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Structural Insulated Panels (SIPs)

By Lt. John Shafer

SIPs is an acronym for Structural Insulated Panel. Structural Insulated Panels (SIPs) are a high performance building system for residential and light commercial construction. The panels consist of an insulating rigid foam core sandwiched between two structural facings, typically oriented strand board (OSB). SIPs are manufactured under factory controlled conditions and can be fabricated to fit nearly any building design. The result is a building system that is extremely strong, energy efficient and cost effective.

Types of SIPs

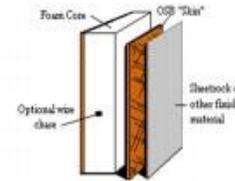
There are three main types of SIPs, although the SIPs themselves can be encased in different outer materials called skins. The inner insulation core is usually made from expandable polystyrene (EPS), polyurethane or polyisocyanurate. Each delivers a strong, light building material with exceptional insulation properties.

Types of SIP skins

Most SIPs feature OSB as the skins that encompass the inner foam insulation core of the panel. But other skins are available, including:

- Metal
- Fiber cement
- Fiber reinforced concrete
- Plywood
- Gypsum board

What is a SIP?



- The most common Structural Insulated Panel(SIPs) is a composite structural panel with an insulating core of rigid foam—usually EPS or polyurethane—and structural facings, most commonly of 7/16" thick oriented strand board (OSB).



Insulating Core

- The most common foam core:
- Expanded Polystyrene (EPS) * Most used
- Extruded Polystyrene (XPS)
- Polyurethane
- Polyisocyanurate



Structural Facing (skin)

- The most common material used is OSB however they can also come with Metal or Cementitious/Composite skins.



OSB



Metal



Cementitious/Composite



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The third component in SIPs is the spline or connector piece between SIP panels. Dimensional lumber is commonly used but creates thermal bridging and lowers insulation values. To maintain higher insulation values through the spline, manufacturers use Insulated Lumber, Composite Splines, Mechanical Locks, Overlapping OSB Panels, or other creative methods. Depending on the method selected, other advantages such as full nailing surfaces or increased structural strength may become available.

SIPs share the same structural properties as an I-beam or I-column. The rigid insulation core of the SIP acts as a web, while the OSB sheathing exhibits the same properties as the flanges. SIPs combine several components of conventional building, such as studs and joists, insulation, vapor barrier and air barrier. They can be used for many different applications, such as exterior wall, roof, floor and foundation systems.

SIPs are GREEN

Structural insulated panels (SIPs) are one of the most airtight and well insulated building systems available, making them an inherently green product. An airtight SIP building will use less energy to heat and cool, allow for better control over indoor environmental conditions, and reduce construction waste.

Why you will see more SIPs in the future!

Why SIPs?

- **SIPs Save Time & Labor:**
- Prefabricated SIPs can save builders a significant amount of onsite labor.
- SIPs are ready to install when they arrive, eliminating the need to perform the operations of framing, sheathing and insulating.
- A recent R.S Means study shows building with SIPs saves 41 % percent on labor.



Why SIPs?

• 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

Courtesy of Structural Insulated Panel Association (SIPA)



SIPs are GREEN

- SIPs score well in the following Green Rating Systems:
- **LEED for Homes**® (Leadership for Energy and Environmental Design (LEED) for Homes)
- **NAHB Green Building Program & ICC** (ICC 700 National Green Building Standard®)
- **LEED for New Construction**® (Leadership for Energy and Environmental Design (LEED) for New Construction)



Why SIPs?

- **SIPs Save Energy:**
- The insulating core of a SIP provides high-density continuous insulation.
- U.S. Dept. of Energy Oak Ridge Lab studies have shown a SIP room to have 90% less leakage than stick-framed counterpart.
- When combined with other high-performance systems, SIPs homes can reduce annual energy use by 50 % or more.





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Firefighting Concerns:

As you have saw from the information above there are several types of SIPs and many types of skins however as mentioned before the most common is Oriented Strand Board (OSB) as the skin and the core made of Expanded Polystyrene Foam. So I am going to focus on concerns with those two materials.

Oriented Strand Board (OSB)

This material begins to break down at relatively low temperatures for fire conditions (about 450 F – same as sawn wood) and it is now a major structural component and not just a covering.

The adhesives used in OSB can vary by manufacturer. It appears that the wood components will burn before the adhesives in most cases. The wood will start to burn at about 450 F and the adhesives around 750 F. The manufactures state that the OSB will behave like sawn wood in a fire, which may be true, but it is the thickness (mass) that then becomes the problem, as OSB is usually no more than $\frac{3}{4}$ ” thick and usually less.

Although the manufactures state that the products of combustion are no worse than natural wood, some of the materials in the adhesives may be extremely toxic, corrosive, or carcinogens.

Expanded Polystyrene (EPS)

- When heated it melts!
- Expanded Polystyrene is combustible.
- It should not be exposed to flame or other ignition sources
- Flash Point: 600°F to 650°F
- Auto-ignition Temperature: 824F – 914°F
- Fire and Explosion Hazards: WILL MELT WHEN EXPOSED TO TEMPERATURES OF 300F TO 500F
- Extinguishing Media: DRY CHEMICAL (ABC TYPES), CO₂, WATER SPRAY, WATER FOG, FOAM, WATER
- Unusual Fire and Explosion Hazards: Pentane vapors may be emitted from freshly expanded or processed foam or when product is heated. Hazardous concentrations may accumulate inside a sealed container or within confined areas. If ignited, there may be a very high rate of flame propagation and/or an associated explosion.
- Hazardous Combustion Products: Burning foam emits a dense, black, irritating smoke with acid gases. Primary combustion products are carbon monoxide, carbon dioxide, and styrene.
- Special Firefighting Procedures: SCBA & Full PPE

SIPS & Firefighting Concerns

- The following are possible concerns with SIPs:
- SIP structures have 90% less leakage than stick-framed counterpart = Significant Air Tight buildings = Greater Backdraft potential with NO Indicators !
 - Depending on skin (usually OSB) and core (usually EPS) there is a chance of large amount of smoke production.
 - Once involved in fire there is less mass than traditional stick frame building.
 - **MASS = FIRE RESISTIVE**



For more information go to
<http://greenmaltese.com/>