Research Brief

Wisconsin Highway Research Program
Project 0092-20-03
April 2022

Expansion of AASHTOWare Mechanistic-Empirical (ME) Design Inputs

Research Objectives

- Expand the current PMED material library using asphalt mixtures being paved in Wisconsin
- Estimate the empirical asphalt structural layer coefficient to represent the current asphalt mixtures being placed in Wisconsin
- Understand how material/construction specification changes influence PMED changes

Research Benefits

- Expanding the materials library supports efforts to implement the PMED software in Wisconsin
- Provided an update to the structural layer coefficients required by the AASHTO Interim Design Guide to represent current asphalt mixtures being placed in Wisconsin
- Updated XML files for use in the PMED software to avoid input errors

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Background

The Wisconsin Department of Transportation (WisDOT) has supported several research studies in the past decades to measure the mechanical or performance properties of asphalt mixtures in support of the AASHTOWare Pavement ME Design (PMED) software to design pavement structures in Wisconsin. The outcome of those studies was to prepare a library or catalog of the asphalt materials inputs that can be integrated into the WisDOT pavement design practice for using the AASHTOWare PMED. The material properties required for the AASHTOWare PMED software are tied to a hierarchical input approach: Level 1 inputs represent project-specific mixture properties derived from comprehensive laboratory and/or field testing; Level 2 inputs are calculated from volumetric properties or other variables using regression equations embedded in the PMED software; and Level 3 inputs represent “best-guessed” material properties.

The primary objective of this study was to expand the existing PMED software’s material library by testing asphalt mixtures being paved in Wisconsin. Additionally, the research team aimed to estimate the empirical asphalt structural layer coefficient needed by the AASHTO 1972 Interim Design Guide to represent current asphalt mixtures being placed in Wisconsin and understand how material specification changes influence the PMED inputs for Levels 1, 2 and 3. The study’s outcomes will also help WisDOT understand how frequently the PMED inputs library needs to be updated and expanded.

Methodology

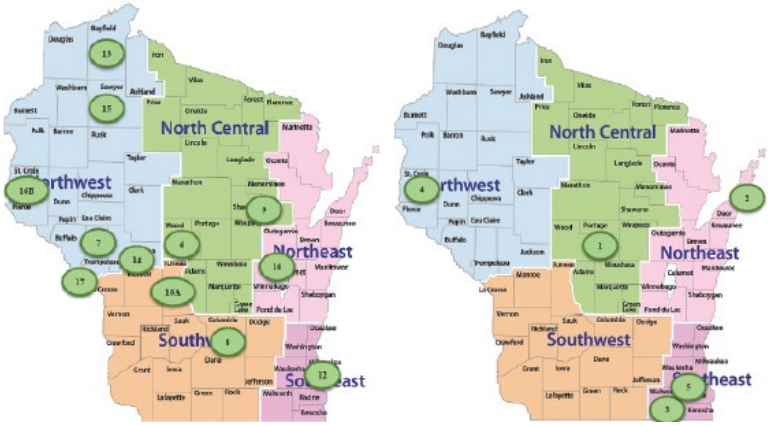
The outcome of WHRP 0092-08-06 and WHRP 0092-10-17 research studies provided the mechanical properties for WisDOT asphalt mixtures with a complete Level 1 library of asphalt mixtures.

This study tested asphalt binders and mixtures with the following tests: dynamic modulus, IDT creep compliance and strength, repeated load plastic strain, bending beam fatigue strength and IDT strain at failure. Six binder grades have been used in Wisconsin construction projects since 2019; the final test plan included all six from two sources, for 12 total asphalt binder samples. Five base mixtures were sampled throughout the state; a total of 17 combinations of binders and bases were tested. The map (below, left) shows the sample sites for the 12 asphalt binders; the map on the right shows the sample sites for the five base mixtures.

"Results from this study are going to improve WisDOT's pavement design process."
– Erik Lyngdal, WisDOT

Interested in finding out more?

Final report is available at:
WisDOT Research website



Maps of procurement sites for asphalt surface and base mixtures

To determine the 1993 AASHTO structural layer coefficients from laboratory test results, the research team calculated the structural layer coefficient from the asphalt mixture modulus using the 1993 AASHTO regression equation and back-calculated the structural layer coefficient from the distress predictions of the PMED software.

Results

This research study expanded the PMED software's material library by testing asphalt mixtures that are being paved in Wisconsin. The catalog includes the level 1 material inputs selected by pavement designers in Wisconsin to reflect the mixtures used in day-to-day practice. The input Level 1 measured asphalt properties were found to be consistently different from the input Level 3 default properties included in the PMED software. The asphalt mixtures that exhibited poor rut depth resistance did exhibit better resistance to bottom-up fatigue cracks; the dynamic modulus between the different mixtures, however, was not significantly different.

Recommendations for implementation

This study resulted in the creation of XML files of asphalt binders and mixtures, and of subgrade soils that can be input into the PMED software to simplify the inputs and reduce the potential for input errors. WisDOT should consider and use both previous and new asphalt and soil XML files in future calibration efforts to verify global calibration coefficients. The research team also recommends a new structural coefficient for hot material asphalt (HMA) materials, if warranted, as well as a sampling strategy to verify and update HMA materials inputs with time.

This brief summarizes Project 0092-20-03,
"Expansion of the AASHTOWare ME Design Inputs for Asphalt Layers"
Wisconsin Highway Research Program