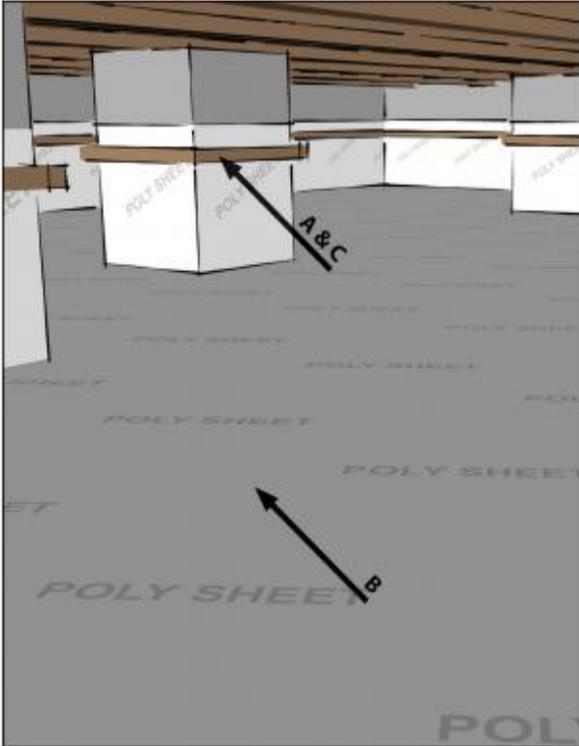


Capillary Break at Crawlspace Floors - Polyethylene Lapped Up Walls and Piers or Secured in the Ground

Last Updated: 07/25/2017

Scope



Capillary break at all crawlspace floors using ? 6 mil polyethylene sheeting, lapped 6-12 in., and lapped up each wall or pier and fastened with furring strips or equivalent

All crawlspaces should have a ground covering of polyethylene sheeting that serves as a capillary break and vapor barrier to keep ground moisture and soil gases from entering the crawlspace where they can be pulled into the home through cracks in or around the subfloor.

- Use ? 6-mil polyethylene sheeting.
- Lap any seams in the sheeting by 6 to 12 inches and seal the seams with a continuous bead of acoustical sealant, butyl rubber, or butyl acrylic caulk, or with tape manufactured to seal or patch polyethylene.
- Seal the sheeting around any pipes coming up from the ground.
- Lap sheeting up walls and piers at least 6 inches and attach to the walls or piers with mechanical fasteners. Or, secure sheeting to the ground by staking at the perimeters of the crawlspace.

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.

Description

Moisture in crawlspaces can cause harm to the home by promoting mold and rot along floor joists and rim joists. Moisture can enter a crawlspace if it migrates into the soil beneath the crawlspace then enters the crawlspace as liquid water or water vapor from the soil, which can then condense on floor joists. To prevent water or water vapor from entering the crawlspace, the crawlspace floor should be covered with a heavy polyethylene plastic capillary break that is sealed to the walls and piers to provide a continuous vapor barrier. This plastic ground cover should be installed regardless of whether the crawlspace is vented or unvented. This plastic covering will also help keep soil gases from entering the home. This task should be included in the contract for the appropriate trade depending on the workflow at the specific job site.

Moisture can enter a crawlspace from sources other than vapor from the ground. In vented crawlspaces, the dominant source of crawlspace moisture is bulk water intrusion from improper grading of the site, lack of perimeter drainage, improper irrigation practices, etc. See these other Building America Solution Center guides for more information about good water management practices around the home site: [Final Grade Slopes Away from Foundation](#), [Patio Slabs, Porch Slabs, Walks, and Driveways Slope Away from House](#), [Gutters and Downspouts](#), and [Footing Drain Pipe](#).

In humid climates, water vapor in warm outdoor air can enter through crawlspace vents and condense on cooler framing. In humid climates, building scientists recommend building insulated, unvented crawlspaces (see [Unvented Crawlspaces and Conditioned Basements](#)).

Because radon accumulation in a home cannot be measured until after the home is built, as an added precaution, consider installing a passive radon venting system, which collects soil gasses under the plastic and vents them through the roof via a vent pipe (see [Vertical Radon Ventilation Pipe](#)).

How to Install a Polyethylene Ground Cover

1. Spread a layer of 6-mil or thicker polyethylene across the entire ground surface. Edges should lap up side walls.
2. Overlap all seams by 12 inches and tape them. Ensure that surfaces where tape will be applied are clean and dry.
3. Attach the polyethylene to the walls at least 6 inches up the walls or to a height at least equal to the exterior ground level. Attach the polyethylene with pressure-treated wood furring strips or other mechanical fasteners. The edges can be sealed to the wall with fiberglass mesh tape and duct mastic. Or, secure the sheeting to the ground by staking at the perimeters of the crawlspace with landscape fabric stakes.

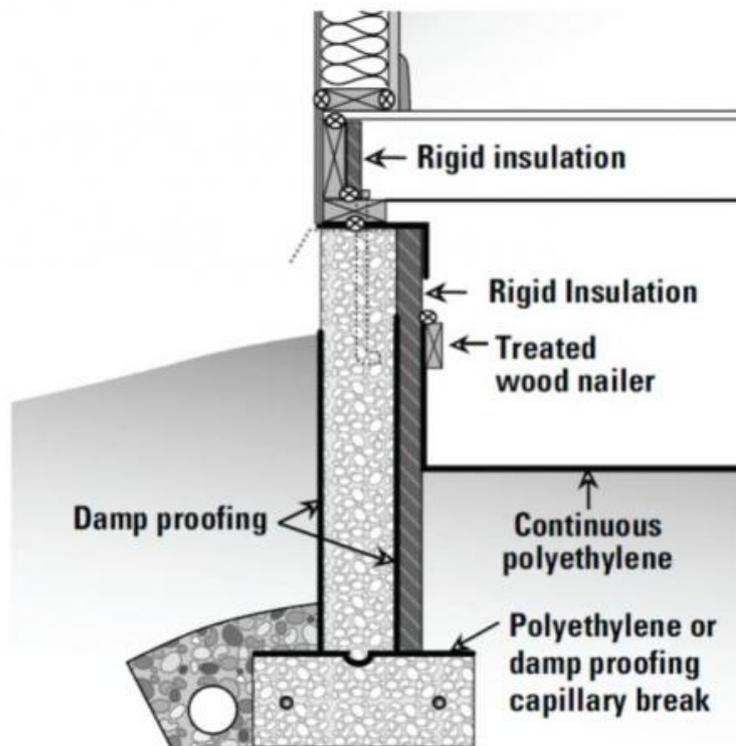


Figure 1 - A continuous layer of polyethylene covers the crawlspace floor and is attached to the wall with wood nailing strips

4. Lap the vapor retarder up the sides of any interior columns at least 4 inches above the crawl space floor; mechanically fasten the polyethylene to the pier and seal the edges.
5. For added durability, consider one of the following:

1. Lay one polyethylene groundcover at the beginning of construction. When construction is completed, install a second sheet over the first sheet to cover any rips in the first sheet (make sure the first sheet is dry and free of organic matter). Seal the top sheet to the walls.
2. Lay a vinyl runner or extra plastic over any areas that will get traffic, such as a service path to the furnace.
3. Cover the single sealed layer of polyethylene with a concrete slab 2 or more inches thick. (See the guide [Capillary Break at Crawlspace Floor – Polyethylene Sheeting under Concrete Slab.](#))



Figure 2 - Polyethylene completely covers the floor of this crawlspace and is attached to the walls and piers as well to serve as a capillary break and continuous vapor barrier.



Figure 3 - Polyethylene ground cover is attached to the crawlspace walls with plywood furring strips.

Ensuring Success

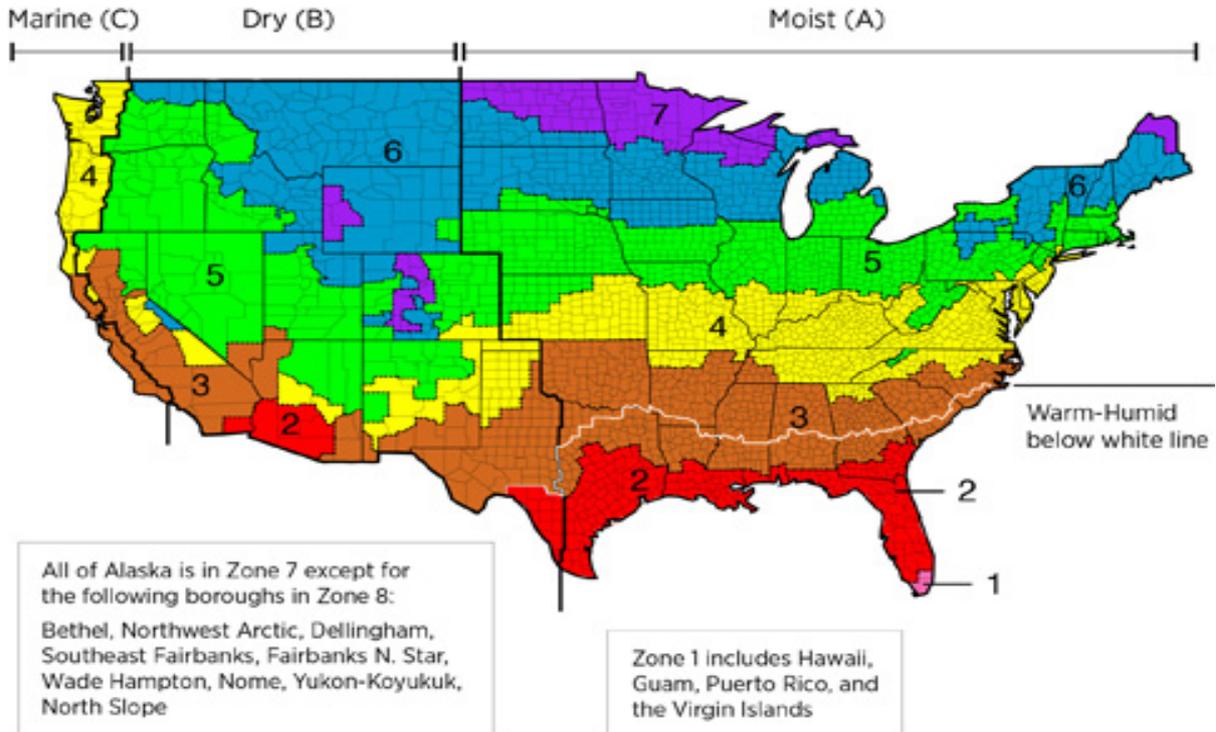
Visually inspect the crawlspace to ensure that the earthen floor is completely covered with a layer of polyethylene sheeting at least 6 millimeters thick, that the sheeting extends up the sides of each wall or pier and is mechanically fastened with wood furring strips or other fasteners, and that any seams in the plastic are overlapped 6 to 12 inches and taped or sealed.

Climate

ENERGY STAR Version 3 (Rev 08) Water Management Checklist, 1. Water-Managed Site and Foundation. 1.4. Capillary break at all crawlspace floors using ? 6 mil polyethylene sheeting.

Polyethylene sheeting is not required in Dry (B) climates shown in the International Energy Conservation Code (IECC) climate map (2009 IECC, Figure 301.1 and Table 301.1), except in U.S. EPA Zone 1 Radon areas ([see the EPA Radon Map](#)). Polyethylene sheeting is also not required for raised pier foundations with no walls.

Although not required in dry climates designated as EPA Radon Zone 2 or 3, polyethylene sheeting is still recommended, as is a passive radon venting system, to help keep soil gasses out of the home and to mitigate radon should it be present at the house site.



International Energy Conservation Code (IECC) Climate Regions

Training

Right and Wrong Images



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Display Image: [ES_WMSBC_1.4.2_PG18_25d_32311_0_0.jpg](#)



Display Image: [CapillaryBreak.jpg](#)



Display Image: [Wrong-thevapor.jpg](#)



Display Image: [Righ--AHeavyPoly.jpg](#)

CAD

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](#)

ENERGY STAR Certified Homes (Version 3/3.1, Revision 08), Water Management System Builder Requirements

1. Water-Managed Site and Foundation:

1.4.2 Capillary break at all crawlspace floors using \geq 6 mil polyethylene sheeting, lapped 6-12 in., & lapped up each wall or pier and fastened with furring strips or equivalent AND 1.4.3 Secured in the ground at the perimeter using stakes ^{3, 4, 5}

Footnotes:

(3) Not required in Dry (B) climates as shown in 2009 IECC Figure 301.1 and Table 301.1.

(4) Not required for raised pier foundations with no walls. To earn the ENERGY STAR, EPA recommends, but does not require, that radonresistant features be included in homes built in EPA Radon Zones 1, 2 & 3. For more information, see www.epa.gov/indoorairplus.

(5) For an existing slab (e.g., in a home undergoing a gut rehabilitation), in lieu of a capillary break beneath the slab, a continuous and sealed Class I or Class II Vapor Retarder (per Footnote 7) is permitted to be installed on top of the entire slab. In such cases, up to 10% of the slab surface is permitted to be exempted from this requirement (e.g., for sill plates). In addition, for existing slabs in occupiable space, the Vapor Retarder shall be, or shall be protected by, a durable floor surface. If Class I Vapor Retarders are installed, they shall not be installed on the interior side of air permeable insulation or materials prone to moisture damage.

(7) The 2009 IRC defines Class I vapor retarders as a material or assembly with a rating of \leq 0.1 perm, using the desiccant method with Proc. A of ASTM E 96. The following materials are typically \leq 0.1 perm and shall not be used on the interior side of air permeable insulation in above-grade exterior walls in warm-humid climates or below-grade exterior walls in any climate: rubber membranes, polyethylene film, glass, aluminum foil, sheet metal, and foil-faced insulating/non-insulating sheathings. These materials can be used on the interior side of walls if air-permeable insulation is not present (e.g., foil-faced rigid foam board adjacent to a below-grade concrete foundation wall is permitted).

Note that this list is not comprehensive and other materials with a perm rating \leq 0.1 also shall not be used. Also, if manufacturer's specifications for a product indicate a perm rating \leq 0.1, then it may be used, even if it is in this list. Also note that open-cell and closed-cell foam generally have ratings above this limit and may be used unless manufacturer's specifications indicate a perm rating \leq 0.1. Several exemptions to these requirements apply:

- Class I vapor retarders, such as ceramic tile, may be used at shower and tub walls;
- Class I vapor retarders, such as mirrors, may be used if mounted with clips or other spacers that allow air to circulate behind them.

Builders Responsibilities: It is the exclusive responsibility of builders to ensure that each certified home is constructed to meet these requirements. While builders are not required to maintain documentation demonstrating compliance for each individual certified home, builders are required to develop a process to ensure compliance for each certified home (e.g., incorporate these requirements into the Scope of Work for relevant sub-contractors, require the site supervisor to inspect each home for these requirements, and / or sub-contract the verification of these requirements to a Rater). In the event that the EPA determines that a certified home was constructed without meeting these requirements, the home may be decertified.

ENERGY STAR Revision 08 requirements are required for homes permitted starting 07/01/2016.

[DOE Zero Energy Ready Home National Program Requirements](#)

The U.S. Department of Energy (DOE) [Zero Energy Ready Home National Program Requirements](#) requires (Exhibit 1, Items 1 and 6) that all homes meet ENERGY STAR Certified Homes Version 3 or 3.1 and the U.S. Environmental Protection Agency [Indoor airPLUS Construction Specifications](#).

[EPA Indoor airPLUS](#)

The U.S. Environmental Protection Agency ([EPA Indoor airPLUS Construction Specifications](#)) requires homes to meet the ENERGY STAR Certified Homes requirements, which fulfills Indoor airPLUS requirements to install polyethylene sheeting or XPS insulation under concrete basement slabs or polyethylene sheeting at crawlspace floors. Additional requirements include the following.

Note: In EPA Radon Zone 1 (see Specification 2.1):

- Polyethylene sheeting must be installed and overlapped by 6 to 12 in. at the seams.
- ENERGY STAR staking method for poly sheeting may not be used in crawlspaces with no slab.

- ENERGY STAR exceptions for capillary break (polyethylene) under slabs do not apply. Poly is required in Radon Zone 1.

Advisory: 10 mil polyethylene is recommended if crawlspace floors are not covered with a concrete slab.

2.1 Radon-Resistant Construction

NOTE: Completion of the ENERGY STAR requirements now satisfies the following Indoor airPLUS requirement: Air seal all sump covers (Builder-W 1.7).

Additional Indoor airPLUS Requirements:

- Construct homes in EPA Radon Zone 1 (see www.epa.gov/radon/zonemap.html) with radon-resistant features to conform to ASTM E1465; or IRC, Appendix F; or NFPA 5000, Chapter 49. Consult EPA's "Building Radon Out" (EPA 402-K-01-002) for general guidance on installing radon-resistant features.

Visually verify the following requirements:

- Capillary break installed according to Specification 1.2, irrespective of climate zone.
- A 3 or 4 in. diameter gas-tight vertical vent pipe, clearly labeled to conform with the radon-resistant standard used, e.g., "Radon Reduction System" or "Radon Pipe" or "Radon System." The vent pipe shall be connected to an open T-fitting in the aggregate layer (or connected to geotextile drainage matting according to the manufacturer's instructions) beneath the polyethylene sheeting, extending up through the conditioned spaces and terminating a minimum of 12 in. above the roof opening. For crawlspaces, install at least 5 ft. of horizontal perforated drain tile on either side of the T-fitting, attached to the vertical radon vent pipe beneath the sheeting and running parallel to the long dimension of the house.
- Radon fan installed in the attic (i.e., an active system) OR an electrical receptacle installed in an accessible attic location near the radon vent pipe (i.e., a passive system) to facilitate future fan installation if needed.
- Foundation air sealing with polyurethane caulk or the equivalent at all slab openings, penetrations and control or expansion joints.

Note: Consult local building codes to determine whether additional radon requirements apply. In January 2013 ANSI-AARST published a standard of practice for "Reducing Radon in New Construction of 1&2 Family Dwellings and Townhouses (CCAH-2013)," available at www.aarst.org/bookstore.shtml.

Advisories:

1. Elevated levels of radon have been found in homes built in all three zones on EPA's Map of Radon Zones. Consult your state radon program for current information about radon in your area. Go to www.epa.gov/radon/wherelive.html and click on your state for contact information.
2. EPA recommends, but does not require, that all homes built with radon-resistant features in EPA Radon Zone 1 pre-emptively include a radon vent fan. EPA also recommends, but does not require, radon-resistant features for homes built in EPA Radon Zones 2 and 3. EPA further recommends that all homes built in EPA Radon Zones 2 and 3 with radon-resistant features be tested for radon prior to occupancy. A radon vent fan should be installed when the test result is 4 pCi/L (the EPA action level) or more.
3. The U.S. Surgeon General and EPA recommend that all homes built in Radon Zones 1, 2 and 3 be tested for radon. Provide buyers with EPA's Citizen's Guide to Radon, encourage them to test for radon and refer them to www2.epa.gov/radon for more information.
4. If soil or groundwater contamination is suspected on or near the building site (e.g., former industrial sites), volatile chemical contaminants from soil gas or vapor intrusion into a building may pose an IAQ risk. In such cases, EPA recommends radon-resistant features consistent with Specification 2.1, which can minimize or prevent the vapor intrusion into a house. See the EPA Vapor Intrusion Primer or ASTM E2600 for more information. You should also consult your state, tribal, or local environmental regulatory agency for information on the location of contaminated sites, including those subject to Superfund (CERCLA), Resource Conservation and Recovery Act (RCRA) cleanup requirements, or the Brownfields program. Visit EPA's "Where You Live" for more information.

2009, 2012, 2015, and 2018 IRC

Section R408.1 Ventilation. Ventilated crawlspaces should have at least 1 ft² of vent opening for each 150 ft² of floor area, unless the ground is covered with a Class 1 vapor retarder, then 1 ft² of vent area is required for each 1,500 ft² of floor area.

Section R408.2 Openings for under-floor ventilation. Ventilated crawlspaces should have at least 1 ft² of vent opening for each 150 ft² of crawlspace floor area, unless the ground is covered with a Class 1 vapor retarder, then the total area of ventilation openings should be equal to 1/1,500 of crawlspace floor area.

Section R408.3 Unvented crawl space. Ventilation openings are not required in the crawlspace if the exposed earth is covered with a continuous Class I vapor retarder with seams that are overlapped by 6 inches and sealed or taped and with the edges fastened and sealed to the foundation walls at least 6 inches above the ground level.

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.

More Info.

Access to some references 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.

Case Studies

1. [New Whole-House Solutions Case Study: Insight Homes: Deep Creek, Seaford, Delaware](#)
(867KB)
Author(s): PNNL
Organization(s): PNNL
Publication Date: April, 2012
Case study about a home builder that has refined its home designs to achieve HERS scores of 49 to 56 on 40 to 70 homes per year.

References and Resources*

1. [Designing Closed Crawlspace](#)
Author(s): Dastur, Davis, Warren
Organization(s): Advanced Energy
Publication Date: February, 2012
Guide about designing and installing closed crawlspaces.
2. [DOE Zero Energy Ready Home National Program Requirements](#)
Author(s): Department of Energy
Organization(s): DOE
Publication Date: April, 2017
Standard requirements for DOE's Zero Energy Ready Home national program certification.
3. [ENERGY STAR Certified Homes, Version 3 \(Rev. 08\) National Program Requirements](#)
Author(s): U.S. Environmental Protection Agency
Organization(s): EPA
Publication Date: December, 2015
Webpage with links to Document outlining the program requirements for ENERGY STAR Certified Homes, Version 3 and 3.1 (Rev. 08).
4. [Water Management System Builder Checklist Guide](#)
Author(s): U.S. Environmental Protection Agency
Organization(s): EPA
Publication Date: February, 2011
Guide describing details that serve as a visual reference for each of the line items in the Water Management System Builder Checklist.

*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.

[Pacific Northwest National Laboratory](#)