Wind Loads Using ASCE 7-10
Windows and Doors

presented by
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ASCE 7-10

- **Available May 2010**
- **Most comprehensive update to wind load provisions since ASCE 7-98**
- **Referenced in the 2012 IBC and the 2012 IRC**
- **Referenced in the 2010 Florida Building Codes (Primary references in the Building and Residential Codes)**

ASCE 7-10 Wind Provisions

- **Topics Discussed**
  - **Wind speed maps**
  - **Converting ASCE 7-10 pressures for design pressures on windows and doors**

Hitchhikers Guide to the Galaxy

- **Answer to life, the universe, and everything?**

Answer

0.6

ASCE 7-10 Basic Wind Speeds

- **Basic wind speeds didn't changed at all from ASCE 7-98 through ASCE 7-05**
- **3-sec gust wind speeds introduced in ASCE 7-95 to replace fastest-mile wind speeds**
- **Minor adjustments between ASCE 7-95 and ASCE 7-98**

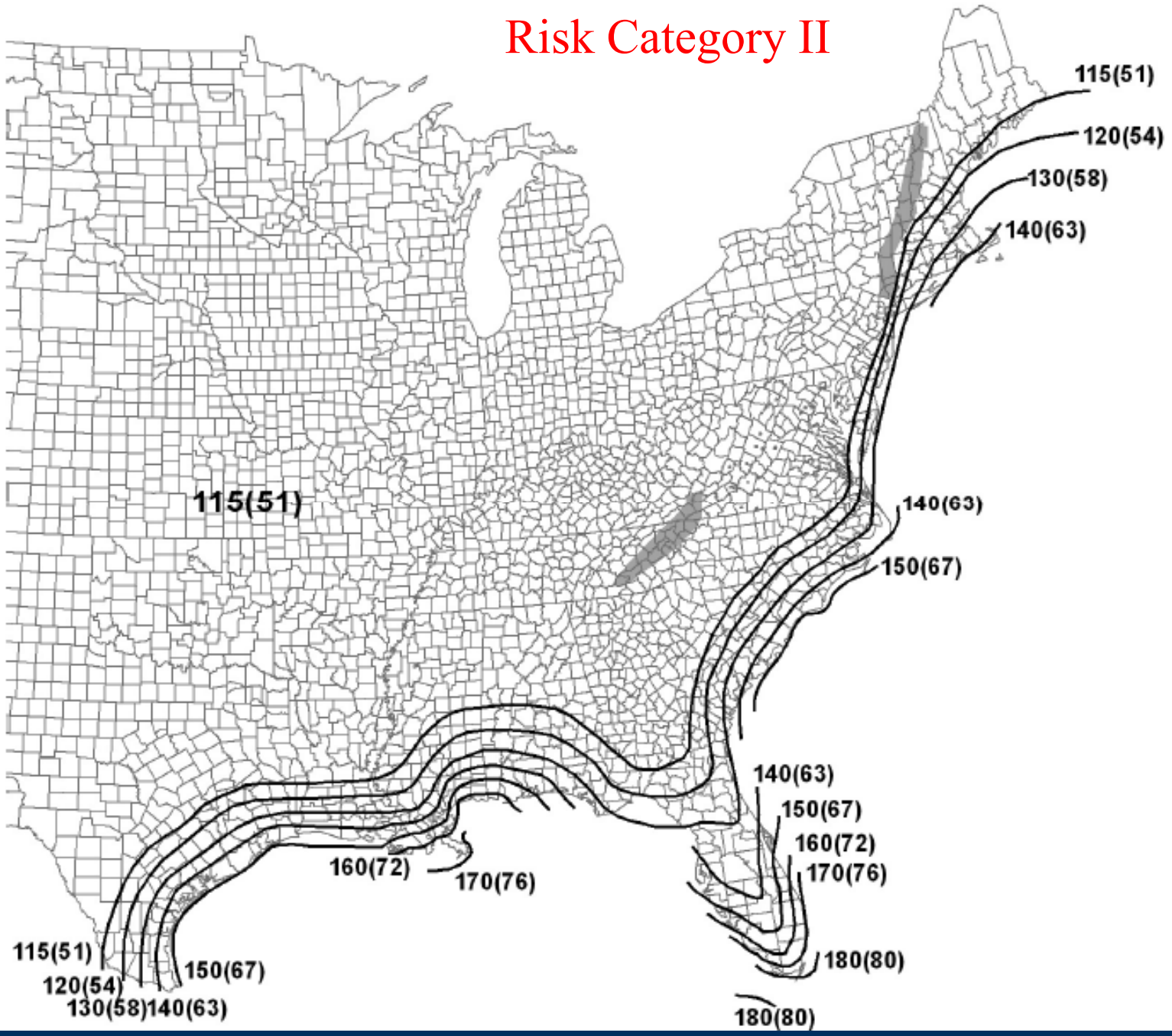
ASCE 7-10 Basic Wind Speeds

- 3 new maps
  - Risk Category II (700 year return period)
  - Risk category III and IV (1700 year return period)
  - Risk Category I (300 year return period)
- Strength design-based or “Ultimate” wind speeds
- Risk Category replaces the term Occupancy Category

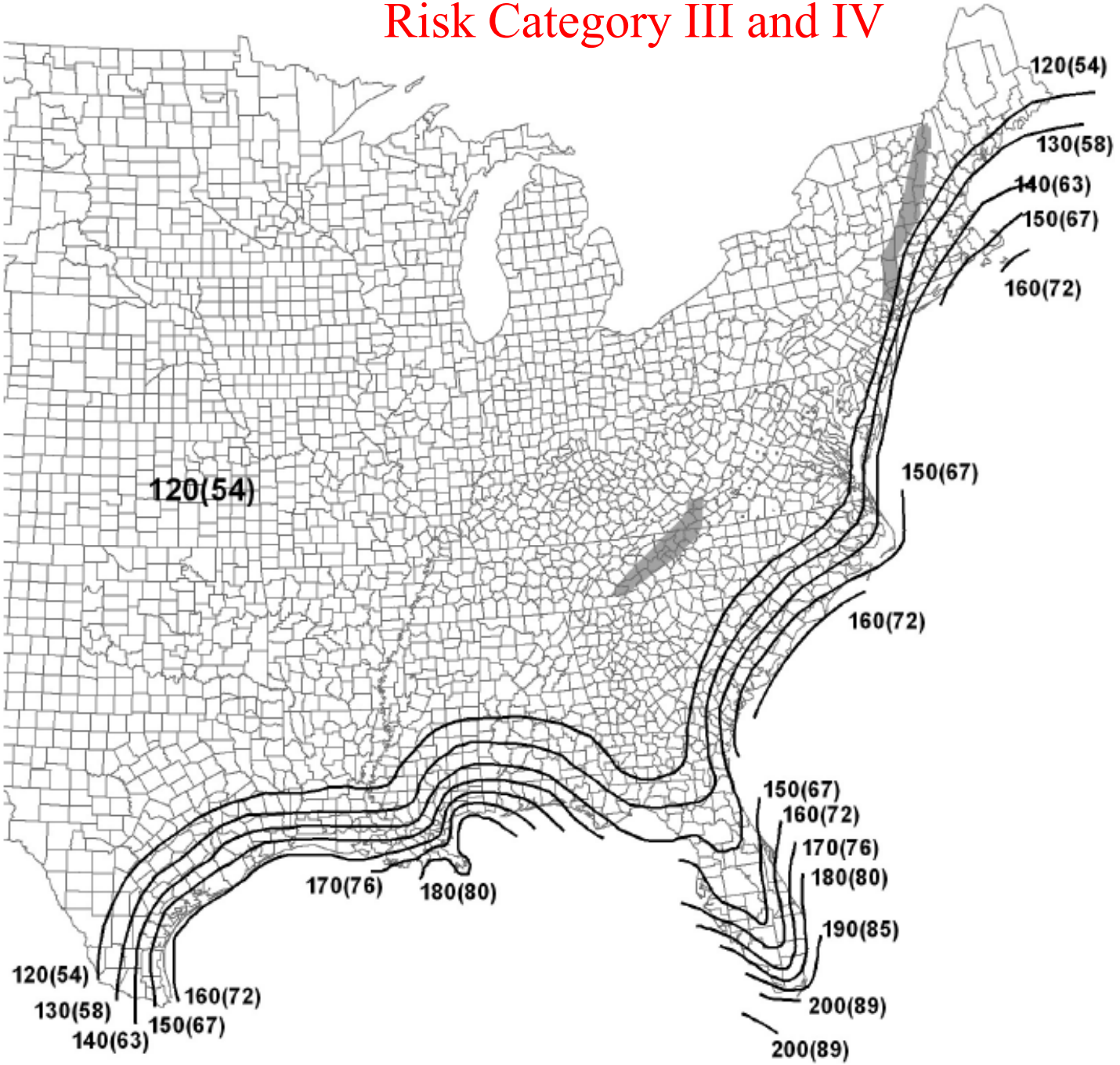
ASCE 7-10
Basic Wind Speeds

- ***Risk*** **Categories replace** ***Occupancy*** **Categories**
  - **Risk Category I ⟹ Occupancy Category I**
  - **Risk Category II ⟹ Occupancy Category II**
  - **Risk Category III ⟹ Occupancy Category III**
  - **Risk Category IV ⟹ Occupancy Category IV**
- **Table 1.5-1**
- **Table 1604.5 in IBC**

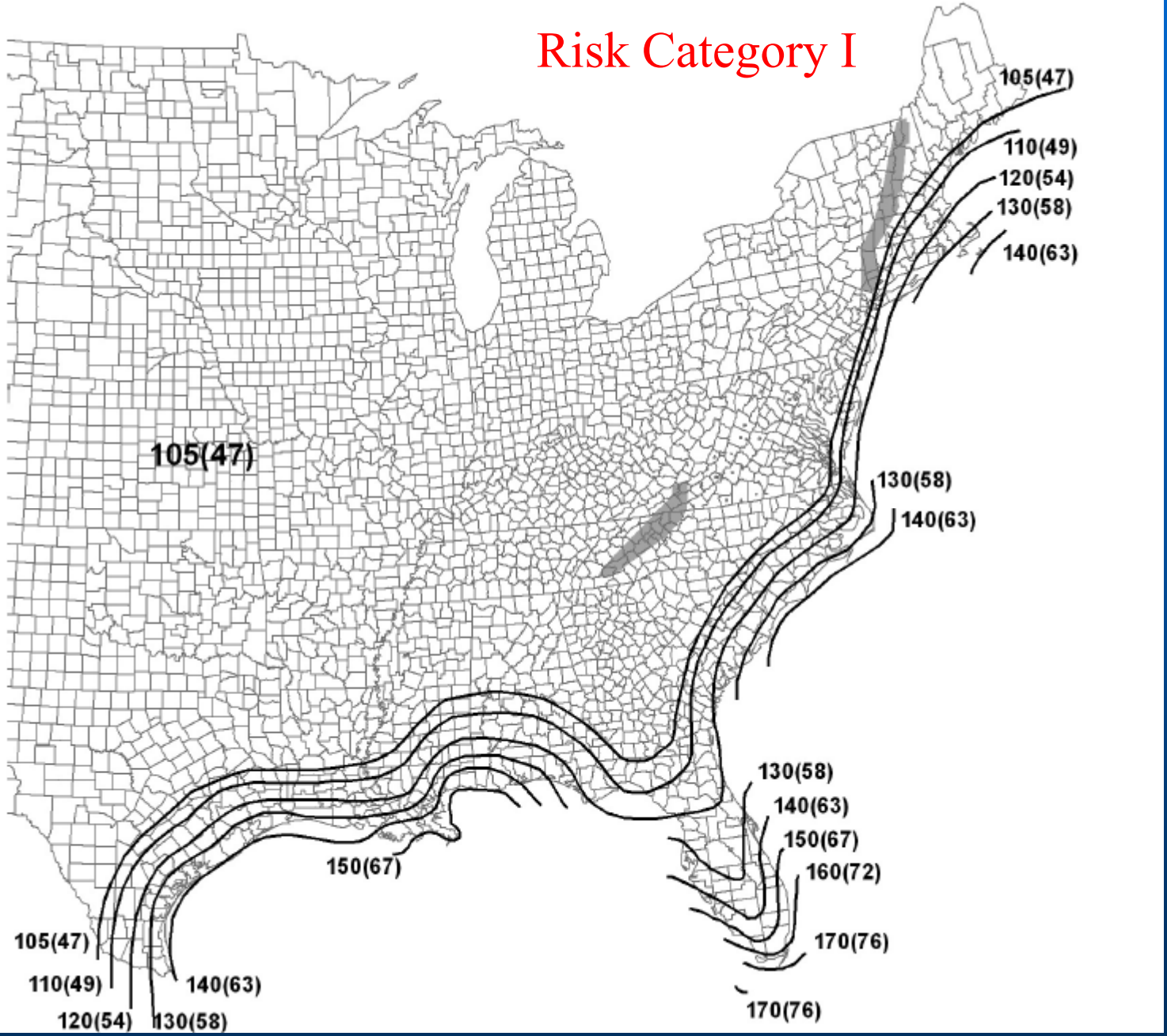
Risk Category II



Risk Category III and IV



Risk Category I



ASCE 7-10
Strength Design Load Combinations

ASCE 7-05

1.2*D* + 1.6*W* + *L* + 0.5(L_r or *S* or *R*)

0.9*D*+ 1.6*W*

ASCE 7-10

1.2*D* + 1.0*W* + *L* + 0.5(L_r or *S* or *R*)

0.9*D*+ 1.0*W*

ASCE 7-10
Allowable Stress Design Load Combinations

ASCE 7-05

***D* + (*W* or 0.7*E*)**

0.6*D* + *W*

ASCE 7-05

***D* + (0.6*W* or 0.7*E*)**

0.6*D* + 0.6*W*

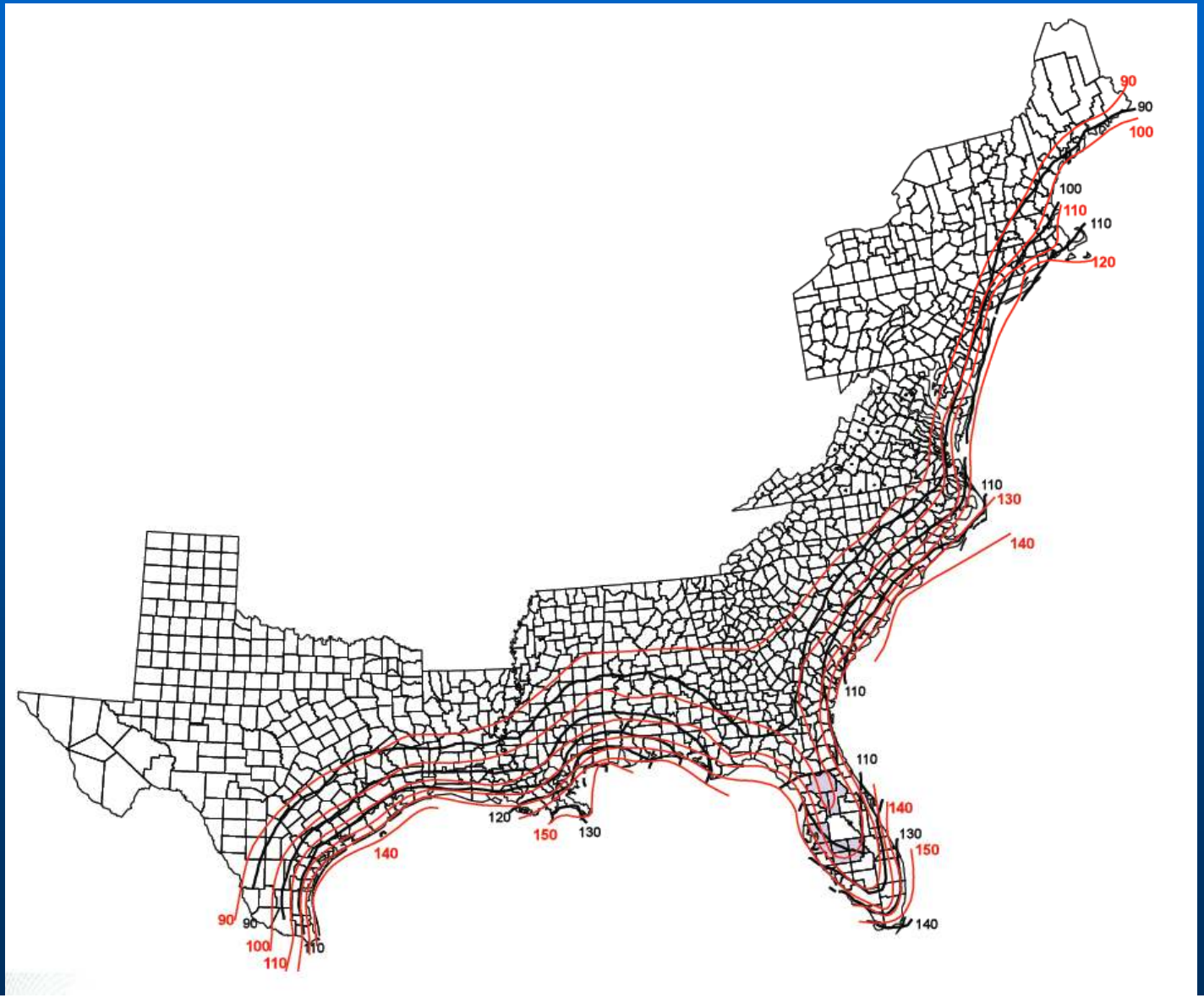
ASCE 7-10 Basic Wind Speeds

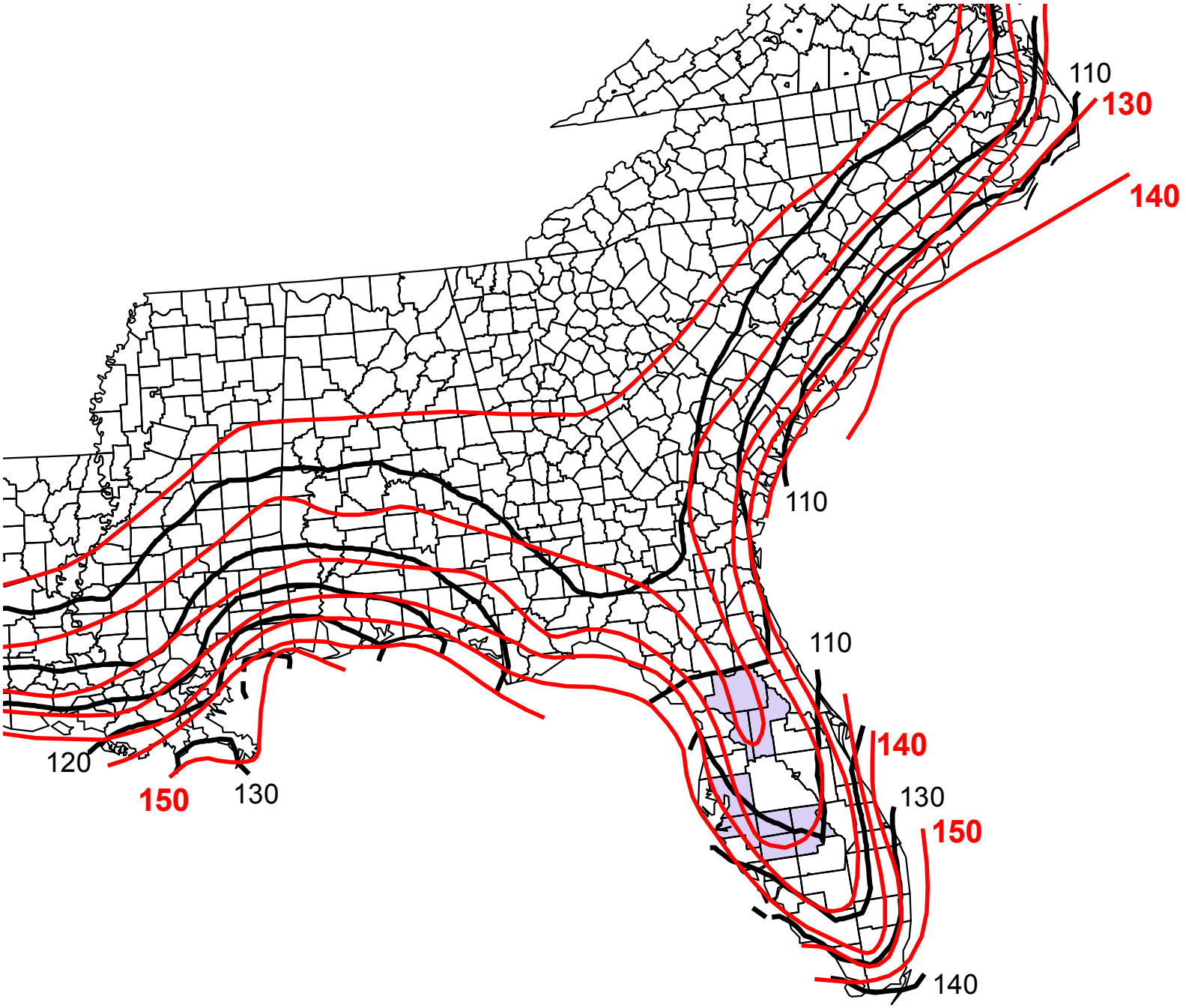
- **Implications**
  - **Net wind loads are decreasing**
- **New data suggests ASCE 7-05 wind speeds are conservative**

ASCE 7-10 Basic Wind Speeds

- **How to compare ASCE 7-05 design pressures to ASCE 7-10 design pressures**
  - **Adjust the wind speed ($\sqrt{0.6}$)**
  - **Adjust design pressures (0.6)**

Comparison of ($V_{700}/\sqrt{1.6}$) to ASCE 7-05 Wind Speeds




110
130
140
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110
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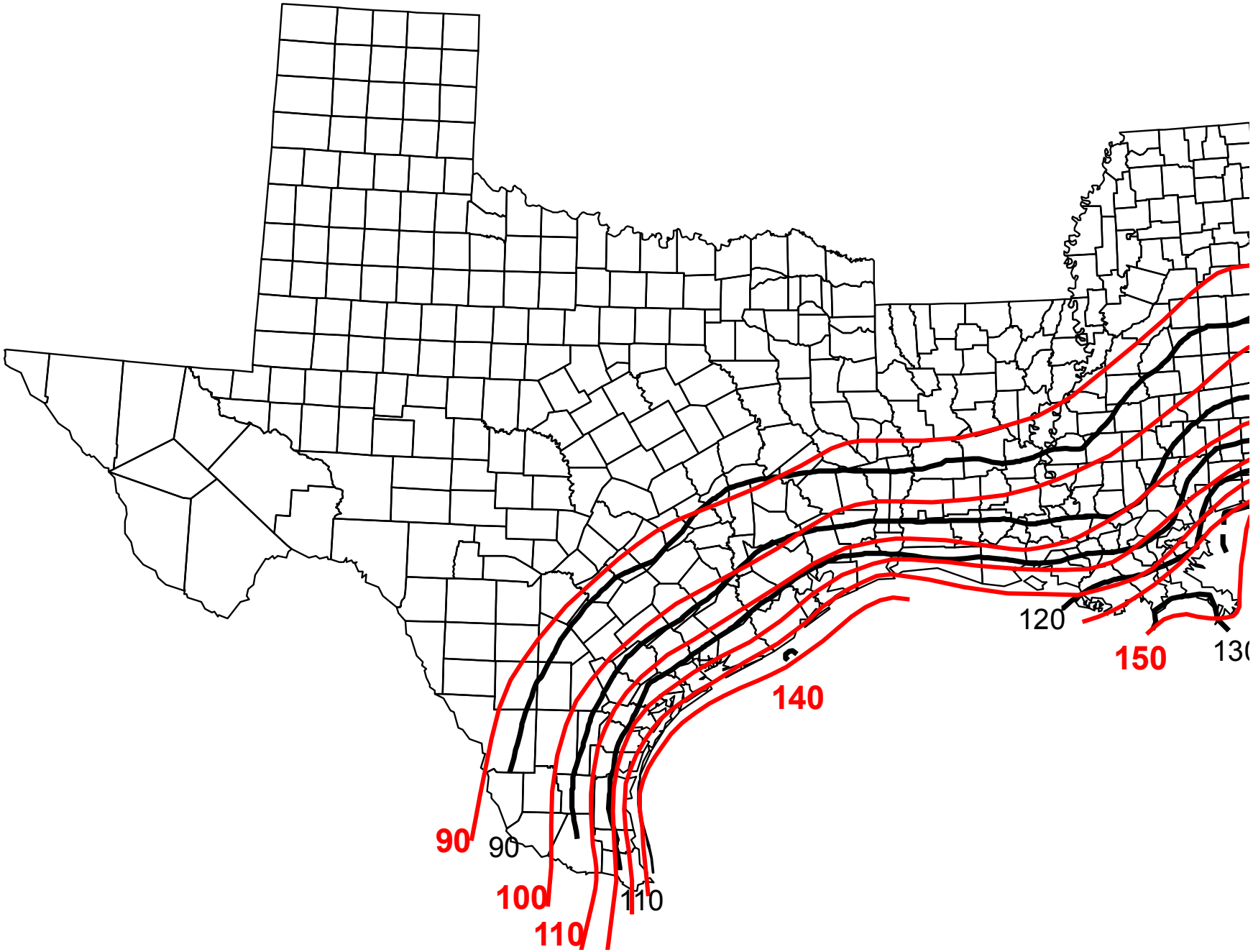
130
150
120
150
130
140


90
90
100
110
110
120
140
150

Design Pressure Comparisons Risk Category II - Florida

City	V ASCE 7-05/2007 FBC	V ASCE 7-10 (est.)	Percent Difference in Comparable Design Pressures	
			Exp B Inland	Exp D[2,3] Coastal
Pensacola	140	155	-27%	-12%
Tampa	123	145	-17%	0%
Orlando	110	135	-10%	NA
Miami-Dade[1]	146	175	-14%[1]	+3%
Broward[1]	140	170	-12%[1]	+6%
Tallahassee	110	118	-31%	NA
Gainesville	100	125	-7%	NA
Jacksonville	120	125	-35%	-22%

Design Pressure Comparisons Risk Category II - Louisiana

City	V ASCE 7-05/2009 IBC	V ASCE 7-10/2012 IBC	Percent Difference in Comparable Design Pressures	
			Exp B	Exp D
New Orleans	126	144	-22%	-6%
Baton Rouge	106	124	-18%	-1%
Shreveport	90	115	-2%	+18%
Lafayette	107	130	-11%	+6%
Lake Charles	108	131	-12%	+6%
Metairie	124	142	-21%	-6%

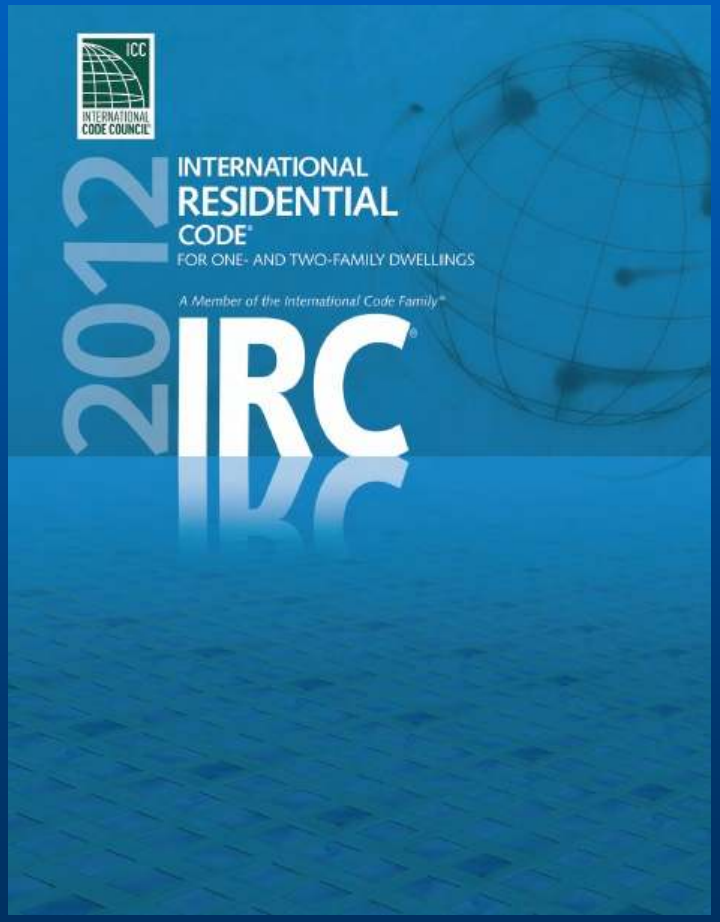
Design Pressure Comparisons Risk Category II - Alabama

City	V ASCE 7-05	V ASCE 7-10	Percent Difference in Comparable Design Pressures	
			Exp B	Exp D (formerly Exp C)
Mobile	130	153	-17%	0%
Dauphin Island	150	160	-32%	-18%
Orange Beach	145	157	-30%	-15%
Citronelle	118	143	-12%	+5%
Bay Minette	125	149	-15%	+2%

Design Pressure Comparisons Risk Category II – South Carolina

City	V ASCE 7-05	V ASCE 7-10	Percent Difference in Comparable Design Pressures	
			Exp B	Exp D (formerly Exp C)
Charleston	131	147	-24%	-9%
Columbia	95	115	-12%	+6%
Hilton Head	128	141	-27%	-13%
Beaufort	124	140	-24%	-8%

2012 International Codes



2012 IBC

- **Section 1609.1.1 *(excerpt.)*.**

- **The wind speeds in Figure 1609A, 1609B and 1609C shall be converted to nominal wind speeds, V_{asd}, in accordance with Section 1609.3.1 when the provisions of the standards referenced in Exceptions 1 through 5 and 7 are used unless the wind provisions in the standards are based on Ultimate Wind Speeds as specified in Figures 1609A, 1609B, or 1609C or Chapter 26 of ASCE 7.**

2012 IBC

- **Wind Speed, V_{ult}.** Ultimate design wind speeds.
- **Wind Speed, V_{asd}.** Nominal design wind speeds.

2012 IBC

- **Section 1609.3.1 Converting from V_{ult} to V_{asd}**

$$V_{asd} = V_{ult}\sqrt{0.6}$$

Where:

V_{asd} = allowable stress design wind speed applicable to methods specified in Exceptions 1 through 5 of Section 1609.1.1

V_{ult} = strength design wind speeds determined from Figures 1609A, 1609B, or 1609C.

2012 IBC

TABLE 1609.3.1
WIND SPEED CONVERSIONS

V_{ult}	100	110	120	130	140	150	160	170	180	190	200
V_{asd}	78	85	93	101	108	116	124	132	139	147	155

2012 IRC Wind Provisions

- **Wind provisions in the 2012 IRC differ significantly from the 2012 IBC**
- **Different basis for wind speed maps (ASD)**
- **Different wind-borne debris region triggers**

2012 IRC Wind Provisions

- **Using the strength design-based maps in the 2012 IRC was deemed not workable due to the significant number of ASD-based wind speed triggers.**

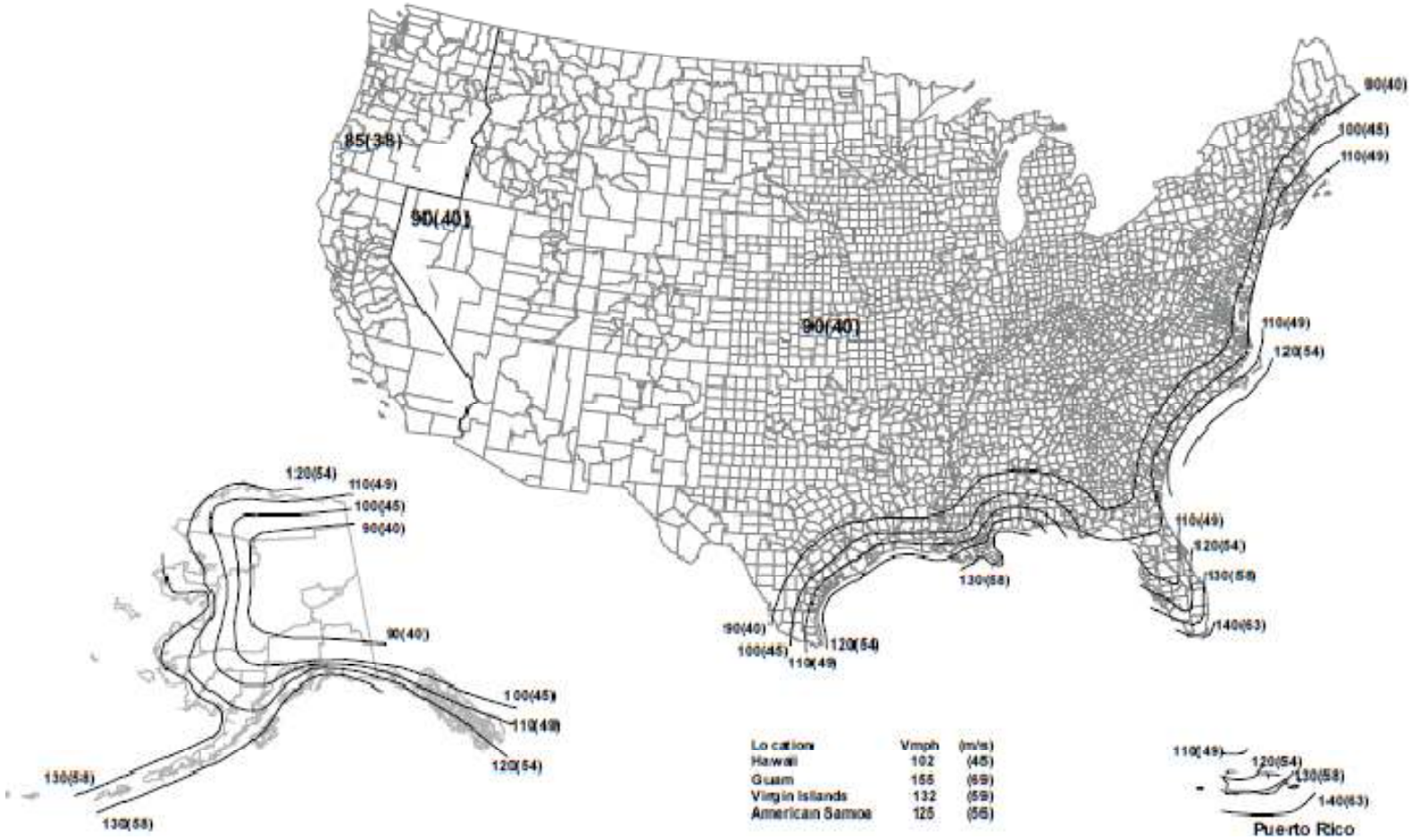
ASD –based wind speed trigger

TABLE R905.2.4.1(1)
CLASSIFICATION OF ASPHALT ROOF SHINGLES PER ASTM D 7158

MAXIMUM BASIC WIND SPEED FROM FIGURE 301.2(4)A (mph)	CLASSIFICATION REQUIREMENT
85	D, G or H
90	D, G or H
100	G or H
110	G or H
120	G or H
130	H
140	H
150	H

2012 IRC Wind Provisions

- Decision was made to create a nominal or ASD-based map for the IRC
- Accomplished by taking the ASCE 7-10 wind speed map for Risk Category II buildings and dividing the values by $\sqrt{1.6}$ (removes the load factor from the map values).
- Adjusted wind speeds were re-drawn aligning contours on whole numbers
- Resulting Figure R301.2(4)A in the 2012 IRC



Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
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. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

FIGURE R301.2(4)A
BASIC WIND SPEEDS

Design Pressures for Windows and Doors

- **Confused?**
- **What does all this mean for testing of windows and doors?**
- **What's the bottom line?**

Design Pressures for Windows and Doors

- **2012 IBC and 2012 IRC don't deal with this issue very well**
- **2010 Florida Building Codes specifically address this issue**
- **2015 IBC and IRC will somewhat address this issue**

Design Pressures for Windows and Doors

- **Bottom line for purposes of testing windows and doors using AAMA/WDMA or ASTM E 330:**
  - **ASCE 7-10: multiply design pressures by 0.6**
  - **2012 IBC: multiply design pressures by 0.6**
  - **2012 IRC: use Table R301.2(2) without any adjustments**
    - Note different wind speeds in 2012 IRC

Design Pressures for Windows and Doors

- **How do we get there?**
- **2010 FBC straightforward**

2010 FBC

- **1609.1.5 Testing to allowable or nominal loads.** Where testing for wind load resistance is based on allowable or nominal wind loads, the design wind loads determined in accordance with ASCE 7 or 1609 are permitted to be multiplied by 0.6 for the purposes of the wind load resistance testing.

2010 FBC

- **1715.5.1 Exterior windows and doors.** The design pressure for window and door assemblies shall be calculated in accordance with the component and cladding wind loads in Section 1609. The design pressures, as determined from ASCE 7, are permitted to be multiplied by 0.6.

2012 IBC

- **1715.5.1. Exterior windows and doors.** The design pressures for window and door assemblies shall be calculated in accordance with component and cladding wind loads in Section 1609.
- Does not directly address this issue…would have to have an understanding of what the new maps mean.

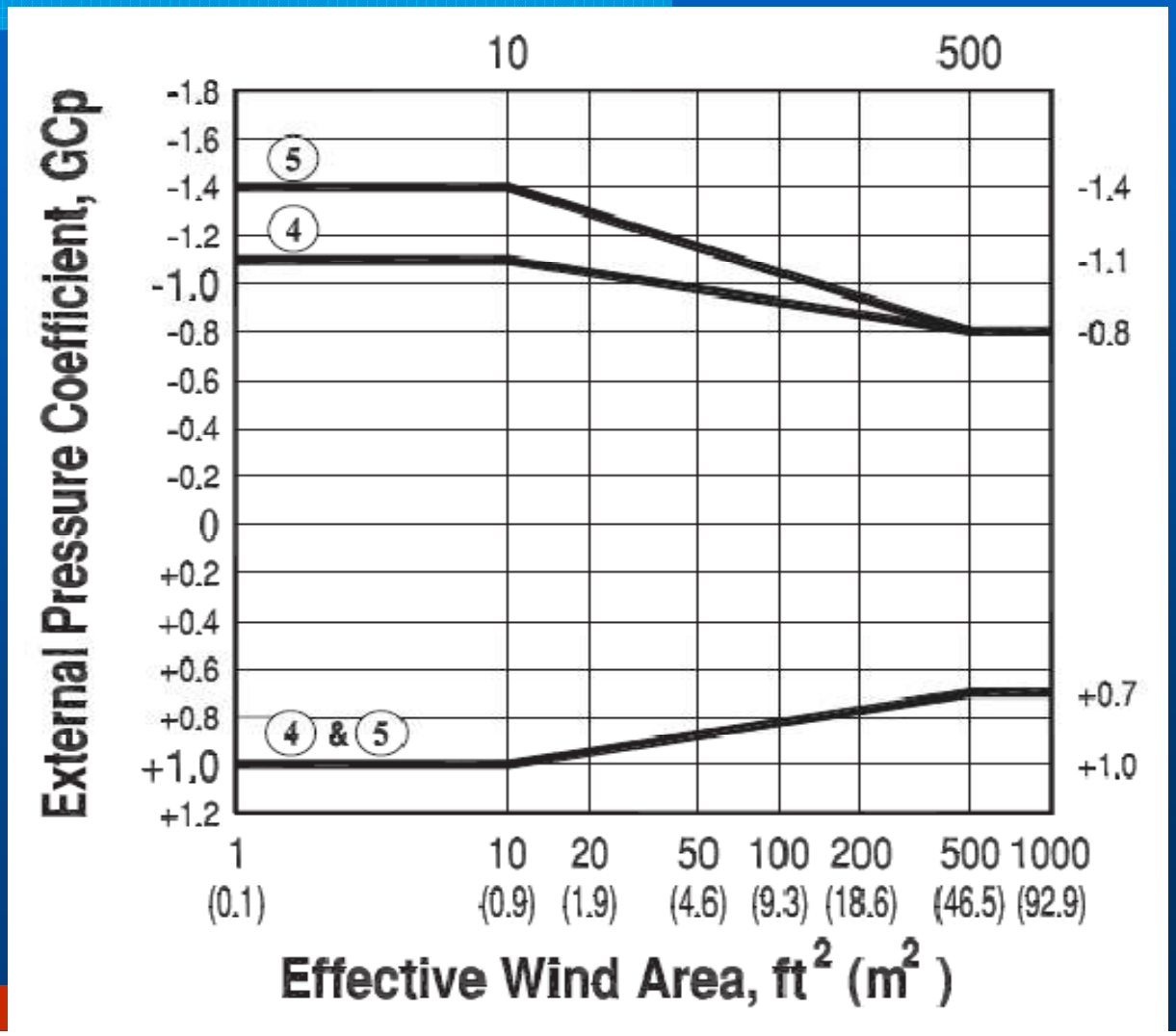
2012 IRC

- **Not an issue…wind speeds are ASD-based and component and cladding loads in Table R301.2(2) are ASD-level.**

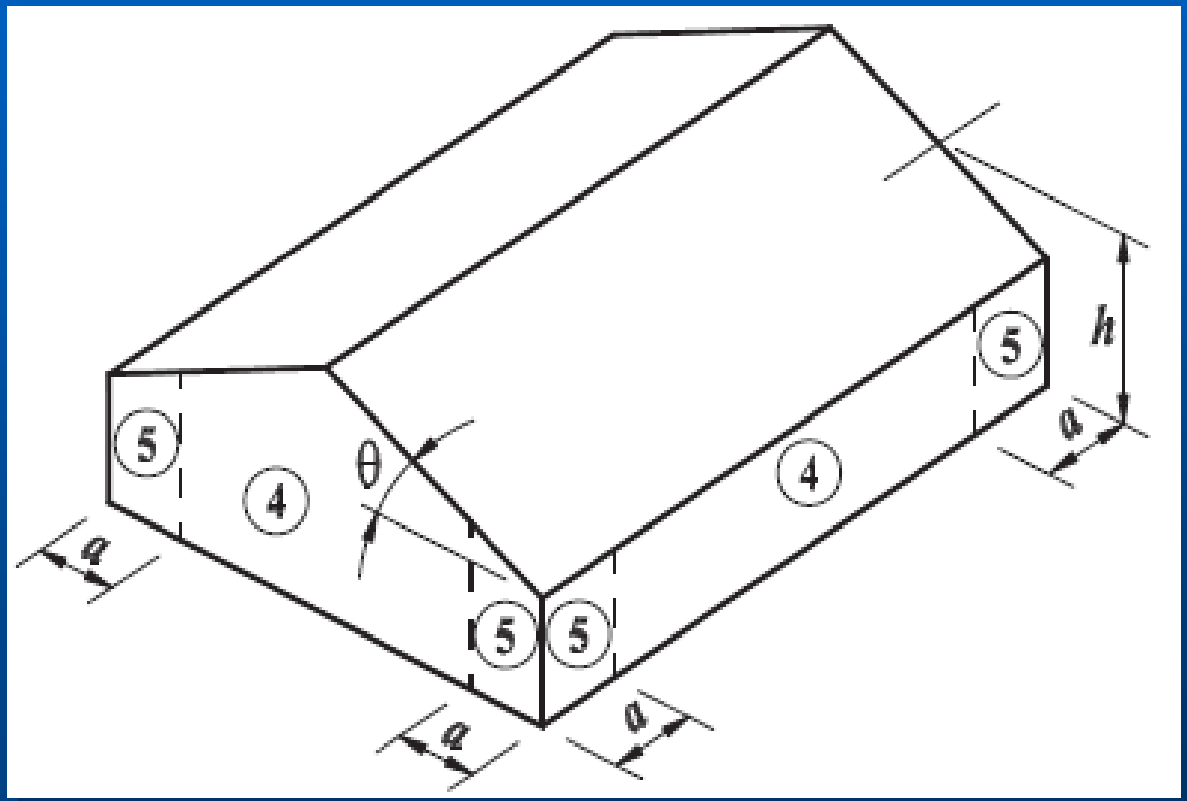
Example

- SFD in Charleston, SC
- Suburban environment
- MRH less than 30 feet
- Window size = 20 square feet
- Find required DP using ASCE 7-10 and 2012 IRC
- Window in corner zone

ASCE 7-10


10
500
External Pressure Coefficient, GCp
-1.8
-1.6
-1.4
-1.2
-1.0
-0.8
-0.6
-0.4
-0.2
0
+0.2
+0.4
+0.6
+0.8
+1.0
+1.2
5
4
4 & 5
-1.4
-1.1
-0.8
+0.7
+1.0
1 (0.1)
10 (0.9)
20 (1.9)
50 (4.6)
100 (9.3)
200 (18.6)
500 (46.5)
1000 (92.9)
Effective Wind Area, ft² (m²)

ASCE 7-10



ASCE 7-10

- V_{ULT} = 147 mph
- $q = 0.00256(0.85)(0.7)(147)^2$

  $q = 32.91$ psf
- $p = 32.91\ (-1.3 - 0.18)$

  $p = 48.71$ psf (strength design)
- Required DP = 48.71 x 0.6 = 29.2 psf

2012 IRC

- Get wind speed from Figure R301.2(4)A
- $V_{ASD} = V_{ULT}\sqrt{0.6}$
- $V_{ASD} = 147\ \sqrt{0.6}$
- $V_{ASD} = 114$ mph

- Use Table R301.2(2) and R301.2(3)

TABLE R301.2(2)
COMPONENT AND CLADDING LOADS FOR A BUILDING WITH A MEAN ROOF HEIGHT OF 30 FEET LOCATED IN EXPOSURE B (psf)[a, b, c, d, e]

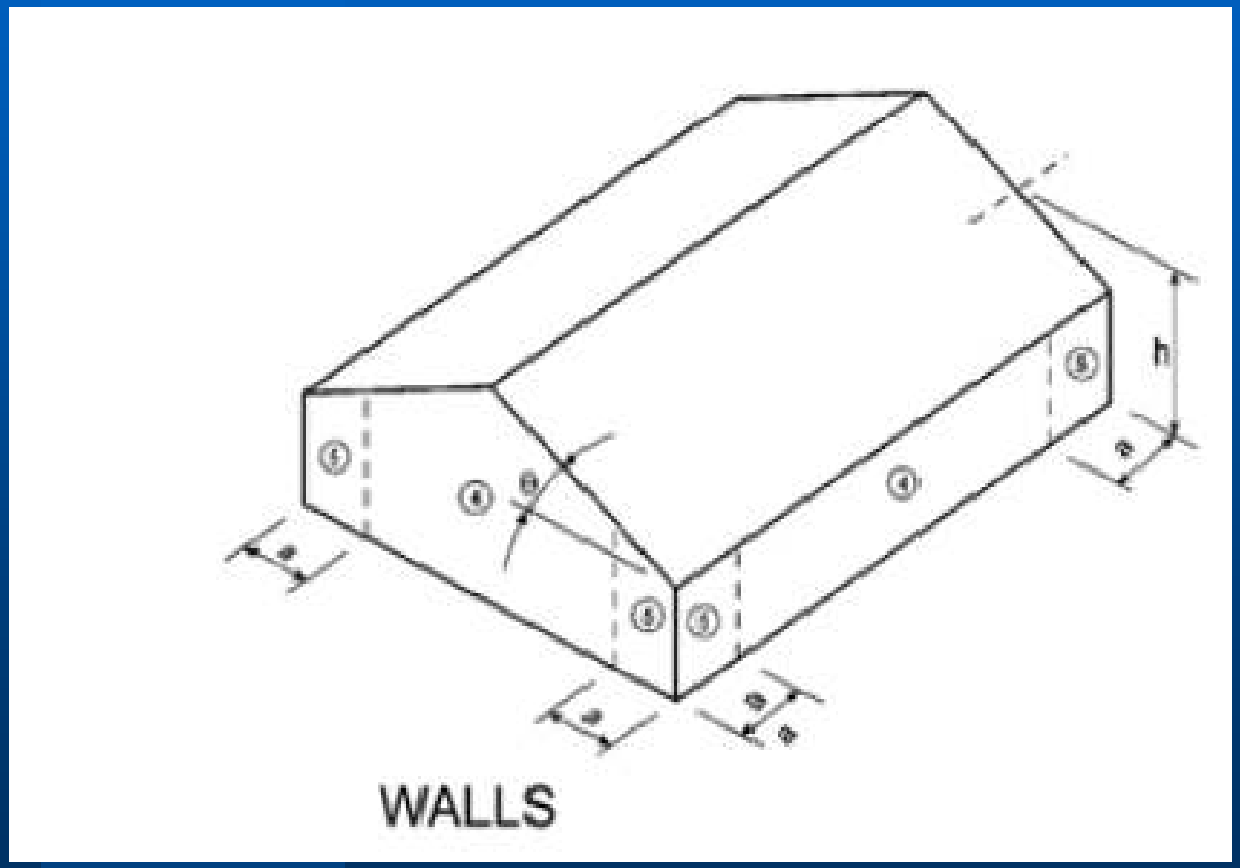
	ZONE	EFFECTIVE WIND AREA (feet²)	BASIC WIND SPEED (mph-3-second gust)																					
			85		90		100		105		110		120		125		130		140		145		150		170	
Wall	4	10	13.0	-14.1	14.6	-15.8	18.0	-19.5	19.8	-21.5	21.8	-23.6	25.9	-28.1	28.1	-30.5	30.4	-33.0	35.3	-38.2	37.8	-41.0	40.5	-43.9	52.0	-56.4
	4	20	12.4	-13.5	13.9	-15.1	17.2	-18.7	18.9	-20.6	20.8	-22.6	24.7	-26.9	26.8	-29.2	29.0	-31.6	33.7	-36.7	36.1	-39.3	38.7	-42.1	49.6	-54.1
	4	50	11.6	-12.7	13.0	-14.3	16.1	-17.6	17.8	-19.4	19.5	-21.3	23.2	-25.4	25.2	-27.5	27.2	-29.8	31.6	-34.6	33.9	-37.1	36.2	-39.7	46.6	-51.0
	4	100	11.1	-12.2	12.4	-13.6	15.3	-16.8	16.9	-18.5	18.5	-20.4	22.0	-24.2	23.9	-26.3	25.9	-28.4	30.0	-33.0	32.2	-35.4	34.4	-37.8	44.2	-48.6
	5	10	13.0	-17.4	14.6	-19.5	18.0	-24.1	19.8	-26.6	21.8	-29.1	25.9	-34.7	28.1	-37.6	30.4	-40.7	35.3	-47.2	37.8	-50.6	40.5	-54.2	52.0	-69.6
	5	20	12.4	-16.2	13.9	-18.2	17.2	-22.5	18.9	-24.8	20.8	-27.2	24.7	-32.4	26.8	-35.1	29.0	-38.0	33.7	-44.0	36.1	-47.2	38.7	-50.5	49.6	-64.9
	5	50	11.6	-14.7	13.0	-16.5	16.1	-20.3	17.8	-22.4	19.5	-24.6	23.2	-29.3	25.2	-31.8	27.2	-34.3	31.6	-39.8	33.9	-42.7	36.2	-45.7	46.6	-58.7
	5	100	11.1	-13.5	12.4	-15.1	15.3	-18.7	16.9	-20.6	18.5	-22.6	22.0	-26.9	23.9	-29.2	25.9	-31.6	30.0	-36.7	32.2	-39.3	34.4	-42.1	44.2	-54.1

2012 IRC

TABLE R301.2(3)
HEIGHT AND EXPOSURE ADJUSTMENT COEFFICIENTS FOR TABLE R301.2(2)

MEAN ROOF HEIGHT	EXPOSURE		
	B	C	D
15	1.00	1.21	1.47
20	1.00	1.29	1.55
25	1.00	1.35	1.61
30	1.00	1.40	1.66
35	1.05	1.45	1.70
40	1.09	1.49	1.74
45	1.12	1.53	1.78
50	1.16	1.56	1.81
55	1.19	1.59	1.84
60	1.22	1.62	1.87

2012 IRC



a = 4 ft

2012 IRC

- V_{ASD} = 114 mph
- From Table R301.2(2)

  p = 29.3 psf
- Required DP = 29.3 psf

2015 I-Codes

- **Any new clarifications?**
- **A little…**

2015 IBC

- **1710.5 Exterior window and door assemblies.** The design pressure…Section 1710.5.1 or 1710.5.2. For the purposes of this section, the required design pressure shall be determined using the allowable stress design load combinations of Section 1605.3.

2015 IRC

- Wind speed map has been changed to V_{ult} consistent with ASCE 7 and IBC
- Table R301.2(2) still gives ASD-based pressures

2015 IRC

- **R301.2.1.3 Wind speed conversion.** Where referenced documents are based on nominal design wind speeds and do not provide the means for conversion between ultimate design wind speeds and the nominal design wind speeds, the ultimate design winds of Figure R301.2(4)A shall be converted to nominal design wind speeds using Table R301.2.1.3.

ASCE 7-10 Enclosure Classification

- **Protection of Glazed Openings**
  - **Wind-borne debris region triggered by wind speed**
  - **New wind speeds necessitate recalibration of the trigger.**

ASCE 7-10
Protection of Glazed Openings

26.10.3 ~~6.5.9.3 Wind-Borne Debris~~ Protection of Glazed Openings.

Glazed openings in Risk Category II, III, or IV buildings located in hurricane-prone regions shall be protected as specified in this Section ~~Glazing in buildings located in wind-borne debris regions shall be protected~~

26.10.3.1 Wind-borne Debris Regions.

Glazed openings shall be protected in accordance with Section 26.10.3.2 in the following locations:

1. Within 1 mile of the coastal mean high water line where the basic wind speed is equal to or greater than 130 mi/h (58 m/s), or
2. In areas where the basic wind speed is equal to or greater than 140 mi/h (63 m/s).

ASCE 7-10
Protection of Glazed Openings

- ***Cont.***

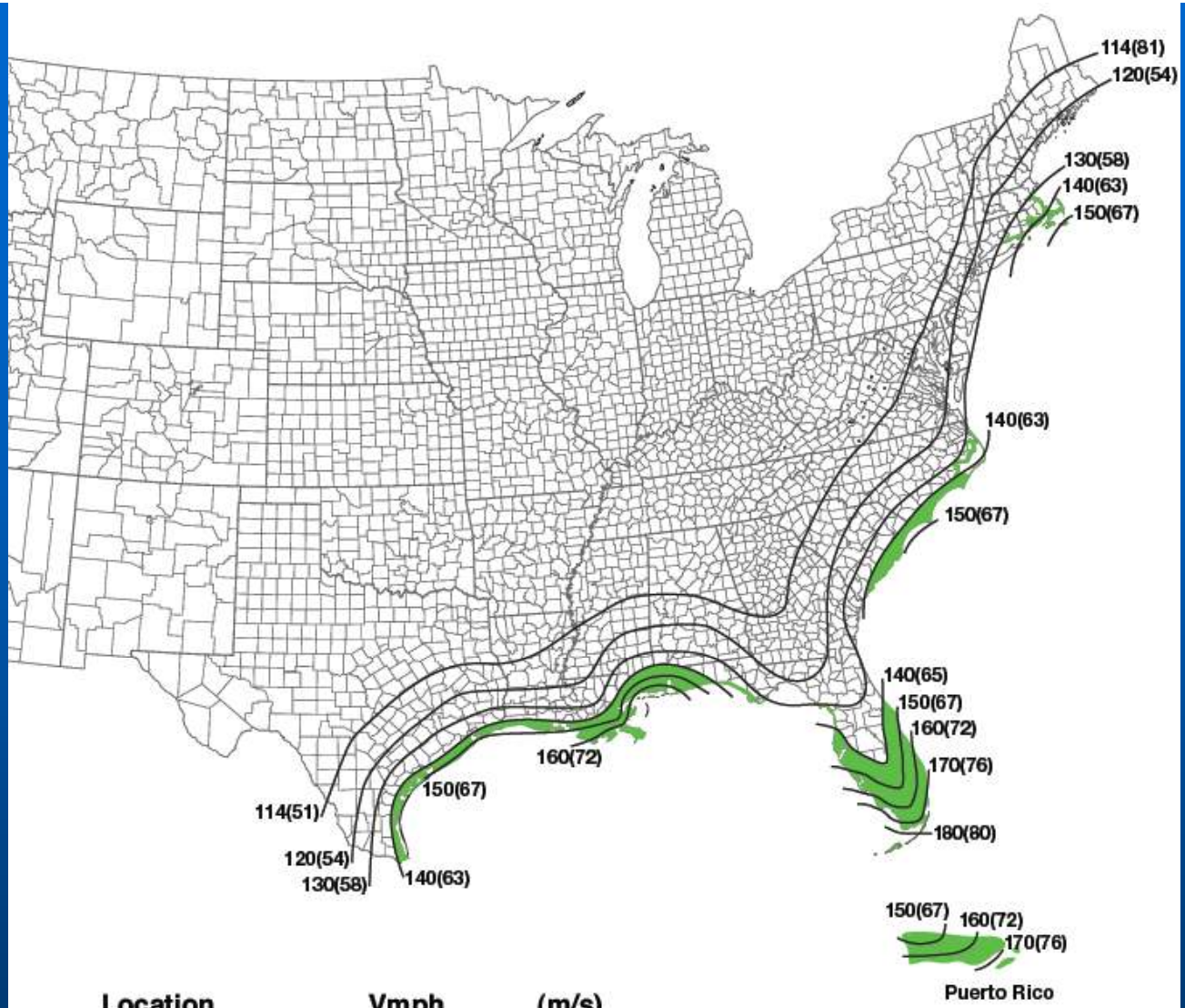
For Risk Category II buildings and structures and Risk Category III buildings and structures, except health care facilities, the windborne debris region shall be based on Figure 26.5-1A. For Risk Category III health care facilities and Risk Category IV buildings and structures the windborne debris region shall be based on Figure 26.5.1-B. Risk Categories shall be determined in accordance with Section 1.5.

Exceptions:

1. Glazing in ~~Category II, III, or IV buildings~~ located over 60 ft (18.3 m) above the ground and over 30 ft (9.2 m) above aggregate surface roofs located within 1,500 ft (458 m) of the building shall be permitted to be unprotected.
2. ~~Glazing in Category I buildings shall be permitted to be unprotected.~~

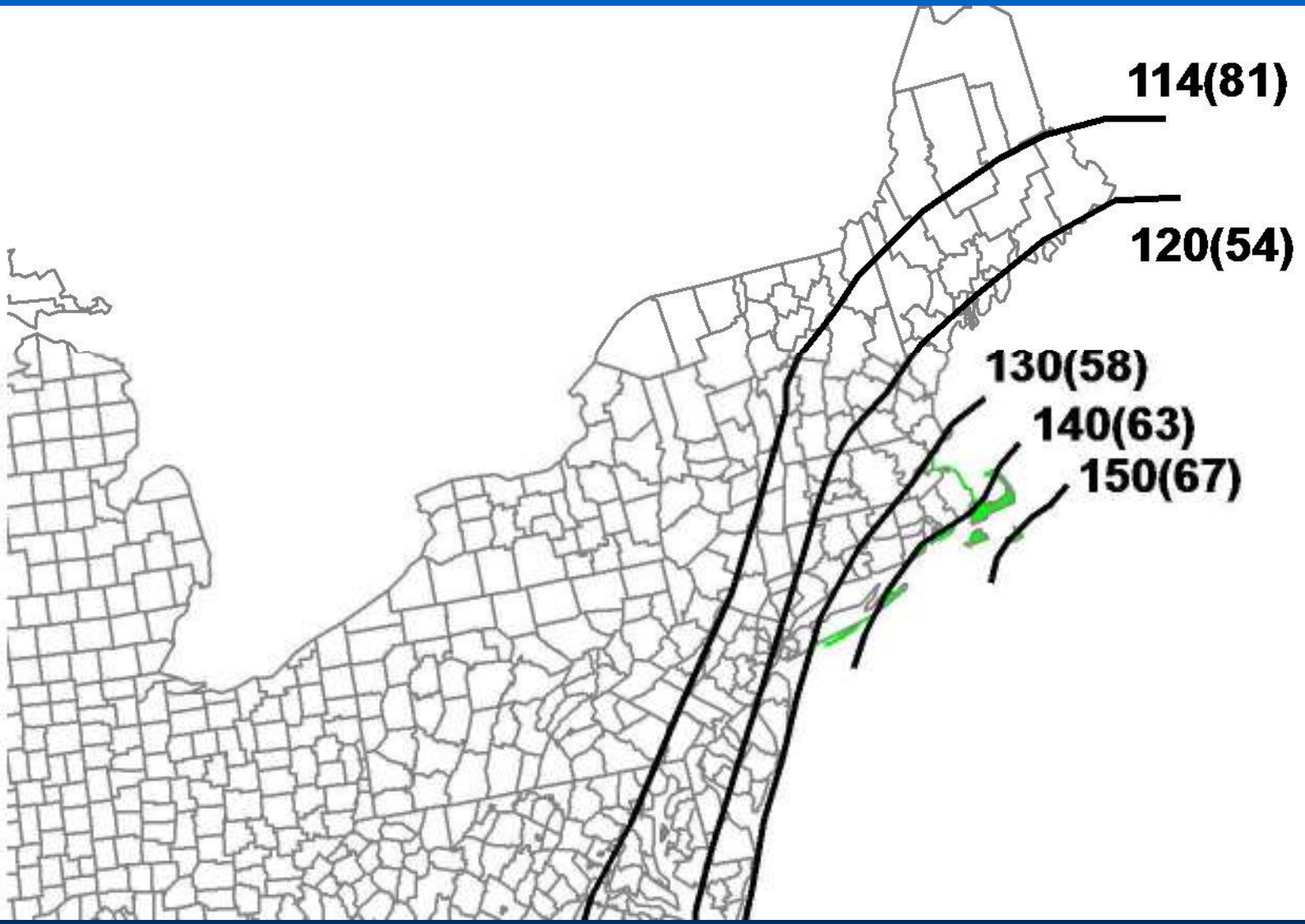
ASCE 7-10 Protection of Glazed Openings

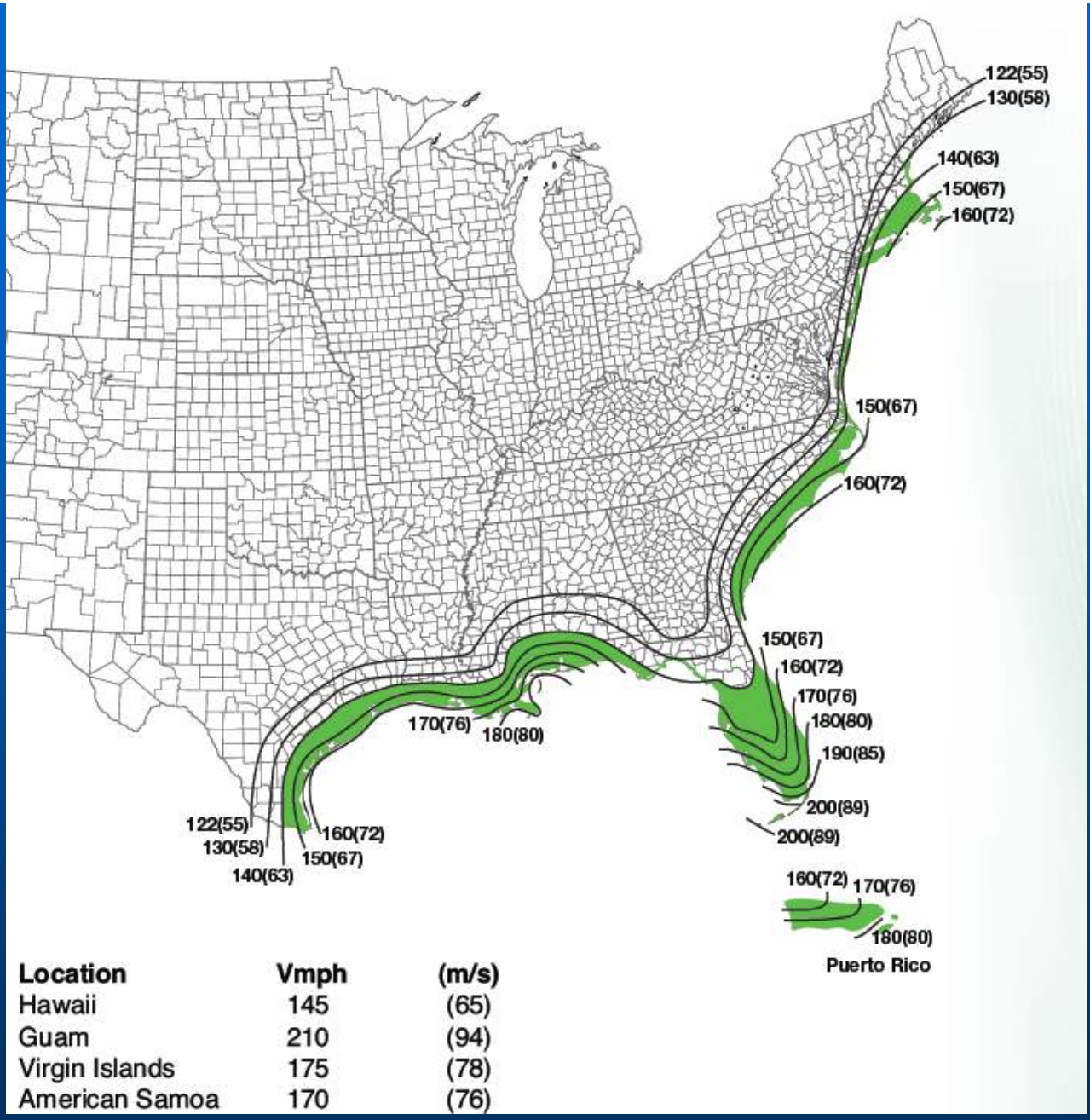
- **Risk Category II and Risk Category III Buildings, excluding health care facilities use Risk Category II Map wind speeds**
- **Risk Category III health care facilities and Risk Category IV Buildings use Risk Category III and IV Map wind speeds**



Location	Vmph	(m/s)
Hawaii	130	(58)
Guam	195	(87)
Virgin Islands	165	(72)
American Samoa	160	(72)

WBDR for Risk Category II and Risk Category III buildings excluding health care facilities V ≥ 140 mph; and Within 1 mile of the coastal mean high water line where V ≥ 130 mph

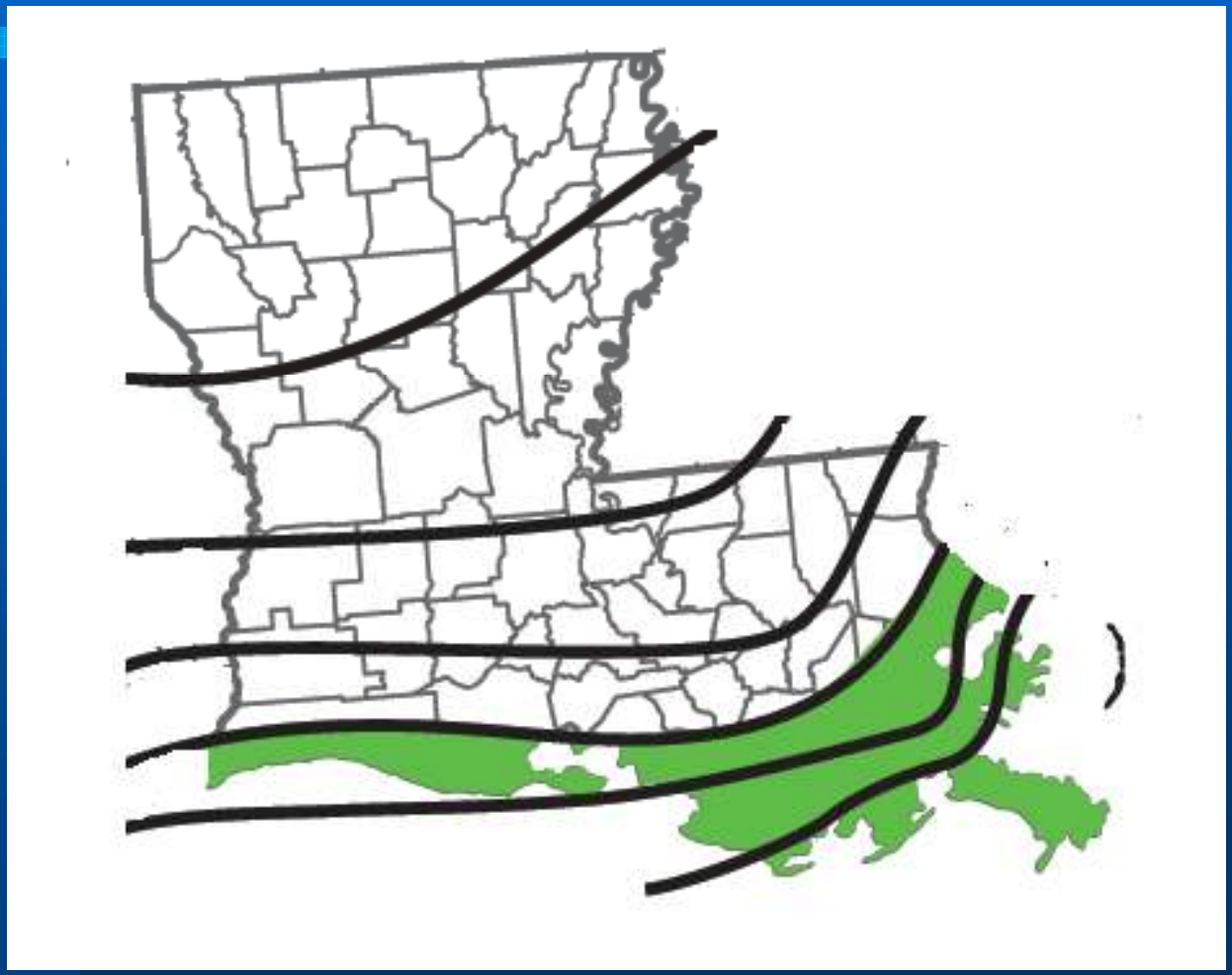

114(81)
120(54)
130(58)
140(63)
150(67)



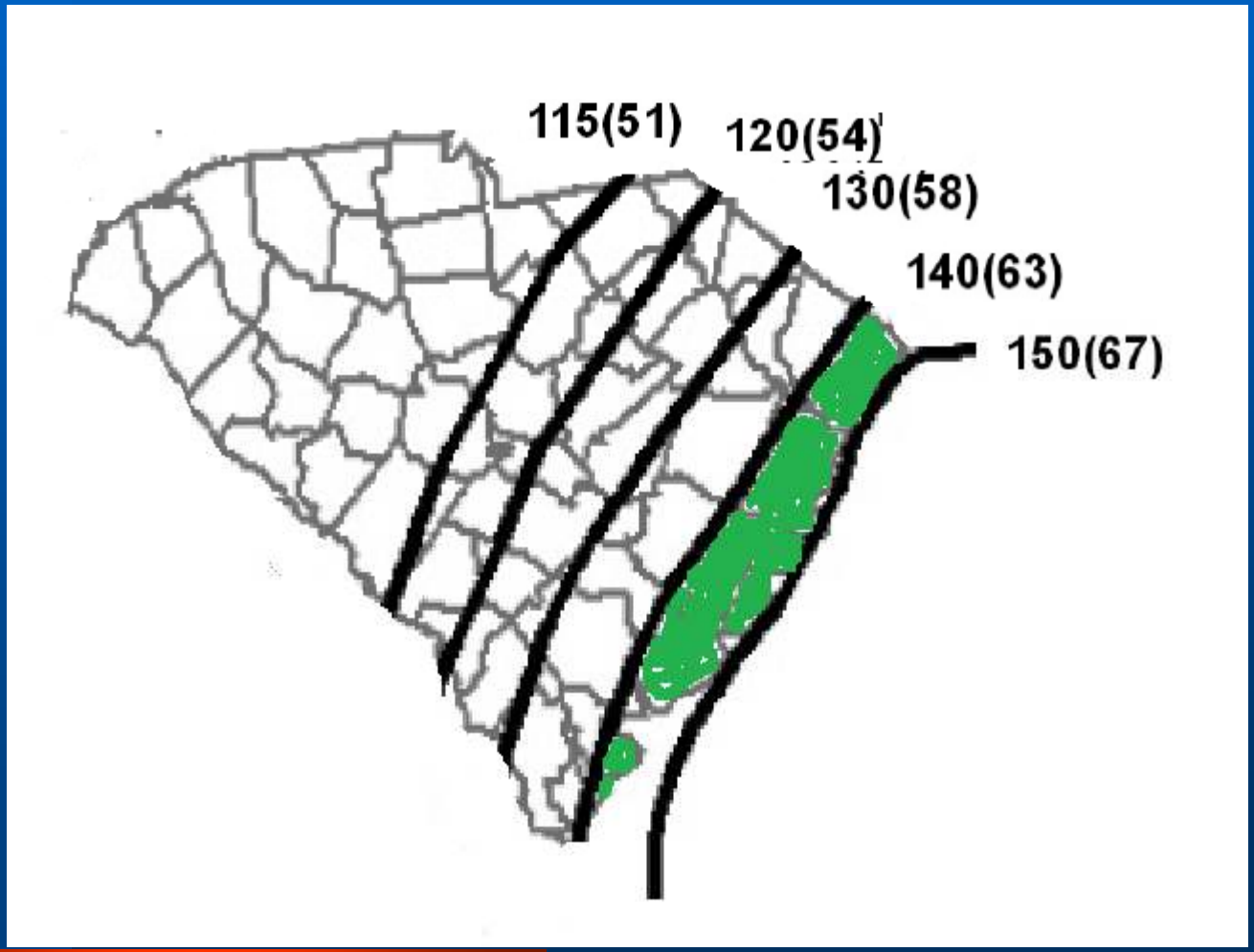
Location	Vmph	(m/s)
Hawaii	145	(65)
Guam	210	(94)
Virgin Islands	175	(78)
American Samoa	170	(76)

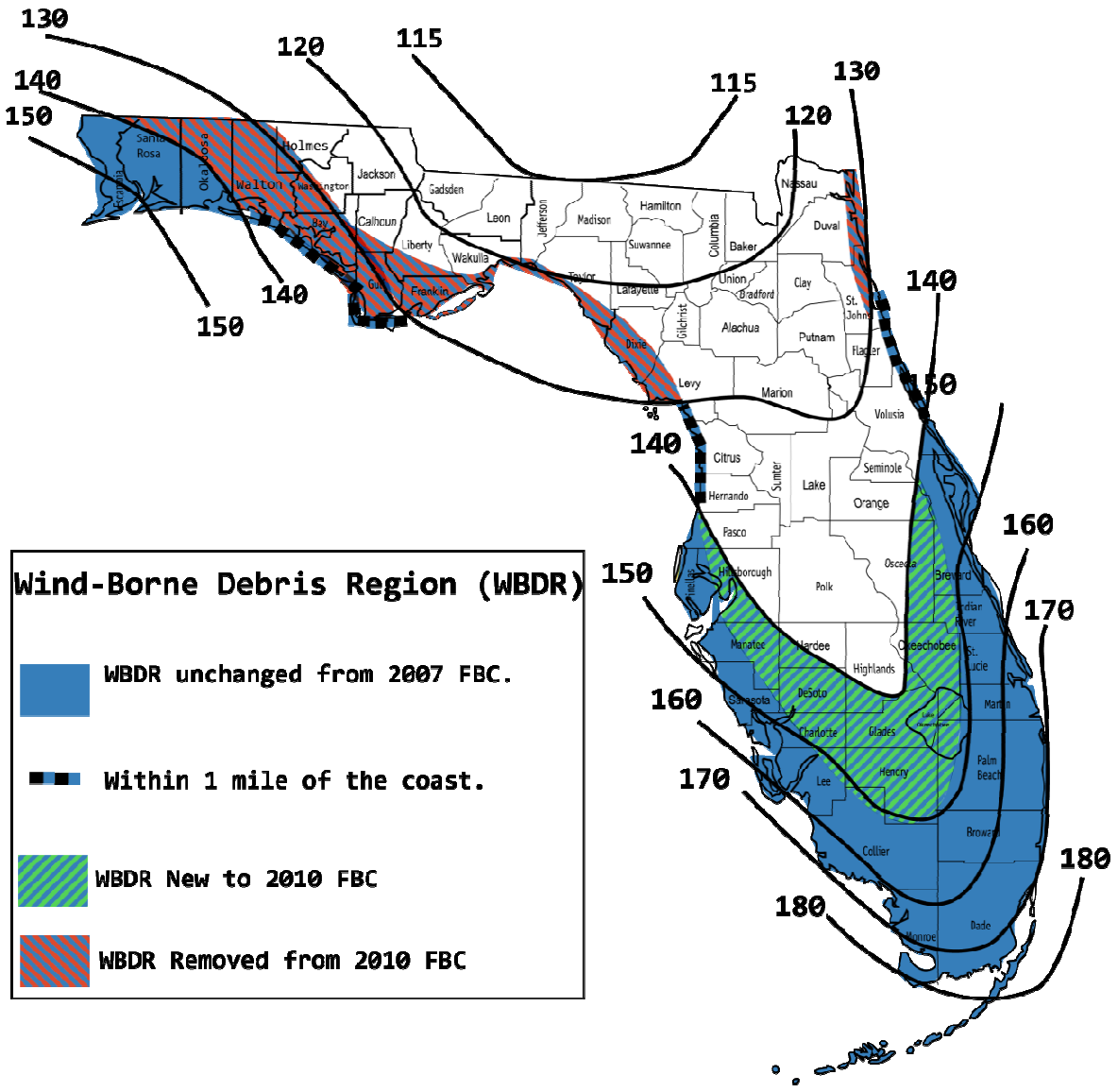
WBDR for Risk Category IV and Risk Category III buildings health care facilities
V ≥ 140 mph; and Within 1 mile of the coastal mean high water line where V ≥ 130 mph

ASCE 7-10 WBDR Risk Category II



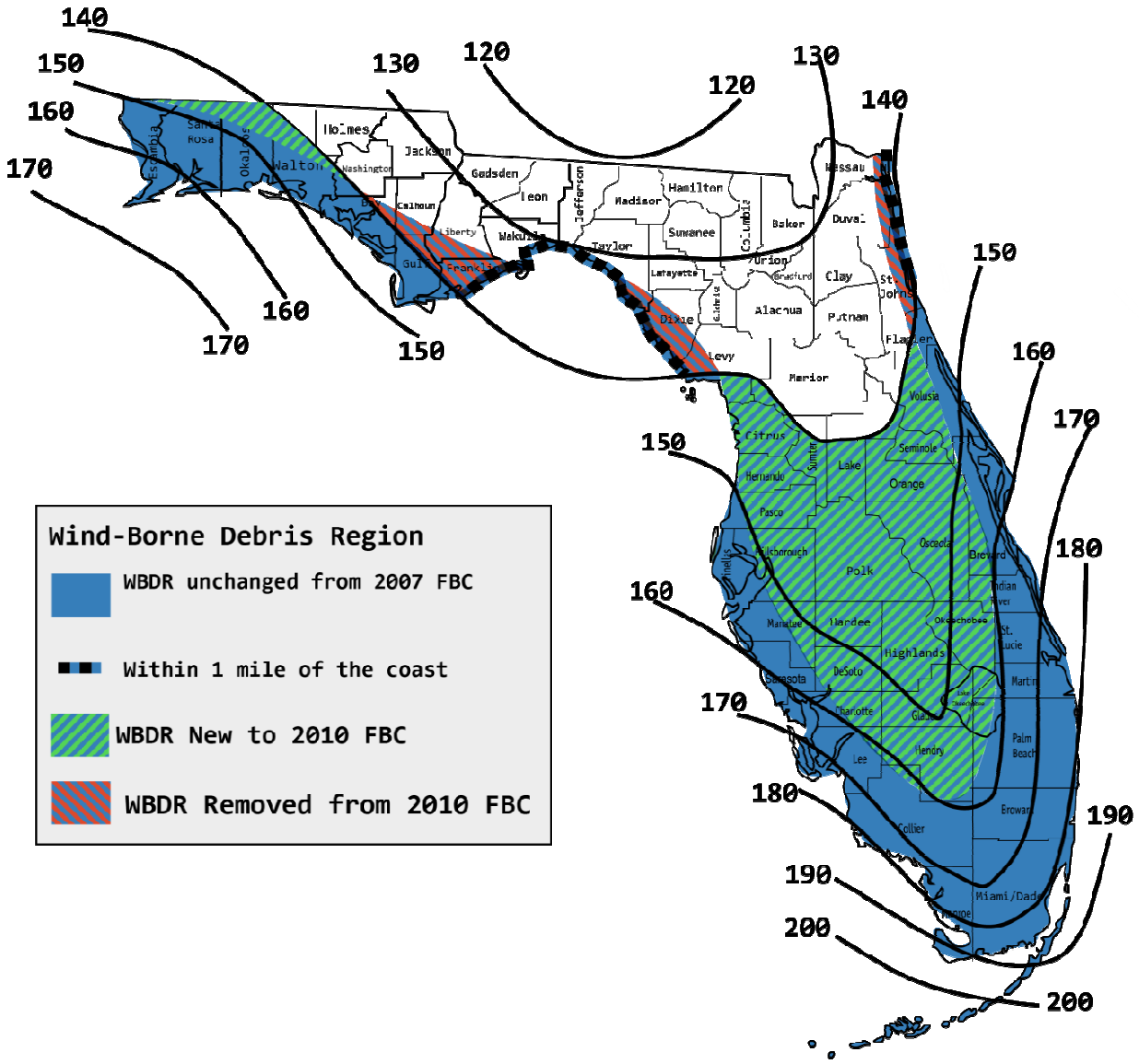
ASCE 7-10 WBDR Risk Category II





Changes to the WBDR for Risk Category II and III Buildings and Structures except health care facilities. Includes Buildings scoped by the FBCR.

WBDR Risk Category II Buildings and Risk Category III excluding healthcare facilities



Changes to the WBDR for Risk Category IV Buildings and Structures and Category III healthcare facilities

WBDR
Risk Category IV
Buildings and
Risk Category III
healthcare
facilities

The End

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