CONCRETE SASK

TECH TIP #13

www.concretesask.org

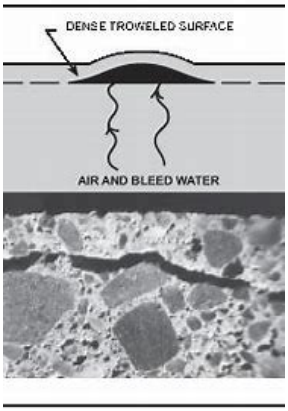
CONCRETE BLISTERS

WHAT are blisters?

Blisters are hollow, low-profile bumps on the concrete surface typically in size of a dime (10mm) up to the size of a quarter (25mm), but occasionally even 50 to 75mm in diameter. A dense troweled skin of mortar about 2mm thick covers an underlying void which moves around under the surface during troweling.

The void forms under a dense surface skin by one of two phenomena: air voids rise in sticky concretes and are trapped under a dense surface skin produced by troweling, or bleed water rises and collects to form a void under this skin. That water is reabsorbed into the underlying concrete leaving a weak layer or irregular void space under the surface which can cause blistering. Frequently, the blister is lined with a faint layer of "washed" sand.

In poorly lighted areas, small blisters may be difficult to see during finishing and may not be detected until they break under traffic.



WHY do blisters form?

Blisters form on the surfaces of fresh concrete surface when either bubbles of entrapped air or bleed water migrate through the concrete and become trapped under the surface which has been sealed prematurely during finishing operations. These defects are not easily repaired after the concrete hardens.

Blisters are more likely to form if:

- Insufficient or excessive vibration is employed. Insufficient vibration prevents entrapped air from being released. Excessive vibration on higher slump concrete, such as caused by vibrating screeds, can work up a thick layer of mortar at the surface.
- An improper tool is used for floating the surface or a correct tool was used improperly. The concrete surface should be tested to determine which tool does not seal the surface. The floating tool, whichever is used, should be kept as flat as possible.
- Excessive evaporation of bleed water occurs, and the concrete appears ready for final finishing while the underlying concrete is still releasing bleed water and entrapped air. The rate of evaporation is affected by the ambient and concrete temperatures, humidity and wind conditions.
- The subgrade is cooler than the concrete and ambient temperature. The top surface sets faster than the underlying concrete. The surface appears ready to be finished while the concrete is still bleeding.
- Entrained air is used or is higher than normal. The rate of bleeding and the amount of bleed water is

- reduced, giving the appearance that the concrete is ready to float and finish.
- Bleed water and entrained air take longer to rise to the surface in thick slabs.
- The concrete mix is sticky from higher cement contents and or excessive fine sand. These mixes bleed less and at slower rates.
- A dry shake hardener is applied prematurely, particularly over air-entrained concrete.
- The concrete is placed on a vapour retarder (poly barrier) or saturated base, preventing bleed water from being absorbed.

How to prevent blisters?

The finisher should be wary of a concrete surface that appears ready for final finishing before it would be normally expected. Emphasis in finishing operations should be on placing, consolidation, strike off and floating the concrete without working up a layer of mortar at the surface. For initial floating, float blades should be flat to avoid densifying the surface.

Subsequent finishing should be delayed, to allow for bleeding and the concrete to achieve set. In high evaporative conditions, the concrete should be covered with either a polyethylene barrier, fog sprays or evaporation retardants.

In cold weather, subgrades should be heated. Concrete temperature should be a minimum of 10°C and contain an accelerating admixture for faster set.

Non-air-entrained concrete should be used for interior slabs. Steel trowelling air-entrained concrete should be avoided. Concrete mixtures should not have a high-water content, high mortar fraction or excessive cement content. Slumps should not exceed 125mm.

Blisters may form during subsequent trowelling due to the inclination of the finishing blades being too much for the concrete conditions. The trowel blades should be flattened to eliminate and rebond the blister areas.

Follow These Rules to Avoid Blisters

- Order the right concrete mix for slabs that need to be hard trowelled.
- Use set accelerating admixtures in concrete when placing in cooler weather.
- Concrete slumps should only be tempered with slump modifying admixtures to aid in placement.
- Do not overwork the concrete surface to trap air or bleed water while the concrete is still plastic. Use a wooden float on non-air-entrained concrete to prevent early sealing.
- Avoid dry shake hardeners on air-entrained concrete.
- Avoid placing concrete on vapour retarders or saturated base.
- Avoid premature finishing.
- Protect surfaces from premature drying and evaporation that results in surface crusting.
- Avoid excessive consolidation on concretes that have slumps exceeding 125mm.
- Air-entrained concretes should not be steel trowelled. If required by specifications, allow bleed water and air to escape before final finishing operations.

References:

1. *CIP 13 – Concrete Blisters*, *CIP 14 – Finishing Concrete Flatwork, CIP 20 – Delamination of Trowelled Concrete Surfaces, NRMCA*
2. *Guide for Concrete Floor and Slab Construction*, ACI 302.1R, American Concrete Institute
3. *Concrete Slab Surface Defects: Causes, Prevention, Repair,* Portland Cement Association
4. *Slabs on Grade, Concrete Craftsman Series CCS-1, American Concrete Institute*
5. *Concrete Slab Surface Defects: Causes, Prevention, Repair IS 177, Portland Cement Association*
6. *CAN CSA A23.1-24/A23.2-24*