South Dakota Department of Transportation Tie Bar Inspections using Ground Penetrating Radar (GPR)

Jason Smith, PE SDDOT

INTRODUCTION

The South Dakota Department of Transportation (SDDOT) recognizes the importance of designing longer lasting pavements. Therefore, in 2008 SDDOT adopted the use of Ground Penetrating Radar (GPR) to verify the placement of tie bars on their PCCP projects. The process of using the GPR units have allowed the SDDOT to correct the deficient bars that are known to cause problems or a premature failure of pavement.

Figure 1: South Dakota Pavement Before Using GPR

SDDOT has multiple GPR units: One unit is mounted to an ATV mule. This unit allows the technician to drive down the longitudinal joint and record the scan the GPR produces. The scan can be studied later in the office with a Windows friendly software called RADAN.

Another unit is a simple compact push cart. The push cart unit provides the technician more flexibility in pinpointing the location of tie bars.

Figure 2: ATV (LEFT) and Push Cart (RIGHT) GPR Units

2016 Current Criteria

Research was first performed in 2008 with the newly purchased GPR units on 68 Miles of longitudinal joints.

- *Every major concrete project paved in 2008*
- *5 projects from previous construction seasons*
- *Every type of placement – Centerline inserted, side inserted, staked in grade, drilled and epoxy*
- *Every manufacturer of paver and/or tie bar inserter*

This research allowed SDDOT to develop and provide a consistent and fair method of dealing with various contractors and projects throughout the state. The only existing criteria that could be used to identify out of tolerance bars was the industry standard for placement of reinforcement. This would be very restrictive so the current criteria SDDOT is using to identify those tie bars that are out of tolerance and requiring corrective action is as follows:

Standard: Tie bars shall be placed a minimum of 15 inches from any transverse contraction joint
SDDOT: *Tie bars shall be a minimum of 12 inches from any transverse contraction joint. Tie bars within 12 inches of the joint shall be cut full depth. Tie bars that are over dowels and deemed to be too close to the surface will be required to be removed.*

Standard: Tie bars shall be placed T/2 in depth where "T" is the thickness of the slab
SDDOT: *Tie bars less than T/3 in depth have insufficient depth and should have already been cut when the longitudinal joint was sawed to T/3. Tie bars with depth greater than 2T/3 are treated as a non functional bar.*

Standard: Tie bars shall be centered over the longitudinal joint with 15 inches on each side of the joint for normal 30 inch tie bars.
SDDOT: *Tie bars with less than 10 inches of embedment on either side of the joint shall be treated as a non functional bar.*

The above guidelines are significantly less restrictive than the standard industry reinforcing steel tolerances. If a Contractor is having trouble meeting these tolerances, changes to their operation would be needed.

In addition to these guidelines, SDDOT also requires stitching when necessary. Determination of required stitching is based on the number, type, and degree of deficient bars in each panel. The South Dakota Concrete Engineer will make the final decision for stitching based on the potential for future spalling and possible maintenance. SDDOT is continuing to look into to proper tie bar placement tolerances.

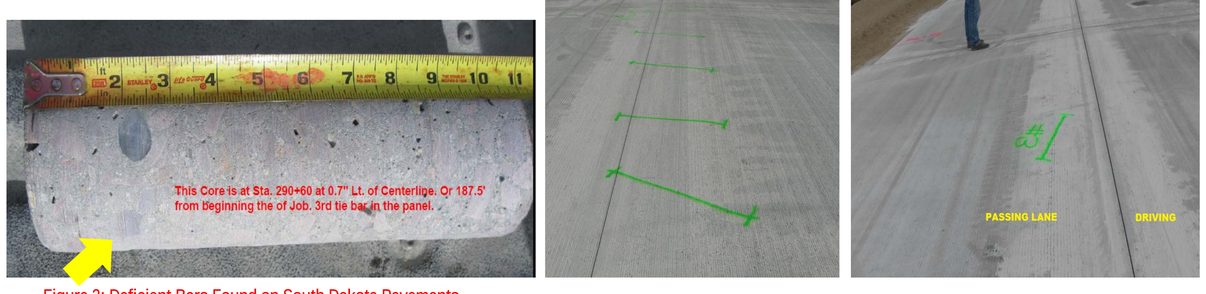

Figure 3: Deficient Bars Found on South Dakota Pavements

GPR IN SOUTH DAKOTA

SDDOT performs GPR scans on all state funded and special requested projects as soon as possible after the contractor has met sufficient distance to produce an efficient scan.

Initial scans allow SDDOT to determine and fix any problems found on the first few concrete placements. If the initial scans look well with little or no discrepancies, no further GPR scans are needed until a final check at the end of the project. However, if it appears the contractor is consistently have problems, more of the project will be GPR scanned until problems are resolved.

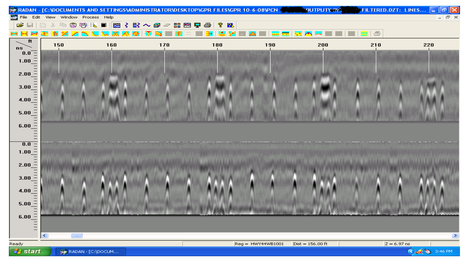

Figure 4: Scan With RANDON

CONCLUSIONS

GPR has allowed SDDOT to improve its PCCP projects by changing various operations. One operation changed was the decision to prohibit tie bar inserter attachments. GPR scans have shown contractors consistently had difficulties with placements during their operations. Therefore, tie bars are now either placed using a "P"-stake setup or a tie bar basket setup.

Figure 5: "P"-Stake Setup (LEFT) and Tie Bar Basket (RIGHT)

All costs related to corrective measures, including but not limited to concrete removal or cutting of reinforcement, price deducts, and delays to the project schedule are the responsibility of the Contractor. Therefore, the use of GPR units not only helps South Dakota with longer pavement life, but also helps its local Contractors.

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