Building Tight with SIPs

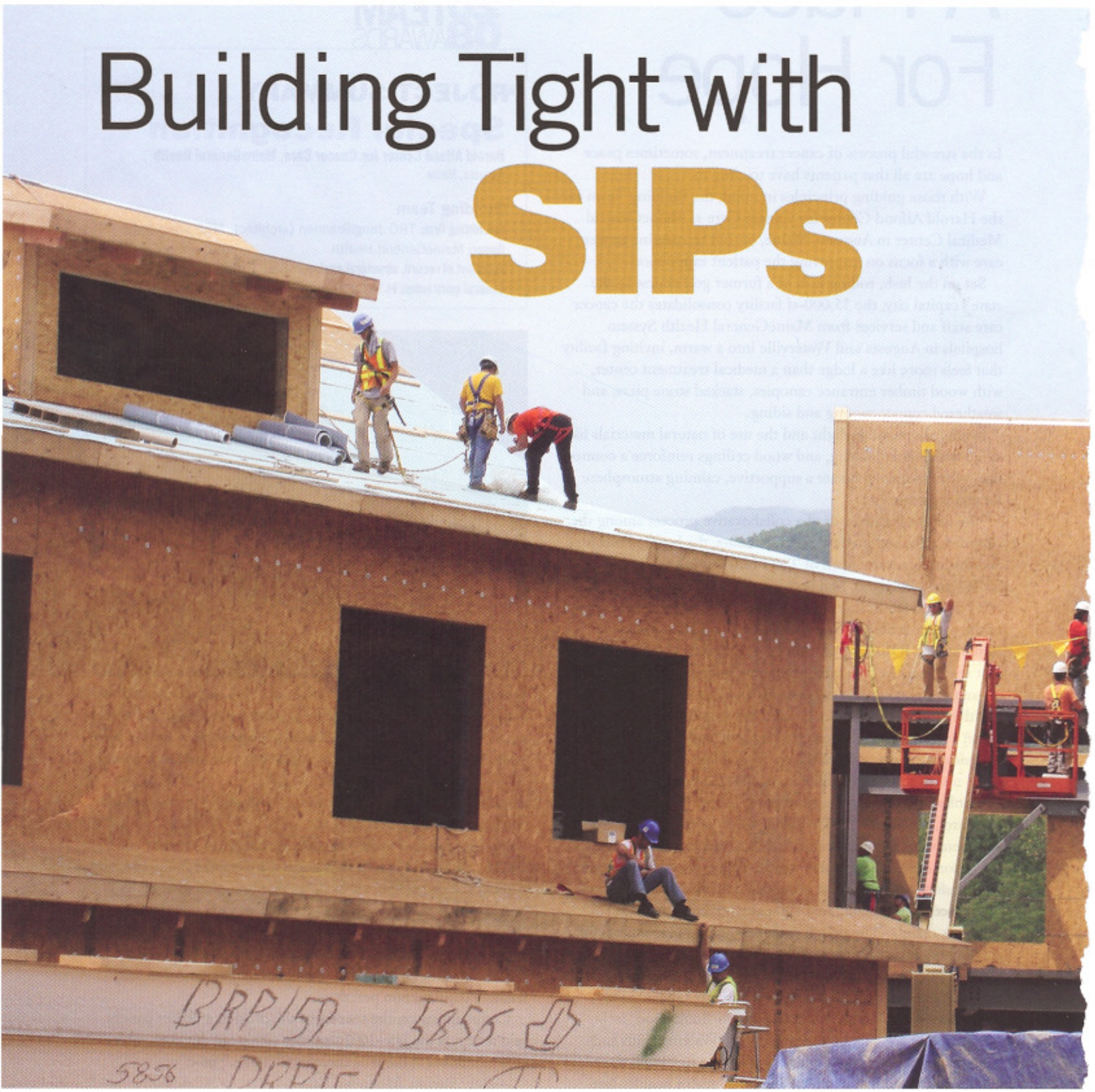

PHOTO: AL COBB, PANELWRIGHTS

Long popular in single-family home construction, structural insulated panels are making their way into the nonresidential industry as a high-performance alternative to traditional building envelopes.

By Dave Barista, Managing Editor

Structural insulated panels, commonly referred to as SIPs, have been used in the construction of single-family homes for more than 40 years. But only recently has the technology really caught on in the nonresidential building market.

With the emergence of the green building movement, a growing number of Building Teams in the commercial and institutional sectors are specifying SIPs for low-rise structures, from schools and retail stores to chain restaurants and churches.

"We have seen a huge increase in interest for SIPs in the commercial building market," says Chris Kreple, product manager with PorterSIPs, a Holland, Mich.-based manufacturer of the panels. Kreple says commercial work, like assisted-living complexes and quick-service chain restaurants, make up more than 50% of the company's business. "Clients are interested in the energy-efficiency benefits and being able to achieve LEED points," he says.

The SIPs concept is simple: Sandwich a piece of rigid foam insulation between two panels of wood with an industrial adhesive to form a structurally rated, highly insulated building panel that can be used for exterior walls, roofs, floors, and even foundations.

SIPs are commonly composed of 7/16-inch-thick oriented strand board with a core of expanded polystyrene, polyurethane, extruded polystyrene, or polyisocyanurate. Some manufacturers offer alternative "skins" made of plywood, fiber-cement board, or metal, as well as a variety of panel thicknesses—four to six inches for wall system applications and eight to 14 inches for roofing projects. Standard panels come in 4x8-foot sheets, but many suppliers offer SIPs as large as 8x24 feet for large-scale buildings and projects that call for long spans.

Panels are prefabricated to custom sizes and dimensions as

A growing number of Building Teams are specifying structural insulated panels (SIPs) to create highly insulated building envelope systems. One application involves fastening the sandwich panels to a structural steel frame (left) to form an airtight curtain wall enclosure.

PHOTOS: TONY CRUZ

SIPs are available in panel sizes of up to 8x24 feet for large-scale building projects, like this two-story office in Las Vegas, which was constructed using SIPs manufactured by Premier Building Systems.

specified by the design team and are shipped to the job site ready for installation based on a predetermined sequence. Openings for building details like windows, doors, electrical chases, and wall switches are all pre-cut in the factory. Even curved panels are available.

The panels are installed one piece at a time and fastened together using staples, nails, or screws. All joints are then sealed with manufacturer-recommended sealing mastic, low-expanding foam sealant, or SIP tape, creating a relatively airtight envelope.

Aiming for higher R-values

For Building Teams, the primary attraction of SIPs is the ability to quickly erect a building envelope that can provide a whole-wall R-value that exceeds 14 (for a four-inch SIP wall) or 20 (for a six-inch SIP wall). In comparison, a typical 2x4-inch wood stud wall at 16 inches on center with standard fiberglass batt insulation provides an R-value of about 10, while a 2x6-inch wood stud wall at 24 inches on center with standard batt provides an R-value of 13.7, according to a study on SIPs wall construction by Oak Ridge National Laboratory.[1]

The gains in energy efficiency over conventional construction stem from the continuous foam core and the relatively airtight seal created when the panels are adjoined. With traditional wood framing, the ORNL study found, thermal bridging through the studs and installation imperfections, such as cavity voids and the use of batt insulation with rounded shoulders, often lead to reduced insulation performance.

SIP roof systems can provide R-values that exceed 50, "substantially more than you'd get out of standard roof construction," says Dave Matthews, AIA, senior associate with Jones & Jones Architects, Seattle. Matthews says most of his firm's sustainable projects, which include the $12 million Africa Live!

Calculated R-values of SIPs

EPS core thickness (in.)	3⅝	5⅝	7⅝	9⅝	12⅝
R-value at 75 F	15.34	23.04	29.77	40.36	49.02
R-value at 40 F	16.57	26.26	32.28	43.80	53.23
R-value at 25 F	17.15	27.16	33.46	45.42	55.21

Source: SIPA; calculated R-values are for a generic SIP with two sheets of 7/16-inch OSB and an expanded polystyrene foam core.

exhibit building at the San Antonio Zoo, incorporate SIP roofs in lieu of traditional roof truss and deck construction.

"We like it because it's a super-insulated panel that spans a good distance and goes up very quickly," says Matthews. "In a matter of a day or so the contractor can have the entire roof covered and ready for a membrane."

But this high-performance envelope does come at a price. Conservative estimates put the additional upfront cost for SIPs materials at 10-25% over conventional stick frame construction.

Experienced design and construction teams, however, can make up much of the additional investment in reduced onsite labor costs, says Kreple. For example, his firm's chain restaurant clients, including Pizza Hut and Wendy's, typically shave "a few weeks" off the envelope construction schedule by using SIPs.

"We had a crew that tore down an existing Wendy's, erected a new structure, and had it fully operational in 30 days," says Kreple. "But speed really depends on the crew, the site, and the design."

Do's and don'ts in SIPs construction

SIPs can offer advantages over traditional building envelope systems, but working with the technology can be tricky, especially for first-time users. *BD+C* asked several manufacturers and building experts for their advice on building with SIPs. Here's what our experts had to offer:

Don't skimp on the joint treatment. "All bad things happen at joints," says Joseph Lstiburek, PhD, PE, principal of Building Science Consulting, Westford, Mass., and author of *Builder's Guide to Structural Insulated Panels* (2008). "With commercial precast panels, we have learned to use two-stage joints, with an inner and outer air seal and drain space in between. That same approach should be applied with SIPs."

Sweat the details when it comes to moisture control. Moisture protection is vitally important in any building enclosure system, but even more so with SIPs because the technology can be "a little less forgiving" when it comes to controlling

SIPs provide a high-performance curtain wall for N.C. school

The most common application for SIPs is a low-rise structure where the panels serve as both the building envelope and a primary structural support. However, due to the nature and size of many nonresidential projects, SIPs are often limited to non-load-bearing curtain wall applications, in which the panels are used to form a nearly airtight envelope over a structural steel frame.

A case in point is the Cherokee (N.C.) Central School currently under construction in the Eastern Band Cherokee Indian Nation. There, a crew of 30 SIP installers is cladding 15 of the campus's 16 buildings with the sandwich panels, which are being bolted to a steel superstructure. In all, 376,000 sf of panels will be erected, representing the largest project ever to be built with SIPs, according to Al Cobb, owner of PanelWrights, Shenandoah Junction, W.Va., a SIPs distributor and installer.

PHOTO: AL COBB, PANELWRIGHTS

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Cobb said working with the steel frame poses several challenges. Because of the size of the structural steel members, self-tapping screws commonly used to connect SIPs to structural steel cannot be used. Instead, Cobb's team must first install dimensional lumber nailers to the steel frame using powder-actuated fasteners. The SIPs are then attached to the nailers using a standard wood connection.

In addition, to ensure an airtight envelope, the installers have to modify the prefabricated panels to accommodate inconsistencies in dimensions of the steel frame.

"SIPs are as close to perfect as you can get," said Cobb, commenting on the precise dimensions of the machine-cut panels. "When you try to attach to them to steel, masonry, and concrete that is not [as precise], we have the challenge as the SIP provider to accommodate the imperfections of the current building structure."

For Cobb, who has been installing SIPs for 19 years, on-site modifications are a breeze. But Building Teams working with SIPs for the first time should first consult with the SIPs manufacturer.

Adapting the panels to meet electrical code and accommodate the considerable amount of electrical wiring required was another concern. The International Building Code requires that all wiring be enclosed in conduit. Wiring in the exterior walls of the school was accomplished using prefabricated chases cut into the foam core of the SIPs. Chases in the panels were made larger than the standard 1¼ inch to accommodate the conduit and additional wiring.

PHOTOS: PREMIER BUILDING SYSTEMS

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moisture, says PorterSIPs's Kreple. He advises Building Teams to pay close attention to getting details like flashing and drain planes just right.

Check for fire restrictions. Remember, most SIPs are made with wood panels. "SIPs may be lighter than precast concrete and more heavily insulated, but they burn," says Lstiburek. That means that the typical wood sandwich may not be suitable for certain applications, such as industrial process buildings, where excessive heat is generated.

If a noncombustible system is required, a steel or aluminum panel with a polyurethane core is recommended.

"Right-size" the HVAC system. Frank Baker, director of PFB Corp., the Calgary-based maker of Insulspan SIPs, recommends that design teams right-size the building mechanical systems for the highly insulated and airtight environment. "There are economies to be had in the HVAC and ducting systems because you simply don't need nearly as much air to be moved through the building when it's that airtight and well insulated," he says.

More SIPs may equal less expense. Baker says architects often detail buildings to minimize the use of SIPs in an effort to reduce upfront materials costs. But in certain instances, such as designing building overhangs, using more SIPs may actually cut overall project costs by reducing construction time. "You can do substantial overhangs with SIPs very easily just by specifying a larger panel to extend out over the eave," says Baker. "That has multiple benefits, not the least of which is labor savings and savings in other materials required to frame out the overhang." **BD+C**

[1] *"Heating and Blower Door Tests of the Rooms for the SIPA/Reiker Project," ORNL, March 2002.*