



COLORADO READY MIXED CONCRETE ASSOCIATION

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Concrete in Colorado Scaling of Concrete Surfaces

Technical information prepared by:
Colorado Ready Mixed Concrete Association (CRMCA)

SCALING

Scaling is local flaking or peeling of a finished surface of hardened concrete because of exposure to freezing and thawing or improper curing of the surface.



- 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.

Scaling in Colorado

Colorado's severe weather climate creates conditions where moisture is consistently present during freeze-thaw cycles, compelling the use of deicing chemicals.



Concrete exposed to freezing and thawing in the presence of moisture and/or deicing chemicals is susceptible to scaling. Special precautions need to be taken to prevent scaling of concrete surfaces.

TYPICAL CAUSES OF SCALING

- 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, air-entrained concrete will scale if other conditions, as described below, are present.
- The use of concrete with **inadequate strength** or excessively high water to cementitious ratio.
- Adding water to the surface during finishing operations.
- Intentional application or incidental **exposure to deicing chemicals** increases the risk of scaling of concrete surfaces.



- Any **finishing operation performed while water is on the surface**. If water is worked back into the top surface of the slab, a higher water to cementitious ratio, and therefore lower 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. **Steel trowels are not recommended** for use on exterior concrete.
- Any **premature finishing operation** performed before bleeding stops. Especially in the dry Colorado climate, premature finishing may seal the surface and entrap bleed water immediately beneath the finished surface. This weakened subsurface is susceptible to scaling.
- **Insufficient curing**. Fall and winter concrete placements should receive special attention to achieve desired strength prior to exposure to freezing and thawing conditions.

PREVENTION AND LIMITING SCALING

- Specify concrete exposed to freezing and thawing (e.g. driveways, garage floor slabs, curbs, walkways, ramps, patios, porches, steps and stairs).
 - **Maximum water to cementitious ratio of 0.45, minimum 4,500 psi strength at 28 days, with 6.0% ±1.5% air-entrainment.**
- **DO NOT use deicing chemicals on concrete.**
 - Use clean sand for traction.
 - When conditions permit, hose off accumulation of deicing chemicals deposited on concrete surfaces.
 - Do not allow snow and ice to accumulate on concrete, especially during the first winter.
 - Shovel your walk instead of using deicing chemicals. Deicing chemicals can destroy concrete surfaces.
 - Poor drainage, which permits water and deicing chemicals to stand on the surface for extended periods of time, greatly increases the likelihood of scaling. (This is often noticed in gutters and sidewalks where the snow from plowing keeps the surface wet for long periods of time.)
- Provide **proper curing**, immediately after placement. Curing ensures the proper reaction of cement with water, known as hydration, which allows the concrete to achieve its highest potential strength.
- **DO NOT perform any finishing operations with water present on the surface.**
 - Bull floating must promptly follow initial screeding.
 - Avoid overworking the concrete surface which may reduce air-entrainment.
 - Steel trowels are not recommended for use on



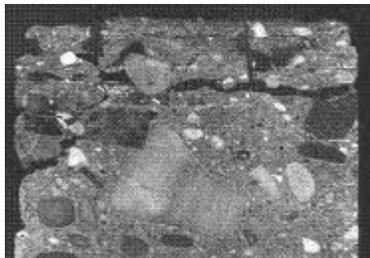
exterior concrete.

- Delay finishing operations until all the bleed water has risen to and disappeared from the surface. This is critical with air-

entrained concrete in dry and windy conditions like **Colorado** where concrete that

is continuing to bleed may appear dry on the surface.

- **Protect concrete from the harsh winter environment.** It is important to prevent concrete from becoming saturated with water prior to freeze and thaw cycles during the winter months.
 - Apply a commercially available silane or siloxane-based breathable, penetrating concrete sealer specifically designed for use on concrete slabs.
 - Follow the manufacturer's recommendations for application procedures and frequency.



Scaling caused by freezing and thawing (www.fhwa.dot.gov)

- 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, brushed, or rolled on the surface of the concrete.

GUIDELINES TO MINIMIZE SCALING POTENTIAL

- Specify the use of air-entrained concrete; typically 4,500 psi strength at 28 days and a maximum water to cementitious ratio of 0.45.
- In cold weather, concrete temperatures when placed should be at least 50°F.
- Specify ACI Flatwork certified finishers. Information on upcoming certifications available at www.crmca.org
- Use correct timing for all finishing operations and do not use steel trowels on exterior concrete slabs.
- **CURE** properly, keeping adequate moisture in the concrete with appropriate temperature control.
- Seal the concrete surface with a commercial-grade sealer, preferable 30 days after placement, following the manufacturer's guidelines.
- Do not use deicing chemicals.

DISCLAIMER

Contact with wet (unhardened) concrete, mortar, cement, or cement mixtures can cause SKIN IRRITATION, SEVERE CHEMICAL BURNS (THIRD-DEGREE), or SERIOUS EYE DAMAGE. Frequent exposure may be associated with irritant and/or allergic contact dermatitis. Wear waterproof gloves, a long-sleeved shirt, full-length trousers, and proper eye protection when working with these materials. If you have to stand in wet concrete, use waterproof boots that are high enough to keep concrete from flowing into them. Wash wet concrete, mortar, cement, or cement mixtures from your skin immediately. Flush eyes with clean water immediately after contact. Indirect contact through clothing can be as serious as direct contact, so promptly rinse out wet concrete, mortar, cement, or cement mixtures from clothing. Seek immediate medical attention if you have persistent or severe discomfort.

REFERENCES:

ACI PRC-201.2-16, Guide to Durable Concrete, American Concrete Institute, Farmington Hills, MI, 2016, https://www.concrete.org/store/201_2-16

CIP 2 Scaling Concrete Surfaces, CIP Series, Concrete In Practice, NRMCA, Silver Spring, MD, www.nrmca.org/.../cip/



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