JOINT TRANSPORTATION RESEARCH PROGRAM

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Structural Evaluation of Full-Depth Flexible Pavement Using APT

Introduction

Many state agencies around the country have recorded various forms of pavement surface distresses. Among these distresses, permanent deformation, also known as rutting, is one of the most severe types of flexible pavement distress. The fundamentals of rutting behavior for thin full-depth flexible pavements (i.e., asphalt thickness thinner than 12 inches) are investigated in this study. The scope incorporates an experimental study using full-scale accelerated pavement tests (APTs) to monitor the evolution of each pavement's structural layer's transverse profiles. The findings were then employed to verify the local rutting model coefficients used in the current pavement design method, the *Mechanistic-Empirical Pavement Design Guide* (MEPDG).

Methodology

Four APT sections were constructed using two thin, typical pavement structures (seven- and ten-inch thicknesses) and two types of surface course material (dense-graded and SMA). A mid-depth rut monitoring and an automated laser profile system were designed to reconstruct the transverse profiles at each pavement layer interface throughout the process of accelerated pavement deterioration that is produced during the APT. The contributions of each pavement structural layer to rutting and the evolution of layer deformation were derived. This study found that the permanent deformation within full-depth asphalt concrete significantly depends upon the pavement thickness. However, once the pavement reaches sufficient thickness (more than 12.5 inches), increasing the thickness does not significantly affect the permanent deformation. Additionally, for thin full-depth asphalt pavements with a dense-graded Hot Mix Asphalt (HMA) surface course, most pavement rutting is caused by the deformation of the asphalt concrete, with about half of the rutting amount observed within the top 4 inches of the pavement layers and only around 10% of the rutting observed in the subgrade. However, for thin full-depth asphalt pavements with an SMA surface course, most pavement rutting comes from the closet sublayer to the surface, i.e., the intermediate layer.

Findings

In SPR-3307, local MEPDG (version 2.3) rutting prediction coefficients were developed using a database that contains both APT thick full-depth pavement sections and field roadway segments. A particular procedure was followed to verify the accuracy of that MEPDG model on thin full-depth asphalt pavements. This procedure provides the most faithful simulations of the APT conditions using virtual weather station generation, particular traffic configuration, and falling weight deflectometer

Subgrade soil compaction.

evaluation. The accuracy of the MEPDG's prediction models for thin full-depth asphalt pavement was evaluated using some statistical parameters, including bias, the sum of squared error, and the standard error of estimates between the predicted and actual measurements. Based on the statistical analysis (at the 95% confidence level), no significant difference was found between the version 2.3-predicted and measured rutting of total asphalt concrete layer and subgrade for thick and thin pavements. A new version of MEPDG (i.e., Pavement ME Design version 2.6), is available, and INDOT has a plan for the implementation. However, the current local model is not applicable to version 2.6, and a recalibration for the rutting model in version 2.6 is needed. The ongoing study, SPR-4447: *MEPDG Implementation*, performs local calibrations for the version 2.6 implementation. The rutting distributions in terms of pavement layers found in this study will be provided to SPR-4447 for the recalibration process. The INDOT Pavement Design Office will implement the study findings in the pavement design process.

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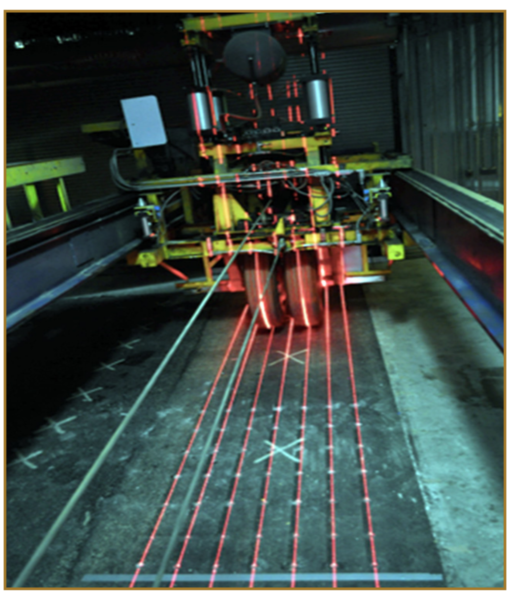

Accelerated pavement testing (APT) machine.

Fabricated holes to monitor the layer deformation.