

Company

Address
City, State
Phone
other

JOB TITLE Example 3 - ASCE7-02

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

www.struware.com

STRUCTURAL CALCULATIONS

FOR

Example 3 - 157' Building, flat terrain

Guide to the Use of the Wind Load Provisions of ASCE7-02

Company

Address
 City, State
 Phone
 other

JOB TITLE Example 3 - ASCE7-02

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

www.struware.com

Code Search
I. Code: ASCE 7 - 02
II. Occupancy:

Occupancy Group = B Business

III. Type of Construction:

Fire Rating:

Roof =	2.0 hr
Floor =	2.0 hr

IV. Live Loads:
 Roof angle (θ) 0.00 / 12 0.0 deg

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	50 psf
Stairs & Exitways	100 psf
Balcony	100 psf
Mechanical	150 psf
Partitions	20 psf

V. Wind Loads : ASCE 7 - 02

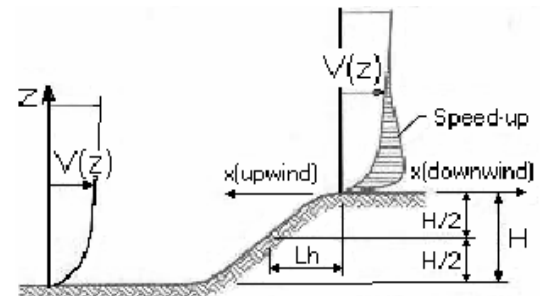
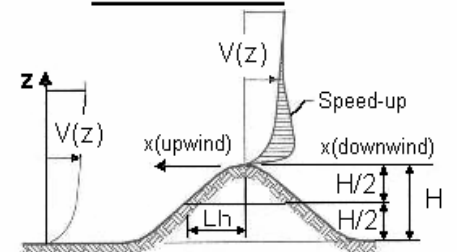
Importance Factor	1.00
Basic Wind speed	120 mph
Directionality (Kd)	0.85
Mean Roof Ht (h)	157.0 ft
Parapet ht above grd	160.0 ft
Exposure Category	B
Enclosure Classif.	Partially Enclosed
Internal pressure	+/-0.55
Building length (L)	200.0 ft
Least width (B)	100.0 ft
Kh case 1	1.124
Kh case 2	1.124

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 = 0.98	K ₃ =	1.000

At Mean Roof Ht:

$$K_{zt} = (1 + K_1 K_2 K_3)^2 = 1.000$$
**ESCARPMENT****2D RIDGE or 3D AXISYMMETRICAL HILL**

Company

Address
City, State
Phone
other

JOB TITLE Example 3 - ASCE7-02

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

V. Wind Loads - cont.:

Gust Effect Factor

h = 157.0 ft
use this h : 157.0 ft
B = 100.0 ft
Calculated /z = 94.2 ft
Use this /z : 94.2 ft

Flexible structure if natural frequency < 1 Hz (T > 1 second).

However, rule of thumb is if h/B < 4 then rigid structure.

h/B = 1.57 Therefore, probably rigid structure

G = 0.83

Rigid Structure

/ε = 0.33
l = 320 ft
z_{min} = 30 ft
c = 0.30
g_Q, g_v = 3.4
L_z = 453.9 ft
Q = 0.83
I_z = 0.25
G = 0.83

Flexible or Dynamically Sensitive Structure

Natural Frequency (n₁) = 0.0 Hz
Damping ratio (β) = 0
/b = 0.45
/α = 0.25
V_Z = 102.9
N₁ = 0.00
R_n = 0.000
R_h = 28.282 η = 0.000 h = 157.0 ft
R_B = 28.282 η = 0.000
R_L = 28.282 η = 0.000
g_R = 0.000
R = 0.000
G = 0.000

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.
A_o ≥ 0.8A_g

Test for Partially Enclosed Building:

Input	Test
A _o ≥ 1.1A _{oi}	YES
A _o > 4' / 0.01A _g	NO
A _{oi} / A _{gi} ≤ 0.20	NO

Building is NOT Partially Enclosed.
Unless impact glazing is required, but not provided.

Conditions to qualify as Partially Enclosed Building. Must satisfy all of the following:

- A_o ≥ 1.1A_{oi}
- A_o > smaller of 4' or 0.01 A_g
- A_{oi} / A_{gi} ≤ 0.20

Where:

- A_o = the total area of openings in a wall that receives positive external pressure.
- A_g = the gross area of that wall in which A_o is identified.
- A_{oi} = the sum of the areas of openings in the building envelope (walls and roof) not including A_o.
- A_{gi} = the sum of the gross surface areas of the building envelope (walls and roof) not including A_g.

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

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

Total area of all wall & roof openings (A_{og}): 0 sf
Unpartitioned internal volume (V_i): 0 cf
R_i = 1.00

Altitude adjustment to constant 0.00256 :

Altitude = 0 feet Average Air Density = 0.0765 lbm/ft³
Constant = 0.00256

Company

Address
City, State
Phone
other

JOB TITLE Example 3 - ASCE7-02

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

V. Wind Loads - MWFRS all h (Enclosed/partially enclosed only)

Kh (case 2) = 1.12 h = 157.0 ft GCpi = +/-0.55
Base pressure (qh) = **35.2 psf** ridge ht = 157.0 ft G = 0.83
Roof Angle = 0.0 deg L = 200.0 ft z for qi = 90.0 ft
Roof tributary area - (h/2)*L: 15700 sf B = 100.0 ft qi = 30.0 psf for positive internal pressures
(h/2)*B: 7850 sf

Surface Pressures (psf)	Wind Normal to Ridge (psf)				Wind Parallel to Ridge (psf)				
	B/L = 0.50		h/L = 1.57		L/B = 2.00		h/L = 0.79		
Surface	Cp	qhGCp	w/+qiGCpi	w/-qhGCpi	Dist.*	Cp	qhGCp	w/+qiGCpi	w/-qhGCpi
Windward Wall (WW)	0.80	23.5	see table below			0.80	23.5	see table below	
Leeward Wall (LW)	-0.50	-14.7	-31.2	4.7		-0.30	-8.8	-25.3	10.6
Side Wall (SW)	-0.70	-20.6	-37.1	-1.2		-0.70	-20.6	-37.1	-1.2
Leeward Roof (LR)		**				Included in windward roof			
Windward Roof: 0 to h/2*	-1.04	-30.5	-47.1	-11.2	0 to h/2*	-0.98	-28.8	-45.3	-9.4
> h/2*	-0.70	-20.6	-37.1	-1.2	h/2 to h*	-0.79	-23.1	-39.6	-3.7
					h to 2h*	-0.61	-18.0	-34.6	1.3

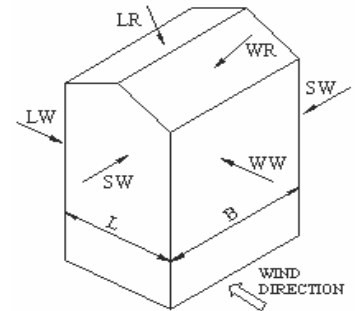
*Horizontal distance from windward edge

**Roof angle < 10 degrees. Therefore, leeward roof is included in windward roof pressure zones.

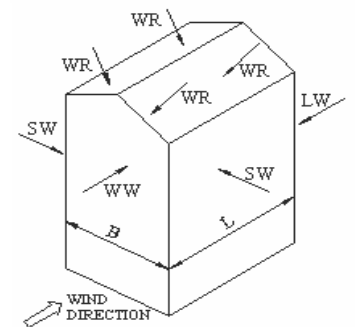
For monoslope roofs, entire roof surface is either windward or leeward surface.

Windward Wall Pressures at "z" (psf)

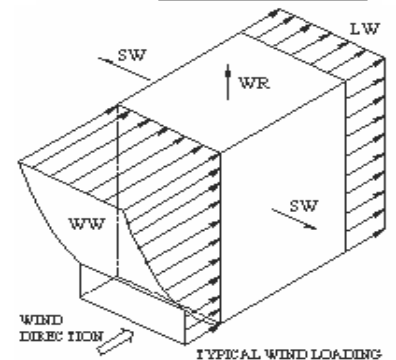
z	Kz	Kzt	Windward Wall			Combined WW + LW	
			qzGCp	w/+qiGCpi	w/-qhGCpi	Normal to Ridge	Parallel to Ridge
0 to 15'	0.57	1.00	12.0 psf	-4.5 psf	31.4 psf	26.7 psf	20.8 psf
30.0 ft	0.70	1.00	14.6	-1.9	34.0	29.3	23.4
50.0 ft	0.81	1.00	16.9	0.4	36.3	31.6	25.7
80.0 ft	0.93	1.00	19.4	2.8	38.7	34.1	28.2
120.0 ft	1.04	1.00	21.8	5.2	41.1	36.4	30.6
h= 157.0 ft	1.12	1.00	23.5	7.0	42.9	38.2	32.3



WIND NORMAL TO RIDGE



WIND PARALLEL TO RIDGE



TYPICAL WIND LOADING

NOTE:

See figure 6-9 of ASCE7 for the application of full and partial loading of the above wind pressures. There are 4 different loading cases.

Parapet

z	Kz	Kzt	qp (psf)
160.0 ft	1.13	1.00	35.4

Windward parapet: 63.7 psf (GCpn = +1.8)
Leeward parapet: -39.0 psf (GCpn = -1.1)

Company

Address
 City, State
 Phone
 other

JOB TITLE Example 3 - ASCE7-02

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

Roof Design Loads

Items	Description	Multiple	psf (max)	psf (min)
Roofing	3 ply felt & gravel		5.5	5.0
Deck	Metal Roof deck, 1.5, 22 ga.		1.7	1.2
Framing	Steel roof joists & girders		3.0	2.0
Insulation	Rigid insulation, per 1" x 2.0"		3.0	1.5
Ceiling	Suspended acoustical tile x 1 ply(s)		1.8	1.0
Sprinklers	Sprinklers		2.0	1.5
Mech & Elec	Mech. & Elec.		2.0	0.0
Misc.	0	1	0.0	0.0
	Actual Dead Load		☉ 19.0	○ 12.2
	Use this DL instead		○ 20.0	☉ 9.0
	Live Load		20.0	0.0
	Snow Load		8.5	0.0
	Wind (zone 2 - 100sf)		0.0	-83.0
<u>ASD Loading</u>	Dead + Live Load		39.0	-
	Dead + 0.75(Wind + Live) Load		34.0	-
	0.6*Dead + Wind Load		-	-77.6
<u>LRFD Loading</u>	1.2D + 1.6 Lr + 0.8W		54.8	-
	1.2D + 1.6W + 0.5Lr		32.8	-
	0.9D + 1.6W		-	-124.7

Roof Live Load Reduction

Roof angle 0.00 / 12 0.0 deg

0 to 200 sf: 20.0 psf
 200 to 600 sf: $24 - 0.02 \text{Area}$, but not less than 12 psf
 over 600 sf: 12.0 psf

300.0 sf: 18.0 psf
 400.0 sf: 16.0 psf
 500.0 sf: 14.0 psf
 User Input: 450.0 sf: 15.0 psf

Company

Address
 City, State
 Phone
 other

JOB TITLE Example 3 - ASCE7-02

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

Floor Design Loads

Items	Description	Multiple	psf (max)	psf (min)
Flooring	Carpet & pad		1.0	1.0
Topping	Concrete regular per 1"	x 4.25"	53.1	51.0
Deck/Sub-floor	Metal Floor deck - 2", 20ga		2.0	1.5
Framing	Steel roof joists & girders		3.0	2.0
Other	Concrete lightwt per 1"	x 0.75"	7.5	6.4
Ceiling	Suspended acoustical tile	x 1 ply(s)	1.8	1.0
Sprinklers	Sprinklers		2.0	1.5
Mech & Elec	Mech. & Elec.		2.0	0.0
Misc.	0	1	0.0	0.0
Misc.	None		0.0	0.0
Actual Dead Load			<input checked="" type="radio"/> 72.4	<input checked="" type="radio"/> 64.4
Use this DL instead			<input type="radio"/> 100.0	<input type="radio"/> 50.0
Partitions			20.0	0.0
Live Load			50.0	0.0
Total Live Load			70.0	0.0
Total Load			142.4	64.4

FLOOR LIVE LOAD REDUCTION (not including partitions)

NOTE: Not allowed for assembly occupancy or LL>100psf or passenger car garages, except may reduce columns 20% if 2 or more floors & non-assembly

$L = L_o(0.25 + 15/\sqrt{K_{LL}A_T})$

Unreduced design live load: $L_o =$ 50 psf

Floor member $K_{LL} =$ 2
 Tributary Area $A_T =$ 300 sf
 Reduced live load: $L =$ 43.1 psf

Columns (2 or more floors) $K_{LL} =$ 4
 Tributary Area $A_T =$ 500 sf
 Reduced live load: $L =$ 29.3 psf

IBC & FBC alternate procedure

Smallest of:
 $R = .08(SF - 150)$
 $R = 23.1(1+D/L) =$ 56.6%
 R= 40% beams; 60% columns

 $R =$ 12.0%
 Reduced live load: $L =$ 44.0 psf

 $R =$ 28.0%
 Reduced live load: $L =$ 36.0 psf

CODE SUMMARY- continued

Component and cladding wind pressures

Select method : C&C>60 feet

Roof	Area	Surface Pressure (psf)		
		10 sf	50 sf	100 sf
Negative Zone 1		-65.8	-55.5	-48.2
Negative Zone 2		-97.5	-83.0	-72.9
Negative Zone 3		-97.5	-83.0	-72.9

Wall	Area	Surface Pressure (psf)		
		20 sf	50 sf	100 sf
Negative Zone 4		-48.2	-44.7	-41.2
Negative Zone 5		-79.9	-65.8	-51.8
Positive Zone 4 & 5				
	0 to 15'	39.1	35.8	32.5
	30 ft	39.1	35.8	32.5
	50 ft	42.2	38.4	34.6
	80 ft	45.5	41.2	36.8
	120 ft	48.7	43.8	38.9
	157 ft	51.1	45.8	40.5