Winter Weather, Deicers Need Not Damage Concrete

Winter weather can take a toll on more than just cars and attitudes. Concrete walks, driveways, and steps take a pounding from both deicing chemicals and the elements. But some simple precautions can prevent damage to concrete this winter.

The most common winter damage to concrete is scaling—the flaking or peeling away of surface mortar. Scaling can leave the concrete's surface pockmarked and expose the stones (coarse aggregate) in the concrete mix. Minor scaling can be merely a cosmetic flaw. But if left unchecked, it can turn a smooth concrete walk into a rustic gravel path.

Scaling is caused by cycles of freezing and thawing. Water is absorbed into very fine capillary spaces in the concrete. When the temperature drops, this absorbed water freezes and expands. Such expansion creates pressure that forces flakes of mortar loose from the surface. As the temperature swings above and below freezing, this process is repeated—in some areas many times throughout winter.

Convincing proof of the improvement in durability effected by air entrainment is shown in these photos taken many years ago at the PCA Skokie, Illinois, test plot. The only difference between these test slabs is that those in the left-hand photo contained 6% entrained air while those in the right-hand photo contained no entrained air. All slabs received 65 applications of salt over a five-year period. Almost all of the non-air-entrained slabs scaled. None of those containing air exhibited any scaling after five winters of severe weather exposure and heavy salting.

Start with Good Concrete

To prevent freeze-thaw damage, use quality materials and sound construction methods. A few considerations in the planning and building stages will ensure durable, scale-resistant concrete.

The best protection against freeze-thaw damage is air-entrained concrete. By purposely incorporating an air-entraining agent into the concrete mix, the hardened concrete will be interspersed with billions of tiny air bubbles (300 to 500 billion per cubic yard of concrete). When water in the concrete freezes and expands, these air voids act as internal pressure-relief valves. The water has room to expand without building up the pressures that cause scaling.

Proper cement content and strength are also important for durable, scale-resistant concrete. Scaling of concrete pavements and other structures can be largely prevented by strict adherence to the following basic requirements: cement content not less than 564 lb per cubic yard (335 kg/m^3); water-cement ratio not more than 0.45 by weight; and 6% entrained air.

Cure the Concrete

After placing and finishing the concrete, cure it. Curing is one of the most important—and most neglected—steps in concrete construction. Concrete hardens through a chemical reaction between cement and water. Curing promotes and prolongs this chemical reaction, dramatically improving concrete's strength and durability. The idea is to keep moisture available, at a favorable temperature, to fuel the chemical reaction. A simple and effective curing method is to cover the concrete with a sheet of polyethylene to keep the slab moist for 5 to 7 days at a temperature of at least 50°F.

After curing, new concrete should be allowed to air-dry for 30 days prior to the first freeze. If this isn't possible, the slab should be sealed to keep out water. Also, refrain from using deicers until the concrete is three months old. Instead, clean off loose snow before it turns to ice. Use sand or another gritty material for firm footing.

The Role of Sealers

Sealers limit the water that is absorbed by the concrete, supposedly reducing scaling. Sealing concrete is popular but often unnecessary. Good-quality, air-entrained concrete won't scale and needs no sealer. Other drawbacks are that sealers can discolor the concrete and they need reapplication periodically. Also, the best ones are expensive.

For existing concrete that shows signs of scaling, however, sealing can be an effective remedy. Many commercial products are available to help protect the concrete from further damage. These surface treatments are usually penetrating sealers made with silane, siloxane, breathable methacrylate, or other materials.

Avoid sealers that prevent water in the concrete from evaporating. These materials may seal the surface of the concrete, but they also can trap moisture that is absorbed from the ground below. Use a sealer that allows the concrete to breath so this moisture can evaporate.

A Word About Deicers

Other winter hazards to concrete come from chemicals used to melt snow and ice. Deicers can increase scaling by increasing freeze-thaw cycles. But a few deicers attack concrete chemically.

Deicers sold as safe for grass and shrubs can chemically attack concrete. These products usually contain ammonium nitrate or ammonium sulfate—fertilizers. They're fine for landscaping but can destroy concrete.

The safest deicers for concrete are also the most common: sodium chloride—rock salt—and calcium chloride. Sodium chloride, however, will damage vegetation and corrode metal. Calcium chloride has little effect on vegetation but promotes rust. Urea, although more expensive and less effective at low temperatures, will not damage plants, metal, or concrete.

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