by Buck Bartley

Prevent basement wall cracks, bows, and leaks with proper bracing, good compaction, and careful grading

Backfilling Basics

Though it's an essential step in basement construction, backfilling is all too often done quickly and carelessly, without attention to the details that make for a successful job. But if not done right, backfilling can cause serious foundation problems — problems that can be avoided by taking a few simple precautions.

There are four key elements to proper backfilling:

1) Protecting the foundation wall from damage
2) Using the right backfill materials
3) Compacting the backfill
4) Final grading to ensure that water runs away from the foundation

Properly done, these four steps help to ensure that a well-built basement functions the way it's supposed to — providing the homeowner with dry, usable living space.

Protecting the Wall During Backfilling

The surest way to protect walls from damage during backfilling is to backfill only after the basement slab and the first-floor deck are in place. Sill plates should be bolted down and joists nailed to the sill. The floor system then provides the horizontal restraint needed to resist the earth pressures caused by backfilling.

However, builders seldom want to wait until the deck is in place before backfilling. Early backfilling speeds the framing process by making the foundation more accessible, so the carpenters don't have to use ramps. If you decide to backfill before the deck is built, be sure to brace the walls adequately. We brace all straight walls longer than 24 feet that don't have offsets or pilasters. Corners, offsets, and pilasters add stiffness to a foundation wall, but as a rule of thumb we figure that the stiffening effect is negligible more than 12 feet away from the corner. Hence, straight spans longer than 24 feet need bracing.

For vertical bracing we use either scaffold boards or 3x12s (see Figure 1, next page). Another option is steel braces fabricated from 3-inch-diameter schedule 40 pipe, which we quick-bolt to the wall and slab (or pier pad). If for some reason the slab and pier pads can't be used for bracing, horizontal bracing is usually adequate. Attach 3x12s to all four walls, parallel to and about 4 feet above the footing. Then toe-nail 3x12s diagonally across the corners as shown. Add 2x4 cleats and kickers to prevent slippage and flex. This system works well for walls up to 48 feet long. Beyond that length, additional vertical bracing is needed, attached to pier pads, footings, or wood stakes driven firmly into the ground.

Although most building codes require that foundation walls be adequately braced before backfilling, most home builders don't use braces for poured concrete walls. They believe that the concrete is strong enough to resist pressure caused by backfilling. Sometimes they get by without damaging the wall. But too often a wall gets pushed in (Figure 2, next page). Sometimes this happens during the winter when concrete doesn't gain strength quickly because of low temperatures. Sometimes it's because the excavating contractor's equipment gets too close to the foundation, exerting extra pressure against the wall. And sometimes rain saturates the area around the foundation soon after it's backfilled, increasing soil pressures enough to cause wall failure.

Whatever the cause, the builder is left with a costly problem. Fixing it requires

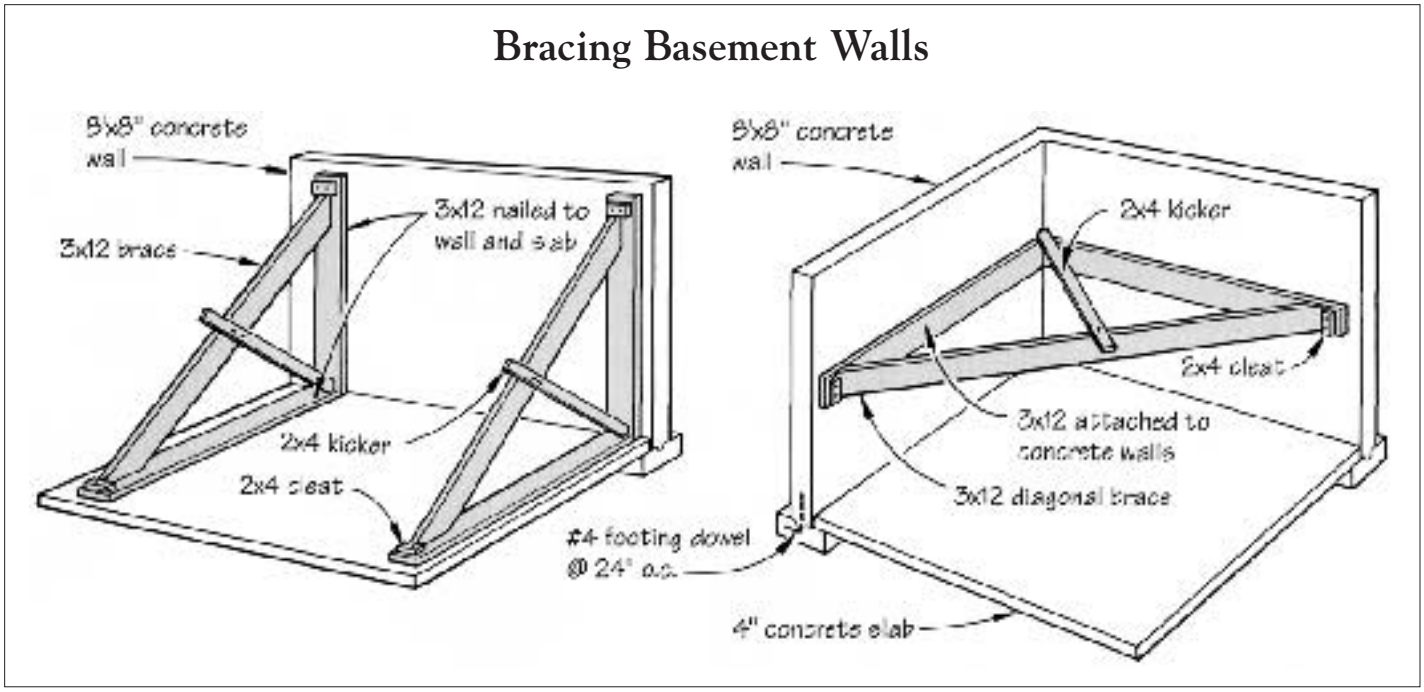

Figure 1. *If you have to backfill a foundation before the floor deck is in place, be sure to use plenty of vertical and horizontal bracing to prevent the walls from cracking and buckling. Vertical braces made from lumber or steel pipe work well (left). For straight walls less than 48 feet long, horizontal bracing also works (right).*

pushing out the bow in the wall and repairing the crack with epoxy injection. Having two carpenters work a couple of hours bracing a wall is a good investment against wall failure.

Choosing the Right Backfill Material

Some people recommend backfilling with a free-draining granular material, but I'm not so sure that's always a good idea. When you dig a hole in the ground for a foundation, water moves toward the hole just as it does in a well. A granular fill makes it easier for water to move toward the foundation wall. If the drain tile should get clogged (or if no drain tile was ever installed), then all that water is sitting against the foundation wall, waiting to cause moisture or frost problems.

I think the object should be to restore equilibrium, as nearly a possible, to the soil moisture system. That usually means putting back in the same soil that came out — *unless* it's a poor soil. If heavy, moisture-laden, or expansive clays are removed during excavation, granular backfill should be used, along with a good exterior drainage system protected by filter fabric (Figure 3).

Avoid backfilling with large clumps of clay or with soil full of roots, tree branches, or other organic materials (Figure 4).These materials won't compact well and will hold a lot of water even if the ground slope is steep enough to carry surface water away from the house.

The amount of overdig for a foundation is usually about 3 feet. Splash blocks for downspouts don't usually carry water more than a foot or two away from the foundation. So most of the water that comes off the roof may still end up next to the foundation if the backfill is porous.

Figure 2. *Backfilling an unbraced wall can result in bows (left) and cracks (right). Fixing these problems requires excavation, pushing out the wall, and installing new waterproofing — at a cost much greater than doing the job right the first time.*

Compacting the Backfill

As backfill soil settles, drainage patterns change and water may flow toward the house or pond next to the foundation. Compacting the soil reduces the amount of settlement that occurs with time.

Failure to compact the soil can cause basement leakage even before the house is completed. Figure 5 shows the results of poor grading and failure to compact the backfill. In this case, rain water collected in the trough caused by settlement and started leaking through shrinkage cracks in the foundation wall. Correcting the faulty drainage stopped the leaking.

Be careful when compacting backfill. Some compactors are powerful enough to damage the wall. One way to avoid this problem is to place the backfill in 6-inch lifts and have workers compact it with vibrating plate compactors or hand rammers. It takes more time to compact thin layers, but the method prevents foundation damage, as well as callbacks for drainage problems.

Final Finishing to Grade

Diverting surface water away from the foundation is one of the most effective ways to prevent basement leakage. The minimum slope for the finished grade should be 1/2 inch per foot for at least 10 feet away from the foundation. This is especially important if there are landscaping beds near the house. Watering plants in low-lying areas close to the foundation saturates the soil and makes basement leakage more likely.

If the house sits high enough on the lot, getting the correct grade for drainage isn't difficult. Too often, however, houses are built too low. Then, instead of the code-required 8-inch minimum between the sill plate and exterior grade level, the house might be built with the finished grade only 4 to 6 inches below the plate. To prevent this problem, avoid making the excavation too deep, and set footing elevations high enough. ■

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Figure 3. *Before backfilling, always install a good perimeter drain, using clean stone and filter fabric to prevent the drain tile from clogging over time. Here, a foundation contractor fits the filter fabric around a vertical flush tube, which allows the drain tile to be cleaned to prevent clogging.*

Figure 4. *Backfill soil should be free of tree roots, sod, and other organic materials that make the fill porous. Such fill can't be properly compacted and is guaranteed to settle with time.*

Figure 5. *Settlement can occur rapidly in poorly compacted fill. Water collecting in the low spots may cause basement leakage even before the house is completed.*