Beyond the Basics
With ICFs

Curved walls and arch-topped openings are possible with standard blocks

by Victor Rasilla

When we first worked with ICFs, we — like most contractors — used the foam forms only for foundations and simple structures. Eventually, though, we began to build entire houses with them.

The Alamo, Calif., custom home featured here was such a project. The plans called for curved walls with large arch-top openings. Given that combination — curved walls and arched windows — most builders would have chosen to stick-frame. But the house was also designed to be extremely energy-efficient, with triple-glazed windows, radiant-barrier roof sheathing, a NiteBreeze ventilation system for cooling, and vacuum-tube solar collectors backed up by on-demand water heaters for hot water and hydronic heating. For all these elements to work, the walls would have to be airtight and well insulated — which made ICFs a good fit.

The house sits on a hill — two stories in front, and one in back — with a crawlspace, garages, and mechanical rooms below and a single level of living space

ICF Wall Section

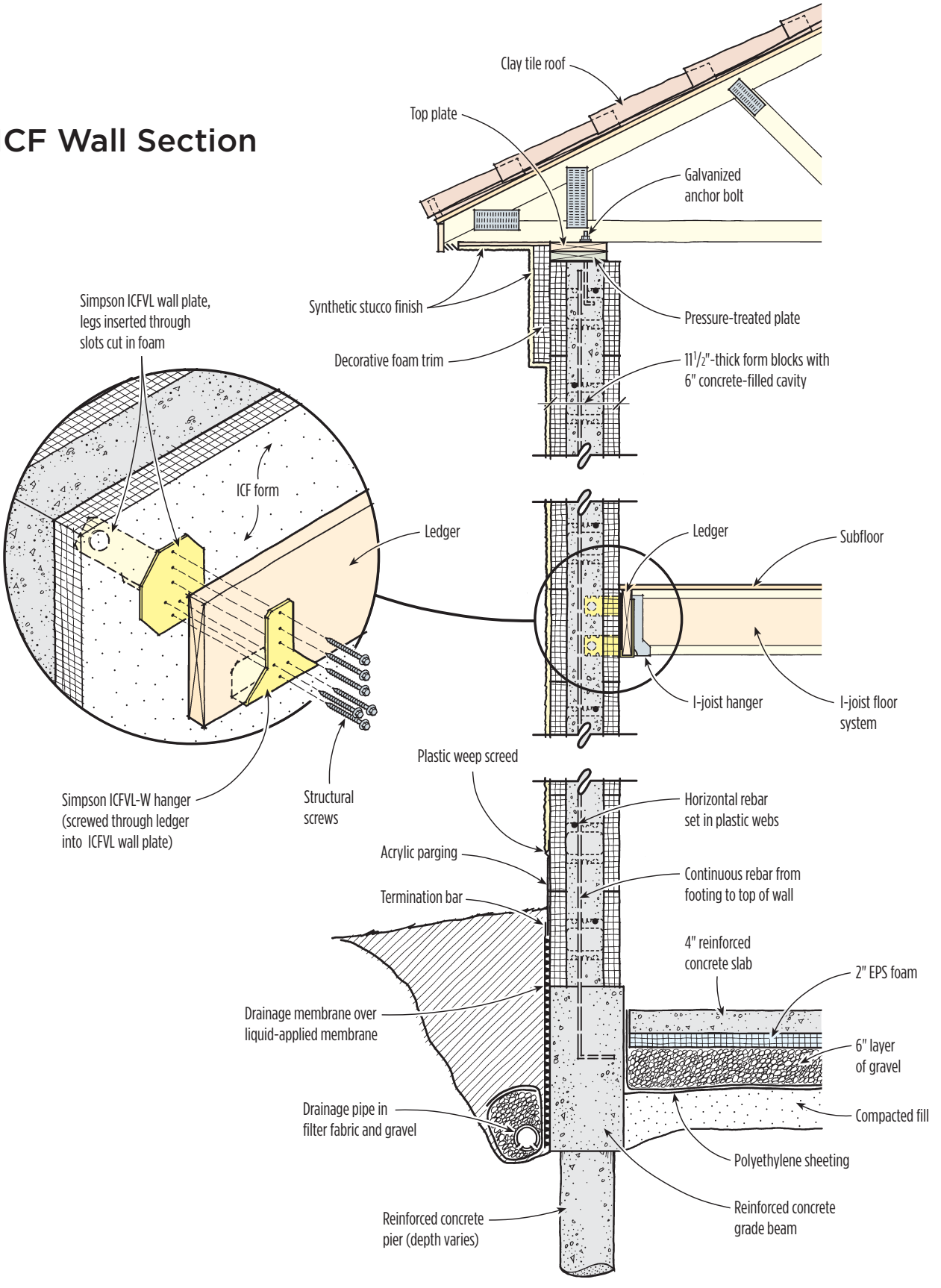

Figure 1. To minimize cutting, the crew works from the corners toward the middle of the wall and fills in the last piece. Here a carpenter trims (left) and installs (above) the last block in a course.

above. The upper floor is framed with I-joists attached to the ICF walls (**see illustration, facing page**). The exterior finish is synthetic stucco applied directly to the ICFs.

The home's foundation — a poured-concrete grade beam on poured concrete piers — is typical for hillside residences in this area. Because the piers are designed to carry the weight of the house, the grade beams don't need to be as wide as conventional footings; on this house, most are 12 inches wide. We took great care to lay out and form an accurate foundation so we could install the ICFs flush to the outside face of the grade beams. In the few places where the grade beams were wider, we used the more standard method of installing the blocks to snapped lines.

Stacking the Blocks

Our company uses Logix blocks (888/415-6449, www.logixicf.com). Like most brands of ICF, they're based on a 48-inch-long by 16-inch-high module and come in a variety of wall thicknesses. On this job we used 11½-inch blocks, which have a 6-inch cavity flanked by 2¾-inch EPS foam.

When setting blocks, we start from corners and work toward the center. Ideally, the length of every wall would be a multiple of 48 inches so we wouldn't have to cut blocks. That almost never happens, but we can usually limit cuts to one per course (**see Figure 1**). The problem with cuts is that you lose the tongue or groove that keys one block to the next, which leaves a weak joint that might blow out during the pour. These joints have to be reinforced, so we either glue them with canned spray foam or screw a plywood gusset to the plastic webs in the foam.

Two at once. We lay the first two courses at once, fastening the first course together with zip ties, snapping in the horizontal rebar, then stacking the second course on top and zip-tying it to the course below (**Figure 2, next page**). This gives us a long run of blocks that can be positioned and leveled as a unit. We use a laser to check the wall for level, then shim or trim the bottom edge as necessary. Once the wall sits straight and level on the foundation, we glue it down with low-expansion polyurethane foam.

Each successive course keys onto the one below and is secured to it with zip ties. We install the horizontal rebar as we go, according to the plans, and every few

Figure 2. The author prefers to fasten the first two courses together (above), using zip ties (above right). He then straightens and levels the two courses as a unit, which he glues to the footing with spray foam (right).

courses we put in "form lock" — zigzag wire bracing that snaps into the plastic webs and helps straighten and stiffen the forms. When the ICFs reach the top of the vertical rebar — which starts at the footing — we splice on new pieces with tie wires so that the reinforcing is continuous to the top of the wall.

Curved walls. We considered special-ordering curved ICFs for the home's 30-foot radius walls, but for budget and schedule reasons ended up fashioning the curved blocks ourselves, from straight ones. We followed a table in the Logix manual that shows how to make various curves by shortening the inside face of standard blocks.

By flexing the blocks slightly, we were able to get them to follow the desired curve. Continuous bracing along the grade beam — kerfed 2x10s — held the bottom course in place; then each succeeding course mated with the nibs of the one below (**Figure 3, facing page**). Considering that they were made from straight blocks, the curves were surprisingly smooth. There were a few lumps and bumps, but nothing we couldn't fix with a belt sander.

Fastening Ledgers

Floor joists in ICF buildings have traditionally hung from ledgers fastened with cast-in anchor bolts. On this job, we saved time by using Simpson's ICF ledger-connector hardware (**Figure 4, facing page**). In accordance with this method, we inserted the legs of an ICFVL wall plate through slots cut in the foam; the concrete anchors the plate. To install the 2-by ledgers, we placed them against the wall plates, lapped them with ICFVL-W hangers, and drove structural screws through into the plates. Hangers for LVL ledgers are also available, while light-gauge steel ledgers can be screwed directly to the plate.

We spaced the wall plates 32 inches apart, taking care to locate them so that the ledger hangers wouldn't interfere with the joist hangers.

Door and Window Openings

If the door and window openings in this house had been rectangular, we could have used vinyl bucks. But because the heads were arched, we built wooden bucks on site (**Figure 5, page 54**).

Often, door and window bucks can be left in place after the pour. But the doors and windows in this house were inset — and the exterior jambs finished with stucco — so the bucks would have to be

Figure 3. The crew creates the curve by cutting the inside faces of the block slightly shorter than the outside faces and flexing the pieces into an arc. Kerfed 2x10 braces hold the bottom course in line with the grade beam.

removed. To make this easier, we fastened the bucks with metal framing angles and screws (**Figure 6, page 55**).

For the arch-top openings in curved walls, we made the bucks straight but much thicker than the wall, to accommodate the radius (**Figure 7, page 55**).

Bracing and Pouring

Solid bracing is of course key to a successful pour, because wet concrete places a lot of pressure on the ICFs. We used the standard adjustable metal bracing designed to hold staging planks (**Figure 8, page 55**) and added wood bracing at those locations where the connections were the weakest — at cut blocks, for example, and at inside corners and the ends of walls. The smaller bucks were faced with solid sheets of OSB and were stiff enough to resist the force of wet concrete. The bucks in the larger openings required additional vertical and horizontal bracing.

We stacked and poured the walls in stages. The first stage brought the walls to just above the main floor level. After a week of curing time, we framed and sheathed the floor, and then we formed and poured the rest of the way up.

Concrete. We used a 5-inch-slump five-sack mix containing 3/8-inch pea gravel

Figure 4. The upper floor hangs from ledgers attached with Simpson hardware designed for ICFs. The legs of the metal plate — punched so that they will key into the concrete — are inserted into slots in the foam (above left), then the plate is fastened with a screw so it can't fall out during the pour (above). After the concrete cures, the ledger is positioned against the wall and fastened to the plate with structural screws driven through a special hanger (left).

and 20 percent fly ash. Normally, we wouldn't drop concrete more than 3 feet, but the forms contained so much rebar the concrete more or less rolled to the bottom. There wasn't room to use a tremie pipe. To avoid blowouts we worked our way around the perimeter — placing concrete in 3-foot lifts and vibrating as we went (**Figure 9, facing page**). We drilled witness holes through the bottoms of the window bucks so we could see whether the concrete had flowed underneath; if need be, we inserted a rod through the holes to move the concrete.

Plumbing and Electrical

ICF plumbing penetrations are simple: You can sleeve through the form before the pour or drill through after. Drains and vents of up to 2 inches in diameter will fit in a channel in the side of the foam form; we cut the sides of the channel with a recip saw and then rake out the foam with a pry bar.

Electrical wire is run in smaller channels, which we fill with spray foam once the wire's in place. Electrical boxes can be cut into the foam and screwed to the concrete. Logix ICFs are ribbed on the inside; we've found that if we cut through the foam and remove the concrete ribs with a cold chisel, a standard electrical box will come out flush with the drywall.

Exterior Finish

To keep the below-grade portions of the building dry, we waterproofed the foundation with Tremproof 250 GC (Tremco, 800/321-7906, www.tremcosealants.com), then covered it with MiraDrain 2000 (Carlisle, 888/229-0199, www.carlisle-ccw.com), a polyethylene air-gap membrane that drains water away from the wall.

Though ICF homes are often finished with lap siding, stucco is preferred in our area. With ICFs, we use the same synthetic stucco materials used with EIFS,

Figure 5. Carpenters plumb and brace the buck for an arch-top window (top). The buck for the garage opening is supported on a temporary stud wall; the pressure-treated side jambs will remain in place for fastening the overhead door tracks (above).

Figure 6. To make it easy to remove, this window buck was assembled from the inside with framing angles and screws. Note the sloped sill; the inspection holes allow carpenters to verify that concrete has filled the blocks below.

Figure 7. The arched bucks in curved walls were made extra wide to accommodate the radius.

which can be applied directly to the foam without paper and lath.

Our plastering sub applied a base coat of Parflex 304 (Parex, 800/537-2739, www.parex.com) with an embedded layer of fiberglass reinforcing mesh, followed by a second coat of the base-coat material. The top coat was Fino Alto (Variance Acrylic Finishes, 888/323-6404, www.variancefinishes.com), an integrally colored acrylic plaster.

Finally, to protect any areas of exposed foam between the top of the waterproofing and the stucco, we parged with Thoroseal (Thoro, 866/518-7171, www.thoroproducts.com).

Figure 8. In preparation for concrete, the window bucks were reinforced with additional pieces of OSB and the wall thoroughly braced.

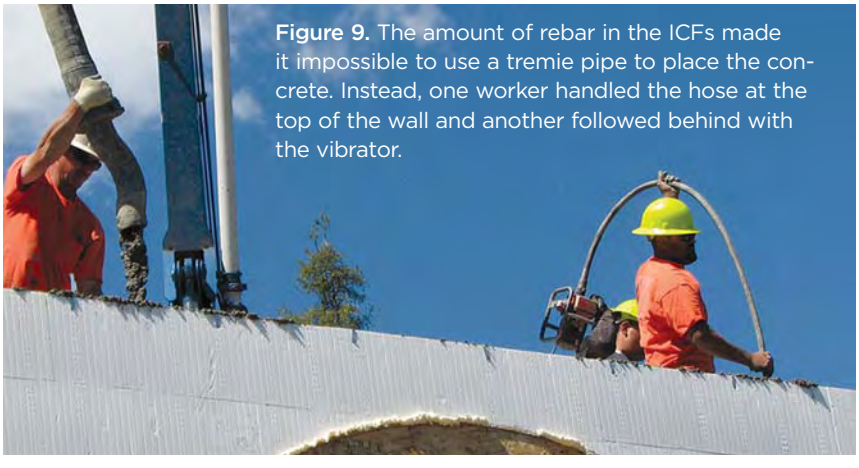

Figure 9. The amount of rebar in the ICFs made it impossible to use a tremie pipe to place the concrete. Instead, one worker handled the hose at the top of the wall and another followed behind with the vibrator.

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JLCEXTRA

To see more photos of this project, go to www.jlconline.com and click on the JLC Extra tab.