

Residential Sheltering: In-Residence and Stand-Alone Shelters



FEMA

MAY 2007 TORNADO RECOVERY ADVISORY

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Intended Audience and Purpose

The purpose of this Tornado Recovery Advisory (RA) is to alert homeowners, renters, and apartment building owners to the concept of in-residence and stand-alone storm shelters.

This Recovery Advisory Addresses:

- Considering the need for a shelter
- In-residence shelter construction and retrofitting options
- Recommendations for sheltering when you cannot place a shelter within your home
- Best available refuge areas
- Emergency supply kits and weather radios

Consider the Need for a Shelter

The purpose of having a shelter (also known as a “safe room”) in or near your home is to protect you and your family from injury or death caused by extreme winds. Shelters are designed to allow occupants to survive tornadoes with little or no injury. To determine your exposure to tornadoes, refer to FEMA 320, *Taking Shelter From the Storm: Building a Safe Room Inside Your House* (Second Edition, March 2004).¹ FEMA 320 provides information that can help you decide whether to construct a shelter to protect you and your family from injury or death during a tornado. Additional information is provided in the Tornado RA titled *Tornado Risks and Hazards in the Midwest United States*.

After determining that you live in a tornado-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. Tornado winds can impart wind and windborne debris loads on your house much greater than those on which building code requirements are based. Only shelters designed and constructed to standards well in excess of minimum code requirements offer adequate occupant protection during a tornado. These specially built shelters can be constructed inside your residence or as stand-alone structures.

In-Residence Shelter Construction and Retrofitting Options

Constructing a shelter inside your home makes it very accessible to your family. A shelter may be installed during the initial construction of a home, or retrofitted. As long as the design and construction requirements are followed, the same level of protection is provided by either type of shelter. Currently, a new shelter standard is being developed by the International Code Council that will incorporate many of FEMA’s shelter guidelines.

See these 2007 Tornado Recovery Advisories for information about sheltering from tornadoes:

- *Tornado Risks and Hazards in the Midwest United States* (Tornado RA1)
- *Storm Shelters: Selecting Design Criteria* (Tornado RA2)

It is also important to remember that shelters offering protection against high-wind events should not be placed where floodwaters have the potential to endanger occupants within the shelter. Consult your local floodplain manager to determine whether your home, or a proposed stand-alone shelter site, is susceptible to flooding.

1. FEMA 320 is available online at <http://www.fema.gov/library/viewRecord.do?id=1536>. Hardcopies may be obtained at no cost by calling 800-480-2520.

In addition to constructing a shelter using plans, such as those provided by FEMA 320, manufactured shelters are now available.² Among many different manufactured shelter alternatives now available to the public, some are stand-alone units, while others can fit into existing or new homes. An association of manufacturers called the National Storm Shelter Association (NSSA) maintains a Web site <http://www.nssa.cc/ProducerRoster.php> where information about members and products can be found.

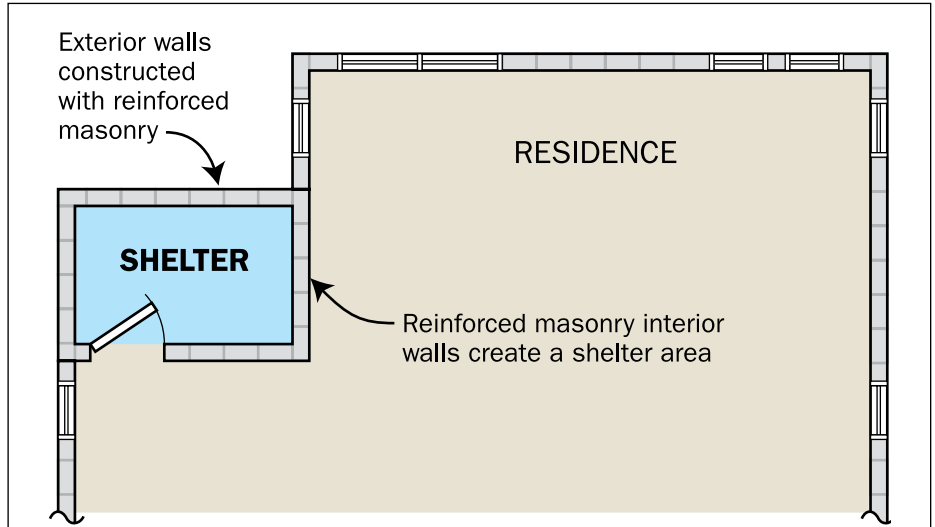
New Construction

FEMA 320 provides detailed drawings and specifications that can be used by a builder/contractor to construct a shelter in your home. The designs provided are for shelters constructed of wood, masonry, or concrete. All of them are designed to resist 250 mph (3-second gust) wind speeds and impacts from windborne debris. Pre-fabricated shelters are also available for installation by a builder/contractor when first building your home. The basic cost to design and install a shelter (site-built or manufactured) during the construction of a new house is approximately \$6,000.

It is relatively easy and cost-effective to add a shelter when first building a 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 required by FEMA 320 can be achieved by slightly modifying the exterior walls at the shelter space by adding steel reinforcement and full grouting. The shelter is easily completed by adding interior walls constructed of reinforced CMU, a concrete roof deck over the shelter, and a special shelter door.



CMU was used for the exterior walls at this house under construction.



Sketch of floor plan showing location of shelter area in house.



View of an in-residence shelter under construction. Steel reinforced and fully grouted CMU surround the shelter space.

2. FEMA doesn't test, verify, or approve manufactured shelters. Materials to use in evaluating manufactured products are available from NSSA.

Retrofitting Existing Houses

FEMA 320 provides general guidance for retrofitting a house with a shelter. Building a shelter in an existing house will typically cost 20 percent more than building the same shelter in a new house while under construction. Because the shelter is being 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 (A/E) should be employed to address special structural requirements, even if inclusion of an A/E in such a project is not required by the local building department.

FEMA 320 also provides designs for building shelters in basements. Instead of assuming that any area below grade can provide protection, a dedicated safe-room should be built into the basement to be used for a shelter. There have been many instances of houses sliding off their foundations and ending up in the basement (as shown in the photograph on the top right). Without dedicated space adequately walled and roofed for protection, a house sliding into the basement can injure or kill inhabitants huddling under the basement stairs or in a basement corner.

FEMA 320 guidance for retrofitting a basement shelter into an existing home emphasizes the requirement that the shelter has its own separate roof and support structure so the shelter occupants are protected from falling debris. Relying on the floor of the house to protect the occupants could mean injury or death (see photographs to the right).



Residence that slid on its foundation and collapsed partially into the basement (Greensburg, KS).



First floor of residence that shifted during a tornado, exposing the basement (Greensburg, KS).

Recommendations for Sheltering When You Cannot Place a Shelter Within Your Home

Many reasons may prevent homeowners or renters from installing or constructing a shelter inside their home. These reasons may 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 other technical or economic constraints. In such cases, stand-alone shelters can be designed and constructed outside of a residence. These shelters can provide the same level of protection against high winds and windborne debris as the in-residence shelters.

Small Stand-Alone Shelters

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 shelter. In these instances, a stand-alone shelter may be constructed (either above grade, partially above grade [see photograph directly below], or below grade) near the residence. Small stand-alone shelters can be constructed to accommodate the occupants of one house, a few houses, or a small apartment building. The photograph below, from Wichita, Kansas, shows how a manufactured home community provided small, pre-fabricated shelters as a refuge for the residents. Each shelter can protect the occupants of several homes in the community.

Community Shelters

For information about community shelters, refer to the Tornado RA titled *Storm Shelters: Selecting Design Criteria*. Many different types of shelters can be designed and constructed to meet the needs of large groups of residents. A shelter may be a single-use building, or it may be a multi-use building, such as a clubhouse (at community pools, golf courses, etc.), school building, or recreation center. Selecting the right type of shelter is a collective decision made by the residents, funding agencies, and property owners and managers. For information on community shelters for larger populations, including planning and operational issues, see FEMA 361, *Design and Construction Guidance for Community Shelters (2000)*.³

Best Available Refuge Areas

Occupants of dwellings that do not have in-residence shelters, or access to stand-alone or community shelters, should identify the best available refuge area within their home before an emergency happens. When people identify *in advance* the best available space for refuge inside a building, they will be less likely to suffer injury or death during an emergency. However, it is important to remember that “best available refuge areas” are not specifically designed as shelters, so occupants will still be at risk for injury or death when using these areas.



View of a pre-fabricated shelter that serves a few manufactured homes (Wichita, KS).



View of remnants of an interior room of a house that survived a strong tornado.

3. FEMA 361 is available online at <http://www.fema.gov/library/viewRecord.do?id=1657>. Hardcopies may be obtained at no cost by calling 800-480-2520.

The following criteria should be used in identifying the best available refuge area in your home:

- Choose the lowest floor of the residence (a basement is preferable, or first floor if there is no basement).
- 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.
- 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.



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

Emergency Supply Kits and Weather Radios

FEMA 320 provides information on how to prepare a Family Emergency Plan and an Emergency Supply Kit for a shelter. Remember, it is important for all individuals who live or work in tornado-prone areas to have a weather radio within their home or place of work. For more information about weather radios, see the Tornado RA titled Tornado Risks and Hazards in the Midwest United States.