INDOT Research

TECHNICAL *Summary*

Technology Transfer and Project Implementation Information

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Concrete Overlays as a Maintenance Option for Distressed Asphalt Pavements

Introduction

The main objective of this study was to investigate the use of thin concrete overlays as a rehabilitation option for rutted asphalt pavements.

The scope of the research included characterization of the material properties of two concrete mixtures used for construction of the ultra-thin white topping (UTW) and evaluation of state of strains and stresses in the UTW installation exposed to slow moving heavy truck traffic.

The UTW concrete mixture was placed on the milled asphalt surface at the Accelerated Pavement Testing (APT) Facility of the Indiana Department of Transportation (INDOT) Research Division in West Lafayette, Indiana. Four different UTW lanes were constructed utilizing two different thicknesses of the overlay (2.5" and 4") and two different types of concrete (plain and fiber reinforced). The lanes were instrumented with various sensors to measure the strains, deflections and temperature changes in the pavement. The pavement was then subjected to varying wheel loads as well as temperature gradients. The strains and the deflections caused by the wheel load were monitored and the permanent strains and deflections of the pavement were recorded. The ultrasonic pulse velocity test was used in an attempt to detect the potential location of cracks and de-bonded zones in the pavement. In addition, cores were removed from the pavement and tested for shear strength using the Iowa Shear Test Method, to determine the quality of the bond between the overlay and the asphalt surface.

A finite element model was developed to predict the stress response of the composite pavement subjected to the wheel load. This model was used to verify the experimental test results obtained from the accelerated testing of the UTW.

Findings

The following conclusions can be drawn based on the results from this study:

- There was no significant damage to the UTW even after prolonged exposure to heavy slow moving wheel loads and elevated temperature. Overall, judging by the magnitudes of deflections and strains observed in various lanes, it could be concluded that the performance of the UTW was very satisfactory.
- The analysis of variation of strains as a function of the wheel position indicates that the overlay experiences significant stress reversal under the moving load.
- The pavement overlaid with UTW works as a composite section as indicated by the existence of a good bond between the overlay and the asphalt.
- Ultrasonic pulse velocity test is a promising technique that can be used to determine the

areas where potential cracking may have occurred.

- The strain gage installation technique used on this project could be deemed satisfactory as seen from the low failure rates and the consistency of the readings over the whole period of the test. In addition, the concrete placement and curing techniques were satisfactory.
- Finite element modeling has proven to be a very useful tool for analysis of the complex state of stresses and strains that develop in a pavement under the wheel loads.

Implementation

The results of this investigation indicate that thin concrete overlays could be used as an effective rehabilitation technique to repair rutted asphalt pavements. However, before this technique can be widely implemented, field tests must be conducted and the pavement performance must be monitored over a sufficiently extended period to determine the effects of environmental conditions on the UTW installation.

Although the results of the current accelerated test can be used to develop preliminary design guidelines for the construction of the UTW overlays more extensive research needs to be conducted to develop a robust design methods. Specifically, there is a need to generate more data (through accelerated as well as field installations) that can help to develop empirical model for UTW performance prediction. Advanced finite element modeling of UTW pavements would provide further insight into the complex stresses that develop in the overlay under the moving wheel loads and help with selection of the optimum thickness and joint spacing.

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