
Designing Homes Using Insulating Concrete Forms

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The primary objective of this article is to offer residential (and light commercial) designers some practical design advice and technical resources when considering the use of insulating concrete forms (ICFs). A basic overview of the ICF technology is also provided for those who may be completely unfamiliar with this increasingly popular building technology.

What is an ICF?

An ICF is essentially a concrete wall that is formed by using innovative, stay-in-place concrete forms. The value-added feature is that the form material is usually made of some type of thermally resistive foam insulation, such as polystyrene. Special form ties are used to resist the pressure of wet concrete and allow for attachment of finishes later in the construction process.

There are three main types of ICFs as shown in [Figure 1](#).

Each ICF manufacturer may have various features that allow for attachment of finishes or special detailing (such as brick ledges or corners). In general, the greater the number of features, the greater the price of the ICF system materials. However, in some cases the added material cost can be regained by labor savings and design flexibility, depending on the complexity of the structure being built and other factors.

Manufacturer Resources

While originally a European technology, there are now many manufacturers of ICFs in the United States. National and regional manufacturers, suppliers, and distributors of insulating concrete form systems can be found on the www.forms.org website by the Insulating Concrete Form Association (ICFA). Manufacturers can offer detailed product information, including options, dimensions, design tables, and specifications. Choosing a manufacturer that provides the technical support and a product with the desired attributes (such as specialty forms for unique architectural or structural features) is an important issue.

There are also issues that are important to construction efficiency that must be considered, though this factor is usually resolved through personal experience or by discussions with a knowledgeable contractor. It should be recognized that there is a "learning curve" that must be overcome in becoming efficient with any new technology. But, with a good approach, the proficient adoption of a viable new technology can pay great dividends in business development and diversity.

Technical Information Resources

Technical information on insulating concrete forms can be found on the Portland Cement Association's website, www.portcement.org, which also links to the ICFA website, www.forms.org. Both sites contain helpful publications for designers, builders, and code officials who are interested in learning more about ICFs. The ICF technology is also recognized with detailed prescriptive design and

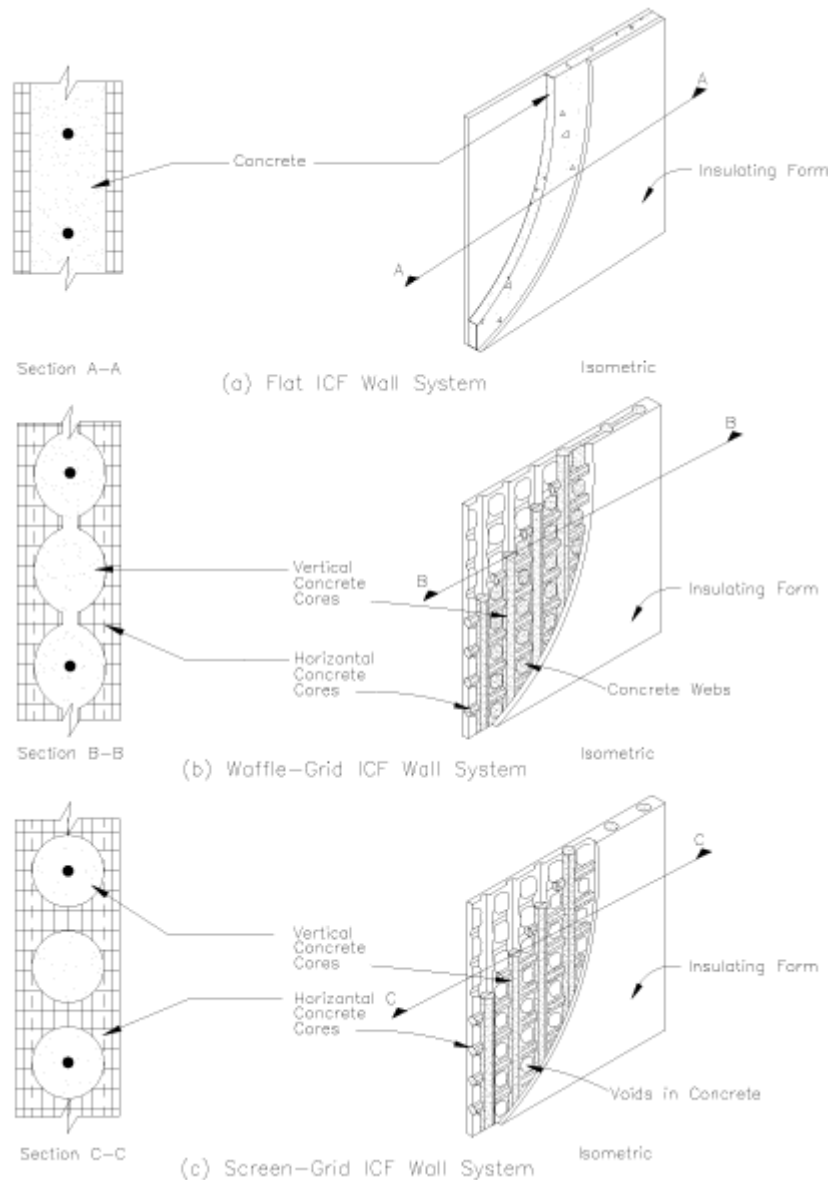


Figure 1 - ICF Wall Systems

construction provisions in the International Residential Building Code, 2000 Edition, published by the International Code Council (copies available through www.icbo.org, www.sbcci.org, or www.bocai.org).

Why consider ICFs?

ICFs have gained increased consumer appeal and market share in recent years for several reasons. First, there is a market segment that is willing to pay more to get more. In the case of ICFs, "more" is perceived by manufacturers and consumers to mean more thermal efficiency, more structural integrity (safety), more quietness, and more durability. Several time-and-motion studies of the construction method have shown that cost premiums for experienced users are typically in the neighborhood of 3 to 5 percent of the total house and land sales price or 6 to 7 percent of the house cost, depending on the ICF system used and the style of the house. There is no reason to suggest that there should be a design cost premium with the resources that are now available to assist designers, including direct manufacturer technical support.

In comparison to wood frame homes meeting only minimum thermal insulation requirements, energy savings for ICF homes are in the neighborhood of 20 percent (primarily due to a higher R-value provided by the foam stay-in-place forms). Recent studies have also shown, as would be expected, that ICF homes tend to lower interior noise levels from exterior sources (such as sirens or traffic or airplanes). However, overall noise reduction is very dependent on design considerations such as "sound tightness" and number of windows and doors. These recent studies can be found on the U.S. Department of Housing and Urban Development's publication web page, www.huduser.org.

Designing a home with ICFs

There are basically three resources available to guide the design of a typical ICF home application:

1. Prescriptive Method for Insulating Concrete Forms in Residential Construction;
2. Section R608 of the International Residential Code, 2000 Edition; and,
3. Manufacturer technical data.

The above resources and their availability were discussed previously in this article. For unique conditions, it may be necessary to use the concrete design specifications of standard ACI 318 - Building Code Requirements for Reinforced Concrete.

Armed with the above information, most design decisions regarding ICFs can be easily resolved by following prescriptive span tables and straight-forward reinforcement details. However, there are a few "design tips" that may be valuable to the first-timer or novice user:

1. More reinforcement is not necessarily better. Adding more reinforcement than required can hamper the proper placement and consolidation of concrete in ICFs. Much of the recent research on ICFs at the NAHB Research Center has focused on more efficient use of reinforcement in ICFs.
2. Lintels (or concrete headers) should be as deep as possible. When the lintel span-to-depth ratio is greater than 5, shear reinforcement or "stirrups" are needed.

- Stirrups can be very difficult to place in ICF forms and over-use can contribute to concrete placement and consolidation problems mentioned above.
3. Don't specify a very low slump concrete for use in ICF forms. Although this practice may slightly reduce the concrete strength, a slump of 6 is good for ICFs because it helps to achieve better concrete consolidation in the forms.
 4. Consider laying out building dimensions, windows, and doors to correspond with modular dimensions of the ICF materials being used. This design investment can provide savings in labor efficiency and waste reduction, particularly in house plans that will be used repetitively.
 5. Be sure to account for thicker walls in architectural plans and details, such as window jambs.
 6. Make sure that the contractor understands appropriate concrete placement practices and forming details related to the specified ICF system. A poorly planned construction endeavor can reflect badly on the ICF technology as well as the designer.
 7. A team approach involving the contractor-builder-manufacturer-designer-owner is encouraged. This means that the entire team should be included in the process as soon as possible after the design concept stage.
 8. Keep plumbing in the slab and route through floor and interior wall cavities to the greatest extent possible.
 9. Electrical wiring in the surface of ICF walls may be required to be protected (i.e., metal sheathed or placed in conduit) when installed in routed channels of the foam forms using a "hot knife" (usually available through the manufacturer). Also, electric switch and receptical boxes will need to be specified as "shallow depth" to fit with in the foam layer of an ICF wall.

Finally, there is no substitute for doing your own homework -- explore the resources mentioned in this article and become informed in the various attributes of ICF systems.

If you don't, you might get left behind.
