

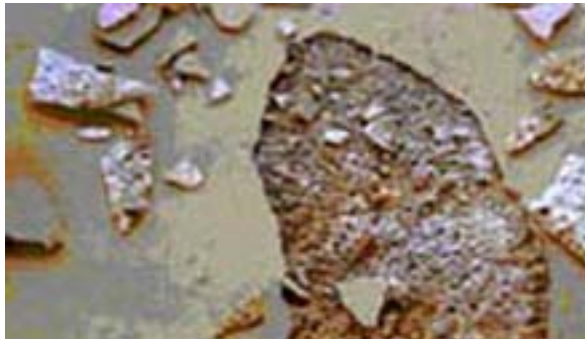
Concrete Delamination

Its Causes and Prevention

INTRODUCTION

Concrete delamination is the separation of the top surface from the underlying concrete. Delamination causes a thin layer (usually about $\frac{1}{8}$ to $\frac{1}{4}$ inch) to flake or blister. Freezing and traffic can worsen the delamination. Concrete that has begun to delaminate can be detected by a hollow sound made when the surface is tapped with a hammer.

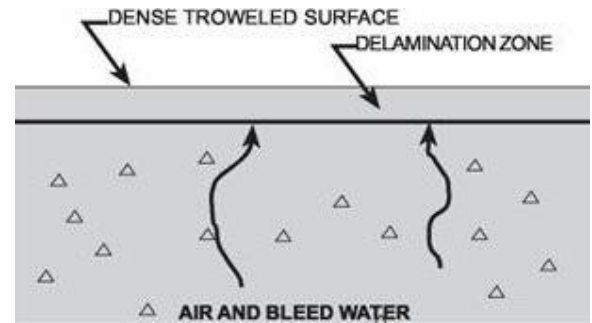
Delamination is usually caused by improper finishing but can also be the result of corroding reinforcing steel near the concrete surface. This newsletter will focus on delamination caused by improper curing and finishing.



CAUSES OF DELAMINATION

Concrete delamination occurs when the top surface of the concrete is densified or sets up before the water in the concrete mixture (the bleed water) and air have a chance to reach the surface. This densified layer is usually thin but it will not allow the air and bleed water to pass to the surface. The dense surface interferes with upward motion of water that results from the settling of solids within the concrete mixture. As the water meets the densified thin layer, it migrates laterally separating the surface from the body of concrete. The dense top film can form when the surface is prematurely troweled.

The problem sometimes occurs when the environmental factors rapidly dry the surface of the concrete. This can include: wind, sun, low humidity, or drying the surface with heaters. This creates conditions making it appear that surface is ready for finishing while the underlying concrete is still plastic and is bleeding air and water. Vapor barriers beneath concrete force all of the bleed water to rise compounding the potential for delamination.



Delamination diagram from NRMCA

Any factor that delays the set of the underlying concrete or promotes rapid surface drying increases the potential for delamination. The National Ready Mix Concrete Association (NCRMA) states the following conditions increase the probability of concrete delamination:

- Slow curing of underlying concrete caused by cool or cold substrates. This condition occurs more frequently in the spring and autumn when soils are cool and the daytime temperature is rising.
- The addition of concrete retarders or cold water to a mix to retard curing.
- High air entrainment levels or air contents higher than necessary.
- Environmental factors causing rapid surface drying making the surface "crust" and appear ready to finish.
- Excessive consolidation of concrete that brings too much mortar to the surface.
- Use of dry shake materials on concrete, particularly with air entrained concrete.
- Placement of thick slabs.
- Placing concrete directly on a vapor barrier.





REPAIRING DELAMINATED CONCRETE

Repairing delaminated concrete can be accomplished but it may be difficult. In some instances, removal and replacement of the delaminated slab may be the preferred method of repair.

Before repairing the concrete, all loose surface material should be removed. The integrity of the surface should be investigated by sounding with a hammer, dragging heavy chains across the surface and listening for a hollow sound, or using more sophisticated techniques such as acoustic impact echo equipment or ground penetrating radar. Scraping, grinding, water blasting, or shot blasting can be used to remove the loose concrete.

A number of topping mixtures are available to refinish the surface including epoxy or acrylic cements. In some instances, it may be possible to grind the remaining concrete to a smooth finish in lieu of applying a new surface. A somewhat reduced lifespan and/or durability should be expected for a repaired concrete surface.

PREVENTING DELAMINATION

In general, delaying the final finishing of concrete surfaces as long as possible helps prevent delamination. This is particularly important if the concrete is placed directly on a vapor barrier. It may be beneficial to cover the surface with polyethylene to prevent evaporation and surface drying until the slab is ready for final finishing. The NRMCA recommends the following measures to avoid delamination:

- Avoid dry shakes on air entrained concrete.
- Use heated concrete or accelerators to promote even setting of concrete throughout the slab.
- Avoid placing concrete directly on vapor barriers.
- Warm the grade beneath the concrete in cool weather. Do not place concrete on grades that are less than 40°F.
- Do not use air entrained concrete for interior slabs that will receive a trowel finish and are not subject to freeze-thaw cycles.
- Do not use steel trowel finishes that produce a dense, impermeable surface.

For more information on geotechnical issues, contact Chuck Brumbaugh P.E., Manager of Geotechnical and Testing Services, or Jeff Kowalski at Gosling Czubak Engineering Sciences, Inc. at (800) 968-1062.

The GCES Construction Monitor is intended to provide discussion and information concerning engineering issues, and is not intended to provide technical or legal advice regarding any specific situation. Readers should consult with an engineer or attorney about specific situations.
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