



The ICF Effect

Energy efficient construction is booming, driven by higher fuel prices, record-setting temperatures and more stringent energy codes. Contractors are pushed to find better solutions for the building envelope. While R-values have been the traditional measure of energy effectiveness, evidence now points to other factors which contribute equally to energy efficiency. This is the rest of the story - the story of the ICF Effect.

The R-value measurement came about in response to the oil crisis in the 1970's. Up until then, fuel was cheap and minimal attention was placed on energy use, as evidenced by the lack of insulation in mid-century homes. The skyrocketing fuel prices triggered a need for immediate improvements in residential energy efficiency. Minimum insulation values were prescribed as a quick and immediate remedy. The values were based on the insulation materials typically used at the time. The existing hot box testing method, measured resistance of heat flow, or R-value.¹

The R-value testing measures the resistance to heat flow of a given material, in a steady state. While not an ideal representation of real world conditions, the R-value provides a straightforward system for comparing insulation materials.

“ The synergy of higher R-value, virtually no air infiltration and the added thermal mass in ICF assemblies result in performance that simply can't be duplicated with traditional framed assemblies.”

*David Shepherd, AIA
Director of Sustainability
Portland Cement Association*

As builders adapted new insulation materials and the HVAC industry developed more accurate equipment sizing software, one thing became quite apparent: R-value alone does not reflect the true effectiveness of a material when installed. If it did, then a wood frame house with an R-19 fiberglass batt would have the same energy performance as an Insulated Concrete Form (ICF) house with R-19 polystyrene foam, all other parts being equal.

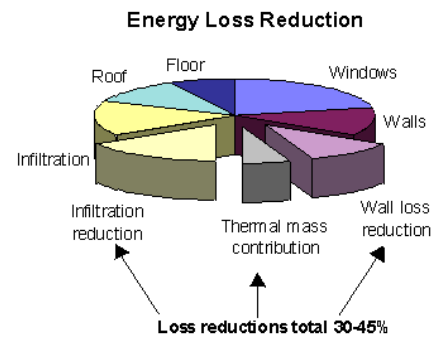
However, houses built with ICF exterior walls typically require 44% less energy to heat and 32% less energy to cool than comparable frame houses.²

What's the difference?

We call this the ICF Effect.

The energy effectiveness of an ICF wall is due to three important factors:

- **Continuous R-value,**
- **Reduced air infiltration, and**
- **Thermal mass moderation.**



Energy Savings from the ICF Effect

Continuous R-Value

The R-value of a material is based on laboratory testing of a sample piece. It does not take into account gaps or variations in thickness. In real life, the R-value of an installed wall assembly should be a weighted average of all the wall components. For example: fiberglass batt (R-13), wood studs (R-4.38 for a 2x4), and air gaps (R-0 zero). In this case, the combined R-value is less than the tested value of the insulation component.

By comparison, the R-value of ICFs is constant. The foam form and its associated R-value, is continuous by necessity as a forming system. For example, an R-22 ICF system performs at a true R-22 level.

Reduced Air Infiltration

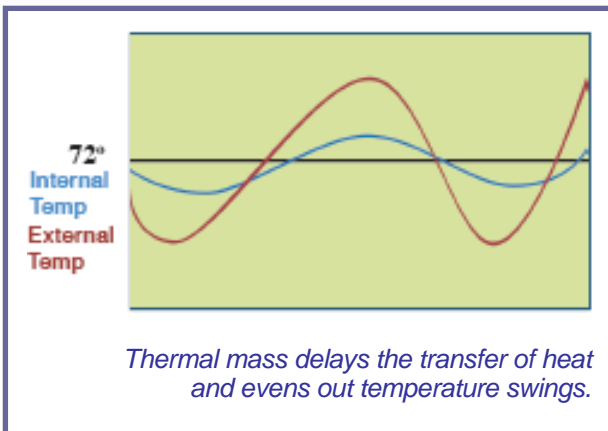
Over half the energy loss of a frame home is due to unwanted air infiltration and heat loss through the wall assembly. Air can penetrate into a building through many channels – sheathing gaps, penetrations at balconies or cantilevered floors, and insulation gaps in the wall cavity. Also, humidity and drying of the wood frame causes movement in the wood framing and contributes to post-construction leakage. Air infiltration coming from these gaps is typically around .5 ACH (air changes per hour), which means that each hour, half the air volume of a house is exchanged for outside air that needs to be heated/ cooled.

There are several ways to combat air infiltration. Choosing blown-in or spray-on insulation can help reduce the air gaps around the wood studs. However, no amount of blown in insulation will address the thermal bridging caused by the lower R-value wood framing.

Insulating Concrete Forms (ICFs) provide a ready solution to these issues. The monolithic concrete core forms a tight air barrier, with penetrations (e.g. windows and doors) which are easy to identify and seal. And, time has no impact on these materials. The foam has a consistent R-value for the full service life of the wall.

Thermal Mass

The benefits of thermal mass have been enjoyed in practice for centuries. Recently, the scientific community has also quantified and validated this effect. Studies conducted by the U.S. Department of Energy (USDOE) confirmed that concrete mass in exterior walls reduces annual energy costs in buildings. In 1987, this was written into the energy code in the form of reduced R-value requirements for a thermal mass wall assembly.³



The ICF concrete core offers the characteristic thermal mass qualities of heat absorption and thermal lag. The additional insulation of an ICF wall further delays the transfer of heat to the inside of the building. This combination serves to reduce and delay peak loads, which may result in lower off-peak energy pricing and reduced HVAC equipment size. In climates with large diurnal temperatures swings, the mass wall can release absorbed heat energy to the cooler night air, a process called heat flow reversal.

This insulated thermal mass application provides an excellent pairing with passive solar design. The ICF wall moderates indoor temperature swings and reduces the amount of heating/cooling needed. This in turn reduces the amount of exposed thermal mass needed for passive solar heating. Mass floors, interior walls and other surfaces can meet this exposed mass requirement.

"The new ENERGY STAR Qualified Homes specification effectively levels the playing field between framed construction and advanced wall systems like insulated concrete forms. This is because complete air barrier assemblies that have been often missing in framed construction, but standard with advanced wall systems, are now required in every labeled home."

Sam Rashkin
National Director ENERGY STAR for Homes
United States Environmental Protection Agency

Energy efficient construction is a top priority for the construction industry. The Energy Star for Homes program has experienced a sizeable increase in builder participation. The guidelines call for a continuous thermal envelope and a tighter air barrier requirements, which are the very strengths of ICFs. The Thermal Bypass Checklist even lists ICFs as a best practices solution for reduced thermal bridging.

The USDOE has set its goal even higher, aiming for a Net-Zero Energy Home. Such a house will remain comfortable even when utilities are disrupted, providing passive resistance to disasters. The only way to make this economically feasible is to improve the thermal envelope for a lower overall HVAC load and thus yield a more affordable renewable energy package. ICFs can help provide this solution.

It's time to look beyond the R-value and learn the rest of the story. Insulating Concrete Form construction offers a complete energy solution that makes economic sense today, while helping to meet the energy needs for future generations.

¹ American Society for Testing and Materials (ASTM)
Designation: C976

² RP119 VanderWerf, *Energy Comparisons of Concrete Homes vs Wood Frame Homes*.

³ Currently Section 402.1.1, IECC 2006

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1730 Dewes Street • Glenview, IL 60025
(888) 864-4232 • www.formsof.org

The Insulating Concrete Form Association (ICFA) is a business association, representing over 500 international firms through ICF promotion, codes and standards, research, partnering and education. Founded in 1994, the ICFA is located in Chicago, IL.