Concrete Atlantic béton Atlantique

Concrete Tech-Tip #19

Scaling Concrete Surfaces

What is Scaling?

Scaling of a concrete surface is the peeling or flaking of the finished surface. Scaling most often occurs on concrete exposed to cycles of freezing and thawing, although some concrete surfaces can scale without the effects of freezing and thawing. This type of scaling is found on interior slabs or floors often due to early use of steel trowels or finishing while bleed water is on the concrete surface.

Scaling is mainly encountered on "hand-finished" flatwork:

- Sidewalks
- Driveways
- Slabs consolidated/finished with vibrating screens (less vulnerable but worse at high water-to-cementitious ratios)

Scaling is rarely encountered on formed or slipformed concrete such as barrier walls.

Scaled Concrete Sidewalk

Why Do Concrete Surfaces Scale?

Concrete slabs exposed to freezing and thawing in the presence of moisture and/or de-icing chemicals are susceptible to scaling. Most scaling is caused by:

- The use of non-air-entrained concrete or too little entrained air. Adequate air entertainment is necessary for protection against freezing and thawing damage. However, even air-entrained concrete will scale if other precautions are not observed.
- Using concrete that has low strength
- Using the improper concrete mixture or mixture proportions for the application. Flatwork concrete with high levels of SCMs are prone to scaling.
- Application of excessive amounts of de-icing chemicals, particularly on newly installed concretes that tend to be saturated and of lower strength.
- Any finishing operation performed while bleed water is on the surface. If bleed water is worked back into the top of the slab, a very high water-cementitious ratio and therefore, a low strength surface layer is produced.
- 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 chemicals.

How to Prevent Scaling?

For concrete exposed to cycles of freezing and thawing in the presence of deicing chemicals, the following guidelines should be followed to ensure adequate concrete performance:

- Use high-quality, air-entrained concrete (W/CM ≤ 0.45, Strength ≥ 32 MPa
- Limit the use of SCM's (for hand-finished flatwork)
- Avoid excessive vibration with high slump concrete (e.g. avoid vibrating screeds)
- Provide proper slope for drainage (1% minimum, 2% preferred)
- Do **not** over-finish the surface
- Cure the concrete properly and allow it to dry for at least 1 month before freezing temperatures are expected

Scaling Concrete Surfaces

- When freezing is imminent, protect new concrete from moisture and deicing chemicals
- Avoid using deicers during the first winter (if possible)
- Consider application of breathable sealers

Three Rules to Consider:

1. Use high-quality, air-entrained concrete with adequate strength.
2. Avoid over-finishing, don't work bleed water into the surface, and cure properly.
3. Protect new concrete from freezing, moisture, and deicing chemicals during the first winter.

References

1. CSA A23.1 A23.2 2024. Concrete materials and methods of concrete construction Test methods and standard practices for concrete. CSA Group
2. Design and Control of Concrete Mixtures. 9th Edition. Cement Association of Canada
3. Guide to Durable Concrete, ACI 201.2R, American Concrete Institute, Farmington Hills, MI.
4. Scale-Resistant Concrete Pavements, Portland Cement Association, Skokie, IL.
5. Protective Coatings to Prevent Deterioration of Concrete by Deicing Chemicals, National Cooperative Highway Research Program No. 16.

Disclaimer