

The Pros and Cons of an Insulated Slab Floor

Given the choice between a raised floor with a crawl space and a concrete slab floor, I choose the latter for the demonstration house. Aside from energy considerations, a slab floor has several advantages:

- There are no wooden members to rot, mildew, or provide homes for termites.
- No unwanted “guests” can take up residence under the house.
- Adding a handicapped ramp and a level pathway from the garage is much simpler because the floor isn’t so high.
- Less labor is required to pour a slab than to build up a raised floor.
- For the same degree of thermal resistance, less insulation is required than for a raised floor with a ventilated crawl space.

On the other hand:

- Interconnecting pipes and ducts must be accommodated elsewhere in the structure (the demonstration house uses selectively dropped ceiling areas for this purpose).
- It is difficult and expensive to relocate or add plumbing fixtures that include drains after the floor is poured.
- Floor insulation cannot practically be upgraded after the house is complete.

In the demonstration house, the floor slab is “floating,” with four inches of structural foam insulation underneath and around the edges. The product used has a compressive strength comparable to the dirt on which it is placed, so the slab position is quite stable.

The insulation material thermal resistance, R , is 20¹, but the effective floor structural R turns out to be 41 because the dirt under the slab gets neither as cold during the winter as the outside air, nor as hot during the summer. Actual measurements of the floor temperature during the coldest days of winter show it to be within one degree of the room ambient temperature -- a number of visitors who were walking around without shoes during an open house assumed the slab must be heated.

The insulation material cost is about \$2/sq.ft. Recent modeling, however, has shown that reducing the thickness of the insulation in the center of the slab by half will reduce material cost by 30% while the heat loss increases less than 9%. Alternately, eliminating the insulation in the center of the slab altogether reduces cost by 60% with only a 25% increase in heat loss.

One final disadvantage of this floor is imbedded energy: conventional concrete is an energy-intensive product to manufacture (accounting for about 7% of global warming emissions), while extruded polystyrene (XPS) insulation is “blown” using gases with significant greenhouse potential. Fortunately, a new type of concrete (“CarbonCure”) imbeds sufficient carbon within its structure that it is claimed to be carbon neutral, while the makers of XPS are exploring the use of more benign blowing agents. Hopefully these improved products will be widely available soon.

¹ The units of thermal conductivity, U , are BTU/hour/degree F/square foot. Thermal resistance, $R = 1/U$.