Start Page

The materials on this CD are intended to help communities mitigate damage or loss from tornadoes and other extreme-wind events, and provide public information resources for conveying the importance of safe room construction. This is part of FEMA's ongoing mitigation effort to lessen the impact that disasters have on people and property.

This CD contains several informative posters, maps, and other resources that can be downloaded in various formats depending on how they will be used, including high-resolution print quality and low-resolution screen quality for web use. Please read the artwork usage requirements.

Contents of this CD

Posters:

6 posters that help you understand the high-wind hazards in your area.

5 FEMA informational exhibits that describe safe room design and construction issues.

For more information, please call the FEMA Safe Room Helpline at 866-927-2104 (toll free) or email Saferoom@fema.dhs.gov

Brochure:

Taking Shelter From the Storm: Building a Safe Room for Your Home or Small Business (FEMA L-233, December 2014)

Quick Guides and Fact Sheets:

Flood Hazard Elevation and Siting Criteria for Residential Safe Rooms, February 2015
Flood Hazard Elevation and Siting Criteria for Community Safe Rooms, February 2015
Fact Sheet: Residential Tornado Safe Room Doors, September 2014

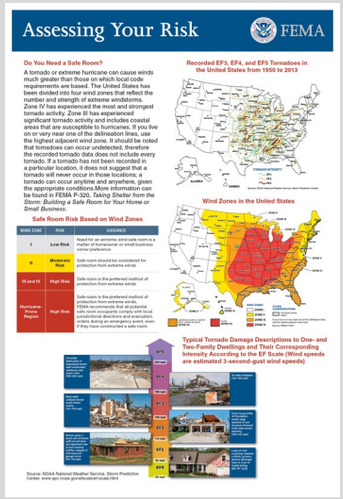
Additional Resources:

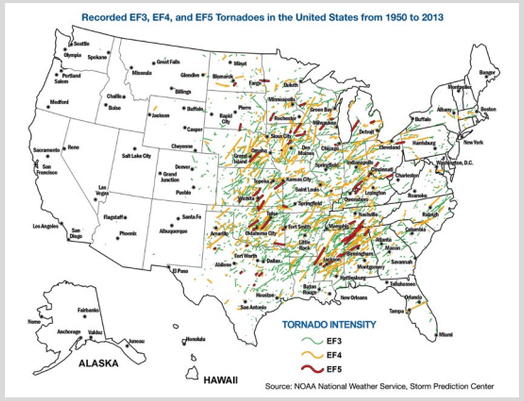
Links to additional information, guidance, and online resources such as publications and websites.

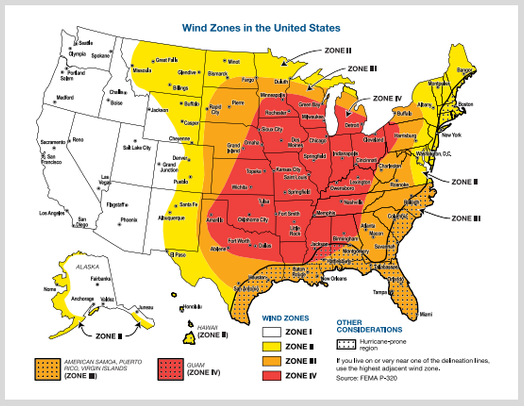
Posters

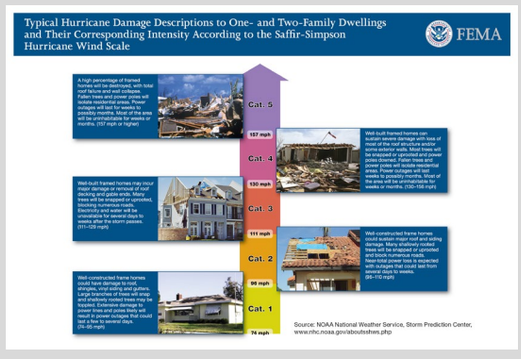
Click a poster to enlarge and download

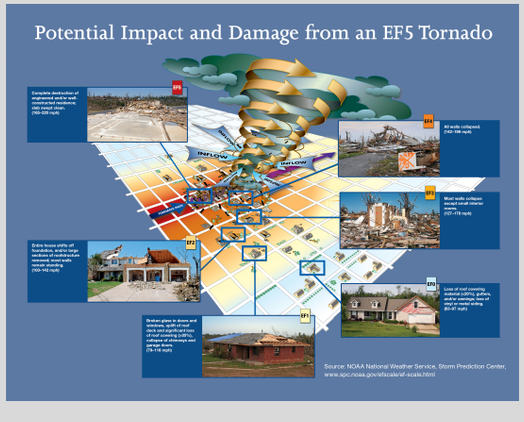
Understanding the Hazards

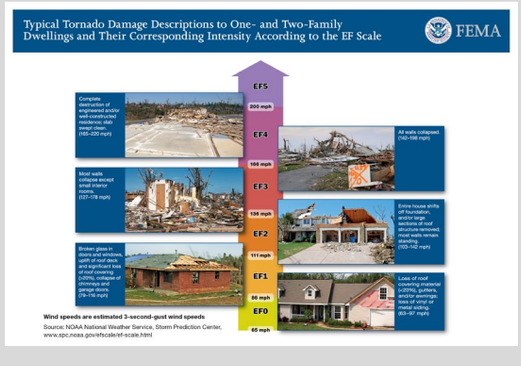




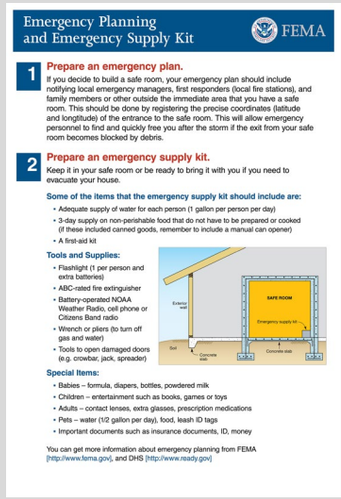


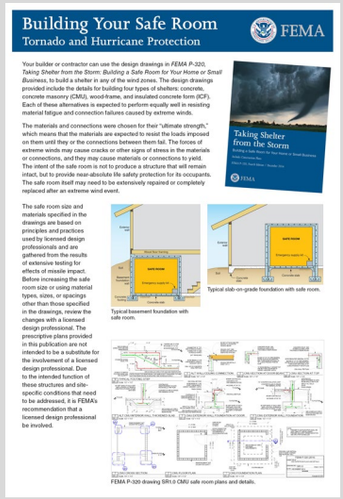


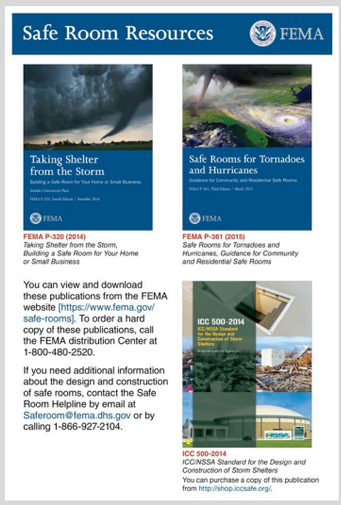


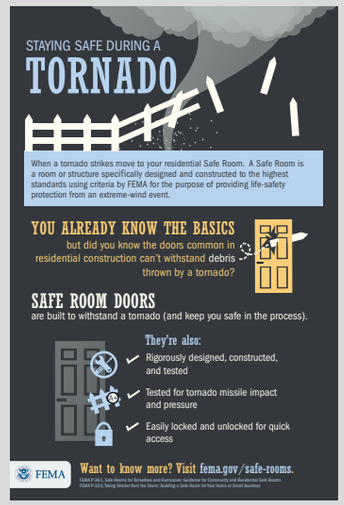


Safe Room Information









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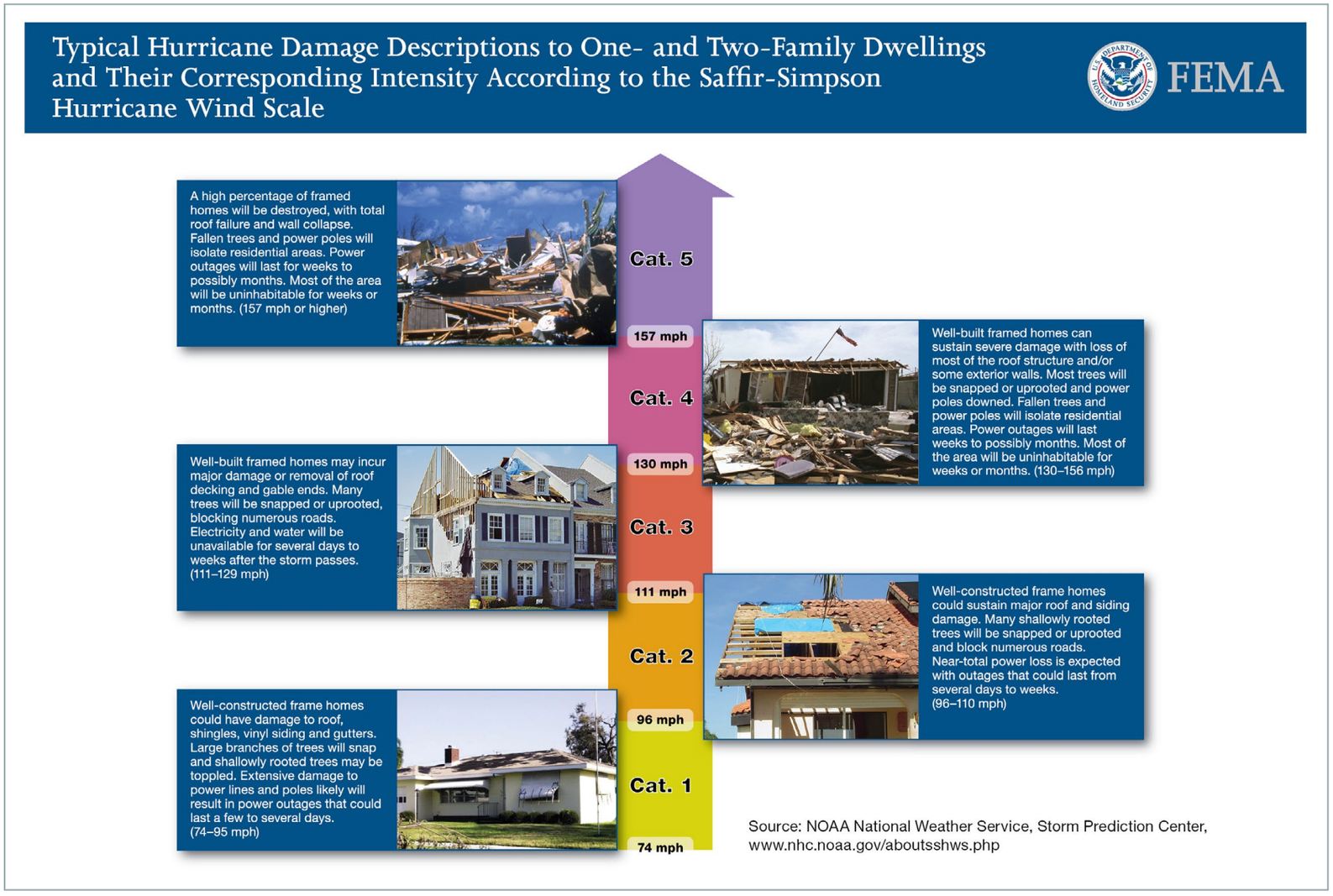

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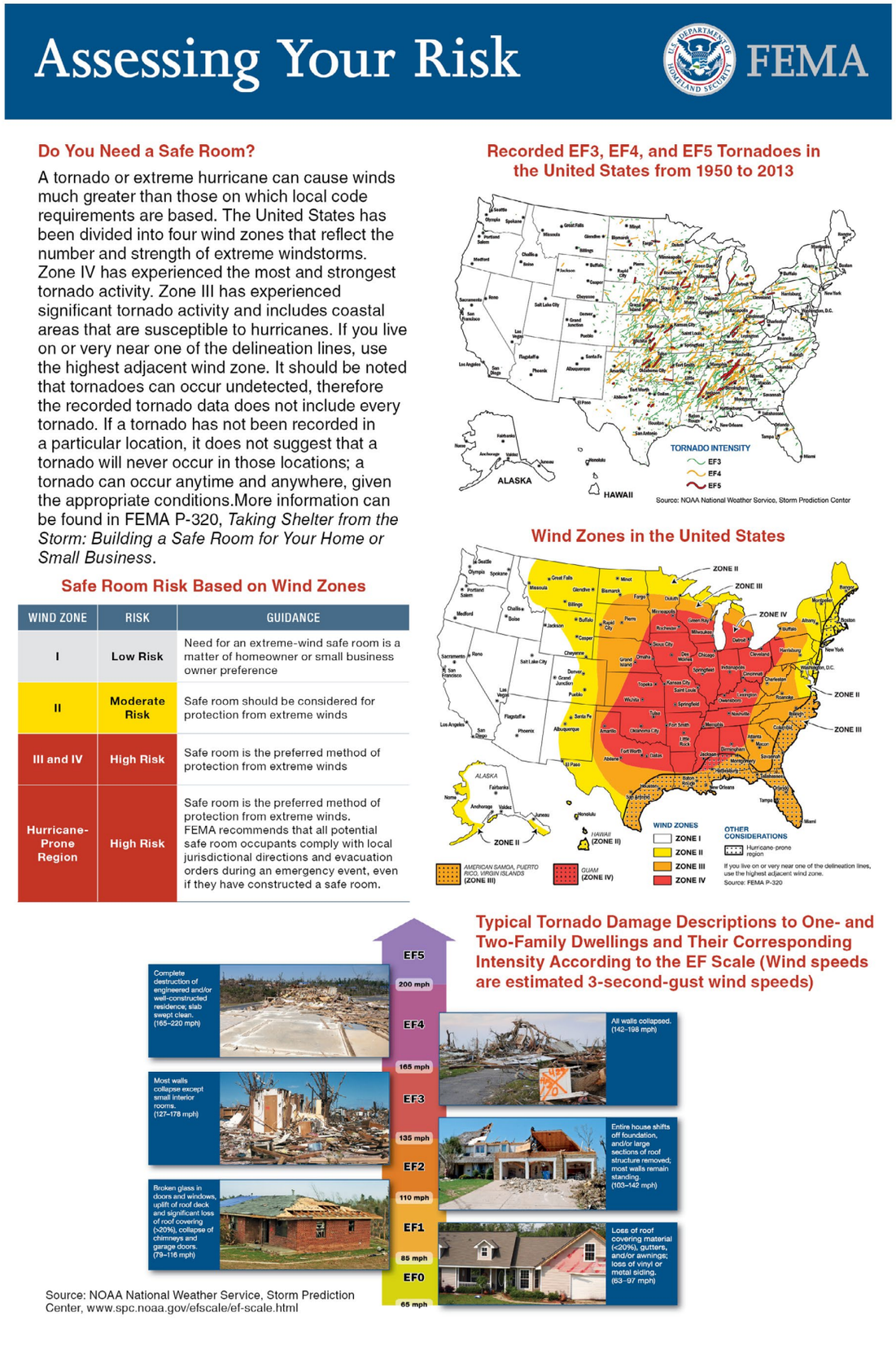

Assessing Your Risk

FEMA

Do You Need a Safe Room?

A tornado or extreme hurricane can cause winds much greater than those on which local code requirements are based. The United States has been divided into four wind zones that reflect the number and strength of extreme windstorms. Zone IV has experienced the most and strongest tornado activity. Zone III has experienced significant tornado activity and includes coastal areas that are susceptible to hurricanes. If you live on or very near one of the delineation lines, use the highest adjacent wind zone. It should be noted that tornadoes can occur undetected, therefore the recorded tornado data does not include every tornado. If a tornado has not been recorded in a particular location, it does not suggest that a tornado will never occur in those locations; a tornado can occur anytime and anywhere, given the appropriate conditions.More information can be found in FEMA P-320, *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business*.

Safe Room Risk Based on Wind Zones

WIND ZONE	RISK	GUIDANCE
I	Low Risk	Need for an extreme-wind safe room is a matter of homeowner or small business owner preference
II	Moderate Risk	Safe room should be considered for protection from extreme winds
III and IV	High Risk	Safe room is the preferred method of protection from extreme winds
Hurricane-Prone Region	High Risk	Safe room is the preferred method of protection from extreme winds. FEMA recommends that all potential safe room occupants comply with local jurisdictional directions and evacuation orders during an emergency event, even if they have constructed a safe room.

Recorded EF3, EF4, and EF5 Tornadoes in the United States from 1950 to 2013

Wind Zones in the United States

Typical Tornado Damage Descriptions to One- and Two-Family Dwellings and Their Corresponding Intensity According to the EF Scale (Wind speeds are estimated 3-second-gust wind speeds)

Source: NOAA National Weather Service, Storm Prediction Center, www.spc.noaa.gov/efscale/ef-scale.html

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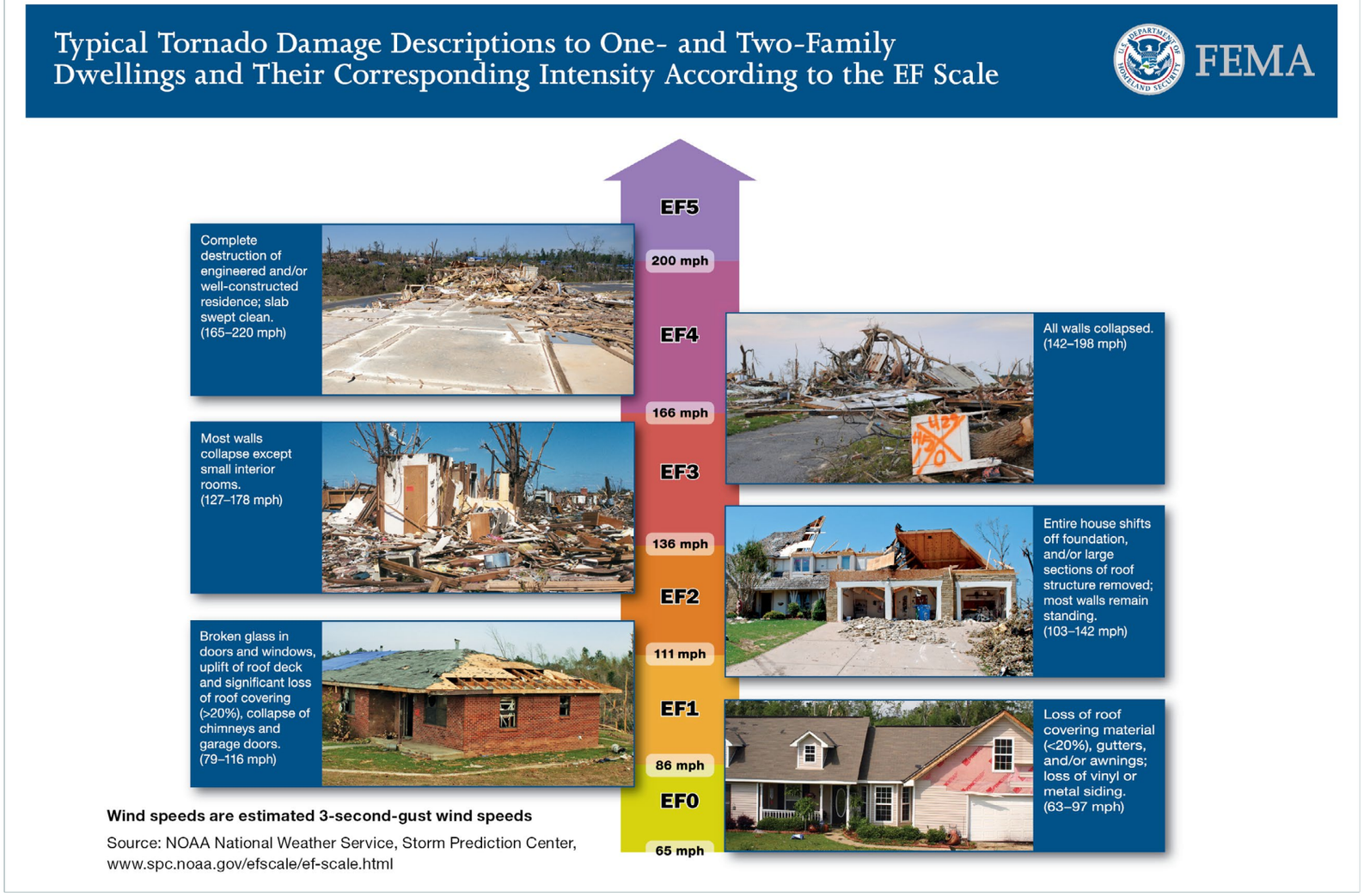

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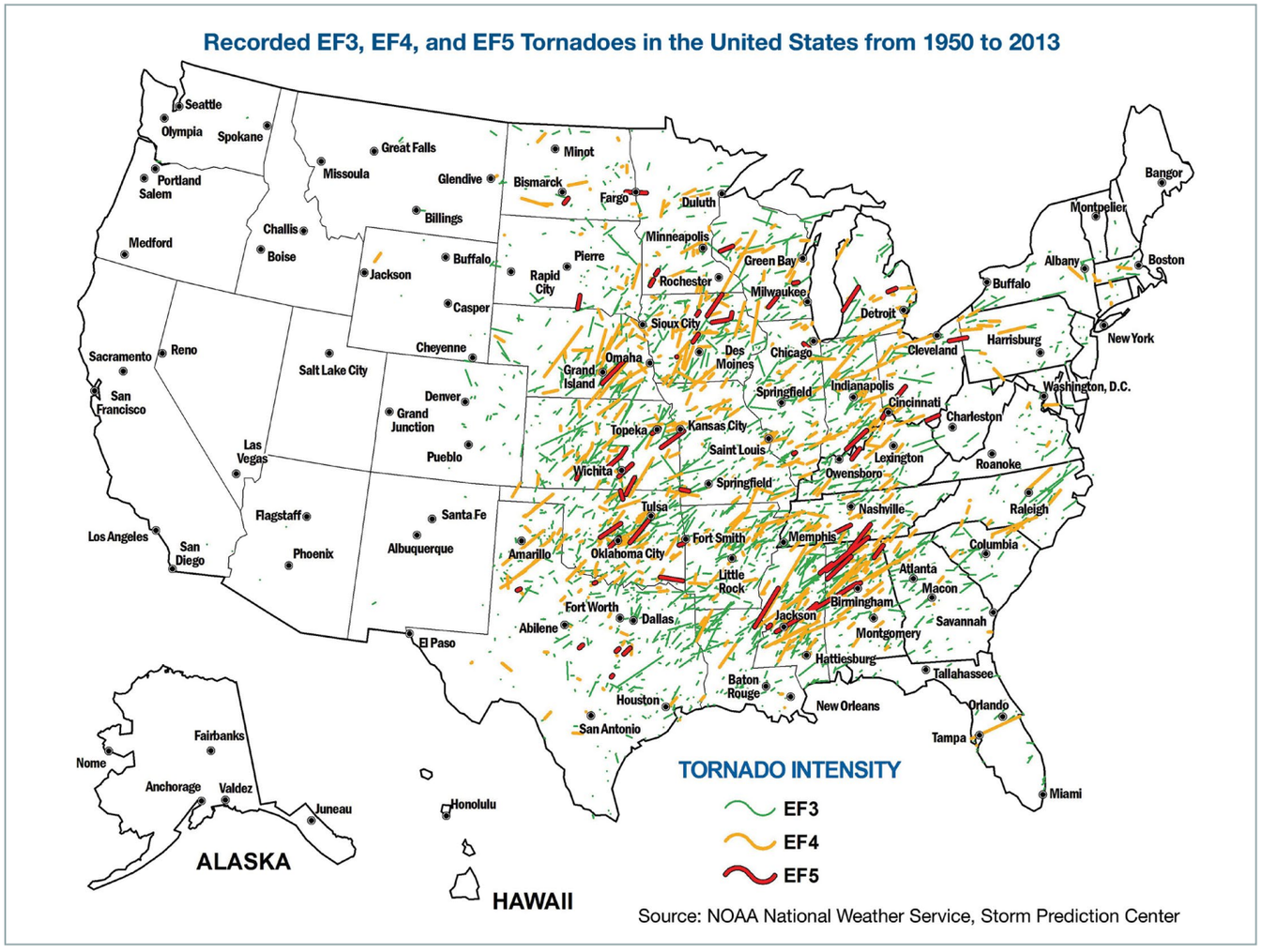

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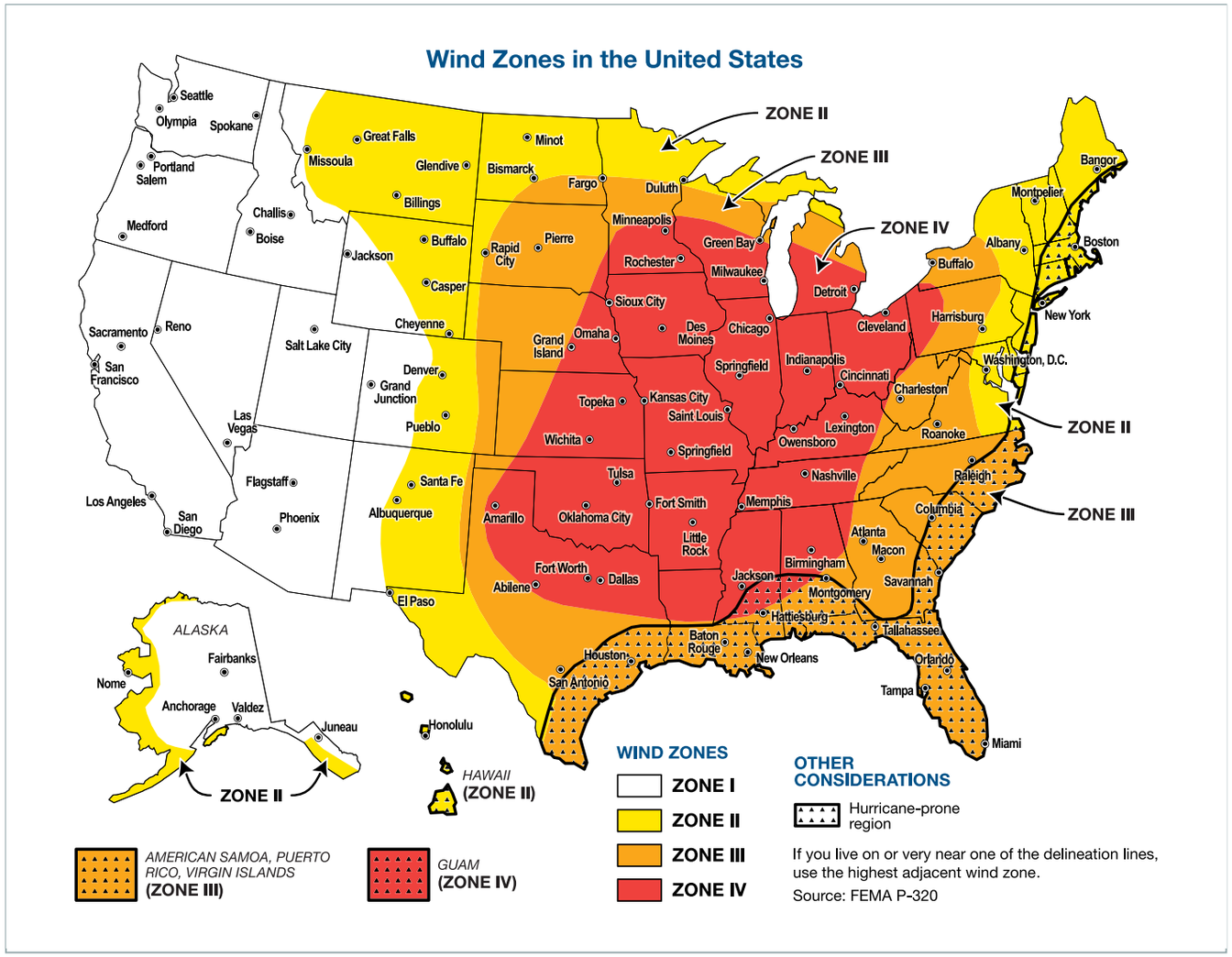

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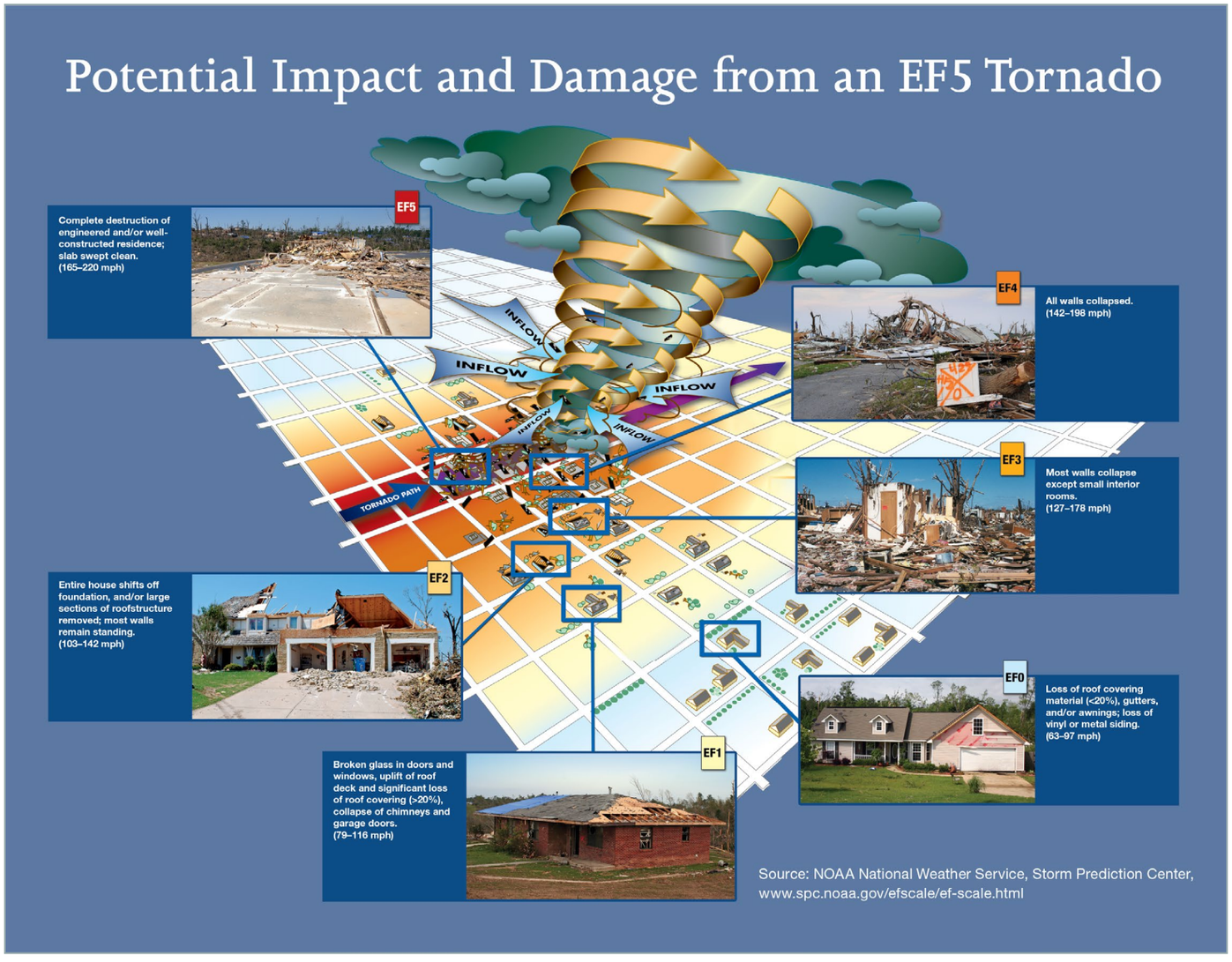

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Emergency Planning and Emergency Supply Kit

FEMA

1 Prepare an emergency plan.

If you decide to build a safe room, your emergency plan should include notifying local emergency managers, first responders (local fire stations), and family members or other outside the immediate area that you have a safe room. This should be done by registering the precise coordinates (latitude and longtitude) of the entrance to the safe room. This will allow emergency personnel to find and quickly free you after the storm if the exit from your safe room becomes blocked by debris.

2 Prepare an emergency supply kit.

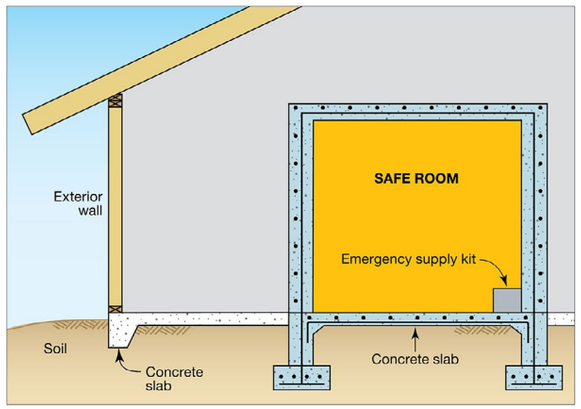
Keep it in your safe room or be ready to bring it with you if you need to evacuate your house.

Some of the items that the emergency supply kit should include are:

- Adequate supply of water for each person (1 gallon per person per day)
- 3-day supply on non-perishable food that do not have to be prepared or cooked (if these included canned goods, remember to include a manual can opener)
- A first-aid kit

Tools and Supplies:

- Flashlight (1 per person and extra batteries)
- ABC-rated fire extinguisher
- Battery-operated NOAA Weather Radio, cell phone or Citizens Band radio
- Wrench or pliers (to turn off gas and water)
- Tools to open damaged doors (e.g. crowbar, jack, spreader)



Special Items:

- Babies – formula, diapers, bottles, powdered milk
- Children – entertainment such as books, games or toys
- Adults – contact lenses, extra glasses, prescription medications
- Pets – water (1/2 gallon per day), food, leash ID tags
- Important documents such as insurance documents, ID, money

You can get more information about emergency planning from FEMA [http://www.fema.gov], and DHS [http://www.ready.gov]

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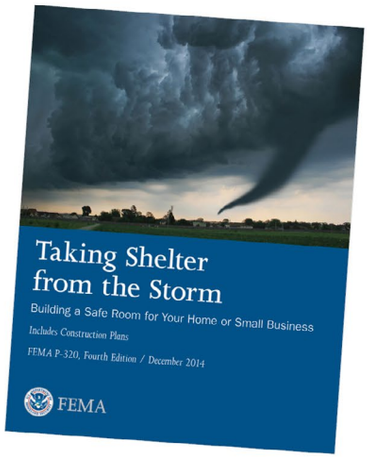
Building Your Safe Room

Tornado and Hurricane Protection

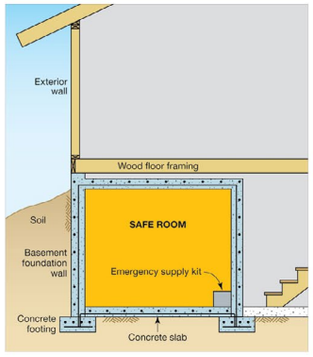
FEMA

Your builder or contractor can use the design drawings in *FEMA P-320, Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business*, to build a shelter in any of the wind zones. The design drawings provided include the details for building four types of shelters: concrete, concrete masonry (CMU), wood-frame, and insulated concrete form (ICF). Each of these alternatives is expected to perform equally well in resisting material fatigue and connection failures caused by extreme winds.

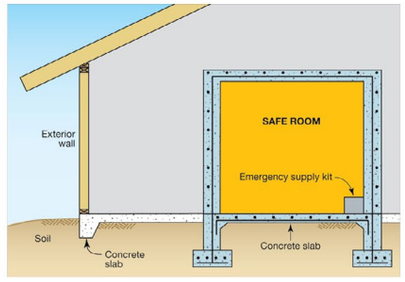


The materials and connections were chosen for their "ultimate strength," which means that the materials are expected to resist the loads imposed on them until they or the connections between them fail. The forces of extreme winds may cause cracks or other signs of stress in the materials or connections, and they may cause materials or connections to yield. The intent of the safe room is not to produce a structure that will remain intact, but to provide near-absolute life safety protection for its occupants. The safe room itself may need to be extensively repaired or completely replaced after an extreme wind event.

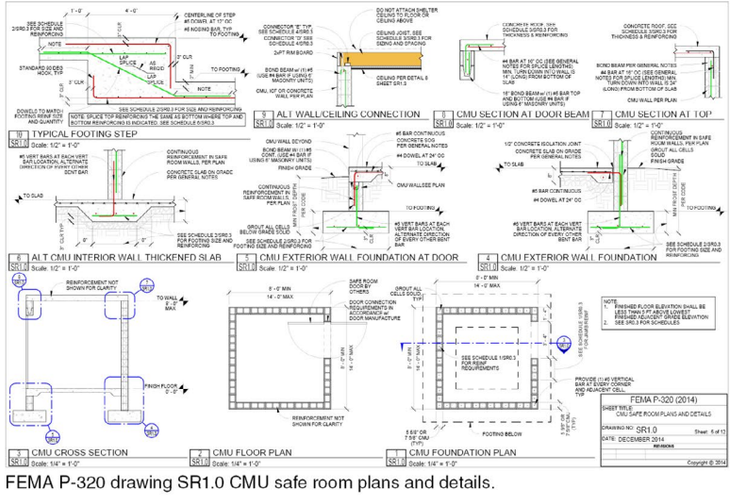
The safe room size and materials specified in the drawings are based on principles and practices used by licensed design professionals and are gathered from the results of extensive testing for effects of missile impact. Before increasing the safe room size or using material types, sizes, or spacings other than those specified in the drawings, review the changes with a licensed design professional. The prescriptive plans provided in this publication are not intended to be a substitute for the involvement of a licensed design professional. Due to the intended function of these structures and site-specific conditions that need to be addressed, it is FEMA's recommendation that a licensed design professional be involved.



Typical basement foundation with safe room.



Typical slab-on-grade foundation with safe room.



FEMA P-320 drawing SR1.0 CMU safe room plans and details.

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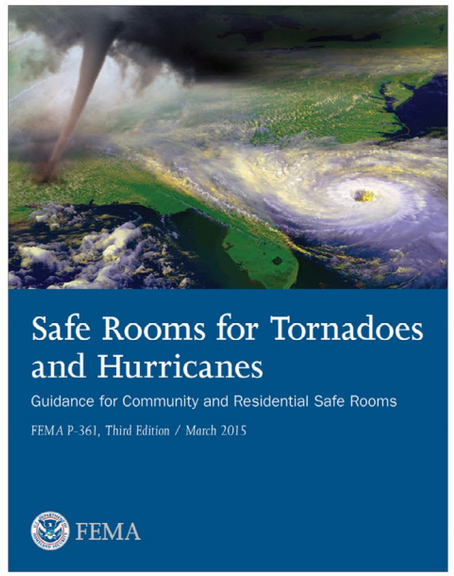
Safe Room Resources

FEMA

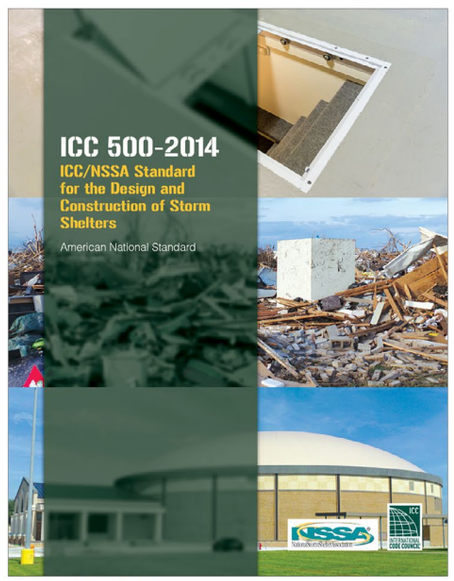
FEMA P-320 (2014)
Taking Shelter from the Storm, Building a Safe Room for Your Home or Small Business



FEMA P-361 (2015)
Safe Rooms for Tornadoes and Hurricanes, Guidance for Community and Residential Safe Rooms

You can view and download these publications from the FEMA website [https://www.fema.gov/safe-rooms]. To order a hard copy of these publications, call the FEMA distribution Center at 1-800-480-2520.

If you need additional information about the design and construction of safe rooms, contact the Safe Room Helpline by email at Saferoom@fema.dhs.gov or by calling 1-866-927-2104.



ICC 500-2014
ICC/NSSA Standard for the Design and Construction of Storm Shelters
You can purchase a copy of this publication from http://shop.iccsafe.org/.

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Background and History of Safe Rooms

FEMA

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 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 to now
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 Oklahama 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 Category 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 ICC 500) in 2008, which is referenced in the 2009 International Building Code® (IBC®).

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.
- FEMA updated FEMA P-320, *Taking Shelter from the Storm, Building a Safe Room for Your Home or Small Business*, in December 2014 with a significant overhaul of the prescriptive plans. Over 1,000,000 copies of this publication have been distributed to date.
- FEMA updated FEMA P-361, *Safe Rooms for Tornadoes and Hurricanes, Guidance for Community and Residential Safe Rooms*, in March 2015 with the latest safe room design information and a reorganization to align the chapters with ICC 500.
- ICC® updated ICC 500 in December 2014. Many of the changes align ICC 500 to be closer to the guidance in FEMA P-361.

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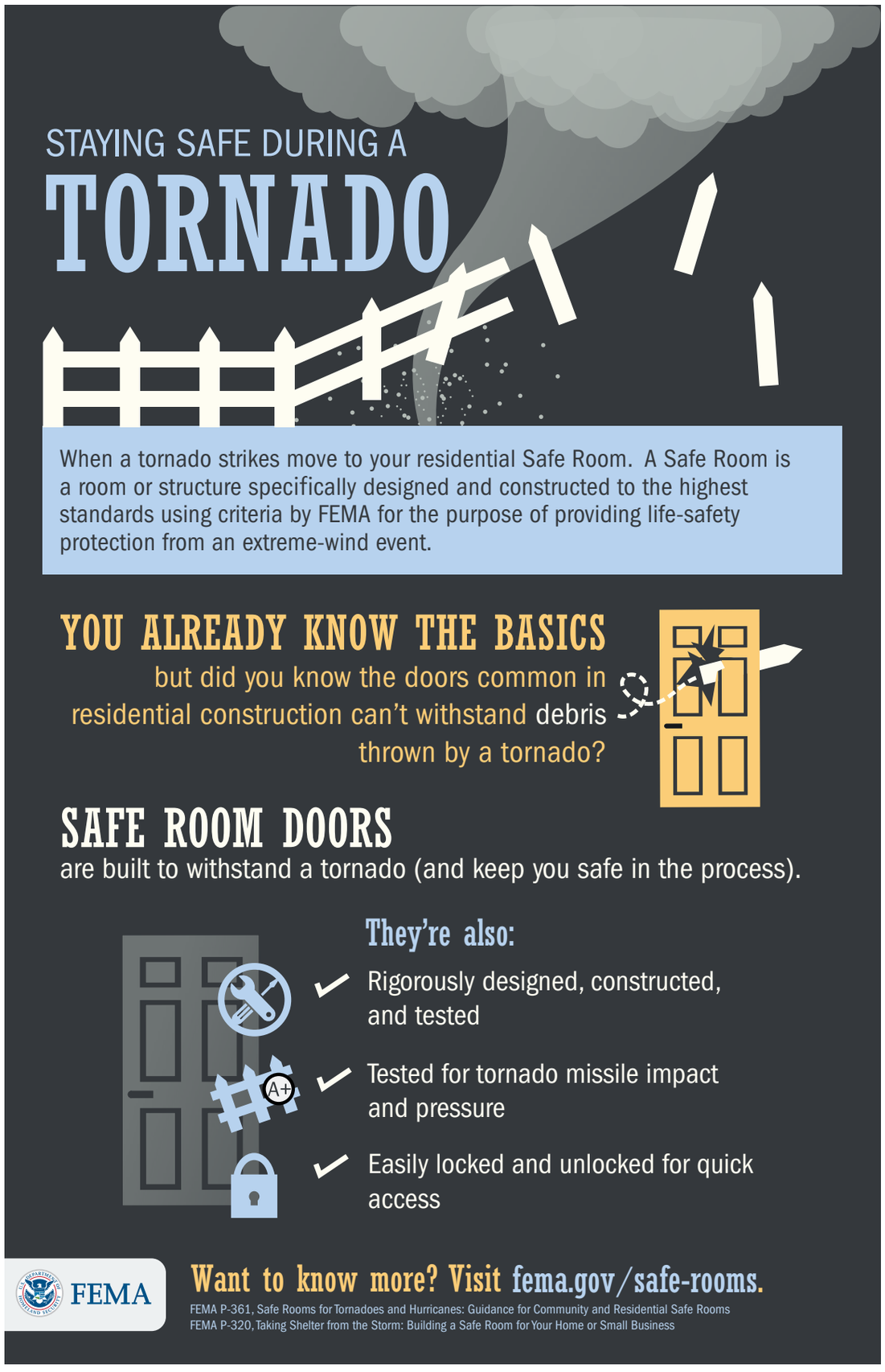

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Brochure

Click to enlarge

Taking Shelter From the Storm: Building a Safe Room for Your Home or Small Business / FEMA L-233 / December 2014

Click image to enlarge or download:

Did You Know…

Almost every state in the U.S. is subject to tornadoes, hurricanes, or both. The extreme winds that accompany these storms can cause extensive damage to buildings and threaten the lives of building occupants.

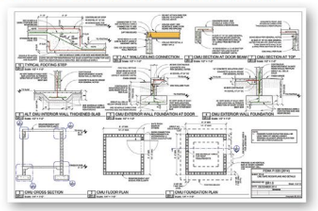
Safe rooms designed to FEMA guidelines provide near-absolute protection from wind forces of up to 250 mph and from the impact of associated windborne debris.

FEMA P-320, *Taking Shelter From the Storm: Building a Safe Room for Your Home or Small Business* for homeowners and builders includes an informational booklet and construction plans:

- Background information to help you understand the hazards
- Guidance on the level of risk in your area
- Guidance for selecting a safe room design
- Detailed safe room construction plans for builders and contractors

Guidance for homeowners and small business owners to help them determine their risk from extreme winds and potential locations for safe rooms.

Detailed construction plans provide all the information a builder or contractor needs to build a safe room.



FEMA P-320 will guide you through the process of determining your risk and selecting a safe room type and location, as well as providing detailed plans for construction.

Want To Learn More?

FEMA P-320 is available from the FEMA Publications and Distribution Facility.
1-800-480-2520

FEMA P-320 is also available on the FEMA website, including design drawings.
http://www.fema.gov/media-library/assets/documents/2009

For more information specifically on safe room doors, please see the fact sheet *Residential Tornado Safe Room Doors*.
http://www.fema.gov/media-library/assets/documents/99139

For additional information, please contact the FEMA helpline.
1-866-927-2104 (toll free)
Saferoom@fema.dhs.gov

Taking Shelter From the Storm

Building a Safe Room for Your Home or Small Business

FEMA L-233 / December 2014

FEMA

Page 1

Extreme windstorms such as tornadoes and hurricanes pose a serious threat to buildings and their occupants in many areas of the U.S.

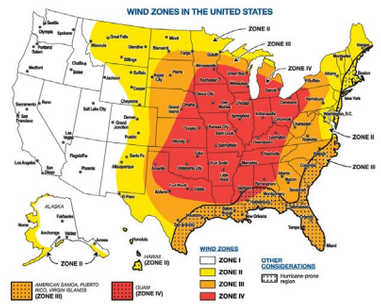
Tornadoes strong enough to damage roofs, destroy manufactured homes, snap or uproot large trees, and turn debris into damaging windborne missiles have occurred in virtually every state.

Hurricanes have struck Hawaii and all Atlantic and Gulf of Mexico coastal areas in the U.S., as well as Puerto Rico and the U.S. Virgin Islands, resulting in severe building damage and loss of lives. Even states not normally considered susceptible to extreme windstorms have areas that can be threatened by dangerous high winds. These areas, typically near mountain ranges, include the Pacific Northwest coast.

Do You Need a Safe Room?

The wind zone map on the right shows how the frequency and strength of extreme windstorms vary across the U.S. This map is based on 40 years of tornado history and over 100 years of hurricane history. Zone IV, the darkest area on the map, has experienced both the greatest number of tornadoes and the strongest tornadoes. The tornado hazard in Zone III, while not as great as in Zone IV, is still significant. In addition, Zone III includes coastal areas susceptible to hurricanes for which new hazard maps have been prepared (see FEMA 361, *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms*, Third Edition, 2015).

Most homes and small business are built in accordance with local building codes in effect at the time of construction; these codes account for the effects of minimum design winds. Design winds are the wind speeds that building codes require all residences and building to withstand. However, a tornado or hurricane can often cause winds much greater than the minimum design wind speed. As a result, ***buildings may be built in accordance with modern building code requirements, but still not be able to withstand winds from extreme events*** and provide life-safety protection for those inside.



If you are concerned about wind hazards where you live, especially if you live in Wind Zones III or IV, you should consider building a safe room.

The Basis of Good Safe Room Design

The purpose of an extreme-wind safe room is to provide a space where you, your family, or your co-workers can survive a tornado or hurricane with little or no injury. Safe rooms can be built in the basement beneath a concrete slab-on-grade foundation or garage floor or in an interior room on the first floor. Under certain conditions, a safe room may also be constructed on an elevated foundation.

For a room to provide near-absolute life-safety protection for its occupants, the room or space must be able to withstand the forces exerted by extreme winds and remain standing, even if the rest of the building is severely damaged.

To do this, the room must have the following elements:

- The safe room must be adequately anchored to resist overturning and uplift.
- The walls, ceiling, and door of the safe room must withstand wind pressure and resist penetration by windborne debris and falling items such as trees and building elements.
- The connections between all parts of the safe room must be strong enough to resist the wind forces without failing.
- The safe room must be located outside of areas with a high risk of flooding (e.g., Zone V and Coastal A Zone) or storm surge inundation.

FEMA provides all the information you need to build a safe room that meets the above criteria. See reverse for details…

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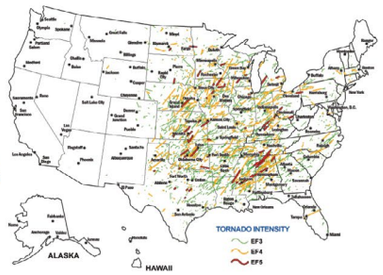
Did You Know…

Almost every state in the U.S. is subject to tornadoes, hurricanes, or both. The extreme winds that accompany these storms can cause extensive damage to buildings and threaten the lives of building occupants.

Safe rooms designed to FEMA guidelines provide near-absolute protection from wind forces of up to 250 mph and from the impact of associated windborne debris.

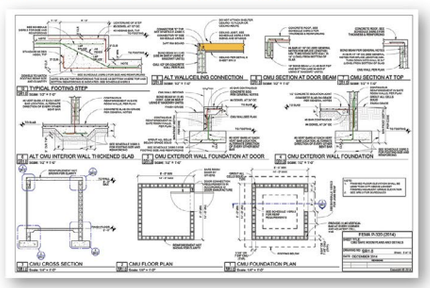
FEMA P-320, *Taking Shelter From the Storm: Building a Safe Room for Your Home or Small Business* for homeowners and builders includes an informational booklet and construction plans:

- Background information to help you understand the hazards
- Guidance on the level of risk in your area
- Guidance for selecting a safe room design
- Detailed safe room construction plans for builders and contractors



Guidance for homeowners and small business owners to help them determine their risk from extreme winds and potential locations for safe rooms.

Detailed construction plans provide all the information a builder or contractor needs to build a safe room.



FEMA P-320 will guide you through the process of determining your risk and selecting a safe room type and location, as well as providing detailed plans for construction.

Want To Learn More?

FEMA P-320 is available from the FEMA Publications and Distribution Facility.
1-800-480-2520

FEMA P-320 is also available on the FEMA website, including design drawings.
http://www.fema.gov/media-library/assets/documents/2009

For more information specifically on safe room doors, please see the fact sheet *Residential Tornado Safe Room Doors*.
http://www.fema.gov/media-library/assets/documents/99139

For additional information, please contact the FEMA helpline.
1-866-927-2104 (toll free)
Saferoom@fema.dhs.gov

Taking Shelter From the Storm

Building a Safe Room for Your Home or Small Business

FEMA L-233 / December 2014

FEMA

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Extreme windstorms such as tornadoes and hurricanes pose a serious threat to buildings and their occupants in many areas of the U.S.

Tornadoes strong enough to damage roofs, destroy manufactured homes, snap or uproot large trees, and turn debris into damaging windborne missiles have occurred in virtually every state.

Hurricanes have struck Hawaii and all Atlantic and Gulf of Mexico coastal areas in the U.S., as well as Puerto Rico and the U.S. Virgin Islands, resulting in severe building damage and loss of lives. Even states not normally considered susceptible to extreme windstorms have areas that can be threatened by dangerous high winds. These areas, typically near mountain ranges, include the Pacific Northwest coast.

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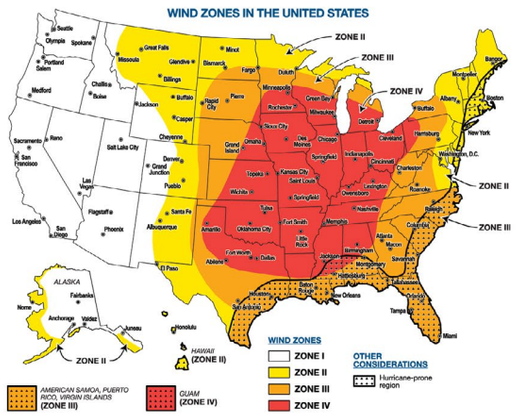

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- The safe room must be located outside of areas with a high risk of flooding (e.g., Zone V and Coastal A Zone) or storm surge inundation.

FEMA provides all the information you need to build a safe room that meets the above criteria. See reverse for details…

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Quick Guides and Fact Sheets

Flood Hazard Elevation and Siting Criteria for Residential Safe Rooms / February 2015
Flood Hazard Elevation and Siting Criteria for Community Safe Rooms / February 2015
Fact Sheet: Residential Tornado Safe Room Doors / September 2014

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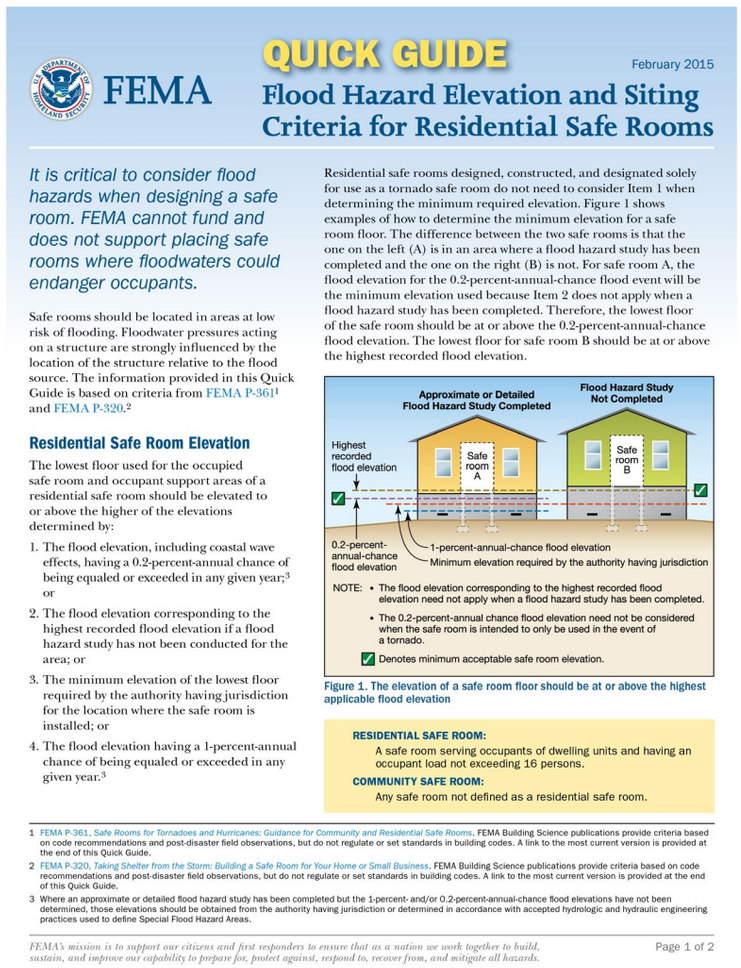

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QUICK GUIDE

February 2015

Flood Hazard Elevation and Siting Criteria for Residential Safe Rooms

It is critical to consider flood hazards when designing a safe room. FEMA cannot fund and does not support placing safe rooms where floodwaters could endanger occupants.

Safe rooms should be located in areas at low risk of flooding. Floodwater pressures acting on a structure are strongly influenced by the location of the structure relative to the flood source. The information provided in this Quick Guide is based on criteria from FEMA P-361[1] and FEMA P-320.[2]

Residential Safe Room Elevation

The lowest floor used for the occupied safe room and occupant support areas of a residential safe room should be elevated to or above the higher of the elevations determined by:

1. The flood elevation, including coastal wave effects, having a 0.2-percent-annual chance of being equaled or exceeded in any given year;[3] or
2. The flood elevation corresponding to the highest recorded flood elevation if a flood hazard study has not been conducted for the area; or
3. The minimum elevation of the lowest floor required by the authority having jurisdiction for the location where the safe room is installed; or
4. The flood elevation having a 1-percent-annual chance of being equaled or exceeded in any given year.[3]

Residential safe rooms designed, constructed, and designated solely for use as a tornado safe room do not need to consider Item 1 when determining the minimum required elevation. Figure 1 shows examples of how to determine the minimum elevation for a safe room floor. The difference between the two safe rooms is that the one on the left (A) is in an area where a flood hazard study has been completed and the one on the right (B) is not. For safe room A, the flood elevation for the 0.2-percent-annual-chance flood event will be the minimum elevation used because Item 2 does not apply when a flood hazard study has been completed. Therefore, the lowest floor of the safe room should be at or above the 0.2-percent-annual-chance flood elevation. The lowest floor for safe room B should be at or above the highest recorded flood elevation.

Figure 1. The elevation of a safe room floor should be at or above the highest applicable flood elevation

RESIDENTIAL SAFE ROOM:
A safe room serving occupants of dwelling units and having an occupant load not exceeding 16 persons.

COMMUNITY SAFE ROOM:
Any safe room not defined as a residential safe room.

1 FEMA P-361, *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms*, FEMA Building Science publications provide criteria based on code recommendations and post-disaster field observations, but do not regulate or set standards in building codes. A link to the most current version is provided at the end of this Quick Guide.

2 FEMA P-320, *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business*. FEMA Building Science publications provide criteria based on code recommendations and post-disaster field observations, but do not regulate or set standards in building codes. A link to the most current version is provided at the end of this Quick Guide.

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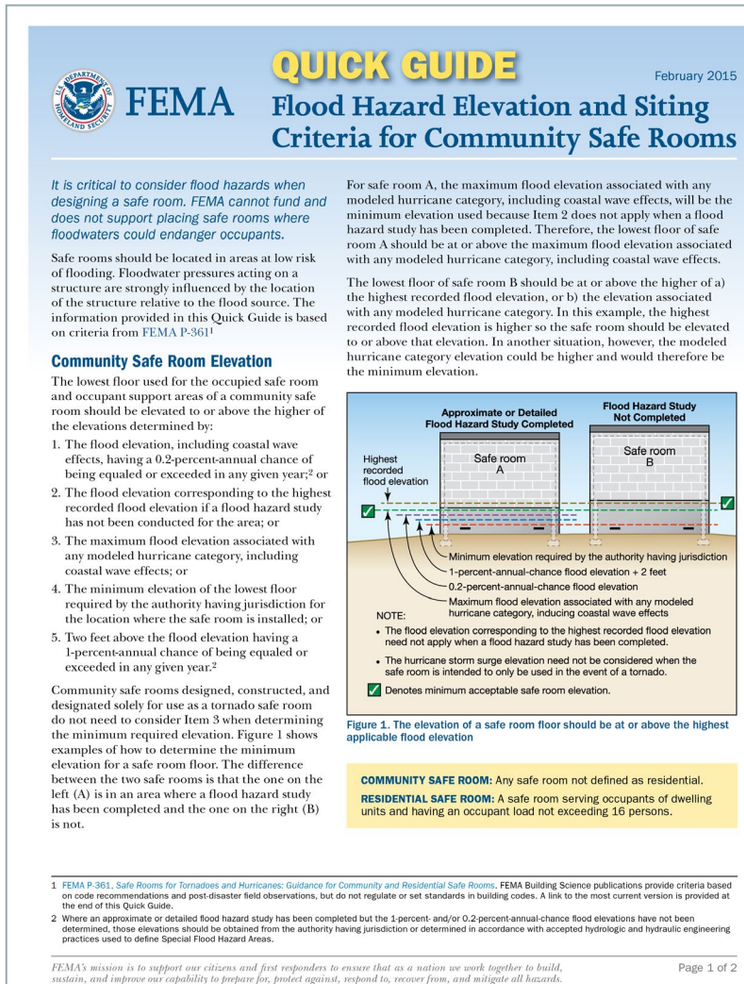

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QUICK GUIDE

February 2015

Flood Hazard Elevation and Siting Criteria for Community Safe Rooms

It is critical to consider flood hazards when designing a safe room. FEMA cannot fund and does not support placing safe rooms where floodwaters could endanger occupants.

Safe rooms should be located in areas at low risk of flooding. Floodwater pressures acting on a structure are strongly influenced by the location of the structure relative to the flood source. The information provided in this Quick Guide is based on criteria from FEMA P-361[1]

Community Safe Room Elevation

The lowest floor used for the occupied safe room and occupant support areas of a community safe room should be elevated to or above the higher of the elevations determined by:

1. The flood elevation, including coastal wave effects, having a 0.2-percent-annual chance of being equaled or exceeded in any given year;[2] or
2. The flood elevation corresponding to the highest recorded flood elevation if a flood hazard study has not been conducted for the area; or
3. The maximum flood elevation associated with any modeled hurricane category, including coastal wave effects; or
4. The minimum elevation of the lowest floor required by the authority having jurisdiction for the location where the safe room is installed; or
5. Two feet above the flood elevation having a 1-percent-annual chance of being equaled or exceeded in any given year.[2]

Community safe rooms designed, constructed, and designated solely for use as a tornado safe room do not need to consider Item 3 when determining the minimum required elevation. Figure 1 shows examples of how to determine the minimum elevation for a safe room floor. The difference between the two safe rooms is that the one on the left (A) is in an area where a flood hazard study has been completed and the one on the right (B) is not.

For safe room A, the maximum flood elevation associated with any modeled hurricane category, including coastal wave effects, will be the minimum elevation used because Item 2 does not apply when a flood hazard study has been completed. Therefore, the lowest floor of safe room A should be at or above the maximum flood elevation associated with any modeled hurricane category, including coastal wave effects.

The lowest floor of safe room B should be at or above the higher of a) the highest recorded flood elevation, or b) the elevation associated with any modeled hurricane category. In this example, the highest recorded flood elevation is higher so the safe room should be elevated to or above that elevation. In another situation, however, the modeled hurricane category elevation could be higher and would therefore be the minimum elevation.

Figure 1. The elevation of a safe room floor should be at or above the highest applicable flood elevation

COMMUNITY SAFE ROOM: Any safe room not defined as residential.

RESIDENTIAL SAFE ROOM: A safe room serving occupants of dwelling units and having an occupant load not exceeding 16 persons.

1 FEMA P-361, *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms*. FEMA Building Science publications provide criteria based on code recommendations and post-disaster field observations, but do not regulate or set standards in building codes. A link to the most current version is provided at the end of this Quick Guide.

2 Where an approximate or detailed flood hazard study has been completed but the 1-percent- and/or 0.2-percent-annual-chance flood elevations have not been determined, those elevations should be obtained from the authority having jurisdiction or determined in accordance with accepted hydrologic and hydraulic engineering practices used to define Special Flood Hazard Areas.

FEMA Fact Sheet

Federal Insurance and Mitigation Administration September 2014

Residential Tornado Safe Room Doors

Residential safe rooms are becoming more popular as families seek protection from violent tornadoes. Like any other room, safe rooms must be accessed through an opening or door. Just as the walls and roof of a safe room are designed and built to protect against extreme winds and wind-borne debris, so must the safe room door.

When careful selection and installation of the safe room door assembly is overlooked, the safe room door opening can leave occupants at great risk of injury or death during tornadoes.

Not all doors are the same

Steel doors commonly used in residential and commercial construction cannot withstand the impact of the wind-borne debris, or "missiles," that a tornado can propel, and their failure has resulted in serious injury and even death during tornadoes. There is a common misconception that a steel "storm door" with three locks and three hinges can provide tornado life-safety protection: it cannot. Only door assemblies designed and tested to resist tornadoes can provide life-safety protection for you and your family.

Residential safe room door (Moore, OK, 2013)

Consumers need to be sure the door they are buying is part of a tested tornado safe room door assembly, as some door suppliers offer non-tested "storm door" assemblies for use in safe rooms. Sometimes door suppliers market levels of safety with corresponding pricing ("good," "better," "best"). Such terminology can give consumers a false sense of security that the less expensive doors provide an adequate level of tornado protection. **In reality, there is no substitute for a tested tornado safe room door assembly!**

The good news is these door assemblies are readily available today.

What is different about a tested safe room door versus a standard door?

For safe room doors to reliably provide life-safety protection during a tornado, they must be rigorously designed, constructed, and tested. FEMA does not certify products, but the manufacturer(s) of safe room door assemblies must certify their products have passed ICC 500 testing to meet or exceed FEMA safe room criteria. Consumers should request documentation from the supplier and/or installer to verify the door assembly's compliance with the most current versions of FEMA's safe room publications[1] (FEMA P-361 and FEMA P-320) or ICC 500[2] for a tornado wind speed of 250 mph. One method of demonstrating compliance is through labeling by third parties, such as UL (Underwriters Laboratories).

> FEMA does not endorse, approve, certify, or recommend any contractors, individuals, firms, or products. Contractors, individuals, or firms shall not claim they are, or produce products that are, "FEMA approved" or "FEMA certified."

UL tornado safe room door label

In addition to having passed required testing for tornado missile impact and pressure, the door assembly should be easily locked and unlocked so that access to and from the safe room is quick and easy.

1 FEMA P-361, *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms* and FEMA P-320, *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business*. FEMA Publications provide criteria based on code recommendations and post-disaster field observations, but do not regulate or set standards in building codes. The most current versions can be found at links provided under "Resources" section at end of Fact Sheet.

2 ICC 500, *ICC/NSSA Standard for the Design and Construction of Storm Shelters*. The most current version can be found at link provided under "Resources" section at end of Fact Sheet.

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QUICK GUIDE

February 2015

Flood Hazard Elevation and Siting Criteria for Residential Safe Rooms

It is critical to consider flood hazards when designing a safe room. FEMA cannot fund and does not support placing safe rooms where floodwaters could endanger occupants.

Safe rooms should be located in areas at low risk of flooding. Floodwater pressures acting on a structure are strongly influenced by the location of the structure relative to the flood source. The information provided in this Quick Guide is based on criteria from FEMA P-361[1] and FEMA P-320.[2]

Residential Safe Room Elevation

The lowest floor used for the occupied safe room and occupant support areas of a residential safe room should be elevated to or above the higher of the elevations determined by:

1. The flood elevation, including coastal wave effects, having a 0.2-percent-annual chance of being equaled or exceeded in any given year;[3] or
2. The flood elevation corresponding to the highest recorded flood elevation if a flood hazard study has not been conducted for the area; or
3. The minimum elevation of the lowest floor required by the authority having jurisdiction for the location where the safe room is installed; or
4. The flood elevation having a 1-percent-annual chance of being equaled or exceeded in any given year.[3]

Residential safe rooms designed, constructed, and designated solely for use as a tornado safe room do not need to consider Item 1 when determining the minimum required elevation. Figure 1 shows examples of how to determine the minimum elevation for a safe room floor. The difference between the two safe rooms is that the one on the left (A) is in an area where a flood hazard study has been completed and the one on the right (B) is not. For safe room A, the flood elevation for the 0.2-percent-annual-chance flood event will be the minimum elevation used because Item 2 does not apply when a flood hazard study has been completed. Therefore, the lowest floor of the safe room should be at or above the 0.2-percent-annual-chance flood elevation. The lowest floor for safe room B should be at or above the highest recorded flood elevation.

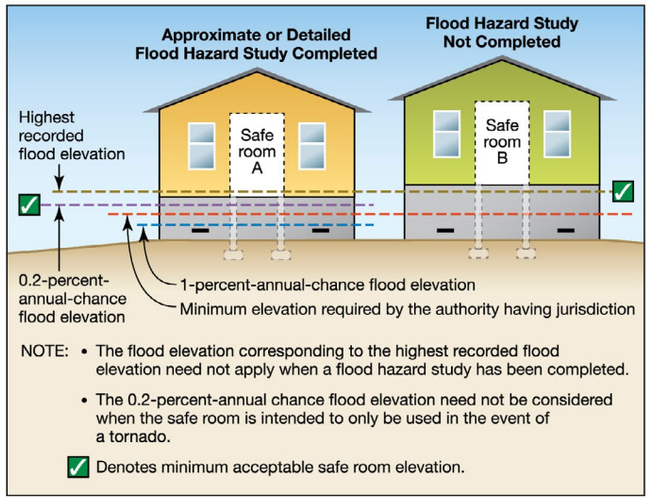

Figure 1. The elevation of a safe room floor should be at or above the highest applicable flood elevation

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3 Where an approximate or detailed flood hazard study has been completed but the 1-percent- and/or 0.2-percent-annual-chance flood elevations have not been determined, those elevations should be obtained from the authority having jurisdiction or determined in accordance with accepted hydrologic and hydraulic engineering practices used to define Special Flood Hazard Areas.

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Residential Safe Room Siting

Residential safe rooms should be located outside of the following high-risk flood hazard areas:

1. Flood hazard areas subject to high velocity wave action (Zone V) and Coastal A Zones;[4]
2. Floodways; and
3. Any areas subject to storm surge inundation associated with any modeled hurricane category, including coastal wave effects.

Figure 2 shows examples of residential safe room locations that FEMA considers acceptable or unacceptable. This figure illustrates high risk flood zones as reflected on a typical Flood Insurance Rate Map. A typical riverine cross section and perpendicular shoreline transect in Figure 3 denotes the stillwater and wave crest elevations associated with the various flood zones shown in Figure 2.

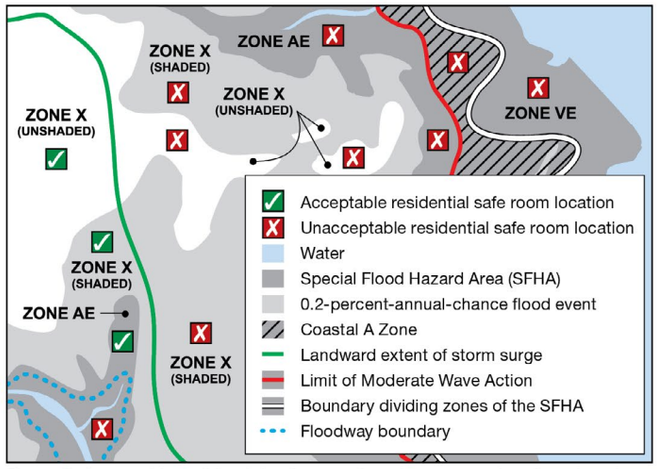

Figure 2. Acceptable residential safe room locations, assuming that elevation requirements are met

FLOOD FREQUENCIES/ELEVATIONS: 0.2-percent-annual-chance flood event = 500-year flood event
1-percent-annual-chance flood event = 100-year flood event → base flood elevation (BFE)

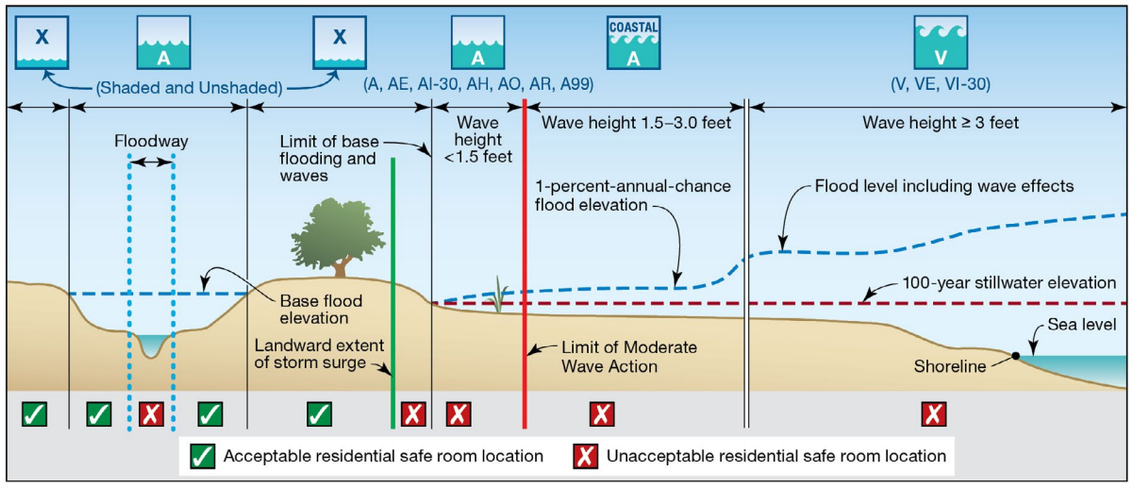

Figure 3. Typical riverine cross section and shoreline transect showing stillwater and wave crest elevations and associated flood zones

Resources

- A free copy of FEMA P-361 can be downloaded or ordered from http://www.fema.gov/media-library/assets/documents/3140.
- A free copy of FEMA P-320 can be downloaded or ordered from http://www.fema.gov/media-library/assets/documents/2009.
- A copy of International Code Council (ICC) 500, *Standard for the Design and Construction of Storm Shelters*, can be purchased and subsequently downloaded from http://shop.iccsafe.org/standards/icc-standards.html?p=1.
- If you have additional questions pertaining to FEMA safe room guidance publications, please email the Safe Room Helpline at Saferoom@fema.dhs.gov.
- More information on the National Flood Insurance Program and flood hazard mapping can be found at https://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping.

4 Coastal A Zones are defined as the area landward of a Zone V or landward of an open coast without mapped Zone Vs. The inland limit of the Coastal A Zone is the Limit of Moderate Wave Action if delineated on a Flood Insurance Rate Map, or designated by the authority having jurisdiction.

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QUICK GUIDE

February 2015

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3. The maximum flood elevation associated with any modeled hurricane category, including coastal wave effects; or
4. The minimum elevation of the lowest floor required by the authority having jurisdiction for the location where the safe room is installed; or
5. Two feet above the flood elevation having a 1-percent-annual chance of being equaled or exceeded in any given year.[2]

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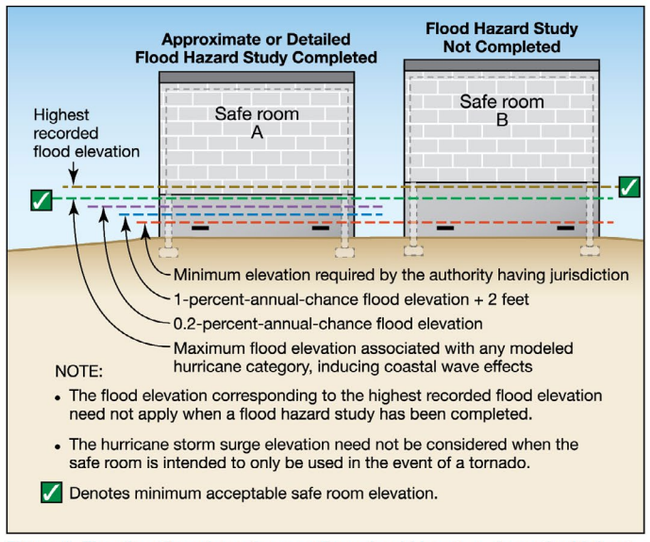
For safe room A, the maximum flood elevation associated with any modeled hurricane category, including coastal wave effects, will be the minimum elevation used because Item 2 does not apply when a flood hazard study has been completed. Therefore, the lowest floor of safe room A should be at or above the maximum flood elevation associated with any modeled hurricane category, including coastal wave effects.

The lowest floor of safe room B should be at or above the higher of a) the highest recorded flood elevation, or b) the elevation associated with any modeled hurricane category. In this example, the highest recorded flood elevation is higher so the safe room should be elevated to or above that elevation. In another situation, however, the modeled hurricane category elevation could be higher and would therefore be the minimum elevation.



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2 Where an approximate or detailed flood hazard study has been completed but the 1-percent- and/or 0.2-percent-annual-chance flood elevations have not been determined, those elevations should be obtained from the authority having jurisdiction or determined in accordance with accepted hydrologic and hydraulic engineering practices used to define Special Flood Hazard Areas.

FEMA's mission is to support our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards.

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Community Safe Room Siting

Community safe rooms should be located outside of the following high-risk flood hazard areas:

1. Flood hazard areas subject to high velocity wave action (Zone V) and Coastal A Zones;[3]
2. Floodways.

Community safe rooms may be located within Zone V and Coastal A Zones[4] where permitted by the Board of Appeals in accordance with the provisions of the International Building Code and after completing the 8-step Decision Process for Executive Order (EO) 11988, as amended, and as provided by Title 44 of the Code of Federal Regulations Part 9.6, Decision-Making Process. Figure 2 shows examples of community safe room locations that FEMA considers acceptable or unacceptable. This figure illustrates high risk flood zones as reflected on a typical Flood Insurance Rate Map. A typical riverine cross section and shoreline transect shown in Figure 3 denote the stillwater and wave crest elevations associated with the flood zones shown in Figure 2.

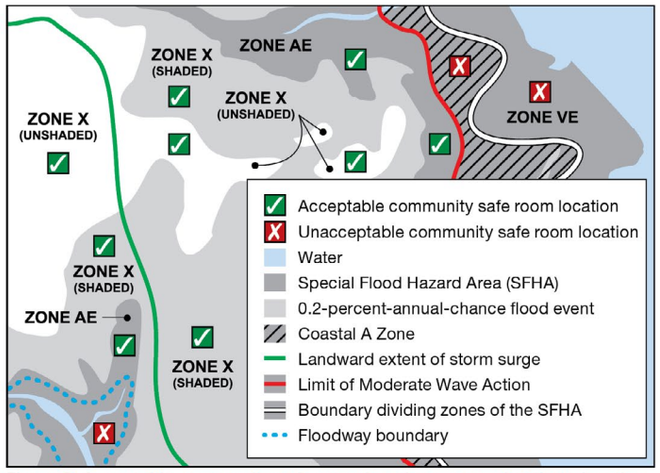

Figure 2. Acceptable community safe room locations, assuming that elevation requirements are met

FLOOD FREQUENCIES/ELEVATIONS:
0.2-percent-annual-chance flood event = 500-year flood event
1-percent-annual-chance flood event = 100-year flood event → base flood elevation (BFE)

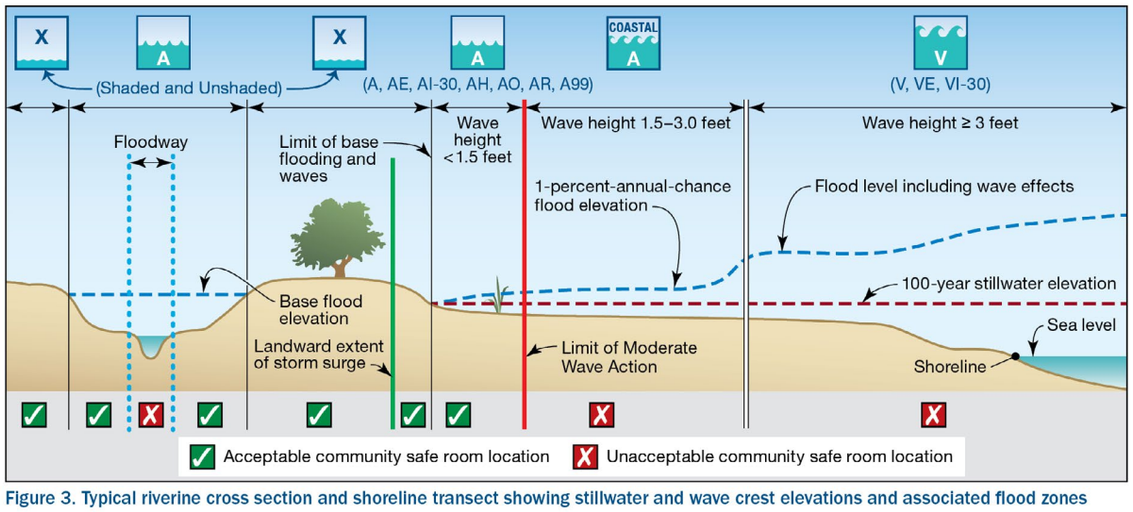

Figure 3. Typical riverine cross section and shoreline transect showing stillwater and wave crest elevations and associated flood zones

Resources

- A free copy of FEMA P-361 can be downloaded or ordered from http://www.fema.gov/media-library/assets/documents/3140.
- A free copy of FEMA P-320 can be downloaded or ordered from http://www.fema.gov/media-library/assets/documents/2009.
- A copy of International Code Council (ICC) 500, *Standard for the Design and Construction of Storm Shelters,* can be purchased and subsequently downloaded from http://shop.iccsafe.org/standards/icc-standards.html?p=1.
- If you have additional questions pertaining to FEMA safe room guidance publications, please email the Safe Room Helpline at Saferoom@fema.dhs.gov.
- More information on the National Flood Insurance Program and flood hazard mapping can be found at https://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping.

3 Coastal A Zones are defined as the area landward of a Zone V or landward of an open coast without mapped Zone Vs. The inland limit of the Coastal A Zone is the Limit of Moderate Wave Action if delineated on a Flood Insurance Rate Map, or designated by the authority having jurisdiction.

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FEMA Fact Sheet

Federal Insurance and Mitigation Administration September 2014

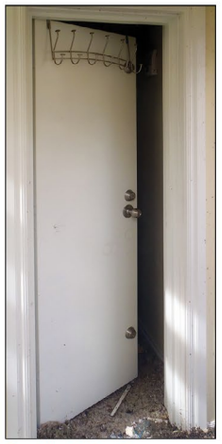
Residential Tornado Safe Room Doors

Residential safe rooms are becoming more popular as families seek protection from violent tornadoes. Like any other room, safe rooms must be accessed through an opening or door. Just as the walls and roof of a safe room are designed and built to protect against extreme winds and wind-borne debris, so must the safe room door.

When careful selection and installation of the safe room door assembly is overlooked, the safe room door opening can leave occupants at great risk of injury or death during tornadoes.

Not all doors are the same

Steel doors commonly used in residential and commercial construction cannot withstand the impact of the wind-borne debris, or "missiles," that a tornado can propel, and their failure has resulted in serious injury and even death during tornadoes. There is a common misconception that a steel "storm door" with three locks and three hinges can provide tornado life-safety protection: it cannot. Only door assemblies designed and tested to resist tornadoes can provide life-safety protection for you and your family.



Residential safe room door (Moore, OK, 2013)

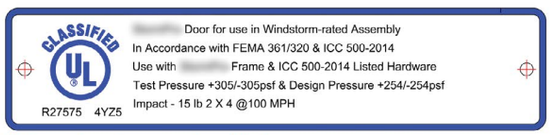
Consumers need to be sure the door they are buying is part of a tested tornado safe room door assembly, as some door suppliers offer non-tested "storm door" assemblies for use in safe rooms. Sometimes door suppliers market levels of safety with corresponding pricing ("good," "better," "best"). Such terminology can give consumers a false sense of security that the less expensive doors provide an adequate level of tornado protection. **In reality, there is no substitute for a tested tornado safe room door assembly!**

The good news is these door assemblies are readily available today.

What is different about a tested safe room door versus a standard door?

For safe room doors to reliably provide life-safety protection during a tornado, they must be rigorously designed, constructed, and tested. FEMA does not certify products, but the manufacturer(s) of safe room door assemblies must certify their products have passed ICC 500 testing to meet or exceed FEMA safe room criteria. Consumers should request documentation from the supplier and/or installer to verify the door assembly's compliance with the most current versions of FEMA's safe room publications[1] (FEMA P-361 and FEMA P-320) or ICC 500[2] for a tornado wind speed of 250 mph. One method of demonstrating compliance is through labeling by third parties, such as UL (Underwriters Laboratories).

FEMA does not endorse, approve, certify, or recommend any contractors, individuals, firms, or products. Contractors, individuals, or firms shall not claim they are, or produce products that are, "FEMA approved" or "FEMA certified."



UL tornado safe room door label

In addition to having passed required testing for tornado missile impact and pressure, the door assembly should be easily locked and unlocked so that access to and from the safe room is quick and easy.

1 FEMA P-361, *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms* and FEMA P-320, *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business*. FEMA Publications provide criteria based on code recommendations and post-disaster field observations, but do not regulate or set standards in building codes. The most current versions can be found at links provided under "Resources" section at end of Fact Sheet.

2 ICC 500, *ICC/NSSA Standard for the Design and Construction of Storm Shelters*. The most current version can be found at link provided under "Resources" section at end of Fact Sheet.

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Why is installing the complete tested door assembly in its entirety so important?

The door assembly includes the door, hardware (locks and hinges), frame, and attachment devices used to anchor the door frame to the surrounding safe room wall. Installation instructions should be specific to the actual safe room wall type (e.g., wood-frame, concrete masonry units (CMUs)) of the home or small business. The entire safe room door assembly must have passed the required testing exactly as it is to be installed in the safe room to make sure it will withstand the required tornado wind pressures and debris impacts.

Some suppliers may offer the door and frame without the tested hardware; if substitutions are made, the door may fail during a tornado.

Tornado safe room impact test results: Door assembly failed at latch/lock

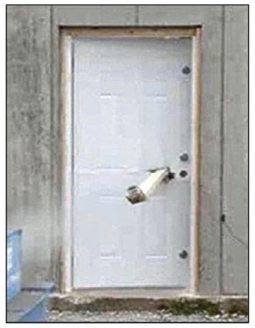
Where can you buy a tested safe room door?

Tested door assemblies are typically not available off the shelf in most home improvement stores, but can be purchased through commercial building product suppliers or safe room/storm shelter component suppliers. Texas Tech University testing facility and UL maintain a list of safe room doors (product names and suppliers) that have passed testing. Refer to the "Resources" below for information.

What should you request when selecting your safe room door?

- The test certification document or UL label that shows the product passed ICC 500 testing to meet or exceed FEMA safe room criteria
- Confirmation that the hardware supplied with your door is identical to the hardware used during testing

When it is time to install your safe room, make sure to contact your local building department for permitting and inspection guidelines.



Tornado safe room impact test results: Door assembly failed when perforated

Resources

- More information on testing protocol and a list of safe room products that have passed testing at Texas Tech University may be found at http://www.depts.ttu.edu/nwi/research/DebrisImpact/index.php.
- The UL Online Certification Directory may be found at http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.html.
  - After linking, enter 'zhla' in the UL Category field and 'ICC 500' in the Keyword field for safe room-tested products.
- A free copy of FEMA P-361 can be downloaded or ordered from http://www.fema.gov/media-library/assets/documents/3140.
- A free copy of FEMA P-320 can be downloaded or ordered from http://www.fema.gov/media-library/assets/documents/2009.
- A copy of ICC 500 can be purchased and subsequently downloaded from http://shop.iccsafe.org/standards/icc-standards.html?p=1.
- If you have additional questions pertaining to FEMA safe room guidance publications, you may contact the Safe Room Helpline at Saferoom@fema.dhs.gov.

Tornado safe room impact test results: Door assembly passed; no perforation or latch/lock failure

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Additional Resources

Publications

Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business **(FEMA P-320)**
Order or download from http://www.fema.gov/media-library/assets/documents/2009

Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms **(FEMA P-361)**
Order or download from http://www.fema.gov/media-library/assets/documents/3140

Mitigation Assessment Team Report – Spring 2011 Tornadoes: April 25-28 and May 22 **(FEMA P-908)**
Order or download from https://www.fema.gov/media-library/assets/documents/25810

Tornado Protection: Selecting Refuge Area in Buildings, Second Edition **2009 (FEMA P-431)**
Order or download from https://www.fema.gov/media-library/assets/documents/2246

FEMA Web Resources

FEMA Safe Room web site, https://www.fema.gov/safe-rooms

FEMA Safe Room Resources web site,
https://www.fema.gov/safe-room-resources

FEMA Mitigation Assessment Team (MAT) web site,
https://www.fema.gov/mitigation-assessment-team-program

Related Web Resources

International Code Council: http://www.iccsafe.org

Ready.Gov: http://www.ready.gov/

Storm Prediction Center: http://www.spc.noaa.gov

FEMA strongly encourages homeowners and communities to build safe rooms and shelters, but cannot endorse or approve specific manufacturers or producers.
Read FEMA Disclaimer.

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FEMA strongly encourages homeowners and communities to build safe rooms and storm shelters but cannot endorse or approve specific manufacturers or producers.

FEMA Designs

FEMA P-320, *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business*, contains prescriptive designs for safe rooms that can range in size from 8-feet by 8-feet to 14-feet by 14-feet. The criteria for a safe room are provided in FEMA P-361, *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms*.

Others

The National Storm Shelter Association (NSSA) in conjunction with the International Code Council®(ICC®), has also developed an industry standard for shelters, *Standard for the Design and Construction of Storm Shelters* (ICC 500). The ICC 500 is referenced in the 2009, 2012, and 2015 International Building Code ®(IBC®) and International Residential Code ®(IRC®), and is therefore part of the building code (incorporated by reference) as a readily enforceable design standard. You can purchase a copy of this publication from http://shop.iccsafe.org/.

Individuals considering purchasing or installing a safe room should contact their local building official about building code requirements. However, the extreme loads generated by tornadoes are not covered under model building code requirements. FEMA P-320, FEMA P-361, the NSSA standard, or the NPC can all be used to address these extreme loads.

For more information, please call the FEMA helpline at 866-927-2104 (toll free) or email Saferoom@fema.dhs.gov

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