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MOBILE ASPHALT TECHNOLOGY CENTER

FHWA MATC Site Visit to New Jersey

68th Annual New Jersey Asphalt Pavement Association Conference

March 4th, 2025

U.S. Department of Transportation

Federal Highway Administration

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ACRONYMS

- AASHTO: American Association of State Highway and Transportation Officials
- ABML: Asphalt Binder and Mixture Laboratory
- ABT: Asphalt Binder Tester
- AMPT: Asphalt Mixture Performance Tester
- ASTM: American Society for Testing and Materials
- BMD: Balanced Mix Design
- DO: FHWA Division Office
- DPS: Dielectric Profiling System
- FTIR: Fourier-Transform Infrared Spectroscopy
- HICP: FHWA Office of Preconstruction, Construction, and Pavements
- IDEAL-CT: IDEAL Cracking Test
- IDEAL-RT: IDEAL Rutting Test
- I-FIT: Flexibility Index Test
- MATC: Mobile Asphalt Technology Center
- MTV: Material Transfer Vehicle
- NCHRP: National Cooperative Highway Research Program
- NDE: Nondestructive Evaluation
- PEM: Performance Engineered Mixtures
- PEP: Performance Engineered Pavements
- PMS: Pavement Management System
- PRS: Performance-Related Specifications
- QA: Quality Assurance
- R&D: Research & Development
- RC: FHWA Resource Center
- S_{app}: Apparent Damage Capacity
- SCB: Semi-Circular Bend
- SSR: Stress Sweep Rutting
- TFHRC: Turner-Fairbank Highway Research Center
- TxOT: Texas Overlay Text
- XRF: X-Ray Florescence

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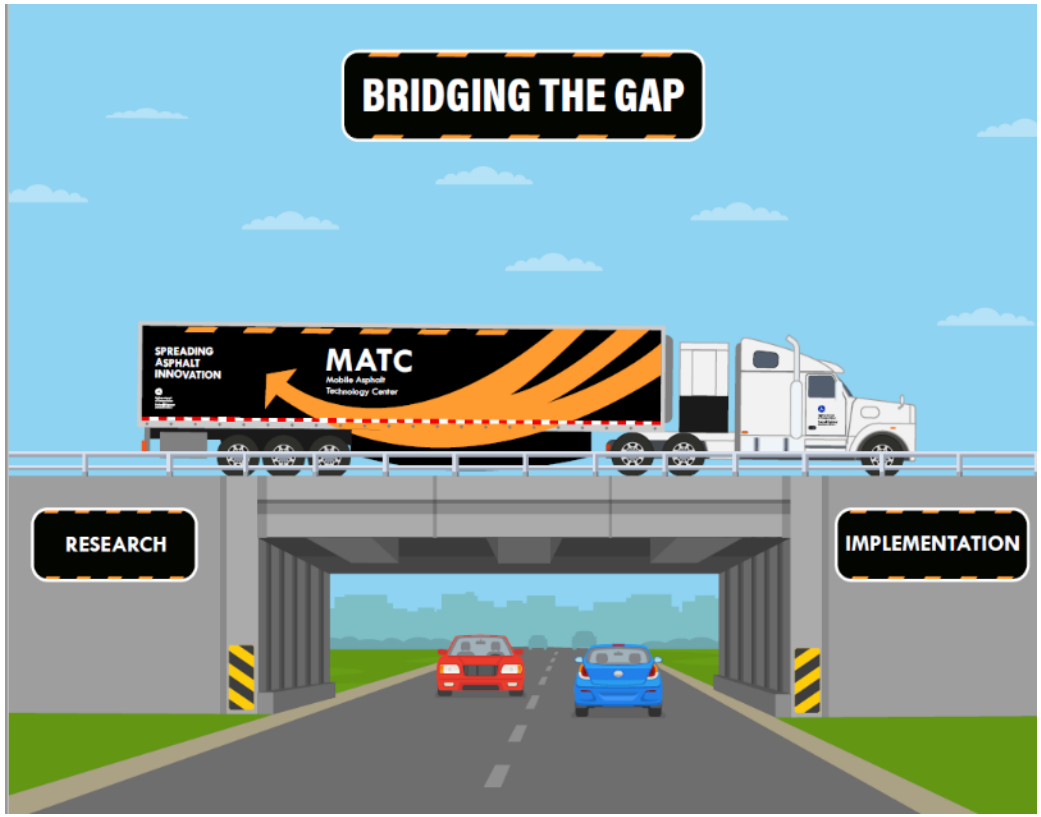
FHWA Mobile Asphalt Technology Center (MATC)

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



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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)	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*	

Technologies Demonstrated by MATC

<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)

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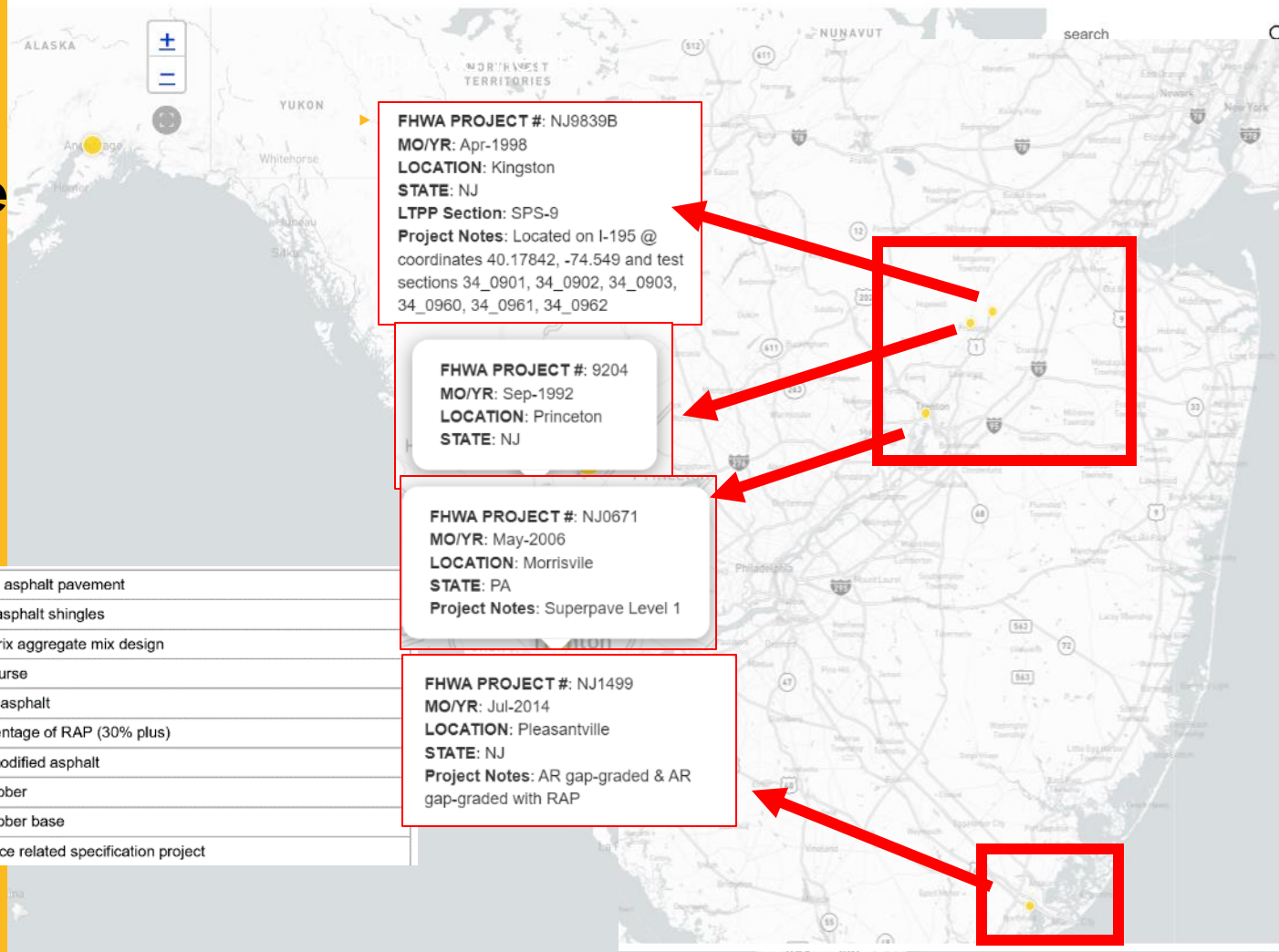
Site Visits Since 1988

New Jersey

- 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 Site Visit to NJ
September - October 2024

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MATC Site Visit Overview

- MATC setup at the New Jersey DOT Headquarters in Trenton, September 25th – October 25th
- Sampling and testing of I-295, 12.5mm High RAP (35%), "BMD" project mixture for both production variability and performance testing as per agreed upon test plan
- Sampling and testing of I-295 "BMD" project mixture's asphalt binder (PG64S-22)
- 1-Day *Asphalt 101* seminar held at NJDOT Materials Office, October 2nd

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MATC Site Visit Overview

- Open House Event held October 9th
  - Morning Session with formal presentations held at Associated Builders and Contractors of New Jersey facility (60+ attendees)
  - Group tours of MATC and its testing capabilities held in the afternoon at MATC location
- Demonstrations of various “emerging technologies” in field testing performed on the live paving project, September 30th

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Mixture Testing

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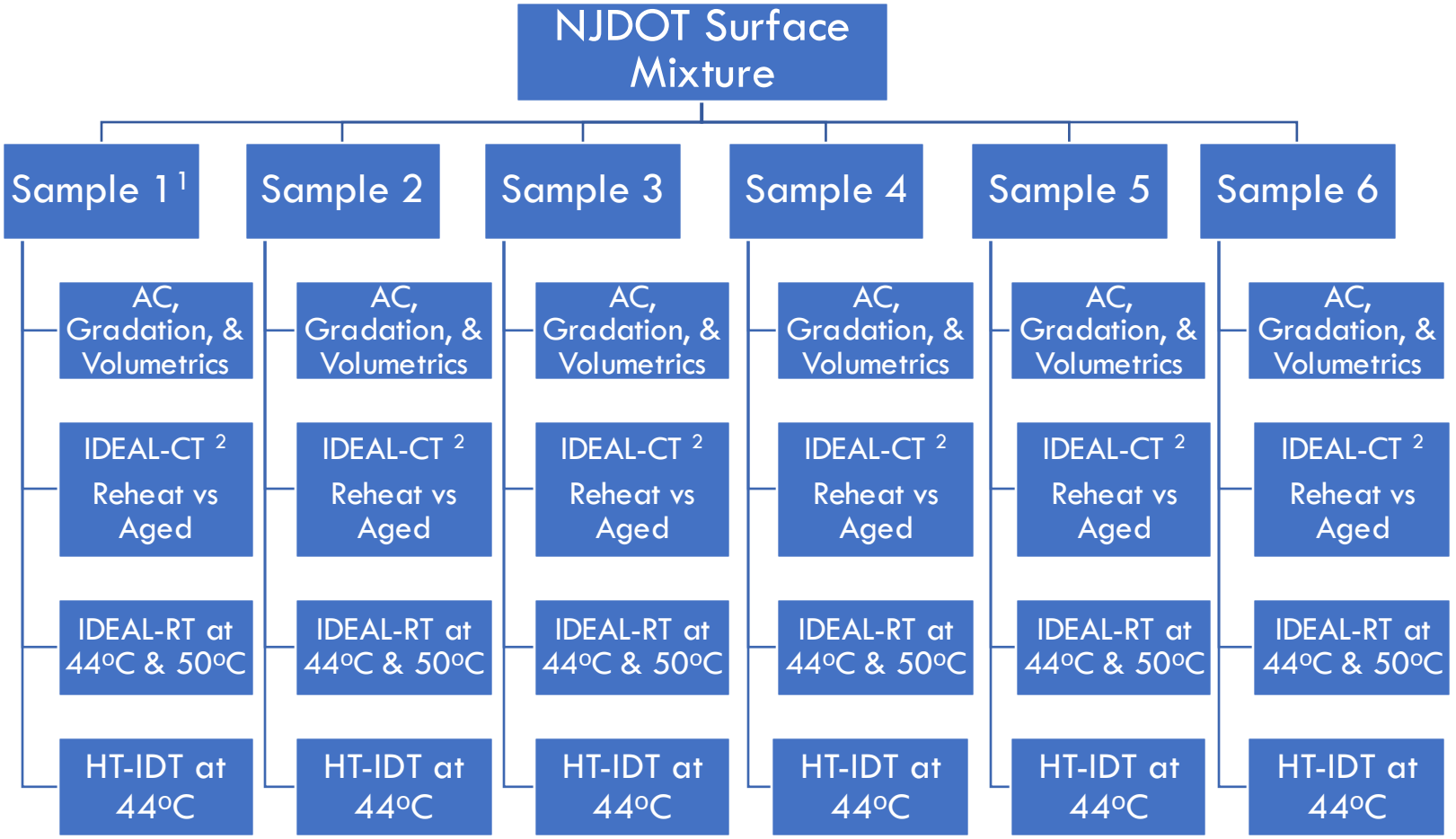
Mixture Sampling & Testing Plan



(1) The "Sample 1" testing protocol will be followed for the one sample ***9.5NMAS Mainline Surface mixture***.

(2) For Aged IDEAL-CT test, mixtures will be aged at 110°C for 20hrs before fabrication & testing.

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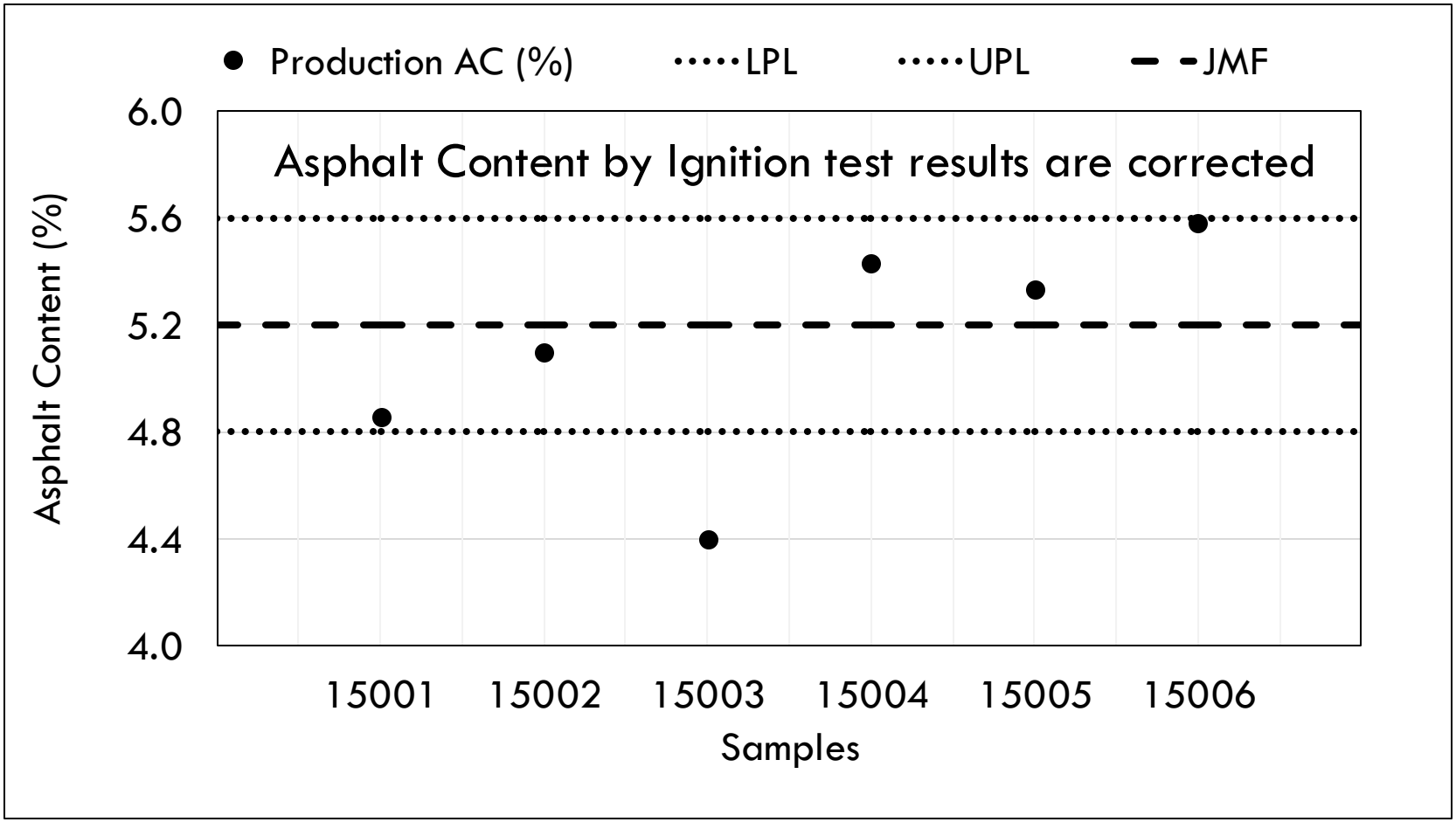
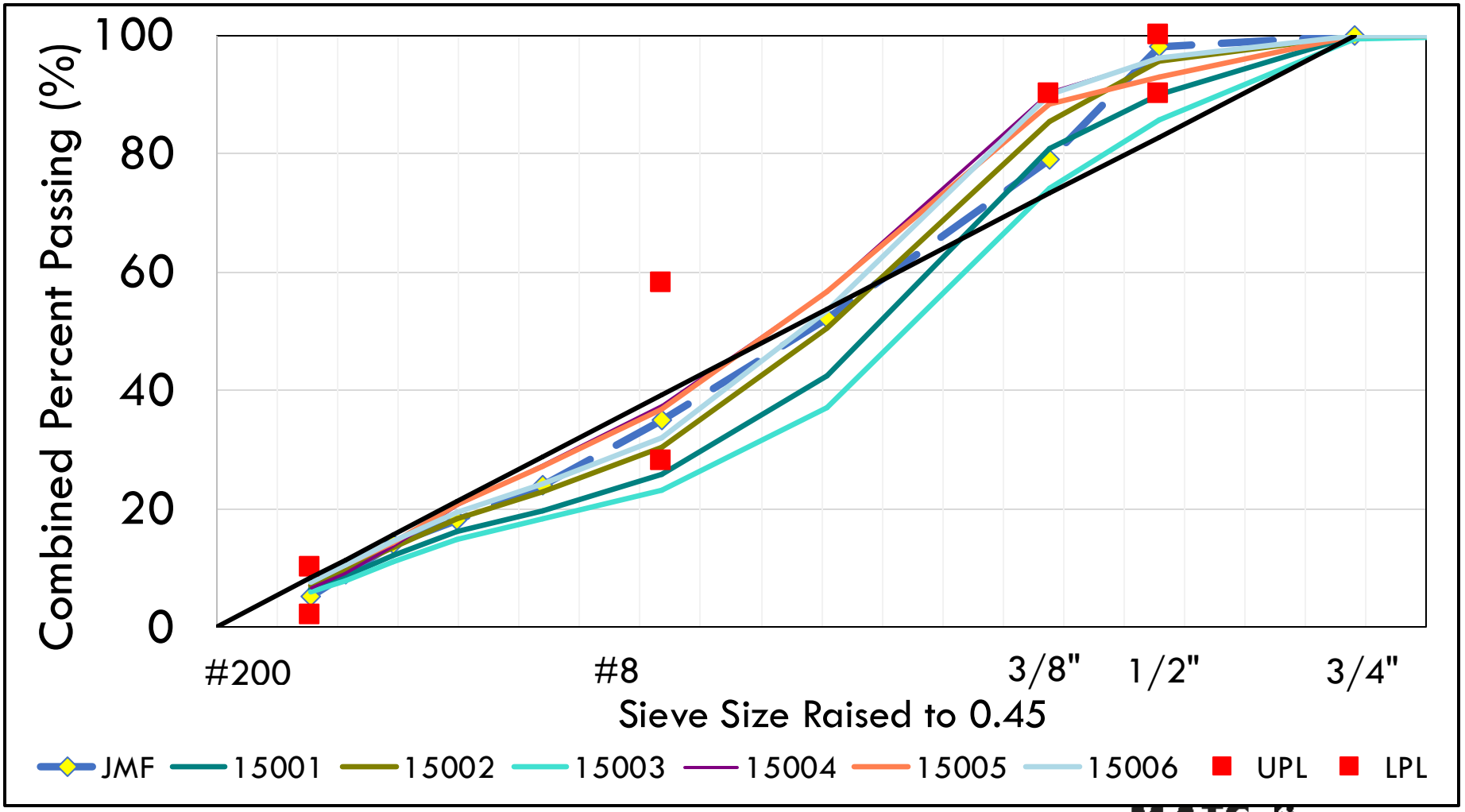
Asphalt Content (%)



Gradation


Combined Percent Passing (%)
100
80
60
40
20
0
#200
#8
3/8"
1/2"
3/4"
Sieve Size Raised to 0.45
JMF
15001
15002
15003
15004
15005
15006
UPL
LPL

Performance Testing: Cracking & Rutting

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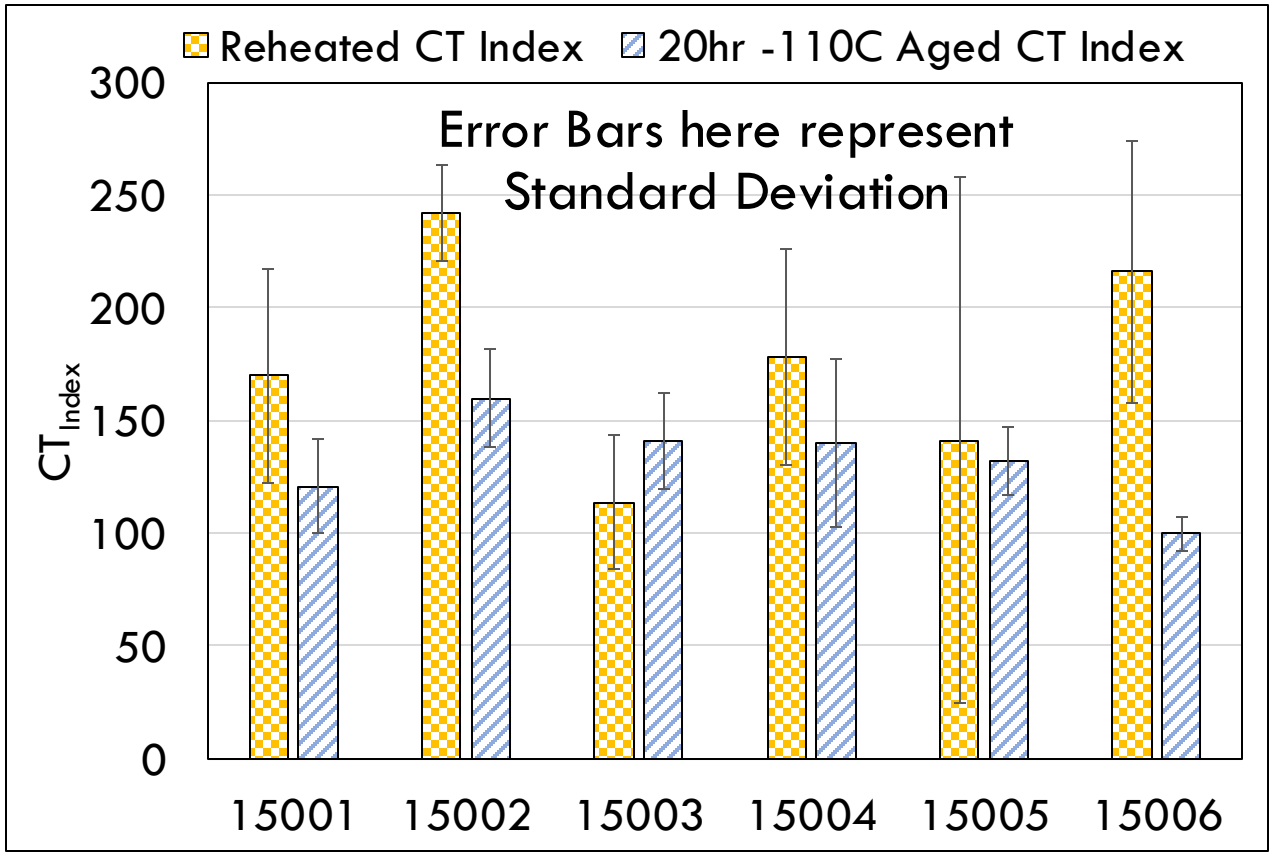
IDEAL-CT



Sample ID	Reheated		20hr - Aged	
	Avg CT_{Index}	COV	Avg CT_{Index}	COV
15001	169.8	27.9	120.7	17.5
15002	242.0	8.7	159.6	13.7
15003	113.8	26.4	141.0	15.1
15004	178.0	27.0	140.0	26.8
15005	141.3	82.8	132.2	11.4
15006	216.0	26.9	99.8	7.7

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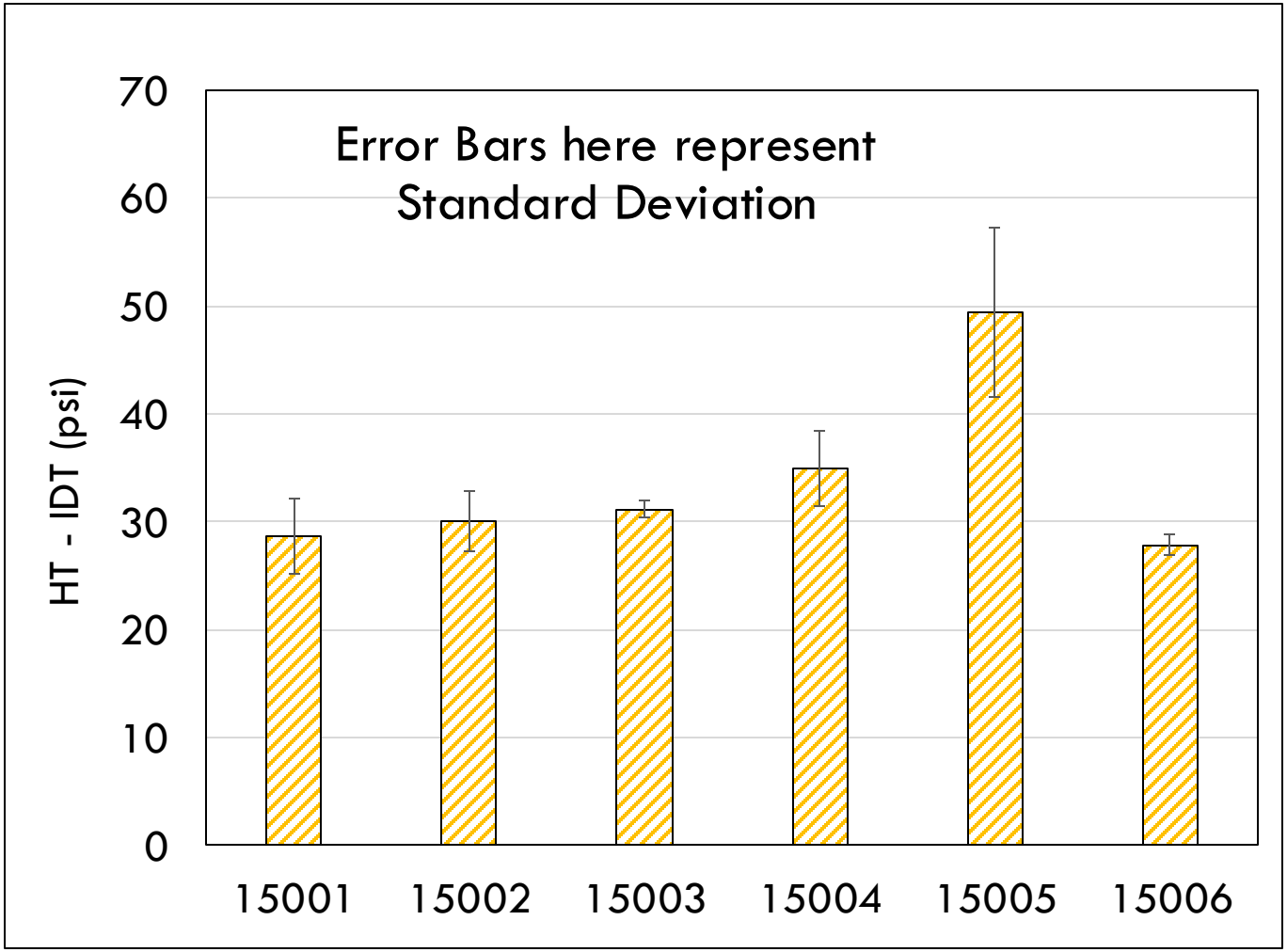
HT-IDT



Sample ID	44°C	
	Avg HT-IDT (psi)	COV
15001	28.6	12.2
15002	30.1	9.2
15003	31.2	2.4
15004	34.9	10.0
15005	49.4	15.9
15006	27.9	3.5

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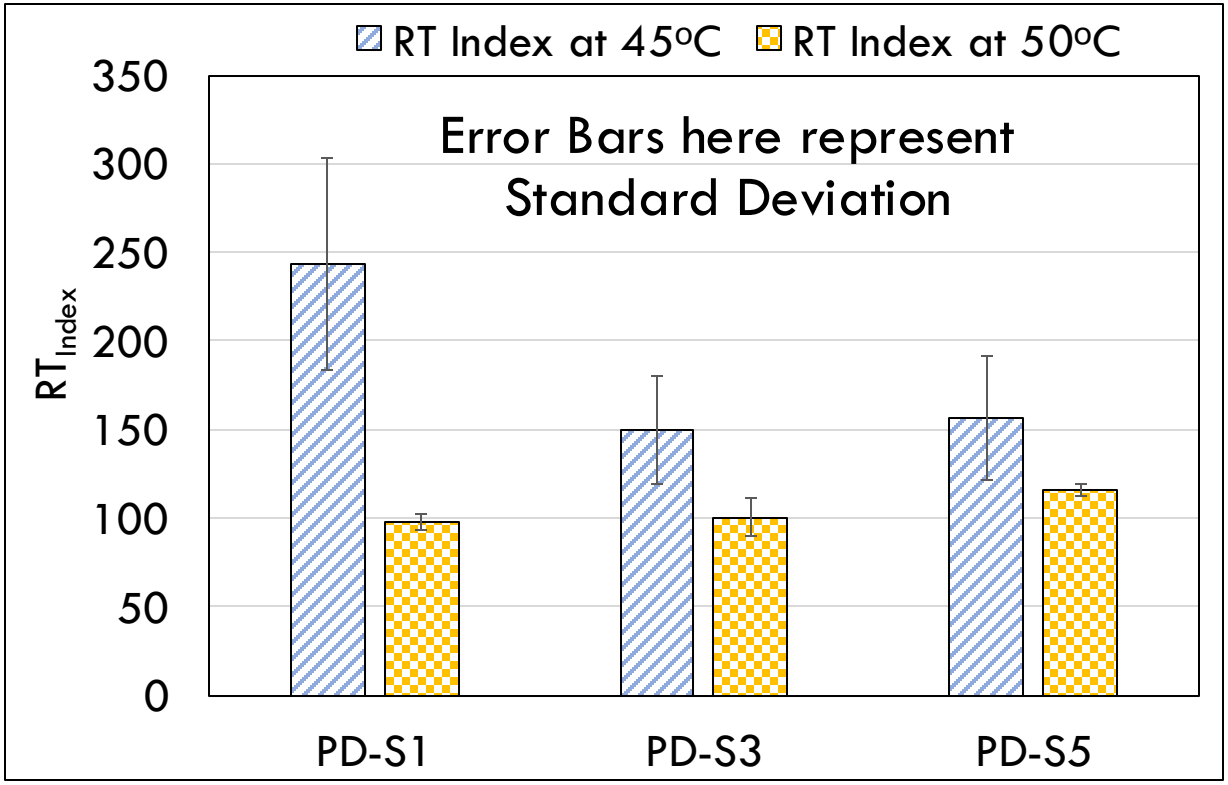
IDEAL-RT



Recommended by Dr. Fujie Zhou (TTI)	
PG Binder	RTIndex
PG 64-XX	≥60
PG 70-XX	≥65
PG 76-XX	≥75

Sample ID	44°C		50°C	
	Avg RT Index	COV	Avg RT Index	COV
15001	243.6	24.5	97.7	4.8
15003	149.8	20.1	100.2	10.9
15005	156.3	22.5	115.6	2.8

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Asphalt Binder Testing

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Asphalt Binder Testing Plan

- Determination of AASHTO M 320 performance grade of binder
  - PG Continuous or True Grade of asphalt binder
- Determination of AASHTO M 332 performance grade
  - Multiple Stress Creep & Recovery (MSCR) test
- Determination of durability properties of asphalt binder
  - Delta T_c (ΔT_c)
- Elemental & Chemical Analysis
  - X-ray Fluorescence Spectroscopy (XRF) and Fourier-Transform Infrared Spectroscopy (FTIR) testing to determine both the binder's elemental and chemical composition as well as detect the presence of modifiers, additives, and/or contaminants

- Performance Grade Prediction
  - Asphalt Binder Quality Tester (ABQT) used as a quality control tool to predict asphalt binder's performance grade

X-ray Fluorescence (XRF) Spectroscopy

Sample ID	Calcium (ppm)	Molybdenum (ppm)	Zinc (ppm)	Copper (ppm)
PG64S-22 Sample1	225	24	<LOD	<LOD
PG64S-22 Sample2	229	18	<LOD	<LOD
PG64S-22 Sample3	244	15	<LOD	<LOD
Average	**233**	**19**	**<LOD**	**<LOD**

LOD = level of detection

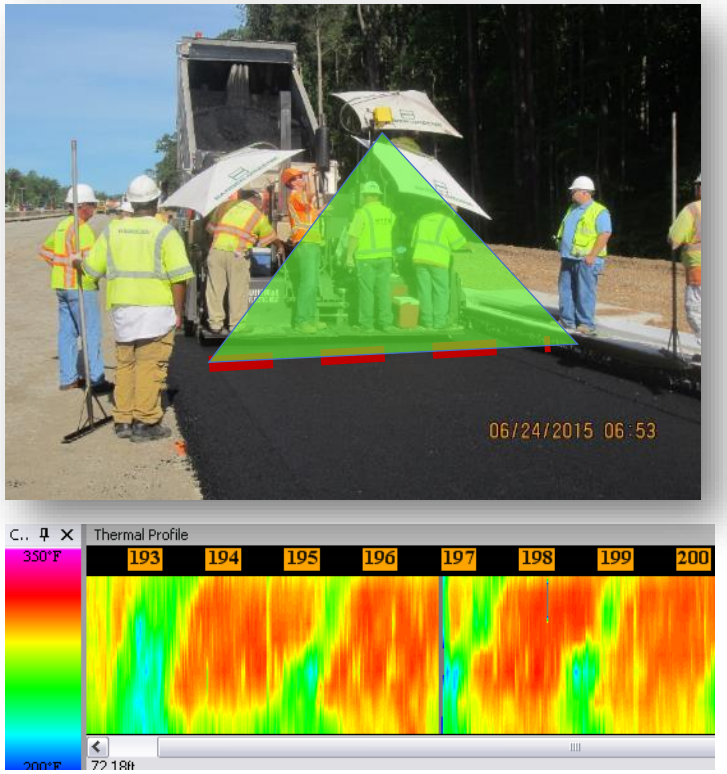
REOB (%) ~ 0%

Field Testing Demonstrations

Paver-Mounted Thermal Profiler

Ready to Use Technology

- 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



Images: SHRP2 (R06 C)

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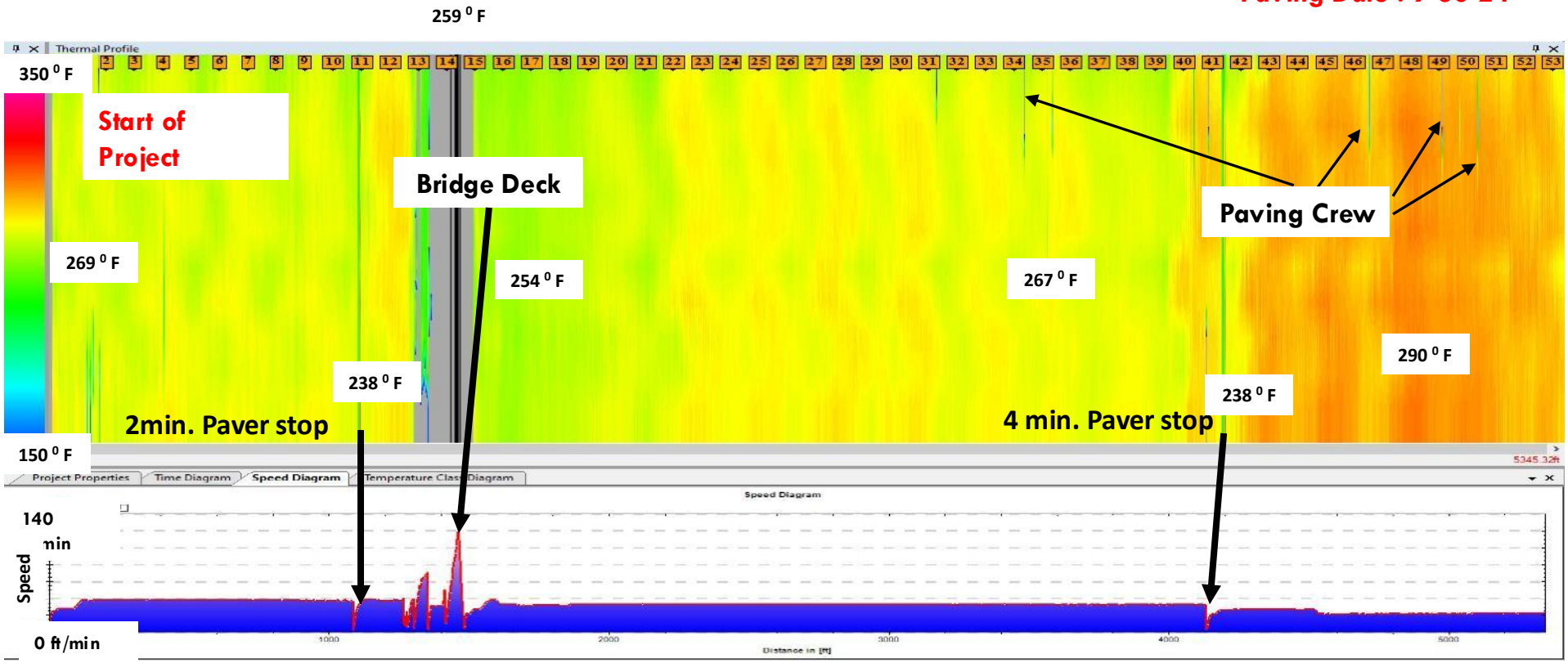
Paver-Mounted Thermal Profiler

Paving Date : 9-30-24



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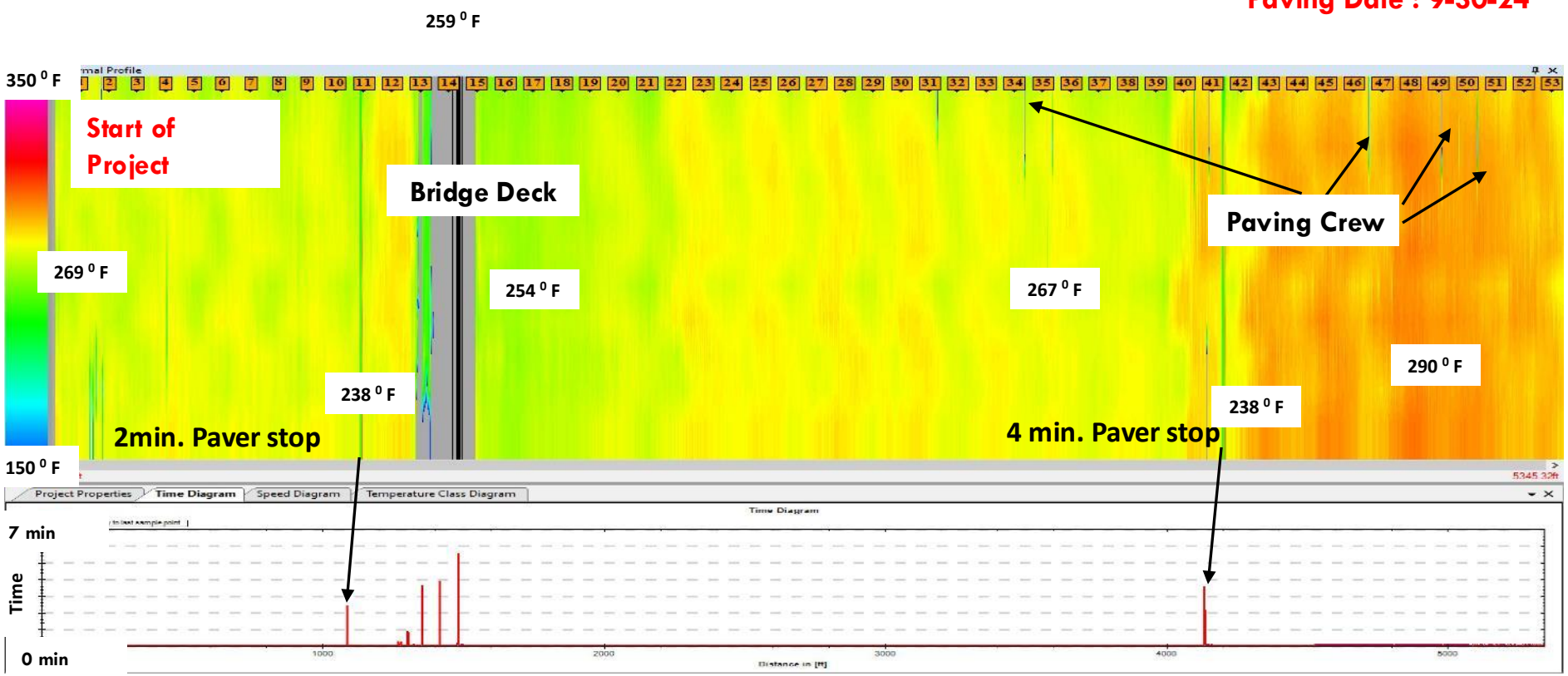
Paver-Mounted Thermal Profiler

Paving Date : 9-30-24



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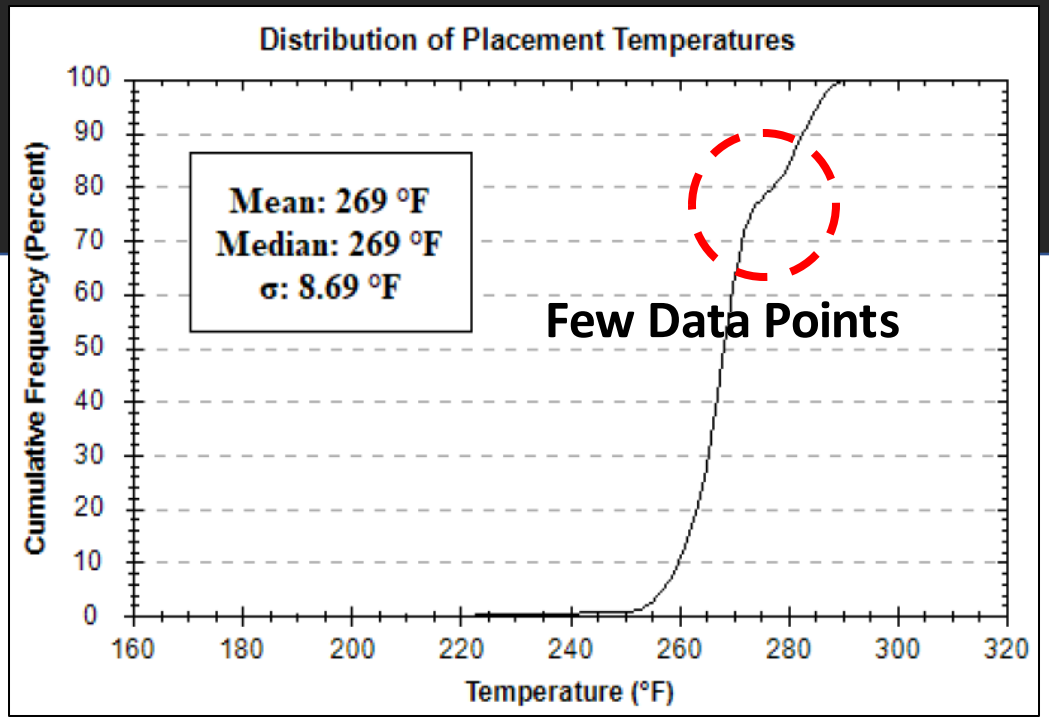

Total Profiles	Moderate Thermal Segregation (25.0°F <Differential <50.0°F)		Severe Thermal Segregation (Differential > 50.0°F)	
	Number of Profiles	Percent	Number of Profiles	Percent
30	3	10%	2	7%

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Pulse Induction Technology

Ready to Use Technology

- Nondestructive device to measure pavement thickness on either asphalt or concrete pavements
- Eliminates the need for taking cores
- Pulse Induction device requires placing a thin metal 'target' (plate) on the existing surface prior to paving
- Distance between the plate and final surface of the new layer is measured

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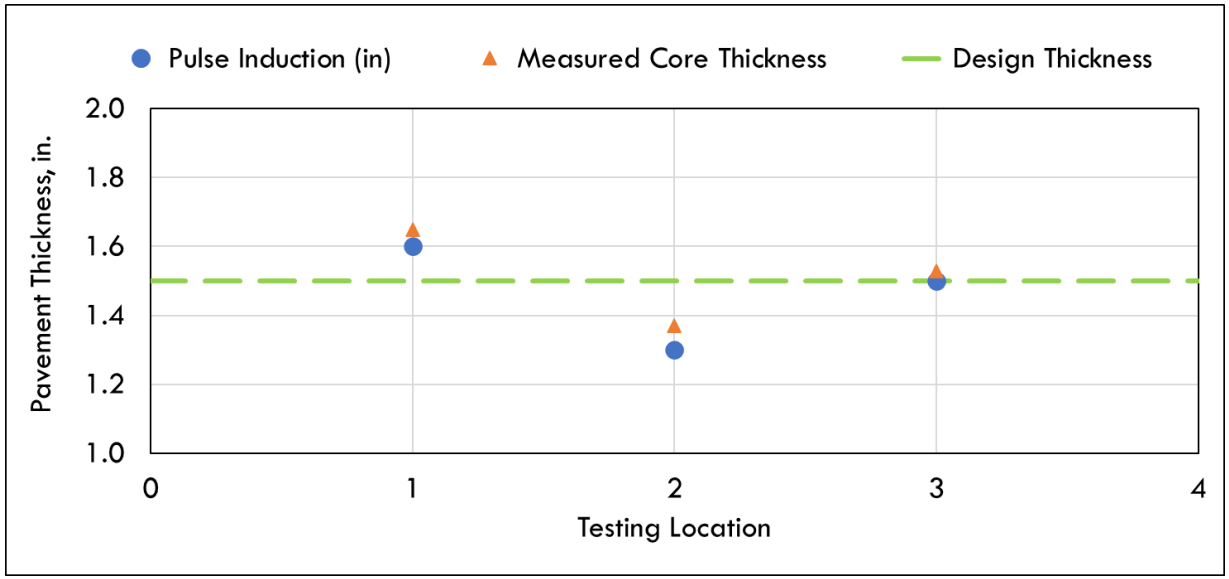
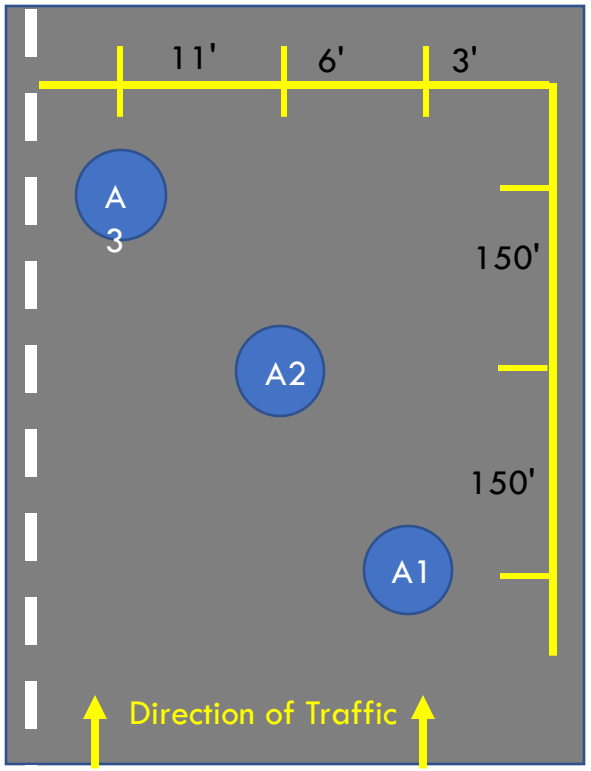
Pulse Induction Technology

GPS - 40°10'37.0"N 74°43'21.3"W
Location – I-295, Hamilton Township, NJ





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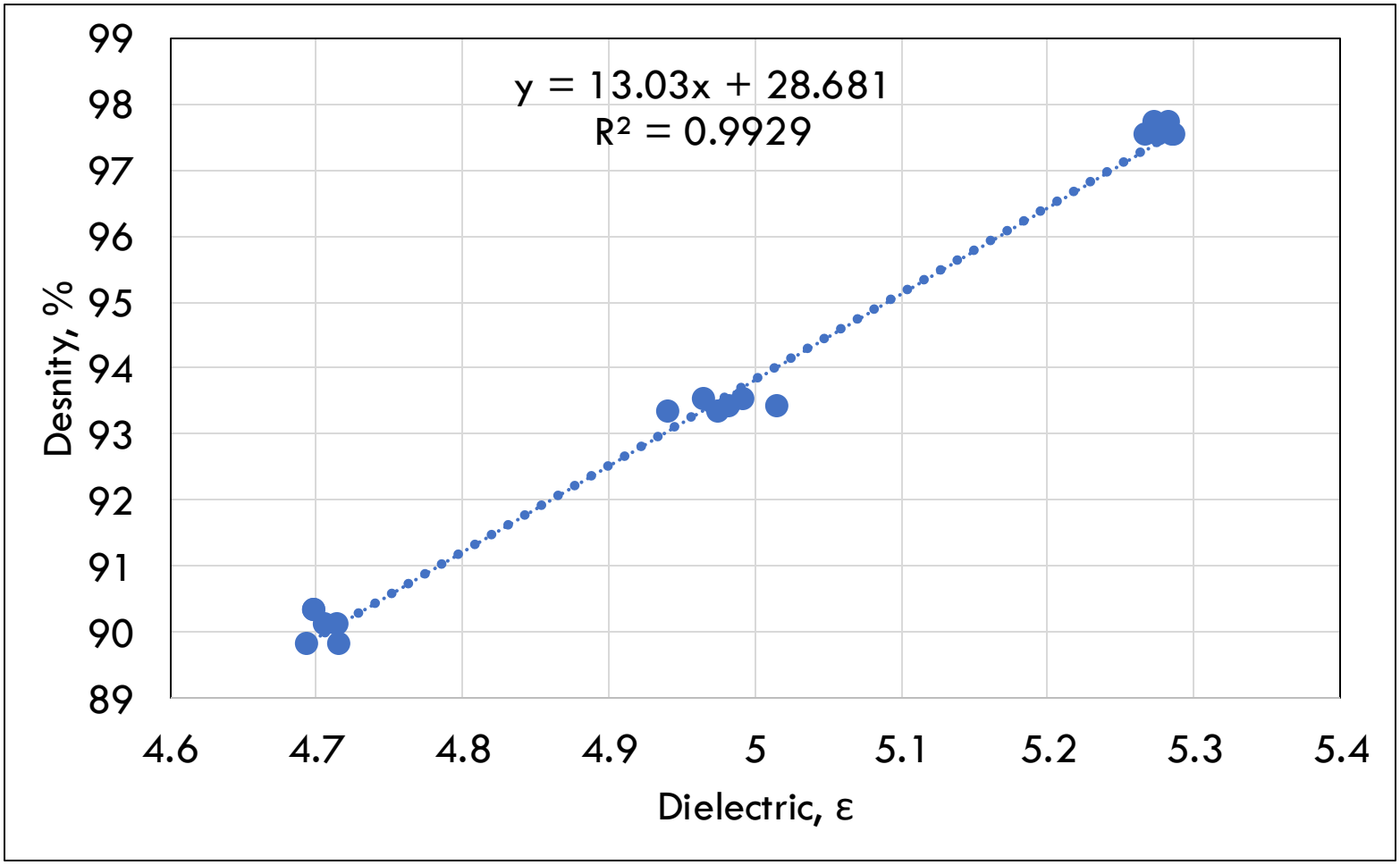
Dielectric Profiling System (DPS)

Emerging Technology

- Uses Ground Penetrating Radar (GPR) technology to measure density.
- Unlike coring, DPS provides continuous measurements, resulting in nearly 100% coverage of the constructed layers.
  - Field cores and/or 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)



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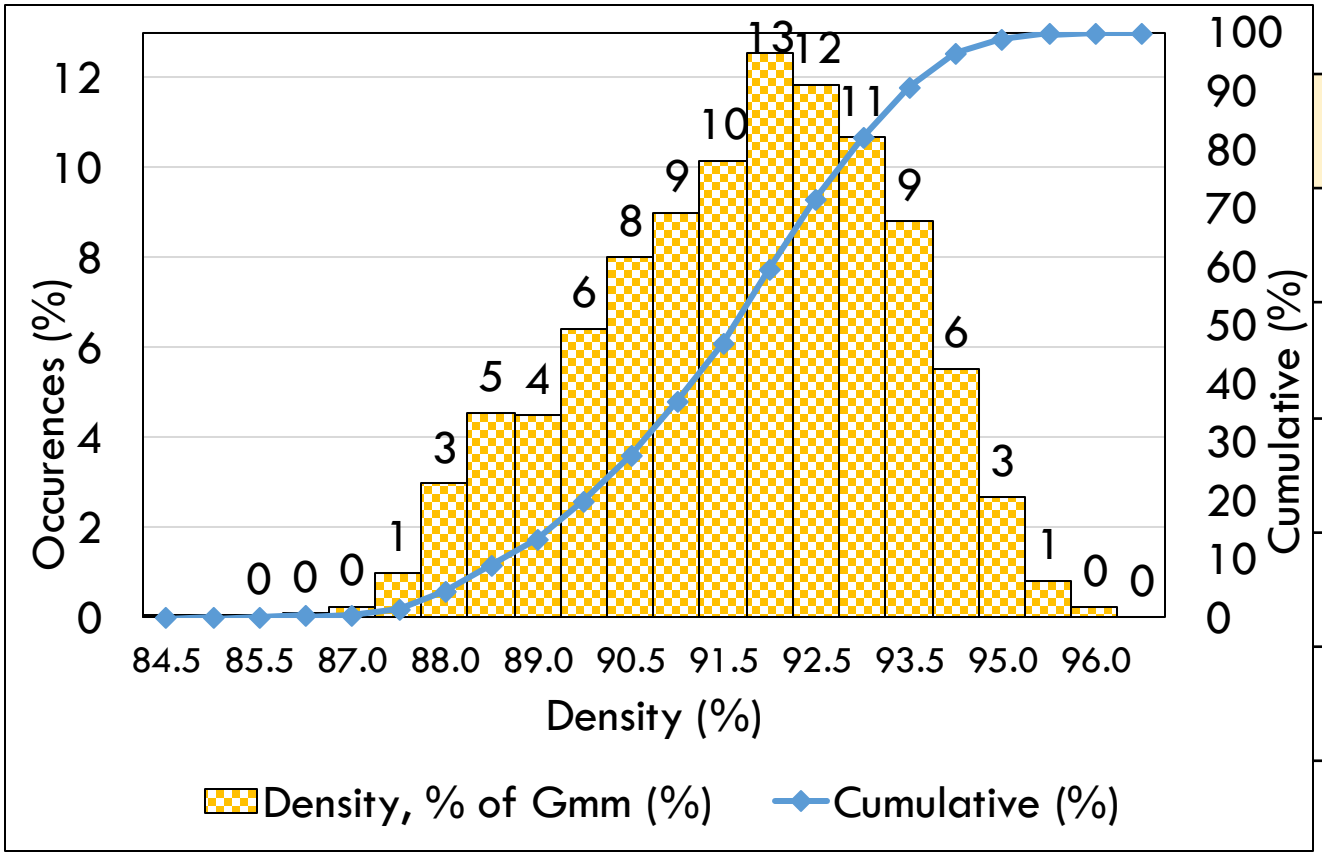
Dielectric Profiling System (DPS)



1000-ft Test Section

Statistic	Value
Mean	91.6
Standard Deviation	1.8
CoV (%)	2
Variance	3.35
Sample Size	12,162

Dielectric Profiling System (DPS) - VETA

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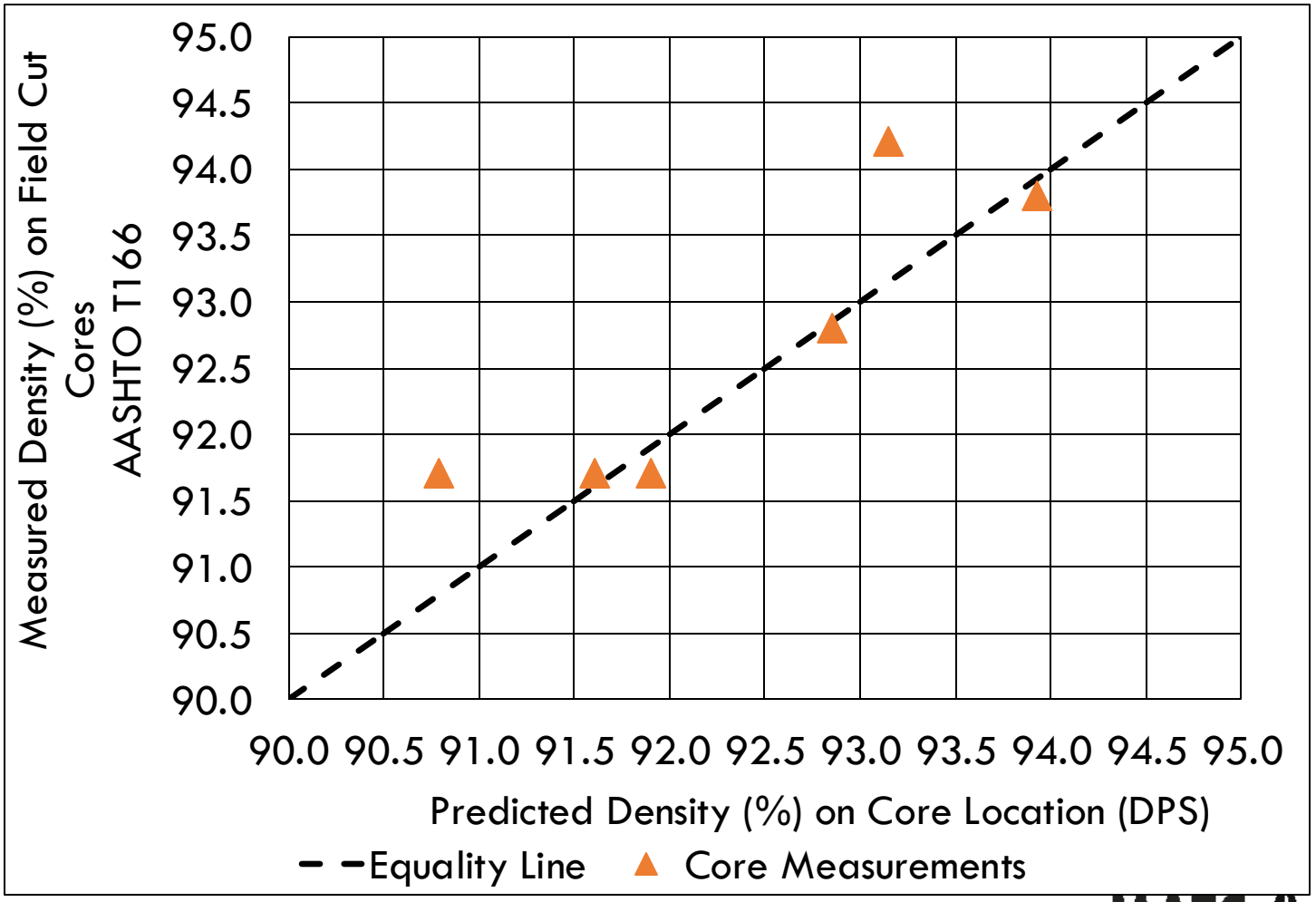
Comparison of Measured %Density vs. Predicted %Density



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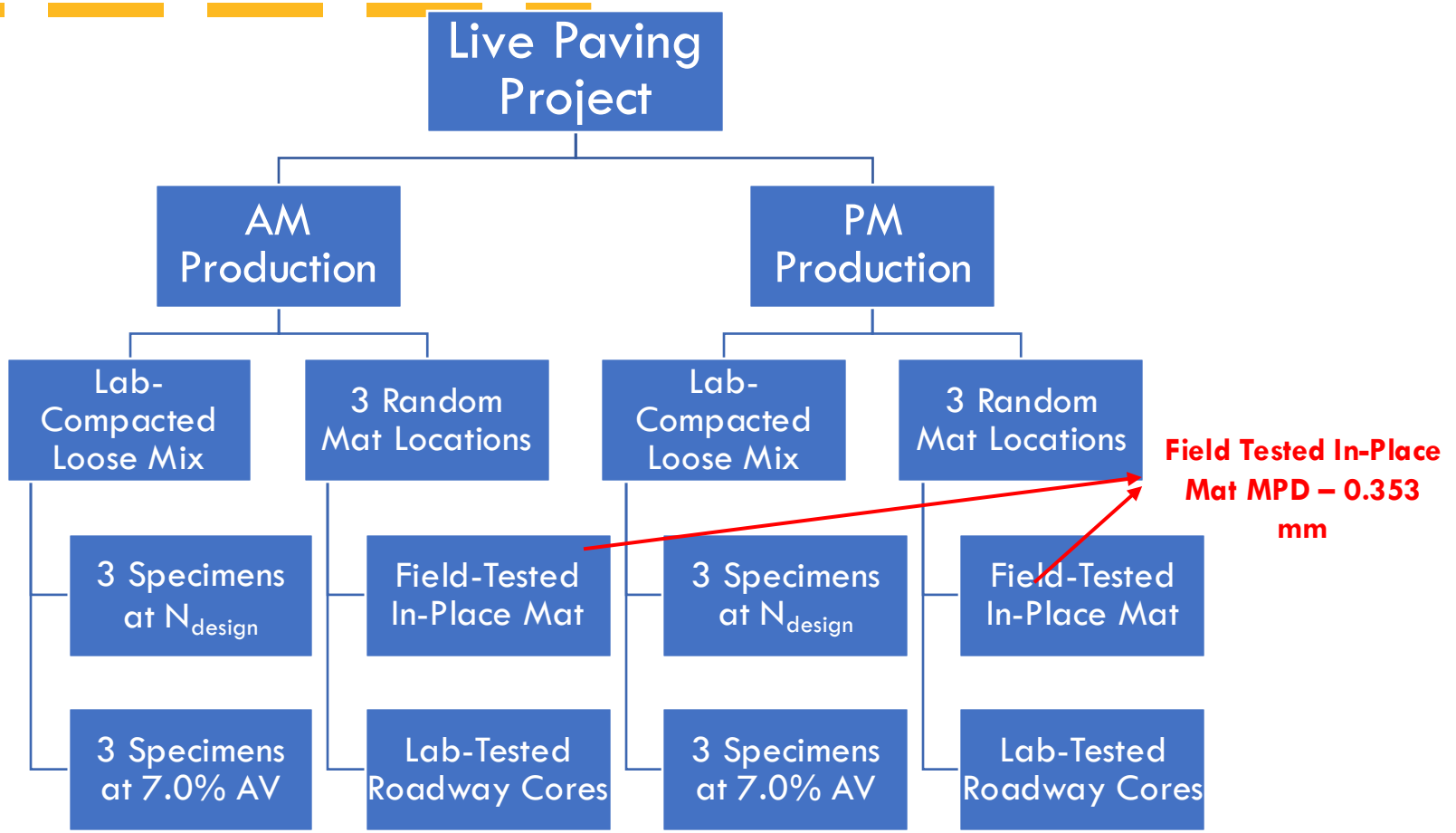
Laser Texture Scanner (LTS)

Emerging Technology

- Portable 3D Laser Texture Scanner
  - Rapid Measurements – within 90s
  - 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

Macrotexture Testing Plan



Dense-Graded HMA– MPD Typically ranges from 0.4 to 0.8 mm according to 2022 AASHTO Guide for Pavement Friction

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Testing Plan Being Completed…
Stay Tuned…

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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

Quality in the Asphalt Paving Process 2-day Workshop

2-day Workshop on Asphalt Materials and Construction

- Builds off observations from field visit, specification review, and test results for each state
- Scheduled for November 2025
- Agency and Industry participation (50/50)
- Goal: Identify key action items

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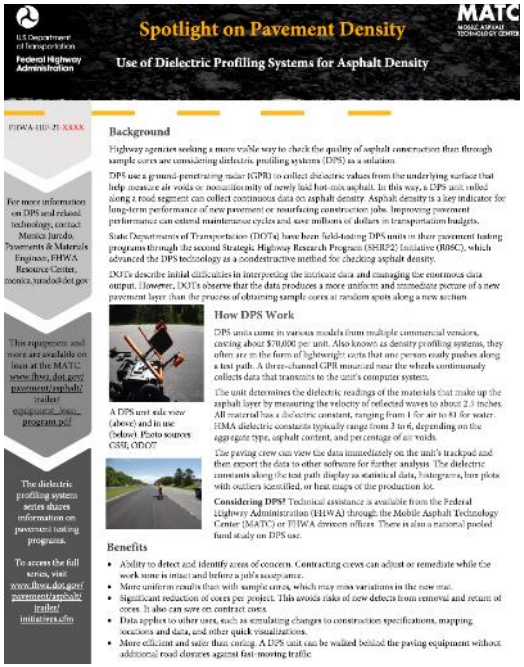
Technology Transfer



Spotlight on Pavement Density

Use of Dielectric Profiling Systems for Asphalt Density

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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 noncompliance 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.

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.

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

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.

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

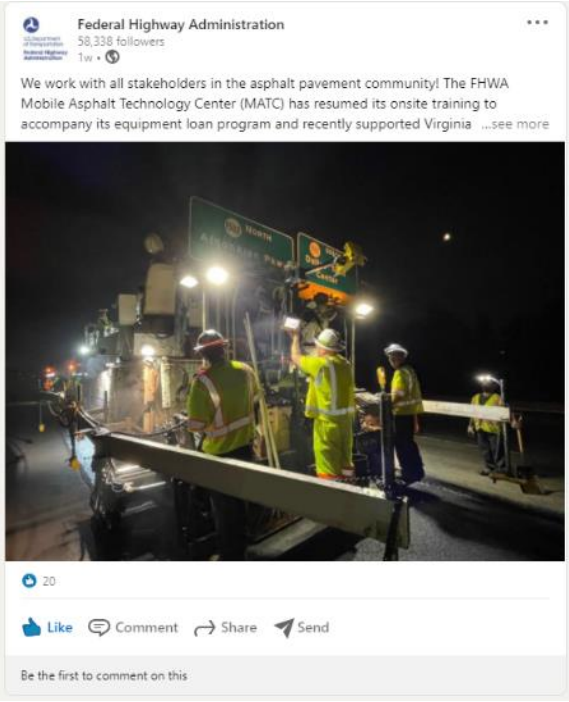
This equipment and more are available on loan at the MATC www.fhwa.dot.gov/pavement/asphalt/matc/equipment_loan_program.pdf

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

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

- Join **social media** (LinkedIn, Facebook) to follow FHWA MATC efforts

- **1-pagers on Asphalt Construction:**
  - Enhancing in-place density
  - Spotlight on Pavement Density: Dielectric Profiling System Series
  - Spotlight on Constructability: Paver-Mounted Thermal Profiler Series



Technical Documents - Mobile Asphalt Technology Center - Asphalt - Pavement & Materials - Pavements - Federal Highway Administration (dot.gov)

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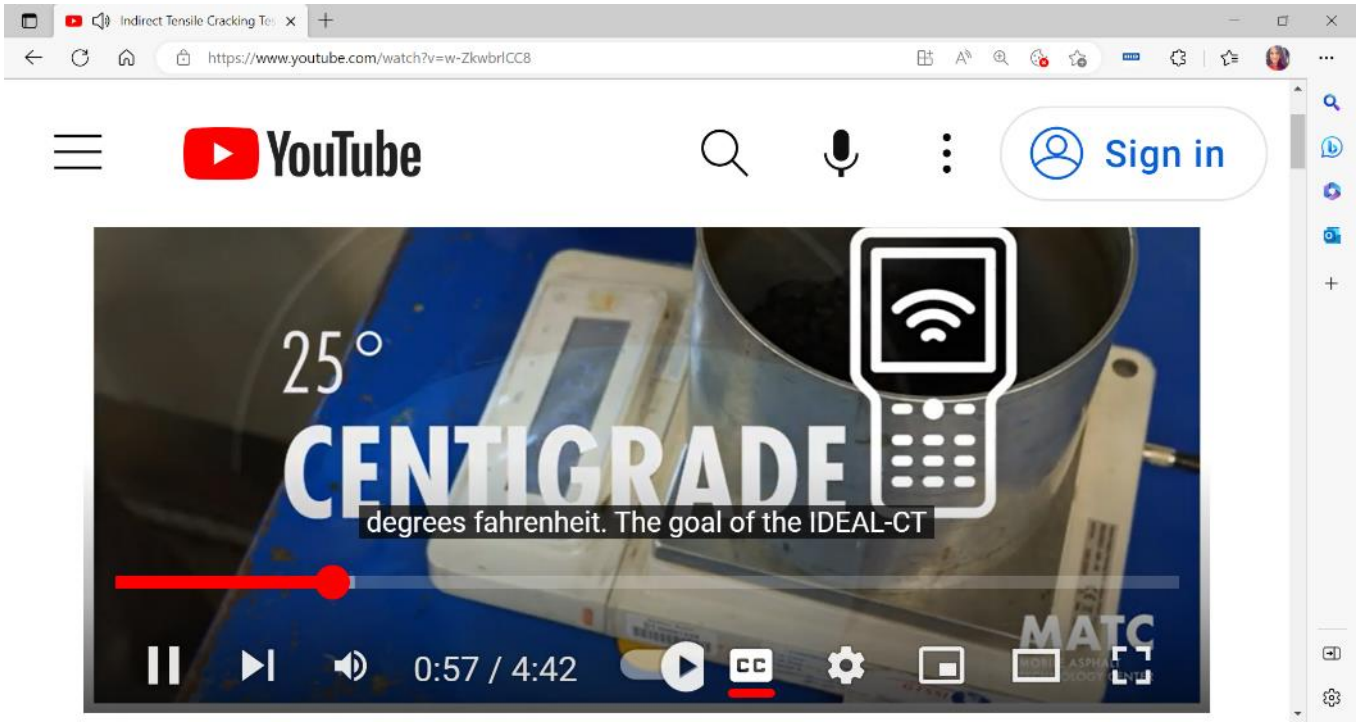
1-pagers & “Technician’s Tips and Tricks” videos

- Capabilities - Mobile Asphalt Technology Center - Asphalt - Pavement & Materials - Pavements - Federal Highway Administration (dot.gov)



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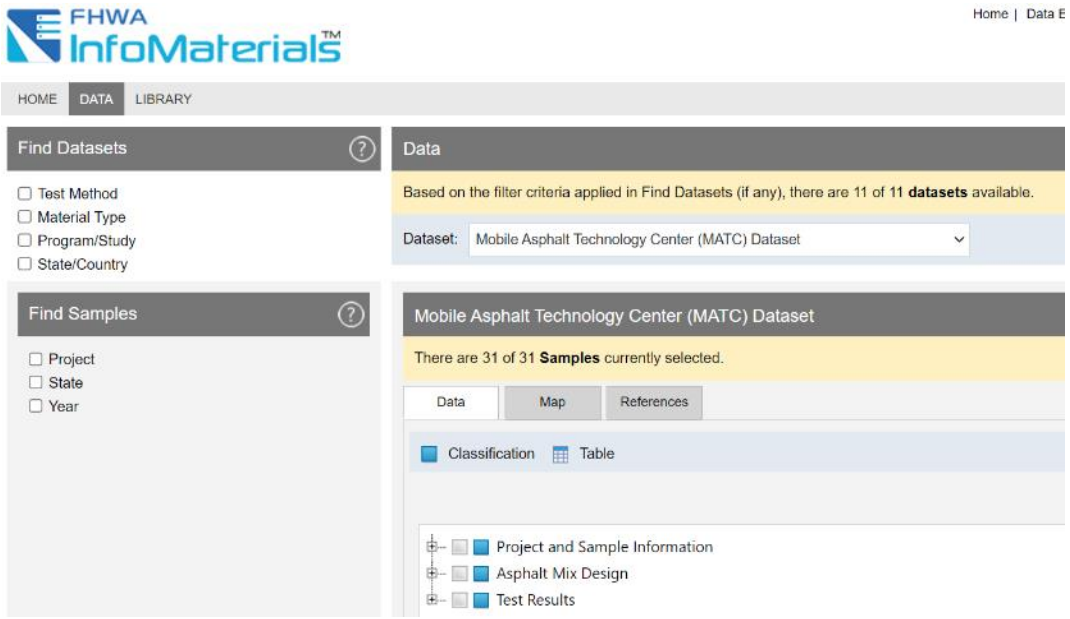
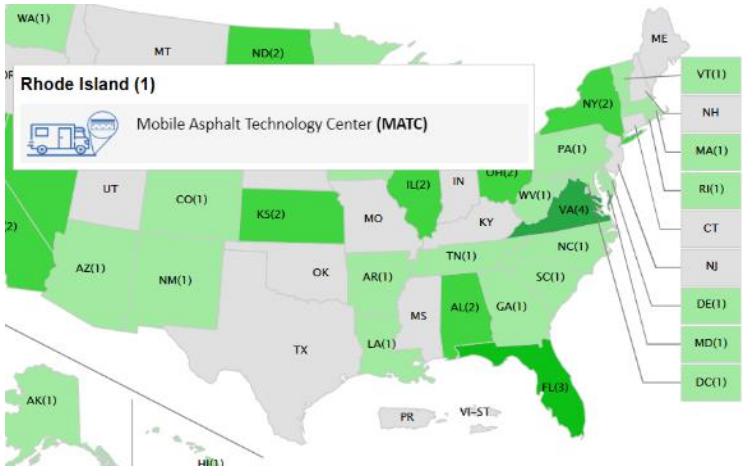
FHWA InfoMaterials: MATC Data from Past Site Visits





https://infomaterials.fhwa.dot.gov/Dataset/DatasetDetails

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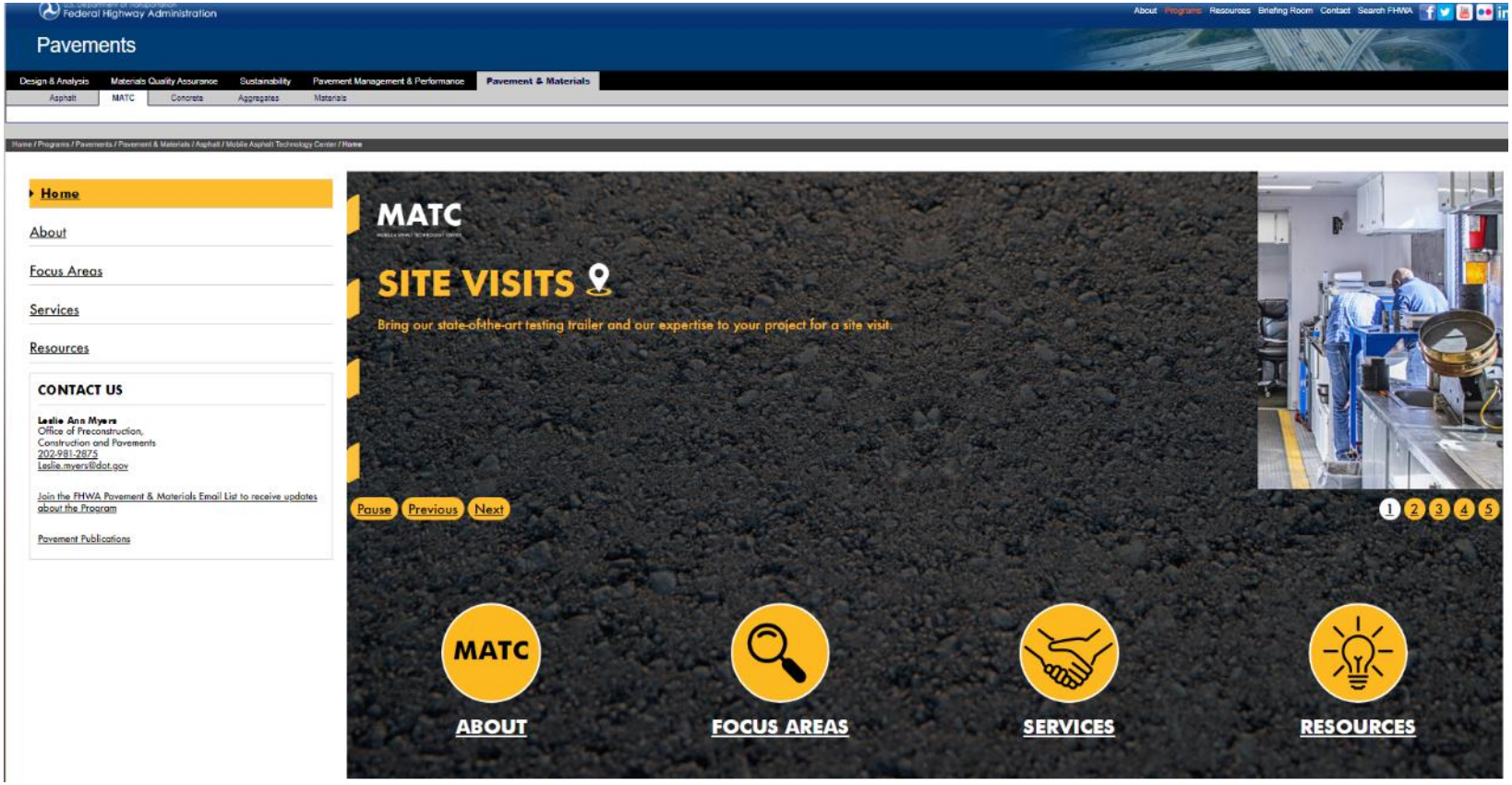
MATC Website

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



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