Research Brief

Wisconsin Highway Research Program
Project 0092-15-04
March 2017

# Asphalt Pavement Performance-Based Specifications

## Research Objectives

- Identify effective asphalt testing procedures and evaluate the performance of common Wisconsin mixtures
- Establish relationships between test results and surrogate measures for production testing
- Ensure quality of high-RAM mixtures through the use of performance based testing
- Develop a criteria-type framework with suggested performance limits for future evaluation

## Research Benefits

- Identified the most effective methods for evaluating resistance to rutting, moisture damage, fatigue and thermal cracking
- Confirmed that modifying aggregate properties and asphalt binder content significantly affects performance
- Determined that high-RAM mixtures perform adequately

### Principal Investigator

Hussain Bahia
University of Wisonsin – Madison
bahia@engr.wisc.edu

### Project Managers

Barry Paye
WisDOT
barry.paye@dot.wi.gov

Stacy Glidden
Construction Resources Management, Inc.
SGlidden@crmanagement.com

## Background

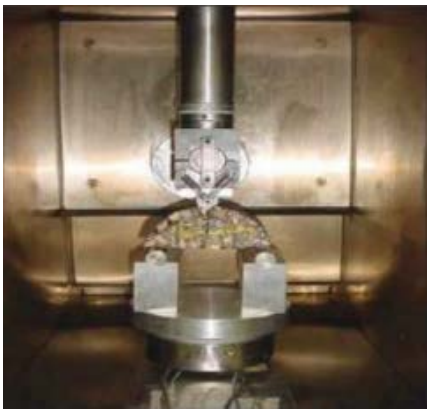
The fundamental objective of asphalt mix design is to select an aggregate skeleton and asphalt binder content that balances constructability and performance. High performance mixtures that protect against rutting, cracking and moisture damage are difficult to achieve while still maintaining a workable mixture. When designing a pavement mixture, the Wisconsin Department of Transportation (WisDOT) follows a modified version of the Superpave mix design procedure and does not employ performance testing other than assessing moisture susceptibility using a modified Lottman (Tensile Strength Ratio) test.

Since the adoption of the Superpave method, advancements have been made in asphalt binder and mixture technologies that warrant reevaluation of design policy. The goal of this research was to identify which performance-related properties of mixtures to evaluate, which tests to conduct and how this information will be incorporated into WisDOT's asphalt pavement mixture design and quality management program.

## Methodology

The project involved four stages: evaluating mixtures that passed the Lottman test and met current specifications; evaluating the effects of production variability on mixture performance; providing additional guidance for high-recycled asphalt material (RAM) mixtures; and validating in-service field findings. Common WisDOT mixtures were replicated and subjected to the Hamburg Wheel Tracking (HWT), asphalt mixture performance tester (AMPT) flow number, semi-circular bend (SCB), dynamic modulus and disk compact tension (DCT) tests to evaluate resistance to rutting, moisture damage effects, fatigue and thermal cracking.

Asphalt and dust content were then adjusted, and the effects on mixture performance were measured. Linear blending charts and a developmental grading procedure provided guidance for determining the effective binder properties for high-RAM mixtures. Finally, field cores were compared to laboratory mixtures in order to develop relationships between laboratory test methods and field performance.



An SCB test is performed to assess fatigue cracking resistance.

*"This study advances WisDOT's ability to evaluate mixture performance in the lab prior to paving, which will help achieve better-performing pavements in the field."*

*–Barry Paye, WisDOT*

Interested in finding out more?

Final report is available at: WisDOT Research website.

## Results

The HWT showed that mixtures with a history of successful performance did not consistently pass the rutting and moisture damage limits, while the AMPT flow number test did not yield clear results on rutting resistance. Louisiana State University's SCB test, analyzed using the Illinois Flexibility Index Test (IFIT) procedure, was successful in finding correlation between the flexibility index (FI) and mix design factors. Prior to adjustments, only two mixes met the fracture energy minimums of the DCT test. Modifying aggregate properties and asphalt binder content during production significantly influenced lab-measured resistance to cracking.

The use of high RAM content in field trials displayed similar performance grades and mechanical properties as conventional mixes, and performed as well or better than the control designs when tested for the fracture energy.

## Recommendations for Implementation

The researchers recommend the following test methods for evaluating asphalt mixture performance: HWT test at 45 degrees Celsius for evaluating rutting and moisture damage; SCB test at an intermediate temperature of the performance grade with one notch depth to evaluate fatigue resistance; and DCT and the SCB following the AASHTO TP105 for evaluating thermal cracking. Recommendations were also made for a specification framework for each of the distress and tentative limits for the key performance indicators from each of the selected tests. If the FI is used in specifications, limits should be set low enough to allow for the inherent variability in asphalt content, and aggregate source changes should be restricted.

This study introduced new parameters for evaluating field samples and set baseline values for future comparisons of how these parameters change with time. The material properties of asphalts in future projects should be tested annually or bi-annually and tracked to further develop the relationships with pavement performance.

This brief summarizes Project 0092-15-04,
"Analysis and Feasibility of Asphalt Pavement Performance-Based Specifications for WisDOT"
Wisconsin Highway Research Program