Texas A&M Transportation Institute

PROJECT SUMMARY

Texas Department of Transportation

5-6744-01: Implementation of the HMA Shear Test for Routine Mix Design and Screening

Background

Under high temperatures and heavy traffic loading, hot-mix asphalt (HMA) pavements are prone to rutting and shear failure, particularly in high-shear-stress locations with slow-moving vehicles such as intersections or controlled stop-go zones. In recent years, pavements in several Texas districts have experienced increased truck traffic due to improved economic activity such as in the energy industry. In addition, Texas experiences prolonged periods of high summer temperatures exceeding 100°F (38°C). As documented in the *Data Storage System (DSS) for Texas Flexible Pavements and Overlays (TxDOT Project 0-6658)*, HMA pavements located in areas with air temperatures above 100°F easily heat up to 140°F (60°C),thus exacerbating the HMA shear failure and surface rutting (Figure 1).

The high truck traffic and temperatures in Texas have interactively aggravated pavement rutting and shear failure of surface HMA mixes, even for mixes traditionally passing the laboratory screening using the Hamburg wheel tracking test (HWTT) at 50°C. In an effort to mitigate these distresses, Project 0-6744, New HMA Shear Resistant and Rutting Test for Texas Mixes, proposed a new supplementary HMA shear test, namely the simple punching shear test (SPST) (Figure 2), and several modifications to the HWTT protocol to improve its ability to simulate field rutting conditions under extreme shear-stress environments. This project worked to implement the SPST alongside the traditional HWTT test for screening HMA mixes.

Figure 1. Surface Rutting.

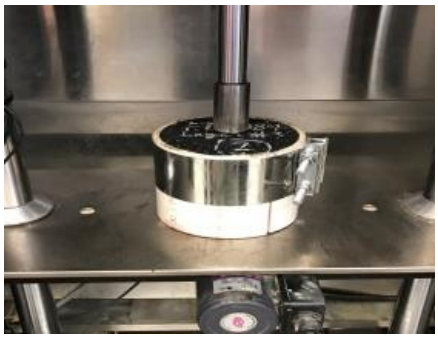

Figure 2. SPST Setup.

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What the Researchers Did

Using 6-inch diameter by 2.5-inch thick HWTT-sized specimens at 7±1 percent air voids, researchers completed the following tasks:

- Conducted HWTT-SPST parallel testing at 50°C and 60°C.
- Validated the laboratory test results with field performance data of in-service highway test sections.
- Recommended enhancements to the HWTT protocol (Tex-242-F) for improved HMA screening capabilities.
- Compared the SPST output parameters (i.e., HMA shear strength, shear modulus, and shear strain) to the HWTT rutting criterion.
- Conducted sensitivity analysis to determine the SPST HMA screening criteria.
- Validated and provided an implementable SPST protocol, test specifications, and guidelines.
- Assisted Texas Department of Transportation districts, such as Laredo, with its routine mix-design screening and HMA shear strength testing.

What They Found

There is a good correlation between SPST shear strength, HWTT rutting, and HMA field rutting, so the HMA shear strength was selected as the SPST parameter to screen surface mixes for shear resistance with the following screening criteria:

$$HMA\ shear\ strength\ (\tau) \geq \begin{cases} 300\ psi\ at\ 50°C \\ 200\ psi\ at\ 60°C \end{cases}$$

For surface HMA mixes to be used in high-temperature, high-shear-stress environments, it is recommended that, where practically applicable, the HWTT (Tex-242-F) should be performed at multiple temperatures (i.e., 50 and 60°C).

What This Means

Costly premature pavement rutting will be minimized by optimizing the HMA shear resistance through improved laboratory testing that better simulates HMA field rutting conditions, namely through:

- Running the HWTT, where practically applicable, at multiple temperatures for surface HMA mixes to be used in high-temperature, high-shear-stress environments.
- Using the SPST for evaluating the HMA shear properties as a surrogate and/or supplement to the HWTT for surface HMA mixes to be used in high-temperature, high-shear-stress environments.

For More Information

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