STRUCTURAL CALCULATIONS

FOR

Chapter 13 sign example

Guide to Wind Load Provisions of ASCE 7-10

Company
Address
City, State
Phone

JOB TITLE Chapter 13 sign example

JOB NO. **SHEET NO.**
CALCULATED BY **DATE**
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Code Search

Code: ASCE 7 - 10

Occupancy:

Occupancy Group = U Utility & Miscellaneous

Risk Category & Importance Factors:

Risk Category =	I
Wind factor =	1.00
Snow factor =	0.80
Seismic factor =	1.00

Type of Construction:

Fire Rating:

Roof =	0.0 hr
Floor =	0.0 hr

Building Geometry:

Roof angle (θ)	3.00 / 12	14.0 deg
Building length (L)	2.0 ft	
Least width (B)	50.0 ft	
Mean Roof Ht (h)	80.0 ft	
Parapet ht above grd	0.0 ft	
Minimum parapet ht	0.0 ft	

Live Loads:

Roof
0 to 200 sf: 20 psf
200 to 600 sf: 24 - 0.02Area, but not less than 12 psf
over 600 sf: 12 psf

Floor:

Typical Floor	N/A
Partitions	N/A

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Wind Loads : ASCE 7- 10

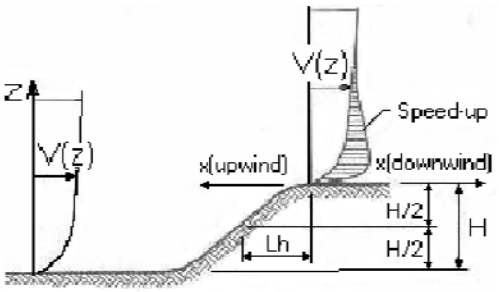
Ultimate Wind Speed	105 mph
Nominal Wind Speed	81.3 mph
Risk Category	I
Exposure Category	C
Enclosure Classif.	Enclosed Building
Internal pressure	+/-0.18
Directionality (Kd)	0.85
Kh case 1	1.208
Kh case 2	1.208
Type of roof	Monoslope

Topographic Factor (Kzt)

Topography		Flat
Hill Height	(H)	80.0 ft
Half Hill Length (Lh)		100.0 ft
Actual H/Lh	=	0.80
Use H/Lh	=	0.50
Modified Lh	=	160.0 ft
From top of crest: x =		50.0 ft
Bldg up/down wind?		downwind

H/Lh= 0.50	K_1 =	0.000
x/Lh = 0.31	K_2 =	0.792
z/Lh = 0.50	K_3 =	1.000

At Mean Roof Ht:
$Kzt = (1+K_1K_2K_3)^2$ = 1.00



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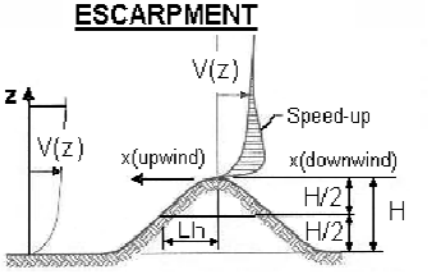

2D RIDGE or 3D AXISYMMETRICAL HILL

Gust Effect Factor

h =	80.0 ft	use 20.0
B =	50.0 ft	
/z (0.6h) =	48.0 ft	use 70.0

Flexible structure if natural frequency < 1 Hz (T > 1 second).
However, if building h/B < 4 then probably rigid structure (rule of thumb).
h/B = 0.40 Therefore, probably rigid structure

G = 1.155 Using flexible structure formula

Rigid Structure

$\bar{e}$ =	0.20	
ℓ =	500 ft	
z_{min} =	15 ft	
c =	0.20	
g_Q, g_v =	3.4	
L_z =	581.1 ft	
Q =	0.93	
I_z =	0.18	
G =	0.89	use G = 0.85

Flexible or Dynamically Sensitive Structure

Natural Frequency (η_1) =	0.7 Hz				
Damping ratio (β) =	0.01				
/b =	0.65				
/α =	0.15				
Vz =	112.4				
N_1 =	3.62				
R_n =	0.062				
R_h =	0.342	η =	2.292	h =	80.0 ft
R_B =	0.468	η =	1.433		
R_L =	0.883	η =	0.192		
g_R =	4.104				
R =	0.970				
G =	1.155				

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Enclosure Classification

Test for Enclosed Building: A building that does not qualify as open or partially enclosed.

Test for Open Building: All walls are at least 80% open.
Ao ≥ 0.8Ag

Test for Partially Enclosed Building:

	Input			Test	
Ao	0.0	sf	Ao ≥ 1.1Aoi	YES	
Ag	0.0	sf	Ao > 4' or 0.01Ag	NO	
Aoi	0.0	sf	Aoi / Agi ≤ 0.20	NO	Building is NOT
Agi	0.0	sf			Partially Enclosed

Conditions to qualify as Partially Enclosed Building. Must satisfy all of the following:
Ao ≥ 1.1Aoi
Ao > smaller of 4' or 0.01 Ag
Aoi / Agi ≤ 0.20
Where:
Ao = the total area of openings in a wall that receives positive external pressure.
Ag = the gross area of that wall in which Ao is identified.
Aoi = the sum of the areas of openings in the building envelope (walls and roof) not including Ao.
Agi = the sum of the gross surface areas of the building envelope (walls and roof) not including Ag.

Reduction Factor for large volume partially enclosed buildings (Ri) :

If the partially enclosed building contains a single room that is unpartitioned , the internal pressure coefficient may be multiplied by the reduction factor Ri.

Total area of all wall & roof openings (Aog): 0 sf
Unpartitioned internal volume (Vi) : 0 cf
Ri = 1.00

Altitude adjustment to constant 0.00256 (caution - see code) :

Altitude = 0 feet
Constant = 0.00256
Average Air Density = 0.0765 lbm/ft^3

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Wind Loads - Other Structures: ASCE 7- 10 Ultimate Wind Pressures

Wind Factor = 1.00
Gust Effect Factor (G) = 1.16 Ultimate Wind Speed = 105 mph
Kzt = 1.00 Exposure = C

A. Solid Freestanding Walls & Solid Signs (& open signs with less than 30% open)

s/h = 0.25
Dist to sign top (h) 80.0 ft B/s = 2.50
Height (s) 20.0 ft Lr/s = 0.00
Width (B) 50.0 ft Kz = 1.208
Wall Return (Lr) = qz = 29.0 psf
Directionality (Kd) 0.85
Percent of open area to gross area 0.0%
Open reduction factor = 1.00

Case C reduction factors
Factor if s/h>0.8 = 1.00
Wall return factor for Cf at 0 to s = 1.00

Case A & B
C_f = 1.80
F = qz G Cf As = **60.2 As**
As = 1000.0 sf
F = 60238 lbs

CaseC

Horiz dist from windward edge	Cf	F=qzGCfAs (psf)
0 to s	2.43	81.2 **As**
s to 2s	1.60	53.5 **As**
2s to 3s	1.15	38.5 **As**

B. Open Signs & Lattice Frameworks (openings 30% or more of gross area)

Height to centroid of Af (z) 30.0 ft
Width (zero if round) 0.0 ft
Diameter (zero if rect) 0.0 ft
Percent of open area to gross area 35.0%
Directionality (Kd) 0.85

D(qz)^.5 = 0.65
I = 0.65
C_f = 1.5

Kz = 0.982
Base pressure (qz) = 23.6 psf
$F = q_z G C_f A_f$ = **40.8 Af**
Solid Area: A_f = 10.0 sf
F = 408 lbs

C. Chimneys, Tanks, Rooftop Equipment (h>60') & Similar Structures

Height to centroid of Af (z) 30.0 ft This should be 15', but example problem uses 30'.
Cross-Section Round
Directionality (Kd) 0.85
Height (h) 30.0 ft
Width (D) 1.3 ft
Type of Surface Moderately smooth

Kz = 0.982
Base pressure (qz) = 23.6 psf
h/D = 22.50
D(qz)^.5 = 6.47

Round
C_f = 0.69
$F = q_z G C_f A_f$ = **18.7 Af**
A_f = 1.3 sf
F = 25 lbs

D. Trussed Towers

Height to centroid of Af (z) 15.0 ft
∈ = 0.27
Tower Cross Section square
Member Shape flat
Directionality (Kd) 0.95

Kz = 0.849
Base pressure (qz) = 22.8 psf
Diagonal wind factor = 1.2
Round member factor = 1.000

Square (wind along tower diagonal)
Cf = 3.24
F = qz G Cf Af = **85.1 Af**
Solid Area: Af = 10.0 sf
F = 851 lbs

Square (wind normal to face)
C_f = 2.70
$F = q_z G C_f A_f$ = **71.0 Af**
Solid Area: A_f = 10.0 sf
F = 710 lbs