BUILDING WITH STRUCTURAL INSULATED PANELS (SIPS)

PREFABRICATION, LABOUR SAVINGS AND HIGH INSULATING VALUES ARE JUST A FEW OF THE MANY ADVANTAGES TO THIS INCREASINGLY POPULAR BUILDING METHOD

By Jerry Eberts

Whether a home or cottage uses SIP walls only (with conventional trusses) or a complete SIP structure (walls, gables and roof panels), it takes only a few days to reach the lock-up stage.

SIPs are widely used in timber frame construction due to their excellent shear values and quick construction times. The panels are simply placed and attached on the outside of the frame for both the walls and roof systems.

IMAGINE IF THERE WAS A simpler, stronger way to build a cottage, a method that cut construction time in half—or more—and resulted in a significantly more energy-efficient building than traditional stud-frame construction. If such a method existed, wouldn't any builder be keen to try it?

Consider this: structural insulated panels—better known as SIPs—deliver all this and more.

SIPs have been in use for more than 60 years and continue to gain momentum with builders and homeowners alike. Initial material costs are slightly higher than with stick-built structures, but a SIP home can be put up in a matter of days—even hours—and the costs are offset by startlingly lower long-term heating and cooling costs.

WHAT IS A SIP? A structural insulated panel is a sandwich made up of a core of expanded polystyrene foam between two pieces of oriented strand board (OSB). Normal thickness for the OSB is 7/16 inch, but 5/8 inch is often used for flooring. The boards are bonded to the foam core with waterproof urethane glue. The finished panel is strong, reliable and, as noted, extremely energy-efficient.

The top and bottom of wall panels have 1½-inch voids to allow them to be anchored to standard 2x6 dimensional lumber sole and top plates (the latter inserted after the wall panels are raised). Roof SIPs, trusses or second-storey floor joists can then rest on the top plate. SIPs are joined together vertically by narrow SIP spline blocks that fit into recesses on the edge of each panel. The spline blocks are constructed in the same way as the SIPs themselves, with a foam core. Panels are joined together using SIP screws, designed to go through one panel and into the next panel to a depth of at least 1½ inches.

Structural insulated panels are available in widths of four and eight feet and from eight feet to 24 feet in height and, once assembled, there are practically no seams. There is nearly total elimination of studs during assembly.

SIPs can replace conventional walls in just about any structure designed for stick-frame construction. Rake walls (gables) and rounded windows are easy to cut and shape. The panels can also be used for roofs and floors.

Structural strength of a SIP wall is better than for a conventional stick-build. In fact, the vertical axial loading capacity of a SIP wall is more than 4,000 pounds per lineal foot—all without using studs, though extra reinforcing is required around widow and door openings.

A handy homeowner can install his or her own panels, but the assistance of a carpenter experienced with SIPs might be a good idea the first time out.

LEFT Detail of how SIP corners are attached. Note the specialized long SIP fastener being screwed through one SIP into the intersecting corner panel. Large washers provide superior holding strength.

ABOVE In areas such as above windows and doors where headers or beams are required, vertical studs or members are embedded within the panels and provide structural support.

INSULATING VALUES AND MOISTURE ISSUES First and foremost, even the slimmest of SIPs offer higher R-values than a conventional framed wall insulated with fibreglass. SIPs come in a variety of thicknesses—from 4½ to 12¼ inches, but the normal recommended panel is 6½ or 8¼ inches. These last two panel thicknesses give insulating values of R-24 and R-32, an improvement of more than 40 to 75 percent over conventional insulated walls, according to Larry Croome, president of Nanaimo, BC-based SIP Building Systems Inc. Additionally, the airtightness provides even more efficiency.

"The minimum wall thickness is 4½ inches, but I recommend 6½ inches as a minimum," says Croome. "The increase in cost from 4½ to 6½ is just 9 percent, but the gain in insulation is 50 percent—a big bang for the few extra bucks. We've even done walls 10 inches thick."

The various thicknesses of the SIPs are engineered to fit standard lumber for sill and top plates.

"The big difference between SIPs and framed walls using fibreglass insulation is that with framing there is still a large amount of air trapped in the conventional wall. It's the job of the fibreglass to trap air. But the trapped air goes through a daily hot and cold cycle within the wall, creating condensation, and that is challenging for the building envelope. Moisture can build up, leading to

mold and rot. The solid foam in panels eliminates that potential.

"Two things create the insulating value in a structure," says Croome. "The first is the net system R-value, which comes from the insulation in the walls. But the other is overall air leakage; SIP walls are extremely airtight and so less energy is wasted overall.

"Splines are fully insulated unless they also function to transfer point loads from beams," says Croome. "If it's a post and beam house, a wall will need eight to 10 joins to transfer the structure load."

Croome explains that panels can be supplied full-size and handled with a crane, or smaller so two people can lift them. If the SIPs have been cut to order, with maximized prefabrication and splines pre-installed, a building footprint of 1,500 square feet could go up in as little as four hours, not including the roof.

SIPS AND TIMBER FRAMING SIPs have always been popular with timber framers. SIPs are simply placed and attached on the outside of the timber frame for both the walls and the roof systems. The SIP components quickly provide the "closed in" and insulated portion of the timber frame, as well as an excellent source of shear value. With the full sheathing of SIPS, the interior and exterior OSB sheets bonded to the foam interior, SIPS are "locked up." With no nail points, there is much greater shear resistance. "With fastenings only at the top and bottom, shear stiffness is extreme," says Croome.

ROOFING Log home structures and builders often use SIPs for roof systems over vaulted areas because the SIPs themselves are their own structure. Splines may be used to stiffen the panels, but Croome says a SIP panel on the roof can withstand 100 pounds per square foot without needed further support for 10 feet or less. The large SIP panels are easily lifted into place and are set onto the existing log roof ridge beams. SIPs can also be used to make a flat roof. Log homes and other homes not fabricated with SIP walls often use SIPs for roofing.

"What could take three to four weeks or more for a conventionally built roof system can be done in just a fraction of the time with SIPs," says Duane Svendson, marketing and business development manager for Kamloops, BC-based Trout Creek Enterprises. "SIPs are also used in commercial and institutional structures all the time.

"SIPs are becoming very common in residential building due to an increasing demand by the consumer for more energy-efficient homes. It is very typical for a residential home to incorporate six-inch R-24 exterior SIP walls in the design and to use conventional roof trusses with SIP roof panels to increase the R-value within the truss roof system and to complement the airtight energy-efficient wall system.

ABOVE The cut-out shown here is for an under-window panel with a full-length stud and cripple at the edge of the SIP panel to support the header above. The short stud shown will support the windowsill. The worker is caulking the edges and face of the short stud to create an airtight seal. All seams in a SIP structure are similarly caulked. A half-height SIP will fit over the short stud and the sill plate, which is still to be caulked.

"Many contractors have found these systems to be very cost-effective and that they meet the requirements of the customers," says Svendson.

VENTILATION Because SIPs leave no gaps—and therefore no errant drafts—the air inside a house can become stale and even damp. As Svendson says, "The tighter we seal up our buildings, the more we need to rely on a mechanical aid to exchange the air inside the building. This is a bit of an expense, but it would be needed in any airtight building, not just with SIPs. Many energy-efficient homes are testing out at less than one air exchange per hour. In the past, this was not a great concern as air exchange was taken care of on its own through air leakage."

However, another great advantage of structural insulated panels is the lessening of mold and dry rot within the walls, as already stated.

ABOVE A worker uses special SIP fasteners to attach the roof panels to the top wall plate. The screws travel through both layers of OSB and the EPS (expanded polystyrene) and into the top plate of the SIP wall below.

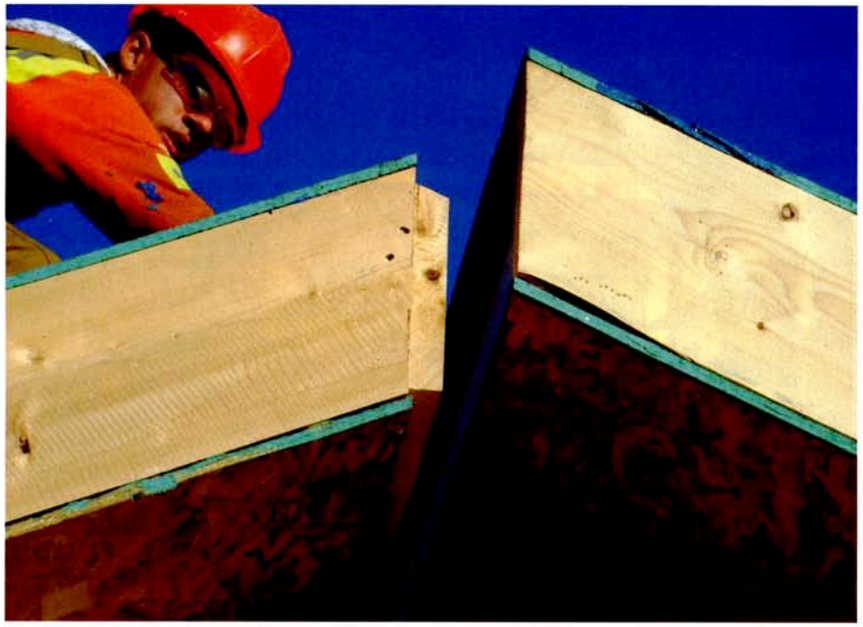
"With no voids in the walls, no cavities, there is no meeting of warm and cold air," says Svendson. "That's where the moisture gathers. With solid-core foam walls, we avoid the mold issue altogether.

"SIPs are a fantastic engineered product," says Svendson. "Extremely energy-efficient. Air infiltration is the worst enemy of the homeowner and SIPs eliminate that problem."

CLADDING According to Croome, the exterior of a SIP cottage can be treated exactly as any stick-built structure: "People use a cementitious covering—a mixture of concrete and wood fibre. If you were to use exterior panelling, then we recommend that fasteners are doubled for siding and so on. So if the normal stick-built wall calls for nails every 16 inches or however far apart the studs are, we say every eight inches."

Croome says there is no deformation of the SIPs, even when heavy panelling is placed on the outside of the walls. Square and true remains square and true.

ABOVE SIP roofs are popular among log homebuilders. One reason is that in most cases, there is already a crane on site for lifting the logs. The roof panels on this log cabin were installed in three hours and then topped with metal roofing.



ABOVE SIP roof panels being fitted at the peak of the roof. Once joined, the OSB will be fastened to the 2x10 and the structure will then be attached to the ridge beam below.

EARTHQUAKE RESISTANCE In an earthquake, one could say all bets are off. But SIP homes are highly resistant to racking—the motion caused by the ground accelerating first to one side, then the other, in a violent shaking motion—something that can crack concrete and even bring down flexible stick-built structures.

"Anyone living in a seismic zone has worries," says Croome. "But seismic performance can be increased simply with SIPs. Since the SIP walls have virtually zero motion, they are extremely tough."

FIRE RESISTANCE "Fire performance can be comparable to a framed building, which owes its fire resistance on the interior to drywall. For those who don't want to use drywall on the inside of their SIP wall, intumescent [fire-resistant] latex paint provides an equivalent fire barrier at a fraction of the cost of drywall—and without the dust, time and heavy weight of drywall," says Croome.

Of course, adding drywall to the interior of the home would add further fire protection, but many homeowners simply go straight to interior wood or other panelling.

"If drywall is used on the inside of walls, we guarantee zero drywall cracks with a SIP-built home," says Croome.

BUG RESISTANCE Croome notes that SIPs are also extremely bug and ant resistant. "The EPS foam we use also has a borate component in it for added resistance to dwelling insects. We also offer BluWood pre-coating on the exterior side. This adds antifungal, anti-termite and moisture resistance, in addition to low flame spread."

ELECTRICAL RUNS The way a structural insulated panel is built, there are electrical chases (a conduit for wiring) every four feet vertically, from top to bottom. Horizontally, other chases are built into the SIPs at 16 and 45 inches through the middle of each panel.

As an option, electrical cutouts are precut into the wall and wiring is easily run up or down the hollowed edges of the panels. Wiring can travel along the splines, or a V can easily be cut into the foam with a special tool.

The horizontal chases are unobstructed so that outlets can be placed at each end of a wall and wires run horizontally for the length of that wall without having to drill a single hole through a stud. Vertical chases are just as simple and even an electrician unused to SIPs will soon understand the simplicity of the system.

"Lots of electricians don't know SIPs," says Croome. "But when they see the plug-box cut in, they realize how simple it is. In the case of, say, exterior lights at the doors, we take care of those details when we customize the panels to make it easy for the electrician."

PREFABRICATION According to Svendson, "SIPs are becoming more and more popular. The cost of labour is a lot less than conventional building. The prefabricated portion of the home, typically the exterior walls and, in some cases, a portion of or the complete roof assembly arrives to the site ready to install. This can save up to 60 percent on combined labour of overall framing and insulating costs. The SIPs are prefabricated, so all that work is done at the plant with everything going out as the whole product.

"Sometimes the biggest problem can be getting the building materials to the site," says Svendson, "especially if it's out in the wild somewhere. With a SIP package, there is very little waste. We only have to move what we need. The challenge of bringing in the materials and also moving the crew back and forth is much less. We supply the structure and deal with the contractors and architects—the whole package."

ENERGY EFFICIENCY "The number one reason they are so popular is energy efficiency," says Svendson. "The way building codes are headed, all new homes are going to have to be more energy- and water-efficient. Anyone building a new home today should address that because building codes are going to enforce better efficiency in the near future."

According to figures supplied by Svendson's Trout Creek Enterprises, operating costs of a SIP home versus a conventionally constructed home are considerable.

In five years, the SIP homeowner will pay $2,464 annually; the conventional home will cost $5,647 (a saving of $3,183 per year).

ENVIRONMENTAL ADVANTAGES Apart from energy efficiency, building a prefabricated SIP cottage means there is far less waste (and hauling costs) while building—up to 60 percent less waste.

SIPs are 100 percent recyclable. They are manufactured using a low-environmental impact process of steam expansion. SIPs contain no chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) or formaldehyde. The expanded polystyrene used is inert, so there is no off-gassing or dust. Even the OSB sheathing is made from fast-growing new-growth trees, so the wood fibre used is renewable and sustainable.

CONTACT INFORMATION

SIP Building Systems Inc. (SIPBSI), based in Nanaimo, BC, is very much a one-stop-shop for those wanting to use structural insulated panels to build their home. Whether the owner has an architect or needs one, SIPBSI can help design a residential structure up to five storeys in height.

Once the plan is in place, the company prepares the SIPs for site-ready installation. Like a huge jigsaw puzzle, the pieces can be fitted together far quicker and more easily than a conventional stick-build.

Kamloops, BC-based **Trout Creek Enterprises** has several specialties, including timber frame components, custom-cut specialty lumber, milling logs into timbers and custom design work for residential, commercial and industrial clients.

One subsidiary, Trout Creek International Homes, is the Canadian dealer for Premier Building Systems—one of the largest manufacturers of SIPs in North America.