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RESEARCH PROJECT TITLE
Evaluation of Hot Mix Asphalt Moisture Sensitivity Using the Nottingham Asphalt Test Equipment

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Evaluation of HMA Moisture Sensitivity Using the Nottingham Asphalt Test Equipment

tech transfer summary

Identifying moisture-susceptible pavements can reduce maintenance costs accrued with a poorly performing pavement.

Objectives

- Evaluate the usefulness of the dynamic modulus and flow number tests in moisture-susceptibility evaluation
- Compare the results to those achieved using the AASHTO T 283 test
- Study the effect of different methods of sample conditioning and testing conditions
- Study the variability in the test results

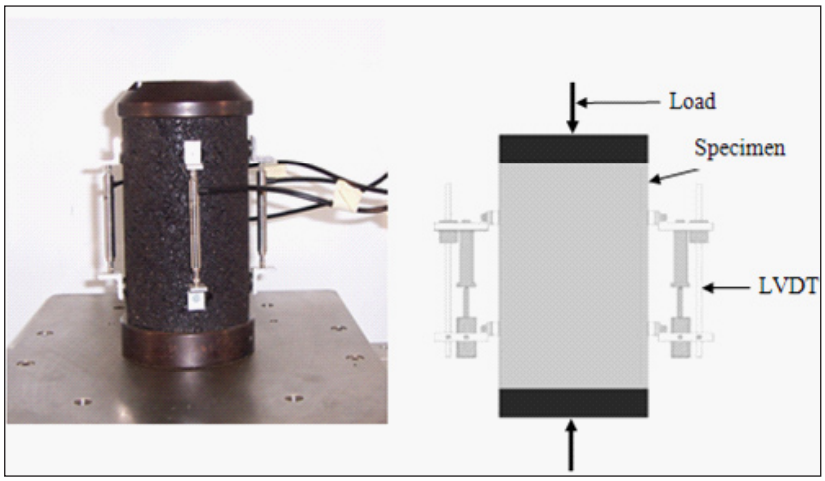
Problem Statement

Moisture damage is a significant problem for flexible pavements. The damaging effect of moisture on pavements, specifically hot mix asphalt (HMA), is a significant environmental distress that should be considered. As a pavement is subjected to a freeze/thaw cycle, the material expands and contracts. During expansion, water can seep into permeable air voids created with the increased volume and can freeze. When the material contracts during thawing, the water can propagate the cracks created during freezing and cause further damage in the next freeze cycle, ultimately weakening the structural strength of the pavement layer. Over time, the repetition of the freeze/thaw cycle deteriorates the pavement and can lead to mix instability and road damage, such as ruts, if the moisture-susceptible mix is below the surface mix. Surface mixes that are susceptible to moisture damage can experience raveling. Identifying pavements susceptible to moisture damage and the effects of moisture damage on the life of pavement can reduce maintenance costs accrued with the placement of a poorly performing HMA.

Deteriorated asphalt pavement

Technique Description

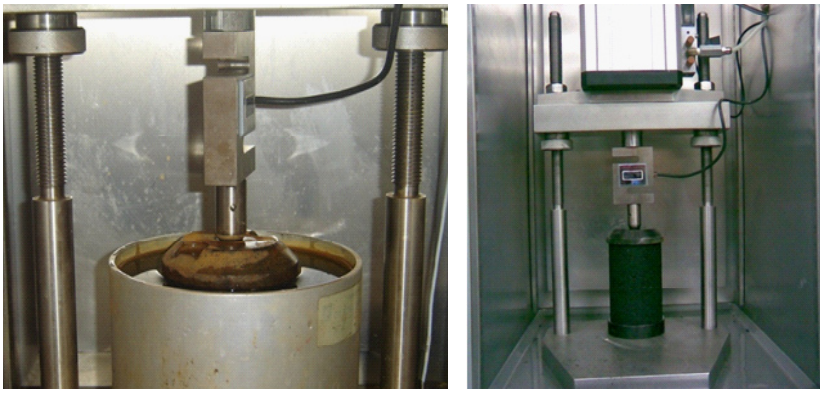
Dynamic modulus and flow number testing results are used to identify moisture-susceptible mixtures in comparison to AASHTO T 283 test results. The capacity of these tests to identify moisture-susceptible mixes is especially evident when examining dynamic modulus test results at higher temperatures and lower test frequencies. The m parameter, a coefficient derived from the Ohio State model that describes flow number testing, is also beneficial for identifying moisture-susceptible mixtures.



Dynamic modulus test setup

Key Findings

- The dynamic test is sensitive to the effect of moisture on the mixture. The extent by which the dynamic modulus value is affected due to the moisture conditioning is impacted by the temperature and the loading frequency, which means that the effect of moisture varies by the loading conditions.
- For the dynamic modulus results, the effect of moisture appears more with higher temperatures and/or lower frequencies.
- For best results, the dynamic modulus test results need to be combined either with information about the conditions at which the mix is going to be used or with a tool that helps visualize the effect of temperature over a range of temperatures and frequencies.
- Plotting a master curve provides a good tool to visualize the effect of moisture on the mix.
- All the parameters evaluated from the flow number test results gave mixed results, except for the parameter m, which provided consistent results.
- There is no evidence of a statistical difference between the ratios calculated using the average dynamic modulus values (E*) and the indirect tensile test when compared to parameter m.
- The different conditioning schemes used in conjunction with the flow number test showed no evidence of statistical difference. The effect of the different conditioning schemes of the mixes on the flow number results varied from one mix to the other, and this variability makes them inconclusive. These results can be attributed to the variability of the flow number test. Alternative methods of examining flow number data need to be considered, such as accumulated strain at a prescribed number of load cycles.



Flow number test setup

Implementation Benefits

By comparing asphalt mixture test results for samples that have undergone dynamic modulus testing with and without freeze/thaw cycling, moisture-susceptible mixtures can be identified more accurately than with other tests.

Implementation Readiness

The results of this research are ready for implementation. However, dynamic modulus and flow number testing equipment is relatively expensive, and expertise in conducting the tests and the associated analysis is needed. Thus, implementing the outcomes of this study should be limited to specialty mixtures or high-volume mixtures.