

# TOOLBASE™ TECHSPECS

## Structural Insulated Panels

### DOLLARS & SENSE

Costs to buy, install, and operate a home with SIPs...  
*Page 2*

### MAKING THE SWITCH

What it takes to switch from standard wall systems to SIPs...  
*Page 2*

### RESULTS FROM THE FIELD

Real world demonstrations from Maryland, Texas, and Arizona...  
*Page 2*

### FOOD FOR THOUGHT

What to consider to be sure SIPs are right for your project...  
*Page 3*

### TECH CHECK

Steps to take if you decide to start using this building technology...  
*Page 3*

## TECH @ A GLANCE

### BENEFITS (+) / DRAWBACKS (-)

- + **AFFORDABILITY:** Reduced labor time due to ease of installation; minimal learning curve going from traditional materials; fast assembly and erection
- + **ENERGY EFFICIENCY:** Increased insulation (R-value) and reduced air infiltration
- + **ENVIRONMENTAL PERFORMANCE:** Reduction in use of dimensional lumber
- + **DURABILITY:** High wind resistance
- **AFFORDABILITY:** Need for careful design; additional construction costs; higher material cost; once house is designed and panels produced, changes are costly; remodeling may require the services of a design professional

### INITIAL COST

Producing and engineering customized panel layouts may drive up the initial cost of SIPs, making them more expensive than conventionally-framed homes. However, some manufacturers offer competitively-priced prefabricated SIP packages. On-site panel modifications may be more difficult and more costly than for conventional framing, but SIPs can be installed quickly, reducing on-site labor costs.

### OPERATIONAL COST

Operational energy costs for SIPs are typically lower than stick-built homes, often offsetting the higher initial cost. Cost savings result from increased thermal performance, resulting in lower utility bills.

### CODE ACCEPTANCE

SIPs are not currently addressed in the body of the model codes, rather SIP systems are permitted after receiving approval under Evaluation Reports. The model building code Evaluation Services have reviewed and accepted SIPs systems, and have issued Evaluation Reports for several SIP systems. An initiative to standardize SIP construction methods and

include SIP techniques within the main body of the International Residential Code (IRC) is underway. SIPs structures are highly resistant to wind damage, and can be designed for areas with stringent wind or seismic lateral (shear) bracing requirements. Most manufacturers provide technical design and support services to ensure adherence to codes.

### RESULTS FROM THE FIELD

Field results indicate increased energy efficiency, demonstrated by higher HERS ratings and lower homeowner utility bills, as well as decreased framing time compared with conventionally-framed homes. There have been two PATH field evaluations with this technology – one in Dallas and one in Minneapolis.

### WARRANTY

Most manufacturers provide a structural warranty for the expected life of the building, provided that the panels are installed and used correctly. Some manufacturers may offer insulating performance guarantees or warranties, and additional warranties on insect infestation.

### MAKING THE SWITCH

Use of SIPs requires careful planning. Custom designs may require a completely customized panel layout. However, some manufacturers can provide pre-designed house packages that simplify this process.

Work with your masonry contractor to ensure that foundation designs and construction techniques are appropriate for SIPs construction. The concrete foundation must be placed precisely to specification to provide a level bearing surface. SIPs are easily and quickly assembled. Assemblers will need basic carpentry skills, but not the skill level of a conventional framer.

## THE BASICS

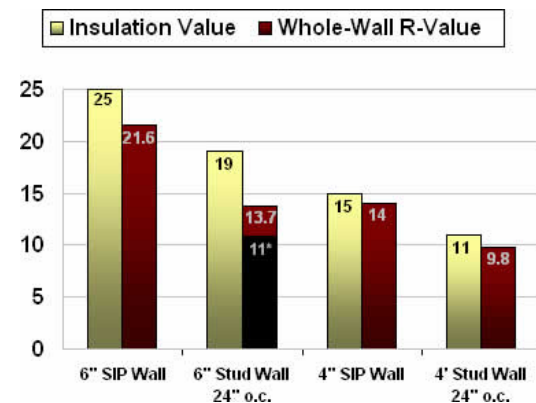
Structural insulated panels (SIPs) consist of a thick layer of foam (polystyrene or polyurethane) sandwiched between two layers of oriented strand board (OSB), plywood, or fiber cement, which creates web-and-flange structural strength across the panel. SIPs can handle axial, bending, racking, and shear loads, and easily replace conventional framing. SIPs are widely used for wall and roof framing, and some manufacturers also provide floor panels.

Panels are prefabricated by the manufacturer, either from pre-designed plans or a customized layout. Once the foundations are in place on site, panels are shipped to the site and assembled.

SIPs structures are strong and highly

## WHOLE WALL R-VALUE COMPARISON

Source: Oak Ridge National Laboratory, [www.ornl.gov](http://www.ornl.gov)



## DOLLARS AND SENSE

**Initial Cost** - For a 2,500 s.f. home, one custom home builder in Arkansas (Stitt Energy Systems) estimates an **additional \$5,000 to 8,000 for materials**. Labor savings are substantial, however, and can tip the economic scales in favor of SIPs. For example, in areas of the country with high labor rates, installed costs for SIPs compare to conventional wall systems. In areas with low-cost labor rates, the installed costs for SIPs are higher than conventional wall systems.

**Operational Cost** – The energy efficiency of homes constructed using SIPs can be very high compared to standard framing techniques. Again, the actual savings will vary widely from between designs and systems, but several examples in the field have illustrated the potential. For the PATH field evaluation in Dallas, Texas, **utility bills half those of comparable stick-framed homes** were reported. Another site in Minneapolis, Minn., reported **annualized heating bills of a mere \$48 per month** (see Results from the Field for more details).



### THE BASICS *continued*

resistant to wind damage and seismic forces. Their increased insulation capacity can significantly reduce costs for heating and cooling and lower utility bills. They use much less dimensional lumber than stick-built homes and can help conserve timber resources.

Assembly is quick – a home is usually “closed in” within a matter of days, compared with weeks for a conventionally-framed home. Assembly is relatively easy and requires only basic carpentry skills.

SIPs have a higher initial cost than traditional framing materials. And although some panel modifications on site are possible, they are usually more difficult and more costly than for conventional framing.

However, labor savings for the builder and energy savings for the homeowner can help offset these costs, making this technology more affordable in the long run.

Most SIPs systems are recognized by all major code organizations. Although no specific prescriptive language currently exists in building codes, PATH has launched an initiative to standardize SIP construction methods, produce prescriptive tables and details, and include SIP techniques in the ICC’s International Residential Code (IRC).

## RESULTS FROM THE FIELD

*This technology has been evaluated by other builders in real-world building projects – learn from their experiences. For more information on these Technologies in Practice, visit [www.toolbase.org](http://www.toolbase.org).*

Field results indicate increased energy efficiency, demonstrated by higher HERS ratings and lower homeowner utility bills, as well as decreased framing time compared with conventionally-framed homes.

### **Dallas, Texas, Carl Franklin Homes, Vistas at Kensington Park (PATH Field Evaluation)**

- Constructed 17 single-family homes using SIPs for walls and roofs and a geothermal heat pump for heating and cooling
- Home received a Home Energy Rating System (HERS) score of 93; 65% more efficient than an equivalent Model Energy Code (MEC) home
- Builder reported that homeowner utility bills are half of those for conventionally-built homes

### **Minneapolis, Minnesota, AFM Study House**

- Used ICFs and SIPs to construct a 4,964 s.f. home
- Home had annualized winter heating bill of \$48 per month
- Independent, third-party energy evaluation indicated a Home Energy Rating System (HERS) score of 91.6; comparable conventional wood-framed home satisfying the Model Energy Code would receive a HERS score of 80

## MAKING THE SWITCH

*What training, tools, and home design changes are required to switch from your current building practices to using this technology?*

- **Update your home designs** – SIPs require more time for up-front planning and less time for on-site construction. Unless a builder is using a pre-designed home plan, a completely customized layout is developed. Builders must approve plans before the manufacturer can begin production.
- **Learn the assembly process and order and update your schedules** – Panels are shipped once the foundation and floor deck (if not using SIPs floor panels) are completed on site. Manufacturers recommend unloading panels with a forklift, or having enough people on site to unload the truck by hand. Materials are unloaded in reverse order of when needed. Learn the timing and order of assembly of the panels to ensure that the construction can be properly scheduled. A visit to a jobsite where SIPs are being used can help speed the learning curve.
- **Tools** – A crane may be required to set wall panels. A router may be useful for cutting openings for electrical junction boxes, switches, and outlets. A hot knife may be useful

**FOOD FOR THOUGHT**

*This section provides some things to think about before switching to this building technology – make sure it’s the right choice for you.*

- Because panels are manufactured precisely according to specifications, the foundation must be poured accurately. Failing to do so can result in the need to make on-site modifications, which are often expensive and difficult or unfeasible.
- Builders should expect a longer review and approval process by the building department. SIP homes will also require special inspections by county or private engineers during the construction process.
- Although SIPs can significantly reduce construction time, builders should be prepared for a more involved up-front process. The builder must review plans carefully and approve them before the manufacturer can construct them.
- Initial costs are higher for SIPs than for conventional framing materials, especially when using customized layouts. Builders should compare the higher initial cost with the estimated labor and energy savings.
- Installation of electrical wiring and plumbing lines may require special techniques. Because SIPs structures are more airtight, the builder should give special attention to mechanical ventilation design in order to avoid potential backdrafts and to ensure proper ventilation to gas appliances.
- Joints must be properly sealed to ensure the thermal performance of SIPs and to prevent potential moisture damage.
- If SIPs are used in roof construction, a builder may need to change his roof sheathing ventilation practices. Some shingle manufacturers will not warrant products placed on sheathing without air circulation beneath. As a result, some manufacturers provide roof panels with channels in the core material, running underneath the upper sheathing layer.
- Small remodeling projects, such as adding a window or door, are not easy but are possible with SIPs. A structural engineer must be consulted to specify the required headers and connections. Big remodeling projects, such as moving a wall or adding a room or a second floor is very difficult and expensive with SIPs.
- SIPs are particularly suitable for extreme climate zones because of their high insulation value. Their high R-values and low air leakage rates increase energy efficiency and homeowner comfort and lower utility bills.

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**TIP: Translate SIPs benefits into homeowner values — a faster “close-in” time can mean a quicker move-in date; higher energy efficiency means lower bills and increased comfort; increased strength and durability mean a lower likelihood of damage during storms or earthquakes.**

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**MAKING THE SWITCH** *continued*

to efficiently cut foam at boxes as well. Sealants are required at wall, floor, and ceiling junctions to provide air sealing. Use manufacturer recommended products. Pneumatic nailers are used to fasten panels to top and bottom plates, and to make vertical connections.

- **Work with your trade contractors –** Drywall and siding installers may find SIPs easier to work with, since they do not need to locate studs. However, electricians and plumbers may need to make some alterations. Most panels include a formed chase in the core for wiring, but insets for boxes and additional channels must be mechanically routed, then resealed with aerosol foam. If placement of plumbing pipes in SIPs panels instead of interior walls is necessary, significant routing and foaming may be required.
- **Check your local codes –** Most SIPs systems are recognized by major code organizations, though no prescriptive method for their installation currently exists. Work with the manufacturer to make sure that home designs meet all local code provisions.

**TECH CHECK**

*Below is a checklist of steps to follow in order to implement this technology in each of your projects.*

- Prepare plans.** Unless you plan to use a manufacturer’s pre-designed plan, the manufacturer will need your building plans in order to produce a customized panel layout and working drawings.
- Review and approve plans.** Plans should be reviewed carefully. Any changes made after panels are manufactured will be costly and cause delays. A structural engineer must certify the design. Many manufacturers may offer this service in-house.
- Prepare foundation.** The foundation should be in place before panels are delivered to the site. The foundation must be poured precisely.
- Unloading.** Manufacturers recommend using a forklift, or having at least four people on site to unload the truck. Panels are typically unloaded in the reverse order they will be needed. Additional charges may apply for extra unloading time.
- Tools.** You will need circular saw with regular blades, adjustable saw to cut 45-degree angles, hammer, battery-powered drill, 1/4” x 6” concrete bits, 1/4” hex driver bits, regular and adjustable squares, 3-foot level, putty knife, sealant gun, metal shears, scaffolding and ladders. Power-driven nails or staples are used as fasteners. Special tools needed include a hot wire cutter for EPS foam cores or routers for urethane/isocyanurate cores, which may be expensive.
- Assembly.** Wall panels can usually be assembled in one day. Larger panels, including roof panels, generally require a crane.
- Sealing.** Sealing is vital for SIPs to retain their insulating properties. Aerosol foam, gaskets, or other caulking materials may be used.
- Trades.** Drywall and siding installers may find SIPs easier to work with because they do not need to find studs. Electricians will have to pull wiring through chases cored through the foam core.



The Partnership for Advancing Technology in Housing (PATH) is dedicated to accelerating the development and use of technologies that radically improve the quality, durability, energy efficiency, and affordability of America's housing. Managed by HUD, the PATH partnership includes the homebuilding, manufacturing, insurance and financial industries, and Federal agencies concerned with housing.

PATH addresses barriers to innovation, provides information on advanced building technologies, and advances housing technology research; making affordable, quality American homes a reality.

For more information on the PATH program, visit [www.pathnet.org](http://www.pathnet.org).

*Tech Specs are Prepared for PATH by the NAHB Research Center.*

## RESOURCES

### **ToolBase Services**

Information on this building technology and many others brought to you by PATH and the building scientists at the NAHB Research Center.

[www.toolbase.org](http://www.toolbase.org)

### **APA - The Engineered Wood Association**

7011 So. 19th  
Tacoma, WA 98466  
253.565.6600

[www.apawood.org](http://www.apawood.org)

### **Structural Insulated Panel Association**

P.O. Box 1699  
Gig Harbor, WA 98335  
253.858.SIPA (7472)

[www.sips.org](http://www.sips.org)

