Wind Load Example

- 30' x 60' structure w/ 15' high, flat roof
- Location : Newark, DE ; flat; open terrain
- Cladding : debris-resistant glass
  (therefore enclosed building : internal pressure effects, prevents loss of property)

A. Find q_z (6.5.3 Gives Procedures)

$q_z = 0.00256 K_z K_{zt} K_d V^2 I$ [lb/ft²]

1. $V = 100$ mph (from Wind Map, Fig. 1-12)
   $K_d = 1.00$ (wind is only load being considered, otherwise ~~6.5.4~~ Table 6.4 = 0.85)

2. $I = 1.00$ (from Table 6-1, need Category from Table 1-1 - Category II)

3. K_z : need "exposure" category
   6.5.6.2 Gives Surface Roughness Category → Category C
   6.5.6.3 Exposure Category → Exposure C
   $K_z = K_h = 0.85$ (from Table 6-3)

   note could result in variable pressure vs. height for taller structures

4. K_{zt} : no special topography ∴ $K_{zt} = 1.00$

$q_z = 0.00256\,(0.85)(1.0)(1.0)(100)^2(1.0) = \underline{21.76 \text{ lb/ft}^2}$

B. Find P - [Assume 30' side is windword wall]

$P = qGC_p - q_h(GC_{pi})$

5. $G = 0.85$ for rigid structures

6. Enclosure classification : enclosed

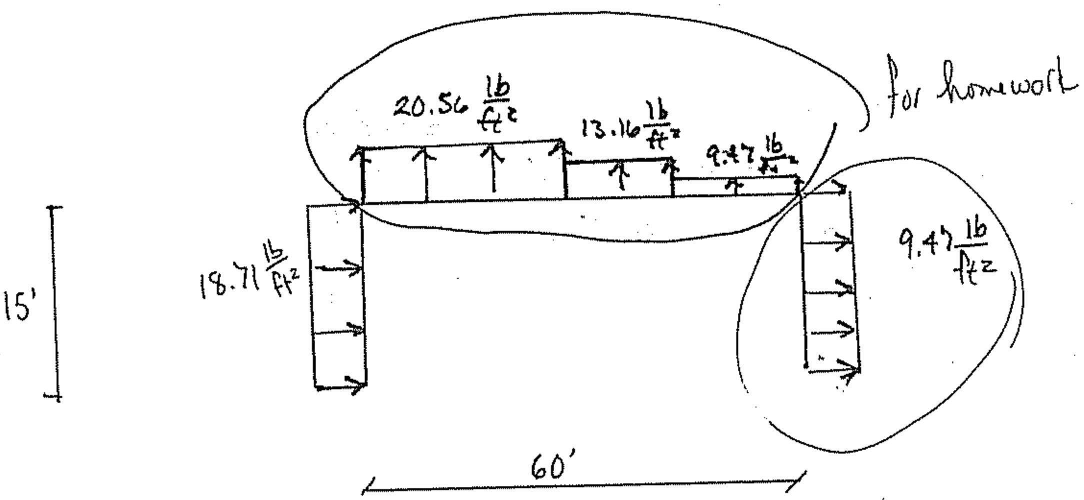
7. $GC_{pi} \rightarrow \pm 0.18$

8. Fig 6-6
   $C_p = 0.8$ for windward wall
   $C_p = -0.3$ for leeward wall ($L/B = 2$)
   B ≡ length of wind Ward wall
   $C_p = -0.7$ Side wall
   h/L = .25 C_p ... −0.9; −0.18 0−7.5'   −0.5, −0.18 15−30'

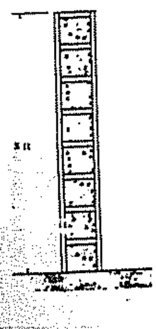
Design wind load p:

for homework

Component	p
Windward Wall	$(21.76)(0.85)(0.8) \pm (0.18)(21.76) = 18.71\ lb/ft^2$
Leeward Wall	$(21.76)(0.85)(-0.3) \pm (0.18)(21.76) = -9.47\ lb/ft^2$
Side Wall	$(21.76)(0.85)(-0.7) \pm (0.18)(21.76) = -16.86\ lb/ft^2$
Roof 0-7.5'	$= -20.56\ lb/ft^2$
Roof 7.5-15'	$= -20.56\ lb/ft^2$
Roof 15-30'	$= -13.16\ lb/ft^2$
Roof 30-60'	$= 9.47\ lb/ft^2$



1–2. A building wall consists of 12-in. light-aggregate concrete block and 2-in. solid plaster on both sides. If the wall is 8 ft high, determine the load in pounds per foot length of wall that it exerts on the floor.



From Table 1-3,

Clay Brick = 115 psf

Wood Studs = 2(4) psf = 8 psf

Total = 123 psf

Therefore for an 8-ft high wall

Load = 8ft(123 psf) = 984 lb/ft **Ans**

1–10. A two-story school has interior columns that are spaced 15 ft apart in two perpendicular directions. If the loading on the flat roof is estimated to be 20 lb/ft², determine the reduced live load supported by a typical interior column at (a) the ground-floor level, and (b) the second-floor level.

Tributary area $A_t = (15)(15) = 225\ \text{ft}^2$

$F_R = 20(225) = 4.50\ \text{k}$

Since $K_{LL}A_T = 4(225) > 400$

Live load for second floor can be reduced.

$$L = L_0\left(0.25 + \frac{15}{\sqrt{K_{LL}A_t}}\right)$$

$$L = 40\left(0.25 + \frac{15}{\sqrt{(4)(225)}}\right) = 30\ \text{psf}$$

a) For ground floor column:

$L = 30 > 0.5\,L_0 = 20$

$F_F = 30(225) = 6.75\ \text{k}$

$F_t = F_F + F_R = 6.75 + 4.50 = 11.25\ \text{k}$ **Ans**

b) For second floor column:

$F = F_R = 4.50\ \text{k}$ **Ans**

1–11. A three-story hotel has interior columns that are spaced 20 ft apart in two perpendicular directions. If the loading on the flat roof is estimated to be 30 lb/ft², determine the live load supported by a typical interior column at (a) the ground-floor level, and (b) the second-floor level.

$A_t = (20)(20) = 400\ \text{ft}^2$

$L_0 = 40\ \text{psf}$

$$L = L_0\left(0.25 + \frac{15}{\sqrt{K_{LL}A_t}}\right)$$

$$= 40\left(0.25 + \frac{15}{\sqrt{4(400)}}\right) = 25\ \text{psf}$$

a) $F_t = 2[(400\ \text{ft}^2)(25\ \text{psf})] + (400\ \text{ft}^2)(30\ \text{psf}) = 32.0\ \text{k}$ **Ans**

b) $F_{2F} = (400\ \text{ft}^2)(25\ \text{psf}) + (400\ \text{ft}^2)(30\ \text{psf}) = 22.0\ \text{k}$ **Ans**

***1–12.** A four-story office building has interior columns spaced 30 ft apart in two perpendicular directions. If the flat-roof loading is estimated to be 30 lb/ft², determine the reduced live load supported by a typical interior column located at ground level.

Floor load:

$L_0 = 50\ \text{psf}$

$A_t = (30)(30) = 900\ \text{ft}^2$