Research Summary

PHASE 1: Improving the Long-Term Condition of Pavements in Massachusetts and Determining Return on Investment: Implementing the AASHTO Mechanistic-Empirical Pavement Design Guide

Research Need

MassDOT is striving to improve its highway infrastructure's resiliency to climate change, environmental impacts, and traffic loading by implementing new technologies that can provide valuable return on investment. These improvements should begin with the pavement design process which currently utilizes antiquated empirical design methods from the 1960's. The new American Association of State Highway and Transportation Officials (AASHTO) Mechanistic - Empirical (M-E design) pavement design method is currently used by 33 state agencies and would be a significant improvement in pavement design.

AASHTO M-E design predicts pavement distresses utilizing models that were developed and nationally calibrated using in-service pavements. To accurately predict the design performance in Massachusetts, these models need to be calibrated according to Massachusetts local conditions.

Goals/Objectives

Due to the complexity of the research problem, a multi-phase (four phase) approach over several years was suggested. The objectives for this introductory phase were:

1. Determine the overall state-of-practice with regards to AASHTO M-E design and implementation.

2. Conduct initial testing of already sampled mixtures to accelerate future phases of this research.

3. Determine what pavement design methods MassDOT currently utilizes in an effort to capture the current state-of-practice.

Methodology

The experimental plan designed for this project included:

1. Conduct a literature review to examine and assess research projects that are closely related to local calibration of M-E performance predictions. The focus of the literature review was on material related to flexible pavements.

2. Gather information from state agencies that have successfully completed local calibration in an attempt to understand the steps to M-E implementation (data, software, tests, calibration, etc.), potential problems associated with calibration, and potential benefits from using the methodology.

3. Conduct initial dynamic modulus testing that is required for the M-E design using numerous plant-produced mixtures already sampled.

Key Findings

This study is a phase one of a four phase larger research project aimed at implementing the AASHTO Mechanistic-Empirical Pavement Design Guide (MEPDG) in Massachusetts. The goal of this study was to conduct a thorough literature review to determine the overall state-of-practice with regards to AASHTO MEPDG implementation with focus on local verification and calibration.

The literature review of published works by other state agencies that are implementing the AASHTO M-E design method indicated that it is critical to calibrate the distress models using local inputs and available performance data. This is critical because the distress prediction models included in the AASHTO M-E design method were calibrated using a national database which likely does not represent local climatic conditions, traffic, and materials.

In an effort to accelerate future phases of this research, the research team started generating data for the database needed to conduct the local calibration. Seven plant-produced mixtures were sampled and tested. These mixtures represent the most produced (based on tonnage) surface and intermediate course mixtures placed in Massachusetts.

The AASHTO M-E design method is a sophisticated tool used to design and predict the performance of pavements. It requires rigorous input data relating to traffic, climate and materials properties. This is contrary to MassDOT's current pavement design method which relies heavily on empirical relationships.

Project Information

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Mechanistic-Empirical (M-E) pavement design, MEPDG, AASHTO M-E design

Use of Findings

The findings of Phase 1 of this research demonstrate the necessity for local calibration of the AASHTO MEPDG for successful implementation. This local calibration process will be undertaken in the planned future phases of this research.

The data generated in Phase 1 can be used in conjunction with the data generated in future phases to perform local calibration.

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