Structural Insulated Panel Association

Commercial Design with Structural Insulated Panels

Structural Insulated Panel Association (SIPA)
An AIA Continuing Education Program
Credit for this course is 1 AIA HSW CE Hour

The Structural Insulated Panel Association (SIPA) is a nonprofit association representing manufacturers, suppliers, dealer/distributors, design professionals and builders committed to providing quality structural insulated panels (SIPs) for all segments of the construction industry.

Structural Insulated Panel Association (SIPA)

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Credit for this course is 1 AIA/CES HSW CE Hour

Course number SIPS101C

An American Institute of Architects (AIA) Continuing Education Program

Approved Promotional Statement:

- SIPA is a Registered Provider with The American Institute of Architects Continuing Education Systems (AIA/CES). Credit(s) earned on completion of this program will be reported to AIA/CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.
- This program is registered with AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA or SIPA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.
- Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

An American Institute of Architects (AIA) Continuing Education Program

- Course Format: This is a structured, live, instructor-led course
- Course Credit: 1 AIA Health Safety & Welfare (HSW) CE Hour
- Completion Certificate: A copy is sent to you by email upon request. When you fill out the Course Attendance, please indicate if you need one. Also please ensure the information you provide is legible. Send email requests to info@sips.org

Design Professionals: ***Certificates of Completion are sent to your email address***

COURSE DESCRIPTION

This one-hour course will discuss the benefits of commercial building design with structural insulated panels (SIPs), including energy savings, waste minimization and other sustainable contributions. The designer will gain a better understanding of how to properly utilize SIPs. Below is a course outline:

- SIP basics
- Engineering methods
- Sound and fire ratings
- Energy code compliance
- Interaction with structural systems
- Life cycle analysis
- Thermal characteristics of SIPs
- Climate specific issues and design
- SIPs and indoor air quality
- Construction methods and specifications

LEARNING OBJECTIVES

At the conclusion of this course, the design professional will be able to:

1. Discuss the basics of SIPs, including their composition, common engineering methods, applicable codes and standards, and how SIPs contribute to sustainable design.
2. Identify the energy-efficient characteristics of SIPs and how they improve whole building energy efficiency.
3. Describe the waste reducing and product life cycle benefits of building with SIPs relative to traditional wood framing.
4. Explain how SIPs contribute to better indoor air quality through a reduction in both air infiltration and interior off gassing.

SIP BASICS: WHAT ARE SIPs?

S = **S**tructural

I = **I**nsulated

P = **P**anel

- **Composite structural panel**
- **Rigid foam core – EPS/GPS, XPS, or polyurethane / polyiso**
- **Structural facings - often 7/16” OSB but sometimes plywood or MgO/cement**
- **Structural adhesive**

WHAT ARE SIPs?

- **Originally developed as “stressed-skin” panels in the 1930’s - tested at the Forest Products Laboratory in Madison, WI**
- **The concept was to minimize and eventually eliminate the framing by using the skins to carry the loads**
- **Foam cores were introduced in 1969 to form the modern structural insulated panel**

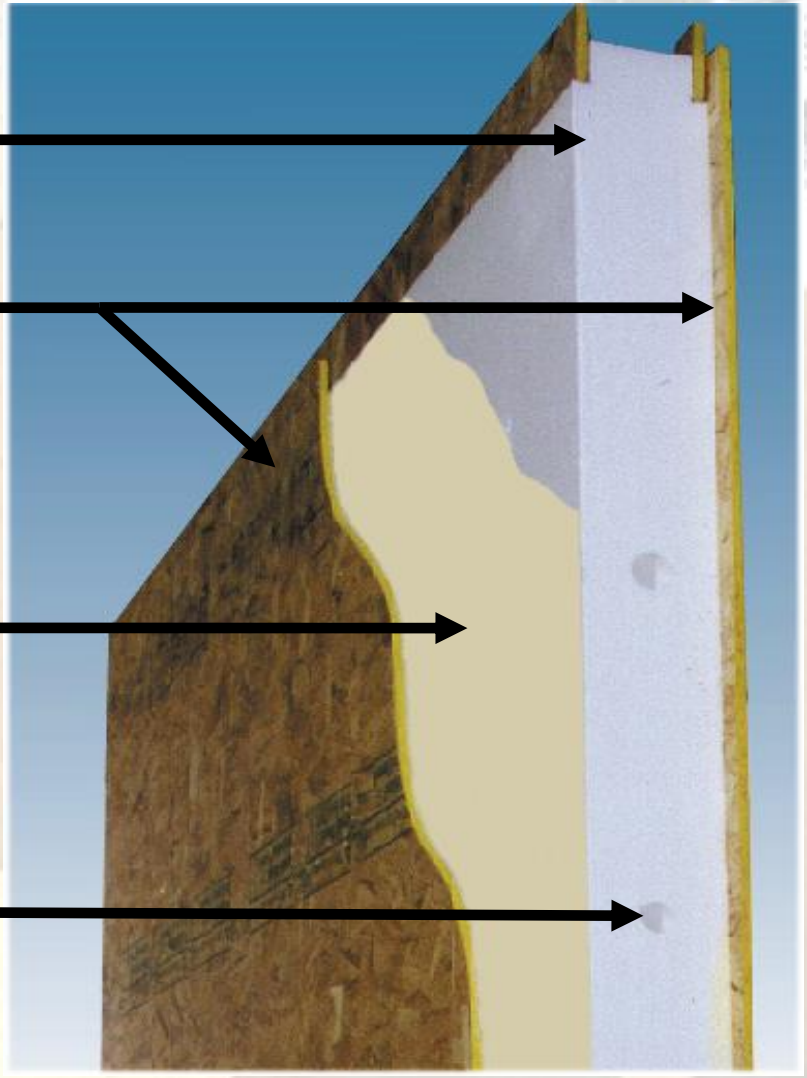
WHAT ARE SIPs?

Rigid Foam Insulation

Structural Facings

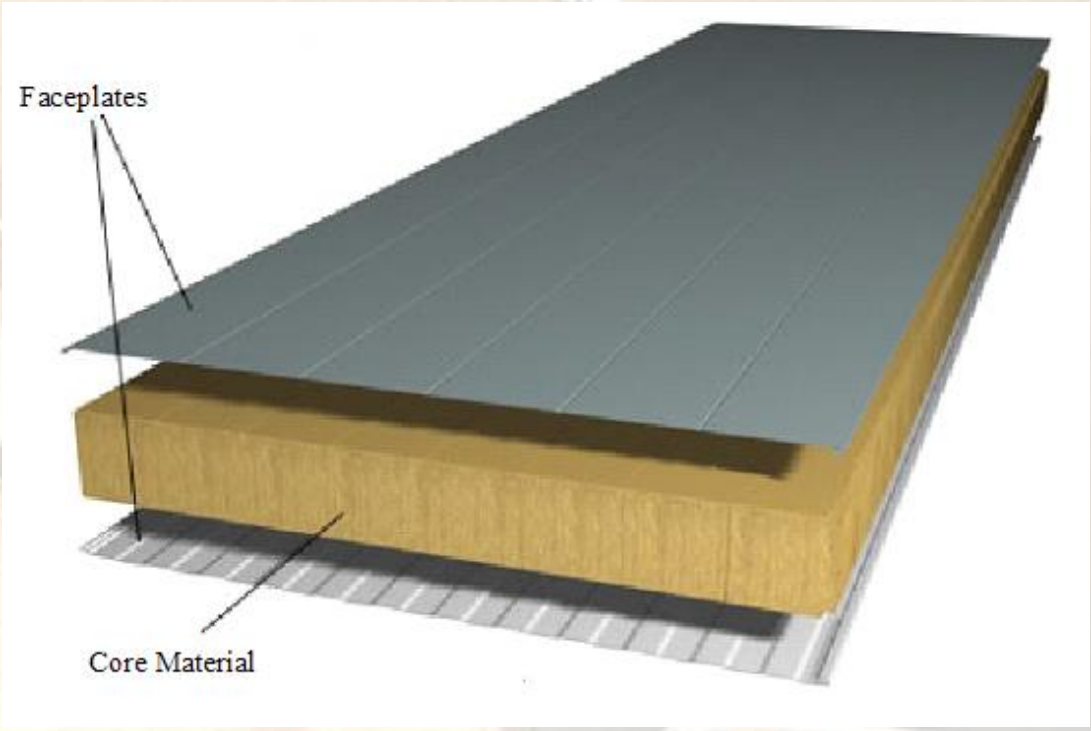
Structural Adhesive

Optional Electrical Chase



TYPES OF SIPs?

Insulated metal wall panels



TYPES OF SIPs?

Also available with cementitious skins – cement board, MgO board

Resistant to fire, mold, mildew

TYPES OF SIPs?

- **Pre-fabricated, pre-insulated stud wall panels are not SIPs**
- **SIPs replace traditional wall studs to provide a better R-value over the entire wall surface (whole-wall R-value)**
- **The idea is to use the OSB as the load bearing element, instead of studs. The bearing area provided by a SIP wall is equivalent to 2x10 studs @ 16”oc**

WHY SIPs?

1. A *simple*, energy-efficient, insulating framing system.

2. Exceed code requirements, while delivering more *comfortable*, durable buildings minimizing time, money and labor.

3. Future-proofs a legacy to meet more demanding, upcoming standards with a third-party verified & engineered *sustainable* solution.

SIP SPECIFICATION

Structural Insulated Panel Association

STRUCTURAL INSULATED PANELS
Guide Specification

Structural insulated panels (SIPs) are a high-performance building system for residential
cial Type V construction. SIPs consist of an insulating foam core sandwiched between two
typically oriented strand board (OSB). SIPs are manufactured under factory-controlled
be fabricated to fit nearly any building design. The result is a building system that is
energy efficient, and cost effective. Building with SIPs will save you time, money, and la

A SIP home or commercial building allows for better control over indoor air quality becau
low air leakage through the building envelope.

The components used to make SIPs (foam, OSB, and adhesive) meet some of the most
standards for indoor air quality.

SIP homes have qualified under the American Lung Association's Health House® indoor a
and the Institute for Business and Home Safety Fortified Program for resilient storm-resi

The Structural Insulated Panel Association (SIPA) is a non-profit trade association repre
turers, suppliers, dealer/distributors, design professionals, and builders committed to
structural insulated panels for all segments of the construction industry. SIPA has been
1990 and has made tremendous progress in advancing energy-efficient construction wi
lated panels.

Access SIPA's extensive technical library and manufacturer directory at www.SIPS.org
mation, contact SPA at (253) 858-7472; info@sips.org.

This document was created by the Structural Insulated Panel Association using best available information for
by design professionals developing project specifications with SIPs.

SECTION 06 12 00 - STRUCTURAL INSULATED PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Structural Insulated Panels (SIPs) and accessories.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for requirements for miscellaneous framing, blocking, and nailers associated with installation of SIPs.
2. Division 07 water resistive barrier section for application on SIP walls.
3. Division 07 roofing section for underlayment application over SIP roofs.
4. Division 09 flooring section for separation layer application over SIP floors.
5. Division 23 Heating, Ventilation, and Air Conditioning (HVAC)

1.2 SYSTEM DESCRIPTION

A. Structural Insulated Panels (SIPs) consist of oriented strand board (OSB) laminated with a structural adhesive to an expanded polystyrene insulation core and SIP manufacturer-supplied accessories.

B. SIP manufacturer-supplied accessories.

1.3 REFERENCES

A. ANSI/APA PRS 610.1- Standard for Performance Rated Structural Insulated Panels in Wall Applications.

B. ASTM C578- Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

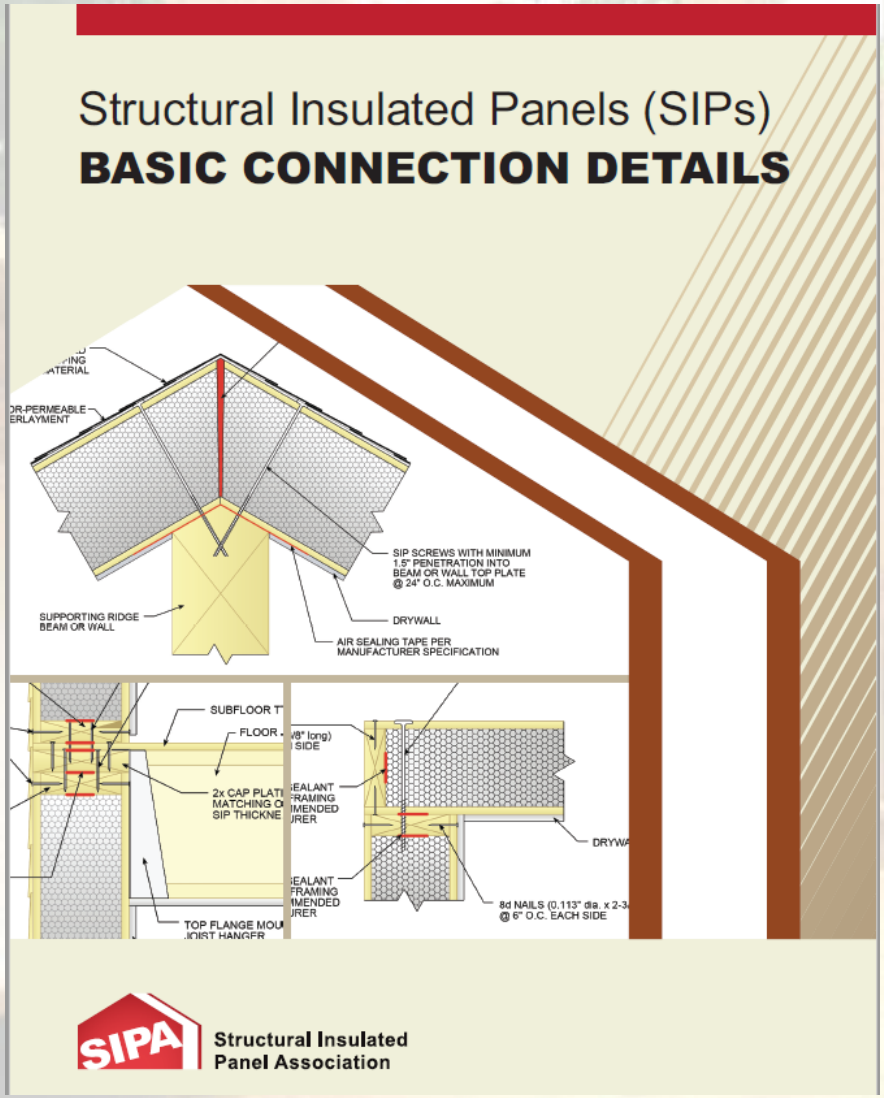
C. ASTM D7446- Standard Specification for Structural Insulated Panel (SIP) Adhesives for Laminating Oriented Strand Board (OSB) to Rigid Cellular Polystyrene Thermal Insulation Core Materials.

D. DOC PS 2- Performance Standard for Wood-Based Structural-Use Panels.

E. ICC-ES AC05- Acceptance Criteria for Sandwich Panel Adhesives.

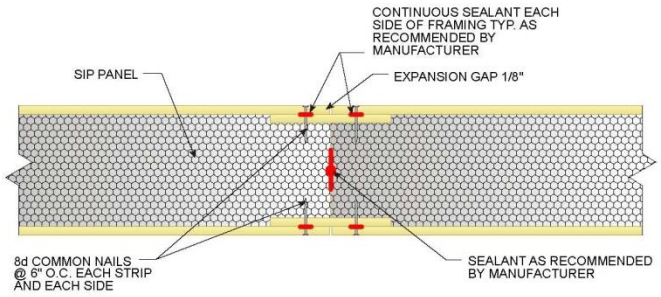
1.4 PREINSTALLATION MEETINGS

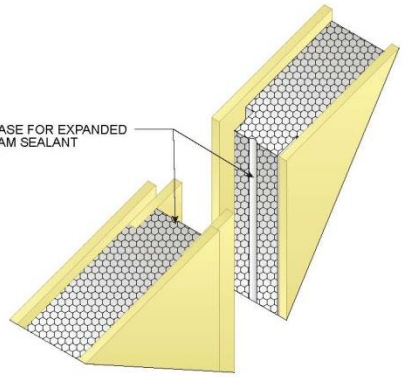
SIP DETAILS



Basic Connection Details for SIPs

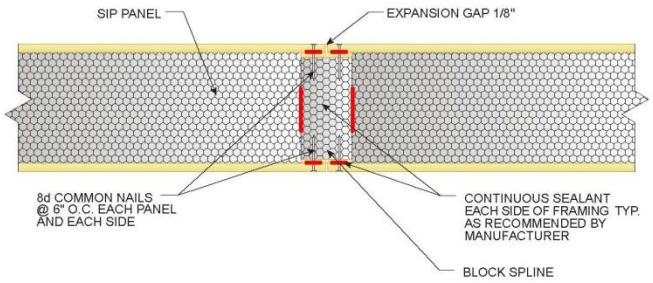
SIP BASICS: DETAILS





WALL-TO-WALL VERTICAL PANEL CONNECTIONS

SURFACE SPLINE FOR VERTICAL SPLICE

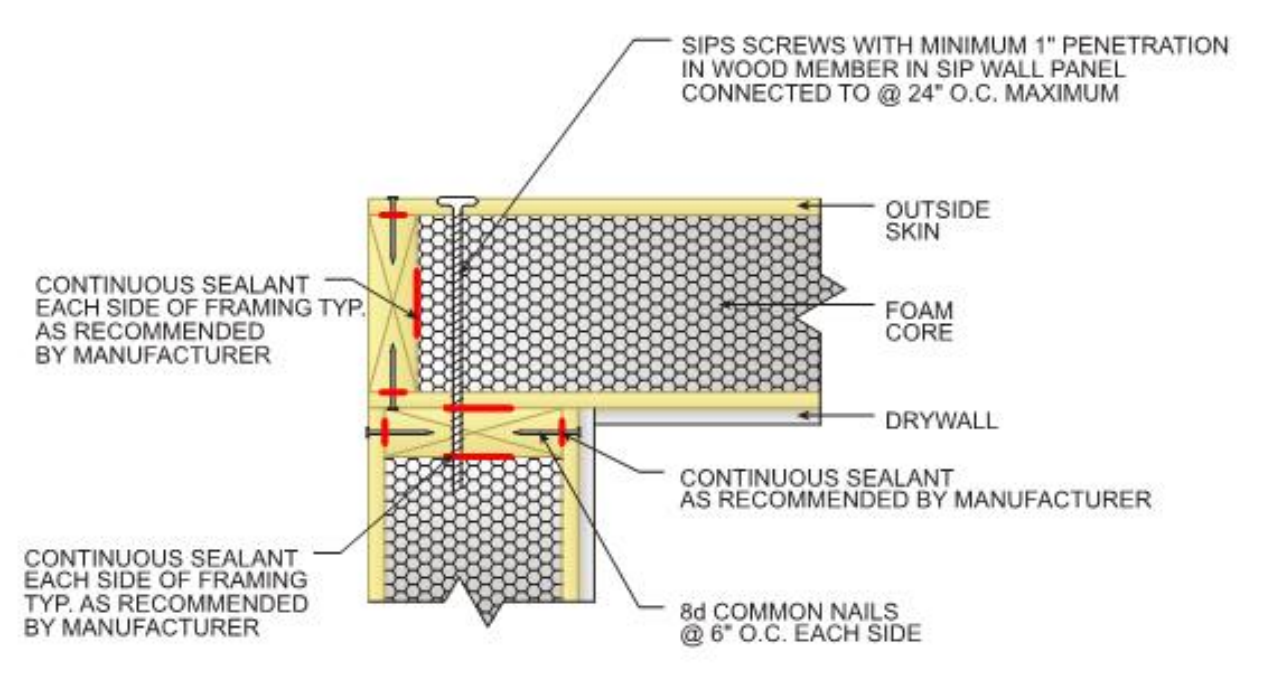


WALL-TO-WALL VERTICAL PANEL CONNECTIONS

BLOCK SPLINE

Panel joints are designed to reduce thermal bridging where structurally possible and sealed to reduce air infiltration

SIP BASICS: DETAILS



- SIP fasteners go through the panels, into structure
- Wood screw point for wood
- Light drill point for metal/light gauge
- Heavy drill point for steel/iron up to ¼” thick

ENGINEERING METHODS

- **A structural engineer with knowledge of SIP applications should be a part of the design process for any SIP structures**
- **Prevent the overdesign of the structural system, reduce costs, and meet code minimums**
- **Consult manufacturer code report and load charts for engineering information (www.sips.org)**

SIP DESIGN

Fire, Hurricane, Seismic & Structural Compliance - Code Reports & Standards

ICC EVALUATION SERVICE

ICC-ES Evaluation Report ESR-4689

Reissued April 2023

This report is subject to renewal April 2024.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 06 00 00—WOOD, PLASTICS, AND COMPOSITES
Section: 06 12 00—Structural

REPORT HOLDER:

STRUCTURAL INSULATED (SIPA)

ADDITIONAL LISTEES:

ACME PANEL COMPANY

ENERCEPT

ENERGY PANEL STRUCTU

FISCHERSIPS

FOARD PANEL, INC.

THE MURUS COMPANY, IN

PORTERCORP

URBAN INDUSTRIES, INC.

EVALUATION SUBJECT:

STRUCTURAL INSULATED

1.0 EVALUATION SCOPE

Compliance with the follow

- 2018 and 2015 *Internation*
- 2018 and 2015 *Internation*

Property evaluated:

Structural

2.0 USES

2.1 General:

3.0 DESCRIPTION

ICC EVALUATION SERVICE

www.icc-es.org | (800) 423-6587 | (56

ICC-ES Evaluation Report

ESR-4524

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 12 00—Structural Panels

REPORT HOLDER:

PREMIER BUILDING SYSTEMS, LLC

EVALUATION SUBJECT:

PREMIER STRUCTURAL INSULATED PANE

ADDITIONAL LISTEES:

BIG SKY INSULATION, INC.

EXTREME PANEL TECHNOLOGIES

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021, 2018 and 2015 *International Build* (IBC)
- 2021, 2018 and 2015 *International Reside* (IRC)

For evaluation for compliance with codes adop Los Angeles Department of Building and Safety see ESR-4524 LABC and LARC Supplement.

AMERICAN NATIONAL STANDARD

ANSI/APA PRS 610.1-2023

Standard for Performance-Rated Structural Insulated Panels in Wall Applications

ANSI APA

Reference over 20 Company Industry Code reports at: https://www.sips.org/resources/building-codes

ENGINEERING METHODS

- **Sample manufacturer load chart from code report**
- **Loads are calculated per Chapter 16 of the IBC**

Table 5: Allowable Axial Loads (plf)[1,2,3,4]

Lateral Brace Spacing (ft)	Panel Thickness		
	4-5/8 inch	6-1/2 inch	8-1/4 inch
8 WAB[5]	2320	2470	2530
8	3630	4070	4240
10	3260	3890	4130
12	2810	3660	4000
14	--	3390	3830
16	--	3090	3640
18	--	2790	3430
20	--	--	3190

1. Permanent loads, such as dead load, shall not exceed 0.50 times the tabulated load.
2. All values are for normal duration and may not be increased for other durations.
3. Axial loads shall be applied concentrically to the top of the panel through repetitive members spaced not more than 24-inches on center. Such members shall be fastened to a rim board or similar member to distribute along the top of the SIP.
4. The ends of both facings must bear on the supporting foundation or structure to achieve the tabulated axial loads.
5. Tabulated values are based on the strong-axis of the facing material oriented parallel to the span direction. WAB indicates weak-axis bending of the facing material (i.e. the facing material weak-axis is parallel to the span direction).

ENGINEERING METHODS

- **Load charts vary by spline type and load type**
- **This is a block spline and surface spline chart**
- **Other spline types include I-joist, LVL, and 2x lumber**

Table R-1-S ROOF PANEL TRANSVERSE DESIGN LOAD (psf)

OSB SURFACE SPLINE OR INSULSPLINE JOINTS														
Thickness		Allowable	PANEL SPAN (feet)											
SIP	EPS	Deflection	4	5	6	7	8	9	10	11	12	13	14	15	16
4 1/2"	3 5/8"	L/240	105	80	63	51	42	35	29	25	21	-	-	-	-
		L/360	70	54	42	34	28	23	20	16	14	-	-	-	-
6 1/2"	5 5/8"	L/240	136	109	91	78	68	60	53	45	38	-	-	-	-
		L/360	131	100	78	63	52	43	36	30	25	-	-	-	-
8 1/4"	7 3/8"	L/240	149	119	99	85	75	66	60	54	50	44	39	34	29
		L/360	149	119	99	85	72	60	50	42	35	31	26	23	19
10 1/4"	9 3/8"	L/240	164	131	109	94	82	73	66	60	55	49	44	39	34
		L/360	164	131	109	94	82	73	66	60	54	47	41	36	31
12 1/4"	11 3/8"	L/240	179	143	119	102	90	80	72	65	60	55	50	44	38
		L/360	179	143	119	102	90	80	72	65	60	55	50	44	38

Notes:

1. Table indicates total design load based upon design objectives as per 2006 International Building Code® and International Residential Code®.
2. The span of a sloped roof panel must be measured along the slope. Design loads are to be calculated as normal loads acting perpendicular to the face of the panel.
3. Insulspan SIP System must be assembled as per Insulspan Installation Guide and recommended assembly details.
4. Insulspan SIP skins are nailed to the OSB splines at vertical panel joints using minimum 8d (0.113"x2.5") @ 6" o.c.
5. Insulspan SIP System core material is molded expanded polystyrene (EPS) insulation complying with the requirements of ASTM C 578, type I.
6. Insulspan SIP System exterior skins are minimum 7/16" thick structural grade oriented strand board (OSB) conforming to DOC PS2, exposure 1.

Revision : May 9, 2008

ENGINEERING METHODS

Shear wall components:

- Total shear wall assembly
  - SIP panels and splines
- Edge members
  - Plates and end studs
- Shear wall connectors
  - Nails and screws
  - Hold down anchors and anchor bolts

Table 6: Allowable In-Plane Shear Strength (Pounds per Foot) for SIP Shear Walls (Wind and Seismic Loads in Seismic Design Categories A, B and C)[1,3]

Spline Type[4]	Nominal SIP Thickness (in.)	Minimum Facing Connections[3,5]			Shear Strength (plf)
		Chord[3]	Plate[3]	Spline[4]	
Block or Surface Spline	4.625	0.131"x 2-1/2" nails, 6" oc	0.131"x 2-1/2" nails, 6" oc	0.131"x 2-1/2" nails, 6" oc	380
	6.625	0.131"x 2-1/2" nails, 6" oc	0.131"x 2-1/2" nails, 6" oc	0.131"x 2-1/2" nails, 6" oc	380
	8.375	0.131"x 2-1/2" nails, 6" oc	0.131"x 2-1/2" nails, 6" oc	0.131"x 2-1/2" nails, 6" oc	400

See Table 7 for notes.

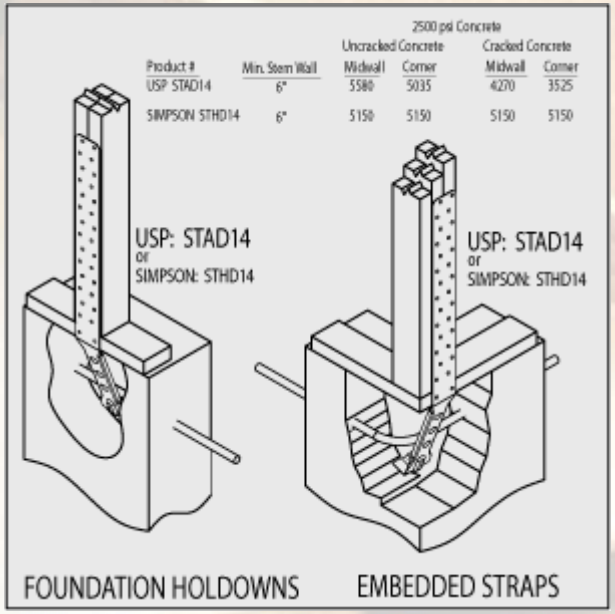
Table 7: Allowable In-Plane Shear Strength (Pounds per Foot) for SIP Shear Walls (Wind and Seismic Loads in Seismic Design Categories D, E and F)[2,3]

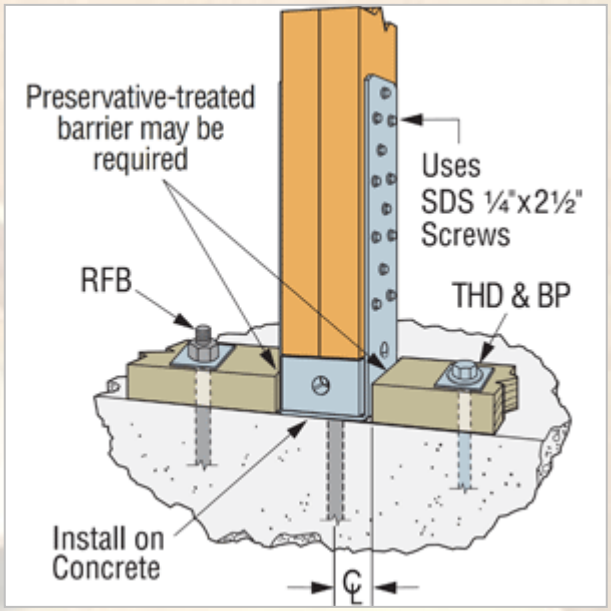
Spline Type[4]	Nominal SIP Thickness (in.)	Minimum Facing Connections[3,5]			Shear Strength (plf)
		Chord[3]	Plate[3]	Spline[4]	
Block or Surface Spline	6.5	0.131"x 2-1/2" nails, 3" oc (3/8" edge distance)	0.131"x 2-1/2" nails, 3" oc (3/8" edge distance)	0.131"x 2-1/2" nails, 3" oc (23/32" thick, 3" wide spline)	900

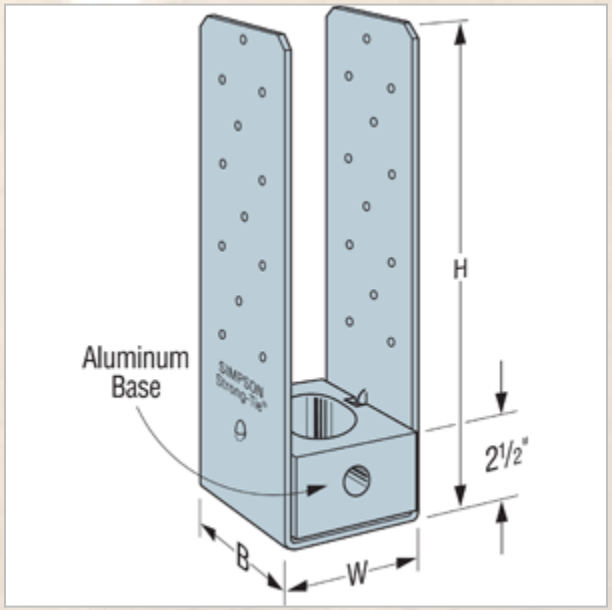
[1] Maximum shear wall dimension ratio shall not exceed 2:1 (height : width) for resisting wind or seismic loads.
[2] Maximum shear wall dimension ratio shall not exceed 1:1 (height : width) for resisting wind or seismic loads.
[3] Chords, holdowns, and connection to other structural elements must be designed by a registered design professional in accordance with accepted engineering practice.
[4] Spline type at interior panel-to-panel joints only, solid chord members are required at each end of each shearwall segment.
[5] Required connections must be made on each side of the panel. Dimensional or engineered lumber shall have an equivalent specific gravity of 0.42 or greater.

ENGINEERING METHODS

- Shear wall strap diagrams
- Hold down anchors at the ends of shear walls
- Shear plate anchor bolts must resist shear load

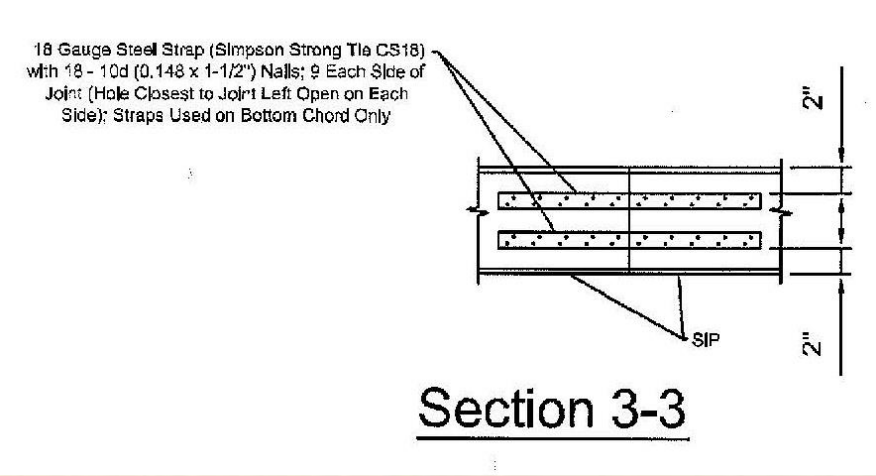


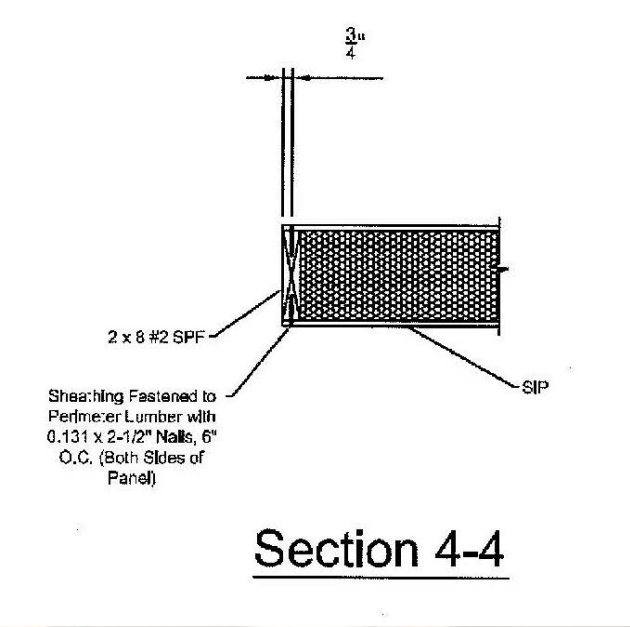




ENGINEERING METHODS

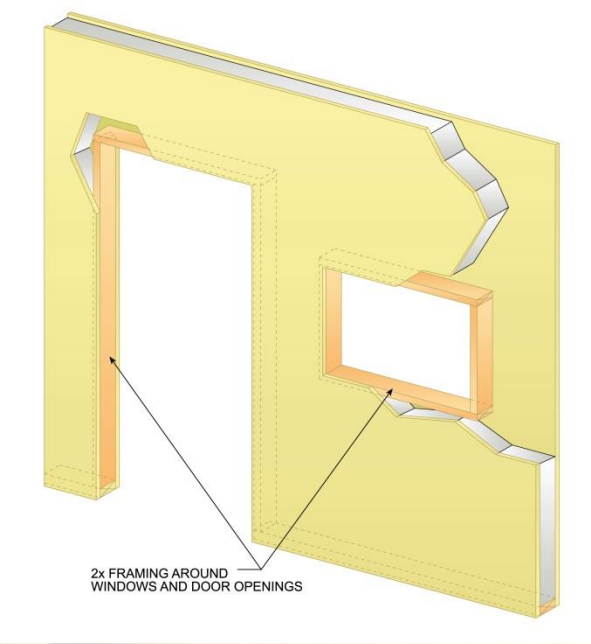
- **Shear wall values are available to cover all seismic design categories**
- **Diaphragm values for wind design for SIP roof panels should be available from the manufacturer**
- **Like all shear walls and diaphragms, chord forces are critical. Straps can help transfer these forces across joints in the edge lumber**



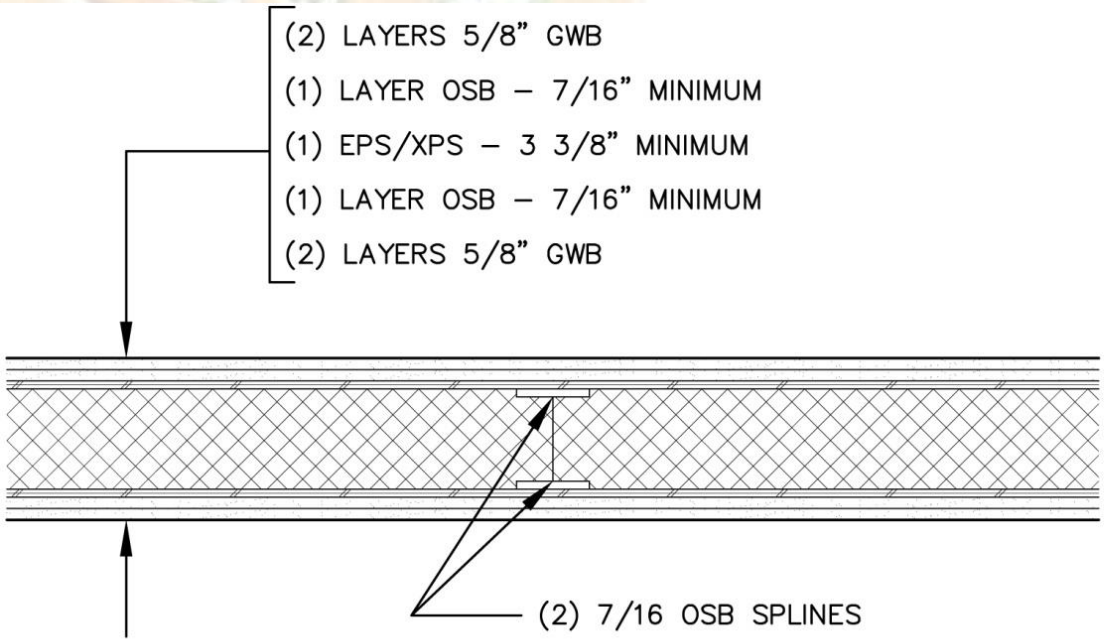


ENGINEERING METHODS

- **Openings with heavy loads may require structural header**
- **Some openings possible with SIP acting as header; consult engineer or manufacturer**

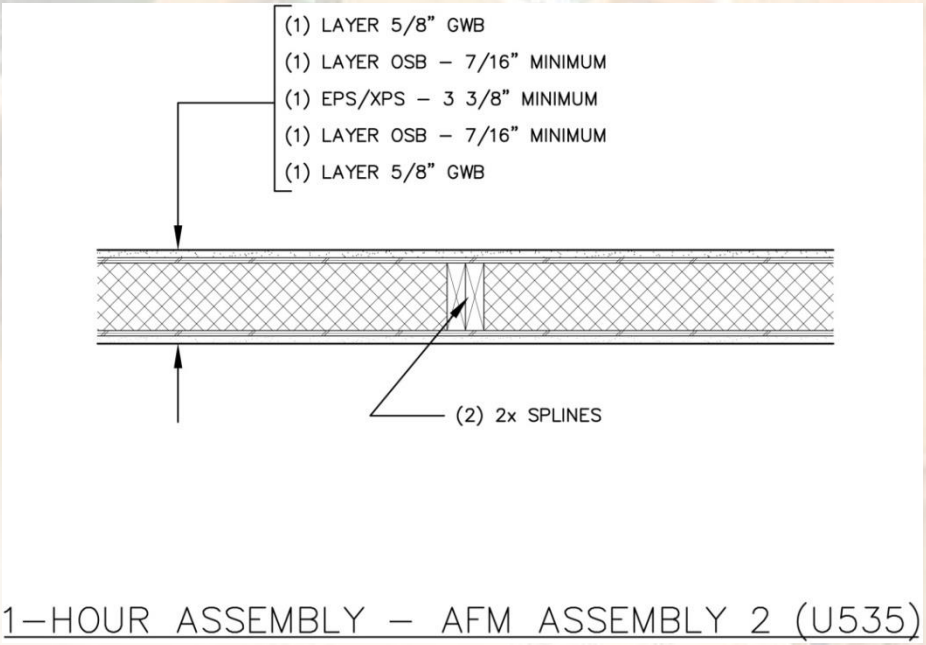


FIRE RATINGS WITH SIPs

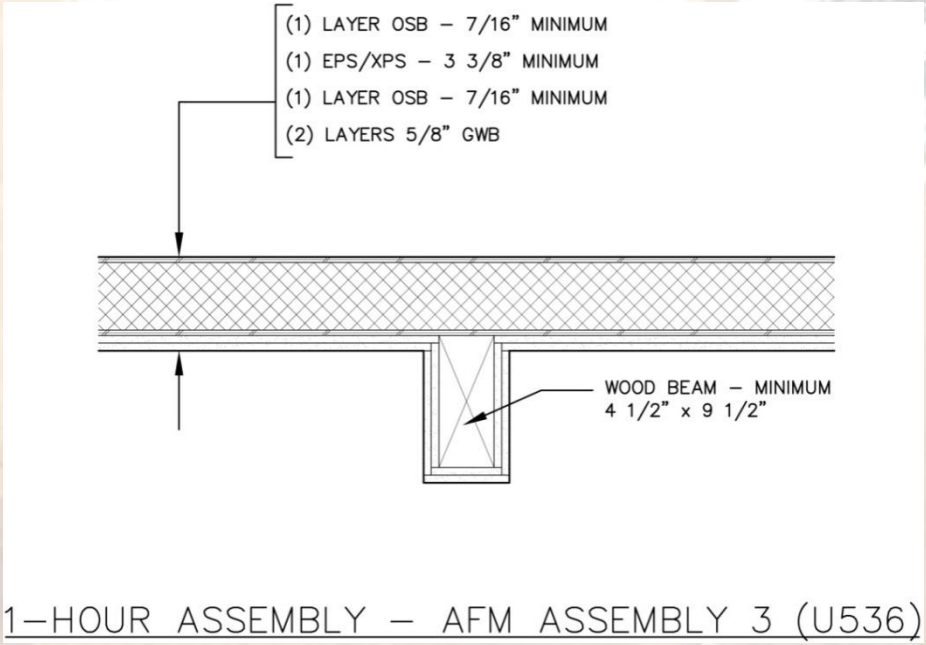


1–HOUR ASSEMBLY – AFM ASSEMBLY 1 (U534)

FIRE RATINGS WITH SIPs



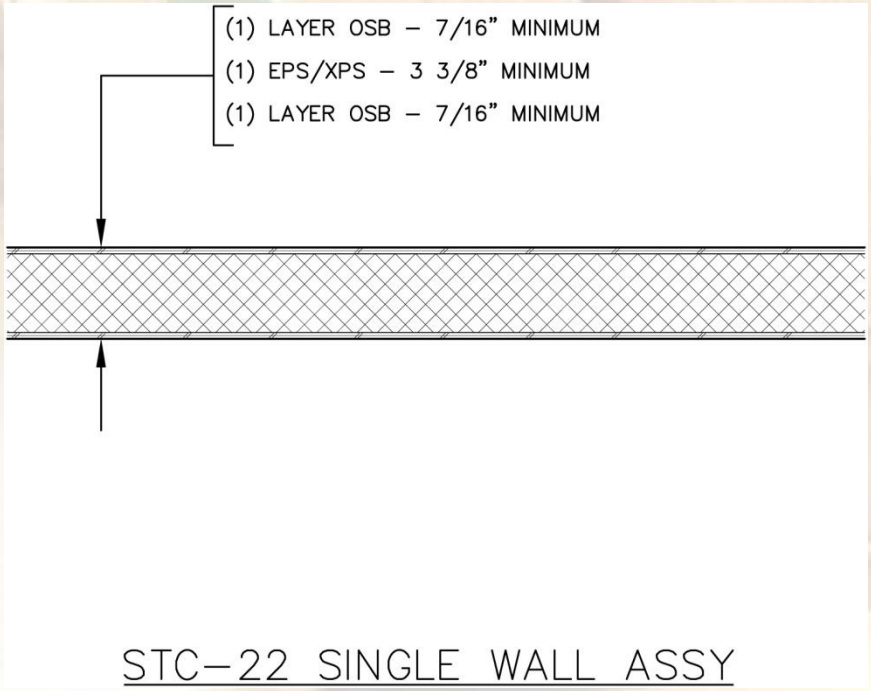
1–HOUR ASSEMBLY – AFM ASSEMBLY 2 (U535)

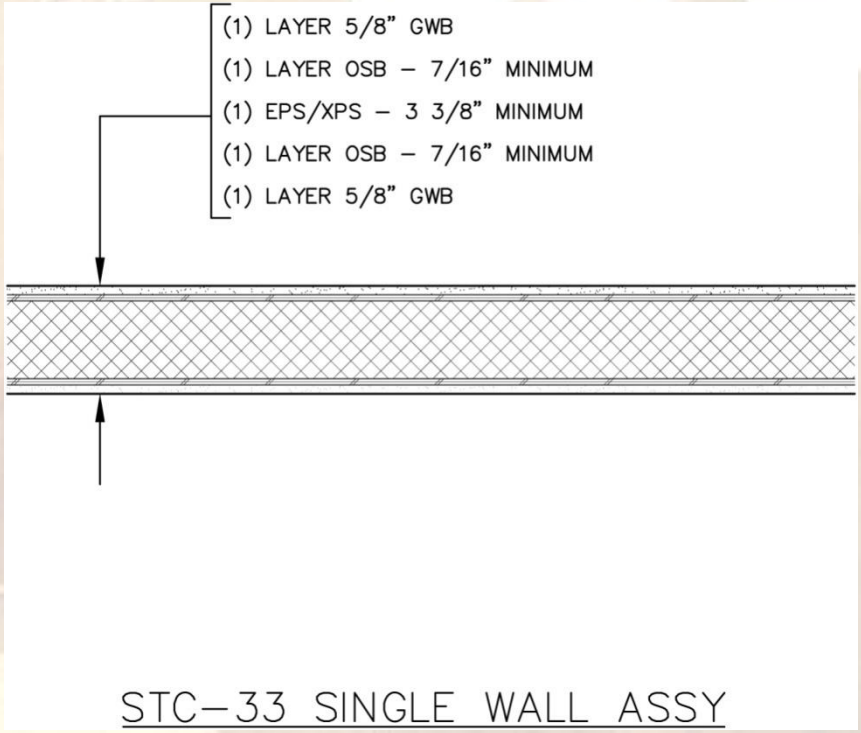


1–HOUR ASSEMBLY – AFM ASSEMBLY 3 (U536)

SOUND RATINGS WITH SIPs

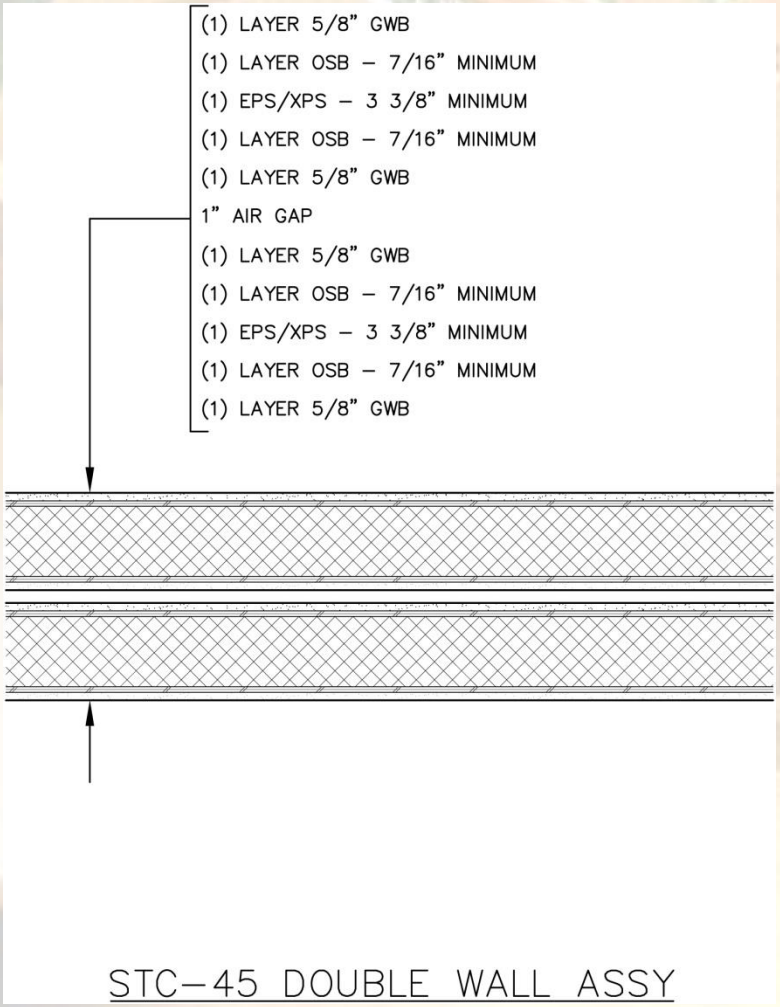
STC rated assemblies: single walls



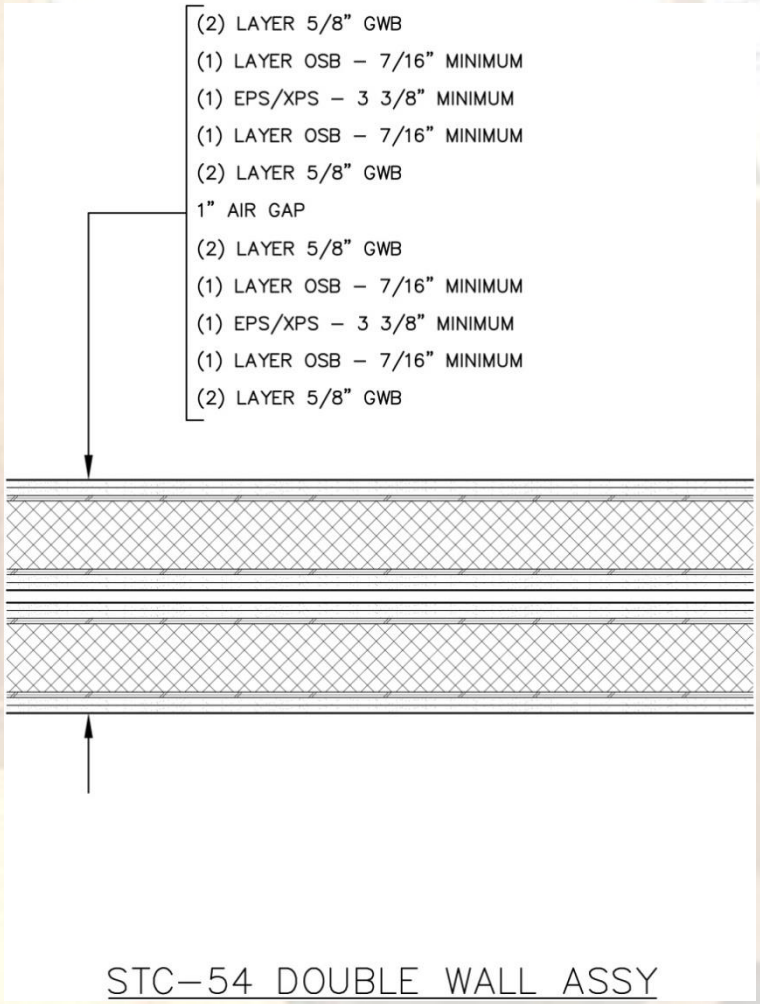


SOUND RATINGS WITH SIPs

STC rated assemblies: double walls



STC–45 DOUBLE WALL ASSY



STC–54 DOUBLE WALL ASSY

STRUCTURAL SIP HYBRIDS

Beyond combining SIPs with wood framing, other structural systems can be combined with SIPs to increase heights and spans in a building:

- **Metal framing**
- **Structural steel**
- **Pre-engineered buildings**
- **Timber framing**
- **Glu-Lams**

STRUCTURAL SIP HYBRIDS

Hybrid systems: SIPs with metal framing

Buffalo University Day Care
Buffalo, New York
Kideney Architects

STRUCTURAL SIP HYBRIDS

Hybrid systems: bar joists and structural steel with SIPs

Silvis Middle School, East Moline, IL

STRUCTURAL SIP HYBRIDS

Hybrid systems: bar joists and structural steel with SIPs

Silvis Middle School, East Moline, IL

STRUCTURAL SIP HYBRIDS

Pre-engineered building with SIPs

SIPs manufacturing plant, Cottonwood, MN

STRUCTURAL SIP HYBRIDS

SIPs and timber framing

Darien Nature Center, Darien, CT

STRUCTURAL SIP HYBRIDS

SIPs and timber framing

10” SIPs roof panels covering 14,900 square feet of conditioned space, achieving R-values that qualified for tax incentives as an Energy Qualified Cool Roof

Washington Fruit & Produce Corporate Office, Yakima, WA

STRUCTURAL SIP HYBRIDS

SIPs with Glu-Lams

Silverwood Park Visitor Center, Minneapolis, MN

SIP BASICS: R-VALUES

SIP R-Values

SIP Panel Thickness	4 ½”	6 ½”	8 ¼”	10 ¼”	12 ¼”
EPS	14.4	21.6	27.9	35.1	45.9
XPS	19.5	29.5	38.3	48.3	58.3
Polyurethane	21.7	32.9	N/A	N/A	N/A

- Consult panel manufacturer to verify R-values. R-values can vary between manufacturers.
- Calculated R-Values include 7/16” OSB on each side. EPS is Type I per ASTM C578-07
- XPS is TYPE IV per ASTM C578-06. Polyurethane information is derived from the range of products offered by SIPA member manufacturers.
- R-Values are at mean temperature of 75 degrees F

ENERGY CODE COMPLIANCE

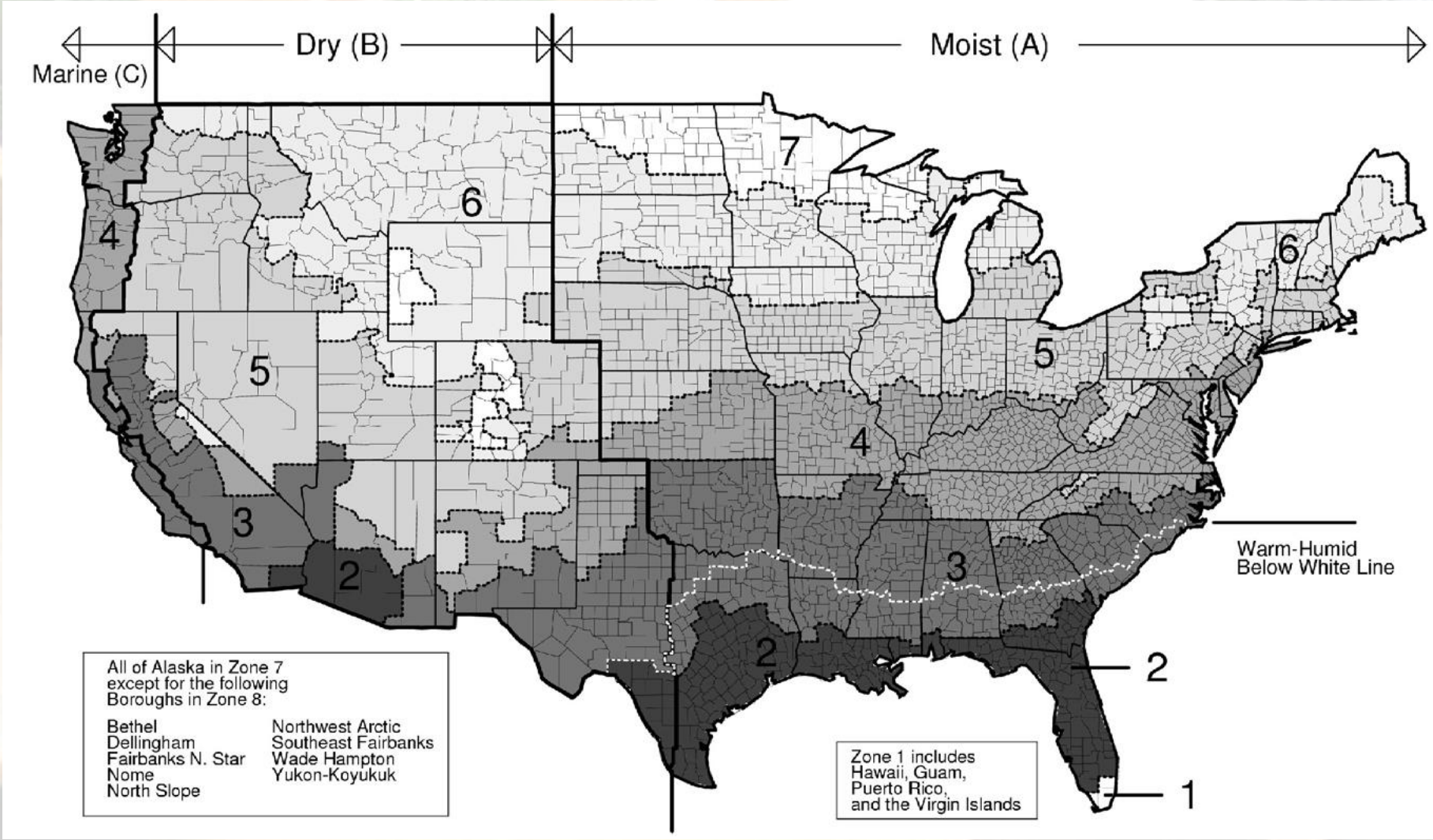
Benefits of SIPs to meet the 2012 thru 2021 IECC

- **Continuous insulation benefits for greater whole wall R-value**
- **Greater airtightness and less infiltration**

New requirements of the energy code

- **201 IECC 50% more efficient than 2006 IECC**
- **Greater insulation requirements for building envelope and continuous insulation (ci)**

ENERGY CODE COMPLIANCE



SIP DESIGN

SIP Roof & Wall Meet 2018 / 2021 Commercial IECC

TABLE 1.2

MINIMUM SIP THICKNESSES* TO MEET COMMERCIAL 2018 IECC TABLE C402.1.4

Climate Zone**	1		2		3		4		5		6		7		8	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roofs																
Insulation entirely above roof deck	U=0.048	U=0.039	U=0.039	U=0.039	U=0.039	U=0.039	U=0.032	U=0.032	U=0.032	U=0.032	U=0.032	U=0.032	U=0.028	U=0.028	U=0.028	U=0.028
Minimum SIP thickness	6-1/2"	8-1/4"	8-1/4"	8-1/4"	8-1/4"	8-1/4"	10-1/4"	10-1/4"	10-1/4"	10-1/4"	10-1/4"	10-1/4"	10-1/4"	10-1/4"	10-1/4"	10-1/4"
Wood framed and other	U=0.064	U=0.064	U=													
Minimum SIP thickness	4-1/2"	4-1/2"	4-													

*Assumes standard Type I EPS fo
**See Figure 1.1

TABLE 1.1.2

MINIMUM SIP THICKNESSES* TO MEET COMMERCIAL 2021 IECC TABLE C402.1.4

Climate Zone**	0 and 1		2		3		4 except marine		5 and marine 4		6		7		8	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roofs																
Insulation entirely above roof deck	U=0.048	U=0.039	U=0.039	U=0.039	U=0.039	U=0.039	U=0.032	U=0.032	U=0.032	U=0.032	U=0.032	U=0.032	U=0.028	U=0.028	U=0.028	U=0.028
Minimum SIP thickness	6-1/2"	8-1/4"	8-1/4"	8-1/4"	8-1/4"	8-1/4"	10-1/4"	10-1/4"	10-1/4"	10-1/4"	10-1/4"	10-1/4"	10-1/4"	10-1/4"	10-1/4"	10-1/4"
Walls, above grade																
Wood framed and other	U=0.064	U=0.064	U=0.064	U=0.064	U=0.064	U=0.064	U=0.064	U=0.064	U=0.051	U=0.051	U=0.051	U=0.051	U=0.051	U=0.051	U=0.032	U=0.032
Minimum SIP thickness	4-1/2"	4-1/2"	4-1/2"	4-1/2"	4-1/2"	4-1/2"	4-1/2"	4-1/2"	6-1/2"	6-1/2"	6-1/2"	6-1/2"	6-1/2"	6-1/2"	10-1/4"	10-1/4"

ENERGY CODE COMPLIANCE

2015 IECC Commercial R-value requirements (prescriptive)

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, *R*-VALUE METHOD[a]

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings[a,b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49
Walls, above grade																
Mass	R-5.7ci[e]	R-5.7ci[e]	R-5.7ci[e]	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci
Metal building	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13+ R-19.5ci	R-13 + R-13ci	R-13+ R-19.5ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-7.5ci	R-13+ R17.5ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R13 + R-15.6ci or R-20 + R-10ci	R13 + R-15.6ci or R-20 + R-10ci

CHARACTERISTICS OF SIPs

More than 40% of a building's total envelope loss is due to infiltration!

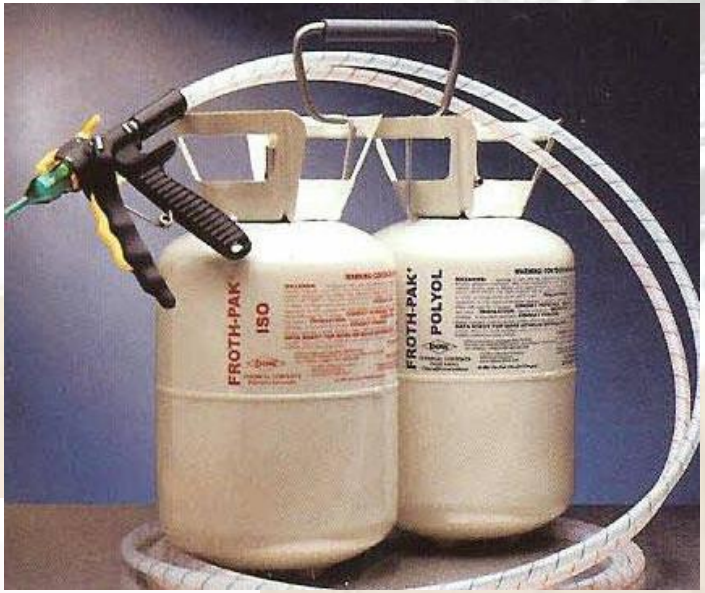
SIPs have:

- Very few gaps (3% vs 25% framing factor)
- Industry standard sealing details
- Superior indoor air quality

SIP DETAILS - Sealing

Foam Everything

- Panel joints
- Windows and doors
- Plumbing stacks
- Chimneys

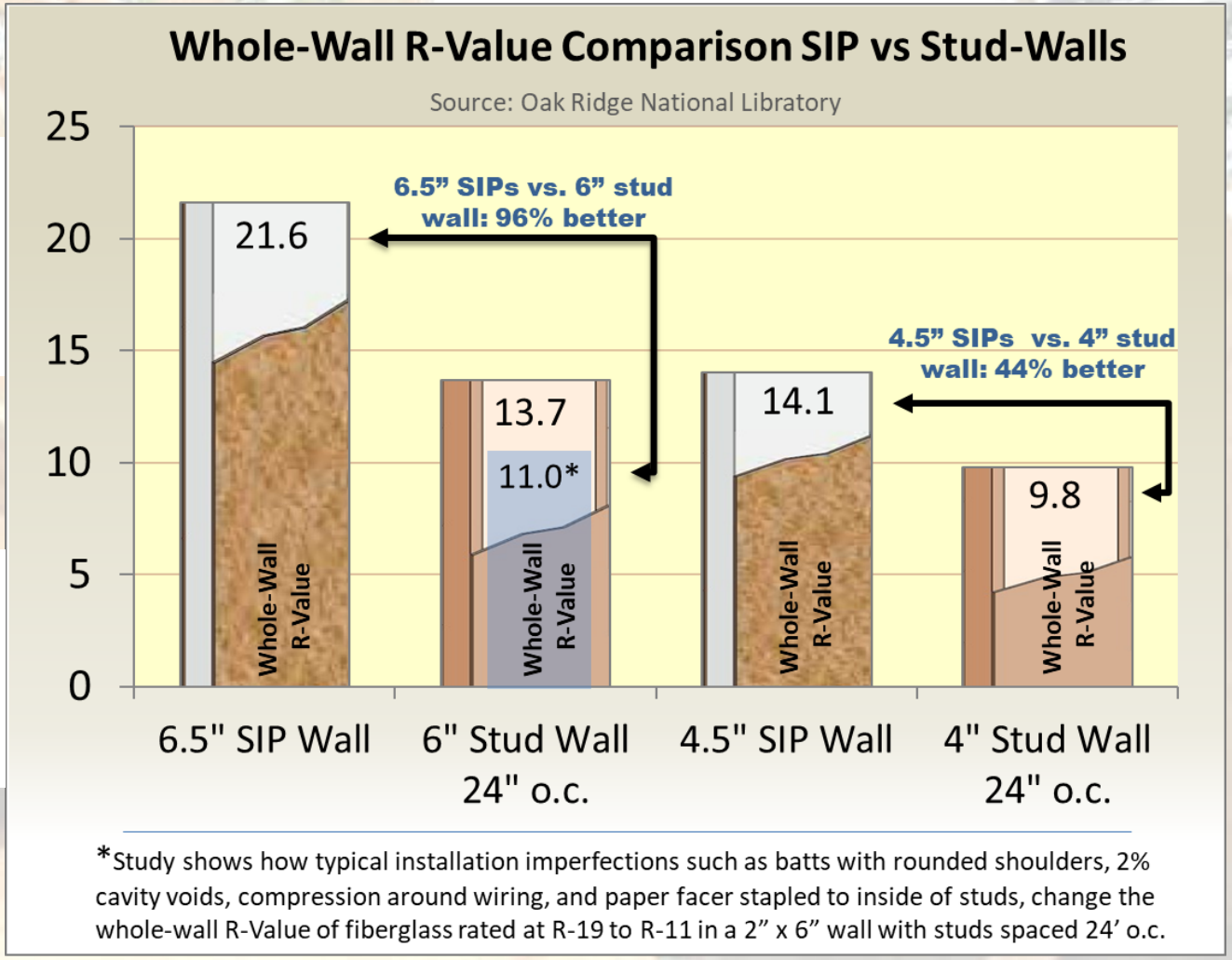


SIP INSULATION BETTER

Oak Ridge National Laboratory Studies

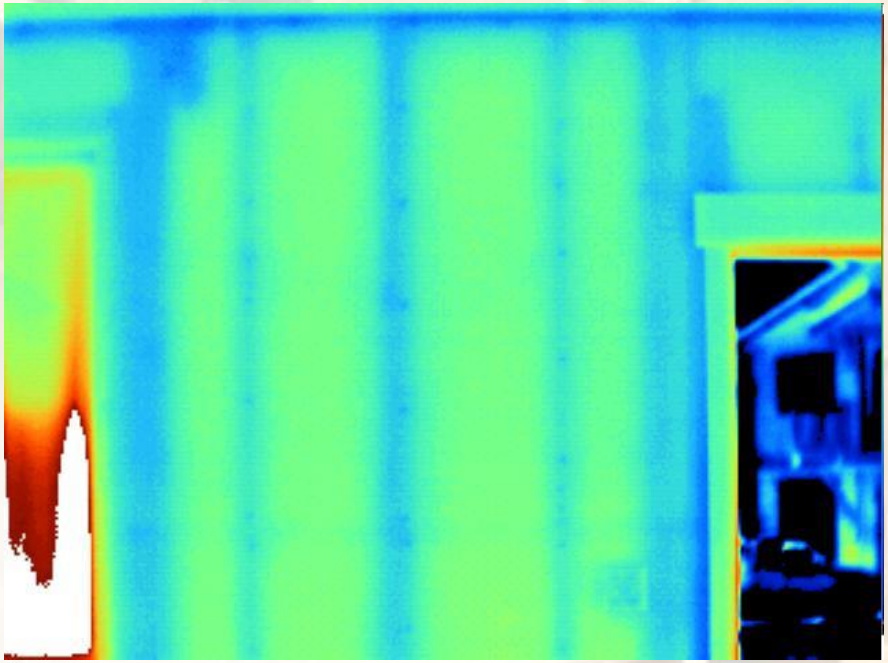
4.5” SIP wall outperforms 2”x 6” stud wall with R-19

6.5” SIP wall 96% better than 2”x 6” with R-19

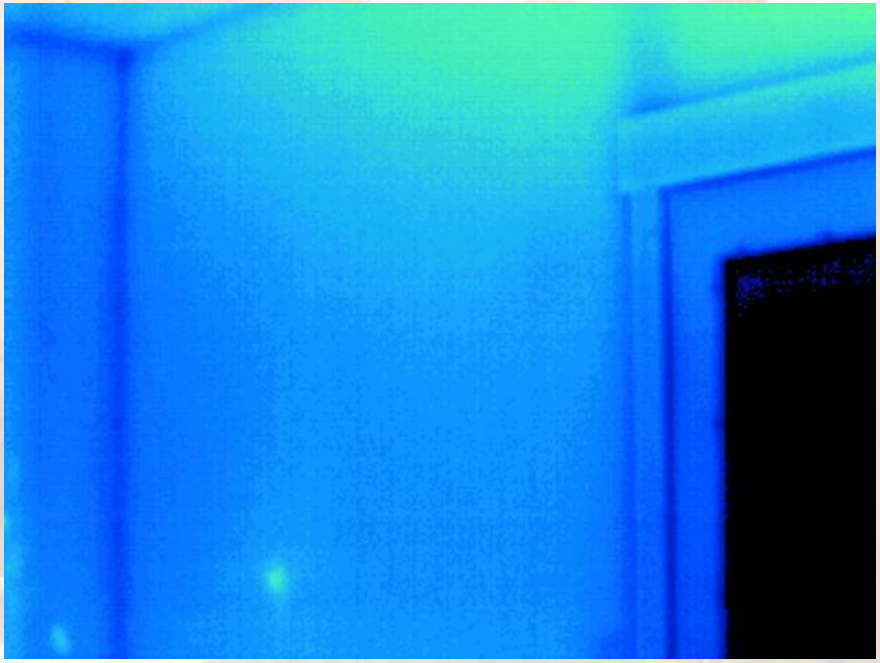


ENERGY CODE COMPLIANCE

Thermal Bridging



Stick Framing



SIP

CHARACTERISTICS OF SIPs

Air Tightness

SIPs can make homes tight enough to meet the Passive House air tightness standard (0.6 ACH50), which is one of the highest in the industry

Date of Test:
Test File:

Technician:

Customer:

Building Address:

Test Results

1.	Airflow at 50 Pascals: (50 Pa = 0.2 w.c.)	327 CFM (+/- 0.5 %) 0.53 ACH 0.07 CFM per ft2 floor area
2.	Leakage Areas:	38.9 in2 (+/- 3.7 %) Canadian EqLA @ 10 Pa 22.4 in2 (+/- 5.8 %) LBL ELA @ 4 Pa
3.	Minneapolis Leakage Ratio:	0.04 CFM50 per ft2 surface area
4.	Building Leakage Curve:	Flow Coefficient (C) = 36.2 (+/- 9.0 %) Exponent (n) = 0.563 (+/- 0.023) Correlation Coefficient = 0.99571
5.	Test Settings:	Test Standard: = CUSTOM Test Mode: = Depressurization Equipment = Model 3 Minneapolis Blower Door

Infiltration Estimates

1.	Estimated Average Annual Infiltration Rate:		21.8 CFM 0.04 ACH 5.5 CFM per person (using bedrooms + 1)
2.	Estimated Design Infiltration Rate:	Winter:	31.6 CFM 0.05 ACH
		Summer:	17.1 CFM 0.03 ACH
3.	Recommended Whole Building Mechanical Ventilation Rate: (based on ASHRAE 62.2)		73.8 CFM

SIP SEALING

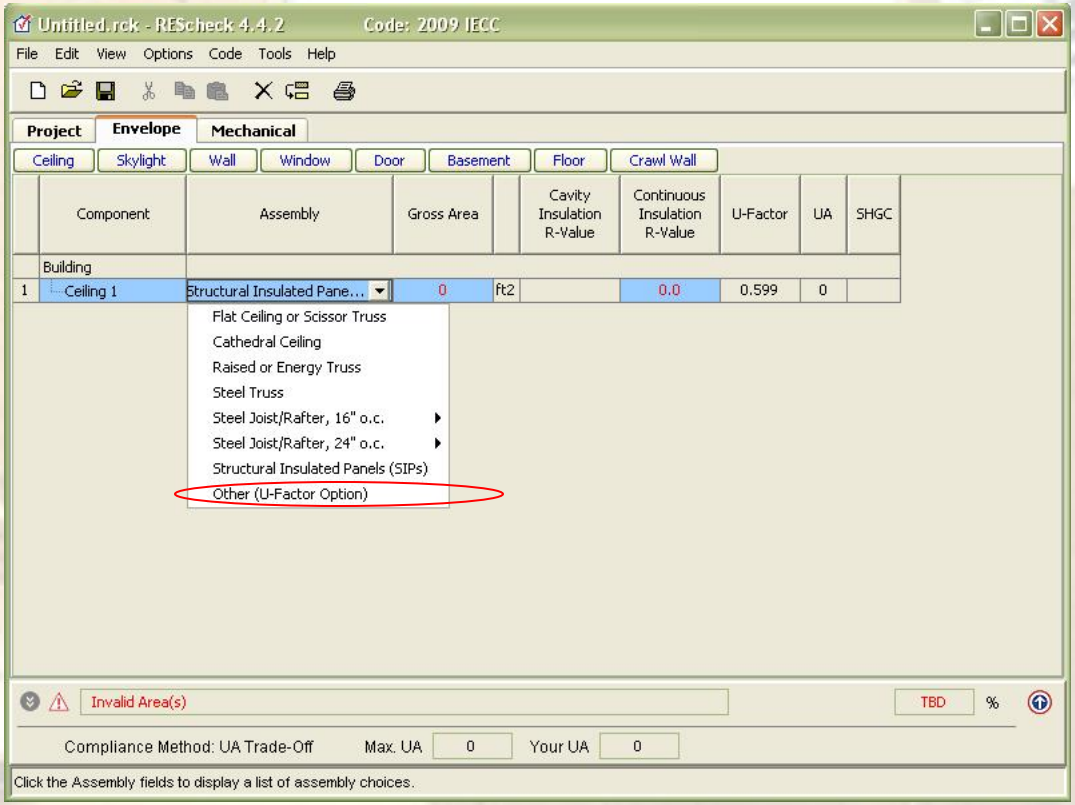
To attain full airtightness with SIPs:

- **Seal joints, openings, and penetrations with tape and mastic per manufacturer requirements**
- **Foam may be used to seal joints per the manufacturer**
- **Tape location varies with climate**

ENERGY CODE COMPLIANCE

Performance method

- Whole building energy modeling compared to reference design
- Use COMcheck or other approved software



TAX INCENTIVES

ENERGY STAR commercial tax deduction 45L, 179d, 25c

- $1.80/ft2 up to $5/ft2
- $0.60 for building envelope
- 50% savings over ASHRAE 90.1-2001
- Use approved energy modeling software

ARCHITECTURE 2030

SIPs contributes to this by…

- **Energy savings as a result of greater insulation values and insulation continuity**
- **Greater building tightness and infiltration reduction**
- **Reducing construction waste as well as waste during the manufacturing process**

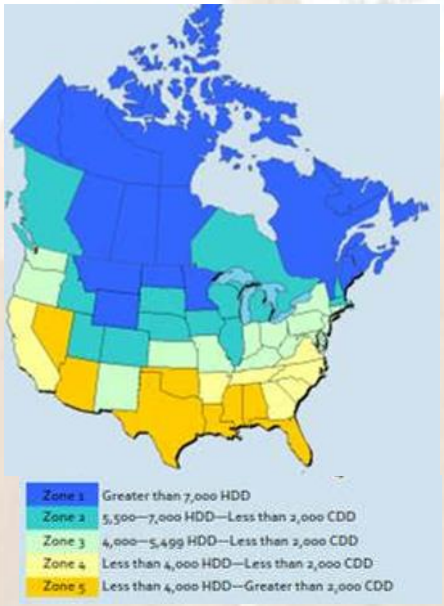
www.architecture2030.org

http://www.aia.org/about/initiatives/

LIFE CYCLE ANALYSIS

LCA (Life Cycle Analysis) studies for SIPs:

- *EPS Industry Alliance*
  - SIPs save energy invested in component and product manufacture and transportation
    - 5.1 yr energy payback (avg. zones 1-5)
    - 3.8 yrs recapture of greenhouse gas emissions (avg. zones 1-5)
- *BASF*
  - SIPs outperform 2x construction for LCA
- *Oregon Department of Environmental Quality*
  - SIPs reduce onsite construction waste when compared to other systems



LIFE CYCLE ANALYSIS

U.S. Model

Energy Savings Provided by using SIPs Single Family Home - U.S			Energy Investment			Millions Btu's
			SIP			177.1
			Stud Wall			110.4
			Additional Energy Invested			66.7
Energy Savings compared to Stud Walls	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	U.S.Average
Conductive Energy Loss	4.2	3.6	3.0	2.3	2.4	2.7
Air Leakage Energy Loss	14.6	12.4	10.0	6.9	5.7	8.0
Total (including energy production and delivery)	24.8	20.7	16.8	11.2	8.6	13.2
Payback Period in Years	**2.7**	**3.2**	**4.0**	**6.0**	**7.8**	**5.1**
Savings Over 50 Years	**1242**	**1037**	**839**	**562**	**431**	**660**

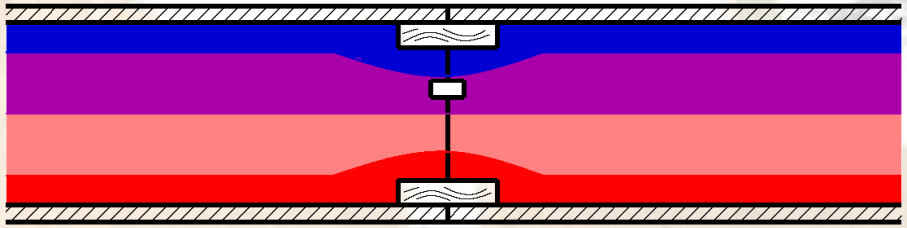
Global Warming Potential (GWP) Reductions Provided by using SIPs Single Family Home - U.S			GWP Investment			Tons CO_2 Eq.
			SIP			9.63
			Stud Wall			5.87
			Additional GWP Invested			3.75
GWP Reductions compared to Stud Walls	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	U.S.Average
Total	1.83	1.49	1.25	0.84	0.67	0.99
Payback Period in Years	**2.0**	**2.5**	**3.0**	**4.4**	**5.6**	**3.8**
Savings Over 50 Years	**91.4**	**74.4**	**62.3**	**42.1**	**33.6**	**49.6**

EPS Industry Alliance Life Cycle Analysis

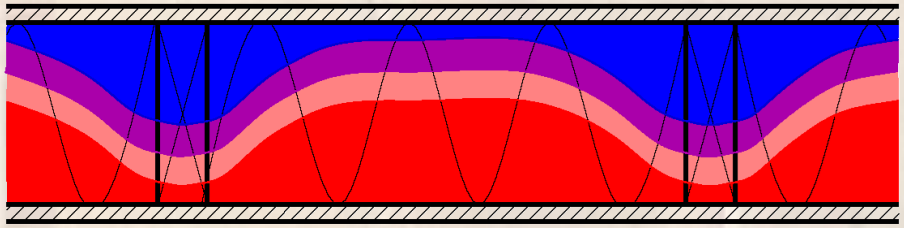
THERMAL CHARACTERISTICS

Fight Cavities!

- **Cavity walls with code enforced high performance increase the possibility of "pumping" water vapor into cavities which can cause mold, rot and mildew.**
- **SIPs eliminate this problem by having no cavity space. This is especially true for cold weather climates.**



A more consistent, symmetric R-value



The more framing you have, the more inconsistent the R-Value

CLIMATE SPECIFIC DESIGN

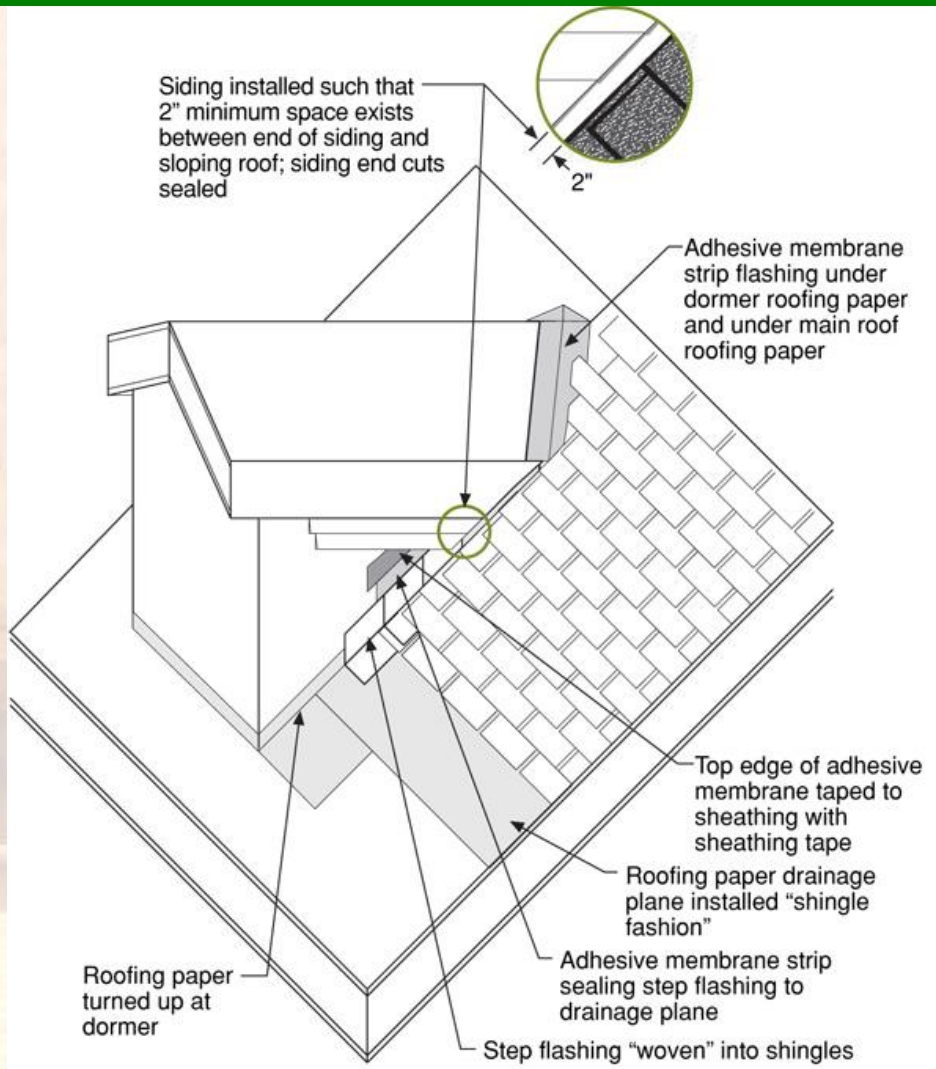
- **SIP durability**
- **Prevent the intrusion and entrapment of moisture in cold and/or wet climates**
- **Design with drainage planes and roof vents for all cold climates and where there is more than 20 inches of rain per year for maximum durability**
- **Three types of water intrusion**
  - **Bulk water**
  - **Air infiltration**
  - **Vapor drive**

CLIMATE SPECIFIC DESIGN

- Drying of the exterior envelope is a universal issue for all building types, including SIPs
- Be aware of the climate you are building in to determine the need for drainage at the exterior envelope
- If required, create a drainage plain or rain screen to allow for the drying of SIPs at the exterior and prevent the trapping of moisture
- A variety of drainage techniques may be used:
    - Drainage mat
    - Furring strips

CLIMATE SPECIFIC DESIGN

- Roofing paper at roof is acceptable for some drier climates in the continental US
- Cold weather climates should have vented roofs
- Flat or low slope roofs should not have TPO applied directly to OSB
- Standing seam metal roofs may not need venting



Note: Layering cut away in this figure shown for clarity, not as recommendation for installation sequencing

INDOOR AIR QUALITY WITH SIPs

OSB is manufactured with a phenolic resin that has negligible quantities of formaldehyde.

"…plywood and OSB manufactured to US product Standards PS 1 and PS 2 have such low emission levels that they are exempt from the leading formaldehyde emissions standards and regulations." (APA)

OSB meets the standards of the following regulators:

- U.S. HUD Manufactured Housing Standard
- California Air Resources Board (CARB) Air Toxic Control Measure for Composite Wood Products
- Japanese Agriculture Standards
- EN 300 standards (Europe)

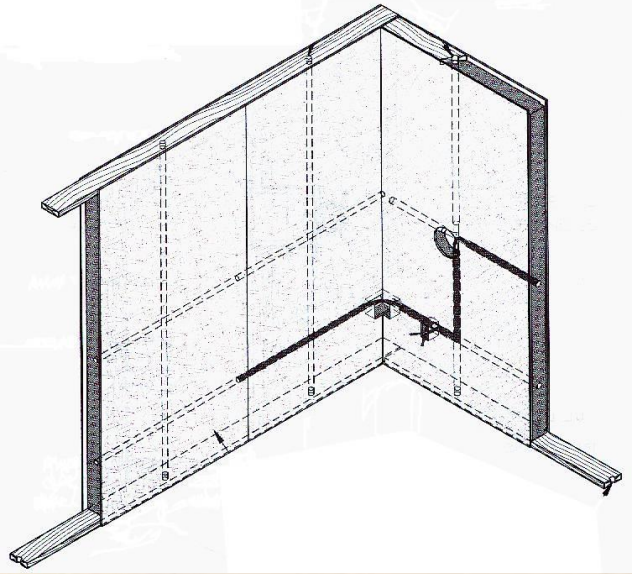
CONSTRUCTION METHODS AND SPECIFICATIONS

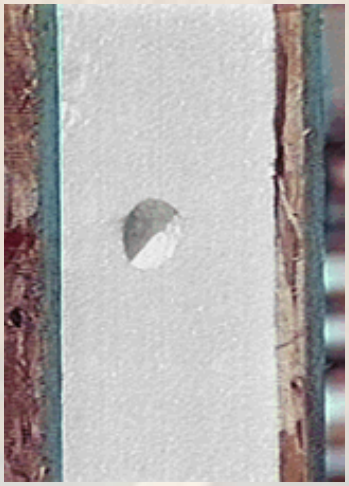
Coordination with the design team is essential before the actual manufacturing of SIPs.

- **HVAC**
  - Mechanical ventilation required
  - Properly design and size equipment
- **Window and door openings**
- **Electrical**
  - Chases in SIP walls or furred walls to run electrical wiring
- **Structural system**
  - Coordinate steel and concrete carefully

SIPs ELECTRICAL

- **Wall panels can have 1” to 1 1/2” diameter electrical chases.**
- **Horizontally at switch & outlet heights**
- **Vertically, typically 4’ OC**
- **Top and bottom plates are drilled during installation to access the vertical electrical chases**





CONSTRUCTION METHODS: SIP BENEFITS

- Shell enclosed and dried in quickly
- Subs start sooner, finish faster
- Drywall hangs faster
- Trim labor reduced
- Less jobsite waste
- Electrical chases provided
- Uniform & straight nailing surfaces

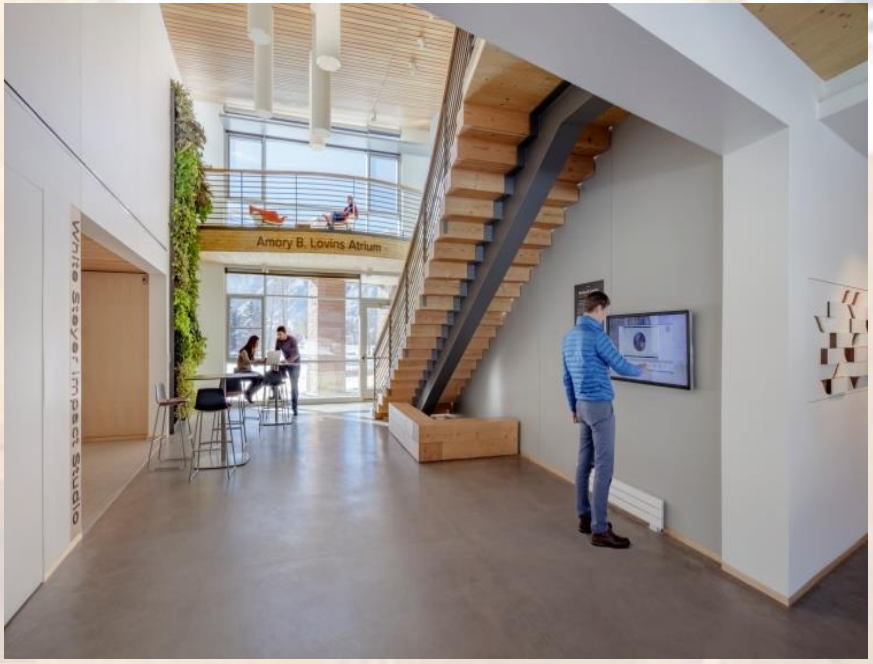
COMMERCIAL APPLICATIONS

SIPs can be used for non-residential applications with high performance and high value

- Schools
- Commercial
- Civic buildings
- Medical buildings
- Warehouses
- Retirement communities
- Multi-family housing
- Restaurants

COMMERCIAL APPLICATIONS

SIPs and timber framing



Innovative use of curved panels. Certified Passive House (largest in the U.S.)
83K of PV; 0.36 ACH

Rocky Mountain Institute Innovation Center, Basalt, CO

COMMERCIAL APPLICATIONS

Jacob E. Manch Elementary School, Las Vegas, NV

COMMERCIAL APPLICATIONS

Jacob E. Manch Elementary School, Las Vegas, NV

COMMERCIAL APPLICATIONS

Coventry Senior Living, Mahtomedi, MN

COMMERCIAL APPLICATIONS

Finn Hill Junior High School, Kirkland, WA

COMMERCIAL APPLICATIONS

Finn Hill Junior High School, Kirkland, WA

COMMERCIAL APPLICATIONS

Aeon Alliance Expansion, Minneapolis, MN

COMMERCIAL APPLICATIONS

Aeon Alliance Expansion, Minneapolis, MN

COMMERCIAL APPLICATIONS

Bend Parks and Recreation, Bend, OR

COMMERCIAL APPLICATIONS

Bend Parks and Recreation, Bend, OR

Course Summary

Now, the design professional will be able to:

- Discuss the basics of structural insulated panels (SIPs) in terms of composition, engineering methods, and codes and standards; and how this contributes toward a more sustainable design.
- Identify the energy-efficient characteristics of SIPs and how these help improve overall building energy efficiency.
- Describe the waste reducing and product life cycle benefits of building with SIPs, compared to traditional wood framing.
- Explain how SIPs contribute to better indoor air quality through a reduction in both air infiltration and interior off gassing.
- Discuss the advanced technical requirements and design applications of SIPs.

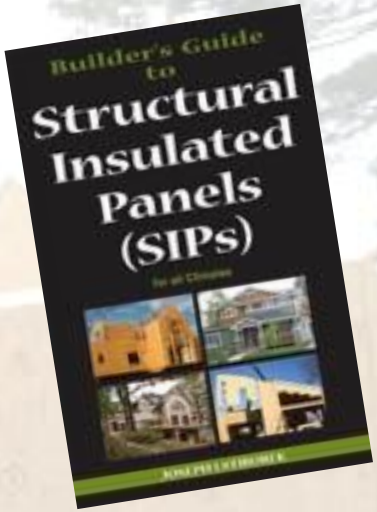
Question and Answer

Any Questions?

The next 10 minutes will be focused on discussing the course material.

SIP RESOURCES

www.SIPs.org



- Free online *Builder Education with SIPs Training* (BEST) 10 videos (or YouTube)
- SIPA Master Builder Program
- *SIPschool* hands on training events
- *Builder's Guide to SIPs* by Joe Lstiburek
- AIA & GBCI Continuing Education courses
- Find a supplier in your area
- Case studies /tech briefs /project maps
- *Builder Need to Know* guide & checklists
- In depth *Best Practices* and *Connection Details*

SIP RESOURCES

Building with SIPs - Need to Know

BUILDING CONSIDERATIONS

- High-performance building envelopes use SIPs
- SIP performance is based on more than its stated R-value
- HVAC system rightsizing reduces costs and enhances comfort and performance
- SIP structural capabilities cater well to virtually any design
- SIPs are typically factory cut for accuracy, quality and reduced onsite labor
- SIPs are manufactured using "SIP shop (or panelized) drawings"
- SIPs are customized to varying levels depending on client needs
- Roof and wall assemblies
- Factory cut electrical chases reduce electrician time in the field
- Design plumbing into interior walls
- Resource to better understand the science of building with SIPs

CHECKLIST

- High-Performance Building Envelope
- HVAC Systems
- Structural Capabilities
- SIP Sizes
- Shop Drawings
- SIP Fabrication
- SIP Installation
- Roof and Wall Assemblies
- Electrical
- Plumbing

Free copies available here
At SIPA table!

Quality

Make sure your SIP manufacturer is a member of SIPA for quality control purposes.

SIPA

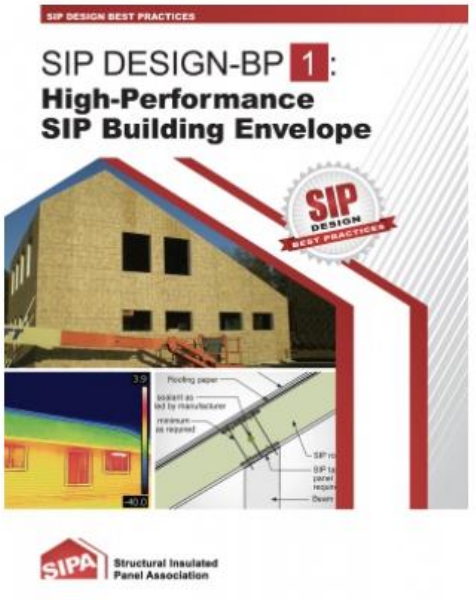
Structural Insulated Panel Association

Resources – Design Best Practice Guides

SIP DESIGN Best Practices Series

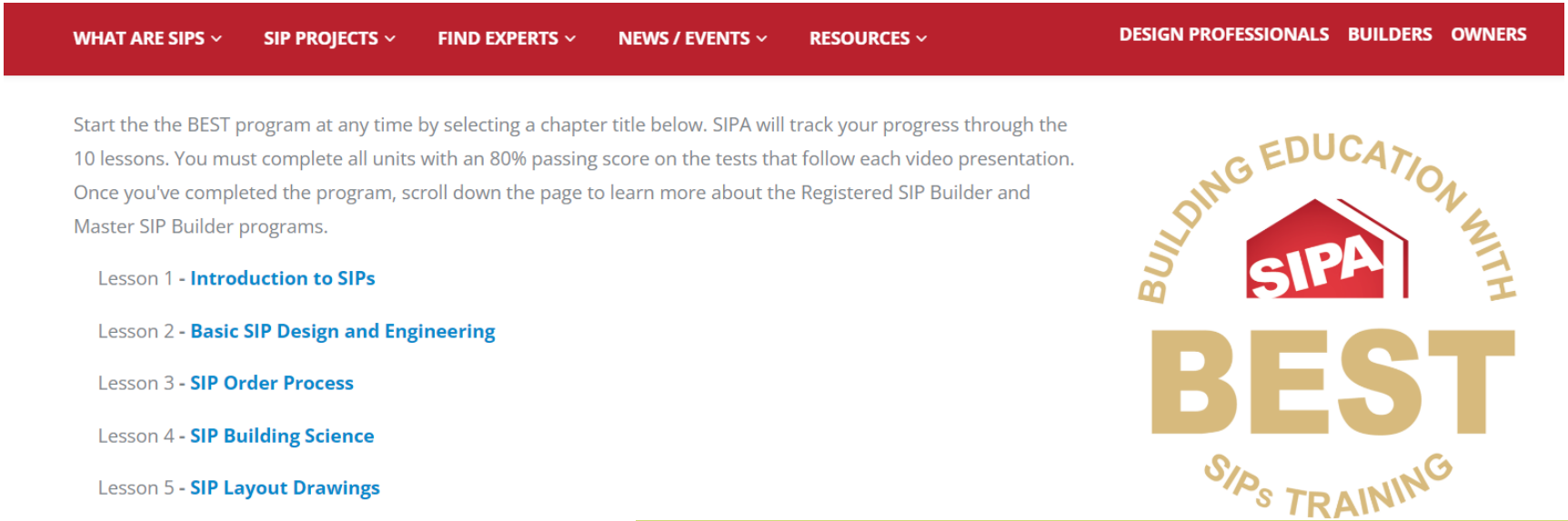
SIPA is publishing a series of "deeper-dive" explorations of the core topics summarized in DESIGN CONSIDERATIONS. The SIP DESIGN BEST PRACTICES series provides the engineering analysis and explanation behind the essential aspects of SIP design.

- SIP DESIGN BP-1: High-Performance SIP Building Envelope
- SIP DESIGN BP-2: HVAC Systems with SIPs
- SIP DESIGN BP-3: SIP Structural Capabilities
- SIP DESIGN BP-4: SIP Sizes
- SIP DESIGN BP-5: SIP Shop Drawings
- SIP DESIGN BP-6: Fabrication/Manufacturing
- SIP DESIGN BP-7: SIP Installation
- SIP DESIGN BP-8: SIP Roof and Wall Assemblies
- SIP DESIGN BP-9: SIP Electrical
- SIP DESIGN BP-10: Plumbing



https://www.sips.org/resources/design#section414

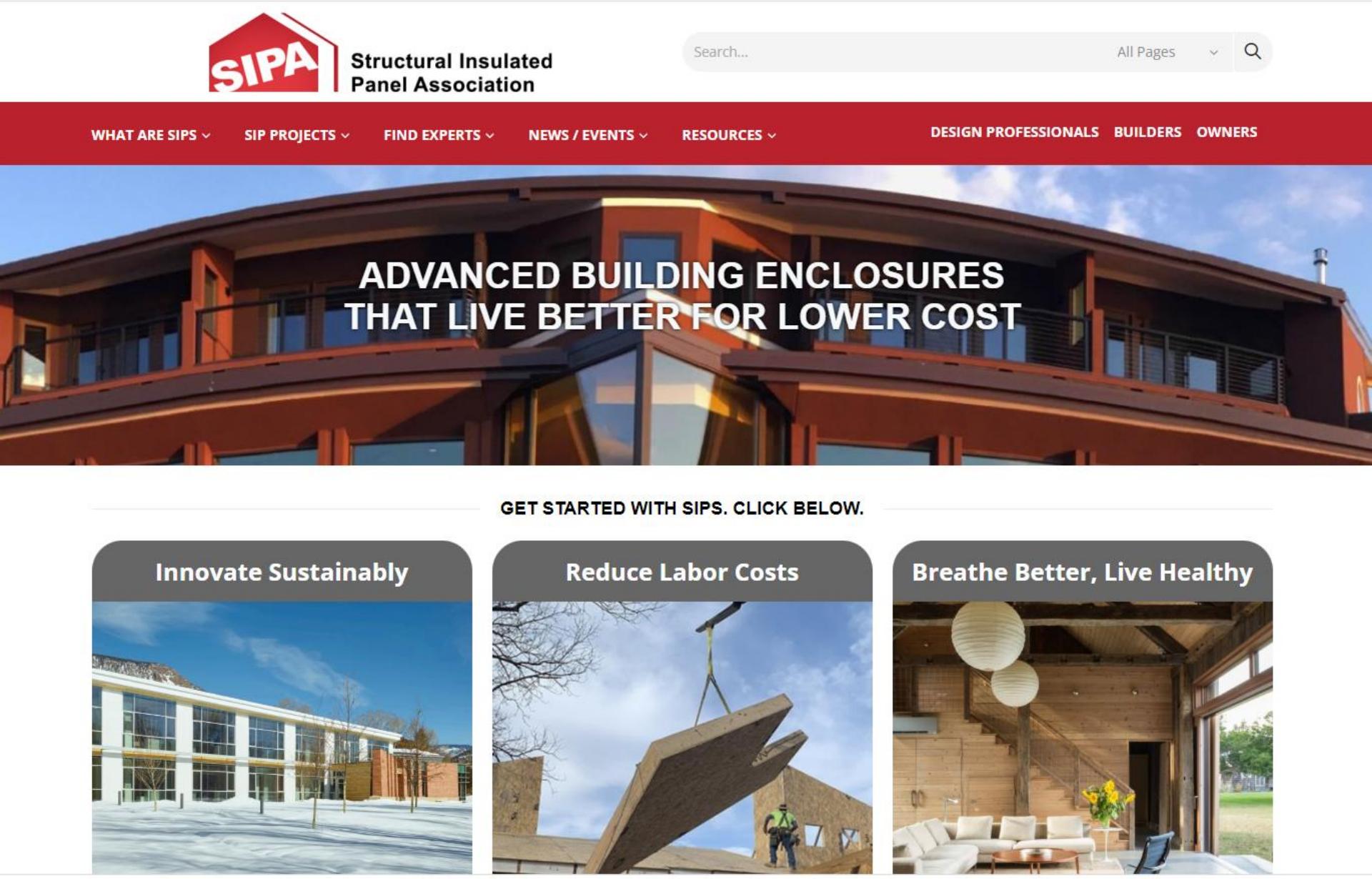
Resources – BEST Program



- ✓ Entire videos series remastered for high-def
- ✓ All credentialled for AIA CEU HSW credits
- ✓ Available at SIPs.org & YouTube and…
- ✓ EEBA & Hi Performance Insulation Pros. hosting

Take for free at: https://www.sips.org/resources/bestprogram

Resources – www.SIPs.org



Structural Insulated Panel Association

Commercial Design with Structural Insulated Panels

Structural Insulated Panel Association (SIPA)
An AIA Continuing Education Program
Credit for this course is 1 AIA HSW CE Hour

The Structural Insulated Panel Association (SIPA) is a nonprofit association representing manufacturers, suppliers, dealer/distributors, design professionals and builders committed to providing quality structural insulated panels (SIPs) for all segments of the construction industry.

Structural Insulated Panel Association (SIPA)

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Credit for this course is 1 AIA/CES HSW CE Hour

Course number SIPS101C