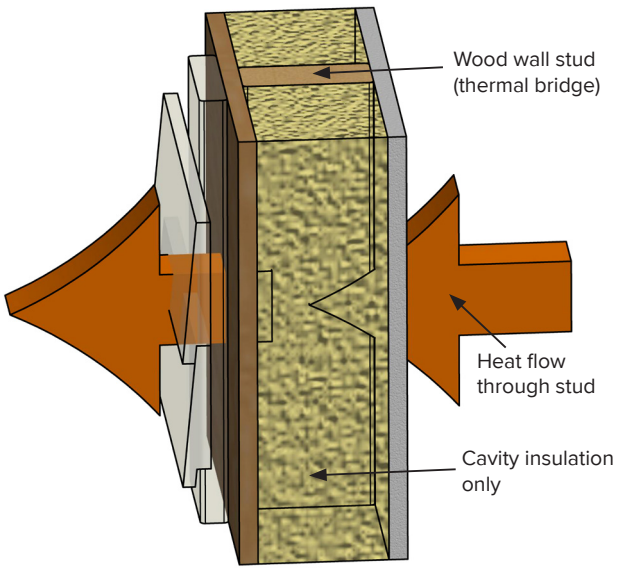
QUICK GUIDE
Foam Plastic Applications for Better Building

CLADDING CONNECTIONS to Wood Frame Walls with Foam Plastic Insulating Sheathing (FPIS) Continuous Insulation (ci)

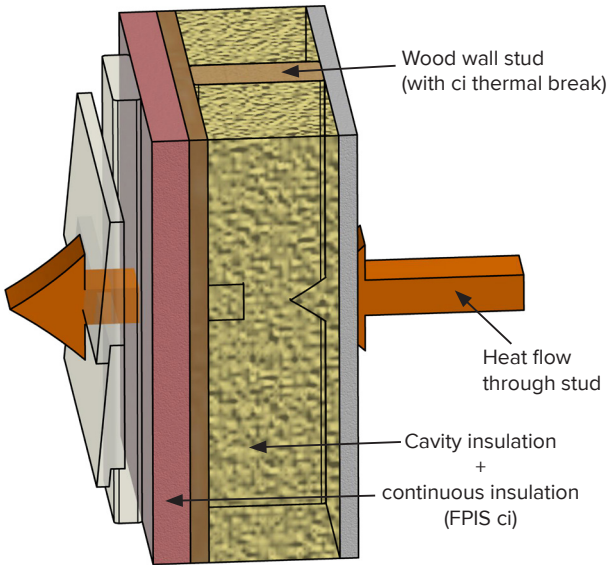
11.05.21

STEP 1: COMPLY WITH ENERGY CODE CONTINUOUS INSULATION REQUIREMENTS

Continuous insulation (ci) is one of the most effective ways for wood frame walls to comply with modern energy codes (see wood frame wall calculator) because it prevents thermal bridging as shown in Figure 1. In addition to meeting ci R-value requirements, cladding connections through ci must comply with the energy code's definition of ci (see text box) and the building code's requirements for cladding attachment (see Step 2).



Thermal bridging in wood framed wall with cavity insulation only.



Thermal bridging in wood framed wall with cavity insulation and foam plastic insulating sheathing (FPIS) continuous insulation (ci).

Figure 1. Illustration of FPIS ci used to minimize thermal bridging through wood framing.

Continuous insulation (ci) is defined in the International Energy Conservation Code (IECC) and ASHRAE 90.1 Standard as "insulation that is uncompressed and continuous across all structural members without thermal bridges other than fasteners and service openings."

A key part of the code's definition for ci requires that only fasteners (e.g., nails or screws) penetrate the ci to minimize thermal bridging. This is particularly important for detailing cladding installations, like example shown in Figure 2, such that the prescriptive R-values for ci can be used as a simple means of energy code compliance. Cladding and furring attachments that result in more than just fasteners penetrating the ci, such as furring support brackets, cannot use the prescriptive ci R-values for compliance. Instead, the total wall assembly's U-factor must be determined by calculation or testing and it must include the impact of thermal bridging of the cladding support system.

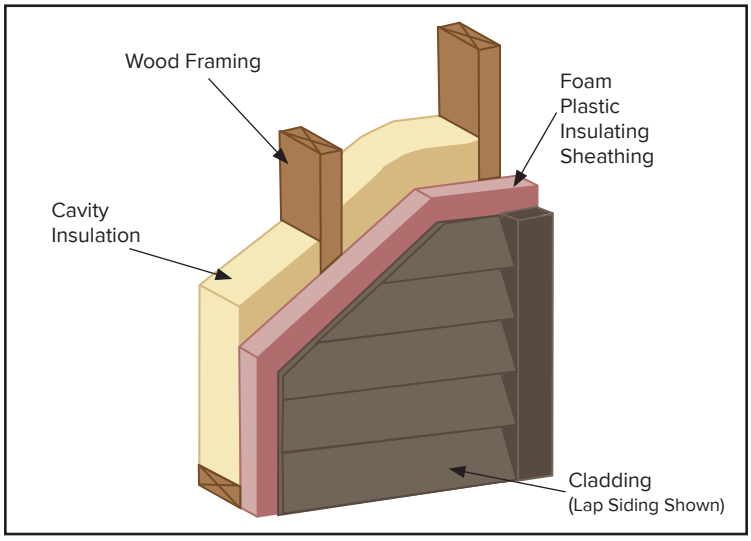


Figure 2. Example of cladding and FPIS ci installation on wood frame wall assembly to mitigate thermal bridging and comply with the ci definition.

Another key part of the ci definition requires that the insulation be uncompressed. Because FPIS ci is a rigid foam plastic with relatively high compressive strength, it is possible to fasten cladding and furring to wood framing or other wall substrates without compressing the insulation. This avoids reduced thermal performance due to insulation compression at points of connection, improves constructability, and makes it possible to fully comply with the ci definition.

STEP 2: COMPLY WITH BUILDING CODE REQUIREMENTS FOR CLADDING CONNECTIONS

Recent editions of the International Building Code (IBC), Chapter 26, and International Residential Code (IRC), Section R703, include three options for attachment of claddings through a layer of FPIS ci using properly specified fasteners that comply with the energy code's ci definition:

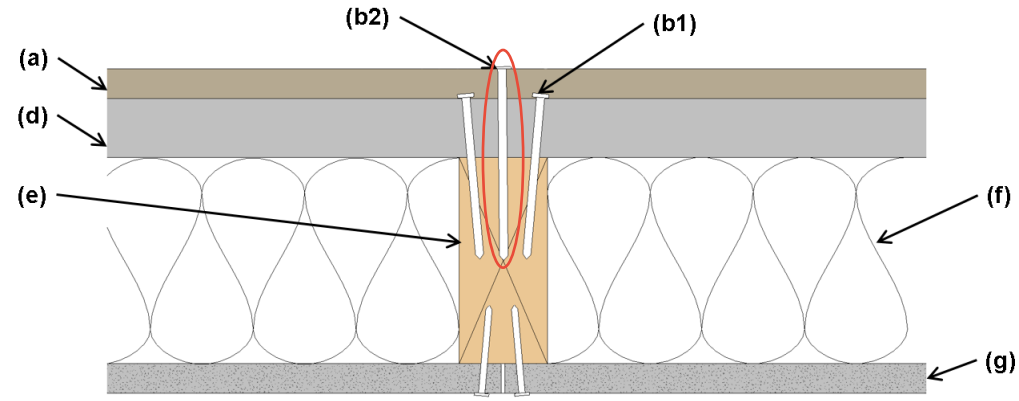
1. Direct Cladding Attachment through FPIS ci (see Figure 3A and Table 1)
2. Furring Attachment through FPIS ci (see Figure 3B and Table 2)
3. Cladding Attachment through FPIS ci to a Wood Structural Panel Substrate (see Figure 4 and Table 3)

These procedures provide assurance that the fastening schedule is sufficient to support the cladding weight and resist movement once installed over FPIS ci (up to 4-inches thick) depending on various conditions, such as cladding weight (see text box). The cladding manufacturer and building code's attachment requirements should be consulted for additional installation requirements, especially where a more stringent fastening schedule is required for reasons other than support of the cladding weight. Also, important specifications and limitations in the table footnotes should be carefully considered. Finally, it is important to note that these solutions are not exhaustive and that other commodity or proprietary fastener solutions or details may be available by design or through the cladding, fastener, or FPIS manufacturer.

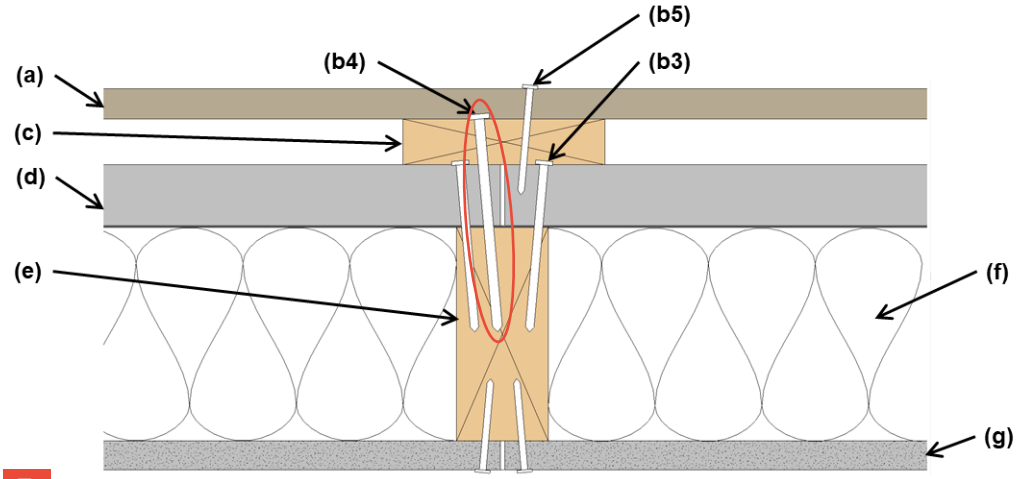
Typical cladding materials included in the weight classes listed in Tables 1, 2, and 3 are as follows (verify with cladding manufacturer data):[1]

- 3 psf – e.g., wood lap and panel siding, vinyl siding, and most fiber-cement sidings
- 11 psf – e.g., 3-coat Portland cement stucco
- 18 psf – e.g., medium weight adhered stone veneer
- 25 psf – e.g., heavy weight adhered stone veneer

[1] The attachment requirements of Tables 1, 2, and 3 do not apply to separately supported claddings such as anchored masonry veneer (i.e., conventional brick or stone veneer). Brick ties and their fasteners are intended to resist out-of-plane wind and seismic loads and not support the veneer weight. Thermally efficient brick ties and fasteners may be specified such that they meet the intent of the ci definition for energy code compliance.



A Plan View – Direct Cladding Attachment Through FPIS to Wood Stud (see Table 1)



B Cladding Attachment Through Vertical Furring (Wood Shown) Parallel to Wood Studs (see Table 2)

KEY:

(a) Cladding
(b1) Fastener (FPIS to Stud) per FPIS manufacturer
(b2) Fastener (Cladding to Stud) per Table
(b3) Fastener (FPIS to Stud) per FPIS manufacturer
(b4) Fastener (Furring to Stud) per Table
(b5) Fastener (Cladding to Furring)
(c) Wood Furring
(d) FPIS
(e) Framing
(f) Cavity Insulation
(g) Wall Finish

NOTE: Where furring is used, it may be oriented horizontally or vertically as noted in Table 2.

Figure 3. Illustration of cladding and furring attachments through FPIS to wood framing.

Table 1. Siding Minimum Fastening Requirements to Wood Framing for Direct Cladding Attachment Over FPIS to Support Cladding System Weight [1,2,3,4]

CLADDING FASTENER THROUGH FPIS INTO:	Siding Fastener Type & Minimum Size	Siding Fastener Vertical Spacing (in.)	MAXIMUM THICKNESS OF FPIS (IN.)							
			16" o.c. Fastener Horizontal Spacing				24" o.c. Fastener Horizontal Spacing			
			CLADDING SYSTEM WEIGHT				CLADDING SYSTEM WEIGHT			
			3 psf	11 psf	18 psf	25 psf	3 psf	11 psf	18 psf	25 psf
Wood Framing (minimum 1¼" penetration)	Nail (0.113" shank; 0.226" head)	6	2.00	1.45	0.75	DR	2.00	0.85	DR	DR
		8	2.00	1.00	DR	DR	2.00	0.55	DR	DR
		12	2.00	0.55	DR	DR	1.85	DR	DR	DR
	Nail (0.120" shank; 0.281" head)	6	3.00	1.70	0.90	0.55	3.00	1.05	0.50	DR
		8	3.00	1.20	0.60	DR	3.00	0.70	DR	DR
		12	3.00	0.70	DR	DR	2.15	DR	DR	DR
	Nail (0.131" shank; 0.281" head)	6	4.00	2.15	1.20	0.75	4.00	1.35	0.70	DR
		8	4.00	1.55	0.80	DR	4.00	0.90	DR	DR
		12	4.00	0.90	DR	DR	2.70	0.50	DR	DR
	16d Nail (0.162" shank; 0.344" head)	6	4.00	3.55	2.05	1.40	4.00	2.25	1.25	0.80
		8	4.00	2.55	1.45	0.95	4.00	1.60	0.85	0.50
		12	4.00	1.60	0.85	0.50	4.00	0.95	DR	DR

For SI: 1" = 25.4 mm; 1 pound per square foot [psf] = 0.0479 kPa

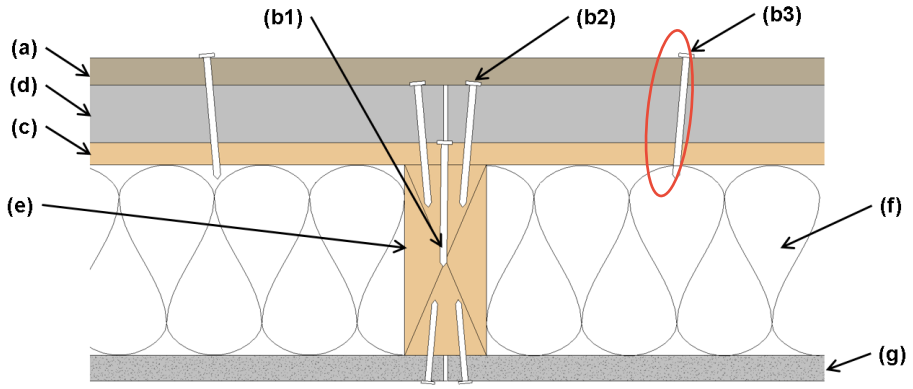
1. Table values are based on wood framing of Spruce-Pine-Fir or any wood species with a specific gravity of 0.42 or greater in accordance with NDS. *Required fastener minimum penetration shall be permitted to include thickness of wood structural panel sheathing materials.*
2. Nail fasteners shall comply with ASTM F1667, except nail l ength shall be permitted to exceed ASTM F1667 standard lengths. Fasteners of equivalent or greater diameter and bending strength shall be permitted.
3. FPIS shall have a minimum compressive strength of 15 psi in accordance with ASTM C578 or ASTM C1289.
4. DR = Design Required

Table 2. Furring Minimum Fastening Requirements to Wood Framing for Application Over FPIS to Support Cladding System Weight [1,2,3,4,5,6]

FURRING MATERIAL	Framing Member	Fastener Type & Min. Size	Minimum Penetration into Wall Framing (in.)	Fastener Spacing in Furring (in.)	MAXIMUM THICKNESS OF FPIS (IN.)							
					16" o.c. Furring				24" o.c. Furring			
					CLADDING SYSTEM WEIGHT				CLADDING SYSTEM WEIGHT			
					3 psf	11 psf	18 psf	25 psf	3 psf	11 psf	18 psf	25 psf
Min. 1x3 Wood Furring	Min. 2x Wood Stud	Nail (0.120" shank; 0.271" head	1¼"	8	3.00	1.85	1.05	0.65	3.00	1.20	0.60	DR
				12	3.00	1.20	0.60	DR	3.00	0.70	DR	DR
				16	3.00	0.80	DR	DR	2.30	DR	DR	DR
		Nail (0.131" shank; 0.281" head	1¼"	8	4.00	2.45	1.45	0.95	4.00	1.60	0.85	DR
				12	4.00	1.60	0.85	DR	4.00	0.95	DR	DR
				16	4.00	1.10	DR	DR	3.05	0.60	DR	DR
		16d Nail (0.162" shank; 0.344" head)	1¼"	8	4.00	4.00	2.45	1.60	4.00	2.75	1.45	0.85
				12	4.00	2.75	1.45	0.85	4.00	1.65	0.75	DR
				16	4.00	1.90	0.95	DR	4.00	1.05	DR	DR
		#10 wood screw (0.363" head)	1"	12	4.00	2.30	1.20	0.70	4.00	1.40	0.60	DR
				16	4.00	1.65	0.75	DR	4.00	0.90	DR	DR
				24	4.00	0.90	DR	DR	2.85	DR	DR	DR
		¼" hex lag screw	1½"	12	4.00	2.65	1.50	0.90	4.00	1.65	0.80	DR
				16	4.00	1.95	0.95	0.50	4.00	1.10	DR	DR
				24	4.00	1.10	DR	DR	3.25	0.50	DR	DR

For SI: 1" = 25.4 mm; 1 pound per square foot [psf] = 0.0479 kPa

1. Table values are based on wood framing and furring of Spruce-Pine-Fir or any wood species with a specific gravity of 0.42 or greater in accordance with *NDS.*
2. Nail fasteners shall comply with ASTM F1667, except nail length shall be permitted to exceed ASTM F1667 standard lengths. Wood screws and lag screws shall comply with NDS Appendix L and ANSI/ASME B18.6.1. Other approved fasteners of equivalent or greater diameter and bending strength shall be permitted. *Required fastener minimum penetration shall be permitted to include thickness of wood structural panel sheathing materials.*
3. A minimum 2x wood furring shall be used where the required siding fastener penetration into wood material exceeds ¾" (19.1 mm) and is not more than 11/2" (38.1 mm), unless approved deformed shank siding nails or siding screws are used to provide equivalent withdrawal strength, allowing the siding connection to be made to a 1x wood furring.
4. Furring shall be spaced a maximum of 24" o.c. in a vertical or horizontal orientation.
   a. In a vertic al orientation, furring shall be located over wall studs and attached with the required fastener spacing.
   b. In a horizontal orientation, furring shall be fastened at each stud with a number of fasteners equivalent to that required by the fastener spacing. If the required nail spacing is 12" o.c. and the studs are 24" o.c., then two (2) nails would be required at each stud (24/12=2). In no case shall fasteners be spaced more than 24" (0.6 m) apart.
5. FPIS shall have a minimum compressive strength of 15 psi, in accordance with ASTM C578 or ASTM C1289.
6. DR = Design Required



KEY:

(a) Cladding

(b1) Fastener (WSP to Stud) per code

(b2) Fastener (FPIS to Stud or WSP) per FPIS manufacturer

(b3) Fastener, Nail or Screw (Cladding to WSP) per Table 3

(c) WSP

(d) FPIS

(e) Framing

(f) Cavity Insulation

(g) Wall Finish

Figure 4. Illustration of light-weight cladding (≤3 psf) attachment through maximum 2"-thick FPIS to minimum 7/16"-thick wood structural panel (WSP) sheathing.

Table 3. Light-weight Cladding (≤3 psf) Minimum Fastening Requirements for Attachment Through Maximum 2"-thick FPIS to Minimum 7/16"-thick Wood Structural Panel [1,2,3]

TYPE AND SIZE OF FASTENER	HORIZONTAL SPACING OF FASTENERS ALONG SIDING
Roof sheathing ring shank nail (0.120" min. shank; 0.281" head)	12" oc
Post frame ring shank nail (0.148" min. shank; 5/16" head)	15" oc
No. 6 screw (0.138" min. shank; 0.262" head)	12" oc
No. 8 screw (0.164" min. shank; 0.312" head)	16" oc

For SI: 1" = 25.4 mm

1. Horizontal spacing of fasteners along siding is based on a siding width (distance between horizontal rows of fasteners) of 12 inches. For other siding widths, multiply required horizontal spacing by 12/w where w is the siding width in inches.
2. This table is based on IRC Table R703.3.3. Use of this table is limited to the wind load scope limits for cladding attachments in accordance with Section R703.3.2 of the IRC (i.e., maximum 30 psf negative design wind pressure).
3. The cladding fastener must be of sufficient length to penetrate a minimum of ¼" beyond the back side of the wood structural panel sheathing.

Additional Resources

For a more in-depth treatment of this subject including installation, code-compliance examples, design methodology, applications other than cladding connections, and supporting research, refer to:

- **ContinuousInsulation.org:** Attachment of Exterior Wall Coverings through FPIS
- **ABTG Research Report 1503-02:** Attachment of Exterior Wall Coverings Through Foam Plastic Insulating Sheathing (FPIS) to Wood or Steel Wall Framing

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