MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 18-364 (project 305) | September 2018

Jointed Plain Concrete Pavement Design and Construction Review

the ISSUE

Inspections of jointed plain concrete (JPC) pavements in South Dakota revealed that once the pavements go through 1 to 2 freeze-thaw cycles, curling and warping start to occur which could lead to uneven surfaces and concrete cracking. To address such deficiencies, a study is needed to optimize JPC pavement design and construction methods.

the RESEARCH

The study included experimental studies of optimized concrete mixtures for JPC pavements and field evaluations of newly constructed JPC pavement sections. Concrete mixtures with reduced cement content and 36 combinations of coarse aggregate types, aggregate top sizes, blending aggregate types, coarse-to-fine aggregate ratios, and water/cementitious materials ratios were tested to develop an optimized mix for use in JPC pavement applications. Freeze-thaw durability, workability (consolidation ability), and mechanical properties of the mixes were measured and evaluated. Four newly constructed JPC pavement sites on South Dakota highways were selected for instrumentation, monitoring, and data collection. The parameters considered in the study included transverse joint sealant type, dowel bar configuration at transverse joints, and amount of curing compound. Three different transverse joint sealing types and two dowel bar configurations were investigated. Select test sections were treated with increased amounts of curing compound. The measured data included the pavement surface strain, transverse joint width, load transfer efficiency, International Roughness Index, and the sub-base moisture content at transverse joints.

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the **FINDINGS**

Pea rock exhibited poor freeze-thaw durability and, therefore, must not be used in concrete mixtures. The use of 1.5" top aggregate size enhanced the workability of the concrete mix. The 65/35 coarse-to-fine aggregate ratio exhibited poor workability. Increasing the curing compound application rate from the normal application rate of 0.67 gal/100 ft^2 to 1 gal/100 ft^2 (1.5 times) resulted in better pavement surface smoothness over time. The moisture ingress at the unsealed and the hot-pour sealed transverse joints was significantly higher than that at the silicone sealed joints. Although the long-term effect of higher moisture ingress was not evaluated in this study, it is believed that higher moisture ingress will lead to increased pumping at the joint. Therefore, it is recommended that SDDOT continue to use silicone sealant for transverse joints.

the **IMPACT**

As a result of the study, two concrete pavement mix designs were developed for SDDOT: one with limestone aggregates and one with quartzite aggregates. The mix designs were designed for optimum workability and durability. The study also resulted in recommendations regarding transverse joint sealing and curing compound application rates for enhanced jointed plain concrete pavement serviceability and longevity.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=922

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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