PUTTING RESEARCH TO WORK **BRIEF**

Field Validation of Lab Tests for Choosing Modified Asphalt Binders

Hot-mix asphalt can rut and crack under the stress of heavy trucks and extremes in temperature. Pavement engineers address these problems by improving HMA design and materials. Two important approaches have been the use of AASHTO performance graded asphalt binders and the use of high-tech modifiers in those binders. Selection of the appropriate PG binder helps accommodate expected temperature fluctuations and projected traffic speeds and volumes, and modifiers and additives help resist rutting and fatigue.

In 1997, WisDOT implemented Superpave PG binder standards. PG binders are categorized based on laboratory tests that forecast field performance of the pavement across a temperature range; PG 64-22 indicates a binder that will sustain an average seven-day maximum pavement temperature of 64° C and a low temperature of -22° C. WisDOT uses PG 58-28 because it closely matches binders used previously in Wisconsin. But the PG categories do not indicate whether modifiers are used, and neither the PG system nor the new AASHTO Mechanistic-Empirical Pavement Design Guide account well for the impact of modifiers on rutting, fatigue and low-temperature cracking.

What's the Problem?

In 2005, WHRP project 0092-01-01, "Development of Guidelines for PG Binder Selection in Wisconsin," recommended new tests and specifications for binder selection tailored to Wisconsin's climate and the improved performance realized through the addition of modifiers to the binder. The new standards are promising, but must be validated in the field to ensure that the specified options for modifiers and performance grades perform as predicted in pavements.

Research Objectives

The research sought to validate the binder selection guidelines by evaluating the performance of Wisconsin pavements constructed using combinations of relevant performance grades and binder modifiers.

At nearly two dozen project sites, investigators sought to validate four performance properties of HMA pavements developed with PG binders: mixing and compaction temperatures, fatigue, low-temperature cracking, and rutting.

Methodology

For each performance property, investigators selected projects representing the range of binder grades and modifiers outlined in the binder selection guidelines, and followed methods recommended by the guidelines.

- For mixing and compaction, viscosity was measured in samples from eight construction sites to assess workability and predict compaction temperatures. Field compaction was evaluated at four sites by measuring temperature with infrared guns after roller passes, and by measuring density with a nuclear gauge.
- For fatigue, investigators inspected eight sites and conducted time sweep tests.
- For low-temperature cracking, the research team used the eight fatigue testing sites where binder grades ranged from -28° C to -34° C. Investigators calculated binder cracking temperatures at specific cooling rates using the current WisDOT test and two newer tests.
- For rutting, researchers conducted creep and recovery tests on samples from six pavement projects. Creep stiffness and elastic recovery for each sample were evaluated for typical urban and rural traffic speeds.

Investigator

"Using asphalt modifiers is a good investment. They improve damage resistance and add service life."

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This Interstate 94 overlay in Waukesha County used Superpave binder technologies designed with additives to extend good performance. (Photo courtesy of FHWA.)

Following this investigation, researchers planned to recommend implementation of the validated binder selection guidelines where appropriate, and deliver an electronic database of pavement materials and performance.

Results

The investigation produced the following results and recommendations:

- **Mixing and compaction.** Field results show that mixing can be effective at a temperature roughly 20° C lower than current practice. The study specified a viscosity parameter that allows a cooler compaction temperature.
- **Fatigue.** Results indicate that the new fatigue parameter correlates well with observed longitudinal cracking, but because field sites haven't aged enough to show fatigue, other recommended guidelines could not be fully evaluated.
- **Low-temperature cracking.** The primary Superpave parameter for low-temperature cracking correlates very well with transverse cracking performance, and the current testing method for setting this binder parameter works well. Newer methods do not need to be used.
- **Rutting.** No site was of sufficient age to show rutting. The rutting parameter used was based on higher traffic accumulations than the sites actually experienced, so research endorses the guideline evaluated.

In addition, researchers delivered an electronic database of pavement materials and performance.

Implementation and Benefits

WisDOT's flexible pavement technical team can now review the binder selection guidelines on mixing and compacting at lower temperatures for potential changes to department specifications. Lower heat would reduce mixing costs and avoid prematurely aging binders before they reach the field.

Methods for selecting binders to resist low-temperature cracking will remain unchanged. Field sites will be monitored to further evaluate standards for rutting and fatigue resistance. Roads built with these standards should require less repair and serve Wisconsin drivers better for longer.

Further Research

WisDOT can continue to follow the rutting and fatigue performance of the sites evaluated in this study. As the pavement sections age and performance data builds, WisDOT will be able to evaluate the performance of these sites and quickly adjust design practices accordingly.

This brief summarizes Project 0092-03-13, "Field Evaluation of Wisconsin Modified Binder Selection Guidelines," produced through the Wisconsin Highway Research Program for the Wisconsin Department of Transportation Research Program, 4802 Sheboygan Ave., Madison, WI 53707.

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"There is a national effort to quantify the benefits of additives in asphalt binders through tests and specifications. This study puts WisDOT a little ahead of the curve."

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