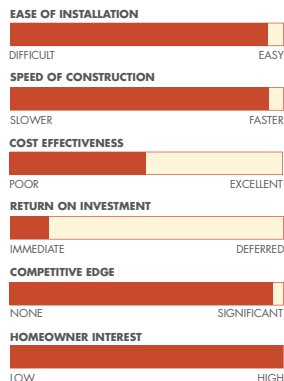


# SIPs Below Ground: *Delivering Comfort Where It's Least Expected*

## Builder's Experience



**Challenges:** Permit Approval  
Transportation

**Would he do it again?** Yes

### PATH Attributes:

- 💰 Affordability
- ⚡ Energy Efficiency
- ★ Quality/Durability

**Builder Tips:** Start early to gain code approval; provide adequate lead-time to order panels.

### Builder:

Curt Stendel  
Panelworks Plus, St. Francis, Minnesota

### Builder Type:

Small Production Builder

### The Technology:

Structural Insulated Panels (SIPs)

### The Project:

Vacation Cabin on Lake Minnetonka in Orono, Minnesota. This 1,400-square-foot, three-story home includes a walkout basement and a partial third floor for a master bedroom. SIPs were used for the entire structure, including the basement. The builder broke ground in spring 2003.

## SIPs below grade? You bet.

**The job:** Learn the correct building practices—and convince the building inspector.

Client Gerald Walsh wants a well-insulated basement in his vacation cabin so that he can comfortably use it as a living room. The local building inspector likes conventional foundations. He's never seen below-grade structural insulated panels (SIPs), and isn't inclined to grant a permit for them.

*"At first, he just wouldn't hear of it."*

— Stendel, reflecting on the inspector's attitude toward below-grade SIPs, an application that is not universally recognized.

## STENDEL'S STORY

*"When a building inspector refuses to give a permit for a technology like below-grade SIPs, you have to be ready to dig in," Stendel says. "Persistence got the cabin finished on time."*

*"In this case, it was the determination of the homebuyer, who was also the general contractor, that finally convinced the inspector to give below-grade SIPs a try. Despite the objections of the Orono*



Gerald Walsh got his dream vacation cabin on Lake Minnetonka. It is made entirely of SIPs, from the foundation to the roof.

building inspector, Walsh felt that he should be able to put in a SIPs system that was engineered at the price he was willing to pay, rather than accept a lower quality, less insulated alternative."

*"And he had done his homework. After a great deal of research, Walsh settled on SIPs from Extreme Panel Technologies of Cottonwood, Minnesota, and he wanted to use them on the entire house. Extreme Panels, with whom I work exclusively, referred Walsh to me."*

## COMPOSITION

*SIPs are made from a thick layer of foam sandwiched between two layers of oriented strand board (OSB), plywood or fiber cement. For below-grade, Extreme Panels offers 4x8, 4x9, and 4x10 panels with 7-3/8th inches of expanded polystyrene and 5/8th of an inch of treated plywood on each side.*



After nearly 40 years in construction, Curt Stendel now specializes in supplying and installing SIPs. He founded Panelworks Plus in 2001 and averages 25 to 30 projects per year, primarily in custom residential. Panels on each home cost about \$50,000, while the homes usually market for about \$350,000.

### Why he switched to SIPs:

*"Projects just go much faster when using SIPs. And when you can get in and out faster, a number of things happen: the customer is happier; it's easier to collect the money; and you are providing them a good service with a shorter construction time."*



With below-grade SIPs, a 5-ply, 2x4 treated glulam functions as the stud, supporting the dirt load against the outside.



The installation had to be done in stages because there wasn't a second floor in part of the house. Also, the crew had to leave the back wall until last to provide an entrance for the upper wall panels.

"The key to the below-grade panels is that at every four feet—at every panel joint—there is a 5-ply, 2x4 treated glulam [glued laminated timber]," says Stendel. "That is basically your stud, which serves as a beam supporting the dirt force against the outside. You stand it vertically to carry a load, just like it would carry a load horizontally."

"The panels are set on a base of washed rock. This helps address moisture infiltration as the layers of granular rock drain the water away from the below-grade panels. Typically, you want to see at least a foot of washed rock below the floor and wall panels. Panels are sealed with panel sealant and expandable foam, then fastened with stainless steel fasteners. The exterior panel joints are covered with panel seal tape and the entire exterior is wrapped with two layers of black 6-mil poly. Backfilling is also done with washed rock to provide drainage and decrease the effects of hydraulic pressure typical in heavier soils."

"And while the rest of the structure is conventional OSB panels, we use plywood on basements because you are working with a product that has to be approved for below-grade construction. Plywood has been proven in below-grade applications

for a long time through permanent wood foundations. All we have done is taken the permanent wood foundation and turned it into a SIP, just like we have done with stick framing on the upper walls. It's the same concept."

## GETTING APPROVAL

The city of Orono refused Walsh's first application for a building permit using below-grade SIPs, and recommended using a conventional poured or block foundation instead. The inspector was concerned about stability and water infiltration, since the cabin was being built on an island. The city told Walsh it had no experience with SIPs and considered them an untested and unapproved technology. Thus began a dogged campaign for the SIPs application.

With help from Panelworks Plus and Extreme Panels, Walsh then provided the city a letter from an engineer and a list of more than 20 SIPs installations in Minnesota. The city reviewed the documents but again denied the permit. The city did tell Walsh he could submit his request to a state review board. Fearing a delay of up to 60 days for state review, Stendel provided Walsh with additional examples of SIPs projects, this time with a list of city inspectors who had approved the SIPs construction. Walsh went back to the inspector's office a third time, armed with this information. The city made some calls, and a week later the permit was approved. City inspectors have been to the site since construction and now acknowledge the successful use of below-grade SIPs.

Read a field evaluation.



Stendel subcontracts the installation to an experienced crew that can vary from four to eight workers depending on the size of the project and the availability of the labor.

## TECHNOLOGY HIGHLIGHTS

This project included the following PATH-profiled technologies:

- High-velocity miniduct air distribution system
- Structural insulated panels

"But this inspector needed to be convinced," Stendel says. "He wouldn't approve the plans because of the foundation. The upper panels were all covered by a National Evaluation Report, but the basement panels weren't."

"Typically, in a situation like that, we provide research from a Minnesota-certified engineer with a stamp on the plans or a letter attached to the drawings. More often than not, that is usually the end of it. But this inspector just didn't accept that. He said you could put in a permanent wood foundation with stick framing, but you can't use panels in the basement because he didn't know anything about them."

## TRANSPORTATION

"The delay pushed the schedule back and made things a little tight," Stendel says. "We were right down to the deadline as to when you could get panels across the frozen lake safely. Extreme Panels delivered the panels at the end of February, but couldn't take their semi across the ice. So, the owner actually transported the panels out there himself with a lighter weight truck and trailer."

Many manufacturers maintain a standard panel width of 4 feet for ease of transportation and handling. Typically, SIP packages from Extreme Panels include all door and window cutouts, gable wall and roof precuts, electrical chases, framing materials, fasteners, sealants, and expandable foam. Extreme Panels delivers its SIPs on a 48-foot covered trailer with a forklift attached to facilitate unloading. Panels are bundled in sequential order to speed the construction process.

## INSTALLATION

"In April, after the ground thawed, we started with the basement walls, then set the basement floor panels on the gravel," Stendel says. "Then we set the floor system—conventional floor trusses and subflooring—since it's really not cost effective to use highly insulated SIPs for an interior floor. Once we got the floors in, we could add the upper wall panels and the SIPs roof system. We had everything we needed to put the whole shell together."

*Panels weigh approximately four pounds per square foot, so 4-foot panels are light enough to be set by hand. Exterior walls for most houses can be erected in less than a day. Nails, panel sealant and expandable foam are used to fasten the panels to top and bottom plates. Vertical connections typically use plywood splines with nails being replaced by screws.*

"The installation went smoothly, but we did have to do everything by hand," Stendel

SIPs have better insulation than conventionally framed walls, providing increased air tightness and thermal performance. As a result, SIPs have higher R-values, which rate the resistance to heat transfer.

R-Values for Walsh's Cabin:

Basement walls	32
Basement floor	16
Above-grade walls	16
Roof	48

"We are extremely pleased with the quality of the product, the build process and the finished product. The SIPs panels allowed us to go from gravel to a building closed to the weather in less than 10 working days—including a below-grade structure and two floors of construction. Amazing since we did not have the usual benefit of a crane on site! We avoided concrete and traditional construction waste, both of which are costly to dispose of on any site and especially so on an island. I would use SIPs again on any project."

— Gerald Walsh,  
Owner/Contractor

says. "Also, we had to do it in stages because there wasn't a second floor in part of the house. We had to do the main floor walls, but leave the back wall off, so we could get our panels for the upper wall where we could handle them."

"Projects just go much faster when using SIPs. And when you can get in and out faster, your customer is happier because you have provided them with good service in a shorter construction time."

## COST SAVINGS

*With SIPs, the ease and speed of assembly makes it possible for houses to be placed under roof within days rather than weeks. While basic carpentry skills are required, assemblers need not have the skill levels of conventional framing crews, which further reduces builder costs.*

"While SIPs cost a little more at the outset, the price difference isn't much," Stendel says. "Some builders will look at initial cost and the four- to six-week wait to receive

the panels, and just walk away. When you look at the overall savings—from dumpster and disposal costs because there is very little waste; a more quickly enclosed shell that keeps the site dry and mold free; and the reduced sizing of HVAC systems with shorter runs up interior walls rather than extending to exterior walls—there isn't much difference in the cost factor. Those are hidden savings that builders don't always take into account when they start."

"As for callbacks, if we get them, it's usually for something pretty minor, like condensation forming into an area that hadn't been sealed by subs yet. Even then, it's pretty rare."

"When comparing to stick framing, it is apples to oranges. I would challenge the stick framers to build a house that is comparable in strength, insulation, and tightness, and be environmentally responsible for the same cost. I don't think they would even be able to come close."

The Partnership for Advancing Technology in Housing (PATH) brings together builders, manufacturers, researchers, government agencies, and other members of the housing industry. PATH partners work to improve the quality and affordability of new and existing homes. The program is administered by the U.S. Department of Housing and Urban Development's Office of Policy Development and Research. To learn more, visit [www.pathnet.org](http://www.pathnet.org).



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Once they got the floors in, Stendel's crew could add the upper wall panels and the SIPs roof system.