cracking concrete surfaces

Definition

Concrete, like other construction materials, contracts and expands with changes in moisture content and temperature and deflects depending on load and support conditions. When provisions for these movements are not made in design and construction, then cracks can occur.

Cracks rarely affect the structural integrity of the concrete. Most random individual cracks look bad and although they permit water to enter, they do not lead to progressive deterioration. Closed spaced pattern cracks or D-cracks due to freezing and thawing are an exception and may lead to ultimate deterioration.

Contributing Factors

The majority of concrete cracks usually occur due to improper design and construction practices such as:

1. Omission of isolation and control joints
2. Delay in cutting joints and/or inadequate depth
3. Improper subgrade preparation
4. The use of high slump concrete and or the addition of water at jobsite
5. Improper finishing
6. Inadequate or no curing

How to Prevent or Minimize Cracking

All concrete has a tendency to crack and it is not possible to produce completely crack-free concrete. However, cracking can be reduced and controlled if the following safeguards are followed.

■ **Subgrade and Formwork.** All top soil and soft spots should be removed. Regardless of the type of soil beneath, the slab should be constructed on compacted soil or granular fill, well compacted by rolling, vibrating or tamping. All formwork must be constructed and braced so that it can withstand the pressure of the concrete without movement. Polyethylene vapor barriers increase bleeding and greatly increase cracking of high slump concrete. Cover the vapor barrier with 2-3 inches of damp sand to reduce bleeding. Immediately prior to concrete placement, dampen the subgrade, formwork and the reinforcement.

■ **Concrete.** In general, use concrete with an increased rock to sand ratio, lower cement content, water reducing admixtures and a moderate slump (not over 5 inches). Avoid retempering. If higher slump, up to 7 inches, is to be used, proportions will have to be changed and special mixtures developed to avoid excessive bleeding, segregation and low strength. Specify air-entrained concrete for outdoor slabs that will be subject to freeze-thaw cycles.

■ **Finishing. Do Not** perform finishing operations with water present on the surface. Initial screeding must be promptly followed by bullfloating. If evaporation is excessive, control it by some means to avoid plastic shrinkage cracking (see plastic shrinkage). Cover the concrete with wet burlap or polyethylene sheets between finishing operations.

■ **Curing.** Start during as soon as possible (see curing).

■ **Joints.** Provisions for contraction or expansion movements due to temperature and/or moisture change should be provided with construction of control or contraction joints by sawing, forming or tooling a groove approximately 1/4 the thickness of the slab, no further apart than 30 times the thickness. Often it is necessary to space control joints closer to avoid long thin areas. The length of an area should not exceed 1.5 times the width of the panel. Isolation joints should be provided whenever vertical or horizontal freedom of movement is anticipated; such as where a floor meets walls, columns or footings. Isolations joints are full-depth joints and are constructed by inserting a barrier of some type to prevent the bond between the slab and the other elements.

■ **Cover over reinforcement.** Cracks in reinforced concrete caused by expansion of rust on reinforcing steel should be prevented by providing sufficient cover (at least 2 inches) to keep salt and moisture from contacting the steel.

References

NRMCA CIP 4 (1998). *What, Why and How? Cracking Concrete Surfaces*
National Ready Mixed Concrete Association

NRMCA CIP 6 (1998). *What, Why and How? Joints in Concrete Slabs on Grade*
National Ready Mixed Concrete Association