Project Capsule

25-2B

October 2024

Validation of SCB J_c Prediction Model and Aging Correction Factor

PROBLEM

The Balanced Mix Design (BMD) approach prioritizes identifying common pavement distresses and selecting appropriate mechanical tests that simulate how well the pavement will resist those distresses. These distresses typically include rutting, moisture damage, and various types of cracking (e.g., fatigue, reflection, and thermal cracking). The semi-circular bend (SCB) test offers a simple and reliable (i.e., rugged) method to assess an asphalt mixture's resistance to cracking. It measures the SCB J_c parameter, which indicates the amount of energy required to propagate a crack through the mixture. Higher SCB J_c values correspond to better cracking resistance. Figure 1 shows a typical SCB test setup.

The primary concern for using the SCB J_c for quality control and assurance (QC/QA) in mixture production and construction is the slow turnaround time, where an extended aging period (5 days at 85°C) is required for SCB specimens before testing. During construction, contractors require quick results to identify and address any mix design issues. In this context, SCB J_c is unsuitable for QC/QA purposes due to its long aging time.

To overcome the challenge of lengthy aging periods for SCB specimens in asphalt mixture QC/QA, the Louisiana Transportation Research Center (L TRC) sponsored a project titled "Implementation of a Semi-circular Bend (SCB) Test for QC/QA of Asphalt Mixtures." LTRC researchers created two critical tools: the SCB J_c Prediction Model and the SCB J_c Aging Correction Factor. The SCB J_c model uses artificial neural networks (ANNs) to predict the SCB J_c values for asphalt mixtures using mix design parameters such as asphalt binder film thickness (FT), percent passing from sieve #4 (P4), aging level (day), asphalt binder polymer modification level (PM), and effective asphalt binder content (Pbe). Figure 2 shows the computer-based user interface developed by LTRC researchers for the prediction of the SCB J_c values. Additionally, the aging correction factor allows the conversion of SCB J_c values obtained from unaged mixtures (i.e., day one of production) to the expected values after long-term aging (e.g., 5 days at 85°C).

Both the SCB J_c prediction model and the aging correction factor aim to significantly improve turnaround time by providing estimated SCB J_c values at different aging levels, eliminating the need for lengthy aging periods. However, for wider acceptance in Louisiana, a comprehensive study is necessary to validate these concepts using a variety of asphalt mixtures commonly employed in the state. This validation process will ensure the model's accuracy and the correction factor's effectiveness for Louisiana's specific materials and conditions.

Figure 1. SCB Test Setup

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July 21, 2024

Duration
24 months

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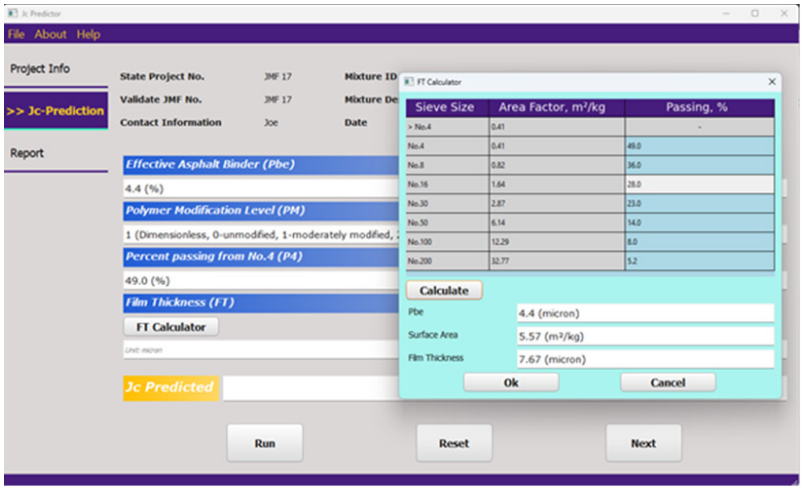

Figure 2. User Interface for SCB J_c Prediction

OBJECTIVE

The objective of the proposed study is to validate the SCB J_c prediction model and aging correction factor concept developed as part of LTRC Project 19-4B.

METHODOLOGY

To fulfill the objective of this research, the team will complete several tasks. First, the research team will conduct a literature review of current and prior research on the SCB test and other test protocols for characterizing the cracking resistance of asphalt mixtures. Next, the team will develop an experimental test plan, which involves selecting asphalt projects with diverse characteristics, including binder type, aggregate type, mixture type, traffic level, RAP content, and additives. Asphalt mixture samples will be collected from these projects and subjected to laboratory testing to determine their composition and validate the mixture design parameters used for predicting SCB J_c as proposed in LTRC Project 19-4B. These parameters will be used to compute SCB J_c for further comparison with the SCB J_c values provided in the job mix formula, as well as those determined in the laboratory, in order to validate the prediction model. The study will further compare the performance of both unaged and long-term aged mixtures to understand the impact of aging on cracking susceptibility. This task aims to calculate the ratio of SCB J_c values for short-term aged mixtures to those of long-term aged mixtures in order to verify the validity of the aging correction factor concept presented in the LTRC Project 19-4B's final report. Finally, the team will prepare a final report detailing the study's findings.

IMPLEMENTATION POTENTIAL

The research team anticipates that the results from this study will provide guidance to state agencies in QC/QA processes to shorten the required time for asphalt mixture aging prior to the SCB test. Additionally, the validation process will ensure the SCB J_c model's accuracy and the J_c correction factor's effectiveness for Louisiana's specific materials and conditions.