Tornado Risks and Hazards in the Southeastern United States

FEMA

FEBRUARY 2007 TORNADO RECOVERY ADVISORY *FEMA DR-1679-RA1*

Purpose and Intended Audience

The purpose of this Tornado Recovery Advisory is to provide background on the tornado hazard in the Southeast. The general population, home owners and renters, policy makers, local officials, builders, and building departments should understand that tornado occurrence in the Southeast is not a rare event. In fact, of the top 20 states in tornado frequency, 5 are in the Southeast.

This advisory also identifies FEMA resources that can be used to help design and construct portions of almost any building type (including residences) to provide safe shelter from tornadoes, or to help minimize damage caused by these wind events.

This Recovery Advisory Addresses:

- Recent events
- Tornado occurrence outside "Tornado Alley"… how great is the risk?
- Can a building survive a tornado? Yes!
- Assessing risk
- Weather radios

See these 2007 Tornado Recovery Advisories for information about sheltering from tornadoes, and improving manufactured homes against damage from high winds:

- Storm Shelters: Selecting Design Criteria (Tornado Recovery Advisory No. 2)
- Residential Sheltering: In-Residence and Stand-Alone Shelters (Tornado Recovery Advisory No. 3)
- Understanding and Improving Performance of Older Manufactured Homes in High-Wind Events (Tornado Recovery Advisory No. 4)
- Understanding and Improving Performance of New Manufactured Homes in High-Wind Events (Tornado Recovery Advisory No. 5)

Recent Events

In the early morning hours of February 2, 2007, a small but devastating outbreak of three tornadoes struck central Florida from Lady Lake to New Smyrna Beach. Two of the tornadoes were rated by the National Weather Service as EF3 and the other was rated EF1 on the Enhanced Fujita Scale (see text box). The three tornadoes struck in the middle of the night. Twenty-one people were killed and dozens were injured. Total damage estimates are still being compiled from this event, but early estimates are that more than $150 million[1] in damage was caused by these tornados. Less than one month later, on March 1, 2007, Enterprise, Alabama experienced one

The Fujita Scale categorizes tornado severity based on observed damage. The six-step scale ranges from F0 (light damage) to F5 (incredible damage). As of February 2007, the National Weather Service uses the Enhanced Fujita Scale (EF Scale). This new scale ranges from EF0 to EF5. See http://www.spc.noaa.gov/efscale/ for further information on the EF Scale.

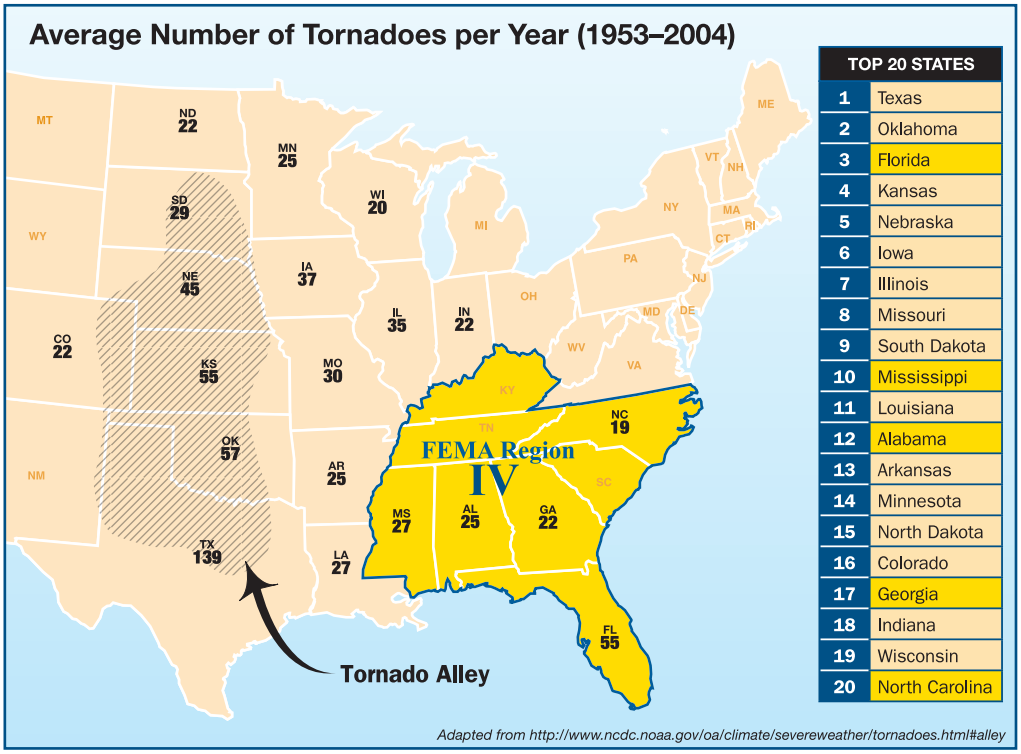
Fujita Scale		EF Scale	
Fujita Scale	3-Second Gust Speed (mph)	EF Scale	3-Second Gust Speed (mph)
F0	45–78	EF0	65–85
F1	79–117	EF1	86–109
F2	118–161	EF2	110–137
F3	162–209	EF3	138–167
F4	210–261	EF4	168–199
F5	262–317	EF5	200–234

1. St. Petersburg Times, "Facing Life Without Family" by Catherine Shoichet, March 2, 2007.

of the top 10 deadliest tornadoes to impact a school when, in the early afternoon hours, a tornado ripped through a high school, killing eight students. Later that day, a tornado severely damaged a hospital in Americus, Georgia. The March 1 storms caused damage and loss of life in several areas of both states.

Tornado Occurrence Outside "Tornado Alley"… How Great Is the Risk?

"Tornado Alley" is an area of the heart-land of the United States known for its tornado activity. Although the exact extent of Tornado Alley can be debated, most scientists agree that Texas, Oklahoma, and Kansas are well known for tornado risk and make up a large portion of Tornado Alley.



What most people may not be aware of is the amount of tornadic activity outside of Tornado Alley. FEMA Region IV has eight states subject to tornadoes and six subject to hurricanes (refer to map on this page).

Although hurricanes have received most of the attention in recent years in the Southeast, the threat and risk of tornadoes is real. The table below shows the number of tornado occurrences for each of the states in FEMA Region IV. For the 55-year study period, over 9,700 tornadoes have been recorded. The State of Florida alone has seen extreme numbers of tornado occurrences. For three of the years between 1997 and 2004, it experienced over 100 tornadoes (115 in 1997, 115 in 1998, and 105 in 2004).

Most tornadoes occurring in the Southeast (with the exception of Mississippi and Alabama) are typically weak or moderately strong (classified as F2 and smaller on the Fujita Scale). However, these weaker tornadoes can be as deadly as the stronger F3, F4, and F5 tornadoes. For example, over 50 of the 78 killer tornadoes that occurred in Florida between 1882 and 2007 were F2 or weaker. Further, tornadoes are not always single tornado events; sometimes outbreaks of several tornadoes are associated with a large storm system. Notable outbreaks in the Southeast include:

The Carolinas Outbreak of March 28, 1984

- 22 tornadoes responsible for 57 fatalities
- Approximately 1,250 injuries
- Approximately $200 million in damages
- 37% of fatalities occurred in manufactured homes

The Kissimmee Tornado Outbreak of February 22–23, 1998

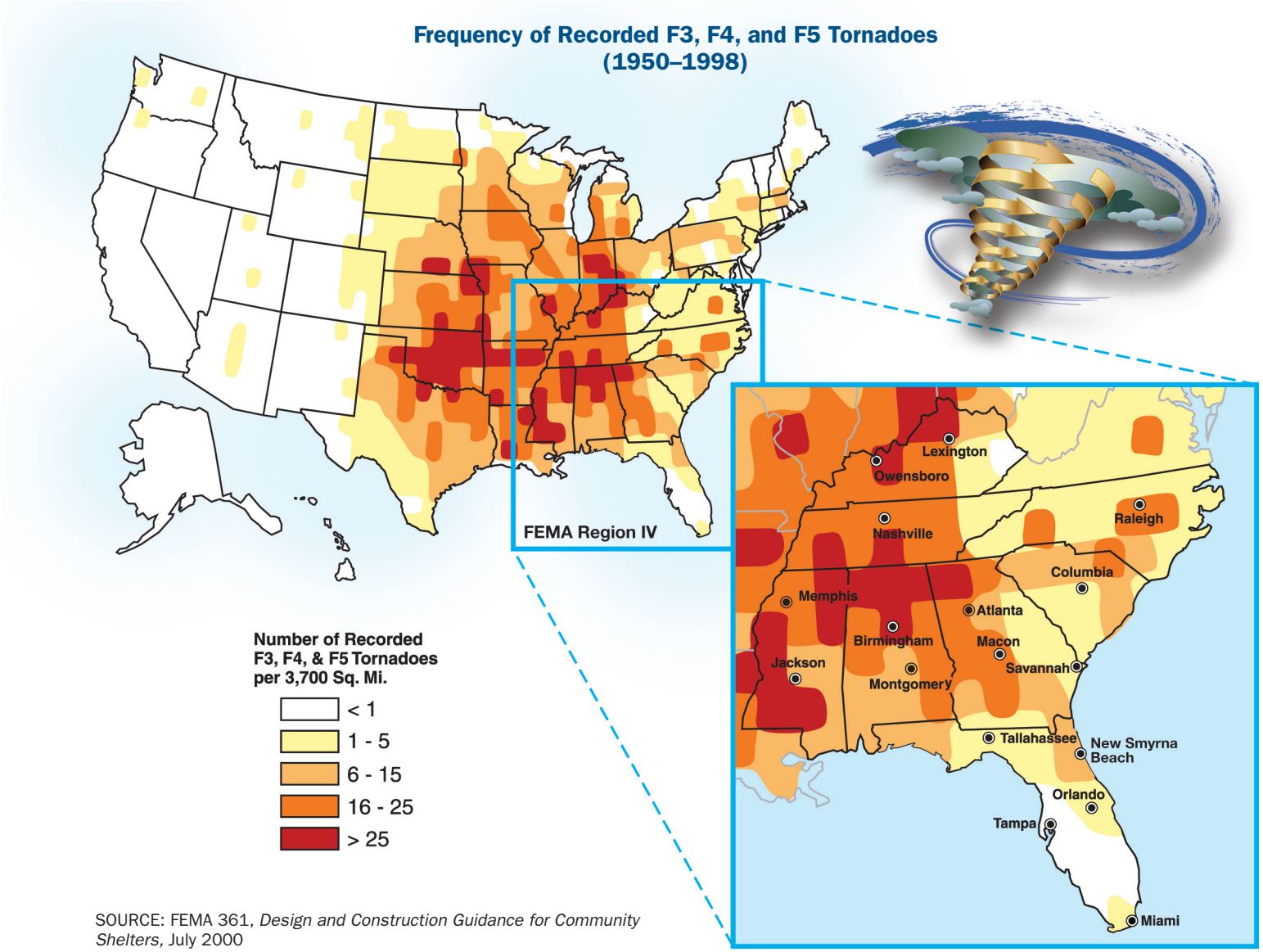
- 7 tornadoes responsible for 42 fatalities
- Approximately 200 injuries
- Over $100 million in damages
- Three strongest tornadoes were rated F3, which destroyed over 300 buildings and damaged more than 7,000

States in FEMA Region IV	Total Tornado Occurrences (1950–2005)	Total Fatalities (1950–1995)[a]	
		Number	Rank
Florida	2,799	85[b]	
Mississippi	1,429	387	2
Alabama	1,301	282	4
Georgia	1,143	111	14
North Carolina	935	82	
Tennessee	788	184	7
South Carolina	718	47	
Kentucky	590	105	15

a. Texas is ranked highest with 475 fatalities for this period of time.
b. In Florida, an additional 21 fatalities occurred between 1995–2007, for a total of 166 (1950–2007).

Assessing Your Risk

To determine if you have a low, moderate, or high tornado risk, use the Frequency Map (below) to determine how many tornadoes were recorded per 3,700 square miles for the area where your building is located. Find the row in the "Risk Table" (below) that matches that number. Next, look at the Wind Zone Map (next page) and note the wind zone (I, II, III, or IV) in which your building is located. Find the matching column in the Risk Table and find the box that lines up with both the number of tornadoes per 3,700 square miles in your area and your wind zone. The color in that box tells you the level of your risk from extreme winds and helps you decide whether to build a shelter. A shelter is the preferred method of wind protection in high-risk areas.



SOURCE: FEMA 361, *Design and Construction Guidance for Community Shelters,* July 2000

Levels of Risk During High-Wind Events

Number of Tornadoes per 3,700 Square Miles (see Wind Zone Map)	Wind Zone (see Frquency Map)			
	I	II	III	IV
<1	LOW Risk	LOW Risk ★	LOW Risk ★	MODERATE Risk
1–5	LOW Risk	MODERATE Risk ★	HIGH Risk	HIGH Risk
6–10	LOW Risk	MODERATE Risk ★	HIGH Risk	HIGH Risk
11–15	HIGH Risk	HIGH Risk	HIGH Risk	HIGH Risk
>15	HIGH Risk	HIGH Risk	HIGH Risk	HIGH Risk

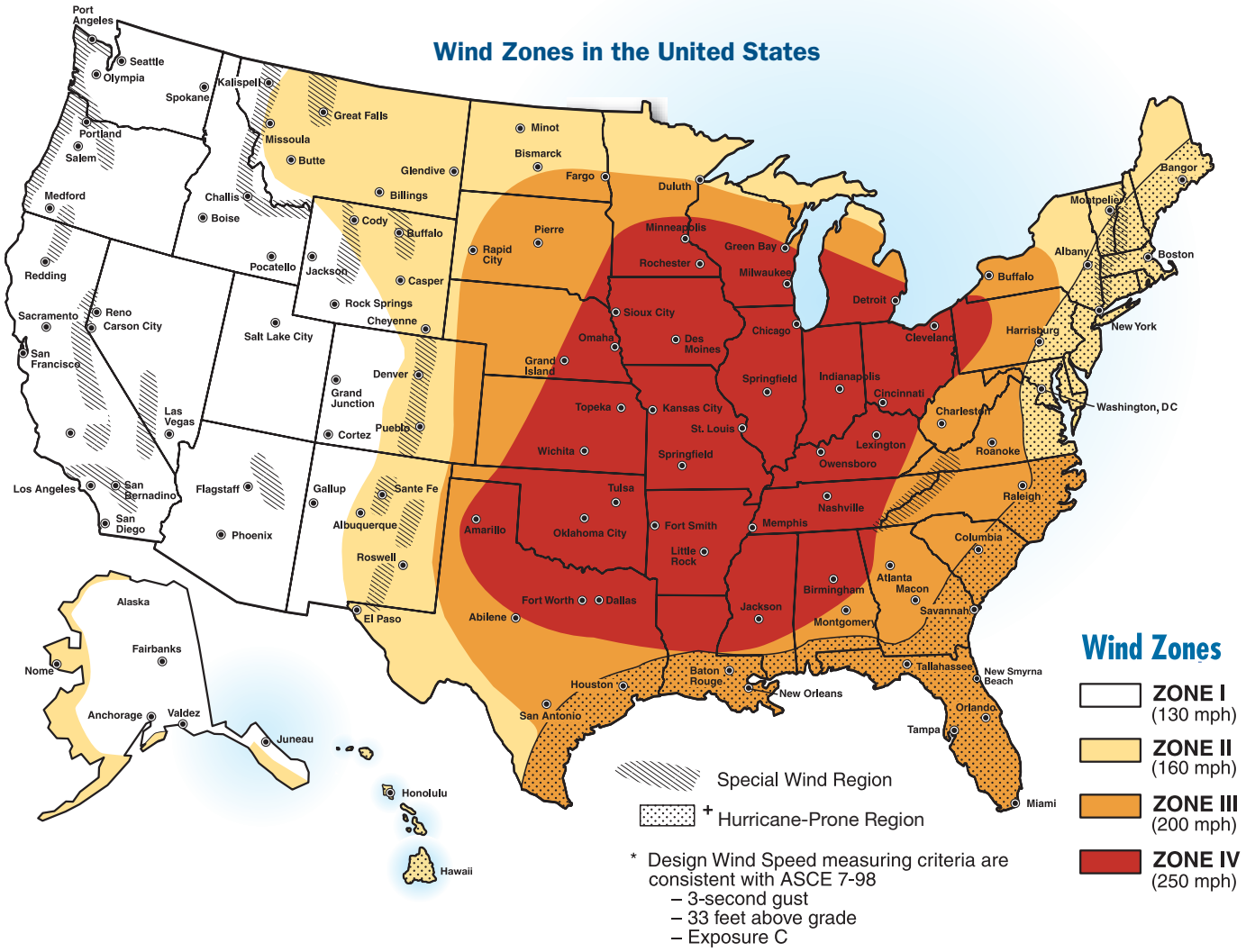
LOW Risk – Sheltering from high winds is a matter of preference.

MODERATE Risk – Shelter should be considered for protection from high winds.

HIGH Risk – Shelter is the preferred method of protection from high winds.

Note that some areas of low or moderate risk, shown as pale blue or medium blue on the Risk Table, are within the region of the United States that is also subject to hurricanes (see Wind Zone Map below). If you live in this hurricane-prone region, your risk is considered high even if the Risk Table only indicates a moderate or low risk.

Example: If your building is located in New Smyrna Beach, Florida, you would see that New Smyrna Beach is in an area shaded yellow on the Frequency Map (previous page). According to the map, the number of tornadoes per 3,700 square miles in the New Smyrna Beach area is 1–5. On the Wind Zone Map (below), New Smyrna Beach is within the dark orange area. The map key tells you that New Smyrna Beach is in Wind Zone III. The box in the Risk Table (previous page) where the 1–5 row and the Zone III column meet is shaded dark blue, which shows that the building is in an area of high risk.



Can a Building Survive a Tornado? Yes!

High-wind shelters can be designed and constructed to protect occupants from winds and windborne debris associated with all tornadoes (EF0–EF5). Buildings designed and constructed above basic code requirements (aka "hardened" buildings), and newer structures designed and constructed to modern, hazard-resistant codes can resist the wind load forces from weak tornadoes (EF1 or weaker). Furthermore, even when stronger tornadoes strike, not all damage is from the rotating vortex of the tornado. Much of the damage is from straight-line winds rushing toward and being pulled into the tornado itself. Many newer homes designed and constructed to modern codes, such as the *International Residential Codes* (IRC 2000 Edition and newer), with a load path to resist high wind forces (specified in building codes for hurricane resistance) may survive without structural failure. The primary damage to these newer homes is to the cladding and exterior systems: roof covering, roof deck, exterior walls and windows. This type of damage may be preventable on buildings that

are designed and constructed according to the IRC 2000 (or newer) when the building experiences weaker tornadoes and the outermost winds from stronger tornadoes.

For most building uses, it is economically impractical to design the entire building to resist tornadoes. However, portions of buildings can be designed as shelters to provide occupant protection from tornadoes. For information on designing shelters to resist the strongest tornadoes and hurricane events, see the Tornado Recovery Advisory titled *Storm Shelters: Selecting Design Criteria.* For residential shelters, see the Tornado Recovery Advisory titled *Residential Sheltering: In-Residence and Stand-Alone Shelters.*

For existing buildings that do not have specifically designed tornado shelters or access to community tornado shelters, it is recommended that best available refuge areas be identified in advance by a qualified architect or engineer. For further information on best available refuge areas, see *Tornado Protection: Selecting Safe Areas in Buildings* (FEMA 431), November 2003.

Weather Radios

All individuals living or working in tornado-prone areas should have a weather radio within their home or place of work. A weather radio is particularly important for those living in an area that does not have storm warning sirens.

The National Oceanic and Atmospheric Administration (NOAA) Weather Radio (NWR) is a nationwide network of radio stations broadcasting continuous weather information directly from a nearby National Weather Service (NWS) office. NWR broadcasts National Weather Service warnings, watches, forecasts and other hazard information 24 hours a day, as well as post-event information for all types of hazards, both natural and technological.

NOAA Weather Radios are available at electronics stores across the country and range in cost from $25 up to $100 or more, depending on the quality of the receiver and number of features. The NWS does not endorse any particular make or model of receiver.

Features to look for in a NOAA Weather Radio:

- The most desirable feature is an alarm tone. This allows you to have the radio turned on but silent, listening for a special tone that is broadcast before watch and warning messages that give immediate information about a life-threatening situation.
- Specific Area Message Encoding (SAME) technology, a NOAA Weather Radio feature available since the mid 1990s, is capable of providing detailed, area-specific information. Unlike other NOAA Weather Radios, the SAME feature will filter out alerts that do not affect your immediate area.
- The NOAA radio should operate on batteries during times when electrical service may be interrupted. Look for radios with an AC adapter and battery compartment.
- The radio should be tunable to all seven NWR frequencies. For the latest list of frequencies and transmitter locations, check the NOAA Weather Radio Web site http://www.weather.gov/nwr.
- The hearing and visually impaired can receive watches and warnings by connecting weather radio alarms to other kinds of attention-getting devices, like strobe lights, pagers, bed-shakers, personal computers, and text printers.

Automated Spanish translation systems are being examined for use on transmitters serving a significant Hispanic population to broadcast Spanish translations of all emergency weather and natural hazard messages immediately after the official Emergency Alert System (EAS) warning is issued. For more information in Spanish, please visit the NOAA Web site http://www.weather.gov/nwr/indexsp.htm.

Other methods to receive forecasts, watches, and warnings directly from the NWS:

- Tune in to your local radio and television stations for the latest weather forecasts, watches, and warnings.
- NWS products and services are also available on the Internet at http://www.weather.gov/nwr. Delivery of data across the Internet, however, cannot be guaranteed because of potential interruption of service.
- Another low-cost method for receiving the NWS's essential information is available on a wireless data system called the Emergency Managers Weather Information Network (EMWIN). This system presents the information directly on your home or office computer. Users may set various alarms to be alerted to particular information, whether for their local area or adjacent areas. For more information, please visit the EMWIN Web site http://www.weather.gov/emwin/index.htm.

Useful Links and Resources

Taking Shelter from the Storm: Building a Safe Room Inside Your House (FEMA 320), March 2004, 2nd Edition

Design and Construction Guidance for Community Shelters (FEMA 361), July 2000

Tornado Protection: Selecting Safe Areas in Buildings (FEMA 431), November 2003