



A Primer on Basement Wall Distress

So, you have found your dream home: perfect location, quiet street, great landscaping, room layout fits your life style, colors match your furniture. You can't wait to relax on the screened patio or that swing on the large front porch. But, you have some qualms: what about those cracks in the basement walls? Let's take a look at them.

Basement walls provide vertical support for the wood framing above (Figure 1). If the structure above, the contents in the structure, and the basement walls are too heavy for the soil under the footings or if the soil drops from landslide, consolidation of a fill material, shrinkage, etc., then the walls drop. When the dropping is not uniform, the walls are bent like a pencil or sheared like the tearing of a piece of paper.

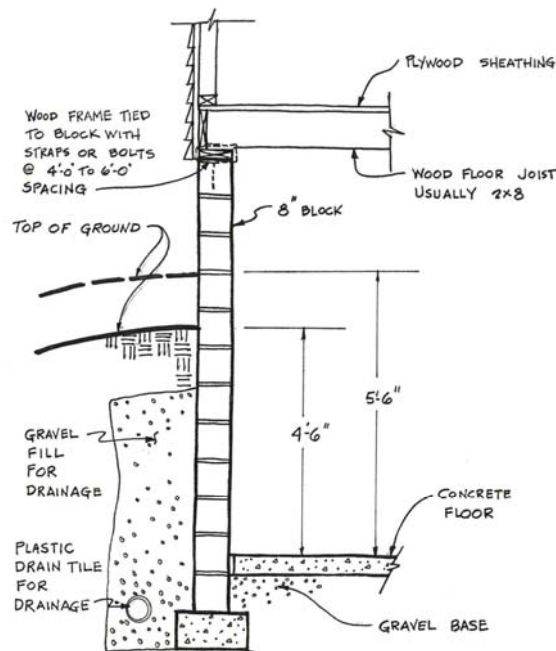


Figure 1 Common basement wall construction

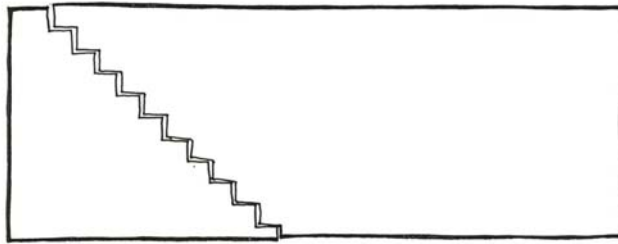


Figure 2 Common stairstep settlement cracking with cracking wider at top than bottom.

Cracking from earth movement can be vertical, horizontal or stairstep in pattern (Figure 2). When the outer ends of the wall(s) drop more than the center portions, the vertical or stairstep cracking is usually wider at the top than the bottom. If the center drops more than the ends, the cracking will be wider at the bottom than the top. Many times the vertical or stairstep cracking from uneven dropping will be evidenced by a vertical offset across the cracking. That is, the portion of wall on one side can be seen to be lower than the portion on the other side.

Horizontal cracking in the lower joints of a wall is often from earth movement below the footing and is often due to a fill material consolidating (compacting under its own weight or extreme moisture variation), a collapse of a tunnel below (such as in mine subsidence), shrinkage of moisture sensitive soil during moisture loss, etc. that causes the soil supporting the footing to drop away from under the wall. This causes the wall to hang from the framing above. Since masonry is weak in tension (pulling), a bottom section of wall often breaks off and drops onto the dropping soil.

If the dropping of a portion of the wall is due to settlement, that is, due to the weight of the structure above, the contents and the wall are compressing the soil and the rate of the movement usually slows over time. If the dropping is due to the consolidation of a fill material, a landslide, or shrinkage, it may continue or stop, accelerate or slow. The history of the dropping may be determined from the evidence seen in the repairs, the patching, the painting, and the finishes in the building.

A dropping foundation may be underpinned with a new footing under the existing or may be supported on helical piers. However, since it is usually necessary to determine why the soil cannot adequately support the structure, a soils engineer may be needed to evaluate the conditions before a repair can be selected.

Basement walls not only support the framing above they also retain the earth and groundwater from the basement area. A basement wall resists the inward pressures of the earth backfill and groundwater by spanning vertically between the basement floor and the wood framing above it (Figure 1). The backfill and groundwater behind the wall push inward as the basement floor and first floor framing hold the wall in place.

The magnitude of the earth pressures generated by the earth fill depends on the height of the backfill above the basement floor, the method of placement, and the condition of the soil. The magnitude of the pressures from the groundwater depends on the depth of the water in the backfill. This depth is affected by the intensity of rainfall, the effectiveness of surface and roof drainage, the effectiveness of foundation drainage, and the ability of the soil to allow passage of water to the foundation drains or the water table.

A conventional, unreinforced concrete masonry wall has a limited capacity to resist these loads. Information about the strength limitations is published by the National Concrete Masonry Association (NCMA) in NCMA-TEK 15-1. NCMA recommends that an eight-inch thick, unreinforced concrete masonry wall can safely support an unbalanced earth fill of five feet for average soil conditions. That is, the backfill measures five feet above the basement floor. NCMA recommends that a twelve-inch thick, unreinforced concrete masonry wall can safely support an unbalanced earth fill of seven feet for average soil conditions. That is, the backfill measures seven feet above the basement floor. NCMA also recommends that the top of the basement wall be attached to the floor framing above with 1/2 inch diameter bolts spaced at intervals of not more than six feet or metal straps (Figure 1). The wood floor framing provides lateral support at the top of the wall through the bolts or the pre-manufactured straps.

When basement walls are retaining excessive amounts of groundwater, the interior face of the walls commonly exhibit moisture staining, mineral deposits (efflorescence), blistering or peeling paint, dampness, or seeping water (Figures 3 and 4).



Figure 3 Interior face of wall exhibits staining, peeling paint, blistering of paint, mineral deposits, and repeated paint coverage.



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When basement walls are exposed to excessive earth pressures and/or excessive groundwater pressures, they often exhibit visible inward bowing and cracking. Cracking from excessive inward pressures is usually comprised of horizontal cracking at or about mid-height of the wall: the ends of the horizontal cracking often extend up and/or down in a stairstep pattern where the horizontal cracking approaches the ends of the wall or an interior cross wall (Figures 5 and 6).

If the wood framing does not adequately support the top of the wall (lack of bolts, the first joists are parallel to the wall, or solid blocking was not provided where the joists are parallel to the wall), the top of the wall may lean inward resulting in a sweep in the wall and vertical cracking near the mid-length of the wall: a sweep is a bow that extends from side to side.

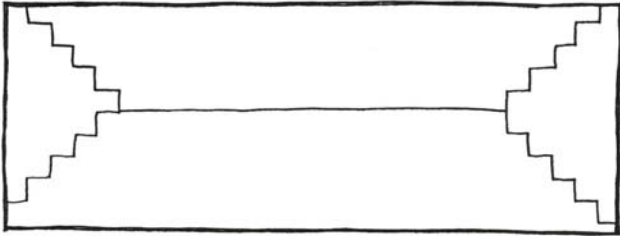


Figure 5 Horizontal cracking from inward bowing with stairstep cracking at ends.

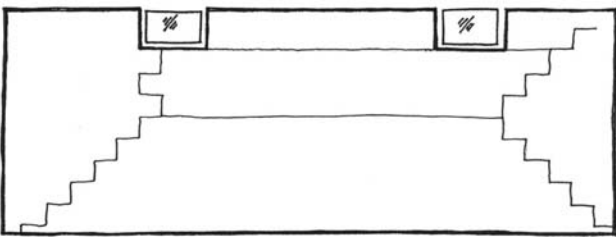


Figure 6 Horizontal pattern of cracking from inward bowing can be altered by window placement.

When heavy equipment is operated on the soils near a basement wall, a third type of inward pressure called surcharge pressure may also be applied to the wall. Surcharge pressure occurs when the earth backfill is compressed downward and against the wall by the heavy object. This phenomena is similar to the outward movement of ice cream when the cookies of a partially melted ice cream sandwich are squeezed together.

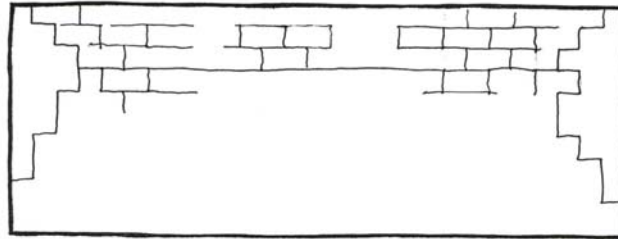


Figure 7 General pattern of extensive and widespread cracking near grade from surcharge pressures.

The magnitude of surcharge pressures from heavy objects near a basement wall depends upon the proximity of the load, the magnitude of the load, the concentration of the load, and the conditions of the soil. Excessive surcharge loads are often experienced when heavy construction equipment is operated within a few feet of a wall or when the backfill soil is very wet.

Basement walls damaged by surcharge pressures usually exhibit more severe damage than those damaged by excessive earth and/or groundwater pressures. That is, the cracking is more dramatic. A previously undamaged wall usually exhibits cracking in the mortar joints around nearly every block in the courses at or a few feet below grade (Figure 7). This is due to the high pressures generated by the soil being squeezed against the wall. A previously cracked basement wall will exhibit similar damage, but the pattern of damage will be modified by the relief of the pressures when the previously existing cracking opens.

If the inward bowing is not excessive, basement walls damaged by excessive inward pressures may often be repaired by excavating behind the wall, allowing the wall to flex back into vertical position, reinforcing the hollow cells of the concrete block with vertical reinforcing rods and a concrete fill, and routing and repointing the cracked joints (Figures 8 through 10). If the inward bowing of the wall is excessive, the wall requires replacement. The foundation drainage system will also require replacement at that time. The details for these repairs may be determined by a qualified and experienced contractor or a structural engineer.



Figure 8 Slots cut for access into cores of block.



Figure 9 Steel reinforcing rods set in core. Note location and long lap.



Figure 10 Slots covered and cores filled with relatively fluid concrete mix.

The cost of repairing or replacing a basement wall and the foundation drainage system can vary from \$100 to \$400 per linear foot depending upon access for excavation equipment, availability of contractors, interior access and finishes, contractor experience, etc.

So now, considering all this, is this your dream home or a nightmare?

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