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Insulated Concrete Forms

Insulated Concrete Forms

Presented By: Fox Blocks
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Description: Provides an overview of ICF design, construction and environmental benefits.

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REGISTERED CONTINUING EDUCATION PROGRAM

Purpose and Learning Objectives

Purpose: Provides an overview of ICF design, construction and environmental benefits.

Learning Objectives:

At the end of this program, participants will be able to:

- list the components of an ICF wall, identifying any contributions to sustainability
- describe and compare the different ICF systems
- recall three necessary design steps, and describe the execution of build
- describe the impact of ICFs on a building's lifetime energy and maintenance costs and any possible LEED® contributions, and
- describe the effect of thermal mass on indoor temperatures and when this effect is most valuable.

How to Use This Online Learning Course

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Table of Contents

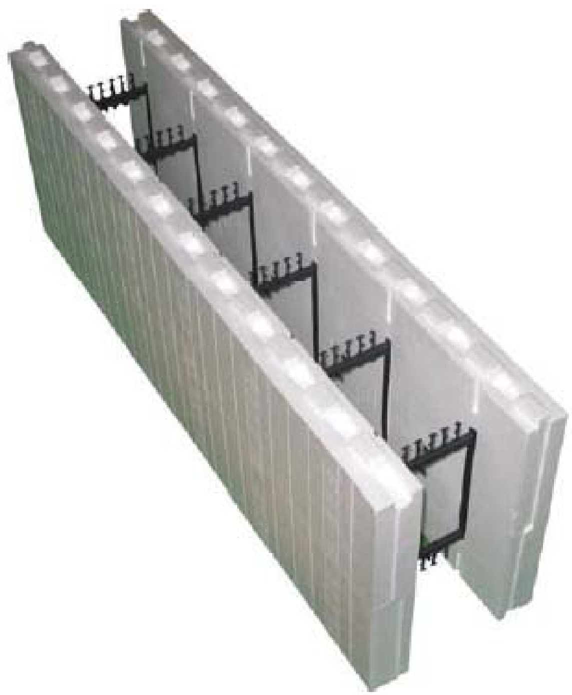
Click on title to view

Introduction to ICFs

ICFs and Sustainability

It is well recognized that the operation of buildings in the U.S. consumes 40% of the total energy used, and more than 73% of the electrical energy used. Therefore, design, construction and operation of buildings so as to use less energy is a significant step towards achieving a sustainable economy and society.

Insulated concrete forms are part of the change towards green construction and sustainable buildings.



ICFs

ICFs are permanent forms with the side panels of the formwork made of EPS insulation material. After the concrete cures, these insulated panels serve as the insulation component of the ICF wall. These types of walls have high continuous insulation values. This enables buildings with ICF walls to have excellent thermal performance, reducing energy consumption and costs of operation while maintaining a very comfortable interior environment.

ICFs are manufactured to form concrete walls with a predetermined thickness and shape. The structural function of the wall is provided by the concrete and rebar components, which form the reinforced concrete core. ICF panels are made from expanded polystyrene typically bridged by plastic ties. The ties act as furring strips for attachment of interior and exterior finishes, similar to traditional wood or steel studs.

Typically, these furring strips range in width from 7/8" to 1 ½". Most ICFs provide a continuous 1 ½"-wide vertical attachment strip, while some ICF tie attachment strips are not continuous and are interrupted by EPS every 12" or 16" vertically.

ICFs

The forms are designed and manufactured in a variety of types, pour widths and shapes and are tested and code approved to meet and exceed the demands. The ICFs are engineered to fit together with an interlocking connection that enables the forms to be stacked up to a specific design and wall height, creating a one-step, insulated, reinforced concrete wall assembly.

Components: Insulation

The ICF stay-in-place panels are typically EPS (expanded polystyrene) foam, although other form materials such as polyurethane, recycled wood fiber and cement mixtures exist. The foam is used to provide formwork for concrete placement and offer the added benefit of providing continuous wall insulation required in building codes. EPS has a typical R-value of 4 per inch or greater.

The EPS in an ICF wall provides energy savings throughout the operational life of the building and, in fact, returns 150 times the energy over the typical building lifetime. The energy savings in ICF applications are much greater than the energy saved by EPS in a single-use application.

EPS does not contain any CFCs or HCFCs and does not facilitate mold or mildew growth. It is stable in high moisture, high and low temperatures, and is not a food source for insects. It is also 100% recyclable where facilities exist.

EPS used for the forms contains no EPS regrind or post-consumer waste, as the contaminates could jeopardize the functional durability of the stay-in-place concrete form while holding back the liquid concrete pressures.

Components: Ties

Ties are typically plastic and are molded into the EPS foam at the factory. Ties are full form height, are spaced 8" on center vertically, and are 1 ½" wide.

Ties serve four key purposes:

- Determine concrete core width (4", 6", 8", 10", 12")
- Provide specific horizontal rebar placement
- Form support during concrete placement
- Full height attachment for interior and exterior finishes

ICF strength is directly attributed to the size and thickness of the form ties and the density of the EPS foam panels. By weight, most ICFs are 50% tie and 50% EPS.

Components: Concrete

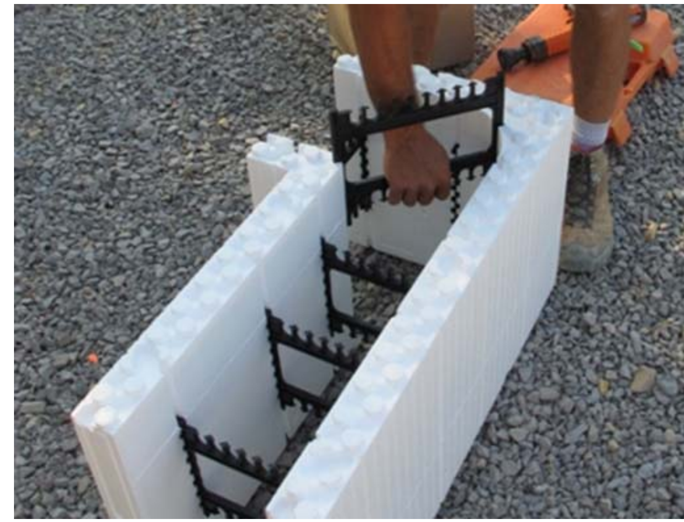
Concrete structures are very durable and should remain in active service for many decades longer than a traditional wood framed structure. This means the ICF walls provide the opportunity for lower up-front mechanical equipment costs, reduced long-term energy requirements and lower maintenance than typical wood or steel construction methods. Quite simply, early decisions made in the design of a building wall assembly can significantly reduce the ongoing energy costs of the building for its useful lifetime. In addition, the concrete mixes used for ICFs usually incorporate high percentages of fly ash, a 100% pre-consumer waste product.

It is acknowledged that the ICFs, rebar, and concrete have a significant embodied energy. However, taking into account the durability of the walls that provides both storm safety and public safety, and the extended service life of the building, the operational energy savings will provide a return of many multiples compared to the initial embodied energy of the walls.

Form Size and Shape

ICFs (blocks resemble a traditional concrete masonry unit (CMU), although they are typically six times the size (1 ICF = 6 CMU) and weigh approximately 75% less than 1 CMU. ICFs have three identifiable variables.

- Pre-assembled, arrive at the construction site ready to be installed
- Compact, arrive at the construction site in component parts, ready to be assembled prior to installation
- Interlock, reversible or non-reversible



ICFs are available in a range of concrete core thicknesses: 4", 6", 8", 10", 12" and greater in a comfort ICF. ICFs typically come in a straight form, 90-degree corner form, 45- degree corner form, and corbel/brickledge form. Additional unique forms now available are “T” form, radius, and curb form for use with hollow core concrete floor systems.

Form Size and Shape

The exterior shapes of the forms are block, panel or plank insulation. ICF blocks resemble a traditional concrete masonry unit (CMU), although the dimensions are typically much larger than CMUs. ICFs in blocks arrive on site ready to stack with their ties molded in place.

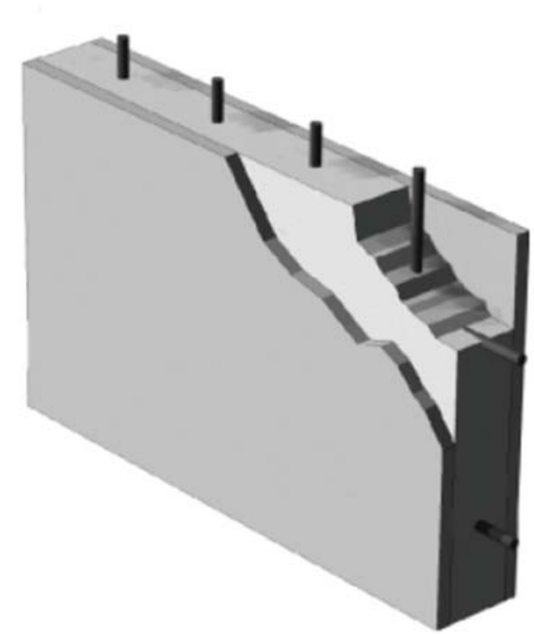
Panel-shaped forms are available in different sizes and resemble traditional plywood forms.

Plank systems differ from block systems in that they can be shipped flat, either because the cross-ties can bend or the cross-ties are inserted as the wall is constructed.

Flat ICF Wall System

This system is the most typical style of ICF in North America and is used 90% of the time. It has a solid concrete wall of uniform thickness with a nominal concrete thickness of 4", 6", 8", 10", 12" or more. The most typical flat wall ICF is the 4'x16" pre-assembled form, though some of these forms must be assembled at the jobsite.

Bracing of the ICFs and steel reinforcing (rebar) for the concrete is as required by the design engineer or the building code. The concrete walls formed by flat wall ICFs can be designed using the standard equations in ACI 318 and in Canada CAN/CSA A 23.3.



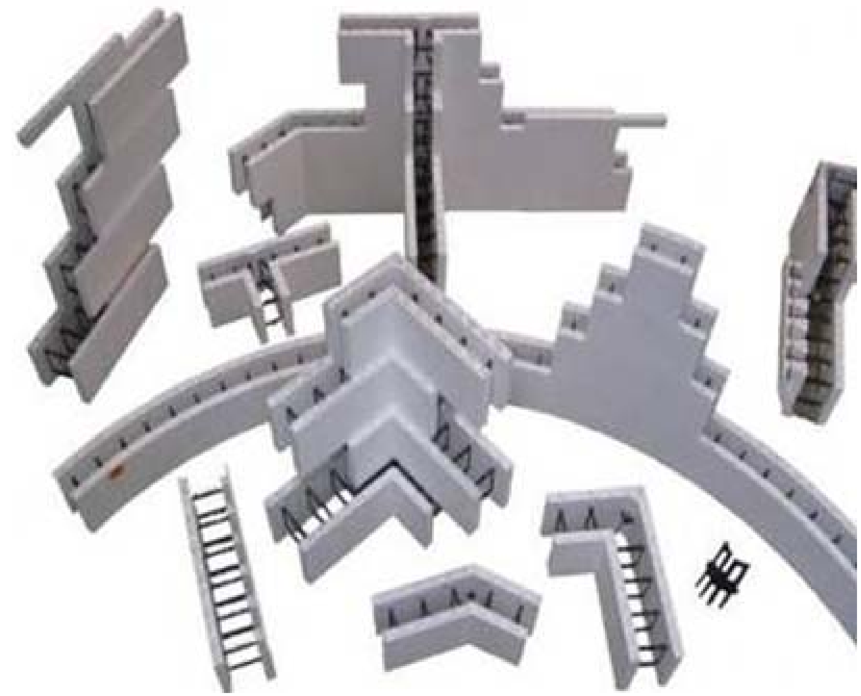
Source: Portland Cement Association, 2001

ICF Design and Construction

ICF Design

Very similar to working with LEGO®, ICFs offer that kind of design flexibility. Height, length, corners and turns—the forms can be easily installed to suit the project design requirements. There are a great many systems available, and the choice depends on your design and whether the variety of block sizes suits your needs.

ICFs come in concrete core thicknesses of 4", 6", 8", 10", and 12" with consistent EPS foam thicknesses. Specialty forms typically are supplied in the 4", 6", and 8" concrete cores.



ICF Design

Additional forms, which are available in some sizes, are: 45-degree corner forms, corbel forms (a cast ledge which can support brick veneer or floor systems), taper top forms (to create increased surface bearing area), half-height forms, T-blocks, height adjusters and radius blocks.

Use of ICF in a design should be incorporated as early as the schematic design stage. Wall thickness is thicker than standard stick build construction and must be considered, especially with interior walls.

Later on, project criteria will determine core size, plate heights, window elevations, rebar schedules and connection details.

Source: Klob, Robert J. "ICF Design 101." *ICF Builder Magazine*. http://www.icfmag.com/articles/features/icf_design_101.html Last accessed on January 25, 2012.

Design Flexibility

Tall walls

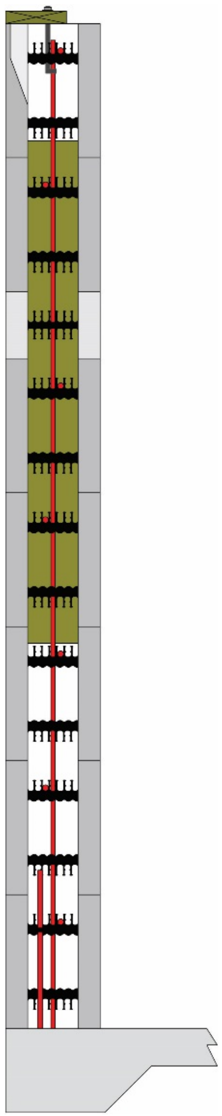
Gables and turrets

Radius walls

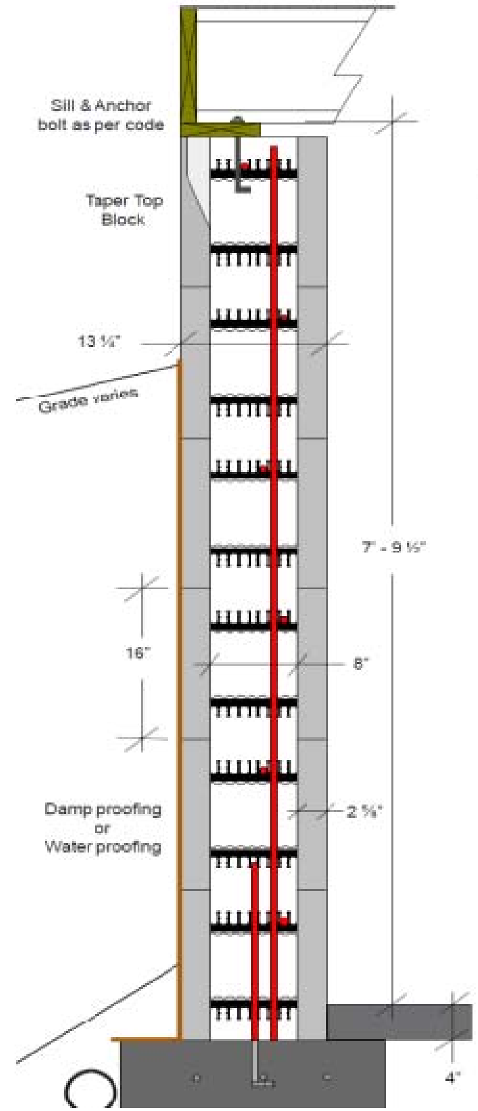
Manufacturer Supplies

The ICF manufacturer is able to supply documents on LEED, ENERGY STAR®, NAHBGreen and other Green Building Program associations and contributions. These are typically found on the manufacturer's website. While most architects are knowledgeable regarding local building code requirements, many ICF manufacturers can supply specific product code testing reports if needed. Intertek IRR, ASTM, Intertek, additional specific design details, installation manual, CSI specifications and in-office Lunch and Learn presentations are available.

Typical Details

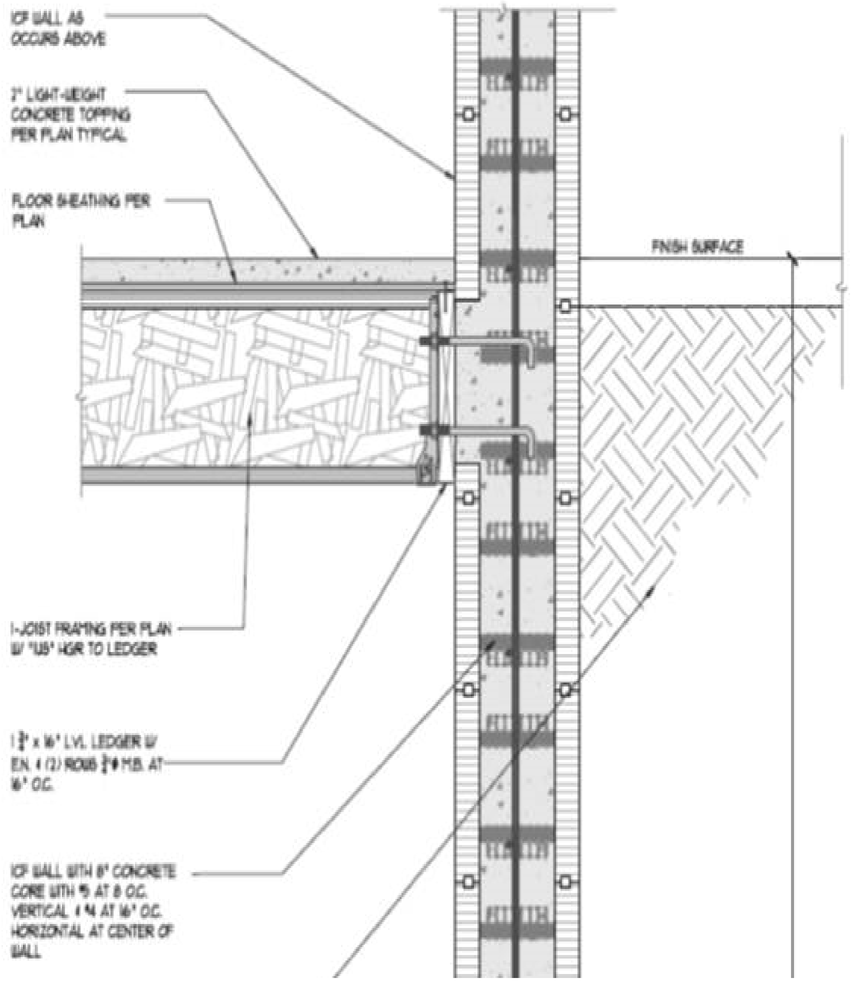


Footing

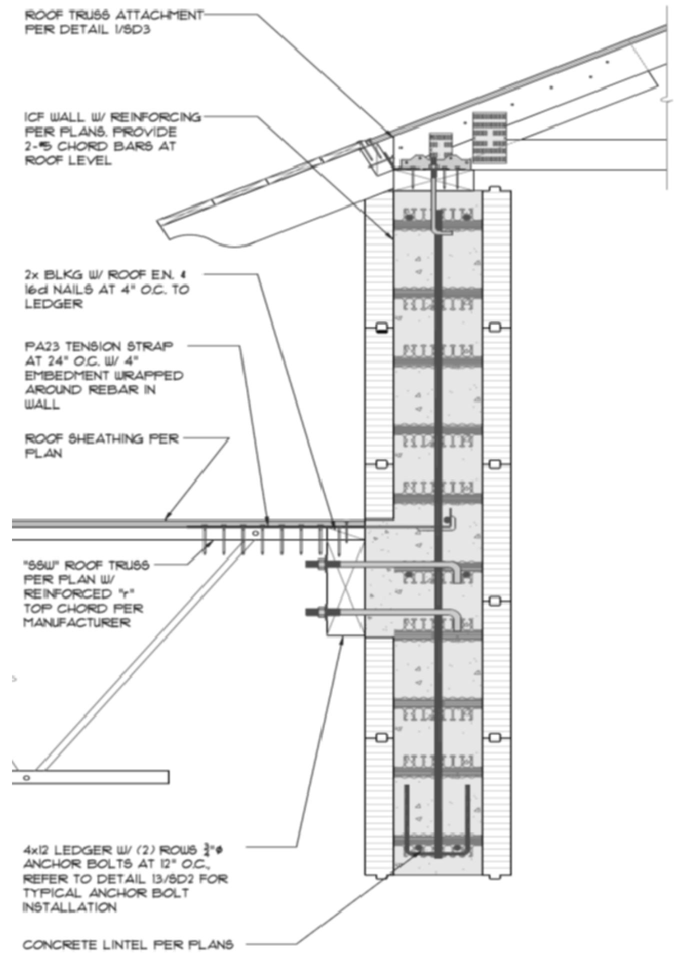


Below Grade

Typical Details



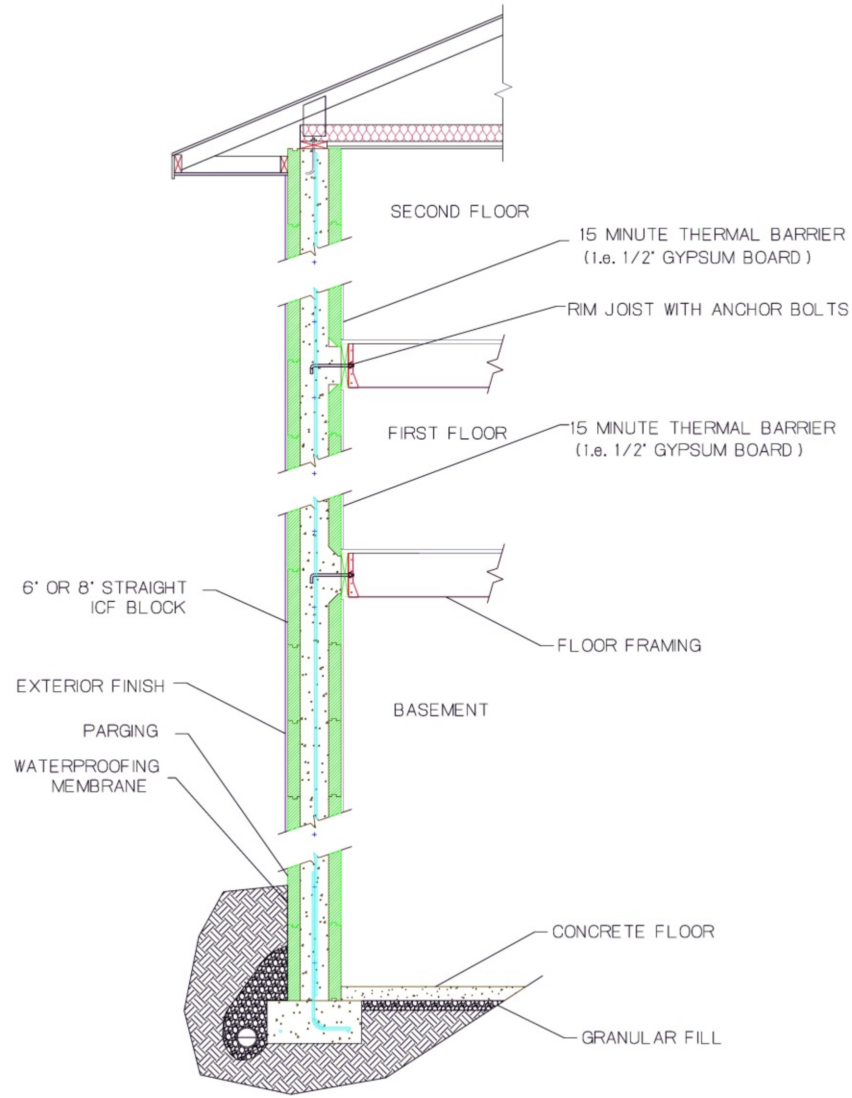
Floor



Roof

Pre-Construction

When constructing ICF walls, it is recommended that a wall elevation profile be prepared prior to the build to confirm the elevation of floors, windows and doors, etc., and determine how these will be located relative to the coursing of the ICFs. Potential issues can be identified and solutions found before the building process starts, saving time and money during the build.



Execution of Build

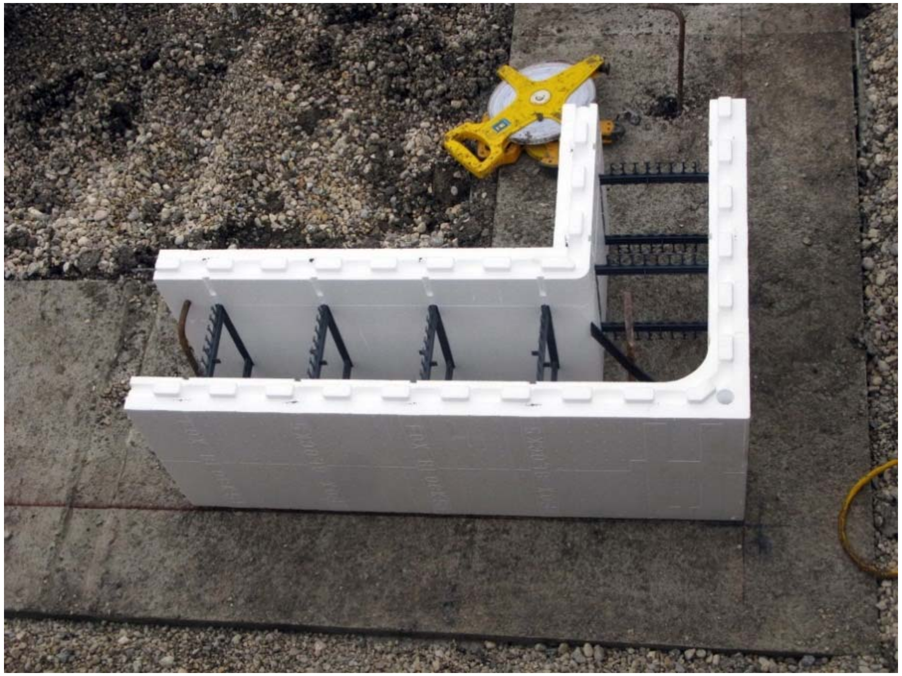
In general, ICF walls are stacked up on the same base as conventional construction. This may include footing, slab or even piles to distribute the load of the walls to the soils below. The specified rebar is placed in the cavity between the EPS panels and held in place by the 8" o.c. plastic ties. Concrete is then placed into the cavity and consolidated with a mechanical vibrator. The substantial reversible interlock between courses provides a tight fit between forms, making an easier build and reducing ICF waste on the jobsite.

The next few slides take you through an ICF build.

First Course Layout

When starting an ICF wall, place the first course of forms on the footing or the slab. It is recommended that the footing or slab be level to within + or – ¼". Clean the working surface, and complete your layout by squaring and chalking lines to work from.

First course placement starts at the corners. Proper vertical dowel spacing is needed to prevent dowels from interfering with the plastic ties during form placement, similar to CMU construction. The spacing of the dowels should be such that the dowels are located between the ties.



Reinforcement

Ties are designed to properly ensure horizontal rebar location during installation, and concrete placement per plan and specification. This photo shows horizontal rebar in position in the forms. As you can see from the photo, the rebar does not have to be tied into position; the rebar chairs hold it in place.

Reinforcement

Tying rebar is recommended when rebar is stacked in a way that it could be moved during concrete placement.

Second and Third Course

After the second or third course is installed, the wall height should be checked to confirm the wall is level. If it is not level, shims may be added below the lowest form or EPS cut from the bottom to correct for uneven footings. After the third or fourth course, wall bracing begins.

View of wall two courses high

Wall Openings

EPS foam, vinyl, steel, or wood bucking materials are fabricated for each location where an opening is required. The forms are then cut and fit around them and temporarily braced, plumb and level. Bucks are used to hold back the concrete and stay in place permanently, providing a fastening surface for the installation of windows and doors.

Additional lintel rebar is installed while the walls are built around door and window openings.

Bracing

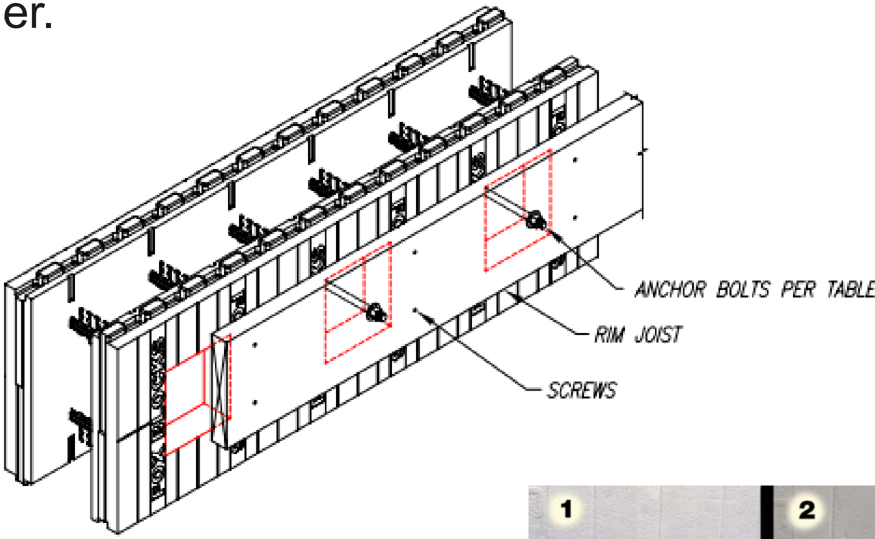
ICF bracing systems serve three purposes:

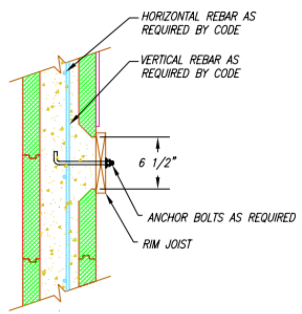
- They brace the wall during construction (temporary support).
- They are used to align the wall so that it is plumb and straight, and
- They provide a safe working platform for the crew (access scaffolding).

Bracing is installed at regular and inverse corners and then every 6'. There are many different ICF bracing systems available in the market.

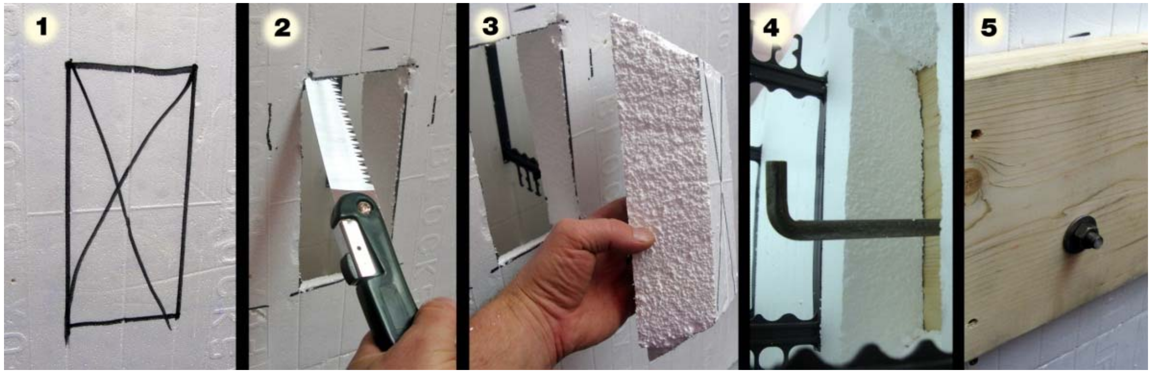
Embeds for Floor and Roof Attachments

Floor systems to be connected to the side of ICF walls are typically installed using a rim joist and joist hangers for the floor joists. There are a number of methods of attaching a rim joist. The rim joist can be connected to the wall using concrete bosses with embedded anchor bolts cast out to the inside face of the EPS, or the rim joist may be attached using a hanger.





WALL SECTION



Through Wall Penetrations

Openings required for utility services should be blocked out with sleeves prior to concrete placement. They can be accommodated by inserting an appropriate sized tube through the forms prior to concrete placement. These sleeves must be able to bear the weight of the concrete without being crushed. The photo on the right shows an example of a sleeve in position after concrete placement.

Concrete Pour and Consolidation

The most convenient concrete placement method is with an overhead concrete placement pump.

Concrete Pour and Consolidation

Concrete should be placed with a constant, moderate and steady flow using two or three lifts of 3' to 4' in height. The time between placements of lifts should be a minimum of 30 to 60 minutes.

Concrete Pour and Consolidation

Proper jobsite concrete consolidation is required and can be accomplished by either internal vibration or external vibration. Each lift should be properly consolidated immediately after concrete is placed.

For second and subsequent lifts, the vibrator should be lowered to the point that it causes mixing of the top of the previous lift with the lift just placed to avoid a cold joint being formed. Consolidate concrete at all windows and door bucks completely with both internal vibration and external tapping, especially at the top corners of bucks.

Concrete Mix Design

Concrete used in the footings and the ICF walls must have a minimum design strength specified by the approved project plans or local-municipal building codes. The use of a mid-range water reducer/plasticizer and fly ash mix designs is encouraged.

Recommended concrete mix design for ICFs:

- 4" ICF - 3/8" maximum aggregate
- 6" ICF - 3/8" to 1/2" maximum aggregate
- 8" ICF - 1/2" to 3/4" maximum aggregate

Required slump:

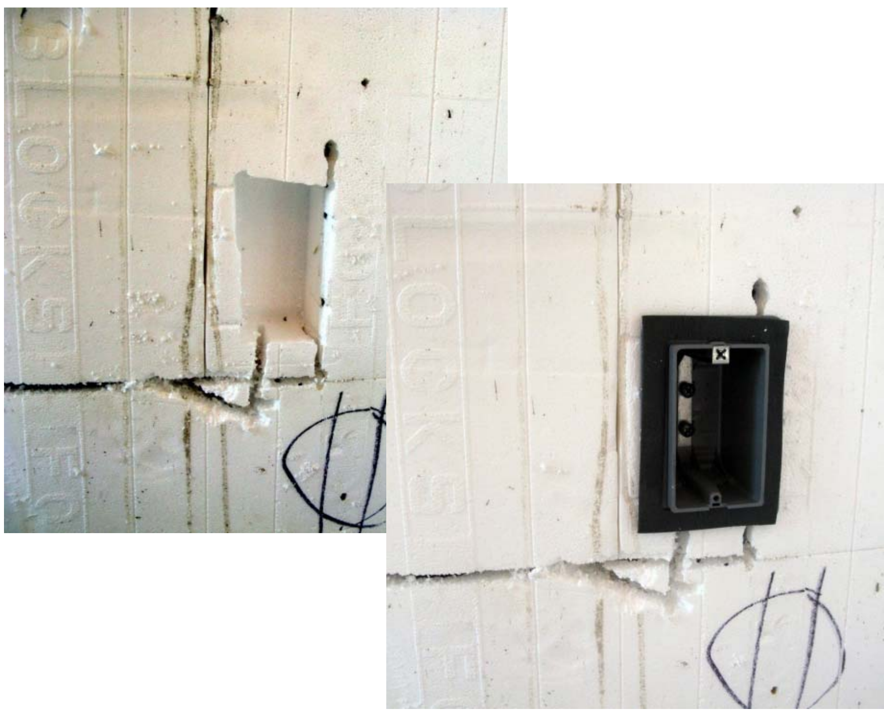
- 4" ICF - 6" to 7"
- 6" ICF - 5.5" to 6.5"
- 8" ICF - 5" to 6"
- 10" ICF - 5" to 6"
- 12" ICF - 5" to 6"

Floor and Roof Connections

ICF walls are compatible with many different systems including Hambro, wood, steel, hollow core, and concrete.

Utility Installation

These photos show how electrical wires, conduit and boxes, and plumbing can be inserted into the EPS, by cutting out the EPS. After the concrete has hardened, channels for electrical wiring are cut through the EPS, using a hot knife, router, grinder or electric chain. Plumbing pipes may be run through the EPS by removing the EPS after the concrete has hardened to create the space for the pipe(s). Bear in mind that the outside diameter of the pipes and connections must not exceed the thickness of the EPS foam.



Finish Compatibility

A wide range of exterior finishes can be used with ICF walls: drywall, hardened materials, brick and stone masonry, siding, acrylic stucco, cementitious stucco. Forms are designed with furring strips embedded in the EPS. Exterior finishes can be attached to the furring strips in the EPS in a similar fashion as would be typically done with frame walls. If any additional anchorage is required, concrete fasteners can be used to fasten directly into the concrete wall. Typical EIFS lamina can be installed directly to the EPS. In all cases the window/door and other penetrations must be properly flashed and caulked where necessary to direct water to the exterior wall surface.

Brick Finishes

ICFs are compatible with brick or brick veneer exterior claddings. When using full brick, the ICF brick or corbel ledge form can be used to create a one-step, built-in brick ledge. Brick ties are easily embedded into the concrete core for strength and stability.

Stucco

Both acrylic and cementitious stucco are compatible with ICFs. As well, additional EPS moldings can easily be added to achieve desired architectural aesthetics.

Applying Drywall

Similar to the exterior, the interior finishes are typically mechanically fastened with screws to the furring strips. The interior of ICF walls must be finished with a thermal barrier. The most convenient material is ½" sheet rock (gypsum board), as it is recognized by the building codes as providing a 15-minute thermal barrier.

Cementitious ICF Hardened Coatings

An alternative to drywall for the required thermal barrier is abuse resistant fire-rated coatings. These are hardened coatings with fire resistance.

They must provide the thermal barrier requirements as specified by codes in the USA or Canada.

Benefits of ICF Construction

Design Flexibility

There are a range of benefits to choosing an ICF system, including overall speed of construction and efficiency of installation. Forms are easily cut and installed to work with building plan design and details.

Light Weight Advantage

ICFs are also light weight, when compared to CMUs. One ICF straight form unit weighs 5 lbs. and delivers 5.33 s/f of wall. One CMU with equivalent wall square footage requires six units weighing 140 lbs. (mortar not included).

Reduction of Labor/Man-Hour Rates

Because of this light weight, there is little heavy lifting or transporting of equipment, and no heavy metal forms to transport, strip and maintain.

Jobsite labor can be quickly trained to become certified ICF installers.

ICFs are much lighter than traditional reusable form systems. This photo shows one man handling a bundle of ICFs.

Typical Costs

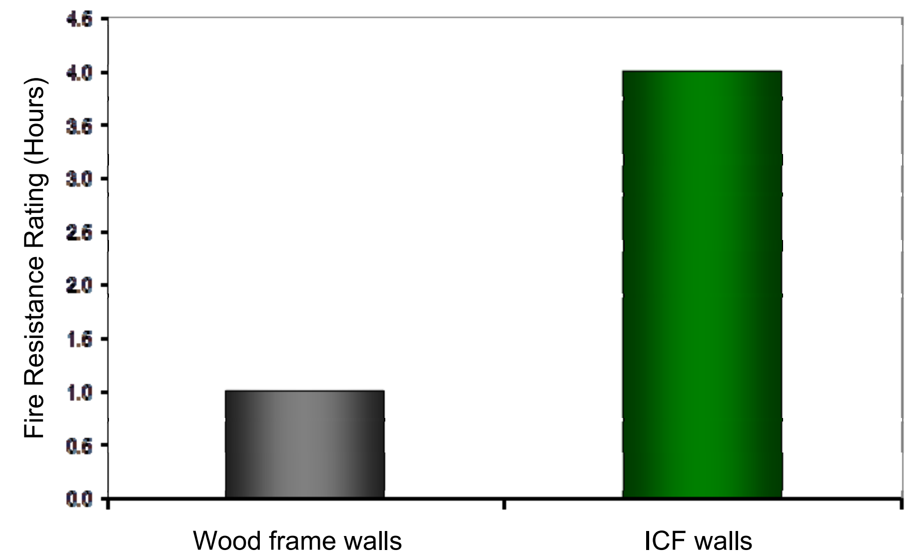
The following is a budget costing per gross square foot of ICF wall surface area installed—subcontractor labor rates.

Insulated Concrete Forms	$3.50
Concrete, Rebar, Bucks, Hardware	$3.75
Boom Pumping, Bracing, Shipping	$2.75
Labor, Insurance, Sub & Gen markup	$5.00–$7.50
Installed ICF Walls, excluding finishes	$15.00–$17.50

Fire Ratings

Some ICFs have Fire Resistance Rating (FRR) listings of up to four hours.

Third-party U.S. testing of the expanded polystyrene shows that the flame spread index (FSI) is less than 25. The maximum by code is 75. The smoke development index (SDI) is less than 450, which also meets code.



Lower Lifetime Maintenance Costs

ICFs have lower lifetime costs. They do not provide conditions which are conducive to the growth of mold, and they do not provide food value for termites or vermin. The concrete generally has minimal shrinkage and/or expansion, thus minimizing drywall screw pops and stucco cracking.

Air Infiltration

Over half the energy loss within 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.

Air infiltration coming from these gaps is typically around .5 ACH (air changes per hour), which means that each hour, half the volume of the house is exchanged for outside air that needs to be heated or cooled.

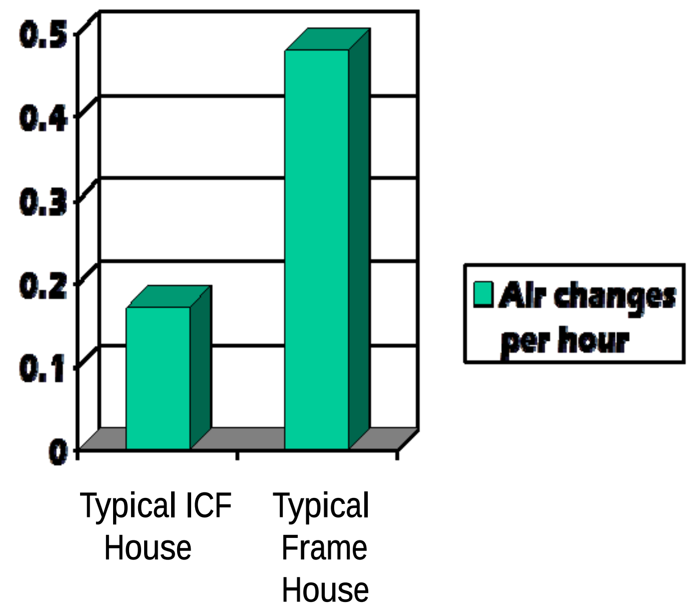
There are several ways to combat air infiltration. Blown-in or spray-on insulation can help eliminate the gaps around wood studs. However, no amount of blown insulation will address the thermal bridging caused by the wood studs.

ICFs meet newer building code requirements by providing solid wall continuous insulation.

Source: ICFA. "The ICF Effect." http://www.forms.org/images/cmsit/fckeditorfile/icfa%20tech%20-%20icf%20effect(1).pdf. Last accessed on July 6, 2012.

Air Tight

ICFs provide a ready solution to these problems. The monolithic concrete core forms a tight air barrier with openings which are easy to identify and seal. Time has no impact on these materials. The foam has a consistent R-value for the full life of the wall.



Source: ICFA. “The ICF Effect.” http://www.forms.org/images/cmsit/fckeditorfile/icfa%20tech%20-%20icf%20effect(1).pdf. Last accessed on July 6, 2012.

R-Value

R-value of a material is based on laboratory testing of a sample choice. It does not take into account gaps or variations of 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). In this case, the combined R-value is less than the tested value of the insulation component.

By comparison, the R-value of an ICF wall is constant. The foam form and its associated R-value is continuous by necessity as a forming system. For example, an R ICF system performs at a true R-23.5 level.

Source: ICFA. "The ICF Effect." http://www.forms.org/images/cmsIT/fckeditorfile/ICFA%20Tech%20-%20ICF%20Effect(1).pdf. Last accessed on July 6, 2012.

Thermal Mass

The ICF concrete core offers 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 a building. This combination serves to reduce and delay peak loads, which may result in lower off-peak energy pricing and reduced HVAC equipment size. This effect is primarily valuable in climates with large daily temperature swings.

Also, the mass wall can release absorbed heat energy to the cooler night air, a process called heat flow reversal.

★ Please remember the **exam password ENERGY**. You will be required to enter it in order to proceed with the online examination.

Source: ICFA. "The ICF Effect." http://www.forms.org/images/cmsit/fckeditorfile/icfa%20tech%20-%20icf%20effect(1).pdf. Last accessed on July 6, 2012.

Indoor Air Quality

ICF walls, with their reinforced concrete core, function as a very effective air barrier. This, when combined with the thermal performance of the walls, results in buildings which can be readily designed and constructed to have consistent interior air quality, less impacted by variable infiltration of outside air. A better ability to control indoor air quality reduces possible reactions to respiratory allergies, asthma, and other related health concerns.

ICFs contain no CFCs, HCFCs, or formaldehydes. Because this type of construction has a very low level of air infiltration, air handling and filtration HVAC components are more efficient. In fact, in ICF buildings, HVAC systems are typically downsized by 20–30%.

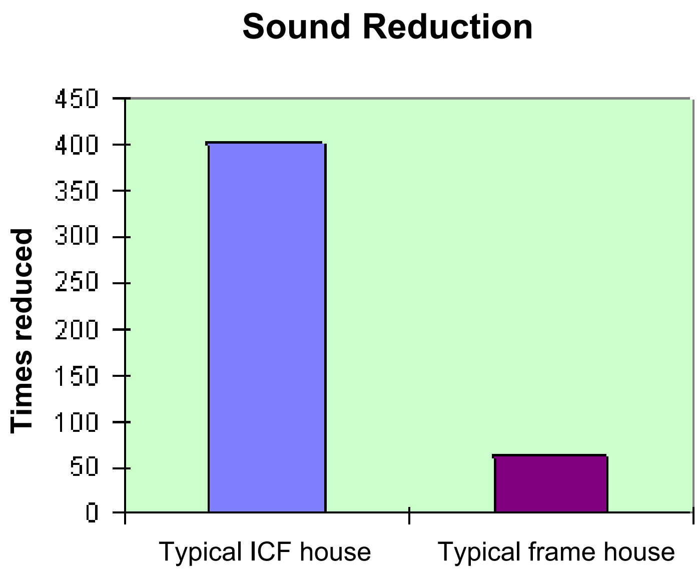
The EPS foam of the ICF panels doesn't support either mold or mildew. ICF construction meets the requirements of the American Lung Association's Health House.

Energy Savings and Noise Reduction

In an ICF building, the superior insulation, air tightness, and mass of the walls cut the amount of energy needed for heating and cooling by 30–40%. Over the lifetime of a building, that calculates to significant energy savings.

In addition, it allows the installation of smaller HVAC equipment. The reduction of HVAC equipment lowers overall initial construction costs.

The continuous monolithic reinforced concrete wall provides a STC 50 wall rating producing quiet, solid, safe walls. Most ICF walls are rated at STC 51 – 52 with ½” gypsum board both sides.



Compared to a typical wood frame wall, only about one-quarter to one-eighth as much sound penetrates through an ICF wall. Scientists would describe loud speech on the opposite side of a frame wall as “audible, but not intelligible.” On the opposite side of an ICF wall, a listener would “strain to hear” loud speech. It would be virtually “inaudible.”
Source: Portland Cement Association. “Technology Brief 6: Comfort and Quiet with Concrete Homes.” *Cement.org.* http://www.cement.org/homes/brief06.asp Last accessed on July 10, 2012.

LEED® Contributions

Sustainability Initiatives

Energy efficient buildings are buildings which, through their design, construction and operation, consume less energy than typical buildings in a region. As noted earlier, buildings consume 40% of the total energy used in the U.S. and 60% of the electricity used in the U.S. Achieving savings in the energy performance of buildings will have a big impact on the reduction in use of energy, reduction in release of greenhouse gasses and improved energy security.

There are many local and state or provincial energy reduction programs. Check with your municipal levels of government and your state or province. Also, the utility companies in your region many have programs or information about locally available programs.

One of the most recognizable voluntary programs is USGBC’s Leadership in Energy and Environmental Design (LEED®) green building certification program.

Overview: LEED® Certification

The U.S. Green Building Council (USGBC) is a 501(c)(3) non profit organization composed of leaders from every sector of the building industry working to promote buildings and communities that are environmentally responsible, profitable and healthy places to live and work. USGBC developed the LEED (Leadership in Energy and Environmental Design) green building certification program, the nationally accepted benchmark for the design, construction, and operation of high performance green buildings.

LEED credit requirements cover the performance of materials in aggregate, not the performance of individual products or brands. Therefore, products that meet the LEED performance criteria can only contribute toward earning points needed for LEED certification; they cannot earn points individually toward LEED certification.

For detailed information about the council, their principles and programs, please visit www.usgbc.org.

LEED Contributions

ICF construction may contribute to the current LEED protocol, LEED NC 3.0, in the following categories:

- Sustainable Sites:
    - Credit 5 - Reduced Site Disturbance. ICFs reduce impact to a construction site as wall bracing is commonly placed on the interior of the wall.

- Energy & Atmosphere:
    - Credit 1 - Optimize Energy Performance. The primary contributions of ICF construction lie within this credit. ICFs are capable of providing significant gains over energy code baseline performance. The energy effectiveness of an ICF wall is due to the unique synergy of continuous insulation, virtually no air infiltration and the added thermal mass of the concrete wall. A maximum number of points within this category can be achieved by designing a high performance building envelope which includes ICF construction.

LEED Contributions

ICF building envelopes contribute significantly to energy savings over light frame construction methods and over the national energy code, the baseline for calculating percentage gain. Energy use analysis shows an ICF envelope is a major contributor to better efficiency over the national baseline, and could potentially contribute up to 75% of the points within EA Credit 1.

		Energy & Atmosphere	**35 Points**
Y	Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
Y	Prereq 2	**Minimum Energy Performance:** 10% New Bldgs or 5% Existing Bldg Renovations	Required
Y	Prereq 3	**Fundamental Refrigerant Management**	Required
	Credit 1	**Optimize Energy Performance**	1 to 19
		12% New Buildings or 8% Existing Building Renovations	1
		14% New Buildings or 10% Existing Building Renovations	2
		16% New Buildings or 12% Existing Building Renovations	3
		18% New Buildings or 14% Existing Building Renovations	4
		20% New Buildings or 16% Existing Building Renovations	5
		22% New Buildings or 18% Existing Building Renovations	6
		24% New Buildings or 20% Existing Building Renovations	7
		26% New Buildings or 22% Existing Building Renovations	8
		28% New Buildings or 24% Existing Building Renovations	9
		30% New Buildings or 26% Existing Building Renovations	10
		32% New Buildings or 28% Existing Building Renovations	11
		34% New Buildings or 30% Existing Building Renovations	12
		36% New Buildings or 32% Existing Building Renovations	13
		38% New Buildings or 34% Existing Building Renovations	14
		40% New Buildings or 36% Existing Building Renovations	15
		42% New Buildings or 38% Existing Building Renovations	16
		44% New Buildings or 40% Existing Building Renovations	17
		46% New Buildings or 42% Existing Building Renovations	18
		48% New Buildings or 44% Existing Building Renovations	19

LEED Contributions

- Materials & Resources:
    - Credit 2 - Construction Waste Management. During the construction phase, there is typically significantly less waste generated at jobsites, as the reversible interlock enables most cut-offs to be used elsewhere in the build. This more efficient use of materials reduces the environmental impact associated with construction. ICF walls have a very low waste factor of 2–5%.
    - Credit 4 - Recycled Content. This credit is applicable for ICF manufacturers who have 100% recycled content in the plastic ties. LEED calculates recycled content by weight. In the reinforced concrete core, the steel rebar is generally over 80% post-consumer recycled content.
    - Credit 5 - Local/Regional Materials. The aggregate in the concrete mix will generally qualify.

LEED Contributions

- Indoor Environmental Quality:
    - Credit 7 - Thermal Comfort. Using ICFs for the building envelope can reduce temperature and humidity variables, and facilitate the maintenance of the comfort ranges specified.

- Innovation & Design Process: Potential exists to utilize ICF walls with their high performance characteristics in new, innovation applications/designs and earn additional credits.

Conclusion

If you desire AIA/CES, state licensing or CE credits for another organization, please click on the button to commence your online examination. A score of 80% or better will allow you to print your Certificate of Completion; you may also go to your AEC Daily Transcript to see your completed courses and certificates.

For additional knowledge and post-seminar assistance, click on the Ask an Expert link above.

If you have colleagues that might benefit from this seminar, please let them know. Feel free to revisit the AEC Daily website to download additional programs from the Online Learning Center.

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