Slab Edge Insulation

2021 VRC/VECC Update Guide

Slab Edge Insulation:

Slab insulation requirements changed for much of Virginia with the modifications to the Prescriptive Pathway R-Value requirements and climate zones contained in the 2021 Virginia Residential Code. Concrete is an excellent conductor of heat, making effective insulation critical. Key details include placement of insulation, depth of insulation, thermal breaks between conditioned and unconditioned spaces, and how additions or retrofits to existing homes should be handled.

CLIMATE ZONE	SLAB R-VALUE AND DEPTH
3	**10 continuous, 2 feet**
4	**10 continuous, 4 feet**
5	**10 continuous, 4 feet**

For heated slabs, insulation not less than R-5 must be installed under the balance of the slab not addressed by the applicable slab edge insulation requirement.

Slabs drive energy consumption primarily as a result of heat conducted outward and through the perimeter of the slab. Proper installation of insulation around the perimeter of the slab edge greatly reduces heat loss and gain through the exposed concrete. *Insulation is included in slab-on-grade construction for two purposes:*

- *Insulation prevents heat loss in winter and heat gain in summer. This effect is most pronounced at the slab perimeter, where an above-grade slab edge comes into closer contact with outdoor air/ambient conditions.*
- *Even in climates and locations on the slab (perimeter vs. middle) where slab insulation may not confer large energy benefits, thermal isolation of the slab can prevent cool slab temperatures that can cause condensation inside the house. This condensation can lead to mold and other moisture-related problems, especially if the slab is carpeted.*[1]

Items of Note:

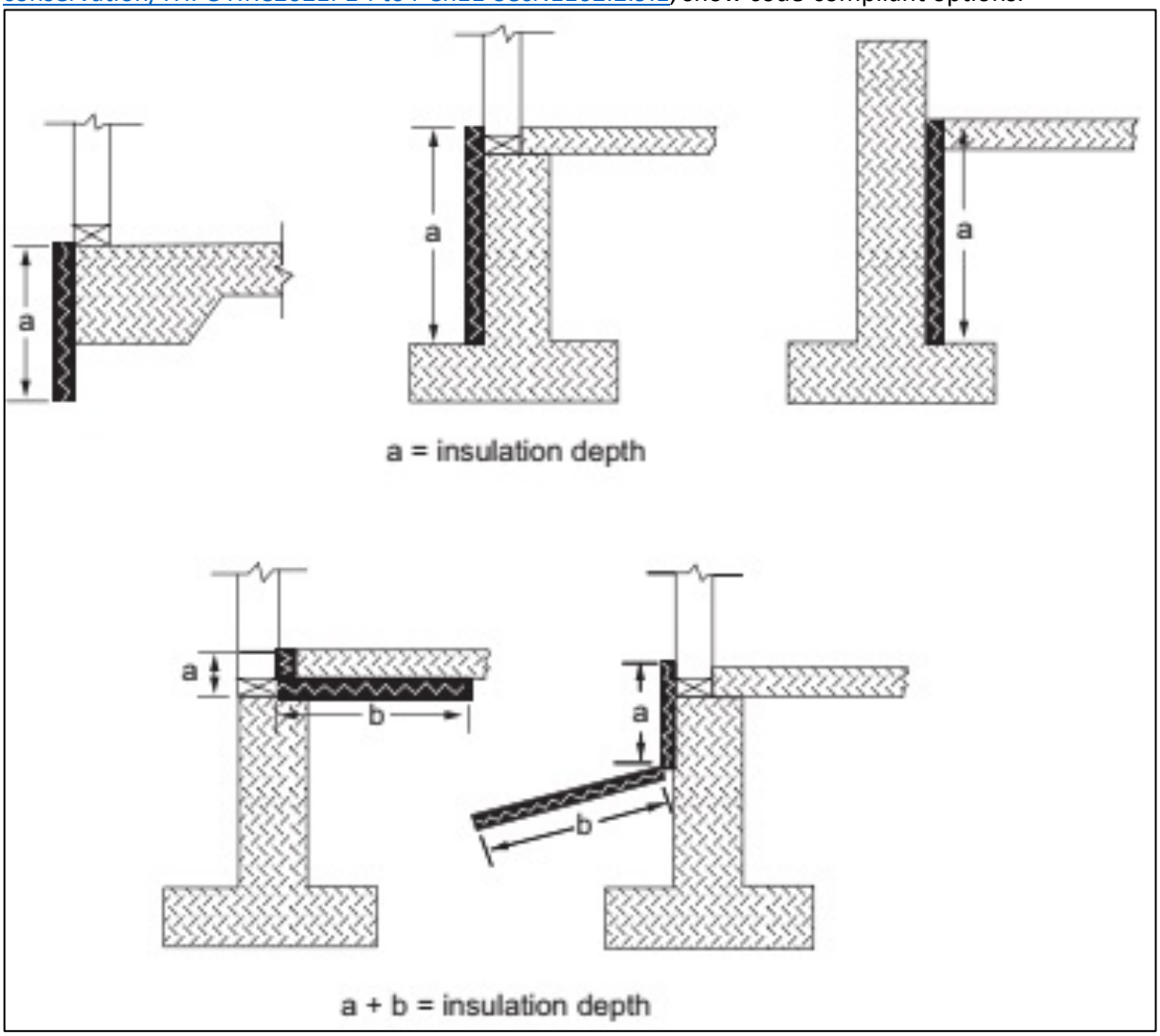
- Typical insulation products used below grade include extruded polystyrene, expanded polystyrene, and rigid mineral fiber panels (Baechler et al. 2005). Extruded polystyrene (XPS) is nominally R-5 per inch. Expanded polystyrene (EPS) is nominally R-4 per inch and can be less expensive. Below-grade foams can be at risk for moisture accumulation under certain

[1] https://foundationhandbook.ornl.gov/handbook/section4-1.shtml

conditions.[2]

- XPS has a higher initial insulating R-value than does a similar thickness and density of EPS, but the R-value of XPS degrades over time. EPS does not experience as much "thermal drift," and the reported R-value remains the same throughout its lifespan. EPS also has better drying capabilities than XPS, allowing it to perform better below grade in locations that can remain wet for large parts of the year.
- For durability and insulation efficacy, final grade must be sloped away from the building. Long-term moisture degrades the insulating value of slab insulations. Proper compressive strength and ground contact rated insulations should be specified.

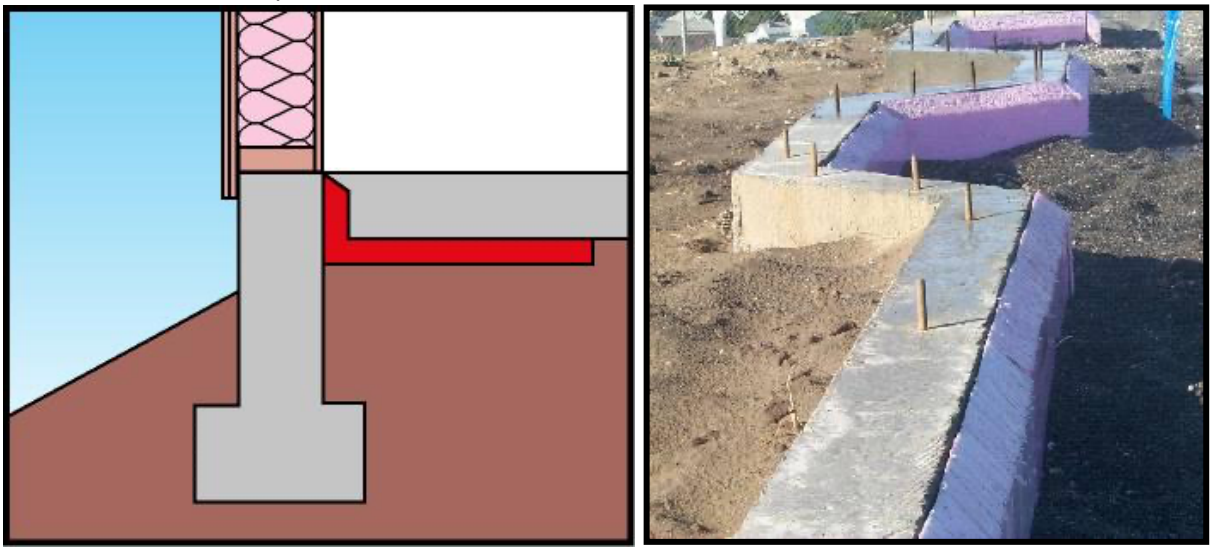
The slab insulation drawings below, available at codes.iccsafe.org/s/THPOTIRC2021P1/part-iv-energy-conservation/THPOTIRC2021P1-Pt04-Ch11-SecN1102.2.9.1, show code-compliant options.



[2] https://foundationhandbook.ornl.gov/handbook/section4-1.shtml

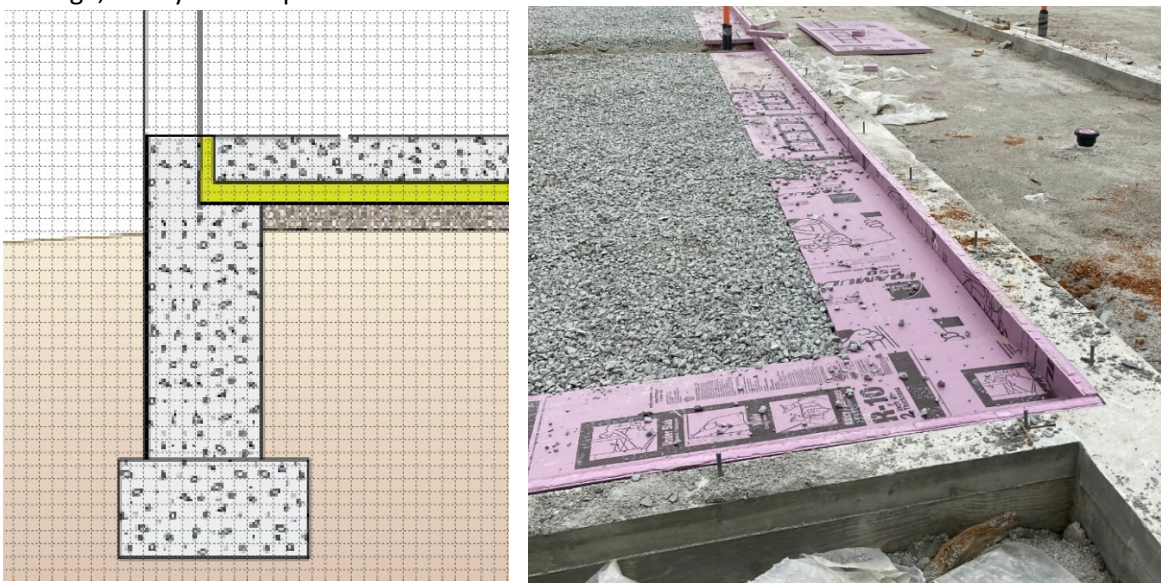
The Total Building Performance or Energy Rating Index pathways offer an option to include sufficient total thermal protection for the whole home using other external slab insulation designs. The research described at https://www.greenbuildingadvisor.com/article/getting-slab-edge-insulation-right shows how to avoid any performance penalty from reduced depth of slab insulation.

Another option not shown above is to cut a 45 degree bevel at the top of the interior slab to allow for concrete to extend some or all of the way to the bottom inside corner of the plate. The images below show versions of this option.



A beveled edge cut into the slab insulation. Drawing and photo from https://www.energycodes.gov/technical-assistance/training/courses/residential-provisions-2021-iecc

Where interior sheathing (drywall or similar) plus base molding and shoe molding will cover the top edge of the interior slab insulation such that the narrow strip of insulation left exposed is not at risk of damage, it may be acceptable to leave off the bevel cut – as shown below.



Plan Review Focus:

Construction Documentation: Review the construction documents for the details describing slab insulation installation and construction techniques.

Vapor Barrier and Under-slab Fill: Ensure that a vapor barrier is specified with all seams overlapped and taped. #57 stone under slabs is recommended as a moisture control strategy but not required by code.

R-Value/Depth: Ensure R-value is denoted in drawings and current details achieve a full thermal break at the slab edge from the top of the slab and extending not less 2' Climate Zone 3 and 4' for Climate Zones 4 and 5. Ensure thermal envelope is completed leaving no gaps between wall and slab edge insulation coverage.

Insulation Protection: Confirm that the construction documents specify proper insulation protection if applicable. Rigid foam board is typically used for insulating slabs and requires protection if exposed.

Flashing: Confirm that the construction documents specify the proper location for installing flashing and flashing material.

Resources:

- https://basc.pnnl.gov/resource-guides/slab-edge-insulation#edit-group-description
- https://foundationhandbook.ornl.gov/handbook/chapter4.shtml
- https://www.greenbuildingadvisor.com/article/getting-slab-edge-insulation-right
- https://www.energy.wsu.edu/documents/FAQ%20Slabs%20prescriptive%20requirements~2023-12-20.pdf

2021 VRC/VECC Code References:

R703.4 Flashing. Approved corrosion-resistant flashing shall be applied shingle-fashion in a manner to prevent entry of water into the wall cavity or penetration of water to the building structural framing components. Self-adhered membranes used as flashing shall comply with AAMA 711. Fluid-applied membranes used as flashing in exterior walls shall comply with AAMA 714. The flashing shall extend to the surface of the exterior wall finish. Approved corrosion-resistant flashings shall be installed at the following locations:

1. Exterior window and door openings. Flashing at exterior window and door openings shall be installed in accordance with Section R703.4.1.
2. At the intersection of chimneys or other masonry construction with frame or stucco walls, with projecting lips on both sides under stucco copings.
3. Under and at the ends of masonry, wood or metal copings and sills.
4. Continuously above all projecting wood trim.
5. Where exterior porches, decks or stairs attach to a wall or floor assembly of wood-frame construction.
6. At wall and roof intersections.
7. At built-in gutters.

R703.8.5 Flashing. Flashing shall be located beneath the first course of masonry above finished ground level above the foundation wall or slab and at other points of support, including structural floors, shelf angles and lintels where masonry veneers are designed in accordance with Section R703.8. See Section R703.4 for additional requirements.

N1101.5 (R103.2) Information on construction documents. Construction documents shall be drawn to scale on suitable material. Electronic media documents are permitted to be submitted when approved by the code official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include the following as applicable:

1. Energy compliance path.
2. Insulation materials and their R-values.
3. Fenestration U-factors and solar heat gain coefficients (SHGC).
4. Area-weighted U-factor and solar heat gain coefficient (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water heating systems and equipment types, sizes and efficiencies.
7. Equipment and system controls.
8. Duct sealing, duct and pipe insulation and location.
9. Air sealing details.

N1101.11.1 (R303.2.1) Protection of exposed foundation insulation. Insulation applied to the exterior of basement walls, crawl space walls and the perimeter of slab-on-grade floors shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation's thermal performance. The protective covering shall cover the exposed exterior insulation and extend not less than 6 inches (153 mm) below grade.

TABLE N1102.1.3 (R402.1.3) INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT

CLIMATE ZONE	SLAB R-VALUE AND DEPTH*
3	**10 continuous, 2 feet**
4	**10 continuous, 4 feet**
5	**10 continuous, 4 feet**

*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.

N1102.2.9 (R402.2.9) Slab-on-grade floors. Slab-on-grade floors with a floor surface less than 12 inches (305 mm) below grade shall be insulated in accordance with Table N1102.1.3.

Exception: Slab-edge insulation is not required in jurisdictions designated by the code official as having a very heavy termite infestation.

N1102.2.9.1 (R402.2.9.1) Slab-on-grade floor insulation installation. Where installed, the insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall extend the distance provided in Table N1102.1.3 or the distance of the proposed design, as applicable, by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by not less than 10 inches (254 mm) of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the exterior wall.

Definitions:

ABOVE-GRADE WALL. A wall more than 50 percent above grade and enclosing conditioned space. This includes between-floor spandrels, peripheral edges of floors, roof and basement knee walls, dormer walls, gable end walls, walls enclosing a mansard roof and skylight shafts.

BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, floors, ceilings, 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 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.

EXTERIOR WALL. Walls including both above-grade walls and basement walls.

HEATED SLAB. Slab-on-grade construction in which the heating elements, hydronic tubing, or hot air distribution system is in contact with, or placed within or under, the slab.

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 (h × ft2 × °F/Btu) [(m2 × K)/W].

THERMAL ISOLATION. Physical and space conditioning separation from conditioned spaces. The conditioned spaces shall be controlled as separate zones for heating and cooling or conditioned by separate equipment.