GOOD DETAILING FOR SUPPORT, MOVEMENT, AND MOISTURE CONTROL ARE THE KEYS

A brick veneer goes right over insulating board and wood studs. The veneer protects the house from wind.

Success with Brick Veneer

by Robert Beiner and Robert Rhault

Many home buyers like the low maintenance and quality look of a brick home. They can get this look without losing the insulation value of frame construction if they choose brick veneer. The veneer will never need painting; it will protect the house from wind; and if the work is done right, the veneer will last the lifetime of the house.

But contractors with a carpentry background may not understand the finer points of masonry-veneer construction. Mistakes made in foundation construction, in design, and even in homeowner maintenance can undermine long-term performance of brick veneer.

The brick veneer layer behaves differently than the structural wall behind it. Wood begins to shrink the moment a house is finished; concrete does too. But brick actually expands as it ages.

Unlike structural components, brick veneer can only support its own weight; in fact, it must be supported (see Figure 1). Think of veneer as a stack of dominoes; the higher the stack, the more unstable it becomes. A stack on a slanted surface is extremely unstable.

Finally, the brick skin isn't completely waterproof. Water squeezes through small cracks in the mortar, and the brick itself can absorb water. Small amounts of water evaporate without causing problems, but if brick is exposed to a downpour or to water-saturated soil, it can be damaged.

Four simple concepts will help you avoid problems and will help you understand the details that follow:

- Support the brick on a stiff, stable ledge.
- Tie the brick securely to its back-up.
- Leave room for expansion.
- Use flashing to keep water out.

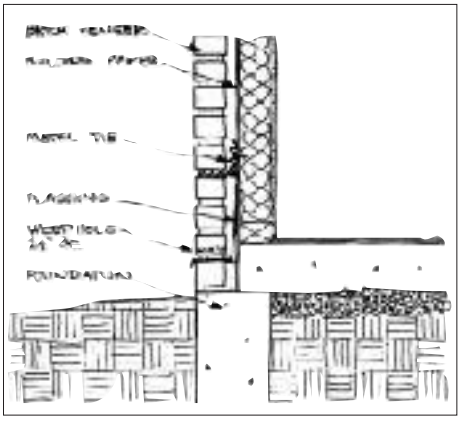

Figure 1. *The foundation supports the veneer. Elastomeric or metal flashing comes through the wall above the first brick joint. Metal ties connect the brick back to the structure.*

Vertical Support

If you support brick veneer properly, you're off to a good start. The foundation, the brick ledges, and the lintels all have to support the brick without moving or deflecting.

Firm footings. Contractors know they should build on undisturbed soil. This minimizes building settlement. Settlement is not necessarily bad for a structure, however. If a building settles uniformly, you probably won't see cracks in brick veneer.

A major problem will show up if a building settles at different rates across its foundation area. If differential settlement occurs, step cracks will occur and will follow the mortar joints (see Figure 2). The crack pattern will grow larger as it goes from the bottom to the top of the wall.

Even though uniform settlement probably won't hurt the wall, you don't want to take chances. The only way to guarantee that settlement won't damage the veneer is to make sure the underlying soil has been properly compacted. Don't throw in an extra shovelful of dirt just to save a little on concrete. In parts of the country where soil has a high expansive-clay content (like Texas), you may have to take special precautions. These can include subsoil foundation watering or foundation drainage systems.

Sometimes homeowner maintenance can cause problems with veneer. If you're brought in to repoint a cracked veneer, you should look for the cause. Poor drainage of surface water away from the foundation can cause settling. More often the problem is caused by a downspout spilling water against the foundation wall (see Figure 3).

Downspouts frequently end at the corner of the house. Water gathers around the foundation and percolates down to the footing or foundation slab. The moving water washes away fine particles of silt, creating voids in the soil and undermining the slab or foundation footing. Eventually, the weight of the house causes the soil to collapse, and a corner of the slab can crack off. In an extreme case, the foundation tips because the footing is undercut.

After you've repaired the damage, make sure you build up the soil level around the house so water drains away. Otherwise, you may be blamed if the crack opens again. Make sure all downspouts use extensions or splash pans.

Ledge. If you're sure the foundation's on solid footing, concentrate on getting a good brick ledge to support the veneer. The brick ledge should be large enough so that it will support two-thirds of the width of the brick.

Sometimes the contractor provides a 3 1/2-inch ledge, thinking this is adequate for the masonry. However, the contractor may also install 1-inch rigid insulation, taking the ledge down to 2 1/2 inches. The mason also needs finger room behind the brick. Without this finger room the mortar would push the veneer away from the wall. After taking away finger room, the mason is left with only 2 inches—less than the minimum needed. The mason's not going to stop work if you didn't leave enough room. He'll build it anyway. It's up to the general contractor to provide a minimum of 2 1/2 inches plus finger room for the veneer.

Brick veneer can be added to an existing building—even if no brick ledge was provided originally. But you will need to make a ledge from steel angle attached to the existing foundation. Place the angle at or below grade, and make sure it's corrosion-resistant. Also make sure you get an engineer to look at the angle size, foundation strength, and bolt size and spacing (see Figure 4).

Lintels. Poor lintel design is common. Lintels over garage openings or wide windows should be designed to minimize deflection (see Figure 5). With wood lintels, you should limit deflection to 1/600 of the span length or a maximum of 0.3 inches. This will prevent cracking of the supported brick veneer. Or, use steel lintels for openings that exceed 8 feet. Make sure you leave extra room at the ends of the lintel where it is supported on the masonry. Steel expands, and you need to leave space for expansion. Otherwise the expanding steel will induce high stresses and cause the surrounding brick to spall (see Figure 6).

For smaller openings, steel angles or reinforced-masonry lintels may be adequate. However, some builders leave out lintels over basement windows altogether. This is a poor practice that will lead to future window and veneer problems.

Tie it Tight

The brick veneer receives its vertical support from the foundation or from stiff horizontal lintels. But the veneer must also be supported laterally. This is the job of the tie-support system. The wall ties transfer the horizontal wind loads on the building into the structural system and ultimately into the foundation. The ties must be strong enough to resist tensile and compressive forces.

Follow these rules of thumb in low-rise construction:

- Use one tie for every 31/4 square feet of wall area, with a maximum spacing of 24 inches on-center, or approxi-

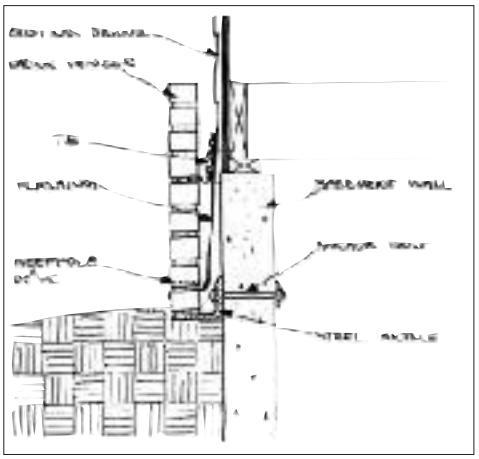

Figure 4. *When adding brick veneer to an existing building, the angle of the support shelf and the number of bolts tying it to the building must be figured by an engineer.*

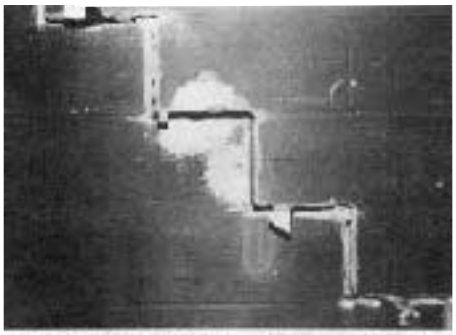

Figure 2. *We've used spray-paint to highlight differential settlement cracks on the inside of this foundation. You can imagine what the brick outside looks like.*

Figure 3. *This conductor pipe spills water down the foundation wall and excavates a trench below the footing.*

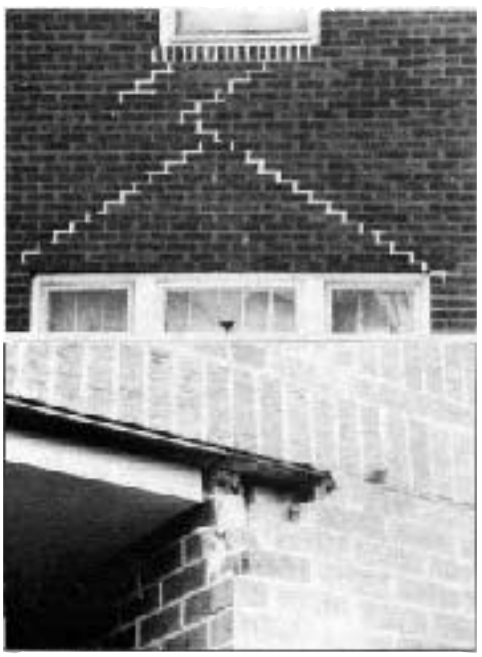

Figure 5. *Deflection of a wood window frame caused the triangular chunk of brick above the window to drop. The brick was only supported by the window frame.*

Figure 6. *Expansion of the steel lintel caused this brick to spall.*

Preventing Common Problems

Of all the essentials of brick-veneer construction, none is more important than proper detailing. The majority of problems that occur during the service life of a building are centered around the proper detailing of such items as flashing and weep holes. Caulking and sealants for sills, jambs, shelf angles, lintels, and parapets should also receive special attention. If the detailing is well thought out and construction is done according to plans, the nagging problems of efflorescence, water penetration, brick cracking and spalling, and wall bowing can be virtually eliminated.

Let's examine some common problems and how to avoid them.

Wood shrinkage. Wood shrinks far more along its width than it does along its length. Every time you place horizontal members, you have the potential for wood shrinkage. Floor joists, for example, shrink more across their width than studs do along their length. With a two-story, split-level house, you may have as many as three platforms. If you're using a brick veneer, you're going to have to allow for shrinkage of the wood and expansion of the brick.

Problems often occur beneath windows. Leave room for the window to come down to the brick. If you don't take shrinkage into account, the window frame can come down hard on the brick. The window will jam and become inoperable.

A similar problem occurs with half-height veneer on a single-story house. When the wood shrinks, the siding can come down tight onto the veneer. If the soldier course has been flashed, the flashing tips toward the house, causing water to drain toward the inside. Even if no flashing is used, the siding will frequently be so tight that it will begin to buckle or rot. To avoid this, leave room between the flashing and siding for shrinkage, but tuck metal flashing behind the siding so that the gap does not allow water to penetrate.

Depending on the height of the building, you could get as much as 1/2 to 1 1/2 inches of shrinkage in the wood frame. You can try to overcome the shrinkage problem by using balloon framing. If you do, however, make sure you also use balloon framing for interior walls. On one job, the contractor tried to protect the veneer on a three-story apartment building by using balloon framing on the exterior walls. But he used platform framing on the inside walls. He had so much shrinkage inside that a 10-foot row of cabinets sloped 2 inches toward the center of the building, and plumbing vent-stack flashing popped through the shingles.

Another way to tackle shrinkage on multi-story buildings is to support the veneer with shelf angle at each floor level. Leave an expansion joint below the shelf angle. Use a foam neoprene pad in the joint, and face the joint with backer rod and sealant.

During design and planning, consider how wood shrinkage will affect the veneer and the structure. Leave enough room so that wood shrinkage and brick expansion won't damage the structure or the veneer.

Flashing Problems. Brick needs flashing to stop the flow of water. In Figure A flashing was left out below the sill. Notice the efflorescence. This is salt that rises to the surface as brick goes through wet/dry cycles. The surface efflorescence shows that water has entered the wall at the sill. Over time, through freezing and thawing, there is a good chance the brick will begin to spall.

Parapets are exposed on both sides to the weather. It's easy for water to get in. Parapet design should be considered carefully before construction begins. Notice the manner the wall was capped in Figure B. The numerous brick joints allow water to enter the wall. Cap the wall with large pieces of stone, continuous metal, or glazed terra-cotta tile coping. This allows fewer joints and less down-the-road headaches. But remember to properly seal the coping joints with sealant. Figure c shows what happens if the sealant is inadequate or omitted. The mortar has begun to fall apart. Not only will wall damage eventually occur, but efflorescence will result, as shown in Figure D.

Figure A. *White powder on the surface of masonry indicates the brick is saturated with water.*

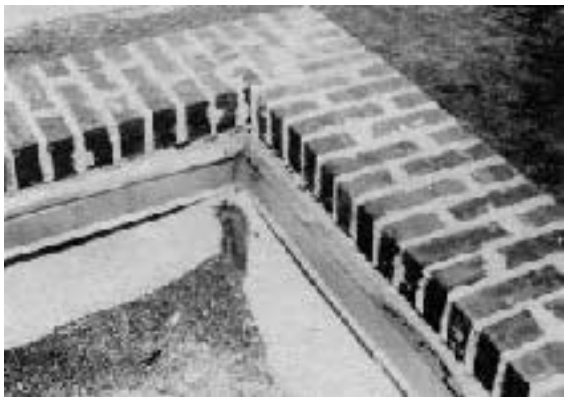

Figure B. *Parapet walls, exposed to weather, are vulnerable to water damage.*

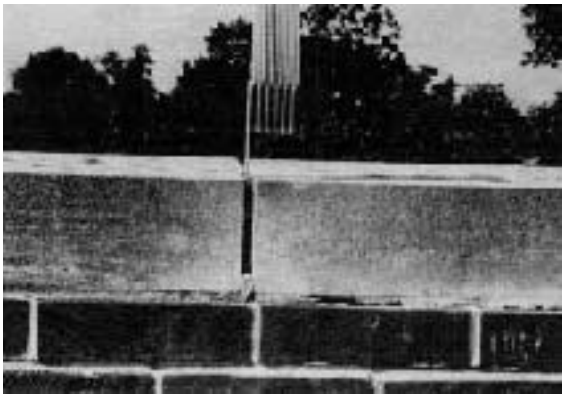

Figure C. *Cap parapet walls with stone, metal, or tile. But be sure to seal the joints. If sealant is not maintained, mortar deteriorates.*

Figure D. *Water spilling out weep holes leaves a trail of efflorescence. With no flashing to cover the flat brick parapet ledge, damage like this is bound to happen.*

mately one tie per stud every 6th or 7th course.
- For a concrete masonry back-up, use continuous horizontal joint-reinforcement with U-tabs or individual Z-ties.
- For wood framing, ties should be corrosion-resistant corrugated metal, at least 22 gauge, 7/8 inch wide and 6 inches long.

Engrave these numbers in your mind—maximum spacing of 24 inches on-center. Put a tie about every 6th or 7th course. You see a lot of veneer installed with no wall ties. The mason might tell you ties aren't needed for a one-story building, but they are. Winds whip across the prairie and along the coasts, and even an occasional high wind can put unacceptable stress on a veneer wall.

Make sure the ties are corrosion-resistant, particularly in coastal climates or areas where rainfall is high. Also, if you're building in winter, heat your water and materials instead of using an admixture. Admixtures can cause tie corrosion and veneer failure.

Leave Room for Expansion

Walls are subjected to movement. Thermal expansion and contraction, moisture absorption, material shrinkage, or building loads may cause movement of the building components. Provide room for this movement so it won't damage the veneer. The main way to handle movement is with expansion joints.

Expansion joints. Expansion joints look like a long, vertical slice down a brick wall. You'll see them near corners of large buildings. Expansion joints are placed in brick masonry construction to prevent overstressing of the veneer. Expansion joints prevent cracking due to thermal movement, moisture-absorption, and load effects. Since the brick is exposed to the outside, temperature and moisture changes can be significant. A south-facing wall, for example, can experience temperature swings of 140°F in a day.

In residential construction most walls are relatively short. Accumulated movements are usually not large enough to warrant expansion joints. However, long walls—75 feet or more—can have problems. Problems also occur where there are abrupt changes in wall geometry. If you're building a long ranch house, with the brick veneer facing the sun, you may need to use expansion joints.

The approximate amount of expansion from the various sources can be calculated by an engineer. When you build an expansion joint, however, you'd better make sure the joint is about twice as large as the anticipated movement because the mason will fill this joint with sealant. If you don't provide enough room for the volume of the sealant, it will squeeze out of the joint during maximum expansion, and the water seal may break. In repairing a wall that has cracked because of wall movement, you should never seal the crack with mortar. Always repair with a compressible sealant to prevent further distress.

Keep Water Out

The fourth concept is probably the hardest to accomplish in practice. That's because there are many ways for water to enter a veneer wall. And in residential construction, masons do not always follow recommended industry practice. For example, it's common for masons to leave out base flashing. But base flashing is one of the most important safeguards against water damage.

Flashing. Although it's common not to use base flashing, it is very important and should be used. Even when it is used, it is often torn or damaged during construction. Figure 7 shows how to do the job right. The bricklayer is lapping and sealing the flashing to ensure a continuous membrane. He has also extended the flashing beyond the exterior face of the brick. This will direct water that enters the wall to exit on the exterior face. Water won't accumulate in the cavity between the block and the veneer.

Figure 7. *The bricklayer laps the flashing and seals the joint. Loose bricks hold the flashing in place and ensure that it won't get bunched up in the wall or torn during construction.*

Weep holes. In case water should get into this cavity, the mason must provide channels for it to escape. Put weep holes every 24 inches on-center directly above all flashing. Some contractors incorrectly place weep holes several courses above the flashing. This can cause problems since it allows water to accumulate from the flashing up to the exit point. The water may freeze, and the resulting ice can put pressure on the brick, causing cracking or spalling.

Also, the mason should make sure the mortar droppings do not clog the weep holes. One way to keep weep holes free is to use short lengths of cotton sash cord. Place the cord where the weep holes should be, but make it long enough so it will stay above the mortar droppings. Water will wick out the sash cord. When the sash cord eventually rots, the weep hole will be free.

Another way to provide weep holes is to leave out every third brick in the base course. As the wall goes up, the brick mason can have a helper clean out the mortar droppings. When the wall is finished, the mason mortars in the missing brick, leaving out the head joint (the joint at the side of the brick). You'll have weep slots right where you need them.

The masonry contractor should also flash any horizontal brick ledge or surface. Suppose, for example, the brick veneer is only half the height of the wall. A flat soldier course will collect water. The soldier course should either be flashed or sloped to shed water. It's best to avoid flat soldier courses altogether.

Mortar and brick quality. The quality of brick and mortar can affect how much water gets into a wall. On the one hand, porous brick absorbs water. On the other hand, very hard-fired brick may not bond as well with mortar. Without a good mortar joint, the wall may leak, even though the brick is not porous. Brick with about 6- to 9-percent water absorption by boiling (ask for bricks that conform to ASTM C216) provides good bonds.

Mortar quality is also critical. The mason should be using mortar made from portland cement and Type S (fully hydrated) lime. Cement makes the mortar strong, and lime makes the mortar "plastic." Lime mortars fill in small cracks that could otherwise allow water to penetrate the wall.

Make sure the temperature doesn't fall below freezing until the mortar cures because ice crystals can form in mortar. The mortar may eventually cure, but the crystalline holes will be embedded in the joints. Even a normal rain will get through the joints and leak into the house.

Good Construction

Brick-veneer buildings are pleasing to the eye, sturdy, and economically valuable. Most problems with brick veneer are due to a lack of knowledge about the simple details that make the building function. A small effort taken in planning, design, and construction will reap great rewards in a well constructed and maintenance-free structure that will last for many years. ■

Robert J. Beiner, P.E., is Director of Technical Services for the International Masonry Institute, Washington, D.C. and Robert Rhault is the New England Regional Director of the International Masonry Institute.