Company
Address
City, State
Phone

JOB TITLE Example 5.1 Wind on Sign

JOB NO.   SHEET NO.
CALCULATED BY   DATE
CHECKED BY   DATE

CS2024 Ver 2024-03-08   www.struware.com

STRUCTURAL CALCULATIONS

FOR

Example 5.1 Wind on Sign

Guide to Wind Load Procedures ASCE 7-22

www.struware.com

Code Search

Code: ASCE 7 - 22

Occupancy:

Occupancy Group = U Utility & Miscellaneous

Risk Category & Importance Factors:

Risk Category = I

Wind Factor = 1.00
Snow Factor 1.00
Seismic Importance factor = 1.00

Type of Construction:

Fire Rating:

Roof = 0.0 hr
Floor = 0.0 hr

Building Geometry:

Roof angle (θ) 0.00 / 12 0.0 deg
Building length 2.0 ft
Least width 50.0 ft
Mean Roof Ht (h) 20.0 ft
Parapet ht above grd 0.0 ft
Minimum parapet ht 0.0 ft
hb for Elevated bldg 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

Partitions N/A

Company
Address
City, State
Phone

Example 3.3 & 4.1 Example 5.1 Wind on Sign

JOB NO.		SHEET NO.
CALCULATED BY		DATE
CHECKED BY		DATE

Wind Loads :   ASCE 7- 22

Ultimate Wind Speed	103 mph
Nominal Wind Speed	79.8 mph
Risk Category	I
Exposure Category	C
Enclosure Classif.	Enclosed Building
Internal pressure	+/-0.18
Bldg Directionality (K_d)	0.85
Kh MWFRS<=60	0.903
Kh all other	0.903
Type of roof	Monoslope

Topographic Factor   (K_{zt})

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

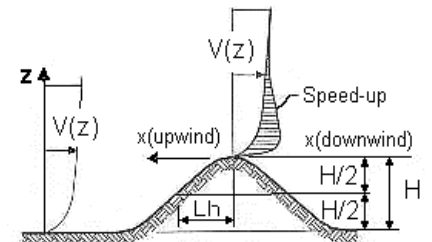|	
H/Lh= 0.50	K_1 = 0.000
x/Lh = 0.31	K_2 = 0.792
z/Lh = 0.13	K_3 = 1.000

At Mean Roof Ht:

$$K_{zt} = (1+K_1K_2K_3)^2 = 1.00$$
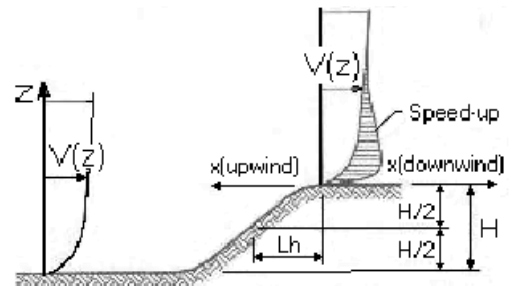
ESCARPMENT

2D RIDGE or 3D AXISYMMETRICAL HILL

Gust Effect Factor

h =	20.0 ft	use 20.0
B =	50.0 ft	
/z (0.6h) =	15.0 ft	use 70.0

Flexible structure if natural frequency < 1 Hz   (T > 1 second).
If building h/B>4 then may be flexible and should be investigated.
h/B = 0.40

G =   1.354   Using flexible structure formula

Rigid Structure		**Flexible or Dynamically Sensitive Structure**				
ē =	0.20	Natural Frequency (η_1) =	0.7 Hz			
ℓ =	500 ft	Damping ratio (β) =	0.01			
Z_{min} =	15 ft	/b =	0.660			
c =	0.20	/α =	0.156			
g_Q, g_v =	3.4	Vz =	112.1			
L_z =	581.1 ft	N_1 =	3.63			
Q =	0.926	R_n =	0.062			
I_z =	0.176	R_h =	0.706	η =	0.574	h = 20.0 ft
G =	**0.89** use G = 0.85	R_B =	0.468	η =	1.436	
		R_L =	0.883	η =	0.192	
		g_R =	4.104			
		R =	1.392			
		Gf =	1.354			

Ground Elevation Factor (Ke)

Grd level above sea level =   895 ft   Ke =   0.9681
                Constant =   0.00256   use Ke =   0.9640
        0.00256Ke =   0.00247

Enclosure Classification

Test for Enclosed Building: Ao < 0.01Ag or 4 sf, whichever is smaller

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

Test for Partially Enclosed Building: Predominately open on one side only

	Input			Test	
Ao	500.0	sf	Ao ≥ 1.1Aoi	NO	
Ag	600.0	sf	Ao > 4sf or 0.01Ag	YES	
Aoi	1000.0	sf	Aoi / Agi ≤ 0.20	YES	Building is NOT
Agi	10000.0	sf			Partially Enclosed

Conditions to qualify as Partially Enclosed Building. Must satisfy all of the following:
Ao ≥ 1.1Aoi
Ao >   smaller of 4sf 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.

Test for Partially Open Building: A building that does not qualify as open, enclosed or partially enclosed.
(This type building will have same wind pressures as an enclosed building.)

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):   -   SF
Unpartitioned internal volume (Vi) :   -   CF
                                Ri =   1.00

Wind Loads - Other Structures: ASCE 7- 22   Ultimate Wind Pressures

Wind Factor =   1.00
Gust Effect Factor (G) =   1.35 Ultimate Wind Speed =   103 mph
Kzt =   1.00   Exposure =   C

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

		s/h =	0.25	**Case A & B**		
Dist to sign top (h)	80.0 ft	B/s =	2.50	C_f =		1.80
Height (s)	20.0 ft	Lr/s =	0.00	F = Kd qh G Cf As =		**65.0 As**
Width (B)	50.0 ft	Kz =	1.198	As =		50.0 sf
Wall Return (Lr) =	0.0 ft	Kd qh =	26.7 psf	F =		3248 lbs
Directionality (Kd)	0.85					

Percent of open area   Open reduction   **CaseC**
to gross area   0.0%   factor =   1.00   Horiz dist from

				windward edge	Cf	F=KdqhGCfAs (psf)
	Case C reduction factors			0 to s	2.43	87.5 **As**
	Factor if s/h>0.8 =	1.00		s to 2s	1.60	57.7 **As**
	Wall return factor			2s to 3s	1.15	41.5 **As**
	for Cf at 0 to s =	1.00				

B. Open Signs & Single-Plane Open Frames (openings 30% or more of gross area)

Height to centroid of Af (z)	15.0 ft			Kz =	0.851
				Base pressure (Kd qz) =	18.9 psf
Width (zero if round)	0.0 ft				
Diameter (zero if rect)	2.0 ft	D(qz)^.5 =	8.70	F = Kdqz G Cf Af =	**28.2 Af**
Percent of open area		I =	0.65	Solid Area: A_f =	10.0 sf
to gross area	35.0%	C_f =	1.1	F =	282 lbs
Directionality (Kd)	0.85				

C. Chimneys, Tanks, & Similar Structures   Sign Posts

Height to centroid of Af (z)	30.0 ft	Kz =	0.980
Cross-Section	Round	Base pressure (Kd qz) =	25.7 psf
Directionality (Kd)	1.00	h/D =	45.11
Height (h)	60.0 ft	D(qz)^.5 =	6.74
Width (D)	1.3 ft		
Type of Surface	Moderately smooth		

Round
C_f =   0.70
F = Kdqz G Cf Af =   **24.3 Af**
A_f =   2.7 sf
F =   65 lbs

D. Trussed Towers

Height to centroid of Af (z)	15.0 ft		Kz =	0.851
ε =	0.27		Base pressure (Kd qz) =	18.9 psf
Tower Cross Section	square			
Member Shape	flat		Diagonal wind factor =	1.2
Directionality (Kd)	0.85		Round member factor =	1.000

Square (wind along tower diagonal)		Square (wind normal to face)	
Cf =	3.24	C_f =	2.70
F = Kdqz G Cf Af =	**83.0 Af**	F = Kdqz G Cf Af =	**69.2 Af**
Solid Area: Af =	10.0 sf	Solid Area: A_f =	10.0 sf
F =	830 lbs	F =	692 lbs