SIPs:

Are They Right for Your Next Project?

BY JOHN ROSS

A crane provides muscle. *Most of the time, walls can be tilted up by hand. However, for staging and stacking panels, tilting up large gable-end walls, and placing roof panels, a crane or a large forklift is a must.*

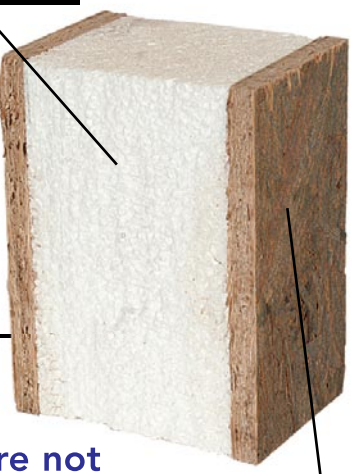
The first time I used structural insulated panels (SIPs), I didn't even know what they were called. I was lead carpenter for a small school project, and one day, the general contractor said to me, "Change of plans. We're flying in the SIP roof next week." I never had heard of SIPs, or built with a roof system that had to be flown in.

"Hmmm. OK," I replied.

Without any more preparation than that, a crane truck arrived the next week, pulling a trailer loaded with 8-ft. by 24-ft. roof panels that looked like giant ice-cream sandwiches.

The crane operator worked for the SIP manufacturer and gave me a 15-minute installation primer. To me, it didn't matter what these panels were called; they were simply something else that needed to be put together.

Structural insulated panels make stronger homes that go up faster and reduce energy bills dramatically



SIPs are not new

Although they were new to me, SIPs were invented by the Forest Products Laboratory in the early 1930s. When Frank Lloyd Wright used them in his innovative Usonian houses during the post-World War II building boom, they were poised to revolutionize residential construction. But it didn't work out that way. Production stud framing became deeply entrenched as a preferred building method. Until recently, framing lumber, labor, and home-heating fuel have remained cheap enough that there hasn't been an incentive to change. Nonstructural stress-skin panels (one side is faced with wallboard instead of oriented strand board, or OSB) have been used widely in the timber-frame resurgence that began in the early 1980s, but SIPs never made big inroads into the general residential-construction market.

Today, manufacturers such as Insulspan and Premier, longtime suppliers to the timber-framing market, are making a run at the broader residential market, only this time on the back of the climate crisis and the drive for more-efficient houses. According to the Structural Insulated Panel Association (SIPA; www.sips.org), SIPs posted 20%-plus growth in the residential market in 2005. However, the overall market share is less than 1%. Before SIPs can break into the mainstream, information about how to build with them has to lead the way. For the uninitiated, building with SIPs can seem like a big

SIP materials are not exotic

In the United States, the vast majority of SIP panels used for residential construction are made with two layers of oriented strand board (OSB) glued to an expanded-polystyrene (EPS) core. EPS is economical, readily available, easy to work with during manufacturing, and easy to work with on the job site. On the downside, EPS has an R-value of 3.6 per in. compared with polyurethane, which has an R-value of 6.8 per in. (See *FHB* #187, p. 120.) OSB as a skin material is also readily available and is made from fast-growing softwood trees, which are considered a renewable resource. However, the availability of other specialized skin materials, such as metal, cementboard, fiberglass, and pressure-treated plywood, is growing quickly.

POLYURETHANE CORE WITH CEMENTBOARD SKIN

POLYURETHANE/POLYISOCYANURATE CORE WITH OSB SKIN

Product photos: Krysta S. Doerfler

TOOLS

SIP assembly requires some specialized tools

Beyond basic carpentry gear, a SIP installation requires an investment of about $1000. Nylon webbing, lifting plates, and ratchet straps as well as a modified chainsaw, hot wires, and a flex bit all should be on the short list of tools to buy ("Sources," p. 61).

Panels are moved into place with lifting plates and straps. *Steel lifting plates are screwed to the skin of wall and roof panels. Nylon webbing attaches to the pin on each plate. A crane or forklift grabs the webbing to move the panel where it needs to go. Manually operated ratchet straps have literally tons of pulling strength. Straps are essential for finessing large panels into difficult spots and for holding them in place while fastened.*

Job-site modifications include cutting, burning, and boring. *Fitted with a custom foot, an electric chainsaw (right) makes quick work of trimming panels to size. Hot wires (bottom left) remove excess foam for splines and lumber connections. A flex bit (bottom right) is the electrician's best friend on a SIP job, easily boring chases between outlets and switches.*

mystery not only about house systems like wiring and HVAC but also about siding, roofing, and basic structural connections.

Good carpentry skills make using SIPs easier

Six years after my first SIP encounter and now a *Fine Homebuilding* editor, I got the chance to see how the technology had changed and how complicated it would be to build a complete SIP house. To do this, I visited a job site where a crew was erecting a large SIP addition. Brian Grogan is lead installer for Panel Pros, a dealer/installer in the Boston area with 20 years of SIP-construction experience.

Grogan is quick to smile and resembles a large teddy bear. By the way the crew moves around him, though, I get the feeling that a grizzly might be lurking inside.

Grogan talked to me while he worked. Time and again, he insisted that building with SIPs is not much different from building with studs. "Think about it," he explains. "Once I get a series of wall panels connected together lying on the floor deck, the wall gets tilted up and braced, just like a stick-built wall." The big difference, of course, is speed. SIPs eliminate the work of laying out plates, spreading studs, nailing together all the pieces, squaring up the wall section, and covering it with sheathing. With SIPs, Grogan uses a crane to move panels from the staging area to the floor deck of the house. His crew connects them in a couple of minutes, and the wall stands up.

When a panel needs modification, it doesn't slow down the crew. At one point, because of a discrepancy in the plans, one of the panels needed 6 in. trimmed off. A crew member pulled out a regular circular saw, cut the OSB skins from each side, and broke off the piece.

Drawings: Dan Thornton

After that, the excess foam was removed with a burner (see "Tools," facing page). The fix took 10 minutes.

During Grogan's 20 years in the field, he has trained hundreds of people to work with SIPs. For him, it's a matter of having solid construction skills rather than SIP-specific skills. "Anyone with basic carpentry or construction skills can catch on in a few days."

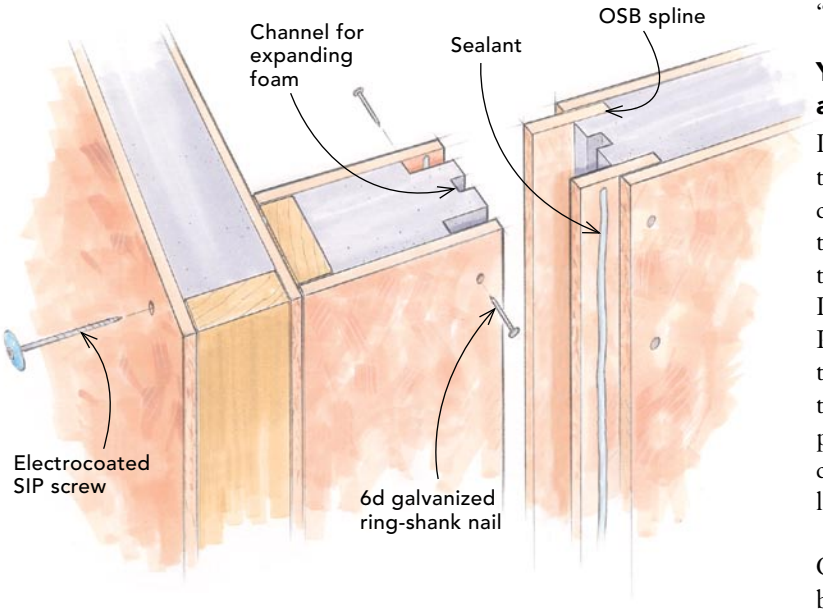
The main thing is to learn how to move panels into place. To do this on Grogan's job, ratchet straps were used in almost every phase of house assembly, from snugging together long sections of walls prior to tilt-up to manipulating roof panels tightly into place.

After watching Grogan and his crew, I thought that with my own framing experience, I probably could get through a whole-house SIP project. But I didn't have a complete picture yet. Building a tight, well-insulated shell is only part of the picture. I still had questions about running wires, sizing and installing an HVAC system, and choosing the right finish materials and details.

CONNECTIONS

Corner and spline joints are most common

Electrocoated SIP screws with broad tin washers fasten the corner joints where dimensional lumber is installed. Midwall joints use splines that are slipped into channels routed in the foam. Splines are secured with 6d ring-shank nails; then expanding foam is inserted into the center channel to seal the joint.



SIP School jump-starts understanding

To further my SIP education, I decided to visit a school dedicated to showing how SIP houses are designed, built, and finished. SIP School (www.sipschool.org), located in Shepherdstown, W.Va., offers several courses, the keystone of which is a hands-on Installer Certification Workshop that offers good basic instruction and forces participants to think and problem-solve like SIP aficionados.

The 15 participants in the class anted up $1500 each to attend the weeklong session. At the course, I met professional SIP installers looking to deepen their already good knowledge of SIPs; contractors and carpenters wanting to learn about a construction method generating interest in the marketplace; and enthusiasts looking for a career shift to building with SIPs.

During the week, we built an entire house out of SIPs and got enough practice on a class-2 forklift to become certified operators. We also learned about electrical installation and weatherization. One of the most informative sessions was a lecture by Al Cobb, the owner and director of SIP School.

Cobb could be right out of a 1950s yearbook with his crew-cut hair, flyboy ears, and maverick take-on-the-world smirk. Cobb's presentation focused on how passive airflow is almost entirely absent in a SIP house. This tight construction makes a house efficient to heat and cool. Too little airflow, however, can cause problems.

As Cobb says, "If we're not actively ventilating, we are screwing up." Typically, ventilation is handled with a heat-recovery ventilator (HRV). Part of the house's ventilation system, an HRV exchanges stale interior air for fresh outside air while transferring some of the interior air's heat (a process called air-to-air heat exchange).

An HVAC contractor used to dealing with leaky houses often designs the HVAC system to handle worst-case scenarios. This can cause problems in a SIP house. When an oversize system turns on and off in short bursts, called short cycling, it cools the air quickly but then turns off before it effectively lowers the humidity. This usage is inefficient and also can lead to moisture problems (see "Bigger Isn't Better," *FHB* #164, pp. 88-91). Cobb advises that every house plan be evaluated by a home-energy rater ("Sources," p. 61). "If your HVAC contractor doesn't know what that is," Cobb says, "then find one who does."

Your supplier is a resource

If you're building a SIP house, the panel manufacturer you choose has a lot to do with the success of the project. The three big panel makers are Insulspan, R-Control, and Premier. Most panels sold by them and other U.S. manufacturers are made with expanded polystyrene (EPS) as the foam core. But the real differences lie in product support.

"It's a product and service," Cobb says. "If you can't get both, you're not getting a good value." This responsibility falls on a dealer or supplier who can coordinate the panel fabrication according to your needs, then have the completed package delivered to the site. Cobb recommends finding a dealer or supplier who offers full product support, which could include translating the architect's plans into a SIP scheme, cutting all window and door openings, boring electrical-wire chases, and cutting and installing lumber where possible. The support also could include providing weatherization information, fastener schedules, HVAC-system sizing, and even installation crews or on-site consultants. For an end user or installer, Cobb does not recommend trying to save money by going straight to a manufacturer and buying blank panels.

SIPA has more than 200 members throughout the United States, and the SIP School Web site offers information on hundreds more

SIP-related professionals. Finding someone in most areas of the country should not be difficult ("Sources," facing page).

A high-performance house has a slim margin of error

To understand how design choices affect a house's performance and maintenance issues, I traveled to Vermont, which, because of its timber-framing roots, is considered by many to be the Silicon Valley of SIP manufacturing.

Paul Malko is a project engineer at Foard Panel, one of the only manufacturers of extruded-polystyrene (XPS) panels in the United States. Malko is bookish and enthusiastic, and he prides himself on his in-depth knowledge of building science as it pertains to high-performance houses.

Malko has put together a presentation that he gives to timber-framers, SIP installers, and SIP-home owners. In it, he stresses that water management is the top issue for SIPs. Like Cobb, who hammers home the importance of ventilating inside, Malko says that builders need to be sure they are ventilating the outside as well. "SIPs can take a lot of abuse in the form of water exposure as long as they get a chance to dry out," Malko says. And the most effective way to allow them to dry out is to provide a ventilation space as well as a drainage plane between the siding or roofing material and the OSB skin of the SIP (drawings right).

SIPs are part of a growing trend of prefabrication

SIPs are not the only choice for new ways of building. Insulating concrete forms (ICFs), prefabricated stud-frame walls, and a variety of new manufactured homes are all part of the changing look of the residential-construction industry. Whether builders try SIPs or other prefabricated techniques might depend less on their openness to try new things and more on how much longer they intend to be building houses. In the future, using many of these new building techniques in every home could be a foregone conclusion. □

John Ross is an assistant editor at *Fine Homebuilding*. Photos by the author, except where noted.

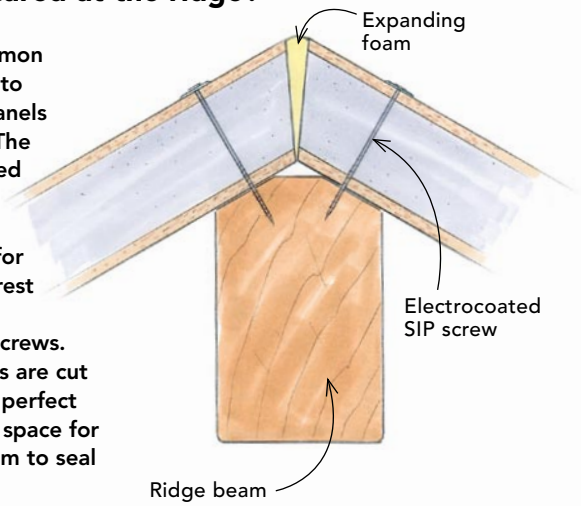
SIPs cost less over time

The cost of the SIPs for a 1000-sq.-ft. house built in West Virginia in 2005 was $13,500. That's more than double the cost of framing lumber and insulation for a like-size house built with stud framing. However, the final project cost was $110,000, so adjusting for a less-expensive HVAC system, the homeowners paid only a 6% premium for SIPs. With tax breaks (www.energystar.gov) and reduced heating and cooling loads, the savings averaged $120 per month. After two years and eight months, the homeowners broke even on their investment. If they live in the home for 10 more years, they will have an overall savings of $14,400. If they put the money back into their mortgage, the 30-year term would be reduced to 20.

Q&A CONSTRUCTION DETAILS

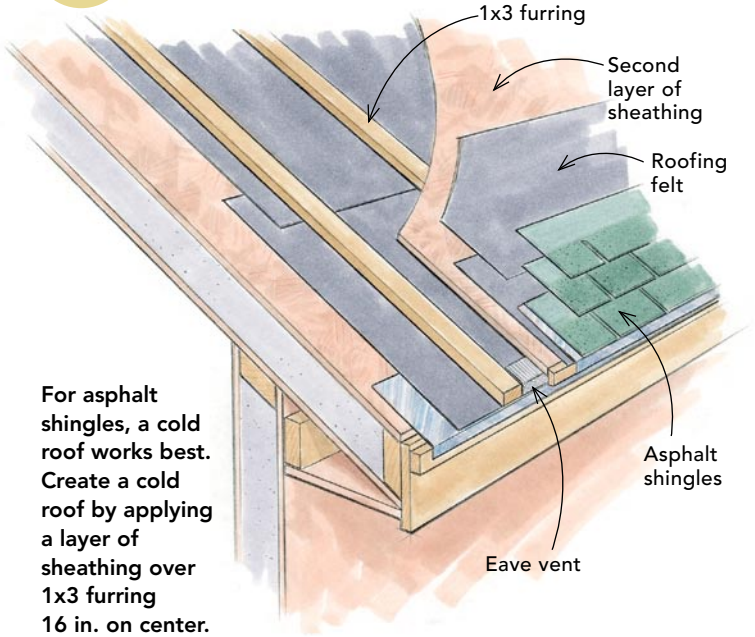
Most SIP manufacturers have their own booklets devoted to all the key construction details a builder might encounter (the details shown here came from Winter Panel). The most common questions concern roof, wall, and floor intersections as well as cladding and wiring.

1 How are roof panels sealed and secured at the ridge?

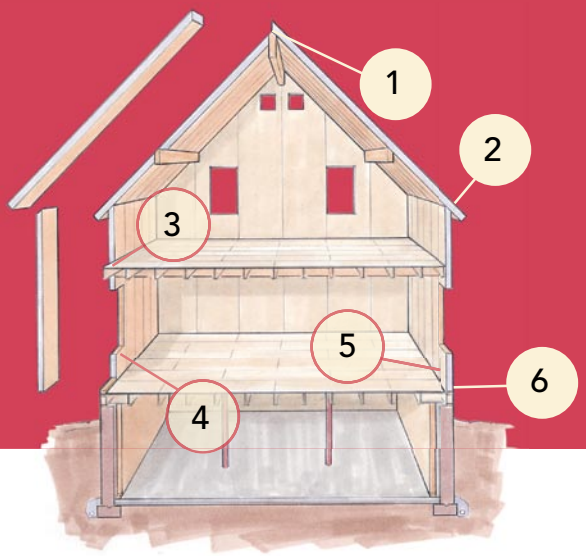


The most common ridge detail is to support the panels with a beam. The beam is beveled slightly on top to provide a good surface for the panels to rest against when secured with screws. The panel ends are cut just short of a perfect miter to allow space for expanding foam to seal the joint.

2 How is the roof vented?



For asphalt shingles, a cold roof works best. Create a cold roof by applying a layer of sheathing over 1x3 furring 16 in. on center. Venting at the ridge and eave allows air to move freely between the two layers of sheathing. This style of roof helps to prevent moisture buildup.

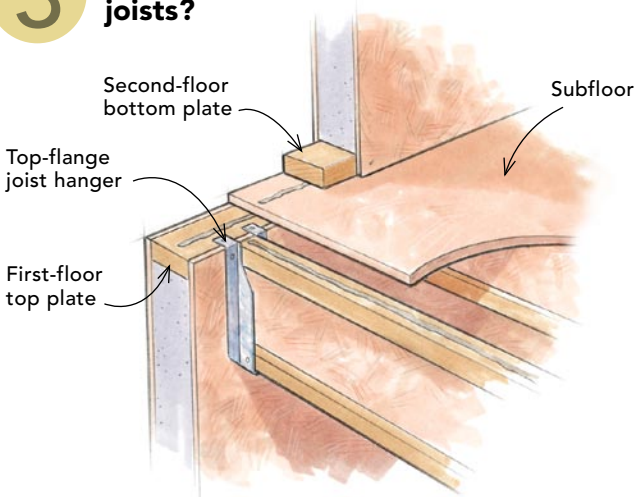


SIP information sources

To jump-start a Web search, try these sites rich with SIP information.

- Structural Insulated Panel Association **www.sips.org**
- Toolbase Services **www.toolbase.org**
- SIP School **www.sipschool.org**
- SIP forum **www.sipweb.com**
- Find a home-energy rater **www.natresnet.org**

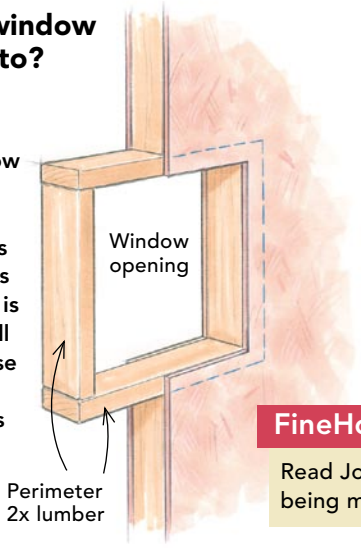
3 How do I support the second-floor joists?



Top-flange joist hangers work in most situations. Typically, there is a 2x plate let into the top of a wall panel that is connected to both skins. The top-flange joist hanger is connected to the wall's top plate. The second-floor sheathing is installed over this connection flush with the outside skin of the wall panel.

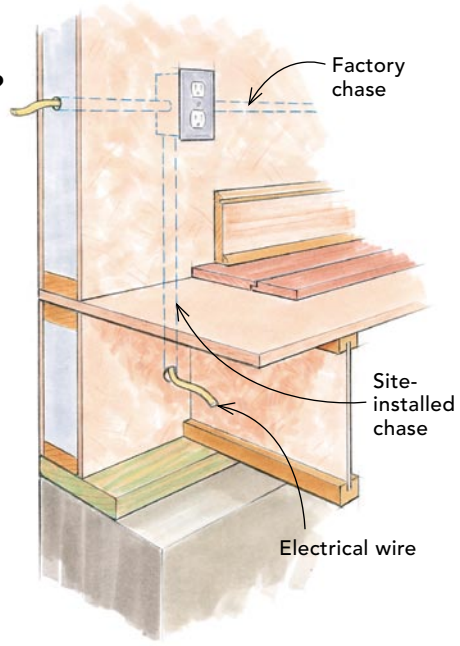
4 Can I have a window where I want to?

Yes, within reason. Should you cut an unplanned window without checking with your supplier? No. Each supplier has load charts specific to its brand of SIPs. Sometimes, as in the drawing (right), there is plenty of panel surface on all sides of the opening. In these cases, simply installing the perimeter lumber completes the rough opening.



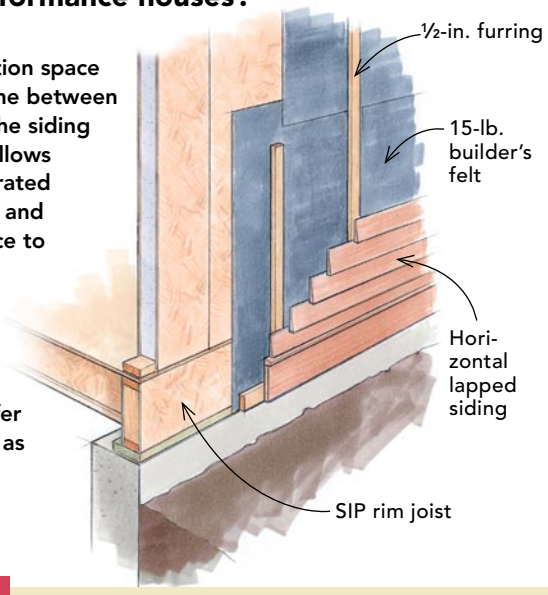
5 How do I run wires in SIPs?

Wiring is mostly the same as in any house. Manufacturers usually bore wire chases in the panels for no extra charge. However, because there are fewer places to run wire, good planning is key. Electricians who are SIP savvy learn to use floor systems for major chaseways, interior walls for vertical runs, and flex bit for site-installed chases.



6 What's the optimum siding detail for high-performance houses?

Providing a ventilation space and a drainage plane between the SIP's skin and the siding is important. This allows condensed or infiltrated moisture to escape and helps the SIP surface to stay dry. The siding should be lapped horizontally and be back-primed. Also, a growing number of SIP builders prefer 15-lb. builder's felt as the housewrap.



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Read John Ross's blog written while attending SIP School. Also, see video of SIPs being manufactured at the Winter Panel and Foard Panel factories in Vermont.