



## **Bringing it All Together with SIPs: Structural Insulated Panels Support Energy and Resource Efficiency**

By James Hodgson

Imagine ordering a sandwich from a deli, but instead of it coming ready to eat, one server brings the bread, later another person from down the street brings the meat, and after that someone else from another restaurant provides the cheese, lettuce and pickles.

In some ways, this reflects the way most buildings are developed today. Different crews construct walls, floors and roofs from disparate components. This makes it a challenge to achieve an integrated system that performs well across a range of functional areas – from structural integrity to energy efficiency to meeting green building goals.

Fortunately, the focus on sustainable building design and construction is driving renewed interest in a systems-built approach. Advanced building techniques such as [structural insulated panels](#) (SIPs) are growing in popularity for their role in creating an efficient and sound building envelope – one that combines multiple systems into ready-to-install units.

Builder Frank McNeil of Vail Associates (Vail, Colorado) sums up the benefits of using SIPs: “I like the fact that you can take care of five steps with this one product. Framing, sheathing, insulation, vapor and sound control. Once you familiarize yourself with the basics of panel construction, you realize the labor savings immediately. “

### A Tight Envelope

Compared to alternative construction practices such as stick-built framing, steel framing, concrete masonry units (CMUs) and tilt-up concrete panels, SIPs provide tighter and better-insulated walls and roofs.

The rigid foam core within each SIP provides continuous insulation across the panels' width, length and depth, avoiding the thermal bridging created by wall studs. In addition, the large-size panels have significantly fewer joints to be sealed.

The U.S. Dept. of Energy's Oak Ridge National Laboratory (ORNL) has conducted extensive blower door tests and found that SIPs buildings have about 90 percent less air leakage than stick-framed ones.

The lab also evaluated the R values for whole wall assemblies using SIPs versus stick framing, taking into account energy loss through the structural members, corners, joints and around windows. The results showed that a 3.5-inch-thick core SIP wall had a

14.09 R value compared to a 9.58 R value for 2 x 4 wall with studs 16 inches on center and standard insulation practices. The SIP was 47 percent more efficient in insulating capability.

Comparing the same type of SIP wall with 2 x 6 studs at 24 inches on center, the SIP still came out on top with a whole-wall R value of 14.09 versus 13.69.

Because of their ability to create a tight envelope, SIPs dramatically reduce energy use and related costs.

In homes, SIPs work with other high efficiency systems – such as low-e, double-pane glazing and radiant floor heating – to commonly achieve between 50% - 70% savings over the Model Energy Code (MEC).

In commercial applications, designers often use SIPs as part of achieving zero-energy buildings – a trend that will likely be led by California in coming years where the state's Title 24 "Energy Efficiency Standards for Residential and Nonresidential Buildings" sets aggressive goals for improved energy efficiency.

### Efficient Material Use

In addition to being energy efficient, SIPs are also resource efficient in several other ways. Notably, by allowing for precision control of materials in a factory setting, SIPs eliminate the large volumes of waste generated by other common construction practices. Compared to stick framing, SIPs can reduce jobsite material waste up to 60 percent.

The foam in many SIPs (typically expanded polystyrene – EPS) is 100 percent recyclable, and some manufacturers use a specified level of recycled content in their panels.

The oriented strand board (OSB) facing / sheathing layers are also resource efficient. OSB producers typically manufacture the material from fast-growing, renewable trees and use a high percentage of each log for either the panel itself, or to power their mills.

### SIPs and Green Building

Design and construction professionals can use SIPs as part of [environmentally responsible building](#) and to earn points under green building rating systems, including up to 36 or more points in LEED for Homes, and up to 23 points in LEED for New Construction. The panels also fit very well into the National Association of Home Builders (NAHB) National Green Building Standard.

Examples of LEED point categories to consider for SIPs include "EA 1: Optimize Energy Performance," "MR 7: Certified Wood," "EQ 4.1: Low Emitting Materials: Adhesives and Sealants" and "EQ 4.4: Low Emitting Materials: Wood and Agrifiber Products," among others.

Beyond energy efficiency and waste reduction, SIPs also can significantly improve indoor air quality by reducing infiltration of common pollutants such as radon, molds, pollen, volatile organic compounds (VOCs), lead dust and asbestos.

### Structural Strength

SIPs are able to bear high loads in wall, roof and floor applications, including those from gravity, snow, high winds and seismic forces. The OSB facing and rigid foam core work together to achieve high strength in a manner comparable to other pre-manufactured structural systems, such as I-joists or trusses. As a result, they provide exceptional axial, transverse, racking and diaphragm capacities.

Given their strength, SIPs work well in both single- and multi-story, low-rise buildings (up to four stories). As with other wood-framed construction, the practical limit on building height for SIPs comes from the fire restrictions imposed by Type V construction, more so than load bearing capability.

As part of their technical services, SIP manufacturers typically work with building professionals to ensure code acceptance of their panels. This includes providing alternative material evaluation or listing reports and other testing reports as required. Depending on the specific manufacturer and testing they have completed, SIPs can meet residential and commercial code requirements for structural design (including use as shear walls and diaphragms) and fire-resistance (up to one hour).

SIPs have been proven for use in all seismic design categories, including D, E and F. After the 1995 magnitude 6.9 earthquake in Kobe, Japan, SIPs buildings and homes were among the few still standing.

### Working with SIPs

Converting from other methods of construction to SIPs is straightforward. Design professionals provide the project design drawings to a SIP manufacturer or dealer who converts them into shop drawings, which detail each panel's specific dimensions. After the designers, engineers, code officials, and other appropriate parties review the shop drawings, the manufacturer finalizes them and makes the panels.

Manufacturers typically provide technical support throughout the process, whether the design is for a new building based on a SIP design from the beginning, or conversion of a prior design to a SIP design.

During the construction phase, SIPs substantially reduce dry-in time since crews can install entire wall, roof and floor sections in large segments. Because they integrate structural components and insulation, SIPs eliminate the need for separate framing, insulating and sheathing work functions on site.

In addition, since manufacturers pre-cut window openings and electrical chases, less time is needed for other trades to complete their work.

## Costs

As with adapting to any new building practice, designers and contractors experience an initial learning curve using SIPs, but once experienced with their use, the cost is comparable to other building methods.

In many cases, overall construction costs may even be lower since SIPs reduce on-site labor and wasted materials. They can also reduce building costs by allowing for smaller-sized heating and air conditioning equipment.

After occupancy, the cost savings from SIPs continue in the form of reduced energy usage. These benefits start from day one and continue throughout the life of the building.

## Getting Started

From homes, to schools to churches to light commercial construction of all types, converting to SIPs is relatively simple. As architect Glen Aasland of Vail Associates (Vail, Colorado) acknowledges, "Working with the panels proved very easy from a design standpoint. We were able to translate my concepts from drawing to structure without sacrifice." Builders also frequently report an easy transition. To begin, contact a SIPs manufacturer or distributor for details on services offered.

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