Sealing and Insulating Existing Exterior Walls - Code Compliance Brief

Overview:

The intent of this brief is to provide code-related information about sealing and insulating existing walls in existing residential buildings to help ensure that the measures will be accepted as being in compliance with the code. Providing notes for code officials on how to conduct plan reviews and field inspections can provide jurisdictional officials with information for acceptance. Providing the same information to builders, contractors, designers, and others is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.

From a model code perspective, submittal of construction documentation, permitting, plan review, and field inspection may be required depending upon specific details of renovating exterior walls of an existing home. Several different approaches can be taken to seal and insulate existing exterior walls during a renovation project. For example, insulation can be installed by filling the wall cavities with spray foam insulation from the outside/exterior side of the wall, while keeping the wall sheathing, house wrap, and cladding intact. Insulation can be installed from the interior where the renovation has exposed the interior wall down to the framing members (removal of gypsum board and/or sheathing). The following Plan Review section provides the code sections for alterations followed by the details of inspecting the alteration under the Field Inspection section regarding sealing and insulating existing exterior walls. Refer to the Technical Validation/Resource Materials section of this brief for the resources on technical validation on the different methods that exterior walls can be insulated, best practices, and measure guidelines on techniques to ensure sealed and insulated exterior walls.

Plan Review:

This section lists the applicable code requirements followed by details that will be helpful for plan review regarding the provisions associated with sealing and insulating existing exterior walls.

Per the 2015 International Energy Conservation Code (IECC)/International Residential Code (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.

Construction Documentation. Review the construction documents for details describing the renovation of the exterior walls, insulation and sealing materials, installation, and construction techniques.

- 2015 IECC/IRC, Section R103.2/N1101.5 Information on construction documents. Construction documents should include:
  - Details associated with the exterior wall(s) renovation (e.g., water/moisture damage, water control layer, and drainage)
  - Insulation material(s) and their R-values with the wall(s) and any openings in the walls
  - Details indicating how the insulation is to be installed to the existing wall(s) or the interior and/or exterior of the existing wall(s) and/or stud cavity
  - Air sealing details.

- 2015 IECC/IRC, Section R501.1.1/N1107.1.1 Alterations – General. Alterations to an existing building or portion of a building should comply with Sections R502/N1108, R503/N1109, or R504/N1110. Unaltered portions of the existing building are not required to comply.
- **R503.1/N1109.1 General.** Alterations to any building or structure should comply with the requirements of the code for new construction. Alterations should not negatively impact conformance of a building or structure to the provisions of this code; that is, code conformance should be the same as existed for the building or structure prior to the alteration. Alterations should not create an unsafe or hazardous condition or overload existing building systems. Alterations should be such that the altered building or structure uses no more energy than the existing building or structure prior to the alteration.

- **R503.2/N1103.2 Change in space conditioning.** Any non-conditioned or low-energy space that is altered to become conditioned space must be brought into full compliance with this code. (This means not only the altered assembly must be brought into compliance but the entire space or building would need to be brought into compliance.)

- **R503.1.1/N1109.1.1 Building Envelope.** Building envelope assemblies that are part of the alteration must comply with Sections R402.1.2/N1102.1.2 (Insulation and Fenestration Table) or R402.1.4/N1102.1.4 (U-factor Alternative), and Sections R402.2.1/N1102.2.1 through R402.2.12/N1102.2.12, R402.3.1/N1102.3.1, R402.3.2/N1102.3.2, R402.4.3/N1102.4.3 and R402.4.4/N1102.4.4.

  - Exception: The following alterations need not comply with the requirements for new construction provided the energy use of the building is not increased:
    - Existing wall cavities exposed during construction, provided that the cavities are filled with insulation
    - Construction where the existing wall cavity is not exposed.

- **2012 IECC/IRC, Section R101.4.3/N1101.3 and 2009 IECC/IRC, Section 101.4.3/N1101.4.3 Alterations – General.** Alterations to an existing building or portion of a building should comply to the provisions of the code as they relate to new construction without requiring unaltered portion(s) of the existing building to comply with this code.

- 2015 IECC/IRC, Section R402.1.2/N1102.1.2 Insulation Criteria. The building thermal envelope must meet the requirements of Table R402.1.2/N1102.1.2, based on the climate zone specified in Chapter 3 of the code and the building assemblies associated with the exterior wall(s) that are considered part of the building thermal envelope.

- **2015 IECC/IRC, Section R402.1.3/N1102.1.3 or 2012 IECC/IRC, Section R402.1.2/N1102.1.2 R-Value Computation.** Insulation material used in layers, such as framing cavity insulation, or continuous insulation should be summed to compute the corresponding component R-value. The manufacturer’s settled R-value should be used for blown insulation. Computed R-values should not include an R-value for other building materials or air films. (2015 IECC/IRC new language added: “Where insulated siding is used for the purpose of complying with the continuous insulation requirements of Table R402.1.2/N1102.1.2, the manufacturer’s labeled R-value for insulated siding should be reduced by R-0.6.”)

An excerpt from the **Insulation and Fenestration Requirements by Component Tables** follows:

### 2015 IECC/IRC, Table R402.1.2/N1101.1.2 or 2012 IECC/IRC, Table R402.1.1/N1102.1.1

(R-values are the same for both versions, but, the footnotes have changed from 2012 to 2015 IECC/IRC)

<table>
<thead>
<tr>
<th>Climate Zone</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, 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Frame Wall R-value</td>
<td>13</td>
<td>13</td>
<td>20 or 13+5(^a)</td>
<td>20 or 13+5(^a)</td>
<td>20 or 13+5(^a)</td>
<td>20+5 or 13+10(^a)</td>
<td>20+5 or 13+10(^a)</td>
</tr>
</tbody>
</table>

\(^a\)2015 IECC/IRC footnote: The first value is cavity insulation, the second value is continuous insulation, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation.

\(^a\)2012 IECC/IRC footnote: First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers <= 40% of the exterior, continuous insulation R-value should be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used to maintain a consistent total sheathing thickness.

### 2015 IECC/IRC, Section R402.1.4/N1102.1.4 or 2012 IECC/IRC Section R402.1.3/N1102.1.3 U-Factor Alternative.** An assembly with a U-factor equal to or less than that specified in Equivalent U-factor Tables should be permitted as an alternative to the R-value in Insulation and Fenestration Requirements by Component Tables of the IECC/IRC.

An excerpt from the **Equivalent U-factor Tables** follows:

### 2015 IECC/IRC, Equivalent U-factor Table R402.1.4/N1101.1.4
### 2012 IECC/IRC, Equivalent U-factor Table R402.1.3/N1102.1.3

<table>
<thead>
<tr>
<th>Climate Zone</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, 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Frame Wall U-factor</td>
<td>0.084</td>
<td>0.084</td>
<td>0.060</td>
<td>0.060</td>
<td>0.060</td>
<td>0.045</td>
<td>0.045</td>
</tr>
</tbody>
</table>

### 2009 IECC/IRC Insulation and Fenestration Requirements by Component Table 402.1.1/N1102.1

An excerpt from the 2009 IECC/IRC follows:

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Frame Wall R-value</td>
<td>R-13</td>
<td>R-13</td>
<td>R-13</td>
<td>R-13</td>
<td>R-20 or 13+5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>R-21</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>13+5<sup>a</sup> means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers <= 25% of the exterior, insulated sheathing is not required where structural sheathing is used. If structural sheathing covers > 25% of exterior, structural sheathing should be supplemented with insulated sheathing of at least R-2.

### Air Sealing/Air Leakage Control

- **2015 IECC/IRC, R402.4.1/N1102.4 Air Leakage.** The building thermal envelope should be constructed to limit air leakage.
  - **R402.4.1.1/N1102.4.1.1 Installation.** The components listed in the Air Barrier and Insulation Installation Table should be installed in accordance with the manufacturer’s instructions and the criteria listed as the applicable method of construction. Below are the General Requirements and components from the table that are applicable to insulating and sealing exterior walls.
  - **R402.4.1/N1102.4.1 Building Thermal Envelope.** Methods used to seal between dissimilar materials should allow for differential expansion and contraction.

- **2015 IRC/IECC, Air Barrier and Insulation Installation Table R402.4.1.1/N1102.4.1.1**
  - **Continuous air barrier.** Confirm that construction documents specify a continuous air barrier for the building components associated with the insulation of the exterior wall(s). Breaks or joints in the air barrier should be sealed. Air-permeable insulation should not be used as a sealing material.
  - **Walls.** Cavities within corners and headers of frame walls should be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope insulation for framed walls should be in substantial contact and continuous alignment with the air barrier.
  - **Rim joists.** Rim joists should include the air barrier and be insulated.

- **2012 IECC/IRC, R402.4.1/N1102.4 Air Leakage.** The building thermal envelope should be constructed to limit air leakage.
  - **R402.4.1.1/N1102.4.1 Building Thermal Envelope.** Methods used to seal between dissimilar materials should allow for differential expansion and contraction.
  - **R402.4.1.1/N1102.4.1.1 Installation.** The components listed in the Air Barrier and Insulation Installation Table should be installed in accordance with the manufacturer’s instructions and the criteria listed as the applicable method of construction. Below are the components from the table that are applicable to sealing and insulating walls.
  - **R402.4.1.1/N1102.4.1.1 Air Barrier and Insulation Installation Table**
    - **Air barrier and thermal barrier.** A continuous air barrier should be installed in the building envelope (wall). Breaks or joints in the air barrier should be sealed. Air-permeable insulation should not be used as a sealing method.
    - **Walls.** The junction of the top plate and top of exterior walls should be sealed. Exterior thermal envelope insulation for framed walls should be installed in substantial contact and continuous alignment with the air barrier.
    - **Rim joists** – Similar language as the 2015 IECC/IRC.

- **2009 IECC/IRC, R402.4.1/N1102.4.1 Air leakage, Building Thermal Envelope**
  - The building thermal envelope should be constructed to limit air leakage. Methods used to seal between dissimilar materials should allow for differential expansion and contraction. Sources of infiltration (see listing below) should be caulked, gasketed, weather-stripped, or otherwise sealed with an air-barrier material, suitable film, or solid material:
- All joints, seams, and penetrations
- Rim joist junction
- Other sources of infiltration.

**Moisture Control**

- **2015/2012 IRC, Section R702.7 Vapor retarders.** Class I or II vapor retarders are required on the interior side of frame walls in Climate Zones 5, 6, 7, 8, and Marine 4.
  - Class III vapor retarders are permitted where one of the conditions are met per the Class III Vapor Retarder Table R702.7.1

[1] The term “building thermal envelope” is defined as the basement walls, exterior walls, floor, roof, and any other building elements that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.

[2] The term “continuous air barrier” is defined as a combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.

**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 (in some instances, inspections can be difficult to examine especially if the insulation is drilled and filled on the existing exterior side of the walls). 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**, for onsite construction, 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 insulation and sealing of existing exterior walls where one or more specific types of inspection per the IECC or IRC may be necessary to confirm compliance. To confirm code compliance, framing and rough-in would be the typical type of inspection performed for new construction. However, since this document addresses existing residential exterior walls where framing already exists, the framing inspection would involve ensuring the wall(s) that have any sources of air leakage (exterior or interior) are sealed and the existing framing is acceptable (e.g., if load bearing is not compromised).

- Joints, seams, holes, and penetrations are caulked, gasketed, weather-stripped, or otherwise sealed.
- Ensure that the appearance of insulation of the interior/exterior wall, as appropriate, in the field matches what is on the approved construction documents.
- If the R-value or U-factor approach for compliance was used in the documentation, ensure that the insulation installed meets the minimum R-value or maximum U-factor required for the type of assembly and climate zone per the approved construction documents.
- Confirm that the continuous air barrier is properly installed. Confirm that the insulation for framed walls is installed in substantial contact and continuous alignment with the air barrier.
- If applicable, confirm that the vapor retarder is installed in accordance with approved construction documents.

**Technical Validation(s):**

This section provides additional related information and references to materials that are applicable to the provision.

  - Author(s): ICC
  - Organization(s): ICC
  - Publication Date: May 2014

This code establishes a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems, and service water heating systems in homes and commercial businesses.
2015 IRC—International Residential Code for One- and Two-Family Dwellings

Author(s): ICC
Organization(s): ICC
Publication Date: May 2014
This code for residential buildings 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.

2012 IECC—International Energy Conservation Code

Author(s): ICC
Organization(s): ICC
Publication Date: January 2012
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