LTRC RESEARCH PROJECT CAPSULE

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04-6B

TECHNOLOGY TRANSFER PROGRAM

Characterization of Louisiana Asphalt Mixtures Using Simple Performance Tests and MEPDG

JUST THE FACTS

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36 months

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SPR

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SPECIAL POINTS OF INTEREST:

- Problem Addressed
- Objectives of Research
- Methodology Used
- Implementation Potential

PROBLEM

The Superpave volumetric mix design procedure developed during the Asphalt Research Program of the Strategic Highway Research Program did not include a mechanical "proof" test similar to those commonly used in the Marshall mix design or Hveem mix design such as the Marshall stability and flow tests or the Hveem stabilometer method, respectively. The Superpave mix design method, however, did use volumetric mix criteria to ensure satisfactory performance of mix designs that were intended for low volume traffic. In addition, the original Superpave mix design protocol required mix verification for intermediate and high volume traffic through advanced materials characterizations tests utilizing the Superpave Shear Tester test protocols. The complexity of those test protocols for routine mix design application was quickly recognized. There is a need for a simple performance test to complement the Superpave volumetric mix design procedure. In response to this need, NCHRP Project 9-19, Superpave Support and Performance Models Management, recently recommended simple performance tests (SPTs) to complement the Super pave volumetric mixture design method. These are flow time (F_t), flow number (F_n), and dynamic modulus |E*| tests. In addition, the dynamic modulus test was selected for the hot mix asphalt (HMA) materials characterization input utilized in the Mechanistic Empirical Pavement Design Guide (MEPDG) developed under NCHRP Project 1-37A.

OBJECTIVES

The objective of this research is to characterize common Louisiana hot mix asphalt mixtures using SPT protocols (flow number, flow time, and dynamic modulus) to create a catalog for dynamic modulus values inputs for various levels of traffic volumes and mixture types in the MEPDG software. The specific objectives include:

- Determine the dynamic modulus |E*| and phase angle (Ø) at various temperatures and frequencies, in axial, and indirect tension (IDT) mode;
- Determine the flow time (F_t) and flow number (F_n);
- Evaluate the performance of mixtures from master curves of dynamic modulus |E*|;
- Validate the Witczak and Hirsch models in the dynamic modulus |E*| prediction for local mixtures;
- Investigate the sensitivity of rutting as computed by the MEPDG software due to variation in the dynamic modulus |E*| values;
- Compare the dynamic modulus test results from the axial and indirect tension (IDT) mode; and
- Evaluate the permanent deformation characteristics of HMA mixtures based on two SPTs and a loaded wheel tracking test.

A wide range of mixtures commonly used in the state will be selected. Mixtures from on-going field projects will be used in the experimental program. A minimum of 22 projects will be examined. The desired variables in the selection include mixture type, nominal maximum aggregate size, traffic level, and binder type. Mixture characterization tests include dynamic modulus, flow time, flow number, and loaded wheel tracking. Triplicate samples will be used in all tests, except for the loaded wheel tracking test, where two samples will be used. In addition, the mixtures selected will be used in evaluating the Witczak and Hirsch dynamic modulus prediction models.

METHODOLOGY

Commonly used Louisiana asphalt mixtures designed for different traffic volumes as per the Louisiana Standard Specifications for Roads and Bridges (2000 Edition) will be selected in this study. The following mixture attributes will be considered:

- Nominal maximum size: 4 levels will be included in this study. These are 37.5, 25.0, 19.0, and 12.5 mm;
- Mixture type: dense and SMA;
- Asphalt cement: PG 76-22M, PG 70-22M, and PG 64-22; and
- Compaction level (N_{des}): 75 and 100 gyrations.

Laboratory binder tests will include:

- Complex shear modulus (G*) and phase angle tests on rolling thin film oven (RTFO) aged binder at a frequency of 10 rad/sec at seven temperatures (40, 55, 70, 85, 100, 115, and 130°F);
- Viscosity tests at three temperatures (60, 135, and 165°C).

Laboratory mixture characterization tests will include:

- Dynamic modulus |E*| in the axial mode at various temperature and frequencies;
- Flow number (F_n) test;
- Flow time (F_t) test; and
- Dynamic modulus test in the indirect tension mode.

Triplicate samples will be used in all tests, except the Hamburg wheel tracking device test, where two samples will be used. All the mixtures selected will be used in evaluating the Witczak and Hirsch models for their prediction of dynamic modulus |E*|. For all the mixtures selected, the sensitivity of the rut prediction from the MEPDG will be evaluated.

IMPLEMENTATION POTENTIAL

The outcome of this research is first to utilize the developed dynamic modulus catalog values in predicting the performance of different mixes. As well, these predictions can be utilized to grade the mixes based on their performance in terms of design traffic. The outcome of rut prediction's sensitivity from the MEPDG can be used to diagnose the mix design ingredients to enhance the performance of different mixes.