WIND LOADS – IMPACTS FROM ASCE 7-16

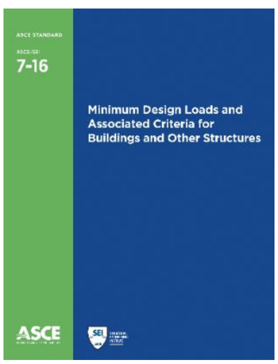
June 2020

CHANGES TO WIND LOADS IN THE 7TH EDITION (2020) FLORIDA BUILDING CODE,

BUILDING AND RESIDENTIAL – IMPACTS FROM ASCE 7-16

American Society of Civil Engineers ASCE 7-16

The 7th Edition (2020) Florida Building Code, Building (FBCB) and Florida Building Code, Residential (FBCR) have been updated to reference ASCE 7-16 *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. Accordingly, the wind criteria in the 7th Edition FBCB and FBCR have been updated to correlate with ASCE 7-16. ASCE 7-16 includes a number of notable changes to the wind load provisions. A few key changes are identified as follows and are summarized in this fact sheet:



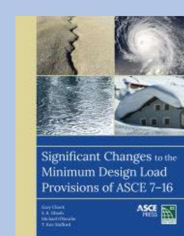
- New Risk Category IV wind speed map
- New wind load criteria for rooftop solar panels
- Revised (higher) design wind pressures on roofs of buildings with mean roof height ≤ 60 feet
- New wind load criteria for attached canopies
- New guidance in the commentary for designing for tornadoes

New Risk Category IV Wind Speed Map – 7th Edition (2020) FBCB (ASCE 7-16 Figure 26.5-1D)

While the wind speed maps in ASCE 7-16 have been revised significantly for the nonhurricane-prone region, for the State of Florida, the only significant change to the wind speed maps is the introduction of a new wind speed map for Risk Category IV buildings and structures. Wind speeds for Risk Category I, II, and III buildings are unchanged from the 6th Edition (2017) FBCB. In the 6th Edition (2017) FBCB (and ASCE 7-10), wind speeds for Risk Category III and IV buildings were the same and provided on a single map. However, Risk Category III and IV represent different levels of risk as Risk Category IV includes essential facilities whose failure could pose a substantial hazard to a community if they failed. The addition of a new wind speed map specific to Risk Category IV buildings and structures recognizes the higher reliabilities required for these buildings and structures. The Risk Category IV wind speed map is based on a mean recurrence interval (MRI) of 3000

Significant Changes to ASCE 7-16

A comprehensive review of all changes to ASCE 7-16 including dead, live, snow, and earthquake loads can be found in *Significant Changes to the Minimum Design Load Provisions of ASCE 7-16* published by ASCE.



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years. While the impact of the new of Risk Category IV wind speed map varies throughout the state, wind speed increases for Risk Category IV buildings range from 2% to 6% throughout compared to the 6th Edition (2017) FBCB.

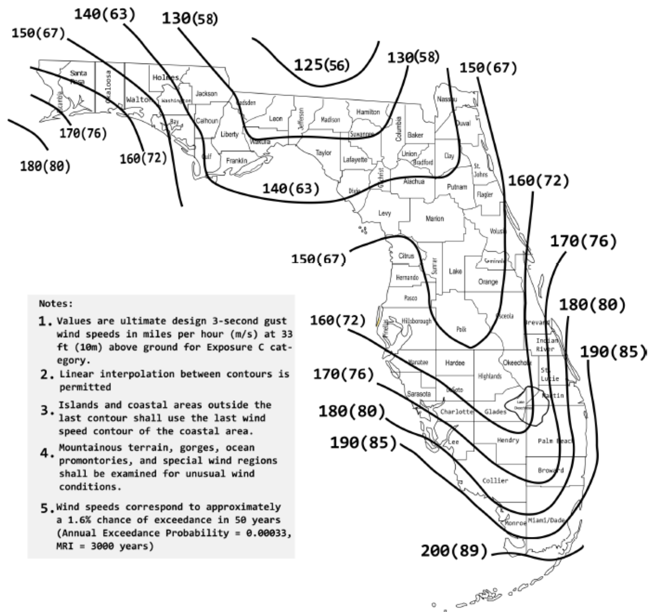

FIGURE 1609.3(3)
ULTIMATE DESIGN WIND SPEEDS, V_{ULT}, FOR RISK CATEGORY IV BUILDINGS AND OTHER STRUCTURES

NOTE: Because the FBCR only addresses one- and two-family dwellings and townhouses (Risk Category II buildings and other structures) the new Risk Category IV wind speed map was not added to the FBCR. The wind speed map in the FBCR is unchanged from the 6th Edition (2017) FBCR.

In the High-Velocity Hurricane Zones, where a single wind speed for each Risk Category is specified for Miami-Dade County and Broward County, the applicable Risk Category IV wind speeds are as follows:

Miami-Dade County

Risk Category IV Buildings and Structures: 195 mph

Broward County

Risk Category IV Buildings and Structures: 185 mph

The addition of a separate wind speed map for Risk Category IV building and structures also required a tweak to the definition of the Wind-borne Debris Region (WBDR) in the FBCB. The WBDR for the Risk Category IV buildings and structures is now based on the new Risk Category IV wind speed map which will result in a moderate increase in the WBDR for Risk Category IV buildings and other structures compared to the 6th Edition (2017) FBCB.

Section 202 in the FBCB

WIND-BORNE DEBRIS REGION. Areas within hurricane-prone regions located:

1. Within 1 mile (1.61 km) of the coastal mean high water line where the ultimate design wind speed, V_{ult}, is 130 mph (58 m/s) or greater; or

2. In areas where the ultimate design wind speed, V_{ult}, is 140 mph (63.6 m/s) or greater.

For *Risk Category* II buildings and other structures and *Risk Category* III buildings and other structures, except health care facilities, the wind-borne debris region shall be based on Figure 1609.3(1). For *Risk Category* III health care facilities, the wind-borne debris region shall be based on Figure 1609.3(2). For Risk Category IV buildings and other structures, the wind-borne debris region shall be based on Figure 1609.3(3).

Important Note Regarding the Use of Site-Specific Wind Speed Websites

The ATC Hazard By Location (hazards.atcouncil.org) and the ASCE Hazard Tool (www.asce7hazardtool.online) websites are commonly used to obtain site-specific wind speeds. While the 7th Edition (2020) FBC has adopted ASCE 7-16, Florida-specific changes to two of the wind speed maps will make the hazard tool unreliable for some areas of Florida. The 7th Edition (2020) FBC retained the ASCE 7-10 Risk Category II map, because the ASCE 7-16 Risk Category II map reduced wind speeds in the Big Bend area. Additionally, the 7th Edition (2020) FBC corrects an error on the ASCE 7-16 Risk Category IV wind speed map. The error is primarily limited to Franklin and Gulf Counties. In these counties, wind speeds should be obtained from the code and not the wind speed websites.

Wind Loads on Rooftop Solar Panels (ASCE 7-16 Sections 29.4.3 and 29.4.4)

New provisions for determining wind loads on rooftop solar panels have been added to ASCE 7-16. Prior versions of ASCE 7 have not specifically addressed loads on rooftop solar panels. Two methods for specific types of panels have been added. The first method applies arrays on low sloped roofs (less than 7°) with limitations on panel length, tilt and height above the roof. The arrangement and limitations of this type of array have been subjected to wind tunnel testing and are in widespread use. This method has specific pressure coefficients to be used and includes adjustments for the presence of parapets, length of the panels, and proximity to the edge of the roof.

> **Rooftop Solar Panels ASCE 7-16 Example Calculations**
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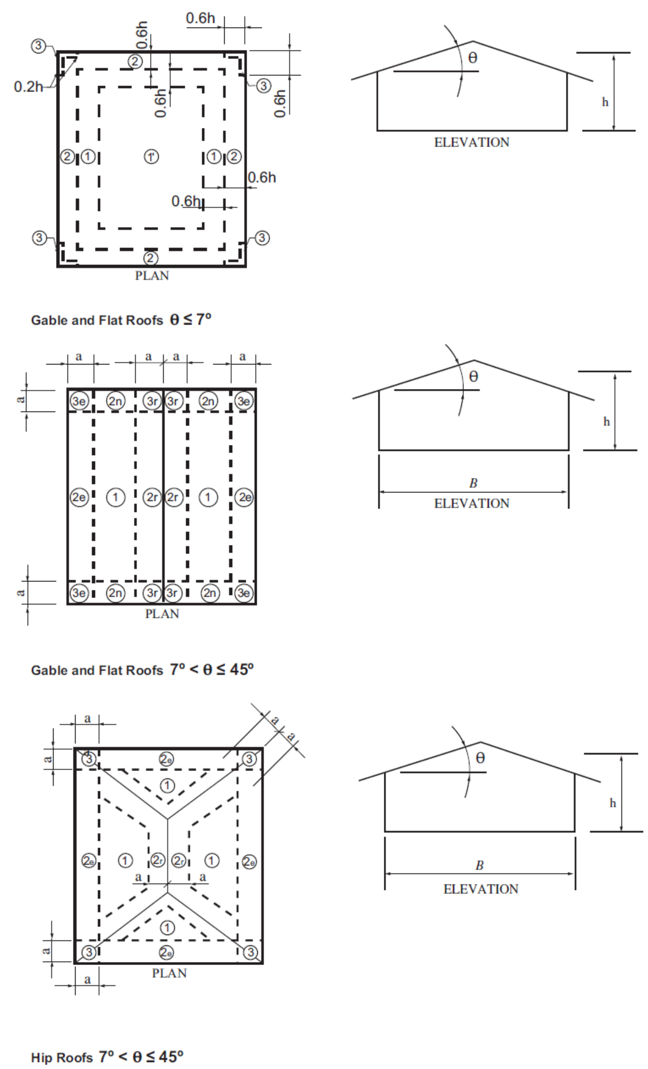
> Example calculations for using the new provisions in ASCE 7-16 for determining wind loads on rooftop solar panels are provided in the report PV2-2017 Wind Design for Solar Arrays published by the Structural Engineers Association of California (www.seaoc.org).

The second method applies to solar panels that are installed close to and parallel to the roof which would be typical of solar panels installed on one- and two-family dwellings. Loads for this system are calculated using the normal roof component and cladding calculations with adjustments for pressure equalization and proximity to the edge of the roof. Pressure equalization lowers the wind pressures on the panels.

Revised (Higher) Design Wind Pressures on Roofs of Buildings with Mean Roof Height ≤ 60 feet (ASCE 7-16 Section 30.3)

Roof component and cladding loads for buildings with mean roof heights of 60 feet or less have been revised significantly from ASCE 7-10. Whereas ASCE 7-10 contained 4 pressure coefficient (GC_p) graphs for roof slopes of 0° to 45°, ASCE 7-16 includes 9 new figures including 5 new figures specific to hip roofs and hip roof overhangs. In addition to the new figures, there are a couple of other notable changes to the figures. In ASCE 7-10 for effective wind areas of 10 square feet or less, pressure coefficients are constant. For some roof slopes in ASCE 7-16, pressure coefficients are constant for effective wind areas less than 10 square feet (2 square feet in some cases). Roof zones have also changed. A new Zone 1 has been added for low slope roofs and the width and shape of Zones 2 and 3 have changed. For higher sloped roofs, the width of the zones has not changed but the zone designations have. For example, corner zones include Zone 3es (eave) and 3r (ridge). Similarly, the other edge zone includes Zones 2r (ridge), 2n (rake), and 2e (eave).



Excerpt of Figure R301.2(7) from the 7th Edition (2020) FBCR

The changes mostly result in significant increases in design wind pressures on roofs compared to ASCE 7-10. In some cases, the roof pressures increase by 100% or more. However, this is generally not the case for the high-pressure zones such as corners and roof edges.

For proper context, when ASCE 7-10 was adopted in the 2010 FBC, design wind speeds decreased substantially for most of the State of Florida.

> **BASF Roof Assemblies Fact Sheet**
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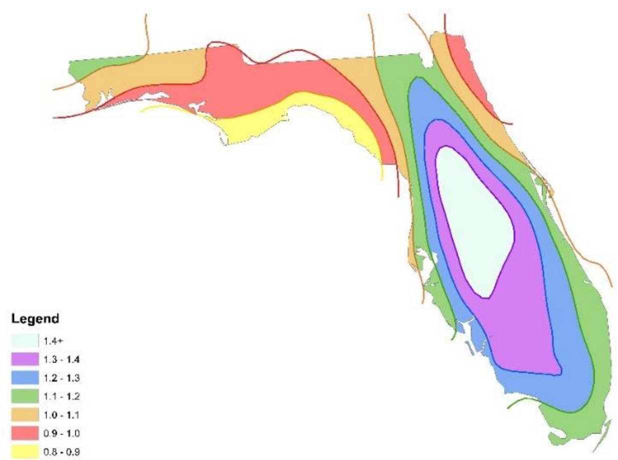
> The BASF Roof Assemblies Fact Sheet provides an overview of the impact of the increased roof pressures in ASCE 7-16 on roof assemblies. The BASF Roof Assemblies Fact Sheet can be downloaded at www.floridabuilding.org.

Therefore, it is appropriate to compare the roof design loads in ASCE 7-16 to the design loads determined from ASCE 7-98 through ASCE -05 which collectively formed the basis of the wind criteria in the first three editions of the FBC. The following figure shows the net change in the "worst-case" Zone 3 design pressure from ASCE 7-05 to ASCE 7-16 (2007 FBC to 7th Edition (2020) FBC).

Ratio of ASCE 7-16 to ASCE 7-05 Wind Loads for "Worst-Case" Zone 3 Design Wind Pressures



While roof loads have increased significantly compared to ASCE 7-10, due to the wind speed changes in ASCE 7-10 for some areas, the roof design pressures are lower when compared to ASCE 7-05.

Simplified Component and Cladding Loads – FBCR

The simplified component and cladding load tables in the FBCR (Tables R301.2(2) and R301.2(3)) have been updated to correlate with ASCE 7-16. The load table has essentially doubled in size and includes new roof zones due to the changes in how roof component and cladding loads are determined in ASCE 7-16. The height and exposure adjustment table has also been revised slightly by reducing the adjustment factor mean roof heights less than 30 feet and located in Exposure Category B. In the 6th Edition (2017) FBCR, there was no adjustment permitted for mean roof heights less than 30 feet and located in Exposure Category B.

Excerpt of Table R301.2(2) in the 7th Edition (2020) FBCR

	Zone	Effective Wind Area (ft^2)	Ultimate Design Wind Speed, V_{ult} (mph)			
			150		160	
			Pos	Neg	Pos	Neg
Gable Roof 0 to 7 degrees	1,1'[g]	10	10.0	-38.7	11.2	-44.0
	1,1'[g]	20	10.0	-34.4	10.5	-39.1
	1,1'[g]	50	10.0	-28.6	29.9	-32.5
	1,1'[g]	100	10.0	-24.3	29.9	-27.6
	2	10	10.0	-51.0	11.2	-58.1
	2	20	10.0	-45.5	10.5	-51.8
	2	50	10.0	-38.1	29.9	-43.3
	2	100	10.0	-32.5	10.0	-37.0
	3	10	10.0	-69.6	11.2	-79.1
	3	20	10.0	-58.4	10.5	-66.5
	3	50	10.0	-43.6	10.0	-49.6
	3	100	10.0	-32.5	10.0	-37.0
Gable Roof >20 to 27 degrees	1, 2e	10	18.1	-34.6	20.6	-39.3
	1, 2e	20	15.6	-34.6	17.8	-39.3
	1, 2e	50	12.3	-29.4	14.0	-33.5
	1, 2e	100	10.0	-25.3	11.2	-28.8
	2n,2r,3e	10	18.1	-55.2	20.6	-62.8
	2n,2r,3e	20	15.6	-48.4	17.8	-55.0
	2n,2r,3e	50	12.3	-39.3	14.0	-44.7
	2n,2r,3e	100	10.0	-32.5	11.2	-37.0
	3r	10	18.1	-65.4	20.6	-74.5
	3r	20	15.6	-55.2	17.8	-62.8
	3r	50	12.3	-40.8	14.0	-46.4
	3r	100	10.0	-40.8	11.2	-46.4

Excerpt of Table R301.2(3) in the 7th Edition (2020) FBCR

MEAN ROOF HEIGHT (ft)	EXPOSURE CATEGORY		
	B	C	D
15	0.82	1.21	1.47
20	0.89	1.29	1.55
25	0.94	1.35	1.61
30	1.00	1.40	1.66

Attached Canopies on Buildings with Mean Roof Heights ≤ 60 feet (ASCE 7-16 Section 30.11)

New criteria have been added to ASCE 7-16 to address loads on canopies attached to buildings. Attached canopies are a common feature on modern buildings but prior editions of ASCE 7 have provided limited guidance on how these structures should be designed for wind loads. Due to limited guidance, many engineers have resorted to using roof loads and/or roof overhang loads to determine loads on attached canopies. However, attached canopies are unique in that a roof overhang is simply an extension of the roof. The new provisions apply to attached canopies that are essentially horizontal (maximum slope of 2%) and that are attached to buildings with mean roof heights of 60 feet or less. Two conditions are addressed – 1) attached canopies with a covering or soffit on the underside, and 2) attached canopies without a covering or soffit on the underside.

Designing for Tornadoes (ASCE 7-16 Section C26.14)

Tornadoes have historically not been addressed in ASCE 7 or building codes because of their low probability of occurrence, particularly compared to thunderstorms or hurricanes. Due to an increasing focus on making our buildings more resilient, many designers and building owners desire to minimize the impacts of tornadoes on their buildings by specifically including them in their designs. The commentary of ASCE 7-16 new guidance for designing buildings to minimize damage from tornadoes. While the recommended methodology is similar to designing for other wind loads, due to a lack of field pressure measurements and other uncertainties related to tornadic wind loads, many of the parameters and coefficients for normal wind load calculations are recommended to be adjusted. The recommended adjustments in the ASCE 7-16 commentary are summarized as follows:

Enhanced Fujita Scale

EF Number	Wind Speed (mph)
EF0	65 – 85
EF1	86 – 110
EF2	111 – 135
EF3	136 – 165
EF4	166 – 200
EF5	> 200

Wind speed – use the upper range wind speed associated with the targeted Enhanced Fujita (EF) number

Exposure Category – use Exposure Category C

Directionality Factor – use K_d = 1.0

Gust Effect Factor – use G = 0.90

Internal Pressure – use GC_{pi} = +/- 0.55

Velocity Pressure – calculate q at mean roof height for all procedures

MWFRS – determine wind loads on the Main Wind-Force Resisting System (MWFRS) using the Directional Procedure in Chapter 27

A simplified tornado factor (TF) is also provided for several conditions that captures all the recommended adjustments into a single multiplier that is applied to design pressures used for the normal wind load calculations.

Resources

Florida Building Code, www.floridabuilding.org

International Code Council, www.iccsafe.org

Insurance Institute for Business and Home Safety, www.ibhs.org

American Society of Civil Engineers, www.asce.org

Significant Changes to the Minimum Design Load Provisions of ASCE 7-16, https://sp360.asce.org/PersonifyEbusiness/Merchandise/Product-Details/productId/233136876

Don't know where to go for an answer to a specific question?

Contact: Florida Building Commission 850-487-1824 www.floridabuilding.org

Contact: Building A Safer Florida, Inc. 850-222-2772 www.buildingasaferflorida.org