Most basements show some signs of leaking and cracking. Through the years, problems with water, poor soils, grading, drainage and possible settling affect the integrity of a basement. Being able to recognize small problems allows homeowners to take steps to avoid large ones. Maintenance or simple repairs often eliminate the need for major expenses.

This article covers how to determine the seriousness of typical basement cracking. Additional information about basements can found at www.htoyh.com in the article "Keep Your Basement Dry" and in the chapters of "How To Operate Your Home," second edition, that review the basics of basement construction, drainage systems, sewer systems and routine maintenance every homeowner should perform.

THE BASIC BASEMENT PROBLEMS – CRACKS AND SEEPAGE

Most damage to basements occurs slowly, over many years, and homeowners may not notice a problem until there is a water leak or a major crack and wall movement. Homeowners should take some time to inspect the basement and its environment. A little common sense and simple maintenance will prevent potentially serious problems. Knowledge about changes in the foundation's condition is essential to recognizing problems. Remember, water is the real threat to any foundation.

Cracks can be signs of an overload or excessive stress on a wall. As homes get older, cracks have a better chance of appearing. Excessive displacement, continuing movement, differential settlement and certain combinations of cracks are real problems we will discuss. The exception — those little hairline cracks that appear in floors and walls — often are caused by shrinkage and are not a concern since they are just cosmetic in nature.

Seepage, another common problem, may occur in combination with cracks. However, seepage problems are not always directly related to cracks. Seepage often is caused by surface water reaching the exterior of basement walls. Ineffective or poorly maintained drainage systems also can allow seepage. If seepage and leaks continue after correcting drainage and water removal systems, they need further investigation— something that I cover in detail in "Keep Your Basement Dry."

Remember: A dry basement may have serious cracks and structural problems, while a leaky basement may be structurally sound. Cracks, movement and leaks do not always go hand in hand. Surface-drainage issues often cause seepage problems. Wet soil from poor surface drainage causes leaks, and pressure from the wet soil can cause cracks and structural failures.

CRACKS – THE GOOD AND THE BAD

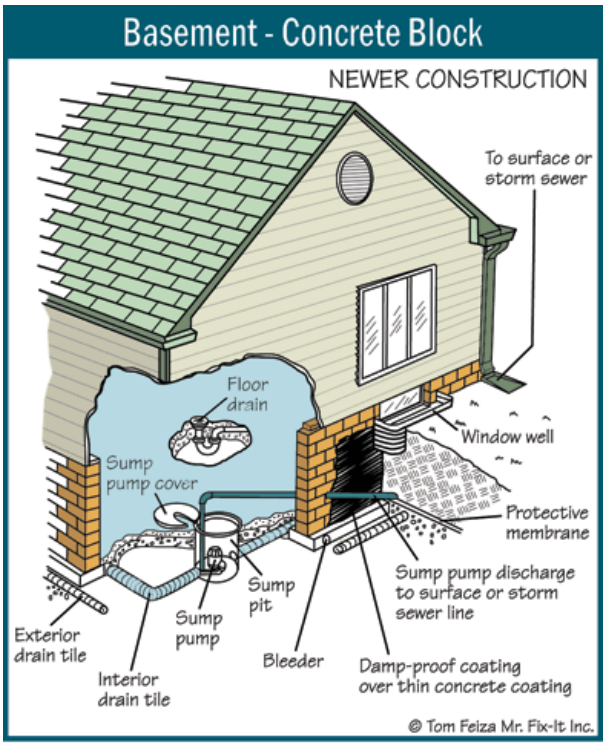
How can you determine whether a crack is good or bad? There is no easy answer. It depends on the type of construction and the history of the basement. Understanding basement cracks requires recognizing basic types and knowing how they occur. Take a good look at the sketches of various types of cracks. Which ones does your basement have?

What distinguishes a minor crack from a major problem? The key often is the amount of wall movement. Any movement over 1/2 inch signals a potentially serious problem. Any long horizontal crack at the second or third mortar joint, under the top block or over the bottom block, combined with step cracks and inward movement, indicates a problem. While step cracks near windows and corners often are not serious, if they are combined with floor cracks, shear or vertical cracks, you should be concerned. Sound confusing? It is; read on.

TYPICAL BASEMENT CONSTRUCTION

A typical basement or foundation is constructed to support the home, resist lateral soil pressure and resist the movement of frost. Often, in heating climates, basements are constructed because the foundation must extend below the frost line—and once you dig down four feet to get below the frost line, a full-depth basement makes sense. In mild climates, there is little or no frost and the foundation often consists of a concrete slab on grade or a crawl space.

A typical basement is constructed of a footing or footer that supports the basement walls and floor. The footing must rest on solid or undisturbed soil. The wall may be constructed of cement block, poured concrete, brick, stone or tile. In the past 80 years, most foundation walls have been constructed of cement block or poured concrete. The floor is poured concrete supported on the edges by the footing and in the center by compacted gravel.



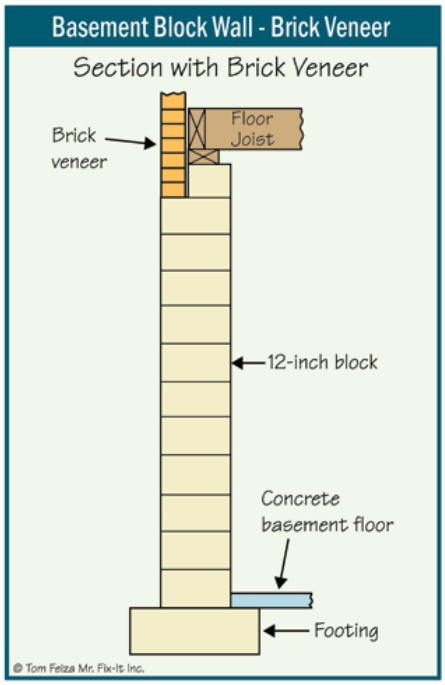
B005

In areas with soils that don't drain well, such as clay soil, a drain tile system often is installed. Drain tiles (today "tiles" are made of perforated plastic tubes) are laid outside or on the footing and inside under the floor. Bleeders are installed through the footing to allow water to pass from the outside to the inside. The inside tile then is connected to a sump pump crock and sump pump. As water drains into the crock and the level rises, the pump turns on and removes the water. (In some parts of the country prior to 1954, the drain tiles may be connected to a combined sewer system through a check valve in the floor drain.)

BLOCK OR POURED CONCRETE WALLS

A block or cement block wall is laid up like a brick wall. Mortar is used to set the block in place and bond the block together. Today, a block is called a concrete masonry unit (CMU) and blocks are built to specific engineering standards. Most blocks used in basements have a hollow core. The term block also refers to a cinder block — old block that may have some cinder or burnt coal content.

A block basement wall easily supports the weight of a home. Block is very strong in compression. However, block walls, if subjected to horizontal pressure, have less strength than poured concrete. Some block walls are reinforced with special metal bars and grids built into the mortar joints for increased strength.



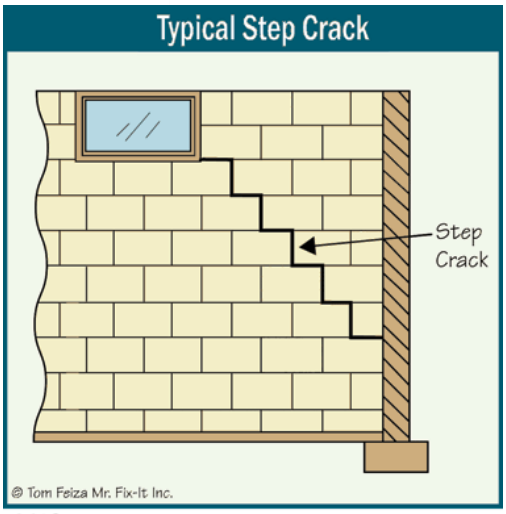
B022

The basement walls also can be made of poured concrete. These walls typically are stronger against horizontal pressure, and they easily support the weight of a home. The construction looks the same except that poured concrete is substituted for cement block. The texture inside the basement may be smooth or may be a decorative brick texture.

In newer construction, grooves often are cut into the poured concrete wall or formed in the wall to control cracking. We know the walls will shrink and crack because poured concrete shrinks about 5/8 inch per 100 feet if the mix is properly controlled and weather conditions are correct. With a poor mix, extra water or poor weather, the wall may shrink even more. The grooves allow cracks to occur in a controlled fashion.

STEP CRACKS

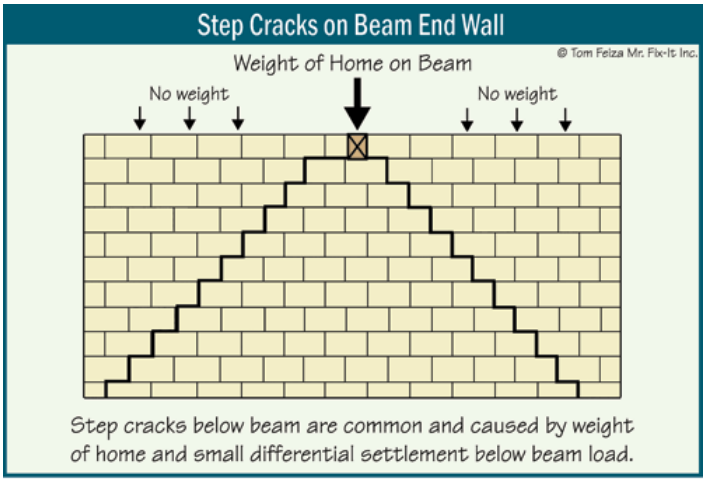
Step cracks, stairstep cracks or stepping cracks all refer to cracks that follow the mortar joints in a block wall. The cracks step up or down along the mortar. In many cases, this type of crack is caused by minor movement of the footing, shrinkage or wall movement, and by itself is not a major cause for concern; however, wide cracks or step cracks combined with other cracks and movement indicate a problem.



B016

STEP CRACKS AT WINDOWS AND BEAM ENDS

Step cracks often will occur at the weak point of a wall—around window openings. Step cracks are common at "beam-end" walls. At the beam-end wall, the beam transfers a large point load to the wall. The load often creates step cracks down and away from the beam as the footing settles ever so slightly. Block walls do not like to move; they do like to crack. A vertical crack also may occur at the beam end wall, below the beam.



B029

STEP CRACKS COMBINED WITH HORIZONTAL SHEAR

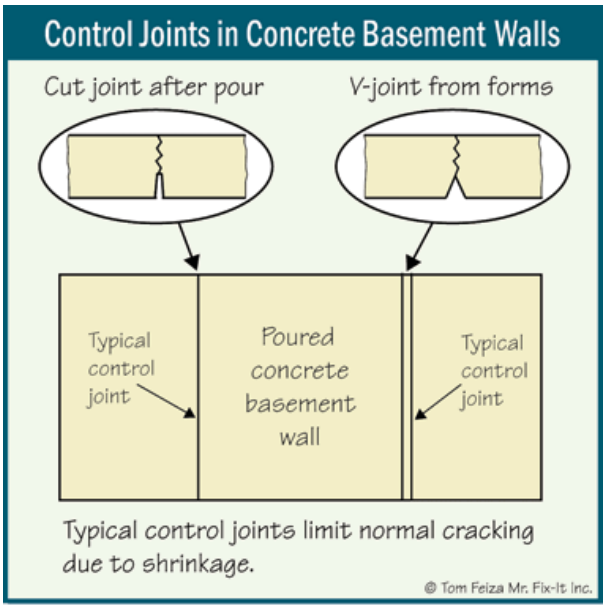
Combinations of cracks often indicate a more serious problem. Step cracks may be found with horizontal cracks, vertical cracks and wall movement. A combination of cracks needs a professional review.

VERTICAL CRACKS

Vertical (up and down) cracks can be caused by simple shrinkage of materials. These cracks often occur in the control joints of poured walls. They appear as hairline cracks in mortar joints and through blocks in a cement block wall. Some vertical shrinkage cracks in poured concrete can be up to 1/8 inch wide. Cracks in block walls should be very narrow, without horizontal movement.

Vertical cracks are an issue if they are wide, tapered from top to bottom, or found in combination with other cracks. They can occur because of settlement, wall movement or tipping walls. Vertical cracks also occur if a wall is pushed in and breaks away from the adjacent corner or surface. Vertical cracks with horizontal or shear movement at the crack always indicate a problem.

Vertical shear cracks at a corner with no horizontal cracks indicate a large amount of water freeing at the corner. In this case, the center of the wall can be stable.



B030

HORIZONTAL CRACKS

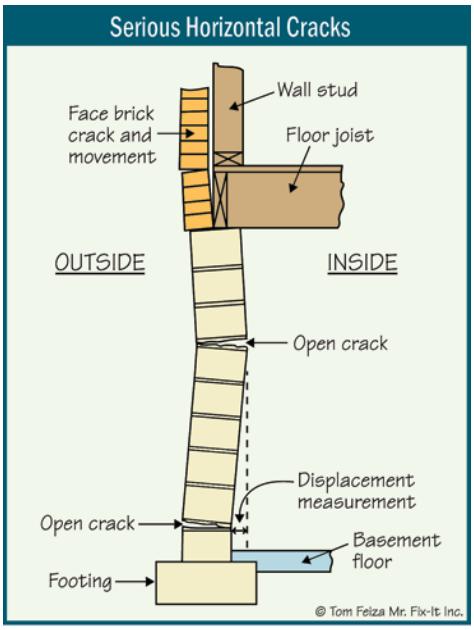
Horizontal (left to right) cracks can appear at the mortar joints in block walls. They indicate that the wall is displaced horizontally. As the wall is pushed in, the joint opens up inside the

basement, and a similar crack will occur outside near the base of the wall. Horizontal cracks are caused by wet soils, poor maintenance of surface water and frost. Horizontal cracks in block walls always need to be taken seriously. A horizontal crack combined with step or vertical cracks indicates a problem. When the crack is over 1/8 inch wide and there is horizontal wall movement of 1/2 inch or more, the problem needs to be addressed.

Horizontal cracks often will change seasonally. When there is water in the soil, the soil may expand — a common trait of clay soils. When the wet soil expands, the wall may be pushed in and the horizontal crack may open further. When the soil dries, the crack may close. Frost in exterior soil causes similar movement and cracking as the frost expands the soil.

If soil settles behind a wall when the wall is bowed seasonally, it will remain displaced. It just can't move back against the soil.

A horizontal crack can happen suddenly under adverse conditions. Rain and snowmelt combined with freezing temperatures can cause a wall to move and crack suddenly.

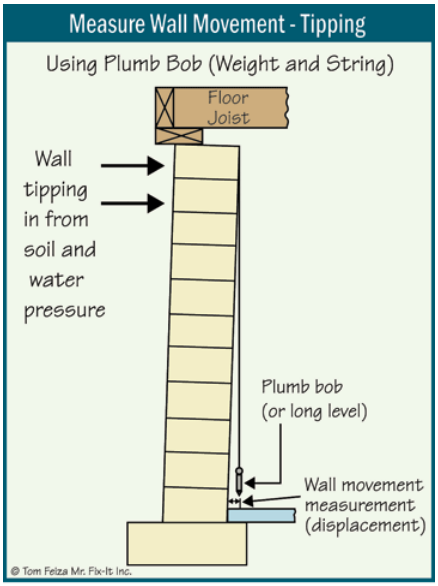


B018

MEASURE DISPLACEMENT

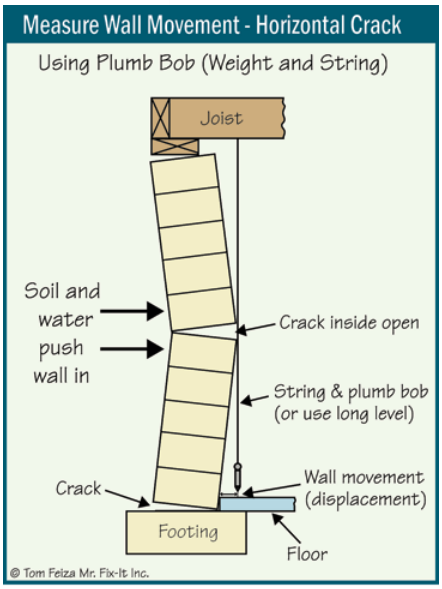
The displacement or movement of the wall is a critical measurement to determine whether a wall is in jeopardy. Measurements can be made with a 4-foot or longer level, a laser level or a plumb bob. The key is to measure over the height of the wall and then compare measurement to the corners.

In many cases, corners don't move because the block is "woven" together in a strong joint that resists horizontal movement. The corner of a concrete wall also is very strong. If the wall is displaced in relation to the corner, there may be a problem. If the corner is tipped and the whole wall is similarly tipped, the wall might have been built out of plumb. As the block wall was built, a string was pulled from the corner to align the block of the wall; if the corner is tipped, the wall will be tipped.



B025

The plumb bob measurement makes the movement easy to visualize. The weight at the bottom of a string holds the string "plumb" or vertical, and you can measure from the vertical string back to the wall. If you find cracks and displacement over 1/2 inch, you should start to question the stability of the wall and consider possible repairs.
Wall displacement also may be referred to as deflection. However, technically "deflection" usually describes materials that move under load or stress and then move back to their original position once the load is removed.



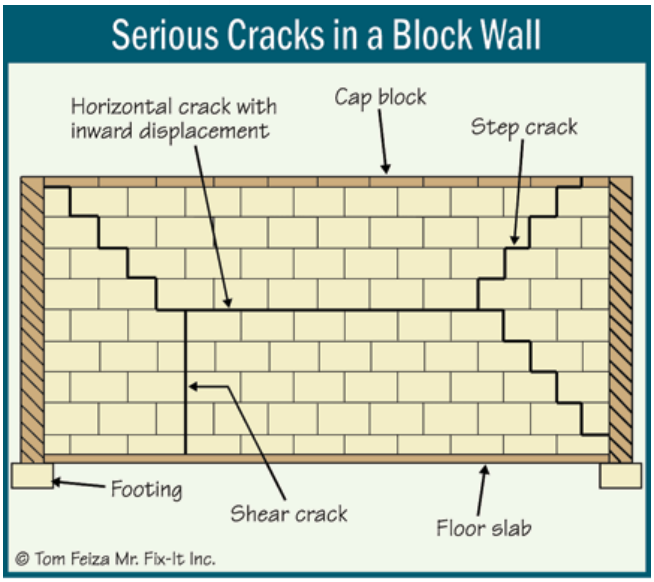
B026

MULTIPLE HORIZONTAL CRACKS

At times, you may see multiple horizontal cracks—cracks that occur in several mortar joints above and below each other. This often is the sign of ongoing movement or movement on several occasions. This is reason for concern.

COMBINATIONS OF CRACKS

All combinations of cracks are cause for concern. Illustration B017 depicts a wall with serious cracks and displacement.

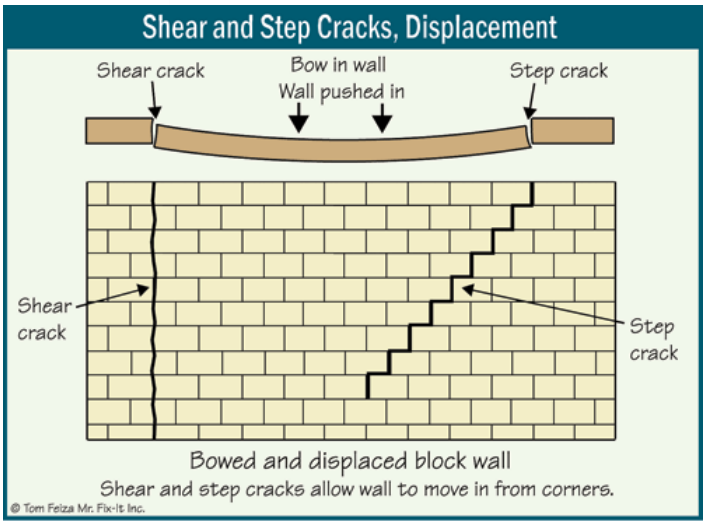


B017

As the wall is pushed in, the horizontal cracks open. With more movement, the wall breaks away from the corners, resulting in step cracks and vertical cracks. The corners are stable, while the wall breaks away. This type of movement and cracking typically occurs in a block basement, not in one made of poured concrete.

When bowing or movement occurs in a poured concrete wall there will be a combination of vertical and 45-degree angle cracks. The cracks allow the wall to break away from the stable corners and move inward.

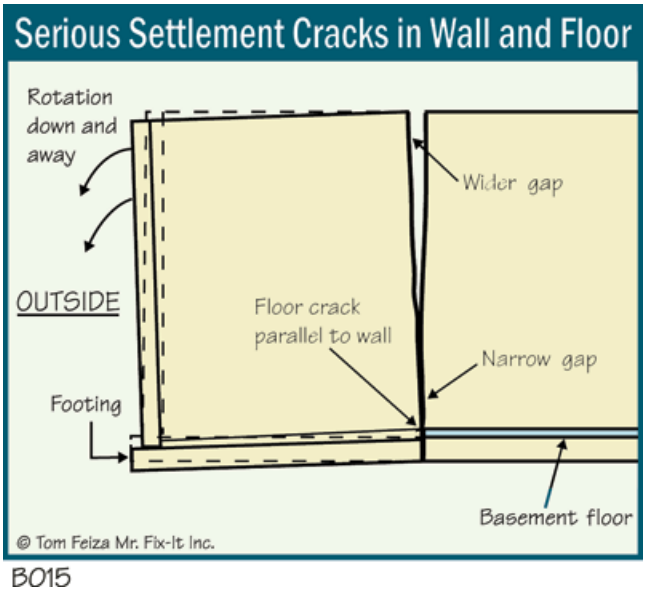
Illustration B024 depicts a wall with a serious inward bow. As the wall moves inward, the wall splits away from the adjacent surface with a vertical shear crack and a step crack. The illustration shows the top view and the displacement of the wall. On the outside, vertical cracks will occur in joints near the corners.



B024

SETTLEMENT AND FOOTING MOVEMENT

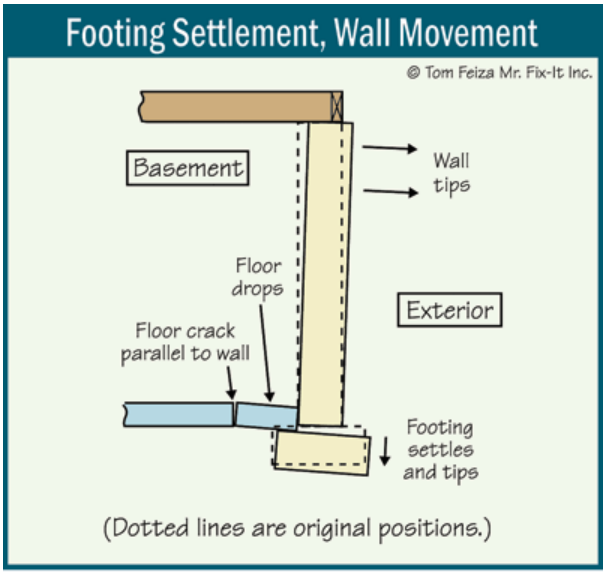
Settlement cracks are caused when the footing supporting the home moves downward or tips. Illustration B015 depicts a footing that has settled, creating a crack in the wall above the settlement. The crack is open at the top and tighter at the bottom. There often will be a crack in the floor where the footing has started to drop. A wide gap also may develop between the floor and the wall if the footing settles and the wall rotates outward.



B015

Illustration B068 shows a footing that has settled and
tipped away from the foundation. In this case, the wall tips outward and may have step or vertical shear cracks. There often will be a floor crack parallel to the footing movement, and

the floor may be raised or dropped. There may be shear or lifting at the floor crack.



B068

If a corner settles, step or vertical cracks will develop on both adjacent walls. Floor cracks may meet at the wall cracks.

With serious settlement, crushed lead plumbing pipes may be visible where they enter the concrete floor. The floor also may be cracked and heaving with significant displacement. Settlement also may result in a corner that tips away from the foundation walls.

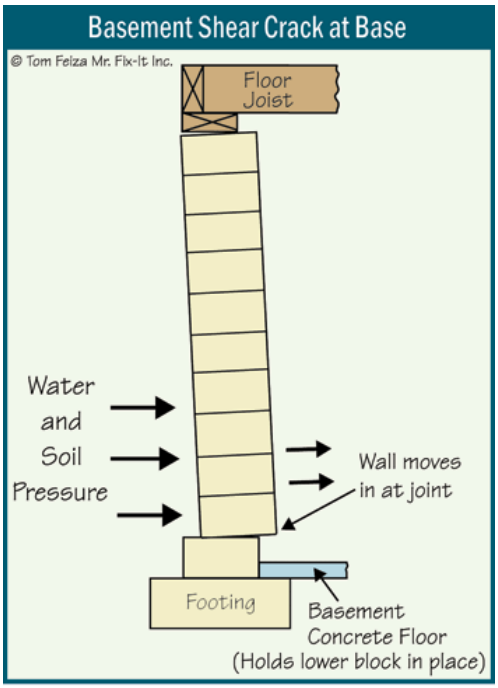
All significant settlement issues must be addressed by a professional and often require an engineered-design solution. Work may require soil testing and a special pier design to provide support to the footing from stable soil below.

DISPLACED WALLS – TIPPED, SHEAR AND SLIDE

Walls also can move with little signs of cracking. A wall that tips in over time (*see illustration B025, above*) will be found by measuring for displacement and movement relative to the floor framing. This can happen in block and cement walls. Severe movement creates vertical or step cracks that allow a section of wall to break away. With minor movement, the problem can occur without creating cracks and it is hard to detect. The framing sill plate could be split or could slide on the top of the wall.

Walls also can be pushed in at the base when there is slip or shear at a lower mortar joint (see illustration B023). In this case, soil pressure forces the wall in and a lower block joint is

broken or sheared. This often is hard to see with a cursory look, but it is a serious issue because the wall has lost its ability to resist horizontal pressure, which is greatest at the base of the wall. The poured concrete floor is holding the lower block in place.



EXTERIOR SIGNS OF PROBLEMS BRICK VENEER MOVEMENT

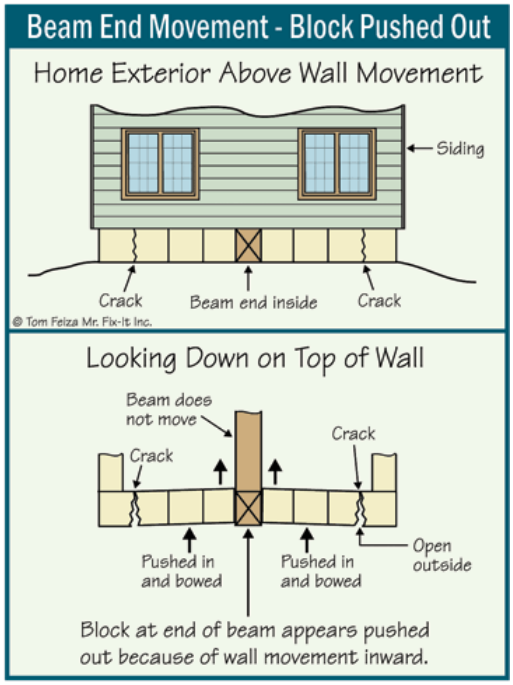
A basement supports the brick or stone veneer on homes that we call brick or stone homes (although they actually are wood-framed homes with masonry veneer). If a basement wall has serious cracks and inward displacement, the top of the wall tips outward. As the top tips out, the brick veneer supported by the wall also tips outward. You also may see horizontal cracks in the veneer, or the veneer may be pulling away from the wood framing. You will see this movement at the end joint between the veneer and the siding. Look for additional trim or caulk filling a gap at the top of the masonry veneer.

DISPLACEMENT AT SIDING AND BEAM-END CRACKS

Often, when a basement is pushed in, the top of the wall undergoes significant movement. You may see this movement outside the home. There will be vertical cracks at the corners where the wall breaks away from the corners. The block covering the end of the beam may be pushed out as the wall moves in because the beam normally will not move.

You also can detect serious movement by measuring from the siding to the top of the block

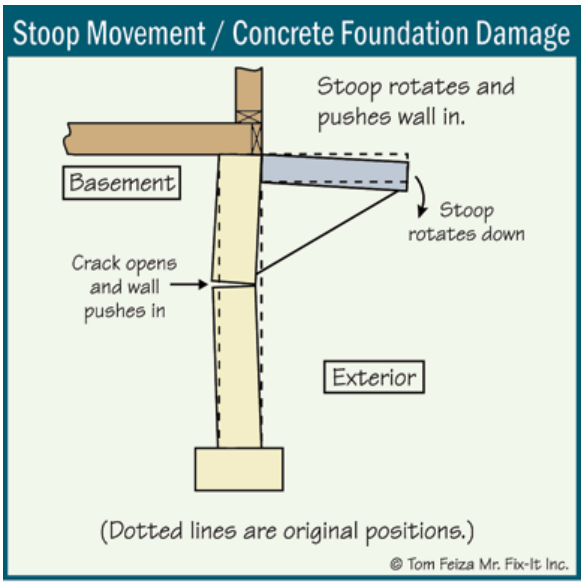
wall. Measure at the corners from the outer edge of the siding to the block, and then measure at the center of the wall. The increase in the measurement at the center of the wall indicates how much the wall has moved.



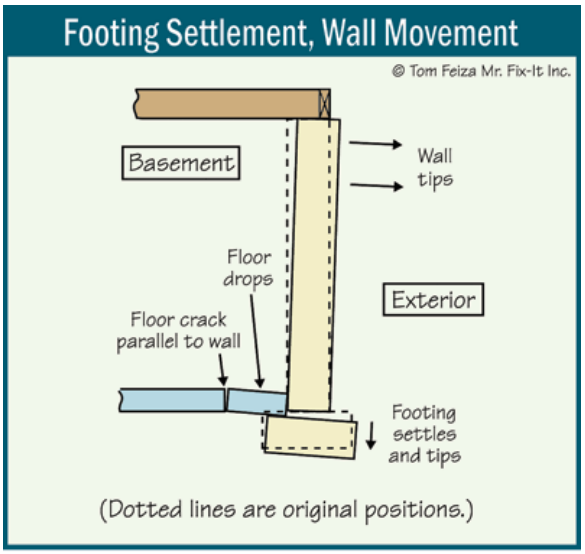
TIPPED STOOPS

Tipped entrance stoops can cause a basement problem and often result from the lack of a proper footing for support. As depicted in illustrations B067 and B066, stoop movement can crack basement walls. If the stoop tips down, away from the home, the pressure of movement can displace and crack a block wall. If the stoop support is not properly designed and executed for the poured wall, the concrete foundation wall also can crack.

A stoop that tips toward the foundation wall can also crack a block wall. When a stoop tips in, it will direct water toward the foundation wall — and this always is a problem.



B067



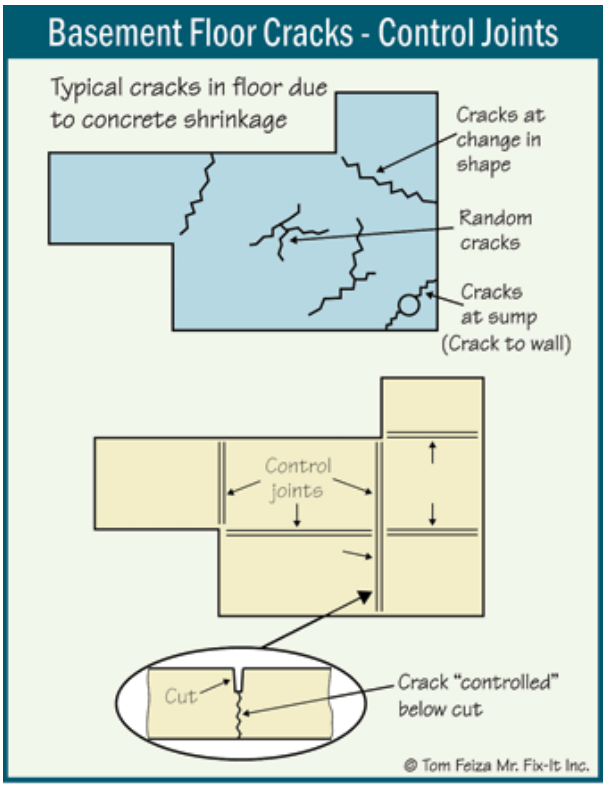
B068

FLOOR CRACKS

Basement floor cracks are common, because concrete shrinks as it cures. Don't be concerned with random spiderweb-like cracks or cracks that occur from an inside corner. These often are shrinkage-related. Basement floors often have gaps between the floor and the wall or around the sump pump crock in a corner. Think of your basement floor as a cake mix in a 9-by-13" pan — as it bakes, it pulls away from the pan (the basement wall).

Do be concerned if the cracks are parallel to the wall and footings or if there is vertical movement associated with the cracks. Displacement at the cracks, or floor cracks that align

with wall cracks, can indicate a problem. Floors that are tipped and cracked need to be evaluated. Floors that are heaved and cracked are a problem. Heaving indicates hydrostatic pressure from a hampered drain tile system or an inoperative or improperly adjusted sump pump.

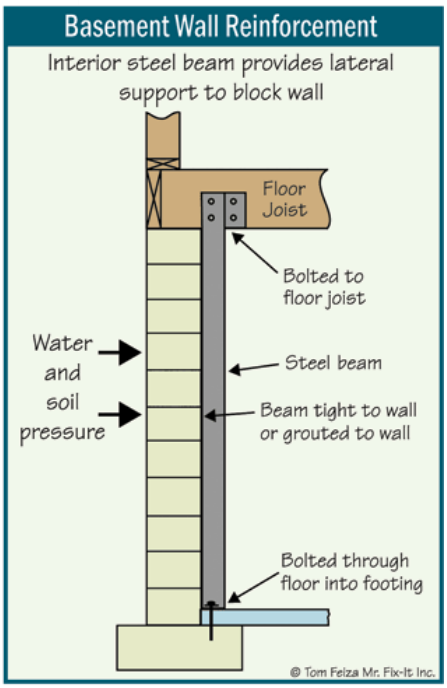


B031

REPAIR BEAMS FOR WALLS

While basement wall repair can be accomplished with various techniques, a common repair for walls with minimal displacement is an interior steel beam.

Illustrations B035 and B036 depict a common beam repair. The beams are bolted to the floor framing and the concrete floor and set tight to the wall. If the floor is being cut, the beams may be set into the concrete. The gap between the wall and the beam is filled with



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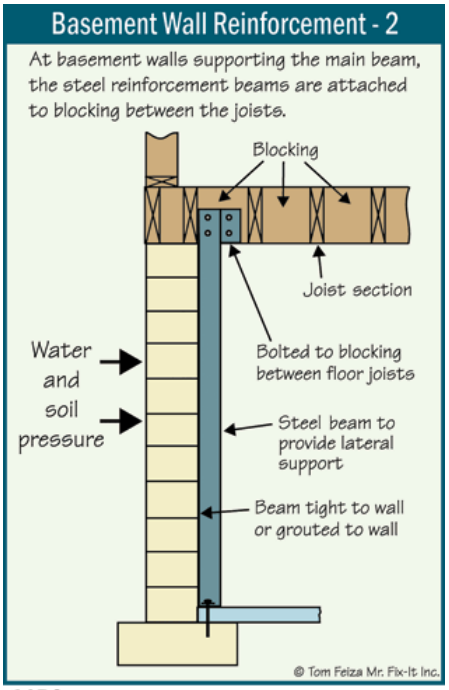


B036

The beams are bolted to the side of the floor joists on a supporting foundation wall. When placed on a beam-end wall with joists parallel to the wall, they will be blocked back to several joists and to the subfloor for support. The beams are placed with 36- to 48-inch spacing and are cut and fabricated around obstructions. For serious displacement, an

engineer should design the beam repair. Excavation and straightening of the wall may be necessary.

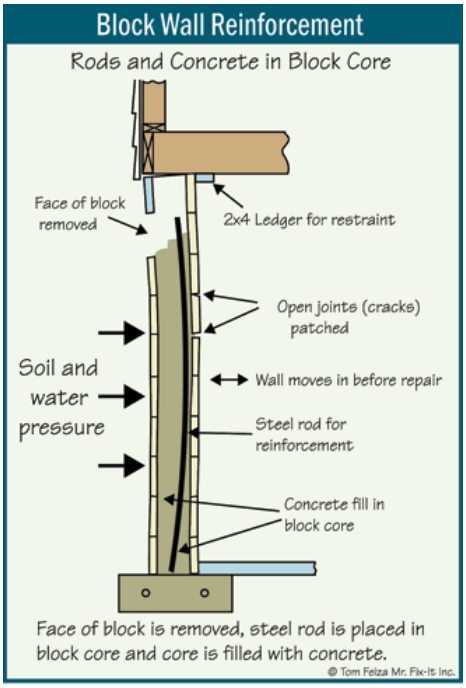
If a beam repair is done in conjunction with an interior drain tile replacement, the lower end of the beam will be set into the concrete patch for the drain tile repair.

REPAIR WITH RODS AND CONCRETE

Block walls with cracks and displacement also may be repaired and reinforced with rods and concrete. Since the typical block has hollow cores, these cores can be reinforced with vertical reinforcing rods set in concrete. The exterior face of the block is broken away and rods are pushed down the core. Concrete then is poured down the core.

This repair method is difficult to implement because it
is hard to control the placement of the rods and the
concrete. The rod and reinforcement concrete also does not extend into the top block.

If patches are visible in the face of the exterior top blocks, a repair probably was done with rods and concrete.



BO41