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EVALUATION OF FEASIBILITY OF USING COMPOSITE PAVEMENTS IN FLORIDA BY MEANS OF HEAVY VEHICLE SIMULATOR TESTING

BACKGROUND

The increasing truck weights and tire pressures on our pavements in recent years have pushed the demand on the performance of our pavements to a higher level. Many asphalt pavements have experienced rutting while many others have experienced longitudinal cracking. One of the possible solutions to this problem is the use of whitetopping (WT), which is a concrete layer placed over an existing asphalt pavement. Whitetopping is stronger than asphalt overlay, and thus more resistant to rutting and surface-initiated cracking. Consequently, whitetopping pavements pose potential economical and technical benefits. However, they need to be effectively evaluated for feasibility and proper application techniques, suitable for Florida, so that their use can achieve the maximum benefits to the traveling public.

OBJECTIVES

The main objectives of this research are to (1) develop analytical models to analyze the behavior of WT pavements, (2) evaluate the potential performance of the WT pavement test sections for use under Florida conditions, and (3) assess the applicability of WT techniques for rehabilitation of asphalt pavements in Florida.

FINDINGS AND CONCLUSIONS

A total of nine full-scale and instrumented WT test sections were constructed and tested using a Heavy Vehicle Simulator (HVS). Researchers developed a 3-D finite element model to analyze the behavior of the WT pavement test sections, and then verified and calibrated it using the measured FWD deflections and HVS load-induced strains from the test sections. The model was then used to evaluate the potential performance of these test sections under a typical critical temperature-load condition in Florida.

Six of the WT pavement test sections were constructed to have a bonded concrete-asphalt interface, achieved by milling and cleaning the asphalt surface and spraying it before the placement of concrete. This method produced excellent bonding at the interface, with shear strength of 195 to 220 psi. Three of the test sections were intended to have an unbonded concrete-asphalt interface: a white-pigmented curing compound was sprayed on the surface of the asphalt to act as a debonding agent before the placement of concrete. However, results of Iowa shear test on the cores from these test sections indicated an average shear strength of 119 psi before the HVS loading and 135 psi after the HVS loading. This indicates that partial bonding existed at the interface and that the bonding improved with additional loading on the pavement.

Researchers developed and verified a 3-D finite element model for analyzing WT pavements. They calibrated the model with the measured FWD deflections and HVS load-induced strains. The model then was used to evaluate the potential performance of the nine test sections under a critical temperature-load condition. Maximum tensile stresses in the pavement were computed for the critical condition (1) when a 24-kip single axle load (which is higher than the legal limit of 22 kips in Florida) was placed at the mid-edge of the slab (which is the most critical loading position) and (2) when the temperature differential in the concrete slab was +20 °F (which is a typical severe temperature condition in summer in Florida.)

The maximum computed stresses in the concrete slabs were all below the flexural strength of the concrete for all the 9 test sections. Using the computed maximum stresses in the concrete, the researchers computed the expected numbers of repetitions of the 24-kip single axle loads at the critical thermal condition for the nine test sections. The results show that the 4-inch slabs can be used for heavy (24-kip single axle) loads but only for low-volume traffic condition. The allowable traffic volume increases as the concrete slab thickness increases. In order to be able to withstand the critical load without fear of fatigue failure (for an infinite number of critical load repetitions), a minimum slab thickness of 6 inches would be needed for a joint spacing of 4 ft, and a minimum slab thickness of 8 inches would be needed for a joint spacing of 6 ft.

BENEFITS

The findings from this study have improved the understanding of the behavior and performance of WT pavements under Florida conditions. The researchers developed a reliable and effective tool for analyzing WT pavements. With further testing and verification, this tool will lead to more effective application of WT technologies in Florida.

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