Balanced Mixture Design Pilot and Test Sections

Objectives

- Assist in the experimental design and construction of pavement test sections for assessing the long-term field performance of BMD pavements and validate preliminary criteria
- Statistically analyze the variance of BMD test results from shadow projects

Benefits

- Help establish criteria for asphalt mixture design approval and quality assurance
- Create recommendations for implementation of BMD as well as indicate where further research is needed

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Background

State highway agencies and the asphalt pavement industry have recognized the limitations of the Superpave mix design and the need for implementing balanced mix design (BMD) for improved asphalt mix design approval and quality assurance. The Wisconsin Department of Transportation (WisDOT) continues to make thoughtful steps toward the implementation of BMD tests and criteria for asphalt mixture design approval and Quality Assurance. This research project involved two important steps toward that goal: validation of BMD tests and criteria, and assessing the overall variability of the BMD test results in a mix production setting.

Methodology

For the experiment, six test sections were recommended to establish correlations between BMD test results and field performance with a good balance between cost and experimental robustness. WisDOT selected State Project Number 1693-05-72, WIS 69 in Dane County, south of Verona, as the site for the BMD experiment. The designed cross-section of the reconstructed pavement is a 5-inch asphalt pavement consisting of a 2-inch upper layer and a 3-inch lower layer, and a 12-inch granular base constructed over 12-inches of select crushed material. The six experimental mixes were surface layers; the same medium-traffic (3 MT) mix containing a PG 58-28 S binder was used under each of the test sections. Falling Weight Deflectometer (FWD) testing was conducted, and the results were analyzed by the research team to assess the uniformity of the base and subgrade in the areas where the test sections were planned.

WIS 69 prior to reconstruction

Test section mixtures sampled during construction were tested using the Indirect Tensile Asphalt Cracking Test (IDEAL-CT) and Hamburg Wheel Tracking Tests (HWTT). The IDEAL-CT test was performed in

"Outcomes from this project advanced implementation of BMD for WisDOT as well as provide valuable lessons learned on how to build test sections." – Tirupan Mandal, WisDOT

accordance with ASTM D8225 after reheating the buckets of mixture samples for two hours to enable splitting samples to individual test portions, then aging the mixture samples at 135°C for six hours at a thickness of three-quarters to one inch, followed by SGC compaction. Hamburg tests were performed in accordance with AASHTO T 324 on samples that were reheated then compacted to 7+/-0.5% air voids with an SGC.

To quantify the overall variability of asphalt mixture BMD tests, ten shadow projects were chosen from across Wisconsin to represent the state's diversity in aggregate type, binder grades, and mix types. The asphalt mixtures from the shadow projects were sampled during plant production while the contractor was sampling for regular quality control (QC) testing.

Results

A few issues were encountered during construction of the test sections. Different granular base materials were placed and compacted in the area where the test sections were constructed. Analysis of FWD data from tests conducted throughout the area where the test sections were constructed was inconclusive, leaving uncertainty about the uniformity of the pavement structures which could impact field performance of the test sections and confound the desired lab-to-field correlations.

Another issue was from the lab-to-lab comparisons of the IDEAL-CT and HWTT) for the mixtures sampled from the test sections. Despite the large lab-to-lab differences in the results, the ranking of the mixtures is similar. The range of resistance to rutting and cracking indicated should provide a suitable lab-to-field correlation.

Recommendations for Implementation

Based on the results, the research team offers several recommendations for future research and implementation:

- WisDOT should closely monitor the rutting and cracking performance of the test sections with the state's Automated Road and Pavement Condition Survey vehicles to provide consistent measures of pavement condition over time.
- The lab-to-lab differences in rutting results from the test section mixtures should be further investigated to determine the possible causes – starting with a review of each lab's procedures for mix reheating, splitting, sample preparation and conditioning.
- Field performance of the shadow projects should also be monitored as they may provide useful information about the ability of the BMD test parameters to indicate the resistance of the mixtures to rutting, cracking and moisture damage.
- A formal technician training program for the IDEAL-CT, HWTT and HT-IDT should be prepared and conducted. This will be critical as more pilot and shadow projects are conducted.

Interested in finding out more?
Final report is available at:
WisDOT Research website

This brief summarizes Project 0092-22-04
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