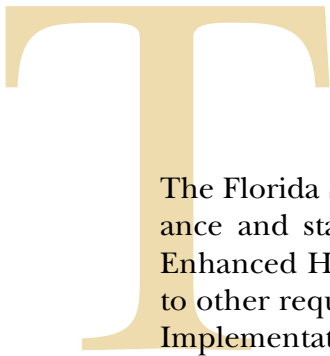




Guidance and Statute Requirements for Design and Construction of EHPAs



The Florida Statewide Emergency Shelter Plan (SESP) provides guidance and statute requirements for the design and construction of Enhanced Hurricane Protection Areas (EHPAs) and compares them to other requirements. From Appendix G, Consultative Guidance for Implementation of Public Shelter Design Criteria:

“EHPAs are required to be designed and constructed in accordance with the wind load provisions of the American Society of Civil Engineers Standard 7, Minimum Design Loads for Buildings and Other Structures (ASCE 7). The minimum design wind speed is per ASCE 7’s basic wind speed map, using the importance factor (I) for a Category III or IV (essential facility) building occupancy. Also, to ensure that the EHPA remains an enclosed structure (and avoid a partially enclosed condition, which would invalidate the design), building openings are also required to withstand impact by windborne debris in accordance with Test Standard for Determining Resistance From Windborne Debris SSTD 12 (SSTD 12).”

¹ The presumption that 50 years is the useful life expectancy of a facility may be incorrect.

The selection of an appropriate design wind speed is critical to the performance of public hurricane shelters. ASCE 7's wind speed map is based upon a 50-year recurrence level, which presumes that 50 years is the useful life expectancy of a facility.¹ The Category III/IV importance factor (1.15) is used to adjust the wind speed design up to a 100+ year recurrence level to account for a greater degree of hazard due to the nature of a facility's occupancy. This is the minimum wind design and construction requirement for EHPAs, and reflects the **minimum** national design standard for designated hurricane shelters.

However, the EHPA code provisions highly recommend that the ASCE 7 map wind speed be increased by 40 miles per hour, with an importance factor of 1.00. The Department also highly recommends the 40 mile per hour increase in base wind speed. The 40 mile per hour increase in base wind speed translates into wind designs of as high as 200 miles per hour in the Florida Keys, to as low as 140 miles per hour in inland north-central Florida. The 40 mile per hour increase in base wind speed is used to adjust the wind speed design up to about a 1,000+ year recurrence level, and is consistent with the Department of Energy's DOE-STD-1020 hurricane wind Performance Category (PC) 3 criteria. The Department of Energy's enhanced performance expectations are that its facilities not only resist collapse, but that occupants, critical equipment and contents be protected from wind, windborne and falling debris, rainwater intrusion, and continue to maintain operation as an essential facility. The Department of Energy's enhanced performance expectations are more consistent with public hurricane shelter design and construction performance expectations than ASCE 7's minimum design standard."

Furthermore, the SESP design requirements provide commentary of minimum design levels and "best practices" for the design of high-wind shelters as presented in additional text from Appendix G of the SESP and in the summary table provided herein as Table F-1 (SESP Table G-2). Using a scale of "Performance Criteria" the table identifies different levels of design, provides comments and provides references for the standard from which the criteria was provided. The criteria for these performance criteria are taken from the SESP itself, the Department of Energy STD-1020 standard for hazard-resistant construction, and ASCE 7. Additional commentary on the design assumptions shown in the table, including the different wind hazard return periods, are found in each of the reference documents. From Appendix G of the SESP:

“...Therefore, to ensure that public hurricane shelters are designed and constructed to resist major hurricanes, the 40 mile per hour increase in base wind speed is critical to achieve the EHPA performance expectation. Table G-2 provides a comparison summary of hurricane shelter performance objectives to be considered when selecting an appropriate design wind speed.

The 40 mile per hour increase in design wind speed is especially important for certain types of buildings. Buildings with tall exterior walls, long span lightweight roof systems, wide roof overhangs, located in open areas with minimal sheltering, etc., are particularly vulnerable to damage in “design level events.” The Department strongly recommends use of the 40 mile per hour increase in design wind speed for buildings that possess these characteristics.”

Table F-1. Summary of EHPA Wind Design Criteria

Crosswalk of EHPA, DOE-STD-1020 and FEMA 361 Performance Criteria						
Performance Category	X	0	PC 1	PC 2 (EHPA min)	PC 3 (EHPA rec)	PC 4 (FEMA 361)
Wind Hazard Return Period (yrs)	<50	<50	>50	>100	>1,000	>10,000
Design Wind Speed	Does not meet ARC 4496	Code and meets ARC 4496	ASCE 7 or Code and ARC 4496	ASCE 7, essential facility and ARC 4496	ASCE 7 plus 40 mph	ASCE 7 plus 80 mph
Design Wind Speed, V (mph), 3-second peak gust	<90	100±	100 -150	100 -150	140-200 (tornado @ 160+)	200-230 (tornado @ 200+)
Importance Factor, I	<1.00	<1.00	1.00	1.15	1.00	1.00
Exposure Category	N/A	N/A	Code	ASCE 7 (Exposure C)	ASCE 7 (Exposure C)	C
Directionality Factor, K_d	N/A	N/A	Code	ASCE 7 (0.85)	1.00	1.00
Internal Pressure Coefficient, GC_{pi}	N/A	N/A	Code	ASCE 7 (hurr. @ ±0.18, or tornado @ ±0.55)	ASCE 7 (hurr. @ ±0.18, or tornado @ ±0.55)	ASCE 7 (hurr. @ ±0.18, or tornado @ ±0.55)
Load Combinations	N/A	N/A	Code	ASCE 7	ASCE 7	ASCE 7
Hurricane Windborne Debris Impact Criteria	N/A	Equivalent to ½-in plywood; max. height 30* ft.	2x4 timber plank, 9 lb @ 34 mph; max. height 30* ft.	2x4 timber plank, 9 lb @ 34 mph; max. height 60* ft.	2x4 timber plank, 15 lb @ 50 mph w/ max. height 60* ft	2x4 timber plank, 15 lb @ 50 mph w/ max. height 60* ft
Tornado Windborne Debris Impact Criteria	N/A	N/A	N/A	2x4 timber plank, 15 lb @ 50 mph; max. height 60* ft.	2x4 timber plank, 15 lb @ 100 mph w/ max. height 150 ft.	2x4 timber plank, 15 lb @ 100 mph w/ max. height 200 ft.

* Glazed openings in exterior envelope of hurricane shelters and critical support areas located above large missile protection height indicated in this table should resist penetration to small missile standards.

Note: PC 2 ^a EHPA minimum requirement; PC 3 ^a EHPA recommended requirement; and PC 4 ^a FEMA 361 “near absolute protection” requirement.