Research Brief

Wisconsin Highway Research Program
Project 0092-16-01
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Concrete Joint Sawing Practices and Impacts on Durability

Research Objectives

- Investigate concrete joint sawing techniques currently used in Wisconsin
- Assess impacts of these techniques on the durability of the constructed pavement joints
- Recommend best practices for joint sawing to improve durability and performance

Research Benefits

- Determined causes for premature deterioration of joints in young concrete pavements
- Recommended strategies to mitigate joint deterioration and improve joint performance through better sawing timing, technique and equipment

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Background

Wisconsin and other northern states have recently seen premature deterioration in concrete pavement joints. The Wisconsin Department of Transportation (WisDOT) has traced the causes of deterioration to the construction of the joints. Joints are sawn into hours-old concrete pavement to control random cracking. Improper saw timing, equipment and methods can damage the pavement and require high levels of maintenance. The objectives of this research were to evaluate which sawing factors most impact the durability of near-joint concrete and recommend best practices.

Methodology

The researchers inspected and joint-cored five sites to identify the relationship between sawing practices and durability. Two concrete pavement test sections were constructed to assess the impacts of: saw type (conventional versus early-entry); timing of sawing operations; type and quality of the saw blade and equipment; depth of the saw cut; adherence to matching saw blade type with predominant coarse aggregate (northern igneous gravels versus southern limestones); and the application of penetrating sealers to the sawn face.

Laboratory tests were conducted on samples recovered from the joints of each constructed test section, including water absorption, freeze-thaw durability and deicer scaling resistance.

Performing an early-entry saw cut

"This research will help WisDOT improve the long-term performance of concrete joints through optimized saw-cut practices and application of penetrating sealers."

– Myungook (MK) Kang, WisDOT

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Final report is available at:
WisDOT Research website

Results

Sawing early in the timing window using early-entry equipment can cause physical damage to the aggregate and concrete. For limestone mixtures, the damage occurred directly underneath the sawing shoe while, for gravel mixtures, cracks formed immediately outside the shoe.

Absorption was affected by differences in sawing timing, technique and equipment. Old and worn blades produced higher absorption and more variability in all cases than the corresponding joint sawn at the same time with a new blade. The mixture containing igneous gravels had lower absorption than the limestone mixture. Silane treatment of the joints provided significant reduction in absorption.

The test sections showed no significant freeze-thaw deterioration after 300 cycles. Physical damage from early sawing only became distinguishable beyond 500 freeze-thaw cycles.

Surface deicer scaling was not influenced by sawing factors except for some minor raveling at the intersection of the joint face and surface. The gravel mixture performed better than the limestone mixture. The application of a topical silane sealer significantly improved the performance of both. Chloride penetration for the limestone samples was inconclusive, as the limestone aggregate absorbed the deicer salt. However, silane reduced chloride penetration of the granite mixture by 50 percent.

Recommendations for Implementation

Research results indicated that conventional sawing was substantially less sensitive to the variables tested. Results also indicated that the softer (limestone) mixture was more sensitive to sawing variables. The research team recommends discouraging sawing early in the early-entry sawing window. Early-entry sawing equipment should only be allowed on mixtures containing predominantly gravel coarse aggregates and should commence only when the concrete is sufficiently hard enough to prevent marring the surface tining/brooming and minimize raveling, chipping spalling and other pavement damage.

Early-entry saws should have diamond blades with functioning blade guards and be equipped with guides or other devices to control cut alignment and depth. It is not acceptable or appropriate to use one type of saw blade for all cuts. Blades should be selected for the coarse aggregate present and used accordingly, especially for limestone aggregate. Worn blades cause measurable impact to concrete. Contractors should be required to maintain a blade log documenting blade type, depth and distance sawn.

This brief summarizes Project 0092-16-01,
"Joint Sawing Practices and Effects on Durability"
Wisconsin Highway Research Program