Concrete Atlantic béton Atlantique

Concrete Tech-Tip #21

Blisters on Concrete Slabs

What are Blisters on Concrete Slabs?

Blisters are hollow, shallow bumps that form on the concrete surface, typically ranging in size from about 10 mm to 25 mm in diameter, though in some cases they may reach 50 to 75 mm. They are covered by a dense, troweled mortar skin approximately 2 mm thick, beneath which a void exists that can shift under the surface during troweling.

These voids develop beneath the dense surface layer due to one of two mechanisms. In cohesive or sticky concretes, air bubbles rise toward the surface and become trapped beneath a tightly troweled skin. Alternatively, bleed water may migrate upward and accumulate beneath the surface layer. As this bleed water is later reabsorbed into the concrete, it can leave behind a weak zone or irregular void beneath the surface, leading to blister formation. In many cases, the interior of the blister is lined with a thin layer of washed fine aggregate.

In areas with poor lighting, small blisters can be difficult to detect during finishing and may not become apparent until they rupture under service traffic.

Example of concrete blisters

Why Do Blisters Form?

Blisters develop on the surface of fresh concrete when entrapped air or bleed water migrates upward and becomes trapped beneath a surface layer that has been sealed too early during finishing. Once the concrete has hardened, these defects are difficult to repair effectively.

Blistering is more likely to occur under the following conditions.

- Inadequate or excessive vibration. Insufficient vibration prevents entrapped air from escaping, while excessive vibration of higher slump concrete, such as from vibrating screeds, can bring an overly thick mortar layer to the surface.
- Improper selection or use of finishing tools. Floating tools should be chosen and used in a manner that avoids sealing the surface too early. Regardless of the tool used, it should be kept as flat as possible during finishing.
- Rapid evaporation of bleed water. Under high evaporation conditions, the surface may appear ready for finishing even though the underlying concrete is still bleeding and releasing entrapped air. Evaporation rate is influenced by concrete and air temperatures, relative humidity, and wind speed.
- A subgrade that is cooler than the concrete and surrounding air. In this situation, the surface can set faster than the concrete below, giving the false impression that finishing can begin while bleeding is still ongoing.
- Higher than normal air entrainment. Air entrainment reduces the rate and amount of bleeding, which can make the surface appear ready for finishing earlier than it actually is.
- Thick slab placements, where bleed water and entrapped air require more time to reach the surface.
- Sticky concrete mixtures with high cement contents or excessive fine sand. These mixtures bleed less and at slower rates, increasing the risk of premature surface sealing.

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- Premature application of dry shake hardeners, particularly on air entrained concrete.
- Placement of concrete on a vapour retarder or saturated base, which prevents bleed water from being absorbed into the subgrade.

How to Prevent Blisters?

Blistering can be minimized by careful timing and control of finishing operations. Finishers should be cautious of surfaces that appear ready for final finishing earlier than expected. Finishing should focus on proper placement, consolidation, strike off, and initial floating without drawing excess mortar to the surface. During initial floating, blades should be kept flat to avoid prematurely densifying the surface.

Final finishing should be delayed until bleeding has ceased and the concrete has begun to set. Under high evaporation conditions, the surface should be protected using polyethylene sheeting, fogging, or evaporation retardants. In cold weather, subgrades should be heated and concrete temperatures maintained at or above 10°C, with accelerating admixtures used where appropriate to promote timely setting.

For interior slabs, non air entrained concrete is preferred, and steel troweling of air entrained concrete should be avoided. Concrete mixtures should be properly proportioned with moderate water content, limited mortar fraction, and reasonable cement contents, with slumps not exceeding 125 mm.

If blisters form during troweling, the blade angle is often too steep for the concrete condition. Flattening the trowel blades can help collapse and rebond blistered areas before the concrete hardens.

Things to Consider to Avoids Blisters

To reduce the risk of blistering:

- Use a concrete mixture suitable for hard troweled slabs and incorporate set accelerating admixtures when placing in cool weather.
- Adjust workability only with slump modifying admixtures rather than added water.
- Avoid overworking the surface, premature finishing, and excessive consolidation, particularly for concretes with slumps greater than 125 mm.
- Do not apply dry shake hardeners to air entrained concrete, and avoid steel troweling air entrained mixtures unless bleeding and air release are complete.
- Protect surfaces from premature drying, and avoid placing concrete on vapour retarders or saturated bases where possible.

Three Rules to Consider:

1. Use a well-proportioned mix with moderate water, limited mortar, and appropriate cement, avoiding air entrainment for hard-troweled slabs.
2. Time finishing carefully, delaying final troweling until bleeding stops, keeping blades flat, and avoiding overworking the surface.
3. Protect the surface from rapid drying, avoid vapor retarders or saturated bases, and use polyethylene, fogging, or admixtures as needed.

References

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