Concrete Perspectives

Basement wall cracks: No problem? Or signs of trouble?

Owners don't like cracks in concrete, and homeowners are particularly paranoid about cracks in basement walls. Every homeowner has heard a horror story about a sinking foundation or a flooded basement, so a crack in new concrete is a serious red flag. But which cracks are acceptable and which are signs of trouble? For some answers, we asked an engineer, Willard Norton of Norton & Schmidt Consulting Engineers, Kansas City, Mo., and a repair contractor, Jim Bushby, president of Structa-Bond of Maryland Ltd., Jessup, Md., for their views on the causes, significance, and repair options for foundation cracking.

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Concrete Construction: Why do basement walls crack? Can you determine the cause by simply looking at the crack?

Norton: Basement walls crack for essentially four reasons: drying shrinkage, thermal stress, lateral pressure, and differential settlement. You often can determine the cause of cracks by their location, orientation, and the time they occurred.

Shrinkage cracks are usually vertical and often appear shortly after the forms are stripped. The footing, which has already undergone initial shrinkage, resists wall shrinkage and a crack propagates from the bottom up. In many cases, the crack does not extend all the way to the top of the wall.

Contractors can prevent most shrinkage cracks by putting enough horizontal rebar in the wall. Unfortunately, most contractors put #4 rebar on 2-foot centers in an 8-inch-thick wall, which isn't enough to prevent shrinkage cracks. Placing the rebar on 12-inch centers is sufficient.

Thermal cracks also are vertical and almost always occur at corners. They can occur at any time but usually appear during construction, when the foundation is exposed to ambient temperature swings.

Cracks caused by lateral pressure typically occur during or shortly after backfilling. If the basement wall is properly restrained at the top (the joists are nailed to the sill plate, which is bolted to the foundation), backfill pressure should not cause cracking if the wall is adequately reinforced. As I mentioned earlier, many contractors place #4 bars on 2-foot centers. This usually is enough reinforcement to prevent flexural cracking in an 8-foot-high wall. If there's not enough reinforcement, a horizontal flexural crack can form. The crack will turn upward at each end of the wall, so it looks like a smile.

If the top of the wall is not anchored to the framing, lateral pressure can push it in under the sill plate. In this case, diagonal cracks can extend up from the bottom corners of each end of the wall. In extreme cases, you also get a vertical crack in the middle of the wall. In addition, the wall may bulge and induce a bending moment at each corner, causing outside vertical cracks in the wall at each end of the bulging wall.

Finally, cracks caused by differential settlement can be vertical or on an angle, and they usually don't appear until after the framing has been loaded onto the walls. Unless a house is on firm material, such as rock or shale, the foundation will settle a little, and it's not necessarily going to settle uniformly because different parts of the house are different in weight.

Bushby: Most foundation wall cracks are caused by mechanical overload from backfilling green walls—walls that have not gained enough strength to resist the lateral pressure. Many walls are backfilled within 3 to 5 days, which is too early. The wall bows inward at the center and often tears on the outside corners. On the inside, you get diagonal cracking from the corners and sometimes a vertical crack in the middle of the wall.

Another cause of cracking is minor settlement of the foundation. The cracks usually appear within the first year or so after construction. Settlement cracks typically appear at the weakest areas of the wall, such as the

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corners of steel beam pockets, windows, and door frames.

Many people blame concrete shrinkage for basement wall cracking, but rarely will you find shrinkage cracks in a poured wall. Those that do occur almost never penetrate all the way through the wall, so leakage is not a problem.

CC: When do cracks require repair, and how do you repair them?

Norton: Regardless of their cause, foundation cracks require repair only if they continue to get wider or they leak. Cracks increasing in width are a sign of a structural problem, which must be addressed. Leaking cracks are a result of poor drainage, which should be corrected before the individual cracks are treated.

Shrinkage and thermal cracks are common and don't require repair unless they're leaking. The stresses are relieved when the concrete cracks and no further problems occur. This often is true for cracks caused by backfill pressure and settlement. However, these cracks must be monitored and remedial action taken if there is an ongoing condition.

To see if a crack is getting wider, I like to place a plaster patch across the crack. If the crack changes, the plaster will crack and the time and amount of movement can be recorded for evaluation of repair needs, if any.

There are two ways to stabilize walls pushed in by lateral pressure. Outside the foundation, you can hold the wall back by installing earth anchors, or deadmen. Inside the basement you can install vertical steel columns by burying their bottoms in the concrete slab and then bracing them off into the floor frame. If the wall is moving in only at the top, you can prevent further movement by bolting angle irons to the bottom of the floor joists. Ongoing differential settlement requires underpinning the foundation with concrete or steel piers that extend down to stable soil.

If a crack is leaking, you first need to solve the underlying cause, which is typically poor drainage. The way you solve that is to provide a positive grade slope away from the house and to make sure the drain tile is open by injecting water into the drain tile with a deep root feeder. If the drain tile is clogged, you can relieve pressure by drilling through the bottom of the wall and diverting water into a sump pump system.

If a crack is still leaking, I recommend sealing it with silicone from the inside. Using a caulking gun, squirt the silicone into the crack and scrub the excess in with a gloved hand. Some people recommend epoxy injection as a way to structurally repair the crack and stop leaks. But unless the underlying cause of a structural crack is eliminated, the wall will simply crack again if the crack is epoxy-injected. As far as stopping leaks, I think silicone does just as good a job and costs much less.

Bushby: In the case of lateral overload, the backfill must be excavated and the wall straightened. I always recommend building the house before backfilling the foundation because the weight of the house will help keep the wall from bowing.

If settlement cracks are wide and displaced or out of plane, check the footing to see if it's cracked as well. That could be a sign of ongoing settlement. In that case, the footing may need to be underpinned before the cracks are repaired.

Once the wall is stabilized, you can repair the individual cracks. Hairline cracks that don't leak may not require repair. Otherwise, we typically epoxy-inject basement wall cracks. The walls are designed to be monolithic, and epoxy injection returns them to that state. However, the cracks should be injected only after the house is built to allow the weight of the house to stabilize stresses within the wall. ■

Publication #C00A072