BUILDING WITH STRUCTURAL INSULATED PANELS (SIPs) *WITHOUT* ADDING COST

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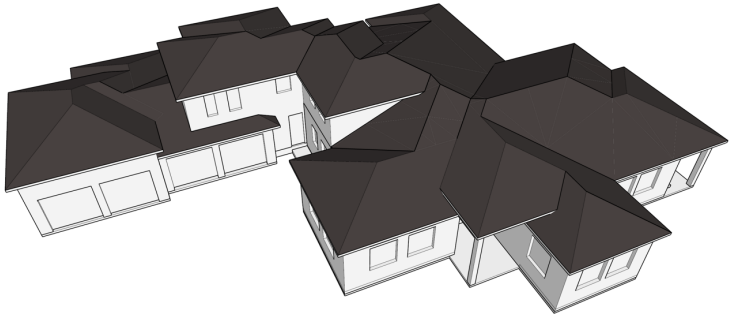
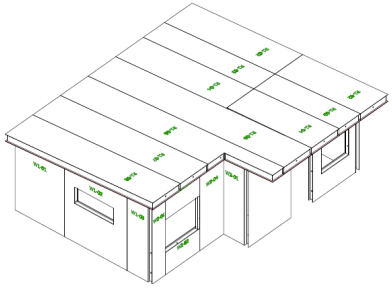
COMFORT CASITAS
Quality Green ADU Design

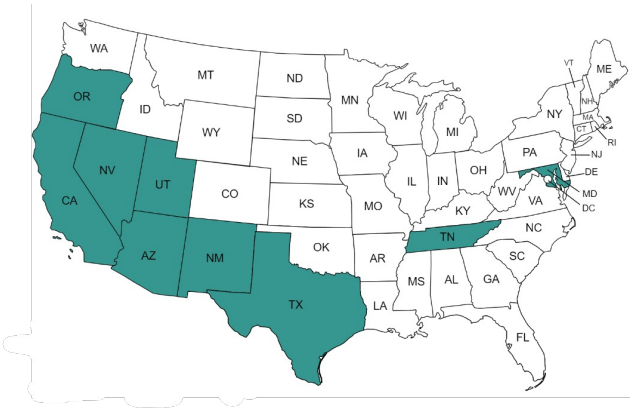
Bertolami Engineering
Engineering & Architectural Drawings

SIP Resume

- Professional Civil Engineer (CA, NV, OR, UT, AZ, MD, NM, TN, & TX)
- Bachelor's & Master's in Mechanical Engineering
  Cal Poly, San Luis Obispo & Stanford University
- Designing with SIPs since 2017
  Engineering in California since 2008
- Member of SIPA (Structural Insulated Panel Association)







PRESENTATION ROADMAP

- Review of Structural Insulated Panels
- How Can Architects Design for SIPs?
- What Can SIPs Do for Architects?
- 10 Common SIP Structural Engineering Mistakes
- Building a SIPs Structure
- SIPs and Energy

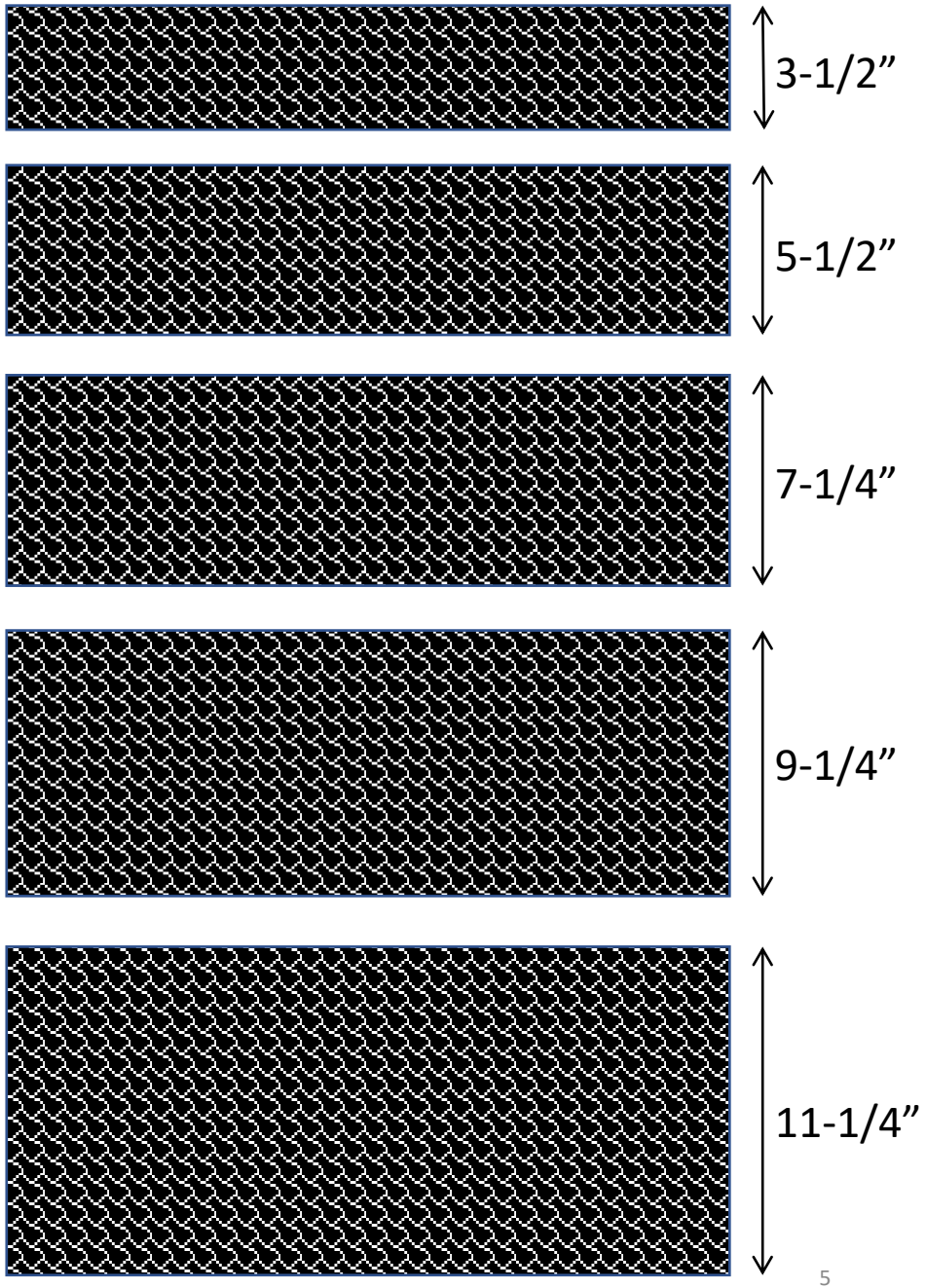
Review of Structural Insulated Panels

What is a SIP?

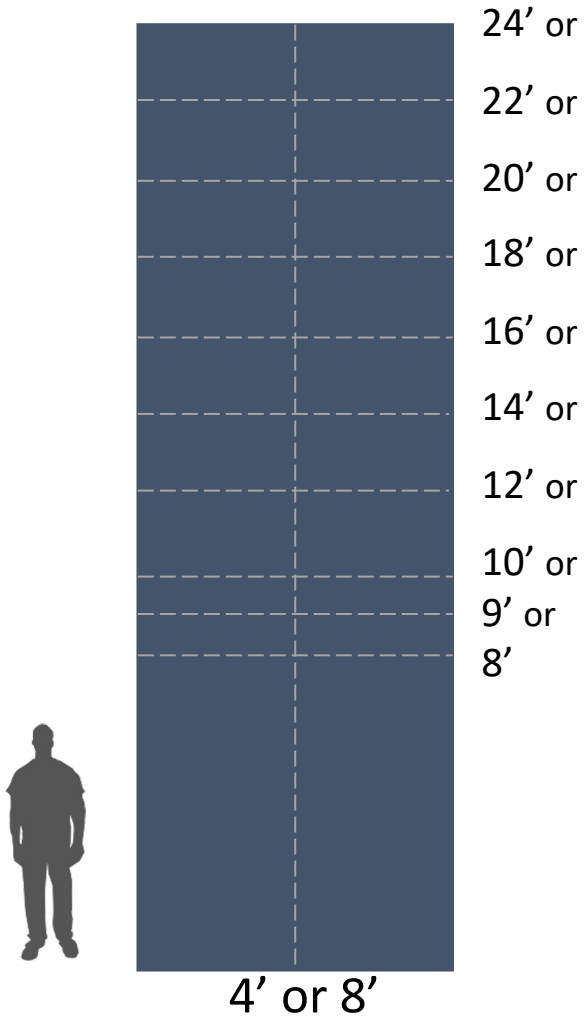
7/16” Oriented Strand Board (OSB)

Expanded Polystyrene Foam Core (2x width)

7/16” Oriented Strand Board (OSB)



How big is a SIP?



Note: SIP skins are a single piece of OSB.

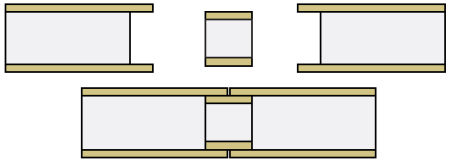
What can a SIP do?

- Replace Exterior Walls, Floors, Roofs
- Support Vertical Loads in Walls
- Support Transverse Loads (Wind against wall, Gravity Loads on Roofs and Floors)
- Support In-Plane Loads (Shear Walls and Diaphragms)
- Provide an Exceptional Environmental Envelope
- Provide Straight and Rigid Walls
- Provide Faster Construction Schedule

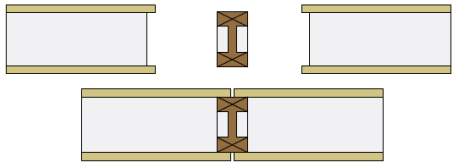
How do SIPs attach together?

Panels – with splines

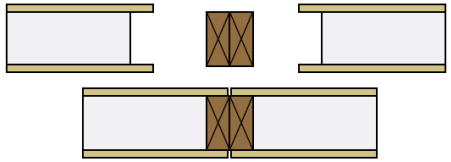
TYPE S SPLINE



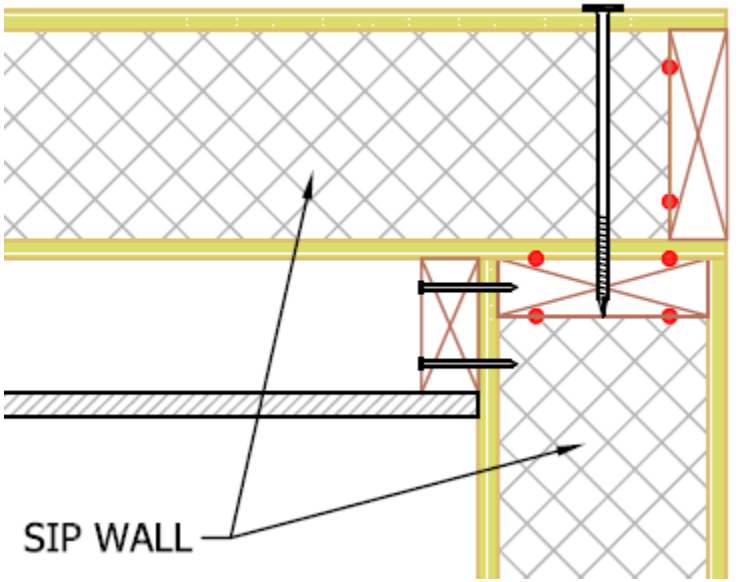
TYPE I SPLINE



TYPE L SPLINE



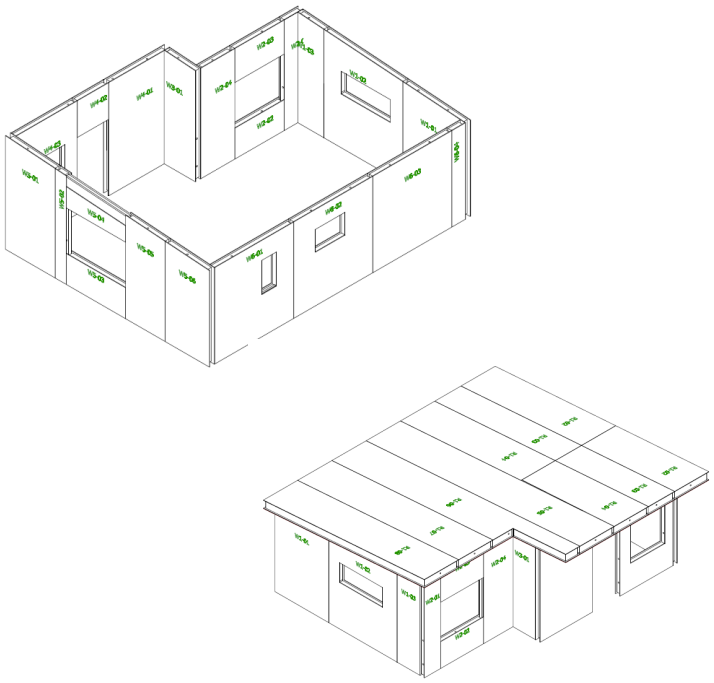
Corners – with SIP screws



How do SIPs make a house?

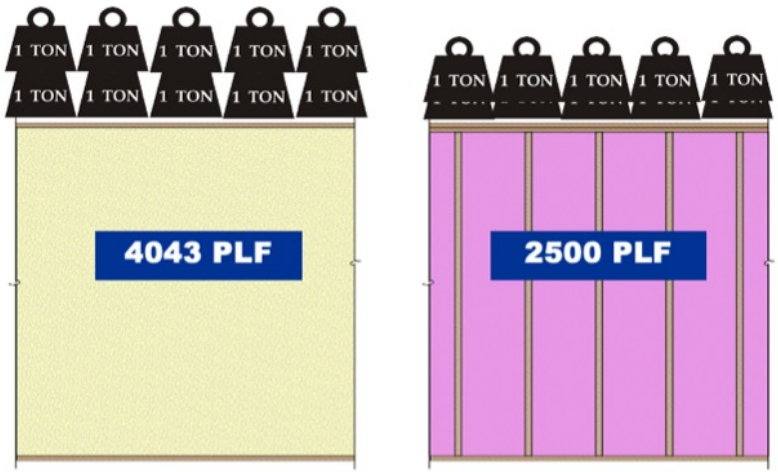
SIP manufacturer:

- Receives plans
- Creates shop drawings showing each type of panel and its location
- Fabricates the panels per plan

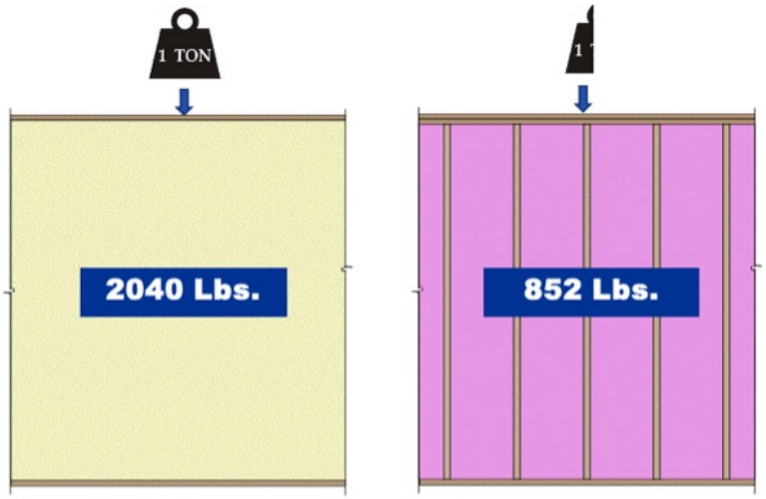


How do SIPs make a house?

How strong are SIPs?



2 tons of uniform load



1 ton of point load

How Can Architects Design for SIPs?

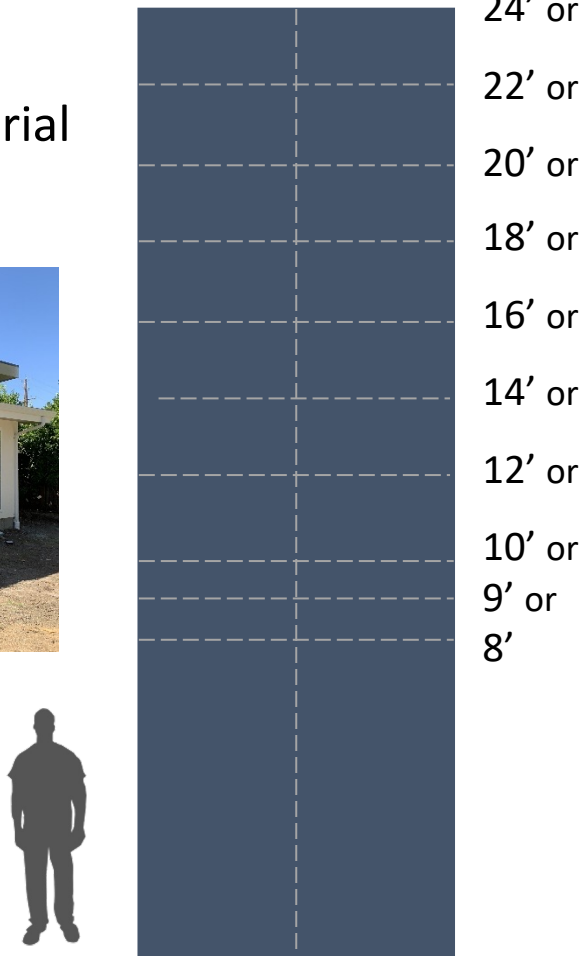
Structure Design

Plate Heights

- Use standard heights to avoid excess material/assembly time

Wall Lengths

- Keep 4’ and 8’ lengths in mind to save material and splines

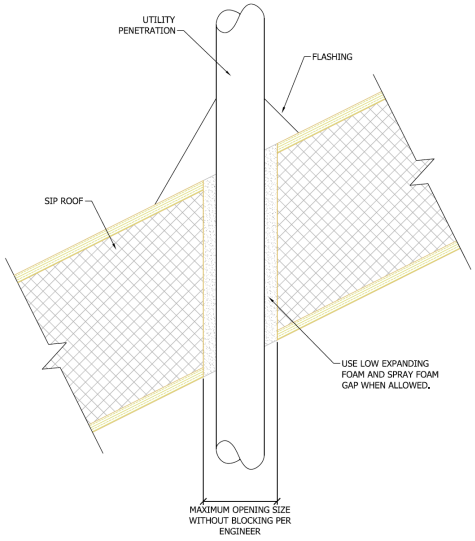


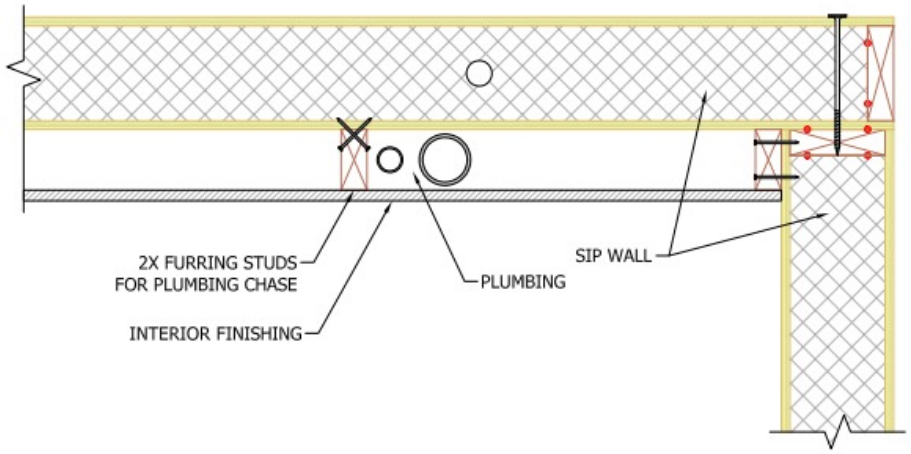
HVAC Best Practices

- Consider duct locations
- Dropped ceilings in bathrooms, closets, and hallways
- Soffits to access remaining parts of the structure
- Account for returns

Plumbing Considerations

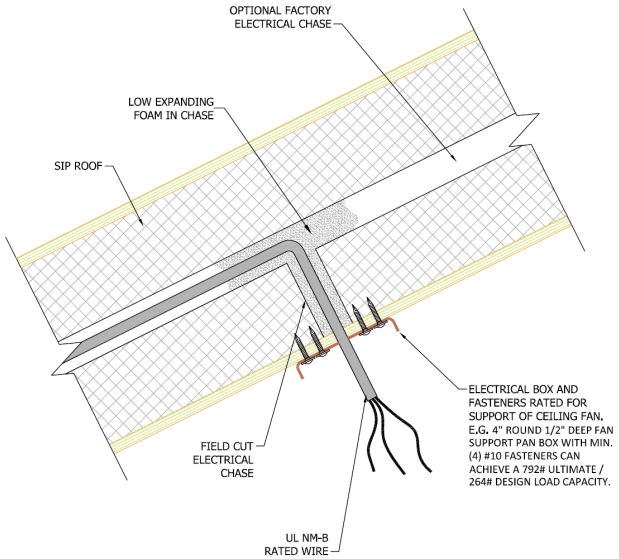
- Drill a hole through the SIP for water/gas lines
- Furring is a design option
- Never place plumbing lines in exterior walls
- Water lines cannot run inside a SIP wall

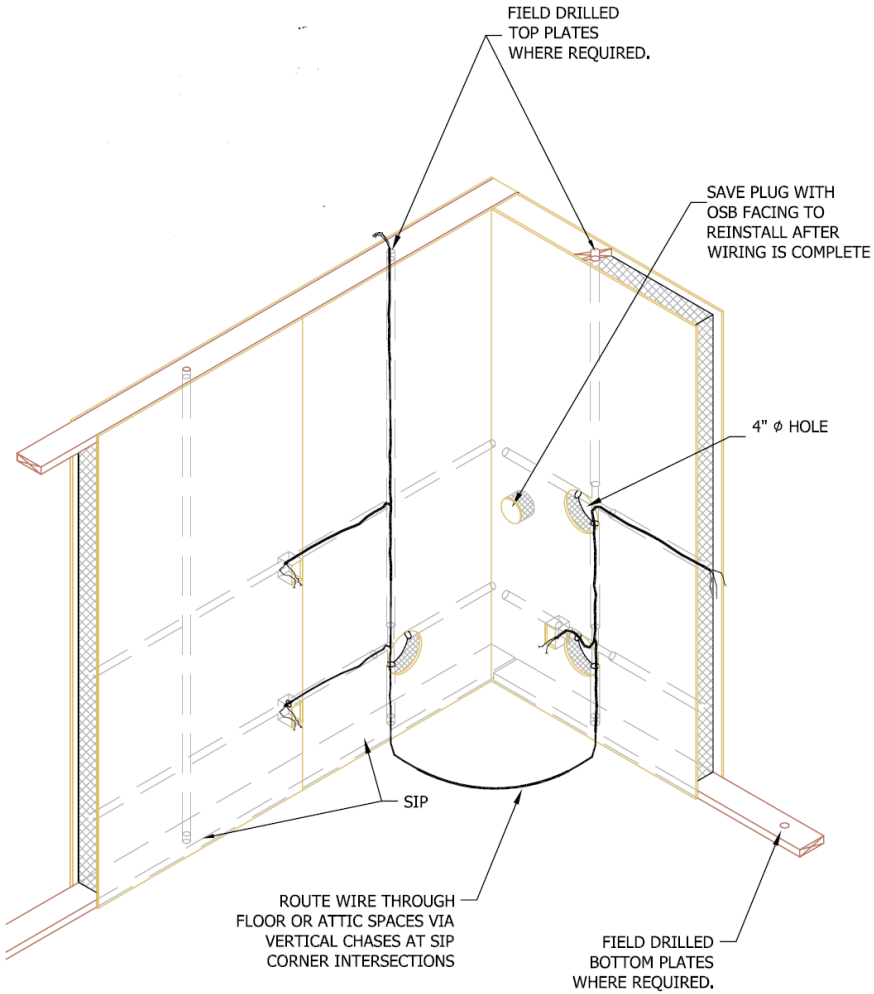




Electrical Considerations

- SIPs come with electrical chases
- Use 2X4 flush ceiling for recessed lighting
- SES can be surface mounted
- Can design SIPs around the SES





What Can SIPs Do for Architects?

Cathedral Ceilings

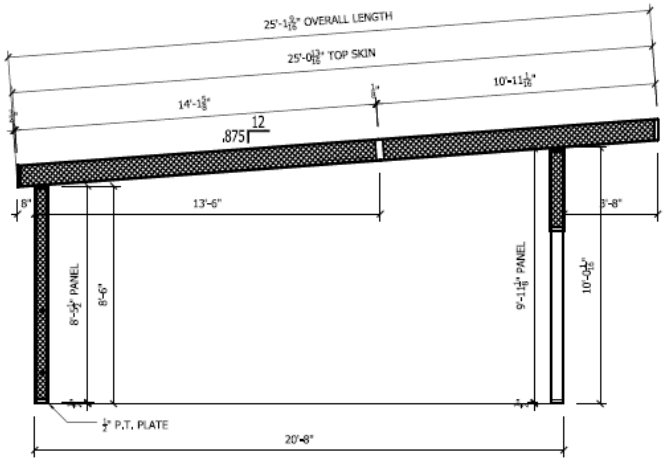
SIP Advantages:

- Long spans
- Avoid drywall sag and cracking
- 8’ plate height is a base for a tall ceiling feel

Long Overhangs

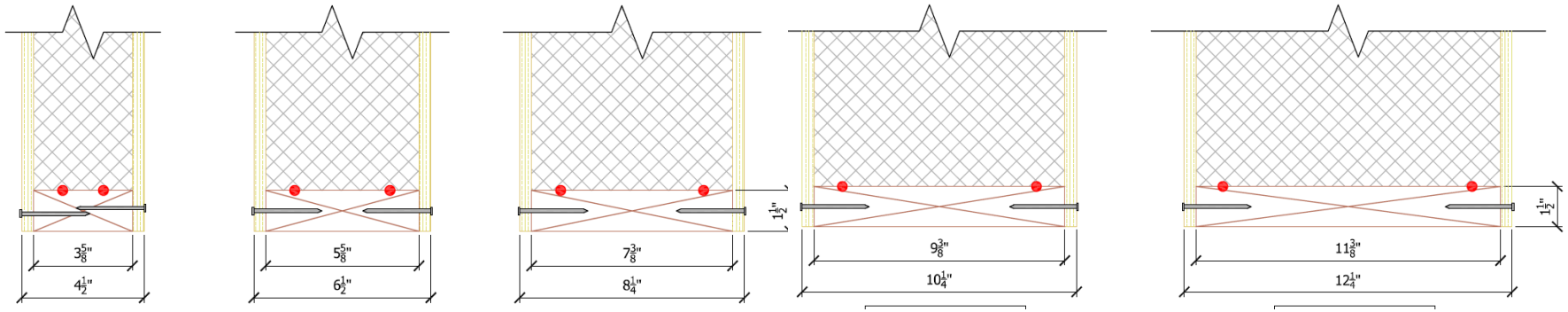
SIPs can cantilever up to 12’

- Must check loading



Wall Thickness Variation

- Wall thickness does not necessarily affect cost
- Double plumbing wall adds architectural flare in kitchens and bathrooms
- Can play with recesses
  - 12” thick wall with 8” recessed window
  - Special order thicker panels for a more dramatic recess



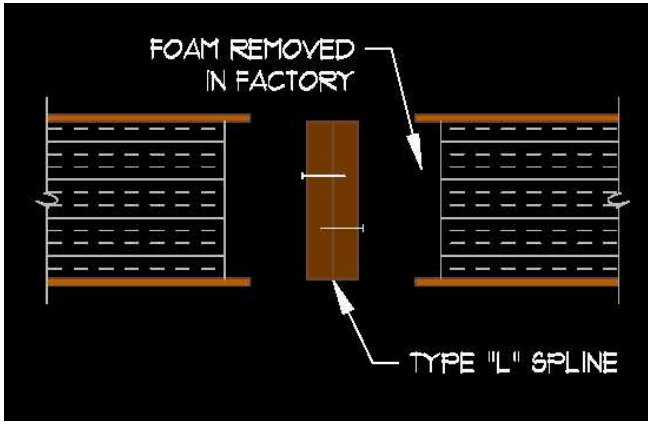
Corner Window Options

Need (2) “L” or “C” shaped panels

- No headers, no steel required
- No back-spans
- Just design it in!

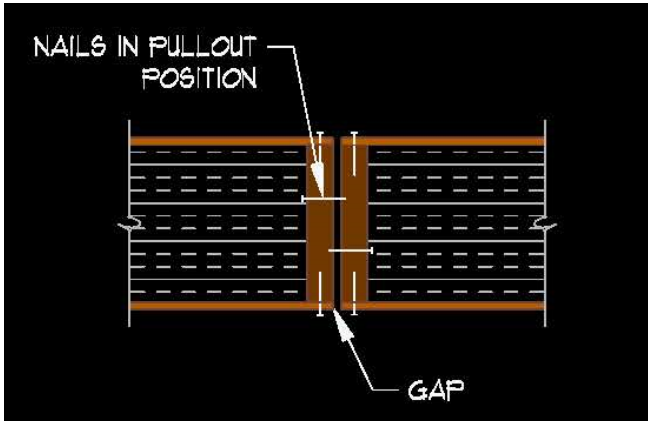
10 Common SIP Structural Engineering Mistakes

1 – Double Lumber Splines



Characteristics

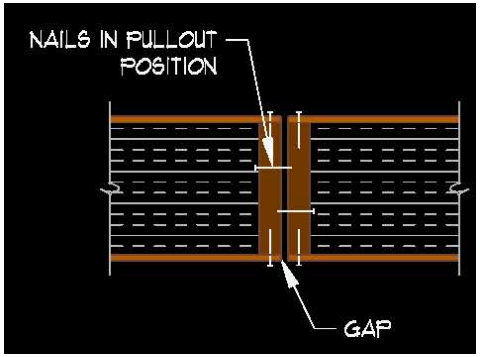
- Two 2x's nailed together
- Not straight
- "Through" joist created
- Thermal bridge created – R value similar to stick framing
- ICC requires this at 4'-0"
- Need to drill for electrical
- Vertical and transverse capacity of 10'-6" SIP by ~50%
- Typical wind force <30 psf
- Adds material and labor cost

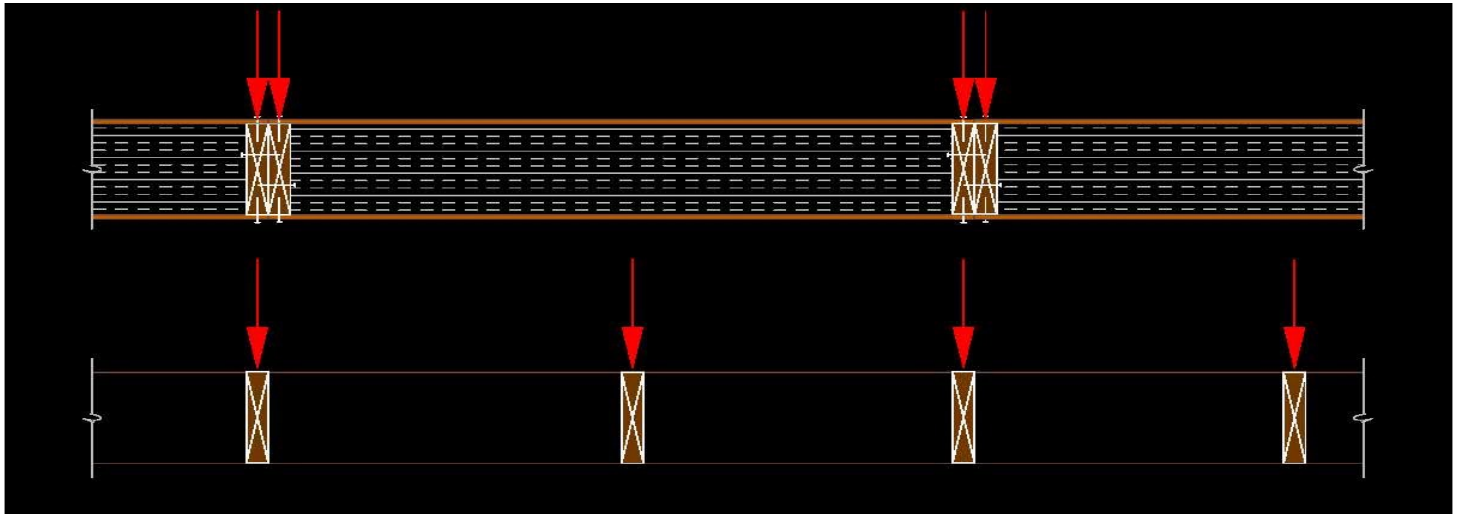


1 – Double Lumber Splines

Concerns

- 2x's will expand and contract with temperature changes
- Air will leak
- Once the "through" joist opens, does not close
- Nails in "pull out" position with little resistance
- Stucco and drywall will crack
- Placing (2) 2x's at 48" is just like placing (1) 2x at 24"

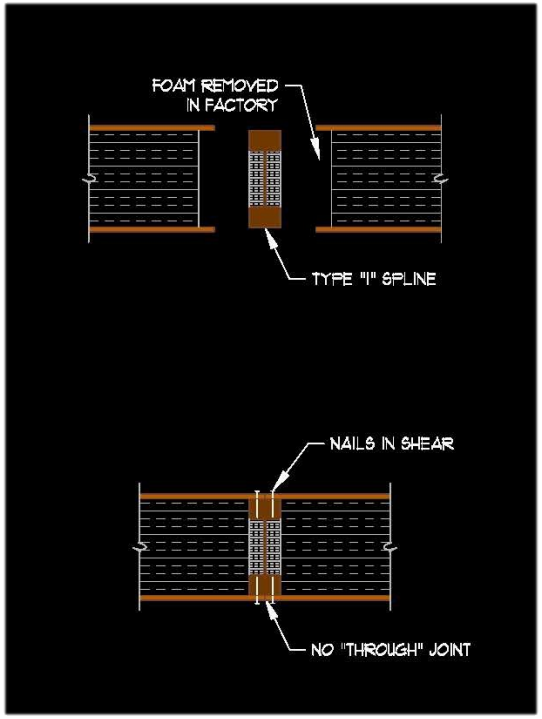




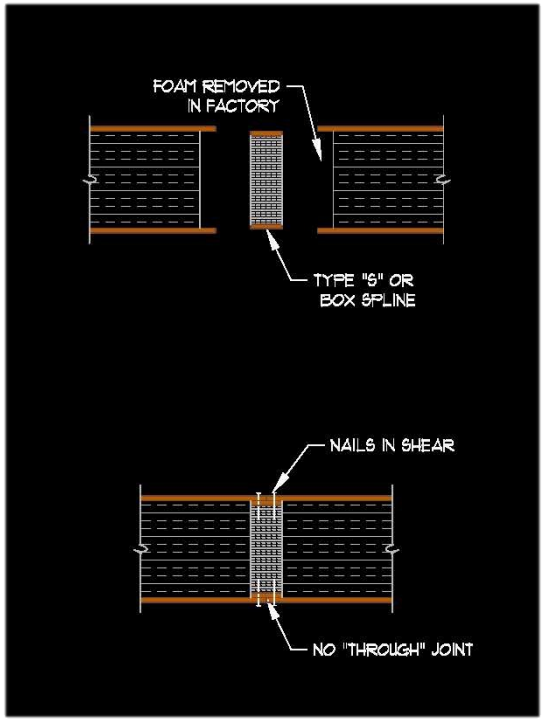
1 – Double Lumber Splines

Alternatives:

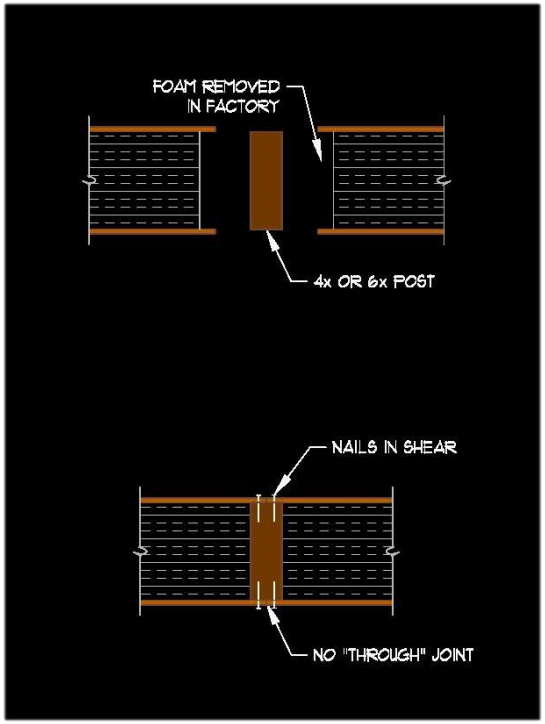
I Spline



S Spline



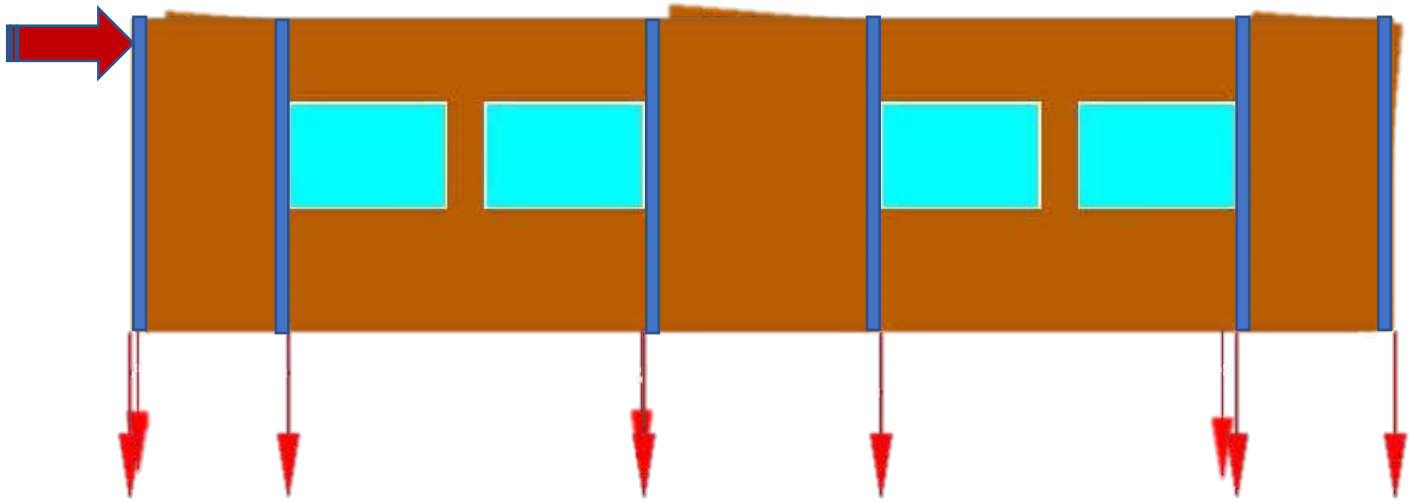
Post



2 – Shear Walls

Conventional Framing

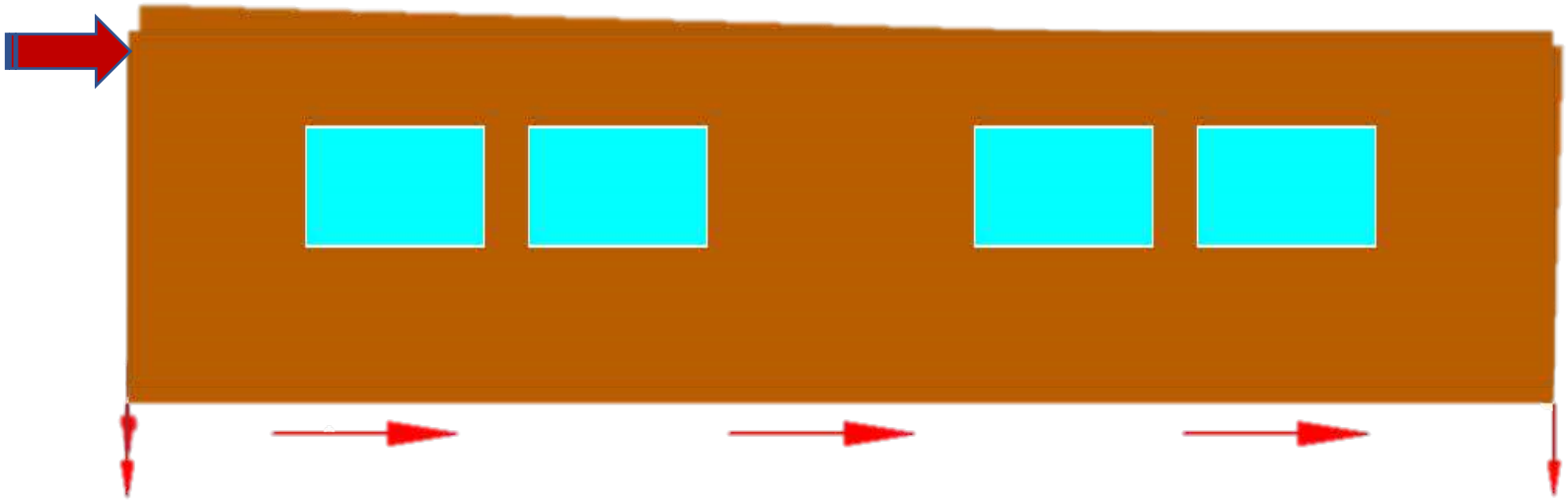
- Almost always designed as distinct shear panels
- Each shear panel acts alone
- Requires hold downs and extra lumber



2 – Shear Walls

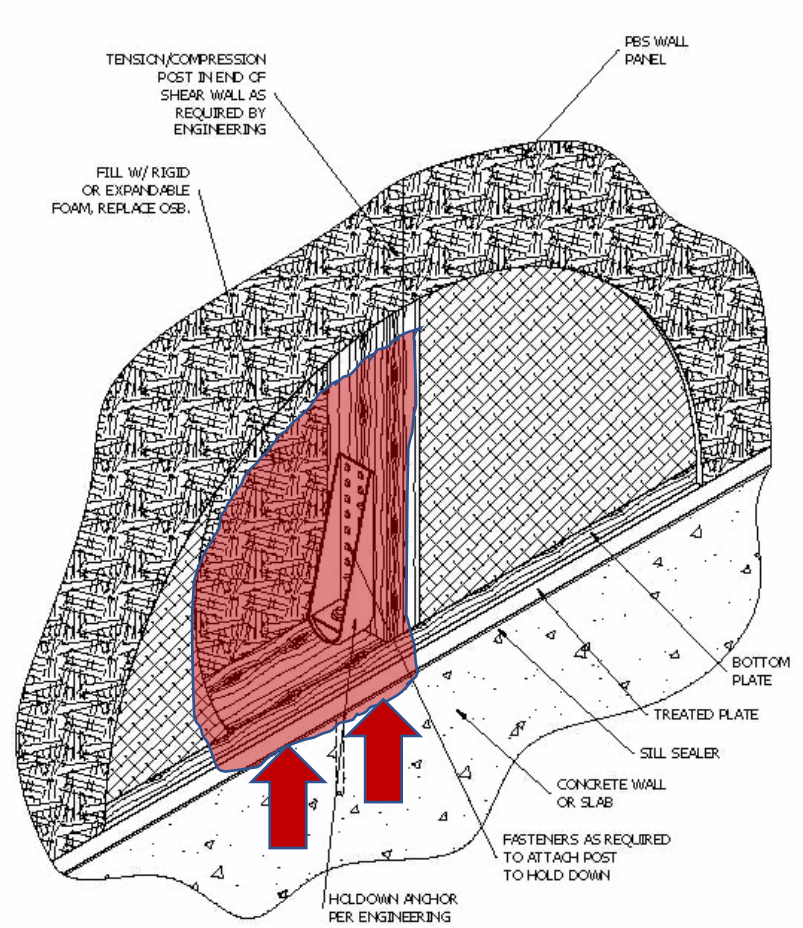
SIPs

- Act as a rigid diaphragm for the entire length of the wall
- Design your SIP as perforated shearwall

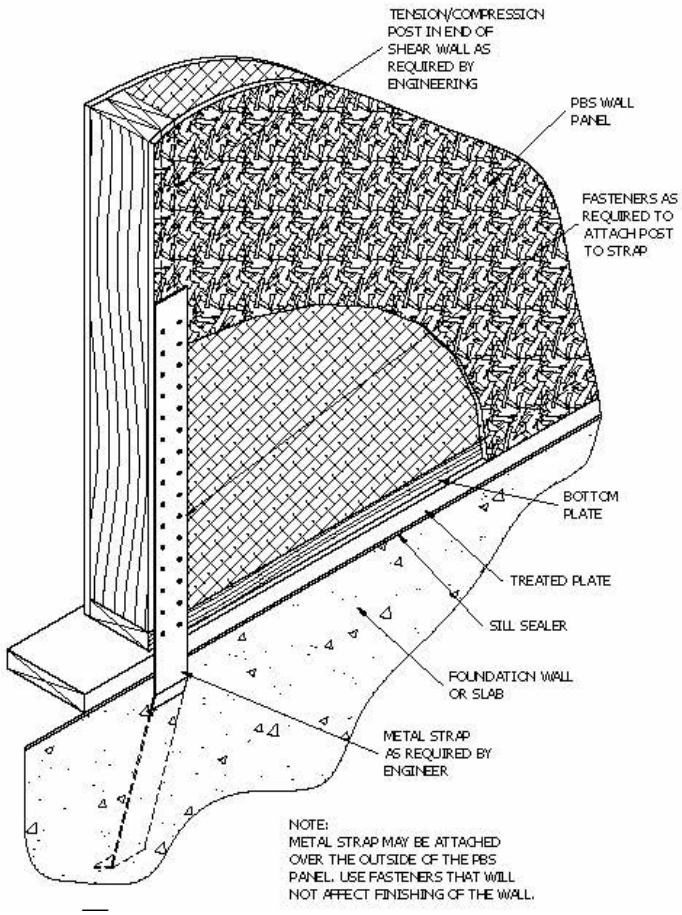


3 – Hold Downs

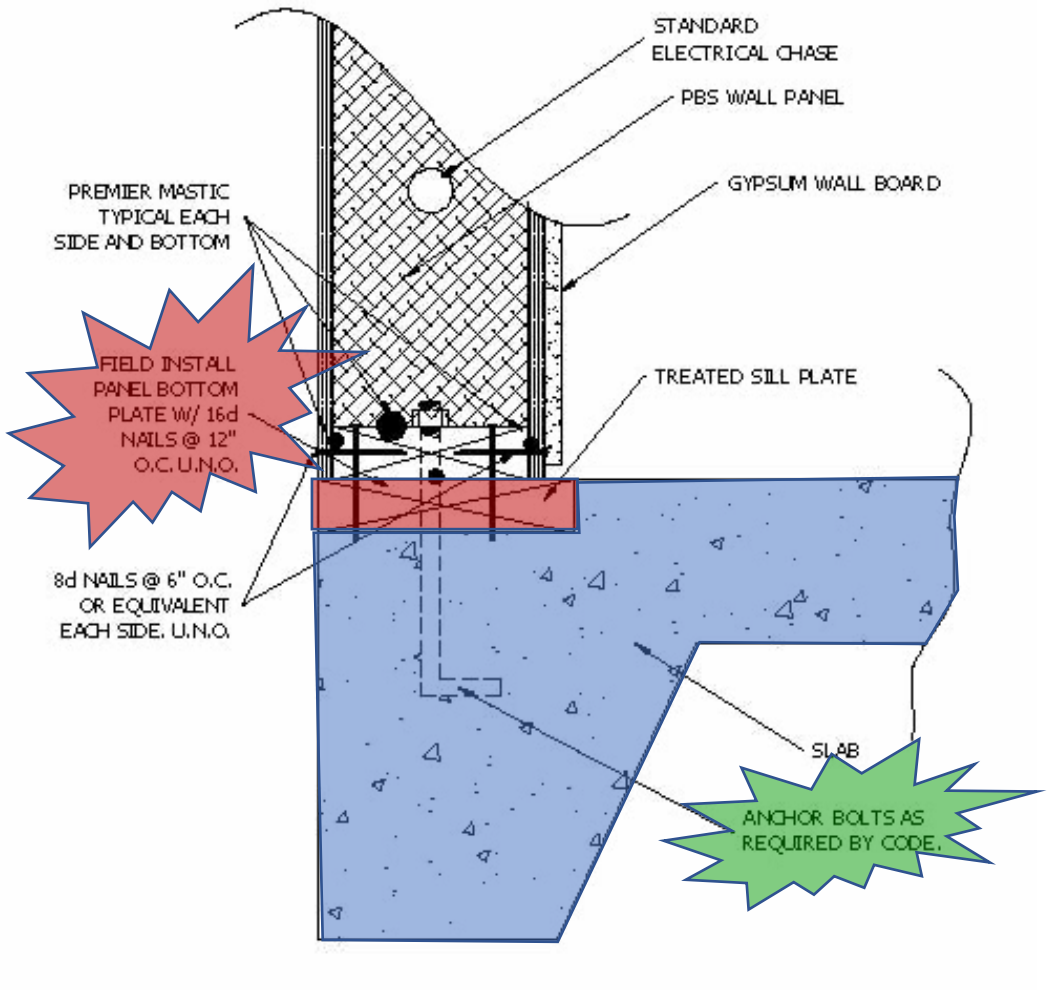
HDU Hold Down – Time/Cost



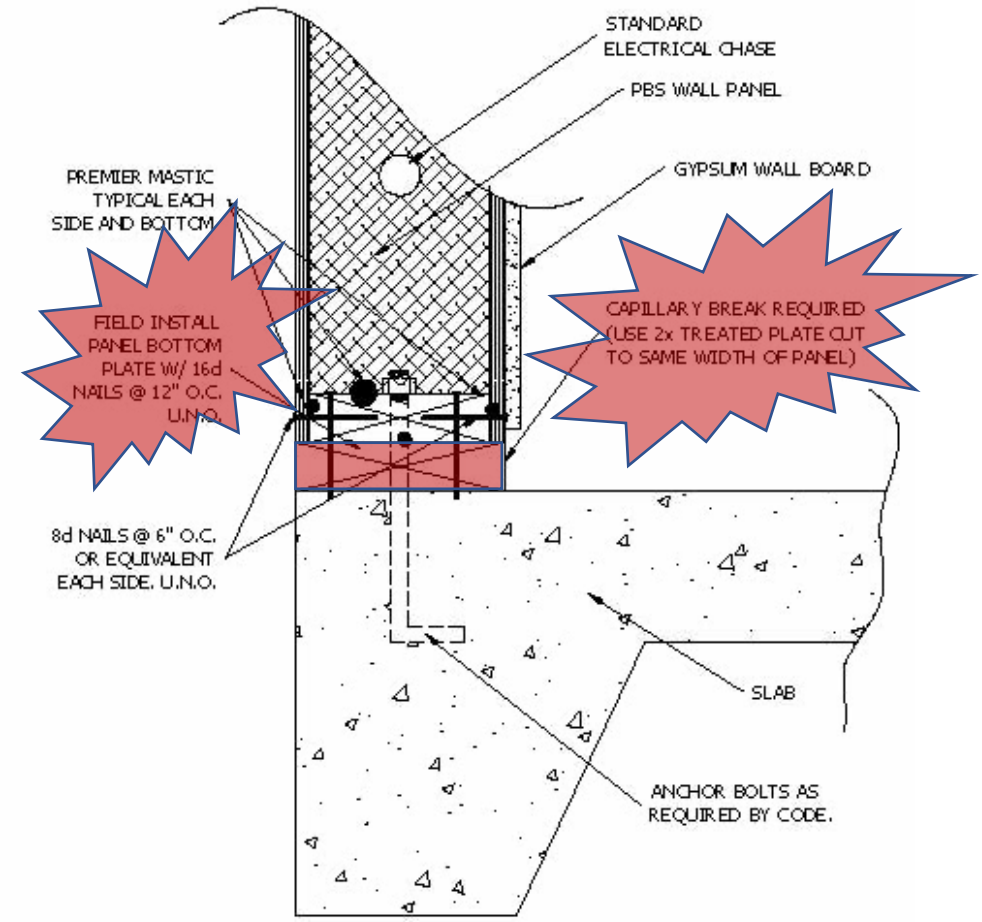
Strap Hold Down – More Efficient



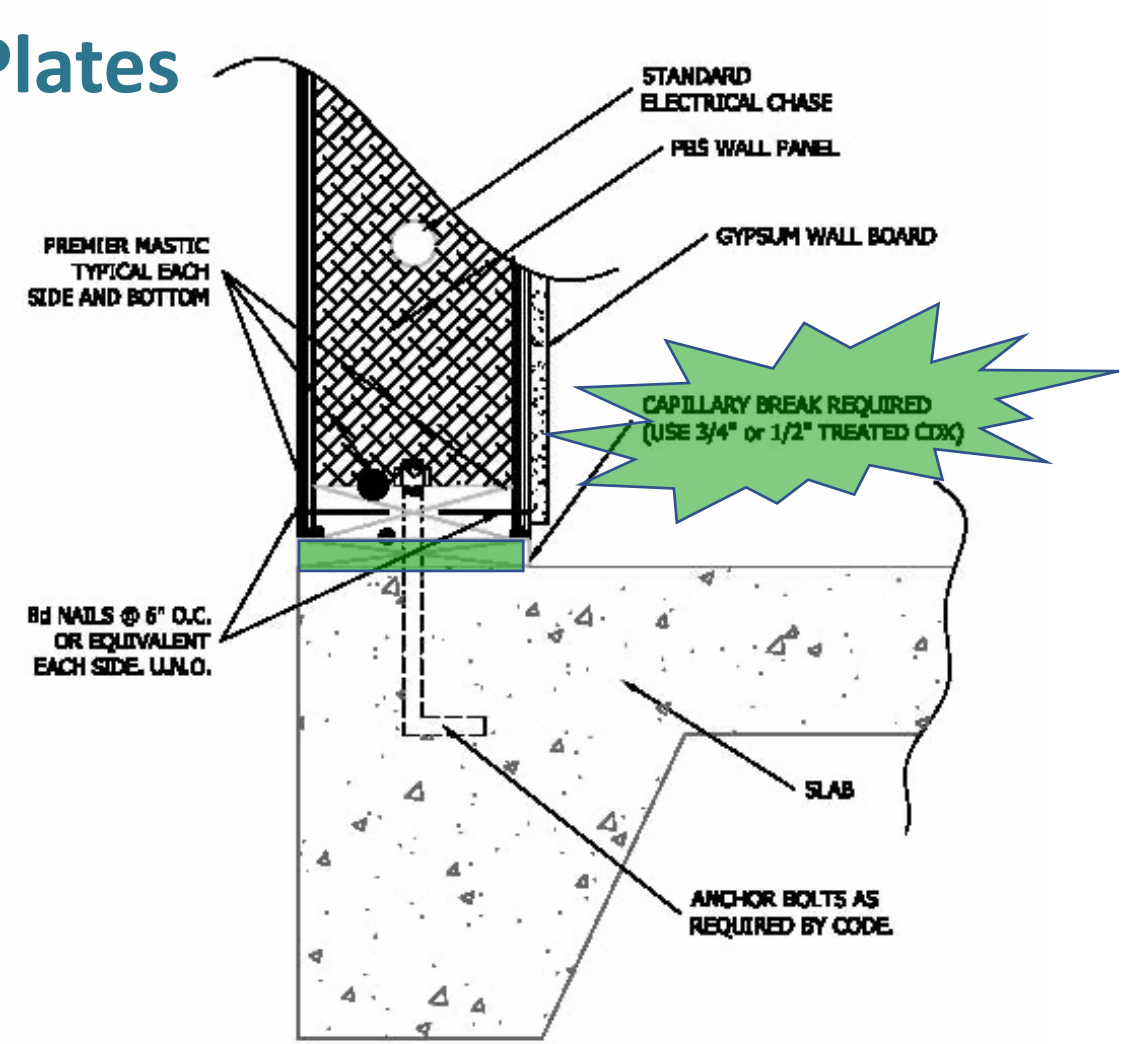
4 – Sill Plates



4 – Sill Plates



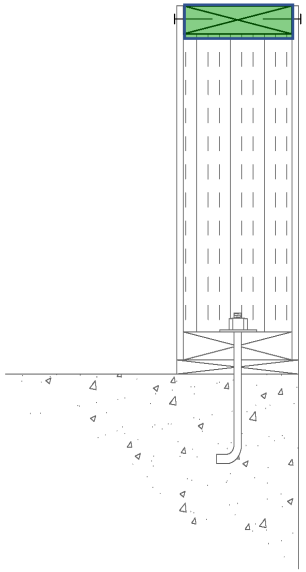
4 – Sill Plates



5 – Top Plate Options

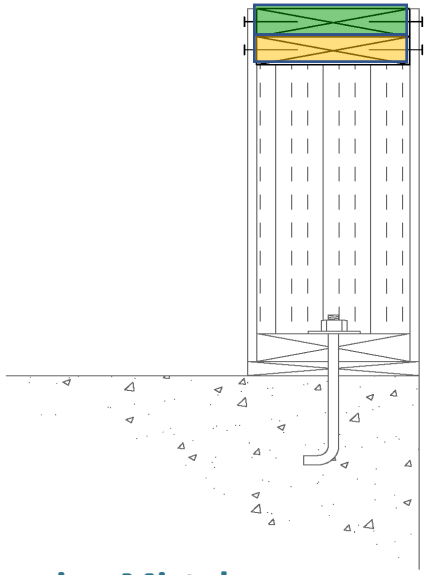
Single Top Plate

- Typical condition
- Used in testing
- No splices
- Less lumber
- Less labor



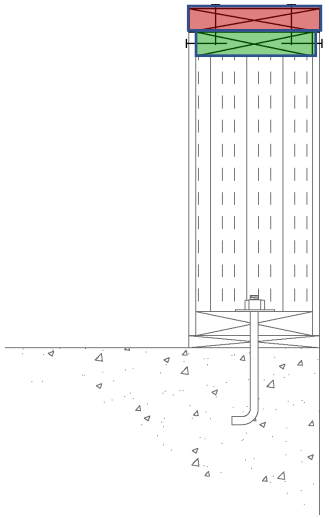
Double Top Plate

- Not typical
- For higher strength shear
- No splices
  - offset
- More lumber
- More labor



Cap Plate

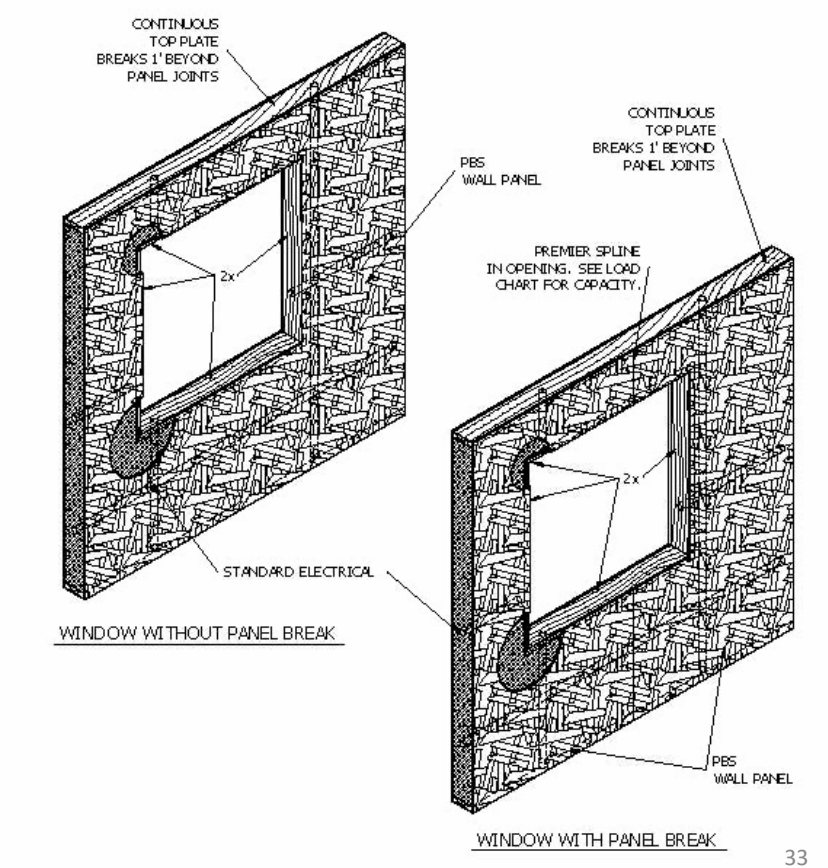
- 2x must be ripped to wall width – expensive
- Creates thermal bridging
- Increases wall allowable point load from 1 ton to 2 tons



6.1 – Panel Headers

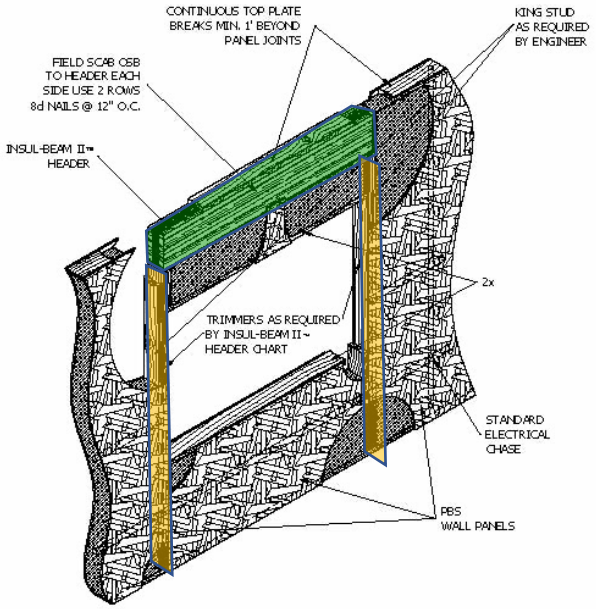
SIP panel often supports the loads

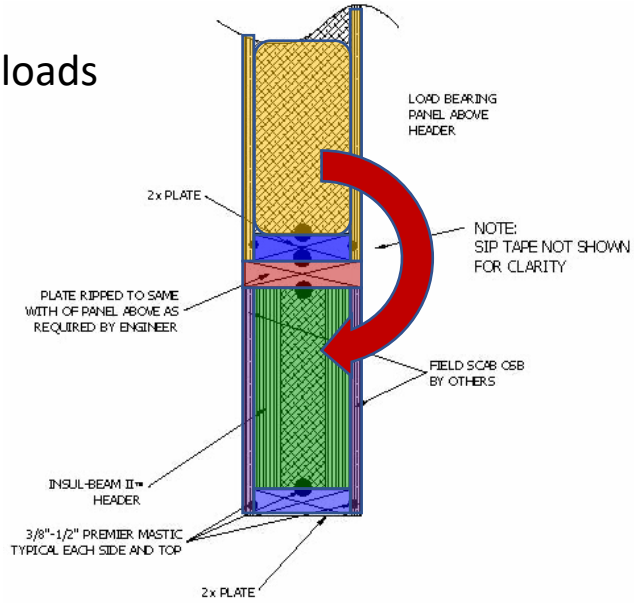
- Do not need a header for the opening
- Factory cut opening into the panel
- Site build an opening with panels
- No trimmers



6.2 – Insulated Headers

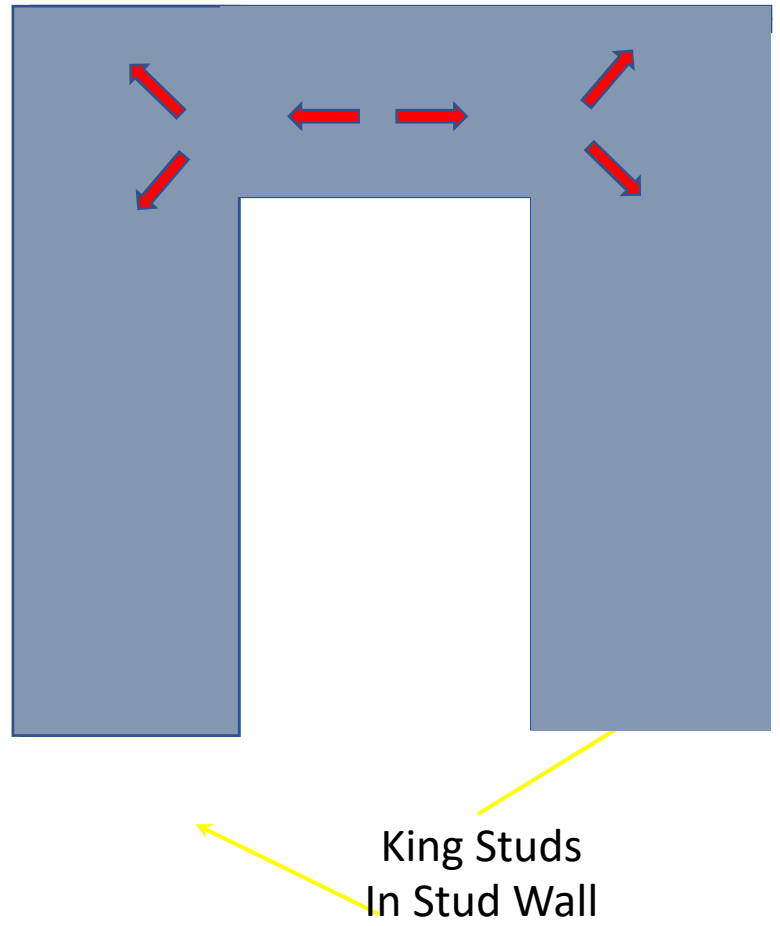
- For larger spans and/or heavy loads
- Usually placed at top of wall
- Require trimmers
- Several parts to assemble
- Hinge created
- Skins must bear on beam
- Place header inside SIP to save cost
- Nails used for shear
  - Staggered rows of (4) 16d nails at 6” o.c. carry high loads





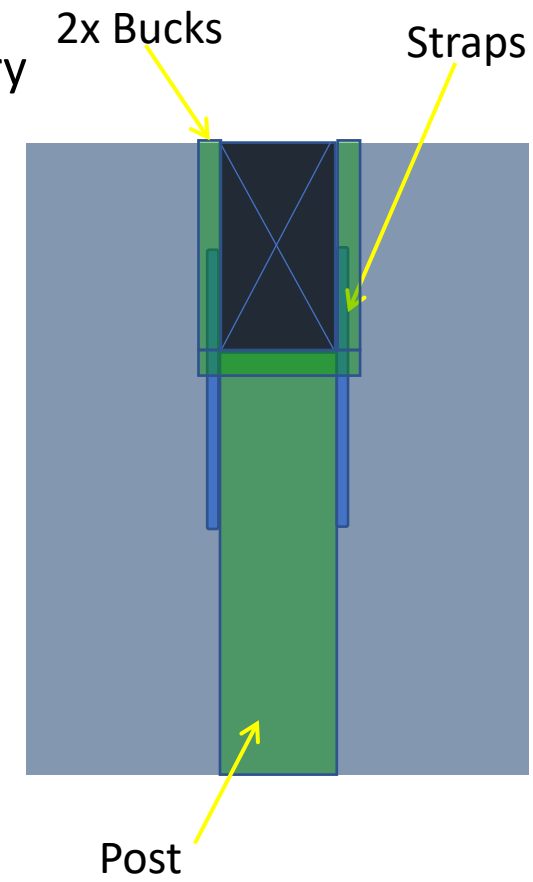
7 – King Studs

- Transfer load from wall above to walls beside an opening
- With SIPs, king studs have no load
  - SIP walls use the skin
- Therefore, no king studs required in most SIP applications



8 – Beam Pockets

- Most beams just need a pocket (no post-2450# capacity)
- Add post if necessary
- In a few cases, need a strap- no bucket necessary



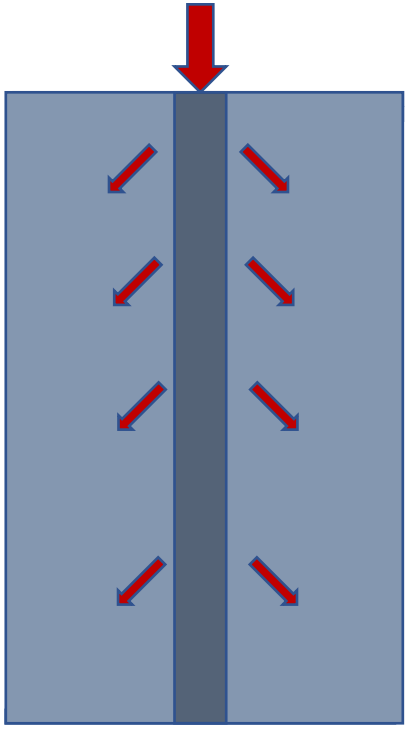
9 – Columns / Posts

Conventional Framing

- Load goes straight down the post
- Point load for next level down

SIPs

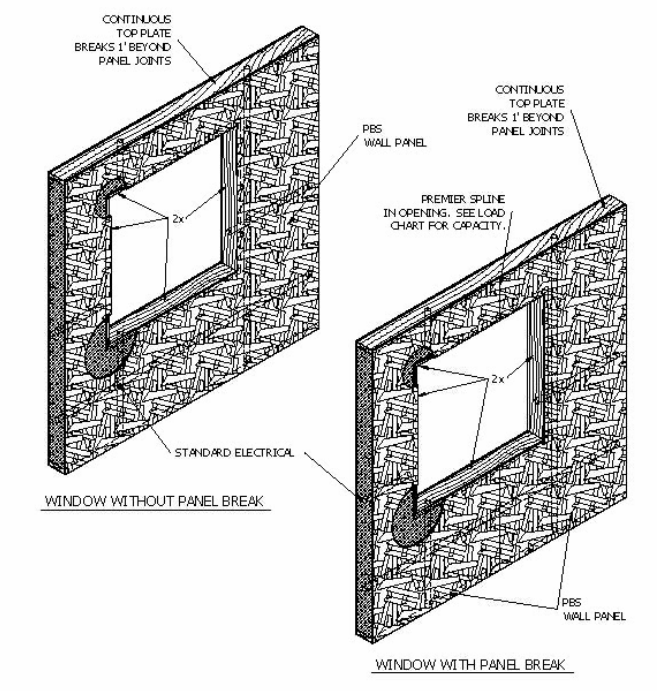
- Load distributed through the skin (like a CMU wall)
- Linear load for next level down



10 - Framing

Conventional Framing

- Every opening has a header
  Time and labor to frame



SIPs

- Most openings do not need headers
- Designing such that larger loads fall on smaller openings could mean no headers needed

Building a SIPs Structure

1 – Organization

Before the panels arrive:

- Install and inspect sill plate
- Mark sill plate with panel numbers
- Decide which corner you will start with (back is best)

Before construction begins:

- Sort the panels – they arrive on the truck based on what fits best
- Create stacks of 4-5 panels in order of installation
- Have permit and shop drawings on the jobsite for reference

2 – 5-Person Crew

Walls

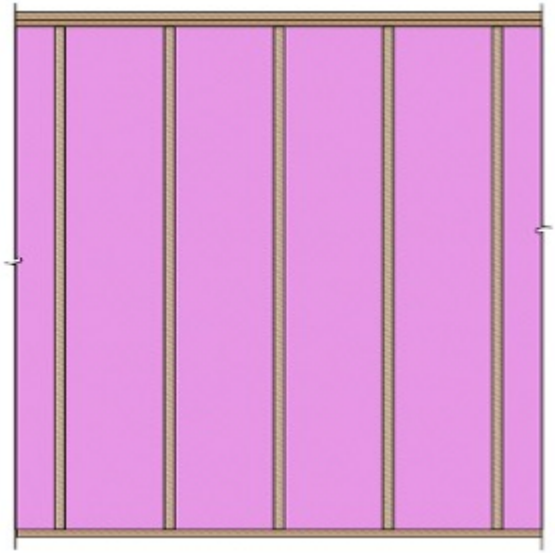
- 2 people installing panels
- 2 people preparing the next panel for installation
- 1 person getting mastic, cutting helping lift, etc.

Roof

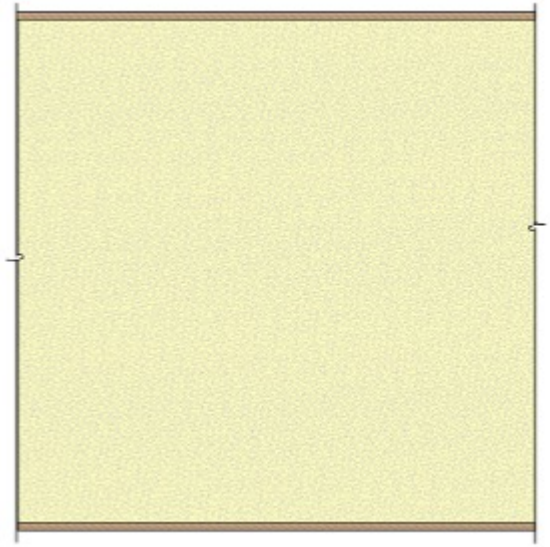
- 2 people installing panels
- 2 people preparing the next panel for installation
- 1 driver/helper

3 – Wall Installation

- Can slide panels instead of carrying them
- Tilt and slide panels together
- Drop panels into place
- Install corner screws as panels are installed
- Plumb and level corners, checking every few panels
- Minimal to no bracing



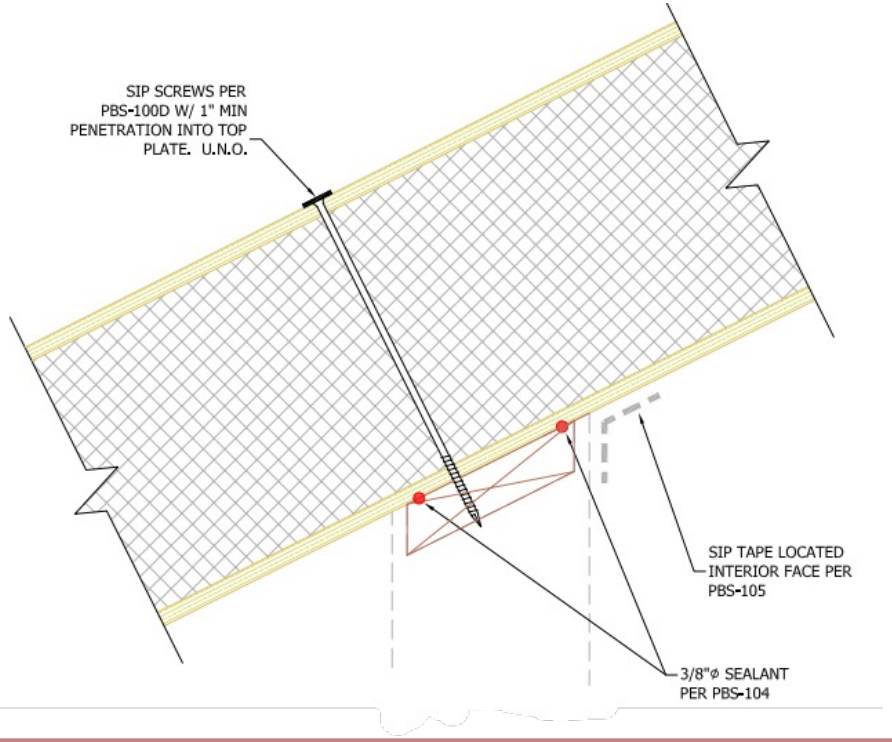
Conventional Wall



SIP Wall

4 – Roof Installation

- Use rigging for first few panels
- Can use panels as a staging area
- Slide instead of carrying panels
- Use furniture dollies to carry them across the roof
- Start at one corner, nail, slide in the other corner
- Double nail the top if underside is inaccessible



5 – Top Plates / Bucks

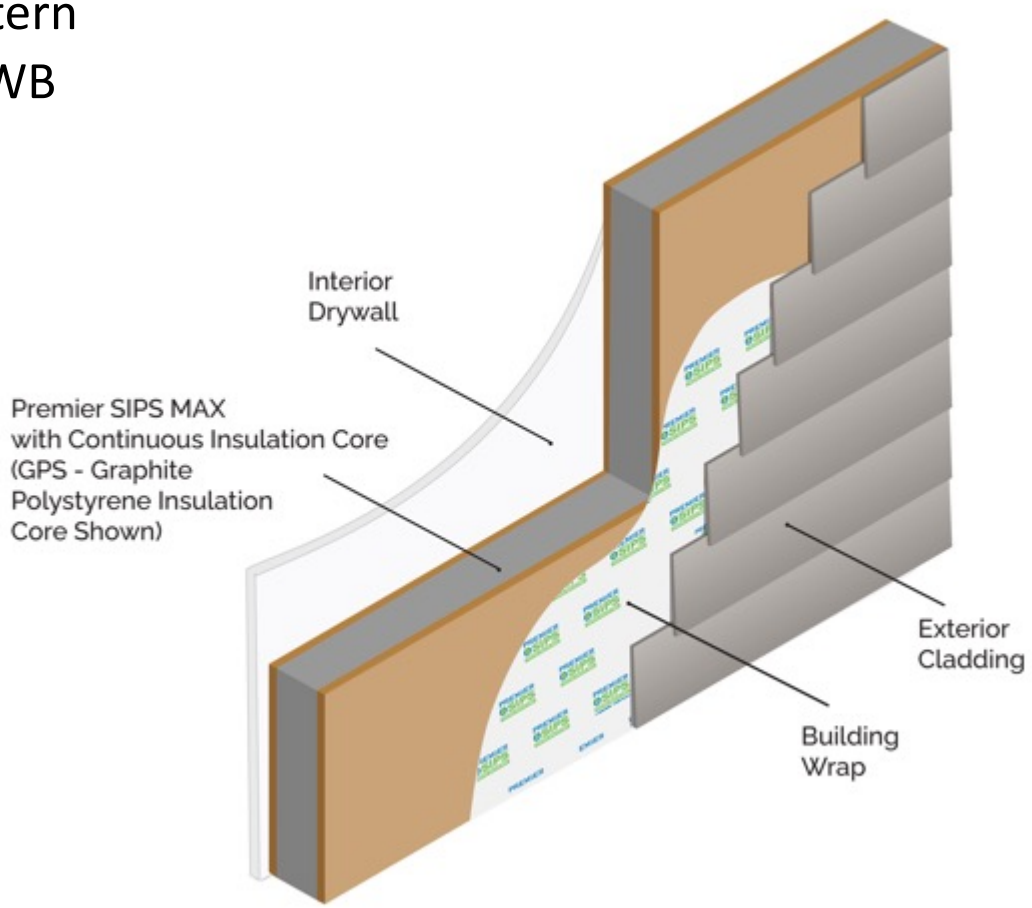
- Wall Top Plates come last (after electrician)
- Filler work
- Top and bottom plates cut 3” wider than the opening, 1.5” each side
- Remember the mastic / glue

6 - Stucco

- No Styrofoam
  - House paper – lath – scratch coat – final coat
- 50% more staples
- Should save on labor time/cost

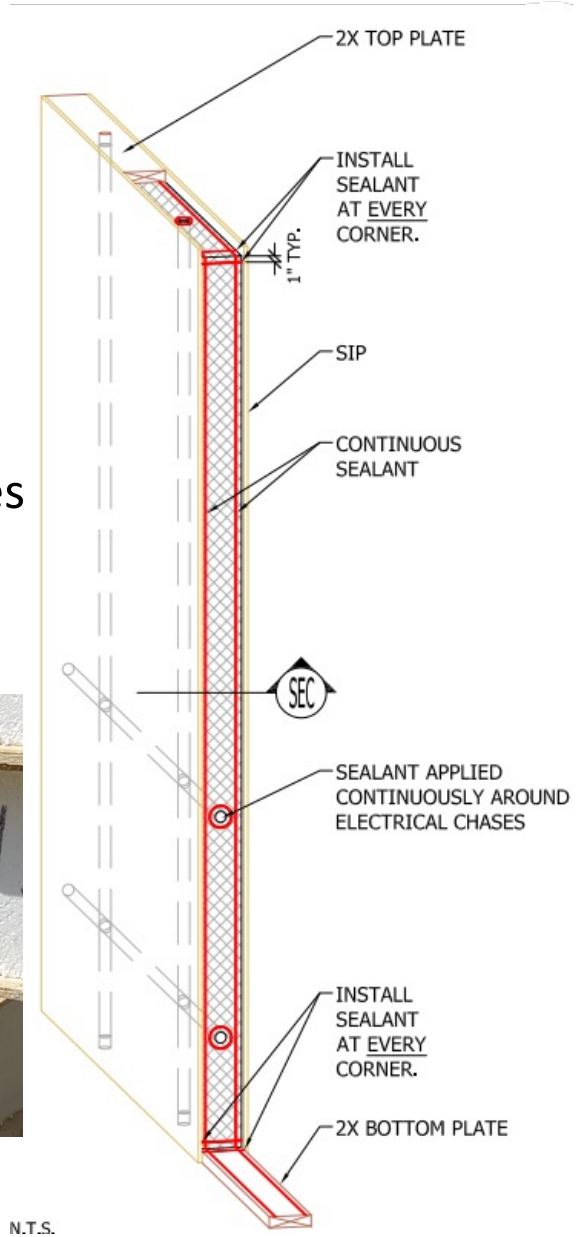
7 - Drywall

- Use full sheets on exterior walls
  - No trimming to match studs
- Simple 12” o.c. screw pattern
- Can use ¼”, ½”, or 5/8” GWB



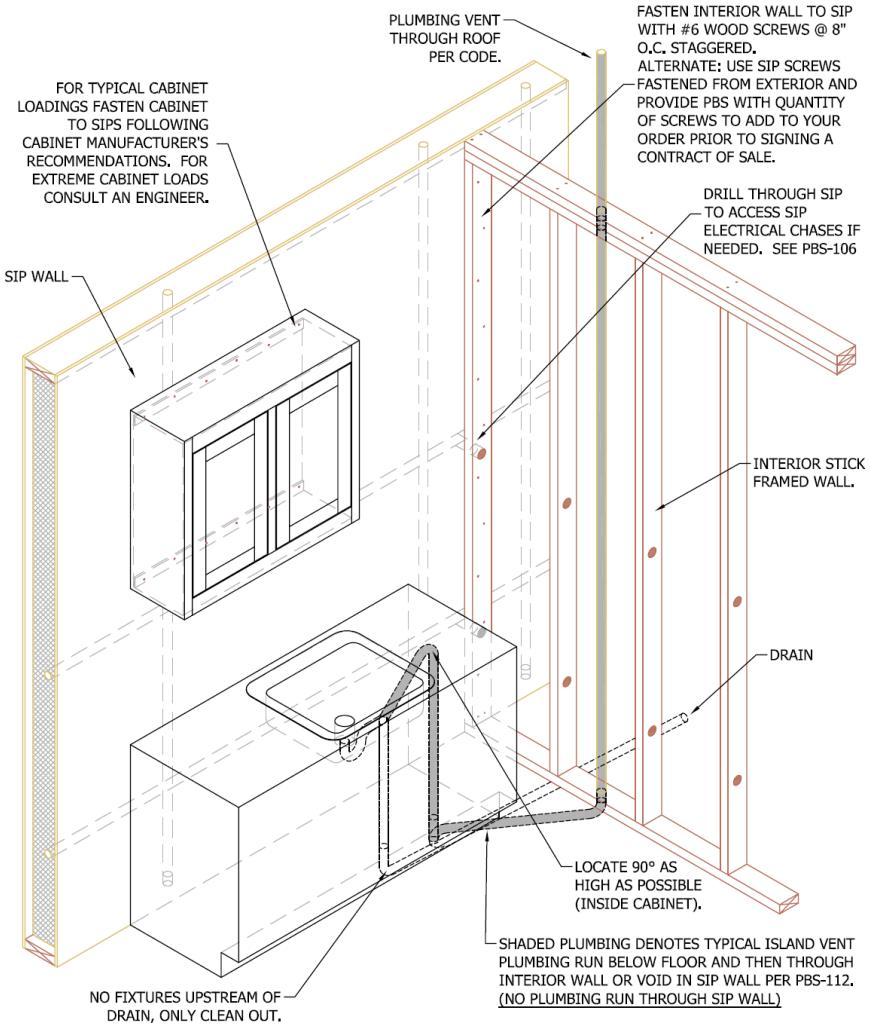
8 - Electrical

- Horizontal chases are at outlet and switch levels
  - No drilling studs
- Vertical chases around every 4 ft
- Push Romex wire or use wire puller
  - No wire staples
- Use top of wall, door and window plates for chases
- Can specify unique chase locations
- Can use affordable blue plastic work boxes



9 – Wall Hung Units

- Walls are manufactured straight
  - No shims required
- Use 50% more screws to OSB
- Put screws anywhere



10 - Callbacks

Fewer callbacks with SIPs

- Stucco less likely to crack
- No drywall nails/screws to pop
- No sticking windows and doors

SIPs and Energy

Ratings: Energy Star vs. HERS

Most rating programs have a SIPs option

- SIP house rates better than a stick-framed house
- Some rating programs require a modified R value

Energy Star

- Federal EPA program
- Minimum standards for a home
- Inspectors have checklists to verify requirements

HERS (Home Energy Rating System)

- National (not federal) rating system by RESNET
- Assigns a home a rating based on a 2006 home standard
- No minimum requirements
- Lower score = better

Insulation

Insulation has a high impact on HERS rating

- 3 ratings:

Lowest

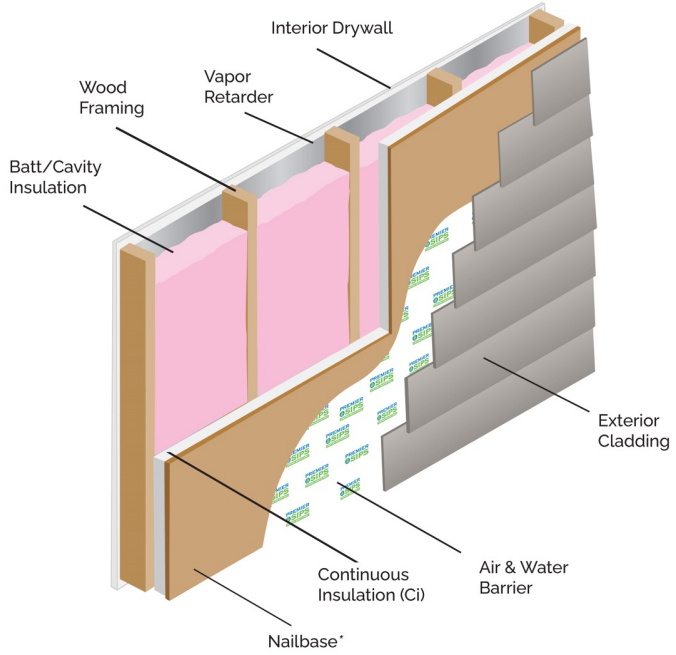
- Most batt insulation

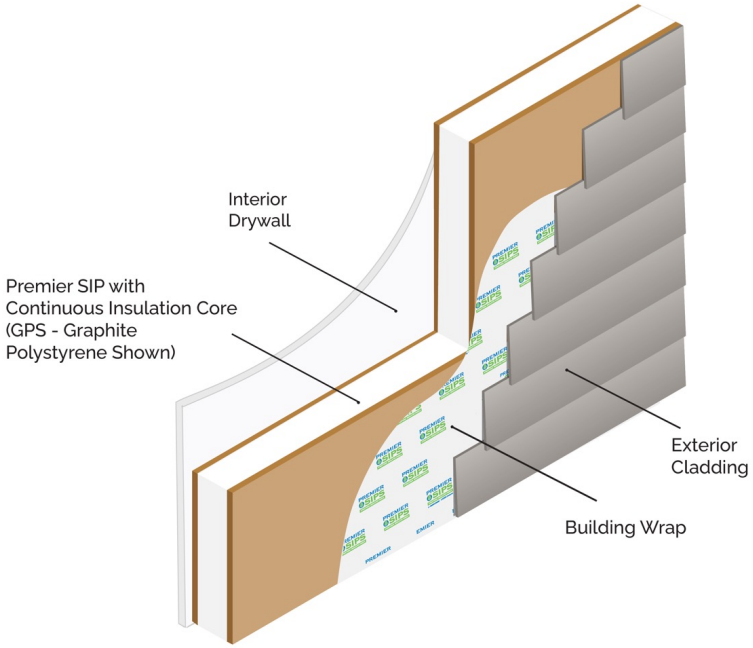
Middle

- Most spray insulation
- Special Inspection

Highest

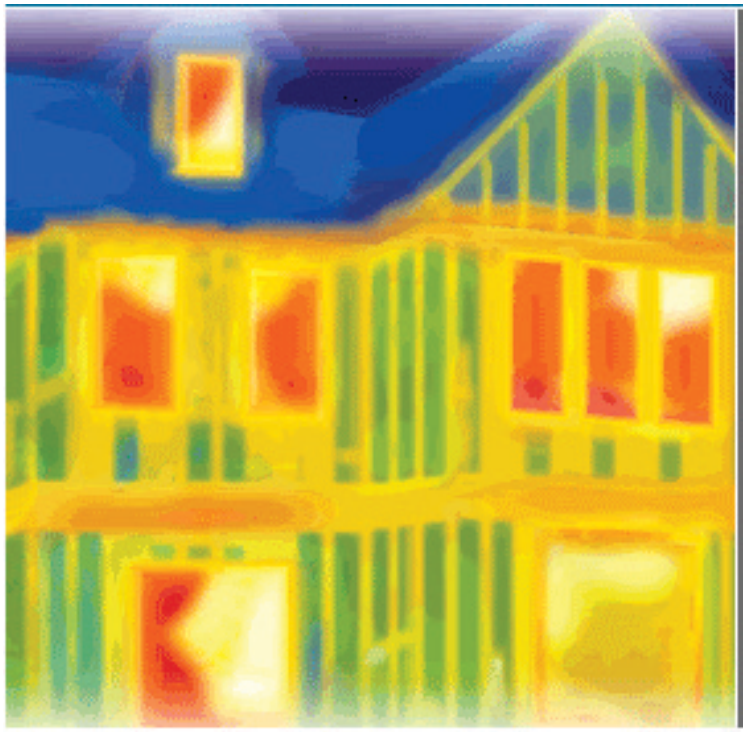
- SIPs
- May not require an inspection





Door Blower Test

- Determines tightness of home
- Energy Star does not require this for SIP structures
- HERS requires this – SIPs get top ratings



Conclusion

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SIPs 101 – Introduction to Structural Insulated Panels

- Structural, energy smart, durable, fast construction

What Can Architects Do for SIPs?

- Streamline design for constructability

What Can SIPs Do for Architects?

- Options for style

10 Common SIP Structural Engineering Mistakes

- SIPs can be complicated with poor design or materials

Building a SIPs Structure

- Learn Best Practices to save the most time

SIPs and Energy

- Cost savings over building lifetime

Taking advantage of SIPs can significantly reduce project costs.

Thank You!
Questions?

* Some graphics provided by Premier Building Systems

PREMIER SIPS
STRUCTURAL INSULATED PANELS
BY INSULFOAM A CARLISLE Company

Bertolami Engineering
Engineering & Architectural Drawings

COMFORT CASITAS

Quality Green ADU Design

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