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CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

Research Results

PPRC 17 PRS-B: Performance Related Testing in Superpave

Performance Related Testing to Complement Current Superpave Mix Design Methodology Adopted by Caltrans

Pavement

NOVEMBER 2023

Project Title:
PPRC 17 PRS-B: Performance Related Testing in Superpave

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WHAT WAS THE NEED?

Superpave methodology for mix design was incorporated into Section 39 "Hot Mix Asphalt" in the 2015 Caltrans Standard Specifications. Across the country, for more than 30 years, the need has been identified for performance-related tests to provide a greater level of risk mitigation for rutting and cracking. Caltrans and other states are continuing to look for suitable performance-related tests for routine mix design and quality control and assurance testing. Tests that have been identified in previous projects for "balanced mix design" considering both cracking and rutting need further validation and if suitable, calibration, against both currently used performance-related tests and field performance. If suitable, the tests need to be incorporated into standard Superpave mix design procedures and construction specifications.

WHAT WAS OUR GOAL?

The goal is to develop approaches for performance-related testing for rutting and cracking for routine asphalt mix design and to incorporate them into Caltrans specifications, follow these approaches in pilot projects, and evaluate feasibility for commercial adoption.

WHAT DID WE DO?

The objective of this project is to support the implementation of the Superpave HMA mix design process in California, and the goal was accomplished through the following tasks:

- Implement the use of the repeated load triaxial (RLT) test for HMA mix design and Quality Control/Quality Assurance (QC/QA) testing

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- Identify appropriate cracking tests for mix design and QC/QA testing
- Evaluate and account for differences between plant and lab produced mix
- Support implementation in pilot projects
- Evaluate commercial adoption of performance related testing
- Write report to document the study

WHAT WAS THE OUTCOME?

A surrogate performance-related test for cracking performance of asphalt materials was developed in this study. Four testing methods were evaluated (I-FIT [semicircular notched beam], LOU-SCB [semicircular notched beam], and IDEAL-CT [indirect tensile]; and fine aggregate mixes [FAM] with linear amplitude sweep [LAS] test). and it was investigated the correlation between results of those tests and initial flexural stiffness and fatigue life from the benchmark four-point beam (4PB) test. The results from the three tests (I-FIT, LOU-SCB and IDEAL-CT) were very well correlated linearly with each other for both the strength and fracture parameters. Considering that they produced very similar results, but the IDEAL-CT test was simpler and faster, the IDEAL-CT test was the recommended test among the three.

A strong correlation existed between the strain at failure from LAS fatigue testing of FAM mixes and the strain value for fatigue life of one million cycles from 4PB fatigue testing of full mixtures, indicating that FAM mixes LAS testing may serve as a good candidate fatigue test for mix design and QC/QA. A procedure for determining the criteria value for a specific material to implement the Strength criteria in practice for QC/QA was developed based on the relationships found in this study between flexural stiffness and flexural fatigue, and flexural stiffness and Strength from the I-FIT and IDEAL-CT tests.

WHAT IS THE BENEFIT?

An optimal mix design will balance rutting and fatigue-cracking performance by reducing the risk of rutting to an acceptable level, while at the same time maximizing fatigue-cracking performance and achieving at least a minimum required cracking performance. The RLT test using the asphalt mixture performance tester (AMPT) equipment and the semi-circular beam (SCB) test have potential for suitability for routine asphalt mix design and quality control and assurance testing. Use of better designed AC mixes with higher quality will decrease maintenance costs and create savings by maintaining longer lasting pavements, which thus eventually improves system performance.

LEARN MORE

Here is a report published for this project:
https://escholarship.org/uc/item/52d1d1q5

IMAGES

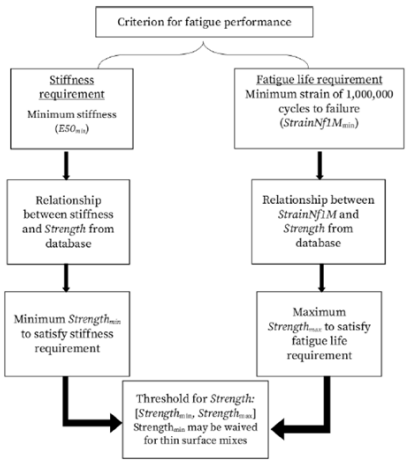

Image 1: Flowchart for determining criteria for fatigue cracking based on Strength