

## PLASTIC SHRINKAGE CRACKING

### WHAT is Plastic Shrinkage Cracking?

Plastic shrinkage cracks appear in the surface of fresh concrete soon after it is placed, and while it is still plastic. These cracks appear mostly on horizontal surfaces. They are usually parallel to each other on the order of 1 to 3 feet apart, relatively shallow, and generally do not intersect the perimeter of the slab. Plastic shrinkage cracking is highly likely to occur when high evaporation rates cause the concrete surface to dry out before it has set.

Plastic shrinkage cracks are unsightly but rarely impair the strength or durability of concrete floors and pavements. The development of these cracks can be minimized if appropriate measures are taken prior to and during placing and finishing concrete.

Note: Plastic shrinkage cracks should be distinguished from other early or prehardening cracks caused by settlement of the concrete around reinforcing bars, formwork movement, early age thermal cracking, or differential settlement at a change from a thin to a deep section of concrete.

### WHY Do Plastic Shrinkage Cracks Occur?

Plastic shrinkage cracks are caused by a rapid loss of water from the surface of concrete before it has set. The critical condition exists when the rate of evaporation of surface moisture exceeds the rate at which rising bleed water can replace it. Water receding below the concrete surface forms menisci between the fine particles of cement and aggregate causing a tensile force to develop in the surface layers. If the concrete surface has started to set and has developed sufficient tensile strength to resist the tensile forces, cracks do not form. If the surface dries very rapidly, the concrete may still be plastic, and cracks do not develop at that time; but plastic cracks will surely form as soon as the concrete stiffens a little more. Synthetic fiber reinforcement incorporated in the concrete mixture can help resist the tension when concrete is very weak.

Conditions that cause high evaporation rates from the concrete surface, and thereby increase the possibility of plastic shrinkage cracking, include:



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- Wind velocity in excess of 5 mph
- Low relative humidity
- High ambient and/or concrete temperatures

Small changes in any one of these factors can significantly change the rate of evaporation. ACI 305 (ref. 1) provides a chart to estimate the rate of evaporation and indicates when special precautions might be required. However, the chart isn't infallible because many factors other than rate of evaporation are involved.

Concrete mixtures with an inherent reduced rate of bleeding or quantity of bleed water are susceptible to plastic shrinkage cracking even when evaporation rates are low. Factors that reduce the rate or quantity of bleeding include high cementitious materials content, high fines content, reduced water content, entrained air, high concrete temperature, and thinner sections. Concrete containing silica fume requires particular attention to avoid surface drying during placement.