Transportation Consortium of South-Central States (Tran-SET)

Evaluating the Moisture Susceptibility of Asphalt Mixes in Oklahoma

Project Number:

22BOSU57

Start Date:

04/01/2022

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Funding Source(s):

Tran-SET

Oklahoma State University

Total Project Cost:

$ 138,000

Assessing the moisture susceptibility of asphalt using MiST

Moisture damage in the form of stripping is a common mode of failure in asphalt pavements. Stripping occurs in asphalt mixtures through the combined effect of the loss of cohesion in the asphalt binder and loss of adhesion between the aggregate surface and the asphalt binder. Water penetrating the asphalt pavement causes a scouring action under traffic which also contributes to stripping. Water inside the asphalt pavement enters between the aggregate-asphalt binder interface and breaks the bond between the aggregate and the asphalt binder. The adhesion force between the aggregate and the asphalt binder is determined by the chemical interaction at the aggregate-asphalt binder interface. Adhesion is also promoted by the aggregate texture and the absorbed asphalt inside the aggregate pores. The objective of this study is to assess the ability of different laboratory tests and moisture conditioning methods to evaluate the moisture susceptibility of asphalt mixes. The study involves testing several asphalt mixes prepared using different asphalt binders and aggregates representing a wide range of moisture resistance. The asphalt mixes are conditioned using the moisture-induced stress tester (MiST) and the modified Lottman method and tested using the indirect tensile test (IDT). The use of antistripping additives is evaluated, and the ability of the different tests to assess the improvement in performance is determined.

Problem Statement

Moisture-induced damage can be detrimental to pavement performance. The ingress of water into asphalt pavements leads to several distresses including stripping, potholes, soil erosion, and freeze-thaw damage. Surface water can penetrate the pavement through cracks and air voids within the asphalt mix. Subsurface water can enter the pavement structure from the sides of the pavement and from groundwater underneath the pavement. Good pavement drainage is essential to protect the pavement structure against moisture damage. Asphalt mixes need to be designed properly to ensure sufficient resistance to moisture ingress. The effect of moisture on the asphalt mix performance depends on many factors including the degree of saturation, freeze-thaw cycles, internal air void structure, traffic, and the bonding between the asphalt binder and the aggregates. Several laboratory tests have been introduced to simulate the field performance of asphalt mixes under moisture damage. The most important aspect of these laboratory tests is to provide an accelerated lab procedure that correlates with field conditions. The effect of moisture can be assessed by measuring the strength, stiffness, or fatigue performance of the mix before and after moisture damage. The procedure currently utilized in AASHTO T 283 is based on subjecting the compacted asphalt specimens to partial vacuum saturation followed by a freeze-thaw cycle. The conditioned specimens are tested to determine their tensile strength. A tensile strength ratio (TSR) is calculated representing the ratio of the tensile strength of the moisture-conditioned specimens to that of unconditioned specimens. Oklahoma uses AASTHTO T 283 to evaluate the stripping susceptibility of mixtures in Oklahoma. Several states including Oklahoma have raised concerns related to the ability of AASHTO T 283 to predict field performance. Several problems have also been identified regarding the conditioning procedure followed in AASHTO T 283. These problems include the forced saturation using vacuum which could damage the internal structure of the asphalt, which does not reflect the in-situ field conditions. The AASHTO T 283 conditioning protocol also does not account for the effect of traffic.

Objectives

The objectives for this research project are: 1) Evaluate the potential of using the MiST conditioning procedure to characterize the moisture susceptibility of hot mix asphalt (HMA) mixes prepared using different aggregates and asphalt binders from Oklahoma; 2) Assess the impact of the MiST procedure on the HMA mix performance through indirect tensile strength testing and compare the severity of the MiST procedure with the AASHTO T 283 procedure. 3). Determine the appropriateness of using the MiST to evaluate the effectiveness of antistripping additives. 4) Provide recommendations on the use of MiST procedure in HMA mix design.

Figure 1. MiST device

Intended Implementation of Research

The outcome of this research will lead to a comprehensive report that will provide design methods and guidance for utilization of inorganic and organic coatings on rebar corrosion control actions in RC, capable of long-term performance in marine or harsh corrosive environment. Workforce development will also take place through the series of the outreach activities targeting broader audience of corrosion, civil and materials engineers, and potential industrial partners with the goal of increasing their awareness on importance of developing new technologies for ecofriendly and durable transportation infrastructure. The information will also be disseminated in various venues including technical publications, and conference presentations. Two graduate students, and two undergraduate students will be trained in developing reinforced multifunctional corrosion control-based concretes, characterization of their performance and carrying our independently complex electrochemical and corrosion testing.

Anticipated Impacts/Benefits of Implementation

The findings of this study will be used to make preliminary recommendations regarding the selection of an appropriate moisture-susceptibility test. The study will also contribute to the current knowledge on moisture-induced damage and provides a better understanding of the different factors affecting moisture-induced damage. Implementing the findings of this study will help in improving the durability of asphalt pavements and reduce pavement repair costs in region-6 states.

Web links

- Tran-SET's website https://transet.lsu.edu/research-in-progress/

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit our website, LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at transet@lsu.edu.