

Sealing and Insulating Existing Crawl Space Walls - Code Compliance Brief

Overview:

The intent of this brief is to provide code-related information about sealing and insulating crawl space walls in existing residential buildings to help ensure that the measures will be accepted as being in compliance with the code. Providing the same information to all interested parties (e.g., code officials, builders, contractors, designers, etc.) is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.

Sealing and installing insulation in an existing crawl space is challenging for a number of reasons. First, a decision about conditioning or not conditioning the crawl space volume needs to be made. This is important because it will define what assemblies associated with the crawl space are to be sealed and insulated and what assemblies do not need to be insulated. It is also important because the decision could 'trigger' other changes to the crawl space with respect to moisture control and ventilation.

The amount and location of insulation applied to the crawl space is determined by which assemblies associated with the crawl space are considered to be part of *the building thermal envelope*.^[1] Where the crawl space is ventilated and therefore open to the outdoors or directly or indirectly communicates with an unconditioned space, the *building thermal envelope* components of the crawl space are the floor assembly separating the crawl space from any conditioned areas above the crawl space. Where the crawl space is not ventilated and does not directly or indirectly communicate with an unconditioned space, then the crawl space can be considered unconditioned and the floor assembly considered part of the *building thermal envelope* as discussed above—OR—it can be considered conditioned and the walls, and any openings in those walls that separate the crawl space from the outdoors or other unconditioned spaces, can be considered part of the *building thermal envelope*. If the crawl space is specifically conditioned (e.g., has dedicated heating or cooling system output into the space), the walls and any openings in those walls as mentioned above are considered part of the *building thermal envelope*.

The floor above or the interior and/or exterior of crawl space walls and associated openings can be tricky to insulate considering the insulation is being applied to existing construction. In addition, any sources of air leakage from the crawl space through the walls or floor must be sealed depending on the classification of the crawl space and the assemblies that comprise its thermal envelope components.

Where the crawl space is being 'converted' from a vented to an unvented space and the walls are being insulated instead of the floor above, there will be additional moisture-related issues to address per the building code (see below on how to address water management issues).

How to Address Water Management Issues in a Crawl space

Several steps can be taken to address moisture issues in the crawl space depending on the initial conditions at the site and the project budget:

1. Reduce the chances of bulk intrusion of water into the crawlspace by re-grading the ground around the building to slope away from the structure, installing drainage pipes around exterior footings that drain to daylight or a drywell, and installing or modifying gutters and downspouts to ensure that they carry rainwater away from the foundation. Ensure that any existing concrete patios, sidewalks, or driveways slope away from the house. If they slope toward the house, consider replacing with pervious pavers or correctly sloped concrete, or install drains, for example at the base of a down-sloping driveway, to carry water away from the foundation.
2. Block off and thoroughly seal crawl space windows and vents with durable, waterproof materials that will prevent air and water leakage. Completely fill crawlspace window wells to above-grade levels.
3. Install exhaust fans that will pull damp air out of the crawl space, while indirectly pulling drier air from the dwelling unit into the crawlspace. This infusion of conditioned air will help to dry out the crawl space.
4. Install sump pumps in low-lying areas of the crawl space floor that can be activated to carry away any water that accumulates at the crawl space floor from seepage under the foundation walls or rising water table from periodic storm events. The sump pump should have a plastic pit that is 2-ft to 3-ft deep and perforated with holes drilled in the bottom so that if the water table rises (for example due to storm events), the water will be removed before it reaches the floor of the crawl space. Use sump pumps that are equipped with gasketed, tight-fitting lids. For more on sump pumps, see the guide [Drain or Sump Pump Installed in Basements or Crawl spaces](#) [1].
5. Install a vapor barrier of 6-mil or thicker polyethylene sheeting that completely covers the crawl space floor and extends up the foundation walls and any piers by 8 to 12 inches, or preferably up to the exterior ground level. The plastic should be secured with pressure-treated wood furring strips, mechanical fasteners, or fiberglass mesh tape and duct mastic. Seams in the vapor barrier sheeting should be overlapped 6 to 12 inches and taped. This vapor barrier can be covered with a concrete slab for additional durability. For more information, see the guides [Polyethylene Lapped Up Walls/Piers and Secured in the Ground](#) [2] and [Concrete Slab over Polyethylene](#) [3].

Once the crawl space assemblies associated with the *building thermal envelope* are identified, then the type of insulation materials and their R-value or U-factor must be determined and compared to the minimum requirements in the code. Where framing is involved in the wall assembly being insulated, the R-value of the insulation should be shown on the plans along with

the type of insulation to be installed; however, the designer, builder, or contractor can also choose to provide the U-factor for the entire assembly instead. Where no framing is involved, the U-factor or R-value of the insulation should be shown. If there are any access openings in the walls of the conditioned crawl space from the exterior or unconditioned spaces, the type and thermal properties of the insulation should be shown along with the means of sealing the opening against air leakage.

The following section (Plan Review) provides the code sections with requirements for alterations. The Field Inspection section provides the details of inspecting the sealing and insulating of existing crawl spaces. Refer to the last section of this brief (Technical Validation and Reference Materials) for resources on technical validation, best practices, and measure guidelines on the detailed proper techniques to ensure an improved sealed and insulated crawl space will increase the home's overall energy efficiency.

[1] The term “*building thermal envelope*” in the 2015 IECC/IRC 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.

Plan Review:

This section lists the applicable code requirements followed by details helpful for plan review regarding the provisions associated with sealing and insulating existing crawl spaces.

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.

Construction Documentation. Review the construction documents to identify that the information necessary to determine if the crawl space is conditioned and based on that information the walls and openings associated with the crawl space are to be sealed and insulated. The type, amount, and location of the insulation in the wall assemblies must be shown as well as how any openings (e.g., access doors) in insulated walls are to be sealed and insulated. Note that where the crawl space in question is located adjacent to another interior space that is not conditioned, the wall separating the crawl space from that other interior space must also be insulated.

- **2015 IECC/IRC, Section R103.2/N1101.5 Information on construction documents.** Construction documents should include:
 - Details associated with the conditioning of the crawl space (e.g., unconditioned and/or ventilated or conditioned indirectly or directly) that are needed to define the assemblies of the crawl space that are part of the thermal envelope and must be insulated
 - Insulation materials and their R-values or U-factor associated with the walls and any openings in the walls
 - Details indicating how the insulation is to be applied to the existing interior and/or exterior of the existing crawl space walls
 - Where an unconditioned vented crawl space is being considered conditioned and the walls and associated openings insulated, details indicating how the crawl space will be renovated to address moisture related criteria in the codes
 - Air sealing details.
- **2015 IECC/IRC, Section R501.1/N1107.1.1 Alterations - General.** Alterations to an existing building or portion thereof 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 not cause the modified building or structure to use more energy than the pre-existing building or structure prior to alterations.
 - **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 the entire space or building, including the altered assembly, 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 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 thereof 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.

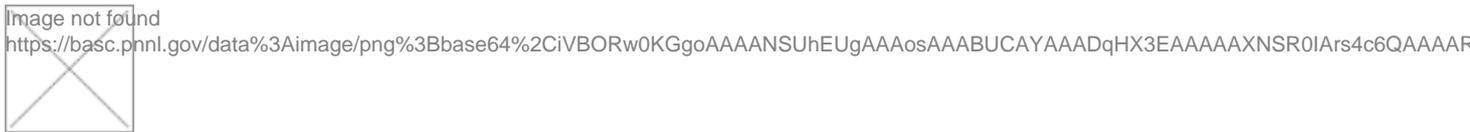
Exception: The following alterations need not comply with the requirements for new construction provided the energy use of the building is not increased:

- Existing wall cavities exposed during construction, provided 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 and the building assemblies (i.e., floor or wall and openings) associated with the crawl space 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. Computed R-values should not include an R-value for other building materials or air films. Where crawl space walls are being insulated on the exterior of the wall and 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/N1102.1.2 or 2012 IECC/IRC, Table R402.1.1/N1102.1.1

(R-values and footnotes are the same for both versions of the codes)

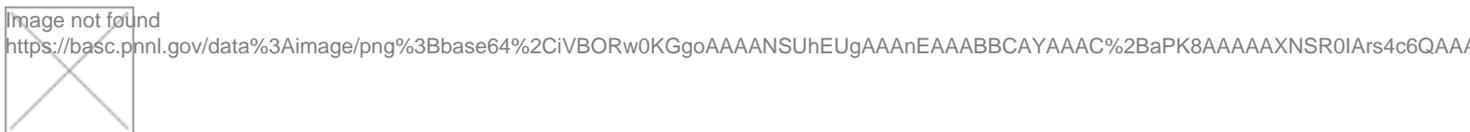


- **2015 IECC/IRC, Section R402.1.4/N1102.1.4 or 2012 IECC/IRC Section R402.1.3/N1102.1.3 U-Factor Alternative.** An assembly with a U-factor equal to or less than that specified in Equivalent U-factor Tables should be permitted as an alternative to the R-value in Insulation and Fenestration Requirements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

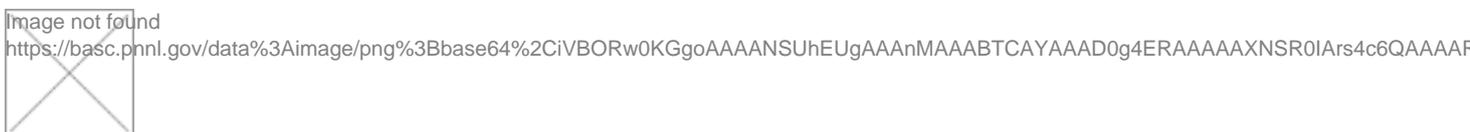
An excerpt from the **Equivalent U-factor Tables** follows:

2015 IECC/IRC, Table R402.1.4/N1102.1.4 or 2012 IECC/IRC, Table R402.1.3/N1102.1.3

(U-factors are the same for both code versions)



An excerpt from the **2009 IECC/IRC Insulation and Fenestration Requirements by Component Table 402.1.1/N1102.1.1** follows:



- **2015 IECC/IRC, Section R402.2.4/N1102.2.4 Access Hatches and Doors.** Any access hatches or doors located in a crawl space wall or floor that is part of the *building thermal envelope* and is consequently being insulated must also be insulated to a level equivalent to the floor or wall in which it is located. In addition, the access hatch or door must also be provided with weather stripping and gaskets to minimize air leakage.
- **2012 IECC/IRC, Section R402.2.4/N1102.2.4 and 2009 IECC/IRC Section 402.2.3/N1102.2.3** have similar language as the 2015 IECC/IRC regarding Access Hatches and Doors.

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.

- **R402.4.1/N1102.4.1 Building Thermal Envelope.** The sealing methods used to seal 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 General Requirements and components from the table that are applicable to sealing and insulating crawl space walls.
- **2015 IRC/IECC, Air Barrier and Insulation Installation Table R402.4.1.1/N1102.4.1.1**
- **Continuous air barrier^[1]** – Confirm that construction documents specify a continuous air barrier for the building components associated with the insulation of the crawl space.
- **Crawl space walls** – Exposed earth in unvented crawl spaces should be covered with a Class I vapor retarder with overlapping joints taped.
- **Insulation Installation** – Where provided instead of floor insulation, insulation should be permanently attached to the crawlspace walls.
- **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.** The sealing methods 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 crawl space 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 (floor or walls). Breaks or joints in the air barrier should be sealed. Air-permeable insulation should not be used as a sealing material.
 - **Crawl space walls** – Where provided instead of floor insulation, insulation should be permanently attached to the crawlspace walls. Exposed earth in unvented crawl spaces should be covered with a Class I vapor retarder with overlapping joints taped.
- **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. Sealing methods used 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
 - Other sources of infiltration.

[1] The term “continuous air barrier” in the 2015 IECC/IRC 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. Required inspections include footings and foundations, framing and rough-in work, plumbing rough-in, mechanical rough-in, and final inspection.

For **2015 IRC, Section R109 Inspections**, the wording is somewhat different in that sometimes for on-site 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 sealing and insulation of crawl space 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 work would be typical types of inspection performed. Because this document addresses existing residential crawl spaces where framing already exists, the framing inspection would involve ensuring that any sources of air leakage in the wall have been sealed and the framing is acceptable (e.g., no water damage or deterioration). Inspections should focus on the following areas:

- Confirm that 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.
- 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.
- Ensure that the continuous air barrier is properly installed. Confirm that the insulation is permanently attached to the crawl space walls and is in continuous alignment with the air barrier.
- Confirm that vapor retarder is installed, per approved construction documents.

Technical Validation(s):

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

- ASHRAE Handbook of Fundamentals, ASHRAE-2013, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., Atlanta, GA, <http://www.techstreet.com/ashrae/products/1858361> [4]
- Technology Face Sheet – Crawlspace Insulation, U.S. DOE Office of Building Technology, <http://web.ornl.gov/sci/roofs+walls/insulation/fact%20sheets/crawlspace%20insulation%20technology.pdf> [5]

Related BASC Guides:

Unvented Crawl Spaces and Conditioned Basements, <https://basc.pnnl.gov/resource-guides/unvented-crawlspaces-and-conditioned-basements> [6]

Rigid Foam Board Interior Insulation for Existing Foundation Walls, <https://basc.pnnl.gov/resource-guides/rigid-foam-board-interior-insulation-existing-foundation-walls> [7]

Water Management of Existing Crawl Space Floor, <https://basc.pnnl.gov/resource-guides/water-management-existing-crawlspace-floor> [8]