0-6889: Rolling Density Meter to Ensure Long Term Performance of Flexible Pavements

Background

Currently, the Texas Department of Transportation (TxDOT) measures the roadway compaction of asphalt mixtures with field coring where one pair of cores is collected per sublot. This low level of testing coverage results in high producer and consumer risks, posing good chances for missing localized problem areas that govern pavement life.

The Rolling Density Meter (RDM) is a ground penetrating radar system tailored for rapidly and continuously measuring asphalt mixture density (Figure 1). This research analyzed the readiness level of the RDM and provided recommendations for how this technology could be used in quality control/quality assurance.

Figure 1. Rolling Density Meter.

What the Researchers Did

To evaluate the RDM precision, four different antennas were used in a laboratory environment to test six different materials. The RDM was then deployed on six field projects for multiple paving days. The projects considered different mix types and thicknesses. On the first day of paving, a calibration curve was established between the RDM surface dielectric measurement and core air voids. On subsequent days, the surface dielectric was measured continuously at 6-in. intervals over both wheel paths and the centerline. In addition, several random locations were tested with the RDM, a nuclear density gauge, and cored to measured air void contents. Researchers evaluated the reproducibility of calibration curves, the precision and bias of the system and of a nuclear density gage, and the distribution of predicted air voids. The field data were also used to perform a producer and consumer risk analysis.

Finally, an alternative 3D radar system was deployed on three test sections to compare with results from the RDM.

Research Performed by:
Texas A&M Transportation Institute

Research Supervisor:
Stephen Sebesta, TTI

Researchers:
Bryan Wilson, TTI
Tom Scullion, TTI

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What They Found

In the lab, increasing the number of scans averaged did improve the precision. The dielectric measurement was repeatable within 0.15 and reproducible within 0.22 or better.

Based on field testing, overall air void calibrations were good with an average R^2 value of 0.76. The calibration curves were unique for different paving projects, and in some cases, unique for different days of paving. Using different antennas for calibration did not influence the resulting calibration curves. Using the RDM with the proposed calibration method was more precise than the nuclear density gauge. For a given reading with the RDM, the true value is expected to lie within ±2 percent voids.

Pay factors and percent within limit characterizations were calculated for each project. Most projects had similar pay factors for both the RDM data and random coring with some noticeable exceptions. Any errors in the calibration curves would significantly affect these findings.

The single-core acceptance method exposes producers and consumers to considerable risk with a tolerable measurement error no better than 2 percent voids. Since density profiling with the RDM can generate 10,000+ measurements per sublot, the risk is effectively eliminated and the tolerable measurement error is lowered to 0.1 percent voids.

The 3D radar system produced high resolution scans of the asphalt surface and subsurface, but further work is needed to tailor data processing for density testing.

What This Means

Researchers recommend adopting the draft test method and equipment specifications for rapid full-coverage testing of asphalt mixture density. The methods would run parallel, not supplant, existing core requirements. TxDOT should decide how exactly to incentivize districts and contractors to try the technology.

For More Information

Project Manager:
Joe Adams, TxDOT, (512) 416-4748

Research Supervisor:
Stephen Sebesta, TTI, (979) 458-0194

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Research and Technology Implementation Office
Texas Department of Transportation
125 E. 11th Street
Austin, TX 78701-2483

www.txdot.gov
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