Stucco Over Rigid Foam Insulation

Last Updated: 02/22/2018

Scope

Install stucco as an exterior wall cladding over rigid foam insulation with proper preparation to provide water management as well as a sound substrate for the stucco.

- Determine the location of the wall’s water control layer (typically behind the insulation over the exterior sheathing).
- Provide a drainage gap in front of the water control layer.
- Flash all windows, doors, and other penetrations to the water control layer prior to installing the insulation.
- Install stucco cladding per manufacturer requirements.

See the Compliance Tab for related codes and standards requirements.
**Description**

In response to more demanding energy codes, and as occupants and home owners press for more energy-efficient, thermally comfortable, and quiet houses, builders and designers are increasingly considering continuous rigid foam exterior insulation, even in warmer climates (zones 1-3), and with cladding types more common to those warmer climates. (Stucco is the subject of this guide, but please note that adhered stone and tile follow the same principles).

With increased efficiency and comfort, however, also comes an increase in the risk of water-related building failures (such as mold, rot, and odors) because the exterior insulation reduces the energy flow through the wall, which also reduces its capacity to dry. For this reason, it is essential that proper drainage is provided behind cladding materials such as stucco.

Installing stucco cladding over rigid foam insulation requires additional preparation to ensure proper water management as well as a sound substrate for the stucco. This involves determining the location of the wall’s water control layer (typically behind the insulation over the exterior sheathing), providing a drainage gap in front of the water control layer, and flashing all windows, doors, and other penetrations to the water control layer prior to installing the insulation. After the insulation is installed, the stucco cladding may be installed per typical manufacturer requirements. Coordination between the designer or builder and installing subcontractor is required.

![Figure 1 - Expanded polystyrene insulation is installed with joints taped and lath attached in preparation for the application of stucco. Windows are flashed to the drainage plane (not seen), which is behind the insulation. (Image Source: Building Science Corporation).](image)

With respect to the location of the drainage plane, either over the face of the sheathing (behind the insulation) or at the face of the insulation, the former is far more common than the latter. Indeed, keeping the water control layer at the face of the exterior sheathing means that standard window and door flashing details (and standard installation sequencing) are maintained – windows, doors, and other penetrations are flashed to the water control layer at the face of the sheathing regardless of whether continuous insulation is used or not. When the face of the insulation becomes the water control layer, window and door flashing details must be adjusted accordingly and a different installation sequence must be followed. That said, there are material (and perhaps also labor) cost savings associated with using the face of the insulation as the water control layer (a separate membrane is no longer required).

The following guidance is for installations where 1.5 inches or less of continuous exterior rigid foam insulation is installed under the stucco cladding. Where more than 1.5 inches of continuous exterior rigid foam insulation is installed, additional structural support such as a second layer of structural sheathing (plywood or OSB) may need to be installed over the rigid foam. In this case, the second layer of sheathing must be protected from decay by installing a water control membrane over it with a drainage
How to Install Stucco over Continuous Rigid Insulation

1. Determine the location of the wall’s water control layer (the drainage plane). Typically this will be behind the insulation and over the exterior sheathing, but the face of the rigid insulation may also serve as the wall’s water control layer/drainage plane if the joints are taped.

2. Install a water control layer (building wrap, self-adhered or fluid-applied membrane) over the face of the exterior sheathing and flash all windows, doors, and penetrations to that layer. See Figure 2. IRC 2018 requires the water control layer to be equivalent to two layers of Grade D paper. Or, if the face of the rigid insulation is to be the water control layer, tape the joints with acrylic sheathing tape or self-adhered membrane (which is recommended at the inside and outside corners for better adhesion) and flash the windows, doors, and penetrations to the face of the insulation.

3. Provide a drainage space in front of the water control layer:
   a. If the water control layer (drainage plane) is behind the insulation and over the exterior sheathing, the drainage space can be achieved by installing a layer of textured house wrap over a water control membrane. Alternately, cap nails can be used as spacers between the water control layer and the rigid insulation. The installer should use his or her professional judgment to determine the number of cap nails and the spacing required to provide a clear drainage plane.
   b. If the water control layer (drainage plane) is the face of the insulation, the drainage space can be achieved by installing a layer of textured building wrap over the insulation.
   c. For buildings that exceed two stories, are architecturally complex, or are built in locations that receive more than 20 inches of rain per year, the drainage space described above is insufficient, and a drainage mat (minimum ¼ inch thick) is recommended in lieu of the cap nail spacers or textured building wrap. Note that if drainage mat is used, it either needs to have an integral facer (typically a geotextile fabric) or a paper-backed lath should be used to prevent the pores of the drainage mat from becoming blocked with the subsequent application of the stucco.

4. Install rigid insulation and tape the joints, even if the water control membrane is behind the insulation. This is not for water management but to maintain a continuous thickness of stucco. Maintaining continuity in the stucco across joints avoids differential rates of drying between the thicker stucco at untaped joints and the thinner stucco over the field of the insulation. When the joints are left untapped, shadow lines can appear at the joints from this differential drying. For the same reason, the material used to tape the joints should roughly match the absorption of the insulation. Acrylic sheathing tape or self-adhered membrane is appropriate for XPS, while mesh tape is typically used with EPS insulations. After the above preparation, the installer may then:

5. Install lath and stucco in accordance with the manufacturer’s instructions.

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Figure 2 - Stucco is installed over rigid insulation, which is installed over a drainage plane consisting of a drainage gap and building wrap layer over the sheathing. Note the continuity of the thermal control layer via overlapping foam layers at the slab-to-wall interface.
Ensuring Success

Ensure that all windows, doors, and penetrations are flashed and sealed to the water control membrane, not just to the face of the stucco. Install metal or rigid plastic through-wall flashing at the base of the wall and strip it in with self-adhered membrane so that water running down the drainage plane is directed to the exterior at the base of the wall. Wherever possible, use flanged electrical boxes and flanged penetrations for better integration with the building’s water control layer.

Tape the joints of the insulation, even when the water control layer and drainage plane are located behind the insulation, to keep stucco out of the joints so that a uniform stucco thickness is maintained for even drying.
Climate

The location of the building will inform (1) the amount of drainage provided and (2) the amount of insulation in the assembly. If the climate receives more than 20 inches of rain annually, a drainage mat at least ¼ inch thick should be installed over the water control layer.

For insulation thicknesses, consult the International Energy Conservation Code (IECC) and the local building code. See the Compliance tab for more.
Training

Right and Wrong Images

Display Image: Stucco lathe BSC.jpg
None Available
Compliance

The Compliance tab contains both program and code information. Code language is excerpted and summarized below. For exact code language, refer to the applicable code, which may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

The International Energy Conservation Code (IECC) and ASHRAE Standard 90.1 are the codes and standards most commonly referenced by local jurisdictions and building certification programs (such as the U.S. Green Building Council’s LEED) with respect to insulation in walls.

It is becoming increasingly difficult for opaque wall assemblies to comply with the prescriptive requirements of the IECC without the use of continuous exterior insulation, even when those walls are wood-framed residential walls.

The relevant prescriptive requirements for insulation in opaque walls can be found in Table C402.1.3 of the IECC.

Insulation requirements for the 2015 IECC are shown in Table 1 below. Note that the first number in the recommendations for framed walls refers to cavity insulation and the second (labeled ci) refers to continuous exterior insulation.

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4, Except Marine</th>
<th>5 and Marine 4</th>
<th>6</th>
<th>7 &amp; 8</th>
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<td>8/13</td>
<td>13/17</td>
<td>15/20</td>
<td>19/21</td>
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<tr>
<td></td>
<td>2015</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>2009</td>
<td>3/4</td>
<td>4/6</td>
<td>5/8</td>
<td>5/10</td>
<td>13/17</td>
<td>15/19</td>
<td>19/21</td>
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<tr>
<td></td>
<td>2009</td>
<td>13</td>
<td>13</td>
<td>13</td>
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<td>20 or</td>
<td>20 or</td>
<td>21</td>
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<td></td>
<td>13+5ci</td>
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</table>

Table 1: IECC 2015 and 2018 Table R402.1.2 Minimum Insulation Requirements for Residential Walls by Climate Zone and Wall Type

2018 IRC

R703.7 Exterior Plaster (stucco)

Installation of plaster shall be in compliance with ASTM C926, ASTM C 1063, and the provisions of this code. R703.7 and R703.2: Water-resistive vapor-permeable barriers shall have a performance equivalent to two layers of Grade D paper. The layers shall be independently installed so each layer provides a separate continuous plane. Install horizontally with upper layer lapped over lower layer by 2 or more inches, continuous to tops of walls. See IRC R 703.7 for specific requirements on lath, plaster, water-resistive barriers.


Section N1101.3 (Section N1107.1.1 in 2015 and 2018 IRC). Additions, alterations, renovations, or repairs shall conform to the provisions of this code, without requiring the unaltered portions of the existing building to comply with this code. (See code for additional requirements and exceptions.)

Appendix J regulates the repair, renovation, alteration, and reconstruction of existing buildings and is intended to encourage their continued safe use.

Continuous Insulation – Cladding/Furring Attachment - Code Compliance Brief

Overview:

The intent of this brief is to provide code-related information to help ensure that the measure will be accepted as being in compliance with the code. Providing notes for code officials on how to plan review and conduct field inspections can help builders or remodelers with proposed designs and provide jurisdictional officials with information for acceptance. Providing the same information to all interested parties (e.g., code officials, builders, designers, etc.) is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.

Guidance is needed for code-compliant installations of various cladding materials when installed over thicker foam sheathing also known as insulated sheathing or continuous insulation (c.i.). The code has generally provided generic prescriptive attachment requirements without consideration of c.i. thickness or deferred to the manufacturers to provide guidance on fastener selection. But, many manufacturers’ installation instructions have limited the thickness of c.i. applications to 0.5 inch to 1.5 inches of thickness, or not addressed it at all. Therefore, warranty, liability, and potential code conflicts exist when using thicker (>1.5”) levels of c.i. due to the limitations cited in manufacturer installation instructions for exterior finishes and code provisions that prescriptively require c.i. > 1.5” in certain climate zones. In such cases, a designed alternative solution may be required to address these concerns. However, newer codes have now begun to
provide engineered prescriptive solutions for use by builders, designers, code officials, and siding manufacturers.

As the energy codes continue to become more stringent, the thickness of c.i. has increased prescriptively. Only recently have codes begun to question whether all applicable loads were being addressed. Loads include seismic, wind, and dead load. Seismic and wind loads can be identified by referencing current codes and standards. The concern with adding thicker c.i. to a wall assembly is whether the cladding fastener can withstand the dead load from the weight of the siding or c.i. In practice, there has been little concern with typical light-weight sidings, such as vinyl and wood, or separately supported claddings such as anchored masonry veneer installed over c.i. up to 1.5 inches thick. The main issues have been identifying fasteners that are an appropriate length to maintain embedment in wood framing for wind and seismic resistance with a diameter and head type that is suitable for the siding material. However, for heavy claddings such as Portland cement stucco or adhered masonry veneer, concern with rigidly supporting the weight of the cladding installed over thick c.i. grows.

• Increased thickness of c.i. introduces the following practical considerations:
  • Selecting the appropriate cladding fasteners that can withstand the dead load from the weight of the siding for a given thickness of c.i. while also still complying with the siding manufacturer’s fastener type and diameter specifications.
  • Identifying and specifying non-standard fasteners where required by the thickness of c.i. and cladding connection detail.
  • Siding manufacturer’s installation instructions may be limited to c.i. thicknesses ≤1.5” (or not address such installation at all).
  • Siding manufacturer’s warranties might be void when >1.5” of c.i. is used.
  • Where furring is used, the lack of any prescriptive connection solutions in the code for furring applications with or without an underlying layer of c.i.
  • For thick c.i. applications, additional framing or detailing may be required at some locations to provide a fastening base for corner trim.

Based on further research and technical validation, provisions were added to the 2015 International Residential Code® (IRC). States and local jurisdictions adopt different building and energy codes and code versions (e.g., 2009 IRC/IECC, 2012 IRC/IECC, or 2015 IRC/IECC). For states and locations that have not adopted the 2015 IRC, one approach to overcome this barrier would be to reference the most recent version of the IRC for guidance. The building code (IRC/IECC) allows for alternative materials, design, and methods of construction and equipment not specifically prescribed by code and this would include consideration of new guidance published in more recent versions of model codes. Consequently, the code official has the authority and responsibility to review and approve the proposed design as satisfactory and compliant with the intent of the provisions of the code (per Section R104.11/IRC, Section R102.1/IECC) as a means of achieving code compliance. The alternative materials, design, and methods provision has been a long-standing allowance and this important tradition has been continued in every version of the IRC/IECC.

This brief addresses code-compliant cladding attachment over foam sheathing to light-frame wood and cold-formed steel wall assemblies. For guidance regarding cladding attachment over foam sheathing to masonry or concrete wall construction refer to the 2015 IRC, Section R703.17.

Plan Review:

Per the 2015 IECC/IRC, Section R103.3/R106.3 Examination of documents. The code official/building official must examine, or cause to be examined, construction documents for code compliance.

This section lists the applicable code requirements and details helpful for plan review regarding the provisions to meet the requirements for “continuous insulation and cladding attachments.”

Construction Documentation. Review the construction documents to identify the materials, installation specifications, and design.

• 2015 IECC/IRC, Section R103.2/N1101.5 Information on construction documents. Construction documents should include:
  • Insulation materials and R-values
  • Moisture management, vapor retarders, and flashing specifications
  • Cladding attachment materials and specifications
  • Air barrier materials and specifications

• Insulation: Verify insulation R-value(s) specified on construction documents meets or exceeds the insulation levels per the applicable code. The amount of insulation is generally dictated by the energy codes, and generally determined by building type (e.g., R1, R2, R4), framing material (wood, steel, concrete), and climate zone.
  • (The prescriptive insulation R-values in the 2009, 2012, and 2015 IECC are referenced below.)
Moisture: Verify the design and specification of the weather-resistant covering, water-resistant barrier, flashing and drainage are specified on the construction documents and meet the applicable building code.

Vapor Retarders: The IRC (Section 702.7) states Class I or II vapor retarders are required on the interior side of the frame walls in Climate Zones 5, 6, 7, 8, and Marine 4 with some exceptions for basement walls, below grade portion of any wall, or construction where moisture or freezing will not damage the material. A Class III vapor retarder (latex or enamel paint) is permitted where c.i. exceeds the R-values specified in Table R702.7.1. Confirm the c.i. thickness meets the values specified per climate zone or construction documents specify a Class I or II vapor retarder (refer to Section R702.7 Vapor Retarders for further details). Where a Class III vapor retarder is used in colder climate zones on 2x6 walls, the amount of c.i. required may exceed the minimum energy code insulation requirements reported in the tables above. This can be used as a means to improve wall assembly and overall building performance or provide flexibility in other envelope and energy efficiency provisions (e.g., use of trade-offs).

Table R702.7.1

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Class III Vapor Retarders Permitted for:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Frame Wall</td>
<td>R-13</td>
</tr>
<tr>
<td>Steel Frame Wall 16” o.c.</td>
<td>R-0+11.2 OR R-13+6.1 OR R-15+5.7 OR R-19+5.0 OR R-21+4.7</td>
</tr>
<tr>
<td>Steel Frame Wall 24” o.c.</td>
<td>R-0+9.3 OR R-13+3.0 OR R-15+2.4</td>
</tr>
</tbody>
</table>

2012 and 2015 IECC Prescriptive Above-Grade Wall Insulation R-values
(R-values are the same for both versions)
<table>
<thead>
<tr>
<th>Marine 4</th>
<th>c.i. R-value ? 2.5 over 2 x 4 wall</th>
<th>c.i. R-value ? 3.75 over 2 x 6 wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>c.i. R-value ? 5 over 2 x 4 wall</td>
<td>c.i. R-value ? 7.5 over 2 x 6 wall</td>
</tr>
<tr>
<td>6</td>
<td>c.i. R-value ? 7.55 over 2 x 4 wall</td>
<td>c.i. R-value ? 11.25 over 2 x 6 wall</td>
</tr>
<tr>
<td>7 and 8</td>
<td>c.i. R-value ? 10 over 2 x 4 wall</td>
<td>c.i. R-value ? 15 over 2 x 6 wall</td>
</tr>
</tbody>
</table>

- **Air barrier**: Verify the construction documents identify a continuous air barrier and installation practice that complies with the applicable code (e.g., IECC). In the United States, air barrier requirements are addressed only in the energy code even though they also serve an important role in actually meeting the moisture vapor control intention of the building code.

- **Cladding/Furring Attachments**:
  - Determine and verify wind load requirements for the project in accordance with applicable code.
  - Review cladding manufacturer's approved instructions and any limitations including thickness for cladding or furring attachments through foam plastic sheathing to framing, or an approved design.
  - Verify cladding or furring attachments through foam sheathing to framing are specified on the construction documents and meet or exceed minimum fastening requirements per the applicable code based on:
    - Framing types (wood, cold-formed steel, masonry, or concrete)
    - Furring (16” o.c. or 24” o.c.)
    - Fastener type and size
    - Fastener spacing

**Direct Cladding Attachment**:
For direct cladding attachment over foam sheathing where cladding is installed directly over foam sheathing without the use of furring, specify cladding minimum fastening requirements to support the cladding weight in accordance with Table R703.15.1 (wood frame) or Table R703.16.1 (steel frame) of the 2015 IRC, or an approved design.

If an exception has been identified on the construction documents confirm it meets one of the exceptions per the IRC:
1. Where the cladding manufacturer has provided approved installation instructions for application over foam sheathing, those requirements shall apply.
2. For exterior insulation and finish systems, refer to Section R703.9.
3. For anchored masonry or stone veneer installed over foam sheathing, refer to Section R703.7.

<table>
<thead>
<tr>
<th>Table R703.15.1</th>
<th>Cladding Minimum Fastening Requirements for Direct Application over Foam Plastic Sheathing to Support Cladding Weight¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cladding Fastener Through Foam Sheathing</strong></td>
<td><strong>Cladding Fastener Type and Minimum Size²</strong></td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood Framing (minimum 1/1/4 inch penetration)</td>
<td>0.113” diameter nail</td>
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<td></td>
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<tr>
<td></td>
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</tbody>
</table>

¹ Cladding Weight
² Cladding Fastener Type and Minimum Size
³ Maximum Thickness of Foam Sheathing (inches)
### Cladding Fastener Through Foam Sheathing

<table>
<thead>
<tr>
<th>Cladding Fastener Type and Minimum Size</th>
<th>Cladding Fastener Vertical Spacing (inches)</th>
<th>Maximum Thickness of Foam Sheathing (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel Framing (minimum penetration of steel thickness + 3 threads)</td>
<td>6, 8, 12</td>
<td>3, 1, 3, 4</td>
</tr>
<tr>
<td>No. 8 screw into 33 mil steel or thicker</td>
<td>1.5 0.5 3</td>
<td>1 0.5 DR 0.75 DR</td>
</tr>
<tr>
<td>No. 10 screw into 33 mil steel</td>
<td>2 0.75 4</td>
<td>1 0.75 DR</td>
</tr>
</tbody>
</table>

| Steel Framing (minimum penetration of steel thickness + 3 threads) | 6, 8, 12 | 3, 1, 3, 4 |
| No. 8 screw into 33 mil steel or thicker | 1.5 0.5 3 | 1 0.5 DR 0.75 DR |
| No. 10 screw into 33 mil steel | 2 0.75 4 | 1 0.75 DR |

DR = Design required, see Technical Validation, manufacturer literature references

1. Wood framing should be Spruce-pine-fir or any wood species with a specific gravity of ≤ 0.42 in accordance with AWC NDS.
2. Nail fasteners to comply with ASTM F 1667, except nail length is permitted to exceed ASTM F 1667 standard lengths.
3. Foam sheathing must have a compressive strength of 15 psi in accordance with ASTM C 578 or ASTM C 1289.

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### Table R703.16.1

Cladding Minimum Fastening Requirements for Direct Application over Foam Plastic Sheathing to Support Cladding Weight

<table>
<thead>
<tr>
<th>Cladding Fastener Type and Minimum Size</th>
<th>Cladding Fastener Vertical Spacing (inches)</th>
<th>Maximum Thickness of Foam Sheathing (inches)</th>
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<tbody>
<tr>
<td>Steel Framing (minimum penetration of steel thickness + 3 threads)</td>
<td>6, 8, 12</td>
<td>3, 1, 3, 4</td>
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<tr>
<td>No. 8 screw into 33 mil steel or thicker</td>
<td>1.5 0.5 3</td>
<td>1 0.5 DR 0.75 DR</td>
</tr>
<tr>
<td>No. 10 screw into 33 mil steel</td>
<td>2 0.75 4</td>
<td>1 0.75 DR</td>
</tr>
</tbody>
</table>
Furred Cladding Attachment:
Where wood or steel furring is used to attach cladding over foam sheathing, specify furring minimum fastening requirements to support the cladding weight in accordance with Table R703.15.2 (wood frame) or Table R703.16.2 (cold-formed steel frame) of the 2015 IRC, or an approved design.

Where placed horizontally, wood furring shall be preservative-treated wood in accordance with Section R317.1 or naturally durable wood and fasteners shall be corrosion resistant in accordance with Section R317.3 of the IRC.

Steel furring to have a minimum G60 galvanized coating.

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### Table R703.15.2

<table>
<thead>
<tr>
<th>Furring Material</th>
<th>Framing Member</th>
<th>Fastener Type and Minimum Size</th>
<th>Minimum Penetration into Wall Framing (inches)</th>
<th>Fastener spacing in Furring (inches)</th>
<th>Maximum Thickness of Foam Sheathing (inches)</th>
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<tr>
<td>Minimum 1X Wood Furring</td>
<td>Minimum 2 X Wood Stud</td>
<td>6 8 12</td>
<td>1 1/4</td>
<td>8 12 16</td>
<td>4 2 1 4 1.5 0.75 DR</td>
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<td></td>
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<td>6 8 12</td>
<td>1 1/4</td>
<td>8 12 16</td>
<td>4 4 1.5 4 2 0.75</td>
</tr>
</tbody>
</table>

DR = Design required, see Technical Validation, manufacturer literature references

1. Steel framing a minimum 33 ksi steel for 33 mil and 43 mil steel, and 50 ksi steel for 54 mil steel or thicker.
2. Screws must comply with the requirements of ASTM C 1513.
3. Foam sheathing a minimum compressive strength of 15 psi in accordance with ASTM C 578 or ASTM C 1289.
Furring Minimum Fastening Requirements for Application over Foam Plastic Sheathing to Support Cladding Weight

<table>
<thead>
<tr>
<th>Furring Material</th>
<th>Framing Member</th>
<th>Fastener Type and Minimum Size</th>
<th>Minimum Penetration into Wall Framing (inches)</th>
<th>Fastener spacing in Furring (inches)</th>
<th>Maximum Thickness of Foam Sheathing (inches)</th>
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<tr>
<td></td>
<td></td>
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<td>16”o.c. Furring</td>
<td>24”o.c. Furring</td>
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<td>Siding Weight</td>
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<td>11 psf</td>
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<tr>
<td>3 psf</td>
<td>11 psf</td>
<td>25 psf</td>
<td></td>
<td>3 psf</td>
<td>11 psf</td>
</tr>
</tbody>
</table>

DR = Design required, see Technical Validation, manufacturer literature references

1. Wood framing and furring should be spruce-pine-fir or any wood species with a specific gravity of 0.42 in accordance with AWC NDS.

2. Nail fasteners to comply with ASTM F 1667, except nail length is permitted to exceed ASTM F 1667 standard lengths.

3. Where the required cladding fastener penetration into wood material is > ¾” and is < 1½”, a minimum 2 x wood furring or an approved design must be used.

4. Foam sheathing a minimum compressive strength of 15 psi in accordance with ASTM C 578 or ASTM C 1289.

5. Furring must be spaced 24” o.c., in a vertical or horizontal orientation. In a vertical orientation, furring must be located over all studs and attached with the required fastener spacing. In a horizontal orientation, the indicated 8-inch and 12-inch fastener spacing in furring must be achieved by use of two fasteners into studs at 16” o.c. and 24” o.c., respectively.
<table>
<thead>
<tr>
<th>Furring Material</th>
<th>Framing Member</th>
<th>Fastener Type and Minimum Size²</th>
<th>Minimum Penetration into Wall Framing (inches)</th>
<th>Fastener spacing in Furring (inches)</th>
<th>Maximum Thickness of Foam Sheathing (inches)⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 8 screw</td>
<td>Steel thickness + 3 threads</td>
<td>12</td>
<td>3</td>
<td>1.5</td>
<td>DR</td>
</tr>
<tr>
<td>No. 10 screw</td>
<td>Steel thickness + 3 threads</td>
<td>16</td>
<td>3</td>
<td>1</td>
<td>DR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24</td>
<td>2</td>
<td>DR</td>
<td>DR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td>4</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16</td>
<td>4</td>
<td>3</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>24</td>
<td>4</td>
<td>2</td>
<td>DR</td>
</tr>
</tbody>
</table>

DR = Design required, see Technical Validation, manufacturer literature references

1. Wood furring must be spruce-pine-fir or any softwood species with a specific gravity of ≥ 0.42. Steel furring minimum 33 ksi steel. Steel studs a minimum 33 ksi steel for 33 mil and 43 mil thickness, and 50 ksi steel for 54 mil steel or thicker.

2. Screws must comply with the requirements of ASTM C 1513.

3. Where the required cladding fastener penetration into wood material is > ¾" and ≥ 1½", a minimum 2-inch nominal wood furring or an approved design shall be used.

4. Foam sheathing must have a minimum compressive strength of 15 psi in accordance with ASTM C 578 or ASTM C 1289.

5. Furring must be placed ≥ 24" o.c., in a vertical or horizontal orientation. In a vertical orientation, furring must be located over all studs and attached with the required fastener spacing. In a horizontal orientation, the indicated 8-inch and 12-inch fastener spacing in furring must be achieved by use of two fasteners into studs at 16" o.c. and 24" o.c., respectively.

Field Inspection:

Per the 2015 IECC, Section R104 Inspections. Construction or work for which a permit is required is subject to inspection. Construction or work is to remain accessible and exposed for inspection purposes until approved. Required inspections include footing and foundation, framing and rough-in work, plumbing rough-in, mechanical rough-in, and final inspection.

Per the 2015 IRC, Section R109 Inspections. The wording is somewhat different in that for onsite construction, from time to time the building official, upon notification from the permit holder or his agent, can make or cause to be made any necessary inspections. Further details are provided for inspections regarding foundation, plumbing, mechanical, gas and electrical, floodplain, frame and masonry, and final inspection. Any additional inspections are at the discretion of the building official.

This section provides details for inspecting to the specific provisions for continuous insulation and cladding attachments where one or more specific type of inspection per the IECC or IRC may be necessary to confirm compliance. Verifying code compliance would typically be at the framing and rough-in work inspection.

Inspections should provide verification in the following areas:

- Cavity insulation completely fills the cavity with no compression or gaps, the manufacturer’s R-value mark is readily available, and meets the approved R-value per plans.
- Continuous insulation is installed in accordance with manufacturer’s installation instructions, the manufacturer’s R-value mark is readily available, and meets the approved R-value per plans.
- Cladding or furring attachments are installed in accordance with manufacturer’s installation instructions and fastening requirements included in the locally applicable code, designed, or otherwise approved by the code official and specified on construction documents.

- Joints, seams, and penetrations in the c.i. are caulked, gasketed, weatherstripped, or otherwise sealed.

- Vapor retarder (if applicable) is properly installed on the interior (warm-in–winter) side of the exterior wall and in compliance with the locally applicable building code (e.g., only required in mixed or colder climate zones).

- Air barrier is properly installed on the interior or exterior (or both sides) of the exterior wall, or in the cavity if using an air-impermeable insulation product. All seams, gaps, and holes are sealed properly. Confirm corners and headers are insulated and the junction of the foundation and sill plate is sealed. The junction of the top plate and top of exterior walls are sealed. Confirm the exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with the air barrier.

Technical Validation(s):

This section provides additional information and helpful resources.

Building America Top Innovation Hall of Fame Profile

Exterior Rigid Insulation Best Practices


Initial and Long-Term Movement of Cladding Installed Over Exterior Rigid Insulation, P. Baker, Building Science Corporation, September 2014

Attachment of Exterior Wall Coverings Through Foam Plastic Insulating Sheathing (FPIS) to Wood or Steel Framing, Applied Building Technology Group, LLC, March 27, 2015

Manufacturer Literature and Technical Code Compliance Data:

Applying James Hardie Siding over Continuous Insulation and Non-Nailable Substrates, #19, September 2014.

DRJ Technical Evaluation Report, Use of FastenMaster HeadLOK™ Fasteners to Attach Cladding and/or Furring to Wood Framing through Foam Sheathing, April 2015.

Engineering Evaluation Report TRU11910-21, Guide to Attaching Sheathing, Furring and/or Cladding through Continuous Foam Insulation to Wood Framing, Steel Framing, Concrete and CMU Substrates with TRUFAST SIP, TP, SIP LD and Tru-Grip Fasteners
Case Studies

1. **Technology Solutions Case Study: Cladding Attachment Over Thick Exterior Insulating Sheathing**
   - **Author(s):** BSC
   - **Organization(s):** BSC
   - **Publication Date:** November, 2013
   - Case study describing optimal design and limitations of cladding attachments over exterior sheathings.

References and Resources*

1. **2009 IRC - International Residential Code for One and Two Family Dwellings**
   - **Author(s):** International Code Council
   - **Organization(s):** ICC
   - **Publication Date:** January, 2009
   - Code for residential buildings that creates minimum regulations for one- and two-family dwellings of three stories or less. It brings together all building, plumbing, mechanical, fuel gas, energy and electrical provisions for one- and two-family residences.

2. **2012 IRC - International Residential Code for One and Two Family Dwellings**
   - **Author(s):** International Code Council
   - **Organization(s):** ICC
   - **Publication Date:** January, 2012
   - Code for residential buildings that creates minimum regulations for one- and two-family dwellings of three stories or less. It brings together all building, plumbing, mechanical, fuel gas, energy and electrical provisions for one- and two-family residences.

3. **2015 IRC - International Residential Code for One and Two Family Dwellings**
   - **Author(s):** International Code Council
   - **Organization(s):** ICC
   - **Publication Date:** May, 2014
   - Code for residential buildings that creates minimum regulations for one- and two-family dwellings of three stories or less. It brings together all building, plumbing, mechanical, fuel gas, energy and electrical provisions for one- and two-family residences.

4. **2018 IRC - International Residential Code for One and Two Family Dwellings**
   - **Author(s):** International Code Council
   - **Organization(s):** ICC
   - **Publication Date:** August, 2017
   - Code for residential buildings that creates minimum regulations for one- and two-family dwellings of three stories or less. It brings together all building, plumbing, mechanical, fuel gas, energy and electrical provisions for one- and two-family residences.

5. **All About Water-Resistive Barriers**
   - **Author(s):** Holladay
   - **Organization(s):** Green Building Advisor
   - **Publication Date:** September, 2013
   - Article about different types of weather resistant barrier.

   - **Author(s):** ASTM
   - **Organization(s):** ASTM
   - **Publication Date:** January, 2018
   - Specification covering the standard requirements for application of full thickness Portland cement-based plaster for exterior (stucco) and interior work.

7. 

More Info.

Access to some references may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our [webmaster](#) if you find broken links.
8. **Cladding Attachment Over Thick Exterior Insulated Sheathing**
   - **Author(s):** Baker, Lepage
   - **Organization(s):** Building Science Corporation
   - **Publication Date:** January, 2014
   - Report on the stability of furring strips as a means for cladding attachment over walls with thick exterior rigid insulation.

9. **EIFS - Problems and Solutions**
   - **Author(s):** Lstiburek
   - **Organization(s):** Building Science Corporation
   - **Publication Date:** July, 2007
   - Report on problems and solutions with EIFS stucco wall cladding systems.

    - **Author(s):** Baker
    - **Organization(s):** Building Science Corporation
    - **Publication Date:** October, 2013
    - Report about an expert meeting focused on issues surrounding cladding attachment and performance of walls with exterior insulating sheathing.

11. **Measure Guideline: Transitioning From Three-Coat Stucco to One-Coat Stucco With EPS**
    - **Author(s):** Brozyna, Davis, Rapport
    - **Organization(s):** IBACOS, National Renewable Energy Laboratory
    - **Publication Date:** April, 2012
    - Document developed to help residential new construction builders transition from using a three-coat stucco system to a one-coat stucco system installed over 1 in. of expanded polystyrene (EPS) insulation.

12. **Plaster and Drywall Assemblies Manual**
    - **Author(s):** Fowler, Stanley, Coats
    - **Organization(s):** Technical Services Information Bureau
    - **Publication Date:** October, 2014
    - Manual covering design, detailing, material selection and troubleshooting for plaster, IEFs, and drywall, with info on continuous insulation, air barriers, rain screens, fire and sound ratings, etc.

13. **Stucco that Works**
    - **Author(s):** DeKorne
    - **Organization(s):** DeKorne
    - **Publication Date:** May, 2006
    - Information sheet describing correct application of stucco.

*Publication dates are shown for formal documents. Dates are not shown for non-dated media. Access dates for referenced, non-dated media, such as web sites, are shown in the measure guide text.

**Contributors to this Guide**

The following authors and organizations contributed to the content in this Guide.

**Building Science Corporation**