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Sturdy Walls

Without Wood Sheathing

$125 in hardware and a few extra drywall fasteners solve the structural shortcomings of walls without plywood or OSB

BY FERNANDO PAGÉS RUIZ

I'll admit that my recent motivation to omit structural sheathing was cost. The price for building a 2x6 exterior wall on 24-in. centers sheathed with OSB shot up nearly 500%, and ready alternatives such as Zip System and Ox Thermo Ply were back-ordered.

Sheathing a house without plywood or OSB involves three primary considerations: how to achieve resistance to uplift and racking, how to install siding without backing underneath, and how to get a warranty for windows installed on foam. Recently I was able to solve all three problems and save a total of $2,755 on an affordable spec home I built.

In addition to costing less than OSB or plywood at present, continuous exterior foam insulation slows thermal bridging through framing members, adds an R-value of R-4 or R-5 per inch, and simplifies vapor control. In my case, 1-in. of R-5 foam with R-15 cavity insulation performs better than a 2x6 wall with R-19 cavity insulation.

Many high-performance builders add continuous exterior foam over plywood or OSB sheathing; foam insulating sheathing (like Zip R-Sheathing) is another option that makes installing continuous exterior insulation over sheathing a one-step process. But I intended to omit OSB to save money. Here's how I did it.

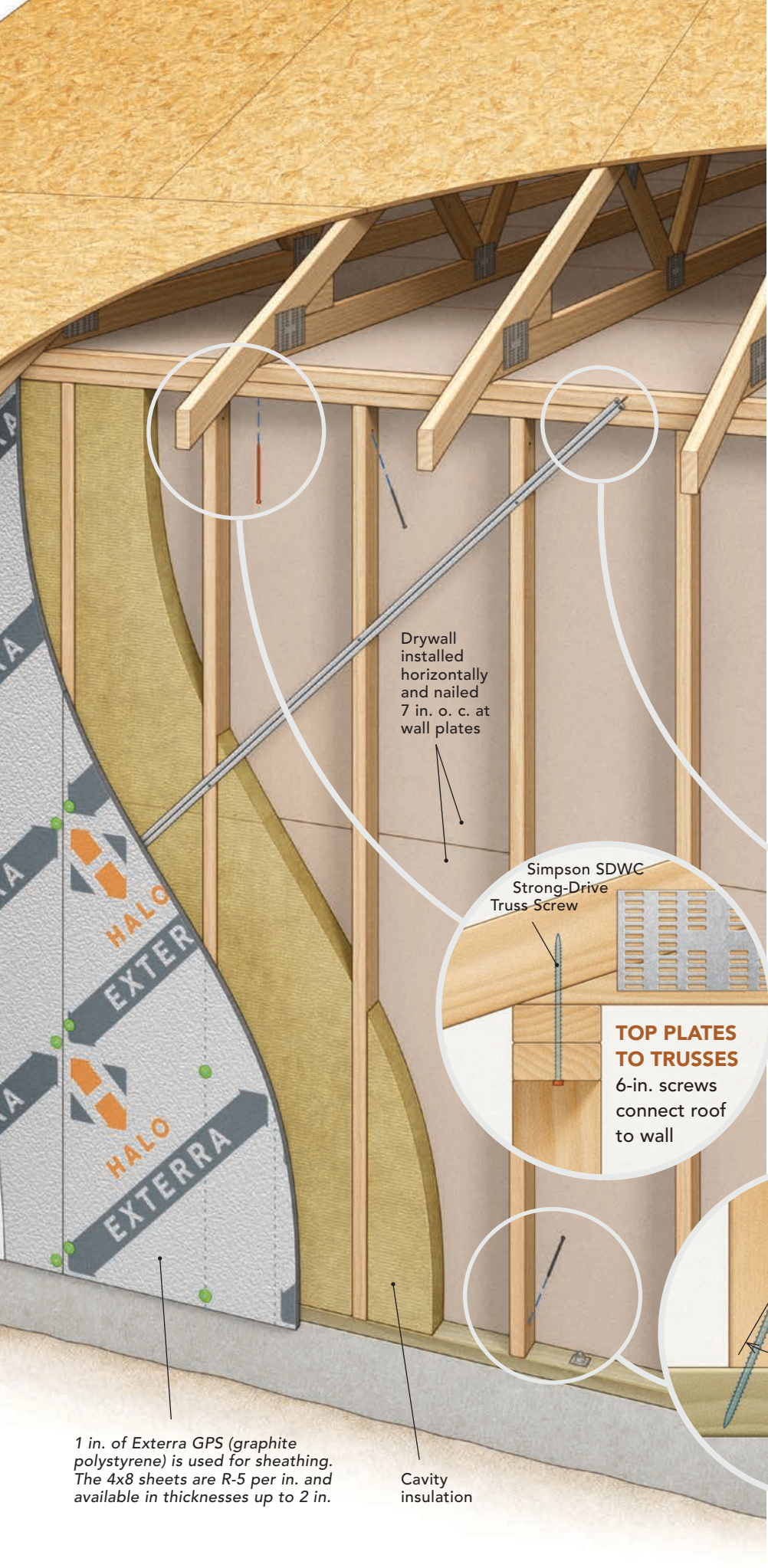
CRITICAL CORNERS
Tension ties prevent corners lifting and overturning

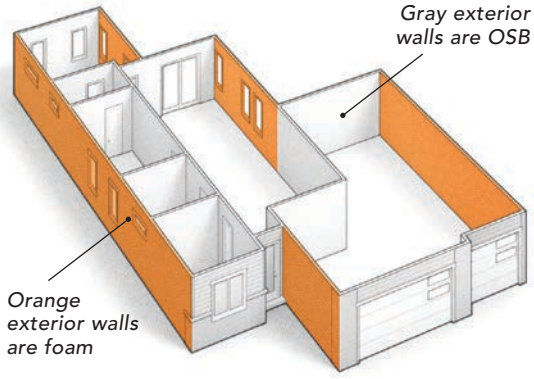
A sturdy house without a structural skin

Removing solid sheathing requires structural improvements to prevent wind from lifting the roof or pulling the house from its foundation. You also have to beef up the walls to prevent racking, which is when the house tilts laterally under the power of wind or earthquakes.

In other words, to avoid building a house of cards, your structure must have connections that transfer the gravity, wind, and earthquake loads from the roof, through the walls, and into the foundation. Engineers refer to this as "load path." Solid sheathing—or creating a rigid box with plywood or OSB on all the exterior walls—is a sturdy, simple,

Drawings: Christopher Mills

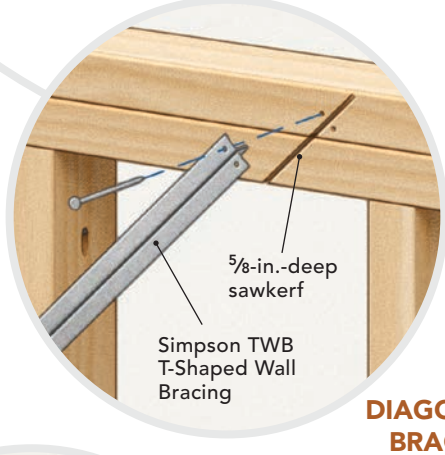




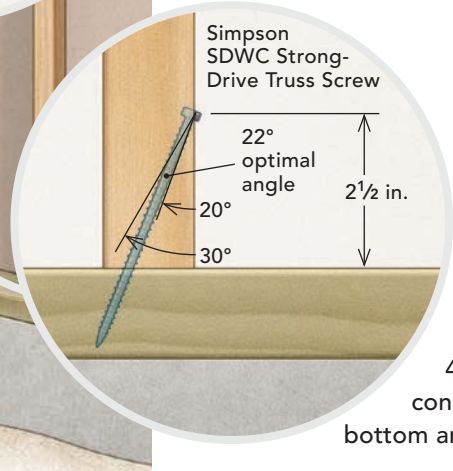
STRUCTURAL CONNECTIONS
FOR A STRONG WALL

Corner hold-downs, long screws at top and bottom plates, and additional screws through top plates into the trusses complete the load path that keeps the house together during high winds and earthquakes. The author sheathed critical walls for additional strength and sheathed the gables to make siding easier. Diagonal metal bracing holds the walls square during construction.

TOP PLATES TO TRUSSES
6-in. screws connect roof to wall



DIAGONAL BRACING
Let-in T-channels prevent framing from racking



STUDS TO PLATES
4½-in. screws connect studs to bottom and top plates

HOLD DOWN CORNERS

Without a plywood or OSB skin, houses with foam sheathing need additional uplift resistance on corners that connect the frame to its foundation, otherwise the frame could lift or overturn in high winds or earthquakes.

Some hold-downs connectors require a perfectly positioned anchor bolt that's wet-set or cast in place during the slab pour. It's hard to consistently get cast-in-place bolts perfectly positioned, so we used Simpson's DTT Tension Ties (DTT1Z) installed after the framing to ensure they're in exactly the right place. (These connectors are more commonly used as tension ties in deck construction.)

The 5-in. screw anchor requires a 5¼-in.-deep hole, so we mark the drill bits with tape to ensure the holes are the proper depth. After drilling, the hole is cleared of dust with compressed air and we lubricate the screw with a little oil before driving it into the hole. The manufacturer's instructions tell you to use hand tools or a drill—no impact drivers.

The screw anchor must be tightened to 100-ft.-lb., tighter than a drill can achieve and tighter than intuition would suggest, so we use a torque wrench. Then six ¼-in.-dia. by 1½-in.-long Strong-Drive SDS Heavy-Duty Connector Screws, which are not included with the connector, attach the tension ties to the studs. The hold-down and screw anchor provide more than the required 800 lb. of uplift resistance.

STRENGTHEN PLATE CONNECTIONS

Strong-Drive 4½-in. structural truss screws (SDWC15450-KT) connect the studs to the bottom plate and double top plate. These long, self-drilling screws help strengthen the connections between studs and plates and prevent the frame's structural elements from separating when subject to sliding or uplift forces. The screws come with a T30 driver bit and guide that helps position the screw at the optimal angle. We used it for the first few screws until we felt comfortable eyeing the angle and driving the screw without it to save time.

and forgiving way to achieve sufficient load-path connections and racking resistance. Nowadays, it's also expensive.

Fortunately, the residential building code provides several methods to design and construct strong walls with various methods of bracing that add stiffness to the structure. I counted twelve different braced-wall panel types in the IRC, ranging from let-in diagonal bracing, to wood sheathing and fiberboard, to gypsum wallboard.

It takes a little head-scratching to design a braced-wall system that omits solid-wood panels. The code is cumbersome, and I had to lean on my friend Jay Crandell, PE, to help me, despite relying entirely on the prescriptive methods in the IRC. A warning is due. My design made things easier because it's a single-story house, mostly square, and not in a hazard area—no hurricanes or earthquakes to complicate things. This article is specific to my build, but the techniques are within the grasp of most builders and structural engineers in low-risk parts of the country and they can be adapted for two- and three-story homes. Each building requires an individual braced-wall design strategy. What I did may not apply to your project.

The problems with diagonal braces

One time-tested and code-honored option for walls without wood sheathing is 1x4, let-in wood braces, but they must be installed at the correct angle (45° to 60° from bottom to top plate) and fit with the precision of cabinet joinery to work properly. If the notches are too deep or too wide, or the nailing is off, the wall won't work as designed.

More importantly, this option met with strong resistance from my framers—they had never done it before. Builders often neglect one key aspect of let-in bracing, which is that the wall must have ½-in. gypsum drywall on the interior face using a tighter-than-normal nail spacing.

One carpenter suggested using T-shaped steel braces like Simpson Strong-Tie's TWBs because they're easy to install—just slide the T-brace into a ⅝-in.-deep cut made with a circular saw and nail it. Many builders mistakenly use these as a direct replacement for let-in wood bracing. Unfortunately, when you dig a little deeper you learn in the manufacturer's instructions that T-shaped braces are "designed to resist racking during construction." In other words, they're only meant to keep walls square while framing them, so we still needed a way to satisfy the structural needs of the house.

Jay Crandell is a structural engineer specializing in light-frame wood construction; he offered a solution that didn't rely on diagonal bracing. He suggested hold-down connectors on the building corners, structural screws connecting levels, and additional drywall fastening to make up for the strength lost by omitting plywood or OSB sheathing.

Drywall helps control racking

Canadians and New Zealanders are far ahead of us when it comes to using drywall as a structural panel. Their extensive testing, and later testing done at the National Association of Home Builders (NAHB), revealed the structural power of ½-in. drywall. The results of the tests were convincing enough that the Canadian Building Code considers gypsum bracing on par with exterior wood sheathing, and eliminated the solid-sheathing requirement for much of Canada.

The International Residential Code (IRC) also recognizes gypsum board brace panels, although builders seldom take advantage of the potential added strength they offer. Unfortunately, until the drywall goes up, unsheathed walls remain vulnerable to racking, so I installed those T-shaped metal braces to hold things nice and square—precisely what these braces are designed to do. This also allowed me to complete the rest of the wall-bracing system myself after the framers left, and I didn't have to deal with their grumbling or extra

HOLD DOWN THE ROOF

Strong-Drive 6-in. structural truss screws (SDWC15600B-KT) are used to tie the roof trusses to the top plate and help keep the roof connected to the walls during high winds and earthquakes. You can also use several types of metal truss connector for strengthening this vulnerable connection, but the screws cost less and install faster. The roof trusses have a 24-in. spacing and the wall studs have a 16-in. spacing, so with this roof's simple geometry, the trusses land directly over a stud every 4 ft. The screw is angled when the truss is over a stud.

DRYWALL RESISTS RACKING

The Canadian Mortgage and Housing Corporation and NAHB testing show that 7-in. on-center fastening at the top and bottom plate helps gypsum wallboard significantly increase a wall's racking resistance. The contribution varies with panel orientation and wall length. Panels oriented horizontally are more than 40% stronger than those with panels oriented vertically and drywall nails are slightly stronger than drywall screws because they're less brittle.

For drywall used as bracing to be effective, the drywall must be taped and finished. Walls finished with high-strength setting-type compound can have 50% more shear capacity than those finished with a drying-type compound. Even greater racking strength can be achieved with taped drywall and a 4-in. fastening schedule.

charges. Of course, drywall is not a panacea. We still needed to anchor the walls to the foundation at key points and connect all the framing from mudsill to trusses.

In California, drywall hangers are familiar with shear-wall nailing and even having their installation inspected before tapers move in. In the Midwest, where I build, it's best to ask for a day between hangers and finishers to install the extra nails yourself. It's not difficult to do. The basic code-prescribed pattern requires driving nails or screws every 7 in. into horizontal panels at the bottom and top plates. You don't have to do any special nailing in the field or at panel joints because tape and compound sufficiently transfers loads between sheets.

Hardware completes the load path

The conventional way to connect exterior wall corners to the foundation is with concrete-embedded bolts that attach to the wall framing, but it's difficult to wet-set the anchor bolts exactly where they belong. Jay suggested we use Simpson's DTT Tension Ties. Although these connectors were designed to meet code requirements for connecting deck joists to a supporting ledger, you can also use them on building corners to prevent uplift. The advantage of the Simpson bracket is that you can install it exactly where you need it after the framing is done using a Simpson Titen HD Screw Anchor.

To complete the load path, Jay recommended using Simpson SDWC Truss Screws to securely attach the roof and walls. Similar products are available from other manufacturers. The screws, driven through the top plate into each truss, and then from each stud to the top and bottom plates, connect the roof to the foundation. One laborer can connect all the elements in a house like mine in a couple of hours.

Complications of exterior foam

Using rigid-foam insulation instead of wood structural sheathing means some additional deviations from a typical assembly. For one, the foam is thicker than plywood or OSB, so you have to order wider jambs for doors and windows. Another consideration that is window manufacturers test their products on walls with solid sheathing, so you should check to see if your window manufacturer will warranty their products over the softer surface. My window company didn't object. Now that more builders use continuous exterior insulation, window manufacturers are increasingly testing over foam sheathing.

If you get pushback from inspectors or a window manufacturer, you can remind them of an extensive test by the Department of Energy, NAHB, the window industry, and others. They concluded windows on foam worked with Type II 15-psi foam up to 2 in. thick. You can find more information at continuousinsulation.org/applications/window-installation.

Where's the water-resistive barrier?

Panel manufacturers often recommend taping the panel seams, especially when the foam is also the water-resistive barrier (WRB). I've used foam as a WRB and I do not trust the tape to stay on during construction, especially in cold weather. I prefer a WRB such as Typar or Tyvek over the foam and fastened to the framing with cap nails. Without wood sheathing, your cladding will also be nailed into the studs. I use OSB at gable ends, especially over trusses, where framing can be difficult to find where you need it.

It might seem like a hassle to build a house with foam sheathing, but an affordable, safe, and energy-efficient home has just the right amount of wall bracing with other important design considerations for a measured balance between cost and performance. □

Fernando Pagés Ruiz is a builder and an ICC-certified residential building inspector in Fremont, Neb. Photos by the author.

FOAM VS OSB

Using foam 2x4 walls instead of 2x6s with OSB saved 42% on exterior-wall costs (and offers better thermal performance). The comparison shown here is based on 10 ft. of wall without windows built in Fremont, Neb., in June 2022.

Material	Quantity	Price	Total
Foam sheathing	2.5	$14.50	$36.25
2x4 stud, 116⅝ in.	8	$14.83	$118.64
2x4 treated sill	10	$1.61	$16.10
2x4 top plate	20	$1.35	$27.00
Truss screws	8	$0.43	$3.44
Stud screws	16	$0.43	$6.88
Hold down	1	$3.47	$3.47
Titen HD heavy duty screw	1	$1.49	$1.49

2X4 FOAM WALL $213.27

Material	Quantity	Price	Total
OSB sheathing	2.5	$65.53	$163.83
2x6 stud, 116⅝ in.	6	$22.40	$134.40
2x6 treated sill	10	$2.21	$22.10
2x6 top plate	20	$2.03	$40.60
Truss clips	8	$1.33	$10.64

2X6 OSB WALL $371.57