



# ICFs Stand Up to Storms

Natural disasters happen. Buildings get destroyed ... and rebuilt. Wisdom would point to adopting the construction practices of the surviving structures. In the case of Hurricane Katrina, several Insulating Concrete Form (ICF) buildings withstood not only the furies of the wind, but also the impact of the storm surge. While the builders might have originally chosen ICFs for reasons of energy savings, they were undoubtedly thankful for the strength and durability of the concrete in the face of such a natural disaster.

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*"Safety was a secondary consideration when we chose to build with ICFs. For us, the greatest benefit was its energy efficiency. Yet we're alive today because of these walls."*

*ICF Homeowner Randy Robbins  
Survived a hit by Attica Tornado F2  
Twister Forces of 113-157 mph.*

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While some natural hazards, such as floods and earthquakes, are restricted within certain geographic and geologic regions, wind storms respect no such bounds. They can appear anywhere, and can reach intensities that decimate whole neighborhoods. The challenge is to build in a way to best weather the next storm.

Extreme winds can damage a structure in many ways. Roofs may be pulled off or windows pushed in. The swirling winds turn debris into high speed projectiles that can penetrate most cavity wall construction. Once the building envelope is punctured, the increased pressure inside can greatly increase the risk of failure of other building components. In the case of hurricanes, the subsequent rot and mold from water damage can be just as devastating.

## **Storm Shelters**

One solution for personal protection is to build a storm shelter. For choice of materials, FEMA proposes ICFs, or insulating concrete forms. The recommendation in the "Taking Shelter from the Storm" guide (FEMA 320) is based on testing done at Texas Tech University's Wind Engineering Research Center. Hurricane conditions were simulated with a 2"x 4" wood stud "missile" launched at 100 mph, the speed at which flying debris can travel in a 250 mph wind. Of the various walls types tested, wood frame walls could not withstand the impact, while solid concrete ICF walls held strong.



*This ICF home in the Cayman Islands withstood the Category 5 devastation of Hurricane Ivan (2004).*

Since ICFs also offer other types of protection - from, from noise, insects, heat and cold - it might make sense to build the whole house out of ICFs. This solution would provide passive resistance against possible future disasters, while offering the ongoing benefits of comfort and energy savings.

To build whole house storm resistance, the governing building code provides the minimum construction requirements. For example, IRC section 611.9 specifies the roof-to-ICF wall connection, with prescribed size and spacing of anchor bolts. Some state codes may have stricter measures, or provide alternative guidance.

In general, buildings are required to be designed to withstand a wind speed that has an approximate 500 year return period. While this is not equivalent to the wind speeds that can be generated by tornadoes, ICF buildings designed and constructed in accordance with contemporary codes have withstood hurricanes and tornadoes.

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*ICF Construction is storm insurance...  
which pays for itself through energy savings.*

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*"We're impressed with the wind-load capacity and structural integrity of an ICF wall, as well as the benefits of fire resistance and reduced water damage."*

*Chuck Vance  
Fortified ... for safer living® Program Manager  
Institute for Home and Business Safety (IBHS)*

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### **Fortified Construction**

To promote the construction of homes with more protection than would be provided by attaining the minimum requirements of building codes, the Institute for Business and Home Safety ([www.ibhs.org](http://www.ibhs.org)) has developed a *Fortified ... for safer living®* program. Homes must meet specific design, construction, and landscaping guidelines to be awarded program recognition. The guidelines are tailored to meet the climatic challenges of different geographic regions, such as hurricanes in the southeastern United States and tornadoes in the Midwest.

The *Fortified ... for safer living®* program recognizes the valuable role of ICF construction when reviewing the impact of the height and length-to-width ratio on the building design in high wind areas. While wood frame houses are limited to 2 stories and 10 ft per story, homes built with ICFs can qualify with a 3rd floor and story heights of up to 20 ft.

The additional reinforcing requirements for wind loading are readily achievable with additional reinforcing steel in the ICF concrete walls. The ICF walls can be engineered to withstand winds up to 250 mph with shear wall strength of up to 10,000 pounds per linear foot. The use of ICFs for exterior walls eliminates the time and cost of wood sheathing, special overlaps and nailing schedules.

### **Continuous Protection**

A common element to all wind perils is the need for a continuous and adequate load path from the roof to the foundation of the home as a means to transmit wind uplift and shear loads safely to the ground. The ICF wall to foundation connection is already strengthened by the required vertical reinforcing steel bars.

For the roof and floor connections, manufacturers have produced hardware specific to the ICF industry, which is designed to be either cast-in-place or retrofitted after the concrete has cured. Roof trusses can be attached with straps either to metal plates embedded in the top of the concrete wall or directly to the concrete. The wall to floor connection can be reinforced and secured with

ledger connector systems that have lateral capacity to help resist the horizontal forces imposed on the structure by a high-wind event.

Windows and door penetrations can be a weak link. Design requirements for windows include impact resistance and design pressures. The frames need to be properly anchored to the main wind-force resisting system, which is the concrete core of the ICFs. To prevent water damage, window and door penetrations should have proper flashing in accordance with applicable code requirements and ASTM standard practice.



*This ICF house was a lone survivor after the storm surge from Hurricane Katrina in 2006.*

Storms are here to stay – and so are ICF buildings. With ICF construction, a builder has the opportunity to offer a true luxury – the chance to enjoy comfort and energy savings, as well as the peace of mind that the house is well protected from nature's wrath. Now that makes sense.

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<sup>1</sup> American Society for Testing and Materials (ASTM) C976

<sup>2</sup> VanderWerf "Energy Comparisons of Concrete Homes Versus Wood Frame Homes", RP119

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*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.*