FAST FLOORS WITH Structural Insulated Panels

Using floor panels supported by engineered-lumber girders cuts production time on SIP houses

by Jim LeRoy

My company is a distributor for Insulspan structural insulated panels in New England and New York. Insulspan's Michigan factory ships 8-by-24-foot panel blanks to us, and we cut and reassemble the raw panels into complete precut SIP packages for builders and commercial contractors. We also have several field crews who set panels on site, because many of our customers don't have crews with SIP training and experience.

We try to transmit the lessons that our crews learn in the field to outside framers who are working with our panels and packages. With explanations and tech support from our shop personnel, any competent stick-framing crew should be able to build with SIPs just about as well as our crews can — and similar support is available from other SIP suppliers in our region and around the country.

Eventually, I hope to see builders all over our region learning to use SIPs and handling them as easily as they handle components in stick construction. In principle, the two methods are similar — SIPs are just like big, wide, flat pieces of lumber. They come in standard sizes, and you can cut them up and connect them together to make whatever you want. You can use most of the same tools and fasteners, and most of the same techniques. It takes only one or two jobs for a skilled stick-framing crew to get comfortable using SIP methods.

For this article, I'm going to focus on

floor systems. SIPs work particularly well for certain specialized floor applications. They make a quick and easy floor for a small room addition or bump-out, and a cost-effective and satisfactory floor over a large unheated space, such as a garage with rooms above it. The rural New Hampshire house shown in the photos for this story has SIP walls and roof, SIP floors above the garage and in a small sunroom, and conventionally framed floors over the basement and between the first and second stories.

SIPs are not ideal for floors between stories inside a house. The insulation isn't required at that interior location, and SIPs can be rather noisy underfoot — they easily transmit the sound of upstairs footfalls to spaces below. That's why we frame the floor systems for our SIP houses with conventional methods, using engineered wood beams, wood I-joists, and OSB floor sheathing.

However, to shorten the site time for our road crews, we've started panelizing a lot of our floor systems in the shop, and setting the large floor sections on site with our crane. That helps us make the most of the on-site

Figure 1. In preparation for the SIP floor for this 8-by-16-foot sunroom addition, the crew fastens an LVL ledger beam to the edge of the conventionally framed main floor (top left), leaving a shimmed space below the ledger to receive the bottom edge of the panel. The crane's straps attach to a steel plate that's screwed directly to the SIP (top right). While the floor panel is suspended from the crane, one crew member drills holes at anchor-bolt locations while another applies adhesive sealant to the treated-wood sill (above). Finally, the crane lowers the panel into place (right), where it will be nailed to the sill.

efficiency of SIP wall and roof construction; when we don't prebuild, framing floors on site is the one part of the job that takes us as long as it would take anyone else.

So, on these pages I'll cover SIP floor applications first; then I'll describe the way we panelize wood I-joist floor systems and the various methods of detailing SIP walls to support the loads imposed by stick-framed floors.

Insulated Floor for a Small Room

The floor of a small bump-out or room addition is one of the quickest and simplest uses of SIP technology (see Figure 1, previous page). SIP blanks come 8 feet wide by 24 feet long, so we were able to cut this sunroom floor from a single panel. The floor panel bears on the foundation wall on three sides. Where it joins the floor frame of the main house, it attaches to an LVL ledger beam.

It's common practice for us to sleeve a beam or structural spline into a space routed out of the panel's foam. In this example, we placed the structural member first, and then slipped the panel edge over it. To do that, we had to remember to leave space for the panel's OSB skin between the LVL beam and the member below it. We typically use a 1/2-inch plywood shim to space the beam away from other framing, leaving just a tiny bit of extra room to slide in the 7/16-inch or 15/32-inch OSB. In this case, the panel was a tight fit on the beam, so the crew had to use come-alongs to pull it snugly into position.

The floor panel was 10 inches deep, for about an R-40 insulation value, but it wouldn't have to be that deep to make the 8-foot span. The rule of thumb for typical floor loads goes like this:

- 6-inch panels will span about 8 feet
- 8-inch panels will span 10 feet
- 10-inch panels will span 12 feet

These spans are achieved without structural splines. If you use 4-foot-wide lengths of panel with LVL members embedded in the joints, it's technically possible to achieve clear spans of as long as 24 feet. But when a design calls for long spans, we prefer to support panels from below with engineered beams, as we did for the floor over this house's garage (Figure 2). That's a simpler assembly to set up,

Figure 2. Larger and more complicated SIP floors need underfloor support. Parallam (left) and LVL (below left) beams match up well with SIPs because of their engineered strength, limited shrinkage, and dimensional consistency. A pneumatic palm nailer helps for driving hanger nails into the hard engineered beams (below).

and it's also more convenient to air-seal at the seams.

We lift the floor panels into place with the crane (Figure 3). Panel builders often lift panels using big steel hooks that they drive through the panel skin. We used to do that, but it's frowned upon these days because of the surface damage it does to the panel. So now we use a steel lifting plate, which we screw directly to the panel. The plate accepts 16 screws, enough for a strong attachment.

Once the floor is in place, its routed edge will be filled with an LVL rim joist. The LVL's structural capabilities aren't really needed in this location, but we use LVL because it's stable. Ordinary lumber would shrink away from the panel, creating gaps and potential air leaks.

Insulated Floor Over a Garage

The classic SIP floor application is as an insulated lid for an unheated garage. This location is notoriously hard to insulate and air-seal in stick construction; with 12-inch SIPs, however, you can have a true R-48 floor with no thermal bypasses and virtually no leaks, after just a morning's work.

Official R-values, by the way, are measured under laboratory conditions at an ambient temperature of 75°F. One good thing about expanded polystyrene (EPS), the core material in SIPs, is that its R-value increases as the temperature decreases. At 75°F, EPS has an insulating value of R-3.85 per inch, but at 25°F, it's R-4.35 per inch. That's why I tell people the R-value of a 10-inch panel is "about R-40" and that of a 12-inch panel is "about R-48." At 75°F, it's really a little less, and at 25°F it's a little more — but who needs insulation at 75°F, anyway?

With fiberglass, it's the opposite: The colder it gets, the less actual insulating value fiberglass has. And the

Figure 3. With the girders in place, the crane drops four 8-by-24-foot 12-inch-thick floor panels into position (above left). The perimeters are nailed to the pressure-treated sill (left), and panels are fastened to bearing beams with epoxy-coated self-tapping screws (above).

effect continues: When it's below zero outside, fiberglass loses even more of its rated value, whereas EPS gains value. Keep in mind that the floor over a garage in a cold state like New Hampshire is one of those places where effective R-value really matters. At –5°F with the wind blowing, your feet appreciate insulation that performs *better* when the weather gets colder.

Air-sealing matters, too, of course. The body of a structural insulated panel is airtight by nature, but joints and seams need attention. We seal every joint in the house with construction adhesive, expanding foam, or adhesive membrane tape. For a garage floor like this, we apply construction adhesive to the foundation sills before placing the panels; then, after all the structural connections are made, we inject expanding foam into the panel-to-panel joints.

We make the structural connection between adjoining floor panels by sliding splines into prerouted edge spaces (Figure 4) and stitching the panels together with staples or 8d nails. Floor perimeters, as usual, get stuffed with LVLs (another spot where we apply construction adhesive). We fasten the panels down at the sills and at supporting beams with long, hardened-epoxy-coated screws (Trufast Corp., 800/443-9602, www.trufast.com).

One drawback to a SIP floor is that it has no framing voids where you can run wiring or mechanicals. In a garage, code officials may allow you to fasten Romex cable directly to the ceiling. If they don't, you may have to furr down the ceiling or build out a chase for the wires.

In the house we're showing here, the transition got a little complicated where the floor above the garage met the first-floor frame of the main house

Figure 4. Prerouted grooves at panel edges receive 1/2-inch plywood splines (left), which the crew then staples at 4 inches on-center to stitch the panels together. At the perimeter, carpenters install full-height LVL rim joists (below), using 2.5-inch pneumatic nails. The LVL perimeter members are overkill in structural terms, but sawn lumber would shrink away from the panels and compromise the integrity of the joints.

Figure 5. Where the plans call for a stepped-down entryway floor, a 6-inch panel is used to create the lower level. Here, the crew attaches an LVL ledger to the side of the main beam to catch the edges of the thinner panel (right). The 12-inch floor panel was a tight fit and required some persuasion from a come-along (below), but the 6-inch entryway panel slides easily into place with no argument (bottom).

(Figure 5, previous page). A 6-inch panel provided a convenient stepped-down floor for the home's entryway, but there was some fussy framing involved in joining the different thicknesses of panel and connecting them to the conventionally framed floor.

Panelizing Wood I-Joist Floors

Whether panelizing a wood floor or framing it on site, you have to consider the wall structure that will hold up the floor (Figure 6). The floors for a SIP building can sit on top of the walls, just as they do in conventional platform framing. But then you lose the SIP wall's insulating value at the floor perimeter. So we like to hang the floor systems inside the wall, using top-nailing joist hangers. (Some designers use a system like balloon framing, with a ledger board face-attached to the panel's interior skin, but that brings up some tricky structural issues we prefer to avoid.)

Point loads. SIP walls can carry the distributed load of a "hung floor" even better than a typical stick wall. But for point loads, like the end of a floor's midspan girder, SIPs need structural reinforcement. Where a girder meets a SIP wall, we usually bury a post inside the wall to catch the beam. If there's a window or door opening in the wall where the post would fall, we sleeve an LVL header into the panel above the opening; posts at either side support the header. A beam can either sit on top of the header or attach to the face of it with a beam hanger.

We rely on load tables from the engineered-wood suppliers and hanger manufacturers when we spec this type of connection.

Figure 6. Where a beam end meets the wall above a window, foam is routed out of the panel at the opening edge of the window, allowing the crew to insert jack posts into the recess (above left). A built-up LVL header, sized to carry the load from the beam, is slipped into the panel above the window opening (above). The wall is then stitched together and raised (left).

Wood I-Joist Floor Panels

Panelizing the floors as well as the walls has several advantages. First of all, it lets us take full advantage of the crane we bring to the site. I'll ask my crews to manhandle wall sections as big as 8 by 10 feet without equipment, but we need a crane to set larger wall assemblies, engineered beams, and roof panels. If we use the crane for floors, too, we can maximize the value of our investment in equipment.

Prebuilding also lets us compress the schedule by accomplishing two phases at the same time: Our crews can be at our shop framing the floors while the foundation contractor is still on site forming and pouring the basement. Saving days from the site schedule has particular benefits for us: My crews live near our Keene, N.H., shop, but they often have to travel to jobs around the region, staying overnight in motels. Framing the floors in the shop lets them have more time at home.

When we get a set of plans to panelize, a designer here in our shop analyzes the floor loads to determine where point loads will need to be supported within panels, and where wall openings may need headers. If we're planning to panelize the floors, the designer breaks up floor systems into 8-foot sections (the section width is limited by the length of the floor sheathing). The crew assembles the floor sections in our shop (Figure 7). On site, they use the crane to "fly" the pieces into place (Figure 8, next page).

The total time it takes to frame the floor probably isn't much different with this system than it would be with

Figure 7. For this project, the crew preassembled second-story floor frames in the shop in 8-foot-wide sections (above). A simple 2x4 jig helps to keep floor joists aligned as floor sheathing is placed and fastened (right).

on-site framing. Whether we work in the shop or in the field, we still have to put all the pieces together. But building the floors in the shop is safer: There's less fatigue; there's less time when the crew is exposed to the risk of falling; and help is nearby if there's an accident. It's also easier to keep tools and materials organized and available, and if there's any confusion about the plans, the designers are right in the building.

That doesn't mean things always go perfectly. With panelizing, you have to be careful to double-check everything. It's easy to make a mistake in dimensions or load paths when you're building the house in pieces, and we've made a few. But with each house we panelize, we get a little better, and we're finding that the added productivity — along with the convenience we can offer our customers — makes that learning curve worth the climb.

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Figure 8. Just like the first-story SIP floors, the preassembled I-joist floor sections are flown into place with the crane (left). Previously installed joist hangers receive the I-joist ends as the floor sections drop into position (below).