

## Problem **Rust staining**

Appearance of rust-colored stains on the concrete surface.



Stains from rebar corrosion under a bridge.

### Causes:

**R**ust staining may be an early indication of potentially serious corrosion problems, or it may simply be an aesthetics problem resulting from construction or post-construction processes. Following are some potential causes of rust staining.

**Corrosion.** Usually the first sign of chloride- or carbonation-induced corrosion is the appearance of rust stains on the concrete surface. Although this staining indicates that corrosion has started, it may still be possible to take measures, such as improving drainage or removing sources of chlorides, to prolong the life of the structure.

**Materials.** Aggregates containing forms of iron can corrode over time and cause rust staining on the concrete surface. After the appearance of the stains, popouts may be the next symptom.

### Construction errors.

Contractors can make a number of errors during construction that result in rust stains on the concrete surface. These include:

- Using unprotected chairs or bar supports, an error frequently seen in exposed soffit areas.
- Leaving scraps of metal or tie wire in the forms. If these scraps are close to the concrete surface, staining will result.
- Using unprotected form ties or improperly filling tie holes. When exposed to moisture and oxygen, this unprotected steel can corrode.
- Leaving reinforcing steel protruding from a construction joint for an extended period of time.
- Storing reinforcing steel on a structure during construction or allowing steel scaffolding on a concrete surface to corrode.
- Providing inadequate concrete cover over the rebar.

**Post-construction operations.** After a concrete structure is completed, other events can cause rust staining. Poor drainage detailing can allow rainwater to pass over embedded steel in the concrete. The use of a wire brush to prepare a concrete surface for repair or a coating and the removal of snow with an unprotected plow blade can leave iron particles on the concrete.

### Prevention:

**G**iven the many potential causes for rust staining, it's obvious that no single preventive measure can work for all situations. Here are a few general precautions:

- If the concrete will be used in a corrosive environment, carefully follow the usual recommendations for corrosion prevention.
- If the appearance of the concrete is critical, pay careful attention to design and construction details. Allow for control of rain to

keep water away from any exposed steel. Make sure the aggregate selected has a good service history. Use plastic bar supports or protected steel supports, and be sure to properly fill form-tie holes.

■ Eliminate the potential for staining caused by temporarily exposed reinforcing steel or other steel on the project site.

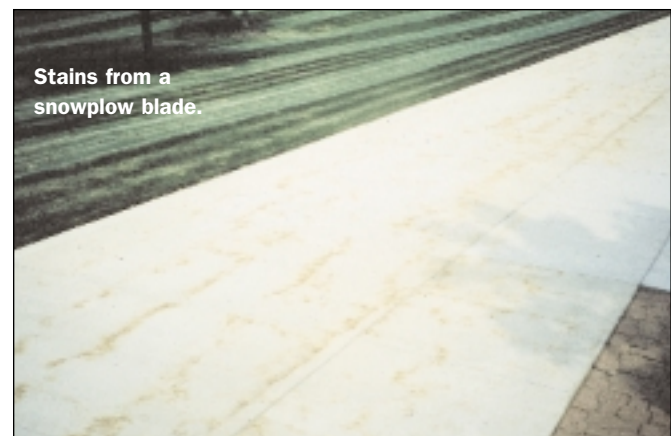
■ After the structure is completed, inform the owner of the potential for rust staining to prevent a simple maintenance procedure, such as snow removal, from ruining the concrete's appearance.

### References

ACI 303R-91, "Guide for Cast-in-Place Architectural Concrete Practice," American Concrete Institute, Farmington Hills, Mich., 1991.

ACI 311.1R-92, *ACI Manual of Concrete Inspection*, 1992.

C.D. Goode, "Weathering of Concrete," *Concrete Construction*, January 1991, pp. 44-54.



Stains from a snowplow blade.