SITE CRITERIA AND LOADS ON STRUCTURE

SITE CRITERIA:

Basic Wind Speed	90 mph, Exposure C
Ground Snow	40 psf
Roof Live Load	10 psf
Roof Dead Load	5 psf assumed

CODE	IBC 2000 / ASCE 7-98

WIND DESIGN

Assume 20^o roof slope

Velocity pressure, q_z:

$q_z = 0.00256 K_z K_{zt} K_d V^2 I$ (psf) (Eq. 6-13)

Where:

K_z =	0.85	(Table 6-5, Exposure C, 0-15' ht)
K_{zt} =	1	(Assume no wind speed-up effects)
K_d =	0.85	(Table 6-6)
V =	90	mph (Figure 6-1)
I =	0.87	(Table 6-1, Category I)

q_z = 13.03 psf

Design wind pressures, *p* (Eq. 6-15)

$p = q(GC_{pf}) - qi(GC_{pi})$ (psf)

Where:

$q = q_i$ = 13.0 psf (= $q_z = q_h$ for this example)

(GC_{pf}) =

CASE A (transverse)

0.53	(Figure 6-4, Case A, building surface 1 = wall, windward)
-0.69	(Figure 6-4, Case A, building surface 2 = roof, windward)
-0.48	(Figure 6-4, Case A, building surface 3 = roof, leeward)
-0.43	(Figure 6-4, Case A, building surface 4 = wall, leeward)

CASE B (longitudinal)

-0.45	(Figure 6-4, Case B, building surface 1 = wall)
-0.69	(Figure 6-4, Case B, building surface 2 = roof)
-0.37	(Figure 6-4, Case B, building surface 3 = roof)
-0.45	(Figure 6-4, Case B, building surface 4 = wall)
0.40	(Figure 6-4, Case B, building surface 5 = wall, windward)
-0.29	(Figure 6-4, Case B, building surface 6 = wall, leeward)

(GC_{pi}) =

0.55	(Table 6-7, partially enclosed buildings)
-0.55	
0.18	(Table 6-7, enclosed buildings)
-0.18	

Case A	Design Wind Pressure, *p* (psf)			
	Partially Enclosed		Enclosed	
	max	min	max	min
Windward:				
Wall (surface 1)	14.08	-0.26	9.25	4.56
Roof (surface 2)	-1.82	-16.16	-6.65	-11.34
Leeward:				
Roof (surface 3)	0.91	-13.43	-3.91	-8.60
Wall (surface 4)	1.56	-12.77	-3.26	-7.95

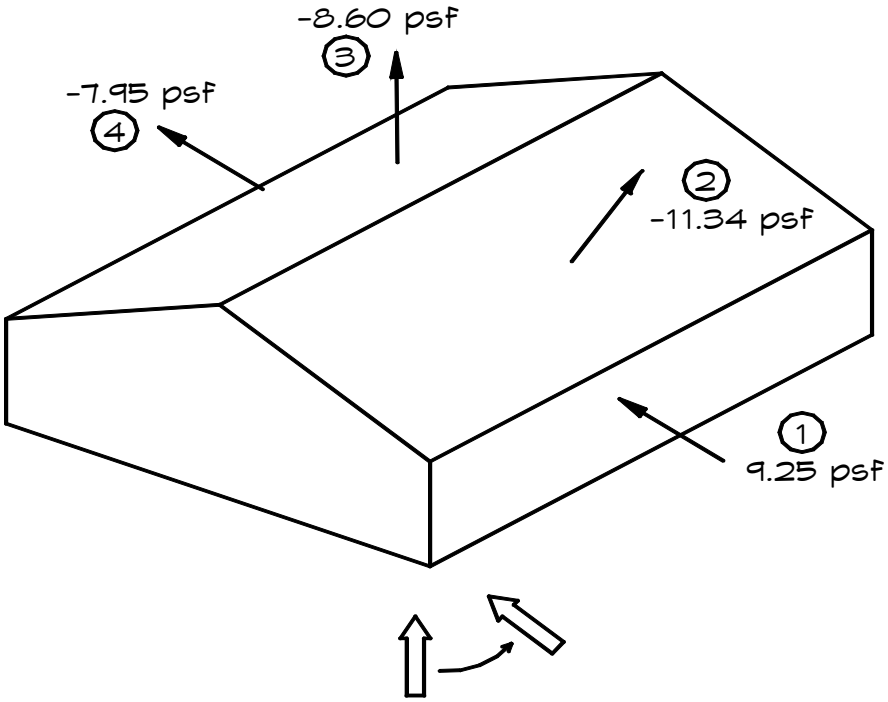
Case B	Design Wind Pressure, *p* (psf)			
	Partially Enclosed		Enclosed	
	max	min	max	min
Wall (surface 1)	1.30	-13.03	-3.52	-8.21
Roof (surface 2)	-1.82	-16.16	-6.65	-11.34
Roof (surface 3)	2.35	-11.99	-2.48	-7.17
Wall (surface 4)	1.30	-13.03	-3.52	-8.21
Windward:				
Wall (surface 5)	12.38	-1.96	7.56	2.87
Leeward:				
Wall (surface 6)	3.39	-10.95	-1.43	-6.13

Determine which wind loads to use (which govern) in load combinations:

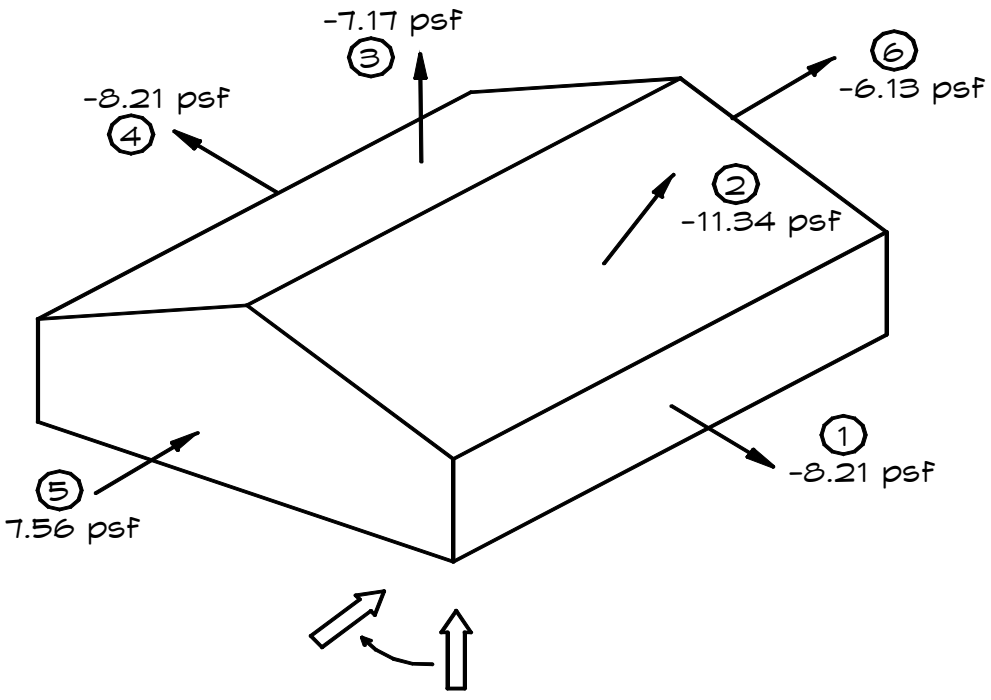
Transverse direction (Case A):
- Vertical load due to wind, on roof (outward pressure)
  - -11.34 psf, max
- Horizontal load
  - 9.25 psf, max - windward
  - -7.95 psf, max - leeward

Longitudinal direction (Case B):
- Vertical load due to wind, on roof (outward pressure)
  - -11.34 psf, max (same as vertical load due to wind in transverse direction)
- Horizontal load
  - 7.56 psf, max - windward
  - -6.13 psf, max - leeward
- side walls:
  - -8.21 psf, max

WIND PRESSURES ON STRUCTURE:



CASE A



CASE B

SNOW DESIGN

Flat-roof snow load, p_f:

$p_f = 0.7C_eC_tIp_g$ (Eq. 7-1)

Where:

p_g =	40	psf (Figure 7-2)
C_e =	1.0	(Table 7-2, partially exposed roof)
C_t =	1.1	(Table 7-3, structure kept just above freezing)
I =	0.8	(Table 7-4, Category I)

p_f = 24.6 psf

Sloped-roof snow load, p_s:

$p_s = C_sp_f$ (Eq. 7-2)

Where:

p_f =	24.6	psf
C_s =	0.90	(Figure 7-2a, 4:12 roof slope, warm roof)

p_s = 22.2 psf

LOAD COMBINATIONS

Roof Dead Load, D =	5.0 psf		
Roof Live Load, L_r =	10.0 psf (Lr < than S therefore S governs)		
Snow Load, S =	22.2 psf		
Wind Load, W =	9.25 psf (inward pressure at wall, transverse)	7.56 psf (inward pressure at wall, longitudinal)	
Assume enclosed building	-7.95 psf (outward pressure at wall, transverse)	-6.13 psf (outward pressure at wall, longitudinal)	
		-11.3 psf (upward wind pressure acting normal to roof)	

Basic Combinations - Strength Design (Section 2.3.2)
(Note, only the governing load combinations are given with the governing loads)

3.	1.2 D + 1.6 S	= 1.2 * (5.0 psf) + 1.6 * (22.2 psf)	= 6.0 psf D + 23.8 psf S	
4.	1.2 D + 1.6 W + 0.5 S	= 1.2 * (5.0 psf) + 1.6 * (9.25 psf) + 0.5 * (22.2 psf)	= 6.0 psf D + 14.8 psf W + 11.1 psf S	Wind - transverse, inward pressure at wall
		= 1.2 * (5.0 psf) + 1.6 * (-7.95 psf) + 0.5 * (22.2 psf)	= 6.0 psf D - 12.72 psf W + 11.1 psf S	Wind - transverse, outward pressure at wall
		= 1.2 * (5.0 psf) + 1.6 * (7.56 psf) + 0.5 * (22.2 psf)	= 6.0 psf D + 12.1 psf W + 11.1 psf S	Wind - longitudinal, inward pressure at wall
		= 1.2 * (5.0 psf) + 1.6 * (-6.13 psf) + 0.5 * (22.2 psf)	= 6.0 psf D - 9.8 psf W + 11.1 psf S	Wind - longitudinal, outward pressure at wall
		= 1.2 * (5.0 psf) + 1.6 * (-11.3 psf) + 0.5 * (22.2 psf)	= 6.0 psf D - 18.1 psf W, roof + 11.1 psf S	Wind ld acting normal to roof (upward wind pressure)
6.	0.9 D + 1.6 W	= 0.9 * (5.0 psf) + 1.6 * (9.25 psf)	= 4.5 psf D + 14.8 psf W	Wind - transverse, inward pressure at wall
		= 0.9 * (5.0 psf) + 1.6 * (-7.95 psf)	= 4.5 psf D - 12.72 psf W	Wind - transverse, outward pressure at wall
		= 0.9 * (5.0 psf) + 1.6 * (7.56 psf)	= 4.5 psf D + 12.1 psf W	Wind - longitudinal, inward pressure at wall
		= 0.9 * (5.0 psf) + 1.6 * (-6.13 psf)	= 4.5 psf D - 9.8 psf W	Wind - longitudinal, outward pressure at wall
		= 0.9 * (5.0 psf) + 1.6 * (-11.3 psf)	= 4.5 psf D - 18.1 psf W	Wind ld acting normal to roof (upward wind pressure)

Allowable Stress Design - Load Combinations (Section 2.4.1)

2.	D + S	= 5.0 psf D + 22.2 psf S	
3.	D + W + S	= 5.0 psf D + 9.25 psf W + 22.2 psf S	Wind - transverse, inward pressure at wall
		= 5.0 psf D - 7.95 psf W + 22.2 psf S	Wind - transverse, outward pressure at wall
		= 5.0 psf D + 7.56 psf W + 22.2 psf S	Wind - longitudinal, inward pressure at wall
		= 5.0 psf D - 6.13 psf W + 22.2 psf S	Wind - longitudinal, outward pressure at wall
		= 5.0 psf D - 11.3 psf W + 22.2 psf S	Wind ld acting normal to roof (upward wind pressure)

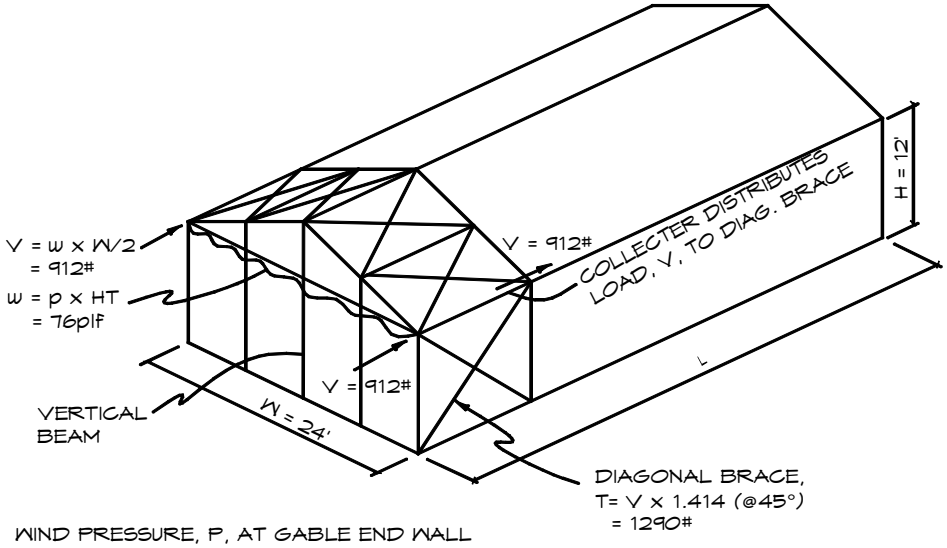
4.	0.6D + W	= 0.6 * (5.0 psf) + (9.25 psf)	= 3.0 psf D + 9.25 psf W	Wind - transverse, inward pressure at wall
		= 0.6 * (5.0 psf) + (-7.95 psf)	= 3.0 psf D - 7.95 psf W	Wind - transverse, outward pressure at wall
		= 0.6 * (5.0 psf) + (7.56 psf)	= 3.0 psf D + 7.56 psf W	Wind - longitudinal, inward pressure at wall
		= 0.6 * (5.0 psf) + (-6.13 psf)	= 3.0 psf D - 6.13 psf W	Wind - longitudinal, outward pressure at wall
		= 0.6 * (5.0 psf) + (-11.3 psf)	= 3.0 psf D - 11.3 psf W	Wind ld acting normal to roof (upward wind pressure)

STRUCTURE DESIGN

Roof Design:
Using Allowable Stress Design or Basic Load Combinations (Strength Design)
- Truss Analysis
- Connectors

Lateral Design (Wind):
Using Allowable Stress Design or Basic Load Combinations (Strength Design)

WIND DESIGN:

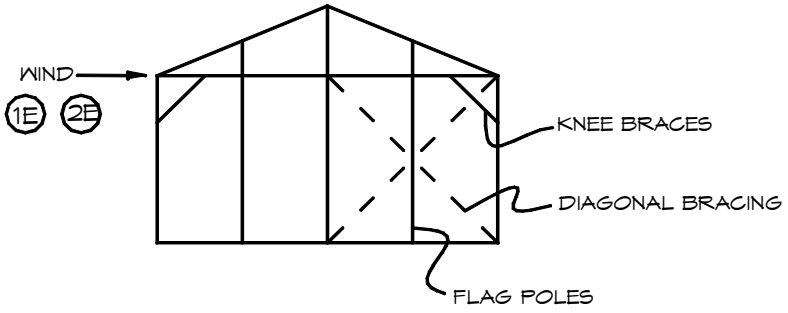


WIND PRESSURE, P, AT GABLE END WALL
(LONGIT. DIRECTION), P = 7.6 PSF

w= 7.6 psf x (12'/2 + 2/3x6') = 76 plf

V_{LONGIT} = 76plf x 24'/2 = 912#

TENSION IN DIAG. CROSS BRACE (@45°)
@ LONGIT. WALL, T = 912# x 1.414 = 1290#



END BEAM
ELEVATION

END BAY DESIGN FOR TRANSVERSE
WIND LOAD:

USE KNEE BRACE FRAME
OR DIAGONAL BRACING
OR FLAG POLES