

National Storm Shelter Standard ICC 500

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ICC/NSSA STANDARD FOR THE DESIGN AND CONSTRUCTION OF STORM SHELTERS

ICC 500-2008
American National Standard

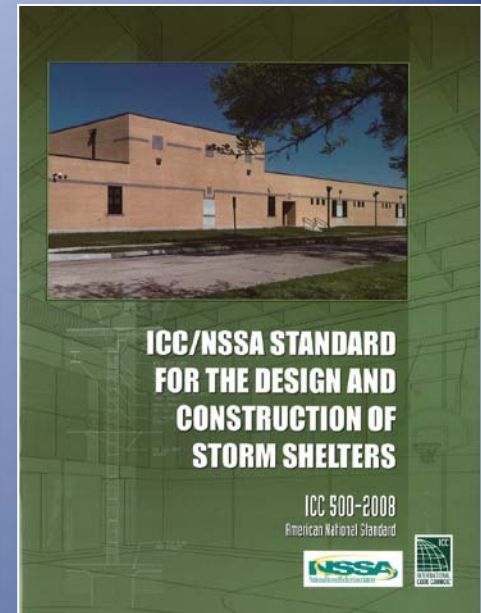


ICC 500

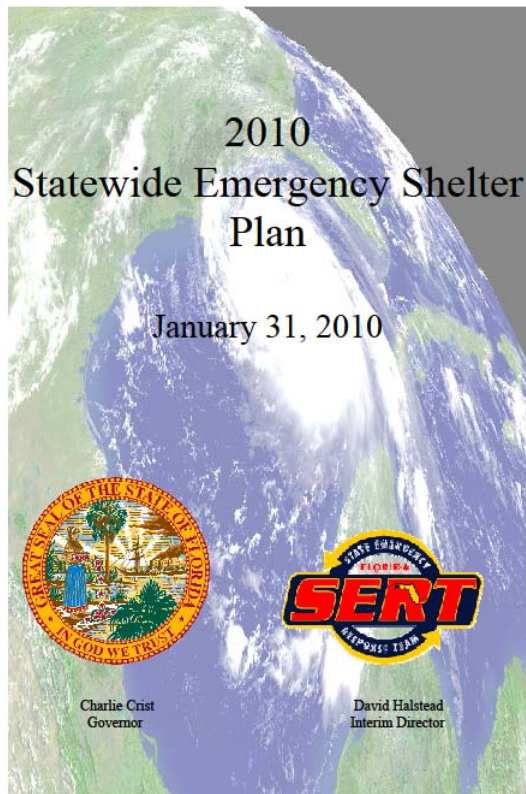
- American National Standard approved
 - Consensus of general interest, user and producer groups
 - Florida was represented by Danny Kilcollins (DEM); Tim Reinhold (IBHS); and Mr. Jaime Gascon (Miami-Dade Building Code Compliance Office)
- Contains separate tornado and hurricane provisions
 - Design storm type is selected by facility owner or other “designator” prior to or during the building design process
 - If a shelter is a combined tornado & hurricane shelter, the more stringent provisions of both will apply.
- Copyrighted material so standard must be purchased

Contents of ICC- 500

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



Comparison of ICC 500 to Florida's Enhanced Hurricane Protection Area (EHPA) in Appendix G of 2010 SESP



G-9 Comparison of Florida's EHPA to the International Code Council's ICC 500.
The ICC 500 was published in August, 2008 and so will become a consideration for design of hurricane shelters in the future. Florida's EHPA code provisions were considered during preparation of ICC 500 so there are many design consistencies between them. However, the objective of the ICC storm shelter committee was to ensure a high-degree of safety for shelter occupants. Therefore, wind design provisions are based on a near-ultimate hurricane event. Table G-4 provides a comparison of Florida's EHPA criteria and ICC 500.

Table G-4. Comparison of Florida Building Code's Public Shelter Design Criteria (EHPA) and the International Code Council's ICC 500 Hurricane Shelter Standard

Design Criteria	2004 FBC EHPA with 2006 Revisions	ICC 500--2008
Design Occupancy Period	8 hours	24 hours
Net Usable Floor Space per Occupant	20 sq. ft. all adults and children	20 sq. ft. for standing, seated or wheelchair; 40 sq. ft. for bedridden
Sanitary Facilities	Toilets 1:40 Handwashing 1:40	Toilets 1:50 Handwashing 1:100
Potable Water Capacity, minimum	No Capacity Given	1 Gallon per Occupant
Wastewater Capacity, minimum	No Capacity Given	1.5 Gallons per Occupant
Flood Design Criteria	ASCE 7	ASCE 7 and ASCE 24
Storm Surge Flood Elevation (if applicable)	EHPA must be located outside Cat. 1, 2 or 3 evacuation zones. EHPA floor slab must be elevated above maximum inundation of a Category 4 hurricane.	No limitation on location of hurricane shelter in storm surge evacuation zones. Lowest floor slab must be elevated above maximum inundation of a Category 5 hurricane.
Inland Rainfall Flooding	Floor slab of lowest finished floor must be elevated above base flood elevation plus one (1) foot.	Lowest floor slab of occupied shelter must be elevated to the higher of the following elevations at the site: 1) flood having 0.2% annual chance; 2) flood elevation having 1% annual chance plus two (2) feet, and 3) if not in mapped special flood hazard area, flood elevation of the highest recorded flood elevation plus two (2) feet
Rain Loads	FBC—Plumbing, Section 1106 (100-year recurrence interval normal drains, plus 2 inch per hour overflow; total of 2 inch emergency overflow capacity)	ICC 500, Section 303.1 (100-year recurrence interval normal drains, and 100-year plus 3 inch per hour overflow; ranges from total of 7.3 to 8 inch emergency overflow capacity)

Hurricane Shelter Design Wind Speeds

Wind speeds in miles per hour at 33 feet
above ground.
Linear interpolation is permitted.
Islands and coastal areas outside the last contour shall use the last wind speed
contour of the coastal area.
Multiply miles per hour by 0.447 to obtain meters per second.

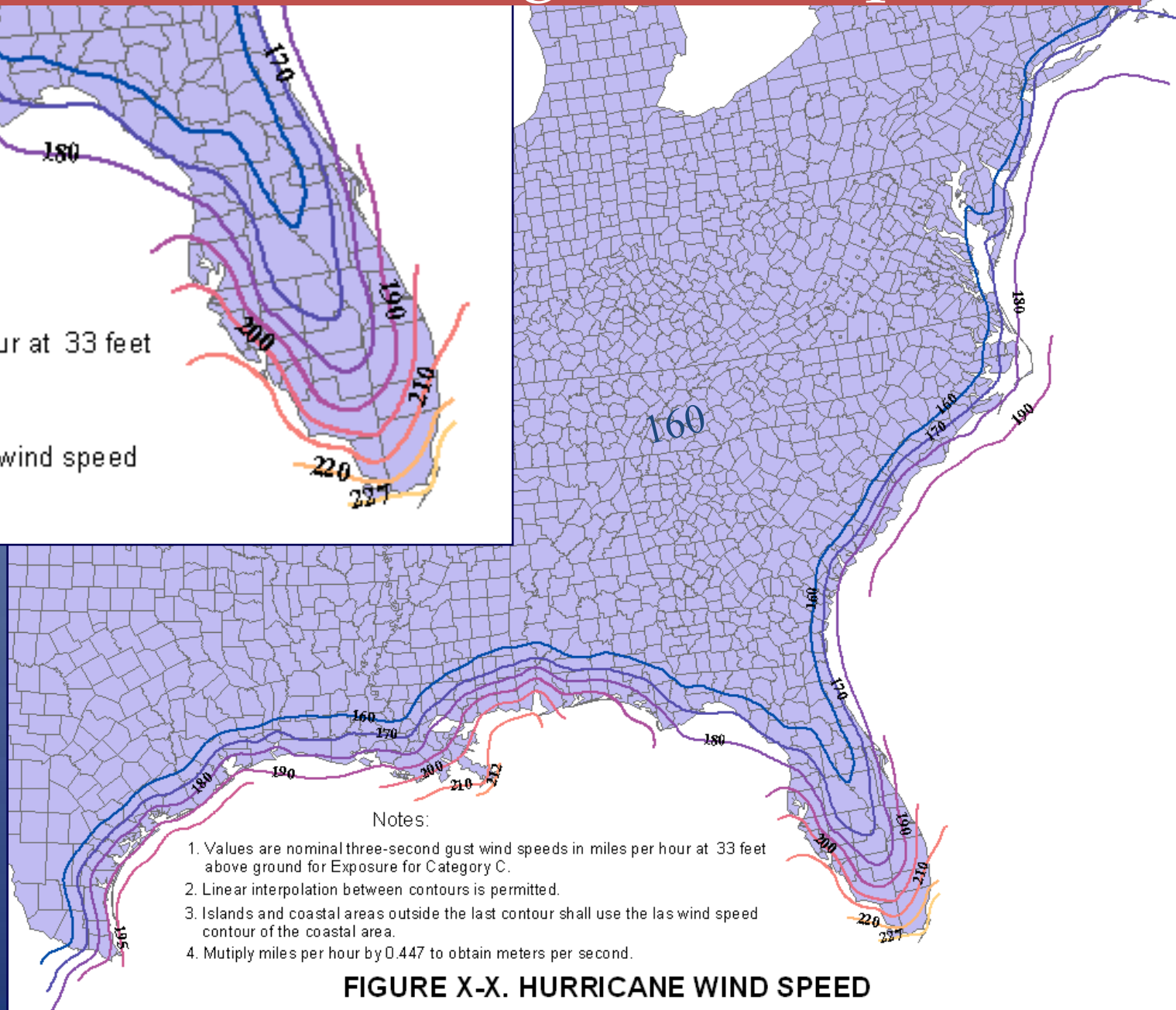


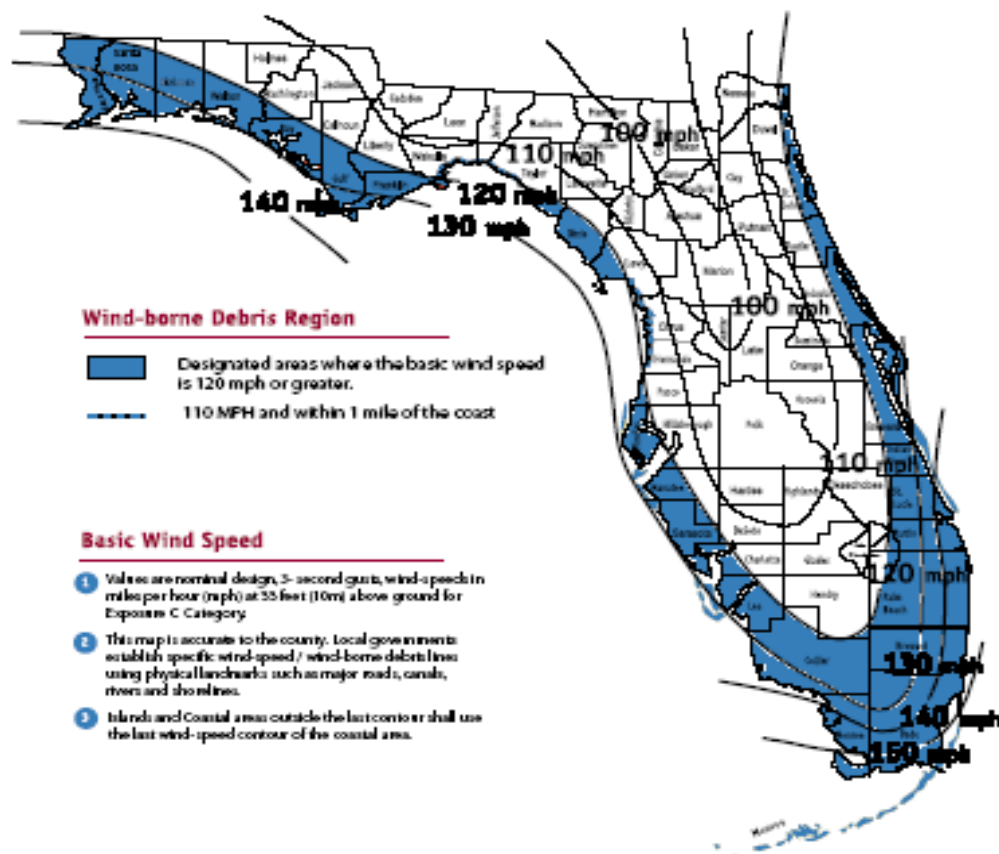
FIGURE X-X. HURRICANE WIND SPEED

Basic Wind Speed Conversions

Equivalent Basic Wind Speeds Wind Speed Conversion 3-second gust, fastest-mile and 1-min. sustained velocities (mph)						
Wind Measurement Scale	Hurricane Category 1	Hurricane Category 2	Hurricane Category 3	Hurricane Category 4	Hurricane Category 5	Extreme Hurricane Category 5
3-second Gust (ASCE 7 and 2004 Florida Building Code)	90	117	135	160	190	230
Fastest Mile (Standard Building Code)	75	100	117	141	170	209
1-minute Sustained (National Hurricane Center)	74	96	111	131	156	188

State of Florida

Wind-Borne Debris Region



Wind-borne Debris Region

- Designated areas where the basic wind speed is 120 mph or greater.
- 110 MPH and within 1 mile of the coast

Basic Wind Speed

- Values are nominal design, 3-second gust, wind speed in miles per hour (mph) at 33 feet (10m) above ground for Exposure C Category.
- This map is accurate to the county. Local governments to establish specific wind-speed / wind-borne debris lines using physical landmarks such as major roads, canals, rivers and shorelines.
- Islands and Coastal areas outside the last contour shall use the last wind-speed contour of the coastal area.

Comparison of Test Missiles to Design Windspeed

Florida Div. of Emergency Management--Hurricane Windborne Debris Impact Test Performance Comparisons									
Vertical Surfaces (<60 ft Height)	Saffir-Simpson Hurricane Category	Design Wind Speed, mph 3-sec. gust	Missile Weight, lbs	Missile Velocity, mph	Missile Velocity, ft/sec	Momentum, lb-sec.	Energy, ft-lb	Kinetic Pulse, kp	Hurricane Level of Protection
ASTM Level D	TS	85	9	34	49.9	13.9	348	4,847	Basic D
	2	120	9	48	70.4	19.7	693	13,638	Basic D
	2	125	9	50	73.4	20.5	752	15,415	Basic D
	2	130	9	52	76.3	21.3	813	17,340	Basic D
ASTM Level E	3	135	9	54	79.2	22.1	877	19,418	Basic E
	3	140	9	56	82.2	23.0	943	21,657	Basic E
	3	145	9	58	85.1	23.8	1,012	24,061	Basic E
	3	150	9	60	88.0	24.6	1,083	26,637	Basic E
	3	155	9	62	91.0	25.4	1,156	29,391	Basic E
ICC 500	4	160	9	64	93.9	26.2	1,232	32,328	Enhanced A
ICC 500	4	165	9	66	96.8	27.1	1,310	35,454	Enhanced A
ICC 500	4	170	9	68	99.8	27.9	1,391	38,776	Enhanced A
ICC 500	4	175	9	70	102.7	28.7	1,474	42,299	Enhanced A
ICC 500	4	180	9	72	105.6	29.5	1,559	46,029	Enhanced A
ICC 500	4	185	9	74	108.6	30.3	1,647	49,972	Enhanced A
ICC 500	5	190	9	76	111.5	31.2	1,737	54,135	Enhanced B
ICC 500	5	195	9	78	114.4	32.0	1,830	58,522	Enhanced B
ICC 500	5	200	9	80	117.4	32.8	1,925	63,140	Enhanced B
ICC 500	5	205	9	82	120.3	33.6	2,022	67,995	Enhanced B
ICC 500	5	210	9	84	123.2	34.4	2,122	73,092	Enhanced B
ICC 500	5	215	9	86	126.2	35.3	2,224	78,438	Enhanced B
ICC 500	5	220	9	88	129.1	36.1	2,329	84,039	Enhanced B
ICC 500	5	225	9	90	132.0	36.9	2,436	89,900	Enhanced B

Comparison of EHPA and ICC 500 Map Windspeeds

Comparison of EHPA and ICC 500 Equivalent Windspeeds

Location	ARC 4496 (ASCE 7, I=1.00, Map Wind Velocity), mph 3-sec gust	EHPA minimum (ASCE 7, I=1.15, Map Wind Velocity), mph 3-sec gust	EHPA recommended (ASCE 7, I=1.00, bV+40), mph 3-sec gust	ICC 500 Hurricane Provisions Map Wind Velocity, mph 3-sec gust	EHPA min. Equivalent Wind Velocity to ICC 500, mph 3-sec gust	Ratio ICC500 to EHPA Minimum Wind Speeds	EHPA rec. (bV+40) Equivalent Wind Velocity to ICC 500, mph 3-sec gust	Ratio ICC500 to EHPA bV+40 Wind Speeds
Brandon, FL	115	123	155	190	178	1.45	152	0.98
Honeyville, FL	125	134	165	180	169	1.26	143	0.87
Jacksonville, FL	115	123	155	165	155	1.26	126	0.81
Sebring, FL	110	118	150	165	155	1.31	126	0.84
Hudson, FL	120	129	160	190	178	1.38	152	0.95
Land-O-Lakes, FL	110	118	150	180	169	1.43	143	0.95
Ft. Lauderdale, FL	140	150	180	215	200	1.33	175	0.97
Pensacola, FL	135	145	175	190	178	1.23	150	0.86

Building Codes that Reference ICC 500

- 2009 International Building Code
- 2009 International Residential Code
- 2010 Florida Building Code
 - Sec. 442 Storm Shelters
 - Becomes effective in March 2012

2010 Florida Building Code

- SECTION 442 ~~423~~ STORM SHELTERS

442.1 General. In addition to other applicable requirements in this code, storm shelters shall be constructed in accordance with ICC-500.

442.1.1 Scope. This section applies to the construction of storm shelters constructed as separate detached buildings or constructed as safe rooms within buildings for the purpose of providing safe refuge from storms that produce high winds, such as tornados and hurricanes. Such structures shall be designated to be hurricane shelters, tornado shelters, or combined hurricane and tornado shelters.

442.2 Definitions. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

STORM SHELTER. A building, structure or portions(s) thereof, constructed in accordance with ICC 500 and designated for use during a severe wind storm event, such as a hurricane or tornado.

Community storm shelter. A storm shelter not defined as a “Residential Storm Shelter.”

Residential storm shelter. A storm shelter serving occupants of *dwelling units* and having an *occupant load* not exceeding 16 persons.



Design and Construction Guidance for Community Safe Rooms

FEMA 361, Second Edition / August 2008



FEMA

Windborne Debris – Hurricane Missiles

Hurricane Design Missile is a 9-lb 2x4 board member impacting the safe room at the following missile impact speed (as a function of safe room design wind speed [V])

Hurricane Design Wind Speed (V)	FEMA 361 Horizontal Missile Speed – Hurricane (0.5xV)	FEMA 361 Vertical Missile Speed – Hurricane (0.1xV)	ICC-500 Horizontal Missile Speed – Hurricane (0.4xV)	ICC-500 Vertical Missile Speed – Hurricane (0.1xV)
255 mph	128 mph	26 mph	102 mph	26 mph
250 mph	125 mph	25 mph	100 mph	25 mph
240 mph	120 mph	24 mph	96 mph	24 mph
230 mph	115 mph	23 mph	92 mph	23 mph
220 mph	110 mph	22 mph	88 mph	22 mph
210 mph	105 mph	21 mph	84 mph	21 mph
200 mph	100 mph	20 mph	80 mph	20 mph
190 mph	95 mph	19 mph	76 mph	19 mph
180 mph	90 mph	18 mph	72 mph	18 mph
170 mph	85 mph	17 mph	68 mph	17 mph
160 mph	80 mph	16 mph	64 mph	16 mph

Note: Walls, doors, and other safe room envelope surfaces inclined 30 degrees or more from the horizontal should be considered vertical surfaces. Surfaces inclined less than 30 degrees from the horizontal should be treated as horizontal surfaces.

Implications of ICC 500 on Florida Hurricane Shelters

- Existing or future public shelters (hurricane or others) designated by local emergency management are not necessarily required to meet ICC 500
 - Statewide hurricane shelter inventory in 2010 or 2012 Statewide Emergency Shelter Plans not affected
- ICC 500 will only apply to new construction of facilities “designated” for use during severe wind storm events
 - Applies to both public and private use facilities
 - Designation is not limited to local emergency management (e.g., facility owner)

Implications of ICC 500 on Florida Hurricane Shelters (cont'd)

- ICC 500 will not apply to new school facilities subject to the EHPA code (unless the code is changed)
 - *S. 423.25, FBC—Building* will continue to be the public shelter design criteria for new schools through at least the next three years

Implications of ICC 500 on Florida Hurricane Shelters (cont'd)

- The Division's hurricane shelter survey program will continue to recognize the American Red Cross' Standards for Hurricane Evacuation Shelter Selection (ARC 4496-2002) as minimum hurricane safety criteria
- The Division's state-funded hurricane shelter retrofit program's minimum criteria will also continue to be ARC 4496 and FBC-approved large-missile impact tested products
 - ICC 500 performance products will be recommended in grant scopes-of-work

Implications of ICC 500 on Florida Hurricane Shelters (cont'd)

- ICC 500 hurricane provisions will be the minimum scope-of-work design criteria for certain new construction grants (unless negotiated otherwise)
 - Consistent with current practice
 - EOC, public shelter, etc.
 - HB 7121 and other EOC grant scopes-of-work were modeled on early ICC 500 concepts and criteria
 - Fasano Regional Hurricane Shelter (Pasco County) and H.L. Fenn Center/Special Need Shelter (St. Lucie County) grant scopes-of-work also modeled on ICC 500.

Implications of ICC 500 on Florida Hurricane Shelters (cont'd)

- Per policy MRR-2-09-1, the federal Hazard Mitigation Grant Program (HMGP) requires that both new and retrofit wind hazard safe-room projects meet FEMA 361.
 - Pre-Disaster Mitigation Program (PDM)
 - Post-disaster HMGP projects
- Applicant, FEMA and state must agree on storm hazard (tornado, hurricane or combination) prior to execution of funding agreement
 - Wind storm hazard type can affect Benefit-Cost Analysis



FEMA

MITIGATION INTERIM POLICY

MRR-2-09-1

I. TITLE:

Hazard Mitigation Assistance for Safe Rooms

II. DATE OF ISSUANCE: April 30, 2009

III. PURPOSE:

This policy updates the previous memorandum on this subject (MRR-2-07-1) issued March 7, 2008, to identify revised design criteria eligible to support Pre-Disaster Mitigation program (PDM) and Hazard Mitigation Grant Program (HMGP) safe room activities. Specifically, the revised FEMA Publications 320 *Taking Shelter From the Storm: Building a Safe Room For Your Home or Small Business – Third Edition, August 2008* and 361 *Design and Construction Guidance for Community Safe Rooms – Second Edition, August 2008*.

This document describes FEMA's policy on the use of PDM and HMGP funds for safe rooms. This policy will ensure national consistency in the use of PDM and HMGP funds for the construction or retrofit of residential, non-residential, or community safe rooms. These activities are for the hazard mitigation purpose of immediate life safety resulting from structural and building envelope protection against extreme wind hazards for a limited at-risk population that cannot evacuate out of harm's way prior to an event.

For the purposes of PDM and HMGP, the term "safe room" only applies to:

- extreme wind (combined tornado and hurricane) residential and non-residential safe rooms;
- extreme wind (combined tornado and hurricane) community safe rooms;
- tornado community safe rooms; and
- hurricane community safe rooms.

IV. SCOPE AND APPLICABILITY:

PDM

This policy applies to PDM projects for which the application period opens on or after the date of this policy.

HMGP

This policy applies to HMGP projects for which funding is made available pursuant to a major disaster declared on or after the date of this policy.

ICC 500 Review Committee

- ICC 500-2008 will be going through the review process over the next year or so
- The International Code Council is making a public call for revision proposals; for more information see the following website:
<http://www.iccsafe.org/cs/standards/Pages/default.aspx>
- ICC 500 Pre-publication overview presentation at 2006 Governor's Hurricane Conference:
<http://www.floridadisaster.org/Response/engineers/documents/2006%20GHC%20ICC%20Tezak.pdf>

Questions ??