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JOB TITLE Example 6&7

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STRUCTURAL CALCULATIONS

FOR

Example 6&7

20' eave height using MWFRS all heights procedure

20' eave height using MWFRS < 60' procedure

Guide to Wind Load Procedures of ASCE 7-02

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www.struware.com

Code Search

Code: ASCE 7 - 02

Occupancy:

Occupancy Group = B Business

Occupancy Category & Importance Factors:

Occupancy Category =	II
Wind factor =	1.00
Snow factor =	1.00
Seismic factor =	1.00

Type of Construction:

Fire Rating:	
Roof =	0.0 hr
Floor =	0.0 hr

Building Geometry:

Roof angle (θ)	4.00 / 12	18.4 deg
Building length (L)	250.0 ft	
Least width (B)	200.0 ft	
Mean Roof Ht (h)	36.7 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	125 psf
Walkways & elevated platforms (non e	60 psf

Mechanical	125 psf
Stairs & Exitways	100 psf
Balcony / Deck	
Partitions	N/A

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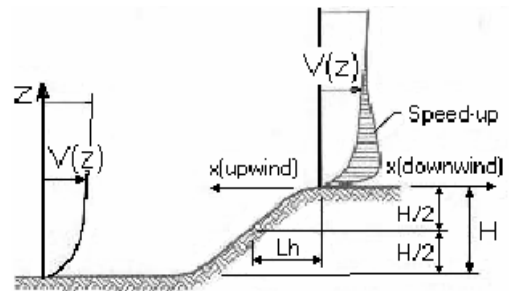
Wind Loads :

Importance Factor 1.00
Basic Wind speed 90 mph
Directionality (Kd) 0.85
Exposure Category C
Enclosure Classif. Enclosed Building
Internal pressure +/-0.18
Kh case 1 1.025
Kh case 2 1.025
Type of roof Gable

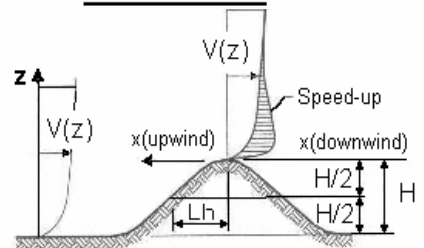
Topographic Factor (Kzt)

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 = 1.00



ESCARPMENT



2D RIDGE or 3D AXISYMMETRICAL HILL

Gust Effect Factor

h = 36.7 ft
B = 200.0 ft
/z (0.6h) = 22.0 ft

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 = 0.18 Therefore, probably rigid structure

G = 0.85 Using rigid structure default

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 η = 0.000 h = 36.7 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

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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.
 $A_o \geq 0.8A_g$

Test for Partially Enclosed Building:

Input		Test	
Ao	0.0 sf	$A_o \geq 1.1A_{oi}$	YES
Ag	0.0 sf	$A_o > 4' / 0.01A_g$	NO
Aoi	0.0 sf	$A_{oi} / A_{gi} \leq 0.20$	NO
Agi	0.0 sf		

Building is NOT Partially Enclosed.

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

- $A_o \geq 1.1A_{oi}$
- $A_o >$ smaller of 4' or 0.01 Ag
- $A_{oi} / A_{gi} \leq 0.20$

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
 $R_i = 1.00$

Altitude adjustment to constant 0.00256 :

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

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

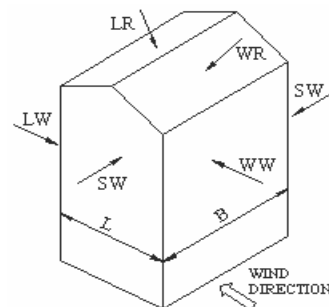
Kh (case 2) = 1.02	h = 36.7 ft	GCpi = +/-0.18
Base pressure (qh) = 18.1 psf	ridge ht = 53.4 ft	G = 0.85
Roof Angle = 18.4 deg	L = 250.0 ft	qi = qh
Roof tributary area - (h/2)*L: 4588 sf	B = 200.0 ft	
(h/2)*B: 3670 sf		

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		
	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

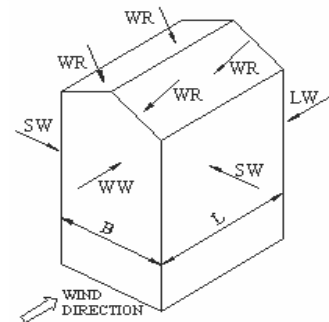
*Horizontal distance from windward edge

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'	0.85	1.00	10.2 psf	6.9 psf	13.4 psf	17.9 psf	17.1 psf
20.0 ft	0.90	1.00	10.8	7.6	14.1	18.5	17.7
25.0 ft	0.95	1.00	11.3	8.1	14.6	19.0	18.2
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
ridge = 53.4 ft	1.11	1.00	13.3	10.0	16.5	21.0	20.2



WIND NORMAL TO RIDGE



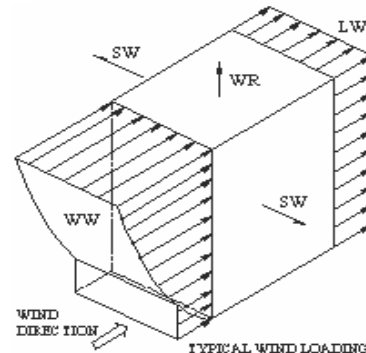
WIND PARALLEL TO RIDGE

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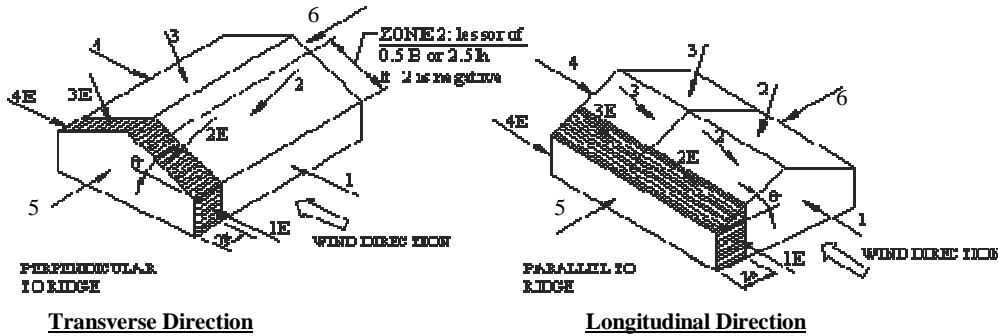
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Wind Loads - MWFRS $h \leq 60'$ (Low-rise Buildings) Enclosed/partially enclosed only



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

Transverse Direction

$K_z = K_h$ (case 1) = 1.02
Base pressure (qh) = **18.1 psf**
GCpi = +/-0.18

Longitudinal Direction

Edge Strip (a) = 14.7 ft
End Zone (2a) = 29.4 ft
Zone 2 length = 91.8 ft

Surface	Transverse Direction			Longitudinal Direction		
	Perpendicular $\theta = 18.4$ deg			Parallel $\theta = 0.0$ deg		
	GCpf	w/-GCpi	w/+GCpi	GCpf	w/-GCpi	w/+GCpi
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 (GCpn = +1.8)
Leeward parapet: 0.0 psf (GCpn = -1.1)

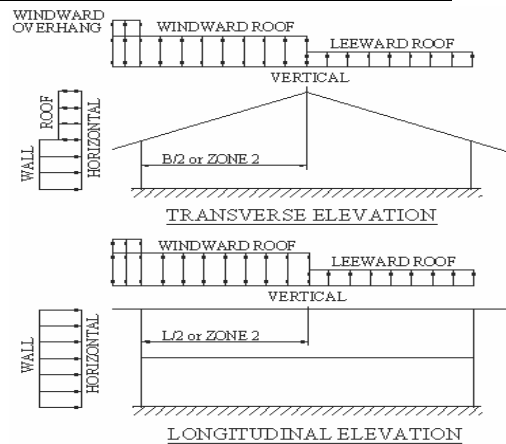
Horizontal MWFRS Simple Diaphragm Pressures (psf)

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



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Wind Loads - Components & Cladding : h <= 60'

Kh (case 1) = 1.02 h = 36.7 ft
 Base pressure (qh) = **18.1 psf** a = 14.7 ft
 Minimum parapet ht = 0.0 ft GCpi = +/-0.18
 Roof Angle = 18.4 deg
 Type of roof = Gable

Roof Area	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	-47.0 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	-45.2 psf	-60.3 psf	-45.2 psf

Overhang pressures in the table above assume an internal pressure coefficient (Gcpi) of 0.0

Parapet

qp = 0.0 psf

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

Solid Parapet Pressure	Surface Pressure (psf)			User input
	10 sf	100 sf	500 sf	40 sf
CASE A : Interior zone:	0.0 psf	0.0 psf	0.0 psf	0.0 psf
Corner zone:	0.0 psf	0.0 psf	0.0 psf	0.0 psf
CASE B : Interior zone:	0.0 psf	0.0 psf	0.0 psf	0.0 psf
Corner zone:	0.0 psf	0.0 psf	0.0 psf	0.0 psf

Walls

Walls Area	GCp +/- GCpi			Surface Pressure at "h"			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

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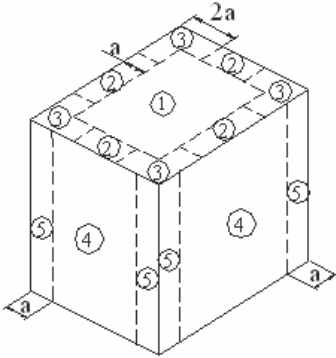
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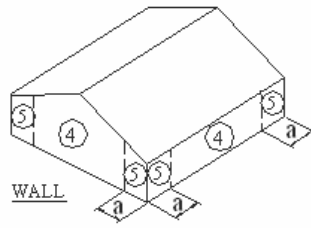
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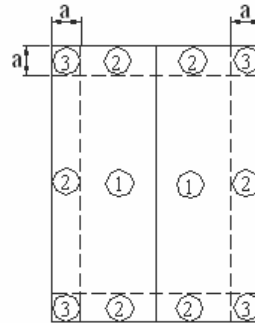
Location of Wind Pressure Zones



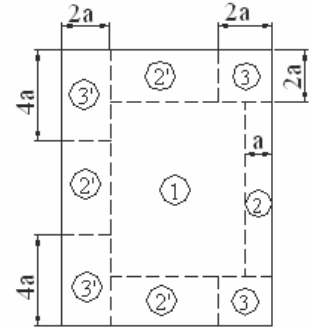
Roofs w/ $\theta \leq 10^\circ$
and all walls
 $h > 60'$



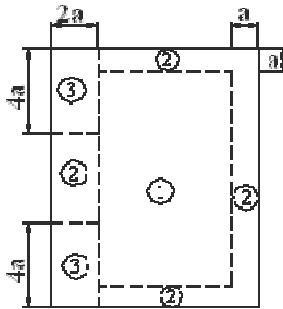
Walls $h \leq 60'$
& alt design $h < 90'$



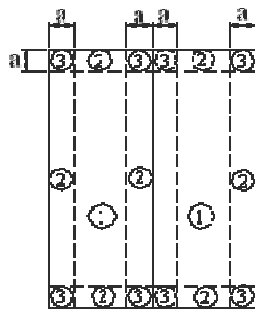
Gable, Sawtooth and
Multispan Gable $\theta \leq 7$ degrees &
Monoslope ≤ 3 degrees
 $h \leq 60'$ & alt design $h < 90'$



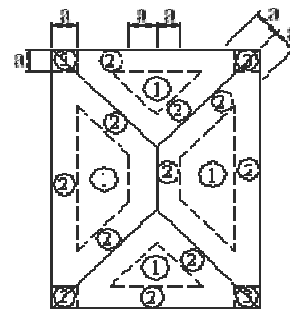
Monoslope roofs
 $3^\circ < \theta \leq 10^\circ$
 $h \leq 60'$ & alt design $h < 90'$



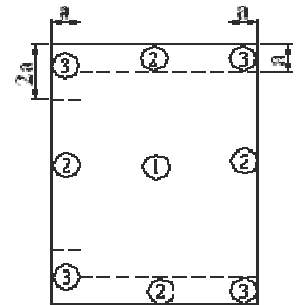
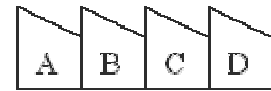
Monoslope roofs
 $10^\circ < \theta \leq 30^\circ$
 $h \leq 60'$ & alt design $h < 90'$



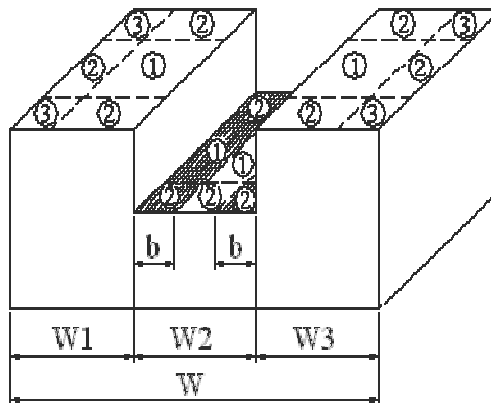
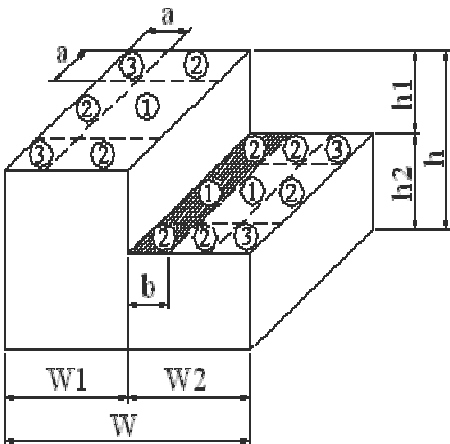
Multispan Gable &
Gable $7^\circ < \theta \leq 45^\circ$



Hip $7^\circ < \theta \leq 27^\circ$



Sawtooth $10^\circ < \theta \leq 45^\circ$
 $h \leq 60'$ & alt design $h < 90'$



Stepped roofs $\theta \leq 3^\circ$
 $h \leq 60'$ & alt design $h < 90'$