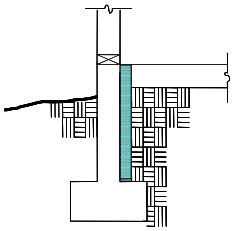
# How to Properly Insulate a Slab

**Presented by:** Mike Turns, Associate Director, PHRC

Tuesday, April 10, 2012 1:00 PM



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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

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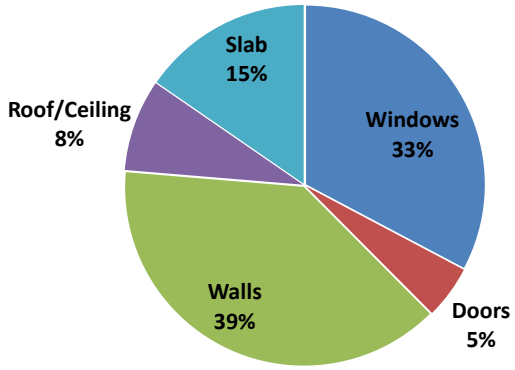
# Heat Loss through an Insulated Slab

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

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E402.1.1

# Insulation and Fenestration Criteria

**Table 402.1.1**
**Insulation and Fenestration Requirements by Component[a]**

| CLIMATE ZONE | FENESTRATION U-FACTOR[b] | SKYLIGHT[b] U-FACTOR | GLAZED FENESTRATION[b,e] SHGC | CEILING R-VALUE | WOOD FRAME WALL R-VALUE | MASS WALL R-VALUE[i] | FLOOR R-VALUE | BASEMENT[c] WALL R-VALUE | SLAB[d] R-VALUE & DEPTH | CRAWL SPACE[c] WALL R-VALUE |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.20 | 0.75 | 0.30 | 30 | 13 | 3 / 4 | 13 | 0 | 0 | 0 |
| 2 | 0.65[j] | 0.75 | 0.30 | 30 | 13 | 4 / 6 | 13 | 0 | 0 | 0 |
| 3 | 0.50[j] | 0.65 | 0.30 | 30 | 13 | 5 / 8 | 19 | 5 / 13[f] | 0 | 5 / 13 |
| 4 except Marine | 0.35 | 0.60 | NR | 38 | 13 | 5 / 10 | 19 | 10 / 13 | 10, 2ft | 10 / 13 |
| 5 and Marine 4 | 0.35 | 0.60 | NR | 38 | 20 or 13+5[h] | 13 / 17 | 30[g] | 10 / 13 | 10, 2 ft | 10 / 13 |
| 6 | 0.35 | 0.60 | NR | 49 | 20 or 13+5[h] | 15 / 19 | 30[g] | 15 / 19 | 10, 4 ft | 10 / 13 |
| 7 and 8 | 0.35 | 0.60 | NR | 49 | 21 | 19 / 21 | 38[g] | 15 / 19 | 10, 4 ft | 10 / 13 |

[a] *R*-values are minimums, *U*-factors and SHGC are maximums, R-19 batts compressed into a nominal 2 x 6 framing cavity such that the *R*-value is reduced by R-1 or more shall be marked with the compressed batt *R*-value in addition to the full thickness *R*-value.
[b] The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
[c] "15/19" means R-15 continuous insulated sheathing on 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-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the home. "10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
[d] R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Zones 1 through 3 for heated slabs.
[e] There are no SHGC requirements in the Marine Zone.
[f] Basement wall insulation is not required in warm-humid locations as defined by Figure 301.1 and Table 301.1.
[g] Or insulation sufficient to fill the framing cavity, R-19 minimum.
[h] "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
[i] The second *R*-value applies when more than half the insulation is on the interior of the mass wall.
[j] For impact rated fenestration complying with Section R301.2.1.2 of the *IRC* or Section 1608.1.2 of the *IBC*, maximum *U*-factor shall be 0.75 in Zone 2 and 0.65 in Zone 3.

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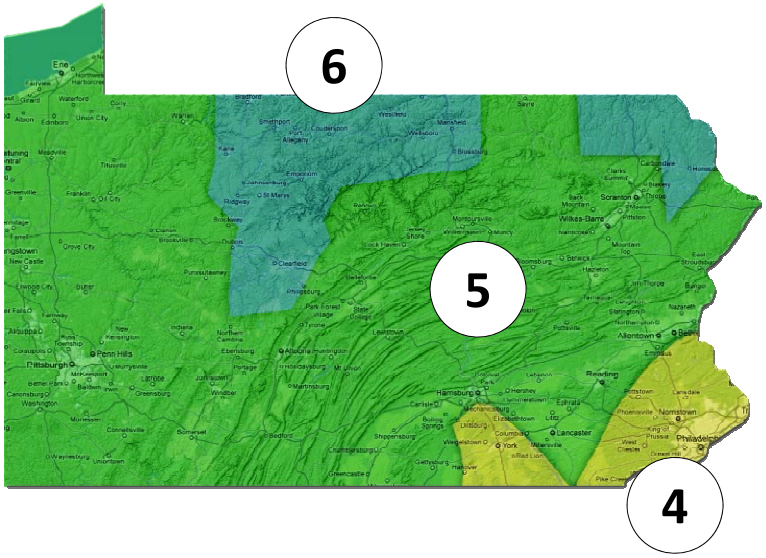
E301.1

# Climate Zones

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# Slab R-Value

**Table 402.1.1**
**Insulation and Fenestration Requirements by Component**

| Climate Zone | Slab R-value[d] |
|---|---|
| 4 | 10, 2 ft |
| 5 | 10, 2 ft |
| 6 | 10, 4 ft |

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

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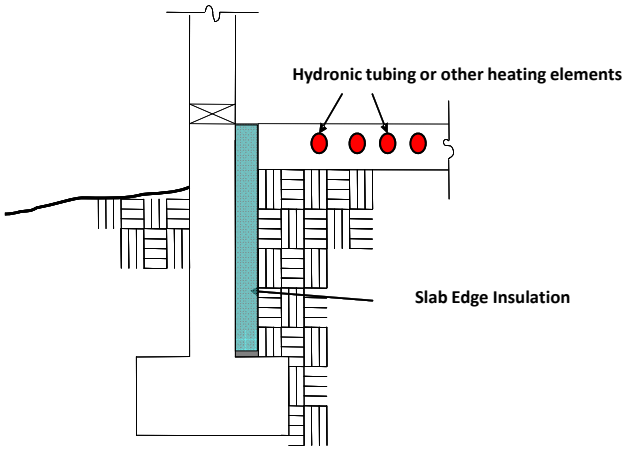
# Heated Slab




**R-15 Required per the IRC and IECC**

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# What materials can be used?

| | Typical R-value per inch | Inches for R-10 | Inches for R-15 |
|---|---|---|---|
| Expanded Polystyrene | 4.0 | 2.5 | 3.75 |
| Extruded Polystyrene | 5.0 | 2.0 | 3.0 |
| Polyisocyanurate | 6.5 | 1.5 | 2.3 |


Expanded Polystyrene (EPS)


Extruded Polystyrene (XPS)


Polyisocyanurate (ISO)

**Check with manufacturer for approval for ground contact**

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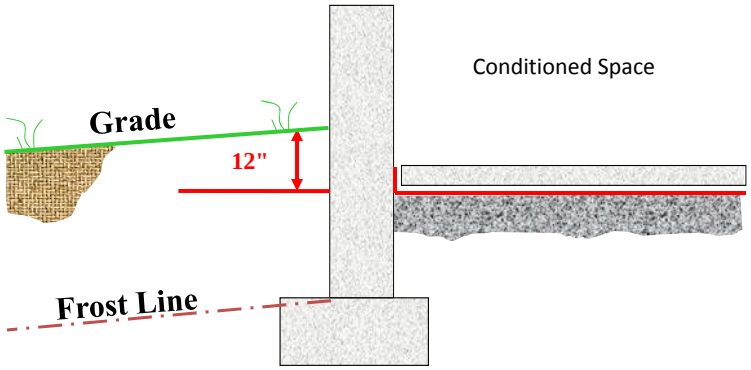
E402.2.8

# When Is Slab Insulation Required?

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

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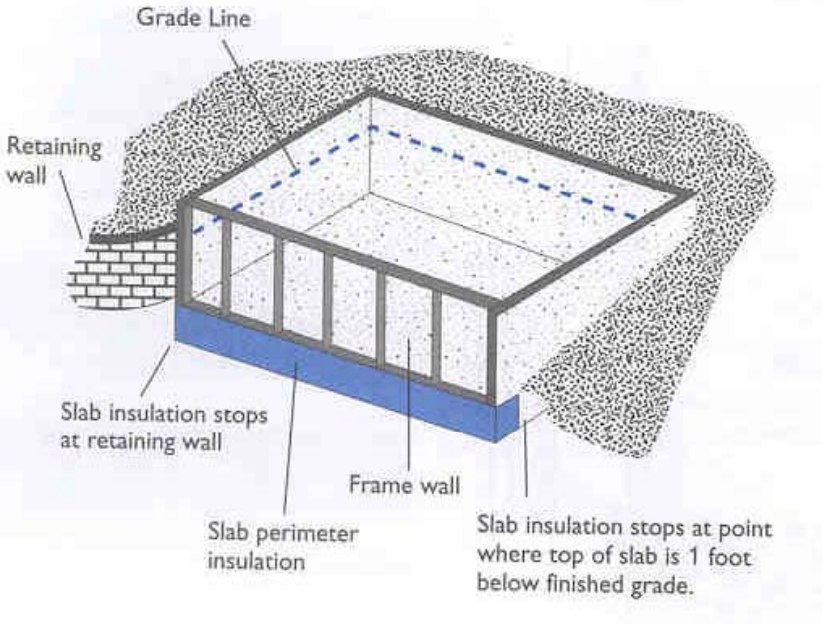


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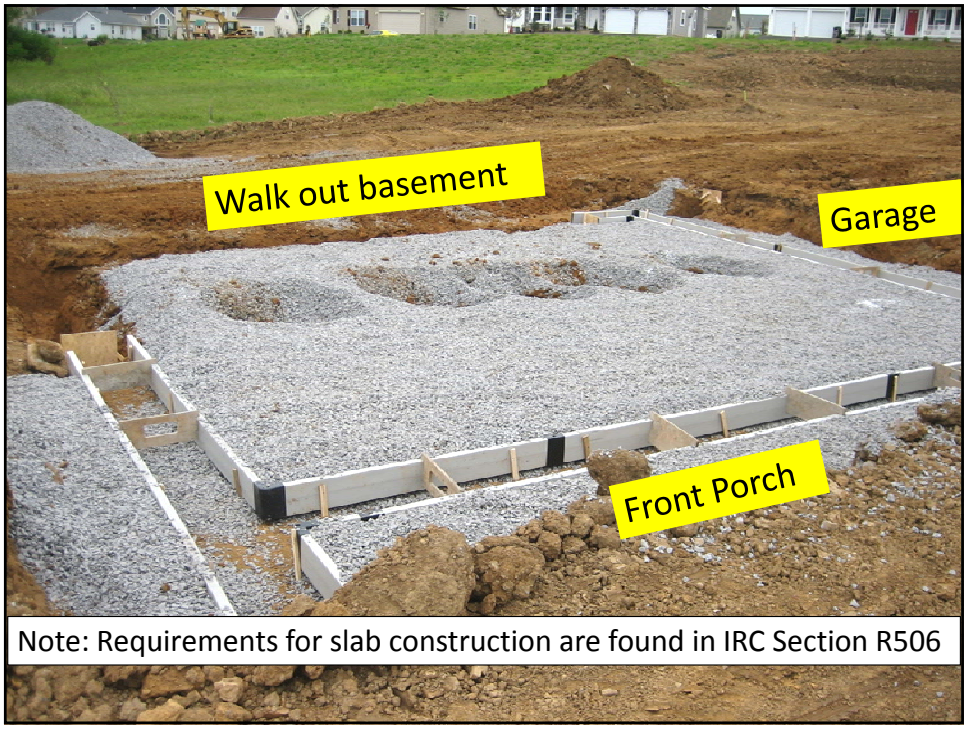
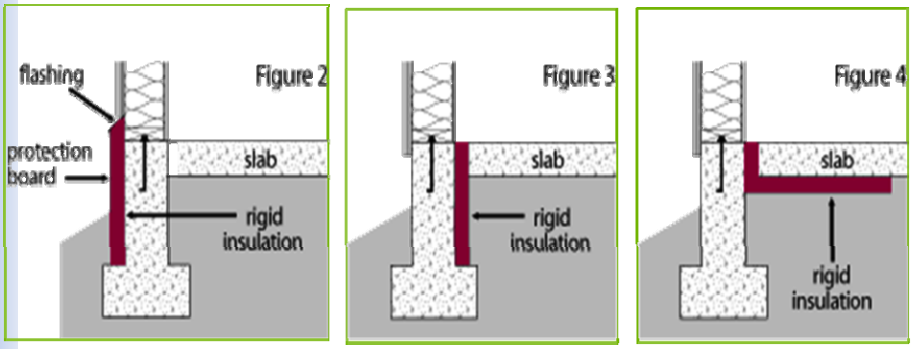



Note: Requirements for slab construction are found in IRC Section R506

E402.2.8

## How Should Slab Insulation Be Installed?

Insulation shall extend downward from the **top of the slab** outside or inside

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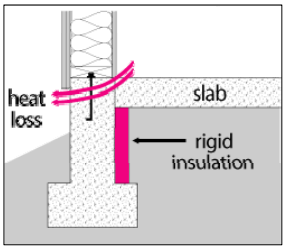
# Effect of Slab Edge Insulation

- 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

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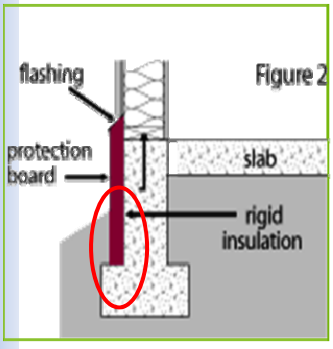
E402.2.8

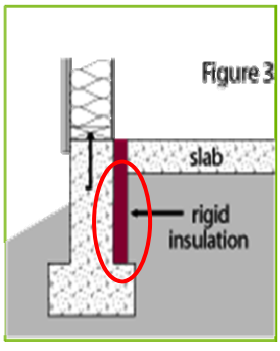
# Distance Below Grade

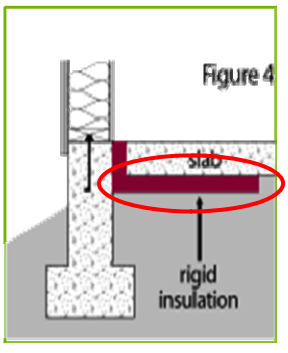
Insulation located below grade shall be extended the distance provided in Table 402.1.1

Climate zones 4-5: **2 ft**

Climate zone 6: **4 ft**

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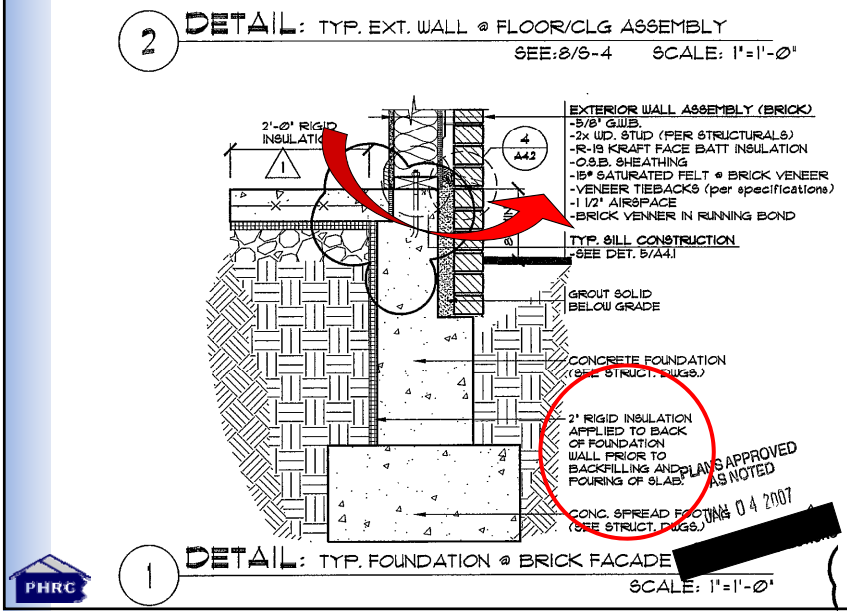
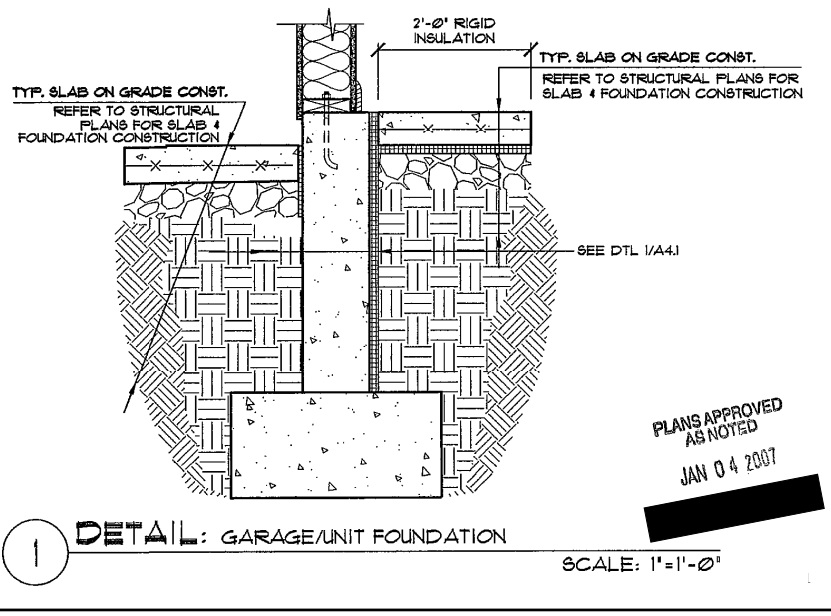
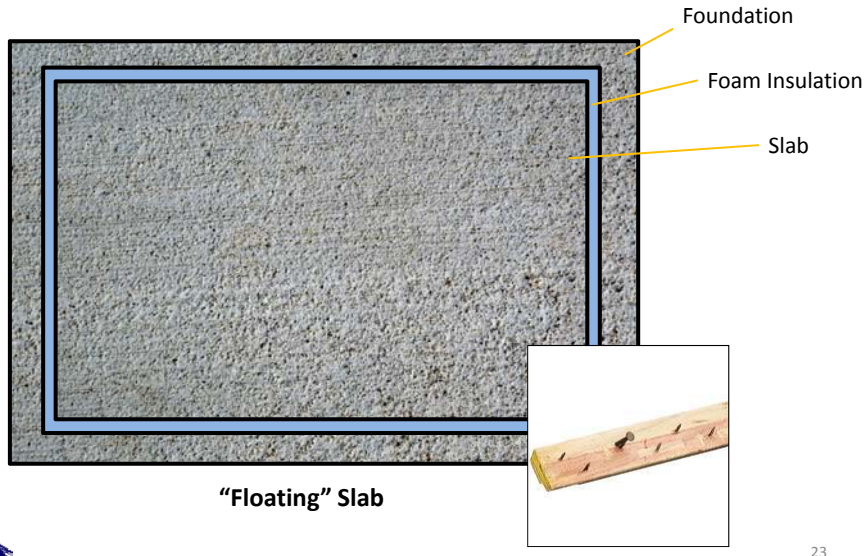
# Incorrect Slab Insulation Detail




## Correct Slab Insulation Detail



# A Problem with 2-Inch Slab Edge Insulation




**"Floating" Slab**

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E402.2.8

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


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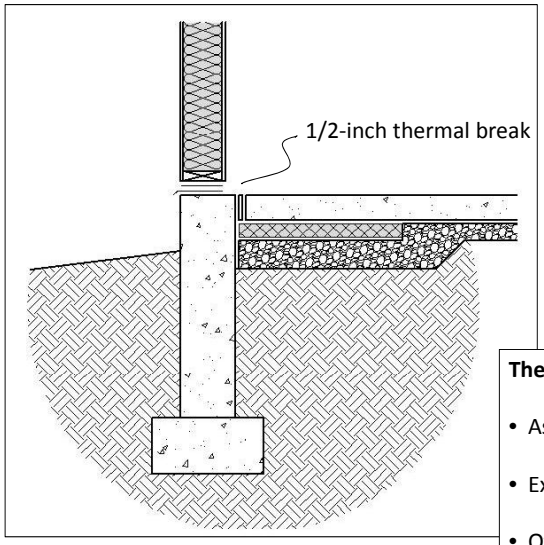
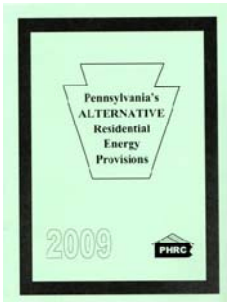
# PA Alternative Detail




**Thermal break materials:**

- Asphalt impregnated fiber board
- Extruded polystyrene
- Other

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

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# 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.

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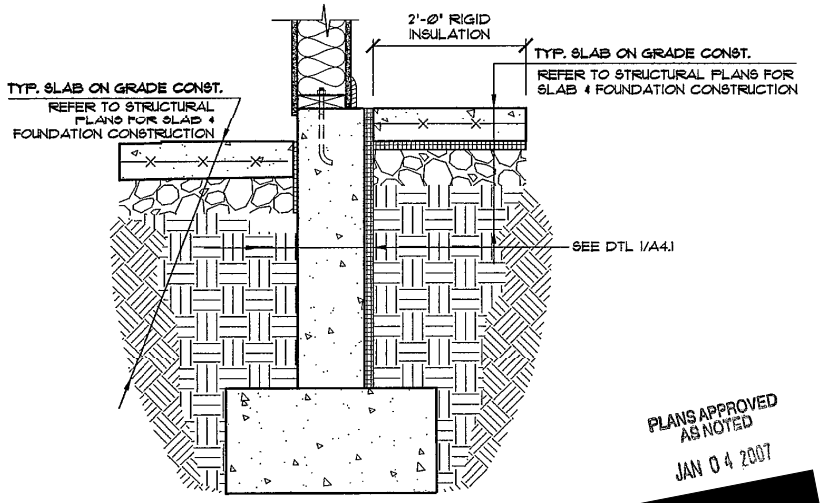
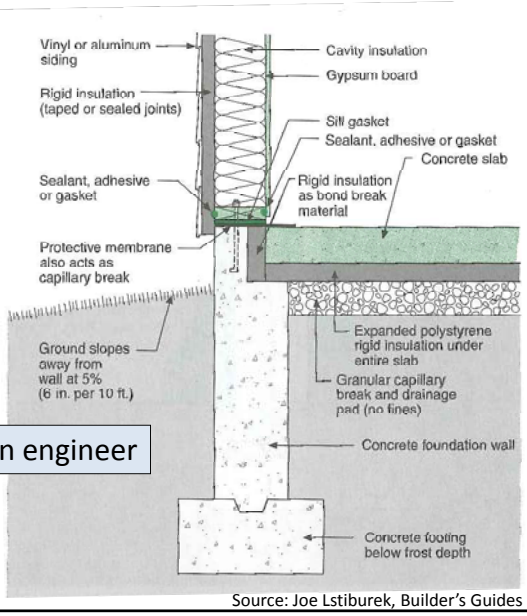
# Details to Achieve Full Perimeter Insulation



# Cantilevered sill plate




Check with an engineer

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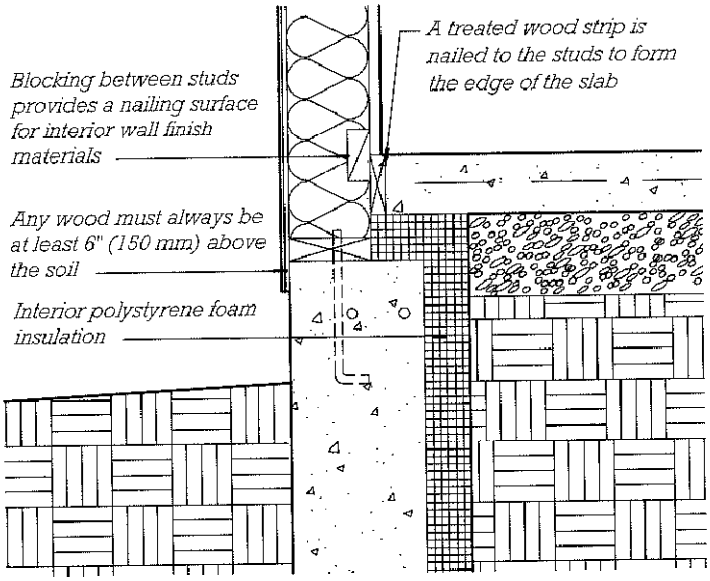
Source: Joe Lstiburek, Builder's Guides

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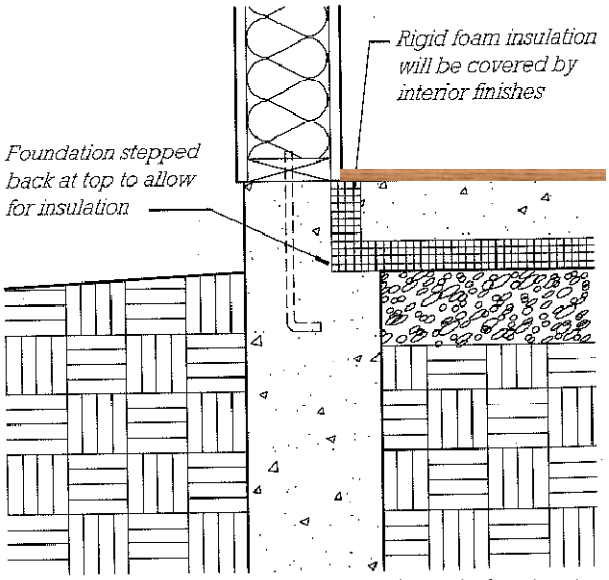
Source: Fundamentals of Residential Construction

## Use Flooring other than Carpet




Source: Fundamentals of Residential Construction

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## EXTERIOR FOUNDATION INSULATION

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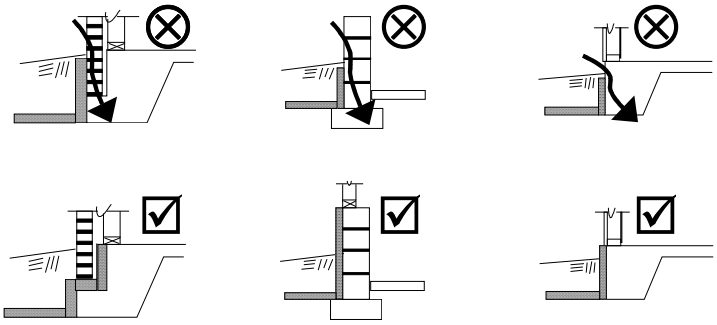
# Exterior Foundation Insulation



(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

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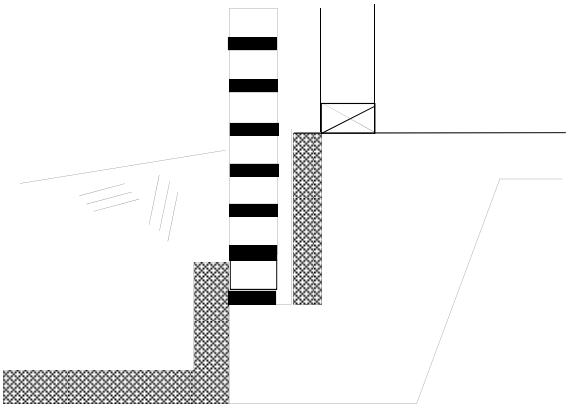
E402.2.10

# Masonry Veneer

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



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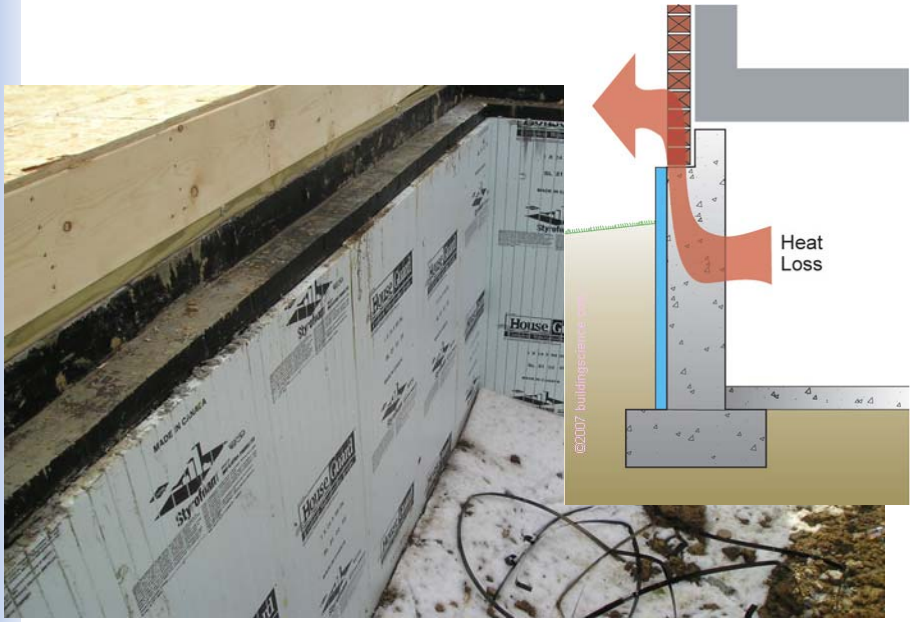


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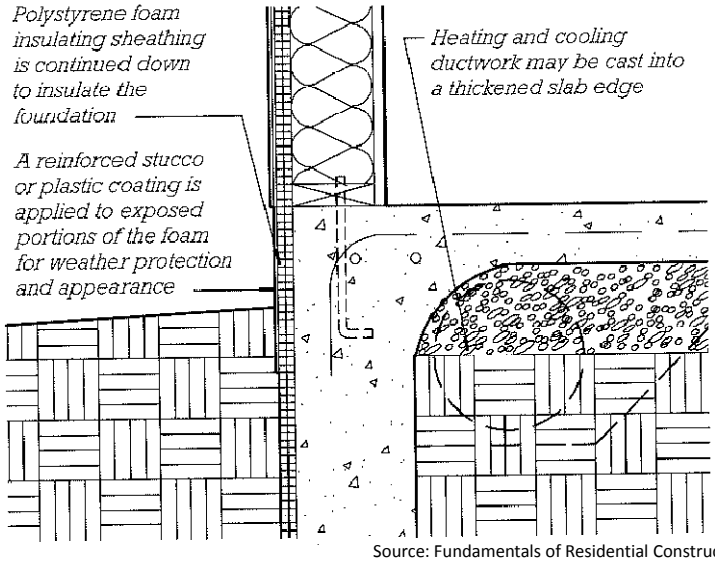
# Monolithic Slab

- Exterior insulation required




Source: Fundamentals of Residential Construction

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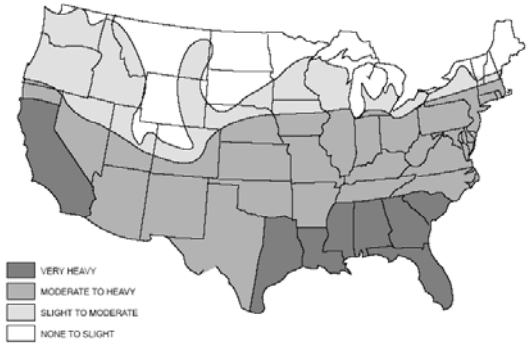
E402.2.8

# Termites

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




Note: Lines defining areas are approximate only. Local conditions may be more or less severe than indicated by the region classification.

FIGURE R301.2(6)
TERMITE INFESTATION PROBABILITY MAP

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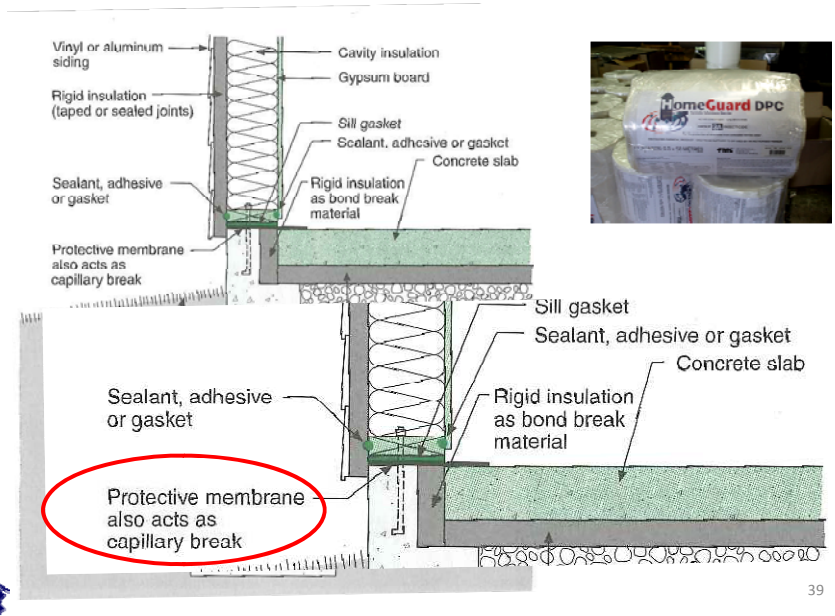
# Termite Shields







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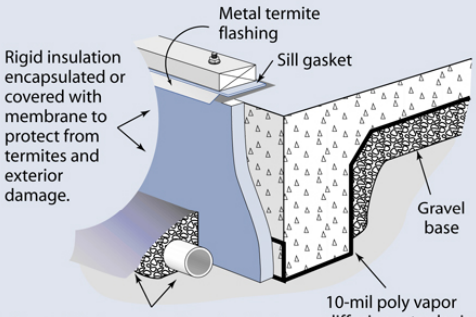
# Termite Shields

**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.

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# Termites – Chemical Treatments


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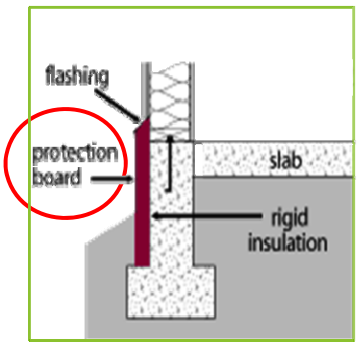
E303.2.1

## Protection of Exposed Foundation Insulation

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

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# Protection Considerations

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# 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.

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# Proprietary Products

Source: Martin Holladay, GBA Advisor

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

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# 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

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## Questions & Evaluations

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


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