

Measuring the Tensile Strength Ratio of Asphalt Mixtures to Ensure Resistance to Moisture Damage

Research Objectives

- Evaluate the moisture damage resistance of asphalt mixtures at the design and production stages.

Research Benefits

- Ensure the durability of asphalt pavements in Wisconsin, a state with high precipitation.

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Background

Moisture damage is one of the predominant distress modes in asphalt pavements causing premature failure. There are many different methods for the evaluation of this type of distress. Wisconsin Department of Transportation (WisDOT) specifications require the use of tensile strength ratio (TSR) test for the evaluation of moisture damage resistance at the design and production stages. The TSR is the ratio of indirect tensile strength (IDT) measured in wet and dry conditions with the equation: $TSR = \frac{Wet\ IDT}{Dry\ IDT}$

Methodology

Research funding was used to equip WisDOT's central laboratory with an indirect tensile test (IDT) fixture for the measurement of TSR. To measure the TSR, the specimens are loaded using indirect tensile loading mode using the IDT fixture. The loading is conducted in dry and wet conditions; then, the TSR is calculated by dividing the wet IDT by the dry IDT.

During the mix design and production, the TSR is measured to ensure having a satisfactory mix design and a high-quality mixture during the production. The test results at the design and production stages are compared with the specification lower limits set by WisDOT. The measured results must be above WisDOT's limits.

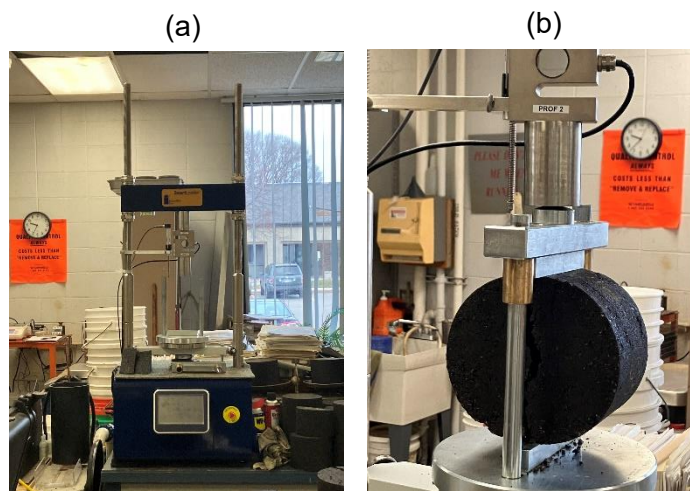


Figure 1. The IDT machine purchased for measuring the TSR: (a) test setup (b) specimen after testing.

“Verification of the Tensile strength Ratio will help reduce the likelihood of moisture damage asphalt pavements.”
–Ali Arabzadeh, WisDOT

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Results

With the purchased testing fixture, the Bureau of Technical Services' (BTS's) central laboratory has been able to continue the evaluation/verification of moisture damage resistance of the mixtures at the design and production stages. The following shows the analysis results obtained from a mix design used in USH 12 with a project ID of 1670-04-71:

$$\text{TSR} = \frac{\text{Wet IDT}}{\text{Dry IDT}} = \frac{921 \text{ psi}}{1002.2 \text{ psi}} = 0.92$$

The calculated value of 0.92 is greater than the specification limit of 0.75 set for the design stage; therefore, the mix design is acceptable (or not prone to stripping/moisture damage).

Recommendations for implementation

To ensure that the asphalt mixtures of Wisconsin are resistant to moisture damage, the performance of the mixtures should be evaluated using the TSR. Such evaluation method must continue until a superior alternative moisture damage resistance testing procedure is identified for the acceptance of the Wisconsin's asphalt mixtures. Currently, the BTS's Hot Mix Asphalt (HMA) Unit is planning to equip the central lab with alternative equipment for the moisture damage resistance evaluation to conduct in-house research.