RESEARCH
PROJECT CAPSULE [14-3B]
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TECHNOLOGY TRANSFER PROGRAM

NCHRP Project 20-07 / Task 361: Hamburg Wheel-Track Test Equipment Requirements and Improvements to AASHTO T 324

JUST THE FACTS:

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POINTS OF INTEREST:

Problem Addressed / Objective of Research / Methodology Used Implementation Potential

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PROBLEM

The Loaded Wheel Test (LWT) is a laboratory-controlled rut depth test that uses loaded wheel(s) to apply a moving load on hot-mix and warm-mix asphalt (HMA and WMA) specimens to simulate traffic load applied on asphalt pavements. In the 1970s Helmut-Wind Incorporated proposed a test method and developed specifications requirements to measure the combined effects of rutting and stripping susceptibility. The equipment developed was named the Hamburg Wheel Tracking Device (HWTD) and has been used for over four decades worldwide. The HWTD measures the combined effects of rutting and moisture damage (stripping) by rolling a steel wheel across the surface of an asphalt concrete slab that is immersed in a temperature-controlled water bath. The interest and use of LWT in performance specifications, alternatively referred to as rut testers or torture testers, has seen an increase in recent years. This interest can be attributed to several factors, including the use of such devices by FHWA and many state Departments of Transportation (DOTs). Other important factors in this increased popularity are the ease of use and good correlation to field performance, which led many DOTs to incorporate LWT tests in their specifications as a pass or fail acceptance criteria.

As the popularity of this test equipment increased, several manufacturers started producing their own variation of the LWT, while others adapted their existing designs from a load over a rubber hose to deadweight loading from a steel wheel. Those machines were built using various solutions for controlling the wheel speed and measuring the rut depth, water bath temperature control, and reciprocating mechanisms, to name a few. These different devices are currently being used by highway agencies and research centers. Despite the aforementioned discrepancies among the different LWT machines, no comprehensive study has been conducted to compare the results from different manufacturers.

In 2010, Shiwakoti et al. carried out a research study focused on wheel tracking devices to develop a rapid test method to evaluate moisture sensitivity. The Asphalt Pavement Analyzer (APA) and the HWTD were used for this research. Compacted cylindrical samples were fabricated using the Superpave Gyratory Compactor. However, the APA tests were carried out using the rubber hose instead of the metal wheel. Results showed major differences on the stripping behavior. APA results did not indicate any stripping inflection points, contrary to the HWTD results that showed significant stripping susceptibility. A recent study carried out by the Iowa DOT statistically evaluated the results from 150 test runs on gyratory specimens using a two-wheel HWTD manufactured by Precision Metal Works (PMW). Linear variable displacement transducers (LVDTs) were used to measure rut depths at 11 locations across the wheel track per pass. Measurements were recorded to the nearest 0.01 mm every 20th pass for the first 1,000 passes. The frequency was reduced to every 50th pass thereafter. Results indicated that the impression measurement location was found to be a source of significant variation in the HWTD. The study suggests that the differences are likely due to the non-uniform wheel speed across the specimen, geometry of the specimen, and air void profile.

OBJECTIVE

The objectives of this research are to document the capabilities of available commercial Hamburg test equipment, components, or design features that ensure proper testing and accurate, reproducible results, and provide proposed revisions with commentary to AASHTO T 324 to enable the use of a performance type specification for Hamburg test equipment.

METHODOLOGY

The proposed research activities are divided into five tasks.

- Task 1: Collect and critically review all available Hamburg test equipment capabilities and specifications
- Task 2: Conduct an engineering desk analysis to identify how AASHTO T 324 must be conducted to ensure accuracy and the required capabilities of Hamburg equipment
- Task 3: Propose revisions to AASHTO T 324 based on the results of Task 2 to ensure repeatability and accuracy of measurements
- Task 4: Develop a statistically-based experimental plan to validate proposed requirements for Hamburg equipment and for specimen preparations and their impacts on test results and acceptance test criteria
- Task 5: Prepare a final report that summarizes the project findings and conclusions, document the study results, and present recommended revisions to AASHTO T 324.

IMPLEMENTATION POTENTIAL

Since there are so many devices that are capable of conducting LWT testing, it is imperative that the standard test procedure (AASHTO T 324) include provisions regarding the equipment. This will ensure that the final test results are comparative with each other. In doing so, this could have a large impact on some of the equipment manufacturers.

Various LWT machines