TEXAS TECH UNIVERSITY
Multidisciplinary Research in Transportation

PROJECT SUMMARY

Texas Department of Transportation

0-6611: Improvements of Partial and Full-Depth Repair Practices for CRCP Distresses

Background

The Texas Department of Transportation (TxDOT) has by far the most continuously reinforced concrete pavement (CRCP) lane miles in the nation, and sections as old as 50 years are still in service. Having served much longer than intended, some sections are showing distresses. Full-depth repair (FDR) is one method used to repair CRCP distresses in Texas. Over the years, various FDR methods have been used, and the effectiveness of each method has varied. The most widely used FDR method—where a full-depth cut is made at 2 ft inside the transverse repair boundaries and a partial-depth cut at repair boundaries with the concrete in between removed to expose longitudinal steel—has inherent disadvantages, with longer repair time required being the primary disadvantage. The full-depth cut FDR method—where a full-depth cut is made at repair boundaries, and transverse and longitudinal tie bars epoxy-grouted into the existing concrete—has the advantage of being a faster operation, minimizing the time of roadway closure. Since CRCP is normally utilized at high-traffic-volume areas, the maximum time allowed for the FDR operation in TxDOT is normally limited to about nine hours, which makes the full-depth cut method the only acceptable repair method. This repair method has been used in Texas since the middle of the 1990s, and its performance has not always been good. Some repaired sections required additional repairs within a few years. FDR of CRCP is quite expensive, in addition to causing traffic delays. There is a strong need to develop an effective FDR method that will ensure long-term good performance.

What the Researchers Did

Researchers evaluated field performance of FDR by visual observations and nondestructive testing with falling weight deflectometer (FWD), with the objective of identifying the causes of a poorly performing FDR. They identified large deflections at repair joints as a primary cause for the poor FDR performance. Next, they conducted laboratory investigations in a test slab of various factors considered to be of a significant effect on deflections at the repair joints. Additionally, field evaluations were conducted of structural responses of repaired sections with various gages installed, including steel strain and concrete vibrating wire strain gages. Researchers then conducted reviews of the TxDOT FDR specifications, design standards, and Departmental Materials Specifications (DMS). Finally, researchers identified a device that can detect delaminations inside the CRCP concrete slab and conducted field testing to evaluate the capability of the device.

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What They Found

The findings from the extensive field and laboratory testing and evaluations can be summarized as follows:

- The primary cause for a poorly performing FDR is the failure to restore structural continuity at transverse repair joints. Common characteristics of poorly performing FDRs were large deflections at transverse repair joints. Poor bond between tie bars and the surrounding concrete at repair joints appears to contribute to these large deflections and poor performance.
- Experiments in a test slab revealed:
  - Keeping the epoxy full in the voids between tie bars and the surrounding concrete in the holes is key to good bond strength between the tie bars and concrete and performance. The requirement of TxDOT Specification Item 361, Full-Depth Repair of Concrete Pavement, that epoxy should be applied in the holes first, followed by the insertion of tie bars, should be positively enforced during FDR.
  - Neither rotary drill nor hammer drill caused significant damage to concrete and resulted in practically the same bond strength. Hammer drill is much faster than rotary drill and will expedite the FDR process.
  - The drilling depth is not a critical element for bond strength, as long as it is greater than 6 inches.
  - Keeping the hole clean positively affects bond strength and shear displacement.
- Field experimentation with steel and concrete strain gages to evaluate stress levels in tie bars and concrete at repair joints indicated:
  - Physical separation occurred between existing and new concretes at a transverse repair joint, which implies that shear stiffness at a repair joint is primarily achieved by tie bars and base support.
  - When tie bars were installed in accordance with specifications and design standards, stresses in tie bars were maintained below the limiting value, which will result in good load transfer and reduced deflections. Reduced deflections will enhance FDR performance.
- A device called MIRA can detect horizontal cracks, mud balls, voids, and reinforcing steel in the concrete with good accuracy.
- A review of Item 361 and DMS 6100, Epoxies and Adhesives, revealed that there are deficiencies in both, and revisions need to be made.

What This Means

Optimum performance of repairs of CRCP distresses can be achieved only when repair operations are conducted strictly in accordance with the requirements in specifications and design standards. Any deviations could result in less than optimum performance, potentially requiring additional subsequent repairs. To enhance the operational efficiency of TxDOT operations on CRCP repairs, periodic training for TxDOT project staff, including maintenance engineers and inspectors, through webinar or other means, on the findings of this study is recommended.

For More Information

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