

Project :  
 Subject :  
 Location :

File :  
 Date : 8/2/2011  
 Eng :

**Design Wind Pressure, p, Equation 6-19 (ASCE 7-05)**

Design wind pressures and forces are determined per equations given in section 6.5.12

System Type	Structure Type	Equation
Main Wind-Force Resisting System	Flexible Buildings Buildings of all Heights	$p$ : $q \cdot G_f \cdot C_p - q_i \cdot G_{Cpi}$ $q = q_z$ : at height z above ground $q = q_h$ : for Leeward and Side Wall $q_i$ : $q_z$ for $G_{Cpi+}$ , $q_h$ for $G_{Cpi-}$ $G_f$ : Obtained by rational analysis $C_p$ : given in Figure 6-6 $G_{Cpi}$ : given in Figure 6-5

**Velocity Pressure Calculations,  $q_z$  and  $q_h$**

Velocity pressure  $q_z$  and  $q_h$  are calculated in accordance with section 6.5.10

$q_z$  = Velocity pressure @ height (z) (Eq. 6-15)  
 $q_z = \text{Constant} \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2 \cdot I$   
 $q_z$  = See wind pressure calculation table

$q_h$  = Velocity pressure @ height (h)  
 $q_h = \text{Constant} \cdot K_h \cdot K_{zt} \cdot K_d \cdot V^2 \cdot I$

Where : Constant = Numerical constant (Section C6.5.10)  
 =  $\frac{1}{2} \cdot [ (\text{Air density lb/cu ft}) / (32.2 \text{ ft/s}^2) ] \cdot [ (\text{mi/h}) (5280 \text{ ft/mi}) \cdot (1 \text{ hr}/3600 \text{ s}) ]^2$   
 = 0.00203

Mean Sea Level = 7,586.00 ft  
 Air Density @MSL = 0.0609 lb/cu ft (Table C6-13)  
 Category = I (Table 1-1)  
 Importance Factor = 0.77 (Table 6-1)  
 Exposure Category = B (Urban areas)  
 Alpha = 7.00 (Table 6-2)  
 $Z_g$  = 1,200.00 ft (Table 6-2)  
 Basic Wind Speed = 165.00 mph (Figure 6-1)  
 Structure Height = 45.00 ft  
 Width = 10.00 ft  
 Depth = 15.00 ft  
 Natural Frequency = 0.1000 Hz  
 Damping Ratio,  $\beta$  = 3.5000 %

Project :  
 Subject :  
 Location :

File :  
 Date : 8/2/2011  
 Eng :

**Velocity Pressure Calculations, qz (Cont.)**

Where : Kz = Velocity pressure coefficient @ height z  
 =  $2.01 \cdot (Z/Z_g)^{2/\alpha}$  for  $15 \text{ ft} \leq Z \leq Z_g$  (Eq. C6-4a)  
 =  $2.01 \cdot (15/Z_g)^{2/\alpha}$  for  $Z < 15 \text{ ft}$  (Eq. C6-4b)  
 = See wind pressure calculation table

Kh @ h = Velocity pressure coefficient @ height h  
 = 0.79

Kz @ z = z = highest opening affecting pressure  
 = 0.70

Kzt = Topographic factor obtained from Fig. 6-4  
 =  $(1 + K_1 \cdot K_2 \cdot K_3)^2$   
 = 1.00

Topography = None

Kd = Wind directionality factor obtained from Table 6-4  
 = 1.00

**Internal Pressure Coefficient, GCpi, Figure 6-5**

The internal pressure coefficients are given in Figure 6-5

Enlosure Classification	GCpi+	GCpi-	Ri	GCpi+	GCpi-
Partially enclosed buildings	0.55	-0.55	0.69	0.38	-0.38

**Reduction Factor, Ri**

Aog (sq. ft.) = 50.00  
 Vi (cu. ft.) = 7,000,000.00

Project :  
 Subject :  
 Location :

File :  
 Date : 8/2/2011  
 Eng :

**Gust Effect Factor, Gf, Obtained by Rational Analysis**

The gust effect factor Gf for main wind-force resisting systems of flexible buildings and other structures shall be calculated by rational analysis, using dynamic properties of the system

**Values Obtained from Table 6-2**

Zmin	=	30.00 ft
e	=	0.333
I	=	320.0 ft
c	=	0.300
b (-)	=	0.450
Alpha (-)	=	0.250
b (^)	=	0.840
Alpha (^)	=	0.143

**Calculated Values**

Analysis	=	Category III : Flexible or Dynamically Sensitive Structures
Damping Ratio, β	=	3.50 %
n1( Frequency )	=	0.100 Hz
z (-)	=	30.00 ft
Iz	=	$c \cdot (33/z)^{1/6}$ (Eq. 6-5)
	=	0.305
Lz	=	$I \cdot (z/33)^e$ (Eq. 6-7)
	=	310.0 ft
Q	=	$Sqr [ 1 / ( 1 + 0.63 \cdot [(b+h)/Lz]^{0.63} ) ]$ (Eq. 6-6)
	=	0.908
Vz (-)	=	$b(-) \cdot [ z / 33 ]^{alpha(-)} \cdot V \cdot (88/60)$ (Eq. 6-14)
	=	106.34 ft/s
N1	=	$n1 \cdot Lz / Vz$ (Eq. 6-12)
	=	0.292
Rn	=	$7.47 \cdot N1 / ( 1 + 10.3 \cdot N1 )^{5/3}$ (Eq. 6-11)
	=	0.216
RI	=	$[ 1/n - 1/2 \cdot n^2 ( 1 - e^{-2 \cdot n} ) ]$ for n > 0 (Eq. 6-13a)
	=	1 for n = 0 (Eq. 6-13b)
nh = 4.6 · n1 · h / Vz	=	0.195
nb = 4.6 · n1 · b / Vz	=	0.043
nl = 15.4 · n1 · L / Vz	=	0.217
Rh = RI ( n = nh )	=	0.882
Rb = RI ( n = nb )	=	0.972
RL = R ( n = nl )	=	0.870
R	=	$Sqr [ ( 1 / \beta ) \cdot Rn \cdot Rh \cdot Rb ( 0.53 + 0.47 \cdot RI ) ]$ (Eq. 6-10)
	=	2.227
g ( peak factor )	=	3.500
gq	=	3.4
gv	=	3.4
gr	=	$Sqr(2 \cdot \ln(3,600 \cdot n1)) + .577/Sqr(2 \cdot \ln(3,600 \cdot n1))$ (Eq. 6-9)
	=	3.599
Gust Factor ( G )	=	$.925 \cdot [(1 + 1.7 \cdot Iz \cdot Sqr(gq^2 \cdot Q^2 + gr^2 \cdot R^2)) / ( 1 + 1.7 \cdot gv \cdot Iz )]$ (Eq. 6-8)
G	=	1.826

Project :  
 Subject :  
 Location :

File :  
 Date : 8/2/2011  
 Eng :

**External Pressure Coefficient, Cp, Figure 6-6**

The pressure force coefficient is given in Figure 6-6

Wall Pressure Coefficients, Cp

Surface	L/B	Cp	Use With
Windward	All Values	0.8	qz
Leeward	2.00	-0.3	qh
Side walls	All Values	-0.7	qh

Roof Pressure Coefficients, Cp, for use with qh

Wind Direction	Winward			Leeward	
	h/L	Angle ( deg. )	Cp	Angle ( deg. )	Cp
Normal to Ridge (Ang. >= 10)	1.00	33.00	-0.24 0.20	13.00	-0.64
Normal to Ridge (Ang. <10) and Parallel to Ridge for all angles	1.00	Horizontal distance from edge			
		0 to H/2	H/2 to H	H to 2H	> 2H
		-1.30	-0.70	-0.70	-0.70
		( 1 )	( 2 )	( 3 )	( 4 )

**Design Wind Pressure, p (psf), Equation 6-19**

Design wind pressures and forces are determined per equations given in section 6.5.12

Surface	Cp	GCpi+	GCpi-	q = qh (psf)	qi+ = qz * (psf)	qi- = qh (psf)	G	p+ (psf)	p- (psf)
Wall Pressures									
Leeward wall	-0.30	0.38	-0.38	33.48	29.81	33.48	1.83	-29.60	-5.69
Side wall	-0.70	0.38	-0.38	33.48	29.81	33.48	1.83	-54.05	-30.13
Roof - Normal to Ridge for Angles > 10.0 deg.									
Windward NTR	-0.24	0.38	-0.38	33.48	29.81	33.48	1.83	-25.94	-2.02
Windward NTR	0.20	0.38	-0.38	33.48	29.81	33.48	1.83	0.96	24.88
Leeward NTR	-0.64	0.38	-0.38	33.48	29.81	33.48	1.83	-50.39	-26.47
Roof - Normal to Ridge (Ang. < 10.0 deg) and Parallel to Ridge All Angles									
(1) PTR or NTR	-1.30	0.38	-0.38	33.48	29.81	33.48	1.83	-90.73	-66.81
(2) PTR or NTR	-0.70	0.38	-0.38	33.48	29.81	33.48	1.83	-54.05	-30.13
(3) PTR or NTR	-0.70	0.38	-0.38	33.48	29.81	33.48	1.83	-54.05	-30.13
(4) PTR or NTR	-0.70	0.38	-0.38	33.48	29.81	33.48	1.83	-54.05	-30.13
Cp = -.18	-0.18	0.38	-0.38	33.48	29.81	33.48	1.83	-22.27	1.65

p+ uses GCpi+

p- uses GCpi-

\* qz, where z = 30.00 ft

Project :  
 Subject :  
 Location :

File :  
 Date : 8/2/2011  
 Eng :

**Design Wind Pressure for Overhang, p, Equation 6-19**

The design equation has been modified to  $q_h \cdot G \cdot (C_p - \text{Underside } C_p)$  for overhang pressures  
 0.80 is used for Underside  $C_p$  instead of  $GC_{pi}$

Surface	$C_p$	Underside $C_p$	$q = q_h$ (psf)	G	$p$ (psf)
Roof - Normal to Ridge for Angles > 10.0 deg.					
Windward NTR	-0.24	0.80	33.48	1.83	-63.57
Roof - Normal to Ridge for Angles < 10.0 deg. and Parallel to Ridge all Angles					
Leeward NTR	-0.64	0.80	33.48	1.83	-88.02
(1) PTR or NTR	-1.30	0.80	33.48	1.83	-128.36
(2) PTR or NTR	-0.70	0.80	33.48	1.83	-91.68
(3) PTR or NTR	-0.70	0.80	33.48	1.83	-91.68
(4) PTR or NTR	-0.70	0.80	33.48	1.83	-91.68
$C_p = -0.18$	-0.18	0.80	33.48	1.83	-59.90

$p+$  uses  $GC_{pi}+$

$p-$  uses  $GC_{pi}-$

\*  $q_z$ , where  $z =$  30.00 ft

**Combined Net Pressure of Parapet, pp, Equation 6-20**

$k_p = 2.01 \cdot (\text{Parapet Height} / Z_g) ^ {2/\text{Alpha}}$

$k_{pt} = (1 + K_1 \cdot K_2 \cdot K_3) ^ 2$ , where  $z =$  parapet height in the  $k_3$  multiplier

$q_p = \text{Constant} \cdot K_p \cdot k_{pt} \cdot K_d \cdot V ^ 2 \cdot I$

$pp = GC_{pn} \cdot q_p$

Side	$GC_{pn}$	$k_p$	$k_{pt}$	$q_p$ (psf)	$pp$ (psf)
Windward	1.50	0.69	1.00	29.23	43.85
Leeward	-1.00	0.69	1.00	29.23	-29.23

Project :  
 Subject :  
 Location :

File :  
 Date : 8/2/2011  
 Eng :

**Design Windward Wall Wind Pressures, p, Equation 6-19**

*Design wind pressures and forces are determined per equations given in section 6.5.12*

*p+ uses GCpi+*

*p- uses GCpi-*

\* qz, where z =

30.00 ft

Heights (feet)	Kz	Kzt	Kd	q = qz (psf)	qi+ = qz * (psf)	qi- = qh (psf)	Cp	GCpi+	GCpi-	p+ (psf)	p- (psf)
40.01 - 45.00	0.79	1.00	1.00	33.48	29.81	33.48	0.80	0.38	-0.38	37.63	61.55
30.01 - 40.00	0.76	1.00	1.00	32.37	29.81	33.48	0.80	0.38	-0.38	36.01	59.93
25.01 - 30.00	0.70	1.00	1.00	29.81	29.81	33.48	0.80	0.38	-0.38	32.28	56.20
20.01 - 25.00	0.67	1.00	1.00	28.30	29.81	33.48	0.80	0.38	-0.38	30.07	53.99
15.01 - 20.00	0.62	1.00	1.00	26.55	29.81	33.48	0.80	0.38	-0.38	27.52	51.44
0.00 - 15.00	0.57	1.00	1.00	24.46	29.81	33.48	0.80	0.38	-0.38	24.46	48.38

Project :  
Subject :  
Location :

File :  
Date : 8/2/2011  
Eng :

**Design Wind Forces Windward Wall (Cp,+GCpi)**

*Design wind forces are calculated as follows :*

Heights (feet)	Area (sqr ft)	p (psf)	Force (lbs)	Shear (lbs)	Moment (lb-ft)
40.01 - 45.00	28	37.63	1,045	1,045	2,607
30.01 - 40.00	222	36.01	8,002	9,047	53,027
25.01 - 30.00	194	32.28	6,277	15,324	113,923
20.01 - 25.00	243	30.07	7,309	22,633	208,779
15.01 - 20.00	250	27.52	6,880	29,512	339,108
0.00 - 15.00	750	24.46	18,343	47,856	919,663

Total Area 1,687 (sq. ft.)  
Base Shear 47,856 (lbs)  
Base Moment 919,663 (lb-ft)

Project :  
Subject :  
Location :

File :  
Date : 8/2/2011  
Eng :

**Design Wind Forces Windward Wall (Cp,-GCpi)**

*Design wind forces are calculated as follows:*

Heights (feet)	Area (sq ft)	p (psf)	Force (lbs)	Shear (lbs)	Moment (lb-ft)
40.01 - 45.00	28	61.55	1,709	1,709	4,264
30.01 - 40.00	222	59.93	13,317	15,026	87,873
25.01 - 30.00	194	56.20	10,928	25,953	190,266
20.01 - 25.00	243	53.99	13,122	39,076	352,773
15.01 - 20.00	250	51.44	12,859	51,935	580,235
0.00 - 15.00	750	48.38	36,282	88,217	1,631,890

Total Area 1,687 (sq. ft.)  
Base Shear 88,217 (lbs)  
Base Moment 1,631,890 (lb-ft)