Field Validation of Asphalt Pavement Density Using Ground Penetrating Radar

What Was The Research Need?

One of the final steps of evaluating the quality of asphalt pavement construction is measuring density of newly constructed pavement. The key to successful asphalt pavement construction is obtaining the desired density uniformly. Current construction and quality assurance procedures require measuring localized density with nuclear densometer or random core sampling from constructed pavement to measure density in the laboratory. This localized and random measuring may not represent the final quality of entire pavement when variations exist in density reading.

PROJECT NUMBER:
RES2023-28

PRINCIPAL INVESTIGATOR:
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Materials & Tests

PROJECT SCHEDULE:
August 2023 to July 2025

Research Objectives

The primary objectives are as follows:

- Comparison of the accuracy and variability of the rolling density meter density data with existing density measurement procedures (nuclear density, coring, etc.).
- Evaluation of the reliability and ease of use of the rolling density meter.
- Evaluation of the mix design module to determine if the dielectric constant can be accurately determined from lab compacted asphalt specimens to eliminate the need for coring for calibration.

What was the Research Approach?

Task 1: Equipment acquisition

This process will involve quoting the units and completing the purchase order. Required purchases include a rolling density meter and the accompanying mix design module.

Task 2: Collect field density data

Select projects will be identified for different mixture types and various thickness levels to evaluate the rolling density meter as compared to traditional density measurement systems of coring and nuclear density testing. Mix types and layer thicknesses that cannot be accurately tested for density by traditional methods should also be included to determine its full capability. Each selected test section will be evaluated using the rolling density meter, as calibrated by coring and the mix design module, as well as by the nuclear gauge and cores.

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Task 3: Analyze the data and report findings

TDOT will post-process and analyze the data, then a final report will be completed documenting the findings and conclusions highlighting the best way to implement this technology into TDOT's quality assurance program.

Task 4: Develop a TDOT best practices and procedure manual for the rolling density meter

Best practices will be observed and noted throughout the study and will be compiled to provide a procedure for using the rolling density meter for TDOT projects.

Task 5: Develop a special provision

A special provision will be composed that can be implemented into select projects for utilizing the rolling density meter as an acceptance test.

Potential Implementation and Expected Benefits

There is much benefit to be gained by measuring and generating a density profile for the whole length of an asphalt project. TDOT will be able to identify areas of low density that will potentially result in premature failures and have corrective action performed or liquidated damages assessed. This will help reduce the required repairs and maintenance of the pavement in the years to come. This equipment would also give density results at the longitudinal joint, which is often one of the earliest modes of asphalt pavement deterioration due to low density. Elimination of coring in the test strip to calibrate a nuclear gauge is also a potential benefit as coring is a destructive test method which could also lend itself to early pavement failures.