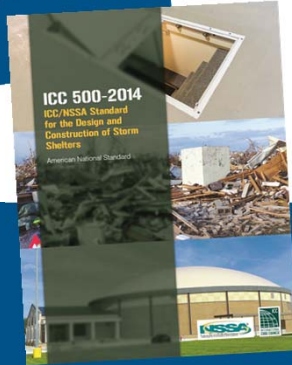


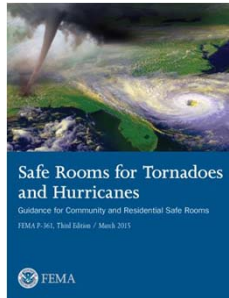
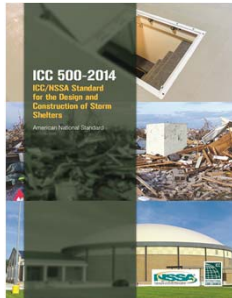
The Latest in ICC 500 Storm Shelter and FEMA Safe Room Requirements

Bob Franke
Federal Emergency Management Agency
Region VII



New Editions of ICC 500 Storm Shelter Standard and FEMA Safe Room Guidance

- ICC 500 (Second Edition) released in December 2014
- FEMA P-361 (Third Edition) released in March 2015
- FEMA P-320 (Fourth Edition) released in December 2014



Latest in ICC 500 and FEMA P-361 Requirements

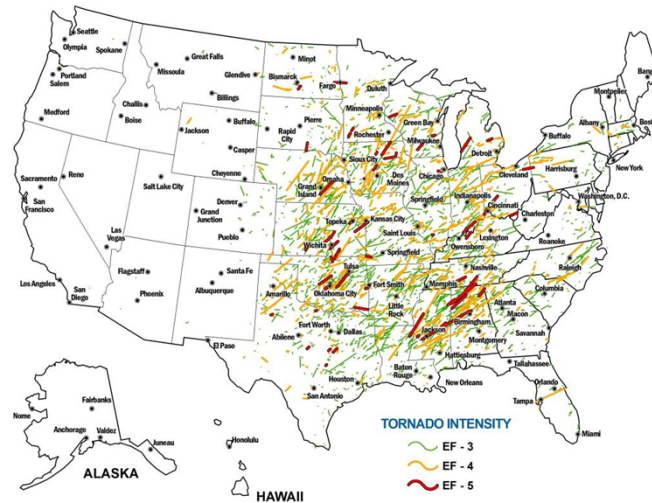
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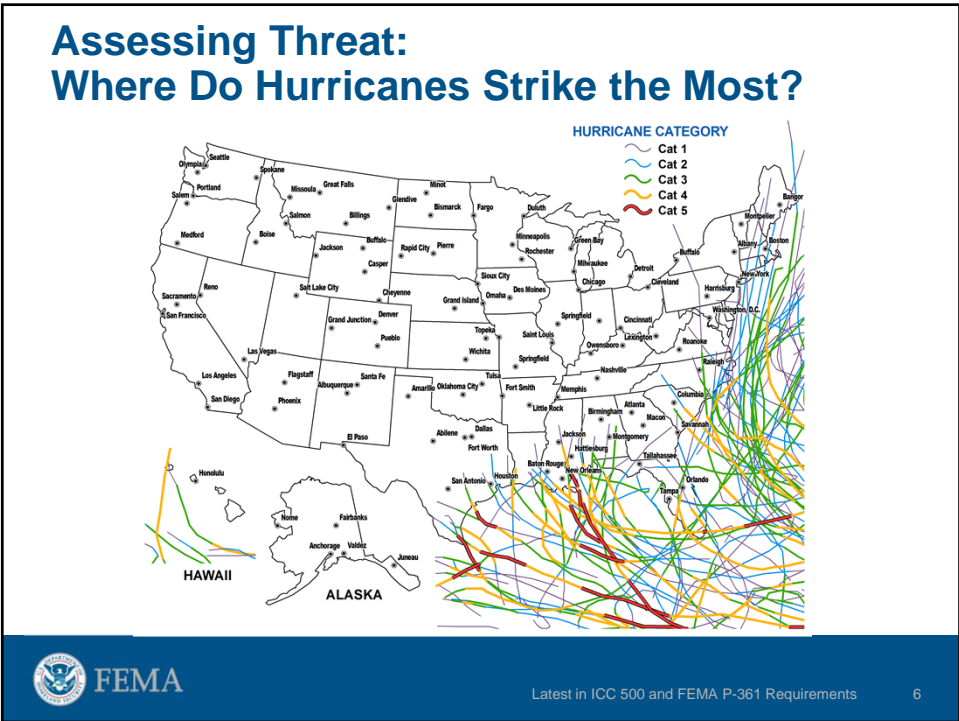
Outline

- Wind hazard and threat
- FEMA P-361 background
- ICC 500 background
- 2015 IBC storm shelter code changes
- ICC 500-14 review
- Differences between ICC 500 and FEMA P-361
- FEMA P-320 and Success stories

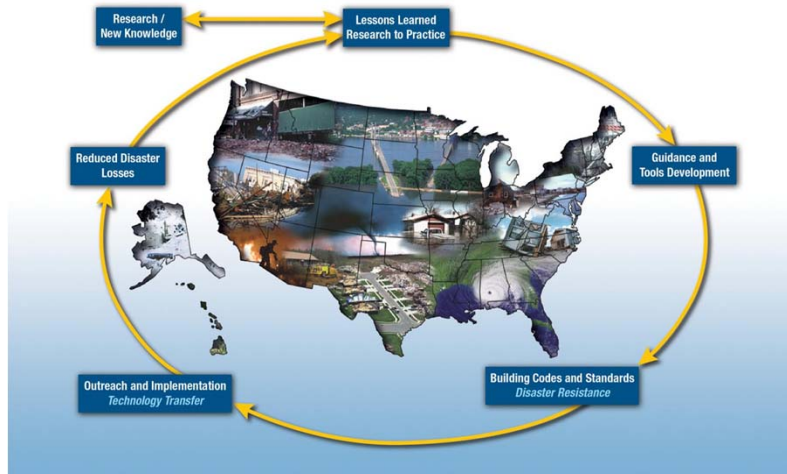


Recorded EF3, EF4, and EF5 Tornadoes in the United States from 1950 to 2013





FEMA Building Science Mitigation Objectives



Latest in ICC 500 and FEMA P-361 Requirements

7

Codes/Standard vs. FEMA Building Science Publications

Building codes and standards

- Written by technical expert panels/committees
- Consensus documents, publically balloted
- When adopted, may be enforced by the building department
- Can only reference other consensus codes and standards
- Products may be approved through code “evaluation services”
- Laboratories and testing agencies provide product approvals and compliance certificates



Latest in ICC 500 and FEMA P-361 Requirements

8

Codes/Standard vs. FEMA Building Science Publications (cont.)

Building Science Publications

- Written by technical expert panels/committees
- Evaluated by Review Committees, not publically balloted
- Typically, not adopted and therefore, not enforceable by the building department
- If adopted through special legislative rule or action, guidance may be enforced by the building department (rare)
- Only when part of a grant program does the design criteria change from “should” to “shall”



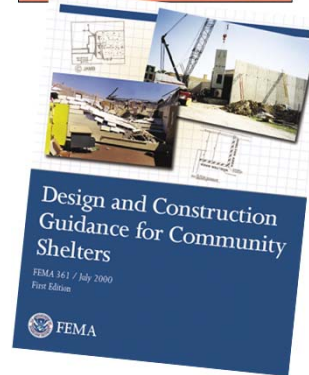
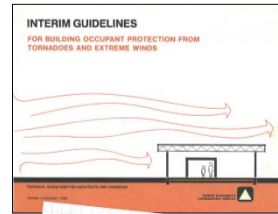
Terminology

- **ICC 500 Storm Shelter** – A building, structure, or portion(s) thereof, constructed in accordance with ICC 500, for the purpose of providing safe refuge from storms that produce high winds, such as tornadoes and hurricanes.
 - **Residential Storm Shelter.** Serves occupants of dwelling units and has an occupant load not exceeding 16 persons.
 - **Community Storm Shelter.** Any storm shelter not defined as a residential storm shelter .
- **FEMA Safe Room** – A building, structure, or portion(s) thereof, constructed in accordance with FEMA P-320 or FEMA P-361, which uses ICC 500 as a referenced standard and also specifies Recommended Criteria that is slightly more conservative than ICC 500.



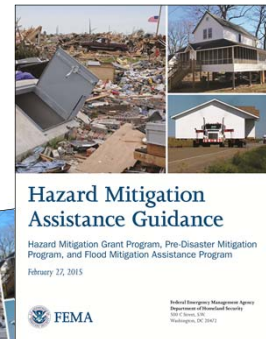
FEMA Safe Room Publication Background

- Post-disaster studies have been conducted since the 1970s to determine safe room design
- FEMA technical building science teams observe and assess building performance after disasters of national significance in the United States
- FEMA has provided technical guidance on tornado protection since 1980, in TR-83A
- FEMA was involved with the development of ICC 500, the first consensus code for storm shelters released in 2008



FEMA-Funded Safe Room Grants

- FEMA's recommended guidance in P-320 and P-361 are *requirements* for FEMA grants
 - Over \$985M in Federal funds granted to design and construct safe rooms
 - Nearly 25,000 residential safe rooms
 - Over 2,000 community safe rooms
 - In 25 states and territories



ICC 500, Standard for the Design and Construction of Storm Shelters

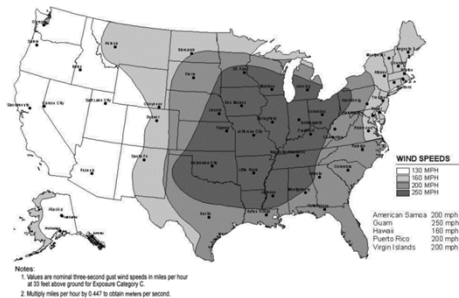


- First released in 2008
- ICC 500 took much of what was presented in the first edition of FEMA P-361 and updated and codified it
- Referenced by the 2009, 2012, and 2015 International Building Code® and International Residential Code®
- ICC 500-14 Commentary published in February 2016

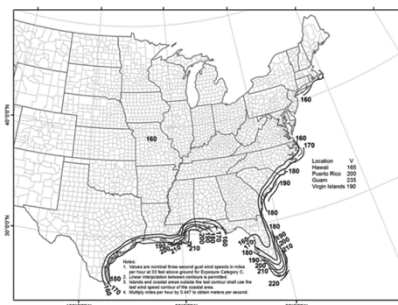


ICC 500 Purpose (Section 101.1)

The purpose of this standard is to establish minimum requirements to safeguard the public health, safety and general welfare relative to the design, construction and installation of storm shelters constructed for protection from high winds associated with tornadoes and hurricanes....



Storm Shelter Design Wind Speeds for Tornadoes (ICC 500 Figure 304.2(1))



Storm Shelter Design Wind Speeds for Hurricanes (ICC 500 Figure 304.2(2))

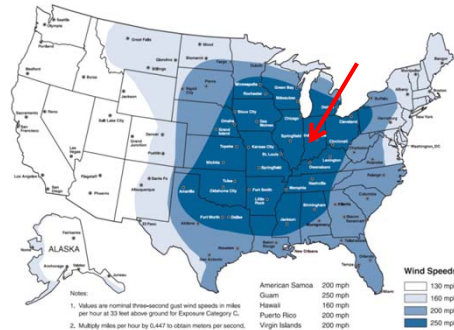


2015 IBC Code Requirement for ICC 500 Storm Shelters

423.3 Critical emergency operations. In areas where the shelter design wind speed for tornadoes per Figure 304.2(1) of ICC 500 is **250 MPH**, **911 call stations, emergency operation centers and fire, rescue, ambulance and police stations shall have a storm shelter constructed in accordance with ICC 500**



Cullman County Government Building. Cullman, AL. 2011



2015 IBC Code Requirement for ICC 500 Storm Shelters

423.4 Group E occupancies. In areas where the shelter design wind speed for tornadoes is **250 MPH** per Figure 304.2(1) of ICC 500, **all Group E Occupancies with an aggregate occupant load of 50 or more shall have a storm shelter constructed in accordance with ICC 500.** The shelter shall be capable of housing the total occupant load of the Group E occupancy.

Exceptions:

1. Group E day care facilities.
2. Group E occupancies accessory to places of religious worship.
3. Buildings meeting the requirements for shelter design in ICC 500.



Jefferson Elementary School. Wichita, Kansas



ICC 500-14 Outline

- **Chapter 1:** Application and Administration
- **Chapter 2:** Definitions
- **Chapter 3:** Structural Design
- **Chapter 4:** Siting
- **Chapter 5:** Occupancy, Means of Egress, Access, and Accessibility
- **Chapter 6:** Fire Safety
- **Chapter 7:** Essential Features and Accessories
- **Chapter 8:** Test Methods for Impact and Pressure Testing
- **Chapter 9:** References



Latest in ICC 500 and FEMA P-361 Requirements 17

ICC 500-14 Chapter 1 – *Application and Administration* – Outline

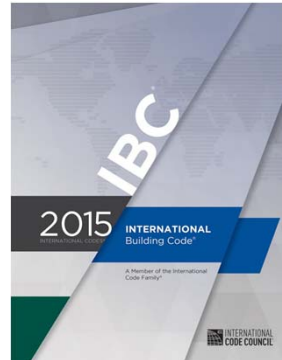
- **Section 101:** General
- **Section 102:** Compliance Alternatives
- **Section 103:** Conventions
- **Section 104:** Occupancy
- **Section 105:** *Applicable Building Code*
- **Section 106:** *Inspections* and Structural Observations
- **Section 107:** *Construction Documents*
- **Section 108:** *Design Information Signage and Labeling*



Latest in ICC 500 and FEMA P-361 Requirements 18

Code Applicability

- In cases where P-361 or ICC 500 do not stipulate requirements, the applicable provisions of the building code adopted by the AHJ should apply
- If no applicable building code is adopted, the most current version of IBC should be used (2015 or most current edition)
- For code requirements not related to structure or life-safety (e.g., plumbing), design for the normal use of a multi-use safe room unless otherwise directed by ICC 500 or the AHJ



Permitting and Code Compliance

- Before construction begins, all necessary State and local building and other permits should be obtained
- 2009 or later editions of IBC and IRC incorporate ICC 500 standard by reference
 - Where these codes are adopted, ICC 500 compliance is triggered for storm shelter or safe room construction
 - *A properly designed and constructed FEMA safe room is considered to be an ICC 500 storm shelter*
- Some communities have chosen to use FEMA P-361 (or even P-320) as an alternate, more restrictive standard



Peer Review

- Both FEMA P-361 and ICC 500 require peer review when:
 - Safe room is designed for more than 50 occupants
 - Safe room is in an elementary school, secondary school, or day care center and has an occupant load greater than 16
 - Safe room is in any Risk Category IV building (essential facility)
- Peer review must include Chapters 3, 5, 6, and 7 of ICC 500
- Peer reviewer must be independent registered design professional



Special Inspections

- A new requirement in ICC 500 (2014 edition) calls for special inspections for post-installed anchors in hardened concrete and masonry
- Safe rooms must be installed on foundation that has been designed to resist the loads
- ICC 500 does have **minimum** requirements for slabs
 - 3.5-inch thickness
 - 6 x 6 – W1.4 x 1.4 welded wire reinforcement, OR No. 4 bars at max spacing of 18 inches on center
- However these requirements may not be sufficient, depending on design. **Always** check loads and design of foundation.



Special Inspections (cont.)

If special inspection is triggered for post-installed anchors, inspection must verify:

- Post-installed anchor installation and capacity
- Foundation adequacy

Construction documents must provide:

- Minimum foundation capacity requirements
- Shelter installation requirements, including anchor location and minimum required capacity per anchor

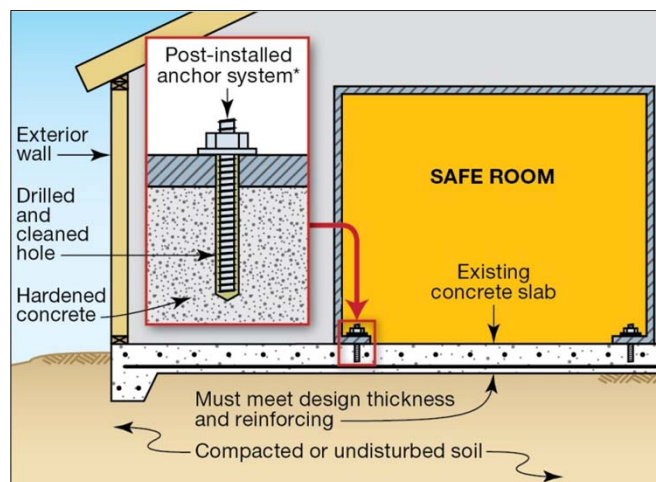
Exception to inspection is permitted if the AHJ verifies that anchorage and foundation will comply with requirements

- If seeking exception, be very transparent with existing conditions and compliance with design



Latest in ICC 500 and FEMA P-361 Requirements 23

Installing Safe Room in Existing Building Option 1: Verify Slab Below Safe Room

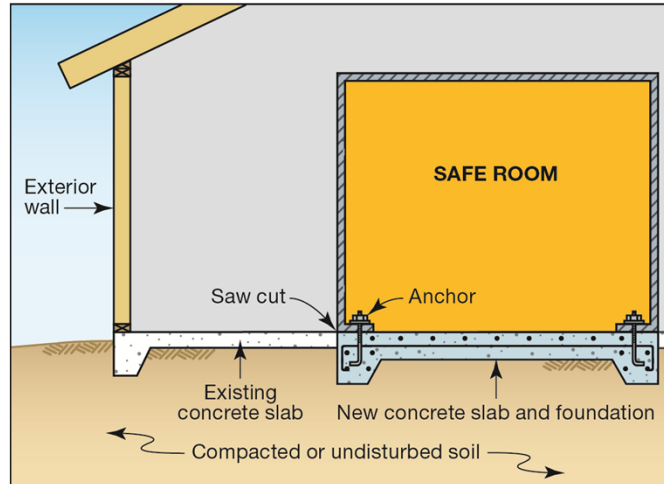


*Special inspection required per ICC 500 Section 106



Latest in ICC 500 and FEMA P-361 Requirements 24

Installing Safe Room in Existing Building Option 2: Replace Slab Below Safe Room



Latest in ICC 500 and FEMA P-361 Requirements 25

Construction Documents

Construction documents should be prepared and maintained for all safe rooms, both residential and community. Per ICC 500, they may be required by the AHJ.

- Documents should include information required by applicable codes, AHJ, and ICC 500 Section 107 (with P-361 Table B1-1 exceptions)
- New requirements in Section 107.2.1 of ICC 500-14 include:
 - Foundation capacity and anchor location and capacity
 - Rainfall information for hurricane shelters
 - Calculations for number of sanitation facilities (for community)



Latest in ICC 500 and FEMA P-361 Requirements 26

ICC 500-14 Chapter 3 – *Structural Design Criteria - Outline*

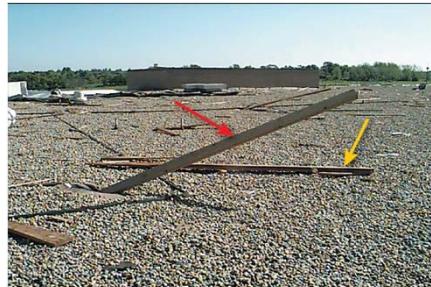
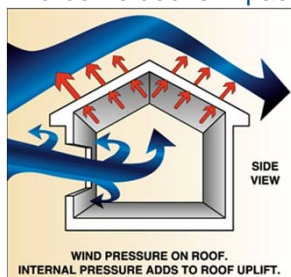
- **Section 301:** General
- **Section 302:** Load Combinations
- **Section 303:** Loads
- **Section 304:** Wind Loads
- **Section 305:** Debris Hazards
- **Section 306:** Component Design and Testing
- **Section 307:** Weather Protection
- **Section 308:** Connection to Foundations or Slabs
- **Section 309:** Penetrations of Envelope by Systems and Utilities



Latest in ICC 500 and FEMA P-361 Requirements 27

Structural and Building Envelope Characteristics of Safe Rooms

- Structural systems are designed for higher wind speeds (and corresponding greater wind pressures) and larger and more energetic wind-borne missiles than conventional buildings
- Envelope (roof, walls, and door assemblies) must resist the specified wind-borne debris impacts



Moore, Oklahoma.1999



Latest in ICC 500 and FEMA P-361 Requirements 28

ICC 500 Section 303 Non-Wind Load Considerations

Modifications required for rain loads, roof live loads, and flood loads (including hydrostatic forces)

- Rain Loads: Determine per ASCE 7, but for *hurricane* safe rooms, add 6" per hour to ICC 500 Figure 303.2 rates
- Roof Live Loads: Determine per ASCE 7, but not less than:
 - 100 psf for *tornado safe rooms*
 - 50 psf for *hurricane safe rooms*
 - Impact loading from collapse or laydown hazards may need to be taken under specific consideration



Latest in ICC 500 and FEMA P-361 Requirements 29

ICC 500 Section 303 Non-Wind Load Considerations (cont.)



Flood Loads: Hydrostatic Loads (ICC 500 Section 303.3)

Design underground portions of safe room to resist buoyancy and hydrostatic loads assuming groundwater at surface elevation at entrance

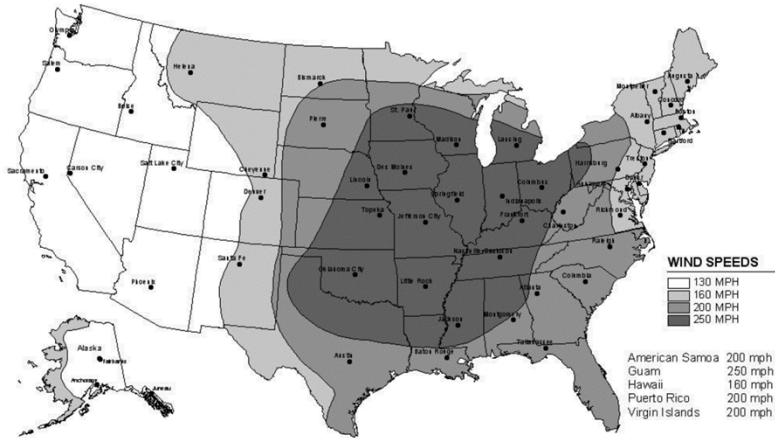
See the *Foundation and Anchoring Criteria for Safe Rooms Fact Sheet* on the safe room website or at

<https://www.fema.gov/media-library/assets/documents/112029>



Latest in ICC 500 and FEMA P-361 Requirements 30

ICC 500 Section 304.2 Design Wind Speeds: Tornado Safe Room

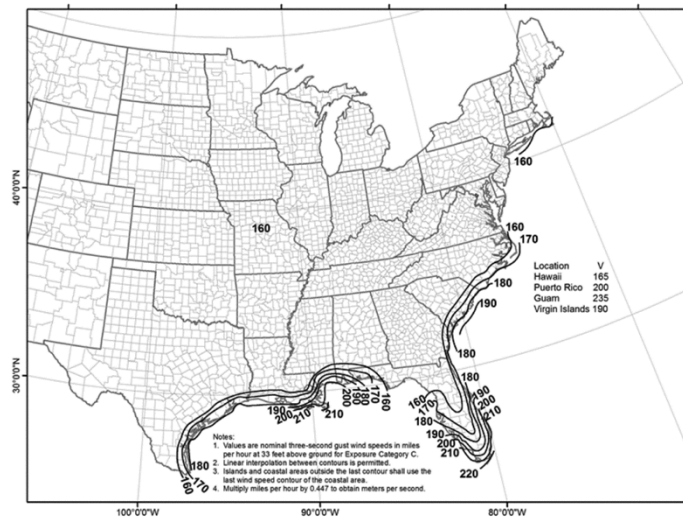


Notes:
 1. Values are nominal three-second gust wind speeds in miles per hour at 33 feet above ground for Exposure Category C.
 2. Multiply miles per hour by 0.447 to obtain meters per second.



Latest in ICC 500 and FEMA P-361 Requirements 31

ICC 500 Section 304.2 Design Wind Speed: Hurricane Safe Rooms

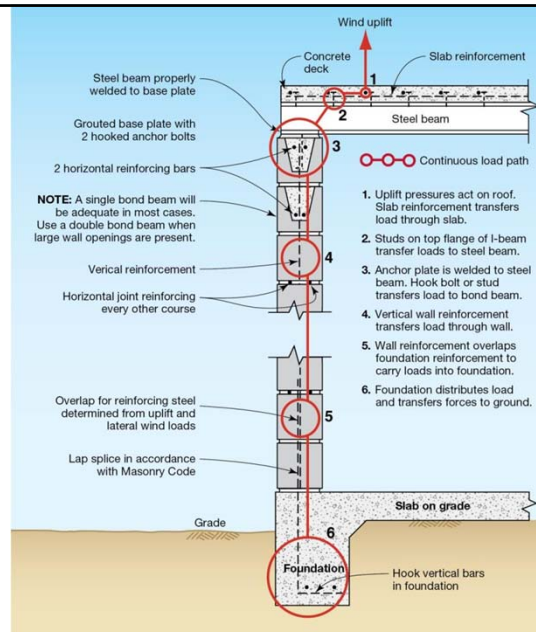


Notes:
 1. Values are nominal three-second gust wind speeds in miles per hour at 33 feet above ground for Exposure Category C.
 2. Linear interpolation between contours is permitted.
 3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
 4. Multiply miles per hour by 0.447 to obtain meters per second.



Latest in ICC 500 and FEMA P-361 Requirements 32

Continuous Load Path



Latest in ICC 500 and FEMA P-361 Requirements 33

ICC 500 Section 305 Debris Hazards

- All safe room building elements that protect the occupants should resist impacts from wind-borne debris
- Openings for ventilation should also be hardened to resist missile impact test criteria
- More detail on debris impact criteria in Chapter 8



Oklahoma City, Oklahoma. 1999

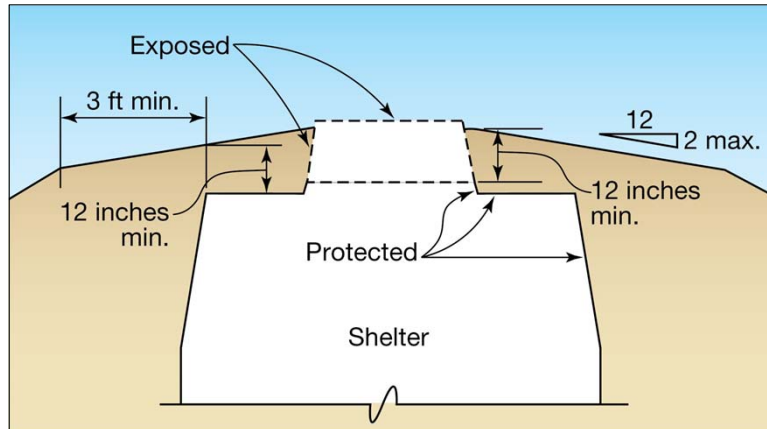


Athens, Alabama. 2011



Latest in ICC 500 and FEMA P-361 Requirements 34

Soil Cover as Protection from Debris Impact



Latest in ICC 500 and FEMA P-361 Requirements 35

Laydown, Rollover, and Collapse Hazards

- Designing to representative test missile impact criteria will produce safe rooms with roof and wall assemblies capable of withstanding some impacts from slow-moving, large (or heavy) falling debris
- Impact loading from collapse or laydown hazards may need to be taken under specific consideration



Joplin, Missouri. 2011



Greensburg, Kansas. 2007



Latest in ICC 500 and FEMA P-361 Requirements 36

ICC 500-14 Chapter 4 – *Siting* – Outline

- **Section 401:** Flood Elevation Criteria
- **Section 402:** Hazardous Materials
- **Section 403:** Siting Proximity for Residential Shelters
- **Section 404:** Siting for Community Shelters



Differences between ICC 500 and FEMA P-361 Flood Hazard Siting for Community

ICC 500-2014

1. Zone V

2. Floodways

Exception: Item 1 shall not apply where permitted by the Board of Appeals in accordance with IBC

P-361 (2015)

1. Zone V **and Coastal A Zone**

2. Floodways

Exception: Item 1 shall not apply where permitted by the Board of Appeals in accordance with IBC **and after completing the 8-step decision-making process as provided by 44 CFR Part 9.6**

Red = more conservative

Blue = less conservative



Differences between ICC 500 and FEMA P-361 Flood Hazard Siting for Residential

ICC 500-2014

No siting restrictions

Note: The 2008 edition of ICC 500 also did not have flood hazard siting restrictions for residential storm shelters

P-361 (2015)

1. Zone V and Coastal A Zone
2. Floodways
3. Areas subject to inundation with any modeled hurricane category, including coastal wave effects

Red = more conservative

Blue = less conservative



FEMA

Latest in ICC 500 and FEMA P-361 Requirements

39

Differences between ICC 500 and FEMA P-361 Flood Hazard Elevation for Community

ICC 500-2014

1. 0.2% + waves
2. Highest recorded
3. Surge from any hurricane Category + waves
4. Local ordinance
5. 1% + 2 ft.

Exception: Items 1 and 3 shall not apply to tornado-only shelters

P-361 (2015)

1. 0.2% + waves
2. Highest recorded
3. Surge from any hurricane Category + waves
4. Local ordinance
5. 1% + 2 ft.

Exception: Item 3 (only) shall not apply to tornado-only safe rooms

Red = more conservative

Blue = less conservative



FEMA

Latest in ICC 500 and FEMA P-361 Requirements

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Differences between ICC 500 and FEMA P-361 Flood Hazard Elevation for Residential

ICC 500-2014

1. 0.2% + waves
2. Highest recorded
3. Any hurricane Category + waves
4. Local ordinance

Exception: Items 1 and 3 shall not apply to tornado-only shelters

Red = more conservative
Blue = less conservative
Green = additional requirement

P-361 (2015)

1. 0.2% + waves
2. Highest recorded
3. *Not even allowed in hurricane surge areas*
4. Local ordinance
5. 1%

Exception: Item 1 (only) shall not apply to tornado-only safe rooms



Latest in ICC 500 and FEMA P-361 Requirements 41

What to Do When a Flood Study Has Not Been Completed for Safe Room Site

- In areas that have no flood hazard study, the elevation of the flood of record should be used
- If no flood of record has been documented, then consult the AHJ



Latest in ICC 500 and FEMA P-361 Requirements 42

Occupant Density for Tornado vs. Hurricane Safe Rooms

Tornado safe rooms:

- Minimum 2-hour planning duration
- Less square footage required per occupant
- Fewer non-structural requirements
- Less warning time for occupants to get to safe room

Hurricane safe rooms:

- Minimum 24-hour planning duration
- More square footage required per occupant
- More non-structural requirements
- More warning time for occupants to get to safe room



Occupant Density for Tornado vs. Hurricane Safe Rooms (cont.)

TORNADO SAFE ROOM OCCUPANT	MINIMUM USABLE FLOOR AREA ^(a) IN SQUARE FEET PER SAFE ROOM OCCUPANT
Standing or seated	5
Wheelchair-user	10
Medical bed-user	30

HURRICANE SAFE ROOM OCCUPANT	MINIMUM USABLE FLOOR AREA ^(a) IN SQUARE FEET PER SAFE ROOM OCCUPANT
Standing or seated	20
Wheelchair-user	20
Medical bed-user	40

TYPE OF SAFE ROOM	MINIMUM USABLE FLOOR AREA IN SQUARE FEET PER SAFE ROOM OCCUPANT
Tornado	
One- and Two-Family Dwelling	3
Other Residential	5
Hurricane	
One- and Two-Family Dwelling	7
Other Residential	10

(a) See Section B5.2.1.1 for guidance on minimum usable safe room floor area.



Number of Doors

- The number of doors for a safe room should be determined based on occupant load for normal occupancy of the space per applicable building code
- Consider the paths to access the safe room; locate entrances to facilitate continuous flow of occupants during an emergency
 - One way to determine the appropriate number of doors is to consider egress requirements and reverse the flow
 - Designers have found that sizing hallways and doorways to be equal in width can reduce bottleneck
- Door swing (inward or outward) depends on applicable building code for normal occupancy of the space
- Where code requires only one door, an emergency escape is required for safe rooms designed for more than 16 occupants



Latest in ICC 500 and FEMA P-361 Requirements 47

Access and Functional Needs

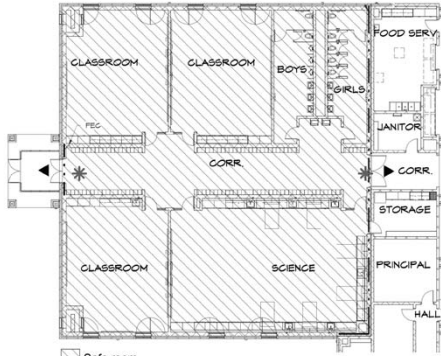
- Community safe rooms must meet the accessibility requirements of the American with Disabilities Act (ADA)
- When planning safe rooms that may house occupants with access and functional needs, refer to *Guidance on Planning for Integration of Functional Needs Support Services in General Population Shelters* (FEMA, 2010)
- Requirements for issues such as egress and emergency lighting are discussed in Chapter 10 of the IBC and NFPA 101 for healthcare facilities
- Functional needs planning can affect overall safe room planning—do not ignore it!



Latest in ICC 500 and FEMA P-361 Requirements 48

Community Safe Room Signage Examples

Identifying sign



Entrance sign with design information

1. The applicable picture should be shown for the hazard(s) the safe room has been designed to resist: tornado, hurricane, or combined (show both pictures).

2. The applicable hazard should be shown here. For a safe room designed to resist both hurricanes and tornadoes, use the term "combined."



ICC 500-14 Chapter 6 – Fire Safety – Outline

- Section 601: Fire-Resistant Construction
- Section 602: Fire Extinguishers



How Fire Safety Requirements Apply

Safe rooms should comply with fire protection and life-safety requirements of the model building code, the State code, or the local code where constructed (whichever is more stringent).



Latest in ICC 500 and FEMA P-361 Requirements

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Fire Separation

Community safe rooms:

ICC 500 requires fire barriers and horizontal assemblies separating the safe room from other building areas to have a 2-hour minimum fire-resistance rating and to comply with applicable building code

Residential safe rooms:

No requirements



Latest in ICC 500 and FEMA P-361 Requirements

52

ICC 500-14 Chapter 7 – *Essential Features and Accessories* – Outline

- **Section 701:** General
- **Section 702:** Tornado Shelters
- **Section 703:** Hurricane Shelters



Safe Room Ventilation

- Ventilation for a safe room should comply with the building code or ordinances adopted by the AHJ. If no code is adopted, use the current edition of IBC or IRC
- Per ICC 500 Sections 702.1 and 703.1
 - Tornado safe rooms may be ventilated by natural or mechanical means
 - All hurricane safe rooms require natural ventilation
 - Community hurricane safe rooms with more than 50 occupants must be also ventilated by mechanical means



Sanitation Management: Tornado Shelters per ICC 500 Table 702.2

Storm Shelter Type	Toilet Facilities	Hand-washing Facilities
Residential, one- and two-family dwellings	Not required	Not required
Residential, other	1	Not required
Community (50 or fewer occupants)	1	Not required
Community (more than 50 occupants)	2 minimum for the first 500 occupants and 1 additional per 500 occupants or portions thereof > 500 occupants	1 per 1000 occupants



Sanitation Management

- Support systems for sanitation facilities must be capable of supplying water and containing waste for the design capacity, and should be protected similar to the safe room
- If the sanitation requirements for a multi-use safe room exceed the requirements for normal use, then additional facilities can include temporary fixtures, chemical toilets, or other means approved by the AHJ
- Best practice is to provide a room or private area where toilets can be used; a portable screen may suffice



Lighting

- Lighting per ICC 500 Sections 702.3 and 703.4
- Not required for residential safe rooms
- Community safe rooms (tornado and hurricane) must have emergency lighting systems
 - Lighting should last for at least the duration of safe room occupancy (2 hours for tornado, 24 hours for hurricane)
 - Standby power source for lighting is essential; battery-powered systems are good for short durations
 - Flashlights are permitted for tornado safe rooms with 50 or fewer occupants



Latest in ICC 500 and FEMA P-361 Requirements 57

Standby Power



Seneca Intermediate School. Seneca, Missouri. 2011

- Standby power per ICC 500 Sections 702.3, 703.4, 703.5, and 703.6
- Standby power systems and all associated components essential to operation require protection from the safe room design event



Latest in ICC 500 and FEMA P-361 Requirements 58

ICC 500-14 Chapter 8 – Test Methods for Impact and Pressure Testing – Outline

- Section 801: General
- Section 802: Terminology
- Section 803: Test Specimens
- Section 804: **Missile Impact Testing**
- Section 805: Pressure Testing
- Section 806: Pressure Testing Procedures

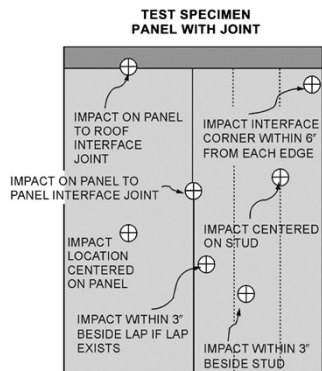


Debris Impact Test Speeds for Tornado Safe Rooms

Design Wind Speed	Missile Speed and Shelter Impact Surface
130 mph	80 mph Vertical Surfaces 53 mph Horizontal Surfaces
160 mph	84 mph Vertical Surfaces 56 mph Horizontal Surfaces
200 mph	90 mph Vertical Surfaces 60 mph Horizontal Surfaces
250 mph	100 mph Vertical Surfaces 67 mph Horizontal Surfaces



Wall and Roof Impact Tests



- No adequate method to model complexity of impacts
- Test specimen must be the exact design as the wall or roof that will be used on the safe room, including:
 - Type, size, thickness of materials
 - Type, size, and spacing of fasteners
 - Configuration of all components
- For more details, see Wall Sections That Passed Previous Missile Impact Tests on FEMA's safe room website:
<http://www.fema.gov/wall-sections-passed-previous-missile-impact-tests>



FEMA

Latest in ICC 500 and FEMA P-361 Requirements

61

Performance of Door Assemblies

- Door assembly includes:
 - Door, vision panel, hardware (locks and hinges), frame, and anchors into the safe room wall
- Installed door assembly must be the same type, size, configuration of materials, and swing direction used during testing
- Assemblies are debris-impact tested on the side of the door facing the exterior of the safe room
- Assemblies are pressure tested from both sides with positive pressure
- Residential Safe Room Door Fact Sheet: www.fema.gov/media-library/assets/documents/99139



FEMA

Latest in ICC 500 and FEMA P-361 Requirements

62

Performance of Glazed Opening Assemblies

- Glazed opening assembly includes:
 - Glazing, glazing frame, anchors into the safe room wall
- Installed glazing assembly must be the same type, size, and configuration of materials used during testing
- Debris-resistant glazing is laminated glass, polycarbonate, or a combination of these materials
- Glazing is permitted to break during testing provided that:
 - The missile does not perforate the glazing
 - The glazing remains attached to the frame
 - Ejected glass fragments do not perforate the witness screen



Latest in ICC 500 and FEMA P-361 Requirements 63

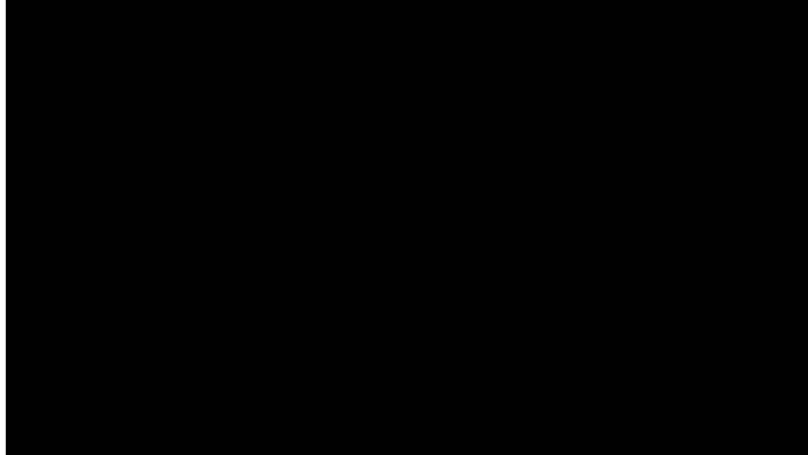
Impact-Protective Systems

- Impact-protective systems include shutters, doors, shields, and cowlings
- Protect openings at louvers, grates, grilles, precast panel joints more than 3/8 inch wide, plumbing vents, roof drains, and emergency generator exhaust vents
- Non-operable, permanently affixed shields or cowlings do not need to be pressure tested, but are required to be tested for resistance to missile impact



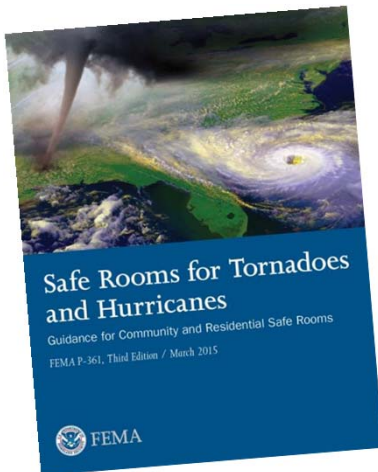
Latest in ICC 500 and FEMA P-361 Requirements 64

ICC 500-2014 Chapter 8 Test Methods for Impact and Pressure Testing



Latest in ICC 500 and FEMA P-361 Requirements 65

FEMA P-361 Safe Room Guidance



Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms (2015)

- Detailed design and construction criteria for hurricane and tornado safe rooms
- Community *and residential* safe rooms
- Uses ICC 500 as a Referenced Standard
- Emergency management considerations not found in ICC 500



Latest in ICC 500 and FEMA P-361 Requirements 66

FEMA P-361 Reorganized

Decision Makers and Emergency Management Considerations

Part A

- A1: Purpose & Background
- A2: Extreme-Wind Risk Assessment and Analysis
- A3: Costs and Benefit-Cost Analysis
- A4: Operation & Maintenance Considerations for Community Safe Rooms

Design Professionals (same chapter sequence as ICC 500)

Part B

- B1: Application & Administration
- B2: Definitions
- B3: Structural Design
- B4: Siting
- B5: Occupancy, Means of Egress, Access and Accessibility
- B6: Fire Safety
- B7: Essential Features & Accessories
- B8: Test Methods for Impact and Pressure Testing

FEMA Recommended Criteria that is more conservative than ICC 500 is presented in a table at the beginning of each chapter and in Appendix D



Summary of Main Differences between ICC 500 and FEMA P-361

ICC 500 (2014)	FEMA P-361 (2015)
Residential storm shelters may be designed according to ICC 500 wind speed maps	For ALL residential safe rooms, the design wind speed should be 250 mph, regardless of location.
Slightly less conservative elevation and siting restrictions with respect to flood hazards	Slightly more conservative elevation and siting restrictions with respect to flood hazards
Prepared construction drawings and details only when required by the authority having jurisdiction	ALL safe rooms require construction drawings and details
First aid kits in hurricane storm shelters and tornado storm shelters with more than 50 occupants (silent on first aid kit size)	ALL tornado and hurricane safe rooms have first aid kits rated for the occupancy of the safe room

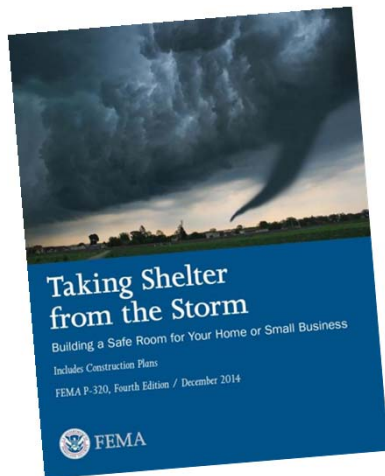


APPENDIX D
**Comparison Matrix of Differences
 Between ICC 500 Requirements and
 FEMA Recommended Criteria**

ICC 500 REFERENCE	ICC 500 REQUIREMENTS FOR STORM SHELTERS	FEMA RECOMMENDED CRITERIA FOR SAFE ROOMS ^(a)
Section 107.1 General	Where required by the authority having jurisdiction, construction documents shall be prepared. Such documents shall contain information as required by the applicable building code and this section.	For all safe rooms construction documents shall be prepared and maintained . Such documents shall contain information as required by the applicable building code and this section.
Section 107.2.1 Design Information	For the areas of a building designed for occupancy as a storm shelter, the following information shall be provided within the construction documents: 2. A statement that the wind design conforms to the provisions of the <i>ICC/NSSA Standard for the Design and Construction of Storm Shelters</i> , with the edition year specified.	2. A statement that the wind design conforms to the provisions of the ICC/NSSA Standard for the Design and Construction of Storm Shelters, with the edition year specified and to the provisions of FEMA P-361, with the edition year specified.
Section 304.2 Design Wind Speed	For tornado shelters, the design wind speed shall be in accordance with Figure 304.2(1). For hurricane shelters, the design wind speed shall be in accordance with Figure 304.2(2). ^(b)	For all residential safe rooms, the design wind speed shall be 250 mph, regardless of location.



FEMA P-320 Safe Room Guidance



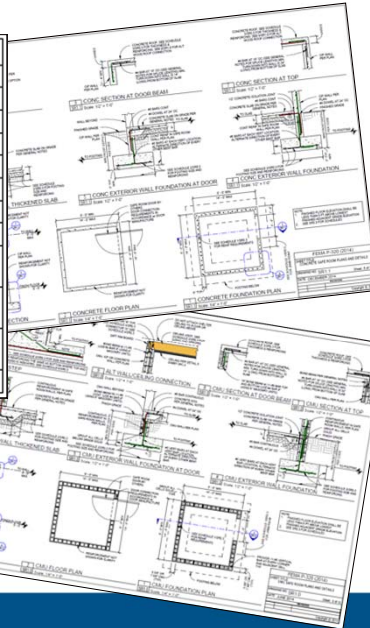
Taking Shelter From the Storm: Building a Safe Room For Your Home or Small Business (2014)

- Understanding the Hazards, and Accessing Risks
- Safe Room Decision Guidance
- Construction Plans for *residential* safe rooms that hold 16 or fewer occupants
- Plans based on design criteria in FEMA P-361 and ICC 500



FEMA P-320 Drawings

DRAWING #	SHEET TITLE
SR0.0	INDEX SHEET
SR0.1	GENERAL NOTES
SR0.2	GENERAL NOTES
SR0.3	TABLES
SR1.0	CMU SAFE ROOM PLANS AND DETAILS
SR1.1	CONCRETE SAFE ROOM PLANS AND DETAILS
SR1.2	ICF SAFE ROOM PLANS AND DETAILS
SR1.3	WOOD FRAME SAFE ROOM PLANS AND DETAILS
SR1.4	WOOD / CMU INFILL FRAME SAFE ROOM AND DETAILS
SR1.5	DETAILS FOR SAFE ROOMS THAT USE BASEMENT WALLS
SR2.1	SHEATHING REQUIREMENTS & WOOD FRAME SAFE ROOM WITH STEEL SHEATHING
SR2.2	EXHAUST / VENTILATION DETAILS



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Safe Room Success Stories



Latest in ICC 500 and FEMA P-361 Requirements 72

Questions

For questions pertaining to
FEMA safe room guidance publications,
please contact the Safe Room Helpline at
Saferoom@fema.dhs.gov

Additional FEMA Building Science resources
can be found at
<http://www.fema.gov/building-science>

