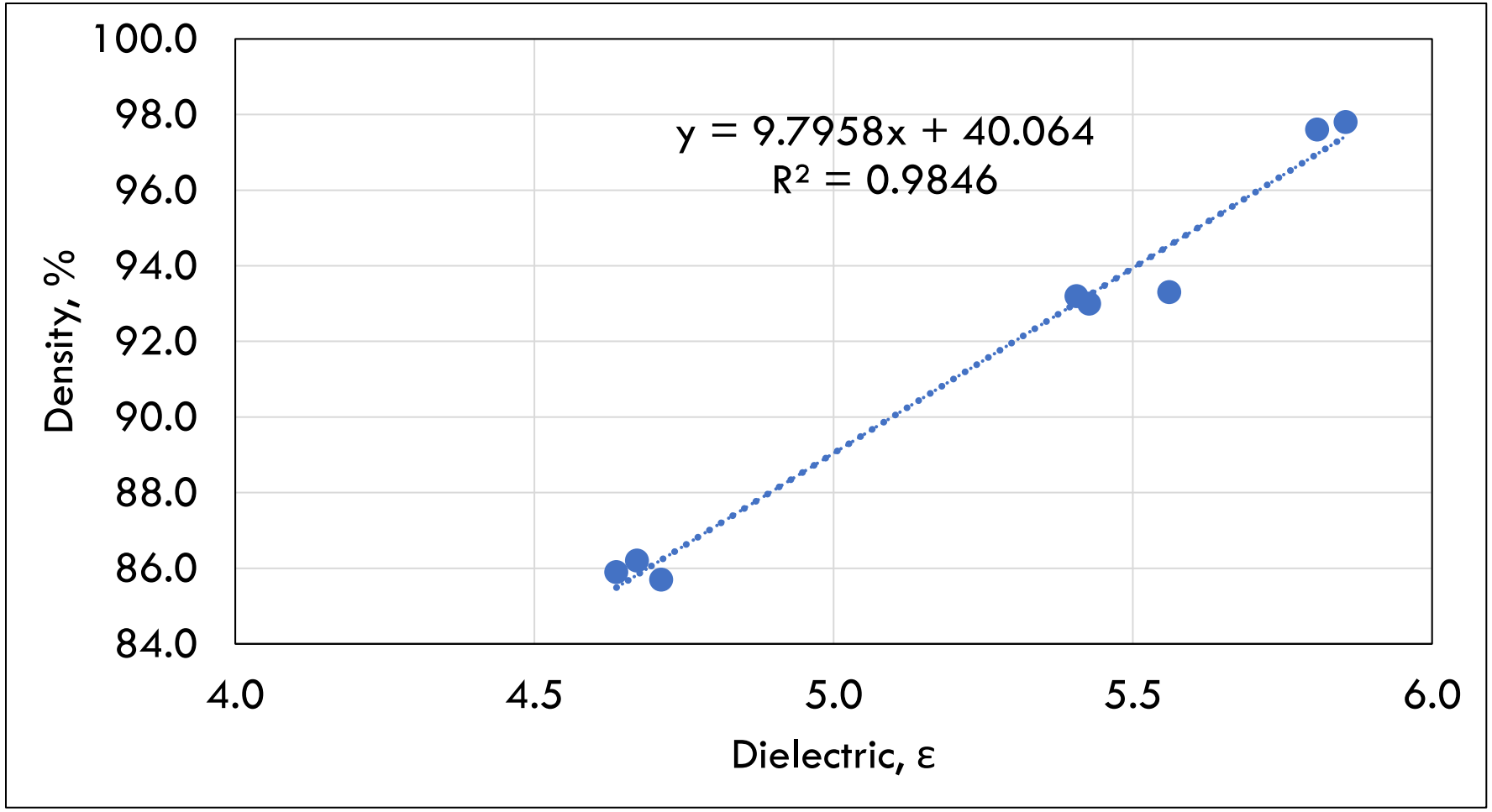


Dielectric Profiling System (DPS)

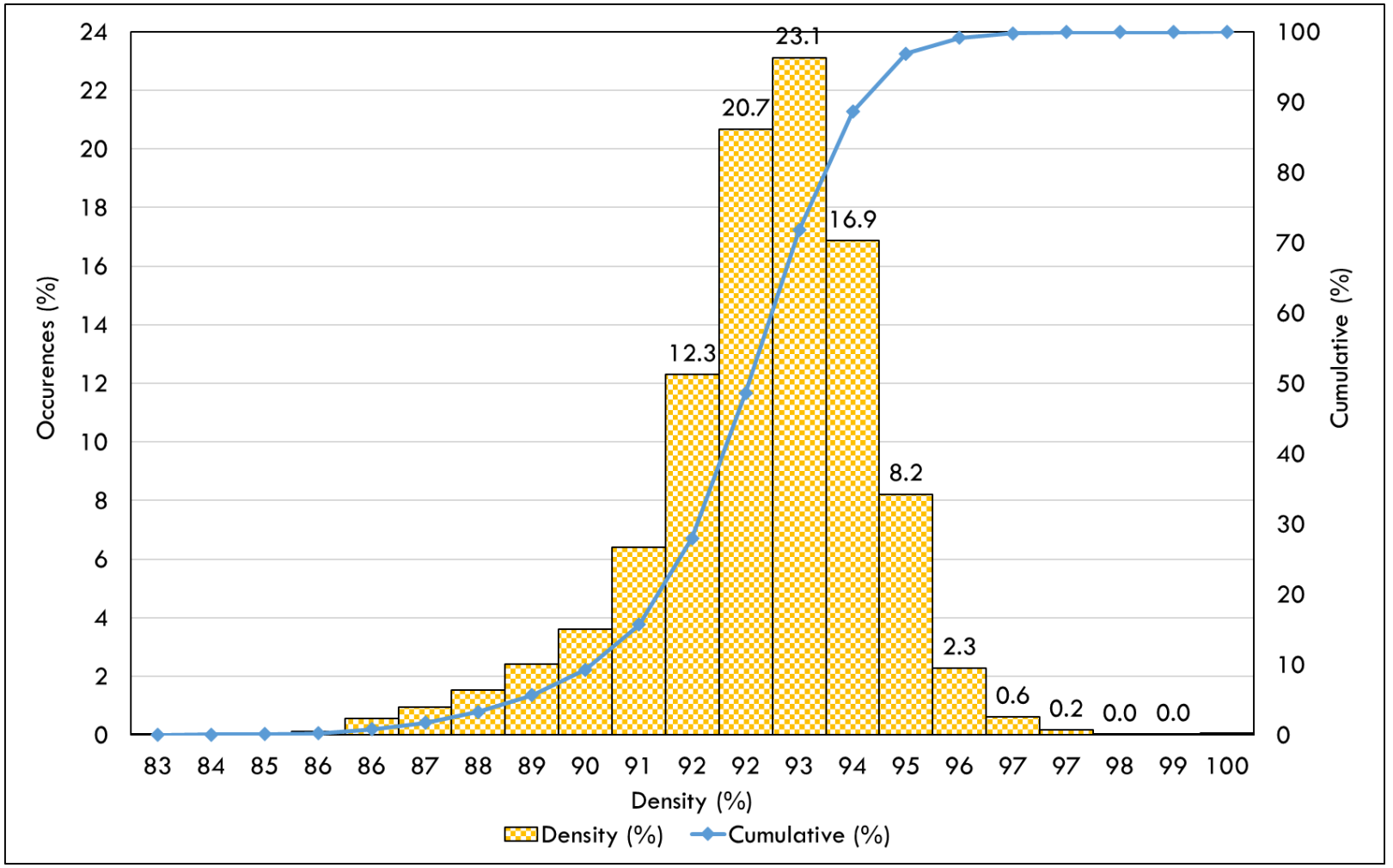
Emerging Technology

- 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)



Dielectric Profiling System (DPS)



Statistic	Value
Mean	95.8
Standard Deviation	1.1
CoV (%)	2
Sample Size	22,041

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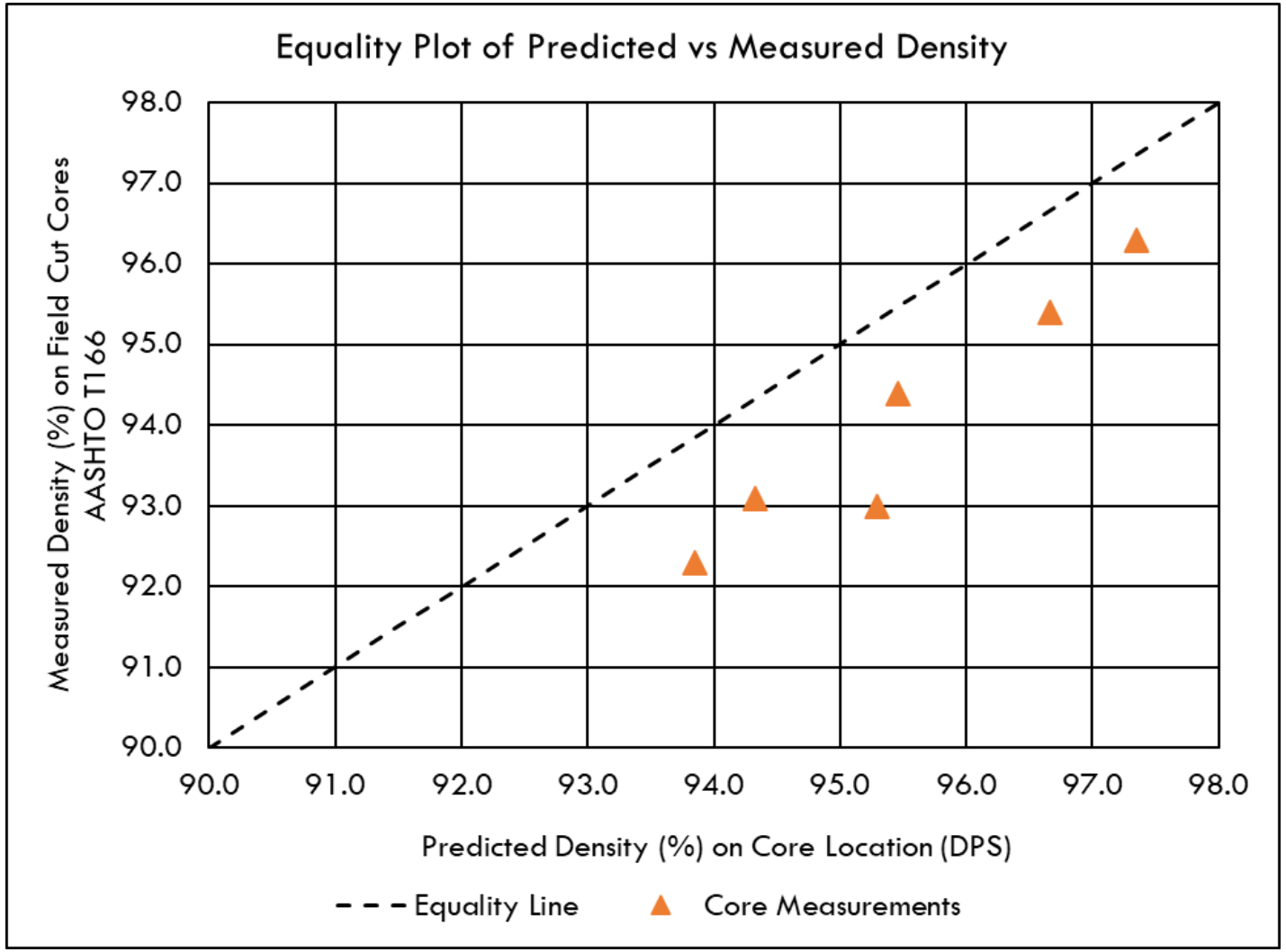
Measured %Density vs. Predicted %Density



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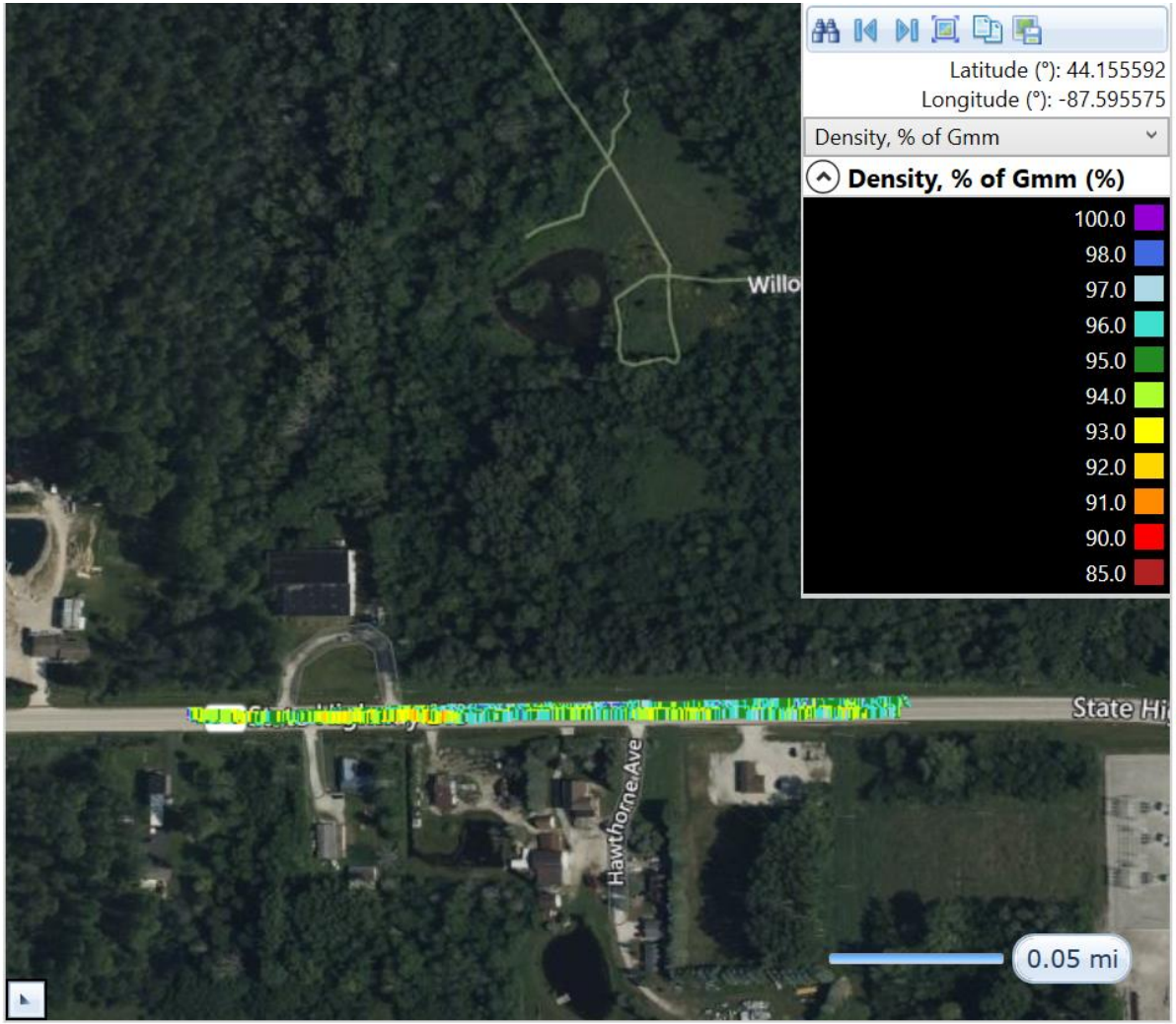
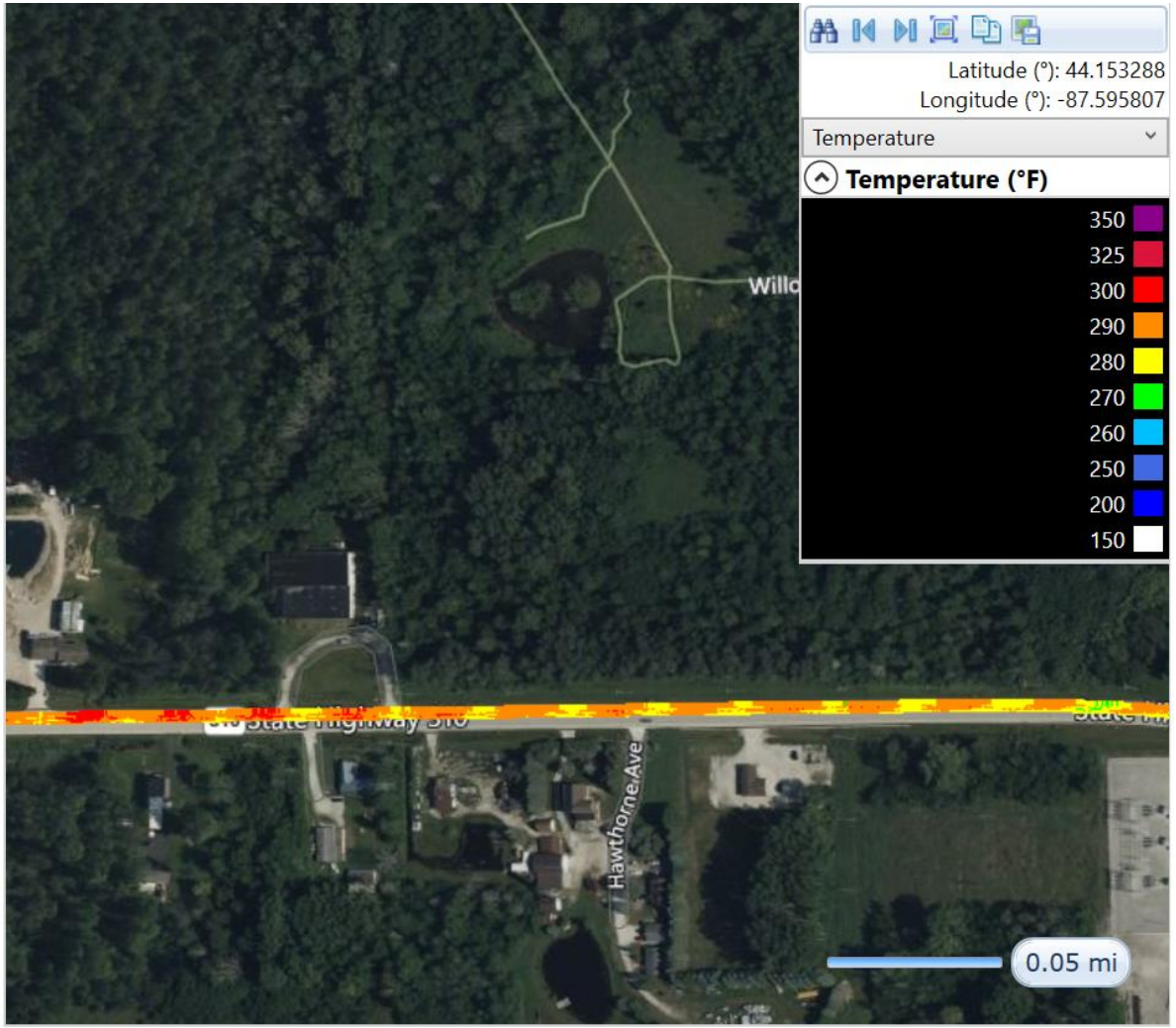
Dielectric Profiling System (DPS) - VETA





Benefits and Challenges of DPS

Benefits

+ Use as QC tool to identify potential issues with paving & compaction operations
+ Nondestructive
+ Helps identify high and low compaction areas
+ Help improve density of mat & longitudinal paving joints

Current Challenges

- Obstacles to use for acceptance (agency resources, proper validation of contractor data, time to collect, etc.)
- Incorporation in specifications & bids
- Staffing the data collection
- Device is run manually

Density Profiling System - Office of Materials and Road Research - MnDOT (state.mn.us)

Technology Transfer

U.S. Department of Transportation
Federal Highway Administration

Spotlight on Pavement Density

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Use of Dielectric Profiling Systems for Asphalt Density

FHWA-HIF-21-XXXX

For more information on DPS and related technology, contact Monica Jurado, Pavements & Materials Engineer, FHWA Resource Center, monica.jurado@dot.gov

This equipment and more are available on loan at the MATC. www.fhwa.dot.gov/pavement/asphalt/trailer/equipment_loan_program.pdf

The dielectric profiling system series shares information on pavement testing programs.

To access the full series, visit www.fhwa.dot.gov/pavement/asphalt/trailer/initiatives.cfm

Background

Highway agencies seeking a more viable way to check the quality of asphalt construction than through sample cores are considering dielectric profiling systems (DPS) as a solution.

DPS use a ground-penetrating radar (GPR) to collect dielectric values from the underlying surface that help measure air voids or nonuniformity of newly laid hot-mix asphalt. In this way, a DPS unit rolled along a road segment can collect continuous data on asphalt density. Asphalt density is a key indicator for long-term performance of new pavement or resurfacing construction jobs. Improving pavement performance can extend maintenance cycles and save millions of dollars in transportation budgets.

State Departments of Transportation (DOTs) have been field-testing DPS units in their pavement testing programs through the second Strategic Highway Research Program (SHRP2) Initiative (R06C), which advanced the DPS technology as a nondestructive method for checking asphalt density.

DOTs describe initial difficulties in interpreting the intricate data and managing the enormous data output. However, DOTs observe that the data produces a more uniform and immediate picture of a new pavement layer than the process of obtaining sample cores at random spots along a new section.

A DPS unit side view (above) and in use (below). Photo sources: GSSI, ODOT

How DPS Work

DPS units come in various models from multiple commercial vendors, costing about $70,000 per unit. Also known as density profiling systems, they often are in the form of lightweight carts that one person easily pushes along a test path. A three-channel GPR mounted near the wheels continuously collects data that transmits to the unit's computer system.

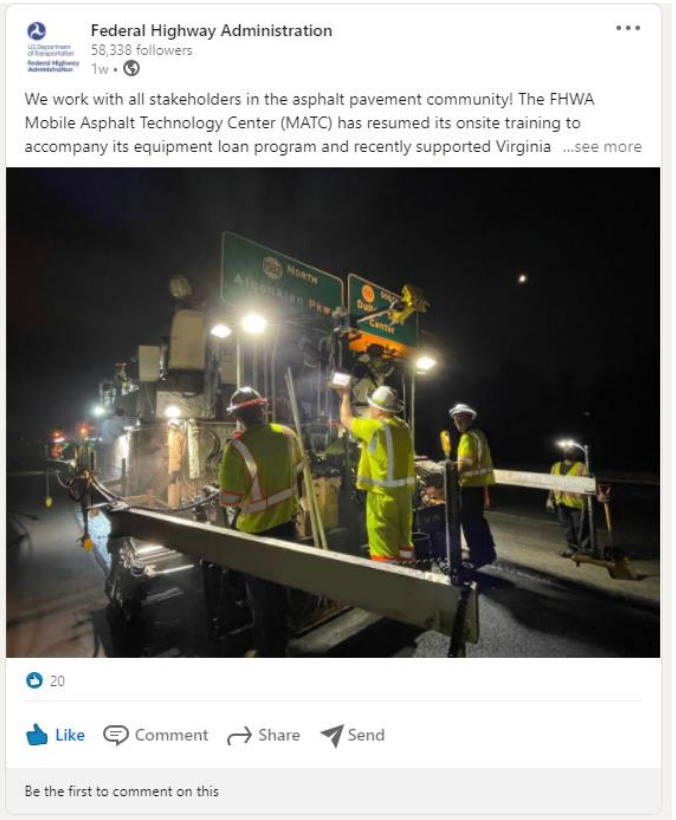
The unit determines the dielectric readings of the materials that make up the asphalt layer by measuring the velocity of reflected waves to about 2.5 inches. All material has a dielectric constant, ranging from 1 for air to 81 for water. HMA dielectric constants typically range from 3 to 6, depending on the aggregate type, asphalt content, and percentage of air voids.

The paving crew can view the data immediately on the unit's trackpad and then export the data to other software for further analysis. The dielectric constants along the test path display as statistical data, histograms, box plots with outliers identified, or heat maps of the production lot.

Considering DPS? Technical assistance is available from the Federal Highway Administration (FHWA) through the Mobile Asphalt Technology Center (MATC) or FHWA division offices. There is also a national pooled fund study on DPS use.

Benefits

- Ability to detect and identify areas of concern. Contracting crews can adjust or remediate while the work zone is intact and before a job's acceptance.
- More uniform results than with sample cores, which may miss variations in the new mat.
- Significant reduction of cores per project. This avoids risks of new defects from removal and return of cores. It also can save on contract costs.
- Data applies to other uses, such as simulating changes to construction specifications, mapping locations and data, and other quick visualizations.
- More efficient and safer than coring. A DPS unit can be walked behind the paving equipment without additional road closures against fast-moving traffic.



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We work with all stakeholders in the asphalt pavement community! The FHWA Mobile Asphalt Technology Center (MATC) has resumed its onsite training to accompany its equipment loan program and recently supported Virginia ...see more

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- Communication bursts to raise awareness on FHWA efforts
- MATC "Lunch-n-Learn: Asphalt" Series
- Examples of Topics:
  - **Enhancing in-place density**
  - Spotlight on **Pavement Density**: Dielectric Profiling System Series
  - Spotlight on **Constructability**: Pave-IR Series
  - Spotlight on **Pavement Safety**: Macrotexture Series

Equipment Loan Program

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

- DPS unit
- Pave-IR unit
- Circular track meter
- Laser texture scanner
- SmartJig for IDEAL-RT and IDEAL-CT tests
- Handheld XRF binder device
  - Limestone, titanium dioxide, REOB

Equipment loan includes on-site training by MATC or consultant, final Lessons Learned document, and post-loan briefing presentation

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EQUIPMENT LOAN PROGRAM

In order to increase the likelihood of adoption of new technologies, the FHWA's Mobile Asphalt Technology Center (MATC) provides loans of laboratory and field equipment to the asphalt pavement community.

Why borrow from FHWA? Providing the opportunity for members of the asphalt paving community to trial technologies and test procedures can significantly increase the likelihood of adoption. By borrowing equipment, agencies and contractors don't have to front the resources to buy an expensive piece of equipment, only to potentially find that it may not meet their needs.

The standard equipment loan duration is limited to 2 months. Depending on both the need and current equipment availability, loan durations can often be extended upon request.

EQUIPMENT AVAILABLE FOR LOAN

- Paver-Mounted Thermal Profiler (PMTP) for mat temperature
- Pulse Induction Technology for mat thickness
- Dielectric Profiling System (DPS) for mat and joint density and DPS Calibration Kit
- Circular Track Meter (CTM) and Laser Texture Scanner (LTS) for surface macrotexture
- Jig sets for balanced mixture design testing for cracking potential (IDEAL-RT, I-FIT, or OT)
- SmartJig device (with software) for balanced mixture design cracking and rutting potential (IDEAL-CT and IDEAL-RT)
- X-Ray Fluorescence Spectrometer (XRF) for determining the elemental composition of asphalt binders
- Automatic Vacuum Sealing Device for specific gravity testing

MATC "Lunch-n-Learn: Asphalt" Series

Pick topics for 1-hr virtual training

Lab look-in test methods (mixture, binder tests, etc.)

Strengthen your Asphalt QA Program

Pavement preservation

- Tack coat best practices
- Longitudinal joint density

- Pavement design policy
- Mechanistic-Empirical Pavement Design

- BMD Concept & Tests
- Specimen fabrication tips for BMD tests
- BMD Key Tasks for Implementation

- Sustainability
- Macrotexture & Safety
- RAP & Warm Mix Usage
- Resilience

QUESTIONS?

For more information on **Balanced Mix Design** and requesting **Specification Reviews:**

Mr. Derek Nener-Plante, FHWA Resource Center
derek.nener-plante@dot.gov

For more information on **Technology Deployment, Site Visits, or Workshops:**

Dr. Leslie Myers, FHWA HQ
leslie.myers@dot.gov

For more information on **Logistics, Equipment Loan, and Scheduling MATC Site Visits:**

Mr. Michael Huner, MATC
michael.huner.ctr@dot.gov

https://www.fhwa.dot.gov/pavement/MATC/