

Cracking Concrete Surfaces

1. WHAT is Cracking?

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. Some forms of common cracks are:

Figure A - Plastic Shrinkage Cracking
(See CTT-5)

Figure B - Cracks Due to Improper Jointing
(See CTT-6)

Figure C - Cracks Due to Continuous External Restraint (eg: - Cast in place wall restrained along bottom edge of footing)

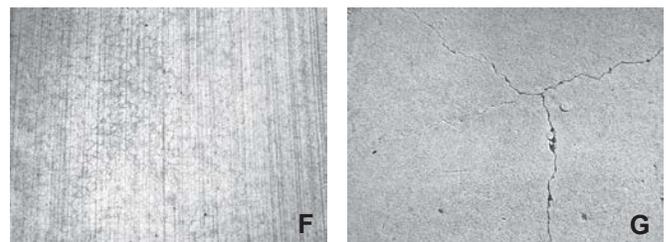
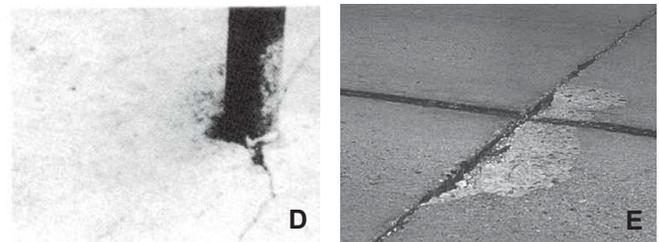
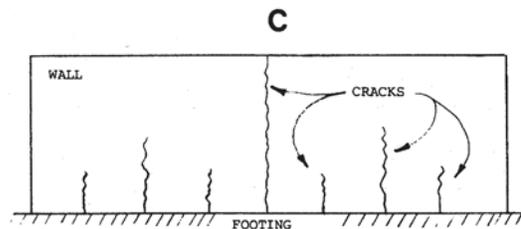
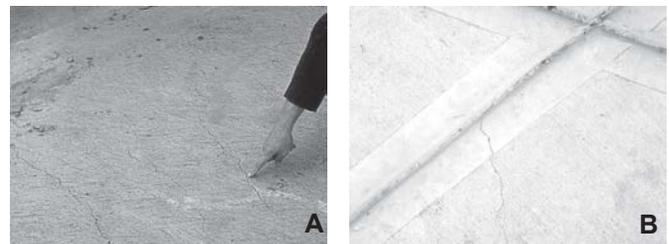
Figure D - Basement Floor Cracks
(See CTT-6)

Figure E - D-Cracks from Freezing and Thawing

Figure F - Craze Cracks (See CTT-3)

Figure G - Settlement Cracks

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



2. WHY Do Concrete Surfaces Crack?

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

- a. Omission of isolation and control joints and improper jointing practices.
- b. Improper subgrade preparation.
- c. The use of high slump concrete or addition of water on the job.
- d. Improper finishing.
- e. Inadequate or no curing.

3. HOW to Prevent or Minimize Cracking

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

- a. *Subgrade and Formwork.* All top soil and soft spots should be removed. Regardless of its type, the soil beneath the slab should be well compacted by rolling, vibrating or tamping. The slab and, therefore, the subgrade should be sloped for proper drainage. Smooth, level sub grades help prevent cracking. 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 25 to 50mm of damp sand to reduce bleeding. Immediately prior to concrete placement, dampen the subgrade, formwork, and the reinforcement.
- b. *Concrete.* In general, use concrete with a moderate slump (not over 100mm). Avoid retempering. If a higher slump 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 **subjected to freezing weather.** (See CTT-2)

- c. *Finishing.* DO NOT perform finishing operations with water present on the surface. Initial screeding must be promptly followed by bull floating. For better traction on exterior surfaces, use a broom finish. If evaporation is excessive, reduce it by some means to avoid plastic shrinkage cracking. Cover the concrete with wet burlap or polyethylene sheets or use a monomolecular film in between finishing operations, if conditions are severe.
- d. *Curing.* Start curing as soon as possible. Spray the surface with liquid membrane curing compound or cover it with damp burlap and keep it moist for at least 3 days. A second application of curing compound the next day is a good quality assurance step.
- e. *Joints.* Provisions for contraction or expansion movements, due to temperature and/or moisture change, should be provided with construction of control joints by sawing, forming or tooling a groove about 1/4 the thickness of the slab, no further apart than 30 times the thickness. Often closer spacing of control joints will be necessary to avoid long thin areas. The length of an area should not exceed about 1.5 times the width. Isolation joints should be provided whenever restriction to freedom of either vertical or horizontal movement is anticipated; such as where floors meet walls, columns, or footings. These are full-depth joints and are constructed by inserting a barrier of some type to prevent bond between the slab and the other elements.
- f. *Cover Over Reinforcement.* Cracks in reinforced concrete caused by expansion of rust on reinforcing steel should be prevented by providing sufficient concrete cover (at least 50mm) to keep salt and moisture from contacting the steel.

Follow These Rules to Minimize Cracking

1. Design the members to handle all anticipated loads.
2. Provide proper control and isolation joints.
3. In slab-on-grade work, prepare a stable subgrade.
4. Place and finish according to established rules.
5. Protect and cure the concrete properly.