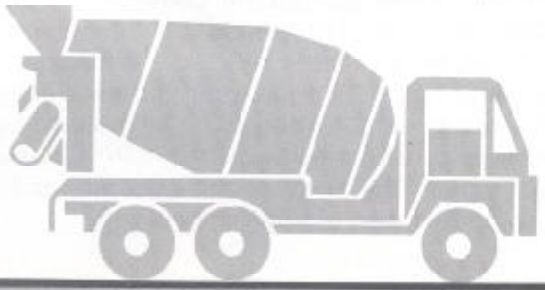

CONCRETE IN PRACTICE

CIP 2

What, Why & How? Scaling Concrete Surfaces

WHAT is Scaling?

When concrete scales from freezing and thawing the finished surface flakes or peels off. Generally it starts as localized small patches which later may merge and extend to expose large areas. Light scaling does not expose the coarse aggregate. Moderate scaling exposes the aggregate and may involve loss of up to 1/8 to 3/8 inch of the surface mortar. In severe scaling more surface has been lost and the aggregate is clearly exposed and stands out.

(Note—Occasionally concrete peels or scales in the absence of freezing and thawing. This type of scaling is not covered in this CIP. Often this is due to the early use of a steel trowel (see reference 6) or finishing while bleed water is on the surface.)

WHY Do Concrete Surfaces Scale?

Concrete slabs exposed to freezing and thawing in the presence of moisture and/or deicing salts are susceptible to scaling. Most scaling is caused by:

a. The use of *non-air-entrained concrete* or too little entrained air. Adequate air entrainment is necessary for protection against freezing and thawing damage. However, even air entrained concrete will scale if other precautions are not observed.

Scaling concrete surface.

b. Appiication of calcium or sodium chloride deicing salts. If other salts such as ammonium sulfate or ammonium nitrate are used they can cause scaling as well as inducing severe chemical attack of the concrete surface.

c. Any finishing operation performed while bleed water is on the surface. If bleed water is worked back into the top ¼ inch of the slab a very high water-cement ratio and, therefore, a low strength top surface layer is produced.

d. Insufficient or no curing. This omission often results in a weak surface skin which will scale if it is exposed to freezing and thawing in the presence of moisture and de-icing salts.

HOW to Prevent Scaling

a. To prevent scaling the use of air-entrained concrete is a must. Severe exposures require air contents of 6 to 7 percent in freshly mixed concrete made with ¾ inch or 1 inch aggregate. In moderate exposures where deicing salts will not be used 4 to 6 percent air will be sufficient. Air-entrained concrete having a low water-cement ratio and moderate slump (up to 5 inches) helps produce a strong wear resistant surface.

b. *DO NOT* use deicing salts, such as calcium or sodium chloride, on new or recently placed concrete. Use clean sand for traction. *Never use ammonium sulfate or ammonium nitrate as a deicer;* these are chemically aggressive and destroy concrete surfaces. Poor drainage which permits water or salt and water to stand on the surface for extended periods of time greatly increases the severity of the exposure and causes scaling. (This is often noticed in gutters and sidewalks where the snow from plowing keeps the surface wet for long periods of time.) Light applications of salts can be more damaging than heavy applications; even salts carried on cars may cause severe scaling of newly placed driveways.

c. Provide proper curing by using liquid membrane curing compound or by covering the surface of freshly placed slab with wet burlap. Curing insures proper combination of cement with water known as hydration which allows the concrete to achieve its highest potential strength.

d. *DO NOT* perform any finishing operations with water present on the surface. Initial screeding must be promptly followed by bull-floating. (Do not use a jitterbug or vibrating screed to work up an excessive layer of mortar on the surface.)

e. Protect concrete from the harsh winter environment. It is important to protect the young concrete from becoming saturated with water prior to freeze and thaw cycles of the winter months. Seal the surface with a 50/50 mixture of boiled linseed oil and mineral spirits or other surface sealer specifically designed for use on slabs on grade. The concrete should be reasonably dry prior to the application of a sealer. Late summer is the ideal time for surface treatment. The sealer can be sprayed on or brushed on the surface of the concrete. *CAUTION:* Linseed oil will darken the color of the concrete and care should be taken to apply it uniformly.

HOW to Repair Scaled Surfaces

The repaired surface will only be as strong as the base surface to which it is bonded. Therefore, the surface to be repaired should be free of dirt, oil or paint and most importantly it must be sound. To accomplish this use a hammer and chisel, sandblasting or jack hammer to remove all weak or unsound material. The clean, rough, textured surface is then ready for a thin bonded resurfacing such as:

a. Portland cement concrete resurfacing
b. Latex modified concrete resurfacing

References

1. "Guide to Durable Concrete," ACI 201.2, ACI Manual of Concrete Practice.
2. "Scaled Concrete," by Fred F. Bartel, Tews Lime and Cement Company, NRMCA.
3. "Problems of Ice Removal from Pavements," by William E. Dickinson, Calcium Chloride Institute, NRMCA Publication No. 98.
4. "Protective Coatings to Prevent Deterioration of Concrete by Deicing Chemicals," National Cooperative Highway Research Program Report No. 16.
5. "Guide for Concrete Floor and Slab Construction," ACI 302.1, Manual of Concrete Practice.
6. "An Unusual Case of Surface Deterioration on a Concrete Brick Deck," by John Ryell, ACI Journal, April 1965.

Follow These Rules to Prevent Scaling

1. For moderate to severe exposures, use air-entrained concrete of medium slump (3-5 in.) and cure properly.
2. If late fall placement cannot be avoided in moderate to severe climates:
   a. Do not use deicers for first winter.
   b. Seal surface with boiled linseed oil.
3. Use correct timing for all finishing operations.
4. Select the proper mix to match placing conditions. Specify air-entrained concrete. Use an accelerator and lower slump in cold weather.

NATIONAL READY MIXED CONCRETE ASSOCIATION

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