

Concrete Cracks

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Introduction

Cracks in concrete are extremely common but often misunderstood. Often when someone sees a crack in his slab or wall, especially if the concrete is relatively new, he automatically assumes there's something wrong. This is not always the case. Some types of cracks are inevitable. The best that a contractor can do is to try to control the cracking. This is done by properly preparing the sub-grade, assuring that the concrete is not too wet, utilising reinforcement where needed, and by properly placing and spacing crack control joints and expansion joints. However, sometimes cracks happen despite of the many precautions taken.

The American Concrete Institute addresses this issue in ACI 302.1-04. Even with the best floor designs and

proper construction, it is unrealistic to expect crack-free and curl-free floors. Consequently, every owner should be advised by both the designer and contractor that it is normal to expect some amount of cracking and curling in every project, and that such occurrence does not necessarily reflect adversely on either the adequacy of the floor's design or the quality of its construction".

Major Reasons of Cracking in Fresh Concrete: The following two types of cracks are very much predominant in fresh concrete:

- Plastic Shrinkage Cracking
- Plastic Settlement Cracking

How Plastic Shrinkage Cracks Occur?

Water from fresh concrete can be lost by evaporation, absorption by subgrade, formwork and during hydration process. When the loss of water from surface of concrete is faster than the migration of water from interior to the surface, the surface dries up. This creates moisture gradient which results in surface cracking while concrete is still in plastic condition.

What is Plastic Settlement Cracking

Plastic settlement cracks form while the concrete is still soft and vibrable. The plastic settlement cracks tend to have a regular pattern and occur over reinforcement, particularly in deep members. They may also occur over steps in formwork, such as in a ribbed floor. They may become visible very early even while finishing is proceeding but are often not noticed until some hours after placement. These cracks are different from plastic shrinkage cracks by their distinct pattern which typically mirrors the pattern of the restraining elements such as the reinforcement. They tend to roughly follow the restraining element like reinforcing bars, or changes in the concrete section. They can be quite wide at the surface, tend to extend only to the reinforcement or other restraining element and taper in width to that location.

How it happens

After concrete is placed, the bleeding phenomena, (the solids settle down and the mix water rises to the surface) begins. If there is no restraint, this merely produces a slight lowering of the concrete surface. However, if the concrete is locally restrained from settling (e.g. by a reinforcing bar, duct or insert) while the adjacent concrete continues to settle, there is the potential for a crack to form over the restraining element. It may also lead to a void under the restraining element and where this is reinforcement it may affect the local bond. The amount of settlement tends to be proportional to the depth of concrete, i.e. the deeper the section the greater the settlement. At changes of section, e.g. at a beam/slab junction, the different amount of settlement can lead to cracks forming at the surface.

Influence of Saudi Arabia climate in plastic shrinkage cracks

Plastic Shrinkage cracks are common in Saudi Arabian arid climate, mainly the three regions Eastern, Central and Western region. In summer temperature can be raise to 46°C and in winter drops to 8°C and the average wind speed is around 25 km/h as well as the average relative humidity is 60%. According to ACI 305 nomograph it shows that, the rate of evaporation approaches to >1.5 kg/m²/hr, which shall recommend to take necessary precautions to control Plastic Shrinkage cracks.

The most effective method in Saudi Arabia to reduce Plastic Shrinkage Cracks:

1. Reduce Concrete Temperature
2. Pre-wet formwork and subgrades
3. Use synthetic fibers
4. Install wind breaks or wind shields
5. Either the ambient temperature is >40°C or the wind velocity is >24 km/h, schedule the concrete placement to begin in the evening or night.
6. Use wet burlaps to maintain moisture above slab.
7. Start instant curing after surface finish and moist
8. curing must be continue for at least 7 days.

Simple Technics to Prevent Cracks

Following precautions shall be taken to minimize the plastic shrinkage cracks:

Mainly,

1. Reduce the paste content
2. Reduce the fresh concrete temperature
3. Apply product to reduce evaporation rate of water from top of slab
4. Use fog misters to maintain moisture above slab
5. Pre-wet formwork and subgrades
6. Erect wind screen or sunshades
7. Use synthetic fibers
8. Increase early age tensile strength

Other than these:

1. Schedule the concrete placement to begin either in the evening or night.
2. Finishing shall be carried out as follows:
 - Before bleeding water rising on the surface
 - Screeding
 - Bull floating
 - After all bleeding water has left the concrete surface
 - Floating
 - Troweling

SRMCC strongly recommends to cover the concrete using wet burlaps or white polyethylene sheet between finishing operations. In case cracks appeared while the concrete is still responsive, a vigorous effort should be made to close the cracks by tamping or beating with the float.

Start instant curing after surface finish and moist curing must be continue for at least 7days.

- Wet Burlap
- Bull Floating

Repair of Plastic Shrinkage Cracks

Concrete repair has classified in to two stages as flows according to Cement Concrete Aggregate Australia CCAA,

In pre-hardened concrete

It is preferable to prevent plastic shrinkage cracking or to identify them while the concrete is still plastic and the surface can be re-worked to close the cracks, rather than rely on repair techniques. Surface vibrators can be used to close the cracks over their full depth and the surface finishing can then be completed as specified. Careful timing is essential to ensure the concrete re-

liquefies under the action of the vibrator and that the cracks close fully. Caution needs to be exercised in the use of re- troweling alone since it may just form a skin over the cracks but not close them. If used it must be done as soon as the cracks become evident.



In hardened concrete

Once the concrete has hardened there is little that can be done. If the cracks are not wide at the surface, then it may be best to tolerate them. Where they are of concern for water-tightness or protection of the reinforcement, or 2 mm or wider, the cracks should be filled with a suitable proprietary filler. The object is to ensure that the durability and wear characteristics of the surface are not impaired.

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