

# Designing with Insulated Concrete Forms (ICF)

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# Designing with Insulated Concrete Forms (ICF)

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Presented By: Amvic Building System  
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Description: Provides an overview of the construction flexibility features of insulated concrete forms (ICFs) which provide innovative solutions for designing sustainable, energy efficient, safe, healthy commercial and residential structures.

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## Learning Objectives

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Upon completing this course, you will be able to:

- discuss insulated concrete forms (ICFs) as a construction technology and recognize its contribution to a sustainable built environment
- explain the benefits ICF construction can provide to commercial building occupants and residential homeowners in terms of providing strong, safe, healthy structures
- explain the benefits ICF construction can provide to builders in terms of strength, performance, safety, ease of construction, reduced costs and labor-saving design
- utilize and apply the design flexibility features of ICFs to design commercial and residential structures with interior and/or exterior walls which are fire resistant, mold resistant and offer protection from the elements, and
- identify additional green building benefits of using ICFs and discuss how the use of ICFs in construction can contribute to the LEED® certification of a building project.

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## Introduction to ICF

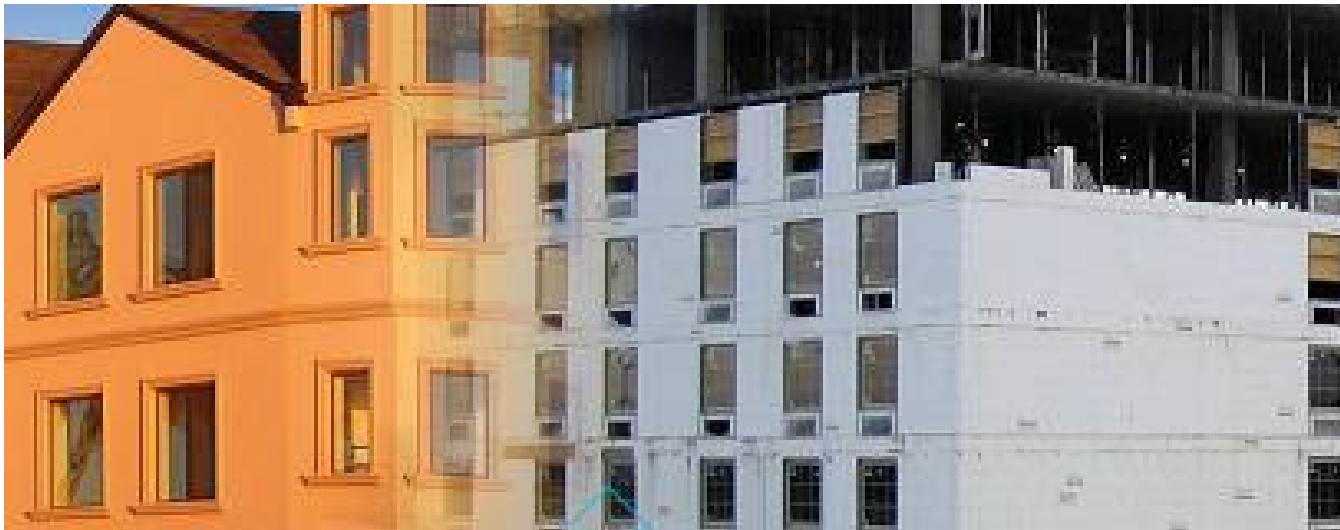
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## ICF Overview

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Insulated concrete forms (ICFs) are stay-in-place forms designed for the construction of reinforced concrete walls. They are often used in place of traditional concrete forming, tilt-up, and masonry walls.

ICFs are stacked together, steel rebar is inserted, braced, and then filled with concrete. This creates a stable, durable, and sustainable structure. ICFs have been in use in North America for over 40 years.

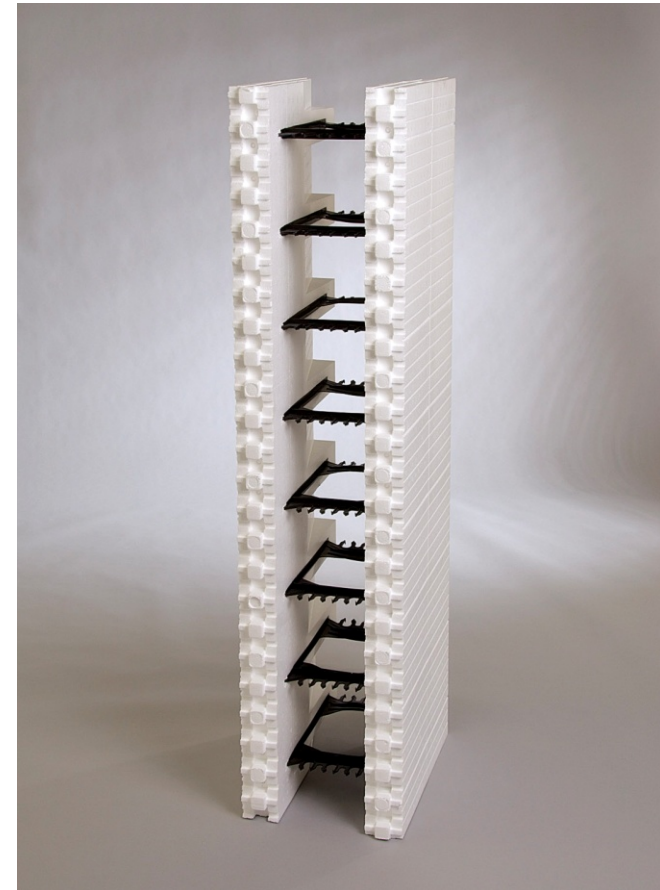


## ICF Overview cont'd...

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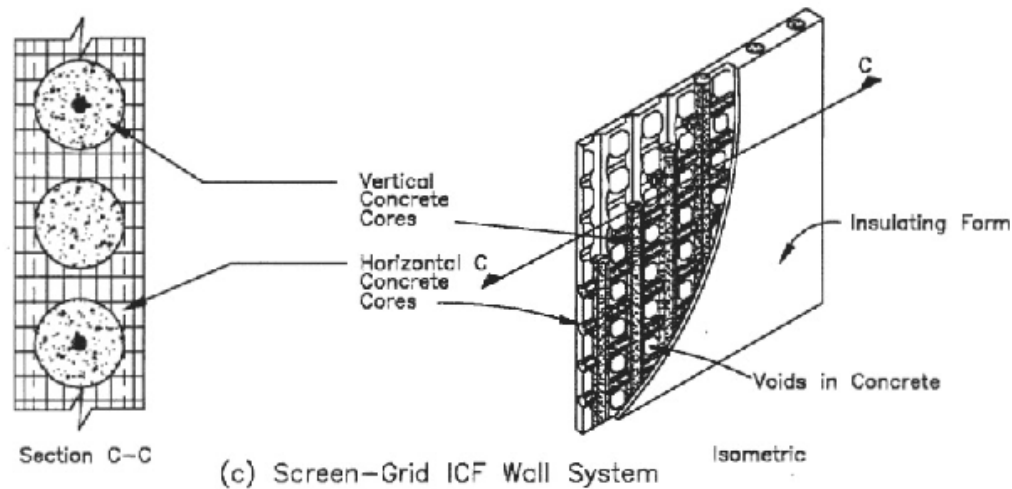
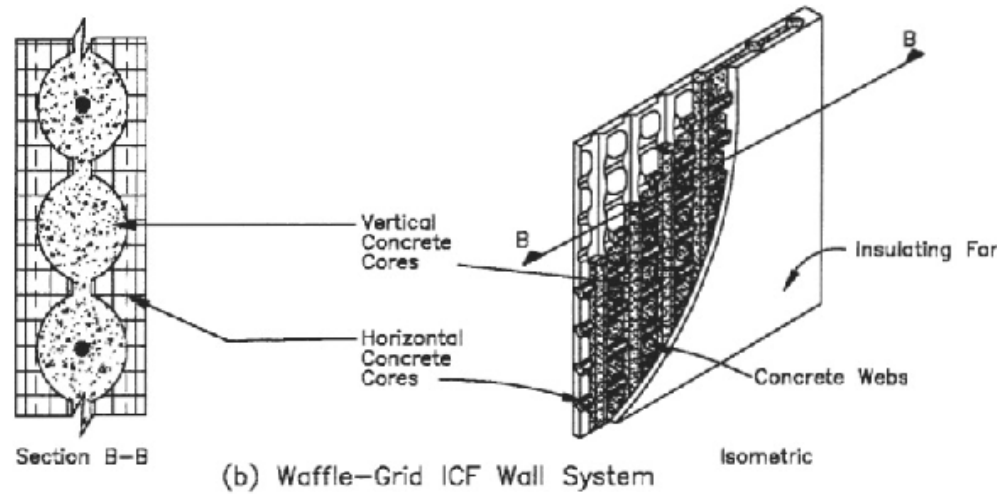
Typically, ICFs are made of two expanded polystyrene (EPS) panels that are connected by either steel or plastic ties, which may also serve as furring strips (for interior and exterior attachments) and steel reinforcement holders.

Some ICFs are delivered preassembled, while others require assembly on site. Compared to collapsible forms, pre-assembled ICFs cost more to ship; however, they save considerable labor during construction and offer superior strength.



# Types of ICFs

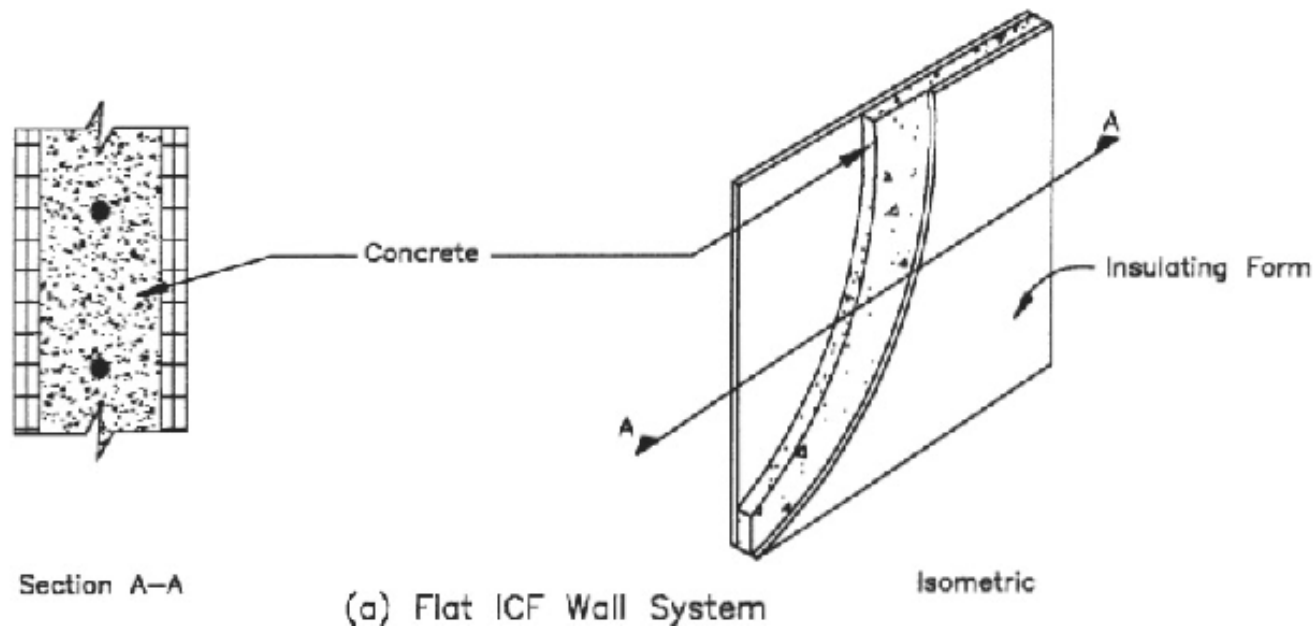
There are three different types of ICFs available including flat wall, waffle grid and screen grid systems.



## Types of ICFs cont'd...

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Of all three types, flat walls make the strongest walls, and as a result, they will be the focus of the remainder of this presentation.



## Flat Wall ICF System Wall

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To put this in perspective, a flat wall ICF system wall is simply:

- a cast-in-place conventional concrete wall
  - wherein the form stays in place afterwards,
- and
- the form provides insulation
  - the web provides an imbedded furring strip to which to attach claddings and fixtures, and
  - the utilities are placed into grooves or recesses cut into the foam, not the concrete.

From a structural point of view, an ICF wall is a cast-in-place reinforced concrete wall ... same as has been built for the last 100 years.

## High Performance Features

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ICFs are made of two sides of expanded polystyrene (EPS) held together by either steel or polypropylene webs, which together provide a “5 in 1” system incorporating:

- structure
- insulation
- framing
- a vapor barrier, and
- a sound barrier.

This “5 in 1” system reduces the number of steps involved in exterior wall construction which results in a decrease in labor costs.



## High Performance Features cont'd...

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ICFs also provide a:

- 3+ hour fire resistance rating (based on a 6" concrete core)
- sound transmission class (STC) of 50+, and
- performance R value of 50+ (when the concrete thermal mass and air infiltration is included in conjunction with the insulation R value of 24.7).

Compared to alternative, more traditional methods of construction, ICFs offer the ability to design a safe, fire resistant, durable, high performance structure.

The performance features and benefits of using ICFs are discussed further in the next section of this presentation.

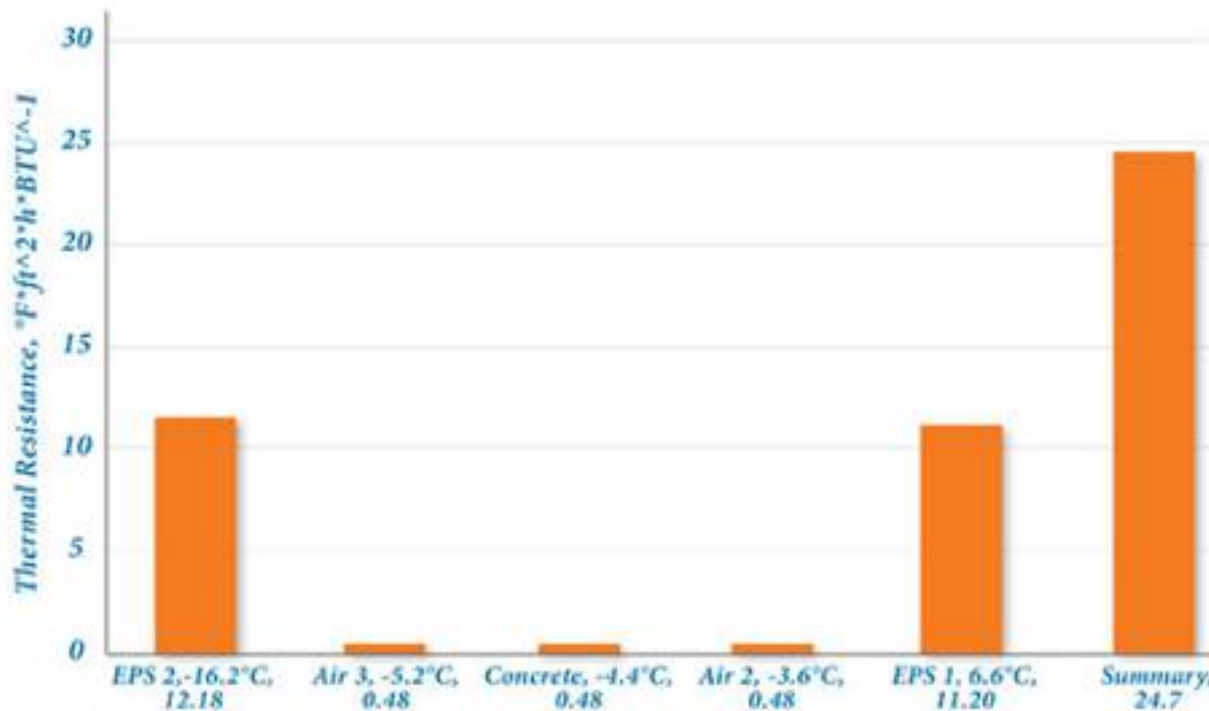


# R-Value of ICFs

This is an example of the r value of an ICF wall with only concrete and no interior or exterior finish. This example is for a northern climate.

**R-Value of typical ICF wall 24.7**  
11" wall without finishing

Northern Ontario - Zone 2

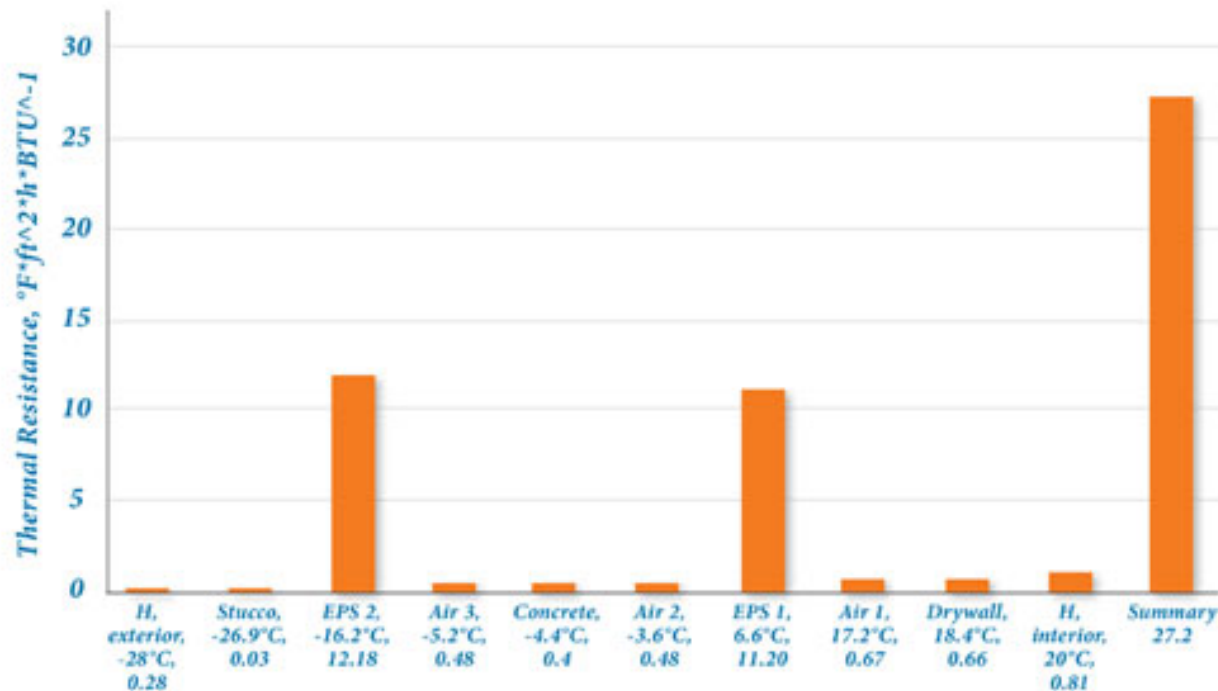


## R-Value of ICFs cont'd...

This example shows the r value of an ICF wall assembly with an exterior stucco and interior sheetrock finish; again it is in a northern climate.

### R-Value of typical ICF wall assembly 27.2 11" wall with stucco exterior finishing and sheetrock interior finishing

Northern Ontario - Zone 2



## Applications for ICFs

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The applications for ICFs are limitless; they can be used for virtually any type of construction including not only residential and commercial, but also institutional, hospitality, retail, storage and many more. The applications are endless and your only limitation is your imagination.



Strip mall



Warehouse



Barn

## Applications for ICFs cont'd...

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ICFs are a best fit situation where:

- the structure will have conditioned space
- the life cycle total cost of the structure is factored into the design
- concrete construction resolves problems that would be challenging with wood frame
- acoustic separation laterally and vertically is valued in the design
- minimizing ongoing energy consumption is valued
- photovoltaic power generation will be implemented - ICF reduces peak demand for A/C and allows a downsizing of the PV system
- a very air tight building envelope is desired to control infiltration of conditioned space,

and

- in passive solar designs to increase the thermal mass of the structure
- as a lower cost alternative to thick wall frame construction
- as an excellent system for sloped terrain, and
- in areas where there is a wildfire potential.

## Applications for ICFs cont'd...

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ICFs probably don't fit where:

- the structure will have unconditioned utility space
- the exposed unfinished concrete is the desired external finish (parking garages, etc.), and
- lowest cost initial construction is the driving factor without regard to lifecycle maintenance costs or ongoing energy costs.

## Residential Construction

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Insulated concrete forms are often used for custom homes as well as multi-family and multi-story structures in residential construction. For these types of residential applications, ICFs are mainly used for exterior walls, but in some cases for partition walls as well.

They can be used for the entire structure, from foundation to top plate, including basements. In addition, insulated concrete forms can be used in combination with other types of construction such as frame or panel.



## Commercial Construction

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For commercial applications, ICFs are not only used for exterior walls, but can be used also for interior walls to provide shear walls or thermal, sound, and fire barriers between areas. ICF construction can be used for unlimited heights, subject to engineering design.



## ICF Construction Benefits

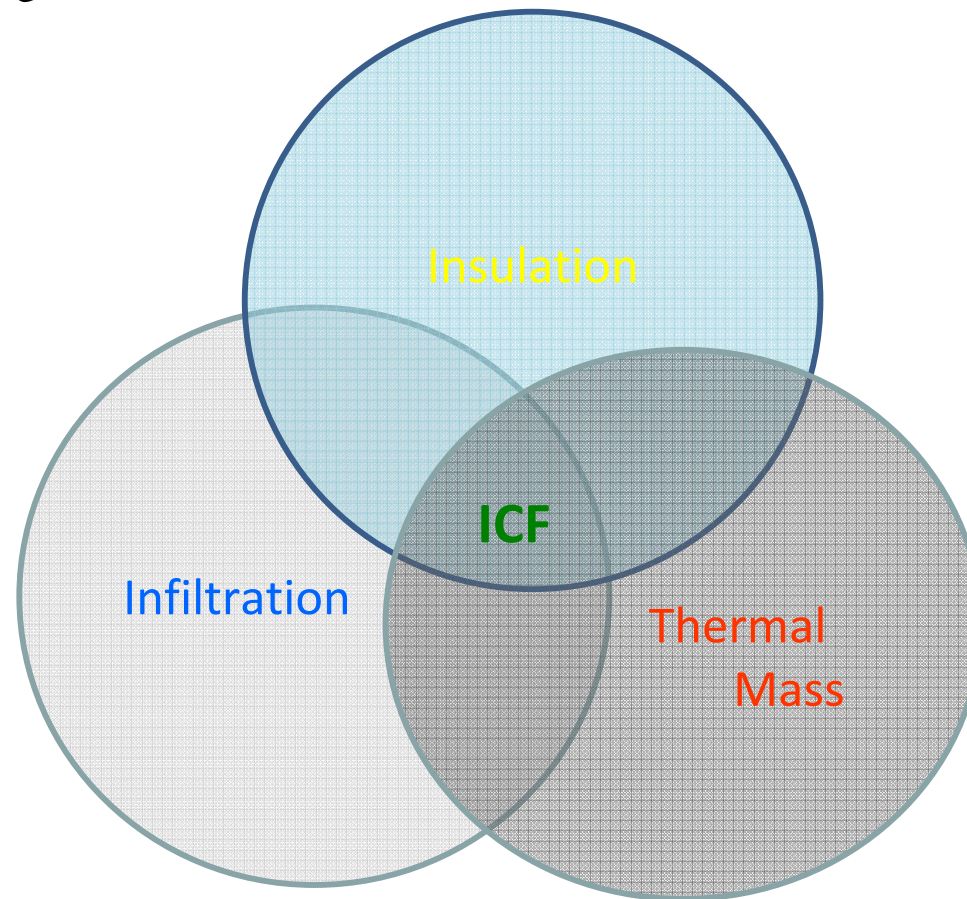
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- ICFs are a breakthrough technology making concrete wall construction economic and efficient in the residential market space.
- ICFs are a system that addresses all three of the issues that affect the energy efficiency of a building envelope, namely:
  - High thermal mass
  - High insulation
  - Low infiltration
- In virtually all climate zones, ICFs contribute positively to a more comfortable dwelling with reduced energy costs.
- In hot weather with cooler nights, the thermal mass facilitates implementation of night time pre-cooling strategies that delay the building temperature rise during the day, and avoid substantial energy needs for cooling.
- During the heating season, the thermal mass of the walls assists in storing day time heat generated by passive solar and allows release throughout the night.
- ICFs have been called “the thinking man’s adobe” - a modern material that offers the thermal advantages long understood in earlier times.

## ICF Construction Benefits cont'd...

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*Three key elements define the thermal performance of a building*



ICF provides a pathway to include valuable substantial thermal mass in a building without excessive cost.



## ICF Features and Benefits

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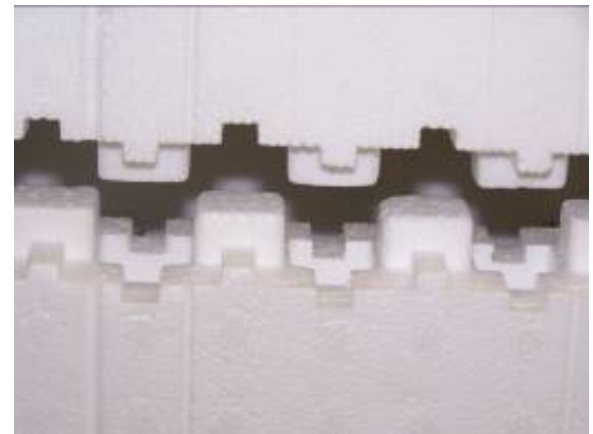
## Benefits to Builders

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### 1. Reduce construction time and labor costs

Projects which use ICFs require fewer man hours to complete, thus reducing overall construction time and project costs.

- A “5 in 1” system, as previously mentioned, incorporates structure, insulation, vapor barrier, sound barrier, and studding, eliminating various stages in the construction process.
- The form locking technology and polypropylene webs eliminates the need to glue, tape or tie.
- Fully reversible forms make the stacking process quick and easy.
- Rigid EPS panels require less bracing than other products during installation.
- An experienced ICF crew can often complete the foundation and/or walls of a typical home in a matter of days, compared to the weeks it might take conventional framers. In addition, it only takes one crew to do the foundation, above-grade exterior walls and framing of interior walls and roof. This reduces the coordination involved between crews, and improves the structure's quality.



## Benefits to Builders cont'd...

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### 2. Minimal tools and machinery requirements

ICFs are lightweight, allowing the benefits of commercial grade construction without heavy machinery costs.

Forklifts, man and masonry block lifts, cement mixers, heaters, and tarps are not required for ICF construction. As for tools, only a handsaw, foam gun, portable rebar cutter and bracing are required for ICF construction.

In addition, electricity is not mandatory on an ICF job site. The elimination of these ongoing soft costs from the construction site can yield substantial savings.



## Benefits to Builders cont'd...

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### 3. Worker safety

ICFs are lightweight and require little effort to lift and carry, therefore greatly reducing the number of back strains and injuries from construction. The weight of 1 sq ft of masonry wall is equivalent to the weight of over 42 sq ft of a wall constructed of lightweight ICFs.

Not only are compensation costs reduced, but crews are safe, much less tired and maintain strength throughout the day. ICFs are easy to cut and shape making unconventional wall shapes manageable.

### 4. Less waste

Finally, ICFs can result in less than 1% construction waste. More on this later in the presentation.



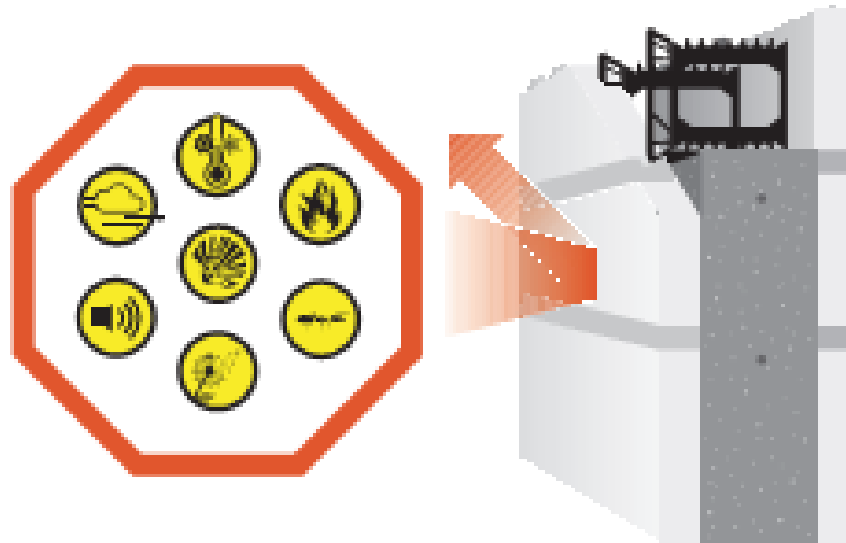
# Protection

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Insulated concrete forms protect a building, the occupants and their possessions.

ICFs stop:

- Extreme weather
- Wind
- Rain
- Water
- Heat/cold
- Fire
- Projectiles
- Noise
- Dust
- Pollen
- Insects
- Mold



## Comfortable Structures

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- **Airtight seal and greater temperature control**

An ICF wall system replaces commonly used fiberglass insulation with expanded polystyrene (EPS).

Traditional fiberglass insulation is a network of intertwined fibers which allows air to move through the gaps in the insulation.

ICFs, on the other hand, consist of closed plastic cells that together with concrete walls prevent air movement, creating an airtight seal around the entire perimeter of a building.



## Comfortable Structures cont'd...

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- **Sound barrier**

Insulated concrete forms provide exceptional sound attenuation. While a traditional wood framed house has a sound transmission class (STC) rating of 36-38, an ICF home has an STC rating of 50+, which corresponds to a reduction in over two thirds of transmitted air borne noise - which would require approximately three to six processes for other types of construction.



- **High indoor air quality**

The use of EPS insulation in ICFs eliminates all air borne glass fibers and insulation settlement caused by fiberglass insulation. Also, the impermeable walls prevent the entry of dust, pollens and pollution.

## Healthy and Safe Structures

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- **Fire resistant**

ICFs provide maximum health and safety, protecting occupants and their possessions, because they are manufactured from a raw material bead with flame-retardant agents that have a 3+ hour fire rating.



- **Insect prevention**

Since there is no food value for insects in an ICF wall system, the possibility of structural damage due to insects, like termites, is entirely eliminated. Also, insects cannot penetrate the concrete core of an ICF wall and therefore cannot enter a home.

## Healthy and Safe Structures cont'd...

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- **Mold resistant**

Traditional homes constructed using organic materials such as wood are easily infiltrated by moisture, which can result in the growth of mold and mildew. Using ICFs virtually eliminates this problem since they are constructed using the highly effective combination of non organic materials, EPS and concrete.



- **Strength**

Unlike conventional homes where walls and floors loosen and shift over time, creating warps and creaks, a structure built with ICFs will remain straight and quiet, maintaining the safety and comfort of a home.

## Extreme Weather Protection

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Compared to those structures which utilize traditional methods of construction, ICF structures are significantly safer during extreme weather.

ICF structures survive high-force winds like hurricanes better than wood structures because the rigidity of the concrete reduces the flex in floors, and cuts shifting and vibration from the force of the wind. ICF walls also stand up extremely well to flying debris and remain virtually undamaged.

When properly designed as per the local building codes and practices, the ICF structures can withstand all external forces in nature like earthquakes, winds and floods.

ICFs are approved under both Dade County and California Building Codes.



## Financial Value

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With ICFs there are many financial benefits which can be gained.

On average, ICF structures consume 30-50% less energy to heat and cool. In some cases they may also require a smaller HVAC unit.

Due to the cost savings on monthly bills, an owner's affordability is improved and therefore they can qualify for energy efficient mortgages. Several Federal and other tax credits are available for ICF structures.

Due to the lifespan and sustainability of concrete walls, an ICF structure requires significantly less maintenance over time and retains value for a much longer period of time.



## Energy Efficiency

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The expanded polystyrene (EPS) panels used in ICFs in a typical assembly with cladding can provide an R-value exceeding R-22.5. When this is combined with concrete thermal mass, temperature fluctuations inside a home are considerably minimized. This highly effective combination greatly reduces the amount of energy required for heating and cooling.



When used in conjunction with other high quality systems such as windows and roofing, homeowners have historically experienced an average of approximately 30-50% savings on heating and air conditioning costs annually. In addition, drafts and hot and cold spots are virtually eliminated, and a room's temperature remains consistent, providing exceptional comfort.

## Energy Savings

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The information from the Portland Cement Association (PCA) indicates that houses built with ICF exterior walls require an estimated 44% less energy to heat and 32% less energy to cool than comparable frame houses.



## Designing with ICF

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## Resources

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ICF walls for residential applications may be designed using these codes/standards:

- Prescriptive Method for Insulating Concrete Forms in Residential Construction - USA
- Section R404.4 and R611 of the International Residential Code 2006 - USA
- Part 9 of the National Building Code of Canada 2005 (adopted or adapted by the local provincial building codes) - Canada

ICF walls for commercial applications may be designed using these codes/standards:

- Chapter 16 of the International Building Code 2006 in conjunction with ACI 318 standard - USA
- Part 4 of the National Building Code of Canada 2005 in conjunction with CSA A23.3 - Canada
- CSI Specifications Sheet

## Design Flexibility

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ICFs provide maximum flexibility for the designer.

Some of the main benefits are:

- the superior engineered spanning capabilities make long window and door insulated lintels and grade beam applications easily achievable
- more glass can be used without compromising energy code requirements due to the high R-value of the wall (R-22+)
- the wall structure and lintels can be designed to allow for large openings



## Design Flexibility cont'd...

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- the concrete strength and rebar eliminates hold downs, shear panels, and most of the steel necessary in frame construction
- non-linear openings, colonnades, archways, etc. are easily constructed at a lower premium
- any exterior and interior wall coverings are easily attached, dramatically improving a structure's appearance, and
- curved walls of nearly any radius can be built without difficulty.



## Design Constraints

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ICFs maximize design flexibility; however, there are a few design constraints.

### Combining wood framing and ICFs

- Although wood framing and ICF concrete walls can be combined within a structure, the ICF walls must always be supported by either concrete or structural steel. Concrete walls cannot be permanently supported by wood framing.
- An ICF wall cannot be supported by a conventional wood or light gauge steel framed floor system; however, a properly designed structural framing or a cantilevered concrete floor system may be designed to carry the loads from the ICF wall above.

### ICF structures have lower air infiltration

- One of the benefits of ICF construction is a tighter structure with significantly lower air infiltration and hence higher energy savings. However, to ensure proper fresh air exchanges and humidity control, proper ventilation is required, such as mechanical air exchange.

## Wall Dimensions

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### Wall heights

To reduce construction time, costs and wastage, it is advantageous to design wall heights to accommodate the standard form heights.

### Wall lengths

Significant compromises to a structure's design to accommodate the form sizes for wall lengths are not recommended. Draw the plan to work within good design practices. Forms can easily be cut to any size and the majority of cutoff pieces can be reused within the walls, which can reduce waste to less than 1%.

### Design tips:

- Since ICF walls are thicker than conventional walls, remember to increase outer dimensions to ensure the desired internal dimensions.
- Consider laying out building dimensions, windows, and doors to correspond with modular dimensions of the ICF materials being used.
- Use appropriate symbols to clearly identify which walls are ICFs, as well as scale the walls to reflect the specified thicknesses.

## Steel Reinforcement

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ICFs comply with ACI-318 - they are regular reinforced concrete walls. Building any structure with ICFs requires the installer to have a good knowledge of the fundamentals of steel reinforcement.

The designer should clearly indicate the following information on the plans:

1. Separate cross sections of all ICF walls. Each cross-section should clearly show the **size of the block** used, for the building inspector and installer.
2. Each cross-section should show the **wall heights** involved for every story.
3. Vertical and horizontal reinforcing **steel bar sizes, spacing and grades** of steel should be clearly marked for every story in each wall cross-section or in a separate note on other sheets.
4. The **placement** of reinforcing steel, especially vertical, should be clearly marked (i.e. off center or towards interior/exterior or centered in the wall).

## Special Applications

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### Projections and cantilevers

Projections and cantilevers require special attention. The best approach is to support upper story concrete walls by placing them directly about a corresponding concrete wall below. Otherwise, detailed engineering and steel beams will be required.

Remember: Upper story concrete walls cannot be supported either by wood frame or light gauge steel frames; however, when using concrete flooring systems, cantilevering modest distances becomes more feasible without substantial added costs.

### Gables

Gables of virtually any pitch can be constructed with ICFs. If there is a cathedral ceiling in the interior space, completing the gable with ICFs is the recommended solution. Alternatively the ICF wall can be stopped at the plate line and the gable can then be framed conventionally.



## Special Applications cont'd...

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### Columns

When forming columns it is important to ensure that there is adequate space for the steel reinforcement and concrete vibration.

### Garages

There are very little cost savings gained from switching from ICF to frame construction for an attached garage. When adding an ICF garage, the wall between the house and the garage is conventionally framed and the wall, where the garage door will be located, requires very few forms. As a result, the amount of additional block required for a 2-3 car garage is approximately only 1-1.5 walls. The benefits of doing an ICF garage include improved fire protection, energy savings, added comfort, and a uniform substrate for exterior cladding. Often total construction time is also reduced by several days since there will be no need to frame the garage after the house has been constructed.

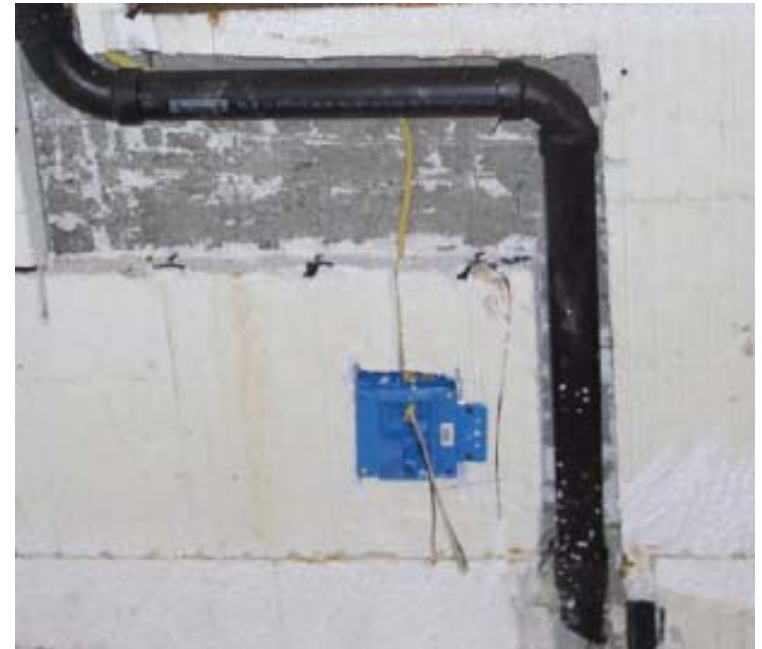
## Utility and Service Installation

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Utility and service installations are easily facilitated through, or embedded within, ICF walls, but proper pre-planning and layout design is required.

For example:

- ICF wall penetrations are blocked out prior to the placement of concrete. Blocking out is done usually by cutting a hole through the ICF wall and inserting the utility line (e.g. PVC pipe).
- Channels/recesses may also be cut on the ICF wall for embedding pipes, electrical conduits, and electrical boxes within the walls after the concrete pour.



Electrical and plumbing installed in an ICF wall

# Waterproofing

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Most waterproofing membranes can be applied to ICF walls. It is important to ensure that the one selected is EPS compatible.

- Liquid applied membranes (ensure that the chosen liquid applied is compatible with ICF)
- Peel and stick membranes
- Dimple sheet damp-proofing for foundation walls



Spraying liquid applied membrane



Peel and stick membrane installed and ready to be backfilled



Installed dimple sheet membrane

## Finishes

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ICF wall systems are compatible with all types of finishes/cladding:

- Interior and exterior finishes
- Drywall
- Traditional hard coat stucco (exterior)
- Soft coat stucco
- Anchored masonry veneer
- Stone veneer
- Siding

Basically any type of finish can be applied. Proper planning should be considered and, in addition, it is necessary to ensure that the finishes are installed per manufacturer specifications.



## Typical Connections to ICFs

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**Interior drywall:** Screw into polypropylene web, using fine thread or coarse thread screws, which have better holding capacity.

**Hard coat stucco (exterior):** Wire lathe of the stucco system is attached directly onto the polypropylene web with screws or approved staples.

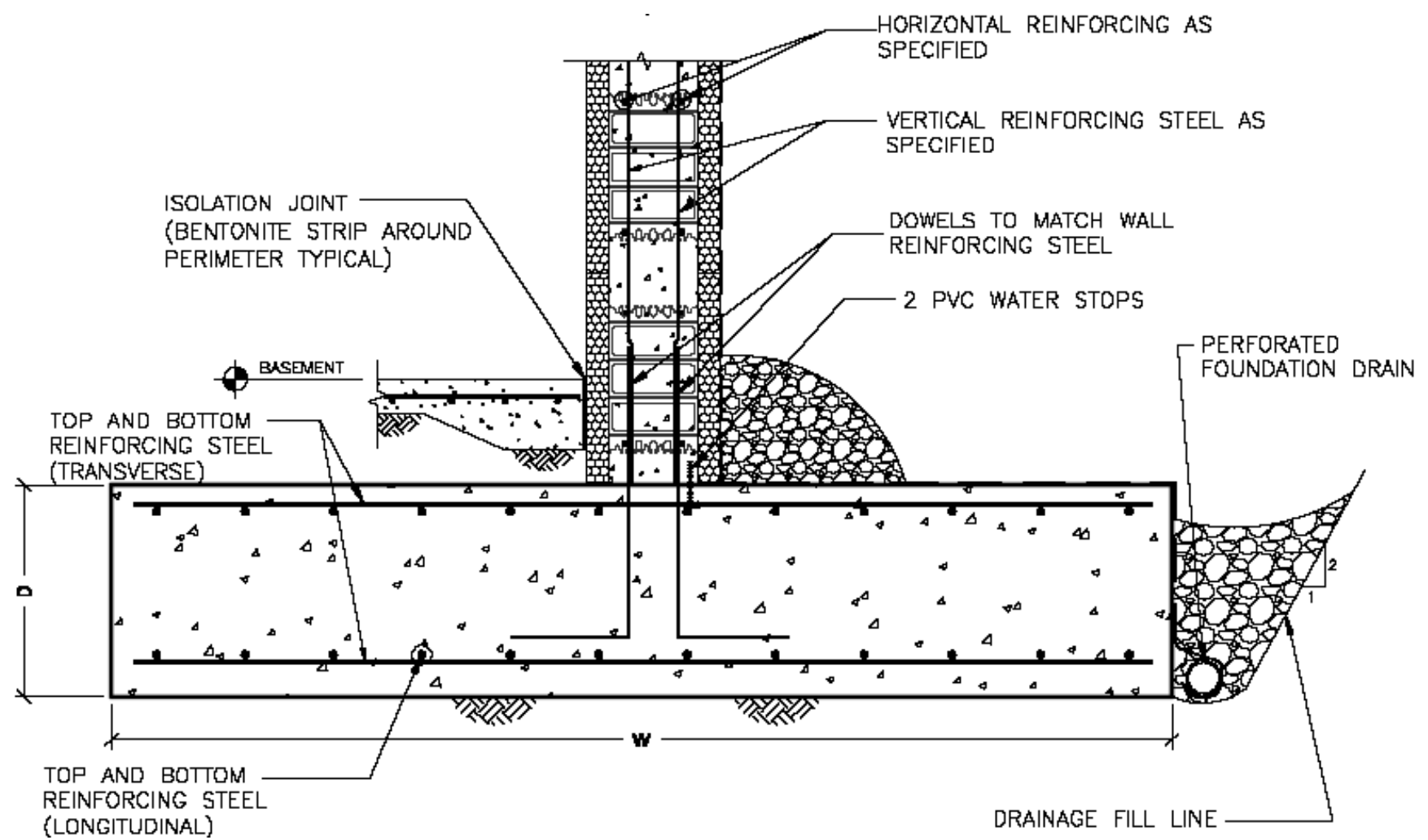
**Soft coat stucco or EIFS (exterior insulation and finish systems):** Can be applied directly onto the ICFs without the need for foam board.

**Anchored masonry veneer:** Masonry veneer ties are connected directly onto the polypropylene web using fine thread or coarse thread screws. A ledge support is required to carry the masonry veneer gravity loads. Masonry veneer above three stories requires the ties be attached directly into the concrete.

**Wood, vinyl and cement siding:** Wood and fiber cement products first require wood/metal strapping to be installed on the EPS surface by screwing to the polypropylene web. The sidings can then be attached to the strapping using nails or screws. Vinyl siding is attached to the polypropylene web using screws.

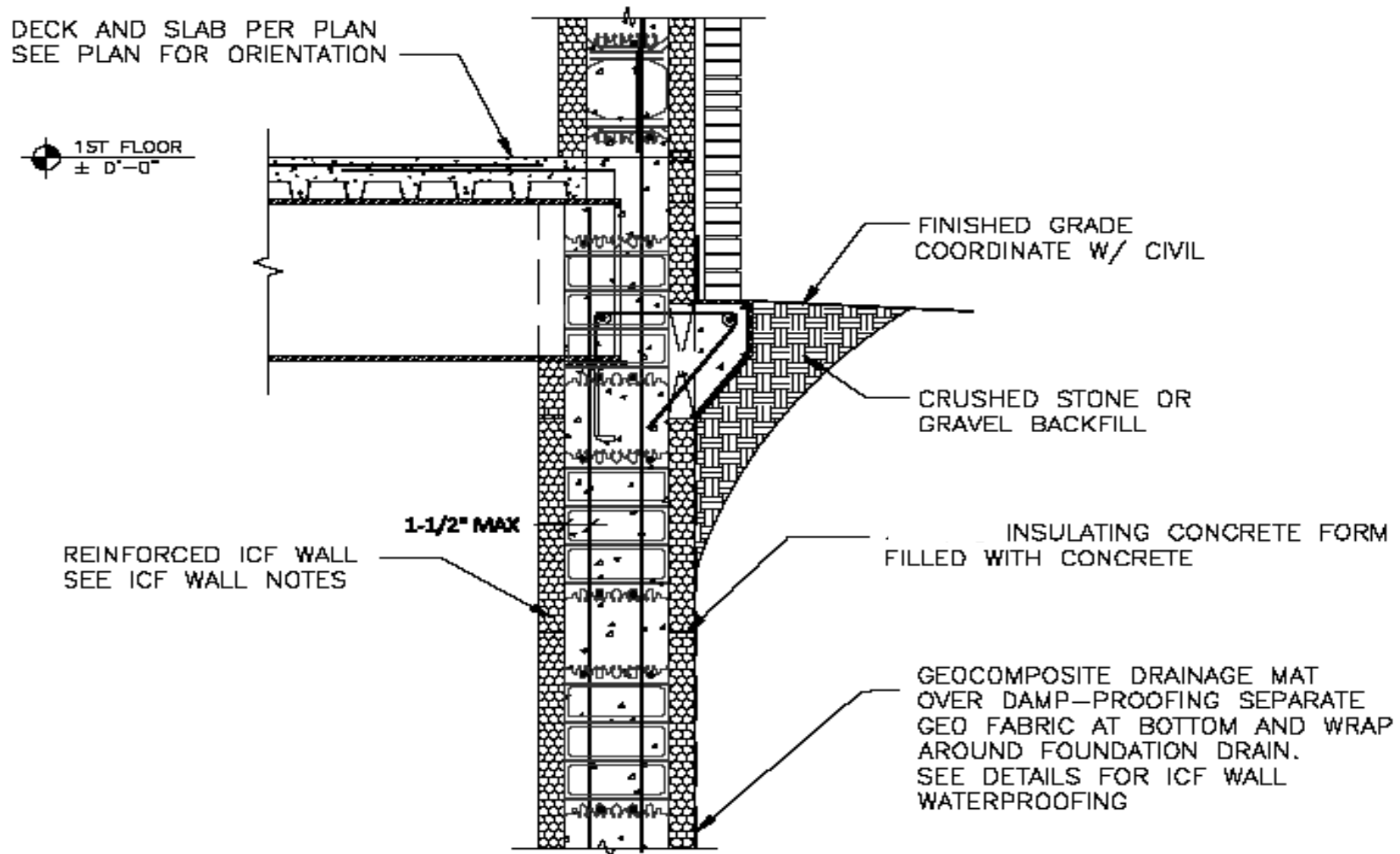
# Example: Section at Footing

Typical ICF detail at footing section.



# Example: Steel Beam at Brick Ledge

ICF details using a brick ledge and steel beam as an example of ICF structural details.





## Green Building

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## Reduce Energy Consumption and Harmful Emissions

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Global warming is a direct result of harmful gas emissions released into the earth's atmosphere. ICFs are a 'green' and environmentally friendly building alternative to traditional building methods.

ICF structures combine expanded polystyrene (EPS) insulation and concrete thermal mass. This highly effective combination of materials minimizes temperature fluctuations by absorbing and storing heat. This equates to an average of 30-50% reduction in energy consumption for heating and cooling, which results in an equivalent reduction in harmful emissions.

Additionally, some manufacturing centers use steam and cold water to produce ICFs. No CFCs, HCFCs, formaldehyde or any chemicals are used in this manufacturing process, and no off-gassing is present.

## Natural Resource Protection

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Worldwide deforestation adds 1-2 billion metric tons of carbon to the atmosphere annually!

In order to protect our atmosphere and ourselves, it is essential to reduce the number of trees we cut down. Every ICF home saves several trees, which absorb carbon dioxide and give us oxygen.



## Recycled Materials and Less Waste

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Some ICF webs are manufactured using 100% post-industrial recycled polypropylene.

This means that over 60% of the weight of an ICF block is comprised of recycled materials.

ICF construction can generate as little as 1% construction waste - this greatly reduces land filling which produces methane emissions.



## Sustainability

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Architects are challenged daily by their clients to design sustainable, energy efficient structures.

Overtime, ICF structures become sturdier and require much less repair maintenance than conventionally built structures. As a result they retain their value for a longer period of time.



## LEED® Certification

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The U.S. Green Building Council (USGBC) is a 501(c)(3) non profit 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 Rating System, the nationally accepted benchmark for the design, construction, and operation of high performance green buildings.

For detailed information about the council, their principles and programs, please visit [www.usgbc.org](http://www.usgbc.org).



## LEED Rating Systems

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LEED 2009, v.3, rating systems include New Construction and Major Renovations; Existing Buildings: Operations and Maintenance; Core and Shell Development; and Schools New Construction and Major Renovations; and Commercial Interiors.

LEED for New Construction and Major Renovations (LEED-NC) awards points in the following five major categories, with additional points available in the two categories, as identified below:

- Sustainable Sites (SS)
- Water Efficiency (WE)
- Energy and Atmosphere (EA)
- Materials and Resources (MR)
- Indoor Environmental Quality (IEQ)
  
- Innovation in Design (ID)
- Regional Priority (RP)



## LEED Credit Requirements

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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.

ICFs can contribute to the LEED certification of a structure. Of the 25 points required for USGBC LEED-NC certification, ICFs can contribute between 14-20 points, depending on the ICF product/ICF manufacturer. See the next two slides for further information, compiled by a third party LEED AP engineering firm, Mindscape.



## LEED Credits - Energy and Atmosphere (EA)

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- **EA - Credit 1 - Optimize Energy Performance (1-19 points available)**  
According to the Portland Cement Association, ICF structures can often achieve enhanced energy performance of 32 to 44% before considering complimentary energy saving measures\*, which would correspond to between 11 and 17 in LEED-NC (1 point for each approximately 3% energy savings).  
**Potential ICF product point contribution: 11 to 17**
- \* Portland Cement Association, Report RP119, *"Energy Comparisons of Concrete Homes vs. Wood Frame Homes"*. Summarized online at [www.cement.org/homes/brief01.asp](http://www.cement.org/homes/brief01.asp) .

## LEED Credits - Materials and Resources (MR)

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- **MR - Credit 2 - Waste Management (2 points available)**

Concrete used in ICFs can easily be recycled or re-used on site (eg. as aggregate fill), or else returned to the supplier for similar re-use on other sites, and thus reduces waste sent to landfill.

Potential ICF product point contribution: 1

- **MR - Credit 4 - Recycled Content (2 points available)**

Recycled content is counted by LEED by a cost fraction that is weighted by mass: The weight fraction of postconsumer recycled content plus  $\frac{1}{2}$  of the preconsumer (post-industrial) content of each building component is multiplied by that component's total cost, and the sum of all recycled fractional costs must comprise at least 10-20% of total material costs in order to earn 1-2 pts. respectively. Concrete and steel work will have a significant impact on the overall measured recycled content of the project due to their typically large impact on the total materials budget.

Potential ICF product point contribution: 1

- **MR - Credit 5 - Regional Materials (2 points available)**

ICFs use concrete, which is available locally in most urban centers.

Potential ICF product point contribution: 1



## Choosing an ICF System

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## Choosing an ICF System

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Product and installation availability are very important considerations when selecting an ICF system.

Consider the number and location of manufacturing facilities and/or local dealers and distributors - look for manufacturers that have factory certified and experienced installers. Often they are a local resource that can provide training, job site visits, pre-pour inspections and much more.

Ensure that the manufacturer you choose can provide you with the technical support and materials that you need. Testing, code approvals and technical manuals are essential, and in-house engineering and field experts can make an important difference to the success of the project.

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

## ICF Design Software

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ICF design engineering software is used for checking the structural adequacy of ICF walls, lintels and the floor and roof systems. The software is a useful tool for engineers and architects who need to streamline their design process and increase efficiency.

The software can be visually interactive, and any changes or inputs made by the user are automatically reflected on the graphics screen in real time. The software also has built-in text and graphic reports output for complete transparency on the analysis and design checks performed. ICF design software can determine code compliance for the IBC 2003 (US), NBC 2005 (Canada) and UBC 1997 (California).

## Specialty Forms

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It is also important to consider the product line and the types of forms that are available when looking at product availability. Specialty forms will allow unlimited freedom in design.

In addition to straight, 90 degree and 45 degree forms which often come in a variety of thicknesses, some manufacturers also provide a line of specialty forms including taper-tops, height adjusters, brick ledges, T-blocks, and radius forms.



## Specialty Forms cont'd...

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Tapered top



Corner reversible block



Radius form



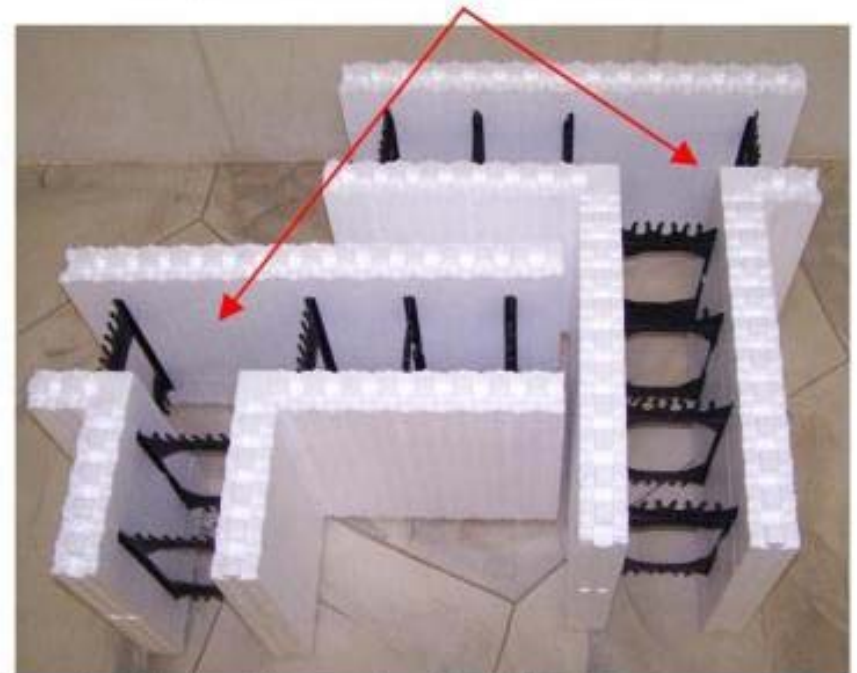
45°reversible block

## Specialty Forms cont'd...

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A T-block is designed for applications where two walls intersect. In most cases this occurs where an interior ICF wall connects to an exterior ICF wall. In residential construction this is uncommon since typically interior walls are constructed with either wood or steel framing. ICF T-blocks are frequently used for commercial projects such as schools and hotels where previously, installers had to construct a T-block on site using straight forms. This process was time consuming and the intersection required special attention and additional bracing. ICF T-blocks increase levels of construction efficiency and productivity.

Additional built-in internal reinforcement



Left: T-block with short leg Right: T-block with long leg



## ICF Systems in Action

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## Education Sector

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**Name:** Maple Children's Learning Centre

**Project type:** School

**Location:** Maple, ON

**Size (sq.ft.):** 15,000

**Floors:** 2 + basement

ICF structure is ideal for an educational facility because it provides a safe and healthy environment for students and requires very little annual maintenance. ICF structures are mold, mildew and fire resistant, have improved air quality and effectively withstand extreme weather. ICF walls have an STC Rating of 50+ which provides excellent sound attenuation between walls; at the same time, ICF walls offer excellent acoustics, making the instructor highly audible within the classroom. This is especially beneficial for gymnasiums, music rooms and theaters.



## Hospitality Sector

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Name: Best Western Burlington Inn

Project type: Hotel

Location: Burlington, ON

Size (sq.ft.): 33,900

Floors: 3

The benefits of using ICF structures in the hospitality sector include:

- reduced operating costs (approx. 20%)
- ROI achieved quickly
- quicker construction time and less labor required
- quiet and comfortable stay for guests, and
- improved environmental performance.



## Business Sector

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Name: Orchard Oaks Business Center

Project type: Commercial Plaza

Location: Ormond Beach, FL

Size (sq.ft.): 14,720

Floors: 1

A major benefit of using ICFs for this location is that ICFs provide the security people need in this storm prone area. In addition, the speed and ease of construction enabled efficient project completion times. This stucco-finished airtight structure has 20ft high walls with 43 openings; it requires little maintenance, is mold and mildew resistant, fire resistant, and maintains constant temperature control.



## Religious Sector

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Name: Cornerstone Assembly of God

Project type: Church

Location: Bethalto, IL

Size (sq.ft.): 54,000

Floors: 1 - 36 ft. high

Benefits of ICF use in the religious sector include reduced operating costs, lower maintenance, quiet and comfortable atmosphere. excellent acoustics, improved environmental performance, safety during extreme weather and fire resistance. This structure requires very little energy to heat and cool due to the ICF walls. In fact, the 20,000 ft. of piping installed for radiant floor heating has not been used yet.



## Housing Sector

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Name: Romance Town Homes

Project type: Town Home Subdivision

Location: Richmond Hill, ON

Size (sq.ft.): 88 Town Homes

Floors: 2 + basement

The benefits of using ICFs in residential housing projects are fire resistance and sound proofing between units, as well as energy savings and green benefits - increased R value and ongoing reduction in heating and cooling costs for the homeowners.



## Housing Sector - High Rise

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Name: 345 King, Student Residence

Project type: 15-Story High Rise Building

Location: Waterloo, ON

Size (sq.ft.): Building footprint 164'x58';  
approx. 132,000 sq.ft. floor areas

Floors: 14

This building combines both ICF and conventional construction methods. The ICF component of the construction process took five months. Using ICFs meant quicker construction, long term energy efficiency and long term life cycle. The building uses ICFs starting on the first floor and at 14 stories is the highest load-bearing ICF structure in North America. Not one exterior strap or extra bracing was required on the outside of the building all the way up. The parapet walls are twelve feet high on top of the 14th story level.





## Summary and Resources

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## Course Summary

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- Insulated concrete forms (ICFs) are stay-in-place forms designed for the construction of reinforced concrete walls. There are three different types of ICFs available including flat wall, waffle grid and screen grid systems.
- ICFs are made of two expanded polystyrene (EPS) panels that are connected by either steel or plastic ties, which may also serve as furring strips (for interior and exterior attachments) and steel reinforcement holders.
- Benefits to builders include: reduced construction time and labor costs, minimal tools and machinery required, worker safety, and less waste.
- Benefits to building owners (residential or commercial) include: protection against extreme weather, heat/cold, mold, dust, pollen, projectiles, noise and fire.
- Product and installation availability are very important considerations when selecting an ICF System. Specialty forms allow unlimited design possibilities.

## References and Resources

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- Amvic Building System, [www.amvicsystem.com](http://www.amvicsystem.com) (accessed on 15/05/2009)
- U.S. Green Building Council, [www.usgbc.org](http://www.usgbc.org) (accessed on 15/05/2009)

## Conclusion of This Program

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