

Structurally Insulated Panels (SIPS)

SIPS: Questions & Answers

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1. What are structural insulated panels?

A: Structural insulated panels (SIPs) are high performance building panels used in floors, walls, and roofs for residential and light commercial buildings. The panels are typically made by sandwiching a core of rigid foam plastic insulation between two structural skins of oriented strand board (OSB). Other skin material can be used for specific purposes. SIPs are manufactured under factory controlled conditions and can be custom designed for each home. The result is a building system that is extremely strong, energy efficient and cost effective. Building with SIPs will save you time, money and labor.

2. I want to build a structural insulated panel home. What is the first step?

A: For homeowners, the first step is to identify a quality builder who has experience with SIP construction. An experienced SIP builder will manage the plan conversion and review process.

For a builder looking to start their first SIP project, the first step is to find a manufacturer or dealer/distributor to work with. These companies typically handle the plan conversions and engineering services necessary to get the project underway.

3. How does the structural insulated panel design and fabrication process work?

A: The construction of a SIP home or commercial building begins with the construction documents. Once the construction documents are in the hands of a SIP manufacturer, dealer/distributor, or design professional, they are converted to SIP shop drawings that give the dimensions of each individual panel.

The shop drawings are reviewed by the builder, engineer, the building owner, and other involved parties. Once the shop drawings are finalized, the SIPs are fabricated and shipped to the jobsite for installation.

4. What is the R-value of structural insulated panels?

A: R-values for SIPs depend on the thickness of the SIP and the type of core material that is used.

Static R-values, like those included in the chart, rate the effectiveness of insulating material. However, they do not accurately describe how products perform in a real world setting. When fiberglass or other types of insulation are installed, they are installed around structural members made of wood or metal that have very poor insulating value. Field-installed insulation materials are also prone to installation imperfections.

The Department of Energy's Oak Ridge National Laboratory has studied and tested the performance of entire wall assemblies in large sections. The resulting whole-wall R-value data reveals that a 4.5" SIP wall rated at R-14 outperformed a 2"x6" wall with R-19 fiberglass insulation.

5. How much faster can I build with structural insulated panels?

A: SIP homes go up faster than traditionally framed buildings. A properly trained SIP installation crew can save a significant amount of time in a build cycle. Panels can be manufactured as big as 8- by 24-ft., so entire walls can be put up quickly, reducing dry-in time. SIPs can be supplied as ready to install building components when they arrive at the jobsite, eliminating the time needed to perform individual jobsite operations of framing, insulating and sheathing stick-framed walls. Window openings may be precut in the panels, and depending on the size, a separate header may not need to be installed. Electrical chases are typically provided in the core of panels, so there is no need to drill through studs for wiring.

6. How much labor can I save with structural insulated panels?

A: Because SIPs are prefabricated, the amount of additional framing required is minimal. SIPs are always straight and true, there are far fewer callbacks, no culling studs, or need to straighten walls. SIPs also provide a uniform nailing surface for both interior and exterior finishing.

7. How much money can I save with structural insulated panels?

A: Builders can save money through decreased construction and labor costs. The superior whole wall R-values and building tightness capable with SIPs allow HVAC equipment to be downsized and ductwork to be minimized. Builders can also significantly reduce jobsite waste disposal and temporary heat during construction. Homeowners that incorporate other energy efficient features with SIP construction can benefit from the energy efficiency of a SIP home with reductions in heating and cooling costs of 50 percent or more possible and may, qualify for Energy Efficient Mortgages, and enjoy higher appraised value.

8. How much do structural insulated panels cost?

A: Pricing information can be obtained by contacting any SIP Manufacturer or Dealer/Distributor. However, the material price does not reflect the labor savings capable with SIP construction.

A recent study shows that building with SIPs can reduce framing labor needs by as much as 55 percent over conventional wood framing. Builders can also expect decreased jobsite waste disposal costs and savings on HVAC equipment. Energy-efficient SIP buildings demand a higher market price because of the utility savings they offer to home buyers. When all these factors are considered, building with SIPs is often less expensive than other building systems.

9. How green are structural insulated panels?

A: Energy efficiency

Structural insulated panels are one of the most environmentally responsible building systems available. A SIP building envelope provides high levels of insulation and is extremely airtight, meaning the amount of energy used to heat and cool a home can be cut by up to 50 percent. The energy that powers homes and commercial buildings is responsible for a large portion of greenhouse gasses emitted into the atmosphere. By reducing the amount of energy used in buildings, architects, builders, and homeowners can contribute to a clean environment for the future.

Resource use

The insulation used in SIPs is a lightweight rigid foam plastic composed of 98% air, and requires only a small amount of petroleum to produce. The foam insulation used in panel cores is made using a non-CFC blowing agent that does not threaten the earth's ozone layer.

Waste minimization

Since SIPs are prefabricated in the factory, there is less jobsite waste that needs to be landfilled. Factory fabrication is often done using optimization software and many manufacturers recycle factory scrap to make other foam products.

10. How strong are structural insulated panels?

A: The structural characteristics of SIPs are similar to that of a steel I-Beam. The OSB skins act as the flange of the I-beam, while the rigid foam core provides the web. This design gives SIPs an advantage at handling in plane compressive loads.

11. How are structural insulated panels supported? Are there studs in the panels?

A: For most applications, SIPs are structurally self-sufficient. The structural characteristics of SIPs are similar to that of a steel I-Beam. The OSB skins act as the flange of the I-beam, while the rigid foam core provides the web. This design is extremely strong and eliminates the need for additional framing.

In cases where a point load from a beam or header requires additional support, a double dimensional lumber spline [link to construction detail] or engineered wood spline is field installed at in-plane panel connections.

SIPs are also used as curtain walls for steel frame or timber frame structures. In large commercial applications SIPs can minimize the amount of structural support needed and reduce material costs.

In roof applications, SIPs rely on beams and purlins for support. SIPs can span long distances, allowing a minimal amount of structural supports to be used.

12. How do I properly size HVAC equipment?

A: The high insulating properties of SIPs allow smaller HVAC equipment to be used. When working with an HVAC contractor, make sure their calculations take into account an accurate estimation of typically low levels of air infiltration in a SIP home. Proper HVAC sizing is crucial because an oversized HVAC system will fail to reach the steady operating rate the equipment was designed for. Short cycling HVAC equipment will be less energy efficient and require more maintenance than properly sized HVAC equipment.

13. How important is ventilation?

A: SIP buildings are extremely airtight and require mechanical ventilation. Ventilation systems bring fresh air into the building in controlled amounts and exhaust moisture laden and stale air to the outside. By limiting air exchange to controlled ventilation systems, SIP homes allow for all incoming air to be filtered for allergens and dehumidified, amounting to better indoor air quality. Proper ventilation is important in all homes to preserve indoor air quality.

14. Are vapor barriers required in structural insulated panel buildings?

A: Air barriers or vapor barriers are not required in SIP buildings because properly sealed SIPs create a code compliant air barrier with a permeability rating of less than 1.0 perm. In addition, the foam core of SIPs is solid and continuous throughout the wall, eliminating the convection and condensation issues that can occur in cavity walls.

15. How do structural insulated panels improve indoor air quality?

A: The tightness of the SIP building envelope prevents air from gaining access to the interior of the home except in controlled amounts. A controlled indoor environment is both healthy and comfortable. Humidity can be controlled more easily in a SIP home resulting in a home that is more comfortable for occupants and less prone to mold growth and dust mites.

16. How do structural insulated panels react to fire?

A: Residential building code requires 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. . Structural insulated panels faced with 0.5” gypsum drywall meet this requirement.

Commercial builders may need a one hour fire-rated wall or roof, which is achieved by testing and listing a specific wall or roof assembly to ASTM E119 with an accredited certification agency.

17. Do structural insulated panels block sound transmission?

A: The sound resistance of a SIP wall depends on the thickness of the gypsum drywall applied, the exterior finish applied and the thickness of the insulating foam core that is used.

SIPs are especially effective at blocking high frequency noise and most homeowners notice the quiet comfort of a SIP home. However, low frequency sounds are not as effectively stopped by a SIP building envelope.

For multifamily and commercial buildings, a universal sound transmission coefficient (STC) is used to specify the sound resistance of wall assemblies. Assemblies with a range of STC ratings are available, including options with a STC rating greater than 50 for party walls in multifamily buildings.

18. Are structural insulated panels compatible with other building systems?

A: SIPs are compatible with other building systems. Wall panels can sit on a variety of foundation materials, including poured concrete, blocks, or insulated concrete forms. SIPs are sized to accept dimensional lumber and are seamlessly compatible with stick framing. Builders may choose to build with SIP walls and a conventional truss roof, or stick walls and a SIP roof with little difficulty. SIPs are also popular as a method of providing a well-insulated building envelope for timber frame structures.

19. What considerations do you need to take into account when building with structural insulated panels vs. conventional framing?

A: The majority of construction with SIPs is very similar to conventional framing. SIPs accept dimensional lumber and are fastened together using staples, nails or screws. Proper sealing is especially crucial in a SIP structure. All joints need to be sealed with specially designed SIP sealing mastic or low expanding foam sealant, and/or SIP tape. Voids between panels and unused electrical chases need to be filled with low expanding foam. In addition to sealing, planning and consideration needs to be applied to material handling. Although smaller 8- by 4-ft. panels can be set by hand, larger 8- by 24-ft. panels require the use of equipment to unload and set.

20. What is the learning curve for structural insulated panel installation?

A: For construction professionals competent in standard wood framing techniques, the task of learning SIPs is not difficult. Many SIP manufacturers and dealer/distributors offer onsite technical assistance for builders that are new to SIP construction. Builders can also learn installation techniques from The SIP School [link].

21. Can structural insulated panels be modified on site?

A: On-site modification can easily be done using a few additional SIP specific tools. Panels can be cut using a beam saw or a beam cutting attachment to a circular saw. The foam core can then be recessed for splines or dimensional lumber using a hot wire foam scoop or specialized angle grinder attachment to recess the core.

22. How are electrical wiring and fixtures installed?

A: Electrical wires are pulled through pre-cut channels inside the core of the panels called “chases.” Manufacturers cut chases during the manufacturing process according to the electrical design of the home. Electricians can then use fish tape to feed wires through panel chases without compressing the insulation or having to drill through studs. Wiring can also be run through baseboard raceways and in the cavity behind the beveled spacer on SIP roof-to-wall connections.

23. Can plumbing be installed in structural insulated panels?

A: Plumbing should not be located in exterior SIP walls because of the possibility of condensation or supply lines freezing in cold climates. During the design phase of the project, all plumbing should be relocated to interior walls.

If plumbing must be located on an exterior wall, it is recommended that a surface chase be installed on the interior of the wall to conceal plumbing. Another option is to construct a small section of the wall using conventional wood framing that can be used to run plumbing.

Plumbing penetrations such as DWV can be placed through SIPs if they are thoroughly sealed to prevent air infiltration.

24. How do I attach siding or other exterior claddings to structural insulated panels?

A: Builders should consult the siding manufacturer’s installation instructions for how to attach their product to SIPs. Because SIPs use very little solid lumber, an increased fastener schedule is often required when attaching exterior cladding.

If the siding manufacturer does not offer recommendations for attaching their product to SIPs, a licensed architect or engineer can calculate the appropriate fastener frequency by obtaining fastener pullout capacities from the SIP manufacturer.

It is also important that proper moisture management procedures be followed when applying any type of cladding to SIPs. With the exception of metal and vinyl siding, it is recommended that all

claddings be installed with a drainage gap between the cladding and the weather resistant barrier in climates that average more than 20 inches of annual rainfall.

25. Can recessed lights be used in structural insulated panels?

A: Recessed lights should never be embedded in structural insulated panels. To install recessed lights, an interior soffit must be constructed.

26. Can kitchen cabinets be attached to structural insulated panels?

A: It is recommended that the cabinet manufacturer provide instructions on how to attach their product to SIPs. Typically, an increased fastener schedule is required. Another option is to install plywood strips behind the cabinets to provide additional holding strength for fasteners.

If the cabinet manufacturer does not offer recommendations for attaching their product to SIPs, a licensed architect or engineer can calculate the appropriate fastener frequency by obtaining fastener pullout capacities from a SIP manufacturer.

27. Are structural insulated panels susceptible to insects?

A: Although termites do not feed on the foam panel cores, there have been instances in which panel cores have been hollowed out by these insects and used as a nesting ground. Many manufacturers offer SIPs with borate treated foam to provide termite resistance. Termites may also be deterred through the use of a specifically designed steel mesh. Both these treatments are highly effective, but they are not a substitute for careful termite prevention and maintenance, as with any other wood structure.

28. Are structural insulated panels susceptible to mold and mildew?

A: An airtight SIP building envelope forms the basis of a successful mold control strategy. The extremely low levels of air infiltration in SIP buildings allow for incoming air to be provided in controlled amounts by air handling equipment. Proper dehumidification will create an environment where mold physically cannot grow.

In addition to creating an airtight structure, SIPs are solid and free of any cavities in the wall where moisture can condense and cause unseen mold growth.

29. Can structural insulated panels be replaced or repaired if damaged?

A: If panels are damaged, a structural engineer needs to assess the damage to determine what is cosmetic and what is structural. If the damage is only cosmetic then the source of moisture must be determined and fixed, whether it is from inside or outside. If the damage is structural, then the source of the problem must be identified and a structural solution to the problem must be found. That can be done by either a site modification of the panels or replacement of the panels, depending on the extent of the damage. In the event that panels are damaged, the manufacturer and installer of the panels should be notified.

30. What about roofing? Does a building with a structural insulated panel roof need to be

ventilated?

A: The area inside a SIP building envelope is considered conditioned space and will be ventilated by the building's HVAC system. There is no need to provide a vented attic beneath a SIP roof, and doing so would compromise the conditioned space of the building. Most roofing manufacturers specify how to attach their product to SIPs. Please contact the roofing manufacturer for application instructions.

31. Do roofing manufacturer's warranty asphalt shingles over structural insulated panel roofs?

A: Some roofing manufacturer's warranty asphalt shingles over unvented SIP roofs, while others void their warranty because of higher shingle temperatures. Research conducted by Building Science Corporation reveals that although asphalt shingle temperatures increase slightly (2 - 3 degrees F) in an unvented roof assembly, the color of the shingles and the roof orientation have a much more profound impact on the durability of shingles. The typical reduction of shingle life over an unvented SIP roof assembly is between one and two years. Builders seeking to comply with roofing manufacturer warranties can choose from a variety of more durable, non-asphalt roofing materials or provide a venting space between the SIP roof panels and the roofing material (known as a "cold roof").

32. Does a building with a structural insulated panel roof need to be ventilated?

A: The area inside a SIP building envelope is considered conditioned space and will be ventilated by the building's HVAC system. There is no need to provide a vented attic beneath a SIP roof, and doing so would compromise the conditioned space of the building.

Research conducted on test homes in hot climates demonstrates that including the attic in the conditioned space allowed for more energy-efficient space conditioning and less probability of moisture related issues.

Some building science experts have advocated venting the roof by providing an air space between the SIP roof panels and the roofing material (known as a "cold roof"). This practice is not a requirement for SIP buildings, but an extra measure to improve the durability and moisture resistance of the building.

33. What is shingle ridging? Does shingle ridging occur in structural insulated panel buildings?

A: Shingle ridging is a bulging of asphalt roofing material that occurs along the joints of engineered wood panels used in roof applications. This rare phenomenon is caused by changing moisture content in the roof sheathing and occurs in traditional truss-framed roof assemblies as well as SIP roof assemblies.

The ridges caused by the expansion of SIP roof panels may be an aesthetic blemish, but it does not affect the performance of the roofing or the SIP roof panels.

Specifying a cold roof, or simply over-sheathing the roof with an additional layer of OSB staggered over the panel joints, will eliminate the possibility of shingle ridging. Alternately, wood shingles, wood shakes, or a standing seam metal roof can be used in place of asphalt shingles.

Do's & Don'ts of SIPs

The Power of Simplicity:

SIPs are simple to use. You can order pre-cut panels that arrive on site ready to set in place. Stand them up, fasten them properly, seal all joints, and in a few days your new house is ready for finish work.

Tips for Success:

To help you get the most satisfaction from your SIP experience, here is a list of tips and suggestions so you'll get the best performance from your SIPs.

General Principles

Air Movement:

All joints must be sealed in such a way to ensure no air infiltration or exfiltration.

Voids:

All voids must be filled with appropriate sealants/panel adhesives manufactured to ensure against air movement and moisture intrusion into the building envelope.

Vapor Transmission:

Vapor permeability for all SIP panel joints must meet local building codes and/or environmental requirements.

HVAC Design:

A HVAC system must be designed to:

1. Provide proper ventilation due to the inherent air-tightness of the structure.
2. Be properly sized to account for the inherent energy efficiency of the structure.

Exterior Cladding and Underlayment:

Exterior cladding shall include a primary and secondary weather resistive system, e.g., drainage plane. Underlayment is required, e.g., common building paper, non-perforated housewrap.

Handling and Storage:

SIPs must be protected from exposure from the elements and must not be stored in direct contact with the ground. SIPs are bulky and heavy. Manpower is enough to move small panels, but larger panels often require a crane or forklift. Here's how to handle material on site:

DO: Set aside a level spot to store panels. Try to organize your panel delivery for efficiency — store panels from the first floor separately from panels for the second floor, and so on. Stack panels so that you can read the identifying marks or labels and find each piece when you need it.

Stacking

DO: Lay panels flat on stickers, no closer than three inches to the ground. Give the panels plenty of support, and don't let them sag — for 8-foot panels, two stickers are enough, but for 12- to 16-foot panels, use three stickers. For longer panels, don't go more than 6 or 8 feet between stickers.

Weather Protection:

Panels are rated for exterior exposure during construction, but keep them dry when stored on site. Cover them with a loose tarp or sheet of poly.

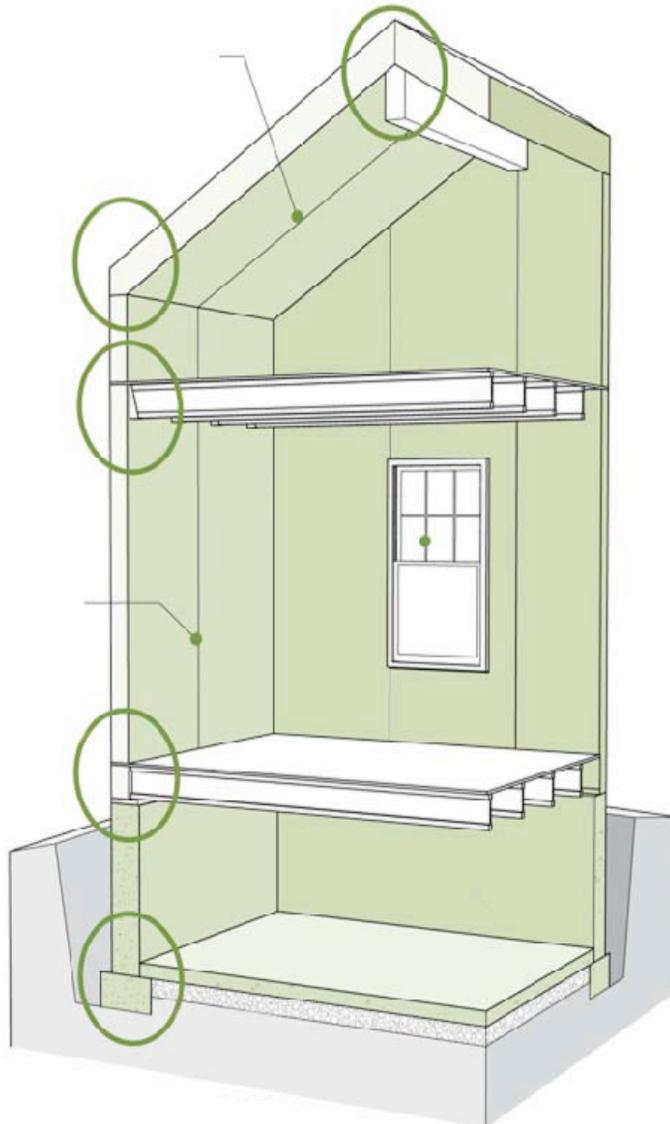


FIGURE 1 — Take special note of the connection details and installation instructions for these areas.

Assembly:

For maximum efficiency, it's best to follow an orderly system. Here are a few tips to keep in mind as you start to work:

DO: Study the installation drawings before setting panels.

DO: Set wall plates carefully. Panel skins provide the strength for walls so panel skins must be fully supported. The panel slips over the wall plate, so remember to set your plates a half inch in from the building edge, and leave room where plates meet for the skin to slide by.

DO: Set panels in order. Mark out your wall plates to show where panel edges fall. When setting walls and roofs, it's a good idea to start in corners or valleys and work out — that way, you won't "box yourself into a corner." At wall corners, one panel "stops short" and the other "flies by" — be sure you know which is which, or one wall will be too long and the other too short.

DON'T: Cut wall panel skins horizontally for installation of electrical wiring.

DON'T: Cut roof or floor panel skins without contacting your supplier.

DO: Always follow the manufacturer's recommended joint sealing techniques. Seal joints as you work.

Panel joints must be thoroughly sealed to ensure there is no air infiltration from the outside or exfiltration from the inside. Be sure to follow the manufacturer's recommendations for sealing joints properly.

DON'T: Be afraid to field-trim panels for an exact fit. Contact your supplier when in doubt.

DON'T: Install panel skins in direct contact with concrete. Provide a capillary break between panel skins and concrete.

DON'T: Install can lights inside the panels.

DO: Install plumbing in interior walls. Furr out interior sections for pipes if necessary.

Improving your comfort

DO: Install standard deterrents to resist termites and carpenter ants such as insect clips and flashing.

DO: Install proper flashing and sealants around all rough openings and penetrations as required.

Weather Details:

SIPs are durable, but they aren't designed to get wet. Your house needs exterior finishes that protect the structure from water.

DO: Use high-quality roofing and siding. High performance asphalt shingles are suitable for use on a SIP roof. Popular siding materials such as steel or tile, vinyl, wood, brick, or fiber-cement are also fine for SIP houses.

DO: Use proper underlayments for roofing and siding. SIP walls are airtight without housewrap, but they do need a drainage plane material (either housewrap or asphalt paper works well).

DO: Flash all penetrations. Most windows will eventually leak some water at the window sill; install flashing under and around windows and doors to direct water away from the wall structure. Hose bibs, dryer vents, exterior lights, and the like must also be flashed, as should roof penetrations such as plumbing stacks, chimneys, and skylights.

Interior Comfort:

SIP houses are airtight, so they let you control the indoor environment. A modern ventilation system will let you have fresh air when, how, and where you need it.

DO: Provide adequate ventilation to maintain indoor air quality.

DO: Provide a mechanical ventilation system. Passive air infiltration will not be enough to provide indoor air quality. In cold climates, use a heat recovery ventilator; you'll save energy, and the incoming air will be tempered for comfort. In hot, humid climates, an "energy recovery ventilator" is best: these systems take humidity out of the incoming air and transfer it to the exhaust stream, reducing the load on your air conditioner and improving your comfort.

DO: Control indoor humidity. High humidity levels can be unhealthy and can damage your building. Set your ventilation system to keep indoor humidity around 40%. Install exhaust fans in kitchens, bathrooms, and laundry rooms to expel moist air as needed. Moisture intrusion through slabs, crawlspaces, and basements can be significant, so make sure your foundation has good drainage and provides for control of moisture vapor.

DON'T: Install or use unvented combustion equipment. "Ventfree" gas logs, fireplaces, or heaters are not appropriate for an airtight SIP house.

Prescriptive Method for Structural Insulated Panels (SIPs) Used in Wall Systems in Residential Construction (Prescriptive Method)

INTRODUCTION

The *Prescriptive Method for Structural Insulated Panels (SIPs) Used in Wall Systems in Residential Construction (Prescriptive Method)* provides prescriptive requirements to facilitate the use of SIPs in wall systems for the construction of one- and two-family dwellings. By providing prescriptive provisions for the construction of typical homes with SIP systems, the need for engineering can be eliminated or reduced for most applications. The provisions in this document were developed by applying accepted engineering practices, standard test procedures and practical construction techniques. The provisions in this document comply with the loading requirements of the most recent U.S. model building codes at the time of publication. However, the users of this document should verify its compliance with local code requirements. The user is advised to refer to the applicable building code requirements where the provisions of this document are not applicable or where engineered design is called out.

This document is not a regulatory instrument, although it is written for that purpose. The user should refer to applicable building code requirements when exceeding the limitations of this document, when the requirements conflict with the building code, or when an engineering design is specified. This document is not intended to restrict the use of sound judgment or engineering analysis of specific applications that may result in designs with improved performance and economy.

1.0 GENERAL

1.1 Purpose

The purpose of the *Prescriptive Method for Structural Insulated Panels (SIPs) Used in Wall Systems in Residential Construction (Prescriptive Method)* is to provide prescriptive requirements for the use of structural insulated panels (SIPs) in wall systems in the construction of residential structures. These provisions include definitions, span tables, material requirements, and other related information appropriate for use by home builders, design professionals, and building code officials.

1.2 Approach

The prescriptive requirements were developed by applying accepted engineering principles and supported with relevant structural test data. The provisions of the Prescriptive Method were also based on the *Minimum Design Loads for Buildings and Other Structures (ASCE 7)* [1], the *International Building Code* [2], and the *International Residential Code* [3].

1.3 Scope

The provisions of the Prescriptive Method apply to the construction of detached one or two-family dwellings, townhouses, and other attached single-family dwellings and accessory structures in compliance with the general limitations to Table 1.1. SIP wall system construction in accordance with this Prescriptive Method shall be limited by the applicability limits set forth in Table 1.1. The limitations are intended to define an appropriate use of this document for most one- and two-family dwellings. Intermixing of these provisions with other construction materials, such as wood or steel framing, in a single structure shall be in accordance with the applicable building code requirements for that material and the applicability limits set forth in Table 1.1.

Engineering design shall be required for houses built in regions where the wind speed is greater than 130 mph (209 km/hr), regions along the immediate hurricane-prone coastline subjected to storm surge (i.e., beach front property), regions in Seismic Design Categories D₀, D₁ and D₂, and regions in near-fault seismic hazard conditions (i.e., Seismic Design Category E) as defined by the provisions of ASCE 7.

Additional criteria as established by the local jurisdiction shall be considered and addressed for buildings constructed in accordance with the provisions of this document as limited by the provisions of this section.

**Table 1.1
Applicability Limits**

ATTRIBUTE	LIMITATION
GENERAL	
Building Dimension	Maximum building width is 40 feet (12.2 m) Maximum building length is 60 feet (18.3 m)
Number of Stories	2 story (above basement)
Basic Wind Speed	Up to 130 mph (209 km/h)
Wind Exposure	Exposures B ¹ (suburban/wooded) Exposures C ¹ (open terrain)
Ground Snow Load	70 psf (3.35 kN/m ²) maximum ground snow load
Seismic Zone	A, B and C ¹
Building Height	Maximum 35 feet (10.7 m)
FLOORS	
Floor dead load	10 psf (0.48 kN/m ²) maximum
Floor live load	
First floor	40 psf (1.92 kN/m ²) maximum
Second floor (sleeping rooms)	30 psf (1.44 kN/m ²) maximum
WALLS	
Wall dead load	10 psf (0.48 kN/m ²) maximum
Load bearing wall height	10 feet (3 m) maximum
Deflection Criteria	L/240
ROOFS	
Roof dead load	10 psf (0.48 kN/m ²) maximum
Roof snow/live load	70 psf (3.35 kN/m ²) maximum ground snow load (16 psf (0.77 kN/m ²) minimum Roof Live Load).
Ceiling dead load	5 psf (0.24 kN/m ²) maximum
Roof slope	3:12 to 12:12
Rake overhang	12 inches (305 mm) maximum
Attic live load (Limited Storage)	20 psf (0.96 kN/m ²) maximum

For SI: 1 inch = 25.4 mm, 1 psf = 0.0479 kN/m², 1 mph = 1.61 km/hr = 0.447 m/sec, 1 foot = 0.3 m. As defined by the provisions in ASCE 7.

1.4 Definitions

Accepted Engineering Practice: An engineering approach that conforms with accepted principles, tests, technical standards, and sound judgment.

Anchor Bolt: A bolt, headed or threaded, used to connect a structural member of different material to a concrete member.

Approved: Reference to approval by the building code authority having jurisdiction. Product testing or a rational design by a competent design professional is commonly accepted by the code body as grounds for approval.

Attic: The enclosed space between the ceiling joists of the top-most floor and the roof rafters of a building not intended for occupancy but sometimes used for storage.

Authority Having Jurisdiction: The organization, political subdivision, office, or individual charged with the responsibility of administering and enforcing the provisions of applicable building codes.

Axial Load: A force acting in line with a member's longitudinal axis. Examples are the gravity loads carried by columns or wall panels.

Basement: That portion of a building, which is partly, or completely below grade and which may be used as habitable space.

Building: Any one- or two-family dwelling or portion thereof that is used for human habitation.

Building Height: The vertical distance between the average grade, as measured against the building foundation, to either the highest point of the roof beams (for flat-roofed buildings) or the mean height between the eaves and the roof peak for pitched roofs.

Building Length: The dimension of a building that is perpendicular to roof rafters, roof trusses, or floor joists (L).

Building Width: The dimension of a building that is parallel to roof rafters, roof trusses, floor joists, or roof SIPs (W).

Ceiling Joist: A horizontal structural framing member that supports ceiling components and which may be subject to attic loads.

Core: The lightweight middle section of the sandwich structural insulated panel composed of molded expanded polystyrene (EPS) insulation or alternative, which provides the link between the two facing shells.

Dead Load: Forces resulting from the weight of walls, partitions, framing, floors, ceilings, roofs, and all other permanent construction entering into, and becoming part of, a building.

Deflection: Elastic movement of a loaded structural member or assembly (i.e., beam or wall).

Design Professional: An individual licensed to practice their respective design profession as defined by the statutory requirements of the state in which the project is to be constructed.

Design (or Basic) Wind Speed: Related to winds that are expected to be exceeded once every 50 years at a given site (i.e., 50-year return period). Wind speeds in this document are given in units of miles per hour (mph) by 3-second gust measurements in accordance with ASCE 7 [1].

Dwelling: Any building that contains one or two dwelling units for living purposes.

Endwall: The exterior wall of a building which is perpendicular to the roof ridge and parallel to floor framing, roof rafters, or trusses. It is normally the shorter dimension of a rectangular building's footprint.

Exposure Categories: Reflects the effect of the ground surface roughness on wind loads in accordance with ASCE 7 [1]. Exposure Category B includes urban and suburban areas or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger. Exposure Category C includes open terrain with scattered obstructions having heights generally less than 30 ft (9.1 m) and shorelines in hurricane prone regions.

Facing: The wood structural panel facers that form the two outmost rigid layers of the structural insulated panel.

Floor Joist: A horizontal structural framing member that supports floor loads and superimposed vertical loads.

Foundation: The structural elements through which the loads of a structure, both vertical and lateral, are transmitted to the earth.

Foundation Wall: The structural element of a foundation that transmits the load of a structure to the earth; includes basement, stem, and crawlspace walls.

Grade: The finished ground level adjoining the building at all exterior walls.

Ground Snow Load: Measured load on the ground due to snow accumulation developed from a statistical analysis of weather records expected to be exceeded once every 50 years at a given site.

In-Line Framing: A framing method where all vertical and horizontal load carrying members are aligned.

Lateral Load: A horizontal force, created by wind or earthquake, acting on a structure or its components.

Lateral Support: A horizontal member providing stability to a column or wall across either of

its smaller dimensions. (Lateral support can be applied to either of the minor dimensions of an axially-loaded member.)

Live Loads: Those loads produced by the use and occupancy of the building or other structure and do not include construction or environmental loads such as wind load, snow load, rain load, earthquake load, flood load or dead load.

Load Bearing Walls: Walls subject to loads that exceed the limits for non-load bearing walls.

Multiple Span: The span made by a continuous member having intermediate supports.

Non-Load Bearing Walls: Walls that are limited to a lateral (transverse) load of not more than 5 psf (240 Pa), a superimposed vertical load per member, exclusive of sheathing materials, of not more than 100 lb/ft (1460 N/m), or a superimposed vertical load per member of not more than 200 lbs (890 N).

Oriented Strand Board (OSB): Sheets made from narrow strands of wood fiber oriented lengthwise and crosswise in layers, with a resin binder, conforming to DOC PS2 [11]. In the building codes it is included in the class of products called "wood structural panels".

Panel Thickness: Thickness of core plus two layers of wood structural panel facers.

R- value, Thermal Resistance: The inverse of the time rate of heat flow through a building thermal envelope element from one of its bounding surfaces to the other for a unit temperature difference between the two surfaces, under steady state conditions, per unit area (h.ft².°F/Btu).

Ridge: The horizontal line formed by the joining of the top edges of two sloping roof surfaces.

Roof Snow Load: Uniform live load on the roof due to snow accumulation as given in ASCE 7 [1].

Seismic Load: The force exerted on a building structure resulting from seismic (earthquake) ground motions.

Seismic Design Category: A classification assigned to a structure based on its Seismic Group and the severity of the design earthquake ground motion at the site. Seismic Design Categories A, B, C, correspond to successively greater seismic design loads.

Sill Plate: A horizontal member constructed of wood, steel, or other suitable material that is fastened to the top of a concrete wall, providing a suitable surface for fastening structural members constructed of different materials to the concrete wall.

Structural Insulated Panel (SIP): A structural sandwich panel which consists of a light weight core securely laminated between two rigid facings (such as wood structural panels).

Smoke-Development Rating: The combustibility of a material that contributes to fire impact

through life hazard and property damage by producing smoke and toxic gases; refer to ASTM E 84 [4].

Solid Wall Length: The length of wall which is without openings. It could be comprised either of a single or multiple SIPs.

Span: The clear horizontal distance between bearing supports.

Spline: A long, narrow strip that fits into a groove cut into the longitudinal edges of the two structural insulated panels to be joined (refer to Figure 6.1). Alternately, the strip (spline) can be a section of structural insulated panel (insulated panel spline) with overall thickness equal to the core thickness of the two structural insulated panels to be connected (refer to Figure 6.2).

Story: That portion of the building included between the upper surface of any floor and the upper surface of the floor next above, except that the top-most story shall be that habitable portion of a building included between the upper surface of the top-most floor and the ceiling or roof above.

Story Above-Grade: Any story with its finished floor surface entirely above grade except that a basement shall be considered as a story above-grade when the finished surface of the floor above the basement is (a) more than 6 feet (1.8 m) above the grade plane, (b) more than 6 feet (1.8 m) above the finished ground level for more than 50 percent of the total building perimeter, or (c) more than 12 feet (3.7 m) above the finished ground level at any point.

Strap: Flat or coiled sheet steel material typically used for bracing and blocking which transfers loads by tension and/or shear.

Stud: Vertical structural element of a wall assembly, which supports vertical loads and/or transfers lateral loads.

Townhouse: A single-family dwelling unit constructed in a group of three or more attached units in which each unit extends from foundation to roof and with open space on at least two sides. **Truss:** A coplanar system of structural members joined together at their ends usually to construct a series of triangles that form a stable beam-like framework.

Wall Height: The clear vertical distance between the finished floor and the finished ceiling. Where a finished floor does not exist (i.e., crawlspace), the wall height is the clear vertical distance between the interior finish grade and the finished ceiling.

Structural Walls: See Load Bearing Walls.

Non- structural Walls: See Non-Load Bearing Walls.

Wind Exposure: Refer to Exposure Categories.

Wind Load: The force or pressure exerted on a building structure and its components

resulting from wind. Wind loads are typically measured in pounds per square foot (psf) or Pascals (Pa).

Wind Speed: Refer to Design Wind Speed.

2.0 MATERIALS, SHAPES, AND STANDARD SIZES

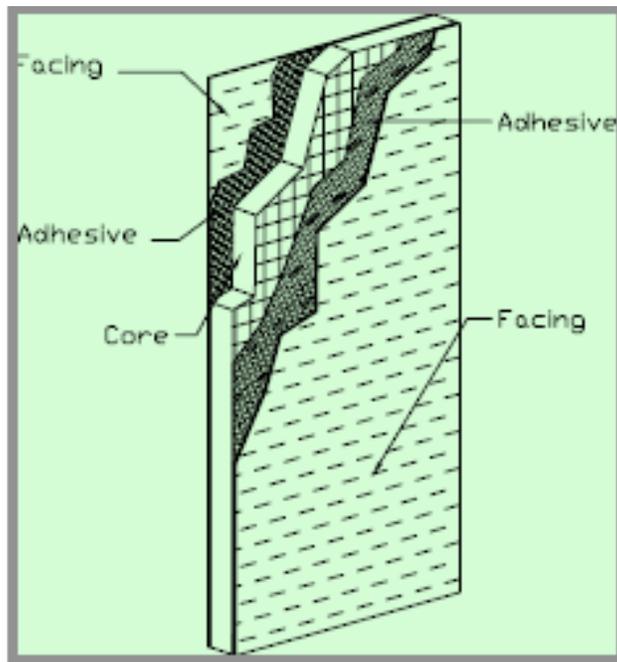
2.1 Physical Dimensions

Walls for residential structures constructed with structural insulated panels (SIP) systems in accordance with this document shall comply with the shapes and minimum cross-sectional dimensions required in this section. SIP walls not in compliance with this section shall be constructed in accordance with accepted engineering practices, manufacturer's recommendations, or an approved design.

2.1.1 SIP Wall Systems

SIPs for above grade wall construction shall comply with Figures 2.1 and 2.2 and shall have minimum panel thickness as specified in Section 2.2. Alternate SIP wall panel configurations that can demonstrate equivalency to SIP wall panels specified in this document shall be permitted. Each SIP wall panel shall be identified by grade mark and/or certificate of inspection issued by an approved agency as per Section 2.7.

**Figure 2.1
SIP Wall Components**

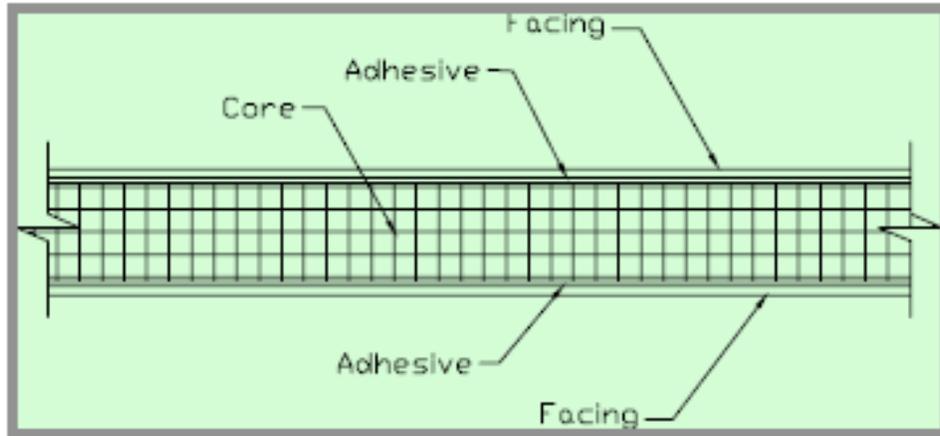


2.2 Core Materials

The core material of SIPs used in wall construction shall be composed of molded expanded polystyrene (EPS) meeting the requirements of ASTM C 578 [5], type I, with minimum density of 0.90 lb/ft³ (14.42 kg/m²), or an approved alternate. Flamespread rating of SIP cores shall be less than 75 and the smoke-development rating shall be less than 450, as tested in accordance with ASTM E 84 [4]. The minimum thickness of the core for SIP walls shall be 3.5 inches (89 mm). SIP core insulation shall bear a label containing the following as a minimum:

- Manufacturer identification,
- Product standard and type,
- Flame-spread/smoke-developed,
- Name, logo or identification of quality assurance agency.

Figure 2.2
Cross Section View of SIP



2.3 Facing Materials

Facing material for SIP walls shall be of wood structural panels used for structural purposes conforming to DOC PS 1 [12], DOC PS 2 [11] or, when manufactured in Canada, CSA O437 [14] or CSA O325 [13] and shall meet the following requirements:

- a. 7/16 inch (11 mm) thickness or greater,
- b. Panels identified by a trademark issued by an approved agency in accordance with DOC PS2 [11],
- c. Strength, stiffness, tension, and density meeting the requirements of Table 2.1 [6].

**Table 2.1
Minimum Properties for OSB Skins Used in SIP Walls**

Thickness (in.)	Flatwise Stiffness ^(b) (lbf-in. ² /ft)		Flatwise Strength ^(c) (lbf-in./ft)		Tension ^(c) (lbf/ft)		Density ^(b,d) (pcf)
	Along	Across	Along	Across	Along	Across	
7/16	54,700	27,100	950	870	6,800	6,500	35

(b) Mean test value.

(c) Characteristic test value (5th percentile with 75% confidence).

(d) Based on oven-dry weight and oven-dry volume.

2.4 Adhesive Materials

Expanded polystyrene (EPS) core insulation shall be adhered to wood structural panel facers with adhesives specifically intended for the lamination of SIPS conforming to ASTM D2559 [7] or type II class 2 in accordance with ICC ES Acceptance Criteria AC 05 [17]. Each container of adhesive shall bear a label with the adhesive manufacturer identification (such as name or logo), adhesive name and type and the name (or logo) of the certifying quality assurance agency.

2.5 Lumber

Lumber framing material used for SIPS prescribed in the Prescriptive Method shall be No. 2 Spruce-pine-fir (SPF) or equivalent. The use of wood species/grades that meet or exceed the mechanical properties and specific gravity of No. 2 SPF shall be permitted.

2.6 Fasteners

Fasteners (such as screws) used for the connection of SIP wall to wood members as specified in this document shall be corrosion resistant, have threaded or drill point and shall be sized to penetrate a minimum of 1 inch (25.4 mm) into the wood member to which the SIP assembly is being attached as shown in Figure 6.3. SIP Fasteners shall meet the following requirements:

- Nominal thread diameter 0.255 inch (7 mm),
- Nominal shank diameter 0.190 inch (5 mm)
- Nominal head diameter 0.625 inch (16 mm).

SIP fasteners shall have a minimum edge distance of 1-9/16 inch (40 mm) and a maximum edge distance of 2-7/8 inch (73 mm).

Galvanized screws, nails or staples shall be permitted for spline and plate attachments.

2.7 Labeling

All SIPS used in wall construction shall be identified by grade mark and/or certificate of inspection issued by an approved agency. The identification shall have the following minimum requirements:

- Manufacturer Identification (such as name or logo)
- Quality Assurance Agency Identification (such as name or logo)
- Conformance with this document

3.0 FOUNDATIONS

The building foundations shall comply with the applicable building code(s). Structural insulated wall panels shall be anchored to the foundation structure according to the requirements of Sections 4.0 and 6.0 of this document.

4.0 SIP ABOVE-GRADE WALLS

4.1 SIP Above-Grade Wall Requirements

SIPs used for above-grade walls shall be constructed in accordance with the provisions of this section and Figures 4.1 to 4.7. The minimum length of SIP wall without openings and lintel requirements above wall openings shall be in accordance with Section 5.0. Lateral support for above-grade SIP walls shall be provided by the roof, floor, and interior braced framing systems in accordance with standard engineering practice. Connection details are provided in Section 6.0. The minimum SIP wall thickness shall be greater than or equal to the SIP wall thickness given in Tables 4.2 and 4.3.

Wood framing and structural insulated wall panels shall be fastened through both facing surfaces to other wood building components in accordance with Table 4.1, unless otherwise provided for in this document.

The nominal SIP wall thickness, for wall panels not taller than 10 feet (3048 mm), shall be determined in accordance with Tables 4.2 and 4.3. SIP walls taller than 10 feet (3048 mm) shall be constructed in accordance with an approved design.

4.2 Top Plate

SIPs used in wall construction shall be capped with a top plate to provide overlapping at corners, intersections and splines in accordance with Figure 4.6. End joints in top plates shall be offset at least 24 inches (610 mm). Plates shall be a nominal 2 inches (51 mm) in depth and have a width equal to the width of the SIP (wall) core.

4.3 Bottom (sill) Plate

SIP walls shall have full bearing on pressure treated sill plates each having a width equal to the nominal width of the SIP core. When structural insulated wall panels are supported directly on continuous foundations in accordance with Figure 4.8, the wood sill plate at exterior walls on monolithic slabs and wood sill plates shall be anchored to the foundation with anchor bolts spaced a maximum of 6 feet (1,829 mm) on center. There shall be a minimum of two bolts per plate section with one bolt located not more than 12 inches (305 mm) or less than seven bolt diameters from each end of the plate section. Bolts shall be at least 1/2 inch (12.7 mm) in diameter and shall extend minimum of 7 inches (178 mm) into masonry or concrete. Foundation anchor straps, spaced as required can be used to provide equivalent anchorage to 1/2-inch-diameter (12.7 mm) anchor bolts.

Interior bearing wall sill plates on monolithic slab foundations shall be positively anchored with

approved fasteners. A nut and washer shall be tightened on each bolt to the plate.

4.4 SIP Wall Bracing

Walls constructed with SIPs shall be considered fully sheathed walls (i.e., continuous wood structural panel sheathing). Tables 4.4 and 4.4a shall be used for determining the length requirements for braced wall panels (full height braced wall panels). Openings (such as for doors and windows) in SIP walls shall be permitted provided that the wall bracing requirements meet or exceed those specified in Tables 4.4 and 4.4a.

The bracing amounts in Table 4.4a shall be permitted to be multiplied by a factor of 0.9 for walls with a maximum opening height that does not exceed 85 percent of the wall height or a factor of 0.8 for walls with a maximum opening height that does not exceed 67 percent of the wall height. Braced wall panels (i.e., full height SIP) shall begin no more than 12.5 feet (3,810 mm) from each end of a braced wall line. Braced wall panels (i.e., full height SIPs) that are counted as part of a braced wall line shall be in line, except that offsets out-of-plane of up to 4 feet (1,219 mm) shall be permitted provided that the total out-to-out offset dimension in any braced wall line is not more than 8 feet (2,438 mm).

4.4.1 Spacing of SIP Wall Bracing

Spacing of braced SIP wall lines shall not exceed 35 feet (10,668 mm) on center along both the length and the width of each story of a building.

Exception: Spacing of braced SIP wall lines not exceeding 50 feet shall be permitted where:

1. The wall bracing provided equals or exceeds the amount of bracing required by Table 4.4 multiplied by a factor equal to the braced wall line spacing divided by 35 feet (10,668 mm), and
2. The length-to-width ratio for the floor/wall diaphragm does not exceed 3:1.

4.5 Above-Grade SIP Wall Coverings

4.5.1 Interior Covering

The interior facing of SIP walls located along interior habitable spaces shall be covered with a minimum of ½-inch (13-mm) gypsum board or an approved finish material that provides a thermal barrier to limit the average temperature rise of the unexposed surface to no more than 250 degrees F (139 °C) after 15 minutes of fire exposure as tested in accordance with ASTM E119 [8]. The use of vapor retarders and air barriers shall be in accordance with the authority having jurisdiction.

4.5.2 Exterior Covering

SIP walls shall be protected from physical damage. All SIP walls in exterior applications shall be covered with approved materials installed to provide a barrier against the weather (such as sunlight, snow, and rain). The exterior wall envelope shall be designed with a water-resistive barrier behind the exterior veneer. The water-resistive barrier shall be one layer of No. 15 felt, free from holes and breaks, complying with ASTM D226 [15] for Type I felt or other approved equal.

4.6 SIP Wall Penetrations

The internal vertical chase penetration in the SIP core shall have a maximum side dimension of 2-inches (51 mm) centered in the panel core. Vertical chases shall have a minimum spacing of 24-inches (610 mm) on center. A maximum of 2 horizontal chases shall be permitted in each wall panel-one at 14-inches (360 mm) and one at 4-feet (1,219 mm) from the bottom of the panel.

The maximum allowable penetration size in a SIP wall panel shall be limited to a 12-inch (305 mm) circular or 12-inch by 12-inch (305 mm x 305 mm) rectangular section in accordance with Figure 4.7. Over-cutting of holes in facing panels shall not be permitted without an approved design.

4.7 Interior Load-Bearing Walls

Interior load-bearing walls shall be constructed as specified in the building code or by the authority having jurisdiction.

Table 4.1
Fastener Schedule for SIP Construction

Building Elements	Number and Type of Fasteners ^{a, b, c, d}	Spacing of Fasteners
3/8" gypsum board	13 gage, 1-1/4" long, 19/64" head; 0.098 diameter, 1-1/4" long, annular-ringed; or 4d cooler nail, 0.080" diameter, 1-3/8" long, 7/32" head.	Nails: 8" o.c. Screws: 16" o.c.
1/2" gypsum board	13 gage, 1-3/8" long, 19/64" head; 0.098 diameter, 1-1/4" long, annular-ringed; or 5d cooler nail, 0.086" diameter, 1-5/8" long, 15/64" head, or gypsum board nail, 0.086 diameter, 1-5/8" long, 9/32" head.	Nails: 8" o.c. Screws: 16" o.c.
5/8" gypsum board	13 gage, 1-5/8" long, 19/64" head; 0.098 diameter, 1-3/8" long, annular-ringed; or 6d cooler nail, 0.092" diameter, 1-7/8" long, 1/4" head, or gypsum board nail, 0.0915 diameter, 1-7/8" long, 19/64" head.	Nails: 8" o.c. Screws: 12" o.c.
Sole (sill) plate face nailed to joist or blocking	16d common nails	16" o.c.
Top plate to cap plate	16d common nails	16" o.c.
Sole (sill) plate to monolithic concrete foundation	Minimum 1/2 inch (13 mm) diameter anchor bolts	6 feet o.c. maximum
SIP wall panel to SIP wall panel corner connection	SIP screws with minimum 1 inch penetration into wood member in SIP wall panel connected to	24" o.c. maximum
SIP wall panel to top wood plate	8d common nails	6" o.c. both sides
SIP wall panel to top/bottom steel track	Min. No. 8 screw	
SIP wall panel to wood sill plate	8d common nails	6" o.c. both sides
SIP wall panel to steel track (on foundations)	Min. No. 8 screw	6" o.c.
SIP wall panel to framing or cripple studs	8d common nails	6" o.c.
SIP wall panel to SIP wall panel	8d common nails	6" o.c. each strip and each side

For SI: 1 inch = 25.4mm, 1 foot = 304.8 mm, 1 mph = 1.61 km/h, 1 ksi = 6.895 MPa

- a. All nails are smooth-common, box or deformed shanks except where otherwise stated. Nails used for framing and sheathing connections shall have minimum average bending yield strengths as shown: 80 ksi for shank diameter of 0.192 inch (20d common nail), 90 ksi for shank diameters larger than 0.142 inch but not larger than 0.177 inch, and 100 ksi for shank diameters of 0.142 inch or less.
- b. Staples are 16-gage wire and have a minimum 7/16-inch crown width.
- c. Nails shall be spaced at not more than 6 inches on center at all supports where spans are 48 inches or greater.
- d. Screws shall be Type S or W per ASTM C 1002 [16] and shall be sufficiently long to penetrate wood framing not less than 5/8 inch and metal framing not less than 3/8 inch.

Table 4.2

**Nominal Thickness (Inches) for SIP Walls Supporting
SIP or Light-Frame Roofs Only**

Wind Speed (3-sec gust)		Snow Load (psf)	Building Width (ft)														
			24			28			32			36			40		
Exp. A/B	Exp. C		Wall Height (ft)			Wall Height (ft)			Wall Height (ft)			Wall Height (ft)			Wall Height (ft)		
		8	9	10	8	9	10	8	9	10	8	9	10	8	9	10	
85		20	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		30	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		50	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		70	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
100	85	20	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		30	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		50	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		70	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
110	100	20	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		30	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		50	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		70	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
120	110	20	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		30	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		50	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		70	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	6.5	4.5	4.5	6.5
130	120	20	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		30	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		50	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	6.5	4.5	4.5	6.5	4.5	4.5	6.5
		70	4.5	4.5	4.5	4.5	4.5	6.5	4.5	4.5	6.5	4.5	6.5	N/A	4.5	6.5	N/A
130	130	20	4.5	4.5	6.5	4.5	4.5	N/A	4.5	4.5	N/A	4.5	4.5	N/A	4.5	6.5	N/A
		30	4.5	4.5	N/A	4.5	4.5	N/A	4.5	4.5	N/A	4.5	6.5	N/A	4.5	6.5	N/A
		50	4.5	6.5	N/A	4.5	6.5	N/A	4.5	N/A	N/A	6.5	N/A	N/A	6.5	N/A	N/A
		70	4.5	N/A	N/A	6.5	N/A	N/A	6.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mph = 1.61 km/hr

1 Deflection criteria: L/240

Roof dead load: 10 psf maximum

Roof live load: 70 psf maximum

Ceiling load: 5 psf maximum

Ceiling live load: 20 psf maximum

Second floor live load: 30 psf maximum

Second floor dead load: 10 psf

Second floor wall dead load: 10 psf

N/A indicates not applicable (design required)

**Table 4.3
Nominal Thickness (Inches) of SIP Walls Supporting**

SIP or Light-Frame Story and Roof

Wind Speed (3-sec gust)		Snow Load (psf)	Building Width (ft)														
			24			28			32			36			40		
			Wall Height (ft)			Wall Height (ft)			Wall Height (ft)			Wall Height (ft)			Wall Height (ft)		
Exp. A/B	Exp. C		8	9	10	8	9	10	8	9	10	8	9	10	8	9	10
85		20	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
		30	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
		50	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
		70	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	6.5	6.5	6.5	6.5
100	85	20	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
		30	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	6.5
		50	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	6.5	6.5	4.5	6.5
		70	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	6.5	6.5	6.5	6.5	6.5	N/A	N/A
110	100	20	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	6.5
		30	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	6.5	4.5	6.5	6.5
		50	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	6.5	6.5	6.5	6.5	N/A
		70	4.5	4.5	4.5	4.5	4.5	6.5	6.5	6.5	N/A	6.5	N/A	N/A	N/A	N/A	N/A
120	110	20	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	6.5	4.5	4.5	6.5	4.5	6.5	N/A
		30	4.5	4.5	4.5	4.5	4.5	6.5	4.5	4.5	6.5	4.5	6.5	N/A	6.5	6.5	N/A
		50	4.5	4.5	6.5	4.5	4.5	6.5	4.5	6.5	N/A	6.5	N/A	N/A	N/A	N/A	N/A
		70	4.5	4.5	6.5	4.5	6.5	N/A	6.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
130	120	20	4.5	4.5	6.5	4.5	4.5	6.5	4.5	6.5	N/A	4.5	6.5	N/A	6.5	N/A	N/A
		30	4.5	4.5	6.5	4.5	4.5	N/A	4.5	6.5	N/A	6.5	N/A	N/A	6.5	N/A	N/A
		50	4.5	6.5	N/A	4.5	6.5	N/A	6.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		70	4.5	6.5	N/A	6.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	130	20	6.5	N/A	N/A	6.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		30	6.5	N/A	N/A	N/A	N/A	N/A									
		50	N/A	N/A	N/A												
		70	N/A	N/A	N/A												

For SI: 1 inch = 25.4 mm, 1 foot = 304. 1 mph = 1.61 km/h.

Table 4.4

Seismic Design Category or Wind Speed	Condition	Amount Of Bracing
Categories A and B or 100 mph and less	One story Top of two-story	Full height SIP panel with minimum length per Table 4.4a located at each end (within 12.5 feet from each corner) and at least every 25 feet on center but not less than 16% of braced wall line
	First story of two-story	Full height SIP panel with minimum length per Table 4.4a located at each end (within 12.5 feet from each corner) and at least every 25 feet on center but not less than 16% of braced wall line
Category C or less than 110 mph	One story Top of two-story	Full height SIP panel with minimum length per Table 4.4a located at each end (within 12.5 feet from each corner) and at least every 25 feet on center but not less than 16% of braced wall line
	First story of two-story	Full height SIP panel with minimum length per Table 4.4a located at each end (within 12.5 feet from each corner) and at least every 25 feet on center but not less than 30% of braced wall line

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm.

1 Linear interpolation shall be permitted.

2 Full-height SIP to either side of garage openings that support light frame roofs with roof covering dead loads of 3 psf or less shall be permitted to have a 4:1 aspect ratio.

Table 4.4a
Requirements for Braced SIP walls

Length of Braced SIP Walls (inches)			Maximum Opening Height Next to the Braced SIP wall (% of wall height)
8-Foot	9-Foot	10-Foot	
48	54	60	100%
32	36	40	85%
24	27	30	67%

Figure 4.1
SIP Wall Supporting Light-Frame Roof Only

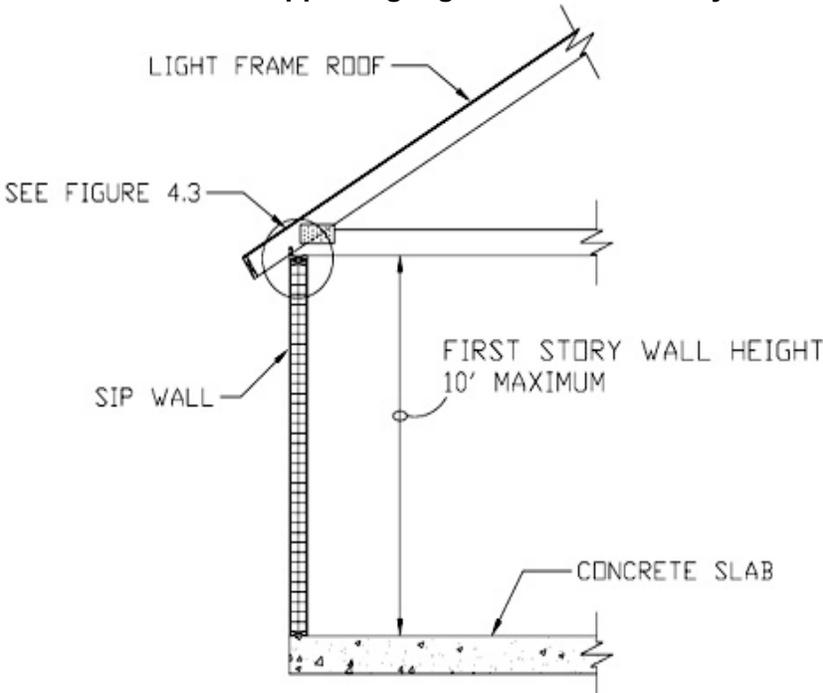


Figure 4.2

SIP Wall Supporting Light-Frame Second Story and Roof

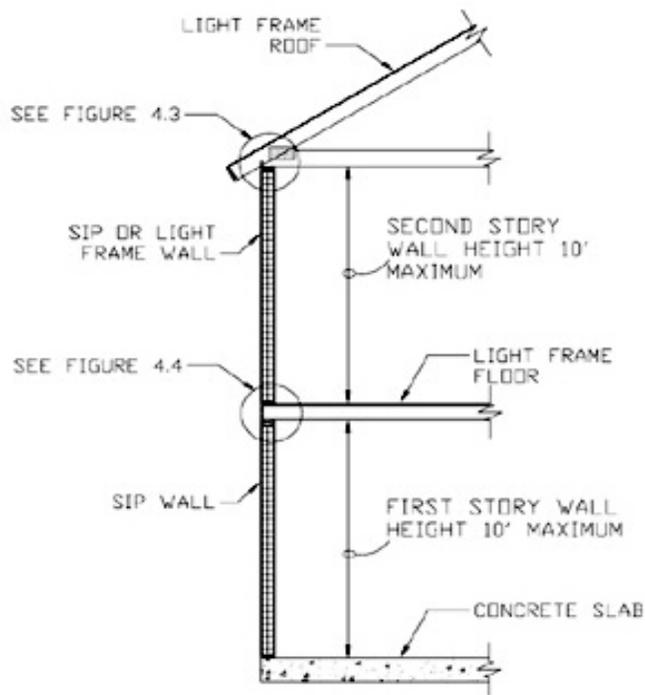


Figure 4.3
SIP Wall to Roof Connection

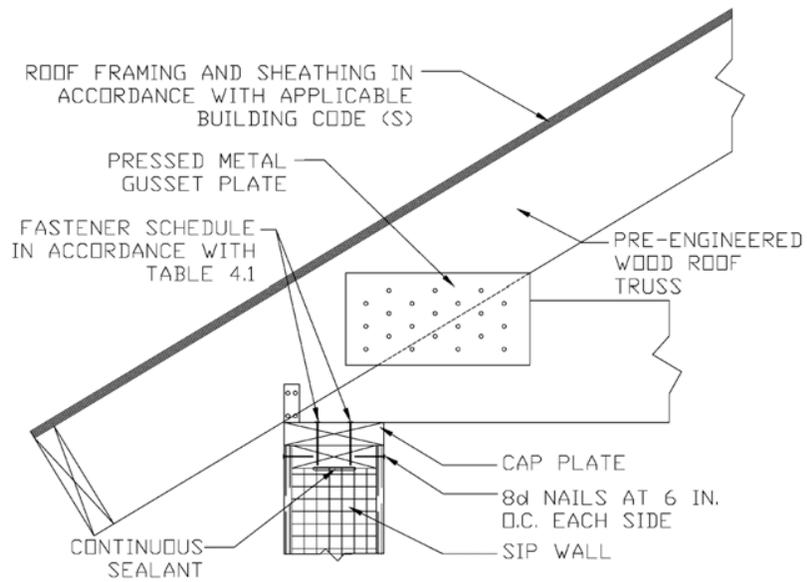


Figure 4.4
SIP Wall to Wall Platform Frame Connection

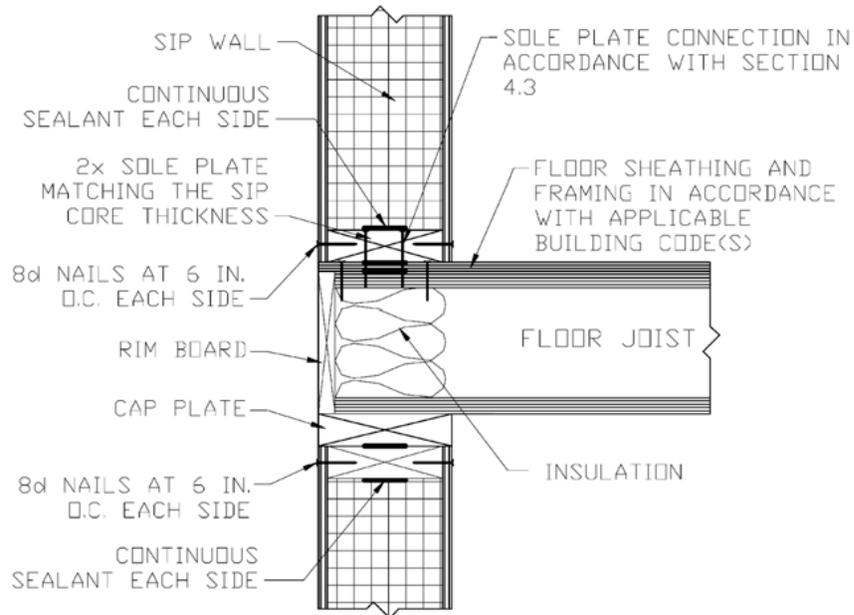


Figure 4.5
SIP Wall to Wall Balloon Frame Connection

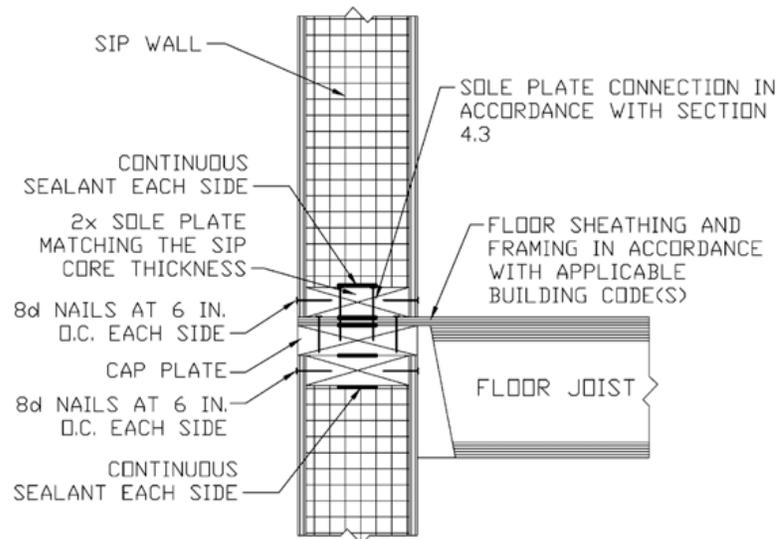
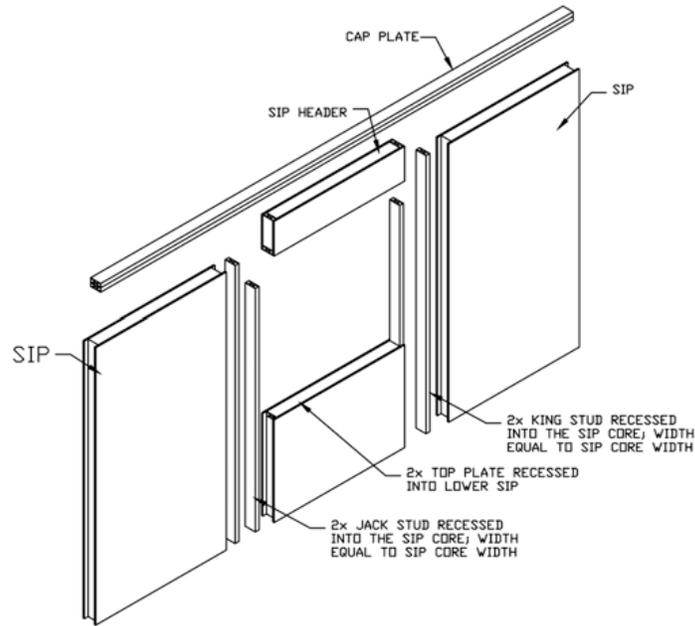


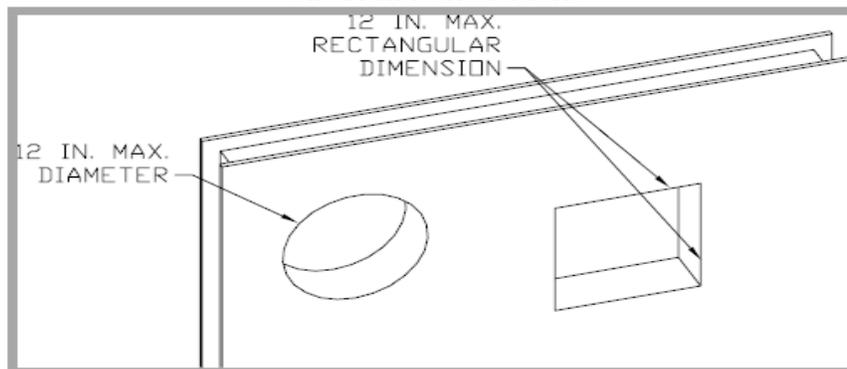
Figure 4.6
SIP Wall Framing Configuration



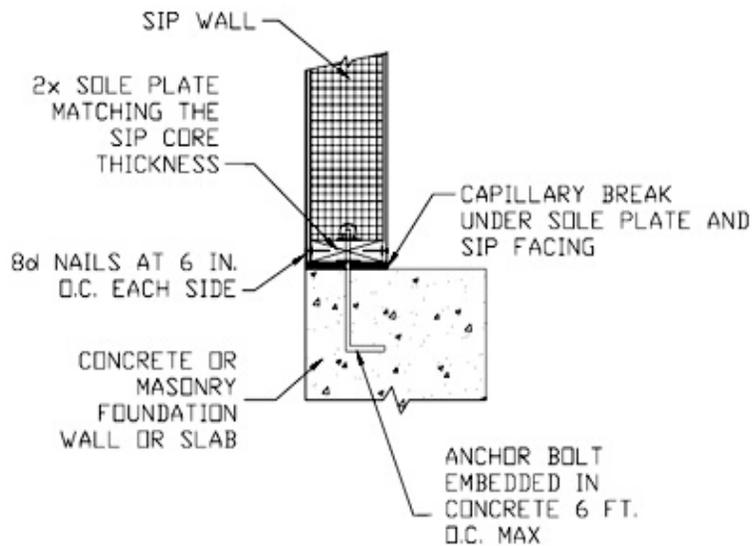
Notes:

1. Top plates shall be continuous over header.
2. SIP facing surfaces shall be nailed to framing and cripples with 8d common or box nails spaced 6 inches (152 mm) on center, staggering alternate nails 1/2 inch (13 mm).
3. Galvanized nails shall be hot-dipped or tumbled. Framing shall be attached in accordance with building code requirements unless otherwise provide for in this document.

**Figure 4.7
SIP Wall Penetrations**



**Figure 4.8
SIP Wall to Concrete Slab or Foundation Wall Attachment**



5.0 SIP HEADER REQUIREMENTS

Structural insulated panel (SIP) wall headers shall be designed and constructed according to Table 5.1 and Figure 4.6. SIP headers shall be continuous sections without splines. Headers longer than 4 ft (1,219 mm) shall be constructed according to Section 5.1. The top plate shall be continuous over the header.

Table 5.1
Maximum Span (Feet) For SIP Headers

Load Condition	Snow Load (psf)	Building Width (ft)				
		24	28	32	36	40
Supporting Roof Only	20	4	4	4	4	2
	30	4	4	4	2	2
	50	2	2	2	2	2
	70	2	2	2	N/A	N/A
Supporting Roof and One-Story	20	2	2	N/A	N/A	N/A
	30	2	2	N/A	N/A	N/A
	50	2	N/A	N/A	N/A	N/A
	70	N/A	N/A	N/A	N/A	N/A

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm
 Deflection criteria: L/240
 Roof dead load: 10 psf maximum
 Ceiling dead load: 5 psf maximum
 Second floor live load: 30 psf maximum
 Second floor dead load: 10 psf maximum
 Second floor dead load from walls: 10 psf maximum
 N/A indicates not applicable (design required)

5.1 Wood structural panel box headers

Wood structural panel box headers are permitted to be used where SIP headers are not applicable. Wood structural panel box headers shall be constructed in accordance with Figure 5.1 and Table 5.2. The top plate shall be continuous over the header. Jack studs shall be used for spans over 4 feet (1,219 mm). Wood structural panel faces shall be single pieces of 15/32-inch-thick (12 mm) or thicker Exposure 1, installed on the interior or exterior or both sides of the header. Wood structural panel faces shall be nailed to framing and cripples with 8d common or galvanized box nails spaced 3 inches (76 mm) on center, staggering alternate nails ½ inch (12.7 mm).

Table 5.2
Maximum Span (Feet) for Wood Structural Panel Box Headers

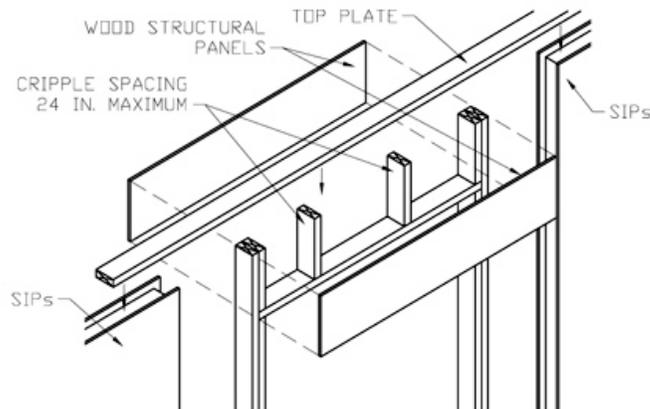
Header Construction ^a	Header Depth (inches)	House Depth (ft)				
		24	26	28	30	32
Wood structural panel – one side	9	4	4	3	3	-
	15	5	5	4	3	3
Wood structural panel – both sides	9	7	5	5	4	3
	15	8	8	7	7	6

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

a. Spans are based on single story with clear-span trussed roof, top story of two-story with a clear-span trussed roof, or two-story with floor and roof supported by interior-bearing walls.

b. See Figure 5.1 for construction details.

Figure 5.1
Typical Wood Structural Panel Box Header Construction

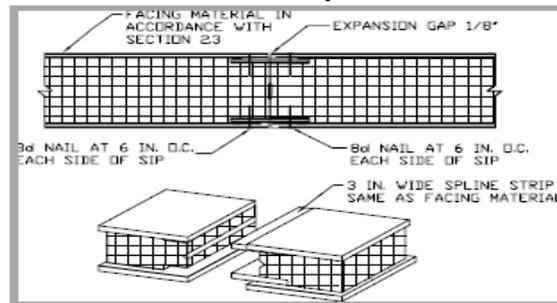


6.0 SIP CONNECTION DETAILS

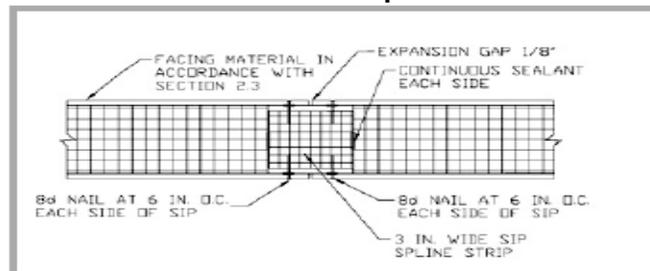
6.1 Wall Panel to Wall Panel Connection

Structural insulated panel walls shall be connected in accordance with Figures 6.1, Figure 6.2, or by other approved method.

**Figure 6.1
Surface Spline**



**Figure 6.2
Insulated Spline**



6.2 Corner Framing

Corner framing of structural insulated panel walls shall be constructed in accordance with Figure 6.3 or other approved method.

**Figure 6.3
SIP Corner Framing Detail**

7.0 UTILITIES

7.1 Plumbing Systems

Plumbing shall comply with the provisions of the IRC or the applicable plumbing code.

7.2 HVAC Systems

HVAC installation shall comply with the provisions of the IRC or the applicable mechanical and/or energy code.

7.3 Electrical Systems

Electrical system installation shall comply with the National Electric Code [9].

8.0 THERMAL GUIDELINES

8.1 Energy Code Compliance

The insulation value (R-value) of SIP wall systems shall meet or exceed the applicable provisions of the IRC, local energy code, or the ICC Energy Conservation Code [10].

8.2 Moisture

SIP wall panels shall be protected from moisture intrusion through the use of approved exterior wall finishes in accordance with Section 4.0. SIP walls that become excessively wet or damaged shall be removed and replaced before proceeding with the installation of additional panels or other work.

8.3 Ventilation

The natural ventilation rate of SIP buildings shall not be less than that required by the local code or 0.35 ACH when no local code exists. When required, mechanical ventilation shall be provided to meet the minimum air exchange rate of 0.35 ACH.