How to Properly Insulate a Slab

Presented by: Mike Turns, Associate Director, PHRC

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Slab edge insulation is “one of the most abused details in construction”.

-- David Hales, Building Science Professor at the University of Washington
Heat Loss through an Insulated Slab

- Typical 2-story, 2,000 SF house with R-10 perimeter slab insulation

**Insulation and Fenestration Criteria**

* Table 402.1.1 Insulation and Fenestration Requirements by Component*

- **Climate Zone**
  - 1
  - 2
  - 3
  - 4 except Marine
  - 5 and Marine 4
  - 6
  - 7 and 8

- **Fenestration U-factor**
  - 0.35
  - 0.60

- **Skylight U-factor**
  - 0.20

- **Glazed Fenestration**
  - 0.75

- **Stucco**
  - 0.30

- **Ceiling R-Value**
  - 13

- **Wood Frame Wall R-Value**
  - 13

- **Mass Wall R-Value**
  - 4/6

- **Floor R-Value**
  - 13

- **Basement Wall R-Value**
  - 19

- **Slab R-Value & Depth**
  - 5/13

- **Crawlspace Wall R-Value**
  - 10/13

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* R-values are minimums. U-factors and SHGC are maximums. R-10 batts compressed into a narrow 3 x 6 framing cavity such that the R-value is reduced by 1/2 or more shall be replaced with the corresponding R-value in addition to the full thickness R-value.

* The fenestration U-factor column excludes shutters. The skim columns apply to all glazed fenestration.

* “15/19” means R-15 continuous insulation shall be placed inside 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-15 cavity insulation on the interior of the basement wall plus R-19 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall.

* It shall be added to the required slab edge R-value for heated slab. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Zones 1 through 3 for heated slabs.

* basement wall insulation is not required in warm humid locations as defined by Figure 301.1 and Table 301.1.

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* Insulation subject to 15/19 framing cavity. R-10 minimum.

* “15/19” means R-15 cavity insulation plus R-19 continuous insulation. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-10.

* The section R-value applies when more than half of the insulation is on the interior of the mass wall.

* For impact and ventilation complying with Section 403.1.1.2 of the IRC or Section U402.1.2 of the IRC, maximum U-factor shall be 0.75 in Zone 3 and 0.65 in Zone 4.
Climate Zones

Slab R-Value

Table 402.1.1
Insulation and Fenestration Requirements by Component

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Slab R-value(^d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>10, 2 ft</td>
</tr>
<tr>
<td>5</td>
<td>10, 2 ft</td>
</tr>
<tr>
<td>6</td>
<td>10, 4 ft</td>
</tr>
</tbody>
</table>

\(^d\) R-5 shall be added for heated slabs

Heated slab: slab-on-grade construction in which the heating elements are in contact with, or placed within or under the slab
Heated Slab

R-15 Required per the IRC and IECC

What materials can be used?

<table>
<thead>
<tr>
<th></th>
<th>Typical R-value per inch</th>
<th>Inches for R-10</th>
<th>Inches for R-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expanded Polystyrene</td>
<td>4.0</td>
<td>2.5</td>
<td>3.75</td>
</tr>
<tr>
<td>Extruded Polystyrene</td>
<td>5.0</td>
<td>2.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Polyisocyanurate</td>
<td>6.5</td>
<td>1.5</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Check with manufacturer for approval for ground contact
When Is Slab Insulation Required?

Floor surfaces less than 12 inches below grade shall be insulated.

Conditioned Space

Grade

Frost Line

12”
Note: Requirements for slab construction are found in IRC Section R506

How Should Slab Insulation Be Installed?

Insulation shall extend downward from the top of the slab outside or inside
Effect of Slab Edge Insulation

• Slab edge may be responsible for about 60% of the slab’s total heat loss (Certainteed)
• REM/Design simulations
  – 8% increase in total heating consumption with no slab edge insulation
  – 62% of heat loss through slab edge

Distance Below Grade

Insulation located below grade shall be extended the distance provided in Table 402.1.1

Climate zones 4-5: 2 ft  Climate zone 6: 4 ft
Incorrect Slab Insulation Detail

Will there be a thermal break?
Correct Slab Insulation Detail
A Problem with 2-Inch Slab Edge Insulation

The top edge of the insulation may be cut at a 45-degree angle

Is this a good idea?
PA Alternative Detail

1/2-inch thermal break

Thermal break materials:
- Asphalt impregnated fiber board
- Extruded polystyrene
- Other

Note: An energy enhancement option must be chosen per PA104.

Using the Performance Path

- Use IECC Section 405: *Simulated Performance Alternative*
  - Software modeling (e.g. REM/Design, EnergyGuage USA)
  - Energy cost of proposed home must be ≤ the reference home
  - Includes:
    - Building orientation
    - Air infiltration rate
    - R-values
    - Etc.
Details to Achieve Full Perimeter Insulation
Cantilevered sill plate

Check with an engineer

Source: Joe Lstiburek, Builder's Guides

Blocking between studs provides a nailing surface for adhesion or wall finish materials.

Any wood must always be at least 6" (150 mm) above the soil.

Interior polystyrene foam insulation.

A treated wood strip is nailed to the studs to form the edge of the slab.

Source: Fundamentals of Residential Construction
Use Flooring other than Carpet

EXTERIOR FOUNDATION INSULATION
Exterior Foundation Insulation

(a) Cold-Bridge Through Brick Veneer and Correction
(b) Cold-Bridge Through Basement Wall and Correction
(c) Cold-Bridge Through Exposed Foundation Wall and Correction

Masonry Veneer

- Insulation not required on the horizontal portion of the foundation that supports a masonry veneer
Monolithic Slab

- Exterior insulation required
  
  Polystyrene foam insulating sheathing is continued down to insulate the foundation. A rainproof stucco or plastic coating is applied to exposed portions of the foam for weather protection and appearance.
  
  Heating and cooling ductwork may be cast into a thickened slab edge.

Source: Fundamentals of Residential Construction

Termites

- Slab-edge insulation not required in areas designated by the code official as having very heavy termite infestation
Termite Shields

Protective membrane also acts as capillary break.

Perimeter Insulation—Slab-on-grade Construction
Provide good drainage away from the foundation and capillary breaks for a durable foundation. Perimeter insulation increases comfort in the living space.

Rigid insulation encapsulated or covered with membrane to protect from termites and exterior damage.

Perforated drainage pipe is embedded in gravel, covered with filter fabric, and located at lower perimeter of foundation footing to provide drainage.
Termites – Chemical Treatments

Protection of Exposed Foundation Insulation

• Exterior foundation insulation shall have a rigid, opaque and weather-resistant protective covering
  – Covering shall extend 6” below grade
Protection Considerations

Insulation Protection Options

1. Pressure-treated plywood

2. Fiber-cement panel siding

3. Cementitious coating (stucco) -
   - either reinforced with fiber,
   - or installed over fiberglass
   - mesh, or installed over metal
   - lath.
Proprietary Products

1. Insul-Cap vinyl covering from Wisconsin Poured Wall Products
2. Ground Breaker fiberglass covering from Nudo Products
3. Insul-Guard 2 fiberglass covering from Diversified Composites
4. Surface-bonding cement
5. Perma-Bond Complete (foam plus factory adhered cementitious coating)
6. FP Ultra Lite panels (factory coated foam panels) from Styro Industries
7. Protecto Bond peel-and-stick membrane
8. EnergyEdge

Summary

• Slab insulation is required when:
  – The space above is conditioned
  – Slab is one foot or less below grade
• R-10 insulation required, extending...
  – 2 feet below grade for climate zones 4 and 5
  – 4 feet below grade for climate zone 6
• Insulation should extend downward from the top of the slab (with two options to reduce slab edge insulation R-value)
• Exterior slab insulation must be protected
Questions & Evaluations

Next Month's Webinar - Makeup air and large kitchen exhaust systems
May 8, 2012 - 1:00 PM