Cost-Effective Detection and Repair of Moisture Damage in Pavements

Evaluating existing non-destructive methods in order to detect stripping and moisture-induced damage in pavements

Highlight | Jan. 2019

Project No. 18PLSU15

PI: Dr. Mostafa Elseifi (LSU)

POP: March 2018 – November 2019

Moisture damage is a significant distress that affects the overall performance of asphalt pavements in Louisiana. To ensure adequate long-term pavement performance against moisture damage, methods of early detection and repair are critically needed as moisture damage only appears at the surface after detrimental damage has already progressed in the underlying pavement layers. The objective of this research is twofold. First, the researchers will evaluate existing Ground Penetrating Radar (GPR), Rolling Wheel Deflectometer (RWD), and Traffic Speed Deflectometer (TSD) data in order to detect stripping and moisture-induced damage in pavements. In addition, the researchers will evaluate test methods that may identify top-down cracking without coring. Second, the researchers will analyze the performance and cost-effectiveness of treatment methods against moisture-induced damage. Maintenance and rehabilitation methods will include overlay of stripped pavements with and without removal, chip seal, and microsurfacing. Performance of past projects as depicted from Pavement Management System (PMS) data will be used to assess the effectiveness of these techniques.

Background

Moisture damage is a significant distress that affects the overall performance of asphalt pavements in Louisiana. The effect of moisture-induced damage on asphalt pavements is manifested in the roadway through stripping and poor durability of the mixes. Moisture-induced damage in pavements has detrimental consequences on the long-term performance, durability, and user safety. To ensure adequate long-term pavement performance against moisture damage, methods of early detection and repair are critically needed as moisture damage only appears at the surface after detrimental damage has already progressed in the underlying pavement layers. The conventional method to detect stripping and moisture damage is through core extraction, which is destructive, time-consuming, and is rarely conducted. Therefore, moisture-induced damage is rarely addressed during pavement preservation activities, which may result in loss of state funds due to unsatisfactory performance after repair. Ground Penetrating Radar (GPR) and Falling Weight Deflectometer are nondestructive evaluation (NDE) techniques, which have been applied to assess as-built conditions and to evaluate damage and deterioration that develops over time. They can also be used to measure layer thicknesses and to detect moisture-induced damage in pavements. TxDOT investigated the ability of GPR to detect stripping in the asphalt pavement layers. Researchers in Texas were able to detect stripping in the asphalt pavement layers using GPR where the deterioration was at a moderate to severe level. The study found that asphalt pavement sections with stripping had higher moisture contents or higher air voids, or both; which resulted in an anomalous change in the dielectric constants of the stripped layers. The authors also noted that intermittent negative peaks within the surface layer in a GPR scan is typically an indication of the presence of stripping in the asphalt pavement layers.

Project Summary

The objective of this research is twofold. First, the researchers will evaluate existing GPR, Rolling Wheel Deflectometer (RWD), and Traffic Speed Deflectometer (TSD) data in order to detect stripping and moisture-induced damage in pavements. In addition, the researchers will evaluate test methods including GPR and that may identify top-down cracking without coring. Second, the researchers will analyze the performance and cost-effectiveness of treatment methods against moisture-induced damage. Maintenance and rehabilitation methods will include overlay of stripped pavements with and without removal, chip seal, and microsurfacing. Performance of past projects as depicted from Pavement Management System (PMS) data will be used to assess the effectiveness of these techniques. Based on the results of this evaluation, the research team will develop a detection testing protocol for moisture-induced damage and will recommend cost-effective

maintenance and rehabilitation strategies to repair stripped pavements.

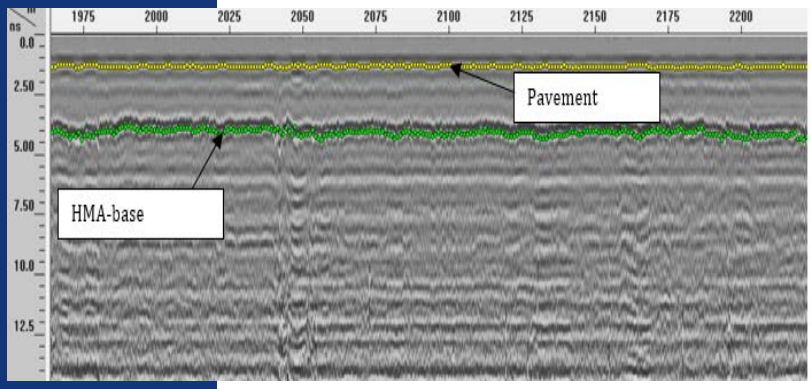

Figure 1. GPR data scan of an asphalt pavement

To achieve the study objectives, the proposed research activities are divided into five research tasks as follows:

Task 1: Literature review of methods of detection and repair of moisture damage in pavements;

Task 2: Review available Pavement Management System (PMS) and GPR data for stripping and top-down/bottom up cracking;

Task 3: Analysis of RWD and TSD measurements for stripping detection and other types of distress;

Task 4: Analysis of PMS data to assess performance and cost-efficiency of pavement maintenance and rehabilitation techniques against moisture damage;

Task 5: Prepare a final report to present the results and recommendations of the study.

Status Update

Guidelines were developed to identify top-down cracking (TDC) in flexible pavements using digital image analysis and the characteristics of these cracks. Past studies indicated that the time after construction of the pavement and location of the cracks are key parameters to identify top-down cracking. The cracks were reported to appear on the wheel path or at the outer edge of the wheel path typically within 3 to 8 years of construction. In-service pavement sections were selected for analysis based on the parameters identified from the literature and computer-vision techniques were employed to investigate the geometric characteristics of these cracks. Based on the results of the analysis, the average crack width was observed to be 3 to 7 mm. With respect to the orientation of the crack, the cracks segments were mostly longitudinal with typical deviation of 20 degrees. The orientation and intensity characteristics of top-down cracks were found as useful features in crack identification.

Figure 2. Successful identification of top-down cracking using digital image analysis

Impacts

This project will research and develop innovative and cost-effective test and treatment methods in order to allow early detection of moisture-induced damage, top-down cracking, and to improve pavement performance against moisture damage. The implementation of the findings will reduce premature failure of pavement preservation activities and will improve the performance and functionality of surface treatments. The results of this research will be used to enhance and to optimize the use of pavement preservation activities in Louisiana and to reduce costs. This research will influence LaDOTD, highway contractors, transportation and civil engineers, and Louisianans in general.

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 Mr. Christopher Melson (Tran-SET Program Manager) directly at transet@lsu.edu.