

## Panelized Systems

Panelized building systems use factory-made panels that are delivered by truck and assembled on-site by hand, sometimes with the aid of a light crane or lift. They may be used for all or part of the structural envelope (walls, foundations, floors, and roofs). Composite building panels can include structure, insulation, vapor barriers, and service chases in a single panel. Panelized systems combine the efficiencies and labor savings of factory-produced building components with the flexibility of a modular site-assembled system.

### Structural Insulated Panels (SIPs)

Structural Insulated Panels (SIPs) are the most prevalent panelized systems in residential construction. SIPs are made by sandwiching a core of foam insulation between two structural skins. This system makes the panel structural without the need for additional framing members. Most SIP systems offer improved strength, insulation value, and air-tightness when compared to standard wood framing. This increases thermal performance and durability. In most cases, SIPs will be engineered and pre-cut to the exact sizes needed, saving time and labor on site.

### Wood SIPs

Wood-sheathed SIPs have a structural skin of oriented strand board (OSB) or, less commonly, plywood. The core may be expanded polystyrene foam (EPS), extruded polystyrene foam (XPS), or polyurethane foam. The material cost, although higher than standard wood framing, is lower than many other panelized systems. Wood-framed SIPs are relatively easy to assemble and limited on-site modifications are possible using regular tools.

### Non-Wood SIPs

SIPs can also be manufactured using a variety of non-wood structural skins. These include metal (stainless or galvanized steel), fiber cement, and fiber-reinforced plastic (FRP). These materials, while more expensive than OSB, offer increased



**(FIG.A) PANELIZED SYSTEMS** are delivered to the site as a package. Builders familiar with SIP construction can erect the structure quickly, reducing labor costs.



**(FIG.B) MANUFACTURERS** can create custom-engineered designs based on architectural drawings.



**(FIG.C) INSTALLING** electrical, mechanical, plumbing, or other systems may require planning ahead. Coordinate with tradespeople to avoid delays or cost overruns.

panels	construction process	speed	delivery method	required equipment	specialized labor	wind resistance	water resistance	fire resistance	thermal performance	life span	environmental impact	product versatility	market exposure	code approval	affordability	coastal considerations
concrete panels		+	-	-	-	+	+	+	-	+	-	-		+	-	+
structural insulated panels	+	+		+	+	+	+	-		+	+	+				+
non-wood structural insulated panels	+	+				+	+	+	+	+	+	-	-		-	+
framed panels	+	+		+	+	+	+	+	+	+	+		-			+

resistance to moisture, water, insects, fire, and other threats. Overall, non-wood SIPs have excellent strength and durability. These SIPs may be used alone or in combination with wood framing or other building systems. Depending on the system, on-site modifications may be difficult or impossible.

### Framed Panels

Framed panels are factory-built modular panels with structural framing elements built in. Some resemble site-built framed walls, but variations are possible. For example, Thermasteel Corporation produces EPS core panels with steel channel framing on the interior and exterior faces, creating a 2-1/2" gap that reduces thermal bridging. These panels are assembled using the techniques of light-gauge steel framing.

### Concrete Panels

Concrete panels precast in a factory can be made to a higher strength than site-built block or cast-in-place walls, and without weather delays. In residential construction, concrete panels are most often used in below-grade foundation walls, but they can be used for part or all of the structural envelope. When used to create conditioned space insulation material will be a necessary addition to the system, as concrete itself has a poor R-value. Concrete panels can be manufactured with an insulating core made of EPS or other foam insulation, or cast with a layer of foam insulation on one side.



**(FIG.D) FRAMED PANELS** use techniques similar to standard wood or light-gauge steel framing but are built in a factory. Shown here is a steel-framed panel manufactured by Dynabilt.

#### FURTHER INFORMATION

- Structural Insulated Panel Association (SIPA) ([www.sips.org](http://www.sips.org))
- Toolbase ([www.toolbase.org](http://www.toolbase.org))
- Residential Advantage Building Systems - Jackson, MS ([www.resadvan.com](http://www.resadvan.com))
- General Panel - Grenada, MS ([www.generalpanel.com](http://www.generalpanel.com))

#### NOTES ON PANELIZED SYSTEMS

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## Panelized Systems structural component systems

# 2

## PANELIZED SYSTEMS

### subjects

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<b>2.2</b>	Non-Wood Structural Insulated Panels
<b>2.3</b>	Framed Panels
<b>2.4</b>	Concrete Panels

## Wood SIPs

**Overview:** Structural insulated panels (SIPs) are composite building panels that combine structure, insulation, and other elements in a single panel. The panels are made in a factory and shipped to the building site for assembly. They can be used to build floors, exterior walls, and roofs for residential and light commercial buildings. SIPs are manufactured by sandwiching a core of rigid foam insulation between two structural skins. In wood-sheathed SIPs, the structural skin is typically oriented strand board (OSB) or plywood. The insulating core may be expanded polystyrene (EPS), extruded polystyrene (XPS), polyurethane (PU), or polyisocyanurate (polyiso). Using SIPs, a strong, tight, well-insulated building envelope can be built quickly and efficiently.

## INSTALLATION

**Construction Process:** In the factory, SIPs can be manufactured in the specific sizes and configurations necessary for the building. They are shipped to the building site to be assembled. Some on-site modifications, such as changes to door and window openings, can be made using simple tools. Panels are connected using dimensional lumber 'splines' or other methods. Roof panels are typically supported using a ridge beam or multiple rafters and beams as necessary. The skills and tools required are not very different from standard wood framing.

**Speed of Construction:** Builders familiar with SIP construction can frame a SIP house significantly faster than a standard wood-framed house. Time and labor savings will be highest in multi-unit developments. Learning to build with SIPs will not be difficult for builders familiar with standard wood framing.

**Delivery Method:** Panels will likely be shipped by flatbed trailer or truck (limiting the size of the panels) and offloaded with a forklift or crane.



**(Fig.1)** A typical wood structural insulated panel (SIP) is made of two oriented strand board (OSB) skins sandwiching an insulating foam core, most commonly expanded polystyrene (EPS) (shown).



**(Fig.2)** Panels laid out on a building site prior to erecting the walls. A partially assembled house is visible in the background.



**(Fig.3)** A crane may be needed to lift large panels into place.

**Required Equipment:** Beyond standard wood framing tools (such as a drill, reciprocating saw, circular saw, and router), little specialized equipment is required. According to ToolBase, a technical construction information resource, “panels weigh approximately 3 lbs per square foot, so 4-foot panels are light enough to be carried and set by hand.”<sup>1</sup> Large panels may need to be lifted by crane or other means.

**Specialized Labor:** Certain contractors specialize in SIP systems. Contact your SIP manufacturer for a list of preferred builders. Learning to build with SIPs will not be difficult for builders familiar with typical wood construction techniques.

## PERFORMANCE

**Wind Load:** Unlike standard framed walls, SIPs have OSB sheathing on both sides, which creates superior resistance to shear loads (wind and other lateral forces). Manufacturers claim that SIPs perform better than standard wood framing in most measures of strength, including axial loads (supporting the weight of the building) in addition to shear loads. SIP houses can be engineered to meet hurricane wind load requirements.

**Water Resistance:** Properly installed SIPs create a tight envelope that resists air and moisture infiltration. However, mold and mildew can grow if panel joints are not sealed properly. Most types of insulating foam are non-nutritive and do not contain cavities that might encourage mold, mildew, or insects. However, like any wood product, OSB is vulnerable to these threats. Panels should not be exposed to the elements for extended periods of time during the construction process. Pressure-treated plywood can be used for applications requiring greater resistance to decay, such as below-grade foundation walls.

**Fire Resistance:** OSB, and most foams, are combustible materials. EPS, the most common insulating foam, is nevertheless quite resistant to the spread of flame, and it gives off the same byproducts as wood when it burns. SIPs have a solid core and do not exhibit the chimney-like fire spreading tendencies of standard wood-framed walls.

Residential building codes require that foam insulation be separated from the interior of the building by a material that remains in place for at least 15 minutes of fire exposure, typically 1/2" drywall.

**Energy / Thermal:** SIP construction can create significant energy savings in two main ways:

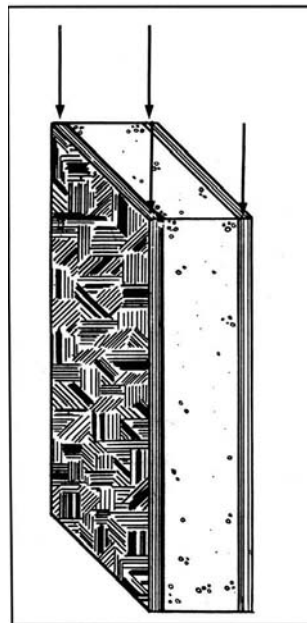
First, SIP walls contain minimal amounts of thermal bridges between the exterior and interior of the building due to the reduced need for wood structural members

and a more continuous layer of insulation.

Second, SIPs can create a very tight house, minimizing heat loss and gain due to air infiltration. According to industry estimates, “The amount of energy used to heat and cool a home can be cut by up to 50 percent.”<sup>2</sup>

See the chart below for typical SIP insulation R-values. Most important, however, is the “whole-wall” insulation value. A wood-framed wall with R-13 fiberglass insulation may have an overall insulating value of R-6 to R-9, depending on how well it is built. By comparison, a SIP wall with R-17 insulation can have an overall insulating value of approximately R-15.<sup>3</sup>

The tight building envelope created by SIP construction does not allow sufficient air exchange for comfort. A properly designed fresh-air ventilation system is required to maintain interior air quality; a system that conditions the indoor air without bringing in fresh air will not be sufficient. Consult a mechanical contractor or engineer to design a system with sufficient fresh air ventilation.



(Fig.4) Vertical loads are carried by the panel skins. Continuous reinforcement by the foam core prevents buckling.

SIP R-Values (Calculated R-Values)

SIP Panel Thickness	4 1/2"	6 1/2"	8 1/4"	10 1/4"	12 1/4"
EPS	14.4	21.6	27.9	35.1	45.9
XPS	19.5	29.5	38.3	48.3	58.3
Polyurethane	21.7	32.9	N/A	N/A	N/A

Consult the panel manufacturer to verify R-values. R-values can vary between SIP manufacturers.

(Fig.5) Base R-values for SIP insulation types. All listed R-values are at mean temperature of 75° F. Note that actual whole-wall insulation values may be lower.

**Life Span:** The OSB and wood members used are comparable to standard wood construction. However, when built properly, SIPs' lower air and moisture infiltration should reduce common sources of deterioration. Due to their strength and durability, SIPs can have a lifespan of many decades.

**Common Failure:** Failing to properly tape and seal seams can lead to moisture intrusion into the panel cavity, expansion of the underlayment at panel joints, and a decrease in the thermal performance of the structure. Long-term consequences could include serious mold and mildew problems and decomposition of the panel structure. Ridges might also become noticeable on the roof during hot weather.

Some roofing manufacturers will not warranty asphalt shingles over unvented SIP roofs because shingle temperatures may be higher (although typically only by a few degrees). Builders wishing to comply with the warranty can add a venting space under the shingles.<sup>4</sup>

## DESIGN

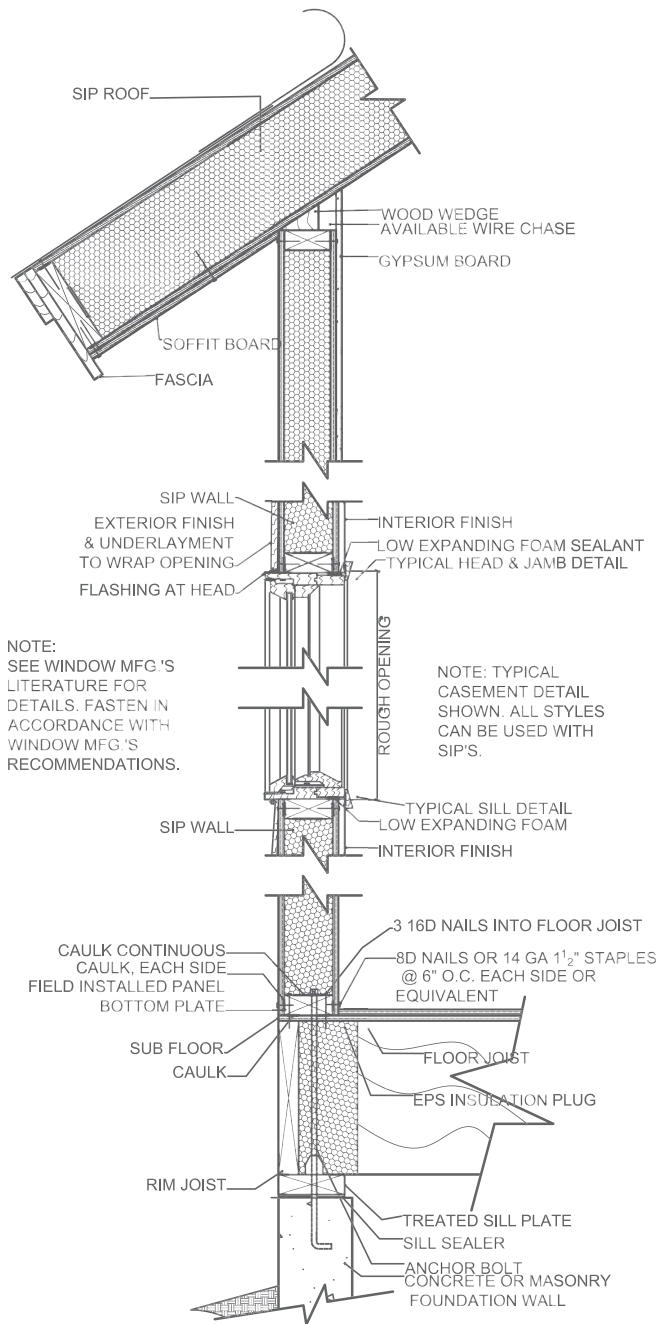
**Environmental Impact:** Factory construction reduces the amount of waste generated. On-site construction waste should be minimal.

EPS and some other types of insulation can be recycled, and can include recycled content. OSB is made using recycled wood scraps and small, renewable trees, so a SIP house requires fewer large trees to be cut for studs and other framing.

The increased thermal efficiency of a SIP house can lead to a reduction in the energy used for heating and cooling.



**(Fig.6)** Assembly of factory-made roof panels. FSU Zero Emissions House.



**(Fig.7)** This is an drawing of typical SIP wall and roof section. Most manufacturers will be able to provide the drawings necessary for code compliance and permitting. Many will design and engineer a custom SIP configuration based on the desired floor plan.

**Versatility / Flexibility:** SIPs come in standard panel sizes, and can also be custom manufactured to create whatever design or configuration is desired. Many manufacturers can use the construction documents to design a complete SIP package. This allows the panels to be assembled on site with few modifications. On-site modifications can be made using common tools. SIPs can work well with other building systems. For instance, interior partition walls are often built using standard wood framing.

**Market Exposure:** While SIPs are not as common as standard wood construction, they are among the most common alternative construction systems. They are relatively well known and understood within the building industry and are built in all areas of the country.

**Code Approval:** SIPs typically meet all building codes; however, building departments may not be familiar with the particular system in use. According to ToolBase, “the majority of manufacturers provide technical design and support services to ensure code acceptance.”<sup>5</sup>

**Affordability:** The cost of a SIP house can be higher than or comparable to standard wood framing. Depending on material prices, demand, and level of customization required, the *material cost* for SIP framing versus standard wood framing will likely be higher. However, an experienced builder can frame a SIP house in days rather than weeks. Particularly with large numbers of units, the savings in time and labor costs can be significant.

Reduced operational costs (energy and maintenance) and a higher-quality finished product mean that a SIP house usually provides a better value than a standard wood-framed house.



(Fig.8) Florida State University Energy & Sustainability Center's “Off-Grid Zero Emissions Building”.

## GULF COAST AVAILABILITY / LOCAL MANUFACTURERS

### ThermaSAVE

- Gulfport, MS
- Eddie Hartwell

### Residential Advantage Building Systems

- Jackson, MS
- Manufactures: EPS foam core SIPs with OSB skins. Panels fully customizable with thicknesses of 4.5”, 6.5”, 8.5”, 10.5”, or 11.5”. Supplies fasteners and tools.
- [www.resadvan.com](http://www.resadvan.com) / (601) 896-9623

### General Panel Corporation

- Grenada, MS
- Manufactures: EPS foam core SIPs with OSB skins. Other types of panel are manufactured at their Tennessee plant (ICF, OSB/GWB, etc).
- [www.generalpanel.com](http://www.generalpanel.com) / (866) 774-0530

### SIPS Team USA

- Bainbridge, GA
- Manufactures: EPS foam core SIPs with OSB skins. Panels fully customizable up to 8’ x 24’ and 2-10” thick.
- [www.sipsteamusa.com](http://www.sipsteamusa.com) / (229) 246-8880

### PanelStar Custom Homes

- Columbus, GA
- Supplies: INSULSPAN SIPs, EPS foam core SIPs with OSB skins. Provides on-site supervision and consultation during construction.
- [www.panelstar.com](http://www.panelstar.com) / (706) 315-4300



(Fig.9) Structural insulated panel components being made in a factory.

## 2.1 | Wood SIPs

### MM & I Construction & Design

- Nashville, TN
- Manufactures and builds: INSULSPAN SIPs, EPS foam core SIPs with OSB skins. Provides on-site supervision and consultation, full construction services, and design assistance.
- [www.design101.tv](http://www.design101.tv) / (615) 673-9294

### Better Building Products LLC

- Salisbury, NC
- Manufactures: SIPTEX, polyurethane foam core SIPs with OSB skins. Wall panels come in 4' x 8' and 4' x 12' sizes and 4.5" thick.
- [www.wabrown.com](http://www.wabrown.com) / (704) 636-5131

### Superior Insulated Systems

- Palm City, FL
- Manufactures: EPS foam core SIPs with 7/16" OSB skins. Sizes up to 8' x 24' and 4-1/2" to 12-1/4" thick.
- [www.sishomes.com](http://www.sishomes.com) / (800) 918-1430

### Triton Building Systems, LLC

- Bay St. Louis, MS
- Builds: new construction, additions, and remodeling projects using SIPs.
- [www.tritonbuildingsystems.com](http://www.tritonbuildingsystems.com) / (228) 220-4620



(Figs. 10-13) Process photos from Florida State University Energy & Sustainability Center's "Off-Grid Zero Emissions Building."



## Non-Wood SIPs

**Overview:** Structural insulated panels can be manufactured using a variety of non-wood structural skin materials. These include metal (stainless or galvanized steel), fiber-reinforced cement, and fiber-reinforced plastic (FRP). Like wood SIPs, these panels are used to build floors, exterior walls, and roofs, and may be used alone or as part of a hybrid system that also uses steel framing, wood framing, concrete, or other building techniques.

### Metal Panels:

Stainless Steel (SS) and G90 Galvanized are the most commonly used metal surfaces. Metal panels can be used for residences or residential roofs, but are more often used in industrial or commercial buildings that require the product's strength or non-corrosive properties. Stainless steel is essentially low carbon steel containing 10% or more chromium, which gives the steel its corrosion-resisting properties. Galvanized steel is coated with a thin layer of zinc that protects the steel from corrosion. Metal SIPs can be costly, but for the right application, the benefits may be worth the extra cost. Benefits include: corrosion-resistance, fire- and heat-resistance, hygiene, noise insulation, good strength-to-weight ratio; and impact resistance.

### Fiber Cement Panels:

Fiber-reinforced cement ('fiber cement') is a mixture of cement, sand, cellulose fibers, silica, and additives, which are autoclaved (cured with pressurized steam) and molded into finished siding products. Fiber cement products such as those manufactured by the James Hardie Corporation are commonly used for siding, trim, and other exterior and interior applications. Panels can be made with fiber cement on one or both sides as a finished or unfinished surface. According to ToolBase, a technical homebuilding information, "manufacturers emphasize that fiber-cement siding is appropriate for hot and humid climates because it is resistant to rot, fungus, and termite infestation. They also state that it has excellent weathering characteristics, strength, and impact resistance."<sup>6</sup>

## Fiber-Reinforced Plastic Panels:

Fiber-reinforced plastic (FRP) is a composite material made of a polymer reinforced by fiberglass or other fibers. FRP is typically used in combination with a polyurethane core. The manufacturing process uses synthetic composite materials and industrial processes similar to those of the marine and aircraft construction industries. This type of construction is most common in coastal areas.

## INSTALLATION

**Construction Process:** Methods of construction vary depending on the manufacturer and system in use. In most cases, panels are mechanically connected using power-driven screws or cam-locks. In other cases, connections are made using glue, resin, and/or specialized tools. Most non-wood SIPs cannot be easily modified on site and must be manufactured to the dimensions required.

Many manufacturers offer a range of services, usually for a fee. Builder training, on-site supervision and assistance,



(Fig.14) A worker installs fiber cement panels in a house in Orlando, FL.

## 2.2 | Non-Wood SIPs

and full construction services are typical examples.

**Speed of Construction:** Claims vary from a fifty percent savings in time (particularly for experienced builders) to no appreciable difference compared to traditional construction techniques. Faster construction time and lower labor costs may offset higher material costs.

**Delivery Method:** Panels will likely be delivered by truck. A standard size for many manufacturers is 4ft x 8ft, but panels can be up to 30ft long, depending on the size of the truck available for delivery.

**Required Equipment:** Metal or fiber cement 4ft x 8ft panels can be handled by two people, but larger panels may require the use of a crane or forklift. Fiber-reinforced plastic panels are lighter and in most cases can be assembled by without the use of heavy lifting equipment.

**Specialized Labor:** Workers familiar with typical construction techniques can easily be trained to assemble many of these systems. Some systems, however, may require additional expertise. In some cases, electrical and plumbing work may require special expertise to install.

## PERFORMANCE

**Wind Load:** Manufacturers of non-wood SIPs claim that they offer higher strength and better resistance to wind loads than either wood SIPs or standard wood framing. For instance, InnoVida claims its panels can withstand wind loads up to 186 mph. OceanSafe warrants its system up to 150 mph. The International Residential Code specifies design wind loads of 140 mph in most hurricane-prone coastal areas.<sup>7,8,9</sup>

Panels can often be engineered to meet the wind load re-

quired for a project. However, wind resistance will depend as much on the connections and configuration of the panels as it does on the strength of the panels themselves. Additionally, panels that perform well under one type of load, such as shear (wind load), may perform differently under other types of loads. Consult the manufacturer for strength information and instructions on correctly installing panels.

**Water Resistance:** Non-wood structural skins used in SIPs typically display superior water resistance. Stainless steel and galvanized steel are waterproof and resistant to corrosion. Fiber cement is highly resistant to moisture absorption. Fiber-reinforced plastic, which is also used in boat-building and marine applications, offers the best water resistance. It resists algae, fungi, water, and osmosis and has a high level of chemical stability against salt water. All of these systems offer advantages in flood-prone areas. However, any system can be weakened by improper installation.

**Fire Resistance:** Many non-wood systems offer excellent fire resistance. Steel and fiber cement are noncombustible materials. When used on the inside of a wall, fiber cement meets the code requirement for a 1/2" fire barrier. In the case of fiber-reinforced plastic, check with the manufacturer that it does not give off toxic chemicals when it burns.

EPS and polyurethane foam (PU), the insulation materials used in many non-wood panels, are not highly flammable materials. Given enough heat and air, they will burn, but are not prone to spread the fire.

**Energy / Thermal:** Energy and thermal performance is significantly better than standard wood framing and equal to or better than wood-sheathed SIPs, depending on the insulation material used. Many manufacturers claim insu-



(Fig.15) A worker installs wiring in a house built using InnoVida fiber-reinforced plastic panels in Dubai, UAE.



(Fig.16) Metal SIP corner showing window openings cased out using galvanized steel channels.

lating values of R-20 or better for standard thickness walls and R-30 or better for roofs and thicker walls.

Building tightness is a major factor in thermal performance, and most non-wood SIP systems offer the same improvements in building tightness as wood SIPs. When panels are properly installed, many manufacturers claim “equivalent R-values” of R-40 or better for the whole system, and energy savings of 30-70% for the occupant.

**Life Span:** Non-wood SIPs can be very durable. Materials like galvanized steel, stainless steel, and fiber cement offer exceptional strength and resistance to mold, moisture, insects, and other sources of decay, and will last significantly longer than wood SIPs or standard wood framing. InnoVida offers a long-term warranty of thirty years, and other manufacturers have similar warranties; however, actual product life span should be even longer.

**Common Failure:** Each system has its strengths and weaknesses. Panels must be designed to meet the expected load conditions. For instance, metal-skinned SIPs may fail under high compressive loads; fiber cement panels are more vulnerable to impacts. Most manufacturers can engineer their products to meet specific requirements such as hurricane wind loads.

The relative lightness of fiber-reinforced plastic panels means that the anchoring system is especially crucial to prevent wind and water damage. Additionally, these panels must be protected from the sun to prevent damage from Ultra Violet (UV) light. The manufacturer recommends painting the surface to avoid this damage.

## DESIGN

**Environmental Impact:** The energy efficiency of a SIP home will be increased due to the reduction of air infiltration and insulating quality of the SIPs. The type of insulation has more impact on the insulating quality than the structural skin. Of the three most common SIP insulation types, expanded polystyrene (EPS) provides an R-value of approximately 3.2 per inch, while extruded polystyrene (XPS) provides 4.3 per inch and polyurethane (PU) provides the best insulating capacity with 4.8 per inch.

Factory production reduces on-site construction waste and, due to greater efficiency, can reduce overall construction waste. Some SIP materials, such as stainless steel, have high recycling value. Additionally, some SIPs can be made using recycled materials.

**Versatility / Flexibility:** Most manufacturers can make panels to specifications in any dimension and shape required, either in thicknesses standardized for walls and roofs or in custom thicknesses. However, non-wood SIPs

are not generally designed for on-site modifications and must be manufactured in the exact sizes and shapes necessary for construction.

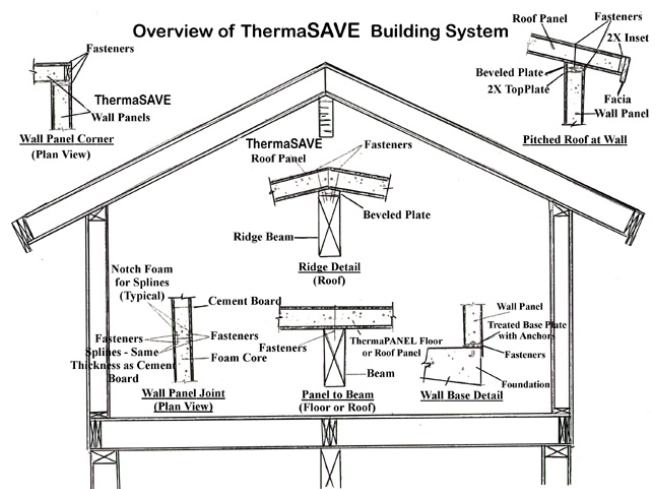
**Market Exposure:** Non-wood SIPs used in residential construction are most common in coastal areas that face threats from wind, flooding, and hurricanes.

**Code Approval:** Manufacturers may need to provide documentation for code approval.

**Affordability:** The initial material cost of non-wood SIPs will likely be higher than both wood-sheathed SIPs and conventional wood framing. However, an experienced builder can frame a SIP house quickly. Savings in time and labor costs can be significant, particularly in multi-unit developments.

Houses built using non-wood SIPs can have greatly reduced operational costs (energy and maintenance) and should last for many decades.

**Coastal Considerations:** Many non-wood SIP systems are designed for coastal applications and are highly resistant to wind, missile impacts, moisture, water inundation, insects, and other threats. Most manufacturers offer



(Fig.17) Most manufacturers provide instructions and drawings showing details and installation methods for their products.

## 2.2 | Non-Wood SIPs

some information about the strength and durability of their products. Check with manufacturers for design wind loads, hurricane loads, missile impact information, fire- and water-resistance, and other engineering data.

### GULF COAST AVAILABILITY / LOCAL MANUFACTURERS

#### Ocean Safe

- New Orleans, LA
- Manufactures and builds: Houses using EPS foam core panels with galvanized steel skins.
- [www.oceansafeinc.com](http://www.oceansafeinc.com) / (504) 812-5519

#### Insulated Component Structures of Florida, Inc.

- Eustis, FL
- Manufactures: Polyurethane core SIPs with skins of OSB, fiber cement, fiber reinforced plastic, or metal.
- [ics-sips-fl.com](http://ics-sips-fl.com) / (352) 483-7477

#### InnoVida

- Miami Beach, FL
- Manufactures and builds: Polyurethane CSIPs (composite structural insulated panels), bonding materials, and additional components. Offers on-site training and supervision during construction.
- [www.innovida.com](http://www.innovida.com) / (786) 837-7200

#### Coastal Steel Homes

- Waynesville, NC
- Manufactures and builds: Steel structural insulated panels (SIPs), steel framing, insulated concrete forms (ICFs) exterior walls, and timber framing.
- [www.coastalsteelhomes.com](http://www.coastalsteelhomes.com) / (828) 545-3303



(Fig.18) SIPs can be manufactured to create custom designs.

#### Homefront SIP Systems

- Englewood, FL
- Manufactures: EPS foam core SIPs with James Hardie fiber cement skins for walls and water-resistant OSB skins for roofs.
- [www.homefronthomes.com](http://www.homefronthomes.com) / (941) 475-6090

#### Marquis Construction & Development

- Holiday, FL
- Builds: Residential and commercial buildings using "Shadowline" steel SIPs manufactured by Kingspan Insulated Panels.
- [www.southernsips.com](http://www.southernsips.com) / (727) 937-3090



(Fig.19) Construction photos from several homes built using steel SIPs by Marquis Construction & Development.

## Framed Panels

**Overview:** Framed panels, like SIPs are modular panels that are built in a factory and assembled on site. Unlike SIPs, which rely on their stressed skins for strength, framed panels are made with framing members such as steel studs. Structurally, they perform like any other framed wall, floor, or roof, although factory production can ensure better and more consistent quality.

Many framed panels are made with rigid foam insulation, just like SIPs, and can deliver similar benefits in insulating value, building tightness, and durability. Like other factory-built panel systems, framed panels can reduce on-site labor costs. Most can be easily assembled using the techniques of light-gauge steel framing.



**(Fig.20)** These panels, manufactured by Dynabilt, combine galvanized steel framing with a polymeric insulated core.

## INSTALLATION

Panels are built in a factory to the sizes and specifications required. Rough openings for windows and doors and chases for electrical and plumbing are included. The panels are delivered to the site for assembly.

Steel-framed panels may be fitted into tracks and are typically installed using self-tapping screws. No specialized equipment is required. 4' x 8' panels weigh 45-50 lbs and can be handled by one or two people, while larger panels may require the use of a forklift or crane. Builders familiar with typical construction techniques or with light-gauge steel framing will be able to assemble the panels quickly.

Pre-installed chases allow electric wiring to be installed easily. A special foam-cutting tool may be used to place electric boxes and plumbing. In some cases, these can be installed in the factory instead, but this requires careful planning and coordination.

## PERFORMANCE

Many framed panels can offer benefits similar to those of SIPs. Steel studs can create a thermal bridge that reduces the insulating quality of the panel, but some manufacturers have addressed this problem. For instance, Thermasteel Corporation produces panels framed with steel channels bonded to the insulation on the interior and exterior faces, creating a 2-1/2" gap in the center that reduces thermal bridging. A 5-1/2" Thermasteel wall has an R-value of 22; however, Thermasteel claims the "effective value" is closer to R-30 due to the tightness of the system.<sup>10</sup>



**(Fig. 21)** The core adds structural strength and rigidity to the overall system.

### 2.3 | Framed Panels

The strength of framed panels comes from the steel studs reinforced by the rigid insulation. Panels can be engineered to meet hurricane wind loads. For instance, Dynabilt Technologies claims its panels are tested to withstand 170 mph wind loads.<sup>11</sup>

Most of the materials commonly used in framed panels, such as galvanized steel and EPS foam, display excellent durability. They resist fire, moisture, water, insects, mold, and other sources of damage and decay.

## DESIGN

Framed panels have the same environmental advantages as SIPs: reduced waste, use of recycled and recyclable materials, increased durability, and an energy efficient building envelope.

Most manufacturers can make panels to achieve any house design that is desired. Some manufacturers offer pre-designed packages at affordable rates; for instance, Dynabilt Technologies “produces complete pre-designed house packages using Modutherm panels and steel truss roofing systems” for as little as \$18.88 per square foot.<sup>12,13</sup>

Framed panels are well suited for coastal applications, and manufacturers located in coastal areas typically offer products engineered to meet hurricane wind loads and other requirements.

## GULF COAST AVAILABILITY / LOCAL MANUFACTURERS

### Dynabilt Technologies Corporation

- Miami, FL
- Manufactures: Galvanized steel-framed panels integrated with a structural polymeric insulated core.
- [www.dynabilt.com](http://www.dynabilt.com) / (305) 919-9800

### Kokoon Homes

- Toccoa, GA
- Manufactures: Galvanized light-gauge steel framed panels with 1/2” OSB sheathing and closed-cell soy-based foam insulation.
- [www.kokoonhomes.com](http://www.kokoonhomes.com) / (706) 344-7528

### Thermasteel Corporation

- Radford, VA
- Manufactures: EPS foam core panels with steel channel framing on the interior and exterior faces.
- [www.thermasteelcorp.com](http://www.thermasteelcorp.com) / (540) 633-5000



(Fig.22) A framed panel house manufactured by Dynabilt.



(Figs. 23-24) Steel-framed panels manufactured by Thermasteel, in the factory (bottom) and being laid out on site (top).

## Concrete Panels

**Overview:** Precast concrete panels first gained acceptance in commercial construction and have become a viable option in residential construction as well. In 2006, “precast reached an estimated 2.7% share of above-grade walls in single-family construction, equaling about 41,000 new homes, up from a zero share just a decade earlier by [the National Association of Home Builder’s] count.”<sup>14</sup>

Made in a factory, the panels can be made to a higher strength than block or cast-in-place walls, with no weather delays, and quickly assembled on site. The result is an extremely strong envelope that can offer good fire resistance, water resistance, durability, and, if well-insulated, thermal performance.

### INSTALLATION

Panels are cast to specification in the factory. According to ToolBase, “Precast concrete foundation and wall panels can take many forms. Some consist of steel-reinforced concrete ribs that run vertically and horizontally...others are solid precast concrete panels.”<sup>15</sup> Door and window openings and spaces for electrical, plumbing, and ducts, if necessary, must be pre-planned and built into the panels, because later modifications will be very difficult.

Once delivered to the site, the panels can be assembled in a matter of days or even hours. A crane is necessary to lift and position the panels in place, which may prove expensive for a single house. If a panelized foundation is used, it may be installed on concrete footers or directly on 4-6” of compacted stone, which eliminates the need for on-site poured concrete.

### PERFORMANCE

While expensive, panelized concrete is particularly suitable for applications in hurricane- and tornado-prone areas due to its very high strength:

“The controlled temperature of the processing plant allows the manufacturer to work with concrete admixtures that focus on ultimate strength rather than cure time and temperature. Manufacturers are able to produce mixes that harden to 5,000 psi, which is stronger than concrete block or concrete walls formed and cast in the field. Better control of the concrete mixture and curing environment allows the use of low water/cement ratios that results in a dense material that prevents water penetration.”<sup>16</sup>

Concrete itself has low thermal insulation values. However, panels can be cast with an integrated layer of foam insulation on one face. Alternatively, panels can be manufactured with an insulating foam core. When insulated, concrete panels are an excellent all-weather building material.

Concrete panels can bring other benefits as well. For instance, TMG International emphasizes the fire resistance and sound ratings of its panels.



(Fig.25) A crane is used to lift panels into place.



(Fig.26) Precast concrete panels loaded on a trailer for delivery.

## DESIGN

Typical panel sizes range between 2-12' wide and 8-12' high, but larger sizes may be available. "Walls may be customized during the order process to allow for door and window openings, steel beam pockets, and brick ledges."<sup>17</sup>

Concrete panels are common in foundation applications but less common in residential construction. They are recognized in the International Residential Code. At a cost of \$55-\$65 per linear foot, they are competitive with other foundation systems but more expensive up-front than standard wood frame construction. According to expert Rich Binsacca,

"Custom builders like the system's performance aspects, but can't afford the one-time cost premiums for engineering, shipping, and crane-assisted assembly. Large-volume production builders, meanwhile, are generally too price-sensitive to consider anything out of their comfort zone of wood-based systems; on a per-foot materials basis only, precast might cost at least 20% more...

"Another hurdle to acceptance for any builder is the system's requirement for exceptionally detailed planning for all openings and mechanical runs; simply, once the panels are cast, those placements are set, literally, in stone... It's a process [that] requires weeks of planning, engineering, and confirming specs—time that most builders are loath to spend when other structural systems are so easy to manipulate in the field to fix mistakes. "But, once the panels are in place, it takes all the guesswork and time out of where to locate those things."<sup>18</sup>

## VARIATIONS:

### Lightweight Aerated Concrete:

Some manufacturers build panel variations to better cater to the needs of residential construction. For instance, Precast Building Solutions in Louisiana uses lightweight aerated concrete to reduce the weight of its 8" wall panels, making them easier to transport and assemble.

### ICS 3-D Panel:

The 3-D system arrives on site as a panel of modified expanded polystyrene (EPS) insulation with a welded wire mesh frame on both sides. Once the panels are assembled on site, concrete is applied to the reinforcing mesh using either shotcrete or troweled concrete. This system allows the lightweight panels to be assembled without the use of a crane and without sacrificing the strength of concrete. ICS claims R-values of 18 to 33 for its walls.<sup>19</sup>

## GULF COAST AVAILABILITY / LOCAL MANUFACTURERS

### Precast Building Solutions

- New Orleans, LA
- Manufactures precast concrete panels and builds fully furnished houses using one of several standard designs. Can also design and manufacture panels for custom house designs.
- [www.precastbuildingsolutions.com](http://www.precastbuildingsolutions.com)
- 504-250-7287 / 504-250-7115

### StormFighter Precast Homes

- Pensacola, FL
- Manufactures precast concrete wall panels.
- [precasthouse.com/index.html](http://precasthouse.com/index.html) / 850-434-9588

### ICS 3-D Panel Works

- Brunswick, GA
- [www.greenfusiondesigncenter.com](http://www.greenfusiondesigncenter.com) / 912-264-3772



(Fig.27) Far from creating a bunker-like feeling, precast concrete panels can be used to create designs with the same flexibility and aesthetic as any other house.