



Residential Construction Details and Manual

Using Structural Insulated Panels (SIPs)

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1. General Information

The information provided in this manual is to be used as a general guide. Refer to detailed drawings provided by EPS for job specific information. Be sure to follow local and state building codes.

a. Panel Make Up

Structural insulated panels (SIPs) are high performance building panels used in floors, walls, and roofs. The panels are made by sandwiching a core of expanded polystyrene (EPS), between two structural skins of oriented strand board (OSB), or plywood. EPS panels have standard overall thicknesses of 4-1/2", 6-1/2", 8-1/4" and 10-1/4". Foundation panels have a thickness of 8-7/8".

Wall Type	Core Thickness	Overall Thickness	Panel Make Up	Whole Wall R-Value at exterior temp of		Weight PSF
				75°	40°	
R-18	3 5/8"	4 1/2"	7/16" OSB, 3 5/8" EPS, 7/16" OSB	18.0	20.6	3.3
R-26	5 5/8"	6 1/2"	7/16" OSB, 5 5/8" EPS, 7/16" OSB	22.8	24.1	3.5
R-33	7 3/8"	8 1/4"	7/16" OSB, 7 3/8" EPS, 7/16" OSB	30.1	31.8	3.6
R-40	9 3/8"	10 1/4"	7/16" OSB, 9 3/8" EPS, 7/16" OSB	38.5	40.0	3.9

*R-Values stated based on standard Type I EPS

b. Foam Specification

EPS used Type I Expanded Polystyrene (EPS) for all SIP panels. Borate is added to the foam to make it insect-resistant. Higher R-Values can be achieved with Graphite Polystyrene also known as GPS with Neopor. Contact EPS for Neopor pricing.

c. Fabricated panels

Fabricated panels are cut to fit each project and ready to assemble. The panel edges are factory routed to accept plates and splines. Window and door rough openings are cut out and routed. Along with having panels cut to fit, vertical and horizontal wire chases are installed in the panels to make the electricians' job easier. Panels are typically cut from an 8'X24' master panel. After a panel comes off the CNC machine it could be as large as 7'-11" wide X the height of the ceiling (jumbos). The panel size will be determined by the engineer. Because each project is unique panel sizes will vary.

d. Thermal Barrier

Section 2603.4 of the 2015 International Building Code requires all foam plastic insulation to be covered with an approved minimum 15 minute thermal barrier. 7/16" OSB itself does not constitute a 15 minute thermal barrier. All interior panel surfaces must be covered with a minimum of 1/2" type X sheetrock to provide an adequate thermal barrier.

e. Fire Testing

One hour fire test have been performed on wall and roof panels. Please refer to testing reports at the back section of this book.

f. Bracing and Shoring

All the shoring and bracing is the responsibility of the general contractor. An EPS building package has little or no waste. Extra bracing material can be sent upon request.

g. Order Information

Before an engineer can get started, a good set of detailed drawings is needed. These drawings need to have a floor plan, foundation plan, elevations and a door and window rough opening schedule. The opening locations will also need to be dimensioned on the plan view. EPS engineers provide detailed structural drawings and panel shop drawings to ensure a structurally sound building.

After the engineer has all the information, a detailed set of preliminary of drawings will drafted. These drawings will then be sent to the dealer for approval. An approval letter will accompany the drawings. Once the approval letter is returned, the project will be completed and turned into production. Any changes to the preliminary drawings over and above what was ordered will result in change orders. If the drawings need engineering seals additional lead times may apply.

h. Delivery

Job packages will be delivered with a typical tractor trailer and flatbed. The job site will need to be tractor trailer accessible. If job site access is not permitted be prepared to shuttle panels from an alternate location using a smaller vehicle at the contractor's expense.

Proper unloading and handling equipment needs to be on site before the panels arrive. EPS can provide unloading services for an additional fee and some restrictions may apply. EPS packages the panels for optimal efficiency for shipping therefore the panels are rarely in order. Be sure to leave room to sort the panels. Refer to the Tools and Equipment section for recommended unloading and handling equipment.

Once the panels have been delivered proper storage is important. The panels must be kept dry and stacked on level blocking. Some panel bundles may be shrink wrapped. If a bundle is shrink wrapped, a slit is made at the bottom of the shrink wrap to allow any moisture within the bundle to escape. The shrink wrap is for transportation only and should be removed at the job site. The panels are to be tarped once they have been unloaded. It is also recommended to keep all the lumber and spline material covered to keep any excess moisture out of the panels.

i. Materials List

EPS offers a complete structural framing package. The following items are provided in a standard EPS panel package.

Wall Panels:

- Top & bottom plates (treated if required)
- Pre-cut wall panels with door and window cut outs
- Pre-built headers (if required)
- Spline and stud material
- 2x material for door and window bucks
- 1 ½" horizontal wire chase 16" & 44" off floor (optional)
- 1 ½" Vertical wire chases approximately 4' O.C.
- Sealants
- Hand drive or Paslode nails
- Seam tape (if required)

Roof Panels:

- Pre-cut roof panels
- 2x panel edging
- Spline material (2x, LVL, surface as required by span & loading)
- Sealants (2-part foam is optional)
- Wire chase at spline
- Ridge or Mid-span beams (if required)
- Out-looker & rake material (if required)
- Hand drive or paslode nails

Foundation Panel:

- Pre-cut foundation panel
- 2x8 treated top & bottom plates
- 2x8 treated studs
- SPF cap plate
- 1x treated screed board

Foundation Panel continued:

- 6 mil poly film
- Sealants & construction adhesive
- Treated plywood strips
- Hand drive or Paslode nails

Floor System:

- 2x treated sill plate
- Rim board material
- Trusses or joist
- Floor beams (if required)
- Hangers (if required)
- Hand drive or paslode nails
- Sealants
- $\frac{3}{4}$ " T&G Subfloor (Advantech, plywood, OSB)
- Strong back bracing & ribbon material

Roof Truss System:

- Roof trusses with 12" energy heel
- Roof sheathing (OSB or CDX)
- Truss bracing
- Hangers & Ties
- Hand drive or paslode nails
- Plywood clips
- 2x Fascia Board
- Porch headers and columns

j. Tools and Equipment

Builders will utilize the same tools that are used to build stick framed structures and other conventionally framed buildings. In addition, some additional SIP specific tools will be necessary. Panels are large and heavy so special lifting equipment is recommended.

General tools:

- Hammer
- Tape Measure
- 4' Level
- Hand Saw
- Caulking Gun/QT
- Square
- Electric drill
- Sledge hammer
- 1" Wood Bit
- Circular saw
- Reciprocating saw
- Pry bars
- Ladders
- String line
- Chalk line
- Come-a-long

SIP specific:

- Foam Scoop
- Chain saw & guide
- Sausage tube applicator
- Hot wire assembly (optional)

Equipment:

- Fork lift or crane
- Fork extensions
- Lifting plates
- Ratchet straps

k. Structural Loading

The base building is designed for the necessary top chord live load, 10 psf dead load on the top chord, and 10 psf dead load on the bottom chord. In the case of SIP roof panels the panel is designed for the necessary live load in addition to 15 psf of total dead load.

The live load is calculated by the county or elevation in which the building ships to and the building use and conditions. EPS can engineer a building above and beyond the local loadings upon request. The structure is assumed to be located in an area defined as Exposure "C" and have an importance factor of 1.0. Exposure "C" is defined as an open, unobstructed area.

The wind load is designed for an IBC 2015 – 115 mph ultimate wind, Exposure "C". Contact EPS for design requirements which exceed what is stated here.

Floor systems will be designed with a minimum loading of 40 psf live load, 10 psf dead load on the top chord, and 5 psf dead load on the bottom chord. Be sure to verify loads stated on contract & construction documents are suitable for the particular location of the project.

I. Design Considerations

The following are features of residential structures that may affect the structure. These items need to be discussed with EPS personnel prior to placing the order.

- Roofing materials. The standard loading assumes standard roof sheathing and asphalt shingles. Roofing materials such as clay tile and slate are much heavier and must be addressed.
- Floor coverings. Areas with heavy flooring materials such as slate, granite, stone or gypcrete covering must be accounted for.
- Architectural features such as stone fireplaces, glass block walls, ect. can impose large loads on the floor system and need to be noted.
- Decks that are attached to the EPS structure need to be noted to ensure that a proper surface is provided for attachment.
- Window walls. Walls with a large number of openings may not be feasible to build with SIPs. This will be noted on the preliminary drawings. Materials will be provided to stick build these areas.
- Window and door rough openings and locations. Due to the nature of SIP panels all window and door rough openings and locations are necessary for the building design. The order **WILL NOT** be started in engineering until all rough openings and locations are determined.

Specifications beyond the standard loading are subject to an increase in price up until the time the preliminary drawings are sent.

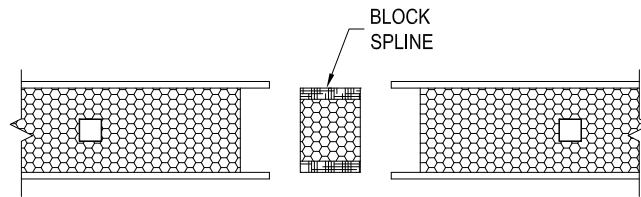
I. Panel Connections

All panels must be fastened at the joints using nails or other EPS approved fasteners. A sealant is used to prevent air and moisture from penetrating the panels. Below are the most commonly used panel connections.

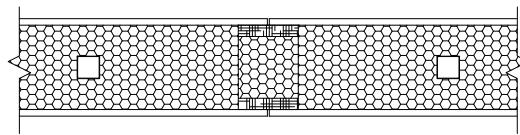
a. Splines

Splines are used to connect two butting panels. There are three typical splines used: Block splines, surface splines, and column splines.

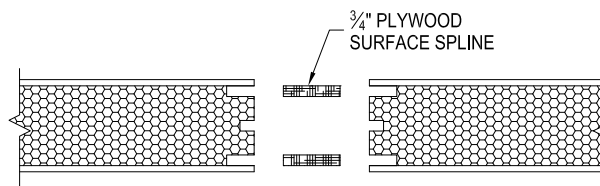
Block spline: These splines are non-structural and can be used in wall and roof applications.



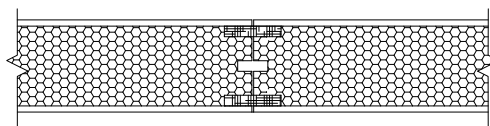
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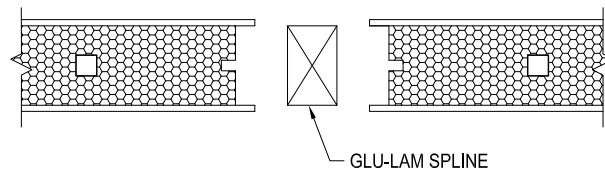
Surface spline: These splines are used in roof panels with short spans.



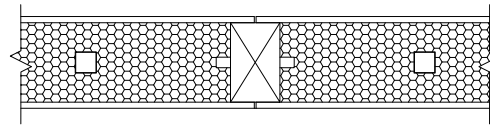
SEE DETAIL SP2



Column spline: These splines are used with large point loads and tall wall.



SEE DETAIL SP9

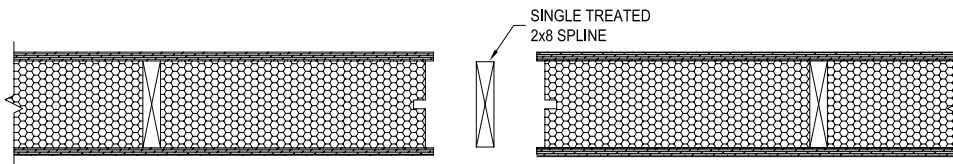


II. Foundation Panels

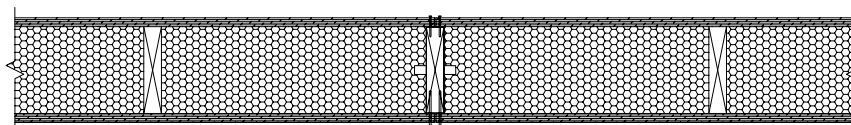
Foundation panels are slightly different than the standard wall panels. Because the panels are below grade, the exterior skin needs to be pressure treated foundation grade plywood. The panel also needs to take horizontal load that the soil pressure is putting on the panel. Therefore, treated 2x8 studs are laminated into the center of a panel. Horizontal wire chases are not allowed in foundation panels. Verticals can still be installed at the spline locations. Foundation panels are limited to 8' or 9' tall.

a. General Assembly (Foundation Panel)

All splines in a foundation panel are treated 2x8 lumber splines. All fasteners are stainless steel exterior and galvanized interior. Refer to fastening schedule and construction details for exact locations and spacing.

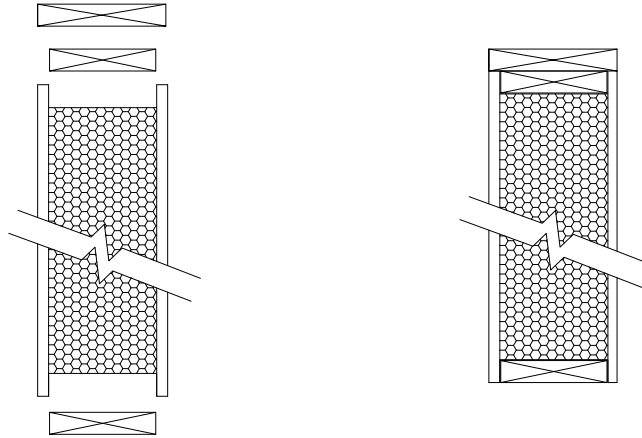


SEE DETAIL SP6

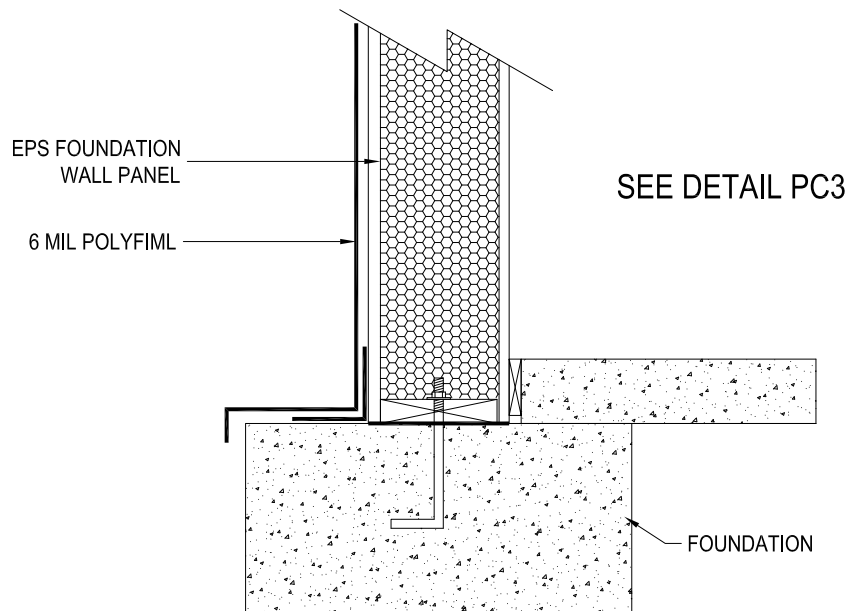


b. Foundation Plate Assembly

SEE DETAIL WA3

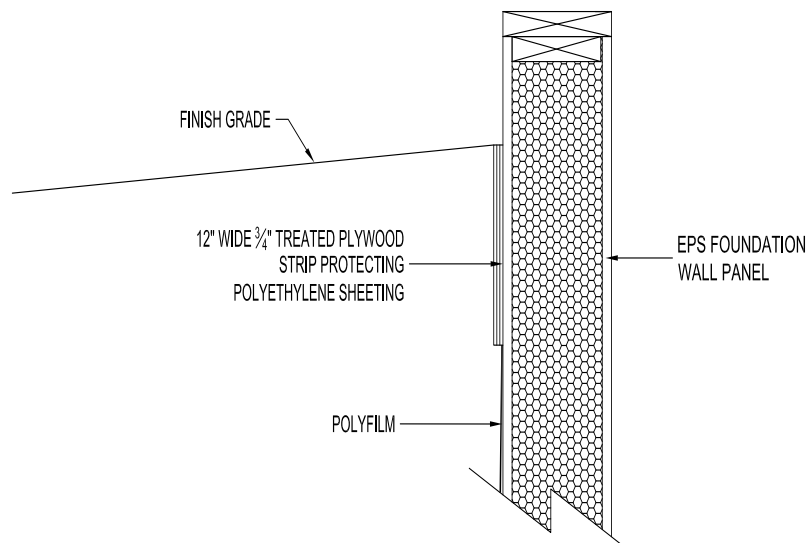


c. Foundation Base Assembly



d. Waterproofing Foundation Panel

Waterproofing is extremely important when using a wood foundation. EPS provides 6mil poly film to cover the foundation walls. The top of the poly is fastened with $\frac{3}{4}$ "x12" strips of foundation grade treated plywood. Seal the top and behind the plywood strip with urethane sealant.



e. Backfilling

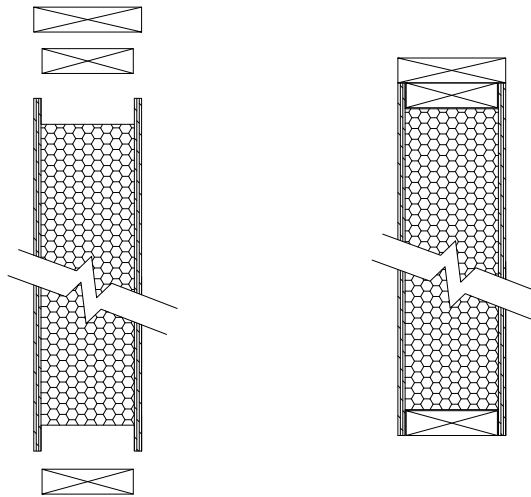
Backfill with crushed stone or gravel 12" deep for group I soils and half the backfill for groups II & III soils. Cover top of gravel w/ asphalt or polyethylene strips prior to remaining backfill. Soil conditions play an important role in determining the design of a wood foundation. Refer to the soil surveys published by the U.S. Department of Agriculture's Soil Conservation Service to determine soil conditions at site location. A soil survey maybe needed to determine if the soil is adequate for an EPS wood foundation.

III. Wall Panel Installation

Before starting, make sure the foundation is square and level. If there are any issues, corrections need to be done ahead of time. Framing on a foundation that is not square or level will cause more corrections and panel modifications. Make sure the panels have full bearing so loads can be transferred through both skins. An EPS wall will have either a double top plate or a single double beveled top plate. The double top plate can be used with roof trusses or roof panels. The single double beveled top plate is used with roof panels only.

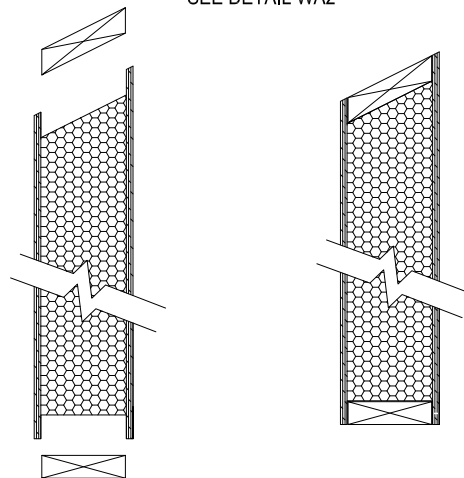
a. Double top plate:

SEE DETAIL WA1



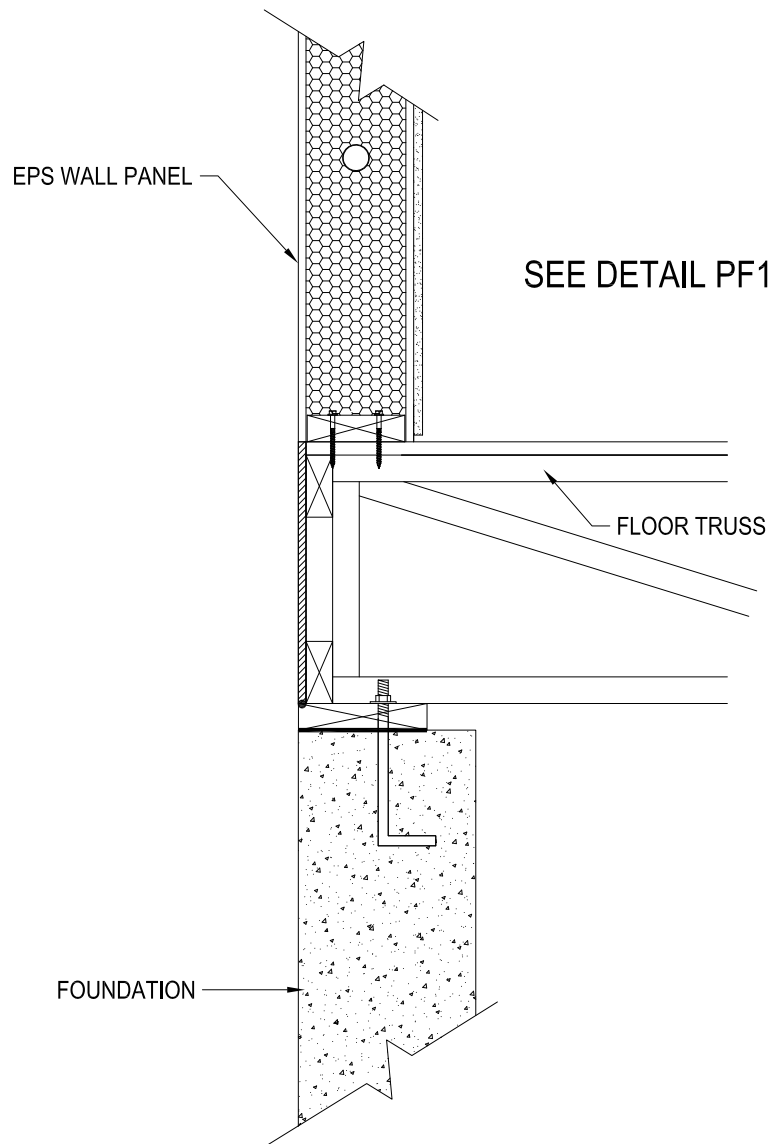
b. Double beveled plate:

SEE DETAIL WA2

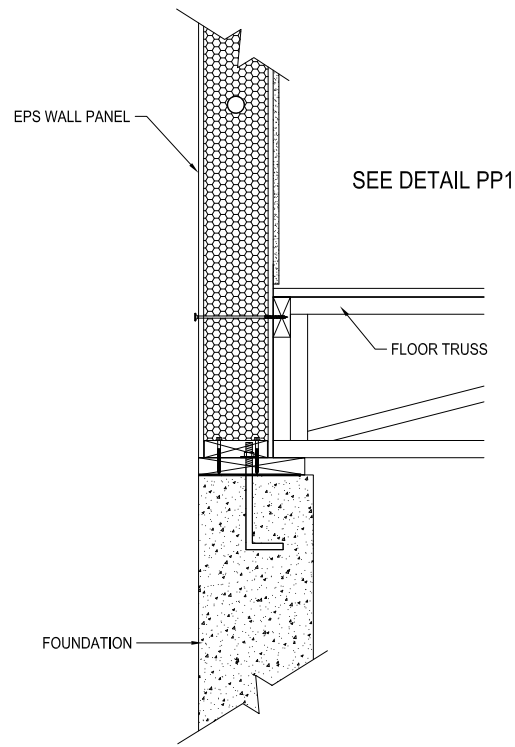


Wall panels are going to be installed to the base in one of three basic ways: On top of the subfloor, running the panels past the floor and setting on top of foundation, or directly on concrete slab. When using panels past, the foundation walls need to be a minimum of 10" thick.

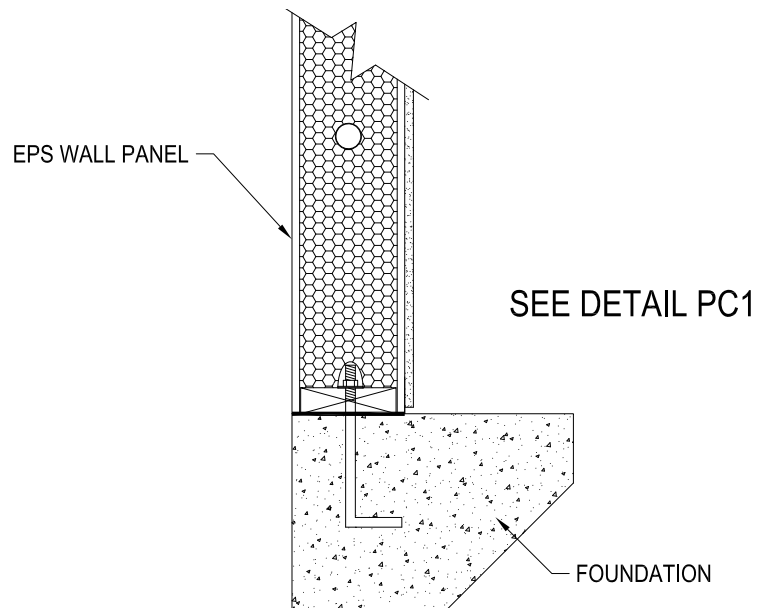
c. Panels on subfloor: (Pricing Option "A")



d. Panels past: (Pricing Option “B”)

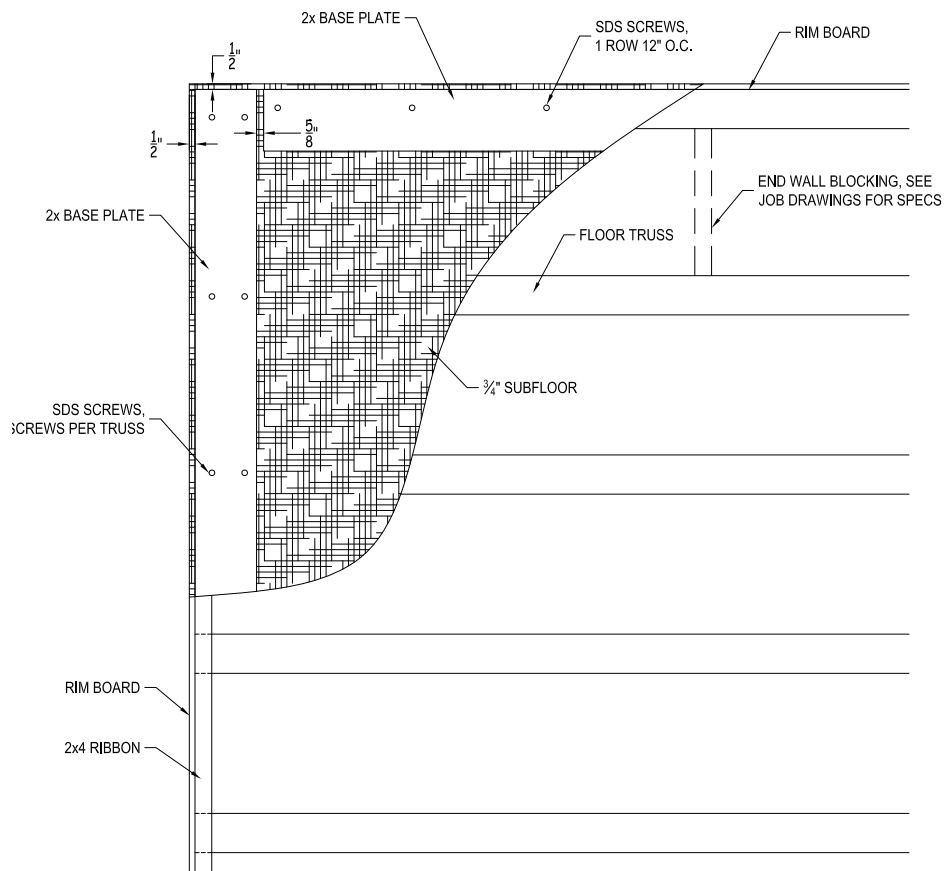


e. Panels on slab:



IV. Base Plate

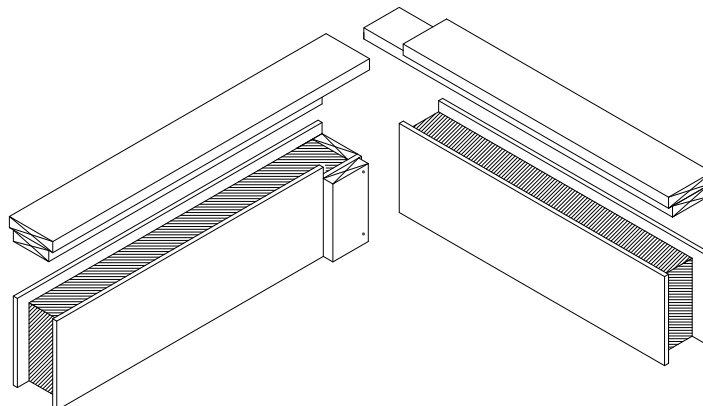
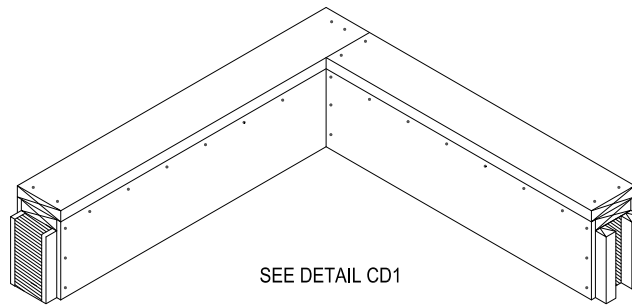
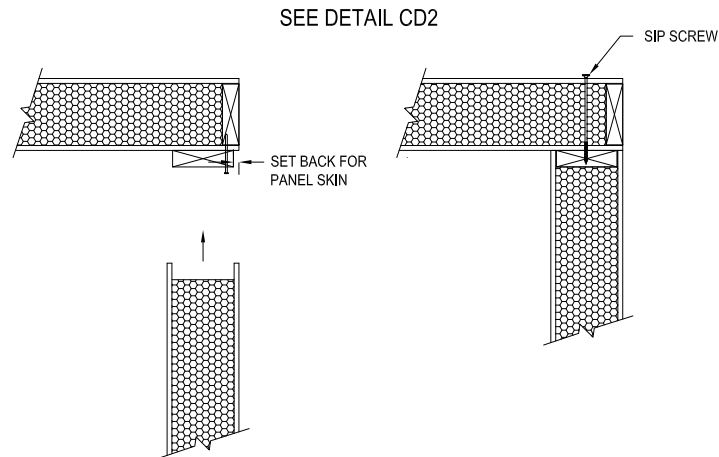
When installing the base plate to the subfloor first check to see if the floor is square. If the floor is square, measure $\frac{1}{2}$ " in from the edge and chalk a line. Base plates need to be fastened to the subfloor using SDS screws and two continuous beads of sealant. First apply two rows of sealant to the area on which the plate will be setting. Then attach the SDS screws 12" O.C. into parallel floor truss/joist and two SDS screws per truss/joist that run perpendicular (see below). Verify screw spacing per plan.



V. Corners

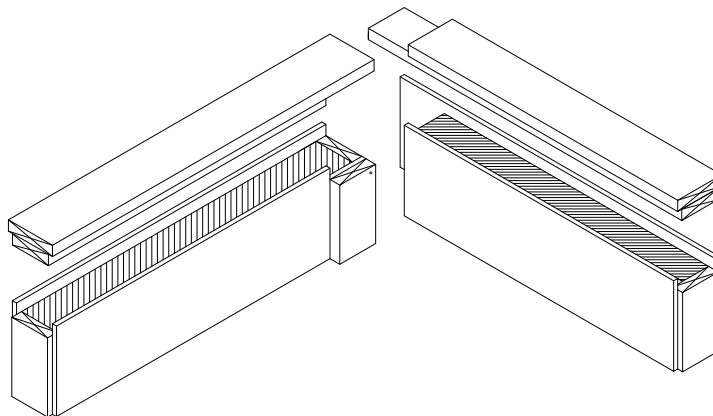
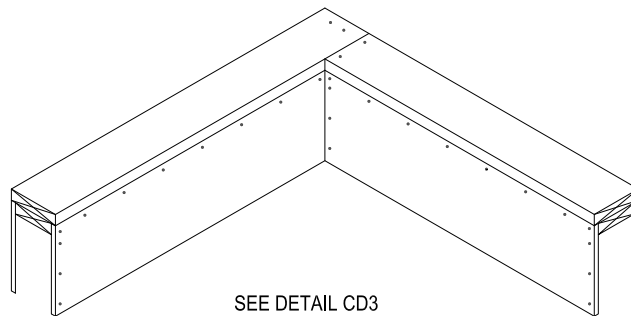
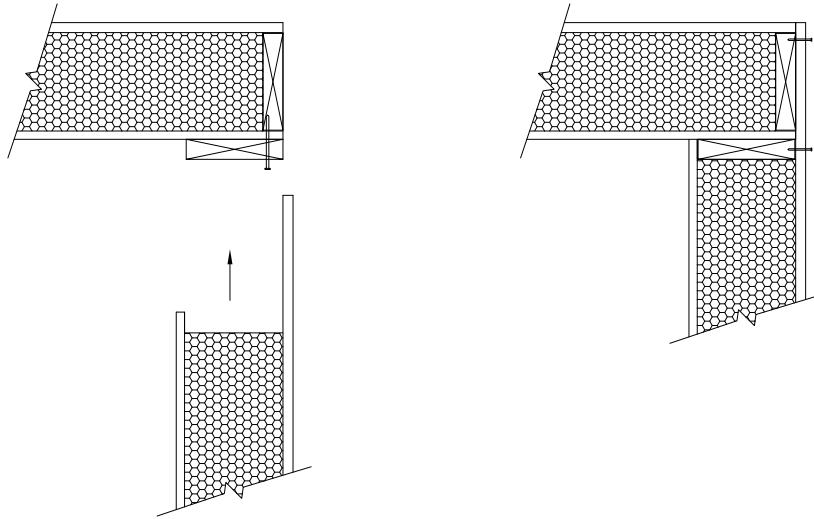
The two basic corner details used are butt corners & fly-by corners. The butt corners are most commonly used with standard residential wall panels while the fly-by corners are used with foundation panels and our Solid Core line of buildings.

Butt corner:



Fly-by corner (foundation panel corner shown):

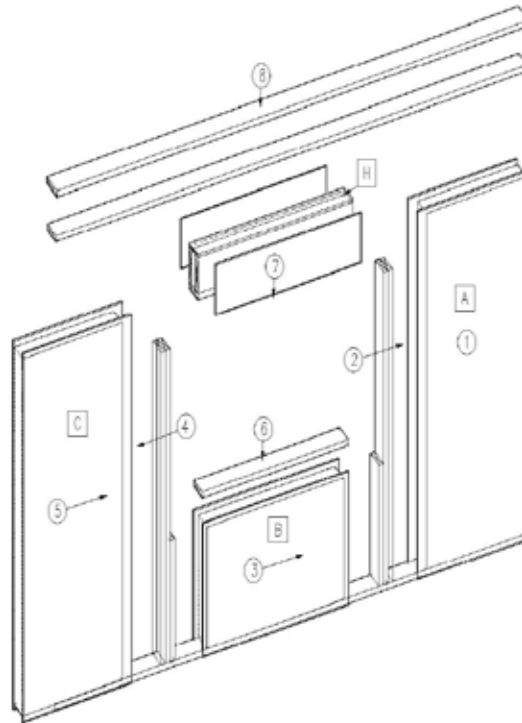
SEE DETAIL CD4



VI. Headers

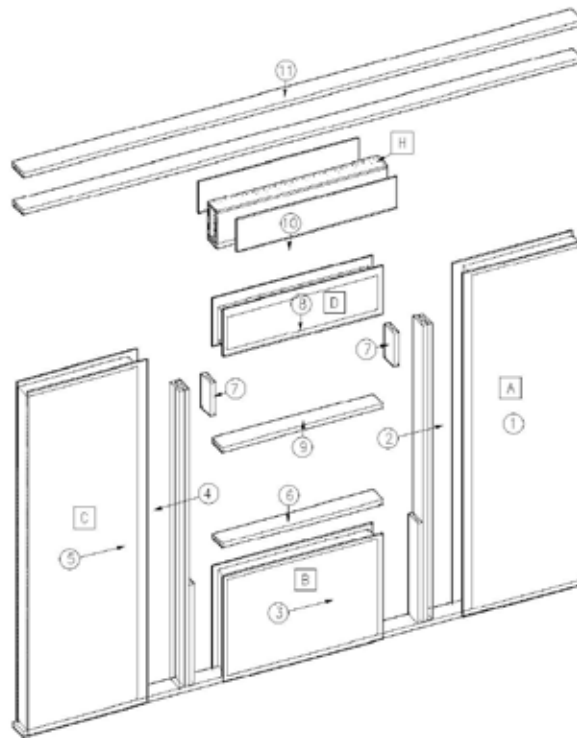
Window size, header panel height, snow load, building size and truss point loads are all factors that determine if a header is needed. A general rule of thumb is no headers are needed on gable end walls. If a header is required, the size will be determined by an EPS engineer. Most box headers are pre-built and ready to install. Longer headers will be sent in pieces. The typical EPS header is a 2-ply 1-3/4"11-1/4" LVL with an eps foam core between, size may vary per job. Windows and doors will have 1 or 2 bearing studs. Openings over 6' may need full length studs to prevent deflection. The header will typically fill the entire distance between the opening and the top plates. On taller walls, a filler panel is installed beneath the header. Below are the two examples.

Header only:



- 1) Start by erecting panel "A"
- 2) Pre-assemble all bearing and filler studs into the panel.
- 3) Slide panel "B" into panel "A".
- 4) Pre-assemble all bearing and filler studs into panel "C".
- 5) Slide panel "C" into panel "B". Check horizontal rough opening dimension.
- 6) Install lower opening framing.
- 7) Drop header "H" into opening and sheath both sides of header with loose OSB.
- 8) Continue with wall and install top plates.

Header and panel:

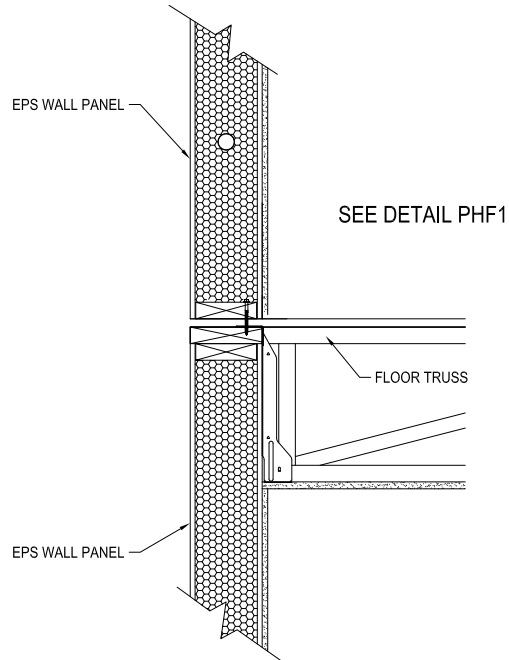


- 1) Start by erecting panel "A"
- 2) Pre-assemble all bearing and filler studs into the panel.
- 3) Slide panel "B" into panel "A".
- 4) Pre-assemble all bearing and filler studs into panel "C".
- 5) Slide panel "C" into panel "B". Check horizontal rough opening dimension.
- 6) Install lower opening framing.
- 7) Install filler panel blocking.
- 8) Slide upper panel into place and verify rough opening dimension.
- 9) Install upper opening framing.
- 10) Drop header "H" into opening and sheath both sides of header with loose OSB.
- 11) Continue with wall and install top plates.

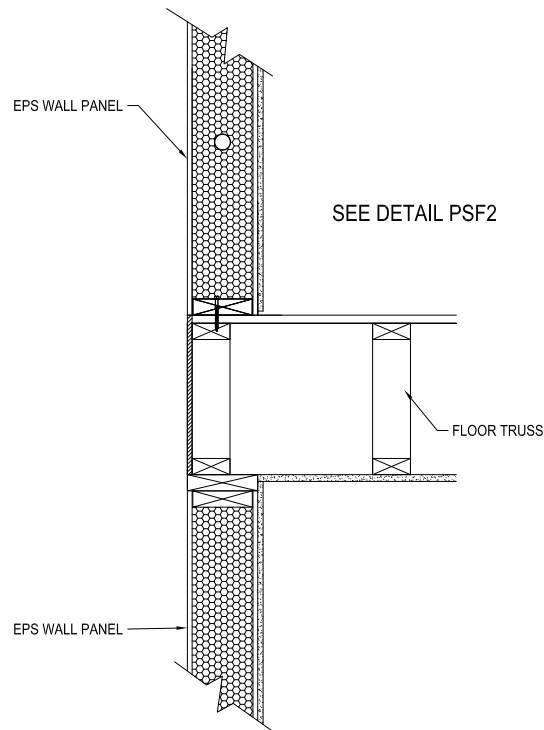
VII. Upper Floors

Many times a house will have more than one floor. Two options exist; conventionally framing the floor or hanging the floor system.

Option #2 (Hanging floor): (Pricing option "C")



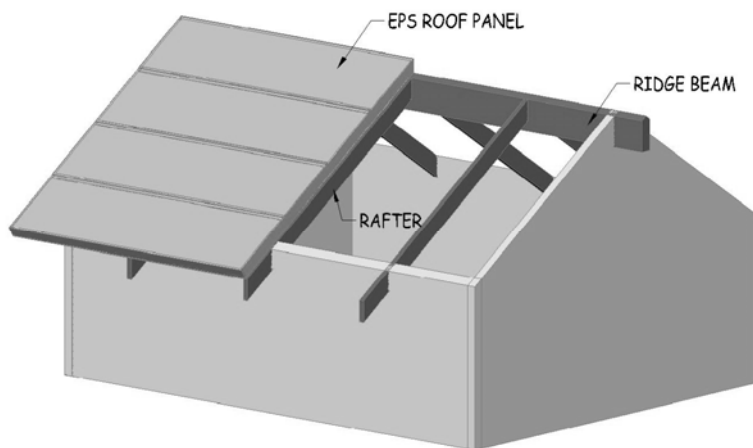
Option #1 (Conventional floor):



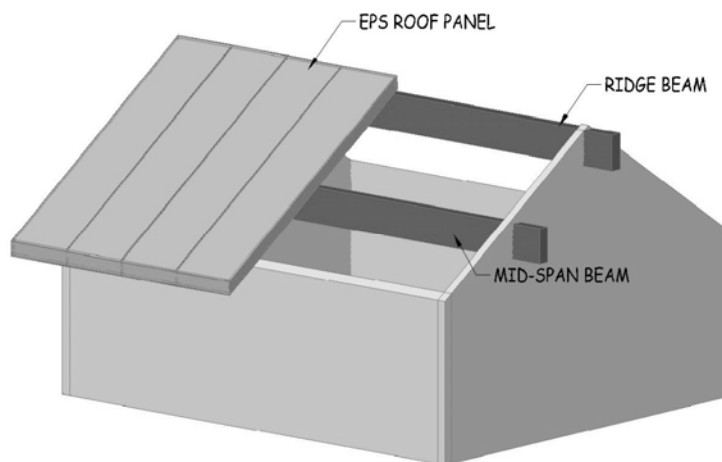
VIII. Roof Panel Installation

Roof panels range in overall thickness from 6-1/2" to 10-1/4". There are two basic ways to set roof panels; parallel to the ridge or perpendicular to the ridge. When panels run parallel to the ridge they typically have support rafters or trusses beneath that run perpendicular to the ridge. When panels run perpendicular to the ridge a mid-span beam may be needed. The span and snow loading will determine which spline is used.

Parallel to ridge:



Perpendicular to ridge:

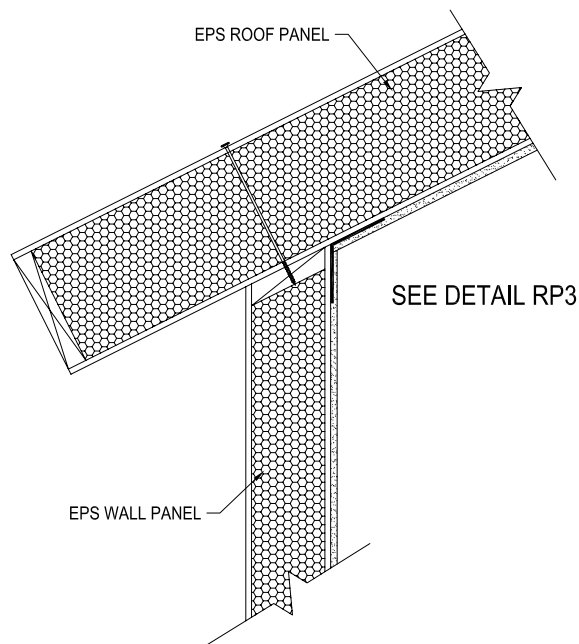


For efficiency, assemble as much of the roof as possible on the ground. This will reduce the time in the air. Some panels might fit together snugger than others. By using ratchet straps the panels can be pulled together. Depending on the size and type of roof, several panels can be put together on the ground and set in large sections. Grouping panels on the ground will also decrease the number of lifts. Roof panel sections are large and heavy so be sure to have a crane operator that has done this type of lifting before.

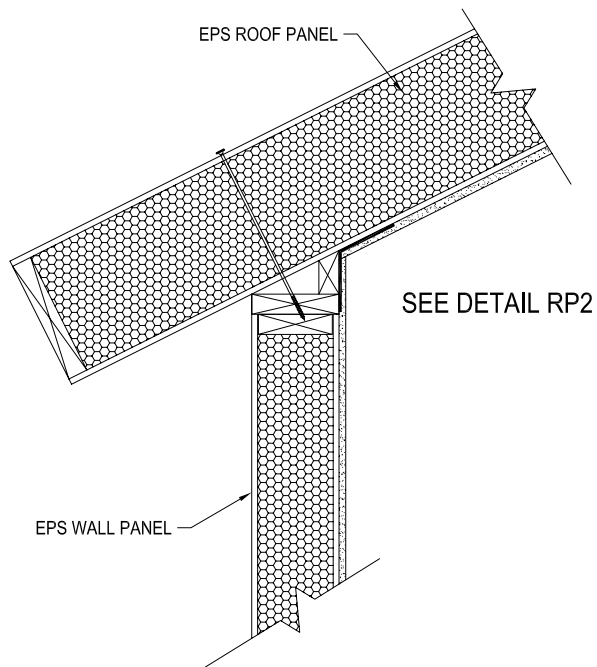
a. Wall to Roof Connections

When using roof panels the wall will be beveled or square. The beveled top plate matches the pitch of the roof panels and is the most energy efficient. A standard double top plate can also be used, with a bearing block installed after the panels are set.

Beveled top plate:



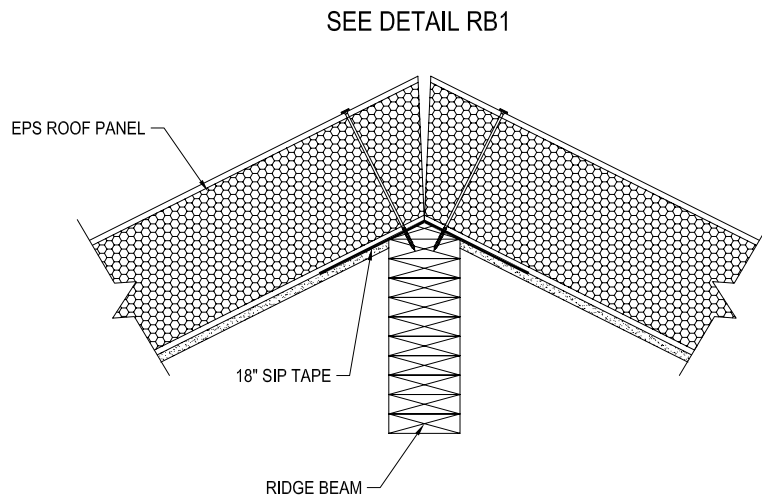
Double top plate:



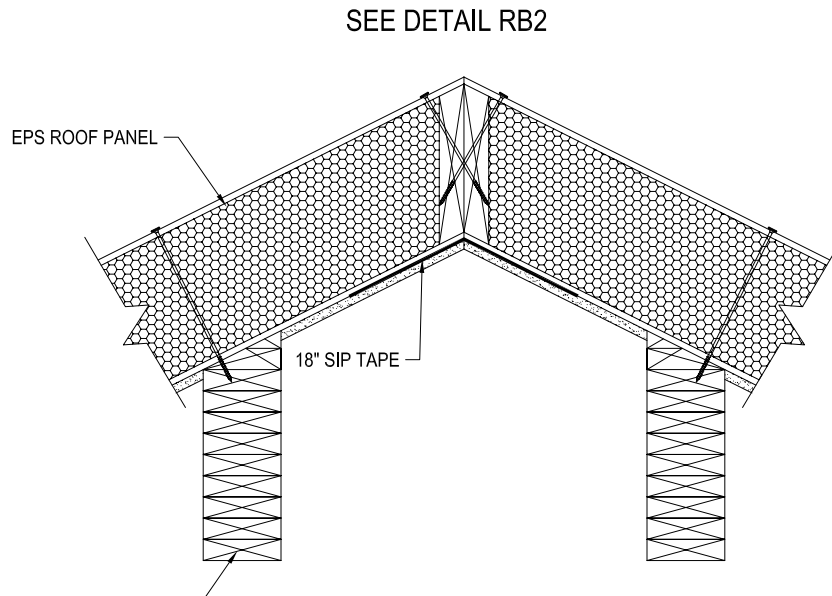
b. Ridge Connections

The type of ridge connection is determined by the direction of the panels and the type of support under the panels. Ridge beams can be either LVL or Glu-Lam's.

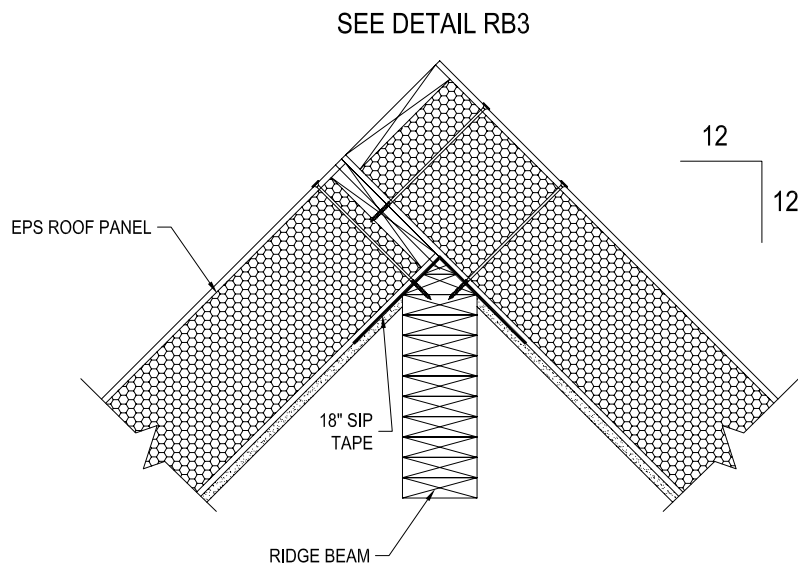
Ridge with void:



Cantilevered ridge with double lumber:

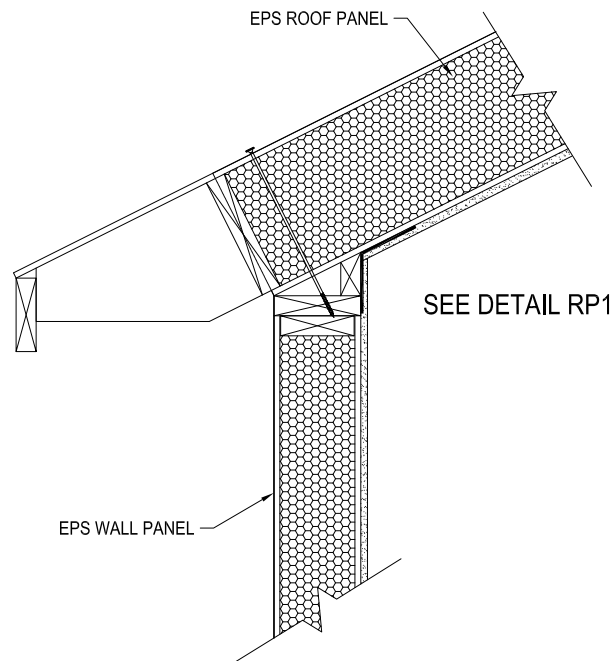
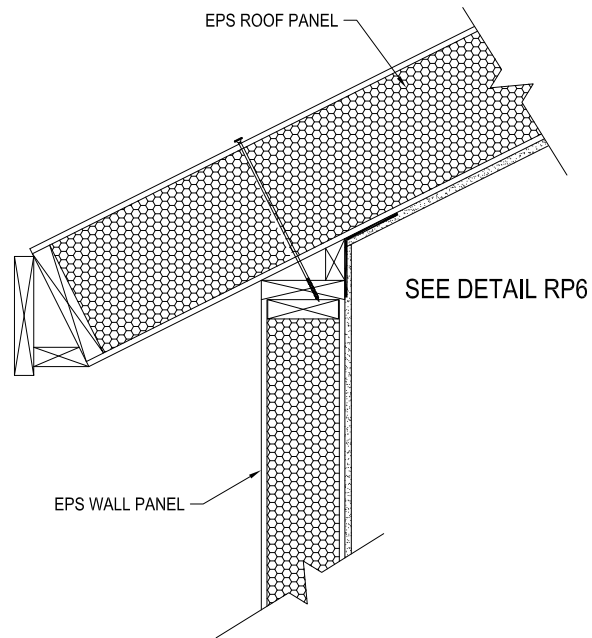


Ridge overlay (12/12 pitch only):



c. Eave Details

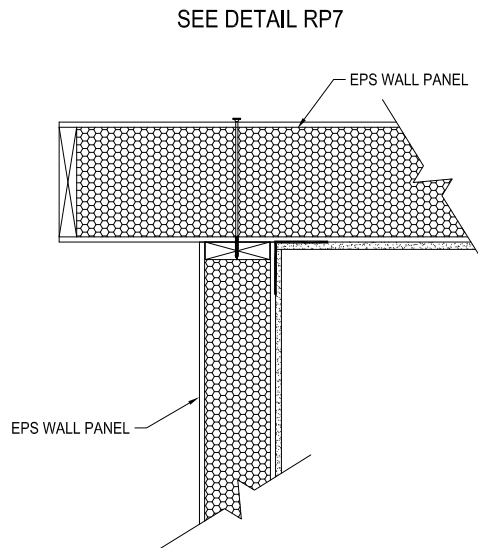
The eave detail will depend on the style of the house and the customer's personal preference. Refer to the detail manual for all eave styles.



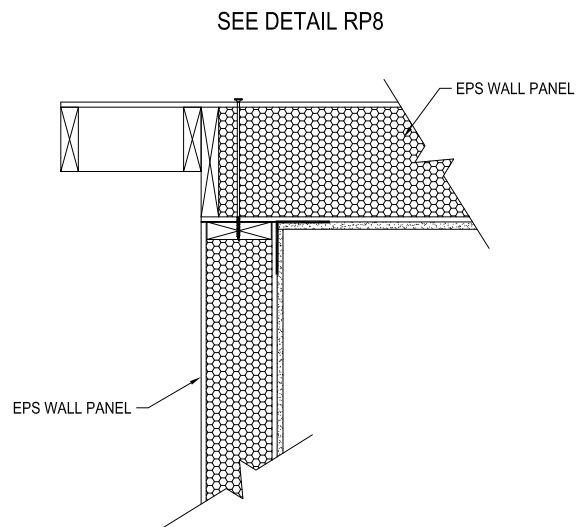
d. Rake Extension Detail

Typically gable end walls will extend up to the underside of a roof panel. When the wall is extended the double top plate is no longer needed. Refer to the construction details for all rake options.

Panel overhang:



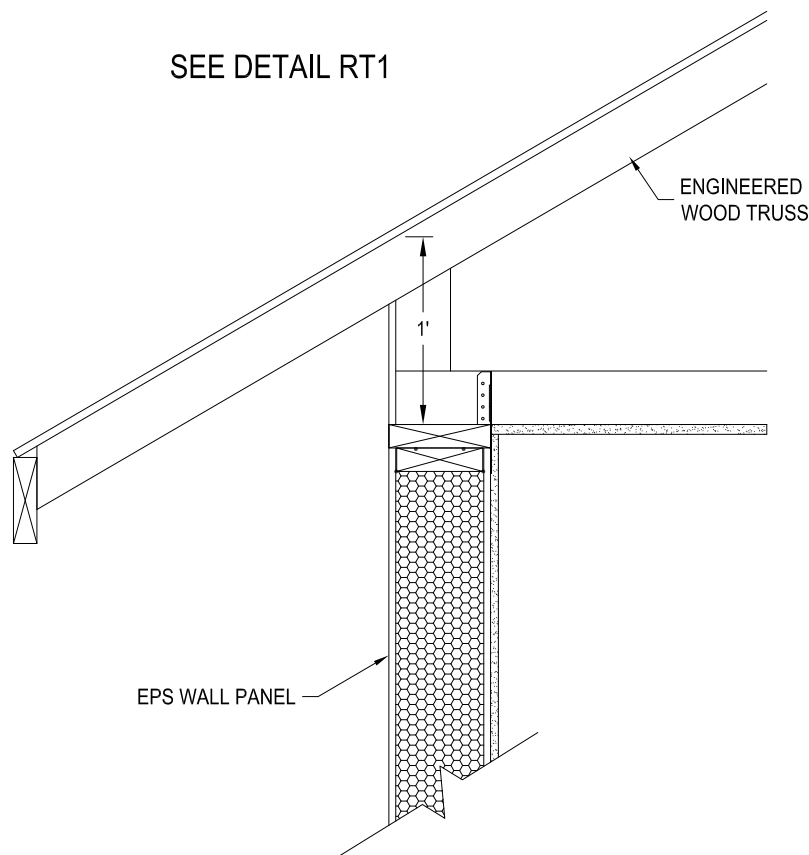
Ladder overhang:



IX. Roof Trusses

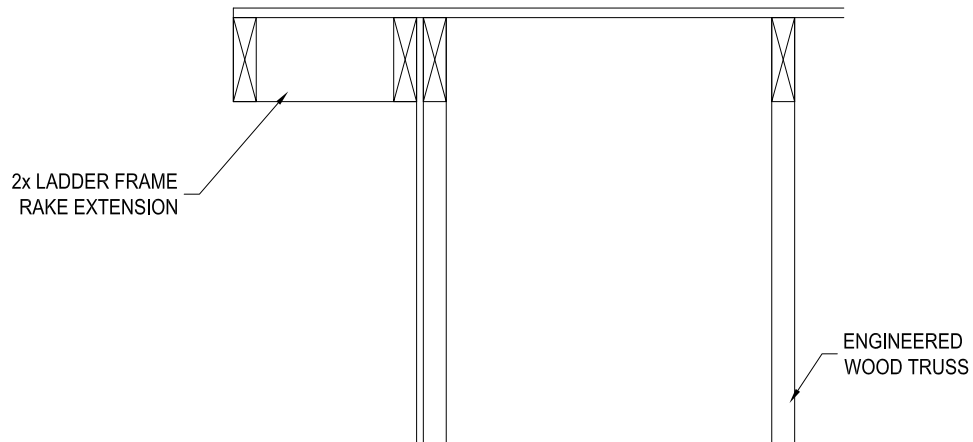
Along with roof panels, EPS also manufactures roof trusses. In many cases roof trusses may be a better option than roof panels. EPS standard roof truss features a 12" energy heel for optimal energy efficiency. Trusses are held back 1/2" to allow for the truss tails to be sheathed. Roof sheathing options are OSB and CDX with thicknesses of 1/2" and 5/8". Two options exist for the gable end rake extension, either a ladder framed overhang or an out-looker overhang with a dropped gable truss.

Eave overhang detail:



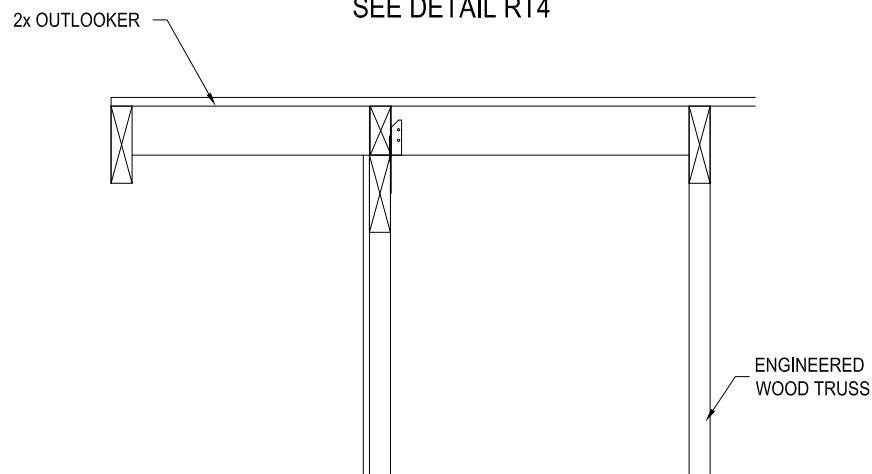
Ladder framed rake detail:

SEE DETAIL RT3



Out-looker framed rake detail:

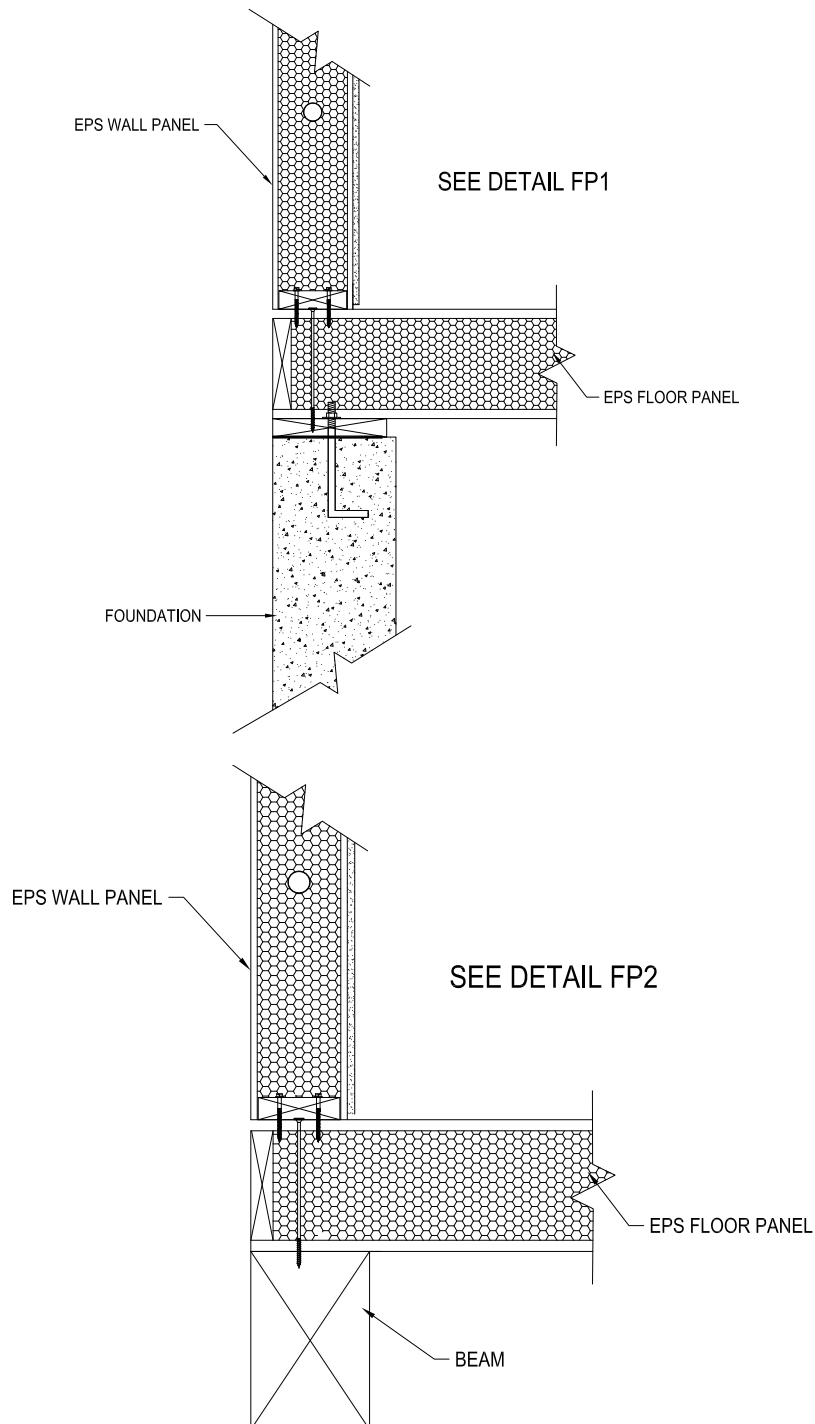
SEE DETAIL RT4



The contractor shall be familiar with the Building Component Safety Information (BCSI) manual. A BCSI manual is available from EPS upon request. Sections B1,B2 and B3 will be provided with all construction prints. It is the contractor's responsibility to read and understand this manual. EPS will provide all permanent bracing material. The contractor is responsible for all temporary shoring and bracing.

X. Floor Panels

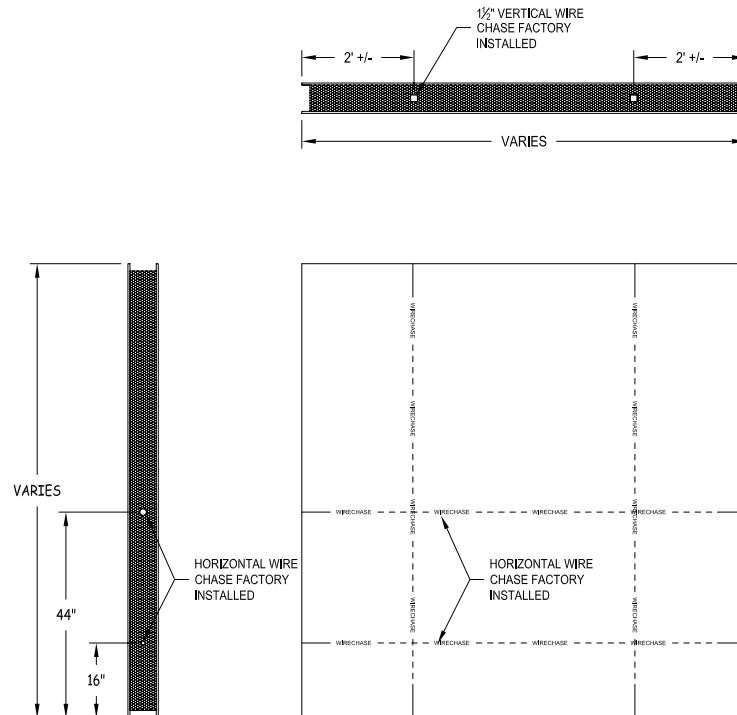
EPS offers floor panels to be used over crawl spaces or with a pier and beam foundation. These panels can be made out of a variety of panel thicknesses and skin make ups.



XI. Wiring & Plumbing

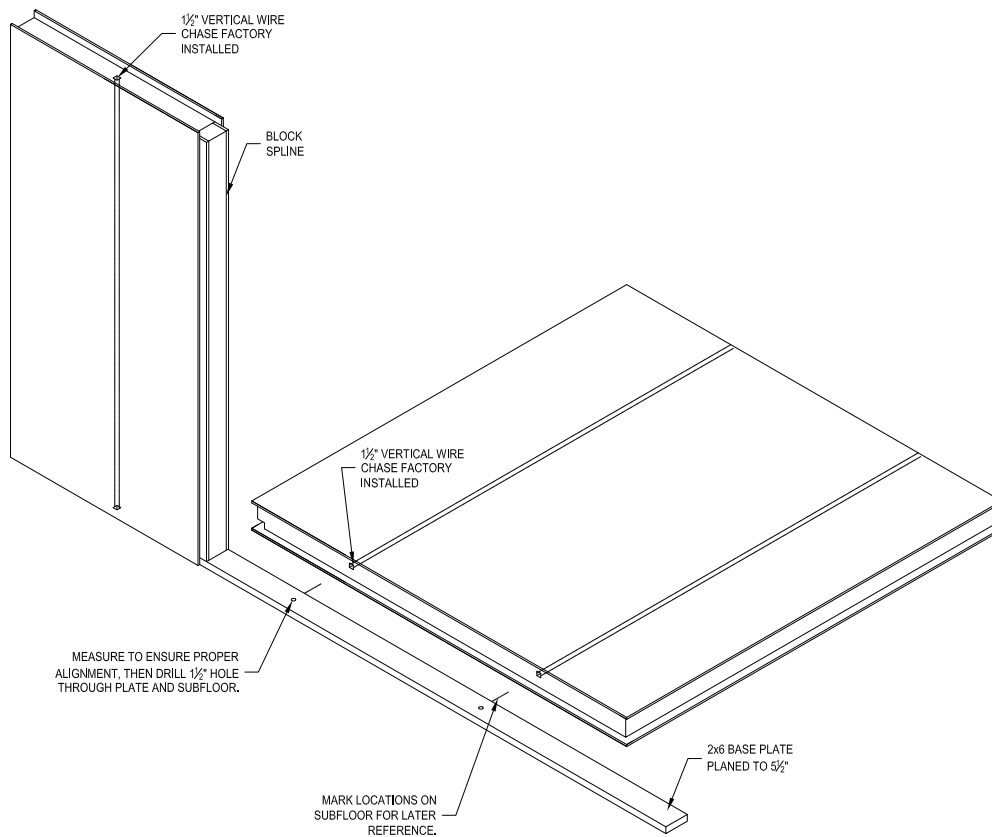
a. Wire Chases

Wire chases are factory installed into every EPS panel unless otherwise noted. Vertical wire chases are installed approximately 4' O.C. with an optional horizontal wire chase at 16" and/or 44" off the floor. Vertical wire chases are provided within 8" of door openings.



The wire chases will be marked on both panel skins with a black marker at both vertical and horizontal locations. If the chase is not marked be sure to mark it before the panel is installed.

Before the panels are installed, take a few minutes to mark the subfloor and drill 1 1/2" access holes through the base plates and subfloor. These few minutes may save hours later on. Once the panels are installed a 1 1/2" hole will also need to be drilled through the top plates.

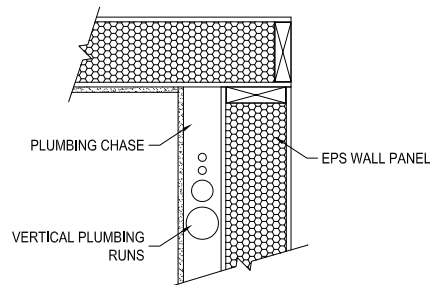
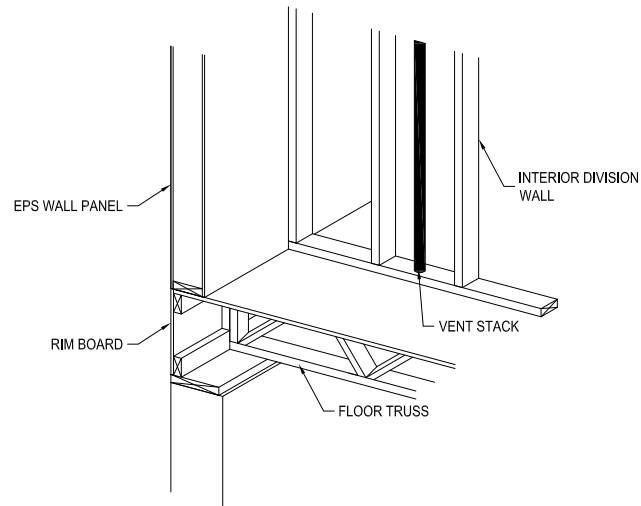


b. Boxes

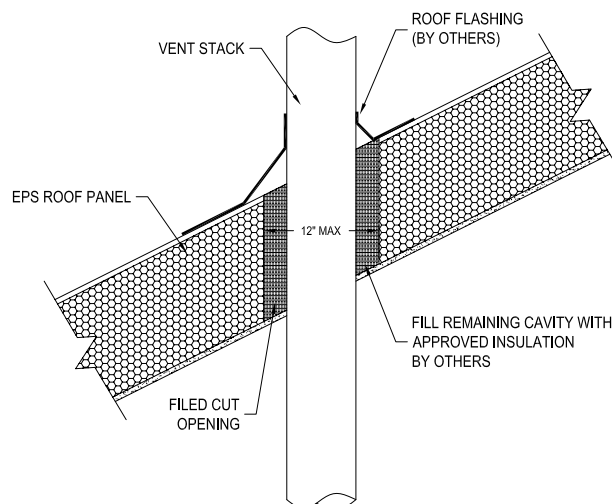
Electrical boxes may be cut into the interior skin by using a router, or a hole saw. A retro fit electric box may be used to fasten the box in the center of a panel. If the box is next to a stud or column spline then the box can be fastened to the lumber.

c. Plumbing

Running plumbing lines through SIP walls is not recommended. Plumbing lines and vertical vents should be run through interior walls or through plumbing chases.

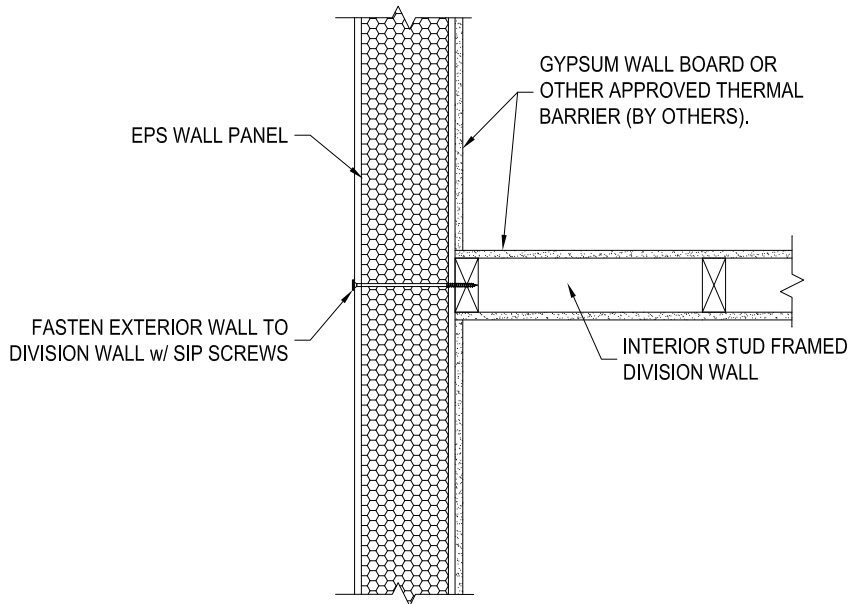


When using EPS roof panels, vertical vent stacks will need to be cut through the roof panel. Unsupported roof penetrations are allowed up to 12". Anything larger will require engineered supports within the panel.

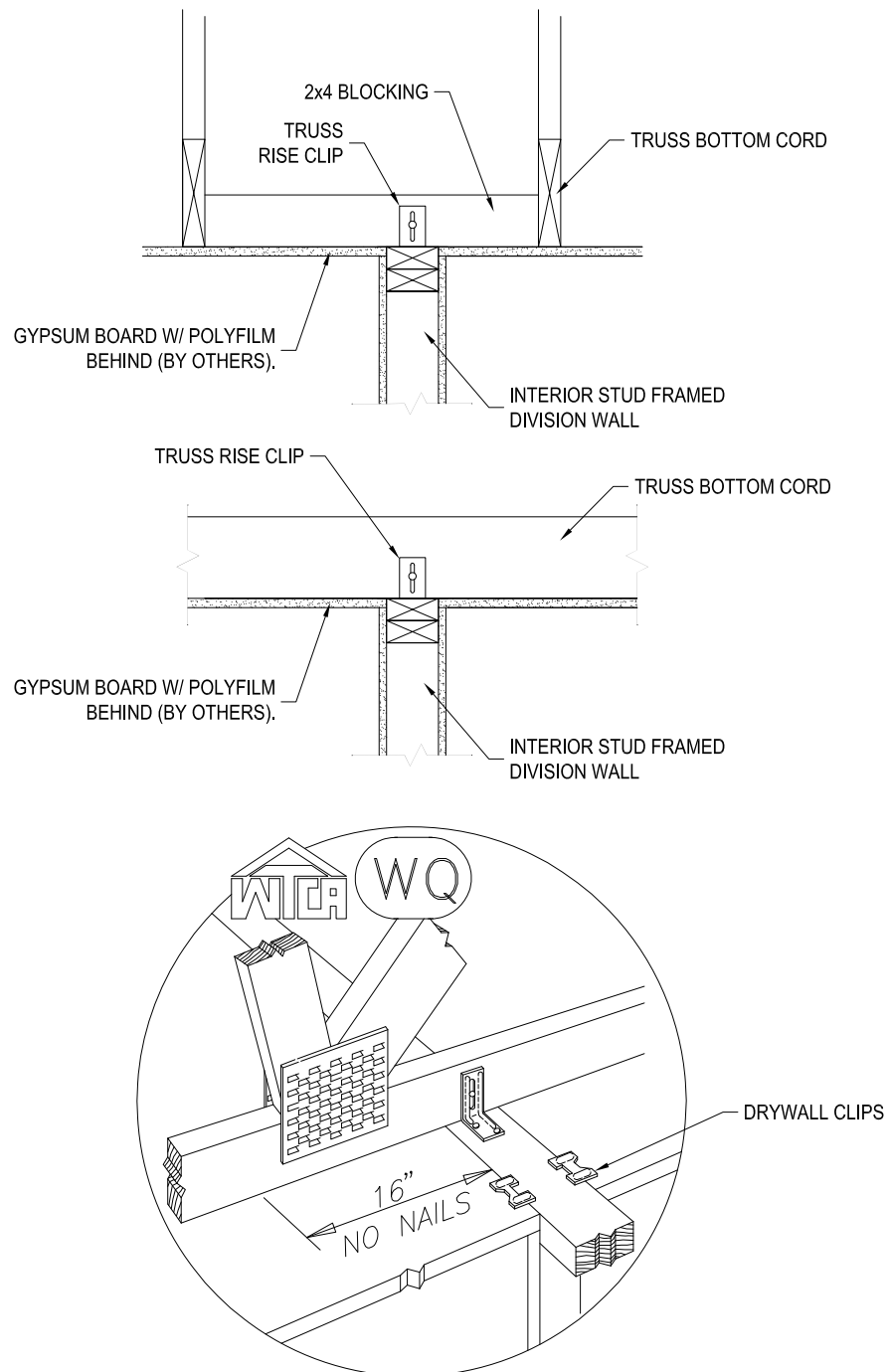


XII. Division Walls

Division walls are a part of almost every project. EPS recommends fastening interior division walls to the panels with SIP screws. This will help prevent drywall separation and cracking in the corners. A floating drywall corner may also be used.



Division walls that are connected to roof trusses should use a truss rise clip to help prevent drywall cracking during truss rise. In addition, drywall clips should be used and the ceiling drywall should not be fastened within 16" of the division walls.



XIII. Sealant, Tape, Adhesive & Fasteners

EPS provides all necessary sealants, tapes, adhesives and fasteners with each building package. Refer to cross sections and construction details for exact placement of each. Refer to fastening and adhesive schedule for proper quantities. Fastening schedule may change depending on location and conditions.

a. SIP-Seal

EPS uses Sustain SIP-seal sealant. This sealant is used for all foam to foam, foam to wood and wood to wood connections. SIP-seal will not harden or become brittle and remains flexible after it cures. It can be applied in temperatures between 0 F to 120 F and will not freeze. SIP-seal comes in 20 oz. sausage tubes that cover approx. 50' at 3/8" bead. EPS can provide a manual and battery operated sausage tube applicators.

b. One-Component (Gun foam-optional)

EPS uses "All Seasons" polyurethane foam gun sealant made by Touch-n Seal. This foam is called one-component expanding low pressure foam sealant. It is ideal for filling small gaps and cracks, providing airtight insulation that stops air infiltration. One 24 oz. can of the "All Seasons" will yield a bead 1/4"x 2,150'. The shelf life of a can will last as long as 12 months. Once the can is started, do not remove the gun until the can is empty; then purge gun and remove can. Clean gun thoroughly with acetone or polyurethane foam cleaner. Do not allow foam to harden in the gun. For more information on foam sealants go to www.touch-n-seal.com.

c. Two-Component (optional)

For large voids and cavities that need filled, a two-component foam may be required. Two-component foam kits are not a part of a standard package, but can be sent upon request. For more information on foam sealants go to www.touch-n-seal.com.

d. Tape

SIP tape is used at all roof seams to prevent air infiltration. Ensure all surfaces are clear of any debris before applying. Tape may not stick as well if surfaces are too cold. SIP tape comes in widths of 4", 9", & 18". SIP tape is also used under panels that rest directly on concrete to prevent moisture from being wicked up into the panel skin. Refer to construction details for exact placement.

XIV. Ventilation

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, resulting in better indoor air quality. Ventilation systems can be designed to incorporate heat recovery ventilators (HRV's). These advanced systems harness heat being exhausted from the home and utilize it to heat the fresh air coming into the home for an even more efficient use of energy. Proper ventilation is important in all homes to preserve indoor air quality.

XV. MSDS

Some areas of the country may require MSDS sheets on the products going into the project. This information is lengthy and not needed by everyone. EPS can provide a complete MSDS packet upon request.

General Recommendations

EPS Structural Insulated Panels (SIPs) must be designed and installed in accordance with:

- All Applicable Codes
- Load Charts & Construction Details
- Information within Quotations & Drawings
- Following Items

Thermal Barriers

All interior surfaces of SIP panels must be finished with a minimum 15-minute thermal barrier, typically ½" gypsum board or 1X wood paneling. One hour fire rated systems can be achieved when constructed per listed design. Consult applicable codes regarding compliance requirements.

Mechanical Ventilation

Properly installed EPS SIP panels will greatly reduce air movement through walls and roofs. While fewer air exchanges saves energy, air quality is affected and humidity is increased possibly causing mold and mildew problems. A professional, familiar with tight construction such as SIPs, should design and install a HVAC system that includes an adequate fresh air ventilation system.

Vapor Retarders

EPS recommends the use of SIP tape at joints when mandated by code or required by climate conditions. Sealants applied to all connections (foam to foam, foam to wood, wood to wood) are required. In addition, a SIP tape must be installed at all roof panel connections including ridge.

Weather Resistive Barriers

Proper usage of sealants at panel connections is necessary. Flashing and sealants around all rough openings and penetrations is required. Properly installed house wrap will help protect the exterior OSB skin from damage due to moisture intrusion.

Storage, Handling and Protection

Store all panels in a level, well supported manner, fully covered with tarps or other protective wraps. When installing panels with a crane, straps or lifting plates should be used. Roof panels must have temporary water resistant paper applied after installation. EPS uses exposure I rated OSB skins which withstand limited weathering. The weatherproof exterior cladding system must be installed promptly. While SIPs are treated to resist termite and carpenter ant intrusion, standard deterrents such as insect clips, flashing or tarps should be installed.

Other Resources

- APA The Engineered Wood Association series “Build a Better Home” www.apawood.org
- NAHB National Association of Homebuilders www.nahb.com