Water Managed Existing Wall Penetrations

Last Updated: 12/21/2015

Scope

Install flashing integrated with air and water control layers around piping, vents, and other wall penetrations as part of an exterior wall retrofit as follows:

- Remove the existing cladding and trim. Prepare the wall sheathing to receive the air/water control membrane.
- Install a continuous air/water control membrane (such as house wrap, fully adhered membrane or liquid applied membrane) with a hole for the vent or pipe.
- Apply a bead of sealant around the duct/pipe penetration.
- Install insulating sheathing and vertical wood furring strips.
- Install sheathing tape flashing and wood blocking for trim.
- Install a trim block over the duct/pipe and install the metal cap flashing.
- Install a vent hood/cap.
- Install wall cladding and trim. Attach to furring strips.

For more on roof/wall connections, see the U.S. Department of Energy’s Standard Work Specifications.

See the Compliance Tab for related codes and standards requirements, and criteria to meet national programs such as DOE’s Zero Energy Ready Home program, ENERGY STAR Certified Homes, and Indoor airPLUS.
Description

When an exterior wall is being upgraded by removing exterior cladding, there are several elements within the field of the wall that “interrupt” the wall assembly, such as pipes, vents, wiring, windows, doors, and architectural elements. While these elements are needed for functional reasons and to add character and amenity to buildings, they can complicate the continuity of the building enclosure functions, including the air, water, vapor, and thermal control layers.

In most walls, a water control layer protects the structure. Water control layers are water-repellent materials (building paper, house wrap, sheet membranes, liquid-applied coatings, or taped and sealed rigid insulation boards) that are located behind the cladding (the siding) and are designed and constructed to protect the wall sheathing by from any rain water that might get through the cladding. Water control layers are interconnected with metal and flexible flashing s around windows, doors, and other penetrations through the building enclosure to provide a continuous path to drain water to the exterior of the building. The materials that form the water control layer overlap in a shingle fashion or are sealed so that water drains down and out of the wall. The water control layer is often referred to as the Drainage plane, the Water-resistive barrier (WRB), or the Water Control layer.

Protection is typically provided by flashings which might be metal as shown in Figure 1 or self-adhering flexible flashing tape). Flashings are the most underrated of building enclosure components and are arguably the most important. Flashings are integrated with the water control layer, creating for all practical purposes a flashing for the entire assembly. Flashings are needed wherever a drainage plane is terminated as at a roof edge or the bottom of a wall, or where the drainage plane is interrupted as at openings, the intersection of assemblies, control joints, or penetrations of the drainage plane.

Figures 2 to 7 show detail drawing for several air sealing details. These figures show how to do these air sealing details as part of an exterior wall retrofit that includes adding rigid foam insulating sheathing to the wall. The air sealing procedures work equally well in the absence of the insulating sheathing.

**Figure 1.** The “down” and “out” approach to flashing – metal flashing directs water down and out of building assemblies.

Duct/Pipe Penetration

Figures 2 and 3 show the proper locations to apply sealant, tape flashing, and metal flashing around a pipe that extends through an exterior wall. In the case shown in Figures 2 and 3, the wall has been retrofitted by installing (over the existing wall sheathing) house wrap, two layers of rigid foam, wood furring strips, and new siding. In this case, the pipe is extended to accommodate the thicker wall, and a vent hood is attached over the end of the pipe. Figure 2 is a plan or overhead view of the pipe sealing detail and Figure 3 is a section or side view of the same detail.

For more information on sealing around pipes, see the guide Plumbing/Piping.
Exterior Electric Box

Figures 4 and 5 show the proper locations to apply foam and caulk sealant and tape flashing around an electrical box that is installed in an exterior wall. In the case shown in Figures 4 and 5, the wall has been retrofitted by installing (over the existing wall sheathing) house wrap, two layers of rigid foam, wood furring strips, and new siding. Figure 4 is a plan view and Figure 5 is a section view of the same detail.
Trim Block with Wire Penetration

Figures 6 and 7 show the proper locations to apply foam and caulk sealant and tape and metal flashing around the wiring and trim block installed in an exterior wall to mount an exterior light fixture. In the case shown in Figures 6 and 7, the wall has been retrofitted by installing (over the existing wall sheathing) house wrap, two layers of rigid foam, wood furring strips, and new siding. Figure 6 is a plan view and Figure 7 is a section view of the same detail.
How to Water Manage Wall Penetrations

1. Remove the existing wall cladding (see Step 1). Prepare the wall sheathing to receive the air/water control membrane. Appropriate preparation of the wall sheathing will depend upon the nature of the existing sheathing and the air control strategy to be pursued. If using a sheet good like house wrap as the air/water control layer, all protruding fasteners must be removed to avoid punctures or tears in the membrane. Gaps or voids in the sheathing layer may need to be filled in.
Step 1. Remove the existing wall cladding to prepare to retrofit an exterior wall.

2. Install a continuous air/water control membrane (building paper, house wrap, sheet membranes, liquid-applied coatings, or taped and sealed rigid insulation boards). Carefully cut holes for any ducts, pipes, or other penetrations. Make holes no larger than necessary. If the air control layer is not a fully adhered material, install a continuous bead of sealant on the existing sheathing around the penetration prior to installing the water control layer (see Step 2).

Step 2. Install a continuous air and water control layer over the existing wall sheathing.

3. Apply a generous bead of urethane sealant, applied similar to caulk, around the duct, pipe, or wiring. If rigid foam sheathing will be installed over the wall, extend the duct pipe if needed so that it will stand 2 inches proud of the insulating sheathing.
Step 3. Apply urethane sealant around the duct or pipe in the retrofitted exterior wall.

4. Install insulating sheathing with joints offset horizontally and vertically and the joints of the outermost layer taped. Attach wood furring strips through the insulating sheathing to the wall studs. Install furring strips in a vertical orientation only. Apply a bead of urethane sealant around the duct, pipe, or wiring at the insulating sheathing.

Step 4. Install insulating sheathing and vertical furring strips on the retrofitted exterior wall; seal around pipe or duct with urethane sealant.

5. Install sheathing tape flashing above the duct/pipe penetration. Attach wood blocking for trim on each side of the pipe, duct, or wiring. The fasteners should extend through the insulating foam to the existing wood sheathing.
Step 5. Install sheathing tape flashing over the duct or pipe and wood blocking on either side for later attachment of trim.

6. Install the vent hood trim block over the duct/pipe and install the metal cap flashing with a drip edge over the trim. Tape the top edge of the metal cap flashing with sheathing tape.

Step 6. Install vent hood trim block, metal cap flashing; seal top edge of flashing with sheathing tape.

7. Install the vent hood over the end of the duct or pipe to keep out rain and snow. Clothes dryer vents should have self-closing louvers. Other vent and pipe openings should be covered with .5x.5 inch metal mesh screens or .25x.25 hardware cloth screening to keep out rodents, birds, and bats.
Step 7. Install a vent hood on the pipe to keep out rain.

8. Attach the new cladding to the furring strips to complete the exterior wall retrofit.

Step 8. Attach the new cladding to the furring strips over the rigid foam for the exterior wall retrofit.
Ensuring Success

Install the materials that form the water control layer in a shingle fashion so they overlap each other and/or are sealed to allow for the water to drain down and out of the wall.

Use mounting blocks for all penetrations.

Remediate any hazardous conditions that will be affected (e.g., exposed or aggravated) by the planned work. (For example, does the existing siding have lead paint?). Follow applicable laws and industry procedures for mitigation of hazardous materials. Engage the services of a qualified professional when needed.
Climate

No climate specific information applies.
Training

Right and Wrong Images

Display Image: WM242_WallPenetrations-1R_BSC_11-27-2012.JPG

Display Image: WM242_WallPenetrations-2R_BSC_11-29-2012.JPG
CAD
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.

ENERGY STAR Certified Homes, Version 3/3.1 (Rev. 09)

Water Management System Builder Checklist

2. Water-Managed Wall Assembly.
2.2 Fully sealed continuous drainage plane behind exterior cladding that laps over flashing in Item 2.1. Additional bond-break drainage plane layer provided behind all stucco and non-structural masonry cladding wall assemblies.\textsuperscript{9, 10}

Please see the ENERGY STAR Certified Homes Implementation Timeline for the program version and revision currently applicable in your state.


Section R703.8 (R703.8.5 in 2015 and 2018 IRC) Flashing.
M2301.2.7 (M2301.2.9 in 2015 and 2018 IRC) Roof and wall penetrations.


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.

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.)

- **2015 IECC/IRC, Section 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.
  - 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.

- **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&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20 or 13+5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20 or 13+5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20+5 or 13+10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20+5 or 13+10&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
Climate Zone 1  2  3  4 Except Marine 5 and Marine 4 6  7, 8

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.

b) 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**

<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>

- **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>0.083</td>
<td>0.083</td>
<td>0.057</td>
<td>0.057</td>
<td>0.057</td>
<td>0.048</td>
<td>0.048</td>
</tr>
</tbody>
</table>

An excerpt from the **2009 IECC/IRC Insulation and Fenestration Requirements by Component Table 402.1.1/N1102.1** 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+5a</td>
<td>R-20 or 13+5a</td>
<td>R-21</td>
</tr>
</tbody>
</table>

a) "13+5" 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./N1102.4 Air Leakage.** The building thermal envelope should be constructed to limit air leakage.
  
  o **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.

  o **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**

  o **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.

  o **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.

  o **Rim joists.** Rim joists should include the air barrier and be insulated.

- **2012 IECC/IRC, R402.4/N1102.4 Air Leakage.** The building thermal envelope should be constructed to limit air leakage.
- **R402.4.1/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, 402.4.1/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.

• **2015 IECC—International Energy Conservation Code**
  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
  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.

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Related Building America Solution Center Guides

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.

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   - **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. **Mass Save Deep Energy Retrofit Builder Guide**
   - **Author(s):** Pettit, Neuhauser, Gates
   - **Organization(s):** Building Science Corporation
   - **Publication Date:** July, 2013
   
   Guidebook providing useful examples of high performance retrofit techniques for the building enclosure of wood frame residential construction in a cold and somewhat wet climate.

*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.

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