Foil Bubble Pack: Subslab Insulation?

This spring, my neighbor poured a slab for an addition over "R-10" bubble pack. He was taken aback when I told him that the claimed insulating value of this product was open to question. Advertisements and Internet sites have quoted values as high as R-15 for two layers of plastic bubbles and a layer or two of foil. Building science and some test data have shown these products to have an R-value closer to 1 or 2. Last September, the editors of *Energy Design Update* (*EDU*) questioned the astounding claims for R-value made by various manufacturers and distributors of foil-faced bubble pack insulation. Curiously, the November issue of *EDU* was full of qualifications from manufacturers, downrating their R-value claims. To help resolve these competing claims, Canada Mortgage and Housing Corporation (CMHC) decided to fund a quick study on the actual installed performance of foil bubble pack and competing subslab insulations.

Four new houses in southwestern Ontario were tested in the winter and spring of 2004. Each house had two sets of four resistance temperature detectors (RTD) stacked vertically to measure the thermal gradient from the top of the slab through the insulation and into the soil below. One set was centrally located in the basement and one was placed 3 ft from the foundation wall. Yet another temperature sensor recorded the basement air temperature several feet above the slab.

The subslab situation was different for each house. The first house had no insulation underneath the slab—the most common setup in new houses in that area. The second house had 2 inches of extruded polystyrene board. The third house had two layers of 5/16-inch clear bubble pack with reflective foil sandwiched in between. The fourth house used an unusual product—the cutouts from steel-skinned doors. During the manufacture of these doors, a steel and polyurethane sandwich, with 1 3/4 inches of polyurethane between two layers of steel, is created first. Then the part for the window is cut out. The window-shaped cutouts from the steel doors were used as the subslab insulation in this last house.

The Canada Mortgage and Housing Corporation tested the performance of foil bubble pack and other subslab insulations.

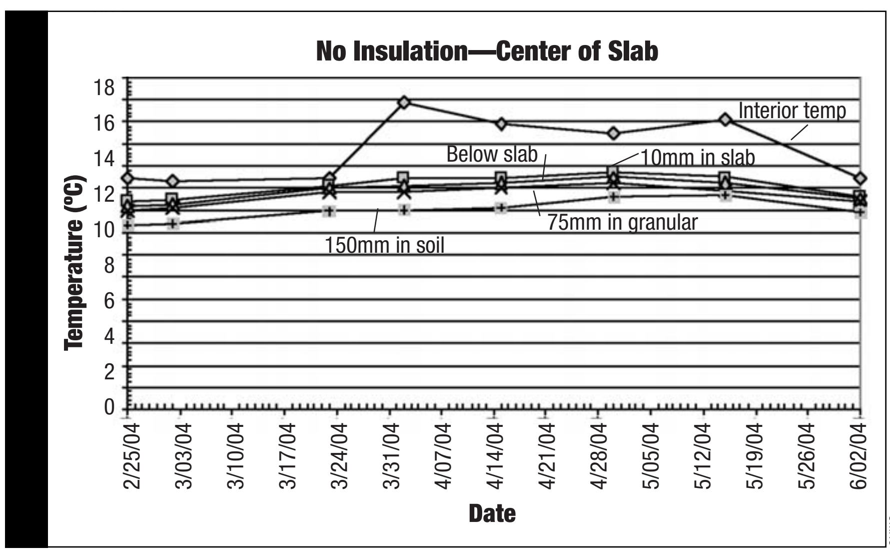

Figure 1. The first house had no insulation underneath the slab—the most common setup in new houses in southwestern Ontario.

For the house with the uninsulated floor, the soil temperature measured in the center of the basement is very close to that of the floor surface temperature (see Figure 1). In this house, either the basement air is warming up the soil below, or else the soil is chilling the basement air.

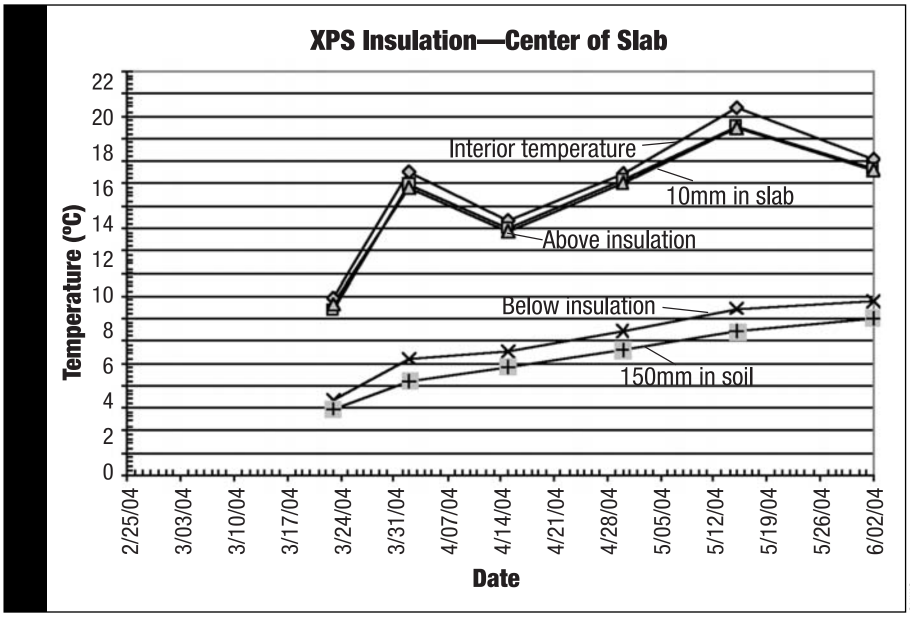

Figure 2. For the house with the extruded polystyrene under the slab, there is a big temperature drop across the insulation, as one might expect, and the soil temperatures are far lower.

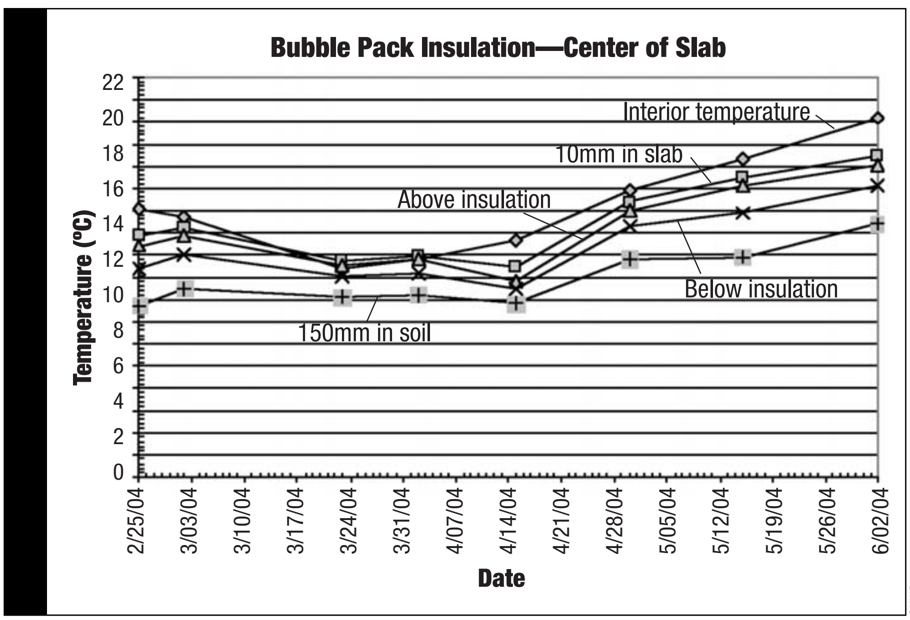

Figure 3. The foil bubble pack tested was next to useless as subslab insulation.

For the house with the extruded polystyrene under the slab, the temperature profiles are completely different (see Figure 2). There is a big temperature drop across the insulation, as one might expect, and the soil temperatures are far lower. The temperature profiles for the house with the polyurethane door panels are very similar.

How about the house with the bubble pack? Do these temperature profiles (see Figure 3) look like those for an insulated floor, or like those for an uninsulated floor? Once again, we are looking at relatively high soil temperatures and no appreciable drop in temperature across the bubble pack material.

The consultants aggregated the data from the center-of-the-floor and the edge-of-slab locations and calculated the effective R-value of the materials from the data (see Table). The calculated values for insulations of known R-value—the polystyrene and the polyurethane—were 12%–20% higher than values from references, such as the manufacturers or ASHRAE. This could be due to the fact that reference values are for aged products, rather than new ones. However, it is likelier that the discrepancy is due to imprecision in the calculation procedure. The R-values assumed for the slab, soil, and air film—the thin layer of air adjacent to these horizontal surfaces also acts as an insulator and has to be included in this calculation—may differ from those on-site. Implying R-values from changing conditions can lead to some inaccuracies. It is probably fair to say that the calculated values are marginally higher than the expected long-term performance.

So what does this experiment reveal? Uninsulated slabs lead to cool floors. Two inches of extruded polystyrene makes a big difference in the comfort of the floor and the amount of energy passed through the slab. The foil bubble pack tested was next to useless as subslab insulation. Steel door cutouts for subslab insulation were very effective, and this application looks like a good use for that material.

Table. Effective R-Values

Insulation Product	R-Value ($h \cdot ft^2 \cdot °F/Btu$)	Standard Deviation
Bubble Pack	2.3	2.1
Steel Skinned Polyurethane	14.5	9.9
Extruded Polystyrene	12.1	5.7

—Don Fugler

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For more information:

The research report, "Comparison of Under-Floor Insulation Systems," by Enermodal Engineering is available from CMHC at (613)748-2003. A Research Highlight, or summary of the project, can be found on the CMHC Web site. Go to www.cmhc.ca/od/?pid=63728.