Concrete in Practice

What, why & how?

NRMCA

CIP 7 - Cracks in Concrete Basement Walls

WHAT Types of Cracks May Occur?

Cast-in-place concrete basements provide durable, high quality extra living space. At times undesirable cracks occur. They result from:

a. Temperature and drying shrinkage cracks. With few exceptions, newly placed concrete has the largest volume that it will ever have. Shrinkage tendency is increased by excessive drying and/or a significant drop in temperature that can lead to random cracking if steps are not taken to control the location of the cracks by providing control joints. When the footing and wall are placed at different times, the shrinkage rates differ and the footing restrains the shrinkage in the wall causing cracking. Lack of adequate curing practices can also result in cracking.

b. Settlement cracks. These occur from non-uniform support of footings or occasionally from expansive soils.

c. Other structural cracks. In basements these cracks generally occur during backfilling, particularly when heavy equipment gets too close to the walls.

d. Cracks due to lack of joints or improper jointing practices.

WHY do Basement Cracks Occur?

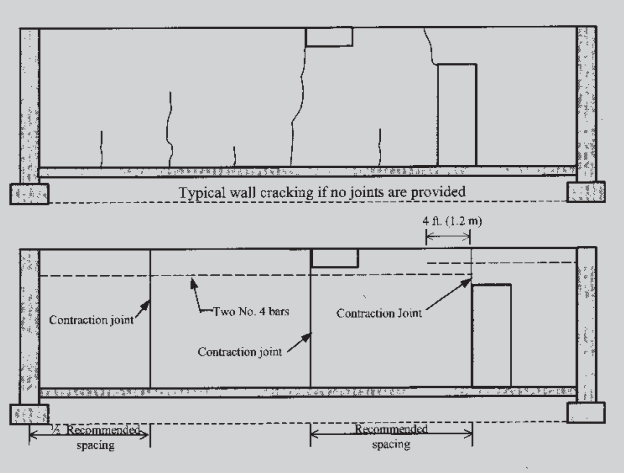
In concrete basement walls some cracking is normal. Most builders or third party providers offer limited warranties for basements. A typical warranty will require repair only when cracks leak or exceed the following:

	Crack Width	Vertical Displacement
Basement Walls	1/8" (3-mm)	–
Basement Floors	3/16" (12-mm)	1/8" (12-mm)
Garage Slabs	1/4" (12-mm)	1/4" (12-mm)

The National Association of Homebuilders requires repair or corrective action when cracks in concrete basements walls allow exterior water to leak into the basement.

If the following practices are followed the cracking is minimized:

a. Uniform soil support is provided.



Typical detail of joints in basement walls

b. Concrete is placed at a moderate slump - up to about 5 inches (125 mm) and excessive water is not added at the jobsite prior to placement.

c. Proper construction practices are followed.

d. Control joints are provided every 20 to 30 feet (6 to 9 m).

e. Backfilling is done carefully and, if possible, waiting until the first floor is in place in cold weather. Concrete gains strength at a slower rate in cold weather.

f. Proper curing practices are followed.

How to Construct Quality Basements?

Since the performance of concrete basements is affected by climate conditions, unusual loads, materials quality and workmanship, care should always be exercised in their design and construction. The following steps should be followed:

a. **Site conditions and excavation**. Soil investigation should be thorough enough to insure design and construction of foundations suited to the building site. The excavation should be to the level of the bottom of the footing. The soil or granular fill beneath the entire area of the basement should be well compacted by rolling, vibrating or tamping. Footings must bear on undisturbed soil.

b. **Formwork and reinforcement**. All formwork must be constructed and braced so that it can withstand the pressure of the plastic concrete. Reinforcement is effective in controlling shrinkage cracks and is especially beneficial where uneven side pressures against the walls may be expected. Observe state and local codes and guidelines for wall thickness and reinforcement.

c. **Joints**. Shrinkage and temperature cracking of basement walls can be controlled by means of properly located and formed joints. As a rule of thumb, in 8-ft. (2.5-m) high and 8-inch (200-mm) thick walls, vertical control joints should be provided at a spacing of about 30 times the wall thickness. These wall joints can be formed by nailing a 3/4-inch (20-mm) thick strip of wood, metal, plastic or rubber, beveled from 3/4 to 1/2 inch (20 to 12-mm) in width, to the inside of both interior and exterior wall forms. The depth of the grooves should be at least 1/4 the wall thickness. After the removal, the grooves should be caulked with a good quality joint filler. For large volume pours or with abrupt changes in wall thickness, bonded construction joints should be planned before construction. The construction joints may be horizontal or vertical. Wall reinforcement continues through a construction joint.

d. **Concrete**. In general, use concrete with a moderate slump up to 5 inches (125-mm). Avoid retempering with water prior to placing concrete. Concrete with a higher slump may be used providing the mixture is specifically designed to produce the required strength without excessive bleeding and/or segregation. Water reducing admixtures can be used for this purpose. In areas where the weather is severe and walls may be exposed to moisture and freezing temperatures air entrained concrete should be used.

e. **Placement and curing**. Place concrete in a continuous operation to avoid cold joints. If concrete tends to bleed and segregate a lower slump should be used and the concrete placed in the form every 20 or 30 feet around the perimeter of the wall. Higher slump concretes that do not bleed or segregate will flow horizontally for long distances and reduce the number of required points of access to the form. Curing should start immediately after finishing. Forms should be left in place five to seven days or as long as possible. If forms are removed after one day some premature

drying can result at the surface of the concrete wall and may cause cracking. In general, the application of a liquid membrane-forming curing compound or insulated blankets immediately after removal of forms will help prevent drying and will provide better surface durability. (See CIP 11 on Curing). During cold weather, forms may be insulated or temporarily covered with insulating materials to conserve heat from hydration and avoid the use of an external source of heat. (See CIP 27 on Cold Weather Concreting). During hot dry weather, forms should be covered. Wet burlap, liquid membrane-forming curing compound sprayed at the required coverage or draping applied as soon as possible after the forms are removed. (See CIP 12 on Hot Weather Concreting).

f. **Waterproofing and drainage**. Spray or paint the exterior of walls with damp proofing materials or use waterproof membranes. Provide foundation drainage by installing drain tiles or plastic pipes around the exterior of the footing, then cover with clean granular fill to a height of at least 1 foot prior to backfilling. Water should be drained to lower elevations suitable to receive storm water run off.

g. **Backfilling and final grading**. Backfilling should be done carefully to avoid damaging the walls. Brace the walls or, if possible, have first floor in place before backfill. To drain the surface water away from the basement finish grade should fall off 1/2 to 1 inch per foot (40 to 80-mm per meter) for at least 8 to 10 feet (2.5 to 3 m) away from the foundation.

h. **Crack repair**. In general, epoxy injection, drypacking, or routing and sealing techniques can be used to repair stabilized cracks. Before repairing leaking cracks, the drainage around the structure should be checked and corrected if necessary. Details of these and other repair methods are provided in Reference 1. Active cracks should be repaired based on professional advice.

References

1. *Causes, Evaluation and Repair of Cracks*, ACI 224.1R, American Concrete Institute, Farmington Hills, MI.
2. *Joints in Concrete Construction*, ACI 224.3R, American Concrete Institute, Farmington Hills, MI.
3. *Residential Concrete*, National Association of Home Builders, National Association of Home Builders, Washington, DC.
4. *Residential Construction Performance Guidelines*, National Association of Home Builders, Washington, DC.
5. *Solid Concrete Basement Walls*, National Ready Mixed Concrete Association, Silver Spring, MD.

National Ready Mixed Concrete Association • 900 Spring Street, Silver Spring, MD 20910 • www.nrmca.org • 888-84NRMCA