A Steel Door in a Brick Foundation

BY JOHN CARROLL

Photos by Werner Lehenbauer

The author opens up a window opening for the door **(1)** and then forms a new sill **(2)**. Bolts threaded onto the jambs form masonry anchors for the side jambs **(3)**. To anchor jambs to the sill, he drills holes **(4)** and then drives Tapcon concrete anchors into the holes with a flexible drill **(5)**.

Last year, clients approached me to install a door at the rear of their walkout basement. They'd attached a workshop to their home, but access to the shop required walking outside in the elements. The only protected route involved climbing through a window, which they had been doing in the worst weather. The plan was to expand the window opening and install a door.

The location of the new door was ideal for access, except for one detail: The rear of the house faced a wooded area, and the new door would be completely hidden from the street and from neighboring houses. A recent break-in at a nearby home made the clients concerned that the secluded location of the door might be attractive to thieves. For maximum security, they wanted a heavy-duty steel door hinged to a steel frame.

At a local supply house, we found a commercial-grade steel door that would fit perfectly in the width of the brick window opening ($40\frac{1}{8}$ inches). But at 80 inches high, the door was too tall for the opening. To make the door fit, I'd have to expand the opening up a few inches and remove the masonry below the window.

Prepping the opening. Like many foundation walls in North Carolina, these basement walls consisted of a wythe of 4-inch-thick block on the inside and a wythe of 4-inch brick on the outside for a total wall thickness of 8 inches. After removing the window, I took out the brick and block below the opening down to a few inches below the basement floor level. Above the window, I removed the steel lintels and then took out a couple of courses of brick on both the inside and the outside. (The original masons used brick instead of block to fill in the space above the inside lintel). As I took out the brick above and below the opening, I toothed out the brickwork to maintain a running-bond pattern.

After removing the masonry, I formed and poured a concrete sill precisely level and one inch above the floor to work properly with the anticipated basement floor covering. On the inside, I set a 1-by board on edge and shimmed it level for the form. On the outside, the door stepped down a few inches to a patio, so I ran the outside form board past the bricks on each side, holding the top even with the interior form. Concrete blocks held the form tight against the bricks during the pour.

Anchoring the door frame. The biggest challenge was anchoring the metal door frame solidly to the sill and the wall. The owner wanted a door that would be a formidable barrier with the frame bonded tenaciously to the opening. I needed to position the door frame precisely. Once a steel frame is set in masonry, it can't be adjusted, and unlike a wood door, a steel door cannot be shaved to fit.

After letting the concrete sill cure for three days, I was ready to install the welded-steel frame. Each side jamb of the frame had four predrilled holes with a dimple around each one to serve as a countersink. I inserted 3-inch-long, $5/16$-inch-diameter flat-head machine screws into the holes and secured them with nuts on the other side of the frame. Then, at each location, I threaded on a second nut about 2 inches from the first, followed by a fender washer and a third nut. Then I tightened everything together with wrenches. Later, when I filled the jamb channels with concrete, these assemblies would embed in the concrete to mechanically anchor the frame in the opening.

With the anchors attached to the jambs, I was ready to bolt the frame to the sill. After setting the frame in place on the concrete sill and making sure it was straight and plumb, I marked the locations of the holes in the attachment plates welded to the bottoms of the jambs. I took the frame out, drilled the holes, and then set the frame back in place. I screwed the jambs to the sill with Tapcon bolts made from steel that was hard enough to cut threads in the green concrete. Toothing the brick next to the jambs gave me plenty of room to fit my hand and the flexible shaft of a nut driver inside the channel, so I was able to use a cordless impact driver to drive the Tapcons.

With the frame attached to the sill, I clamped on braces to hold it plumb. The basement ceiling joists provided good anchor points for the upper ends of the braces. I also notched three temporary 2x6 spreaders into the door opening to keep the sides straight while I filled in the toothed-out sections with brick and grouted the jamb channels.

Filling in around the frame At the bottom of the jambs, I laid five courses of bricks, filling in the toothed-out area over to the steel door frame. Following the recommendations of the Steel Door Institute, I filled in the steel frame channel with mortar as I laid in the courses.

At the top of the frame, I laid single bricks at each corner, which brought the masonry to a point about $1/2$ inch above the top of the head jamb. These bricks would support the two steel lintels (one for the inside wythe and the other for the outside wythe) that would span across the opening. After laying these bricks, I stopped for the day to allow the mortar to set up.

The next step was grouting, or filling in, the rest of the channel with concrete. I kept the three 2x6 spreaders in place to keep the frame from bulging inward as the channel filled. I'd made the spreaders $1/16$ inch longer than the width

Braces clamped to the frame and attached to the joists hold the door frame in place **(6)**. Spreaders keep the jambs from bulging inward while the brickwork and grouting is completed **(7)**. Bricks fill the toothed-out sections near the bottom of the opening **(8)**, and bricks at the top corners of the frame bring the masonry to a height $1/2$ inch above the header jamb **(9)**.

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The author grouts the jamb channels from the top, scraping the mix into the header channel and pushing it into the sides **(10)**. After filling the head channel about two-thirds of the way, he embeds rebar in the mix **(11)**, then finishes grouting **(12)**. Steel lintels (seen above the door) sit on top of the corner bricks and support the brickwork on both sides of the door **(13)**.

of the opening. The tight fit ensured that the door would not hit the jamb after it was installed.

I'd grouted the bottom foot or so of the channel with mortar as I filled in the brick, and now I had to grout the rest of the jamb channels from the top. Before mixing the grout, I put screws into the threaded holes for the hinges and strikes to keep them from being filled up with grout mix. I also put pieces of rigid foam insulation in the slots that would receive the door bolt and the deadbolt.

I made the grout mix out of bagged concrete enriched with Portland cement. The grout needed to be somewhat loose because it had to go more than 5 feet down the channels, flowing around and completely embedding the anchors in the frame. I added plenty of water to make sure the mix flowed readily. A rich, wet mix would also suck deep into the pores of the brickwork, ensuring a tenacious bond. To get the grout into the channels, I loaded up my hawk and used a margin trowel to push the mud onto the header section of the frame and then down into the side channels.

When both side channels were full, I stopped and let the grout cure for two days before removing the spreaders and the braces at the top of the frame. With the braces out of the way, I mixed another batch of grout and filled the (horizontal) head channel. When the channel was about two-thirds full, I placed a length of 1/2-inch rebar in the concrete, letting the ends of the rebar extend a few inches on both sides into the groove between the inside and outside wythes of brick. The rebar provided an additional mechanical connection between the frame and the masonry at the top corners.

Finishing the brickwork. I finished grouting to the top of the header channel and again gave the grout two days to set up. The final steps were setting the lintels and finishing the brickwork on the inside and outside. The steel lintels I'd taken out earlier were in excellent shape, so I was able to re-use them.

When I set the lintels on the top corner bricks, they had about 4 inches of bearing on each side of the door frame and sat about 1/2 inch above the header jamb. I spread a layer of mortar over the grouted header channel to fill in below the steel lintels. After setting the lintels in place, I laid a single course of bricks over the inside lintel, and two courses over the outside lintel. I used tuck pointers to completely fill the joint between the new bricks and the existing masonry with mortar. Although painstaking, it was necessary to fill these joints solidly because the area above the lintels was load-bearing.

After tooling the joints in the brickwork, I installed the hinges on the frame and the door. Then I hung the door and everyone took a deep breath. To everyone's relief, the door fit perfectly.

John Carroll, author of Working Alone, *is a builder who lives and works in Durham, N.C.*

Tile-Membrane Origami

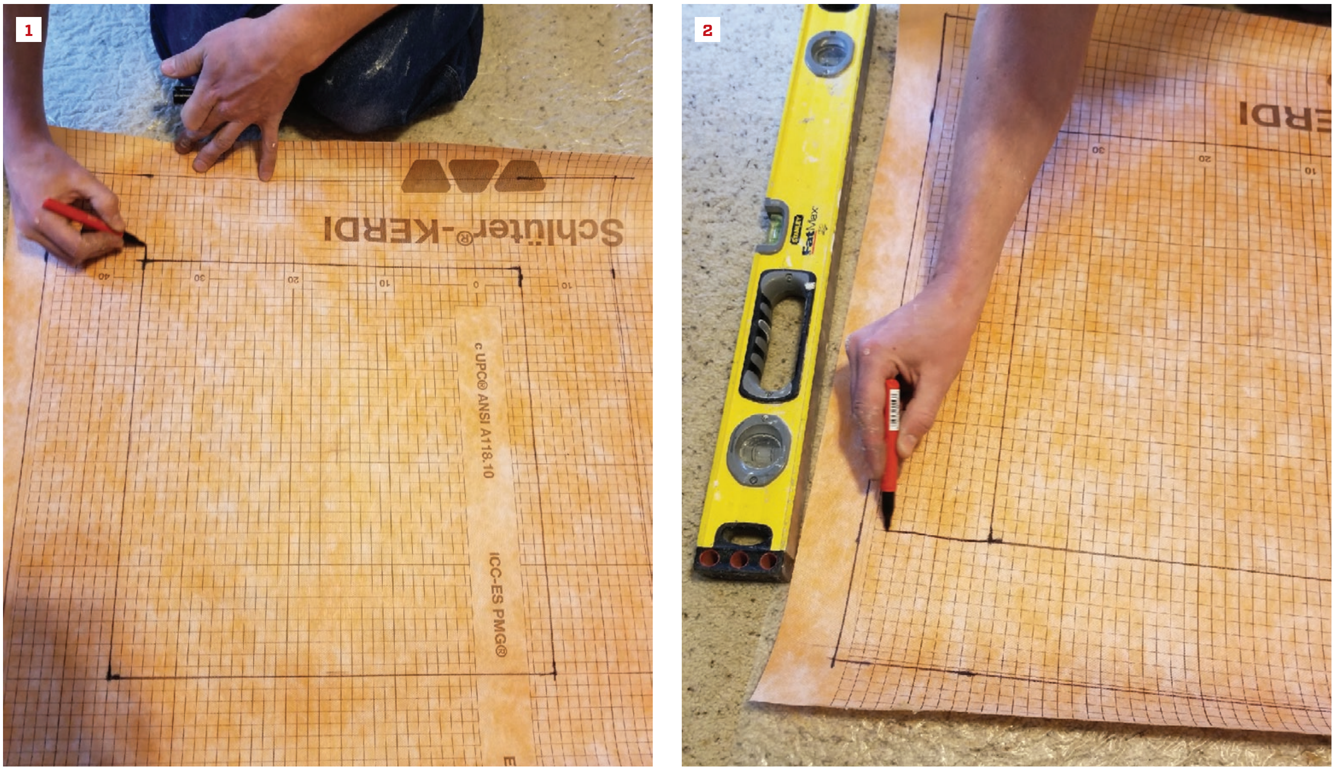
BY JAKE BRUTON

Schluter waterproofing has been our go-to product for almost every tile job for the last 10 years. The primary waterproofing product we use is the Kerdi membrane. It has a tough modified polyethylene core with non-woven polypropylene on both sides that bonds well to thinset mortar. The membrane is anchored to backerboard with thinset, and it provides a good foundation for thinset to hold the tile. Kerdi is lightweight, simple to install, and virtually idiot-proof.

We do all our own tile work in-house, and the only downside for us with the Kerdi product has occurred in situations that require multiple layers of the membrane. These can result in lumps, ridges, and generally uneven surfaces, over which setting tile is difficult. The place this occurs the most is in a shower niche or inset. With layers of Kerdi coming from top, bottom, and all sides, the inset can have multiple layers on multiple surfaces.

After working with the membrane for years, we developed a method that prevents lumps and unevenness by minimizing the number of layers and that uses only one piece of Kerdi. It's a little like origami but isn't too hard to execute once you see how it's done.

Jake Bruton is the owner of Aarow Building in Columbia, Mo. Follow Aarow Building on YouTube, and follow Jake @jakebrutonlive on Instagram.



One sheet of Kerdi. The author starts by drawing the back wall of the inset or niche on a piece of Kerdi. He expands that box to include the depth of the inset on all sides and then adds the prescribed 2 inches of overlap as the outside dimensions of the Kerdi paper. For this example, the interior box is 15 inches square; the second box is 23 inches square (2x4 wall with 1/2-inch drywall); and the sheet size is 27 inches square **(1)**. With the perimeters defined, the author then draws a line from the corners of the interior box to the edges of the exterior box to represent either a cutting line or a folding line **(2)**.

Photos by Jake Bruton

Cut out. While Schluter doesn't prescribe a specific way seams should lap, the author adheres to a shingling method to prevent potential water leaks. To achieve this, the top, or "ceiling," of the inset is cut from the interior box outward, leaving flaps that will fold over the sides **(3)**. Similarly, the sides are cut downward (toward the knees in this photo) to create flaps that will lap onto the base, or "floor," of the inset **(4)**. The entire piece is folded and scored once; the creases provide some rigidity needed for the install **(5)**. We then apply thinset to the entire opening **(6)** and are ready to install the precut, prefolded sheet.

Installation. Starting at the bottom, the author aligns the back corner and presses the membrane into the back wall and bottom of the inset **(7)**. He adds thinset to the bottom corners so the side flaps will adhere over the base. The side walls may then be pushed into the thinset. After the side walls are secure, he adds more thinset to the top of the sides to adhere the top flaps onto the walls. He then presses the flaps and ceiling of the inset in place. All that remains is to spread thinset on the surface of the shower and press the 2-inch perimeter flaps into place **(8)**.

Two-Story Block Addition

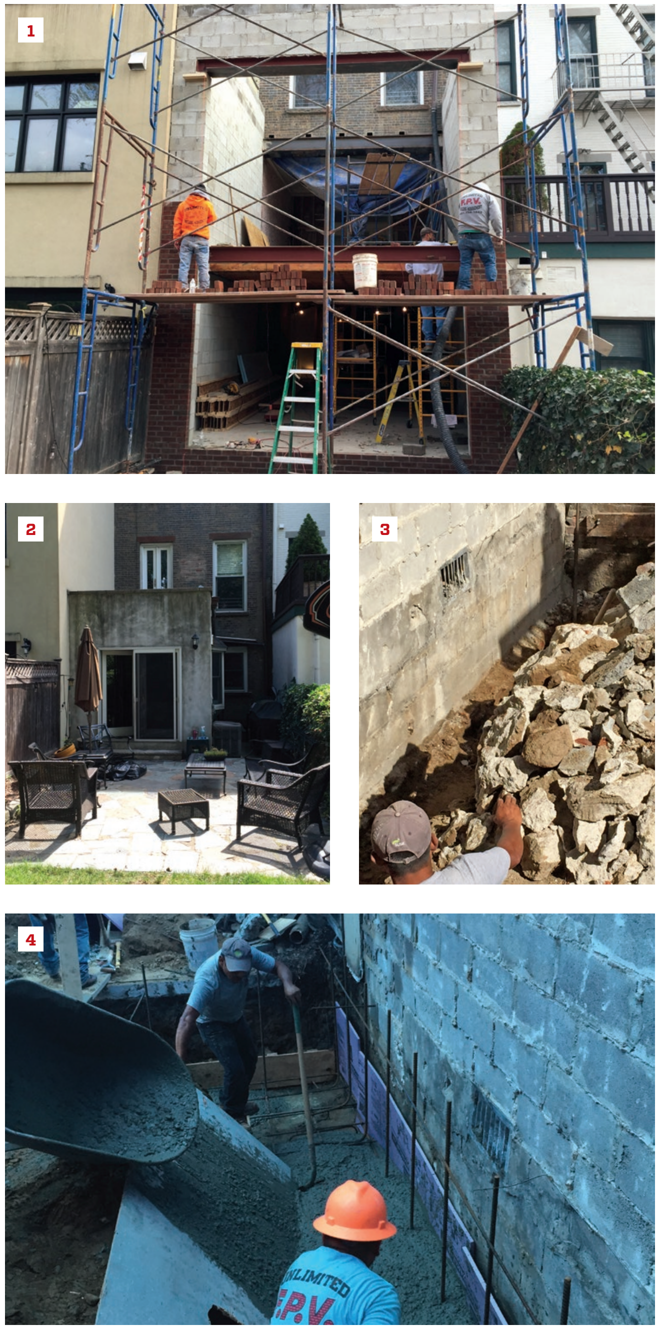
BY ROB CORBO

My company, R Corbo Improvements, specializes in remodeling inner-city row houses in Hoboken, N.J. For the last few years, our work has largely centered around rehabbing the lower two floors (of these four-story homes) into modern kitchen and living-room spaces. An important part of the renovations has been to introduce natural light into these long, narrow homes by opening up the entire back wall and installing large slider doors (see "Revitalizing an Urban Row House," Mar/16).

Our remodeling work is usually confined to the building's original footprint, but we're occasionally asked to build an addition. For this story, I'm going to focus on the steps we took to build a 15-foot-wide-by-18-foot-long two-story block addition. Though we've built a few row-house additions in the past with other code-compliant noncombustible materials, such as structural steel studs with exterior gypsum board, we prefer to lay up block walls.

Documenting existing conditions. When you're working in an urban environment with tight lots and shared party walls, it's best to foster a cooperative relationship with your client's neighbors. Prior to construction, I have a meeting with the abutting neighbors in their homes to review what our client's goals are. This is more than a courtesy call. It allows us to swap contact information to keep the lines of communication open, while also giving me the opportunity to check out the condition of their homes. I want to avoid being wrongfully accused of cracking a wall, or worse, so I take photos of the neighbor's property and of the city-owned sidewalk area out front to establish a baseline of preconstruction conditions.

Case in point, on this project, we started out by demolishing an existing 8-by-10-foot block addition off the kitchen. While removing the addition's block frost walls, we noticed the neighbor's two-story addition was built on top of an old, undersized footing. Hoboken row houses typically had one-story additions (similar to the one we removed), which served as kitchens back in the day. Around the time the neighbor's two-story addition was built, some 30 or 40 years ago, Hoboken was a depressed area. Row houses were haphazardly split up into multifamily homes and boarding houses, and often the work was not done under any municipal supervision. Upon discovery, we notified the project architect and photographed the neighbor's marginal footings.



Masons apply brick veneer to the two-story block addition **(1)**. An existing 8x10 bump-out addition was removed prior to construction **(2)**. During demolition, it was discovered that an abutting neighbor's two-story addition was built on undersized footings **(3)**. New footings had to be poured with concrete wheelbarrowed through the house from a mixer truck parked street-side **(4)**.

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New 12-inch-block frost walls are spaced an inch off the neighbor's walls and placed on the outside edge of the new footings **(5)**. Workers install 2-by boards to form the slab's edge after infilling the sub-slab area with crushed stone **(6)**. A city-mandated structural design called for a heavily reinforced 6-inch-thick slab **(7)**. Walls are built with 8-inch block reinforced with continuous rebar from the footing to the top; block cores are filled with mortar at the vertical rebar locations **(8)**.

BUILDING AFTER A STORM OF REGULATIONS

The architect's initial structural design called for a crawlspace under a framed first floor supported by block frost walls, but the city's zoning administrator made us switch to slab-on-grade construction. I can only guess the reason was to avoid having mechanicals located below grade and thus susceptible to flooding. On a lot of levels, we're still dealing with the aftermath of Hurricane Sandy, which flooded 60% of Hoboken for days in 2012. Many new building regulations were passed in the wake of that event. The resulting structural redesign called for a heavily reinforced 6-inch-thick slab tied into heavily reinforced frost walls and two-story block walls—this was a beefy shell.

Buckets and wheelbarrows. All the demolition and masonry work was jointly coordinated by our project foreman, Danny DoCouto, and our masonry sub, Victor Bezama, of FPV Contracting Co. Working in the city, we don't have the benefit of using excavation equipment. Our foundation prep work is done old-school—by hand with shovels. All demoed rubble and excavated soil had to be carried out in buckets and wheelbarrows through a garden-level (basement) front window or door. Conversely, all building materials, such as block and concrete mix, had to be carried in by hand or wheelbarrow from small staging areas on the street-side sidewalk.

The foundation. We excavated down to the neighbor's footings on either side of our planned addition, then formed our new 12-inch-by-30-inch footings against them. For the footing-to-frost-wall connection, we tied vertical #5 L-shaped rebar 2 feet on-center to the footing's continuous #4 rebar. We placed 1/2-inch XPS foam against the existing walls as a bond break, then wheelbarrowed in concrete from a mixer truck parked street-side.

Our 12-inch-block frost walls were placed about an inch away from the neighbor's existing walls—they sat off-center on the outside edge of the new footings. We installed galvanized metal truss reinforcement on top of the second course to provide lateral strength. After we laid up three courses, we placed 2-inch XPS rigid foam on the block's interior face, then leveled and compacted the under-slab native soil. We infilled with crushed stone to the top of the frost wall, then installed 2-by stock to form the slab's edge.

For the under-slab insulation, we placed 2-inch XPS rigid foam over the crushed-stone base and taped the seams. The architect's structural redesign called for a robust 6-inch-thick slab reinforced with two layers of heavy-duty welded wire mesh tied into the 12-inch-thick-block frost walls, with #5 L-shaped rebar placed 12 inches on-center.

Block walls. The two-story-plus-high walls were built with 8-inch block. We ran continuous #5 rebar, placed 2 feet on-center, from the footing to the top of the wall and infilled the block cores with mortar at the vertical rebar locations. As we laid up the wall, we incorporated two W8 steel I-beams into the blockwork. The I-beams served as lintels for the addition's opened-up back wall (large slider doors provided abundant natural light into the home).

At the second-floor and roof levels, we installed bond-beam courses, which helped tie the walls together and provided solid masonry for anchoring our flush-framed floor and roof ledgers to the wall. A third bond beam was installed at the top of the wall. We ran continuous horizontal #5 rebar in the bond-beam channel (tied to vertical rebar), then grouted the channel solid with mortar.

Flush-framed joists. For the addition's parlor-level (second floor) framing, we installed 3x10 joists flush framed to 3x10 ledgers anchored to the block wall's bond beams. The architect's initial design called for the 16-inch-on-center floor framing to be left exposed to the garden-level (basement) living room below, but we ended up covering the ceiling with drywall to hide wiring and mechanicals.

Prior to lifting and securing the 3x10 ledgers in place, DoCouto installed the joist hangers and applied peel-and-stick to the back of the ledger, then predrilled holes for the expansion bolts. Of note: We followed the structural plans and drilled the holes in-line (rather than in a staggered pattern) and later got dinged by the building inspector for the ledger fastening. The architect had to provide a letter to the city stating that the 3x10 ledgers were structurally sound and wouldn't split.

DoCouto held the ledger in place with 2x4 bracing and then injected Hilti HIT-HY 70 two-component epoxy into the holes with a Hilti HDM 500 manual dispenser gun. He then inserted the expansion bolt, tightened it down, and moved on to the next one. After a little while, the anchor connections hardened like a rock, and we were able to frame the floor.

We flushed-framed the roof similarly, but with TJIs and an LVL box-out for a skylight. Our roof system consisted of a plywood deck with tapered roof insulation (pitched toward a corner roof drain) and a TPO single-ply membrane.

Exterior cladding. We finished off the exterior with brick veneer on the rear façade, and stucco on the right-hand side. For the stucco, the neighbors allowed us access to work from their deck, which was in marginal shape. But I took lots of "before" photos to document its condition and carefully protected the deck from any damage, so we managed to finish without incident.

Rob Corbo is a building contractor based in Elizabeth, N.J.

Workers hoist a wall-to-wall steel I-beam lintel in place **(9)**; the addition's back wall is opened up to provide natural light into the home's interior. Bond beams, coordinated with floor-system ledger locations, are reinforced with continuous horizontal rebar, then grouted solid with mortar **(10)**. Two-part epoxy is injected into predrilled holes prior to inserting the ledger anchor bolts **(11)**. The flush-framed floor is installed **(12)**. The rear façade is clad with brick veneer **(13)**.