THE **PASSIVE HOUSE** BUILD

PART FIVE

Installing High-Performance Windows

By far the weakest link in a Passive House, windows must be installed perfectly

BY STEVE BACZEK

The guiding principle of a Passive House is that its primary source of heat is the sun. Not only do you have to locate and size windows and doors to take advantage of that sunlight, but they have to be high-quality units capable of retaining that energy for times when the sun isn't shining. That's a tall order when you have 24 windows and three entry doors and your goal is a finished house with an air-leakage area that's roughly the size of an index card.

Most of the windows and doors that are built to handle these stringent criteria come from Europe. That's not because Americans can't build them; rather, it's because in Europe, there is a market that demands them.

For this job, we used Makrowin aluminum-clad, triple-glazed tilt-turn windows and matching full-lite doors with an overall thermal value of about R-7. Built in Slovakia, they are imported to the United States through a Massachussetts-based company called Yaro, which also provides the local product support necessary to bridge the gap between the builder and the distant European manufacturer.

In a typical American home, a window is fastened to the exterior sheathing through a nailing flange, and then the flange is sealed to

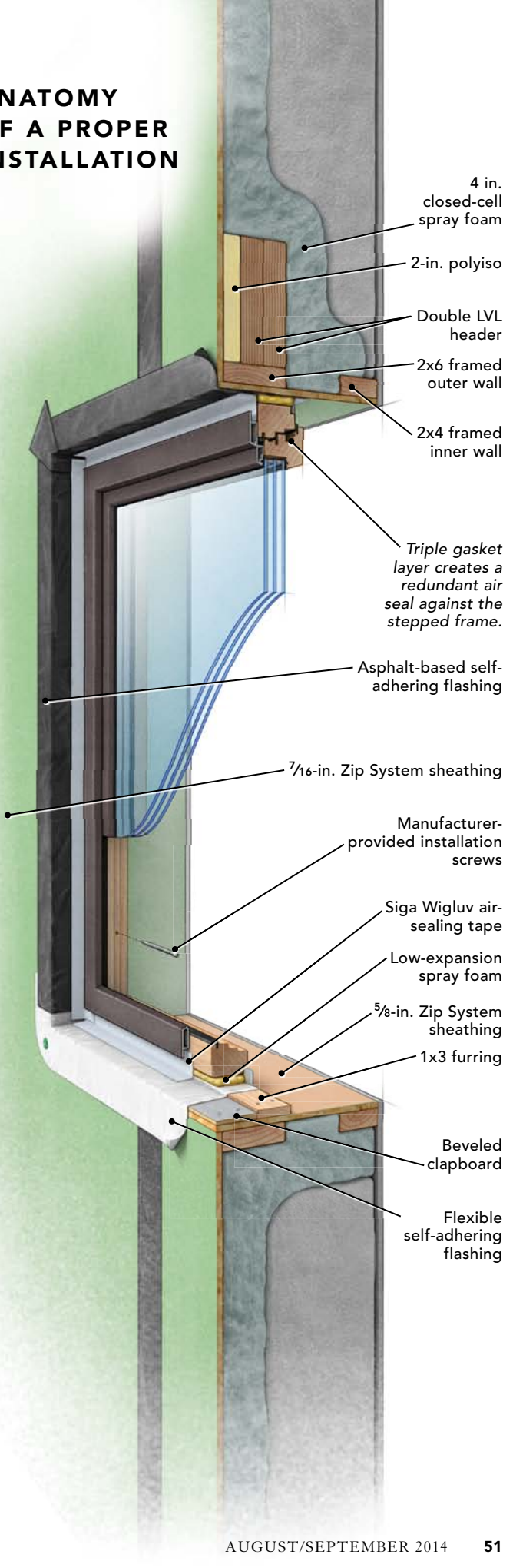
Drawing: John Hartman

START WATER-PROOF

Create a drainage plane. *A sloped sill and back dam are built in place with a piece of beveled clapboard siding and a 1x4. Both pieces are then covered with Tyvek FlexWrap, which wraps over the outside edge of the opening. It is seated with a J-roller and tacked to the face of the Zip System sheathing with a pair of cap nails.*

Seal the vertical seams. *The sides of the rough opening, where the exterior sheathing meets the boxed window-frame assembly, are protected with lengths of Grace Vycor flashing, which lap over the sill flashing.*

ANATOMY OF A PROPER INSTALLATION



the house's weather barrier with flashing tape. As is typical with European windows, the units used on this project had no nailing flange and were instead screwed through their jambs and air-sealed to the Zip System sheathing that was used to build the deep rough openings. The windows were then air-sealed inside and out with a combination of Siga Wigluv tape and expanding foam.

Custom comes standard

The beauty of these Makrowin windows, and many other European windows like them, is that they are customized. Windows that are

WATCH THE VIDEO To see a detailed video of the window installation and hear about the homeowners' first winter in the newly completed house, visit FineHomebuilding.com/extras.

INSTALLATION IS STRAIGHTFORWARD

In and up. *With ½-in. spacers setting a gap at the bottom and scrap 2xs tacked to the sides as temporary stops in the opening, the window frames (free of their heavy sashes) are tipped into place. The frames are square and robust, so after minimal shimming for level, the sides are fastened to the framing through predrilled holes with the included star-drive screws.*

built to suit are great from a design standpoint because I'm able to get what I need and want out of the windows without much restriction. For example, if we decide during the energy-modeling stage that we need to let in a little more sun to make the energy calculations work, we don't need to jump up to the next standard size; we can order the windows 1 in. wider or taller.

One thing to understand about high-performance windows and doors is that the frames are more costly than the insulated glazing units they hold. Therefore, larger windows are more cost-effective than smaller ones—not a bad bonus when windows make up 30% to 40% of the south wall of your house. Aside from function, these windows are just plain impressive in their fit, finish, and function. They close and latch with the heavy satisfaction of a bank vault and are perfectly balanced.

On-site torture testing

Once all the windows were installed, I asked the builders to spray each one with a garden hose for about five minutes. I did this because I believe in testing success rather than just assuming it, but also because 15-in.-thick walls don't have the energy movement neces-

TAPE AND FOAM ELIMINATE AIR LEAKS

Tuck the tape on the outside. *To seal the window to the surrounding rough opening, the builders install Siga Wigluv tape from the sides of the rough opening to the wooden frame that extends around the perimeter on all four sides of the window.*

Foam and seal from the inside. *The installation screws are made to support the weight of the window, so the shims can be removed to allow the ½-in. space that remains around the wooden frame to be fully sealed with low-expansion spray foam. The final step is another round of Siga Wigluv tape to finish the redundantly air-sealed transition between the window and the framing.*

High-stakes window delivery

Unlike ordering through a lumberyard, there was no box-truck delivery of shrink-wrapped units on this job. Instead, the windows and doors left the factory in a private shipping container that was carried overseas and that arrived on site with a lock and a tamper-evident seal about 12 weeks later. Nobody was permitted to open the shipping container until the day of installation, which is when the owners of Yaro—the U.S.-based distributor of these European-made Makrowin windows and doors—came to the job site to inspect the windows and doors for damage and to officially transfer ownership to the builder. The owners also stayed on site for the first day to demonstrate for the crew how to install, air-seal, and adjust the windows. After the details were worked out, the builder proceeded to install the remainder of the windows.

sary to promote drying. In short, the stakes in this wall are high, and there's no room for error. If a window can withstand the spray from a hose, there's not likely to be a water issue from a rainstorm.

As it turns out, the spray test revealed minor leaks in two out of the 24 windows in this house, which we were able to address before moving forward. □

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A white-glove inspection. *After cracking open the locked shipping container, the window reps remove all of the bracing and inspect the windows and doors for damage. Upon approval, the units are then signed over to the builder.*