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JOB TITLE Example 6 & 7 - ASCE7-02

JOB NO.	_____	SHEET NO.	_____
CALCULATED BY	_____	DATE	_____
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www.struware.com

STRUCTURAL CALCULATIONS

FOR

Example 6 - 20' eave height using MWFRS all heights

Example 7 - 20' eave height using MWFRS <60'

from

Guide to the Use of the Wind Load Provisions of ASCE7-03

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Code Search

I. Code: ASCE 7 - 02

II. Occupancy:

Occupancy Group = S Storage

III. Type of Construction:

Fire Rating:
Roof = 0.0 hr
Floor = 0.0 hr

IV. Live Loads:

Roof angle (θ) 4.00 / 12 18.4 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 N/A
Partitions 20 psf

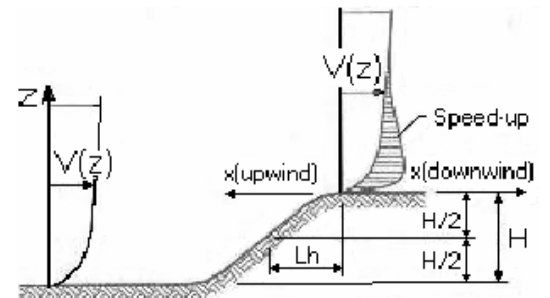
V. Wind Loads : ASCE 7 - 02

Importance Factor 1.00
Basic Wind speed 90 mph
Directionality (Kd) 0.85
Mean Roof Ht (h) 36.7 ft
Parapet ht above grd 0.0 ft
Exposure Category C
Enclosure Classif. Enclosed Building
Internal pressure +/-0.18
Building length (L) 250.0 ft
Least width (B) 200.0 ft
Kh case 1 1.025
Kh case 2 1.025

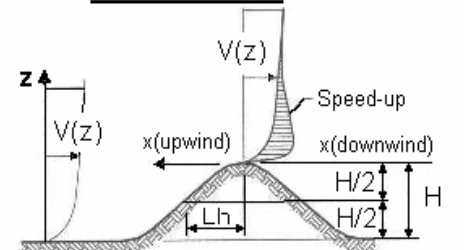
Topographic Factor (Kzt)

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 K₁ = 0.000
x/Lh = 0.31 K₂ = 0.792
z/Lh = 0.23 K₃ = 1.000
At Mean Roof Ht:
Kzt = (1+K₁K₂K₃)² = 1.000



ESCARPMENT



2D RIDGE or 3D AXISYMMETRICAL HILL

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V. Wind Loads - cont.:

Gust Effect Factor

h = 36.7 ft
use this h : 36.7 ft
B = 200.0 ft
Calculated /z = 22.0 ft
Use this /z : 22.0 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 = 0.18 Therefore, probably rigid structure

G = 0.85 Use G = 0.85

Rigid Structure

/ε = 0.20
l = 500 ft
Z_{min} = 15 ft
c = 0.20
g_Q, g_v = 3.4
L_z = 461.1 ft
Q = 0.84
I_z = 0.21
G = 0.84

Flexible or Dynamically Sensitive Structure

Natural Frequency (n₁) = 0.0 Hz
Damping ratio (β) = 0
/b = 0.65
/α = 0.15
V_Z = 80.6
N₁ = 0.00
R_n = 0.000
R_h = 28.282
R_B = 28.282
R_L = 28.282
g_R = 0.000
R = 0.000
G = 0.000

η = 0.000 h = 36.7 ft
η = 0.000
η = 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.

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 (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 :

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

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JOB TITLE Example 6 & 7 - ASCE7-02

JOB NO. _____ **SHEET NO.** _____
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V. Wind Loads - MWFRS all h (Enclosed/partially enclosed only)

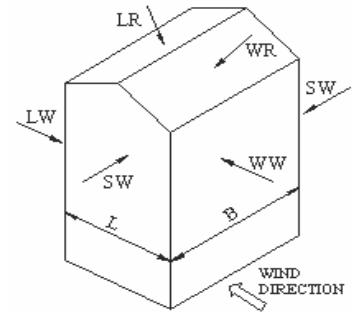
Kh (case 2) = 1.02 h = 36.7 ft GCpi = +/-0.18
Base pressure (qh) = **18.1 psf** ridge ht = 53.3 ft G = 0.85
Roof Angle = 18.4 deg L = 250.0 ft qi = qh 90.0 ft
Roof tributary area - (h/2)*L: 4583 sf B = 200.0 ft
(h/2)*B: 3667 sf

Surface Pressures (psf)	Wind Normal to Ridge (psf)				Wind Parallel to Ridge (psf)				
	B/L = 0.80		h/L = 0.18		L/B = 1.25		h/L = 0.15		
Surface	Cp	qhGCp	w/+qiGCpi	w/-qhGCpi	Dist.*	Cp	qhGCp	w/+qiGCpi	w/-qhGCpi
Windward Wall (WW)	0.80	12.3	see table below			0.80	12.3	see table below	
Leeward Wall (LW)	-0.50	-7.7	-10.9	-4.4		-0.45	-6.9	-10.2	-3.7
Side Wall (SW)	-0.70	-10.7	-14.0	-7.5		-0.70	-10.7	-14.0	-7.5
Leeward Roof (LR)	-0.57	-8.7	-12.0	-5.5		Included in windward roof			
Windward Roof neg press.	-0.36	-5.6	-8.8	-2.3	0 to h/2*	-0.90	-13.8	-17.1	-10.6
Windward Roof pos press.	0.14	2.1	-1.1	5.4	h/2 to h*	-0.90	-13.8	-17.1	-10.6
					h to 2h*	-0.50	-7.7	-10.9	-4.4
					> 2h*	-0.30	-4.6	-7.9	-1.4

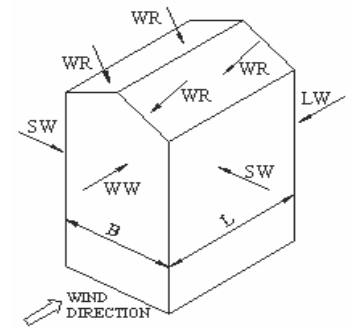
*Horizontal distance from windward edge

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

Windward Wall Pressures at "z" (psf)				Combined WW + LW			
z	Kz	Kzt	Windward Wall			Normal to Ridge	Parallel to Ridge
			qzGCp	w/+qiGCpi	w/-qhGCpi		
0 to 15'	0.85	1.00	10.2 psf	6.9 psf	13.4 psf	17.8 psf	17.1 psf
20.0 ft	0.90	1.00	10.8	7.6	14.1	18.5	17.7
30.0 ft	0.98	1.00	11.8	8.5	15.0	19.4	18.7
h= 36.7 ft	1.02	1.00	12.3	9.0	15.5	20.0	19.2
40.0 ft	1.04	1.00	12.5	9.3	15.8	20.2	19.4
50.0 ft	1.09	1.00	13.1	9.9	16.4	20.8	20.0
ridge = 53.3 ft	1.11	1.00	13.3	10.0	16.5	21.0	20.2



WIND NORMAL TO RIDGE



WIND PARALLEL TO RIDGE

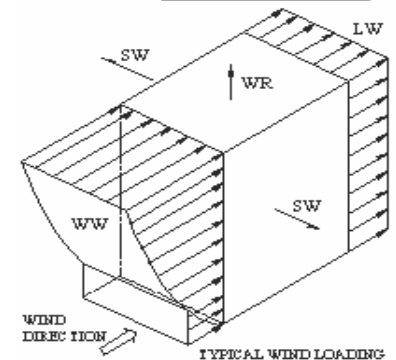
NOTE:

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)
0.0 ft	0.85	1.00	0.0

Windward parapet: 0.0 psf (GCpn = +1.8)
Leeward parapet: 0.0 psf (GCpn = -1.1)



TYPICAL WIND LOADING

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V. Wind Loads - Components & Cladding: Buildings h≤60' & Alternate design 60'<h<90'

Kz = Kh (case 1) = 1.02 GCpi = +/-0.18 NOTE: If tributary area is greater than
Base pressure (qh) = **18.1 psf** a = 14.7 ft 700sf, MWFRS pressure may be used.
Minimum parapet height at building perimeter = 0.0 ft

Roof Angle = 18.4 deg
Type of roof = Gable

<u>Roof</u>	GCp +/- GCpi			Surface Pressure (psf)			User input	
	10 sf	50 sf	100 sf	10 sf	50 sf	100 sf	20 sf	208 sf
Negative Zone 1	-1.08	-1.01	-0.98	-19.5 psf	-18.2 psf	-17.7 psf	-19.0 psf	-17.7 psf
Negative Zone 2	-1.88	-1.53	-1.38	-34.0 psf	-27.6 psf	-24.9 psf	-31.2 psf	-24.9 psf
Negative Zone 3	-2.78	-2.36	-2.18	-50.2 psf	-42.6 psf	-39.4 psf	-46.9 psf	-39.4 psf
Positive All Zones	0.68	0.54	0.48	12.3 psf	10.0 psf	10.0 psf	11.2 psf	10.0 psf
Overhang Zone 2	-2.20	-2.20	-2.20	-39.7 psf	-39.7 psf	-39.7 psf	-39.7 psf	-39.7 psf
Overhang Zone 3	-3.70	-2.86	-2.50	-66.8 psf	-51.7 psf	-45.1 psf	-60.3 psf	-45.1 psf

<u>Walls</u>	GCp +/- GCpi			Surface Pressure (psf)			User input	
	10 sf	100 sf	500 sf	10 sf	100 sf	500 sf	15 sf	208 sf
Negative Zone 4	-1.28	-1.10	-0.98	-23.1 psf	-19.9 psf	-17.7 psf	-22.6 psf	-18.9 psf
Negative Zone 5	-1.58	-1.23	-0.98	-28.5 psf	-22.2 psf	-17.7 psf	-27.4 psf	-20.1 psf
Positive Zone 4 & 5	1.18	1.00	0.88	21.3 psf	18.1 psf	15.9 psf	20.8 psf	17.1 psf

Parapet

qp = 0.0 psf

CASE A = pressure towards building
CASE B = pressure away from building

Solid Parapet Pressure	10 sf	100 sf	500 sf
CASE A : Interior zone :	0.0 psf	0.0 psf	0.0 psf
Corner zone :	0.0 psf	0.0 psf	0.0 psf
CASE B : Interior zone :	0.0 psf	0.0 psf	0.0 psf
Corner zone :	0.0 psf	0.0 psf	0.0 psf

Rooftop Structures & Equipment

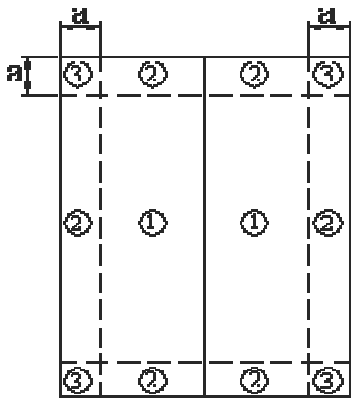
Dist from mean roof height to centroid of Af = 10.0 ft Gust Effect Factor (G) = 0.85
Height of equipment (he) = 15.0 ft Base pressure (qz) = **22.4 Kd psf**

Cross-Section Square
Directionality (Kd) 0.90
Width (D) 10.0 ft
Type of Surface N/A

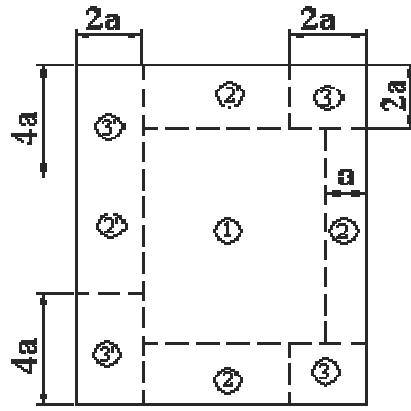
h/D = 1.50

<u>Square (wind along diagonal)</u>		<u>Square (wind normal to face)</u>	
Cf =	1.01	Cf =	1.31
Af =	10.0 sf	Af =	10.0 sf
Adjustment Factor (Adj) =	1.90	Adjustment Factor (Adj) =	1.900
F = qz G Cf Af Adj =	17.2 Af	F = qz G Cf Af Adj =	22.4 Af
F =	172 lbs	F =	224 lbs

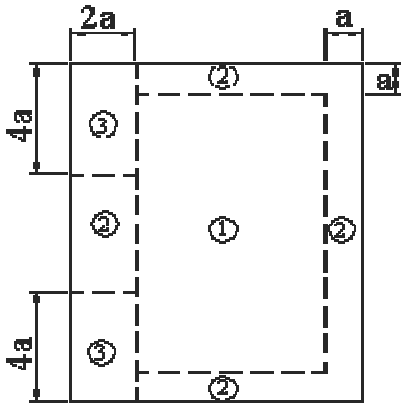
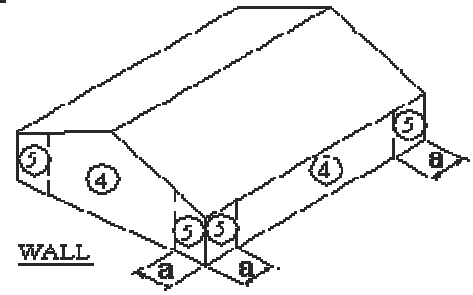
Location of Wind Pressure Zones



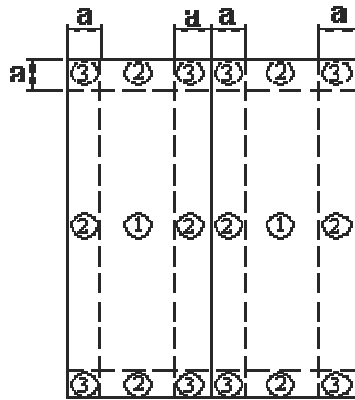
$\theta \leq 7$ degrees and
Monoslope ≤ 3 degrees



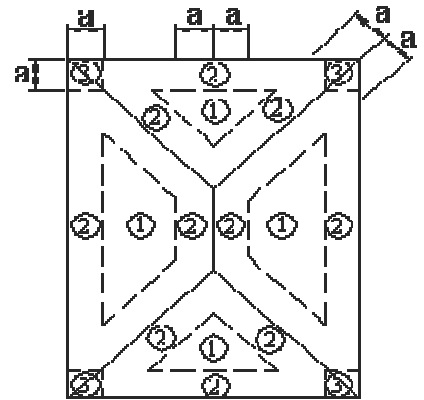
Monoslope roofs
 $3^\circ < \theta \leq 10^\circ$



Monoslope roofs $10^\circ < \theta \leq 30^\circ$



$\theta > 7$ degrees



$\theta > 7$ degrees

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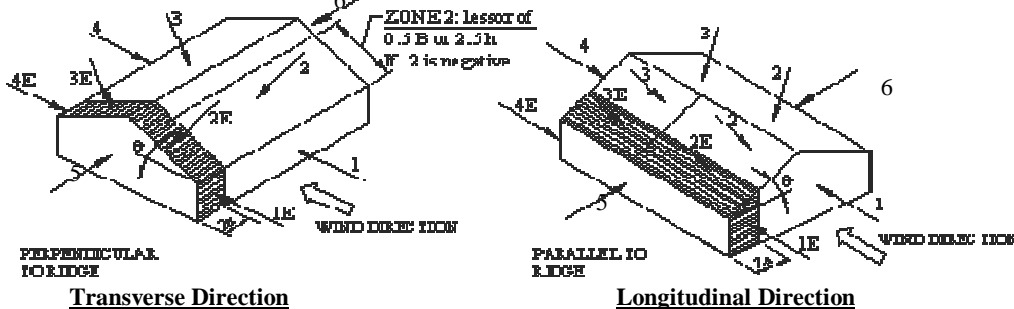
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JOB TITLE Example 6 & 7 - ASCE7-02

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V. Wind Loads - MWFRS $h \leq 60'$ (Low-rise Buildings) Enclosed/partially enclosed only



Torsional loads are 25% of zones 1 - 4. See code for loading diagram

$K_z = K_h = 1.02$ (case 1)
Base pressure (q_h) = **18.1 psf**
GC_{pi} = +/-0.18

Edge Strip (a) = 14.7 ft
End Zone (2a) = 29.3 ft
Zone 2 length = 91.7 ft

Surface	Transverse Direction			Longitudinal Direction		
	Perpendicular $\theta = 18.4$ deg			Parallel $\theta = 0$ deg		
	GC _{pf}	w/-GC _{pi}	w/+GC _{pi}	GC _{pf}	w/-GC _{pi}	w/+GC _{pi}
1	0.52	0.70	0.34	0.40	0.58	0.22
2	-0.69	-0.51	-0.87	-0.69	-0.51	-0.87
3	-0.47	-0.29	-0.65	-0.37	-0.19	-0.55
4	-0.42	-0.24	-0.60	-0.29	-0.11	-0.47
5	-0.45	-0.27	-0.63	-0.45	-0.27	-0.63
6	-0.45	-0.27	-0.63	-0.45	-0.27	-0.63
1E	0.78	0.96	0.60	0.61	0.79	0.43
2E	-1.07	-0.89	-1.25	-1.07	-0.89	-1.25
3E	-0.67	-0.49	-0.85	-0.53	-0.35	-0.71
4E	-0.62	-0.44	-0.80	-0.43	-0.25	-0.61

Wind Surface pressures (psf)

1	12.6	6.1	10.5	4.0
2	-9.2	-15.7	-9.2	-15.7
3	-5.2	-11.7	-3.4	-9.9
4	-4.3	-10.8	-2.0	-8.5
5	-4.9	-11.4	-4.9	-11.4
6	-4.9	-11.4	-4.9	-11.4
1E	17.3	10.8	14.3	7.8
2E	-16.1	-22.6	-16.1	-22.6
3E	-8.9	-15.4	-6.3	-12.8
4E	-7.9	-14.4	-4.5	-11.0

Windward roof overhangs: 12.3 psf (upward) add to windward roof pressure

Parapet

Windward parapet: 0.0 psf (GC_{pn} = +1.8)
Leeward parapet: 0.0 psf (GC_{pn} = -1.1)

Horizontal MWFRS Simple Diaphragm Pressures (psf)

Transverse direction (normal to L)

Interior Zone: Wall 16.8 psf
Roof -4.0 psf
End Zone: Wall 25.3 psf
Roof -7.2 psf

Longitudinal direction (parallel to L)

Interior Zone: Wall 12.5 psf
End Zone: Wall 18.8 psf

