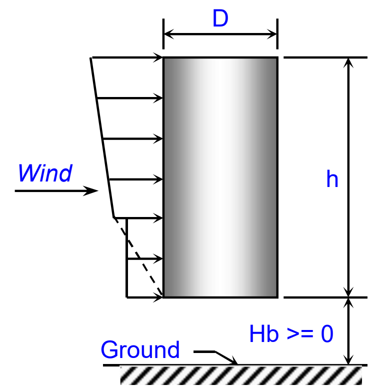
WIND LOADING ANALYSIS - Chimneys, Stacks, and Vertical Tanks

Per ASCE 7-05 Code for Cantilevered Structures Classified as Other Structures

Job Name:		Subject:			
Job Number:		Originator:		Checker:	

Input Data:

V =	90	mph (Wind Map, Figure 6-1)
Class. =	II	(Occupancy Category from Table 1-1)
Exposure =	B	(Exposure Category from Sect. 6.5.6)
Kzt =	1.00	(Topographic Factor from Sect. 6.5.7)
h =	80.00	ft. (Height of Vessel itself)
Hb =	50.00	ft. (Height of Vessel Base Above Ground)
Outside D =	4.00	ft. (Diameter or Width of Surface Normal to Wind)
t =	0.3750	in. (Wall Thickness of Vessel)
γt =	490	pcf (Vessel Material Unit Weight)
Shape?	Round	(Round, Hexagon, Octagon, or Square)
β =	0.010	(Damping Ratio = 0.010-0.070)
Kd =	0.95	(Direct. Factor, Table 6-4)
Cf =	0.750	(Force Coef. from Fig. 6-21)
Hurricane?	N	



Elevation

Resulting Parameters and Coefficients:

If z < 15 then: Kz = 2.01*(15/zg)^(2/α)

If z >= 15 then: Kz = 2.01*(z/zg)^(2/α)

α =	7.00	(Table 6-2)
zg =	1200	(Table 6-2)
I =	1.00	(Table 6-1) (Import. Factor)
h/D =	20.000	
Freq., f =	2.034	Hz. (f >= 1.0) Rigid
Period, T =	0.492	sec.
G =	0.850	(Gust Factor, Sect. 6.5.8)

Velocity Pressure (Sect. 6.5.10, Eq. 6-15):
qz = 0.00256*Kz*Kzt*Kd*V^2*I

Net Design Wind Pressures (Sect. 6.5.13):
p = qz*G*Cf (psf)

Net Design Wind Forces (Sect. 6.5.15, Eq. 6-28):
F = qz*G*Cf*D (lb/ft)

Wind Load Tabulation for Stack / Tank

z (ft.)	Kz	qz (psf)	p=qz*G*Cf (psf)	F=qz*G*Cf*D (lb/ft)
50.00	0.81	15.97	10.18	40.72
55.00	0.83	16.41	10.46	41.85
60.00	0.85	16.82	10.73	42.90
65.00	0.87	17.21	10.97	43.89
70.00	0.89	17.58	11.21	44.83
75.00	0.91	17.93	11.43	45.72
80.00	0.93	18.26	11.64	46.58
85.00	0.94	18.58	11.85	47.39
90.00	0.96	18.89	12.04	48.17
95.00	0.97	19.18	12.23	48.92
100.00	0.99	19.47	12.41	49.64
105.00	1.00	19.74	12.58	50.34
110.00	1.02	20.00	12.75	51.01
120.00	1.04	20.51	13.07	52.30
130.00	1.07	20.98	13.38	53.51

Total Shear & Moment @ Base of Vessel:

ΣV(total) =	3.83	kips
ΣM(total) =	159.74	ft-kips

Determination of Gust Effect Factor, G:

Flexible? No f >= 1.0 Hz.

1: Simplified Method for Rigid Structure

G = 0.85

Parameters Used in Both Item #2 and Item #3 Calculations (from Table 6-2):

α^ =	0.143	
b^ =	0.84	
α(bar) =	0.250	
b(bar) =	0.45	
c =	0.30	
l =	320	ft.
ε(bar) =	0.333	
z(min) =	30	ft.

Calculated Parameters Used in Both Rigid and/or Flexible Structure Calculations:

z(bar) =	48.00	= 0.6*h , but not < z(min) , ft.
Iz(bar) =	0.282	= c*(33/z(bar))^(1/6) , Eq. 6-5
Lz(bar) =	362.57	= l*(z(bar)/33)^(ε(bar)) , Eq. 6-7
gq =	3.4	(3.4, per Sect. 6.5.8.1)
gv =	3.4	(3.4, per Sect. 6.5.8.1)
gr =	4.355	= (2*(LN(3600*f)))^(1/2)+0.577/(2*LN(3600*f))^(1/2) , Eq. 6-9
Q =	0.894	= (1/(1+0.63*((B+h)/Lz(bar))^0.63))^(1/2) , Eq. 6-6

2: Calculation of G for Rigid Structure

G = 0.864 = 0.925*((1+1.7*gq*Iz(bar)*Q)/(1+1.7*gv*Iz(bar))) , Eq. 6-4

3: Calculation of Gf for Flexible Structure

β =	0.010	Damping Ratio
di =	3.9375	= D-(2*t/12), ft. (Inside diameter or clear inside dimension between flats.)
I =	0.767	= 0.0491*(D^4-di^4), ft^4
m =	0.0059	kip-sec^2/ft^2, m = 0.7854*(D^2-di^2)*γt/g
f =	2.034	Hz., f = 0.56/h^2*SQRT(E*I/m) (from ASCE 7-05 Ch. C6, Eqn. C6-22a, page 294)
T =	0.492	= 1/f, sec. (fundamental period)
V(fps) =	N.A.	= V(mph)*(88/60) , ft./sec.
V(bar,zbar) =	N.A.	= b(bar)*(z(bar)/33)^(α(bar))*V*(88/60) , ft./sec. , Eq. 6-14
N1 =	N.A.	= f*Lz(bar)/(V(bar,zbar)) , Eq. 6-12
Rn =	N.A.	= 7.47*N1/(1+10.3*N1)^(5/3) , Eq. 6-11

ηh =	N.A.	= 4.6*f*h/(V(bar,zbar))
Rh =	N.A.	= (1/ηh)-1/(2*ηh^2)*(1-e^(-2*ηh)) for ηh > 0, or = 1 for ηh = 0 , Eq. 6-13a,b
ηb =	N.A.	= 4.6*f*D/(V(bar,zbar))
RB =	N.A.	= (1/ηb)-1/(2*ηb^2)*(1-e^(-2*ηb)) for ηb > 0, or = 1 for ηb = 0 , Eq. 6-13a,b
ηd =	N.A.	= 15.4*f*D/(V(bar,zbar))
RL =	N.A.	= (1/ηd)-1/(2*ηd^2)*(1-e^(-2*ηd)) for ηd > 0, or = 1 for ηd = 0 , Eq. 6-13a,b
R =	N.A.	= ((1/β)*Rn*Rh*RB*(0.53+0.47*RL))^(1/2) , Eq. 6-10
Gf =	N.A.	= 0.925*(1+1.7*Iz(bar)*(gq^2*Q^2+gr^2*R^2)^(1/2))/(1+1.7*gv*Iz(bar)) , Eq. 6-8
Use: G =	0.850	

Version 1.4

Force Coefficients for Chimneys, Tanks, and Similar Structures, Cf (Figure 6-21):				
Cross-Section	Type of Surface	Cf for h/D Values of:		
		1	7	25
Square (wind normal to face)	All	1.3	1.4	2.0
Square (wind along diagonal)	All	1.0	1.1	1.5
Hexagonal or Octagonal	All	1.0	1.2	1.4
Round (D*SQRT(qz)>2.5)	1-Moderately Smooth	0.5	0.6	0.7
	2-Rough (D'/D=0.02)	0.7	0.8	0.9
	3-Very Rough (D'/D=0.08)	0.8	1.0	1.2
Round (D*SQRT(qz)<=2.5)	4-All	0.7	0.8	1.2

Wind Direction =	Normal	(applicable for square cross-section only)
D' =	1.000	ft. (depth of protruding elements)
D'/D =	0.250	
Type Round Surface =	3	Very Rough
h/D =	20.000	
D*SQRT(qz) =	15.98	> 2.5
Cf =	1.144	(interpolated Force Coefficient from Figure 6-21 above)

Note: if applicable, user may input above value of 'Cf' into cell B21.