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Repairs of longitudinal joint separations and their performances

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HIGHLIGHTS

- Three repair strategies were investigated to find economical and effective reinforcement method.
- Performances from seven field projects were discussed.
- Slot stitching is the most cost effective approach to repair wide longitudinal joint separations.

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ABSTRACT

Many miles of CRCP and JCP in Texas suffer distresses due to longitudinal joint separation and slab faulting. The absence or ineffectiveness of tie bars causes larger deflections of concrete slabs and pumping, ultimately resulting in lane separation, cracking and faulting of slabs. In addition to full depth repair, slot stitching, stapling, and cross stitching have been used by districts to repair longitudinal cracks and longitudinal joint separations. Field results indicated that districts have successful experiences with slot stitching and stapling to restore load transfer along longitudinal joint and provide horizontal anchorage to prevent further lane separations. Longitudinal joints that had been repaired with slot stitching did not appear to have suffered any further separation or major faulting. Houston district has utilized stapling in many projects. Some of the stapling projects last for more than 8 years. Condition survey results indicated that the performances vary significantly when different slot filler (or elastomeric) materials were used in stapling projects. Few areas showed poor performance as the filler materials had cracked, spalled, and debonded from the wall of the slot. In some areas, chunks of the filler material had come out of the stapling joints. The cross stitching may be used to repair cracks/separations that are fairly tight. For wider cracks/joint separations and/or faulted slabs, cross stitching is not suitable. Slot stitching with Class P concrete filler material is the most cost effective approach to repair wide longitudinal joint separations. The cost would be double if full depth repair was used instead of slot stitching to repair the wide longitudinal joint separations.

1. Introduction

Over the last 40 years, Texas Department of Transportation (TxDOT) districts have reported longitudinal joint separations and slab faulting in both Continuously Reinforced Concrete Pavement (CRCP) and Jointed Concrete Pavement (JCP), as shown in Fig. 1. The undesirable joint separation at the longitudinal construction joint has often led to further structural deterioration of the pavement. In addition, joint separation and slab faulting creates a safety hazard. Many miles of CRCP and JCP in Texas currently suffer distresses due to the absence or ineffectiveness of tie bars at longitudinal construction joints. The absence or ineffectiveness of tie bars causes larger deflections of concrete slabs and pumping, ultimately resulting in lane separation, cracking and faulting of slabs. It is one of the common types of distresses that stem from joint deficiencies in rigid pavements. Longitudinal joint separation often occurs as a result of a combination of dynamic loading caused by heavy truck traffic and rupturing of tie bars. Fig. 2 shows a rupture of a tie bar in a longitudinal joint. Although the primary purpose of tie bars is to keep the concrete slabs together, their ability to do so is diminished by rupturing and/or corrosion. In addition to tie bar corrosion and rupturing, improper placement of tie bars and the absence of tie bar installation lead to longitudinal joint separation as well.

Results from previous forensic studies indicated that joint separation and slab faulting are associated with either rupture or poor anchoring of the tie bars [2]. Low Load Transfer Efficiency (LTE) values (e.g. less than 40%) are always found in these cases [4]. The LTE was determined from the Falling Weight Deflectometer (FWD) tests. It was reported that poor LTE is one of the main controlling parameters that relates to the longitudinal joint separations and

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Fig. 1. Typical examples of lane separation, faulted and shattered slabs. (A) and (B) Lane separation for IH35. (C) and (D) Faulted JCP slabs on US59-Atlanta district. (E) and (F) Faulted and shatter JCP slabs on US75-Paris district.

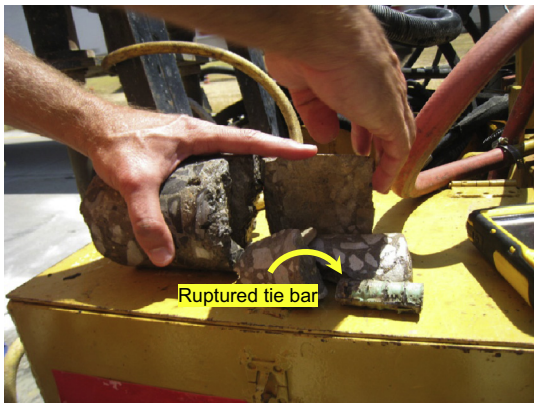

Fig. 2. Ruptured tie bar.

Fig. 3. Void and cracks near the joint.

slab faulting. Field observation indicated that poor LTE and settlement is typically associated with pumping, which creates voids under the joints and concrete slabs, as shown in Fig. 3.

Repairing longitudinal joint separation is imperative for the safety of the travel public and ride quality of roadways. If distressed pavements are not rehabilitated, moisture will easily infiltrate the crack or separation and cause further distresses to the pavement, including cracking, faulting, and settlement. While full depth repair (FDR) was the common repair practice in the past, more economical and effective reinforcement methods such as slot stitching and stapling are being used to restore load capacity across joints and cracks without having to completely remove and replace concrete slabs and its reinforcing steel.

2. Repair methods

In addition to FDR, slot stitching, stapling, and cross stitching have been used by TxDOT to repair longitudinal cracks and longitudinal joint separation [3]. Under research project 0-5444-2, the Center for Transportation Research conducted a lab study to compare these three repair methods [8]. Specimens were constructed