Unvented, Insulated Crawlspaces

Last Updated: 11/17/2017

Scope

Construct an unvented crawlspace and insulate the interior walls with rigid foam insulation; this can provide an insulated, air-sealed environment for ducts and HVAC equipment, protect floor joists from condensation from humid air in humid climates, and protect floors and pipes from cold temperatures in cold climates.

- Install insulation to levels that meet or exceed code or energy-efficiency program requirements.
- Check with local authorities prior to installation of the insulation to ensure that the rigid foam meets all code requirements.
- Cover the walls and floor of the crawlspace with a polyethylene vapor retarder prior to installing the rigid foam.
- If the crawlspace has vents, install pieces of rigid foam cut to fit in the vent openings and seal in place with spray foam or caulk.
- Fasten the sheets of rigid foam to the crawlspace walls using masonry fasteners with large, button cap washers.
- Leave a pest control inspection strip where needed to comply with local codes.
- Insulate access doors and provide air sealing with gaskets or weather stripping.
- If the band joist area is suitable for insulating, it can be insulated with rigid foam cut to fit in each joist bay and sealed in place with spray foam or caulk.

This guide applies to crawlspaces and basements with walls constructed of solid concrete, or concrete masonry units (CMU) with a continuous brick cap or bond beam.

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.
Crawlspaces that are constructed to be unvented, air-sealed, insulated, and conditioned can have several advantages over vented crawlspaces (see Figure 1). They reduce the opportunity for condensation to form on cold floor or rim joists from humid air entering through the vents. Insulated crawlspaces can keep floors warmer and help protect HVAC equipment and plumbing pipes from freezing temperatures in cold climates (BSC 2009). They are less likely to harbor pests.

![Figure 1](image)

**Figure 1.** The sealed, insulated crawlspace is a clean, dry location to house the main floor heating ducts and also provides bonus storage space. (Source: Addison Homes)

Although there are different strategies to insulate closed crawlspaces, this guide is intended to provide a cost-effective method for installing rigid foam insulation on the interior perimeter walls and the band joist area in closed (also called sealed or unvented) crawl space foundations.

Polyisocyanurate or extruded polystyrene (XPS) rigid foam board is recommended as insulation because of its low permeance to water and high insulation value per inch. The thickness of the foam sheeting may depend on the climate zone in which it is installed, as well as the desired levels of performance.

Table 1 shows the three main types of rigid foam board insulation available in the market today. The R-values vary, depending on the manufacturer, but polyisocyanurate offers the highest R-value.

<table>
<thead>
<tr>
<th>Insulation Type</th>
<th>R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyisocyanurate</td>
<td>As high as R-6.5 per inch</td>
</tr>
<tr>
<td>Extruded polystyrene (XPS)</td>
<td>Average R-5 per inch</td>
</tr>
<tr>
<td>Expanded polystyrene (EPS)</td>
<td>Average R-4 per inch</td>
</tr>
</tbody>
</table>

Table 1. R-Values for Various Types of Rigid Foam Board Insulation

Many rigid foam board manufacturers apply a thin polyethylene film to both sides of the panels to strengthen them and to make them impermeable to vapor. Use unfaced sheets, or remove the film from the rigid foam board prior to installation, particularly to allow some breathability at the band joist area.

Foam plastic insulation receives special scrutiny in residential building codes because some foam insulations have the potential to release toxic or flammable gases when heated, or they can accelerate the spread of fire if they ignite. To reduce these risks, most codes require a thermal barrier (typically ½-in. gypsum board or equivalent) or an ignition barrier (typically ⅜-in. gypsum board or equivalent) over foam insulation. However, several foam insulation products have been designed and tested to reduce or eliminate those risks. Check with local authorities to ensure that the rigid foam selected meets all code requirements.

Figure 2 below shows examples of typical foundation wall types to which this guide applies. These examples are constructed of solid concrete or concrete masonry units (CMU) with a continuous brick cap or bond beam.
How to Insulate the Closed Crawlspace Walls with Rigid Foam Board

1. Check with local code officials to ensure all materials and work will comply with local code requirements, such as the R-value of the insulation, fire and combustion safety requirements, radon mitigation requirements, pest (insect) control, and flood prevention requirements. Refer to the Compliance tab of this guide for additional information about potential code requirements.

2. Prior to insulating the crawlspace walls, install a 6-mil polyethylene sheeting vapor retarder on the walls and floor of the crawlspace (see Figure 3). The vapor retarder should completely cover the floor and lap up the walls to within 4 in. of the top of the foundation walls. The vapor retarder should be secured to the foundation walls with strapping attached to the walls using nails, pins, or masonry screws. This wall and floor vapor retarder provides a continuous liner to retard moisture and soil gases from seeping through the ground and the crawlspace walls. The sheeting should be overlapped 12 in. at seams and sealed with adhesive and tape. The IRC requires a 6-inch overlap but 12 inches is recommended. For information on how to install a polyethylene vapor retarder in a crawlspace, see the guide Polyethylene Lapped Up Walls/Piers and Secured in the Ground. A radon venting system should be installed under the vapor barrier. See the guides Vertical Radon Ventilation Pipe and Radon Fan for more information. Optional: a thin concrete slab can be poured over the vapor retarder to increase durability (BSC 2009).

3. Place sheets of unfaced rigid foam board against the interior perimeter of the crawlspace walls. No insulation is needed in the crawlspace ceiling.

4. Allow space for a pest control inspection strip above the foam sheets and below the rim joist, if required by local jurisdictions. In areas of the United States prone to insect infestation (e.g., termites or carpenter ants), 3 in. of bare wall is required (see Figure 4). The polyethylene vapor retarder behind the foam board stops at 4 in. from the top of the foundation wall. This strip of bare wall can be painted white to facilitate pest inspections. Consult with the local building inspector or a pest control professional for local requirements regarding a pest control inspection strip at the top or bottom of the foundation wall.
5. Use masonry fasteners with large, button cap washers (intended for use with foam) to mechanically fasten the rigid foam board to the crawlspace walls. If no pest inspection strip is required, the insulation is installed to the top of the foundation wall. The insulation should extend down to grade and then continue down or horizontally as required by code. The fasteners should be spaced an equal distance apart to ensure effective contact with the foundation wall. The 2009 IRC (Section N1102.2.9, p. 470) states:

“As an alternative to insulating floors over crawlspaces, insulation of crawlspace walls shall be permitted when the crawlspace is not vented to the outside. Crawlspace wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm).”

6. Fill in any wall vents with additional pieces of rigid foam. Cut the pieces to fit into the openings to create a snug fit. If a vent is recessed, it may require doubling the thickness of the foam to be level with the wall surface, as shown in Figure 5. For more information on how to close vented crawlspaces, see “Guide to Closing and Conditioning Ventilated Crawlspaces.” The method is primarily for existing construction, but the principles apply to new construction as well.

7. Apply expansion foam sealer or caulking to seal the additional foam blocks in place (see Figure 6).

8. Insulate the crawlspace access door by gluing rigid foam to the inside of the panel. Caulk around the outside of the framing and install weather stripping around the inside of the frame. Provide a latch that pulls the door or hatch lid securely against the frame to provide a firm seal. See Figures 7, 8, and 9.
9. Code (2009 IRC R 408.3) requires that crawlspaces have a drying mechanism such as a continuously operating exhaust fan or conditioned air supply. If the HVAC equipment is not located in the crawlspace, a small amount of conditioned air can be brought in to semi-condition the crawlspace by cutting a passive return into the floor. At minimum, air should be delivered at a rate equal to 1 cfm (0.47 L/s) for each 50 ft$^2$ (4.7 m$^2$) of under-floor area or 50 cfm total, whichever is greater. This strategy meets the requirements of the 2009 International Residential Code (IRC 2009, Section R408.3, p. 108); however, local codes might have different requirements.

10. In flood-prone areas of the United States, local codes may require the installation of flood vents that allow water to pass freely into and out of a foundation to equalize pressure on the foundation walls. Choose flood vents that are designed to reduce standby air leakage. Install the rigid foam panels around all flood vents and seal the perimeter of the vents with expansion foam sealer or caulking to prevent air leakage. Be careful that the installed foam does not inhibit operation of the vent.

11. When the installation of insulation on the crawlspace walls and band joist is complete, inspect the vapor retarder on the floor of the crawlspace. If any tears or rips in the vapor retarder occurred during the work, repair and seal the tears.

12. If the bottom of the crawlspace is below grade, it will be necessary to damp-proof or waterproof the exterior surface of the foundation walls. For information on how to accomplish this water management strategy, see “Exterior Surface of Below-Grade Walls.”

How to Insulate the Band Joist Area with Rigid Foam Board

CAUTION: Before insulating the band joist area, assess the moisture potential of both the interior and exterior conditions where the sill plate (also known as the mud sill), band joist, and floor system all meet the top of the crawlspace walls (see Dickson 2013). If installation of insulation in the band joist area will not cause high moisture content and likely damage to the wood, then
insulate this area. If there is any doubt about the drying potential at the band joist area, the safest practice would be not to insulate that area and to allow free drying of the wood materials. Refer to “Guide to Closing and Conditioning Ventilated Crawlspace” for guidance on how to assess moisture conditions in the crawlspace and band joist area. Other options for insulating the rim joist are with spray foam or with rigid foam sheathing installed on the exterior of the home (see "Critical Seal Spray Foam at Rim Joist").

1. Cut pieces of unfaced rigid foam sheathing to fit along the band joist in each floor joist cavity. See Figure 10.

![Figure 10](image1.png)

**Figure 10.** Use pieces of rigid foam that are cut to fit and sealed in place with canned spray foam to insulate the band joist above a crawlspace. (Image courtesy of IBACOS).

2. Use expanding spray foam or caulk to air seal all of the perimeters of the rigid foam insulation pieces and to seal around any penetrations through the insulation.

![Figure 11](image2.png)

**Figure 11.** An unvented, air-sealed crawlspace is kept warm and dry with a continuous layer of 6-mil vapor retarder covering the floor and the walls, which are then insulated with rigid foam. (Image courtesy of IBACOS).

**How to Install Ducts in a Sealed, Insulated Crawlspace**
When installing HVAC equipment in an insulated crawlspace, good HVAC design principles still apply:

- Design a compact duct layout with short, straight ducts runs.
- Seal and test ductwork for air leakage.
- Install a balanced ventilation system such as a heat recovery ventilator or central fan-integrated ventilation with a fresh air intake and timered exhaust. (For more information, see Whole-Building Delivered Ventilation.)
- Do not install low-efficiency heating systems that draw their combustion air from the crawlspace or basement. Instead install direct-vent sealed-combustion furnaces or heat pumps. (For more information, see Combustion Furnaces, Traditional Split Heat Pumps.)
Ensuring Success

- Check with local authorities prior to the installation of any insulation in closed crawlspaces and band joist areas. This is imperative to ensure that all local code requirements are met, such as the R-value of insulation, fire and combustion safety requirements, pest inspection requirements, and radon mitigation requirements. Also, local codes in flood-prone areas of the United States may require the installation of flood vents that allow water to pass freely into and out of a foundation to equalize pressure on the foundation walls. Flood vents should be designed to reduce standby air leakage.

- If the bottom of the crawlspace is below grade, it will be necessary to damp-proof or waterproof the exterior wall surface of the crawlspace. For information on how to accomplish this water management strategy, see "Exterior Surface of Below-Grade Walls."

- During any air sealing process, follow safe work practices to minimize any effects from sealants or adhesive fumes on workers’ health. Temporary ventilation could be necessary during the installations.

- Apply a coat of light-colored paint over the 3-in. pest control inspection gap at the top of the foundation walls to facilitate pest inspections.

- Never store flammable materials (e.g., gasoline or solvents) in any crawlspace.

- Cover the floor of the crawlspace and the crawlspace perimeter walls with 6-mil polyethylene vapor retarder.

- Assess the moisture potential in the band joist area, and if appropriate, insulate and air seal the band joist as an integral part of the work.
Climate

During warm seasons in humid climates, the outside air can contain more water vapor than the air within the crawlspace. In humid climates, rather than helping to dry out a crawlspace, the vents can actually encourage condensation in the crawlspace by allowing warm, humid air to enter and condense on the floor joists, which are likely to be cooler, especially if the rooms above are air conditioned. In warm humid climates, a closed crawlspace reduces the potential for moisture problems (e.g., condensation, mold growth, wood rot) within the crawlspace.

Local building codes can have specific requirements for types of insulation and requirements for the 3-in. pest control inspection strip at the top of the foundation wall. See the Compliance tab for prescriptive requirements for insulation levels in the International Energy Conservation Code and International Residential Code.

Climate zones 1 and 2 do not require the use of insulation. However, crawlsspaces in those regions are usually constructed above grade. Thus, reasonable energy savings can occur if an insulation strategy is implemented. Consider insulation levels similar to those in climate zone 3.

IECC Climate Zone Map

All of Alaska is in Zone 7 except for the following boroughs in Zone 8:
Bethel, Northwest Arctic, Dillingham, Southeast Fairbanks, Fairbanks N. Star, Wade Hampton, Nome, Yukon-Koyukuk, North Slope

Zone 1 includes Hawaii, Guam, Puerto Rico, and the Virgin Islands
Training

Right and Wrong Images

Display Image: 2016_HabitatCatawba_Julia-8-HeatPump.JPG

Display Image: 2018-Addison-7-CrawlEntry.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.

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

ENERGY STAR Certified Homes requires that ceiling, wall, floor, and slab insulation levels meet or exceed those specified in the 2009 International Energy Conservation Code (IECC) with some alternatives and exceptions, and achieve Grade 1 installation per RESNET Standards (see 2009 and 2012 IECC Code Level Insulation – ENERGY STAR Requirements and Insulation Installation (RESNET Grade 1)). If the state or local residential building energy code requires higher insulation levels than those specified in the 2009 IECC, you must meet or exceed the locally mandated requirements. Visit the U.S. DOE Building Energy Codes Program to see what code has been adopted in each state.

Water Management System Builder Requirements

1. Water-Managed Site and Foundation.
   1.4 Capillary break at all crawlspace floors using ? 6 mil polyethylene sheeting, lapped 6-12 in., & installed using one of the following: 3, 4, 5
   1.4.1 Placed beneath a concrete slab; OR,
   1.4.2 Lapped up each wall or pier and fastened with furring strips or equivalent; OR,
   1.4.3 Secured in the ground at the perimeter using stakes.

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

DOE Zero Energy Ready Home (Revision 07)

Exhibit 1 Mandatory Requirements.
Exhibit 1, Item 1) Certified under the ENERGY STAR Qualified Homes Program or the ENERGY STAR Multifamily New Construction Program.
Exhibit 2, Item 2) Ceiling, wall, floor, and slab insulation shall meet or exceed 2015 IECC levels and achieve Grade 1 installation, per RESNET standards. See the guide 2015 IECC Code Level Insulation – DOE Zero Energy Ready Home Requirements for more details.
Exhibit 1, Item 3) Duct distribution systems located within the home’s thermal and air barrier boundary or an optimized location to achieve comparable performance.
Exhibit 1, Item 6) Certified under EPA Indoor airPLUS.

Footnote 14) Exceptions and alternative compliance paths to locating 100% of forced-air ducts in home’s thermal and air barrier boundary are:

1. Up to 10’ of total duct length is permitted to be outside of the home’s thermal and air barrier boundary.
2. Ducts are located in an unvented attic, regardless of whether this space is conditioned with a supply register.
3. Ducts are located in a vented attic with all of the following characteristics: Note that in either of these designs the HVAC equipment must still be located within the home’s thermal and air barrier boundary.
   1. In Moist climates (Zones 1A, 2A, 3A, 4A, 5A, 6A and 7A per 2015 IECC Figure R301.1) and Marine climates (all “C” Zones per 2015 IECC Figure R301.1), minimum R-8 duct insulation with an additional minimum 1.5” of closed-cell spray foam insulation encapsulating the ducts; duct leakage to outdoors ? 3 CFM25 per 100 ft² of conditioned floor area (in addition to meeting total duct leakage requirements from Section 4.1 of the ENERGY STAR HVAC Rater checklist); and ductwork buried under at least 2” of blown-in insulation.
   2. In Dry climates (all “B” Zones per 2015 IECC Figure R301.1), minimum R-8 duct insulation; duct leakage to outdoors ? 3 CFM25 per 100 ft² of conditioned floor area (in addition to meeting total duct leakage requirements from Section 4.1 of the ENERGY STAR HVAC Rater checklist); and ductwork buried under at least 3.5” of blown-in insulation.
4. Systems which meet the criteria for “Ducts Located in Conditioned Space” as defined by the 2018 IECC Section R403.3.7
5. Jump ducts which do not directly deliver conditioned air from the HVAC unit may be located in attics if all joints, including boot-to-drywall, are fully air sealed with mastic or foam, and the jump duct is fully buried under the attic insulation.
6. Ducts are located within an unvented crawlspace.
7. Ducts are located in a basement which is within the home’s thermal boundary.
8. Ductless HVAC system is used.

Local building codes have specific requirements such as the R-value of insulation, fire and combustion requirements, radon mitigation requirements, flood prevention requirements, and requirements for a pest control inspection strip at the top and/or the bottom of the foundation wall. Begin by checking with local authorities to ensure that all materials and work will comply with local
code requirements.

**EPA Indoor airPLUS (Revision 04)**

1.4 Basement and Crawlspace Insulation and Conditioned Air.

- Seal crawlspace and basement perimeter walls to prevent outside air infiltration.
- Insulate crawlspace and basement perimeter walls according to the prescriptive values determined by local code or R-5, whichever is greater.
- Provide conditioned air at a rate not less than 1 cfm per 50 sq. ft. of horizontal floor area. This can be achieved by a dedicated supply (2015 IRC section R408.3.2.2) or through crawl-space exhaust (2015 IRC section R408.3.2.1). However, if radon-resistant features are required (see Specification 2.1), do not use the crawlspace exhaust method.

See **Indoor airPLUS Specifications** for exceptions.

**2009 - 2018 IECC and IRC Minimum Insulation Requirements:** The minimum insulation requirements for ceilings, walls, floors, and foundations in new homes, as listed in the 2009, 2012, 2015, and 2018 IECC and IRC, can be found in this [table](#).

**2009, 2012, 2015, and 2018 IECC**

R402.2.9 (2012 IECC - R402.2.10; 2015, 18 - R402.2.11) Crawlspace walls. As an alternative to insulating floors over crawlspace, crawlspace walls can be insulated if the crawlspace is not vented to the outside. The insulation must be permanently fastened to the wall and extend down the wall from the floor to the finished grade then vertical or horizontally at an additional 24 inches. The dirt floor must be covered with a continuous Class I vapor retarder that extends at least 6 inches up the stem wall and is attached and sealed to the wall. The joints of the vapor retarder should overlap by 6 inches with seams sealed or taped.

Table 1 lists the IRC and IECC insulation requirements for the 2009 through 2018 codes. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation on the interior. Code allows 15/19 to be met with R-13 cavity plus R-5 continuous on the interior or exterior.

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Ceiling R-Value</th>
<th>Wood Frame Wall R-Value</th>
<th>Mass Wall R-Value</th>
<th>Floor R-Value</th>
<th>Basement Wall R-Value</th>
<th>Slab R-Value &amp; Depth</th>
<th>Crawl Space Wall R-Value</th>
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<tbody>
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<td>1</td>
<td>30</td>
<td>30</td>
<td>13</td>
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<td>20 or 13+5h</td>
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<td>19/21</td>
<td>38*</td>
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</table>

For Sl: 1 foot = 304.8 mm.

*The IRC code requirement differs from the IECC code requirement, as noted.

a. Table adapted from Table R402.1.1 in the 2009 and 2012 IECC and Table R402.1.2 in the 2015 and 2018 IECC (Table N1102.1 in 2009 IRC, Table N1102.1.1 in 2012 IRC, and Table N1102.1.2 in 2015 and 2018 IRC).

b. 2012, 2015, and 2018 IECC; R-values are minimums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed R-value of the insulation shall not be less than the R-value specified in the table. 2009 IECC; R-values are minimums. R-19 batts compressed into a nominal 2x6 framing cavity such that the R-value is reduced by R-1 or more shall be marked with the compressed batt R-value in addition to the full thickness R-value.

c. Refers to fenestration requirements not shown on this excerpted table.

d. 2009-2018 IECC; “10/13” means R-10 continuous insulation (called “insulated sheathing” in 2009 IECC) on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall. “15/19” means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with “15/19” shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.

e. 2009 IRC Only: The first R-value applies to continuous insulation, the second to framing cavity insulation; either insulation meets the requirement.

f. 2009-2018 IECC; R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-value for slabs, as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.

g. 2009, 2012, and 2015 IECC; R-5 shall be added to the required slab edge R-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

h. 2009, 2012, and 2015 IECC; Insulation sufficient to fill the framing cavity and providing not less than an R-value of R-19.

i. 2015 and 2018 IECC; The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, “13+5” means R-13 cavity insulation plus R-5 continuous insulation.

j. 2012 IECC; First value is cavity insulation, second value 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 percent or less of the exterior, continuous insulation R-value shall 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.

k. 2009 IECC; “13+5” means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.

l. 2009 IECC; Mass walls shall be in accordance with Section R402.2.5 (N1102.2.5 in 2018 IRC). The second R-value applies where more than half of the insulation is on the interior of the mass wall.

m. 2009, 2012, and 2015 IECC; The second R-value applies where more than half of the insulation is on the interior of the mass wall.


Section R101.4.3 (Section R501.1.1 in 2015 and 2018 IECC). 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.)

For IRC 2009-18 insulation requirements, see Table 1 above.

R408.3, states that unvented crawlspaces are acceptable if the dirt floor is covered with a continuous Class I vapor retarder that extends at least 6 inches up the stem wall and is attached and sealed to the wall. The joints of the vapor retarder should overlap by 6 inches with seams sealed or taped.

The crawlspace must be equipped with one of the following:

2.1 “Continuously operated mechanical exhaust ventilation at a rate equal to 1 cubic foot per minute (0.47 L/s) for each 50 square feet (47 m2) of crawlspace floor area, including an air pathway to the common area (such as a duct or transfer grille), and perimeter walls insulated in accordance with Section N1102.2.9 (N1102.2.11 in 2015 and 2018 IRC);

2.2 “Conditioned air supply sized to deliver at a rate equal to 1 cubic foot per minute (0.47 L/s) for each 50 square feet (4.7 m2) of under-floor area, including a return air pathway to the common area (such as a duct or transfer grille), and perimeter walls insulated in accordance with Section N1102.2.9 (N1102.2.11 in 2015 and 2018 IRC);

2.3 "Plenum in existing structures complying with Section M1601.5, if under-floor space is used as a plenum." (Crawlspaces in new buildings cannot be used as plenums so this applies to existing buildings only.)

In the 2018 IRC, the following requirement is added: (R408.3.2.4) Dehumidification sized to provide 70 pints (33 liters) of moisture removal per day for every 1,000 square feet (93 m2) of crawlspace floor area.

2009 IRC N1102.2.9 [2012 IRC, N1102.2.10; 2015 and 2018 IRC, N1102.2.11] states that when crawlspace walls are insulated, the insulation should be permanently fastened to the wall and extend down from the floor above to the finished grade and then vertically or horizontally an additional 24 inches, and the dirt floor should be covered with a Class 1 vapor retarder with all seams overlapped 6 inches and sealed and all edges extending 6 inches up the walls and sealed.

**Retrofit:** [2009, 2012, 2015, and 2018 IRC]

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.
Case Studies
None Available

References and Resources*

1. **2009 IECC - International Energy Conservation Code**
   *Author(s):* International Code Council
   *Organization(s):* ICC
   *Publication Date:* January, 2009
   Code establishing 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.

2. **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.

   *Author(s):* International Code Council
   *Organization(s):* ICC
   *Publication Date:* January, 2012
   Code establishing 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.

4. **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.

5. **2015 IECC - International Energy Conservation Code**
   *Author(s):* International Code Council
   *Organization(s):* ICC
   *Publication Date:* May, 2014
   Code establishing 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.

6. **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.

7. 
2018 IECC - International Energy Conservation Code
Author(s): International Code Council
Organization(s): ICC
Publication Date: November, 2017
Code establishing 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.

8. 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.

9. Closed Crawlspace Do Double Duty
(476KB)
Author(s): Dastur, Davis
Organization(s): Home Energy Magazine
Publication Date: January, 2005
Article describing how closed crawlspace can do "double duty" by controlling moisture and providing energy savings.

10. Conditioned Crawlspace Construction, Performance and Codes
Author(s): Lstiburek
Organization(s): Building Science Corporation
Publication Date: November, 2004
Report outlining how conditioned crawlspace perform better than vented crawlspace in terms of safety, health, comfort, durability and energy consumption.

11. Crawlspace Insulation
Author(s): Building Science Corporation
Organization(s): Building Science Corporation
Publication Date: May, 2009
Information sheet about crawlspace insulation, including installation details.

12. Critical Seal (Spray Foam at Rim Joist)
Author(s): Building Science Corporation
Organization(s): Building Science Corporation
Publication Date: September, 2009
Information sheet about air sealing.

Author(s): Dickson
Organization(s): IBACOS, National Renewable Energy Laboratory
Publication Date: January, 2013
Document designed to explain the issues and concerns with conventional ventilated crawlspace and to outline prescriptive measures for improvements that will create healthier and more durable spaces.

Author(s): ASTM
Organization(s): ASTM
Publication Date: January, 2011
Standard specification covering elastomeric cellular preformed gasket and sealing materials.

Author(s): ASTM
Organization(s): ASTM
Publication Date: January, 2011
Specification covering the properties of a cured single- or multicomponent cold-applied elastomeric joint sealant for sealing, caulking, or glazing operations on buildings, plazas, and decks for vehicular or pedestrian use, and types of construction other than highway and airfield pavements and bridges.

16.

   - **Author(s):** ASTM
   - **Organization(s):** ASTM
   - **Publication Date:** January, 2010
   - *Test method providing a rapid means of determining the steady-state thermal transmission properties of thermal insulations and other materials with a high level of accuracy when the apparatus has been calibrated appropriately.*

   - **Author(s):** ASTM
   - **Organization(s):** ASTM
   - **Publication Date:** January, 2011
   - *Test method designed to obtain reliable values for the WVTR of plastic film and sheeting.*

19. **The Scary Crawlspace**
   - **(1MB)**
   - **Author(s):** Hales
   - **Organization(s):** Home Energy Magazine
   - **Publication Date:** January, 2011
   - *Article describing the risks associated with vented and unvented crawlspaces in different climate zones.*

*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.

- **IBACOS**, lead for IBACOS, a [DOE Building America Research Team](#)