

Residential Sheltering: In-Residence and Stand-Alone Safe Rooms



FEMA

TORNADO RECOVERY ADVISORY

RA3, June 2011

Purpose and Intended Audience

The purpose of this advisory is to inform homeowners, renters, apartment building owners, and manufactured home park owners about in-residence and stand-alone safe rooms.

This Recovery Advisory Addresses:

- Consider a safe room for your home
- In-residence safe room construction and retrofitting options
- Recommendations for sheltering options for when you cannot place a safe room within your home
- Safe room doors
- Refuge areas
- Emergency supply kits and weather radios
- Registering your safe room with local officials

Consider a Safe Room for Your Home

The purpose of having a safe room in or near your home is to protect you and your family from injury or death from extreme winds. Safe rooms are intended to allow occupants to survive tornadoes and hurricanes with little or no injury. To determine your exposure to tornadoes, refer to FEMA 320, *Taking Shelter from the Storm: Building a Safe Room For Your Home or Small Business* (2008). This publication can help you decide whether to construct a safe room to protect you and your family from injury or death during a tornado or hurricane.

Additional information is provided in the Tornado Recovery Advisory (RA) No. 1 titled "Tornado Risks and Hazards in the Southeastern United States" (updated in 2011).

After determining that you live in a tornado- or hurricane-prone region, it is important to understand the risks. Most homes, even new ones constructed according to current building codes, do not provide adequate protection for occupants seeking refuge from tornadoes. A tornado or hurricane can cause much greater wind and wind-borne debris loads on your house than those on which building code requirements are based. Only specially designed and constructed safe rooms, which are voluntarily built above the minimum code requirements, offer near-absolute protection during a tornado or hurricane.

Safe rooms should not be constructed where flood waters have the potential to endanger occupants within the safe room. Safe rooms in areas where flooding may occur during hurricanes should not be occupied during a hurricane. However, occupying such a safe room during a tornado may be acceptable if the safe room will not be flooded by rains associated with other storm and tornado events. Consult your local building official or local National Flood Insurance Program representative to determine whether your home, or a proposed stand-alone safe room site, is susceptible to local, riverine, or coastal flooding.

In-Residence Safe Room Construction and Retrofitting Options

Constructing a safe room within your home puts it as close as possible to your family. While a safe room on the exterior of your home may provide adequate protection, it does require your family to be exposed to the

weather elements while traveling to the safe room. A safe room may be either installed during the initial construction of a home or retrofitted afterward. As long as the design and construction requirements and guidance are followed, the same level of protection is provided by either type of safe room.

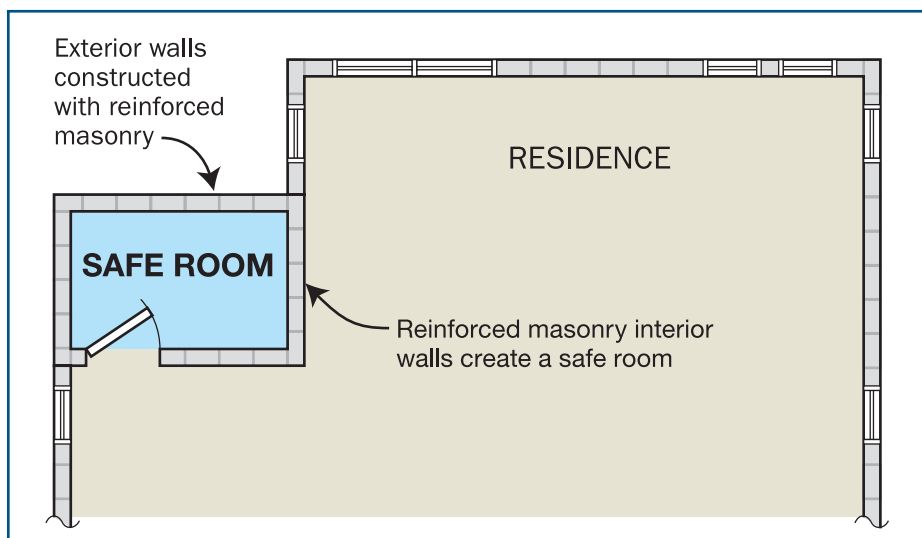
New Construction

FEMA 320 contains detailed drawings and specifications that can be used by a builder or contractor to construct a safe room in your home. The designs provided are for safe rooms constructed of wood, masonry, or concrete. All of them are designed to resist 250 mph (3-second gust) wind speeds and impacts from wind-borne debris. Pre-fabricated safe rooms are also available for installation when first building your home. The basic cost to design and construct a safe room during the construction of a new house is approximately \$6,000; larger, more refined, and more comfortable designs may cost more than \$15,000.

It is relatively easy and cost effective to add a safe room when first building your home. For example, when the home is constructed with exterior walls made from concrete masonry units (CMU, also commonly known as “concrete block,” see sketch this page), the protection level in FEMA 320 can be achieved by strengthening the safe room area’s exterior walls with additional steel reinforcement and grout. The safe room is easily completed by adding interior walls constructed of reinforced CMU, a concrete roof deck over the safe room, and a special safe room door, as shown under construction in the bottom photograph.



CMU was used for the exterior walls at this house under construction (New Smyrna Beach, FL).



Sketch of floor plan showing location of safe room area in house.



View of an in-residence safe room under construction. Steel reinforced and fully grouted CMU surround the safe room space (New Smyrna Beach, FL).

Retrofitting Existing Houses

FEMA 320 contains general guidance for retrofitting a house by adding a safe room. Building a safe room in an existing house will typically cost 20 percent more than building the same safe room in a new house while under construction. Because the safe room will be used for life safety, and because your home might be exposed to wind loads and debris impacts it was not designed to resist, an architect or engineer should be employed to address special structural requirements, even if inclusion of an architect or engineer in such a project is not required by the local building department.

The design drawings provided in FEMA 320 are also appropriate for use in small businesses, fire and police stations, and other public areas where small groups of people may be seeking life-safety protection from extreme winds and wind-borne debris.

Recommendations for Sheltering When You Cannot Place a Safe Room Within Your Home

There are many reasons that homeowners or renters may not be able to install a safe room within their home. These could include lack of permission (the resident does not own the home or does not have rights to modify or change the home), lack of available space, or lack of technical or economic practicality. In those cases, a stand-alone safe room can be designed and constructed outside of a residence. Stand-alone safe rooms can provide the same level of protection against high winds and wind-borne debris as in-residence safe rooms.

For more information about pre-fabricated and stand-alone safe rooms and storm shelters, contact the National Storm Shelter Association (<http://www.nssa.cc>)

Small Stand-Alone Safe Rooms

Some site-built homes, and most manufactured homes, do not lend themselves to the structural modifications and retrofitting required to install or construct an in-residence safe room. In these instances, a stand-alone safe room may be constructed (either above grade, partially above grade or below grade) near the residence. Small stand-alone safe rooms can be constructed to accommodate the occupants of one house, a few houses, or a small apartment building. The photograph from Tuscaloosa, AL, shows how a stand-alone safe room provides refuge for the residents.

Community Safe Rooms

A community safe room can be constructed to accommodate the occupants of several apartments or homes (site-built or manufactured homes). The small safe room designs in FEMA 320 were revised in 2008 and expanded for applications of up to 16 individuals and are suitable for use by business, public facilities, and others when a small, community safe room is desired. The design criteria for these prescriptive designs are presented in FEMA 361, Design and Construction Guidance for Community Safe Rooms (2008). For additional information about community safe rooms, refer to the Tornado Recovery Advisory No. 2 titled "Safe Rooms: Selecting Design Criteria" (updated in 2011). Many different types of safe rooms can be designed and



View of a pre-fabricated safe room that serves a residence (Tuscaloosa, AL).

constructed to meet the needs of small or large groups of residents. A safe room may be constructed to be used solely as a shelter or it may be designed as a multi-use building, such as a clubhouse, school, or recreation center. A safe room may also be constructed above-grade, below-grade, or partially below-grade as shown in the photograph from Brookwood, AL. Selecting the right type of safe room will be a collective decision made by the residents, funding agencies, and property owners and managers. For information on community safe rooms for larger populations, including planning and operational issues, see FEMA 361.



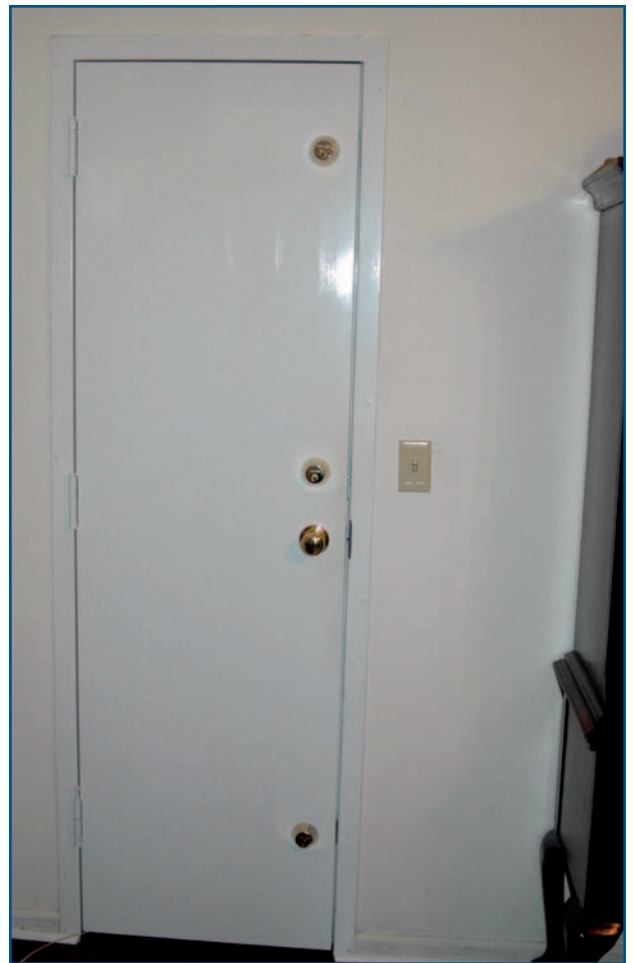
View of a partially below-grade community safe room (Brookwood, AL).

Safe Room Doors

When building a safe room, it is very important to pay extra attention to the safe room door. Door construction has been found to be a common weakness in safe rooms' ability to withstand high wind pressures and missile impacts. Door failures are typically due to the type of door construction and door hardware. Standard door construction that meets minimum code requirements is not sufficient to withstand the extreme wind forces and the wind-borne debris impacts often seen in extreme wind events. It is imperative that the walls, ceilings, and doors of a safe room be able to withstand the impacts of missiles carried by extreme winds.

Safe room doors are tested by laboratories for their ability to withstand the pressures associated with high-wind events and missile impacts. To meet the criteria set forth in FEMA 320 for residential and small community safe rooms, doors must resist wind pressures and wind-borne debris impacts in tests set forth in the International Construction Code/National Storm Shelter Association (ICC/NSSA) *Standard for the Design and Construction of Storm Shelters* (ICC-500), for a 250 mph safe room design wind speed and impacts from a 15-pound 2x4 sawn lumber member traveling horizontally at 100 mph (additional design restrictions apply).

Research by the NSSA has shown that steel doors with 14-gauge (or heavier) skins are able to withstand the standard missile impact test. Such doors in widths up to 3 feet, typical of what is found in a residential safe room, are capable of withstanding wind loads associated with wind speeds up to 250 mph when they are latched with three hinges and three deadbolts. At the time of this publication, there has not been a wood door that has successfully passed the pressure or missile impact



Photograph of safe room door with three deadbolts and three hinges.

tests using the design criteria for 250 mph winds. Testing has been performed on various sized doors, and guidance on choosing an appropriate safe room door can be found in Appendix F of FEMA 361 (2008).

Refuge Areas

Occupants of dwellings that do not have in-residence safe rooms or access to stand-alone or community safe rooms should identify the best available refuge area in their home before an emergency happens. When people identify and take refuge in the best available space within a building, they are less likely to be injured or killed. However, it is important to remember that “best available refuge areas” are not specifically designed as safe rooms, so occupants can be injured or killed during a tornado or hurricane event if the high winds breach the building.

The lowest floor of a building is usually the safest. Upper floors receive the full strength of the winds. Occasionally, tornado funnels hover near the ground but hit only upper floors. Belowground space is almost always the safest location for a refuge area. The following criteria should be considered when identifying the best available refuge area in your home:

- Choose a location that is large enough for all the residents of the home. It is recommended that each person be provided with a minimum of 5 square feet of space in the refuge area. Additional space will need to be accounted for if the residents of the home are wheelchair users or bedridden. Guidance is provided in FEMA P-431, *Tornado Protection: Selecting Refuge Areas in Buildings* (2009).
- Avoid locations with high ceilings. These spaces often have long-span roofs that can collapse under the forces imposed by tornado winds.
- Choose the lowest floor of the residence. A basement is preferable, or first floor if there is no basement).
- Avoid taking refuge in basements with exterior doors or large windows (i.e., walk-out basement). If no other viable option exists, take shelter in a basement area that is away from windows and exterior doors.
- Choose a small interior room without windows (i.e., none of the room’s walls is an exterior wall), such as a bathroom or closet, preferably with only one door.



View of remnants of an interior room of a house that survived a strong tornado (Tuscaloosa, AL).



Avoid selecting a refuge area that is near a masonry chimney (Moore, OK).

- Choose a room located away from masonry chimneys, trees, or power poles.
- Keep the room relatively free of clutter so you and the other residents can enter and remain in the room for up to several hours.

Homeowners and renters should also refer to the Tornado Recovery Advisory No. 2 titled “Safe Rooms: Selecting Design Criteria” (updated in 2011).

Emergency Supply Kits and Weather Radios

FEMA 320 includes information on preparing a family emergency plan and an emergency supply kit for a shelter. Further, all individuals living or working in tornado-prone areas should have a battery-powered weather radio in their home or place of work. For more information about weather radios, see Tornado Recovery Advisory No. 1 titled “Tornado Risks and Hazards in the Southeastern United States” (updated 2011).

Registering Your Safe Room with Local Officials

FEMA recommends that the local fire department, local emergency management agency (EMA), and other relevant local officials be given the location of the safe room. Providing the latitude and longitude coordinates of the entrance to the safe room to local officials can be vital in post-disaster recovery efforts. In the event that debris is surrounding or on top of the safe room, this will allow them to check on the safe room to make sure the occupants are not trapped inside.

Useful Links and Resources

Taking Shelter from the Storm: Building a Safe Room For Your Home or Small Business (FEMA 320), August 2008, 3rd Edition <http://www.fema.gov/library/viewRecord.do?id=1536>

Design and Construction Guidance for Community Safe Rooms (FEMA 361), August 2008, 2nd Edition <http://www.fema.gov/library/viewRecord.do?id=1657>

Tornado Protection: Selecting Refuge Areas in Buildings (FEMA P-431), FEMA, October 2009, 2nd Edition <http://www.fema.gov/library/viewRecord.do?id=1563>

National Storm Shelter Association (NSSA); <http://www.NSSA.cc>