ASCE 7-10
Wind Load Provisions
(Part 2)
Maps and Wind Design Provisions

by

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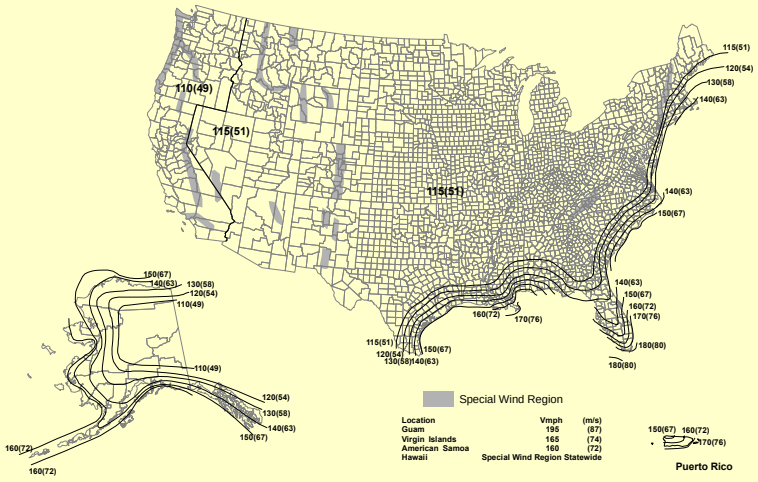
Agenda

- Wind speed maps
- Design procedures
  - Directional (all heights)
  - Envelope (simplified)
  - Simplified (buildings up to 160 ft. in height)
- MWFRS and C&C
- Load Cases

ASCE 7-10
Wind Speed Maps

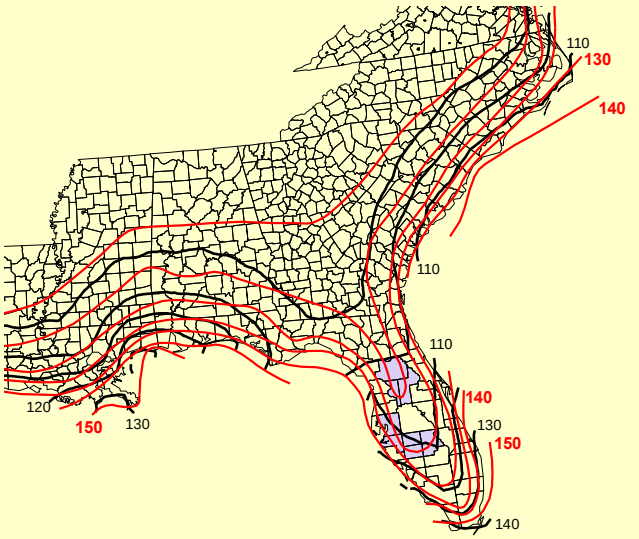
- Speeds are for ultimate event
- Maps for 3 Risk Categories (I, II, III and IV)
- Wind Speeds along the Hurricane Coastline were revised in 1998 to 3-sec peak gust
- Importance Factor is included in the speeds given in the maps

700 Year RP Winds

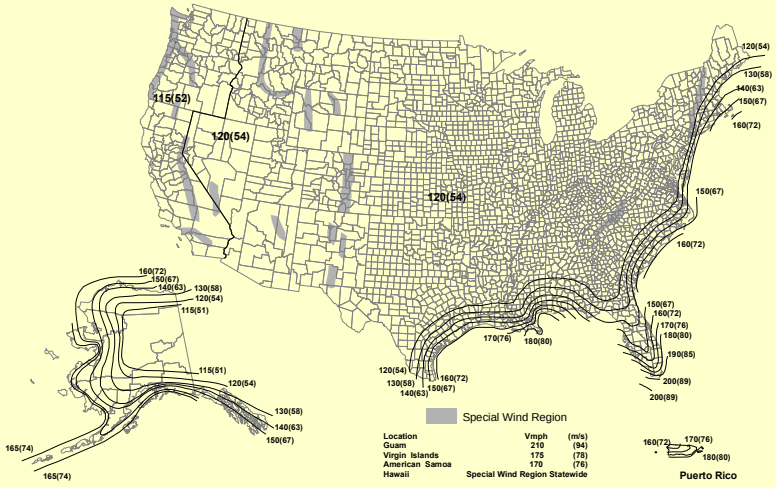


Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) above ground for Exposure C category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
5. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00143, MRI = 700 Years).

New $V_{700}/\sqrt{1.6}$ vs. ASCE 7-05

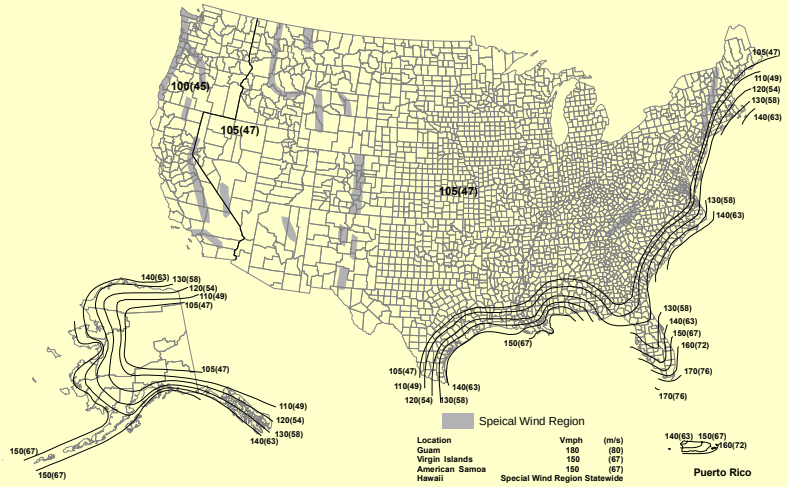


1700 Year RP Winds



Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) 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.
5. Wind speeds correspond to approximately a 3% probability of exceedance in 50 years (Annual Exceedance Probability = 0.000588, MRI = 1700 Years).

300 Year RP Winds



Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) 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.
5. Wind speeds correspond to approximately a 15% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00333, MRI = 300 Years).

Wind speeds at selected locations

Location	ASCE 7-05 Exposure C	$V_{700}/\sqrt{1.6}$	
		Exposure C	Exposure D
Bar Harbor, Maine	97	95	103
Boston, MA	106	103	112
Hyannis, MA	117	112	122
New Port, RI	117	109	119
Southampton, NY	120	110	119
Atlantic City, NJ	114	102	111
Wrightsville Beach, NC	132	119	129
Folly Beach, SC	131	115	125
Miami Beach	145	136	148
Clearwater, FL	128	115	125
Panama City, FL	129	107	116
Biloxi, MS	138	129	140
Galveston, TX	131	119	129
Port Aransas, TX	134	117	127
Hawaii	105	103	112
Guam	170	155	168

ASCE 7-10 MWFRS Alternative Design Procedures

- Chapter 27 (Directional Procedure)
  - Part 1: Buildings of all heights
  - Part 2: Simple diaphragm buildings with h ≤ 160 ft. (pressures read from tables)
- Chapter 28 (Envelope Procedure)
  - Part 1: Enclosed or partially enclosed low-rise buildings
  - Part 2: Simple diaphragm buildings with h ≤ 60 ft. (pressures read from tables)
- Chapter 31 - Wind Tunnel Procedure

Design Procedures

Chapter 27

Directional Procedure

(all heights method)

Chapter 27 Directional Procedure

Velocity Pressure: **(27.3)**

q_z (q_h)= 0.00256 K_z K_{zt} K_d V^2 **(Eq. 27.3-1)**

where:

q_z = velocity pressure at height z

q_h = velocity pressure at mean roof height h

Directional Procedure

- Chapter 27

$$p = qGC_p - q_i(GC_{pi})$$

- where:
  - q = velocity pressure
  - G = gust effect factor
  - C_p = external pressure coefficient
  - q_i = velocity pressure at mean roof height h
  - GC_{pi} = internal pressure coefficient

Directional Procedure

Design Procedure (Table 27.2-1):

1. Wind Speed V (Figure 26.5-1 maps)
2. Wind Directionality Factor K_d (26.6, Table 26.6-1)
3. For each wind direction:
   - Exposure Category (26.7)
   - Velocity Pressure Exposure Coefficient K_z, K_h (Table 27.3-1)

Wind Directionality Factor, K_d

Structure Type	Directionality Factor K_d*
Buildings Main Wind Force Resisting System Components and Cladding	 0.85 0.85
Arched Roofs	0.85
Chimneys, Tanks, and Similar Structures Square Hexagonal Round	 0.90 0.95 0.95
Solid Signs	0.85
Open Signs and Lattice Framework	0.85
Trussed Towers Triangular, square, rectangular All other cross sections	 0.85 0.95

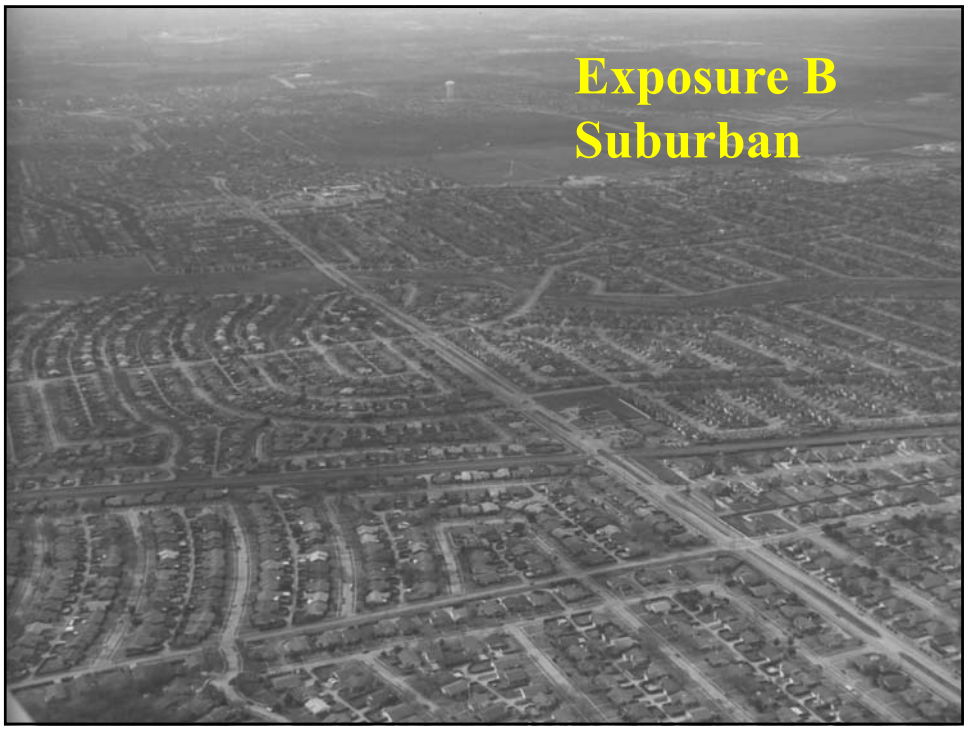
26.7 Exposure Categories

B ***Suburban, use as DEFAULT unless others apply***
>60% to 80% of all buildings are in this category

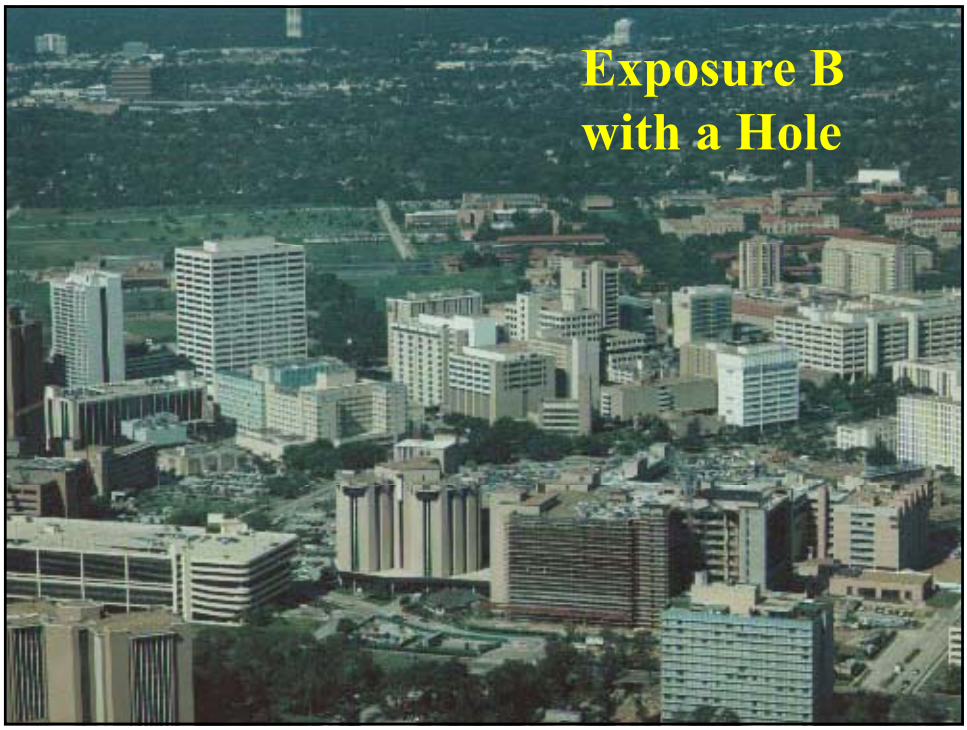
C ***Open country, 1500 ft creates this category***

D ***Water, <u>including on hurricane coast!</u>***

It's about Flow Characteristics vs. Surface Roughness




Exposure B
Urban


Exposure B
with a Hole


Exposure C


Exposure C
(<1500 ft of B)

Table 27.3-1 Velocity Pressure Exposure Coefficients, K_h and K_z

Height above ground level, z		Exposure		
		B	C	D
ft	(m)			
0-15	(0-4.6)	0.57	0.85	1.03
20	(6.1)	0.62	0.90	1.08
25	(7.6)	0.66	0.94	1.12
30	(9.1)	0.70	0.98	1.16
40	(12.2)	0.76	1.04	1.22
50	(15.2)	0.81	1.09	1.27
60	(18)	0.85	1.13	1.31
70	(21.3)	0.89	1.17	1.34
80	(24.4)	0.93	1.21	1.38
90	(27.4)	0.96	1.24	1.40
100	(30.5)	0.99	1.26	1.43
120	(36.6)	1.04	1.31	1.48
140	(42.7)	1.09	1.36	1.52
160	(48.8)	1.13	1.39	1.55
180	(54.9)	1.17	1.43	1.58
200	(61.0)	1.20	1.46	1.61
250	(76.2)	1.28	1.53	1.68
300	(91.4)	1.35	1.59	1.73
350	(106.7)	1.41	1.64	1.78
400	(121.9)	1.47	1.69	1.82
450	(137.2)	1.52	1.73	1.86
500	(152.4)	1.56	1.77	1.89

Table 26.9-1 Terrain Exposure Constants

2. The velocity pressure exposure coefficient K_z may be determined from the following formula:

   For 15 ft. $\le z \le z_g$: $K_z = 2.01\ (z/z_g)^{2/\alpha}$

   For $z < 15$ ft. : $K_z = 2.01\ (15/z_g)^{2/\alpha}$

   Note: z shall not be taken less than 30 feet for Case 1 in exposure B.

3. α and z_g are tabulated in Table 6-2.
4. Linear interpolation for intermediate values of height z is acceptable.
5. Exposure categories are defined in 6.5.6.

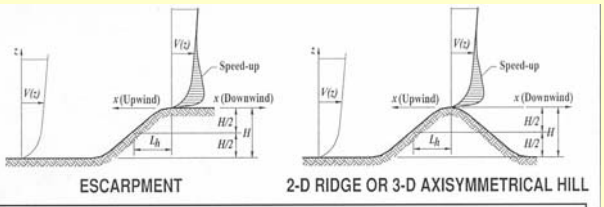
Exposure	α	z_g (ft)	$\hat{a}$	$\hat{b}$	$\bar{\alpha}$	$\bar{b}$	c	ℓ (ft)	$\bar{\epsilon}$	z_{min} (ft)*
B	7.0	1200	1/7	0.84	1/4.0	0.45	0.30	320	1/3.0	30
C	9.5	900	1/9.5	1.00	1/6.5	0.65	0.20	500	1/5.0	15
D	11.5	700	1/11.5	1.07	1/9.0	0.80	0.15	650	1/8.0	7

Directional Procedure

Design Procedure (Table 27.2-1 continued):

4. **Topographic Factor, K_{zt} (26.8, Table 28.8-1)**
5. **Gust Effect Factor G or G_f (26.9)**
6. **Enclosure Classification (26.10)**
7. **Internal Pressure Coefficient GC_{pi} (26.11, Table 26.11-1)**
8. **External Pressure Coefficients C_p, GC_{pf} (Figures 24.4-1-3) or force coefficients C_f (Figures 27.4-4-7)**

Fig. 26.8-1 Topographic Factors, K_{zt}



ESCARPMENT 2-D RIDGE OR 3-D AXISYMMETRICAL HILL

Topographic Multipliers for Exposure C

H/L_h	K_1 Multiplier			x/L_h	K_2 Multiplier		z/L_h	K_3 Multiplier		
	2-D Ridge	2-D Escarp.	3-D Axisym. Hill		2-D Escarp.	All Other Cases		2-D Ridge	2-D Escarp.	3-D Axisym. Hill
0.20	0.29	0.17	0.21	0.00	1.00	1.00	0.00	1.00	1.00	1.00
0.25	0.36	0.21	0.26	0.50	0.88	0.67	0.10	0.74	0.78	0.67
0.30	0.43	0.26	0.32	1.00	0.75	0.33	0.20	0.55	0.61	0.45
0.35	0.51	0.30	0.37	1.50	0.63	0.00	0.30	0.41	0.47	0.30
0.40	0.58	0.34	0.42	2.00	0.50	0.00	0.40	0.30	0.37	0.20
0.45	0.65	0.38	0.47	2.50	0.38	0.00	0.50	0.22	0.29	0.14
0.50	0.72	0.43	0.53	3.00	0.25	0.00	0.60	0.17	0.22	0.09
				3.50	0.13	0.00	0.70	0.12	0.17	0.06
				4.00	0.00	0.00	0.80	0.09	0.14	0.04
							0.90	0.07	0.11	0.03
							1.00	0.05	0.08	0.02
							1.50	0.01	0.02	0.00
							2.00	0.00	0.00	0.00

Fig. 26.8-1 Topographic Factors, K_{zt}

Equations:

$$K_{zt} = (1 + K_1 K_2 K_3)^2$$

K_1 determined from table below

$$K_2 = \left(1 - \frac{|x|}{\mu L_h}\right)$$

$$K_3 = e^{-\gamma z / L_h}$$

Parameters for Speed-Up Over Hills and Escarpments

Hill Shape	$K_1/(H/L_h)$ Exposure			γ	μ	
	B	C	D		Upwind of Crest	Downwind of Crest
2-dimensional ridges (or valleys with negative H in $K_1/(H/L_h)$)	1.30	1.45	1.55	3	1.5	1.5
2-dimensional escarpments	0.75	0.85	0.95	2.5	1.5	4
3-dimensional axisym. hill	0.95	1.05	1.15	4	1.5	1.5

26.9 Gust Effect Factor, G

- For rigid structures as defined in Section 26.2, G shall be taken as 0.85 or calculated by Eqs. 26.9-6, 26.9-7, 26.9-8 and 26.9-9, using Table 26.9-1.
- For flexible or dynamically sensitive structures as defined in Section 26.2, G_f shall be calculated by Eqs. 26.9-10, 26.9-11, 26.9-12, 26.9-13, 26.9-14, 26.9-15a, 26.9-15b and 26.9-16, using Table 26.9-1.

26.10 Enclosure Classification

Buildings, Open:

A building having each wall at least 80% open.

Mathematically, $A_o \geq 0.8A_g$ where:

A_o = Total area of openings in a wall that receives positive external pressure, in sq. ft.

A_g= Gross area of that wall in which A_o is identified in sq. ft.

26.10 Enclosure Classification

Buildings, Partially Enclosed:

If the following two conditions are satisfied:

1. $A_o > 1.1A_{oi}$
2. $A_o > 4$ sq. ft or $>0.01A_g$, whichever is smaller, & $A_{oi} \leq 0.2A_{gi}$

where:

A_{oi} = The sum of the areas of openings in the building envelope (walls & roof) not including A_o, in sq. ft.

A_{gi} = The sum of the gross surface areas of the building envelope (walls & roof) not including A_g, in sq. ft.

26.10.3 Wind Borne Debris Regions

- Glazed openings in Risk Category II, III, IV buildings requires protection
- Exception – Glazing located over 60 ft. above ground and over 30 ft. above aggregate-surfaced roofs shall be permitted to be unprotected

Table 26.11-1 Internal Pressure Coeff, GC_{pi}

Enclosure Classification	GC_{pi}
Open Buildings	0.00
Partially Enclosed Buildings	+0.55 -0.55
Enclosed Buildings	+0.18 -0.18

Directional Procedure

- Base method in ASCE 7 for 30+ years.
- Best representation of actual pressures.
- Best method to adapt to unusual buildings.
- Examples in Seminar 3 – Traditional Methods

Fig. 27.4-1

External Pressure Coefficient, C_p for MWFRS

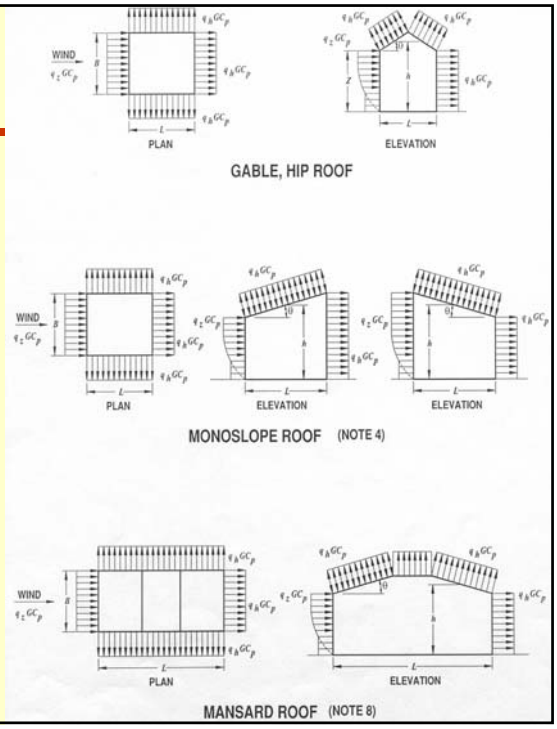


Fig. 27.4-1 C_p for MWFRS: Walls

Wall Pressure Coefficients, C_p			
Surface	**L/B**	**C_p**	**Use With**
Windward Wall	All values	0.8	q_z
Leeward Wall	0-1	-0.5	q_h
	2	-0.3	
	≥4	-0.2	
Side Wall	All values	-0.7	q_h

Fig. 27.4-1 C_p for MWFRS: Roofs

Roof Pressure Coefficients, C_p, for use with q_h

Wind Direction	Windward									Leeward		
	Angle, θ (degrees)									Angle, θ (degrees)		
	h/L	10	15	20	25	30	35	45	≥60#	10	15	≥20
Normal to ridge for θ ≥ 10°	≤0.25	-0.7 -0.18	-0.5 0.0*	-0.3 0.2	-0.2 0.3	-0.2 0.3	0.0* 0.4	0.4	0.01 θ	-0.3	-0.5	-0.6
	0.5	-0.9 -0.18	-0.7 -0.18	-0.4 0.0*	-0.3 0.2	-0.2 0.2	-0.2 0.3	0.0* 0.4	0.01 θ	-0.5	-0.5	-0.6
	≥1.0	-1.3** -0.18	-1.0 -0.18	-0.7 -0.18	-0.5 0.0*	-0.3 0.2	-0.2 0.2	0.0* 0.3	0.01 θ	-0.7	-0.6	-0.6

Normal to ridge for θ < 10 and Parallel to ridge for all θ		Horiz distance from windward edge	C_p
	≤ 0.5	0 to h/2	-0.9, -0.18
		H/2 to h	-0.9, -0.18
		h to 2 h	-0.5, -0.18
		> 2h	-0.3, -0.18
	≥ 1.0	0 to h/2	-1.3**, -0.18
		> h/2	-0.7, -0.18

*Value is provided for interpolation purposes.

**Value can be reduced linearly with area over which it is applicable as follows

Area (sq ft)	Reduction Factor
≤ 100 (9.3 sq m)	1.0
200 (23.2 sq m)	0.9
≥ 1000 (92.9 sq m)	0.8

Fig. 27.4-1 C_p for MWFRS

Notes:

1. Plus and minus signs signify pressures acting toward and away from the surfaces, respectively.
2. Linear interpolation is permitted for values of *L/B*, *h/L* and θ other than shown. Interpolation shall only be carried out between values of the same sign. Where no value of the same sign is given, assume 0.0 for interpolation purposes.
3. Where two values of C_p are listed, this indicates that the windward roof slope is subjected to either positive or negative pressures and the roof structure shall be designed for both conditions. Interpolation for intermediate ratios of h/L in this case shall only be carried out between C_p values of like sign.
4. For monoslope roofs, entire roof surface is either a windward or leeward surface.
5. For flexible buildings use appropriate G_f as determined by Section 26.9.4.
6. Refer to Figure 27.4-2 for domes and Figure 27.4-3 for arched roofs.
7. Notation:
   B: Horizontal dimension of building, in feet (meter), measured normal to wind direction.
   L: Horizontal dimension of building, in feet (meter), measured parallel to wind direction.
   h: Mean roof height in feet (meters), except that eave height shall be used for θ ≤ 10 degrees.
   z: Height above ground, in feet (meters).
   G: Gust effect factor.
   q_z,q_h: Velocity pressure, in pounds per square foot (N/m^2), evaluated at respective height.
   θ: Angle of plane of roof from horizontal, in degrees.
8. For mansard roofs, the top horizontal surface and leeward inclined surface shall be treated as leeward surfaces from the table.
9. Except for MWFRS's at the roof consisting of moment resisting frames, the total horizontal shear shall not be less than that determined by neglecting wind forces on roof surfaces.

#For roof slopes greater than 80°, use C_p = 0.8

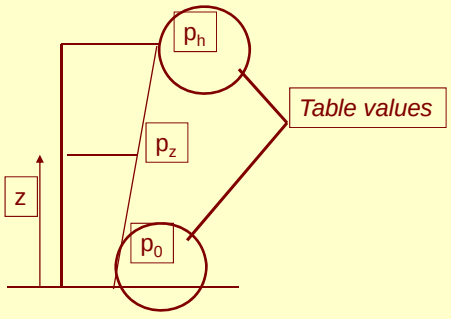
Part 2 – Enclosed Buildings with h ≤ 160 ft.

- Wind pressures obtained directly from tables (Table 27.6-1)
- Derived from Directional Procedure
- Building must be enclosed with simple diaphragm
- Building may be any plan shape and roof geometry
- Must determine L/B ratio to use table

Part 2 – Enclosed Buildings with h ≤ 160 ft.

- *Pressure p_z (psf):*

  $p_z = p_0 (1 - z / h) + (z / h) p_h$



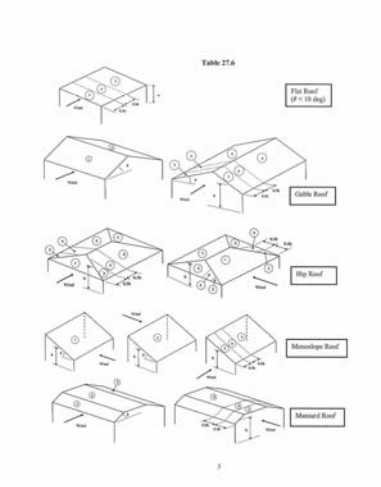
Part 2 – Enclosed Buildings with h ≤ 160 ft.

P_0 P_h

Table 27.6-1
MWFRS – Part 2: Wind Loads – Walls
Exposure C

V(mph)	110			115			120			130			140			160			180			200		
h(ft.), L/B	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2	0.5	1	2
160	49.2	48.7	43.7	54.5	53.9	48.3	60.0	59.3	53.3	72.2	71.1	64.1	85.8	84.3	76.1	117.4	115.0	103.9	155.4	151.8	137.2	200.2	195.0	176.2
	36.1	35.7	30.0	40.0	39.5	33.2	44.1	43.5	36.6	53.0	52.2	44.0	62.9	61.9	52.3	86.2	84.4	71.5	114.1	111.4	94.3	146.9	143.1	121.1
150	48.0	47.5	42.6	53.0	52.4	47.1	58.5	57.7	51.9	70.1	69.2	62.3	83.3	82.0	74.0	113.8	111.7	101.0	150.6	147.3	133.3	198.8	189.0	171.9
	35.5	35.2	29.6	39.3	38.8	32.7	43.3	42.8	36.1	52.0	51.3	43.3	61.7	60.7	51.4	84.3	82.8	70.2	111.5	109.1	92.7	143.5	140.0	118.9
140	46.6	46.2	41.4	51.5	51.0	45.8	56.7	56.1	50.4	68.1	67.2	60.6	80.7	79.6	71.8	110.2	108.3	98.0	145.6	142.6	129.2	187.2	182.9	165.7
	34.9	34.6	29.1	38.6	38.2	32.2	42.4	42.0	35.5	50.9	50.3	42.6	60.4	59.5	50.6	82.4	81.0	68.9	108.9	106.7	90.9	140.0	136.8	116.6
130	45.3	45.0	40.2	50.0	49.6	44.5	55.1	54.5	48.9	65.9	65.2	58.7	78.1	77.1	69.6	106.4	104.7	94.8	140.4	137.7	124.9	180.4	176.5	160.1
	34.3	34.0	28.7	37.8	37.5	31.7	41.6	41.2	34.9	49.9	49.3	41.9	59.1	58.3	49.8	80.5	79.2	67.8	106.2	104.1	89.1	136.4	133.4	114.2
120	43.9	43.6	39.0	48.5	48.1	43.1	53.3	52.8	47.4	63.8	63.1	56.8	75.4	74.6	67.3	102.6	101.1	91.5	135.1	132.7	120.5	173.3	169.8	154.3
	33.6	33.4	28.2	37.1	36.8	31.1	40.7	40.4	34.3	48.8	48.3	41.1	57.7	57.1	48.7	78.5	77.3	66.2	103.3	101.5	87.1	132.6	129.9	111.6
110	42.5	42.3	37.7	46.9	46.6	41.6	51.5	51.1	45.8	61.5	61.0	54.8	72.7	72.0	64.8	98.6	97.3	88.1	129.6	127.6	115.8	166.0	163.0	148.2
	32.9	32.8	27.7	36.3	36.1	30.6	39.9	39.6	33.6	47.7	47.3	40.3	56.3	55.8	47.6	76.4	75.4	64.7	100.4	98.8	85.1	128.6	126.3	108.9
100	41.1	40.9	36.4	45.2	45.0	40.1	49.6	49.3	44.1	59.2	58.8	52.7	69.8	69.3	62.3	94.5	93.5	84.5	123.9	122.2	111.0	158.5	155.9	141.9
	32.3	32.1	27.2	35.5	35.4	30.0	39.0	38.8	33.0	46.5	46.2	39.4	54.9	54.4	46.6	74.2	73.4	63.2	97.4	96.0	82.9	124.5	122.5	106.1
90	39.6	39.4	35.0	43.5	43.3	38.5	47.7	47.5	42.3	56.8	56.5	50.6	66.9	66.5	59.7	90.3	89.4	80.8	118.1	116.7	105.9	150.6	148.5	135.2
	31.6	31.5	26.6	34.7	34.6	29.4	38.1	37.9	32.3	45.4	45.1	38.5	53.4	53.1	45.5	72.1	71.4	61.6	94.2	93.2	80.7	120.3	118.6	103.0

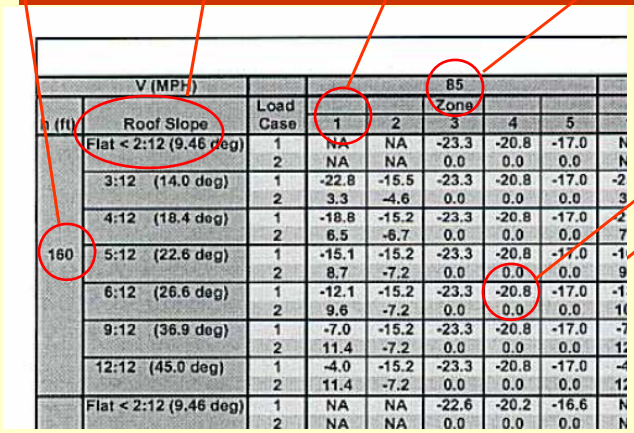
Roof Pressures - MWFRS



Roof Pressure Zones

Roof Shapes:
- **Flat**
- **Gable**
- **Hip**
- **Monoslope**
- **Mansard**

Height h (ft) *Roof Slope* *Roof Zone* *V (MPH)*



h (ft)	Roof Slope	Load Case	1	2	3	4	5
			V (MPH) 85 Zone				
160	Flat < 2:12 (9.46 deg)	1	NA	NA	-23.3	-20.8	-17.0
		2	NA	NA	0.0	0.0	0.0
	3:12 (14.0 deg)	1	-22.8	-15.5	-23.3	-20.8	-17.0
		2	3.3	-4.6	0.0	0.0	0.0
	4:12 (18.4 deg)	1	-18.8	-15.2	-23.3	-20.8	-17.0
		2	6.5	-6.7	0.0	0.0	0.0
	5:12 (22.6 deg)	1	-15.1	-15.2	-23.3	-20.8	-17.0
		2	8.7	-7.2	0.0	0.0	0.0
	6:12 (26.6 deg)	1	-12.1	-15.2	-23.3	-20.8	-17.0
		2	9.6	-7.2	0.0	0.0	0.0
	9:12 (36.9 deg)	1	-7.0	-15.2	-23.3	-20.8	-17.0
		2	11.4	-7.2	0.0	0.0	0.0
	12:12 (45.0 deg)	1	-4.0	-15.2	-23.3	-20.8	-17.0
		2	11.4	-7.2	0.0	0.0	0.0
	Flat < 2:12 (9.46 deg)	1	NA	NA	-22.6	-20.2	-16.6
		2	NA	NA	0.0	0.0	0.0

Pressure (psf) (Two load cases for sloped roofs)

Exposure C Table for Roof, Adjustment factors for other exposures

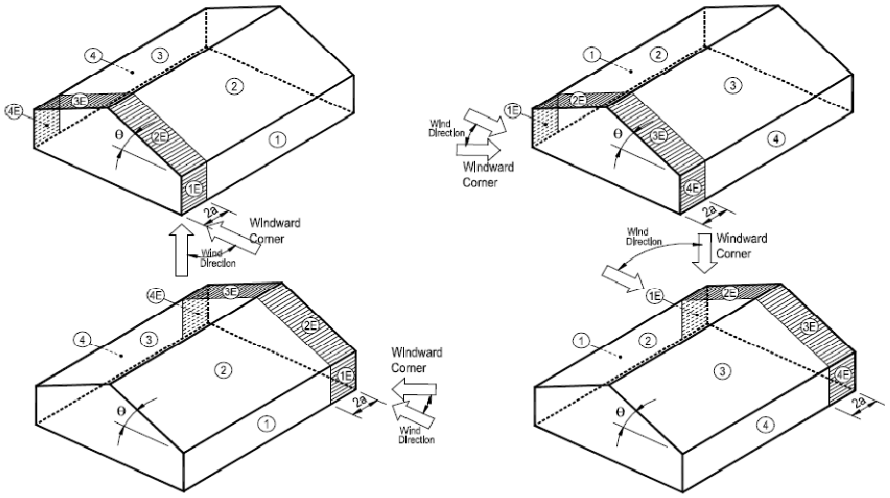
28.4.1 Part 1- MWFRS Envelope Procedure

- **Chapter 28**

$$p = q_h[(GC_{pf}) - (GC_{pi})]$$

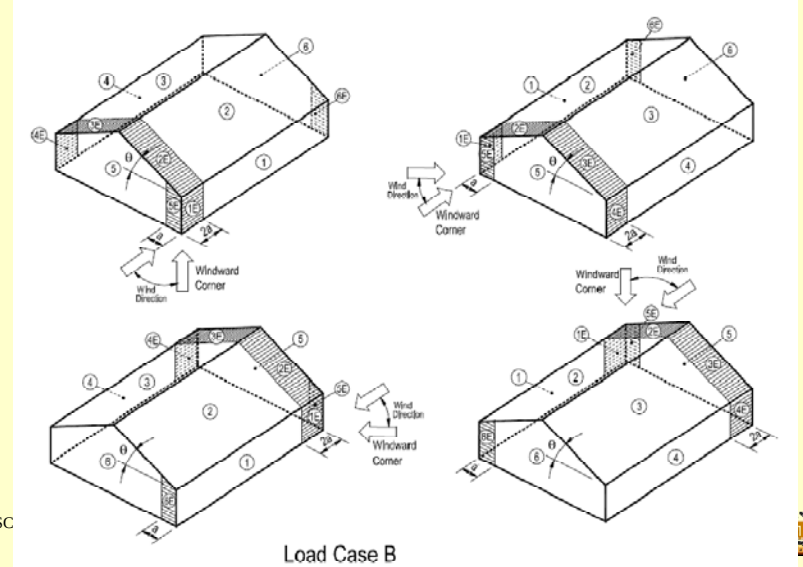
- **where:**
  - q_h = velocity pressure at mean roof height h
  - GC_{pf} = external pressure coefficient
  - GC_{pi} = internal pressure coefficient

Fig. 28.4-1 GC_{pf} for MWFRS: h ≤ 60 ft



Load Case A

Fig. 28.4-1 GC_{pf} for MWFRS: h ≤ 60 ft



Load Case B

Fig. 28.4-1 GC_{pf} for MWFRS

Roof Angle θ (degrees)	LOAD CASE A							
	Building Surface							
	1	2	3	4	1E	2E	3E	4E
0-5	0.40	-0.69	-0.37	-0.29	0.61	-1.07	-0.53	-0.43
20	0.53	-0.69	-0.48	-0.43	0.80	-1.07	-0.69	-0.64
30-45	0.56	0.21	-0.43	-0.37	0.69	0.27	-0.53	-0.48
90	0.56	0.56	-0.37	-0.37	0.69	0.69	-0.48	-0.48

Roof Angle θ (degrees)	LOAD CASE B											
	Building Surface											
	1	2	3	4	5	6	1E	2E	3E	4E	5E	6E
0-90	-0.45	-0.69	-0.37	-0.45	0.40	-0.29	-0.48	-1.07	-0.53	-0.48	0.61	-0.43

There are 9 notes that describe the application of these coefficients and the torsional load cases.

Part 2 - Envelope Method - MWFRS

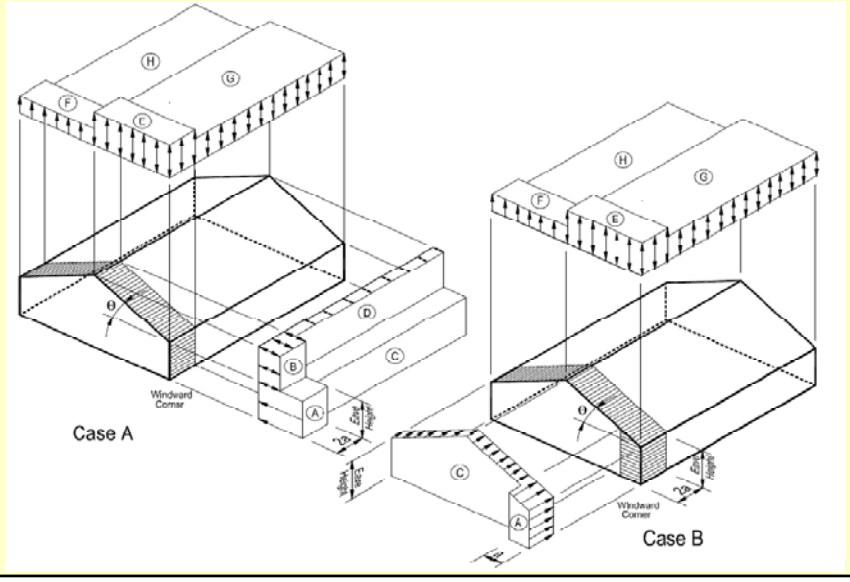
$$p_s = \lambda K_{zt} p_{s30}$$

- **where:**
  - **p_s = simplified design pressure for surfaces A-H**
  - **λ = adjustment factor**
  - **K_{zt} = topographic adjustment**
  - **P_{s30} = pressures read from tables**

28.6.1 Part 2 – MWFRS Envelope Procedure

- Completely revised for 7-02.
- This version first appeared in IBC 2000. There is a slightly different simplified version in the current IBC.
- Wind pressures obtained from tables.
- MWFRS based on the Envelope Procedure contained in Part 1 of Chapter 28.
- Pressures are applied to vertical and horizontal projected areas.
- Building must be enclosed, simple diaphragm, low-rise building with flat, gable or hip roof shape.

Part 2 - Simplified Method - MWFRS



Part 2 - Envelope Method - MWFRS

Simplified Design Wind Pressure , p_{S30} (psf) *(Exposure B at h = 30 ft. with I = 1.0)*

Basic Wind Speed (mph)	Roof Angle (degrees)	Load Case	Zones									
			Horizontal Pressures				Vertical Pressures				Overhangs	
			A	B	C	D	E	F	G	H	E_{OH}	G_{OH}
110	0 to 5°	1	19.2	-10.0	12.7	-5.9	-23.1	-13.1	-16.0	-10.1	-32.3	-25.3
	10°	1	21.6	-9.0	14.4	-5.2	-23.1	-14.1	-16.0	-10.8	-32.3	-25.3
	15°	1	24.1	-8.0	16.0	-4.6	-23.1	-15.1	-16.0	-11.5	-32.3	-25.3
	20°	1	26.6	-7.0	17.7	-3.9	-23.1	-16.0	-16.0	-12.2	-32.3	-25.3
	25°	1	24.1	3.9	17.4	4.0	-10.7	-14.6	-7.7	-11.7	-19.9	-17.0
		2	-------	------	-------	------	-4.1	-7.9	-1.1	-5.1	-------	-------
	30 to 45	1	21.6	14.8	17.2	11.8	1.7	-13.1	0.6	-11.3	-7.6	-8.7
		2	21.6	14.8	17.2	11.8	8.3	-6.5	7.2	-4.6	-7.6	-8.7

Adjustment Factor for Building Height and Exposure, λ

Mean roof height (ft)	Exposure B	Exposure C	Exposure 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

Other MWFRS External Pressure Coefficients

- Domed Roofs– Figure 27.4-2
- Arched Roofs – Figure 27.4-3
- Monoslope Roofs (and other shapes) – Figure 27.4-4-7
- Chimneys, Tanks, & Roof Equip – Figure 29.5-1
- Walls and Solid Signs – Figure 29.4-1
- Open Signs & Lattices – Figure 29.5-2
- Trussed Towers – Figure 29.5-3

Components & Cladding
(Chapter 30)

Pressure Coefficients

C&C Pressure Equations

- **Low-rise buildings with h ≤ 60 ft. based on Envelope Procedure**

$$p = q_h[(GC_p) - (GC_{pi})]$$

- **Buildings with h ≥ 60 ft. based on Directional Procedure**

$$p = q(GC_p) - q_i(GC_{pi})$$

- **Buildings with h ≤ 160 ft. based on Simplified Method (pressures in Table 30.9-1)** $p = p_{table}(EAF)(RF)K_{zt}$

Fig. 30.4-1 GC_p for C & C-Walls: h ≤ 60 ft

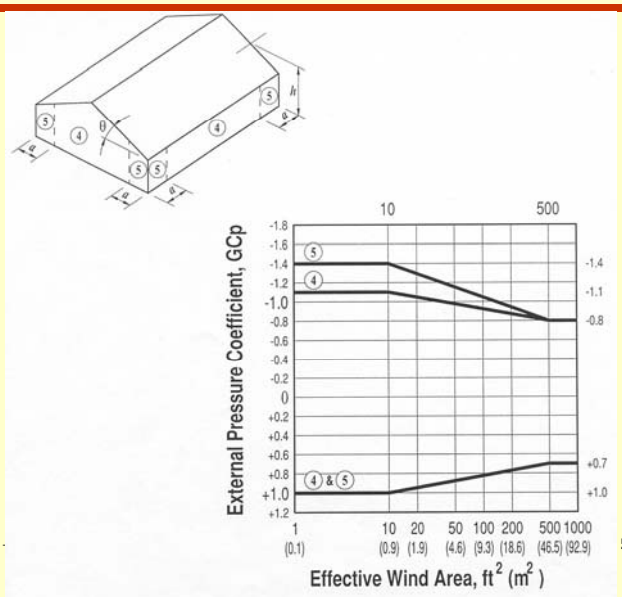


Fig. 30.4-1 GC_p for C & C-Walls

Notes:

1. Vertical scale denotes GC_p to be used with q_h.
2. Horizontal scale denotes effective wind area, in square feet (square meters).
3. Plus and minus signs signify pressures acting toward and away from the surfaces, respectively
4. Each component shall be designed for maximum positive and negative pressures.
5. Values of GC_p for walls shall be reduced by 10% when $\theta \leq 10°$.
6. Notation:
   - a: 10 percent of least horizontal dimension or 0.4h, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft (1 m).
   - h: Mean roof height, in feet (meters), except that eave height shall be used for $\theta \leq 10°$.
   - θ: Angle of plane of roof from horizontal, in degrees.

Fig. 30.4-2A GC_p for C&C-Gable Roofs:h ≤ 60 ft

For $\theta \leq 7^o$

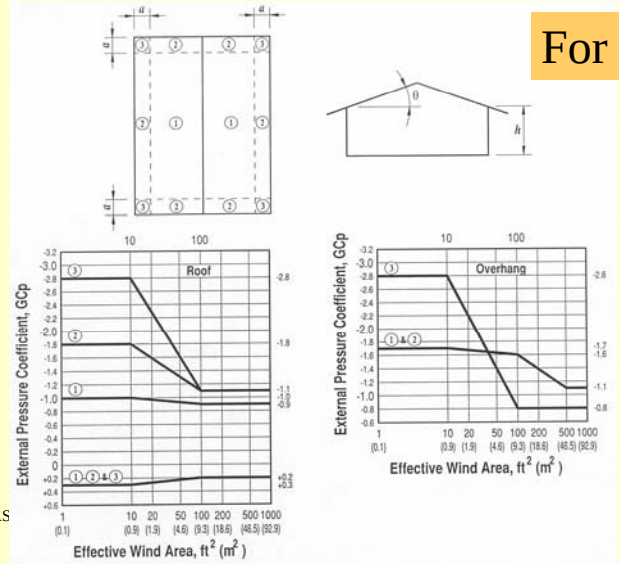
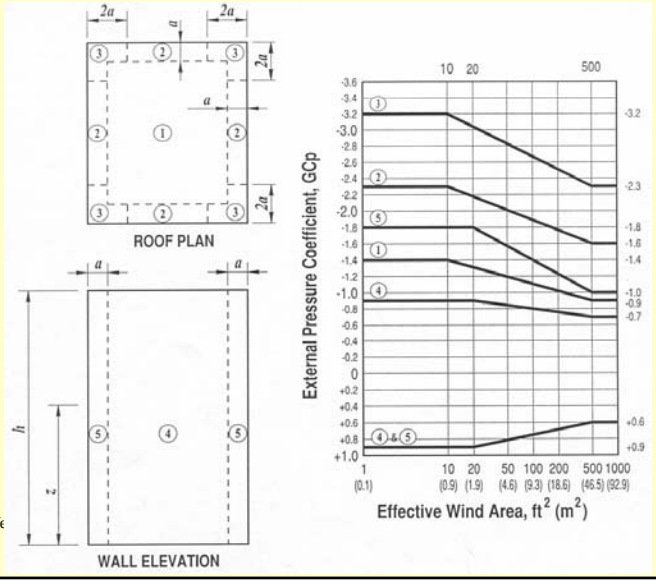


Fig. 30.6-1 GC_p for C & C: h > 60 ft



Chapter 29 Other Structures/Appurtenances

- **Design Force – Solid freestanding walls and solid signs:**

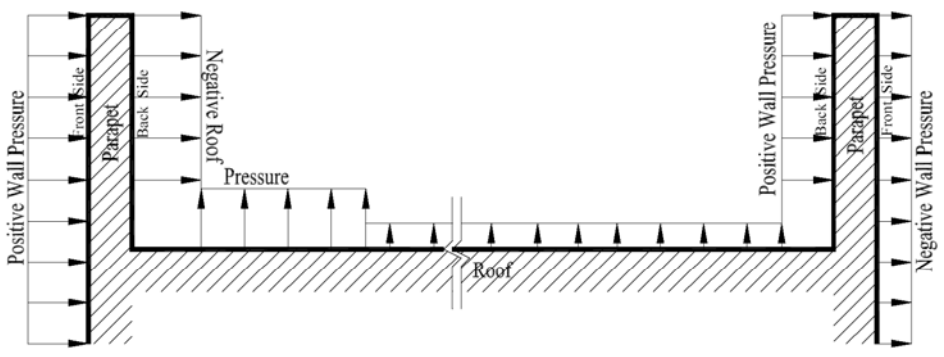
$$F = q_h G C_f A_s \qquad \text{(Eq. 29.4-1)}$$

- **Design Force – Other Structures**

$$F = q_z G C_f A_f \qquad \text{(Eq. 29.5-1)}$$

- **where:**
  - **q = velocity pressure**
  - **C_f = force coefficients**
  - **A_s = gross area of solid sign or wall**
  - **A_f = projected area normal to wind**

Parapets – Chapter 27



Methodology used to Develop External Parapet Pressures
(Main Wind Force Resisting Systems and Components and Cladding)

Parapets – Chapter 27

$$p_p = q_p G C_{pn}$$

where:

p_p = combined net pressure on parapet

q_p = velocity pressure at the top of parapet

GC_{pn} = combined net pressure coefficient

= +1.5 for windward parapet

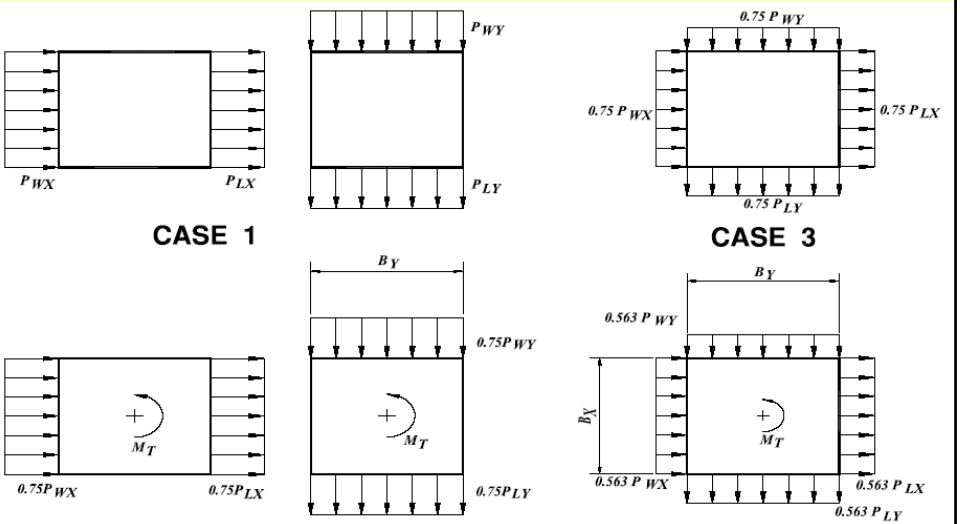
= - 1.0 for leeward parapet

$h = h_p$ = height at top of parapet

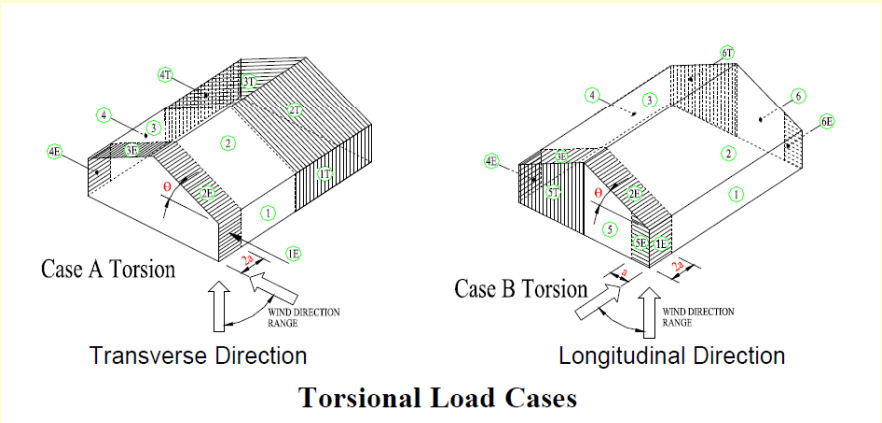
Wind Load Cases

Torsional Loadings

Traditional Method - Load Cases



Envelope Method - Load Cases



Torsional Load Cases

5. For the torsional load cases shown below, the pressures in zones designated with a "T" (1T, 2T, 3T, 4T, 5T, 6T) shall be 25% of the full design wind pressures (zones 1, 2, 3, 4, 5, 6).
   Exception: One story buildings with h less than or equal to 30 ft (9.1m), buildings two stories or less framed with light frame construction, and buildings two stories or less designed with flexible diaphragms need not be designed for the torsional load cases.
   Torsional loading shall apply to all eight basic load patterns using the figures below applied at each windward corner.

Simplified Method h ≤ 160 ft. Load Cases

- Appendix D
- Cases A – F to consider
- Torsional load cases are those shown in Figure 27.4-8 and shown here as the traditional load cases

2.3.2 Strength Design Load Combinations

Wind load factor changed in 2010 Edition:

- Old: LF = 1.6
- New: Load factor from 1.6 to 1.0; load factor is built into the MRI for the maps
- For ASD design, new load factor is 0.63, reduced from 1.0

Future Seminars

February 18

- **Examples**

Resources

- Email for Speaker:
  - bcoulbourne@atcouncil.org
- Guide to the Use of the Wind Load Provisions of ASCE 7-05 (and ASCE 7-10 coming soon)
  - www.pubs.asce.org
- Basic Wind Engineering for Low-rise Buildings
  - www.atcouncil.org
- SEAW commentary on wind code provisions – SEAW/ATC 60 - www.atcouncil.org