RESILIENT MODULUS AND THE FATIGUE PROPERTIES OF THE KANSAS HOT MIX ASPHALT MIXES

Report Number: K-TRAN-KSU-02-6

By: Stefan A. Romanoschi, Ph.D., P.E., Nicoleta I. Dumitru and Octavian Dumitru, ALL with Kansas State University

RESEARCH

Introduction

A new design guide for pavement structures, based on a mechanistic design method, could be adopted by AASHTO in the near future and will replace the current version used by KDOT in the structural design of flexible and rigid pavements. The mechanistic design procedure relates pavement deterioration and thus, pavement life, to the magnitude of stresses and strains developed in the road structure under traffic.

Project Objective

This research study aimed to determine the dynamic modulus, bending stiffness and fatigue properties of four representative Superpave HMA mixtures used in the construction of base layers of Kansas flexible pavements and to compare the measured values with those predicted by the NCHRP Design Guide.

Project Description

To achieve these objectives, asphalt concrete beams were tested in third point-bending at constant strain, at four temperatures and four levels of strain. Dynamic resilient modulus tests were performed on asphalt cylindrical specimens at five temperatures and five loading frequencies. Multi-linear regression analysis was performed to develop a linear relationship between the bending stiffness and the fatigue life for the asphalt mixes tested.

Project Results

It was found that the dynamic modulus is not a good indicator of the fatigue performance of HMA mixes. At all temperatures and strain levels, the mix containing SBS polymer modified binder had a much longer fatigue life while having similar dynamic moduli with those of mixes with unmodified binders. The measured dynamic moduli on all four mixes were, in most cases, more than two times the dynamic moduli predicted by the NCHRP Design Guide. At the same temperatures and at the same loading frequency of 10 Hz, the measured dynamic moduli were more than two times larger than the corresponding bending stiffnesses. The fatigue model incorporated in the NCHRP Design Guide over-predicted the fatigue lives of the mixes with virgin binder and severely under-predicted the fatigue life of the mix with SBS polymer modified binder.

Report Information

For technical information on this report, please contact: Stefan A. Romanoschi, Ph.D., P.E., Kansas State University, 2112 Fiedler Hall, Manhattan, Kansas 66506; Phone: 785-532-1594; fax: 785-532-7717; e-mail: stefan@ksu.edu.

For a copy of the full report, please contact: KDOT Library; 700 SW Harrison Street, Topeka, Kansas 66603-3754; Phone: 785-291-3854; Fax: 785-291-3717; e-mail: library@ksdot.org.