

Seeking Shelter from Tornadoes and Hurricanes



Testing and certification for storm shelters and safe rooms to ICC 500



Two of the most destructive events that Mother Nature delivers, tornadoes and hurricanes, pose a significant threat to life safety. Hurricanes generate wind speeds from 74 mph to over 150 mph, while tornadoes generate wind speeds from 65 mph to over 250 mph. The damage that can result from exposure to these wind speeds has been established using the Saffir-Simpson [Hurricane Wind Scale](http://www.nhc.noaa.gov/aboutsshws.php) and the Enhanced Fujita [Tornado Scale](http://www.spc.noaa.gov/faq/tornado/ef-scale.html).

In order to protect occupants from these extreme wind events, including wind-borne debris impact, the International Building Code (IBC) and the International Residential Code (IRC) include requirements for the construction of storm shelters and safe rooms. According to FEMA, since 1998 thousands of safe rooms have been built, and a growing number of these safe rooms have already saved lives in actual events.

Storm shelters and safe rooms are hardened building structures designed specifically for the protection of occupants against injury or death from the threats of extreme weather events, including hurricanes and tornadoes. The IBC defines a storm shelter as a detached structure, whereas a safe room is typically constructed within the building.

According to FEMA, when properly designed, constructed, and evaluated for compliance with the requirements that govern them, occupants in these structures during extreme weather events have a very high probability of being protected from injury or death. In fact, according to a FEMA report, there has not been a single reported failure of a safe room constructed to FEMA criteria.



Code and FEMA requirements for ICC 500

The Standard for the Design and Construction of Storm Shelters, ICC/NSSA 500 is a consensus-based standard that has emerged as the primary standard for the design, construction, and testing for safe rooms and storm shelters. The following are some of the codes and federal requirements that reference ICC 500. The 2015 International Building Code, Sections 423.3 and 423.4, require storm shelters to be provided for critical emergency operations and certain Group E occupancies when they are located in areas where the design wind speed for tornadoes is 250 mph. These facilities include 911 call stations, emergency operation centers and fire, rescue, ambulance and police stations as well as educational occupancies through grade 12 with occupant loads of 50 or greater.

These storm shelters are required to comply with ICC 500.

The 2015 International Residential Code, Section R323.1, requires storm shelters, when provided, be constructed and

evaluated in accordance with ICC 500.

In addition to the theses codes, FEMA P-361 “Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms,” as well as FEMA P-320, “Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business,” reference ICC 500.

About ICC 500

Among other things, ICC 500 includes impact and pressure performance criteria. One of the most critical parts of a storm shelter design is protecting the openings within the structure, such as doors for entry and egress and windows/shutters. These openings are to be designed, manufactured, tested, and labeled to withstand tornado wind speed pressures including wind-borne debris impacts. Door assemblies typically include the door leaf, a vision panel (if applicable), door frame and attachment methods, and opening and closing hardware, all of which are tested as an integral system using the same materials and construction as that proposed for actual use. Installation of the door assembly into the rough opening is just as critical as the manufactured door assembly itself.



However, to accommodate testing, ICC 500 allows installation of the door within a test buck, as long as the installation details are described in the test report. Storm shelter and safe room door assemblies must go through a demanding test protocol that represents the rigors that would be experienced under actual field scenarios. The impact test includes three impacts to the shelter door with a 15-pound 2x4 lumber missile travelling at 100 mph.



Pressure testing is also conducted by pressurizing the door to 1.2 times the design pressure rating of the door, and is applied away from the door stops (inswing).

If the door is a twin unit or contains glazing within a panel, then additional impacts are required. ICC 500 also requires testing of the largest and smallest unit size within the shelter product family.

The ICC 500 conditions of acceptance for tornado shelters assure that the door provides protection for occupants against extreme wind pressure, as well as windborne debris. The pressure test acceptance is based on the door remaining intact and no visible signs of product or installation damage after loading. Impact test pass/fail criteria is based on not allowing the 2x4 missile impact to perforate the interior surface of the tested door, and not allowing any part of the test specimen, including hardware, to become disengaged or dislodged. In addition, no pieces of the interior surface large enough to cause occupant injury can be propelled more than 5-inches into the room.



*Tornado damage to home in La Plata, Md., taken April 29, 2002, a day after a deadly tornado outbreak.
Photo courtesy of NOAA.*

Product certification and labeling

FEMA does not test, approve, or certify products, but the agency does require within their criteria that manufacturers certify their products in accordance with ICC 500. Certification is evident by the application of a label to the manufacturers' product indicating compliance with the standard. The 2014 edition of ICC 500 indicates that all impact-protective systems used for openings be labeled to indicate compliance. It is important that testing be conducted by an accredited testing laboratory such as UL, to ensure that tests are conducted and reported according to the requirements of the standard, and that the test report contains the information necessary for the code authority to determine code compliance.

UL's certified windstorm rated assemblies and products can be accessed using the UL Product Spec application at ul.com/productspec by selecting "Product, Systems, Assemblies," then "Building or Fire Systems," then "Windstorm Rated Products." Alternately, the UL Online Certifications Directory at ul.com/database can be used to access these certifications by using a "Windstorm" keyword search. The ICC 500 certifications are located within the category Products for Use in Windstorm Rated Assemblies (ZHLL). Products certified for use in windstorm rated assemblies are labeled with a UL Certified or UL Classified Mark that includes the product identity (such as Swinging Door for Use in Windstorm-rated Assembly), the standards for which compliance was determined, along with details on test pressure and 2x4 missile impact speed, as applicable.