Project Summary

Texas Department of Transportation

0-4824: Guidelines for Selecting Asphalt Mixtures and Evaluation of Polymer-Modified Mixes

Background

To implement the *Mechanistic-Empirical Pavement Design Guide* (MEPDG), it was necessary to evaluate hot mix asphalt (HMA) using newly proposed performance tests (dynamic modulus, flow time, and flow number tests). Since manufacturers typically use modified binders to meet Texas Department of Transportation (TxDOT) specifications, it was necessary that the mixes consisting of modified binders be evaluated using the new tests as well. The first objective of this study was to identify the influence of modifiers on the performance of HMA. Since TxDOT specifies the use of the elastic recovery test (Tex-539-C) to identify the presence of modifiers, a test that has not been evaluated to identify its validity, the second objective of this study was to identify the ability of the test to identify the presence of modifiers. Recently, various new mix types have been developed and have been placed on highways. However, an expert system was not available to guide new engineers in selecting an appropriate mix type. The third objective of this study was to develop an expert system that can help in selecting appropriate mix types.

What the Researchers Did

Researchers reviewed the available information and conducted a survey. The purpose of the survey was to identify modifier types used and mix types commonly placed, and to gather expert opinions on the application of various mix types. The survey results suggested that traditional mixes are most commonly used. However, newer mix types are gaining popularity. The information gathered using the survey was then used for the development of an expert system for selection of mixes and modifiers.

Three mixes (Type D, CMHB-C, and PFC) were identified based on survey data. In addition, the survey identified four modifier types currently used within TxDOT. The identified modifiers are: Styrene-Butadiene-Styrene (SBS), Styrene-Butadiene-Rubber (SBR), Elvaloy (E), and Tire Rubber (TR). To make sure that the influence of modifiers was evaluated, researchers obtained original (unmodified) binders from manufacturers. In addition, researchers sought to obtain binders (both modified and unmodified) that had been or will be placed on highways. The reason for this step was to make sure that incompatible asphalt binders were not obtained.

The presence of modifiers was evaluated by performing elastic recovery tests on asphalt binders. The influence of modifiers on the performance of HMA was evaluated using a Hamburg Wheel Tracking Device (HWTD), the dynamic modulus test, flow time tests, flow number tests, and flexural fatigue tests.

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What They Found

Based on the survey results and existing TxDOT guidelines, a web-based system was designed that allows the user to select mix types that are appropriate for the application. The expert system requires that the design thickness of HMA already is obtained from FPS 19 or other design methods. Based on design thickness, the expert system guides users in selecting suitable mix types that are economical and suitable for the application. The expert system can be accessed at http://pavements.ce.utexas.edu/TexSys.

The binder types with and without modifiers were obtained from various sources and evaluated using Tex-539-C. Test results indicated that the unmodified asphalt binders do not meet TxDOT specifications, while modified binders *do* meet TxDOT specifications. Thus, the test results suggest that the test procedure can identify the presence of modifiers in binders. However, the test results also suggest that binders be tested after short-term aging because the elastic recovery diminishes.

The HMA (Type D and CMHB-C) evaluation results suggested that the HWTD tests could identify the presence of modifiers, while dynamic modulus test results suggested that the presence of modifiers could not be identified using this test. However, the dynamic modulus test results on PFC mixes suggested that the presence of modifiers could be identified. This means that the presence of modifiers can be identified only when the modified binder is used in a weaker aggregate skeleton using dynamic modulus tests. Since dynamic modulus data is needed for the new mechanistic pavement design guide, a database consisting of input information for HMA layers was developed.

The flow time and flow number tests were able to identify the presence of modifiers as well. The flexural fatigue tests also suggested that the presence of modifiers could be identified. Although the test results suggested that the presence of modifiers improved the performance of HMA, the testing could not identify which specific modifier was better than another.

What This Means

The Tex-539-C procedure can identify the presence of modifiers. Similarly, HWTD, flexural fatigue, flow time, and flow number tests can identify the presence of modifiers. The presence of modifiers reduces the rut susceptibility and increases fatigue resistance of HMA.

The web-based system and guide developed from this research will allow engineers to select suitable mix types that are economical and suitable for application.

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