

Details for Mechanically Vented Crawlspace - Code Notes

[2000 IRC, 2003 IRC, 2006 IRC, 2003 IECC, 2006 IECC]

Codes allow crawlspaces with mechanical ventilation instead of crawlspaces with passive vents to the outdoors. However, code officials and builders are often uncertain about the design details.

Traditional crawlspace designs include passive foundation-wall vents that are supposed to let moisture and contaminants escape outside. Yet field research shows that wall vents may make moisture problems worse. Replacing crawlspace vents with an exhaust fan and drawing house air in to condition the crawlspace reduces moisture problems and can increase energy efficiency.

The International Residential Code (IRC) specifically allows crawlspace designs with an exhaust ventilation system instead of fixed ventilation openings through the foundation walls. 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 supplied with a continuously operating exhaust fan.

Sizing the fan. Two design options:

- Size to the code minimum: Eliminate the foundation vents when continuously operated 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.) (IRC 2000/2003 Section R408.2, Exception 4; IRC 2006, Section R408.3).
- Size to crawlspace volume: Size for one air-change per hour, the assumed ventilation rate for crawlspaces with passive vents in foundation walls. For example, for a 1000 sq. ft. crawlspace with 3.5 feet between ground and floor deck, a fan should exhaust 58 cfm.

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. Require a fan rated for 44,000 hours (5 years) of continuous operation with flex connections or other installation detailing to reduce vibration and noise associated with the fan. The fan must be connected to a trouble light or an alarm to signal occupants when the fan fails.

Supply air for the exhaust fan: Transfer-air openings, one per 250 sq. ft. of crawlspace floor area, are installed in the decking between the crawlspace and conditioned rooms above. A continuously operating exhaust fan pulls house air down through these openings. Airflow through the transfer openings is restricted (e.g., through a capped boot that has holes drilled in the cap) per the table.

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.

Code Compliant Construction Details

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 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.

Plan Review

1. Removal of debris: the under-floor grade is clean of all construction materials, vegetation, and (non-soil) organic



- material (2000 and 2003 IRC R408.4; 2006 IRC R408.5).
2. Crawlspace insulation: installed in accordance with the IECC or IRC specifications (2003 IECC 502.2.3, 2006 IECC 402.2.8 or 2003 IRC N1102.1.4, 2006 IRC N1102.2.8).
 3. Ground cover: continuous vapor retarder should be sheet material with less than 1.0 permeance (e.g., polyethylene film); or a concrete slab. While lapping and sealing polyethylene at joints is not explicitly required by code, this vapor retarder needs to be sealed/lapped at joints as well as to the foundation wall, plus to all piers and other penetrations, to be an effective ground cover.
 4. Fan, when using Exception 4 of 2000 or 2003 IRC or Section R408.3 of 2006 IRC: sized to provide a minimum of 1 cfm per 50 sq. ft. of under-floor space.
 5. Supply-air pathways: look for pathways allowing house air to be drawn, under slight negative pressure, into the crawlspace (e.g., one transfer-air grille per 250 sq. ft. of crawlspace floor area). Calculations should specify transfer air sizing.

Code Citations*

IRC 2000 and 2003, Section R408.1 Under-Floor Space

R408.1 Ventilation. The under-floor space shall be provided with ventilation openings through foundation walls or exterior walls. Exceptions: #4 (2000 and 2003 IRC Section 408.3). Ventilation openings are not required where continuously operated mechanical ventilation is provided at a rate of 1.0 cfm (0.47 L/s) for each 50 ft² (50 m²) of under-floor space floor area, and the ground surface is covered with an approved vapor-retardant material.

IRC 2006, Section 408.3 Unvented crawl space

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 a continuous vapor retarder.
2. One of the following is provided:

IECC 2003, Section 502.2.3.5 Crawl space walls

Where the floor above a crawl space does not meet the requirements of Section 502.2.3.3 and the crawl space does not have ventilation openings that communicate directly with the outside air, then the exterior walls of the crawl space shall have a thermal transmittance value not exceeding the value given in Table 502.2. [excerpt].

IECC 2006, Section 402.2.8 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 [excerpt].

IMC 2000 and 2003, Section 403.1 Mechanical Ventilation

403.1 Ventilation system. [excerpt] The system shall not be prohibited from producing negative or positive pressure.



For more information:

- The Case for Conditioned, Unvented Crawlspace by Peter Yost and Ann Edminster, Building Safety Journal, May 2003
- Recommended Moisture Control Amendments to the IRC from the Colorado ICC Chapter (Sept 2003 draft); and Guidelines for Design and Construction of New Homes with Below-Grade Underfloor Spaces from the Moisture Management Task Force, September 2003 draft.

* ICC Reference and link Copyright, 2000, [International Code Council](#) , Inc. Falls Church, Virginia. Reproduced with permission. All rights reserved. *2000 International Residential Code* ; 2003 IECC Reference and link

*Copyright, 2003, [International Code Council](#) , Inc. Falls Church, Virginia. Reproduced with permission. All rights reserved. *2003 International Energy Conservation Code* *2003 International Residential Code* ; 2006 IECC Reference and link

*Copyright, 2006, [International Code Council](#) , Inc. Falls Church, Virginia. All rights reserved. *2006 International Energy Conservation Code* . *2006 International Residential Code* ; 2003 IECC Reference and link

*Copyright, 2003, [International Code Council](#) , Inc. Falls Church, Virginia. Reproduced with permission. All rights reserved. *2003 International Energy Conservation Code* *2003 International Energy Conservation Code* ; 2006 IECC Reference and link

*Copyright, 2006, [International Code Council](#) , Inc. Falls Church, Virginia. All rights reserved. *2006 International Energy Conservation Code* . *2006 International Energy Conservation Code* .