0-5445: Project Level Performance Database for Rigid Pavements In Texas

Background

TxDOT has the most mileage of continuously reinforced concrete pavement (CRCP) in the United States. Many miles of this pavement are quite old, still serving the state's transportation needs well beyond their intended design lives. Meanwhile, some sections of CRCP experience premature distresses, requiring repairs and rehabilitations. It is important to understand what makes CRCP perform well, and what could cause distresses in CRCP. One objective of this study was to evaluate the overall performance of CRCP in Texas, along with identifying general characteristics of well-performing and poorly-performing CRCP. To improve the accuracy of pavement design procedures, national efforts were made within the last 10 years, which resulted in the development of a Mechanistic-Empirical Pavement Design Guide (MEPDG). The other objective of this study was to collect information needed to calibrate MEPDG to Texas conditions.

What the Researchers Did

Since the only structural distress in CRCP is punchout, surveys were sent to district pavement engineers requesting the information on whether they have punchout distresses. Researchers conducted visual evaluations and observed some punchout repair projects. They evaluated the condition of CRCP slabs taken out due to punchout distress. They paid particular attention to the crack propagation in slabs with punchout distress. To collect information needed for the calibration of MEPDG, researchers first conducted sensitivity analyses of MEPDG using input values typical in Texas. The results showed that in addition to the variables considered to be important in the previous design procedures – concrete strength and traffic level – environmental conditions during the construction as well as concrete material properties other than strength, such as coefficient of thermal expansion and zero stress temperatures, had substantial effects on structural performance of CRCP. Based on the findings, the state was divided into four different regions based on environmental condition, and a total of 27 sections were selected for detailed evaluations. Pavement age, slab thickness, and environmental region were the primary variables for the selection of the test sections. Each section was 1,000 ft long, with a transverse construction joint in the middle. Transverse crack spacing, load transfer efficiency (LTE) at transverse cracks with different spacing, and overall deflections were evaluated. LTE and deflections were measured using the falling weight deflectometer (FWD).

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What They Found

The changes made during the 1980's to improve PCC pavement performance – use of stabilized non-erodible subbase, tied concrete shoulder, and thicker slabs – appear to have improved PCC pavement performance, since no punchouts have been observed in CRCP sections constructed with those improvements. On the other hand, some CRCP sections constructed in the 1960's and 1970's experienced punchouts. Evaluation of concrete slabs taken out due to punchouts revealed that, in a number of repair projects, horizontal cracking was observed at the depth of longitudinal steel. Field LTE data show that LTE values are maintained at almost 100 % for all 27 sections, regardless of pavement age, crack spacing, and testing season. In one project where aggregate interlock was almost completely deteriorated, LTE was maintained high. There is a relatively good correlation between slab thickness and deflections as shown in Figure 1, with the deflections of slabs over 13 in. thick being quite small.

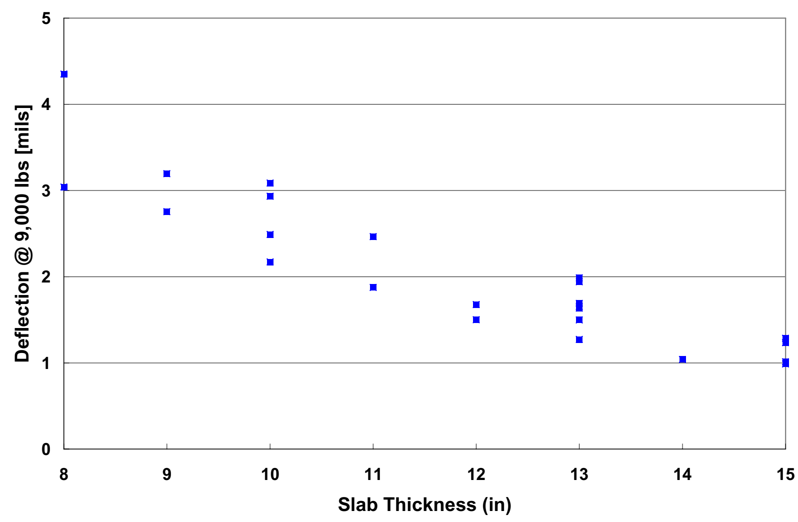

Figure 1. Slab Thickness vs. CRCP Deflections

What This Means

The use of tied-concrete shoulder and stabilized non-erodible subbase along with thicker slabs practically eliminated punchouts by reducing the incidents of pumping, which result in voids underneath the slab. The fact that LTE values were maintained at quite a high level, regardless of pavement age, testing season, and slab thickness, indicates that the current punchout development model – deteriorating LTE over time will lead to punchouts – might need re-thinking. The high LTE value obtained in cracks where aggregate interlock was almost completely deteriorated indicates the contribution of longitudinal steel to LTE. In the punchout development model in MEPDG, the contribution of longitudinal steel to enhancing LTE is not included, which might result in under-estimating the structural capacity of CRCP. The observation of horizontal cracking in a number of punchout repair projects implies the interaction between longitudinal steel and surrounding concrete during the wheel loading applications, which has not been addressed before. A new punchout model is under development in TxDOT research project 0-5832, which will include the findings from this study.

For More Information:

0-5445-1 Mechanistic-Empirical Data Collection Approach for Rigid Pavements

0-5445-2 Analysis of Continuously Reinforced Concrete Pavement Behavior Using Information in the Rigid Pavement Database

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