

Residential Engineering & Design, LLC

Biggest Misconception

A white paper

By Residential Engineering & Design, LLC

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Overview

When potential homebuyers are in the market for a new home, they often notice unsightly cracks in the foundation. They are told this is normal; that this is caused by settling and therefore the resulting cracks are inevitable and are not a concern. This is a misconception and depending upon the severity of the crack, it could have important structural implications.

Cracks in the basement walls of homes could be evidence that the wall has failed. It means that the force exerted upon the wall has exceeded the foundation's design capacity and now could fail to endure excess rain, parking a vehicle close to the home, or other pressures. With additional loads placed upon the soil outside the home, there is no longer a margin of confidence that the wall will not collapse if the foundation indeed has a crack.

What really causes the foundation to fail?

Generally speaking a failed foundation wall will withstand the typical daily pressures for a period of time until there is a large rain or other excessive force placed upon the soil. When a foundation is beginning to fail, the wall may already be bowing or leaking. An additional force, like heavy rain, could result in further bowing or cracking or complete failure of the wall. In these situations, the timing and extent of the failure cannot be determined by anyone.

Basement walls bow because the soil became saturated and expanded beyond the capacity of the wall. Total failure of the wall is not typically seen because these events are generally short term. The cracking or bowing of the walls allows enough room for the soil to get fully saturated. After these events, the soil will dry up and shrink back to its original size, thus effectively applying little pressure to the cracked or bowed wall. Total failure of the wall might take several of these events to occur as the soil settles into the voids created by the wall bowing inward.

Basement walls should be designed for increased soil pressures due to saturation. Most basement walls built prior to the 80's are unreinforced masonry. Most of these walls, depending upon their height, were not adequately designed to handle soil pressures that will be seen throughout the lifetime of the house.

Today's basement walls, now made of concrete, are more adequately designed for soil pressures. However, residential construction still has no regulation around how much water contractors add to the concrete mixture. The reinforcement of these walls does not allow for the resistance of creep and shrinkage (moisture loss in concrete over time). To design a wall properly, there must be an adequate amount of reinforcement to resist these effects, otherwise cracking will occur. The professional home designer must also define and enforce the use of an industry recommended water to cement ratio. They also must design appropriately to account for soil pressures. None of this is currently enforced in residential construction, which is one of the reasons why today's

homes have so many cracked foundation walls.

Prevent Foundation Cracks

Commercial buildings, designed by structural engineers, generally do not have cracked, bowed, or failed foundation walls. The walls were designed using codes and regulations and are reinforced to withstand most factors that could cause a wall to fail.

Unfortunately, structural engineers aren't typically involved in the design or building of homes. The regulations that must be followed when designing residential homes do not account for many of the factors affecting a home's foundation. This is a major reason there are cracks leading to bowed and leaking foundation walls.

To prevent bowing or cracking, basement walls must be adequately reinforced whether they be masonry or concrete walls. The masonry basement walls of older homes were typically not reinforced, which is why the presence of crack and bowing is so prevalent, but note, not "normal.". A single piece of rebar grouted inside the masonry wall at the correct spacing would prevent the walls from failing structurally.

A good first step in limiting problems is using a Geotechnical Engineer who can be consulted to help identify what soils are present. Doing so would better determine the forces for which the basement wall should be designed to withstand. Depending upon the soil profile, the Geotechnical Engineer's expertise will direct the home designer to design the foundation walls for XX pounds per square foot. This takes into account the soil when fully saturated, accounting for maximum force upon a wall. Knowing this, you can estimate soil pressures on basement walls and reinforce accordingly. Some cracks that are present in basement walls are from settling, which is common. These cracks are typically stair step in nature and not an issue as long as horizontal displacements have not occurred and they are repaired in a timely manner.

A thorough preparation and analysis as outlined above is completed for all commercial buildings but most cities do not mandate the same structural integrity regulations for residential homes. A city mandate may provide guidelines if using a certain foundation material like cement or masonry. These guidelines are based upon height of a residential building without further consideration of soil pressure, weather, or other external factors that would affect the home. Designing a home with the use of a complete analysis and professional engineering help is important to the long term viability of the basement walls. Consideration of factors that may cause excess pressure will prevent cracking and preserve the integrity of the walls for years to come.

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