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ACI 201.3T-19
TechNote

Joint Deterioration and Chloride-Based Deicing Chemicals

Keywords: calcium oxychloride; critical saturation; deicers; freezing-and-thawing damage; joint deterioration; supplementary cementitious materials.

Question

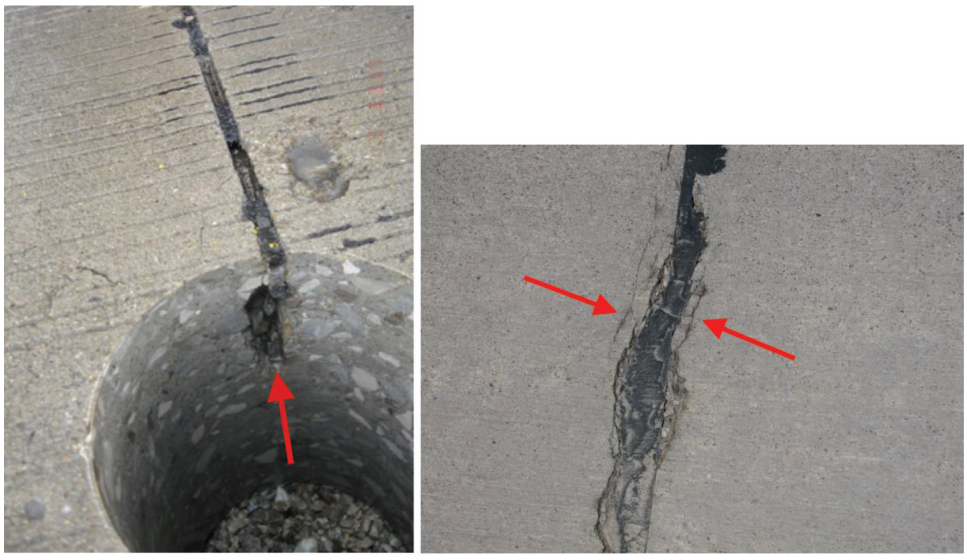
Why do some concrete pavements and concrete flatwork in freezing-and-thawing damage environments show premature deterioration at joints?

Answer

Salt-rich solutions accumulate in joints in pavements, sidewalks, and other flatwork, particularly when the structures are poorly drained. Deterioration can occur as a result of physical and chemical mechanisms that are driven by cyclic wetting and drying of members exposed to chloride-rich solutions. Physical damage is attributed to the concrete reaching critical saturation, which results in freezing-and-thawing damage. The damage related to chemical attack is due to calcium oxychloride formation, which is expansive. This type of deicer attack differs from D-cracking or deicer scaling. Damage manifests primarily as spalling around the walls of the joint and cracking in the concrete parallel to the joint.

Discussion

Concrete pavements and exterior flatwork generally provide excellent performance in all climates and exposures. Concrete durability is an essential component in delivering the return on investment that makes concrete an economical and sustainable material. In recent years, the industry has seen an increase in premature deterioration at joints and saw cuts in concrete pavements and flatwork in areas where winter storm events demand the application of deicing chemicals, which are most commonly chloride-based. The damage most commonly manifests itself in one of two forms. In the first, concrete at the base of the saw cut deteriorates, often producing cracks parallel to joint walls and within 4 to 6 in. (100 to 150 mm) of the original joint (Wiese et al. 2015) (Fig. 1(a)). These cracks should not be confused with D-cracking (ACI 201.2R). In the second form of damage, microcracking along the joint walls causes raveling, where flakes of concrete typically ranging from 1/8 to 1/4 in. (3 to 6 mm) thick are lost from the joint (Wiese et al. 2015) (Fig. 1(b)).



(a) (b)

Fig. 1—Photographs showing: (a) damage at the base of a saw cut (red arrow) that leads to cracks parallel to walls of joint (Arribas-Colón et al. 2012); and (b) flaking of the concrete (red arrow) that presents itself as raveling along a joint (photo courtesy of L. Sutter).