CONCRETE SASK

TECH TIP #7

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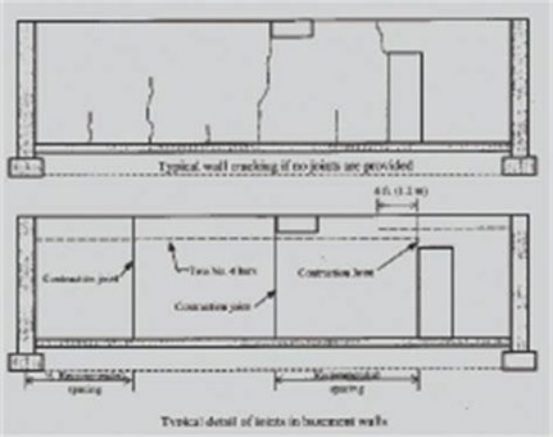
CRACKS IN RESIDENTIAL BASEMENT WALLS

WHAT types of cracks may occur?

Cast-in-place concrete basements provide durable, high quality living space. Cracking of concrete is a natural occurance and at times can be undesirable.



Most common causes of cracks include:

- Temperature and drying shrinkage cracks. With few exceptions, newly placed concrete has the largest volume that it will ever have. As concrete dries and starts to shrink. Temperature variations cause concrete to expand and contract. When tese volume changes are restrained, cracking results.
- Settlement cracks. These occur from non uniform support of footings or occasionally from expansive soils.
- Re-entrantant concrete cracking are diagonal cracks at doors, windows and other openings in walls and are the result of shrinkage.
- Pour lines, or commonly referred to as cold joints, are visible demarcations between placement of two concrete loads, typically due to a delay in placing between the loads and proper consolidation was not perfromed to homoginize the two portions across the separation. Pour lines are often perceived as cracks. They perfrom as cracks if the first placement has partially hardened before the second place, in extreme cases.
- Vertical form lines occur between form panels and can sometimes cause weak zones due to the use of form ties that support two layers of forms during concrete placement. Cracks may initiate at form lines.
- Restraint cracks may form in some portions of walls where contact with footings restrains the shrinkage of the concrete walls.
- Crazing and surface cracking may occur due to a lack of curing and protection if construction is during extreme cold or hot weather.
- Structural cracks may occur during backfilling if concrete strength is not adequate ot the walls are not adequately supported as the design intends. This is most liekly to occur when heavy equipment gets too close to the walls during backfilling or when pressure of backfill materials exceeds the anticipated design, such as liquefied soils.

Why do basement cracks occur?

Some cracking is normal in basement walls. Volume changes and other movements at an early age result in different types of cracks, as discussed earlier. These cracks can grow if the walls are not properly designed and/or constructed, due to the continued horizontal pressures applied by soil, water and temperature. Cracking can be prevented and minimized if proper design and construction practices are followed.

Most builders or third-party providers offer limited warranties for basements. A typical warranty will require repair only when cracks leak, have measurable vertical displacement or if the crack width exceeds 3mm.

HOW to design and construct quality basements?

Cast-in-place concrete basement walls are the strongest and most effective foundation for a residence. Climate conditions, unusual or unforeseen loads, material quality and workmanship may impact the quality of the finished basement. Proper design and construction is important and should following these steps:

- **Site conditions and excavation:** Soil types and conditions should be properly assessed for appropriate design and construction of foundations specific 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 properly moisture conditioned and well compacted by rolling, vibrating or tamping. Footings must bear on undisturbed soil.
- **Formwork and reinforcement:** All formwork must be constructed and braced so that it can withstand the pressure of the fresh concrete. Reinforcement is effective in controlling shrinkage cracks and is especially beneficial where uneven side pressures against the walls may be expected. Observe national, provincial and local guidelines for wall thickness and reinforcement requirements.
- **Joints:** Some cracks in basement walls can be controlled to occur in properly located formed joints.
- **Concrete:** Use concrete with adequate strength in accordance with National Building Codes, CSA, provincial and local building codes. Excess water should not be added to the concrete. Slump modifying admixtures or specially designed concrete mixes (SCC) can be used to increase flow and aid placement. Air-entrained concrete should be used for concrete walls exposed to moisture and freezing temperatures.
- **Placement and curing:** Place concrete in a continuous operation to avoid cold joints and segregation. Adding excess water to concrete to facilitate placement will increase segregation, cause honeycombing or excessive cracking and reduce strength. Consider placement points no greater than 6m to 9m around the perimeter of the wall to minimize segregation. Properly designed higher slump concretes with admixtures will flow horizontally for long distances and reduce the number of required points of access to the forms. Curing should begin after placement. Forms should be left in place until the concrete has attained adequate strength to support itself. Removal of forms too early can result in premature drying and may cause cracking. Forms should be protected to retain heat in cold weather by using insulated blankets or other coverings, along with an external heat source, for a minimum of 3 days at 10°C or 40% of its design strength as per CSA A23.1-24, Table 19. Forms should be covered with wet burlap or other moisture controlling methods during hot, dry weather. Liquid membrane forming curing compounds can be sprayed on the concrete after form removal, as per manufacturer's

recommendations, to prevent excessive drying.

- **Waterproofing and drainage:** Wayer proofing membranes are best applied to exterior foundation walls by either spraying, painting or using mechanically fastened sheet systems, prevent water from leaking through cracks. Provide foundation drainage by installing perforated weeping drain tiles or plastic pipes around the exterior of the footing and connect them to a removal system, then covering with clean granular fill to a height of at least 300 mm prior to backfill. Surface and roof drainage should direct water away from the foundation walls.
- **Backfilling and final grading:** Backfilling should be done carefully to avoid damaging the walls. Brace the walls if possible or backfill after having the first floor in place or other structural elements are in place. Positive surface drainage should be provided away from foundation as per local guidelines.
- **Crack repair:** Cracking is not necessarily a sign of poor materials or workmanship or a structural problem with the walls. If a repair is necessary, epoxy injection, dry-packing or routing and sealing techniques can be used to repair and stabilize cracks. The drainage around the foundation should be assessed and corrected prior to repairing leaking cracks. Seek professional advice to evaluate and repair active cracks that are widening with time.

References:

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3. International Residential Code, International Code Council, Washington, DC, www.iccsafe.org
4. Residential Concrete, National Association of Home Builders, Washington, DC, www.nahb.org
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6. Casting Residential Foundation Walls in Cold Weather, Concrete Foundations Association, Mount Vernon, IA, www.cfawalls.org.
7. Backfilling Foundation Walls, Concrete Foundations Association, Mount Vernon, IA.
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10. CAN CSA A23.1-24/A23.2-24
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