Texas A&M Transportation Institute

PROJECT SUMMARY

Texas Department of Transportation

# 0-6607: The Overlay Tester (OT): Sensitivity Evaluation and Comparison to Other Crack Test Methods

## Background

Premature cracking is one of the principal performance concerns of hot-mix asphalt (HMA) pavements, particularly surfacing mixes. While many U.S. transportation agencies have implemented design-level tests to measure the rutting potential of HMA mixes, regrettably there is no standardized national design-level test for measuring and characterizing the HMA cracking resistance potential.

Currently, the Texas Department of Transportation (TxDOT) uses the overlay tester (OT) to routinely evaluate the cracking susceptibility of HMA mixes in the laboratory. While the OT shows good correlations with field performance data, repeatability and variability in the test results have been major areas of concern. This is particularly true for most conventional Texas dense-graded mixes such as Type C and D mixes that constitute approximately 75 percent of all HMA produced for TxDOT.

A laboratory test to routinely characterize the HMA cracking susceptibility is thus needed for all the Texas mix types. As a minimum, such a test protocol must have the following characteristic features:

- Applicable for routine HMA mix design and screening (not necessarily performance prediction such as fatigue life).
- Practical and easily implementable by TxDOT and contractors.
- Easy sample preparation with potential to test both lab-prepared samples and field cores.
- Reasonable test duration (similar to the current Hamburg test).
- Acceptable level of variability (coefficient of variation [COV] ≤ 30 percent) and test reliability.
- Simulates and/or correlates well with the field conditions.

## What the Researchers Did

To address the OT variability issues and explore new supplementary and/or surrogate crack tests, the researchers:

- Conducted a comprehensive sensitivity evaluation of the OT test procedure (Tex-248-F) to improve the OT repeatability and minimize variability in the test results.
- Recommended updates and modifications to the Tex-248-F specification, including development of the OT calibration and service maintenance manuals, and a video demo.
- Explored and evaluated other alternative OT data analysis methods, including use of the Fracture Energy Index (FE Index) concept under monotonic loading mode.
- Comparatively evaluated several other cracking test methods of both monotonic and repeated loading mode in comparison to the standard repeated loading OT test (Tex-248-F).

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- Developed new crack test procedures, specifications, and technical implementation recommendations.

To accomplish the study objectives, the researchers evaluated up to nine crack test methods, including:

- The standard repeated (Tex-248-F) and monotonic loading OT ($OT_M$) test.
- The monotonic (IDT) and repeated loading indirect-tension (R-IDT) test.
- The monotonic (SCB) and repeated loading semi-circular bending (R-SCB) test.
- The disk-shaped compaction tension test (DSCTT).
- The monotonic direct-tension (DT) and repeated loading direct-tension (R-DT) test.

## What They Found

After evaluating a minimum of five commonly used Texas mixes with markedly different cracking resistance in a round-robin test program between the Texas A&M Transportation Institute and TxDOT laboratories, the researchers concluded that:

- Adhering to the recommended Tex-248-F modifications, including use of trained technicians/operators on well-calibrated OT machines, yielded satisfactory results with acceptable variability, i.e., COV ≤ 30 percent.
- The repeated loading OT test exhibited statistical superiority with generally lower COV values compared to the other repeated loading tests that were evaluated, i.e., the R-IDT and R-SCB. Additionally, the repeated loading OT test also exhibited statistical superiority in terms of discriminating and screening mixes compared to all the crack tests that were evaluated.
- Monotonic loading crack tests, irrespective of the test method, are simpler and more repeatable (lower COV values) than their repeated (dynamic) loading counterparts that are inherently associated with high variability.
- Using the FE Index concept from the monotonic loading OT ($OT_M$) and IDT tests yielded promising results. In particular, the FE Index from the $OT_M$ exhibited good correlations with the OT repeated loading cycles.

## What This Means

The researchers acknowledge that, compared to monotonic loading tests, repeated loading crack tests are inherently associated with high variability (particularly for coarse-graded, recycled asphalt pavement, and recycled asphalt shingle mixes) and that the OT is no exception. Nevertheless, the work conducted in this study shows promise to optimize the OT repeatability and minimize variability in the test results. HMA mix designs will thus be cost-effectively optimized and premature crack failures minimized if the following steps are undertaken:

- The recommended Tex-248-F updates and modifications for the repeated loading OT test should be implemented and enforced.
- The monotonic loading $OT_M$ and IDT tests with the FE Index concept should be investigated further as supplementary and/or surrogate tests to the standard repeated loading OT test procedure (Tex-248-F).


## For More Information

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