

CRAZING CONCRETE SURFACES

WHAT is crazing?

Crazing is the development of a network of fine random cracks or fissures on the surface of concrete or mortar caused by shrinkage of the surface layer. These cracks are rarely more than 3 mm deep and are more noticeable on steel troweled surfaces. The irregular hexagonal areas enclosed by the cracks are typically no more than 40 mm across and may be as small as 12 or 20 mm in unusual instances.



Generally, crazing cracks develop at an early age and are apparent the day after placement or at least by the end of the first week. Often, they are not readily visible until the surface has been wet, and it is beginning to dry out. Crazing cracks are sometimes referred to as shallow map or pattern cracking. They do not affect the structural integrity of concrete and rarely do they affect durability or wear resistance. Crazed surfaces can be unsightly, and cracks can be more conspicuous as dirt gets embedded in them.

WHY do concrete surfaces craze?

Concrete surface crazing usually occurs because one or more of good concrete practices were not followed. The most frequent violations are:

- Poor or inadequate curing. Intermittent wet curing and drying or even the delayed application of curing will permit rapid drying of the surface and crazing.
- Too wet a mix, excessive floating, the use of a jitterbug or any other procedures which will depress the coarse aggregate and produce an excessive concentration of cement paste and fines at the surface.
- Finishing while there is bleed water on the surface or the use of a steel trowel, because the smooth surface of the trowel brings up too much water and cement fines. Use of a bull float or darby while bleed water is on the surface will produce a high water-cementitious ratio weak surface layer which will be susceptible to crazing, dusting and other defects.
- Sprinkling cement on the surface, to dry up the bleed water, is a frequent cause of crazing surfaces. This concentrates fines on the surface.
- Occasionally, carbonation of the surface causes crazing. Carbonation is a chemical reaction between cement and carbon dioxide or carbon monoxide from unvented heaters. In such instances the surface will be soft and will dust as well.

How to prevent crazing?

- To prevent crazing start curing the concrete as soon as possible. The surface should be kept wet by either flooding the surface with water or, covering the surface with damp burlap and keeping it continuously moist for a minimum of 3 days or, spraying the surface with a liquid membrane curing compound. Curing retains the moisture required for proper combinations of cement and water. This chemical reaction between cement and water is called hydration.
- Use moderate slump 80 to 100 mm, air-entrained concrete. Higher slumps can be used providing the mixture is designed to produce the required strength without excessive bleeding and/or segregation. Air entrainment helps to reduce the rate of bleeding of fresh concrete and thereby reduces the chance of crazing.
- NEVER sprinkle or trowel dry cement or a mixture of cement and fine sand into the surface of the plastic concrete to absorb bleed water. Remove bleed water by dragging a garden hose across the surface. DO NOT perform any finishing operation while bleed water is present on the surface.
- Dampen the subgrade prior to concrete placement to prevent it absorbing too much water from concrete. If an impervious membrane, such as polyethylene, is required on the subgrade cover it with 25 to 50mm of damp sand to reduce bleeding.

FOLLOW these rules to prevent crazing:

- Use moderate slump 75-125 mm air-entrained concrete. Only slump modifying admixtures should be used to increase workability without losing concrete mix characteristics, will be less susceptible to segregation and will bleed less.
- Place concrete on compactible granular fills to absorb some water from the concrete and reduce bleeding. Moisten the fills only if conditions exist for a high evaporation rate. For interior slabs placed on a vapour retarder, avoid adding water to increase slump.
- FINISH PROPERLY. Remove bleeding water before performing any finishing operation. Sprinkling cement onto the surface to absorb bleed water is a frequent cause of crazing.
- Avoid excessive manipulation of the surface, which can depress the coarse aggregate and increase the cement paste at the surface and increase the water-cementitious ratio at the surface.
- Delay steel troweling until water sheen has disappeared from the surface.
- Start curing as soon as finishing has been completed. The surface should be kept wet by either flooding the surface with water, wet burlap, curing blankets or covering the surface with non-woven geotextile under polyethylene sheeting and keeping it continuously moist for a minimum of 3 to 7 days and maintaining a minimum temperature of 10°C. Curing retains the moisture required for proper combinations of cement and water. This chemical reaction between cement and water is called hydration.
- Avoid alternate wetting and drying of concrete surfaces at an early age. Avoid curing with water that more than 10°C cooler than concrete.

References:

1. *Guide for Concrete Floor and Slab Construction, ACI 302.1R, American Concrete Institute, Farmington Hills, MI.*
2. *Concrete Slab Surface Defects: Causes, Prevention, Repair, IS 177T, Portland Cement Association, Skokie, IL*
3. *Ward Malisch, Avoiding Common Outdoor Flatwork Problems, Concrete Construction, July 1990.*
4. *Ralph Spannenberg, Use the Right Tool at the Right Time, Concrete Construction, May 1996.*
5. *CIP 3: Crazing Concrete Surfaces, National Ready-Mixed Concrete Association*
6. *CAN CSA A23.1-24/A23.2-24*