Concrete Tech Tip
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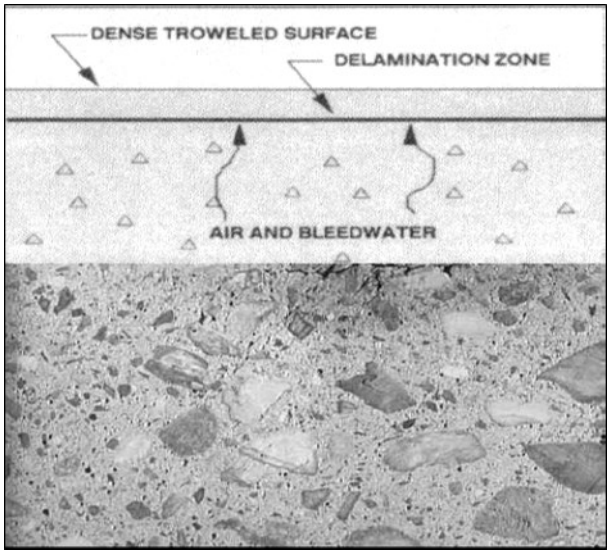
Delamination of Troweled Concrete Surfaces

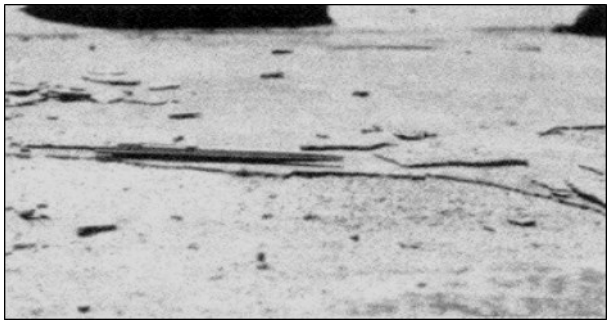
1. WHAT is Delamination?



In a delaminated surface, the top 20mm is densified and separated from the base slab by a thin layer of air or water. The delamination on the surface of a slab may range in size from several square centimeters to many square meters and can be detected by a hollow sound when tapped with a hammer or with a heavy chain drag. Delaminated concrete may exhibit cracking and color differences because of rapid drying of the thin surface during curing. Traffic or freezing may break away the surface in large sheets. They are similar to blisters, but much larger (see CTT-13).

Delamination forms during final troweling. It occurs most frequent in early spring and late fall when concrete is placed on a cool subgrade with rising daytime temperatures, but it can occur at any time.

2. WHY Does Delamination Occur?



Delamination occurs when the fresh concrete surface is sealed by troweling, while the underlying concrete is plastic and bleeding or able to release air. Delamination forms fairly late in the finishing process, after floating and after the first troweling. Rapid evaporation of bleed water, due to surface drying, (wind, sun, or low humidity) makes the surface appear ready to trowel, while the underlying concrete is plastic and can still bleed or release air. Vapour retarders (vapour barriers) under slabs prevent drainage, forcing bleed water to rise and compounding the problem.

Low ambient temperature (less than about 10° C), the use of fly ash and/or chemical retarders will delay initial set of the underlying concrete and subsequently reduce the rate at which bleed water and air move upward which may tempt the finisher to apply the final finish prematurely.

Although entrained air can reduce both bleed water volume and rate, it may promote early finishing which will produce a dense impermeable surface layer. A cool subgrade can delay set in the bottom relative to the top. Air and water can collect under the dense surface layer during finishing.

References:
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3. Concrete Slab Surface Defects: Causes, Prevention, Repair, IS177, Portland Cement Association, Skokie, IL.
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10. CIP#20 Delamination of Troweled Concrete Surfaces, NRMCA, www.nrmca.org with permission.

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Delamination is more likely to form if:

1. The underlying concrete sets slowly because of a cool subgrade.
2. Set is retarded by low ambient temperature, use of retarders and/or fly ash.
3. Entrained air is used (or is higher than normal).
4. Use of a jitterbug or vibrating screed brings too much mortar (or “fat”) to the surface.
5. A dry shake surface hardener is used, particularly with air-entrained concrete.
6. The concrete is sticky from higher cementing material or sand content.
7. The slab is thick – the bleed water has a long distance to travel and setting may not occur evenly throughout.
8. The slab is placed directly on a vapor barrier.

3. HOW to Prevent Delamination

Be wary of a concrete surface that appears to be ready to trowel before it would normally be expected. Emphasis in finishing should be on screeding, straight-edging, and floating the concrete as rapidly as possible - without working up an excessive layer of mortar.

Further finishing should be delayed as long as possible, and the surface covered with polyethylene or otherwise protected from evaporation. In initial floating, the float blades should be flat to avoid densifying the surface too early. Accelerators or heated concrete often prevent delamination in cool weather.

Delamination may be difficult to detect during finishing operations. If delamination is observed, try to flatten the trowel blades or tear the surface with a wood float and delay finishing as long as possible. Any steps that can be taken to slow evaporation, such as erection of sunshades, wind screens or the use of evaporation retarders should help.

If a vapor retarder is required, make sure the subgrade is warm (more than 5oC) and the concrete is designed to minimize bleeding. Do not use air-entrained concrete in floor slabs which have a hard troweled surface or that will not be subject to deicing salts.

Follow These Rules to Avoid Delamination

1. Do not seal surface early – before air or bleed water from below have escaped.
2. Avoid dry shakes on air-entrained concrete.
3. Use heated or accelerated concrete to promote even setting throughout slab depth.
4. Avoid placing concrete directly on vapor retarders, if the application allows.
5. Avoid placing concrete on substrate with a temperature of less than 5oC.
6. Design mix to minimize bleeding.

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