



## Building for Wall-e (Wall-excellence)

There are many materials for building walls: stone, wattle and daub, and the ThreePigs Construction Company's recommended straw, sticks, or brick, depending on your budget. But more than just money is at stake. The material used to build your home's walls is of crucial importance in sustainability because our buildings have a tremendous environmental impact, according to the Green Building Council:

- 71% of our total electricity consumed
- 39% of total energy consumed
- 39% of total CO2 emissions produced
- 30% of total raw materials consumed
- 30% of total waste produced.

So, when deciding on wall materials, those that reduce energy use with a minimum amount of waste are probably better. Certainly, if you want LEED certification, there are few materials that qualify and, if you are building for strength and water resistance like we are, the list gets even shorter.

One material on that short list is Insulating Concrete Forms (ICF), formwork for concrete that stays in place as permanent building insulation for energy-efficient, cast-in-place, reinforced concrete walls, floors, and roofs.



The forms are interlocking modular units, Lego for adults, that are dry-stacked without mortar and with reinforcing steel (rebar) added before concrete placement to give the resulting walls flexural strength, similar to bridges and high-rise buildings made of concrete.

Once stacked, concrete containing pea gravel for increased viscosity is pumped into the cavity to form the walls. Usually the forms are filled with concrete in one to four-foot sections to reduce the risk of blowouts like with other concrete formwork although, as you will see later, that didn't completely prevent them in our case.

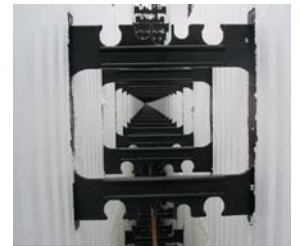


After the concrete has cured the forms are left in place permanently for

- Thermal and acoustic insulation
- Space to run electrical conduit and plumbing. The foam on either side of the forms can easily be channeled to accommodate electrical and plumbing installations.
- Backing for gypsum boards on the interior and stucco, brick, or other siding on the exterior. Most forms have vertical furring strips built into the forms on 6", 8", or 12" centers which are used to secure interior and exterior finishes.

Here's a look inside our assembled, but empty, ICF walls:

ICF can be made from a variety of materials, but we used the most common, expanded polystyrene (EPS). Polystyrene can be transparent or can be made to take on various colors. You know expanded ICF polystyrene as foam coffee cups, packing peanuts, and insulation.



This is what our assembled and braced ICF walls looked like, ready to be filled with concrete.



There are many advantages to ICF.

- Minimal, if any, air leaks, for improved comfort and less heat loss compared with walls without an air barrier
- Thermal resistance typically above R-24, saving energy
- High sound absorption compared with framed walls



- Structural integrity. ICF creates a monolithic concrete wall that is 10 times stronger than wood framed structures. Especially important when part of your house is underground, as ours is.
- Higher resale value due to longevity of materials
- More insect resistant than wood frame construction. When the building is constructed on a concrete slab, as ours is, the walls and floors form one continuous surface; keeping out insects.
- Concrete does not rot when it gets wet
- Reduces HVAC operating costs from 30% to 70%
- Designing and Building with ICF helps attain Leadership in Energy and Environmental Design (LEED) Green Building status.
- Possible “greenbate” from the manufacturer of \$1.00 for every full height block used in the construction of single family homes that receive LEED certification.

However, there are always disadvantages:

- Adding or moving doors, windows, or utilities is harder once the building is complete because it requires concrete cutting tools.
- An average ICF home will cost about five dollars per square foot more than a conventional wood-framed home, although for high-end homes constructed of concrete, ICF is usually less expensive.
- During the first weeks immediately after construction, minor problems with interior humidity may be evident as the concrete cures, so it is important not to close the house in too quickly. Alternatives are using a small residential dehumidifiers or the building's air conditioning system.
- Polystyrene is classified (according to DIN4102) as a B3 product, meaning *highly flammable* or *easily ignited*. This is one grade higher than wood, classified as B2 or *normal combustibility*. Consequently, polystyrene is prohibited in any exposed installations in building construction. It must be concealed behind drywall, sheet metal or concrete.

There were three disappointments for us in using ICF. The first is that EPS doesn't grow on trees, that is, it is not a renewable resource. The second was that we couldn't find a local source of more environmentally-friendly concrete. The third was that we had to take two pick-up truckloads of waste to the landfill. Now that is a small fraction of the waste in building a normal home but it still needn't have happened.

The problem is that we couldn't find anyone in Belleville, Napanee, or Tamworth who would recycle our ICF. EPS can normally be recycled and has the number "6" as its recycling symbol, but our ICF was not stamped and was, therefore, not eligible for recycling.





Unrecycled EPS, which does not degrade very quickly, is often abundant in the environment, particularly along shores and waterways, and is a form of pollution.



Expanded polystyrene scrap can be easily added to products such as EPS insulation sheets and other EPS materials for construction applications and commonly, manufacturers can't get enough scrap.

Recycled EPS is also used in many metal casting operations. It can be combined with cement to be used as an insulating amendment in the making of concrete foundations. Although EPS recycling is not a closed loop, producing more polystyrene; polystyrene cups and other packaging materials can be used as fillers in other plastics.

Once we had the walls assembled and braced, we were ready to fill them with concrete. This went very well with a pumper truck and boom so we could direct the concrete wherever we wanted. In addition, we used an eight-foot vibrator rod to help settle the concrete to the bottom.

We did have one blow-out, though, and quick action by the crew plus some concrete shoveling afterward prevented a disaster.

In general, ICF structures are much more comfortable, quiet, and energy-efficient than those built from traditional construction materials. It was clearly the best choice for us, especially since most of our house is underground. It may be the best choice for you, too.

