

Background and History of Safe Rooms



1970s

Conceptual Phase

- After homes were destroyed by violent tornadoes, investigators continued to find small interior rooms that survived.
- Dr. Ernst W. Kiesling of Texas Tech University (TTU) conceived the idea of hardening a small interior room.
- To design this interior room, researchers studied the wind forces and the type of airborne debris (called missiles) that must be stopped. Quick access to a shelter and cost were also important considerations.
- Based on observed tornado damage and engineering analysis, TTU determined that tornadic wind speeds, once estimated as high as 600 mph, have much lower wind speeds.



Xenia, OH tornado, 1974. Interior rooms that survived a tornado, such as this one, led to the concept of the above-ground safe room.

1980s

Testing Phase

- Researchers Dr. Joseph E. Minor and Dr. Kishor C. Mehta developed preliminary shelter designs funded by the Defense Civil Preparedness Agency (a forerunner of FEMA).
- Dr. James R. McDonald developed a missile impact facility that can launch large missiles at high speeds. Walls, roofs, and doors can now be consistently tested.
- TTU developed construction details for in-residence shelters that were available to the public.



Design missile is 15 lb 2x4 traveling at 100 mph. Two laser timing gates provide verification of the recorded missile speed.



The new debris launch facility allows for a greater range of motion of the barrel and more accurate missile impact.

1990s

Continual Research, Testing, and Implementation

- FEMA studied the technical and economic feasibility of in-residence shelters. Pressure and impact tests are conducted for door structure and hardware. Additional safe room designs are developed and tested.
- In 1997, after the Jarrell, TX, tornado, a national news story brings attention to the in-residence shelter. Wind Engineering Research Center personnel receive over 1,000 requests for shelter plans within a week.
- The publication, FEMA P-320, *Taking Shelter from the Storm, Building a Safe Room for Your Home or Small Business*, is published and introduced to the media in August 1998 at the FEMA National Tornado Forum. The second edition, published in August 1999 incorporates a design for a shelter using insulated concrete forms (ICF)
- In May 1999, a tornado outbreak hits Oklahoma and southern Kansas. Two people survive in an above-ground, reinforced concrete located in the path of the toronado. The President urges families to consider incorporating in-residence shelters when they rebuild their homes.

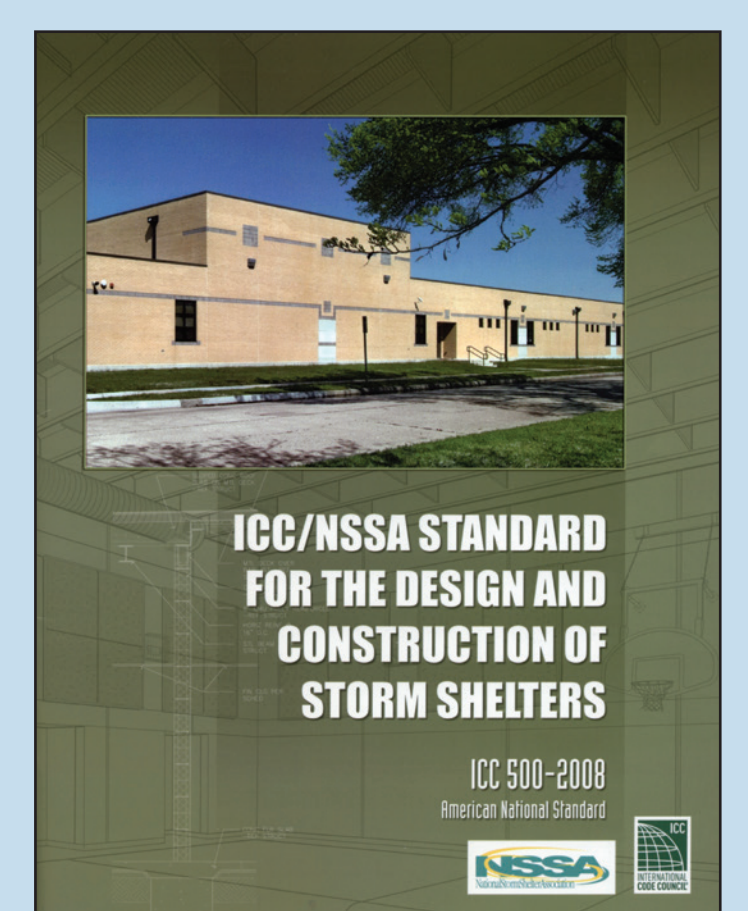


Above ground safe room survives EF-5 tornado in Moore, Oklahoma.

2000s

Continual Research, Testing, and Implementation

- Over 6,000 copies of FEMA P-361, *Design and Construction Guidance for Community Safe Rooms*, which is used to design community and residential safe rooms, were distributed.
- Over 600,000 copies of FEMA P-320, *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business*, were distributed.
- Several Federal, State, and local governments provided funding support and created educational initiatives for both residential and community safe rooms.
- The International Code Council® (ICC®) published the first consensus standard, *ICC/NSSA Standard for the Design and Construction of Storm Shelters* (referred to as ICC500) in 2008, which is referenced in the 2009 International Building Code® (IBC®).



2010s to Now

Continual Research, Testing, and Implementation

- FEMA published the Mitigation Assessment Team (MAT) report on the 2011 spring tornadoes (FEMA P-908), which documented the damage caused by the tornadoes in Alabama, Mississippi, Georgia, and Missouri that year.
- FEMA's code change proposals were approved for the 2015 IBC to require storm shelters for new schools; 911 call stations; emergency operation centers; and fire, rescue, ambulance, and police stations in areas where the design wind speed for tornadoes is 250 mph.
- ICC updated ICC 500 in December 2014 and December 2020. FEMA actively participated in both standard update cycles and continues to advocate for life-safety protection through advancements in storm shelter design and construction.
- FEMA updated FEMA P-361, *Safe Rooms for Tornadoes and Hurricanes, Guidance for Community and Residential Safe Rooms*, in March 2015 and April of 2021 with the latest safe room design information and a reorganization to align the chapters with ICC 500-2014 and ICC 500-2020, respectively.
- FEMA updated FEMA P-320, *Taking Shelter from the Storm: Building or Installing a Safe Room for Your Home*, in December 2014 and March 2021. Both editions updated the prescriptive design plans and homeowner-targeted guidance for concurrence with FEMA P-361 and ICC 500.

