

SCALING CONCRETE SURFACES

WHAT is Scaling?

Scaling is local flaking or peeling of a finished surface of hardened concrete as a result of exposure to freezing and thawing. 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 $\frac{1}{8}$ to $\frac{3}{8}$ inch [3 to 10 mm] 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, over-finishing or finishing while bleed water is on the surface. (see CIP 20 on Delaminations)



Scaling concrete 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 required for protection against freezing and thawing damage. However, even air-entrained concrete will scale if other precautions, as listed below, are not observed.
- b. Application of excessive amounts of calcium or sodium chloride deicing salts on concrete with inadequate strength, air entrainment, or curing. Chemicals such as ammonium sulfate or ammonium nitrate, which are components of most fertilizers, can cause scaling as well as induce severe chemical attack on the concrete surface.
- c. Any finishing operation performed while bleed water is on the surface. If bleed water is worked back into the top surface of the slab, a high water-cement ratio and, therefore, a low-strength surface layer is produced. Overworking the surface during finishing will reduce the air content in the surface layer, making it susceptible to scaling in freezing conditions.

- d. Insufficient 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 deicing salts.

HOW to Prevent Scaling

- a. Concrete exposed to freezing and thawing cycles must be air-entrained. Severe exposures require air contents of 6 to 7 percent in freshly mixed concrete made with $\frac{3}{4}$ -inch [19 mm] or 1-inch [25-mm] aggregate. In moderate exposures, where deicing salts will not be used, 4 to 6 percent air will be sufficient. Air-entrained concrete of moderate slump (up to 5 inches [125 mm]) and adequate quality should be used. In general, concrete strength of 3500 psi [24 MPa] for freezing and thawing exposure and 4000 psi [28 MPa] when deicers are used should be adequate to prevent scaling.