Cladding & Building Enclosure Component Connections Through Foam Plastic Continuous Insulation

Design & Prescriptive Code Compliance

September 19, 2021

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Applied Building Technology Group (ABTG) is committed to using sound science and generally accepted engineering practice to develop research supporting the reliable design and installation of foam sheathing. ABTG's educational program work with respect to foam sheathing is supported by the Foam Sheathing Committee (FSC) of the American Chemistry Council.

ABTG is a professional engineering firm, an approved source as defined in Chapter 2 and independent as defined in Chapter 17 of the IBC.

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Foam sheathing research reports, code compliance documents, educational programs and best practices can be found at www.continuousinsulation.org.

Foam Plastic Applications for Better Building

Overview

- Cladding and building envelope component connections are important to the overall performance and integrity of a building envelope.
- Continuous insulation (ci) is a means of:
  - improving energy efficiency and energy code compliance.
  - providing moisture control (with appropriate use of other control layers).
- CI and connections through it must be properly optimized to achieve structural objectives and minimize impact to thermal objectives.
- Newer model codes provide prescriptive solutions.
- Design methods also are available to evaluate alternatives.

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Outline

- Define continuous insulation
- Practical Challenges
- Foam Plastic Insulating Sheathing (FPIS)
  - Material Properties
  - Common Wall Assembly Applications
- Connections through FPIS
  - Prescriptive solutions for cladding/furring attachment
  - Design procedures and applications
- Conclusions

Ci Definition

- IECC and ASHRAE 90.1:
  - **Continuous Insulation (ci):** Insulation that is uncompressed and continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the building envelope.
- Uncompressed
- Continuous
- No thermal bridges except fasteners and service openings
  - Intent to avoid large thermal bridges (floor edge discontinuities, etc.) but allow for necessary service penetrations (vents, piping, electrical conduit, etc.)
  - Fasteners are small but cumulative thermal bridges. While permitted, their impact should be minimized without sacrificing structural purpose.
  - This requires optimization of thermal performance and structural performance.

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Practical Challenges

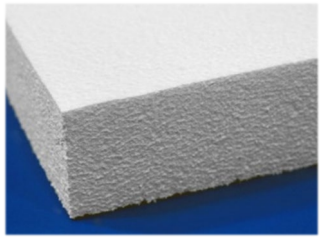
- Fastening of cladding and other components through continuous insulation is not without challenges:
  - Insulation material must not compress due to fastener draw-down forces and shear-transfer reaction forces.
  - Insulation material and fastener must control creep (long term movement).
- If insulation material compresses, it doesn't comply with ci definition.
  - Example: Metal building insulation compressed between metal cladding and purlins or girts.

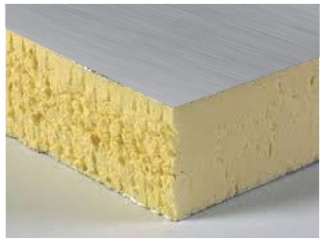
Practical Challenges

- If compressible insulation is used without compression, then other cladding attachment and support methods become necessary.
  - Examples: metal shear tabs supporting offset furring, Z-furring through the insulation, or specialty thermal break devices or brackets.
  - These attachment/support methods do not comply with the ci definition.
  - Must use U-factor method and account for cladding support thermal bridging to determine energy code compliance.

Foam Plastic Insulating Sheathing (FPIS)

- FPIS Material Types:
  - ASTM C578 – Standard specification for rigid, cellular polystyrene thermal insulation
    - —**Extruded polystyrene (XPS)**
    - —**Expanded polystyrene (EPS)**
  - ASTM C1289 – Standard specification for faced rigid cellular polyisocyanurate thermal insulation board
    - —**Polyisocyanurate (Polyiso, PIC, etc)**
- All FPIS types are applicable to building envelope applications; however, foundation and other ground contact applications generally use polystyrenes (e.g., ASCE 32 standard)





FPIS (cont'd)

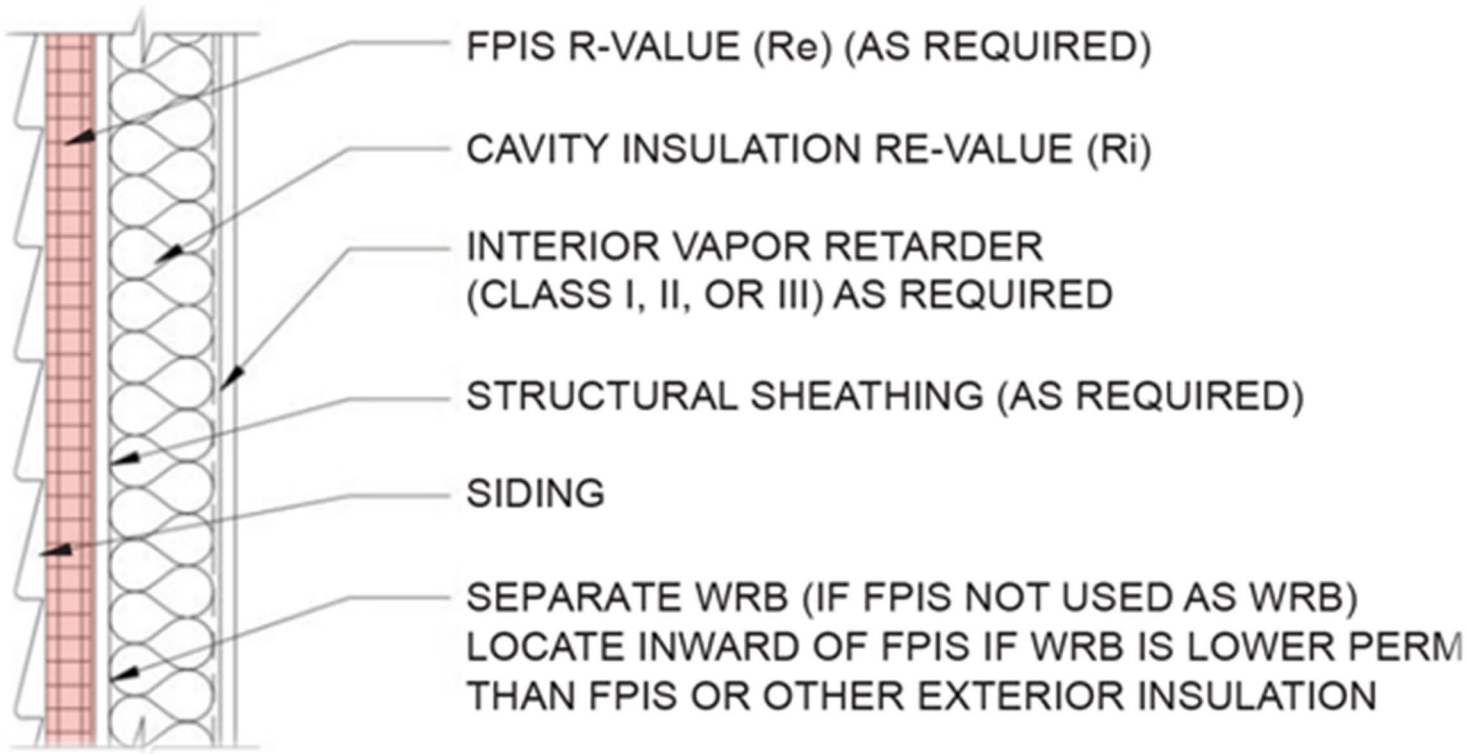
- FPIS Compressive Strength
  - Range from 10 psi to 100 psi or more
  - 15 psi or greater typically used for wall applications (XPS, EPS, and Polyiso)
  - Higher compressive strengths used to support foundation loads (footing loads, structural slab loads, highway/infrastructure loads, etc.)
    - **For example, FPIS can support foundation loads of 3,000 psf or more (with a typical safety factor of 3 to 5 applied to the ASTM rated compressive strength)**
  - Compressive strength and rigidity makes through fastening more practical

FPIS (cont'd)

- FPIS R-values range from 4 to 6 R per inch (e.g., 2"ci = R8 to R12).
  - High R-value/inch allows thinner ci to meet required R-value.
  - Thinner ci makes through-fastening easier (places less stress on fasteners supporting cladding and component loads).

FPIS (cont'd)

- Building Envelope Functions of FPIS:
  - Continuous insulation (thermal control layer)
  - Water-resistive barrier (water control layer)
  - Water vapor control (vapor control layer)
  - Air barrier (air control layer)
- Primary function is thermal control layer



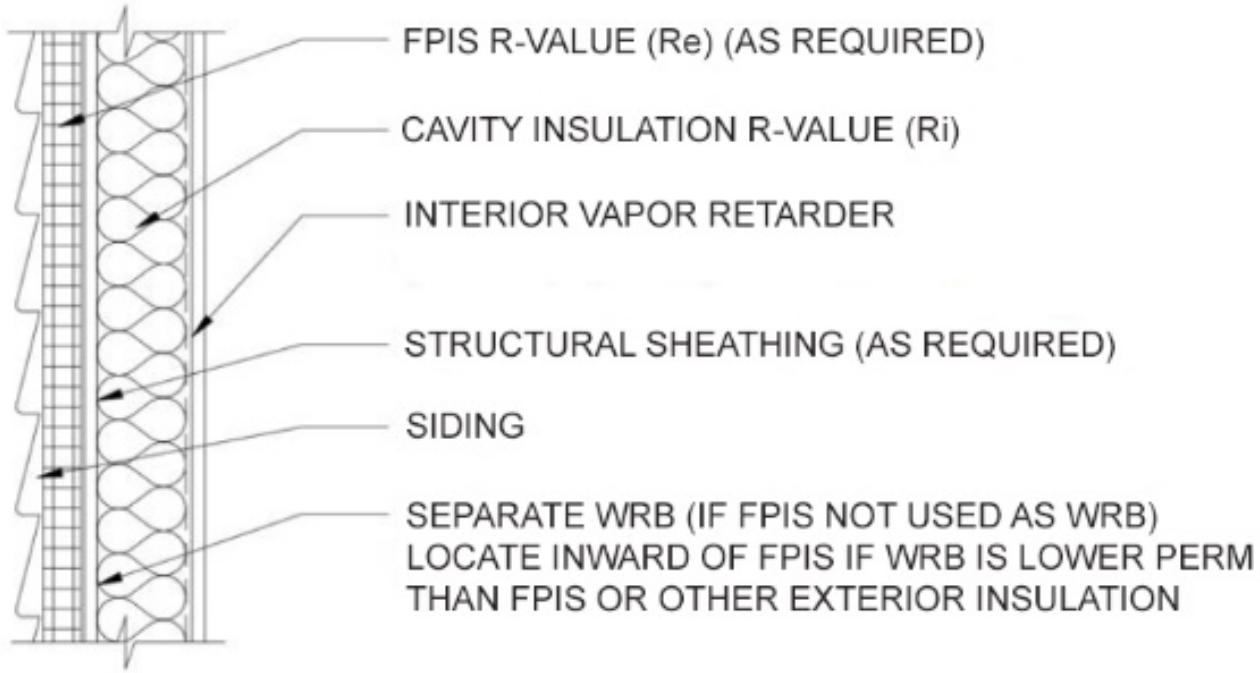
FPIS (cont'd)

- Other functions are based on design preference and product properties/qualification (e.g., many FPIS products are approved for WRB applications, but some not).
- Ci should always be applied in a manner that integrates with the water-vapor control strategy for the overall wall assembly (e.g., insulation ratio based on climate and interior vapor retarder specified).
- Other code requirements must be satisfied (fire safety, wind load, etc.) as with any material or assembly. (See IBC Chapter 26 for many requirements related to code-compliant use of foam plastics.)

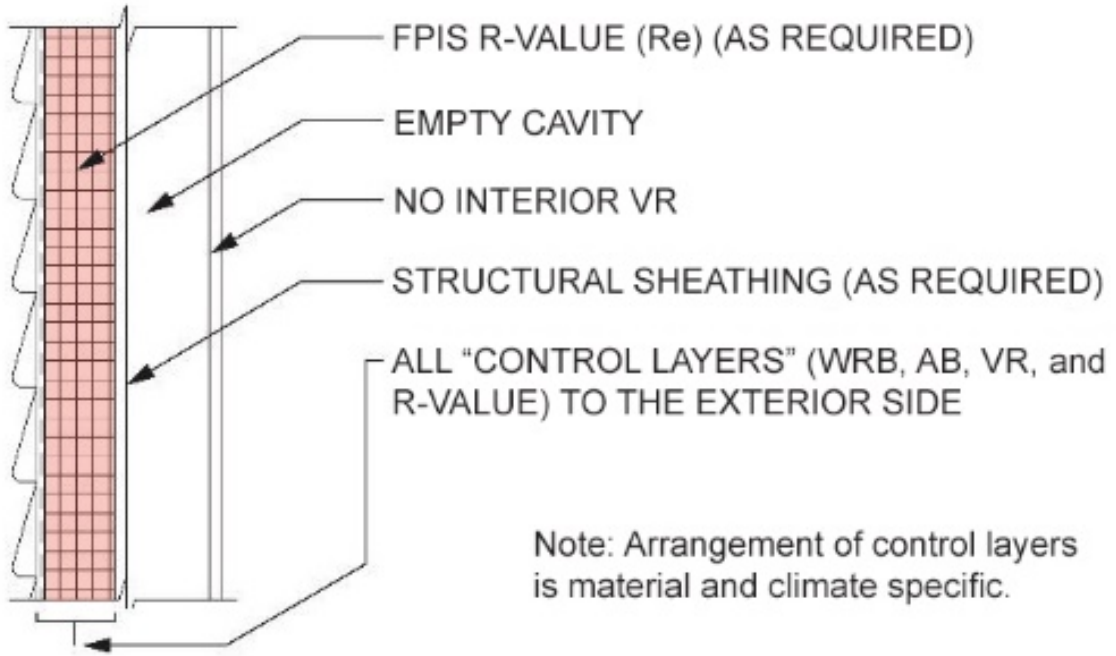
Common Wall Assembly Applications

- Two Examples:
  - "Hybrid wall" (cavity + ci)
  - "Perfect wall" (ci only; all control layers on exterior)

Cavity + Continuous + Interior VR



Continuous Only (no interior VR)



Research: Connections through FPIS ci

- ABTG (2015). Attachment of Exterior Wall Coverings Through Foam Plastic Insulating Sheathing
- Basis for prescriptive requirements in:
  - Section 2603, International Building Code (IBC) – 2012 through 2021 editions
  - Section R703, International Residential Code (IRC) – 2012 through 2021 editions
- Basis for engineering design procedure supporting the above code provisions

Research (cont'd)

- Based on many tests conducted for NYSERDA, FSC, AISI/SFA, and DOE projects, each by independent sources/labs.
- Evaluated both short term load resistance and stiffness of connections through FPIS (15 psi min.) up to 4-inches thick as well as long term creep behavior and stabilization (1 month to 1 year duration).
- Limit short-term deflection to 0.015" maximum and stabilized creep

Short-term load-deflection test

Long-term (sustained) load-deflection test

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Prescriptive Solutions

- General Requirements
  - FPIS minimum 15 psi compressive strength
  - FPIS complies with ASTM C578 or ASTM C1289
  - Solutions address fastener shear capacity and stiffness to support cladding weight
  - Must also check cladding attachment requirements for wind load, etc. (the more stringent fastening schedule will control)
  - Fastener length must be long enough to accommodate FPIS thickness and maintain required fastener embedment in wood/steel
  - Fastener tightened to draw connected materials together but not distort
  - Fastening schedule will depend on FPIS thickness and cladding weight supported
  - Only connections to wood framing or cold-formed steel framing are addressed; connections to masonry/concrete must be approved by alternate means (often proprietary fasteners are used)

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Prescriptive Solutions

- Tabulated requirements addressed 4 cladding weight classes:
  - 3psf or less – vinyl siding, wood lap siding, most fiber cement siding…
  - 11 psf – 3-coat Portland cement stucco
  - 18 psf – medium weight adhered masonry veneer
  - 25 psf – heavy adhered masonry veneer
- Weight should include weight of all materials outbound of FPIS surface
- Other material layers in addition to FPIS, such as gypsum sheathing and drainage matts (up to 3/8" thick), should be counted in the allowable FPIS thickness when applying tabulated requirements.

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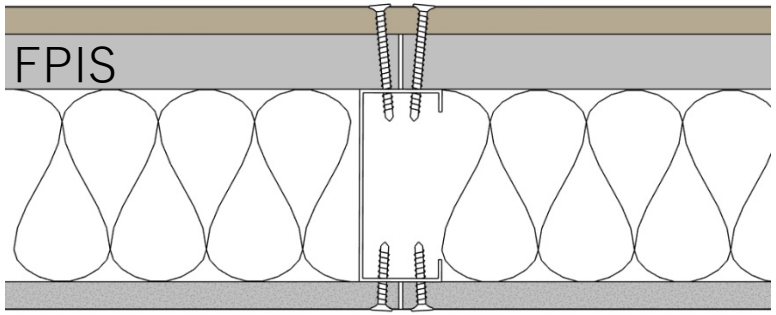
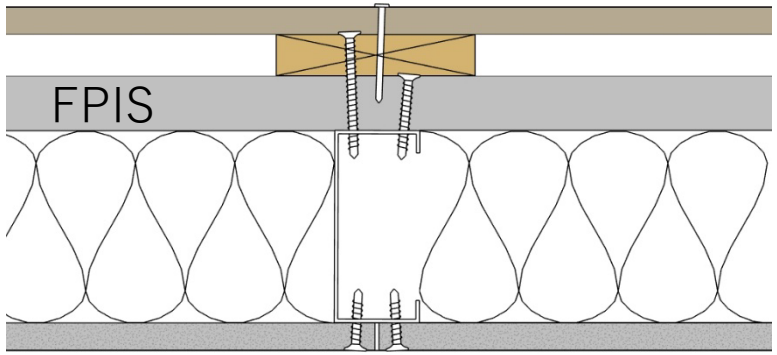
Prescriptive Solutions

- Cladding Connections to Cold-Formed Steel Framing
  - Direct cladding attachment
  - Furring attached (wood or steel furring)

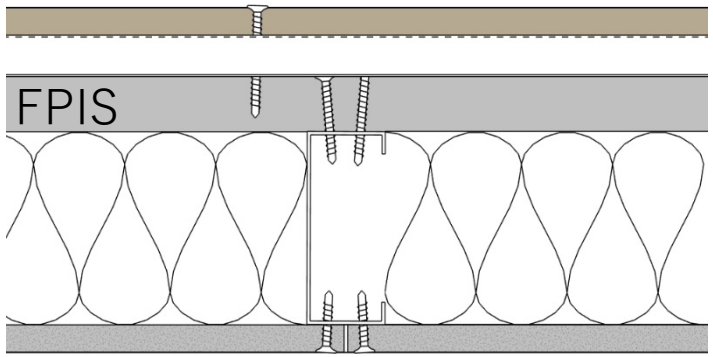
Direct Cladding Attachment



Vertical Furring Attachment



Horizontal Furring Attachment



Prescriptive Solutions

TABLE 1: Siding Minimum Fastening Requirements to Cold-formed Steel 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			
			Max Cladding Weight:				Max Cladding Weight:			
			3 psf	11 psf	18 psf	25 psf	3 psf	11 psf	18 psf	25 psf
Steel Framing (minimum penetration of steel thickness + 3 threads)	#8 screw (0.285" head) into 33 mil steel or thicker	6	3.00	2.95	2.20	1.45	3.00	2.35	1.25	DR
		8	3.00	2.55	1.60	0.60	3.00	1.80	DR	DR
		12	3.00	1.80	DR	DR	3.00	0.65	DR	DR
	#10 (0.333" head) screw into 33 mil steel	6	4.00	3.50	2.70	1.95	4.00	2.90	1.70	0.55
		8	4.00	3.10	2.05	1.00	4.00	2.25	0.70	DR
		12	4.00	2.25	0.70	DR	3.70	1.05	DR	DR
	#10 (0.333" head) screw into 43 mil steel or thicker	6	4.00	4.00	4.00	3.60	4.00	4.00	3.45	2.70
		8	4.00	4.00	3.70	3.00	4.00	3.85	2.80	1.80
		12	4.00	3.85	2.80	1.80	4.00	3.05	1.50	DR

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

1. Tabulated values are based on minimum 33 ksi steel for 33 mil and 43 mil steel and 50 ksi steel for 54 mil steel or thicker.
2. Screws shall comply with the requirements of ASTM C1513.
3. FPIS shall have a minimum compressive strength of 15 psi in accordance with *ASTM C578* or *ASTM C1289*.
4. DR = Design Required

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Prescriptive Solutions

TABLE 2: Furring Minimum Fastening Requirements to Cold-formed Steel Framing for Application Over FPIS to Support Cladding System Weight [1,2,3,4,5]

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			
					Siding Weight:				Siding Weight:			
					3 psf	11 psf	18 psf	25 psf	3 psf	11 psf	18 psf	25 psf
Minimum 33mil Steel Hat Channel or Minimum 1x3 Wood Furring	33 mil Cold-formed Steel Stud	#8 screw (0.285" head)	Steel thickness +3 threads	12	3.00	1.80	DR	DR	3.00	0.65	DR	DR
				16	3.00	1.00	DR	DR	2.85	DR	DR	DR
				24	2.85	DR	DR	DR	2.20	DR	DR	DR
		#10 screw (0.333" head)	Steel thickness +3 threads	12	4.00	2.25	0.70	DR	3.70	1.05	DR	DR
				16	3.85	1.45	DR	DR	3.40	DR	DR	DR
				24	3.40	DR	DR	DR	2.70	DR	DR	DR
	43 mil or thicker Cold-formed Steel Stud	#8 screw (0.285" head)	Steel thickness +3 threads	12	3.00	1.80	DR	DR	3.00	0.65	DR	DR
				16	3.00	1.00	DR	DR	2.85	DR	DR	DR
				24	2.85	DR	DR	DR	2.20	DR	DR	DR
		#10 screw (0.333" head)	Steel thickness +3 threads	12	4.00	3.85	2.80	1.80	4.00	3.05	1.50	DR
				16	4.00	3.30	1.95	0.60	4.00	2.25	DR	DR
				24	4.00	2.25	DR	DR	4.00	0.65	DR	DR

TABLE 2 NOTES

1. Table values are based on:
   a. Wood furring of Spruce-Pine-Fir or any softwood species with a specific gravity of 0.42 or greater per *NDS*.
   b. Minimum 33 mil steel hat channel furring of 33 ksi steel. Steel hat channel shall have a minimum $^{7}/_{8}$" (22.2 mm) depth, 1-1/4" (32 mm) web width, and ½" (12.7 mm) wide flanges with web or flanges bearing on FPIS surface.
   c. Cold-formed steel framing of indicated nominal steel thickness and minimum 33 ksi steel for 33 mil and 43 mil steel and 50 ksi steel for 54 mil steel or thicker.
2. Screws shall comply with the requirements of ASTM C1513.
3. Furring shall be spaced a maximum of 24" o.c. in a vertical or horizontal orientation.
   a. In a vertical orientation, furring shall be located over wall studs and attached with the required fastener spacing.
   b. In a horizontal orientation, furring shall fastened at each stud with a number of fasteners equivalent to that required by the fastener spacing. If the required fastener spacing is 12" o.c. and the studs are 24" o.c., then two (2) fasteners would be required at each stud (24/12=2). In no case shall fasteners be spaced more than 24" (0.6 m) apart.
4. FPIS shall have a minimum compressive strength of 15 psi, in accordance with *ASTM C578* or *ASTM C1289*.
5. DR = Design Required

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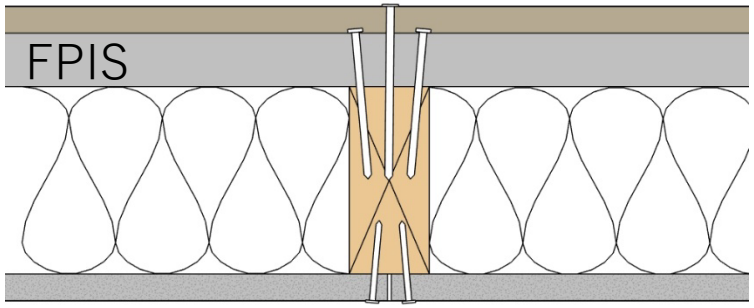
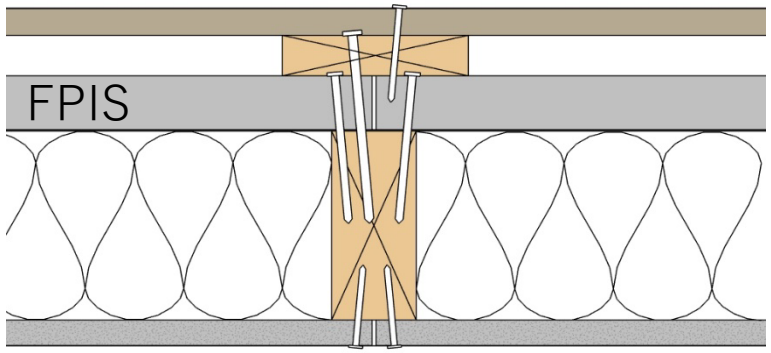
Prescriptive Solutions

- Cladding Connections to Wood Framing
  - Direct cladding attachment
  - Furring attachment (wood furring)

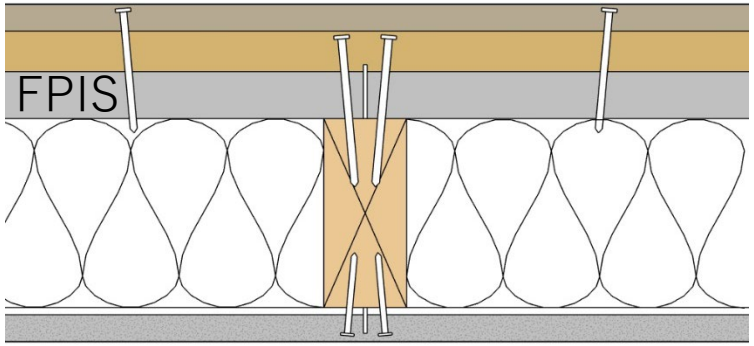
Direct Cladding Attachment



Vertical Furring Attachment



Horizontal Furring Attachment



Prescriptive Solutions

TABLE 3: 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			
			Max Cladding Weight:				Max Cladding 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 length 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

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Prescriptive Solutions

TABLE 4: 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			
					Siding Weight:				Siding 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

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Prescriptive Solutions

- Table 4 Notes:

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 1½" (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 vertical 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

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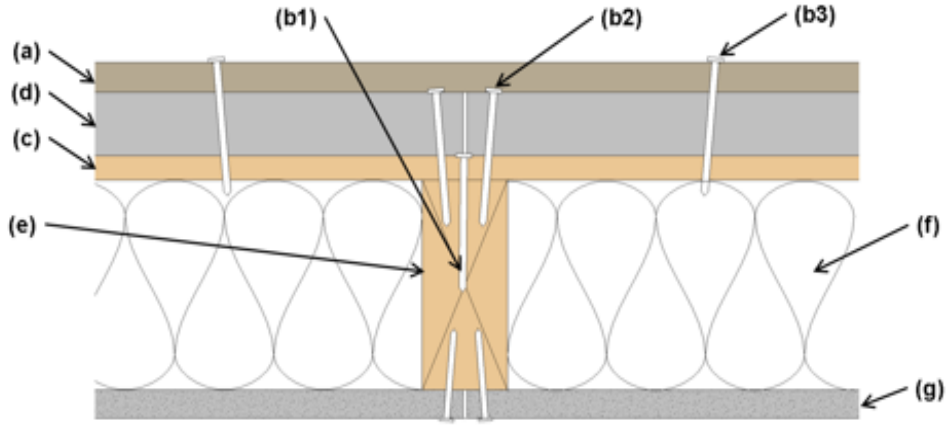
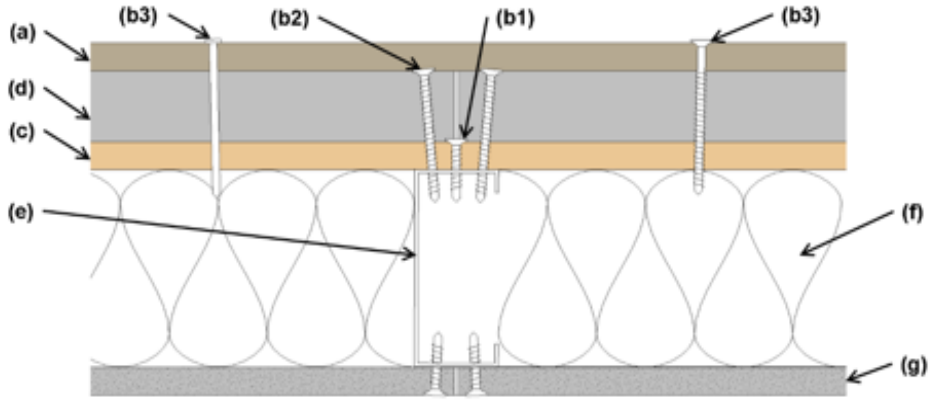
Prescriptive Solutions

- Cladding connection through FPIS directly to wood structural panel (2018 & 2021 IRC Section R703.3.3).
  - Min. 7/16" WSP
  - Max. 2" FPIS
  - Min. 15psi FPIS
  - Max. 30 psf wind load
  - Fastener spacing of 12" oc to 16" oc depending on fastener type/size
  - Max. 3 psf cladding weight



(a) Cladding
(b1) Fastener (WSP to Stud) per code
(b2) Fastener (Foam to Stud) per FPIS manufacturer
(b3) Fastener (Cladding to WSP – nail or screw) per Table
(c) WSP
(d) FPIS
(e) Framing
(f) Cavity Insulation
(g) Wall Finish

(a) Cladding Connection through FPIS to Wood Structural Panels (WSP) on a Wood Frame Wall



(a) Cladding
(b1) Fastener (WSP to Stud) per code
(b2) Fastener (Foam to Stud) per FPIS manufacturer
(b3) Fastener (Cladding to WSP – nail or screw) per Table
(c) WSP
(d) FPIS
(e) Framing
(f) Cavity Insulation
(g) Wall Finish

(b) Cladding Connection through FPIS to Wood Structural Panels (WSP) on a Cold-Formed Steel Frame Wall

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Prescriptive Solutions

- Wind load resistance of furring (separate design check, not in prescriptive codes for claddings, except wood shingles and shakes)

Furring Material	Framing Member	Fastener Type & Minimum Size	Minimum Penetration into Wall Framing (in.)	Fastener Spacing in Furring (in.)	Allowable Wind Pressure Resistance of Furring Attachment (psf)	
					16" o.c. Furring	24" o.c. Furring
Minimum 33mil Steel Hat Channel or Minimum 1x3 Wood Furring	33 mil Cold-formed Steel Stud	#8 screw (0.285" head)	Steel thickness +3 threads	12	52.9	35.3
				16	39.7	26.5
				24	26.5	17.6
		#10 screw (0.333" head)	Steel thickness +3 threads	12	62.9	41.9
				16	47.1	31.4
				24	31.4	21.0
	43 mil or thicker Cold-formed Steel Stud	#8 screw (0.285" head)	Steel thickness +3 threads	12	69.0	46.0
				16	51.8	34.5
				24	34.5	23.0
		#10 screw (0.333" head)	Steel thickness +3 threads	12	81.9	54.6
				16	61.5	41.0
				24	35.1	23.4

Furring Material	Framing Member	Fastener Type & Minimum Size	Minimum Penetration into Wall Framing (in.)	Fastener Spacing in Furring (in.)	Allowable Wind Pressure Resistance of Furring Attachment (psf)	
					16" o.c. Furring	24" o.c. Furring
Minimum 1x3 Wood Furring	Minimum 2x Wood Stud	Nail (0.120" shank; 0.271" head)	1¼"	8	42.6	28.4
				12	28.4	18.9
				16	21.3	14.2
		Nail (0.131" shank; 0.281" head)	1¼"	8	46.5	31.0
				12	31.0	20.7
				16	23.3	15.5
		0.162" diameter nail	1¼"	8	57.5	38.3
				12	38.3	25.6
				16	28.8	19.2
		#10 wood screw	1"	12	107.3	71.6
				16	79.0	52.7
				24	35.1	23.4
		¼" lag screw	1½"	12	140.4	93.6
				16	79.0	52.7
				24	35.1	23.4

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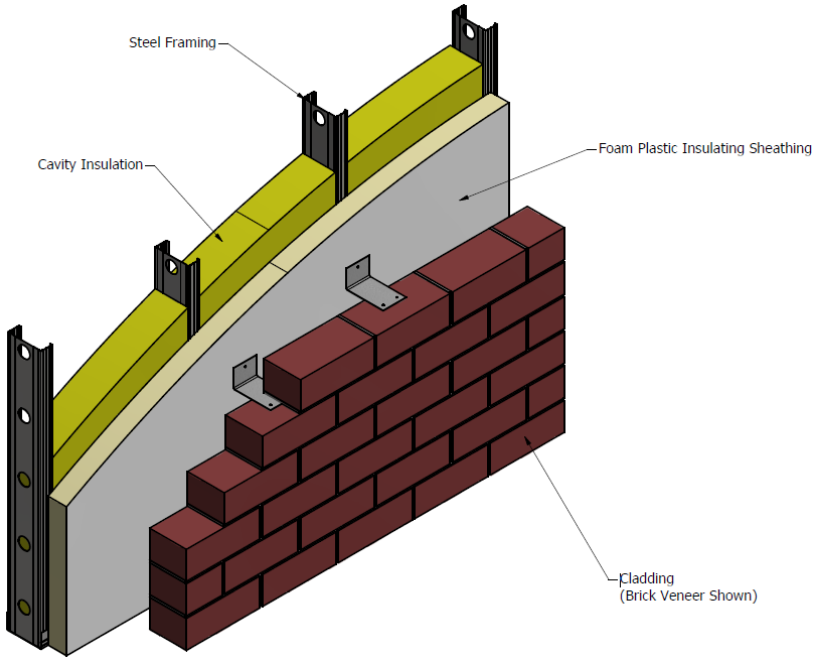
Prescriptive Solutions



- Brick ties attached over foam sheathing to wood framing or sheathing with only the tie fastener penetrating foam sheathing (IRC Section R703.8.4)
- Proprietary brick ties also are available that are “stand-off” ties with pedestals for fasteners penetrating foam sheathing.
- Both of these solutions comply with the code definition of ci.
- Finally, using stainless steel cladding, furring, and brick tie fasteners will result in more durable installation and also reduce thermal bridging.
  - Carbon steel is three times more thermally conductive than stainless.
  - But smooth stainless-steel nails have less withdrawal strength than galvanized or plain, smooth shank carbon steel nails in wood. May need to use deformed shank stainless steel nails.

Design Procedure – Engineered Solutions

- Same general requirements apply
- Can design connections for cladding, furring, and building component attachments (including structural elements like ledgers)
  - Not just limited to cladding and furring attachments

Design Procedures

- Design of Connections through FPIS to Cold-formed Steel
  - Tension allowable design values: Follows same procedure in AISI S100 for screw withdrawal capacity (just use longer screws)
  - Shear allowable design values: Follows the same procedure in AISI S100, Section J4.3.1, but modifies Eq. J4.3.1.-1 by a gap reduction factor, Gr, as follows:
    - For #10 screw in 54mil and 50 ksi steel: $Gr = 0.17 - 0.0048\ r$
    - For #10 screw in 43mil and 33 ksi steel: $Gr = 0.19 - 0.0066\ r$
    - For #8 or #10 screw in 33mil and 33 ksi steel: $Gr = 0.16 - 0.0064\ r$
      - Where,
        - r = d_sep/d
        - d_sep = thickness of FPIS separate connected steel parts
        - d = nominal screw diameter (0.164” for #8, 0.190” for #10)
      - Value of r shall not exceed 21.
      - For $0<r<2$, Gr need not be less than $(1 - r/2)$
      - Material against screw head shall be minimum 33mil and 33ksi steel or minimum 3/8” thick wood or wood-based material with specific gravity of 0.42 or greater.

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Design Procedures

- Design of Connections through FPIS to Wood Framing
  - Allowable withdrawal design values: Follows same procedure as NDS Section 12.2 (just use longer fasteners to accommodate FPIS thickness)
  - Reference lateral (shear) resistance design values: Follows same procedure as NDS Section 12.3, but includes gap parameter per AWC TR No. 12.
    - Modifies to require reduction term, Rd, to be not less than 3.0
    - Minimum fastener penetration into wood not less than 1-inch for screws and 1-1/4 inches for nails.
    - Minimum specific gravity of wood materials of 0.42.

Design Procedures

- Example Applications:
  - Cladding and furring connections using alternative fasteners
  - Load bearing structural component connections through FPIS (e.g., deck and roof ledgers attached to wall surface)
  - Architectural component connections through FPIS (e.g., awning frames, shading devices, etc.)
  - Structural sheathing connections through FPIS (placed under sheathing rather than over sheathing)
  - Window and door frame anchorages where passing through a rough opening gap or through a layer of foam sheathing (e.g., conditions not addressed in fenestration manufacturer instructions)

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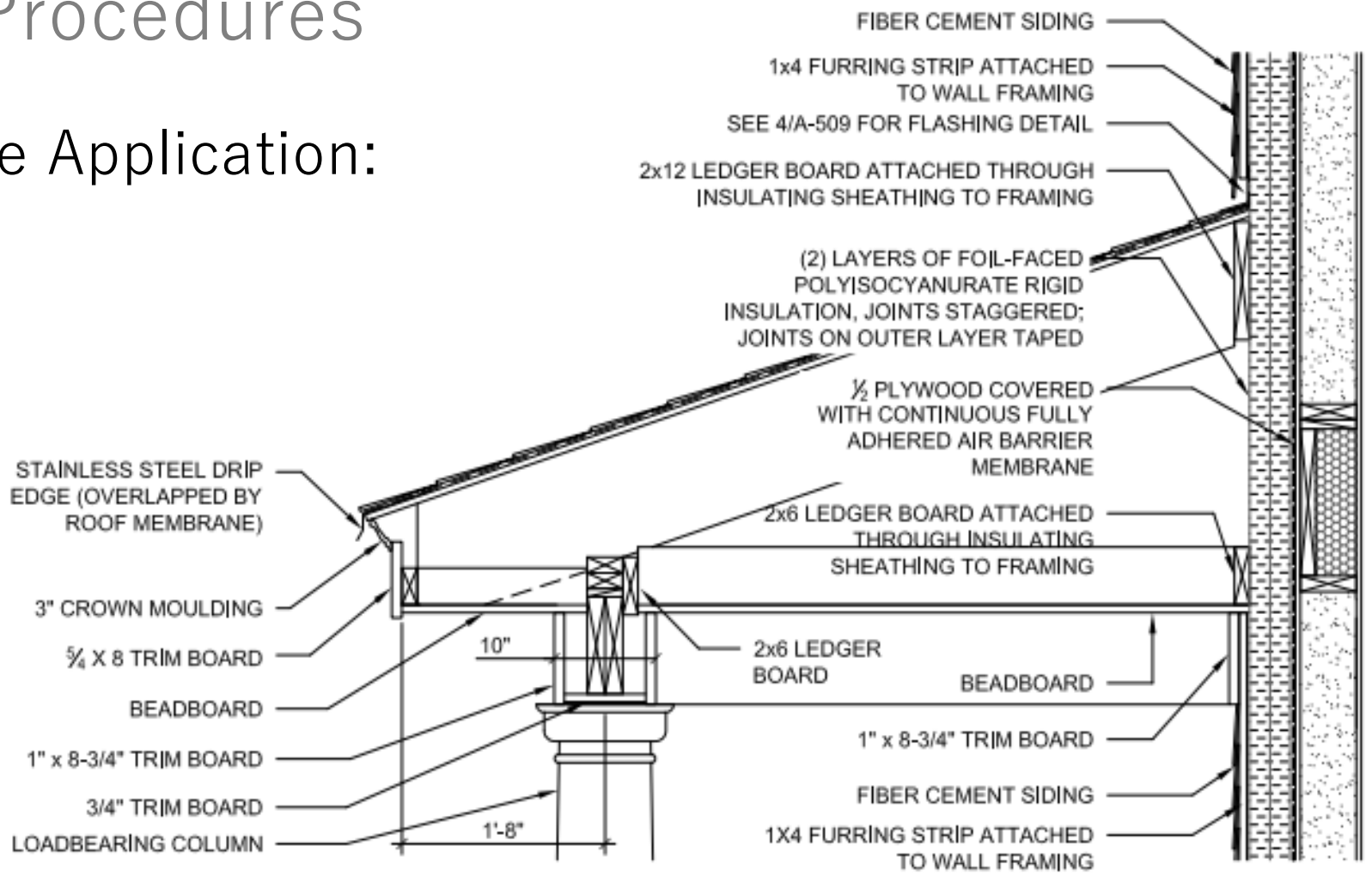
Design Procedures

- Example Application:



6 FRONT PORCH ROOF DETAIL

SCALE: 3/4" = 1'-0"

Conclusions

- Goal of the prescriptive solutions and design procedures is to provide a means to optimize structural integrity, thermal efficiency, and construction efficiency for building envelopes using FPIS continuous insulation.
- Major “take-aways” include:
  - Many options for code-compliant and efficient solutions for attaching cladding and building components through FPIS
  - Provides a means to comply with code definition and performance intent for continuous insulation
  - Consistent with IBC and IRC provisions
  - Applicable to cladding, furring, structural and architectural components attached to building envelope through FPIS
  - Supports use of FPIS for multiple building envelope functions (WRB, vapor control, etc.) for environmentally stable, dry, and thermally efficient building envelopes.

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Suggested Resources

- Cladding Connections – continuousinsulation.org