A High-Performance Shell

Exterior layers protect the structure of this modern house

BY CHRIS LAUMER-GIDDENS

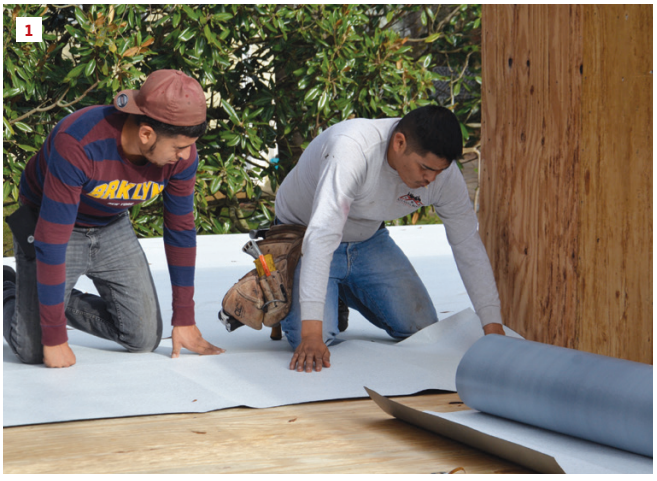
My company, LG Squared, is an architecture and construction management firm based in Atlanta. Our current project is a high-performance custom home in Marietta, Ga. We designed the home, and we are also supervising the construction. In this story, I'll look at the methods we are using to make the home durable and energy-efficient.

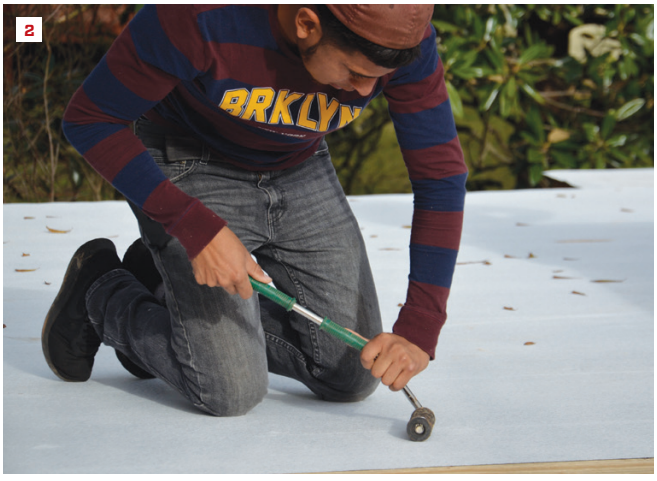
This project is an implementation of the so-called "Perfect Wall" concept, which entails keeping the structure of a building within the conditioned envelope. In theory, the idea is to construct the four control layers—the water control layer, the air control layer, the vapor control layer, and the thermal control layer—so that they wrap the building outside of the structural components. That way, the structure of the building is protected just like the inhabitants are.

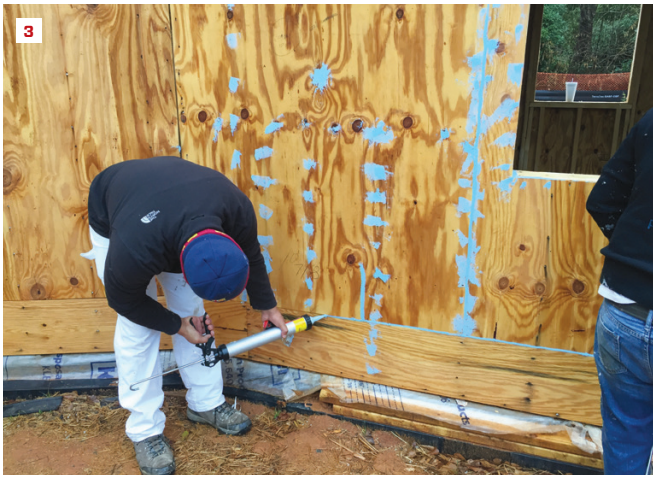
In this case, the structure of the house is wood framing and sheathing. We accomplished air and vapor control by applying the Poly Wall Blue Barrier fluid-applied membrane system to the wall sheathing. We achieved thermal control by applying Rockwool Comfortboard 110 insulation to the wall exterior. We secured the insulation to the wall with 1x4 wood strapping and attached the cladding system to the furring strips to serve as the water control layer.

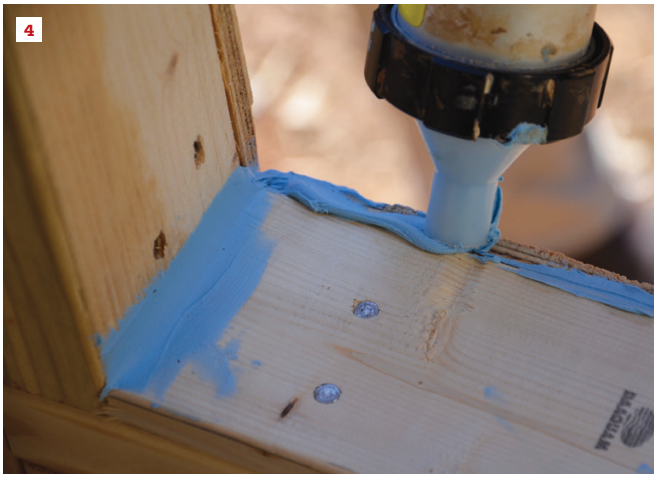
We built the roof in a similar fashion. First, we applied Polyguard Deckguard HT peel-and-stick underlayment to the sheathing. We installed Rockwool Toprock insulation on the

Photos by Chris Laumer-Giddens









The roofing crew applies peel-and-stick underlayment to the plywood roof deck **(1)**, rolling the material under pressure to create a good bond **(2)**. The painters apply Joint Filler 2200 to sheathing cracks and nail holes **(3)**, as well as to window rough-opening corners **(4)**.

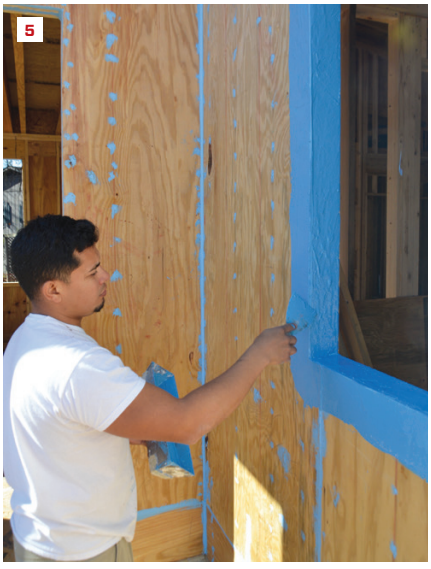
roof deck, secured the insulation with 1x4 wood strapping, and installed standing-seam metal roofing on the top. The result is a shell with water, air, vapor, and thermal control layers that are continuous over the whole enclosure, including both walls and roof. Let's walk through the process.

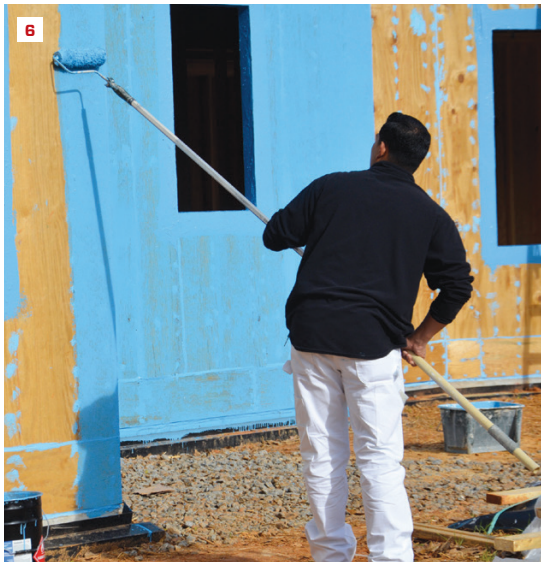
DRYING IN

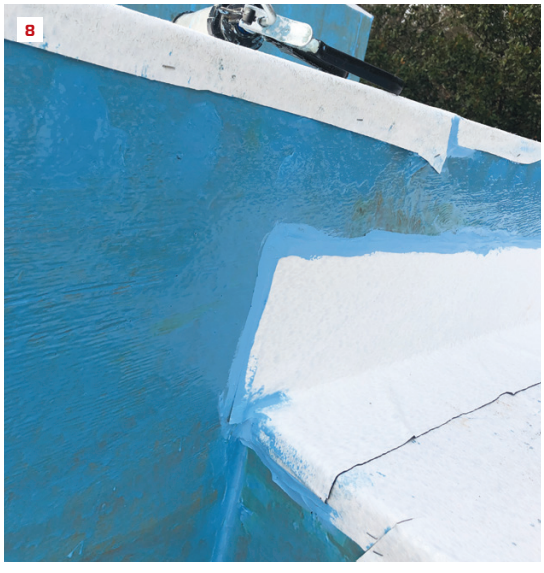
We started by installing the Deckguard HT peel-and-stick underlayment to the roof sheathing **(1, 2)**, so we could have a dry interior for the building. For a belt-and-suspenders approach, we applied Henry Rubberized Wet Patch roofing mastic to the seams of the underlayment. Peel-and-stick underlayment on low-slope roofs, when acting as a temporary roof before a permanent one is installed, tends to leak through capillary action. The roofing mastic helps prevent that, and it adds robustness to the underlayment in service for permanent water and air control.

Next, we applied the Blue Barrier system to the walls. There are three components to Poly Wall's system: Joint Filler 2200, a thick gun-applied structural adhesive and detail sealant; Flash 'N Wrap 2400, a thick trowel-applied flashing for windows and doors; and Liquid Wrap 2300, a roller-applied or spray-applied covering that serves as a vapor-permeable membrane that protects against air leakage and bulk water. All three formulations are based on the same chemistry: STPE (silyl terminated polyether).

Our painting crew installed the Blue Barrier system. They started with the joint filler, installing it in every plywood seam **(3)**. The framers had left a gap the size of a 16d nail between all the sheets of plywood, to allow for a strong, thick bead of sealant. They had also







The painters apply Blue Barrier Flash 'N Wrap 2400 to a window rough opening **(5)**, roll Liquid Wrap 2300 onto the field of the wall **(6)**, and detail a window flange with Joint Filler 2200 **(7)**. At the wall top, the overhanging peel-and-stick underlayment is sealed to the wall with Joint Filler 2200 and Liquid Wrap 2300 **(8)**.

set the nail-gun compressor to slightly overdrive some of the nails, so every overdriven nail head received a dab of sealant.

At the juncture where the wall meets the foundation, we had left a half-inch gap between the wall sheathing and the foundation slab. The painters inserted backer rod into that gap, then applied and tooled a bead of joint filler.

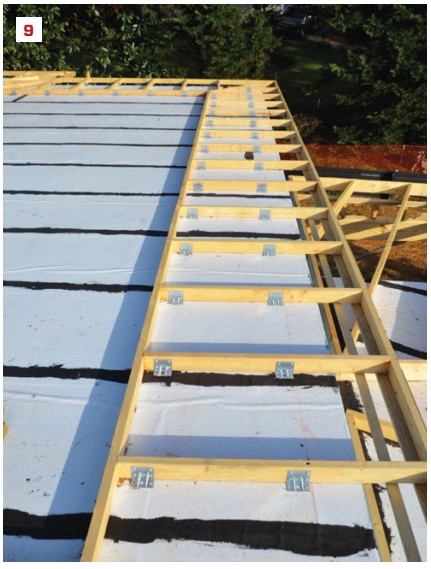
The painters applied Joint Filler 2200 to the corners of window openings as well **(4)**, then trowel-applied Flash 'N Wrap 2400 flashing to the rest of the opening **(5)**. The crew installed 2400 at every door and window opening, covering the jambs, head, and sill of the opening, and then 4 inches onto the face of the plywood sheathing, at a minimum of 25-mil thickness. Thickness was verified with a mil gauge while the product was still wet.

Finally, the painters roller-applied 2300 Liquid Wrap over the entire shell of the building **(6)**, covering all wall sheathing, and all previously installed 2200 and 2400. The minimum thickness installed was 40 mil, verified with a mil gauge.

At the top of the wall, the roofing crew had left the peel-and-stick hanging a few inches past the edge of the wall. When the painters reached the top, they applied a bead of Joint Filler 2200 to the plywood joint between the roof sheathing and the wall sheathing. Then they folded the peel-and-stick down, adhering it to the wall with a bead of 2200 and staples **(8)**. Finally, they sealed that joint with a 50-mil-thick layer of 2400, covering at least 3 inches of both peel-and-stick and sheathing and taking care to seal over every staple.

Windows were next **(7)**. We used Marvin windows with a nailing fin, putting a screw in every hole in the flange. Then the painters came back to trowel apply another coat of 2400 over the flanges and extend the 2400 at least 3 inches past the flanges. Minimum thickness of this application was 25 mil. Overall, the average thickness of the Poly Wall at the windows is 50 to 60 mil, with some areas as thick as 80 mil.

After windows, our crew installed a continuous layer of Polyguard Term Flashing Barrier at the wall-to-foundation-slab joint, connecting to the metal termite flashing installed during the foundation installation. This peel-and-stick barrier (which has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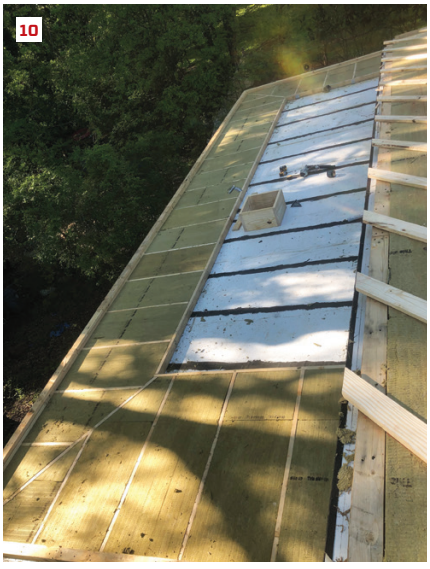
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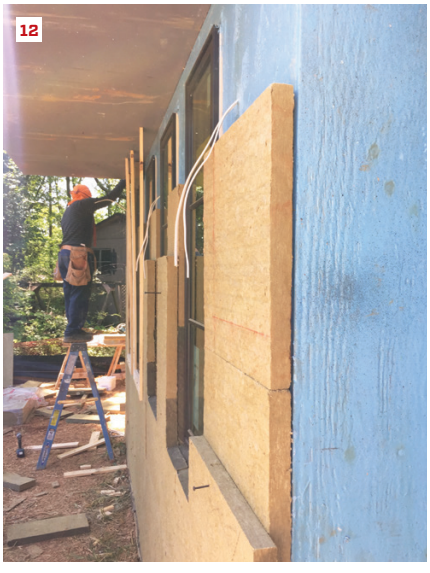
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Outriggers are secured to the roof deck with structural clips **(9)**, and the roof deck is insulated with Rockwool Toprock DD **(10)**. The walls are insulated with Rockwool Comfortboard 110, with joints staggered **(11, 12)**. The insulation is secured to the wall with battens and long screws.

been tested for compatibility with Poly Wall) is termite-proof, and it adds a layer of robustness to the air and vapor control at the joint.

AIRTIGHTNESS TESTING

Immediately after applying Poly Wall, we performed the first blower-door test—first infiltration, then exfiltration. During the exfiltration test, with the house under positive pressure, we filled the house with theatrical fog to help identify leaks. The result was 0.09 ACH50, and 75% or more of that leakage was coming out through the gaps around the blower-door frame and through a patio door that was installed incorrectly (which we corrected before the next test). Considering the leakiness of the blower door itself, we estimated the actual leakage of the house to be closer to 0.05 or 0.07 ACH50.

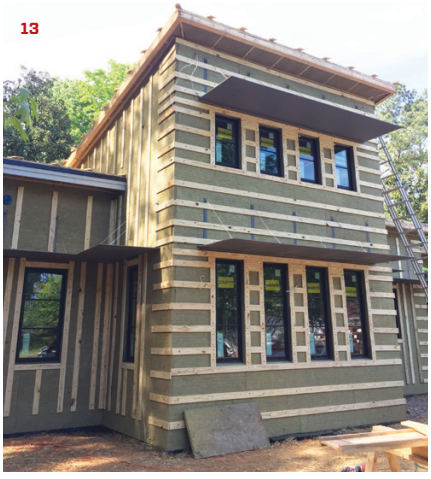
After the blower-door test, we installed rough-in for HVAC, electrical, plumbing, and low-voltage. Then we performed our second blower-door test the same way, checking infiltration and exfiltration, and running the fog machine. The result was 0.05 ACH50—more than 10 times tighter than the maximum allowed by the very strict Passive House standard, and a tiny fraction of the leakage allowed by code.

INSULATION

Once the Poly Wall step was complete, the insulation was delivered. We installed outriggers to the exterior of the air and vapor control layers at the roof edges to support the roof overhang **(9)**, and then began to insulate the roof **(10)**. (The framing crew installed all the insulation and strapping for the roof as well as the walls.)

The outriggers are framed with 2x4s on edge, fastened through the sheathing to the roof trusses using StiffClip CL structural clips made by The Steel Network, and specified by our project engineer. We insulated between the outriggers using 3 1/2-inch-thick Rockwool Toprock DD, then covered the whole field of the roof with that same thickness. Then we went back over everything with a second layer of 3 1/2-inch Toprock, for a total Rockwool thickness of 7 inches, or about R-30. We strapped over the insulation diagonally, fastening the strapping to the framing below with 9-inch screws. Every 8 feet, we cut a gap in the strapping to allow ventilation air to move in the cross-strapping direction. At the roof edge, we installed Cor-A-Vent vent strips around all four sides of the roof.

On the walls, the crew installed two 2-inch-thick layers of Rockwool Comfortboard 110, staggering the joints both horizontally and vertically **(11, 12)**, for a total of 4 inches thick (about R-16). The material came in 2-foot-by-4-foot panels; the crew ripped the first course down to one foot in width and tacked the pieces to the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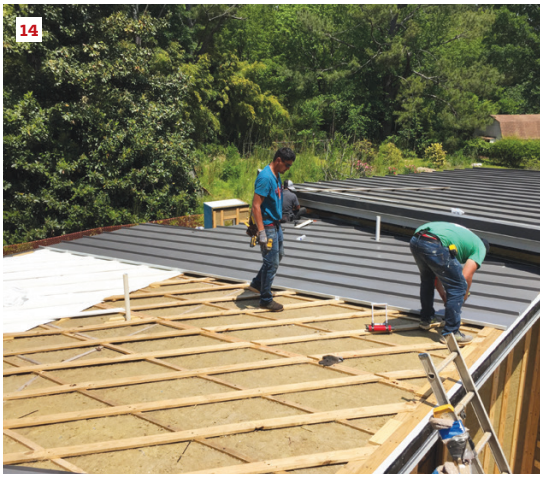
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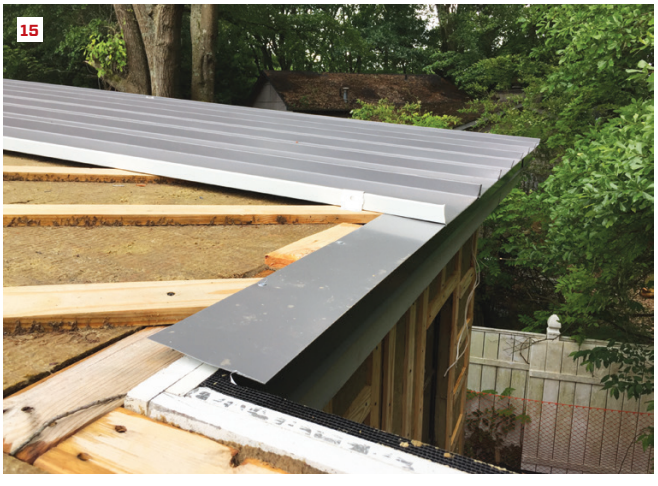
The shell has a continuous blanket of Rockwool **(13)**. Strapping holds the insulation in place and provides nailing for the siding. The roofers install standing-seam metal roofing **(14, 15)**. The siding crew installs Fry Reglet metal trim pieces **(16)**.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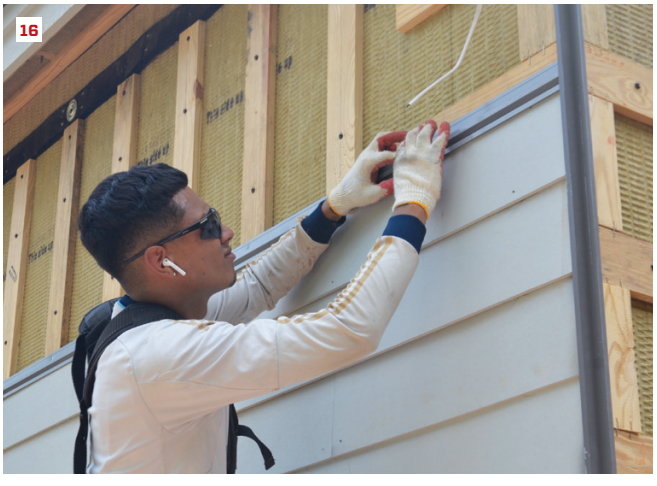
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wall using screws with 3-inch metal washers. Then they stacked successive courses up. The material is stiff and rigid enough that it can be stacked as high as 10 feet without our fastening the pieces to the wall. Then the crew applied the outside courses, temporarily tacking the outer pieces to the inner pieces with the 7-inch screws they were using to fasten the strapping. Finally, they applied the strapping, screwing it to the framing inside **(13)**.

At the time the insulation was being installed, the interior studs were still exposed so that the crew could tell where the studs were. They took care to screw into the framing; in case they should miss a stud, they were instructed to leave the screw in place, not back it out, and use a second screw to hit the stud. That way, the membrane would seal around the screws, and we wouldn't leave any small air-leakage holes.

Part of the house has horizontal lap siding and part has vertical plank siding. We ran the strapping either vertically or horizontally, accordingly, to provide nailing. But at the corners of the house, we ran the strapping horizontally so that we could cantilever the ends all the way out to the corners, where there was no framing behind the insulation. We made sure to span two studs with these horizontal pieces. We installed vertical blocking between the horizontal pieces at the outboard end, securing the blocking in place with wide staples.

The house received standing-seam roofing with a $1^1/_2$-inch standing seam **(14, 15)**. For siding, we chose Trespa composite siding for the vertical treatment, and Nichiha fiber cement for the lap siding and panels. All the wall trim, supplied by Fry Reglet, is metal, which enabled us to terminate the siding without caulking **(16)**. The result is a tough, durable water control layer covering a continuous, uninterrupted thermal control layer (the Rockwool insulation), which in turn protects a resilient, continuous air and vapor control layer (the Poly Wall Blue Barrier and the Polyguard peel-and-stick roofing underlayment). This house should provide the owners with many decades of maintenance-free serviceability.

Architect and builder Chris Laumer-Giddens is a principal of LG Squared, in Atlanta.