Kansas Department of Transportation

TECHNICAL SUMMARY

Verification of Mechanistic-Empirical Design Models for Flexible Pavements through Accelerated Pavement Testing

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Introduction

Midwest States Accelerated Pavement Testing Pooled-Fund Program, financed by the highway departments of Kansas, Iowa, and Missouri, has supported an accelerated pavement testing (APT) project to validate several models incorporated in the NCHRP 1-37A design method, popularly known as Mechanistic-Empirical Pavement Design Guide (MEPDG) for flexible pavements.

Project Objective

The following models were investigated: the dynamic modulus estimation model, the relationship between the dynamic modulus and the pavement response; and the relationship between the pavement response (strains) and pavement performance. In addition to these, the experiment aims to compare the performance of the coarse and fine Superpave mixes, and to validate and calibrate the Asphalt Pavement Analyzer (APA) and Hamburg Wheel-Tracking Device Tester (HWTD) as screening tools for estimating rutting performance of Superpave asphalt mixes.

Project Description

The experiments were conducted at the Civil Infrastructure Systems Laboratory at Kansas State University. The test program consisted of constructing 12 flexible pavement structures and subjecting them to full-scale accelerated loading tests. Six pavement sections were tested in a “rutting” experiment conducted at 95ºF and six sections were tested in a “fatigue-cracking” experiment conducted at 68ºF.

Project Results

The experiment found that the revised Witczak model predicts the dynamic modulus of asphalt concrete mixes with reasonable accuracy. The MEPDG structural response model under-predicted the longitudinal strains at the bottom of the asphalt concrete

layers, while the MEPDG over-predicted the permanent deformation in the asphalt layer. The comparison between the results of the laboratory rutting tests performed at 95°F indicate that results of the Hamburg Wheel Rut Test correlate best with results of the APT experiment, followed by those from the APA.

The following recommendations can be made based on the results obtained in this study:

- The MEPDG model for permanent deformation in flexible pavement structures should be calibrated only with insitu data collected on asphalt pavements designed and built after adoption of the Superpave binder specifications and mix design. This is needed since it appears the current nationally calibrated rutting model over-predicts the permanent deformation by a factor of two to three.
- It is recommended that the MEPDG structural response and performance models be further revised, evaluated, and validated with results from a wider spectrum of instrumented APT and in-service pavement sections, since the accuracy of the response model is critical for achieving an efficient design of flexible pavement structures.
- The MEPDG software code should be verified for accuracy since it appears the computed strains are different than the strains computed by the JULEA software.
- The detailed database of material properties and response and performance of full-scale asphalt pavement structures under-accelerated testing assembled in this research should be used for the validation of other models for predicting response and distress in flexible pavements.
- As a screening test, results of the HWTD test are better related to the insitu rutting performance of asphalt mixes than results of the APA. Therefore, HWTD is recommended as a better tool for studying rutting performance of asphalt mixtures.

Project Information

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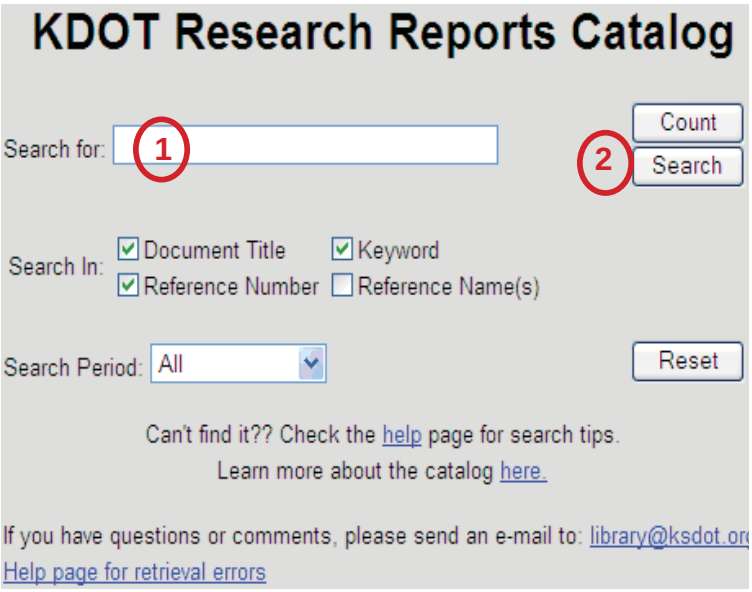

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