Installing a Wide Door In a Tall Brick Wall

by Rob Corbo

In this renovation, engineered steel braces support a solid brick wall from the outside without disturbing the interior

A quick review of the prints told me that this renovation was going to be different. There would be the usual Hoboken, N.J., hurdles, of course — limited parking, virtually no backyard access, and inconvenient curbside deliveries — which would make delivery of materials for the home's new garden-level media room a logistical obstacle course. But the project also involved a unique challenge that would make things even more interesting: We would be cutting an opening large enough to accommodate a new 12-foot-wide, four-panel glass door in a 12-inch-thick, 30-foot-high brick wall (see Figure 1, next page). To install a steel header for the door, we'd first need to shore up 22 feet of brick masonry above the new opening.

Opening a solid brick exterior wall always requires care. Generally, our approach is to needle steel supports all the

way through the wall, fortifying them on both sides with temporary girders and posts. But this particular door installation was complicated by the fact that only the ground floor was being renovated; with a finished kitchen located above the new media room, drilling through the wall wasn't an option. The temporary opening would extend above the kitchen floor joists, and we would have to support the exterior wall from one side only. Because the joists run parallel to the exterior masonry wall and are pocketed into the side party walls, there was no need to support them.

An Engineered Shoring Plan

Though Axis Architectural Studio, of Englewood, N.J., and Feller Design, of Hoboken, N.J., provided us with a fine set of prints to work from, there was no shoring plan for supporting the wall during construction. I enjoy a challenge, but I elected to turn this problem over to an engineer.

There was a time when we felt it was our responsibility to implement the plan as presented and, ultimately, assume all the risk. But as our projects have grown in complexity, we've come to recognize where our own area of expertise ends and that of other professionals begins. Now, if we determine that additional drawings are needed to build a project safely, a clause in our contract allows us to commission them from the appropriate professional. If the additional cost becomes a factor, we'd rather walk away from the project than risk creating an unsafe condition.

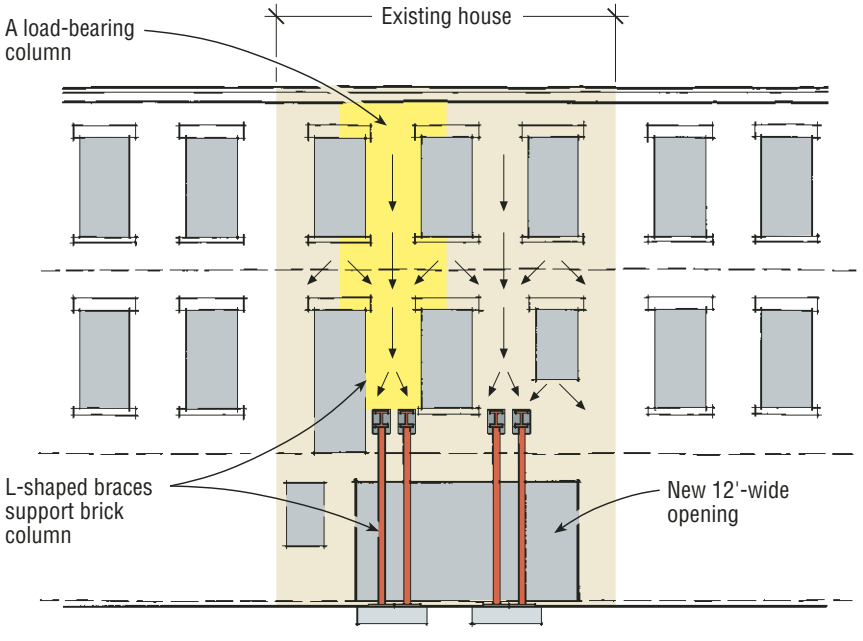
Structural engineer Rich Herschlag, of Turn-key Structural in Easton, Pa., identified four 36-inch-wide load-bearing brick "columns" within the exterior wall, each receiving loads from the numerous door and window headers stacked above each other. The left and right columns that were clear of the proposed opening wouldn't need to be supported, but the two middle columns would (Figure 2, next page).

The plan called for four identical L-shaped steel braces — which cost about $675 each to fabricate — to be fastened to the brick wall from the backyard side, with each of the middle load-bearing columns receiving two equally spaced braces. Inserted 8 inches into the 12-inch-thick wall and positioned roughly

Figure 1. As the centerpiece of an extensive garden-level remodel, the new four-panel glass door would open up the ground level to the backyard, filling the dark room with natural light. First, though, a 12-foot-wide rough opening needed to be cut in the solid brick exterior wall of the Hoboken, N.J., home.

Figure 2. After analyzing critical load paths and identifying the structure's main load-bearing "columns" (shown in the drawing at bottom), a structural engineer designed braces to temporarily shore up the 30-foot-tall, solid masonry wall during construction. Welded from steel I-beams and bolted to poured concrete footings, the four identical braces would support the home's masonry wall from the outside without disturbing interior finishes.

Tributary Load on Steel Beams



2 feet above the kitchen floor joists, the braces would support the exterior masonry wall without disturbing the kitchen wall. Each brace would be bolted to a footing so that it wouldn't kick out from the load (Figure 3, next page).

Because we felt that concrete footings formed on the surface also might kick out, we decided to bury the footings in the ground to help anchor them. We used a transit to verify that the top of each footing was level with the other (Figure 4, page 5).

While the concrete cured, we laid out the rough opening for the new door. On the left side of the new opening (as viewed from the backyard), we needed to remove a small window and close up the opening with brick. Another window located entirely within the rough opening would disappear after demolition for the new door. The window on the far right was a different story: It would be bisected by the rough opening, so we needed to remove it and brick

Cantilevered Steel Brace

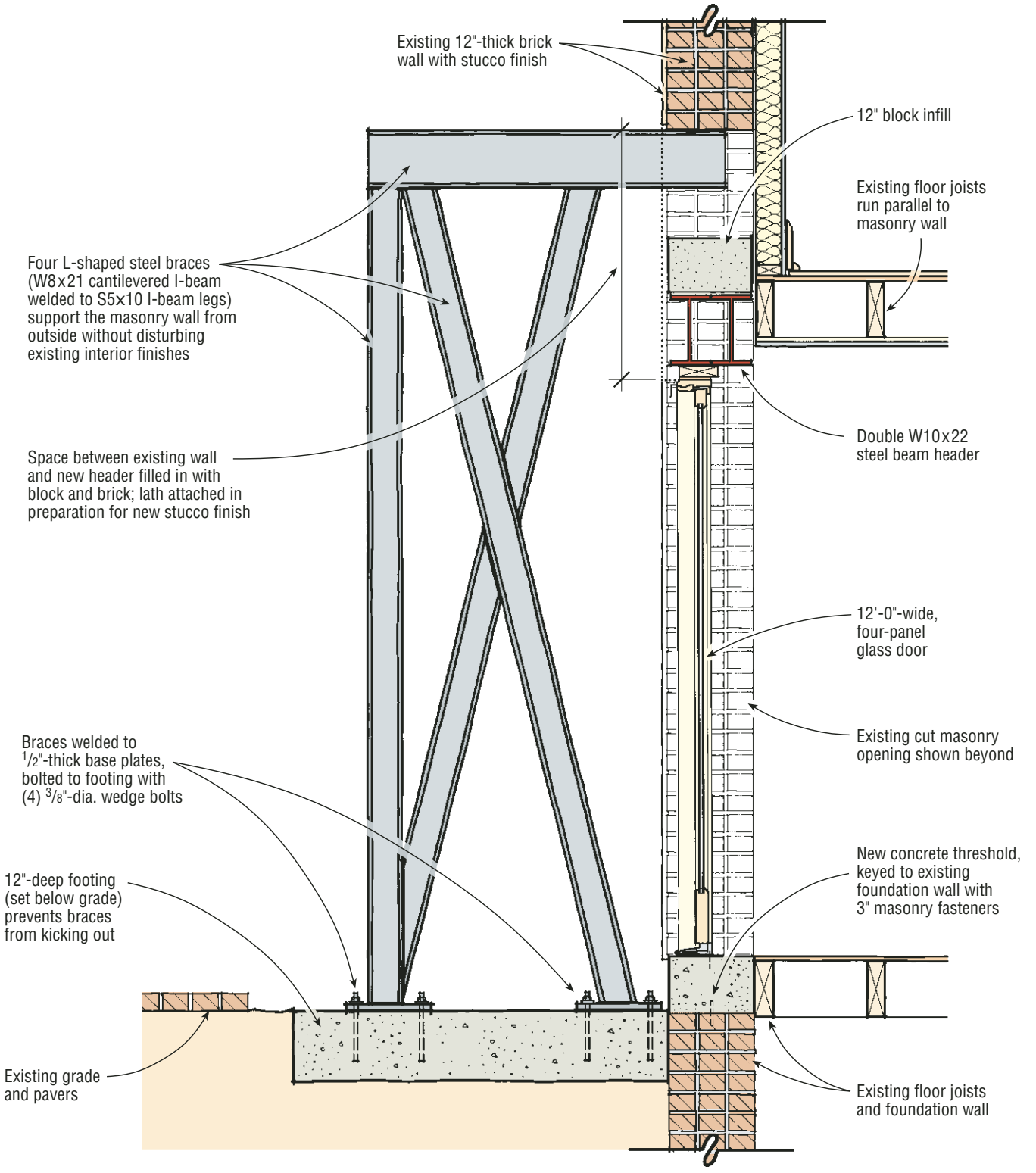


Figure 3. Anchored to poured concrete footings, the four cantilevered steel braces were designed to support vertical loads of 9,900 pounds each without any deflection, so that the solid masonry wall above the new opening wouldn't crack.

Figure 4. To prevent the braces from kicking out from the wall under load, the footings were buried below grade. The author used a transit to make sure the poured footings were level with each other.

Figure 5. After placing the braces on their footings and marking their positions on the wall, the author's crew cut 8-inch-deep pockets into the 12-inch-thick masonry wall for the upper shelf of each brace.

over half the opening. We started our brickwork off the foundation wall and used brick ties on every other course to assure a strong connection between the new brick and the old.

To get the 400-pound braces into the backyard, we removed the sash from one of the garden-level front windows and passed each brace through, a task made easier by their L-shaped design. With the braces temporarily set into position on the footings, we marked their location on the façade. We were lucky that the top of each brace fell 1/2 inch below a mortar joint, which meant we'd need to do minimal shimming. Had the pocket height fallen within a brick, we might have had to shim the braces as much as 2 inches. In hindsight, it would have been better to have approximated the pocket locations before pouring the footings, chipped away the stucco to reveal the bricks and mortar joints, and then determined an optimal footing elevation with the help of a transit.

We used an angle grinder with a diamond blade to score the stucco and outline the pockets that would temporarily house the braces. A rotary hammer equipped with a chipping bit made quick work of the brick as we cleared the pockets (Figure 5). Finally, we inserted

the four support braces. We shimmed where necessary, using wood ripped from 2x4s and pounded into place, and bolted the base plates securely to the footings with wedge bolts (Figure 6).

Cutting the Rough Opening

After marking the rough opening, we scored the wall with the grinder and started chipping away. Although we were confident the braces would support the wall, we still worried about the kitchen's ceramic-tile floor and a granite countertop positioned against the exterior wall: Too much movement might crack one or both. So as we tackled the wall below with our rotary hammers equipped with chisels and points, we monitored conditions in the kitchen above. Fortunately, the braces held everything securely in place, giving us the time we needed to get the rough opening right.

To help smooth out the edge of the section of wall that we had chipped away, we built a plywood form sized to cover half the height of the wall. We first braced the form at the bottom of the wall and then filled it with mortar, pounding the form with a lump hammer to get the mortar to settle and fill in around the ties we had inserted into the old brickwork. The following day, we shifted the form up and finished the top half.

Before inserting the steel beam and installing the new door, we had to create a level threshold. We began by cleaning up as much of the old foundation wall coming up from the basement as we could with a chipping gun. Then we drilled, vacuumed, and screwed 3-inch-long masonry fasteners into the top of the wall, leaving 1 1/2 inches exposed to help tie the new concrete to the old masonry as we formed and poured the new threshold. After marking both the left and right walls at 82 1/2 and 92 1/2 inches to indicate the top and bottom of the beam, we chiseled 6 inches into the walls to create ledges for the beam to sit on, adding 1/2 inch to the rough opening to accommodate steel plates under each end of the beam (Figure 7, next page).

Setting the Header and Installing the Door

The original plans called for a single W14x38 steel beam (measuring 14 inches high by 6 3/4 inches wide, and weighing 38 pounds per lineal foot), fabricated with a brick shelf composed of three 3 1/2-by-3 1/2-by-1/4-inch angles welded together. But the estimated weight for that girder was 675 pounds, way more than we wanted to handle, so Herschlag substituted two 285-pound W10x22 steel beams (measuring 10 inches high by 5 1/2 inches wide by 13 feet long, and weighing 22 pounds per

Figure 6. Once the braces were maneuvered into position, the crew shimmed them (above) and bolted them securely to the concrete footings with wedge bolts (right).

Figure 7. Formed on top of the broken-out foundation wall, the newly poured threshold offered a smooth, level reference point for laying out the rough opening. The brick side walls shown in the photo at right would receive a smooth mortar cap before installation of the new door.

Figure 8. A pair of 5½-by-10-inch steel beams supported the masonry above the new door opening. The author chose to install the door before removing the braces, making it easier to secure the site during construction.

lineal foot, at $275 each) for the W14x38. While not exactly light, these beams were easier to wrestle into position, and their combined 11-inch width was better suited to the 12-inch thickness of the wall. Because the exterior façade had a cover of stucco, we were able to substitute concrete block for brick to rebuild the section of wall above the girder, thereby eliminating the need for the brick shelf.

After we insulated around the girder with fiberglass and spray foam, we were ready for the door. We could have finished patching up the exterior wall at this point and removed the braces, sparing ourselves the risk of dropping something through the glass below. But, for weather and security purposes, we elected to install the door first (Figure 8).

To get the door from the street to the backyard, we had to completely disassemble the 12-foot-wide Marvin "knockdown" unit, which meant breaking down the frame as well as the four door panels. Fortunately, the care we'd taken to square and plumb the masonry paid

Figure 9. Because the masonry wall has a stucco finish, economical 12-inch block instead of brick was used to fill in above the new steel header (above left). The author's crew made sure each section of wall was well supported with block before removing the braces, one at a time (above). Mortar dye added to the stucco matches the new work to the existing wall (left).

off when we reassembled the frame in the R.O. Installing the door first turned out to be a great decision, as it made the site easy to lock up at night, kept out the winter cold, and filled the basement with light.

Finishing Up

With the door installed and the steel girders in place, we finished blocking up the opening. As we laid block, we removed one brace at a time and filled each pocket before removing the next. After each support was removed and the opening blocked, we padded out the steel web with plywood, then fastened wire mesh over the steel and block in preparation for the stucco. We experimented with mortar dyes to approximate the existing stucco color and did our best to blend the new with the old (Figure 9).

We spent the next week working on the interior, but that wall of glass (Figure 10) never let us forget there was 1,600 pounds of steel that we had paid $2,700 for sitting in the backyard. Because the only access to the backyard was through the house, we needed to get the steel out before turning our attention to the extensive interior finish work. After discussing over a few lunches whether we wanted to store these expensive braces in our shop, we decided to keep life simple: We cut them up and scrapped them for peanuts.

Figure 10. The wide glass door brings plenty of light into the new ground-level living space and offers easy access to the backyard.

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