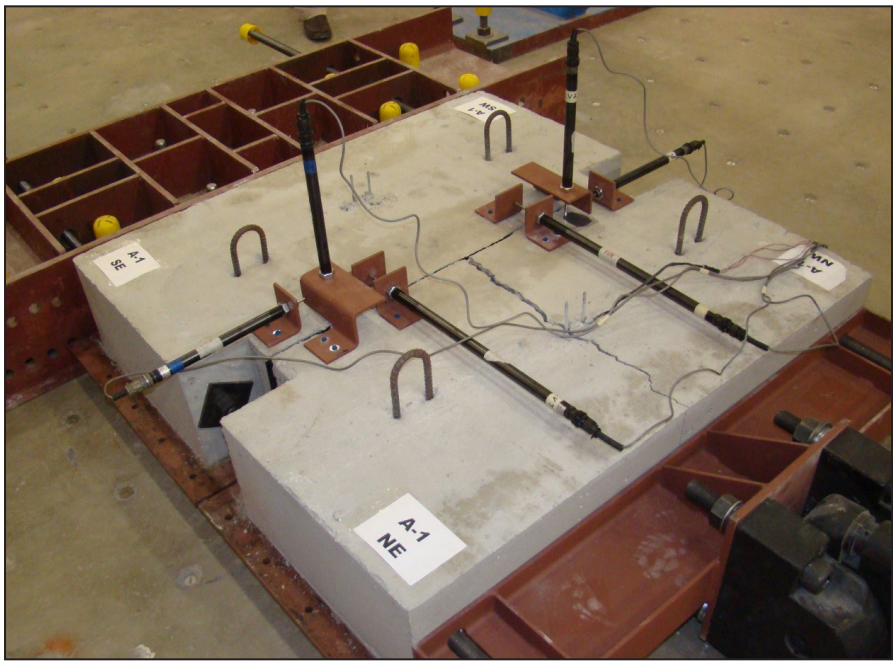
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 20-417 (project 440) | August 2020

Tolerances for Placement of Tie Bars in Portland Cement Concrete Pavement



the **ISSUE**

Longitudinal joints in Portland cement concrete (PCC) pavement slabs require tie (dowel) bars to control joint opening resulting from thermal stresses. Inspections of PCC pavements by the South Dakota Department of Transportation (SDDOT) using ground penetrating radar revealed that it is common for tie bars to be either misplaced or completely missing at some locations. A missing or misplaced tie bar could inhibit the tie bar's ability to provide load transfer across the joint and to prevent excessive joint opening. Misplaced tie bars cause additional maintenance costs and reduced pavement life.

the **RESEARCH**

This research involved two primary tasks to identify current specifications regarding tie bar misalignment tolerances in PCC pavements and to provide recommendations to improve these specifications. These tasks were: 1) conduct a comprehensive literature review and 2) carry out experiments involving several tie-bar misalignment configurations and magnitudes. The literature review includes sources for existing design practices and specifications in addition to the most recent studies about longitudinal joints in PCC pavements. A total of 35 PCC slabs were tested. All slabs had the same concrete mix design, with the only difference among them being the tie-bar misalignment configurations and magnitudes. Three slabs served as controls, having perfectly aligned tie bars. The other 32 slabs incorporated four different misalignment configurations and four different misalignment magnitudes for each misalignment configuration. The misalignment configurations were vertical and longitudinal translations, and vertical and horizontal skews. A direct mechanical tensile force was applied on each specimen. Allowable load, joint opening, and joint faulting were measured to assess the performance of the longitudinal joint.

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Project Title

Tolerances for Placement of Tie Bars in Portland Cement Concrete Pavement

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the FINDINGS

Vertical and longitudinal translation misalignments had no significant effect on the performance of the longitudinal joint. Vertical skew misalignments did not have any significant effect on maximum allowable load or joint opening. Vertical skew misalignments resulted in joint faulting that reached as high as 25 times that of aligned specimens. Horizontal skew misalignments resulted in a decrease in maximum allowable force and an increase in both joint opening and joint faulting. The joint opening limit of 1/8 inch was exceeded at 20 inches of horizontal skew offset. Joint faulting for horizontal skew misaligned specimens reached as much as 35 times that of aligned specimens at an offset of 20 inches. Based on the findings of this study, the research team recommends that the current SDDOT tie-bar tolerance limit for horizontal skew misalignment should be reduced from 18 inches to 16 inches.

the IMPACT

With millions of dollars spent each year on concrete pavement maintenance, the financial impacts of misplaced tie bars could cost SDDOT a substantial amount of money in the long term. This study will help SDDOT set acceptable tie-bar misalignment limits during construction of highway concrete pavement.

For more information on this project, download the entire report at https://www.ugpti.org/resources/reports/details.php?id=993

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.

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