Project Summary

Texas Department of Transportation

0-5482: Concrete Pavement Overlays over Existing Asphalt Pavement Structures

Background

Whitetopping is a pavement system of portland cement concrete (PCC) placed on hot mix asphalt concrete (HMAC) pavement. Whitetopping is used to address distresses in asphalt pavement such as rutting and shoving. Three types of whitetopping pavements are commonly used. They are:

- ultra-thin whitetopping (UTW): slab thickness between two to less than four inches,
- thin whitetopping (TWT): slab thickness of four to less than eight inches, and
- conventional white topping: slab thickness of eight inches or more.

Many state agencies, including the Texas Department of Transportation (TxDOT), have used whitetopping overlays and reported positive results. TxDOT developed design standards and special specifications for thin whitetopping. Currently, however, the agency does not have guidelines or design procedures for the rehabilitation of HMAC pavement with whitetopping. Proper design procedures and guidelines for the use of whitetopping will improve the efficiency of TxDOT's operations in rehabilitation of deteriorated HMAC pavements.

What the Researchers Did

Performance of Whitetopping Projects

The performances of several TWT projects in Texas, as well as in other U.S. states, were reviewed to identify variables with significant effects on TWT behavior and performance. In addition, in-depth literature reviews on TWT design procedures from several agencies were conducted.

Development of TWT Design Procedures for TxDOT

Full-scale whitetopping pavement, which consisted of nine 6 by 6 foot panels, was constructed and tested under static and constant cyclic loading for fatigue. The super-accelerated pavement (SAP) testing technique that has been developed at the University of Texas was used in the field. The stationary dynamic deflectometer (SDD) was used to load the full-scale concrete slabs.

In order to develop mechanistic design procedures for whitetopping pavement for TxDOT, the structural analysis program, ISLAB2000, a 2.5-dimensional program, was selected for analysis of the pavement system. A factorial experiment was set up with a number of input variables at different levels that form large inference space anticipated in Texas conditions. This resulted in more than 7,800 cells. Using log-log regression, the results of ISLAB2000 analyses were statistically analyzed to develop reasonable design equations for slab thickness.

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What They Found

Performance of Whitetopping Projects

The performance of several TWT projects in other states showed some variations in distress types and levels. In some projects, severe corner cracking developed under the wheel paths on the driving lane when the joints were under the wheel paths. In other projects, cracking in the panels on the driving lane near the shoulder was more pronounced. Reflective and load related cracking was common on all projects.

The joint spacing has a significant effect on performance as improperly selected joint spacing puts joints directly under the wheel path, causing corner cracking. Corner cracking appears to be the primary failure mode, and fatigue cracking is believed to be the primary cracking mechanism.

Development of TWT Design Procedures for TxDOT

All test panels in full-scale field testing reached fatigue failure under the edge loading configuration using the SDD. During fatigue loading, cracks formed at the bottom of loading points first, and propagated to the top surface. The field slabs showed a stress redistribution phenomenon during the crack propagation period. The S-N curve from this study is very close to Thompson and Barenburg's S-N curve after the application of the equivalent fatigue life concept.

The proposed design equation generally produces a little more conservative pavement structures than the current TxDOT design calls for. The current TxDOT design method for TWT does not account for the condition of the existing hot mix asphalt pavement. Rather, the slab thickness is determined solely by the future truck traffic. In addition, the current TxDOT design method for TWT requires truck traffic as input while Transportation Planning and Programming (TPP) provides traffic information in terms of equivalent single-axle load (ESALs). The proposed design equation is more realistic in that it accounts for all the design variables including layer characteristics. It also utilizes ESAL as traffic input. Therefore, the proposed design procedures will provide TxDOT engineers with a more accurate and convenient design tool.

What This Means

Based on the research efforts in this study, the following recommendations are proposed:

- Since several factors of existing asphalt pavement have substantial effects on required TWT thickness, it is recommended that the condition of existing asphalt pavement be evaluated with the falling weight deflectometer (FWD) and/or the dynamic cone penetration (DCP) test and the results be incorporated in TWT design.
- The design procedures developed in this study for thin whitetopping design can be implemented in TxDOT.

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