Photos by Tim Healey

Installing Lift-and-Slide Doors

BY TED CUSHMAN

High-performance windows and doors are an essential feature of an advanced energy-efficient home. And when the house is a high-end custom project sited on a property with sweeping water views, architects these days are likely to call for European-style lift-and-slide glass doors.

With triple or quadruple glazing, thermally broken frames, and beefy hardware, those Euro units get heavy fast. So while they offer superb insulating qualities, airtight seals, and easy operation, they are not easy to install.

This winter, Hayward Design Build (haywarddesignbuild.com) installed two lift-and-slide units in a custom home on the shore of Lake Champlain in Vermont. *JLC* editor Tim Healey was on site to see Jim Bradley, along with framing contractor Mike Lovejoy and a crew of carpenters, set the massive units into a foot-thick, double-stud wall. Even with extra hands on site, Bradley said, just moving the doors around was a challenge **(1)**: "They weighed about 750 pounds apiece without the slider, and more like 950 pounds with it."

Lift-and-slide doors need stiff headers; typically, manufacturers specify deflection no greater than 1/16 inch at mid-span. That usually requires a steel header, and this case was no exception—structural designer Chris Hill (engineeringventures.com) called for a steel I-beam skeleton outlining the door openings and supporting the overhanging roof above.

Heavy steel in a wall always complicates the energy calculations, because of steel's thermal conductivity. In this design, the steel lies outboard of the insulated wall assembly, bearing on its own foundation footings.

The interior floor is an exposed polished-concrete slab, and that mass also had to be thermally broken from the exterior-exposed concrete footing. "We used 6 inches of rigid insulation board to separate the slab from the stem wall," Bradley noted. "I told the foundation crew to run the foam proud and then pour the slab. Before we set the door, we cut the foam off flush with the top of the slab **(2)**. Then we injected one-component expanding foam to fill the gaps between the rigid insulation and the concrete stem wall **(3)**."

PREPPING THE OPENING

After the foam was trimmed flush at the door opening, Mike Lovejoy prepared the door sills by screwing down a strip of treated plywood to span from the outer 2x6 mudsill in over the 6 inches of rigid foam **(4)**. The plywood protected the foam insulation and provided a solid, continuous substrate for wide Siga Fentrim self-adhering weather barrier membrane **(5)**.

The low-expansion gun foam that had just been injected below the plywood continued to expand slightly to seal the plywood into place, Bradley said, adding a redundant layer of air-sealing as a failsafe for the adhesive-backed Fentrim.

“Later, we are going to come back with a riftsawn oak threshold that will bridge from the plywood to the polished concrete floor,” Bradley explained. “And the nice thing about the wide Fentrim fabric is that it has a split back. We left the paper backing on the inside part of the piece. Then once the threshold goes in, we are going to bend the Fentrim upwards, perpendicular with the floor, and stick it to the threshold to get an air seal there as well.”

On top of the Fentrim, the crew ran a bead of silicone adhesive caulking to seal the door sill down to the fabric **(6)**. Around the sides of the doors, they sealed the sheathing to the jack studs with Siga flashing tape **(7)**. “We’re also going to slide rigid insulation by the sides of the doors, inject foam into the gap, and seal on both sides with Siga or ProClima tape,” said Bradley.

MANHANDLING THE DOORS

With the openings prepared, the next order of business was to get the massive door frames set into place and correctly plumbed, leveled, aligned, and fastened. For this step, the crew had help from consultant John Mokas, an expert in Euro-style doors and windows who spent years learning the craft in Germany and Greece.

“These are baby doors,” Mokas told *JLC*. “If you want to see big doors, I’ll show you some pictures.” On some other jobs, he said, doors were too heavy for muscle power. Mokas has gone as far as to install an electric hoist on the roof of an apartment building and cut holes in the floors below for a steel lifting cable.

Still, a half ton is no small door—especially since the home’s roof overhang on this site made a crane impractical. To roll the doors around the concrete floor, the crew relied on heavy-duty floor dollies, along with a site-built wooden cradle on casters devised by carpenter Richard Coffin **(8)**. “Those worked great,” said Mokas. “They were a big help.”

Mokas was also a big help, said Bradley, especially with advice on the fine points of aligning the door components and adjusting the mechanisms. “They have to

be spot on, and they're not like ordinary doors," Bradley said. "You have to use lasers. If they're not completely plumb and square, then they're going to whistle when that wind comes in off the lake."

A level base is critical, Mokas told *JLC*; if the track slopes even 1/8 inch, the door may be easy to open but hard to close (or vice versa). Beyond that, he said, maintaining square and plumb may be less critical than making sure that the doors align and meet up as intended, and that all the hardware is properly installed. "The point is to get it where it works perfectly," he said.

At this jobsite, Bradley said, the door supplier recommended Mokas on the day the doors were delivered to the site. But because mix-ups can be costly and disruptive, Mokas told *JLC* that he prefers to get involved earlier in the job. That way, he said, he can verify the measurements and specifications before the doors are custom-built, first by double-checking the plans, and then later by measuring on site after the rough framing is complete.

ATTACHMENT POINTS

To set and align the doors, the crew used the supplied strap connectors, which screw into the jambs from the back **(9)**, then muscled the doors into position **(10)**. Then, for a permanent structural connection, they set structural screws through the jambs into the framing through the predrilled holes in the jambs before placing the sliding doors onto their tracks **(11)**. "Once you've got them dialed in," said Bradley, "they open and close really nicely. I have to admit they're pretty slick."

Ted Cushman is a senior editor at JLC.

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Setting Precast Footings

BY JIM WOLFFER AND STEVE BACZEK

They say the shortest distance between two points is a straight line. That seems easy enough, but things get a bit more complex when the straight line is 78 feet long and there are 11 points along the line that have to be lined up perfectly. That was the challenge that Shoreline Builders, of Scituate, Mass., faced recently when building a new, custom, high-performance residence on Cape Cod. The home was to have a 1,100-square-foot covered porch that measured 78 feet along one side and wrapped around one corner of the house, and many of the standard construction details required an exceptionally high level of precision.

The porch and its roof framing system had to be supported by 20 footings total—16 perimeter footings plus four inside footings to support the wider porch section at the end of the house; the long side of the porch had 11 footings. Because the roof was to be a prefabricated truss system that was ordered about the same time as the footing installation, there was little margin for error or for misalignment of the footings. In addition, the project was located in one of Cape Cod's high-wind zones, so the alignment of all the support and framing components was a critical structural detail specified by the engineer to resist the uplift potential of the large porch roof.

PRECAST FOOTINGS

In reviewing the project with the site contractor, George Botelho, we considered a couple of options for the porch footings: the typical poured-in-place tube footings vs. precast concrete footings. Poured concrete footings pose a number of challenges. The first factor is that they are difficult to install with precise alignment, which was critical to this project. And backfilling tube footings almost inevitably causes the tubes to move a little (and sometimes a lot), which results in a ragged layout. Another consideration when using site-poured tube footings is that they have to be inspected prior to filling, which can often mean a day or more between the placement of the forms and getting them filled. If the soil is at all moist, the tube material can absorb moisture and deform before they can be filled. For these reasons, Botelho suggested that we go with precast footings.

When Botelho started using precast footings a few years back, they were typically made with square tops. But setting a straight line of footings presented a big enough challenge in itself; trying to align the square edges was an additional task that could be eliminated if the footings were cylindrical. So Botelho asked the precast manufacturer to start casting the footings in the round. In the casting process, the manufacturer embedded a fitting in the top of the footing that could accept a threaded eyebolt for lifting and placing the footings. Eventually, these threaded fittings would be the attachment points for the post-base connectors, a critical link in the framing sequence.

The perimeter of the porch required 11 footings along the long section and five additional footings where the porch returned around the corner of the house. Each footing was 5 feet tall and 1 foot in diameter at the top and tapered slightly down to a wide supporting base that was about 30 inches wide and a foot high. When the footings were delivered on site, we were ready to begin installation.

SETTING THE FOOTINGS AT THE SAME HEIGHT

To set the footings, we had to maintain two critical parameters: The 11 footings all had to be set at exactly the same elevation, and they all had to be in a perfectly straight line. With the extremely

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Photos by Jim Wolffer

The site crew dug the hole for each precast footing individually, compacting the base of the hole and using a laser level to set the elevation **(1)**. Each footing has an integral fitting for an eyebolt that was used to lift and place the footing **(2)**. After the footings were placed, the crew used the fittings to attach the post connectors.

Backfilling in lifts and compacting between each layer locks the footings in place **(3)**. As the crew compacted the final grade, they sloped it away gradually from the foundation **(4)**. The grade drops just beyond the footings, for the ground gutter **(5)**. Filter fabric covers the grade **(6)** and then wraps back over the crushed stone and drainage pipe **(7)**.

sandy Cape Cod soil, it made sense to excavate each footing separately. The frost depth for this location was 4 feet, so we excavated to exactly that depth below rough grade. Because the precast footings are 5 feet tall, that left 12 inches of vertical play for the drainage layer under the porch that we would install later.

Botelho's crew compacted the base soil in each excavation by hand, setting the depth of each hole with a laser and a measuring stick, which gave the holes the vertical accuracy that we needed **(1)**. The crew used an excavator equipped with a chain for the actual placement of the footings. A hook on the end of the chain grabbed an eyebolt threaded into the fitting on the top of the footing. The excavator easily lifted the footings into place, setting each one on the compacted, undisturbed soil of the hole excavation **(2)**.

GETTING THE FOOTINGS IN A STRAIGHT LINE

Making sure that the footings were in line with each other was as critical as their all being at the same height. We did a quick check of the foundation wall along the edge of the house adjacent to the porch to confirm that it was perfectly straight. We also verified that the outside corner—where the porch returned along the end of the house—was a true 90 degrees. Having the foundation as a reliable reference helped immensely, as it allowed the crew to pull accurate measurements from the face of the foundation wall to place the footings in a straight line.

As the crew placed each footing, they measured off the foundation as well as off the center point of the previous footing. The footings were 8 feet on-center. The crew set up a 100-foot string parallel to the foundation and a second laser as a secondary check of the footing alignment. The string provided a true sight line to work from and the laser provided a continuous line along the tops of the footings.

After setting each footing, the site crew backfilled about 2 feet and compacted the fill, which helped to lock the footings in place **(3)**. After the initial compaction, they quickly checked that the footings were still in perfect alignment. The crew completed the backfilling in two more lifts, compacting each layer and checking after each compaction to make sure the footings stayed in perfect position.

PERIMETER DRAINAGE

Because this home has no roof gutters, it would rely on a perimeter ground-gutter system (see "A Primer on Water Management," Jun/17). The ground gutter is designed to carry groundwater and roof runoff to an area of reclamation on the other side of the site. The porch was to be open to the weather, so we had to tie

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Crushed stone filled the area under the porch up to the tops of the footings **(8)**. The crew checked the alignment of the footings at every step, and a taut string confirmed that both the height and the placement of all 11 footings along the 78-foot length of the porch were within $1/8$ inch **(9)**. The high degree of accuracy meant that the treated beams supporting the porch were installed without a hitch **(10)**. The precision was critical for engineering the roof frame to withstand severe uplift in this high-wind area **(11)**.

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the area below the porch into the ground-gutter system. After the site crew finished backfilling around the footings, they compacted the top layer of soil, sloping the grade away from the foundation slightly toward the outer edge of the porch **(4)**.

Just beyond the line of the footings, the grade dropped sharply about 18 inches to form one side of the ground gutter **(5)**. The crew covered the sloped ground with heavy-duty filter fabric and then added an 8- to 10-inch layer of crushed stone on top of the fabric **(6)**. The crushed stone would drain any water that filtered through the porch floor above. The filter fabric continued beyond the footings to line the ground gutter, and it was intentionally left long so that it could roll back over the stone to fully encapsulate the drain pipe and the stone around it. We centered the drain pipe side-to-side in the ground gutter so that it sat directly below the "drip line" of the porch roof above **(7)**.

PRECISION PAYS OFF

Before the porch framing could begin, we quickly checked the footings again to make sure that they were all still perfectly in line **(8)**. When all was said and done, Botelho and his site crew had placed all of the footings within $1/8$ inch on-center of each other **(9)**, a level of accuracy and consistency that would have been difficult or nearly impossible to duplicate with poured-in-place footings.

When the framers arrived, they were pleasantly surprised to find such an accurate layout. The precision of the footing placement allowed them to quickly install the treated frame, columns, and beams for the porch **(10)**. And this precision continued throughout the frame; from the straight and level lines of the footings, the crew efficiently placed the grade beams, posts, roof beams, and roof trusses in perfect alignment **(11)**.

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Practical Window Flashing

BY EMANUEL SILVA

As I drive to work each day, I can't help but notice construction sites on the way, and it amazes me to see the huge number of windows that are flashed incorrectly. I see some windows installed with only sill flashing and no side flashing, some with no sill flashing and only housewrap as side flashing, and then others with only housewrap and no flashing at all. But the scenario that bothers me the most is a window installed over the housewrap and then flashed on all four sides—a sure recipe for disaster.

There are many ways to flash windows correctly. You don't have to use proprietary systems; you just need to know that there are no chemical incompatibilities and follow basic principles. For the project in this article, I used material left over from another job: 6-inch 3M All Weather tape for the rough opening (RO) flashing, 6-inch Typar Flex Flashing for the sill pan, and 6-inch Grace Vycor Pro tape everywhere else. I'm aware that combining different products can void their warranties (such as the Zip System warranty). But knowing that there were no compatibility issues, I was willing to chance it because I felt confident that my window installation would outlast any warranty.

PREPPING THE OPENING

Before installing the windows, I precut the flashing tape needed for each window and set the pieces next to each opening. Except for the pan flashing, I make all the lengths out of two pieces of tape. I often work alone, and I find that two shorter lengths of tape are easier to handle and install than a single long length.

Next, I make layout marks on the sheathing to guide placement of the flashing. On the sides, I measure out 3 inches (half the width of the 6-inch tape) and draw a plumb line with a level. At the top and bottom of the opening, the flashing will extend 6 inches beyond the opening, so I measure this distance on both sides and draw these plumb lines, as well.

SILL FLASHING

The first place I apply flashing tape is directly below the opening **(1)**, which I consider to be cheap insurance. I trust the flexible sill pan flashing to adhere to the flashing tape more than to the sheathing. (The alternative, of course, is to use Zip System Stretch tape, but I was using stock I had on hand. As builders, we sometimes have to make practical choices.) I install

Window installation begins with properly flashing the opening. The first piece of flashing to be installed is the sill flashing below the rough opening **(1)**. It extends 6 inches beyond the opening on either side. A length of beveled siding pitches the sill for drainage **(2)**. Flexible flashing tape creates a one-piece sill pan that seals the bottom of the opening from moisture **(3)**.

Photos by Emanuel Silva

the tape in two pieces, working from my marks at each end and overlapping the pieces about 6 inches in the center. Next, I nail a piece of beveled siding to the bottom of the opening **(2)**. The bevel provides positive drainage on the sill.

I find it's faster and more reliable to use flexible flashing to create a seamless, watertight pan than trying to turn corners with multiple pieces of straight flashing. To install the pan, I first mark both the center of the RO and the center of the flashing. I also draw a guideline on the beveled sill 4 inches from the edge of the RO. I peel off the backing, line up both center lines, and let the tape down onto the sill following the 4-inch line. I press the tape firmly into place by hand, working from the center to both corners and then smoothing the ends of the tape up the side jambs. When the sill portion is adhered, I press the remaining 2 inches onto the vertical wall surface, again working from the center toward the ends. When I reach the corners, I pull the tape outward to create a smooth and tight seal **(3)**.

SIDE AND HEAD FLASHING

To keep water from entering between the sheathing and the framing, I flash the sides of the opening next. On the lower section of my two-piece side flashing, I cut out the bottom corner where it wraps over the sill pan. Some folks prefer just to slit the flashing at the corner, but in my experience, cutting that corner out helps to keep the tape from accidentally sticking to itself.

Before I peel off the backing from the tape, I hold it in place and mark the top edge on the wall sheathing. Using this mark as a starting point and using the plumb line I'd drawn earlier, I peel off the backing and apply the jamb flashing to the sheathing, working from top to bottom. Again, I create a wrinkle-free surface with pressure from my hand. With the bottom corners cut out, I wrap the flashing tape into the opening, stretching it slightly as I smooth it out and adhere it in place **(4)**.

The upper piece of side flashing goes on next, extending over the lower piece in shingle fashion **(5)**. Starting a few inches above the top of the opening, I adhere the top piece to the sheathing, again using the plumb line as a guide. I've found that cutting out the corner is not as helpful for the top jamb flashing, so instead, when the tape is adhered to the sheathing, I slit the tape along the top edge of the opening and then wrap it onto the jamb.

At the head, I apply my two pieces of flashing tape, starting on the 6-inch plumb line and making sure it completely covers the top end of the side flashings. As I apply each side, I peel only half of the backing at a time to help keep the flashing from sticking to itself **(6)**. As before, the two pieces overlap by about 6 inches.

The sides of the opening are flashed in two pieces. The bottom piece laps over the sill flashing **(4)**. The top piece of flashing starts a few inches above the opening and laps over the piece below **(5)**. Then the head flashing laps over the side flashing **(6)**. Sealant is applied to the opening before the window goes in **(7)**.

After pressing the window into the wet sealant, the author levels the frame and nails the bottom corners **(8)**. Diagonal measurements ensure that the frame is square **(9)** before the top flange is secured **(10)**. He flashes the flange on the sides and top, with all the lengths done in two pieces. The side pieces extend past the top of the window **(11)**, and the top pieces cover the sides **(12)**.

INSTALLING THE WINDOW

I usually remove the sash from the window frame so that installation requires just one person. First, I center the window frame in the opening and trace the outer edge of the nailing flange. I then remove it from the opening and run a bead of OSI Quad sealant along the top and sides of the opening, keeping the caulk inside the traced lines **(7)**. The bottom edge of the opening should never be sealed, so that any moisture can drain from the opening.

Using the lines I traced as a guide, I press the frame into the wet caulk. I make sure the window is level in the opening **(8)**, and then nail both bottom corners using 2-inch galvanized roofing nails. To ensure that the window is square, I measure across the frame diagonally and tack the center to hold the frame in place **(9)**. After double-checking the diagonal measurements, I drive additional nails at the top corners **(10)**. Before nailing the side flanges of the window, I measure across the opening in three spots to make sure the sides are straight. Finally, I secure the sides of the frame and nail off the bottom flange and any remaining holes in the flange.

FLASHING THE FLANGE

Before going any further, I re-install the sashes and make sure they operate properly. Once the window is set, I begin flashing the window flanges, using two pieces for each section of flashing. As before, I mark the starting point for top edge of the lower side flashing. After peeling half of the backing, I align the top edge with my mark and the inside edge with the corner where the flange meets the window frame. Then I press the tape into place, using my hand to smooth it out as I work my way down to the sill.

I start the top piece of side flashing a few inches above the top flange **(11)**. Peeling off half the backing at a time, I press the tape into place, overlapping the lower piece by 6 inches. The final step is applying the head flashing. I install that in two pieces as well, using the outer plumb lines as starting points and overlapping the pieces by at least 6 inches where they meet **(12)**.

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