ASCE 7 – 16 Wind

Changes Affecting the Design Provisions

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PCS Structural *Solutions*

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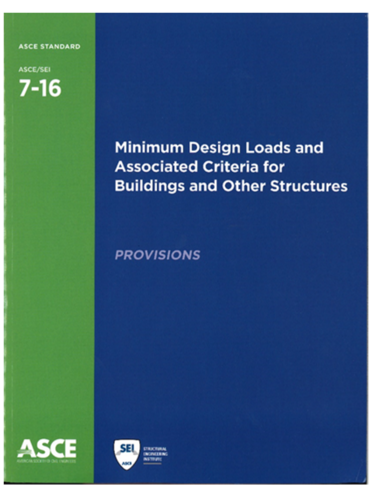
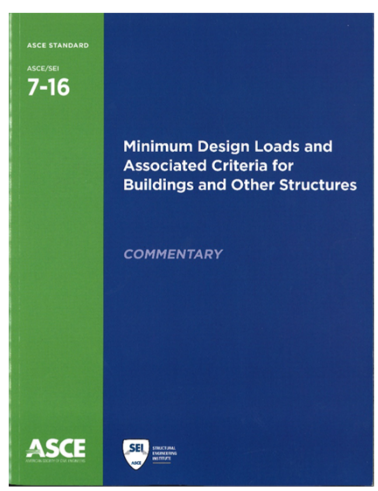
ASCE 7-16 Wind Provisions





Improvements in ASCE 7-16
Wind Speed Maps

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ASCE 7-16 Wind Map Developers

Conterminous US Maps
- Frank Lombardo, NIST and U. of Illinois
- Adam Pintar, NIST Statistical Engineering Division
- Peter Vickery, ARA
- Marc Levitan, NIST Engineering Lab
- Emil Simiu, NIST Engineering Lab

Alaska Maps
- Peter Vickery, ARA

Hawaii Maps
- Gary Chock, Martin and Chock

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Major Changes to Wind Maps in ASCE 7-16

1. Separate return period maps for Risk Category III and IV structures
2. New conterminous US maps, incorporating
   - Completely new analysis of non-hurricane winds
   - Revised hurricane modeling effecting northeast
   - Revised/Corrected Special Wind Regions
3. Revised Alaska maps
4. New maps for Hawaii, incorporating topographic effects
5. Web-based tools for wind speed determination

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1. MRI for Design Wind Speed Maps

- Reliability analysis conducted to estimate return periods needed to achieve target reliability indexes
  - Analysis conducted by Dr. Terri McAllister, ASCE 7 Load Combinations Subcommittee

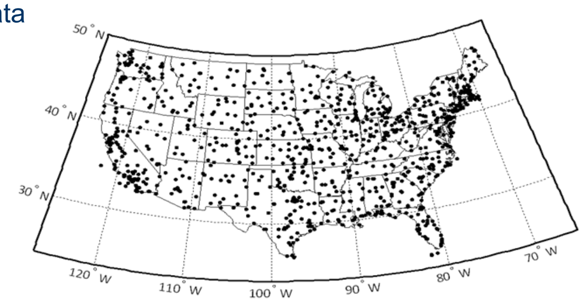
Risk Category	Target Beta (Ch. 1)	ASCE 7-10 Map MRI (years)	ASCE 7-16 Map MRI (years)
I	2.50	300	300
II	3.00	700	700
III	3.25	1,700	1,700
IV	3.50	1,700	3,000

2. New Conterminous US Wind Speed Maps

- Incorporated analysis of additional wind climate data for non-hurricane winds
  - More stations and more years of data
  - Account for terrain exposure at anemometer locations
- Revised inland winds developed using threshold exceedance approach (Pintar and Simiu, 2014)
  - Thunderstorms ~ thunderday methodology
  - Extra-tropical storm modeling ~ Method of storms (Cook, 1983)
- Updated hurricane model for northeast coast
- Replaced all 7 existing maps
  - Standard (300, 700, 1700-yr) and Commentary (10, 25, 50, 100-yr)
- Added a new 3,000-year map for RC IV structures

Improvements to non-Hurricane Wind Speeds

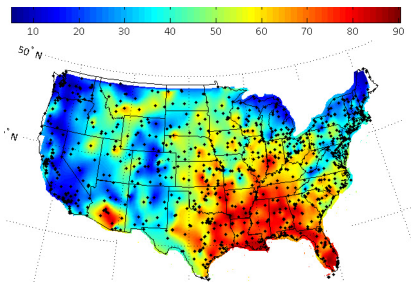
- Existing wind speeds (non-hurricane) have not been updated since ASCE 7-95
- More years of wind data and more stations available now
  - 1995: 485 stations with 5+ years data
  - 2016: ≈1,000 stations with 5+ years data
- **Regional variability in extreme wind climate not captured in ASCE 7-95 through 7-10 maps**



Improved Data Analysis: Accounting for Storm Type

- Non-hurricane winds are broken down into thunderstorm and non-thunderstorm for analysis, then recombined as statistically independent
- Separate distributions for different storm types (Lombardo et al., 2009)
- Similar to how hurricane and non-hurricane winds are treated separately in the previous ASCE 7 map analyses

% of Annual Maximum Wind Speeds from Thunderstorms*

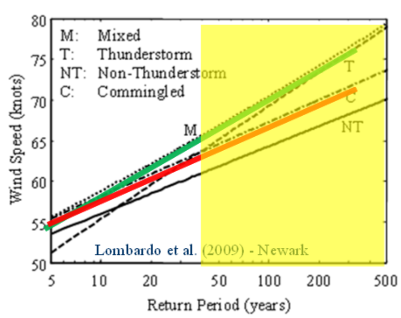


Extreme wind climate clearly dominated by different storm types in different parts of the country

*Excluding maxima from tropical cyclones

Accounting for Storm Type

- Distributions for different storm types shown to be different (Lombardo et al., 2009)
- Failure to account for storm types separately can lead to unconservative estimates
- To include storm types separately can use a “mixed” distribution



- $P(V \le v) = P(V_T \le v)\, P(V_{NT} \le v)$
- M: Mixed
- C: Current Method

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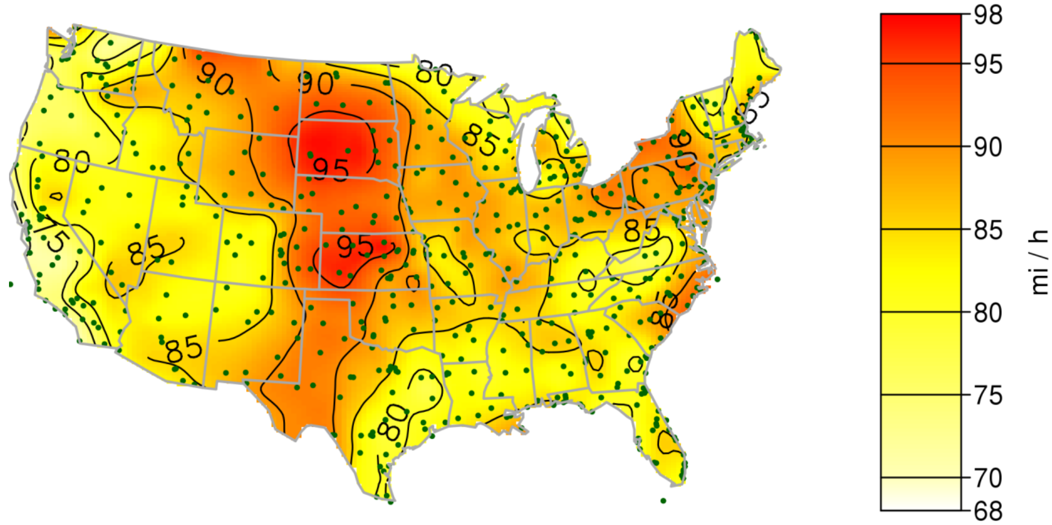
50 Year MRI Non-hurricane Wind Speeds with minimal smoothing



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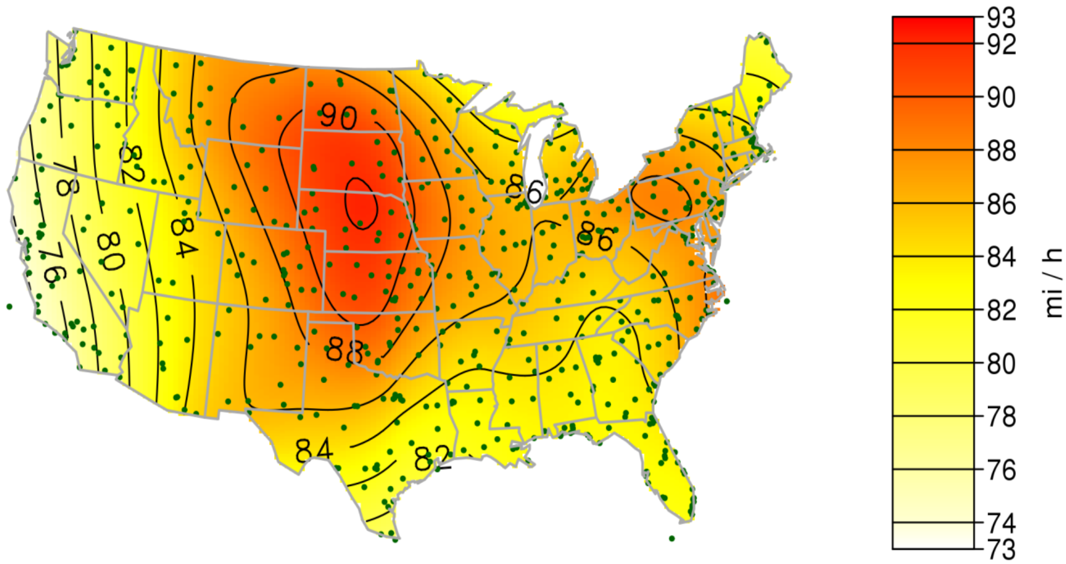
50 Year MRI Non-hurricane Smoothed Wind Speeds



Improved Hurricane Model

- Implemented two changes to the hurricane model
  - Reduced translation speed effect for fast moving storms (published in USNRC NUREG/CR 7005)
  - Simple Extra-Tropical Transition model where the surface winds are reduced linearly by up to 10% over the latitude range 37 N to 45 N. This reduction approximates transitioning from a hurricane boundary layer to an ESDU extratropical storm boundary layer. The full ESDU reduction is around 15%.
- Revised model has been validated using Hurricane Juan winds from Nova Scotia

Combined Winds

- Winds given for return periods of 10 through 100,000 years computed using a Type I distribution
- Non-hurricane (NH) and Hurricane (H) winds are combined as independent events using:
  - $P = 1-(1-P_{NH})*(1-P_H)$
- Computer generated contours were hand smoothed
- The new wind speed maps have both contours and point values, to aid in interpolation (similar to seismic maps)
- Tornado winds are not considered
  - Coming in ASCE 7-22!

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3. Revised Alaska Wind Maps

- The maps for each return period were determined by multiplying the 50-year MRI contours given in ASCE 7-10 Figure CC-3 by a factor, F_{RA} equal to:
  - $F_{RA} = 0.45 + 0.085 \ln(12T)$,

  where T is the return period in years (Peterka and Shahid, 1998)
- Resulting contours were interpolated to the nearest 10 mph, except for the inner most and outermost contours which were rounded to the nearest 5 mph.

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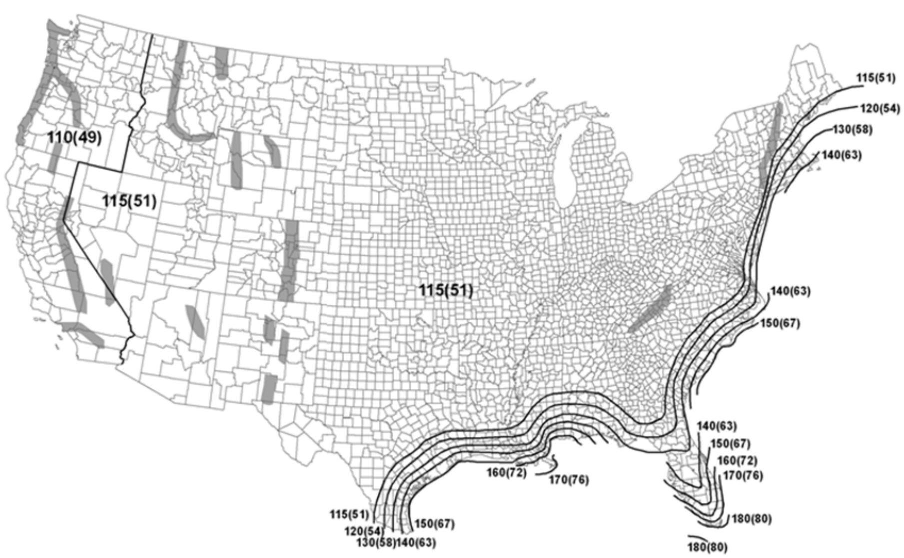
700 Year (Risk Cat II) Map in ASCE 7-10



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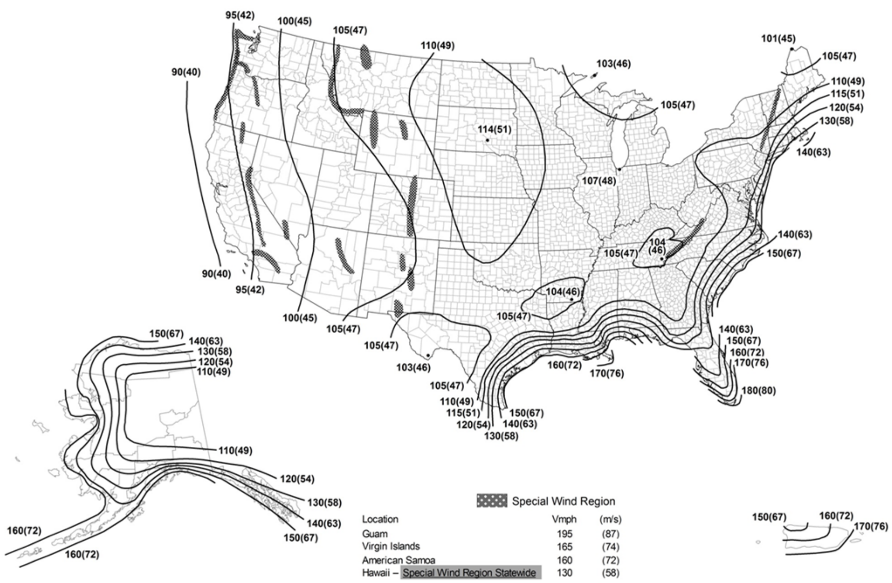
700 Year (Risk Cat II) Map in ASCE 7-16



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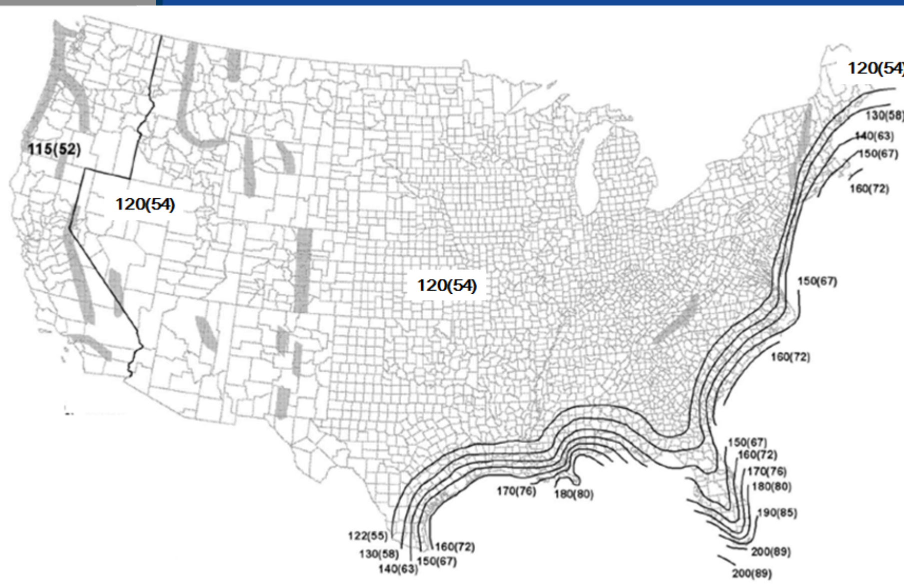
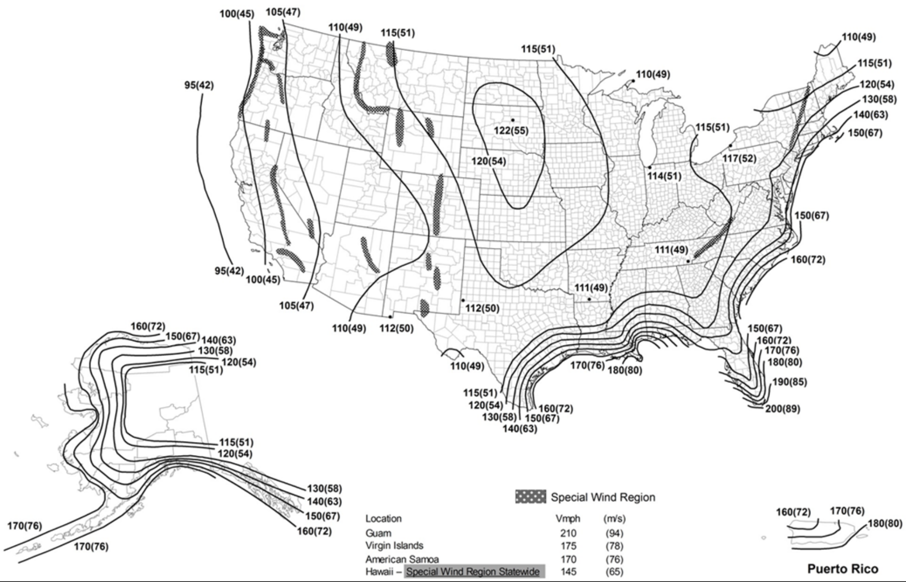
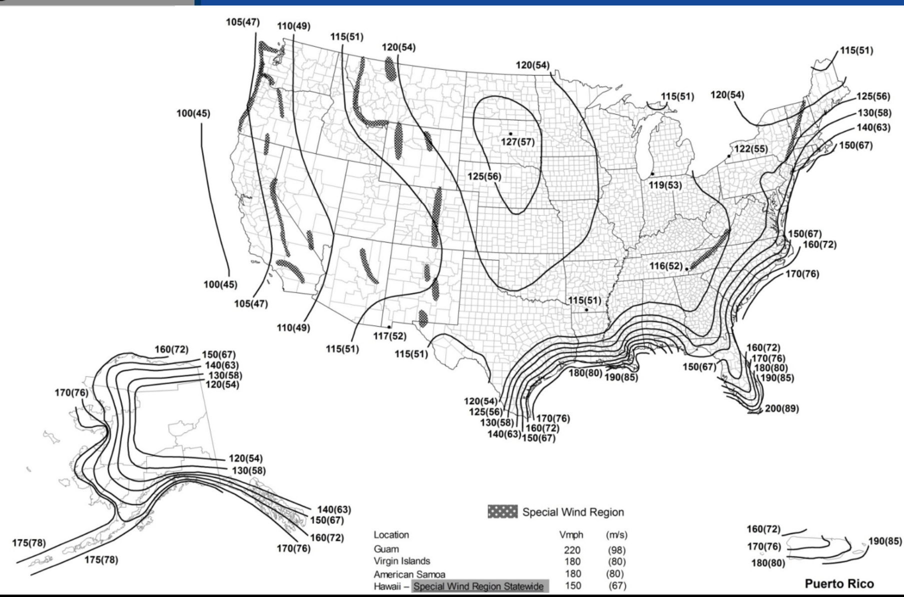
ASCE 7-10 Risk Category III and IV Map



1,700 Year (Risk Cat III) Map in ASCE 7-16



3,000 Year (Risk Cat IV) Map in ASCE 7-16

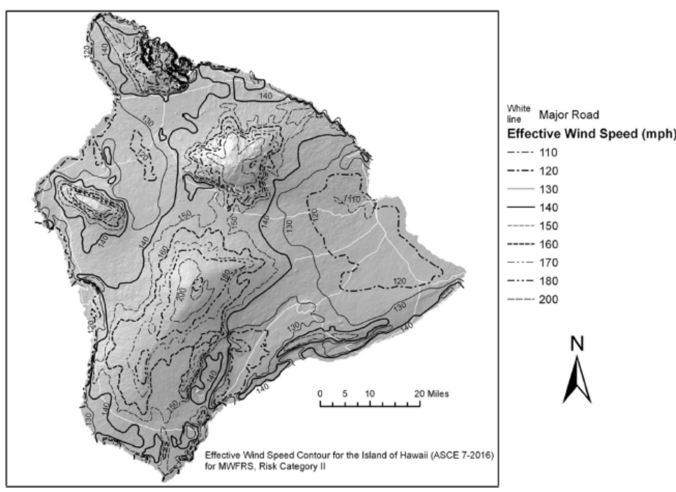


Net Effects of Map Changes

- Hurricane Prone Regions
  - Wind speeds decrease along northeast coast
  - No changes to hurricane contours from the Carolinas to Texas
    - except interior (landward) contours where transitioning to nontropical storms controlling
  - No changes to Puerto Rico and island territories
- Locations not Controlled by Hurricanes
  - Maps now better reflect regional variation in extreme wind climate
  - Wind speeds in Great Plains states nearly unchanged
  - Wind speeds decrease for the rest of the country, significantly so on the west coast

4. Hawaii Wind Speed Maps

- New micro zoned “effective” wind speed maps, including the effect of topography. Formatted to allow use of
- K_{zt} of 1.0
- K_d as given in Table 26.6-1.



Effective Wind Speed Contour for the Island of Hawaii (ASCE 7-2016) for MWFRS, Risk Category II

5. Web-based Wind Speed Tools (1/2)

- Applied Technology Council's (ATC) *WINDSPEED BY LOCATION* web site is recognized as a permitted method to determine wind speed, in a footnote on each wind speed map

> 6. Location-specific basic wind speeds shall be permitted to be determined using www.atcouncil.org/windspeed.

5. Web-based Wind Speed Tools (2/2)

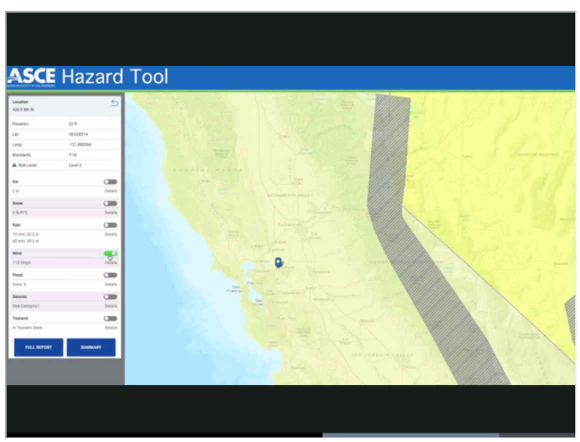
ASCE 7 Hazard Tool

ASCE 7 Hazard Tool is a web-based application that offers a better way to look up key design parameters specified by Standard ASCE 7. Its easy-to-use mapping features quickly retrieve your choice of hazard data, including:

- basic wind speed
- seismic accelerations
- flood zone and base flood elevation
- ground snow load
- rain load
- tsunami-load risk
- ice thickness with concurrent gust speed and temperature

Both individual and corporate subscriptions will be available.

Launches Summer 2017.



5. Web-based Wind Speed Tools (2/2)

ASCE 7 Hazards Report

Location:
No Address At this Location

Elevation: 560 ft
Lat: 36.165526
Long: -86.783927

Risk Category:
II

Soil Class:

Standard Version:
ASCE/SEI 7-16

Elevation Reference Datum:
North American Vertical Datum of 1988 (NAVD 88)

Wind

Results:	
Wind Speed:	105 Vmph
Data Source:	ASCE/SEI 7-16, Fig. 26.5-1B
Date Accessed:	Tue Jul 25 2017

Improvements in ASCE 7-16

Low-Rise Roof Pressure Coefficients

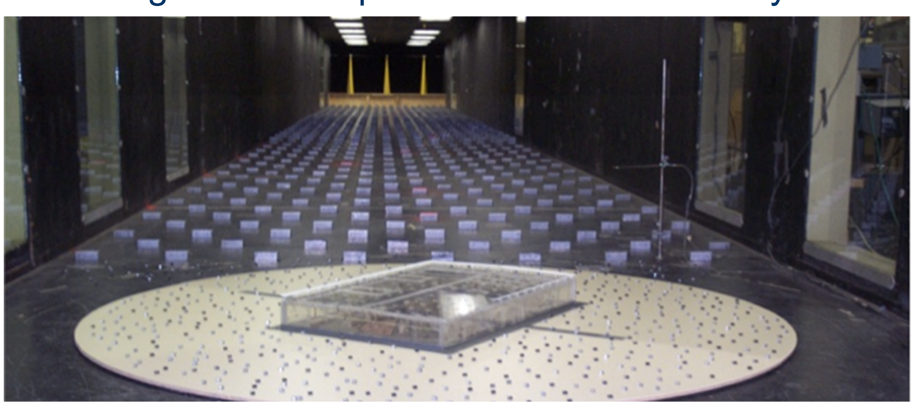
Flat Roof Structures

Background

- The low-rise C&C provisions in ASCE 7-10 are largely based on ground-breaking wind tunnel studies conducted at UWO in the late 1970s
- Since then, there has been a significant increase in knowledge of the aerodynamics of low-rise buildings, and validation of wind tunnel studies using full-scale field experiments.
- Higher turbulence levels were required to have wind tunnel studies match full-scale data. The early studies lead to pressure coefficients which were too low in magnitude when compared to full-scale.

NIST Aerodynamic Database

- The TTU field studies changed our understanding, indicating higher levels of turbulence in ABL.
- This knowledge was incorporated in the UWO study for NIST

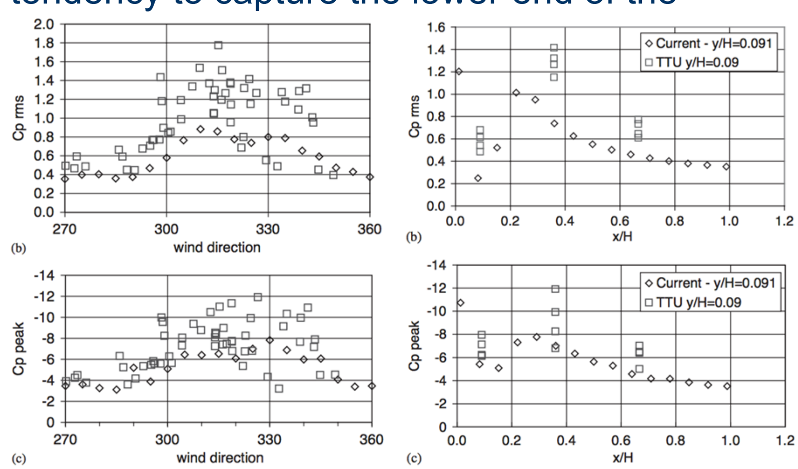


NIST Aerodynamic Database

- Contains time histories of pressure coefficients on more than 30 low-rise buildings in open and suburban terrain.
- The building models have high pressure tap resolution, with more than 650 taps on each.
- The 1/100 length scale accurately represents the full-scale atmospheric boundary layer, with relatively high model-scale Reynolds numbers
- The data set has been extensively peer-reviewed, with many publications (from a variety of international users) and thesis.
- All data are publicly accessible (online).

NIST Aerodynamic Database

- Ho et al. (2005) compare with full-scale field data from TTU
- The wind tunnel has a tendency to capture the lower end of the full-scale peak values



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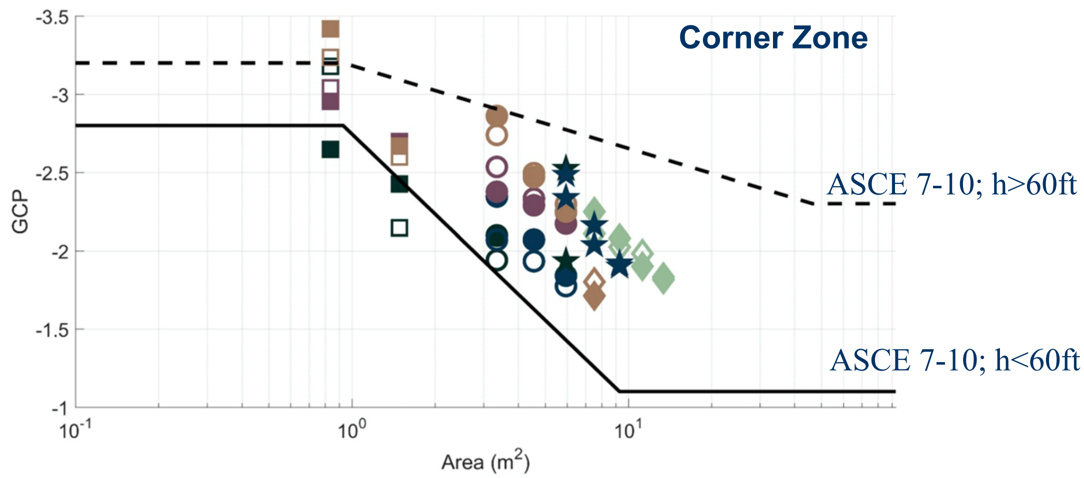
Evaluation of ASCE 7-10, roof C&C



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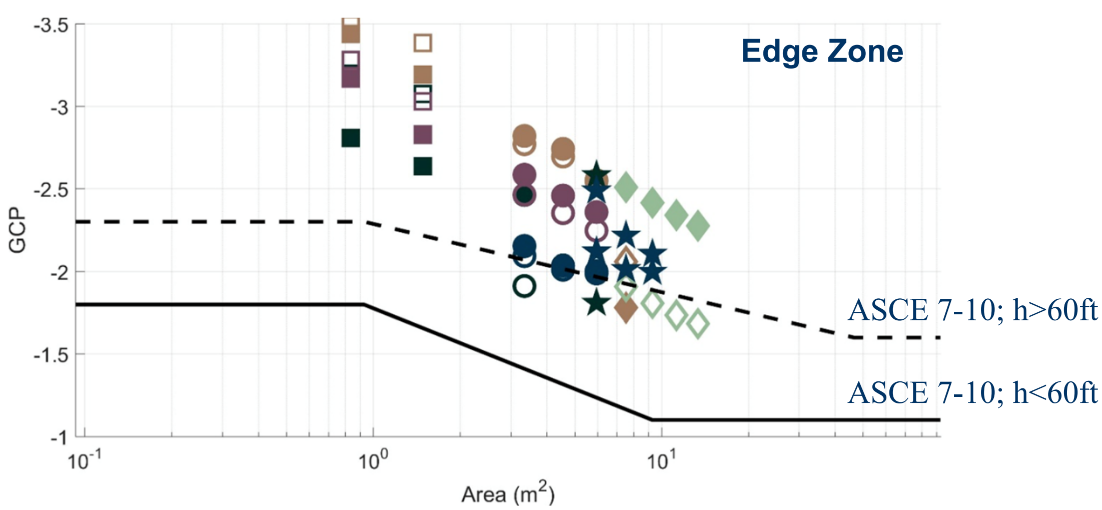
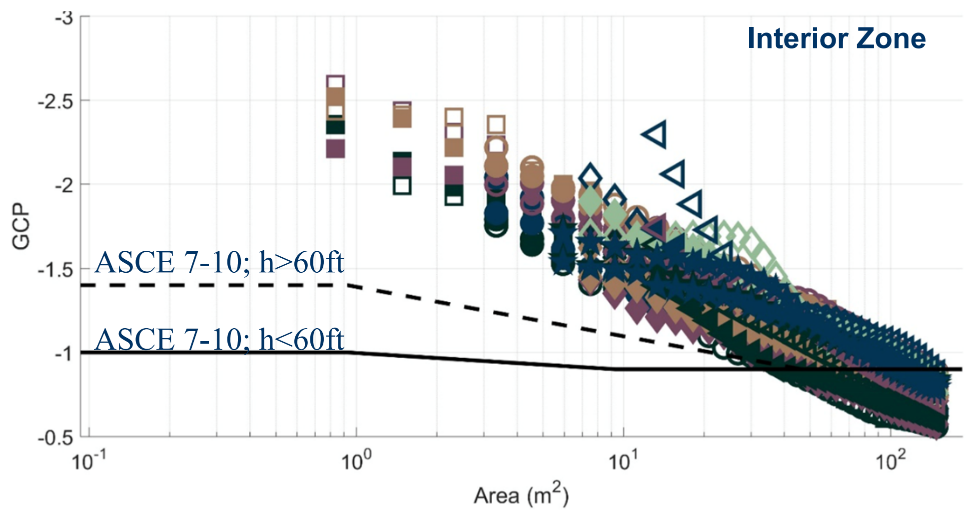
Evaluation of ASCE 7-10, roof C&C



Evaluation of ASCE 7-10, roof C&C

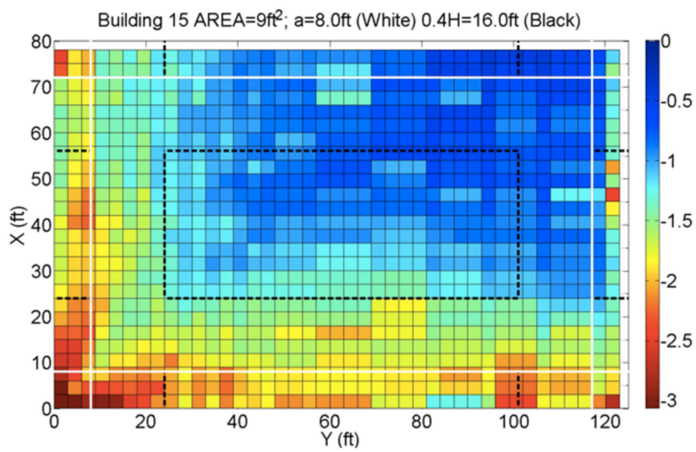


Evaluation of ASCE 7-10, roof C&C

- There are problems with both magnitude of the area-averaged pressure coefficients and the zone sizes
- Using the larger coefficients, and “L” shaped corner, for buildings with h > 60 ft does not solve this.
- The main problems are with the edge and interior.
- The UWO data from the 1970s had limited pressure tap resolution, so C&C coefficients were obtained from limited data.
- The zone sizes were based on point pressure distributions and an assumed 30% reduction from the maxima
- The NIST data allow one to compute the spatial distribution of the enveloped area-averages. This was not available in the 1970s.
- Thus, the current data allow one to assess both the magnitude of the area-averaged pressure coefficients, and their spatial distribution.

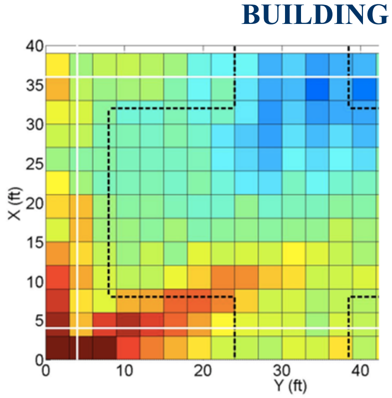
Evaluation of ASCE 7-16, roof C&C

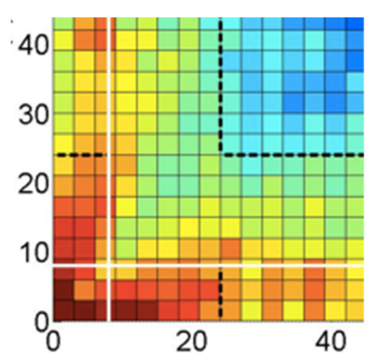
Enveloped *GCp* values for tributary areas of 9 ft^2
Building plan dimensions of **80 ft x 125 ft** in open-country terrain
The white lines corresponds to the current ASCE 7 definitions for the roof zones
BUILDING HEIGHT = 40 FT



Evaluation of ASCE 7-16, roof C&C

Enveloped *GCp* values for tributary areas of 9 ft^2
Building plan dimensions of **40 ft x 62.5 ft** (left) and **80 ft x 125 ft** (right)
The white lines corresponds to the current ASCE 7 definitions for the roof zones
BUILDING HEIGHT = 40 FT





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Spatial distribution of pressure coefficients

- The worst of the peak coefficients are about the same for all of these buildings. (The color bars were in all plots were made the same.)
- For two buildings of the same plan dimensions, the taller building has high magnitude pressures, which also cover larger areas.
- For buildings of the same height, but differing plan dimensions, the pressure distributions are very similar
- Thus, the distribution of enveloped pressures is primarily dependent on roof height. Plan dimensions only play a secondary role.
- Pressures vary continuously with distance from edge, so zone sizes must be chosen.
- Combining these distributions, the coefficients and roofs were modified for ASCE 7-16.

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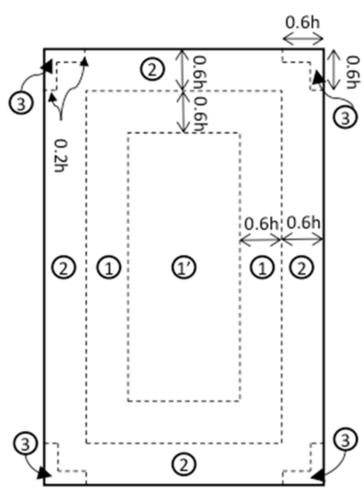
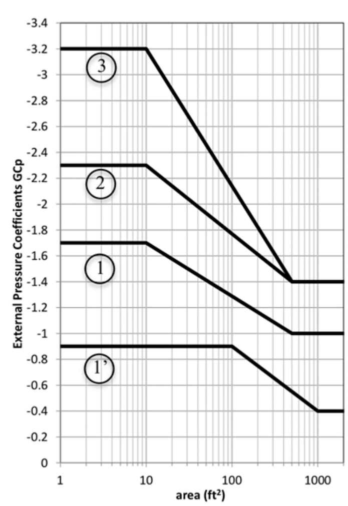
Zoning for ASCE 7-16

Roof Zones and Pressure Coefficients





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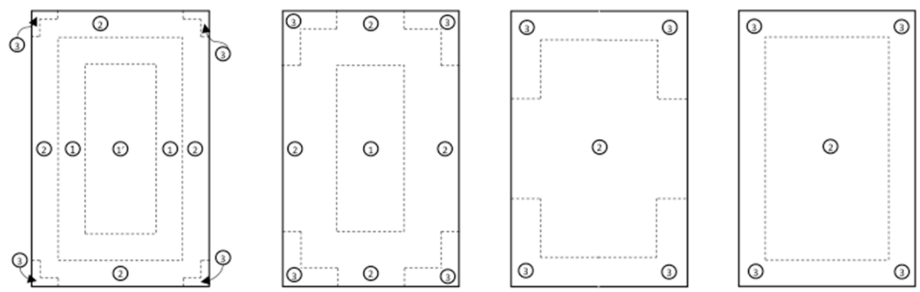
Zoning for ASCE 7-16

Roof Zones



Proposed roof zones for buildings with (left) *L/h* > 2.4, (left-center) 1.2 < *L/h* < 2.4, (right-center) *L/h* < 1.2 and *W/h* > 1.2, and (right) *L/H* < 1.2 and *W/h* < 1.2

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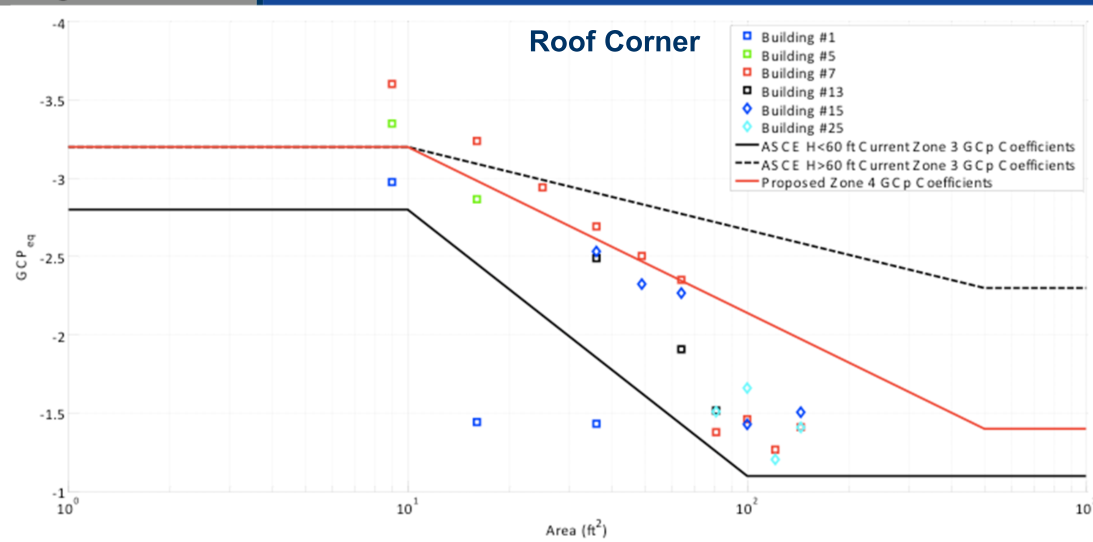
Coefficients for ASCE 7-16



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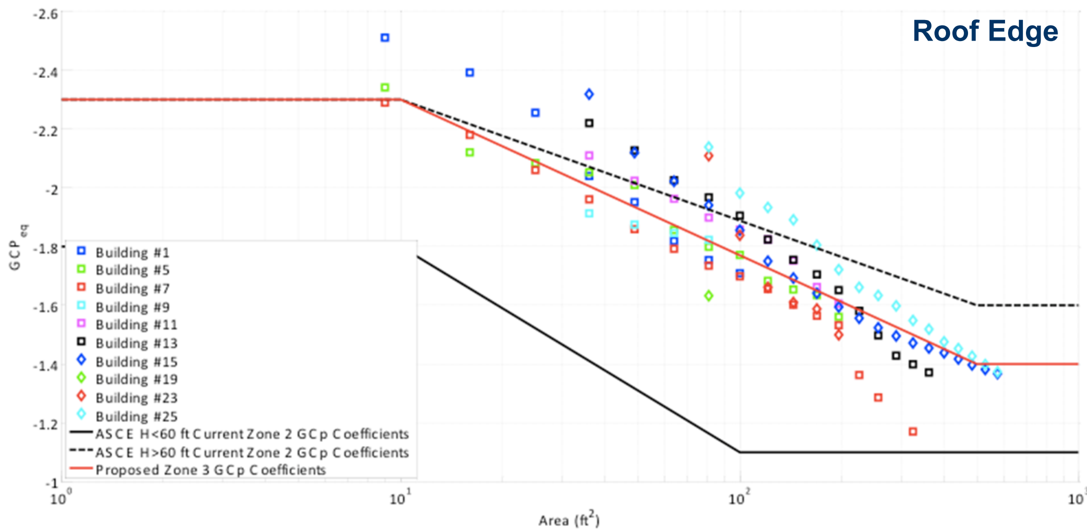
Coefficients for ASCE 7-16



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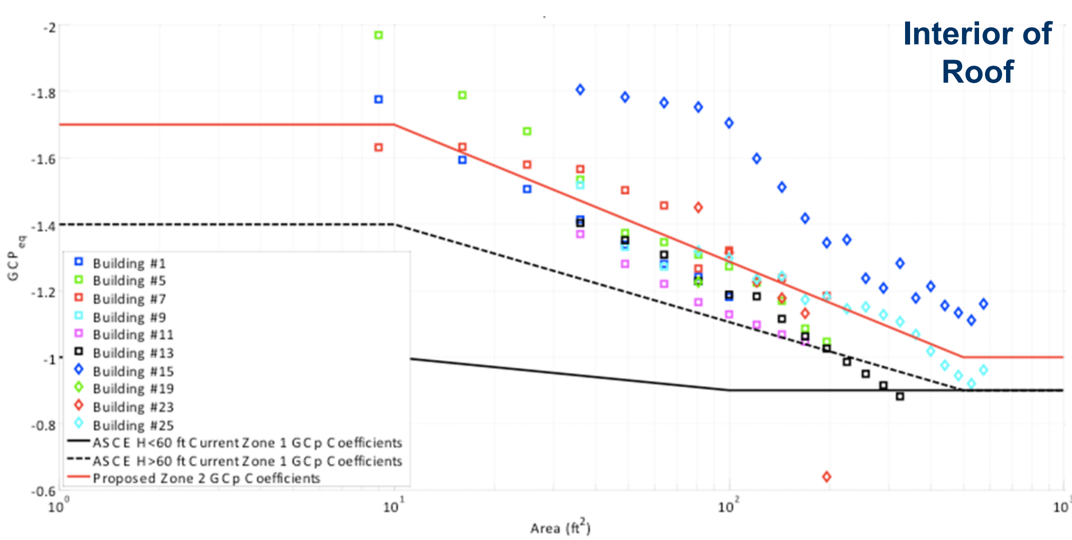
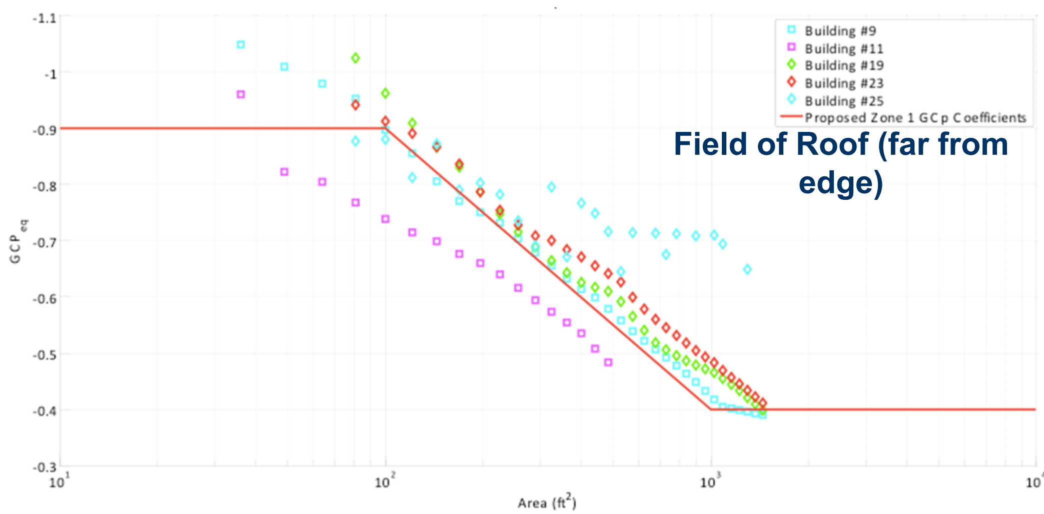
Coefficients for ASCE 7-16



Coefficients for ASCE 7-16



Improvements in ASCE 7-16

Low-Rise Roof Pressure Coefficients

Sloped Roof Structures

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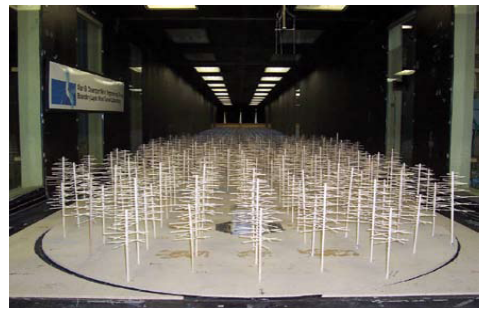
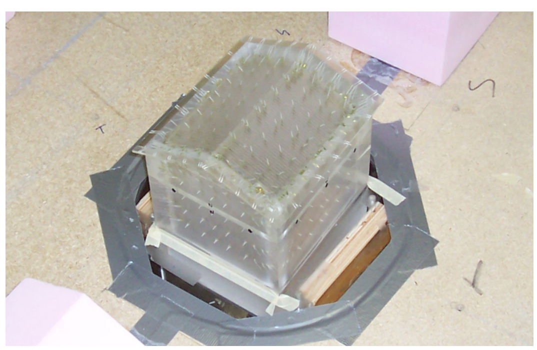
Project History

- 4:12 tests on 1, 2 and 3 stories buildings
  - Performed at the BLWTL at University of Western Ontario early December 2005 to examine the impact h/D on roof pressure coefficients.
  - Tests performed with and without surrounding buildings with two different spacing's.
- 4:12 tests performed in January 2006
  - Effect of trees on wind loads and velocity profile was examined (hip/gable 1,2 & 3 story).
- 7:12, 9:12 and 12:12 May 2007
  - With and without trees (hip/gable 1,2 & 3 story)
- 5:12 and 6:12 tests performed April 2008
  - hip/gable 1, 2 & 3 story plus an interference effects study.



SEI STRUCTURAL ENGINEERING INSTITUTE ASCE

Project History



Current Roof Slopes in ASCE 7

1. 7< θ ≤ 27 degrees (4:12, 5:12 and 6:12)
2. 27< θ ≤ 45 degrees (7:12, 9:12, and 12:12)

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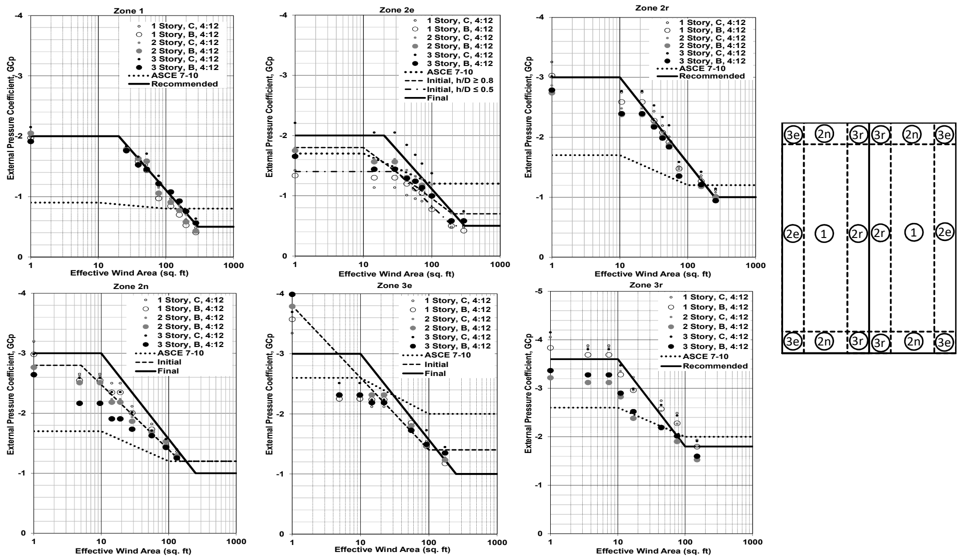
Gable (7° < θ ≤ 20°)



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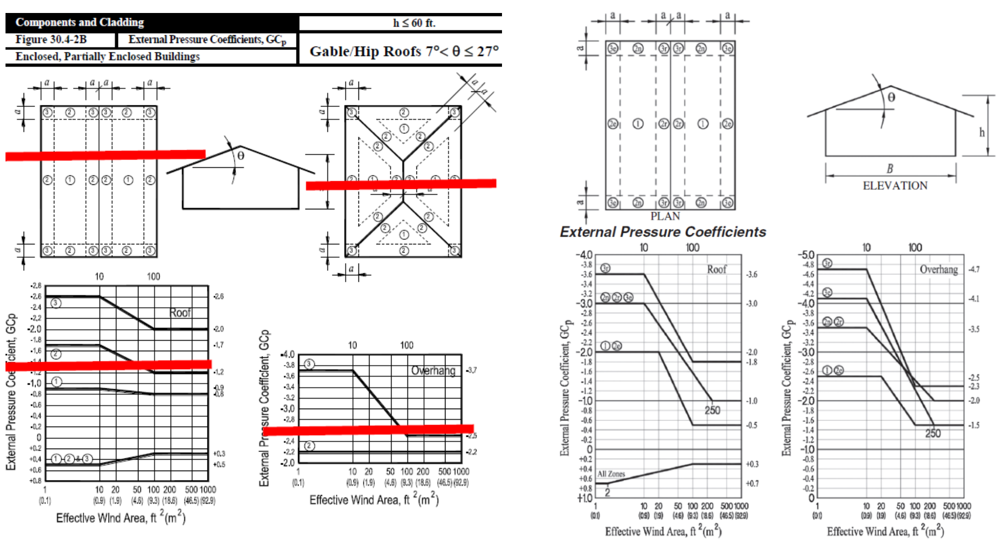
Gable (7° < θ ≤ 20°)



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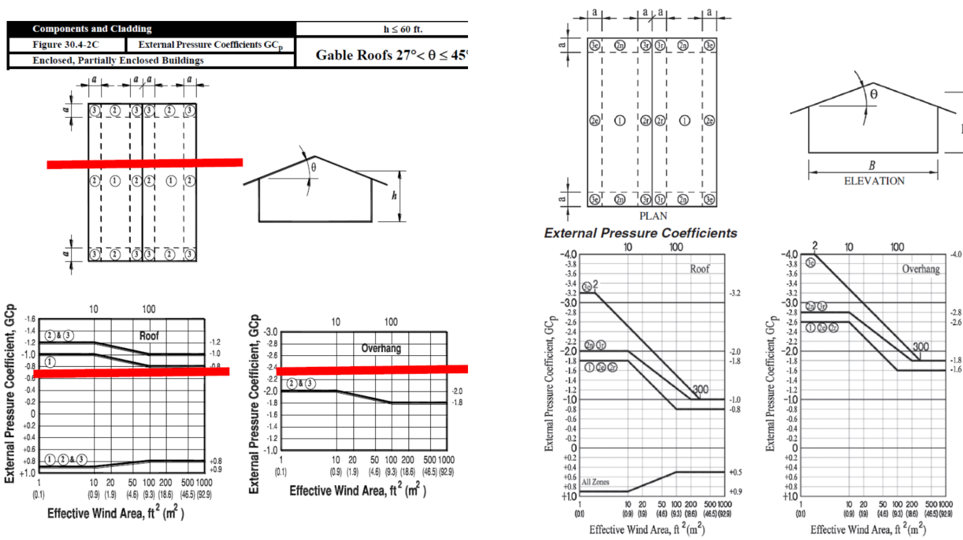
Gable (27° < θ ≤ 45°)



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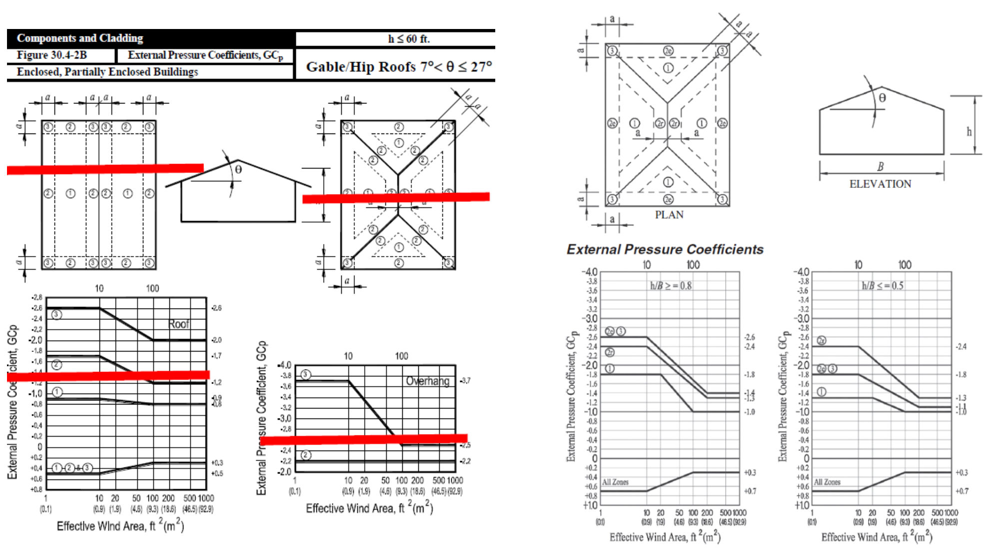
Hip (7° < θ ≤ 20°)



Equations for all GCp's given in Commentary

Table C30.3-5. Gable Roofs, 27° < θ ≤ 45° (Figure 30.3-2D)

	Positive with and without overhang	
All Zones	$(GC_p) = 0.9$	for $A \le 10$ ft²
	$(GC_p) = 1.3000 - 0.4000 \log A$	for $10 \le A \le 100$ ft²
	$(GC_p) = 0.5$	for $A \ge 100$ ft²
	Negative without overhang	
Zones 1, 2e, and 2r	$(GC_p) = -1.8$	for $A \le 10$ ft²
	$(GC_p) = -2.8000 + 1.0000 \log A$	for $10 \le A \le 100$ ft²
	$(GC_p) = -0.8$	for $A \ge 100$ ft²
Zones 2n and 3r	$(GC_p) = -2.0$	for $A \le 10$ ft²
	$(GC_p) = -2.7686 + 0.7686 \log A$	for $10 \le A \le 200$ ft²
	$(GC_p) = -1.0$	for $A \ge 200$ ft²
Zone 3e	$(GC_p) = -3.2$	for $A \le 2$ ft²
	$(GC_p) = -3.5043 + 1.0110 \log A$	for $2 \le A \le 300$ ft²
	$(GC_p) = -1.0$	for $A \ge 300$ ft²
	Negative with overhang	
Zones 1, 2e, and 2r	$(GC_p) = -2.6$	for $A \le 10$ ft²
	$(GC_p) = -3.6000 + 1.0000 \log A$	for $10 \le A \le 100$ ft²
	$(GC_p) = -1.6$	for $A \ge 100$ ft²
Zones 2n and 3r	$(GC_p) = -2.8$	for $A \le 10$ ft²
	$(GC_p) = -3.5686 + 0.7686 \log A$	for $10 \le A \le 200$ ft²
	$(GC_p) = -1.8$	for $A \ge 200$ ft²
Zone 3e	$(GC_p) = -4.0$	for $A \le 2$ ft²
	$(GC_p) = -4.3043 + 1.0110 \log A$	for $2 \le A \le 300$ ft²
	$(GC_p) = -1.8$	for $A \ge 300$ ft²

Table C30.3-7. Hip Roofs, Overhang, 7° < θ ≤ 20° (Figure 30.3-2F)

	Negative $h/D \ge 0.8$	
Zone 1	$(GC_p) = -2.3$	for $A \le 20$ ft²
	$(GC_p) = -2.8584 + 0.4292 \log A$	for $20 \le A \le 100$ ft²
	$(GC_p) = -2.0$	for $A \ge 100$ ft²
Zone 2r	$(GC_p) = -2.9$	for $A \le 10$ ft²
	$(GC_p) = -3.3612 + 0.4612 \log A$	for $10 \le A \le 200$ ft²
	$(GC_p) = -2.3$	for $A \ge 200$ ft²
Zones 2e	$(GC_p) = -3.1$	for $A \le 10$ ft²
	$(GC_p) = -3.6380 + 0.5380 \log A$	for $10 \le A \le 200$ ft²
	$(GC_p) = -2.4$	for $A \ge 200$ ft²
Zones 3	$(GC_p) = -3.7$	for $A \le 10$ ft²
	$(GC_p) = -5.0835 + 1.3835 \log A$	for $10 \le A \le 200$ ft²
	$(GC_p) = -1.9$	for $A \ge 200$ ft²
	Negative $h/D \le 0.5$	
Zone 1	$(GC_p) = -1.8$	for $A \le 20$ ft²
	$(GC_p) = -1.4277 - 0.2861 \log A$	for $20 \le A \le 100$ ft²
	$(GC_p) = -2.0$	for $A \ge 100$ ft²
Zones 2r	$(GC_p) = -2.9$	for $A \le 10$ ft²
	$(GC_p) = -3.3612 + 0.4612 \log A$	for $10 \le A \le 200$ ft²
	$(GC_p) = -2.3$	for $A \ge 200$ ft²
Zones 2e	$(GC_p) = -2.3$	for $A \le 10$ ft²
	$(GC_p) = -2.4537 + 0.1537 \log A$	for $10 \le A \le 200$ ft²
	$(GC_p) = -2.1$	for $A \ge 200$ ft²
Zone 3	$(GC_p) = -2.9$	for $A \le 10$ ft²
	$(GC_p) = -3.8992 + 0.9992 \log A$	for $10 \le A \le 200$ ft²
	$(GC_p) = -1.6$	for $A \ge 200$ ft²

Equations for all GCp's Given in Commentary

Table C30.3-9. Hip Roofs, 27° < θ ≤ 45°, No Overhang (Figure 30.3-2H)

	Positive	
All Zones	$(GC_p) = 0.9$	for $A \le 2$ ft²
	$(GC_p) = 1.0063 - 0.3532 \log A$	for $2 \le A \le 100$ ft²
	$(GC_p) = 0.3$	for $A \ge 100$ ft²
	Negative	
Zone 1	$(GC_p) = -0.6175 - 0.0200\theta$	for $A \le 10$ ft²
	$(GC_p) = -1.0191 - 0.0250\theta + [0.4016 + 0.0050\theta] \log A$	for $10 \le A \le 200$ ft²
	$(GC_p) = -0.0950 - 0.0135\theta$	for $A \ge 200$ ft²
Zone 2e	$(GC_p) = 0.2000 - 0.0670\theta$	for $A \le 2$ ft²
	$(GC_p) = -0.8000 + \left[\frac{\log(280 - 5\theta)(0.0670\theta - 1)}{0.301 - \log(280 - 5\theta)}\right] + \left[\frac{1 - 0.0670\theta}{0.3010 - \log(280 - 5\theta)}\right] \log A$	for $2 \le A \le [280 - 5\theta]$ ft²
	$(GC_p) = -0.8$	for $A \ge [280 - 5\theta]$ ft²
Zones 2r	$(GC_p) = 1.0000 - 0.0820\theta$	for $A \le 5$ ft²
	$(GC_p) = 2.0746 - 0.1261\theta + [0.0630\theta - 1.5373] \log A$	for $5 \le A \le 100$ ft²
	$(GC_p) = -1.0000$	for $A \ge 100$ ft²
Zones 3	$(GC_p) = 1.2500 - 0.1080\theta$	for $A \le [9 - 0.1350\theta]$ ft²
	$(GC_p) = \left[\frac{0.1835\theta - 3.8230}{\log(9 - 0.1350\theta) - 1.6990}\right] - 1.0 + \left[\frac{2.25 - 0.1080\theta}{\log(9 - 0.1350\theta) - 1.6990}\right] \log A$	for $[9 - 0.1350\theta] \le A \le 50$ ft²
	$(GC_p) = -1.0000$	for $A \ge 50$ ft²

Improvements in ASCE 7-16
Miscellaneous Revisions

ASCE 7-16 – Elevation Factor

K_e – Elevation Factor

- In Commentary for previous editions.

Ground elevation above sea level		Ground elevation adjustment factor
ft	(m)	Ke
0	(0)	1.00
1000	(305)	0.96
2000	(610)	0.93
3000	(914)	0.90
4000	(1219)	0.86
5000	(1524)	0.83
6000	(1829)	0.80

- Spokane is approximately at elevation 1,900’ thus, K_e = 0.93
- K_e permitted to always be taken as 1.0

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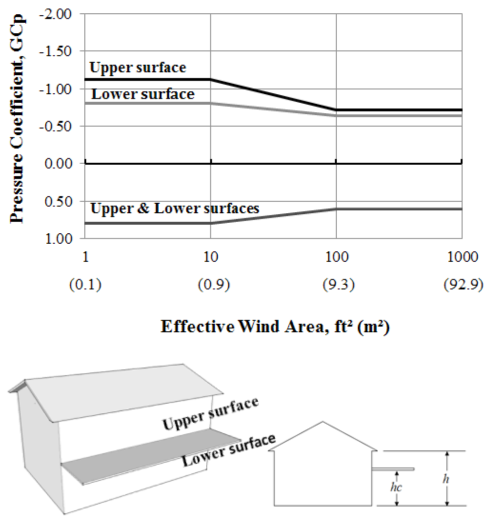
ASCE 7-16 – Attached Canopies

Canopies



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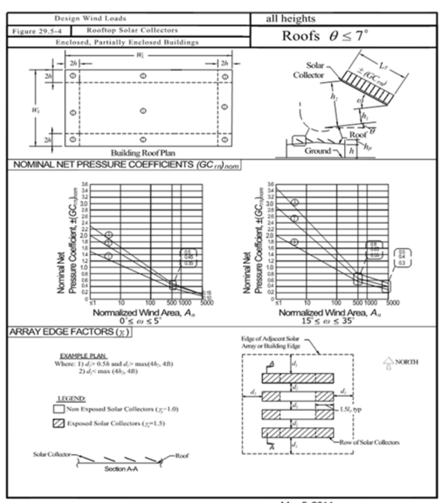
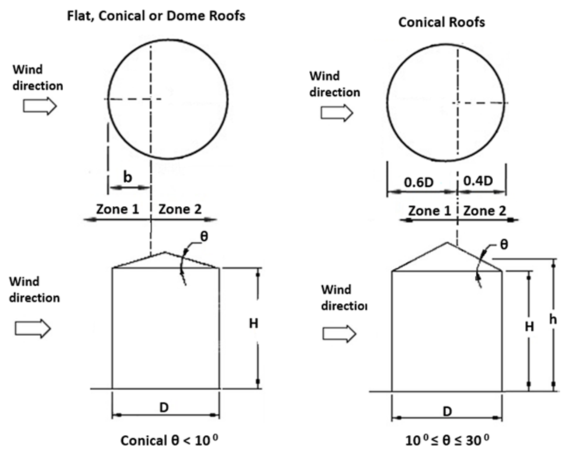
ASCE 7-16 Wind Provisions

- Rooftop Solar



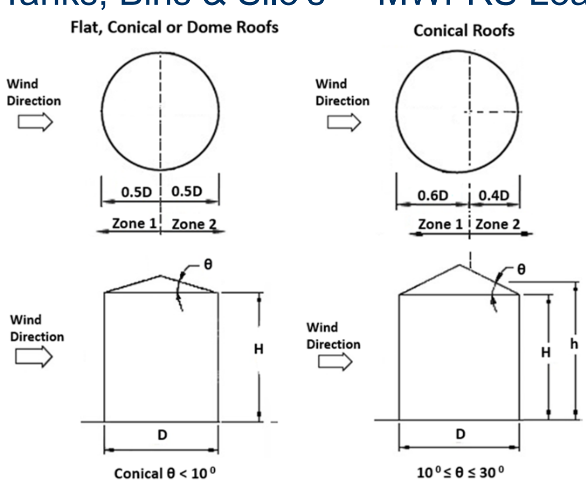
ASCE 7-16 Wind Provisions

- Tanks, Bins & Silo's – MWFRS Loading



ASCE 7-16 Wind Provisions

- Tanks, Bins & Silo's – MWFRS Loading



Wind Drag Force Coefficient (Cf) on Projected Walls

H/D	Cf	Use With
≤1	1.3	qh
2	1.1	qh
4	1.0	qh

Roof Pressure Coefficients, Cp, for use with qh

	H/D	Zone 1	Zone 2
$\theta < 10^0$	≤0.5	-0.9	-0.5
	≥1.0	-1.3	-0.7
$10^0 < \theta < 30^0$	≤4	-1.0	-0.6

ASCE 7-16 Wind Provisions

- Tanks, Bins & Silo's – C&C Loading

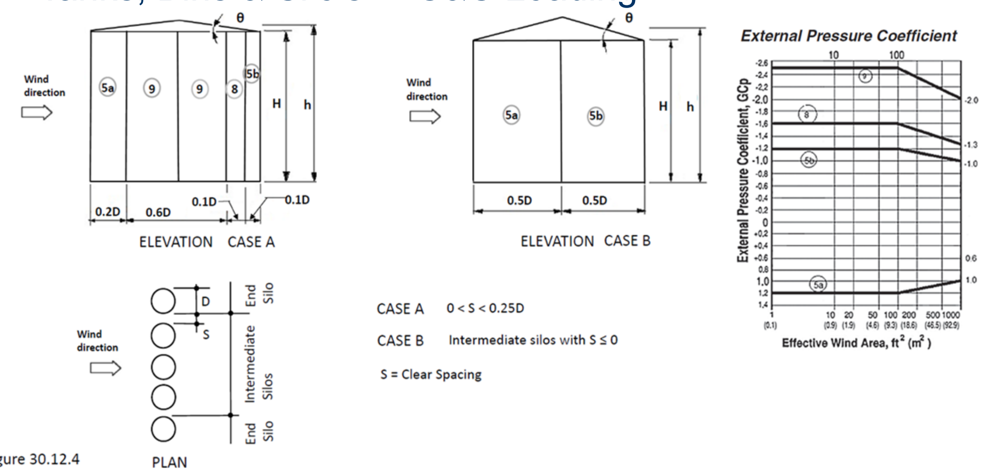


Figure 30.12.4

ASCE 7-16 Wind Provisions

- Tornado Commentary
  - Tornadoes not considered in the body of the standard because probability of strike of a EF0 or EF1 in the central US is in the order of a 4,000 MRI event.
  - For a EF4 or EF5 strike the probability of a particular building being impacted is 10^{-7} (which equates to a 10,000,000 year MRI event).
  - Current commentary is two paragraphs
  - Proposed commentary is 16 pages
  - Includes examples with recommended design parameters for tornadic winds
  - Prompted by recent tornado outbreaks

ASCE 7-16 Wind Provisions

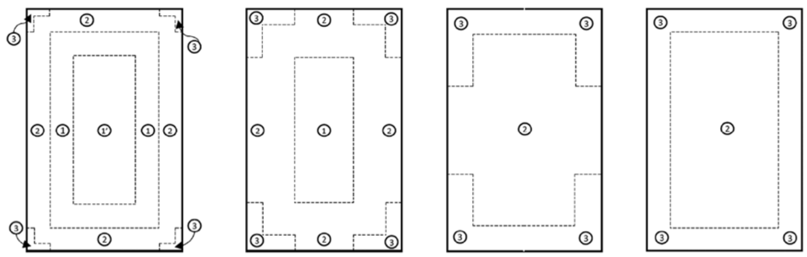
- Tornado Commentary
  - Tornado Wind Speeds and Probabilities
  - Wind Pressures induced by Tornadoes vs. other Wind Storms
  - Designing for Occupant Protection
  - Designing to Minimize Building Damage
  - Designing to Maintain Building Operation
  - Designing Trussed Communication Towers for Wind-Borne Debris

Improvements in ASCE 7-16

Overall Changes to Roof Loading

ASCE 7-16 – Wind Provisions

The evaluation of the data demonstrated that the roof zones for flat roof structures are highly dependent on the mean roof height of the structure as compared to the plan dimensions. Thus, the zone configuration have been modified.



Buildings with least horizontal dimension greater than 2.4*h*

Buildings with least horizontal dimension greater than 1.2*h* but less than 2.4*h*

Buildings with least horizontal dimension less than 1.2*h* and largest horizontal dimension greater than 1.2*h*

Buildings with largest horizontal dimension less than 1.2*h*

FIGURE C30-1 Four Possible Scenarios for Roof Zones, Which Depend on the Ratios of the Least and Largest Horizontal Plan Dimensions to the Mean Roof Height *h*

ASCE 7-16 – Wind Provisions

- Effects vary across the US based on new roof pressure coefficients, new design wind speeds, new elevation factor.
  - Review (4) locations across the US and compare to ASCE 7-10
    1. Miami, FL
    2. Nashville, TN
    3. Casper, WY
    4. San Francisco, CA

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ASCE 7-16 – Wind Provisions

1. Miami, FL
   - Basic Wind Speed = 171 mph
   - Exposure D
   - Elevation = 3'

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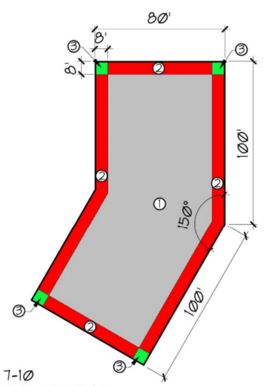
ASCE 7-16 – Wind Provisions

1. Miami, FL

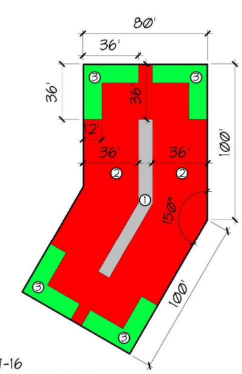


ASCE 7-10
LOCATION: MIAMI, FL
EXPOSURE: D

PLAN

USE 10FT^2

	-	+
ZONE ①	-97.2 PSF	39.5 PSF
ZONE ②	-163.1 PSF	39.5 PSF
ZONE ③	-245.5 PSF	39.5 PSF



ASCE 7-16
LOCATION: MIAMI, FL
EXPOSURE: D
ELEVATION: 3 FT
WINDSPEED: 171 MPH

PLAN

USE 10FT^2

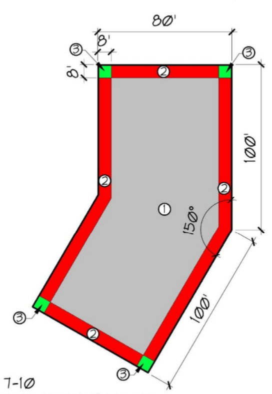
	-	+
ZONE ①	-155.3 PSF	39.6 PSF
ZONE ②	-204.8 PSF	39.6 PSF
ZONE ③	-279.2 PSF	39.6 PSF

ASCE 7-16 – Wind Provisions

2. Nashville, TN
   - Basic Wind Speed = 105 mph
   - Exposure B
   - Elevation = 500’

ASCE 7-16 – Wind Provisions

2. Nashville, TN

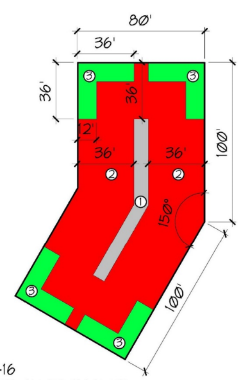


ASCE 7-10
LOCATION: NASHVILLE, TN
EXPOSURE: B

PLAN

USE 10FT²

	-	+
ZONE ①	-29.0 PSF	16 PSF
ZONE ②	-48.7 PSF	16 PSF
ZONE ③	-73.3 PSF	16 PSF



ASCE 7-16
LOCATION: NASHVILLE, TN
EXPOSURE: B
ELEVATION: 500 FT
WINDSPEED: 105 MPH

PLAN

USE 10FT²

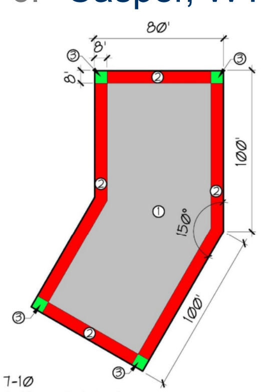
	-	+
ZONE ①	-37.5 PSF	16 PSF
ZONE ②	-49.6 PSF	16 PSF
ZONE ③	-67.5 PSF	16 PSF

ASCE 7-16 – Wind Provisions

3. Casper, WY
   - Basic Wind Speed = 108 mph
   - Exposure B
   - Elevation = 5,150’

ASCE 7-16 – Wind Provisions

3. Casper, WY

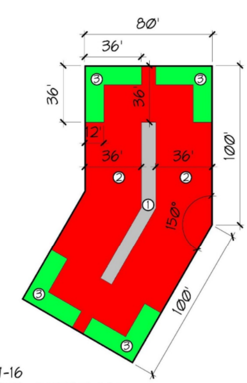


ASCE 7-10
LOCATION: CASPER, WY
EXPOSURE: B

PLAN

USE 10FT²

	-	+
ZONE ①	-29.0 PSF	17 PSF
ZONE ②	-48.7 PSF	17 PSF
ZONE ③	-73.3 PSF	17 PSF



ASCE 7-16
LOCATION: CASPER, WY
EXPOSURE: B
ELEVATION: 5150 FT
WINDSPEED: 108 MPH

PLAN

USE 10FT²

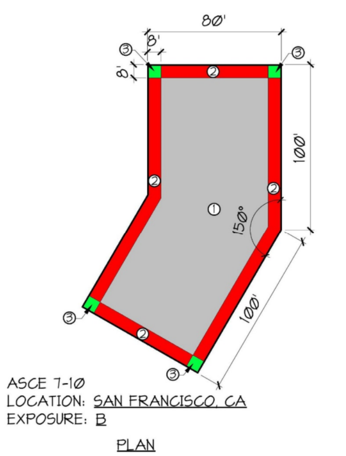
	-	+
ZONE ①	-33.3 PSF	16 PSF
ZONE ②	-43.9 PSF	16 PSF
ZONE ③	-54.8 PSF	16 PSF

ASCE 7-16 – Wind Provisions

4. San Francisco, CA
   - Basic Wind Speed = 92 mph
   - Exposure B
   - Elevation = 34'

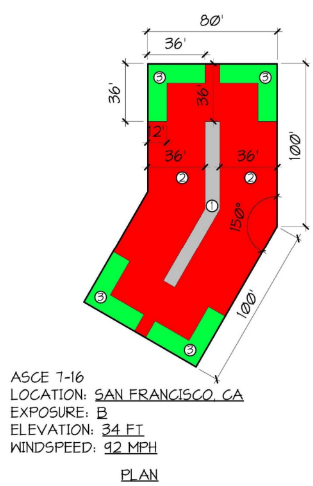
ASCE 7-16 – Wind Provisions

4. San Francisco, CA



USE 10FT²

	-	+
ZONE ①	-26.4 PSF	16 PSF
ZONE ②	-44.4 PSF	16 PSF
ZONE ③	-66.8 PSF	16 PSF



USE 10FT²

	-	+
ZONE ①	-29.5 PSF	16 PSF
ZONE ②	-38.9 PSF	16 PSF
ZONE ③	-53.1 PSF	16 PSF

ASCE 7-16 – Wind Provisions

Summary

- New Wind Speed Maps give lower MWFRS loads in the majority of the non-hurricane regions of the US.
- New Roof Pressure Coefficients increase cladding pressures on roof along the hurricane coast line.
- New Wind Speed Maps & Elevation Factors offset the increase in the Roof Pressure Coefficient increases for the remaining portion of the US.
- New Roof Zones are larger than previous zones, but better reflect the actual roof loading.
- New provisions provided for Roof Top Solar and Building Canopies.
- Tornado Guidelines provided in Commentary.

ASCE 7 – 16 Wind

Changes Affecting the Design Provisions

Questions?

Thank You!