Structural Report for the Secondary Waste Transfer Station at Polashi

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Office Building

Calculation of Uniformly Distributed Load on Roof

For Office Room-1

Slab Thickness of Roof= 5”

Self Weight of roof= (5/12)*150 psf= 62.5 psf

Floor Finish, FF=25 psf

Live Load, LL=40 psf

Total DL= SW+FF= (62.5+25) psf= 87.5 psf

Total DL on 18’ long beam= (87.5*66.94)/18

= 325.4 lb/ft

Total LL on 18’ long beam = (40*66.94)/18

= 148.76 lb/ft

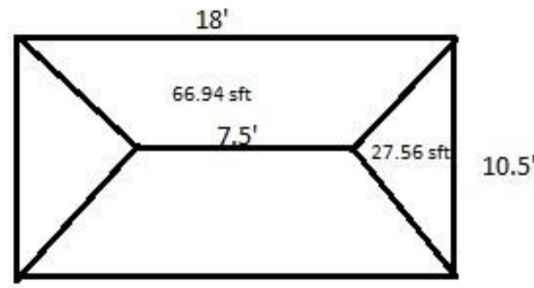


Fig: Tributary Area of office roof

Total DL on 10.5’ long beam= (87.5*27.66)/10.5 lb/ft

= 230.5 lb/ft

Total LL on 10.5’ long beam= (40*27.66)/10.5 lb/ft

= 105.37 lb/ft

For Office Room-2

Total DL= 87.5 psf

LL= 40 psf

DL on 18’ long beam= (87.5*80)/18 lb/ft = 388.89 lb/ft

LL on 18’ long beam= (40*80)/18 lb/ft= 177.78 lb/ft

DL on 16’ beam= (87.5*64)/16 lb/ft = 350 lb/ft

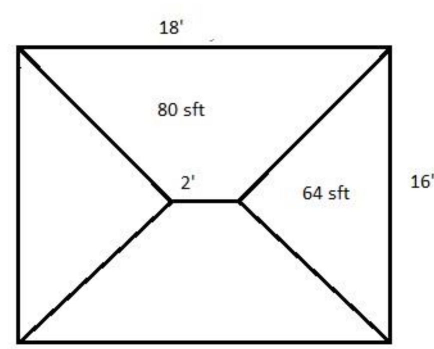


Fig: Tributary Area of office roof

LL on 16’ beam= (40*64)/16 lb/ft

= 160 lb/ft

Calculation of Uniformly Distributed Load on Ground

For Office Room-1

FF=25 psf

PW= 80 psf

DL=105 psf

SW=

Total DL on 18’ long beam= (87.5*66.94)/18

= 325.4 lb/ft

Total LL on 18’ long beam = (40*66.94)/18

= 148.76 lb/ft

Total DL on 10.5’ long beam= (87.5*27.66)/10.5 lb/ft = 230.5 lb/ft

Total LL on 10.5’ long beam= (40*27.66)/10.5 lb/ft = 105.37 lb/ft

For Office Room-2

DL on 18’ long beam= (87.5*80)/18 lb/ft = 388.89 lb/ft

LL on 18’ long beam= (40*80)/18 lb/ft= 177.78 lb/ft

DL on 16’ beam= (87.5*64)/16 lb/ft = 350 lb/ft

LL on 16’ beam= (40*64)/16 lb/ft = 160 lb/ft

Calculation of Wind Load

For Office Room-1

Wind Design Data:

L_x =18/3.28 m = 5.4878 m

L_y= 10.5/3.28m = 3.20122 m

Total height= 10/3.28 m = 3.04878 m

No of Stories=1

Story Height= 3.04878 m

Exposure: A, Wind Speed = 65.7 m/s

Importance Factor, I=1.15

Structure Type: Concrete Moment Resisting Frame

Assuming, topographic Factor, K_{zt} =1, Directionality Factor, K_d = 0.85

Velocity pressure, $q_z = 0.000613k_zk_{zr}k_dv^2I$

$= 0.000613*k_z*1*0.85*(65.7)^2*1.15$

$= 2.586k_z$

Velocity Pressure Coefficient, $k_z = k_h$=0.575

Velocity Pressure, q_z = (2.586*0.575) kN/m^2

= 1.487 kN/m^2

Gust Factor, G_x= 0.895, G_y=0.888

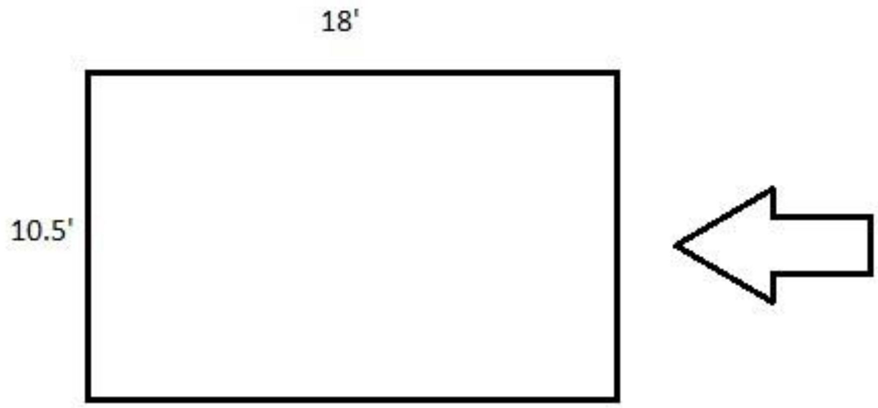
External Pressure Coefficient (Windward), C_{pwx} = 0.8

External Pressure Coefficient (Leeward), C_{plx} = 0.36

External Pressure Coefficient (Windward), C_{pwy} = 0.8

External Pressure Coefficient (Leeward), C_{ply} = 0.5

For Wind Load in X-direction (10’ x10.5’ face):



Design Pressure, P_x (Windward) = q_z*G_x* C_{pwx} = 1.487*0.895*0.8 kN/m^2

= 1.064 kN/m^2

Design Pressure, P_x (Leeward) = q_z*G_y* C_{plx} = 1.487*0.888*0.36 kN/m^2

= 0.475 kN/m^2

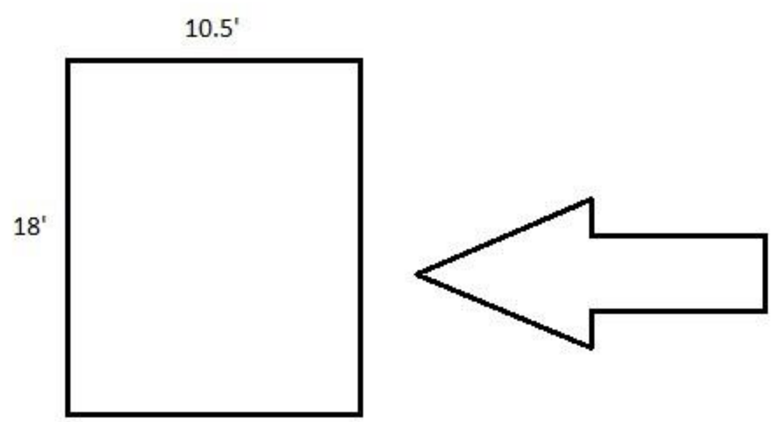
Total Load (Windward) at node = 1.064*20.88*(10/2)*(10.5/2) lb

= 583.18 lb

Total Load (Leeward) at node = 0.475*20.88*(10/2)*(10.5/2) lb

= 260.35 lb

For Wind Load in Y-direction (10’ x18’ face):



Design Pressure, P_y (Windward) = q_z*G_y* C_{pwy} = 1.487*0.888*0.8 kN/m^2

= 1.056 kN/m^2

Design Pressure, P_x (Leeward) = q_z*G_x* C_{ply} = 1.487*0.895*0.5 kN/m^2

= 0.665 kN/m^2

Total Load (Windward) at node = 1.056*20.88*(10/2)*(18/2) lb

= 992.22 lb

Total Load (Leeward) at node = 0.665*20.88*(10/2)*(18/2) lb

= 624.8 lb

For Office Room-2

Wind Design Data:

L_x =18/3.28 m = 5.4878 m

L_y= 16/3.28m = 4.87805 m

Total height= 10/3.28 m = 3.04878 m

No of Stories=1

Story Height= 3.04878 m

Exposure: A, Wind Speed = 65.7 m/s

Importance Factor, I=1.15

Structure Type: Concrete Moment Resisting Frame

Assuming, topographic Factor, K_{zt} =1, Directionality Factor, K_d = 0.85

Velocity pressure, $q_z = 0.000613 k_z k_{zr} k_d v^2 I$

$= 0.000613 * k_z * 1 * 0.85 * (65.7)^2 * 1.15$

$= 2.586 k_z$

Velocity Pressure Coefficient, $k_z = k_h = 0.575$

Velocity Pressure, q_z = (2.586*0.575) kN/m^2

= 1.487 kN/m^2

Gust Factor, G_x= 0.89, G_y=0.888

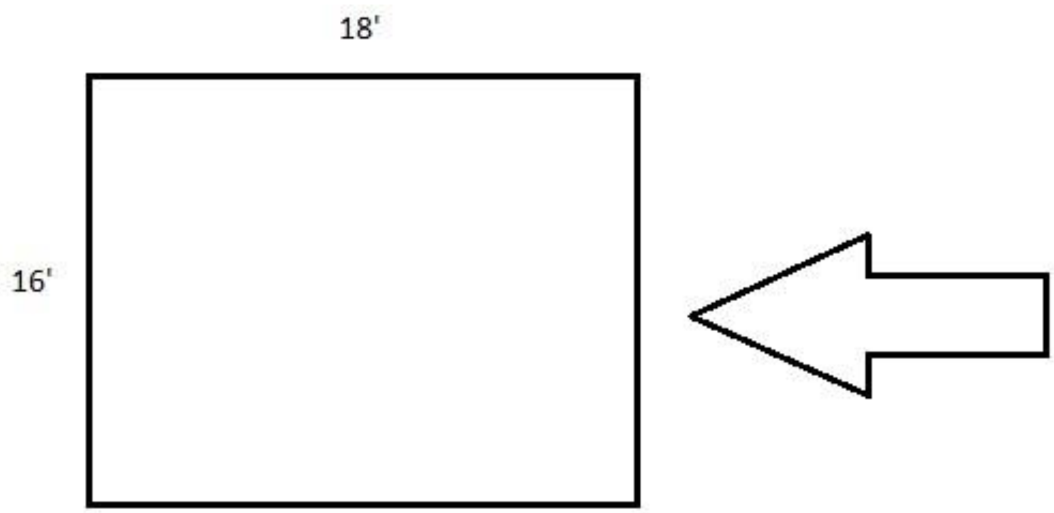
External Pressure Coefficient (Windward), C_{pwx} = 0.8

External Pressure Coefficient (Leeward), C_{plx} = 0.48

External Pressure Coefficient (Windward), C_{pwy} = 0.8

External Pressure Coefficient (Leeward), C_{ply} = 0.5

For Wind Load in X-direction (10’ x16’ face):



Design Pressure, P_x (Windward) = $q_z*G_x* C_{pwx}$ = 1.487*0.89*0.8 kN/m^2

= 1.058 kN/m^2

Design Pressure, P_x (Leeward) = $q_z*G_y* C_{plx}$ = 1.487*0.888*0.48 kN/m^2

= 0.63 kN/m^2

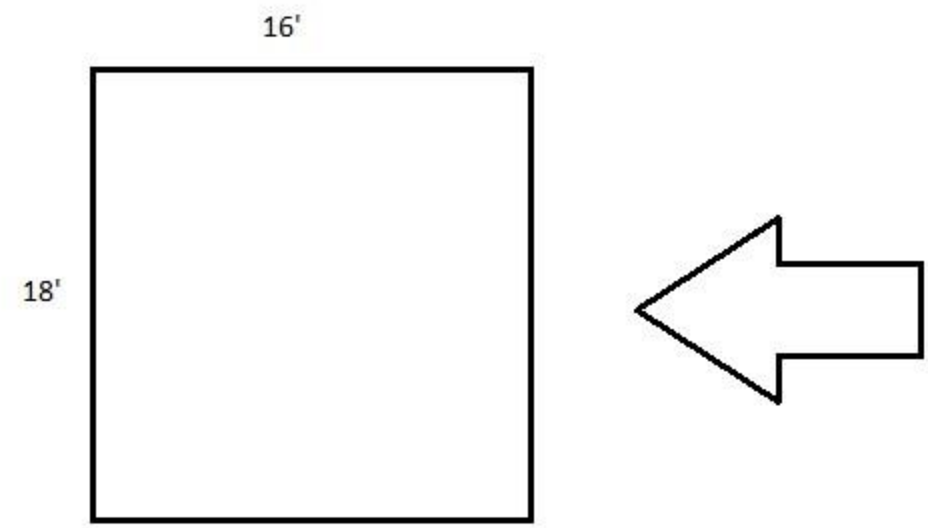
Total Load (Windward) at node = 1.058*20.88*(10/2)*(16/2) lb

= 883.6 lb

Total Load (Leeward) at node = 0.63*20.88*(10/2)*(16/2) lb

= 526.18 lb

For Wind Load in Y-direction (10’ x18’ face):



Design Pressure, P_y (Windward) = q_z*G_y* C_{pwy} = 1.487*0.888*0.8 kN/m^2

= 1.056 kN/m^2

Design Pressure, P_y (Leeward) = q_z*G_x* C_{ply} = 1.487*0.89*0.5 kN/m^2

= 0.662 kN/m^2

Total Load (Windward) at node = 1.056*20.88*(10/2)*(18/2) lb

= 992.22 lb

Total Load (Leeward) at node = 0.662*20.88*(10/2)*(18/2) lb

= 622.02 lb

Earthquake Load Calculation of Office Building

For Office Room-1

Column wt= 2*(12*12)/144*0.15*10 kip= 3 kip

Beam wt= (12*12)/144*0.15*2*(18+10.5) + (12*18)/144*0.15*(18+10.5)= 17.1 kip

DL from Roof Slab:

SW= (5/12)*0.15= 6.25 kip

(25+6.25)*(18*10.5)= 5.9 kip

LL from Roof Slab= 40*18*10.5 kip= 1.56 kip

DL from Ground Floor, Slab= (6.25+105)*(18+10.5)= 21.02 kip

LL from GF slab= 7.56 kip

Total Seismic Weight= (3+17.1+5.9+21.02)+0.25*(7.56+7.56) kip= 50.8 kip

V= S_a*W= 0.0749* 50.8 kip= 3.87 kip

h	w	w*h	$F_{x\ (kip)}$
2	25.40	50.8	0.544
12	25.40	304.8	3.26
		355.6	

dE_5= 0.544*(9*5.25)/(18*10.5)=0.136

dE_8= 0.544*(9*5.15)/(18*10.5)=0.136

dD_5= 0.136 kip

dD_8= 0.136 kip

UE_5 = UE_8= UD_5=UD_8=0.815

For Office Room-2

Column wt= 2*(12*12)/144*0.15*10 kip= 3 kip

Beam wt= (12*12)/144*0.15*2*(18+16) + (12*18)/144*0.15*(18+16)= 20.4 kip

DL from Roof Slab=(25+6.25)*18*16 = 9 kip

LL from Roof Slab= (40*18*16) kip= 11.52 kip

DL from Ground Floor, Slab= 32.04 kip

LL from GF slab= 11.52 kip

Total Seismic Weight= (3+20.4+9+32.04)+0.25*(11.52+11.52) kip= 70.2 kip

V= S_a*W= 0.0749* 70.2 kip= 5.26 kip

h	w	w*h	F_x (kip)
2	35.10	70.2	0.75
12	35.10	421.2	4.51
		491.4	

Secondary Transfer Station

UDL on roof Calculation

Gravity= DL+ll

DL:

0.8 mm thick GI Sheet= 0.096 kPa= 0.096*20.89 psf= 2 psf

Purlin + others= 3 psf (Assumed)

LL: 1 kPa = 20 psf

DL+LL: 2+3+20= 25 psf

Interior:

Dead Load on Rafter: 5*14 lb/ft = 70 lb/ft

Live Load on Rafter: 20*14 lb/ft = 280 lb/ft

Exterior:

Dead Load on Rafter: 5*7 lb/ft= 35 lb/ft

Live Load on Rafter: 20*7 lb/ft= 140 lb/ft

Wind Load Calculation of Station

WL(Normal to Ridge) Calculation of a Warehouse Building

Surface	z(m)	q(psf)	G	Cp	qGCp(psf)	qi(psf)	(+Gcpi)	(-Gcpi)
Windward Wall	6.097560976	29.04	0.85	0.8	19.75	30.71	0.55	-0.55
Leeward Wall	Full Height	30.71	0.85	-0.5	-13.05	30.71	0.55	-0.55
Side wall	Full Height	30.71	0.85	-0.7	-18.27	30.71	0.55	-0.55
Windward Roof	Along Full length	30.71	0.85	-0.8476	-22.13	30.71	0.55	-0.55
		30.71	0.85	-0.18	-4.7	30.71	0.55	-0.55
Leeward Roof	Along Full length	30.71	0.85	-0.5	-13.05	30.71	0.55	-0.55

Design Wind Pressure		Interior		Exterior	
P1(psf)	P2(psf)	P1 Net(lb/ft)	P2 Net(lb/ft)	P1 Net(lb/ft)	P2 Net(lb/ft)
2.86	36.64	40.04	512.96	20.02	256.48
-29.94	3.84	-419.16	53.76	-209.58	26.88
-35.16	-1.38	-369.18	-14.49	-184.59	-7.245
-39.02	-5.24	-546.28	-73.36	-273.14	-36.68
-21.59	12.19	-302.26	170.66	-151.13	85.33
-29.94	3.84	-419.16	53.76	-209.58	26.88

WL(Parallel to Ridge) Calculation of a Warehouse Building

Surface	z(m)	q(psf)	G	Cp	qGCp(psf)	qi(psf)	(+Gcpi)	(-Gcpi)
Windward Wall	6.097560976	29.04	0.85	0.8	19.75	30.71	0.55	-0.55
	#REF!	#REF!	0.85	0.8	#REF!	30.71	0.55	-0.55
Leeward Wall	Full Height	30.71	0.85	-0.29	-7.57	30.71	0.55	-0.55
Side Wall	Full Height	30.71	0.85	-0.7	-18.27	30.71	0.55	-0.55
	0 to h	30.71	0.85	-0.9	-23.49	30.71	0.55	-0.55
Roof	h to 2h	30.71	0.85	-0.5	-13.05	30.71	0.55	-0.55
	>2h	30.71	0.85	-0.3	-7.83	30.71	0.55	-0.55
	0 to h	30.71	0.85	-0.18	-4.7	30.71	0.55	-0.55
Roof	h to 2h	30.71	0.85	-0.18	-4.7	30.71	0.55	-0.55
	>2h	30.71	0.85	-0.18	-4.7	30.71	0.55	-0.55

Design Wind Pressure		Interior		Exterior	
P1(psf)	P2(psf)	P1 Net(lb/ft)	P2 Net(lb/ft)	P1 Net(lb/ft)	P2 Net(lb/ft)
2.86	36.64	30.03	384.72	15.015	192.36
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
-24.46	9.32	-256.83	97.86	-128.415	48.93
-35.16	-1.38	-492.24	-19.32	-246.12	-9.66
-40.38	-6.6	-565.32	-92.4	-282.66	-46.2
-29.94	3.84	-419.16	53.76	-209.58	26.88
-24.72	9.06	-346.08	126.84	-173.04	63.42
-21.59	12.19	-302.26	170.66	-151.13	85.33
-21.59	12.19	-302.26	170.66	-151.13	85.33
-21.59	12.19	-302.26	170.66	-151.13	85.33

Earthquake Load Calculation

Calculation of Seismic Weight

Column Load= 14*(16*16)/144*20*0.150 kip = 74.67 kip

Beam Wt = (12*18)/144*0.15*4*(56+49) kip

= 94.5 kip

Partition Wall Load = (56+56+49) *(10/12)* 0.12 kip

= 24.15 kip

Total Seismic Weight, W = 70.67+94.5+24.15 kip

= 193.32 kip

Design spectral acceleration, S_a= 0.0958

Base Shear, V= S_a*W= 0.0958* 193.32 kip= 18.52 kip

h	w	w*h	F_x (kip)
2	36.60	193.32	1.54
22	96.6	2126.52	16.376
		2319.84	

Nodal Load:

E_1= E_5= 1.54* (7*5.25)/ (56*49) kip = 0.0206 kip

E_2=E_3=E_4=1.54* (14*21.75)/ (56*49) kip = 0.171 kip

D_5= 1.54* (16.5*7)/ (56*49) kip = 0.065 kip

B_5= 1.54* (19.3*7)/ (56*49) kip = 0.076 kip

A_1= A_5 =1.54* (8*7)/ (56*49) kip = 0.0314 kip

A_2= A_3 = A_4= 1.54* (14*27.25)/ (56*49) kip = 0.214 kip