JOINT TRANSPORTATION RESEARCH PROGRAM

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Subsurface Condition Evaluation for Asphalt Pavement Preservation Treatments

Introduction

Most pavement preservation treatments involve some sort of surface coating to the existing pavement. Pavement surface sealing is one of the main purposes of such a treatment, and results in extended life of the pavement in most of cases. However, in rare cases where the existing pavement is not structurally sound due to high air voids (low density) and stripping of the existing underlying pavement, the surface treatments fail with delamination, potholes, cracks, etc. In addition, the surface treatment can accelerate the stripping process of the underlying pavement layer. For example, the SR-70 section with microsurface in the Vincennes district had several small areas of localized failures due to water stripping underneath the pavement.

According to the INDOT Design Manual, water stripping consists of the debonding of the binder film from the aggregate. Visible signs of water stripping include surface delamination, raveling, pothole, or surface discoloration. Water stripping is an aggregate-dependent distress caused by a combination of heat, pressure, and water. The recommended treatment for stripping is to remove the stripped material by asphalt milling and then overlay the milled surface.

INDOT currently does not have any guideline for evaluating or identifying the potential for high air voids and water stripping on existing asphalt pavements. There is currently a need to develop methods for evaluating subsurface condition of the existing asphalt pavement to assess severity and extent of the physical and mechanical distresses. The method can be used for selecting the right pavement for PPI application.

The primary objectives of this research project were (1) to develop tools for identifying and quantifying the subsurface distresses; (2) to conduct a case study of the SR-70 section with microsurface treatment for understanding its subsurface condition and performance; and (3) to develop a methodology for evaluating the asphalt pavement subsurface condition to determine the applicability of pavement preservation treatments, including seal coat, microsurface, ultrathin bonded wearing course, and 4.75 mm asphalt overlay.

Findings

From the case study, it was found that the main distresses on SR-70 were longitudinal cracks, fatigue cracks, and potholes. The longitudinal cracking was the most widely distributed distress among the three distress types with 22% of lane length in the 2-mile test section. Based on the water stripping test results and the core visual observations, it was confirmed that the test section on SR-70 had the water stripping problem. In addition, overall, there was no subsurface condition difference between left wheel and right wheel paths. In general, based on the laboratory test results, a layer consisted of the micro-surfacing and the asphalt surface course was the poorest condition among asphalt layers in the test section.

In order to have a representative condition indicator for the test section, the conditions were converted into the scores scaled from 0 to 100. Layers with a score closer 100 have the better subsurface condition. Therefore, the 28% of the test section length with the surface distress was detected as the fair subsurface condition with a score of 56. The rest 72% of the length was estimated as the good subsurface condition with 77.8% coverage. Similarly, 20.5% of the test section length with the problem locations determined by GPR had the fair subsurface condition with 56 scores and the rest 79.5% of the length had the good subsurface condition with a score of 76.

A new method for quantifying the water stripping severity was developed based on a software program using the digital image analysis technique. The new measurement method could provide a consistent and rational engineering indicator for the water stripping severity.

The test methods used in this study were evaluated and correlated. The lab test results showed poor correlations among the water stripping severities, air voids, and tensile strengths. Thus, the air voids or tensile strength cannot properly estimate the water stripping severity or vice versa.

When the laboratory test results with the surface distresses or in the GPR-based problem locations were compared to that without the surface distresses or in the GPR-based non-problem locations, in general, average air voids and water stripping severities decrease and average tensile strengths increase. The observation confirms that the evaluation processes are applicable for evaluating the subsurface condition. However, t-test revealed that the laboratory test results, which were conducted with and without the surface distresses, were not significantly different. In contrast, the laboratory results in the GPR-based problem and non-problem locations were significantly different.

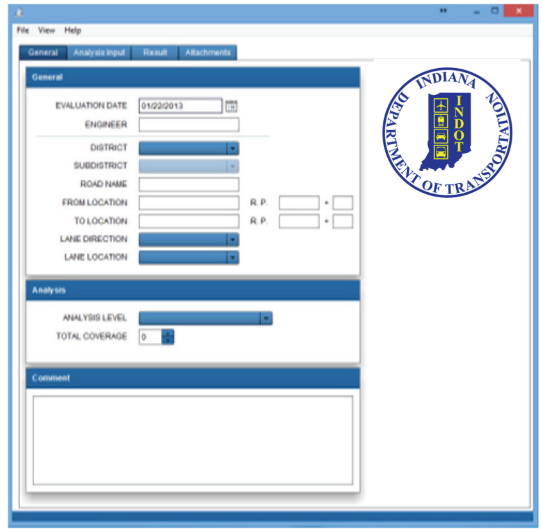
The probability that a location determined to be problematic by GPR to be on one of poor conditions based on lab tests was 1.0. The same probability was obtained for a GPS-based problem location. Accordingly, it was concluded that the laboratory tests with the surface distresses survey or the GPR measurement can be reliable method to evaluate the subsurface condition.

The FWD results had a weak correlation with the laboratory test results possibly due to fairly long testing interval (i.e., 328 ft). The current FWD test protocol should be improved for evaluating the subsurface condition in pavement preservation application.

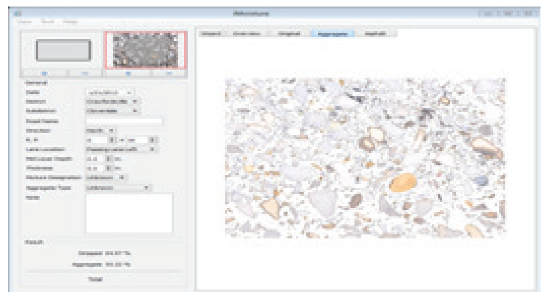
Implementation

Guidelines for subsurface condition evaluation for pavement preservation treatment application was developed utilizing the findings from the case study. A concept of hierarchy was used in the guideline by taking project importance and available resources into consideration. A tool including guidelines, computer software (e.g., iSub and iMoisture), and its manual was also developed based on the methodology as a research product. Based on the guideline, it was concluded that the subsurface condition of the case study section on SR-70 was inadequate for the application of the pavement preservation treatments.

The evaluation tool developed in this study can help achieving a consistent and rational decision making process for project level or district level pavement preservation program. The findings, guidelines, iSub, and iMoisture will be introduced to the INDOT pavement engineers in order to assist them with district level preservation treatment practices. The details in the report and software are intended for reference only, not as specifications or design guidance. In the event that any information presented herein conflicts with the Indiana Design Manual, INDOT's Standard Specifications or other INDOT policy, said policy will take precedence and the software will be managed by the Asset Preservation Engineer so that conflicts do not arise.



iSub: software for evaluating subsurface condition.



iMoisture: software for quantifying water stripping severity in asphalt mixture.

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