U.S. Department of Transportation
Federal Highway Administration

Spotlight on Pavement Density

MATC
MOBILE ASPHALT TECHNOLOGY CENTER

Use of Dielectric Profiling Systems for Asphalt Density

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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. https://www.fhwa.dot.gov/pavement/asphalt/matc/equipment-loan-program.cfm

The dielectric profiling system series shares information on pavement testing programs. To access the full series, visit https://www.fhwa.dot.gov/pavement/asphalt/matc/technical-documents.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 as a result of the second Strategic Highway Research Program (SHRP2) Initiative (R06C), which advanced the DPS technology as a nondestructive method for checking asphalt density. Says Stephen Cooper, Pavement Engineer in the Federal Highway Administration (FHWA) Resource Center: "Several DOTs expressed a strong interest in this technology after completing SHRP2 R06C. FHWA and the Mobile Asphalt Technology Center are working with DOTs to serve as a bridge between research and implementation."

Some DOTs—such as Alaska, Maine, Minnesota, and Ohio—observe that DPS data produces a more uniform and immediate picture of a new pavement layer than 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, DPS 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 FHWA through the MATC or FHWA division offices.

Benefits

- Ability to detect and identify areas of concern. The contractor can adjust or remediate while the work zone is intact.
- More uniform results than with sample cores, which may miss variations in the new mat.
- Increased efficiency through quick non-destructive testing of the entire pavement surface while potentially reducing cores per project. Reducing cores avoids risks of new defects from removal and backfilling 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.