

## Residential Foundation Insulation

Homes being constructed today are more energy-efficient than those built even just a few years ago, primarily due to significant improvements in building products and techniques, as well as development of high-performance heating and cooling systems and other appliances. At InterNACHI, we believe that the benefits of foundation insulation are often overlooked. Heat loss from an un-insulated, conditioned basement may represent up to 50% of a home's total heat loss in a tightly sealed, well-insulated home. Foundation insulation is used primarily to reduce heating costs and has little or no benefit in lowering cooling costs. In addition to reducing heating costs, foundation insulation increases comfort, reduces the potential for condensation and corresponding growth of mold, and increases the livability of below-grade rooms.

### Foundation Types

Foundations types are either full basement, slab on grade or crawlspace. Deep frost-lines and low water tables often make a full basement the primary foundation of choice. However, slab on grade with walkout basement construction is common, and home additions often have crawlspace foundations.

### Full Basements

Basements can be insulated either on the interior or exterior. Interior insulation can use conventional 2x4 framing with batt or wet-spray insulation. Unless the vapor retarder covering on the batt insulation is fire-rated, it should be covered with drywall. Rigid foam is also used on basement interiors. Furring strips are used to hold the foam insulation in place. Extruded or expanded polystyrene or polyisocyanurate insulation boards can also be used. Fire codes require most foam insulation board to be covered with drywall.

Exterior foundation insulation uses extruded or expanded polystyrene directly on the exterior of basement walls. Insulation exposed above-grade must be covered to protect it from physical abuse and the damaging effects of the sun. Typical cover materials include roll-metal stock to match the siding, cement board attached to the sill plate, or application of a stucco-like finish.

A third option is to use a foam-form foundation system. Polystyrene foundation forms are set on conventional footings, much like building a Lego® wall. Concrete is placed into the forms where it cures to form both the structural and thermal components of the basement wall. Exterior foam, either foam boards placed on the exterior of a conventional foundation, or in a foam-form wall system, may provide a concealed entry path for subterranean termites. Termites can tunnel through and behind many foam products. If exterior foam insulation is used, a continuous metal termite shield must be used between the top of the foundation and the sill plate to force termites out of the foam and into view. Even then, treatment with conventional termiticides to stop the infestation may be difficult. Foundation waterproofing, site and footing drainage, and termite treatments are similar for insulated and un-insulated basements. However, if exterior foam insulation is to be used, use waterproofing products compatible with the foam.

### Crawlspace

In many respects, crawlspace walls are just short basement walls. Exterior foam and foam-form insulation systems can be used. However, interior crawlspace wall insulation is usually either foam board or draped insulation. If foam insulation is used, it extends from the top of the foundation to the top of the footing. The cavity formed by the rim joist should be filled with fiberglass batts or foam in place products. Most fire codes allow up to 2 inches of polystyrene exposed on the interior of a crawlspace before covering is required.

If crawlspaces are insulated with fiberglass or mineral wool batts, the batts are usually tacked to the sill plate and draped down and onto the floor. Four-foot-wide batts encased in a plastic cover work well when installed horizontally. Conventional 16- or 24-inch-wide batts leave voids between the batts and do not perform as well.

Some jurisdictions require a ventilated crawlspace to help control moisture. Vent requirements are significantly reduced if the floor of the crawlspace is covered with plastic sheeting with edges overlapped and taped to reduce crawlspace moisture. If required, install operable vents so they can be closed. Don't

forget to fill the rim joist space with fiberglass batt or foamed-in-place foam to complete the insulation treatment.

The floor over the crawlspace can also be insulated. This raises the thermal envelope from the crawlspace walls to the floor. While this technique offers many advantages, piping must be freeze-proofed, and heating and cooling ducts must also be insulated.

## **Slab-on-Grade**

Heat loss is greatest at or near the exterior grade. To reduce heating costs and reduce the cold-floor syndrome common to slab-on-grade construction, insulation is critical. Exterior foam insulation, similar to exterior basement insulation, works well. Insulation should extend from the top of the slab to the top of the footing. Foam insulation inside the footing is also common. It is necessary to provide a thermal break to prevent thermal wicking from the slab to the outside. Installing a pressure-treated nailer or beveled slab edge provide the thermal break while still allowing floor-covering attachment. Climate, cost of fuel, efficiency of heating equipment, and type of foundation help determine the cost-effective level of insulation.

Savings from insulated foundations vary with fuel price, heating equipment performance, and climate. The cost of full-basement foundation insulation will vary, but builders have reported prices between \$800 and \$1,200. If the mortgage of a new home were increased by \$1,200, the increase in home payment would be \$106 annually for a 30-year, 8% loan. The combined heating and mortgage costs would be similar, and the home would be more comfortable and provide a healthier indoor environment.

## **Frequently Asked Questions**

### ***If a basement is unfinished, does it still need foundation insulation?***

Yes, unless the floor above is insulated. Even if used only for storage and heating and cooling equipment, the basement is thermally connected to the rest of the house.

### ***Is floor insulation above a basement or a crawlspace an alternative to foundation insulation?***

Yes, but keep in mind that pipes, ducts and HVAC equipment located in the basement would then need to be insulated to protect pipes from freezing. Sometimes these can be grouped in a small area with insulated walls while the floor above the rest of the basement is insulated.

### ***Doesn't placing insulation on the exterior improve energy performance?***

If the basement incorporates passive solar design with a significant amount of south-facing windows, exterior insulation will be beneficial, provided the walls are exposed to solar gain. In a typical basement, the energy savings are negligible.

### ***Should the interior of foundation walls have vapor barriers?***

If interior insulation is used, yes. The concrete must be allowed to dry, but moist basement air typical of Midwest summers should not be allowed to reach the cool wall where it can condense. Batt insulation specifically designed for the interior of foundation walls has a perforated poly facing that prevents air from circulating through the batt, but allows water vapor from the wall to escape.

### ***Will foundation insulation increase the risk of termite entry?***

Foundation insulation does not increase the risk of termite entry. If termites are present in the soil and wood is used in the building, the risk of infestation exists. Exterior insulation may reduce the probability of early discovery, and inhibit treatment when discovered.

### ***Is it a good idea for the purposes of foundation inspection for termites to allow an open band or a small area where foundation insulation is omitted?***

In some southern states with a high incidence of termite infestation, including Florida, North and South Carolina, Georgia, Alabama, Mississippi, Louisiana, eastern Texas, southern and central California, Georgia, Tennessee, and Hawaii, rigid foam insulation is not allowed to come in contact with the soil. In other areas, a 6-inch gap between the top of the foundation insulation and any wood framing member is required to permit visual inspection for termites. An InterNACHI inspector can be hired to perform required pest inspections.

***Will exterior foundation insulation materials be chemically attacked by damp-proofing?***

It can happen. Always follow the insulation manufacturer's instructions for damp-proofing.

***What about waterproofing?***

Codes often require waterproofing instead of damp-proofing if the wall is adjacent to habitable space. Manufacturers of some foam products offer specific recommendations for waterproofing their foam systems.

***How long will exterior foundation insulation last?***

Properly installed foundation insulation should last as long as insulation installed anywhere else in the building.

***Should foam insulation above grade be protected?***

Foam above grade must be protected from both sun and physical damage. Ultraviolet light degrades and destroys most foams. In addition, damage from lawnmowers, balls, and other incidental contact can degrade the appearance and performance of the foam. Common materials used to protect the foam above grade include two- or three-layer stucco finishes, brush-on elastomeric or cementitious finishes, vertical vinyl siding, cement board, aluminum coil stock, and fiberglass panels.

***Will insulating the foundation increase the risk of radon problems?***

Radon entry into a home occurs through cracks and other openings below grade. The use of foundation insulation should minimize thermal stresses on the foundation and help minimize cracking, thus reducing radon entry.

***Should crawlspaces be ventilated?***

The CABO One and Two Family Code requires 1 square foot of crawlspace ventilation for each 150 square feet of floor area. Operable vents 1/10th as large can be used if a vapor barrier is installed. Warm, damp summer air can condense on the cool earth, even when covered with a poly vapor diffusion-retarder, increasing the risk of crawlspace moisture problems. Installing a vapor barrier and closing the operable vents is preferred. If local code interpretation requires crawlspace ventilation, insulating the floor and incorporating a vapor barrier is preferred.

***Do foam insulation boards installed on the interior require fire protection?***

All foams require thermal protection equal to ½-inch of gypsum wall board when installed on the interior of a building, including a crawlspace. The only exception is Celotex, Thermax<sup>®</sup>, and polyisocyanurate which may be installed without a thermal barrier where approved by the local building code official.

***Are insulating concrete form (ICF) systems less expensive than an insulated, poured-in-place concrete wall?***

ICFs can be competitive, but costs are project-specific. Foam used in these systems should address the same concerns outlined above for foam board.

In summary, taking time to plan the best insulation system for your new home, and taking stock of the insulation currently installed in your home, can lead to energy savings in the long run.