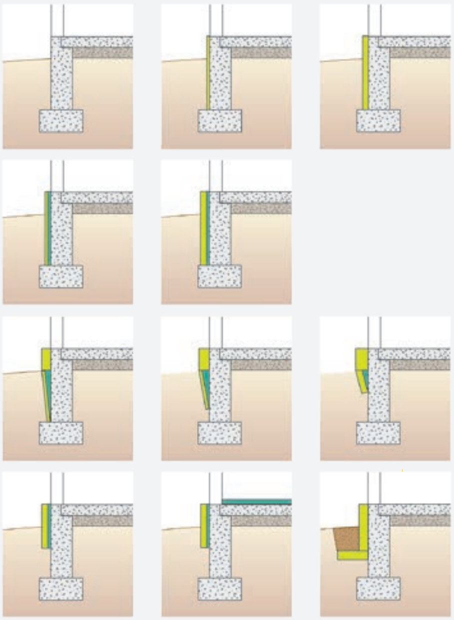

High-performance SOG foundation insulation retrofits

Building America Case Study

Optimized Slab-on-Grade Foundation Insulation Retrofits

Madison, Wisconsin

PROJECT INFORMATION

Project Name: High-Performance Slab-on-Grade Foundation Insulation Retrofits

Location: Madison, WI (climate data)

Northern*STAR* Building America Partnership

Building Component: Existing SOG insulation retrofit

Application: Single- or multifamily, retrofit

Year Tested: 2014

Applicable Climate Zone: 6

PERFORMANCE DATA

Cost of energy-efficiency measure (including labor): $2,363*

Projected energy savings: 4.4%** heating and cooling savings

Projected energy cost savings: $52/year

*Cost estimate based on 1800-ft^2 one-story house.

**Percent savings will increase with better above-grade enclosures.

Existing slab-on-grade (SOG) foundations are difficult to insulate as a retrofit measure because of a lack of interior access to the foundation. Because SOG foundations can be insulated only on the exterior, costly and destructive excavation is usually required. In addition, determining cost-effective insulation upgrade strategies has been hampered by software tools that do not accurately account for heat flow below grade.

This project used a recently developed, three-dimensional, below-grade heat transfer simulation (BUilding Foundation Energy Transport Simulation–BCVTB, BUFETS-B) that operates as a subroutine of EnergyPlus to model 10 insulation upgrade options against a base (uninsulated) case (see illustration, upper left). Before the upgrade options were simulated, the base-case model was compared to experimental data generated at the University of Minnesota's Foundation Test Facility.

Cost estimates were prepared for the 10 upgrade options, and one configuration was found to be the most cost-effective. The optimized insulation upgrade package consists of 4 in. of extruded polystyrene foam (XPS) extending from the ground level to the top of the existing sill plate. The below-grade insulation extends to half the below-grade stem wall depth. It consists of one piece of 2-in. XPS laid at an incline, with the space between the XPS and foundation wall filled with pourable polyurethane foam. See detail on the following page.

The tapered trench is excavated using hydro-vacuum technology in a method developed for earlier Building America work on basement insulation retrofits. This method results in virtually no disruption to landscape features, and it eliminates piles of removed soil onsite. The use of pourable polyurethane foam in this application was also pioneered in the earlier work.

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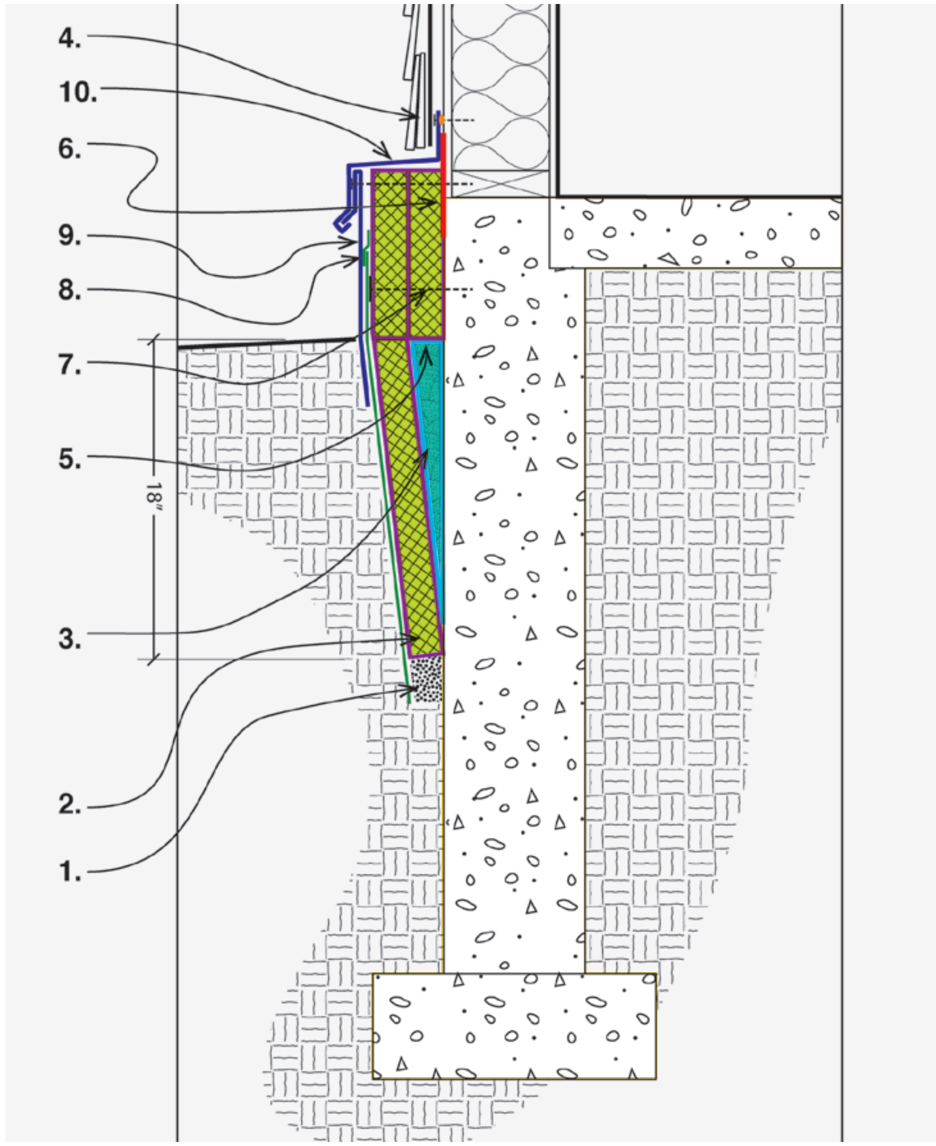
SOG Insulation Upgrade Installation Sequence

1. Create a tapered trench using hydro-vac excavation. Place a 6-mil polyethylene sheet (green line) against the outboard face of the trench and fix in place with pea gravel or permeable fill to allow drainage. Leave a 6-in. minimum "tail" of poly lying flat on the ground outside the trench.
2. Place 2-in. XPS against 6-mil polyethylene.
3. Install poured polyurethane to fill space between XPS and foundation wall.
4. Cut back siding and water-control layer material to allow installation of flashing.
5. Trim polyurethane foam as necessary to create a horizontal surface.
6. Install peel-and-stick membrane to provide air seal and water control.
7. Install two layers of 2-in. XPS from top of below-grade insulation to top of sill plate. Fasten with 6-in. drive pin anchor or equivalent. Seal to below-grade insulation with acoustic caulk (nonreactive with XPS).
8. Tape upper edge of 6-mil polyethylene to XPS insulation.
9. Install lower flashing. Flashing extends minimum 4 in. below grade. Attach with 6-in. washer-head screws driven into sill plate.
10. Install upper flashing. Lap existing water-control layer over upper leg, shingle style. Do not tape or seal. Bed upper leg of flashing in continuous bead of polyurethane sealant, fasten with washer-head screws 14 in. on center maximum. Install siding with mininimum ⅜-in. gap above flashing.

For more information see the Building America report *High-Performance Slab-on-Grade Foundation Insulation Retrofits* at *buildingamerica.gov*.

Image credit: All images were created by the Northern*STAR* team.



Lessons Learned

- Below-grade insulation upgrades in isolation without other measurs are not cost-effective, with simple paybacks ranging from 18 years in Climate Zone 4 to 46 years in Climate Zone 7.
- Hydro-vacuum technology offers a much less disruptive method to excavate soil for below-grade insulation installation than traditional methods.
- In Climate Zone 6 (Madison, Wisconsin), the modeled energy savings reveal a 30% reduction in slab energy flow but only a 4.4% site energy savings. Savings will increase with better above-grade enclosures.
- Additional benefits include increased thermal comfort due to warmer slab temperatures.

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