

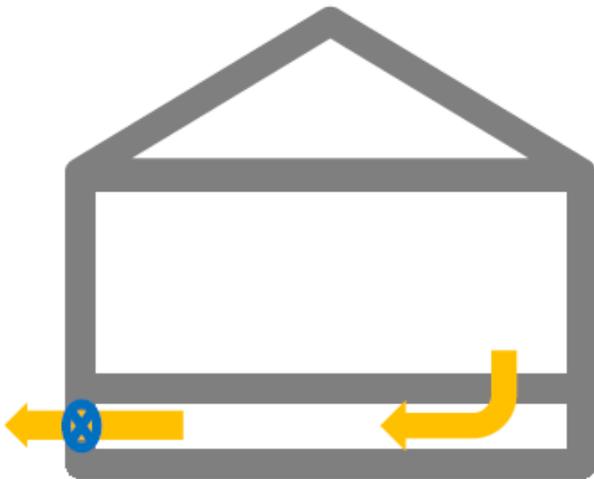
9. Unvented Crawlspace

The International Residential Code (IRC) allows either vented or unvented crawlspaces. If the crawlspace is vented, the floor must be insulated. If the crawlspace is unvented, then the crawlspace walls must be insulated. The IRC (R408.3) goes on to allow two design options for an unvented crawlspace, either mechanically vented or minimally conditioned (a so-called mini-basement). In either case, the required air flow is specified by the code and an air pathway to the house common area is required. All unvented crawlspaces must have a continuous Class I vapor retarder at exposed earth. This requirement is critical since radon, moisture, and other soil gases can find their way into the home without a sealed vapor retarder on the floor of the crawlspace. The vapor retarder must have a six-inch overlap that is sealed or taped and must extend six inches up the stem wall where it is attached and sealed.

Unvented Crawlspace – Two Design Options

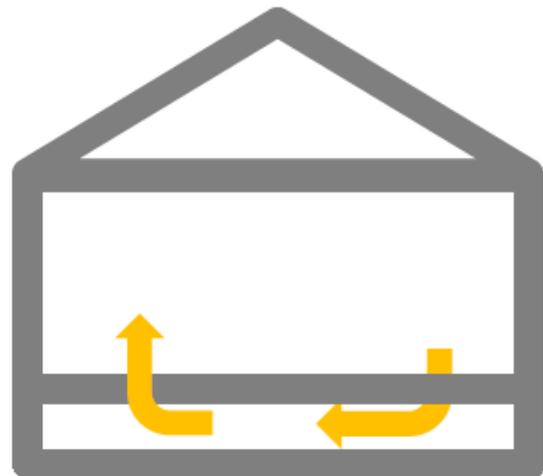
Continuous Exhaust to Exterior

- 1 CFM/50 SF Crawlspace Area
- Air Pathway from Common Area



Conditioned Air Supply

- 1 CFM/50 SF Crawlspace Area
- Air Pathway to Common Area



Continuous Exhaust to the Exterior

Traditional vented crawlspace designs included passive foundations vents that were intended to let moisture and contaminants escape to the outside. Replacing passive crawlspace vents with an exhaust fan and drawing house air in to condition the crawlspace reduces moisture problems and can increase energy efficiency. The IRC specifically allows crawlspace designs with an exhaust ventilation system. To comply, a mechanically vented crawlspace design must have a continuously sealed, vapor-retarding ground cover, have no fixed ventilation openings to the outdoors, and be equipped with a continuously operating exhaust fan.



Sizing the fan: The fan must be sized to the code minimum. The foundation vents must be eliminated when continuously operating mechanical ventilation is provided at a rate of 1.0 cfm for each 50 sq. ft. of under-floor space (e.g., 20 cfm per 1000 sq. ft.).

Type of fan: The code does not specify details about fans used in crawlspaces. One possibility is to follow the Colorado amendments to the IRC. Colorado requires a fan rated for 44,000 hours (five years) of continuous operation with flex connections, or other installation detailing to reduce vibration and noise associated with the fan. Colorado requires that the fan be connected to a trouble light or an alarm to signal occupants when the fan fails.

Supply air for the exhaust fan: The IRC requires an air pathway to the common area (transfer grille), but does not specify size and location. The Colorado amendments to the IRC recommend transfer-air openings, one per 250 Ft² of crawlspace floor area, be installed in the decking between the crawlspace and conditioned rooms above. A continuously operating crawlspace exhaust fan pulls house air down through these openings. In the Colorado amendments airflow through the transfer openings is restricted (e.g., through a capped boot that has holes drilled in the cap) as shown in Table 1.

Amount of air required	Minimum hole size	Maximum hole size
0-10 CFM	1.5 sq in.	2.4 sq in.
11-15 CFM	2.4 sq in.	3.6 sq in.
16-20 CFM	3.6 sq in.	4.4 sq in.

Source: Details for Mechanically Vented Crawlspaces - Code Notes, USDOE Building Energy Codes Resource Center, June 2011

Pressure balance: The crawlspace exhaust fan, typically 30-60 cfm, will exert slight negative pressure on the house above. The resulting negative pressure will roughly equal that from a bathroom fan, but it will be considerably less than the pressure generated by dryers and kitchen exhaust fans. The following is the recommended design specification: when all exhaust appliances and any forced-air HVAC system operate simultaneously, any zone with an atmospherically vented gas appliance should experience less than 3 Pascals of negative pressure.

Conditioned Air Supply

If no mechanical exhaust is provided to an unvented crawlspace then a conditioned air supply must be provided to the crawlspace that is sized to deliver at a rate equal to 1.0 cfm for each 50 ft² of under-floor area. In addition, a return air pathway to the common area (such as a duct or transfer grille) must be provided. The code does not specify the size of the return pathway.

Insulation Requirements

The insulation requirements are the same for continuous exhaust to the exterior or conditioned air supply for unvented crawlspaces. The 2012 IECC Table R402.1.1 for Climate Zone 6 requires an R-value of “15/19” for a crawlspace wall. “15/19” means R-15 continuous insulation on the interior or exterior of the foundation wall or



R-19 cavity insulation at the interior of the basement wall. R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the basement wall also complies.

Plan Review

1. Verify that adequate crawlspace wall insulation is specified.
2. Verify that the crawlspace is designed for either the continuous exhaust to the exterior or conditioned air supply. If the continuous exhaust is used the fan capacity (1 cfm per 50 Ft² of crawlspace) and location should be documented on the plans. When the design includes a conditioned air supply, verify that the submittal documents identify the size (1 cfm per 50 Ft² of crawlspace) and location.

Inspection

1. Verify that debris has been removed per 2012 IRC R408.5. The under-floor grade must be cleaned of all construction materials, vegetation, and (non-soil) organic material.
2. Verify that the appropriate ground cover is installed. A continuous vapor retarder must be installed that is a Class I vapor retarder with less than 1.0 permeability (e.g., sheet polyethylene). All joints in the vapor retarder need to be overlapped by six inches, and sealed or taped. The vapor retarder also must extend up the foundation wall by at least six inches, and attached to the stem wall. The vapor retarder must be attached to all piers and other penetrations.
4. When mechanically exhausting the crawlspace, the exhaust fan specified on the submittal documents must be installed in under-floor space. Verify the air pathway allowing house air to be drawn into the crawlspace.
5. When the design includes a conditioned air supply, supply size and location should be as specified in the submittal documents. Verify air pathway allowing house air to be drawn into the crawlspace.

Code Reference

2012 IRC Section 408.3 Unvented Crawlspace. Ventilation openings in under-floor spaces specified in Sections R408.1 and R408.2 shall not be required where:

1. Exposed earth is covered with continuous Class I vapor retarder. Joints of the vapor retarder shall overlap by 6 inches and shall be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches up the stem wall and shall be attached and sealed to the stem wall or insulation: and
2. One of the following is provided for the under-floor space.
 - 2.1 Continuously operated mechanical exhaust ventilation at a rate equal to 1.0 cfm for each 50 ft² 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 N1103.2.1 of this code.
 - 2.2 Conditioned air supply sized to deliver at a rate equal to 1.0 cfm for each 50 ft² 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 R402.1.



2.3 Plenum in existing structures complying with Section M1601.5, if under-floor space is used as a plenum.

2012 IECC Table R402.1.1 Insulation and Fenestration Requirements by Component

For Climate Zone 6 the “Crawlspace Wall” R-value in the table is 15/19. Footnote C states “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. “15/19” shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.

2012 IECC Section R402.2.10 Crawl Space Walls. As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside. [*Note: Montana amended this provision to allow temporary vents during the construction of the house.*] Crawl space 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). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the *International Building Code or International Residential Code*, as applicable. All joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.

Resources

2012 International Energy Conservation Code, Copyright August 2011 by the International Energy Codes Council, Inc., Falls Church, Virginia.

2012 IECC Code and Commentary, Copyright August 2012 by the International Energy Codes Council, Inc., Falls Church, Virginia.

2012 International Residential Code, Copyright August 2011 by the International Energy Codes Council, Inc., Falls Church, Virginia.

Details for Mechanically Vented Crawlspace - Code Notes, USDOE Building Energy Codes Resource Center, June 2011