

ENERGY



Deep Energy Retrofit Part 2: Doors and Windows

BY PHILIP ARMAND

Around 10 billion donuts are sold each year in the United States. Around 65 million windows and entry doors are sold each year in the United States. You can see through the middle of both, and that's about the extent of the similarities.

Why bring up donuts? Stay with me a minute. Buying windows today is not unlike shopping for a luxury car. After figuring out what size, type, and brand of windows and doors you prefer, then you have options in color and materials for both the interior and exterior; grilles or no grilles, or grilles in a huge variety of geometry; hardware in various colors and finishes; number of panes of glass and the coating on that glass; even the simple bug screen now has options in color and material. The nuance in options is as vast as the variety at your local (and here we are) donut shop.

Now imagine selecting your donut of choice: "I'll have the one with chocolate frosting and rainbow sprinkles." And your donut

purveyor says, "Perfect choice, but before you can have it, I need to tell you all the details about where we sourced the flour and frosting." The face you would invariably make is not unlike one I have seen on my clients when I'm explaining the need for high-performance windows.

AESTHETIC CONCERNS

The most efficient window is small and doesn't open; of course, that rarely meets the clients' expectations and may not satisfy building code requirements. We can have endless building-science-nerd talk about window ratings; however, there is a priority that trumps performance: appearance. We love and care for beautiful things, so our buildings need to be pretty, and for my clients, that is the main priority when they're selecting products for their homes. I rarely have much input on window style and am

Photos: Philip Armand



The new design included 50 double-hung, four casement, and three fixed arch-top windows, three entry doors, three sliding patio doors, and one massive double entry with sidelights.

mostly at the mercy of what the architect and the clients prefer.

My window dealer, David Hauser from Morningstar Doors and Windows, has had similar experiences. As he puts it, “Higher-end clients tend to care more about aesthetic. They typically have architects and designers involved. The husband or wife wants a certain look and efficiency is not at the top of the list. The look is paramount. Recently, I was working with a client on their 15,000-square-foot home on the North Shore (of Long Island). I suggested high-performance glass and my suggestion was overridden for a clearer window, no low-e coating at all. The designer and clients’ priority was not performance.”

On the project we began coverage of in “Deep Energy Retrofit: Part 1” (Mar/23), we were aiming for efficiency within the boundaries of geometry, aesthetics, and budget. The owners had their preferences and the village architectural review board had to approve their desired look and materials. The nearly 5,000 square feet required 50 double-hungs, four casements, three fixed arch-top windows, three entry doors, three sliding patio doors, and one massive double entry with sidelights. A ton of glass, and a ton of potential air leaks.

PERFORMANCE PRIORITIES

Allocating resources for high-performance doors and windows is my second priority when I’m approaching a deep-energy retrofit. A window or door is always the lowest-performing aspect of a well-built wall assembly, yet is an indispensable part of the building envelope and is critical in keeping a home airtight.

It is easy to make a solid wall airtight and stuff it with insulation. In contrast, a window or door has to open and close, and



These Weather Shield Signature double-hung windows are integrated with the proper tape for the application—Zip Tape on the right and Henry Weather Barrier Tape on the left. You can see the DuPont FlexWrap NF peeking out under the lower flanges.

it has to remain operable over a long period of time while consistently performing like a wall when closed.

Performance doors and windows, which have lower U-factors and improved airtightness limits, are now relatively accessible, and slowly, the narrative is changing as awareness about efficiency is being forced on homeowners and contractors alike by increasing energy costs. At the same time, however, high prices in building products are squeezing window and door budgets. We seem to be in transitional throes that may result in remodelers and home builders changing how they build and detail the building envelope, particularly as the EPA implements Energy Star 7.0 (due October 23, 2023). This new specification will mandate improvements to windows, doors, and skylights and has manufacturers scrambling to update their product lines to meet the more stringent guidelines. Indeed, there is transformation all around.

Only occasionally am I hired because I have the knowledge to “up-level” a basic set of blueprints into an energy-efficient final product. I am always hired because my end product looks beautiful, and clients are satisfied. I tend to impose my world-view that homes should also perform well. Sometimes a client agrees, but often we compromise.

Most of the homes I work on aim for a specific look (usually traditional), and when it comes to windows, double-hungs are most common. Performance windows, however, are generally hinged, allowing for a dramatically tighter seal. The only means I have to improve performance with a double-hung is to request the highest-performing glass and proper low-E coating within the selected product line and budget—often working directly with the vendor to avoid the donut face from the client. If a specific look is desired



Keeping continuity of layers is important. In this case, the author's WRB is Henry Blueskin, and the inside of the window is the connection point. The crew used a closed-cell polyethylene foam backer rod and a flexible sealant (Sashco Big Stretch and DAP Extreme Stretch) to connect the window to the WRB. They added the extension jambs during the finishing process. Keeping the extension jambs off until later allows the air barrier connection to be placed as close to the exterior as possible.

and the client is amenable to shopping different brands, then I hunt for performance. I also try (with marginal success) to convert any windows that will likely never be opened into fixed units.

SELECTION

The client on this project shopped brands. The architect recommended Weather Shield Windows and Doors, a family-owned manufacturer in Wisconsin. I was impressed by a sample window; the gaskets and build were robust, and the unit looked like it was going to last. The aluminum-clad unit has integrated nail fins; no floppy, removable business here. The sill dam is tall, seating the window nicely into a corner, lowering the possibility of leaks or drafts. The upper and lower sections overlap at a hardy weatherstripping and an interlock—another fail-safe against drafts and flimsiness. These units were made with performance in mind. Had we zoomed in on my face while I caressed the sample, you would have thought I was shopping for a sports car. The windows look like they should cost more than they do; I assume the firm allocates its marketing budget to making a better product. Up until this project, I had never heard of the brand.

SUPPLY LIST FOR INSTALLING WINDOWS AND DOORS

Tools:

- A good caulking gun [preferably one with an adjustable thrust ratio of 24:1 to 12:1].
- Caulk sealing caps (latex glove for your caulk tip).
- Putty knives, 1- and 1½-inch.
- Spray-foam sealant gun and plastic gun tips to protect the gun and allow easy access to tight gaps and cracks.
- Tape roller for pressure-sensitive tapes.
- Rubber gloves and eye protection.

Materials:

- Henry Blueskin VP 100 self-adhered water-resistive air barrier membrane.
- Weather barrier tapes including Henry Weather Barrier, Zip Tape and DuPont FlexWrap NF (9-inch).
- Closed-cell polyethylene foam backer rod: ½-, 1-, and 1½-inch.
- Sealants: Henry Moistop Sealant for the exterior, Sashco Big Stretch and DAP Extreme Stretch for the interior.
- Low-expansion insulating foam sealant.

Our selection—Weather Shield Signature casements and double-hungs—have a U-factor of 0.3 and a solar heat gain coefficient of 0.19, comparable to the other brands that were in the running, and that's where the similarities ended. The AAMA (now called FGIA, Fenestration and Glazing Industry Alliance) rated the exterior cladding of our selected units at 2605—double the score of the comparably priced alternatives. The alliance rates by testing color retention, chalk resistance, gloss retention, erosion resistance, salt spray, and humidity; the 2605-rated windows have double the warranty of comparable options. The air infiltration rating on the double-hung windows is 0.12, a great score for double-hungs in this price range; the comparably priced brands have a 0.25 rating or worse. The four casements we chose had an air infiltration rating of 0.01.

I spent an evening doing a deep dive on window ratings. If every manufacturer participated in all the available third-party testing offerings, every new window would be plastered with rating reports. Some of the ratings are listed using scoring codes and methods that require a deep-brain squint to fully comprehend. If you head into the weeds on this topic, bring a sharp machete and a gallon of highly caffeinated coffee.

I requested a low-e coating, as the back of the home faces southwest and blasts full-day sunlight into the home. Though we extended the eaves and gable ends, they had a limited impact on shading most of the windows. Another strategy was to order units with short or no extension jambs. This allowed me to install rod backer and caulk as close to the exterior as possible. Some of the walls had a final thickness of 9 inches, so a built-in jamb would have made properly sealing the window impossible. We build the extensions



Strips of 1/4-inch marine plywood act as the rainscreen. The windows are open to drain behind the siding and out.

Where exterior insulation without sheathing was added, the crew created window bucks to project the windows to the proper plane. Impeccably wrapping the buck is critical in keeping the barrier congruous.

during the trim process and then install additional insulation and air-sealing with canned foam. We always caulk the extension jambs to the window, adding another layer of air-sealing.

CONTROLLING THE INSTALLATION

In my area, the framers generally install the doors and windows. On my jobs, however, even if a framer is involved, my crew always handles the door and window installation, to avoid what Hauser has experienced. “Builders generally sub out their window install to the framers. They are aiming for speed and cost,” he says. “We often find no back caulk, improper flashing, no shims, and roofing nails that are too short. This is also true for the high-end market. We try to inform the client directly how the windows should be installed at the front-end.” Installation is what I have control over, and this is where we make certain the only shortcomings of a door and window are built-in, not induced by installation negligence.

Before installing the windows and doors, I watched the manufacturer’s installation training video and asked my rep a few questions. There was nothing dramatically different from any flanged window installation. I did bend up and braze a few lead-coated copper drip caps for a few of the single windows that may see rain; the doubles and triples came assembled with an integral drip cap.

To promote drainage, we made all the rough openings 3/8 inch taller than the call-out to accommodate a piece of cedar clapboard wrapped with Tyvek FlexWrap NF. We glued and stapled the clapboard to the sill framing, then wrapped it with the FlexWrap. This allowed us to make a continuous sill pan going about 6 inches up the sides. The rippled texture of FlexWrap is a built-in drainage plane; if water intrudes, it can drip under the lower flange and out.



After wrapping the window bucks, the crew installed exterior insulation abutting them.



There is no caulk used between the siding elements and the window or door units. This reduces future maintenance. Water intrusion can drain and dry. The rainscreen is a combination of marine plywood strips and Benjamin Obdyke Slicker Rainscreen. The Slicker on the lower section inhibits bugs from getting into the air cavity behind the siding. The rainscreen is pressure balanced, allowing air to flow up from the bottom and into the soffit.

Smoother stretch tapes also work for sill-pan applications but require plastic shims to be installed under the lower flange to allow water intrusion to rectify to the outside. On rigid, aluminum-clad windows, I found the rippled tape reduces the need to worry about an extra step.

On the exterior, we used Henry Moistop Sealant on the upper and side flanges; on the bottom flange, only the nail holes were given a dab of sealant, allowing an opening for water drainage. After plumb and level was established and any shims added to support the bottom of the window, we filled every nail hole, making sure the roofing nails penetrated into the framing a minimum of 1½ inches. Top and side flanges were detailed with a weather barrier tape.

We used a closed-cell-polyethylene foam backer rod and caulk to seal the units from the inside. I have often seen insulation companies using low-expanding foam (not on my jobs), but this is not best practice, and I have also seen a lot of voids and failures. A flexible caulk is most effective and most commonly recommended by window manufacturers. On this project, we used Sashco Big Stretch and DAP Extreme Stretch. Sealing the window on the interior—the conditioned side of the window, protected from ultraviolet light and harsh weather extremes—allows the seal to last the life of the unit. After sealing the windows and doors and allowing the caulk to dry, I did a quick inspection, adding sealant if needed. Later, as we prepped for trim, we adhered the extension jambs with DAP Big Stretch and filled the void between the jamb and framing with low-expanding foam, further blocking leaks and adding R-value.

Impeccability in the installation of door and window units is more critical than in the air-sealing process for opaque walls. I made certain to remain involved with every unit's install, as this is the most critical step in keeping a home airtight. Once we had established process and installed a few units, we gained momentum and moved quickly with prep through install. Every manufacturer and style window may have a different installation process, so I always check the resources available before any install. Even a great window, improperly installed, can lead to poor performance. I now also make sure to look at a sample window if a client has locked in a specific brand that I am not familiar with. This extra effort allows me to see if there are any obvious design flaws that need extra attention during install. I then research installation process and pitfalls; the internet is an amazing tool for learning from others' mistakes.

While donuts remain (mostly) round and sweet, windows continue to advance quickly. European and Canadian Passive House-rated windows are widely available, with some even manufactured locally. The new stringent standards are already yielding improved ratings. Even a double-hung window, installed properly, can yield an amazing blower door score and perform admirably. As craftspeople, we can't always control the products that go into the making of a home, but we can advocate and educate our clients about good products and work unceasingly to add impeccability to our installations.

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