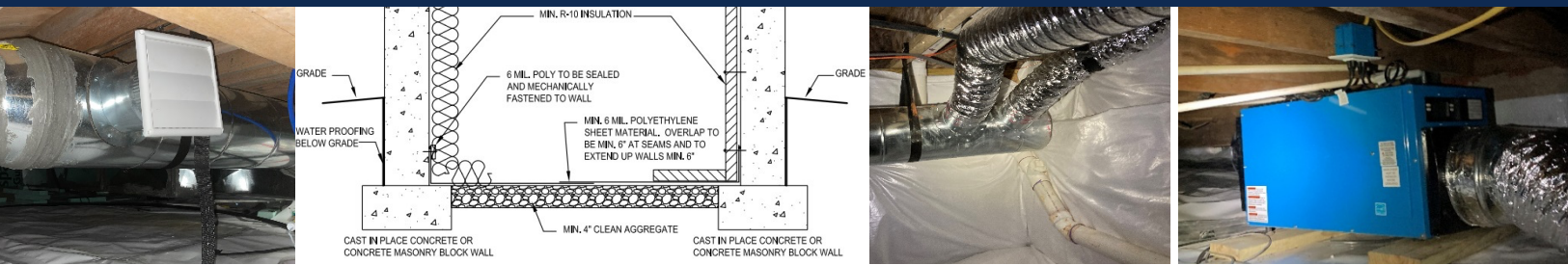


Unvented Crawl Spaces

2021 VRC/VECC Review Guide



Unvented Crawl Spaces:

Summary: The 2021 Virginia Residential Code provides several options for ensuring that unvented crawl spaces maintain acceptable humidity levels. Chapter 4, Foundations (R408.3) and Chapter 11, Energy Efficiency (N1102.2.10 (R402.2.10)) provide requirements for vapor barriers, perimeter insulation, and humidity control strategies when the home's air barrier and insulation layer is constructed to include the crawl space.

Why: Unvented crawl space details have been included in Chapter 4 of the IRC going back at least to the 2000 edition. Extensive research by NC State University, Oak Ridge National Lab, and others has shown that venting permits the crawl space to track exterior moisture levels. This can create elevated *relative humidity* during portions of the year which can cause condensation, mold, and rot in crawl spaces. It's a particular risk in summer months when traditional practice has dictated that operable vents should be opened.

Key Components of an Unvented Crawl Space:

The Vapor Barrier. As with vented crawl spaces, the first and most important element is an effective vapor barrier covering the earth. Joints in the vapor barrier material must overlap and be sealed or taped. Edges of the vapor barrier must extend at least 6 inches up stem walls and be attached and sealed to the stem wall or to insulation on that wall. Best practice advises that the vapor barrier extend at least 6 inches above the level of the exterior grade.

Perimeter Insulation. The walls separating unvented crawl spaces from the exterior must be insulated as noted in the table below. The insulation must be permanently fastened to the wall and must extend downward from the floor above to the finished grade elevation and then vertically or horizontally (as applicable) for at least another 2 feet.

CLIMATE ZONE	CRAWL SPACE WALL R-VALUE
3	13 cavity <i>or</i> 5 continuous
4	13 cavity <i>or</i> 10 continuous
5	19 cavity <i>or</i> 15 continuous <i>or</i> 13 cavity + 5 continuous

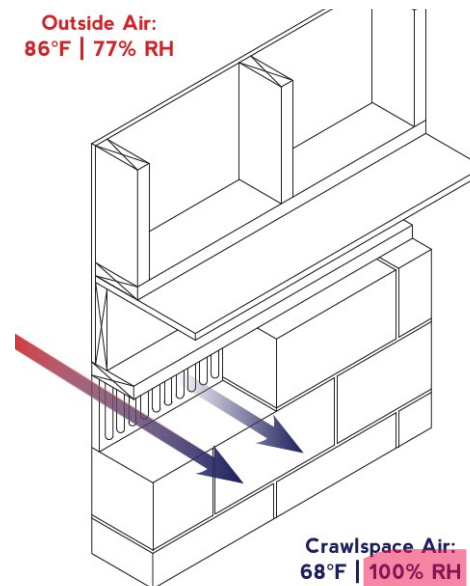


Image: Pennsylvania Housing Research Center

In locations where termites are a risk, the vertical face of the sill plate plus the first 1 to 2 inches of the foundation wall below the sill plate must be uncovered by insulation. These areas may be covered if the insulation is easily removable or if another approved means of inspection is provided. Access doors from the exterior into an unvented crawl space must have a minimum of R-5 insulation and effective weatherstripping.

Humidity Management Strategy. The home must utilize one of the options listed below.

1. A continuously operating exhaust fan pulling conditioned air (1 CFM per 50 SF of crawl space floor area) from the home via a transfer grille or duct, through the crawl, and exiting the perimeter wall
2. Provision of conditioned air (1 CFM per 50 SF of crawl space floor area) to the crawl space with a permanent open pathway to a return grille of the HVAC system
3. Dedicated dehumidification of the crawl space (with moisture removal capacity of not less than 70 pints/day per 1000 SF of crawl floor area). While not stated in the code, for effective moisture removal, the equipment should not require manual emptying of condensate. Many systems drain into the same reservoir and pump that manages condensate from the AC coil.
4. *(Prohibited in new structures; allowable only as a modification or repair to an existing under-floor plenum)* Receives conditioned air because the crawl space is a return plenum.

Radon Mitigation. Crawl spaces utilizing a passive submembrane depressurization strategy to manage radon may not be unvented unless “an *approved* mechanical crawl space ventilation system or other equivalent system is installed.”

2021 VRC/VECC Code References:

R408.1 Moisture control. The under-floor space between the bottom of the floor joists and the earth under any building (except space occupied by a basement) shall comply with Section R408.2 or R408.3.

R408.3 Unvented crawl space. For unvented under-floor spaces, the following items shall be provided:

1. Exposed earth shall be covered with a continuous Class I vapor retarder. Joints of the vapor retarder shall overlap by 6 inches (152 mm) and shall be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (152 mm) up the stem wall and shall be attached and sealed to the stem wall or insulation.
2. One of the following shall be provided for the underfloor space:
 - 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 (4.7 m²) of crawl space 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 N1102.2.10.1 of this code.
 - 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 N1102.2.10.1 of this code.
 - 2.3. Plenum in existing structures complying with Section M1601.5, if under-floor space is used as a plenum.
 - 2.4. Dehumidification sized to provide 70 pints (33 liters) of moisture removal per day for every 1,000 square feet (93 m²) of crawl space floor area.

R408.3.1 Termite inspection. Where an unvented crawl space is installed and meets the criteria in Section R408, the vertical face of the sill plate shall be clear and unobstructed and an inspection gap shall be provided below the sill plate along the top of any interior foundation wall covering. The gap shall be a minimum of 1 inch (25.4 mm) and a maximum of 2 inches (50.8 mm) in width and shall extend throughout all parts of any foundation that is enclosed. Joints between the sill plate and the top of any interior wall covering may be sealed.

Exceptions:

1. In areas not subject to damage by termites as indicated by Table R301.2.
2. Where other approved means are provided to inspect for potential damage.

Where pier and curtain foundations are installed as depicted in Figure R404.1.5.3, the inside face of the rim joist and sill plate shall be clear and unobstructed except for construction joints, which may be sealed.

Exception: Fiberglass or similar insulation may be installed if easily removable.

R408.8 Under-floor vapor retarder. In Climate Zones 1A, 2A and 3A below the warm-humid line, a continuous Class I or II vapor retarder shall be provided on the exposed face of air-permeable insulation installed between the floor joists and exposed to the grade in the under-floor space. The vapor retarder shall have a maximum water vapor permeance of 1.5 perms when tested in accordance with Procedure B of ASTM E96.

Exception: The vapor retarder shall not be required in unvented crawl spaces constructed in accordance with Section R408.3.

N1102.2.10 (R402.2.10) Crawl space walls. Crawl space walls shall be insulated in accordance with Table N1102.1.3.

Exception: Crawl space walls associated with a crawl space that is vented to the outdoors and the floor overhead is insulated in accordance with Table N1102.1.3 and Section N1102.2.7.

N1102.2.10.1 (R402.2.10.1) Crawl space wall insulation installation. Where crawl space wall insulation is installed, it shall be permanently fastened to the wall and shall extend downward from the floor to the finished grade elevation and then vertically or horizontally for not less than 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 this code. 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 not less than 6 inches (153 mm) up the stem walls and shall be attached to the stem walls.

N1102.2.4.1 (R402.2.4.1) Access hatch and door insulation installation and retention. Vertical or horizontal access hatches and doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped. Access that prevents damaging or compressing the insulation shall be provided to all equipment. Where loose-fill insulation is installed, a wood-framed or equivalent baffle, retainer, or dam shall be installed to prevent loose-fill insulation from spilling into living space from higher to lower sections of the attic, and from attics covering conditioned spaces to unconditioned spaces. The baffle or retainer shall provide a permanent means of maintaining the installed R-value of the loose-fill insulation.

Definitions:

ACCESS (TO). That which enables a device, appliance or equipment to be reached by ready access or by a means that first requires the removal or movement of a panel or similar obstruction.

BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, floors, ceiling, roofs and any other building element assemblies that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.

CAVITY INSULATION. Insulating material located between framing members.

CLIMATE ZONE. A geographical region based on climatic criteria as specified in this code.

CONDITIONED FLOOR AREA. The horizontal projection of the floors associated with the conditioned space.

CONDITIONED SPACE. An area, room or space that is enclosed within the building thermal envelope and that is directly or indirectly heated or cooled. Spaces are indirectly heated or cooled where they communicate through openings with conditioned spaces, where they are separated from conditioned spaces by uninsulated walls, floors or ceilings, or where they contain uninsulated ducts, piping or other sources of heating or cooling.

CONTINUOUS AIR BARRIER. A combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.

CONTINUOUS INSULATION (ci). Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior, or is integral to any opaque surface, of the building envelope.

R-VALUE (THERMAL RESISTANCE). The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area ($\text{h} \times \text{ft}^2 \times ^\circ\text{F}/\text{Btu}$) [$\text{m}^2 \times \text{K}/\text{W}$].

VENTILATION. The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

