TEXTBOOK TESTBANKS

Solutions Manual for Structural Analysis 11th Hibbeler

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1–1.

The floor of a heavy storage warehouse building is made of 6-in.-thick stone concrete. If the floor is a slab having a length of 15 ft and width of 10 ft, determine the resultant force caused by the dead load and the live load.

SOLUTION

From Table 1.3,

$DL = [12\ \text{lb}/(\text{ft}^2 \cdot \text{in.})(6\ \text{in.})](15\ \text{ft})(10\ \text{ft}) = 10\ 800\ \text{lb}$

From Table 1.4,

$LL = (250\ \text{lb}/\text{ft}^2)(15\ \text{ft})(10\ \text{ft}) = 37\ 500\ \text{lb}$

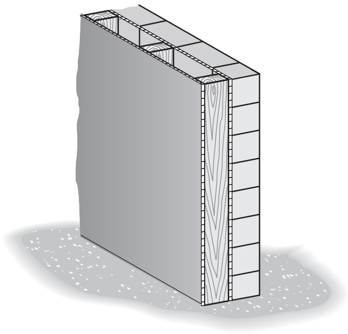
Total load:

$F = 48\ 300\ \text{lb} = 48.3\ \text{k}$ **Ans.**

Ans:
$F = 48.3\ \text{k}$

1–2.

The wall is 15 ft high and consists of 2 × 4 in. studs, plastered on one side. On the other side there is 4-in. clay brick. Determine the average load in lb/ft of length of wall that the wall exerts on the floor.



SOLUTION

Using the data tabulated in Table 1.3,

4-in. clay brick: $(39\ \text{lb/ft}^2)(15\ \text{ft}) = 585\ \text{lb/ft}$

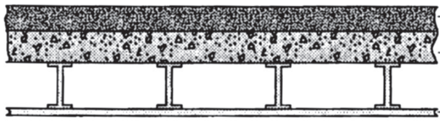
2 × 4 in. studs plastered on one side: $(12\ \text{lb/ft}^2)\ (15\ \text{ft}) = \underline{180\ \text{lb/ft}}$

$$w_D = 765\ \text{lb/ft}$$ **Ans.**

Ans:
$w_D = 765\ \text{lb/ft}$

1–3.

The second floor of a light manufacturing building is constructed from a 4-in.-thick stone concrete slab with an added 3-in. cinder concrete fill as shown. If the suspended ceiling of the first floor consists of metal lath and gypsum plaster, determine the dead load for design in pounds per square foot of floor area.



SOLUTION

From Table 1.3,

4 in. concrete slab $= 4(12) \quad = 48 \text{ lb/ft}^2$

3 in. cinder fill $= 3(9) \quad = 27 \text{ lb/ft}^2$

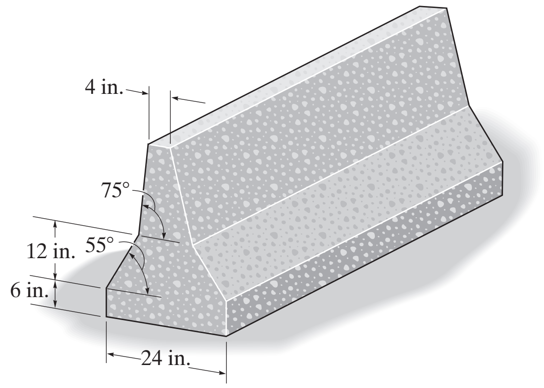
Ceiling $= 10 \text{ lb/ft}^2$

Total $DL = 85 \text{ lb/ft}^2$ **Ans.**

Ans:
$DL = 85.0 \text{ lb/ft}^2$

***1–4.**

The "New Jersey" barrier is commonly used during highway construction. Determine its weight per foot of length if it is made from plain stone concrete.



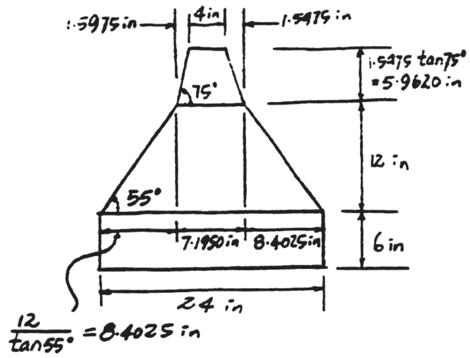
SOLUTION

$$\text{Cross-sectional area} = 6(24) + \left(\frac{1}{2}\right)(24 + 7.1950)(12) + \left(\frac{1}{2}\right)(4 + 7.1950)(5.9620)$$

$$= 364.54\ \text{in}^2$$

Use Table 1.2.

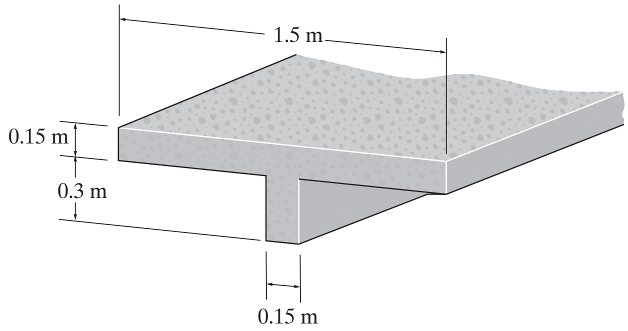
$$w = 144\ \text{lb/ft}^3(364.54\ \text{in}^2)\left(\frac{1\ \text{ft}^2}{144\ \text{in}^2}\right) = 365\ \text{lb/ft} \qquad \textbf{Ans.}$$



Ans:
$w = 365\ \text{lb/ft}$

1–5.

The precast floor beam is made from concrete having a specific weight of 23.6 kN/m^3. If it is to be used for a floor of an office building, calculate its dead and live loadings per foot length of beam.



SOLUTION

The dead load is caused by the self-weight of the beam.

$$w_D = [(1.5 \text{ m})(0.15 \text{ m}) + (0.15 \text{ m})(0.3 \text{ m})](23.6 \text{ kN/m}^3)$$
$$= 6.372 \text{ kN/m} = 6.37 \text{ kN/m} \qquad \textbf{Ans.}$$

For the office, the recommended live load for design in Table 1.4 is 2.39 kN/m^2. Thus,

$$w_L = (2.39 \text{ kN/m}^2)(1.5 \text{ m}) = 3.58 \text{ kN/m} \qquad \textbf{Ans.}$$

Ans:
$w_D = 6.37 \text{ kN/m}$
$w_L = 3.58 \text{ kN/m}$

1–6.

The floor of a light storage warehouse is made of 150-mm-thick lightweight plain concrete. If the floor is a slab having a length of 7 m and width of 3 m, determine the resultant force caused by the dead load and the live load.

SOLUTION

From Table 1.3,

$DL = [0.015 \text{ kN}/(\text{m}^2 \cdot \text{mm})(150 \text{ mm})](7 \text{ m})(3 \text{ m}) = 47.25 \text{ kN}$

From Table 1.4,

$LL = (5.99 \text{ kN}/\text{m}^2)(7 \text{ m})(3 \text{ m}) = 125.79 \text{ kN}$

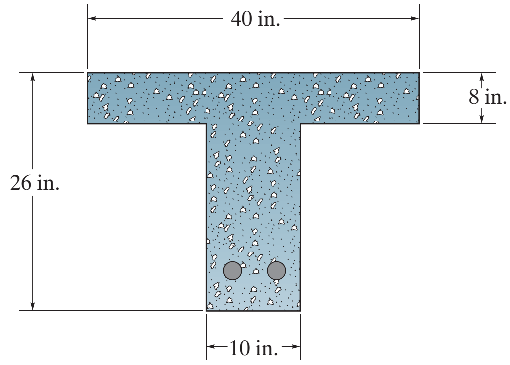
Total Load:

$F = 125.79 \text{ kN} + 47.25 \text{ kN} = 173 \text{ kN}$ **Ans.**

Ans:
$F = 173$ kN

1–7.

The T-beam is made from concrete having a specific weight of $150\,\text{lb/ft}^3$. Determine the dead load per foot length of beam. Neglect the weight of the steel reinforcement.



SOLUTION

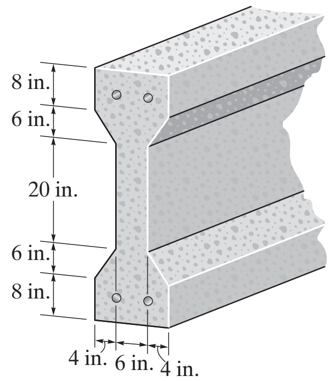
$$w = (150\text{ lb/ft}^3)\,[(40\text{ in.})(8\text{ in.}) + (18\text{ in.})\,(10\text{ in.})]\left(\frac{1\text{ ft}^2}{144\text{ in}^2}\right)$$

$$w = 521\text{ lb/ft}$$ **Ans.**

Ans:
$w = 521\,\text{lb/ft}$

***1–8.**

The prestressed concrete girder is made from plain stone concrete and four $\frac{3}{4}$-in. cold form steel reinforcing rods. Determine the dead weight of the girder per foot of its length.



SOLUTION

$$\text{Area of concrete} = 48(6) + 4\left[\frac{1}{2}(14 + 8)(4)\right] - 4(\pi)\left(\frac{3}{8}\right)^2 = 462.23 \text{ in}^2$$

$$\text{Area of steel} = 4(\pi)\left(\frac{3}{8}\right)^2 = 1.767 \text{ in}^2$$

From Table 1.2,

$$w = (144 \text{ lb/ft}^3)(462.23 \text{ in}^2)\left(\frac{1 \text{ ft}^2}{144 \text{ in}^2}\right) + 492 \text{ lb/ft}^3(1.767 \text{ in}^2)\left(\frac{1 \text{ ft}^2}{144 \text{ in}^2}\right)$$

$$= 468 \text{ lb/ft}$$ **Ans.**

Ans:
$w = 468 \text{ lb/ft}$

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1–9.

The floor of a light storage warehouse is made of 6-in.-thick cinder concrete. If the floor is a slab having a length of 10 ft and width of 8 ft, determine the resultant force caused by the dead load and that caused by the live load.

SOLUTION

From Table 1.3,

$DL = (6\text{ in.})(9\text{ lb}/[\text{ft}^2 \cdot \text{in.}])(8\text{ ft})(10\text{ ft}) = 4.32\text{ k}$

From Table 1.4,

$LL = (125\text{ lb}/\text{ft}^2)(8\text{ ft})(10\text{ ft}) = 10.0\text{ k}$

Total load:

$F = 4.32\text{ k} + 10.0\text{ k} = 14.3\text{ k}$ **Ans.**

Ans:
$F = 14.3\text{ k}$

1–10.

A two-story light storage warehouse has interior columns that are spaced 12 ft apart in two perpendicular directions. If the live loading on the flat roof is estimated to be 25 lb/ft^2, determine the reduced live load supported by a typical interior column at (a) the ground-floor level, and (b) the second-floor level.

SOLUTION

$A_T = (12)(12) = 144\ \text{ft}^2$

$F_R = (25)(144) = 3600\ \text{lb} = 3.6\ \text{k}$

Since $A_T = 4(144)\ \text{ft}^2 > 400\ \text{ft}^2$

Since $L_0 = 125\ \text{lb/ft}^2 > 100\ \text{lb/ft}^2$, no reduction is allowed on a member supporting one floor.

(a) For ground floor column:

$F_F = (125)(144) = 18\ \text{k}$

$F = F_F + F_R = 18\ \text{k} + 3.6\ \text{k} = 21.6\ \text{k}$ **Ans.**

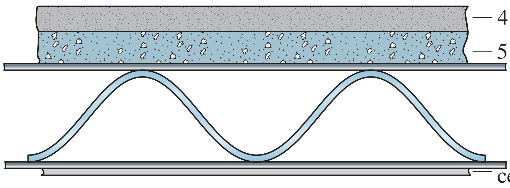
(b) For second floor column:

$F = F_R = 3.60\ \text{k}$ **Ans.**

Ans:
a) $F = 21.6\ \text{k}$
b) $F = 3.60\ \text{k}$

1–11.

The second floor of a light manufacturing building is constructed from a 5-in.-thick stone concrete slab with an added 4-in. cinder concrete fill as shown. If the suspended ceiling of the first floor consists of metal lath and gypsum plaster, determine the dead load for design in pounds per square foot of floor area.



SOLUTION

From Table 1.3,

5 in. concrete slab	= (12)(5)	= 60.0
4 in. cinder fill	= (9)(4)	= 36.0
Ceiling		= 10.0
Total dead load		= 106.0 lb/ft^2 **Ans.**

Ans:
$DL = 106 \text{ lb/ft}^2$

***1–12.**

A hotel has interior columns that support one floor with rooms that are spaced 6 m apart in two perpendicular directions. Determine the reduced live load supported by a typical interior column located on the ground floor under the public rooms.

SOLUTION

Table 1.4:

$L_0 = 4.79 \text{ kN/m}^2$

$A_T = (6 \text{ m})(6 \text{ m}) = 36 \text{ m}^2$

$K_{LL} = 4$

$K_{LL}A_T = 4(36) = 144 \text{ m}^2 > 37.2 \text{ m}^2$

From Eq. 1-1,

$$L = L_0\left(0.25 + \frac{4.57}{\sqrt{K_{LL}A_T}}\right)$$

$$L = 4.79\left(0.25 + \frac{4.57}{\sqrt{4(36)}}\right)$$

$L = 3.02 \text{ kN/m}^2$ **Ans.**

$3.02 \text{ kN/m}^2 > 0.5L_0 = 2.395 \text{ kN/m}^2 \quad \text{OK}$

Ans:
$L = 3.02 \text{ kN/m}^2$

1–13.

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/ft^2, determine the reduced live load supported by a typical interior column at (a) the ground-floor level, and (b) the second-floor level.

SOLUTION

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

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

Since $K_{LL}A_T = 4(225)\,\text{ft}^2 > 400\ \text{ft}^2$ and $L_0 = 40\ \text{lb/ ft}^2 < 100\ \text{lb/ft}^2$,

the live load 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:

$L = 30\ \text{psf} > 0.5L_0 = 20\ \text{psf}$

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

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

(b) For second floor column:

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

Ans:
a) $F = 11.2\ \text{k}$
b) $F = 4.50\ \text{k}$

1–14.

The floor of the office building is made of 4-in.-thick lightweight concrete. If the office floor is a slab having a length of 20 ft and width of 15 ft, determine the resultant force caused by the dead load and the live load.

SOLUTION

From Table 1.3,

$DL = [8\text{ lb}/(\text{ft}^2 \cdot \text{in.})\ (4\text{ in.})]\ (20\text{ ft})(15\text{ ft}) = 9600\text{ lb}$

From Table 1.4,

$LL = (50\text{ lb}/\text{ft}^2)(20\text{ ft})(15\text{ ft}) = 15\,000\text{ lb}$

Total load:

$F = 24\,600\text{ lb} = 24.6\text{ k}$ **Ans.**

Ans:
$F = 24.6\text{ k}$

1–15.

A hospital located in Chicago, Illinois, where the ground snow load is 25 lb/ft^2, has a flat roof. Determine the design snow load on the roof of the hospital.

SOLUTION

$C_e = 1.2$
$C_t = 1.0$
$I_s = 1.2$
$p_f = 0.7C_eC_tI_sp_g$
$p_f = 0.7(1.2)(1.0)(1.2)(25) = 25.2\ \text{lb/ft}^2$ **Ans.**

Ans:
$p_f = 25.2\ \text{lb/ft}^2$

***1–16.**

Wind blows on the side of a fully enclosed 30-ft-high hospital located on open flat terrain in Arizona. Determine the design wind pressure acting over the windward wall of the building at the heights 0–15 ft, 20 ft, 25 ft, and 30 ft. The roof is flat. Take $K_e = 1.0$.

SOLUTION

$V = 120 \text{ mi/h}$

$K_{zt} = 1.0$

$K_d = 1.0$

$K_e = 1.0$

$$q_z = 0.00256\, K_z K_{zt} K_d K_e V^2$$
$$= 0.00256 K_z (1.0)(1.0)(1.0)(120)^2$$
$$= 36.864\, K_z$$

From Table 1.5,

z	K_z	q_z
0–15	0.85	31.33
20	0.90	33.18
25	0.94	34.65
30	0.98	36.13

Thus,

$$p = qGC_p - q_h(GC_{pi})$$
$$= q_z(0.85)(0.8) - 36.13(\pm 0.18)$$
$$= 0.68q_z \mp 6.503$$

$p_{0-15} = 0.68(31.33) \mp 6.503 = 14.8 \text{ psf or } 27.8 \text{ psf}$ **Ans.**

$p_{20} = 0.68(33.18) \mp 6.503 = 16.1 \text{ psf or } 29.1 \text{ psf}$ **Ans.**

$p_{25} = 0.68(34.65) \mp 6.503 = 17.1 \text{ psf or } 30.1 \text{ psf}$ **Ans.**

$p_{30} = 0.68(36.13) \mp 6.503 = 18.1 \text{ psf or } 31.1 \text{ psf}$ **Ans.**

Ans.
$p_{0-15} = 14.8 \text{ psf or } 27.8 \text{ psf}$
$p_{20} = 16.1 \text{ psf or } 29.1 \text{ psf}$
$p_{25} = 17.1 \text{ psf or } 30.1 \text{ psf}$
$p_{30} = 18.1 \text{ psf or } 31.1 \text{ psf}$

1–17.

Wind blows on the side of the fully enclosed hospital located on open flat terrain in Arizona. Determine the design wind pressure acting on the leeward wall, if the length and width of the building are 200 ft and the height is 30 ft. Take $K_e = 1.0$.

SOLUTION

$V = 120 \text{ mi/h}$

$K_{zt} = 1.0$

$K_d = 1.0$

$K_e = 1.0$

$$q_h = 0.00256 K_z K_{zt} K_d K_e V^2$$

$$= 0.00256 K_z (1.0)(1.0)(1.0)(120)^2$$

$$= 36.864 K_z$$

From Table 1.5, for $z = h = 30$ ft, $K_z = 0.98$.

$$q_h = 36.864(0.98) = 36.13$$

From Fig. 1–13,

$\frac{L}{B} = \frac{200}{200} = 1$ so that $C_p = -0.5$.

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

$$p = 36.13(0.85)(-0.5) - 36.13(\pm 0.18)$$

$p = -21.9$ psf or -8.85 psf **Ans.**

Ans.
$p = -21.9$ psf or -8.85 psf

1–18.

The light metal storage building is on open flat terrain in central Oklahoma. If the side wall of the building is 14 ft high, what are the two values of the design wind pressure acting on this wall when the wind blows on the back of the building? The roof is essentially flat and the building is fully enclosed. Take $K_e = 1.0$.

SOLUTION

$V = 105 \text{ mi/h}$

$K_{zt} = 1.0$

$K_d = 1.0$

$K_e = 1.0$

$$q_z = 0.00256 K_z K_{zt} K_d K_e V^2$$
$$= 0.00256 K_z (1.0)(1.0)(1.0)(105)^2$$
$$= 28.22 K_z$$

From Table 1.5,

For $0 \leq z \leq 15$ ft, $K_z = 0.85$.

Thus,

$q_z = 28.22(0.85) = 23.99$

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

$p = 23.99(0.85)(-0.7) - (23.99)(\pm 0.18)$

$p = -9.96 \text{ psf or } -18.6 \text{ psf}$ **Ans.**

Ans:
$p = -9.96$ psf or -18.6 psf

1–19.

The office building has interior columns spaced 5 m apart in perpendicular directions. Determine the reduced live load supported by a typical interior column located on the first floor under the offices.

SOLUTION

From Table 1.4,

$$L_0 = 2.39\ \text{kN/m}^2 < 4.79\ \text{kN/m}^2$$

$$A_T = (5\ \text{m})(5\ \text{m}) = 25\ \text{m}^2$$

$$K_{LL} = 4,\ 4A_T = 4(25\ \text{m}^2) = 100\ \text{m}^2 > 37.2\ \text{m}^2$$

$$L = L_0\left(0.25 + \frac{4.57}{\sqrt{K_{LL}A_T}}\right)$$

$$L = 2.39\left(0.25 + \frac{4.57}{\sqrt{4(25)}}\right)$$

$$L = 1.69\ \text{kN/m}^2 \qquad \textbf{Ans.}$$

$$1.70\ \text{kN/m}^2 > 0.4L_0 = 0.956\ \text{kN/m}^2 \quad \text{OK}$$

Ans:
$L = 1.69\ \text{kN/m}^2$

***1–20.**

A closed storage building is located on open flat terrain where $V = 105$ mi/h. If the side wall of the building is 20 ft high, determine the design wind pressure acting on the windward and leeward walls. Each wall is 60 ft long. Assume the roof is flat. Take $K_e = 1.0$.

SOLUTION

$V = 105 \text{ mi/h}$

$K_{zt} = 1.0$

$K_d = 1.0$

$K_e = 1.0$

$q_z = 0.00256\, K_z K_{zt} K_d K_e V^2$

$\quad = 0.00256\, K_z (1.0)(1.0)(1.0)\,(105)^2$

$\quad = 28.22\, K_z$

From Table 1.5,

z	K_z	q_z
0–15	0.85	23.99
20	0.90	25.40

Thus, for windward wall,

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

$\quad = q_z(0.85)(0.8) - 25.40(\pm 0.18)$

$\quad = 0.68\, q_z \mp 4.572$

$p_{0-15} = 0.68\,(23.99) \mp 4.572 = 11.7 \text{ psf or } 20.9 \text{ psf}$ **Ans.**

$p_{20} = 0.68\,(25.40) \mp 4.572 = 12.7 \text{ psf or } 21.8 \text{ psf}$ **Ans.**

For leeward wall,

$\frac{L}{B} = \frac{60}{60} = 1 \text{ so that } C_p = -0.5.$

$p = q\, GC_p - q_h(GC_{pi})$

$p = 25.40(0.85)(-0.5) - 25.40\,(\pm 0.18)$

Ans:
$p_{0-15} = 11.7$ psf or 20.9 psf
$p_{20} = 12.7$ psf or 21.8 psf
$p = -15.4$ psf or -6.22 psf

1–21.

The hospital is located in an open area and has a flat roof and the ground snow load is 30 lb/ft^2. Determine the design snow load for the roof.

SOLUTION

Since $C_e = 0.8$, $C_t = 1.0$, and $I_s = 1.2$, then

$p_f = 0.7C_eC_tI_sp_g = 0.7(0.8)(1.0)(1.2)(30) = 20.2 \text{ lb/ft}^2$ **Ans.**

Ans:
$p_f = 20.2 \text{ lb/ft}^2$

1–22.

An urban hospital has a flat roof and the ground snow load is 0.96 kN/m^2. Determine the snow load in kN/m^2 that is required to design the roof.

SOLUTION

Since $C_e = 1.2$, $C_t = 1.0$, and $I_s = 1.2$, then

$$p_f = 0.7C_eC_tI_sp_g$$

$$p_f = 0.7(1.2)(1.0)(1.2)(0.96)$$

$$= 0.968 \text{ kN/m}^2$$ **Ans.**

Ans:
$p_f = 0.968\ \text{kN/m}^2$

1–23.

The school building has a flat roof. It is located in an open area where the ground snow load is $0.68\ \text{kN/m}^2$. Determine the snow load that is required to design the roof.

SOLUTION

Since $C_e = 0.8$, $C_t = 1.0$, and $I_s = 1.2$, then

$p_f = 0.7C_eC_tI_sp_g$

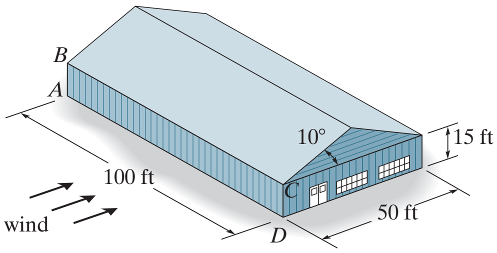
$p_f = 0.7(0.8)(1.0)(1.2)(0.68)$

$= 0.457\ \text{kN/m}^2$ **Ans.**

Ans:
$p_f = 0.457\ \text{kN/m}^2$

***1–24.**

Wind blows on the side of the fully enclosed agriculture building located on open flat terrain where $V = 105$ mi/h. Determine the external pressure acting over the windward wall, the leeward wall, and the side walls. Also, what is the internal pressure in the building which acts on the walls? Use linear interpolation to determine q_h. Take $K_e = 1.0$.



SOLUTION

Since $K_{zt} = 1.0$, $K_d = 1.0$, and $K_e = 1.0$, then

$$q_z = 0.00256 K_z K_{zt} K_d K_e V^2$$

$$q_z = 0.00256 K_z (1.0)(1.0)(1.0)(105)^2$$

$$q_{0-15} = 0.00256(0.85)(1.0)(1.0)(1.0)(105)^2 = 23.9904 \text{ psf}$$

$$q_{20} = 0.00256(0.90)(1.0)(1.0)(1.0)(105)^2 = 25.4016 \text{ psf}$$

$$h = 15 + \frac{1}{2}(25 \tan 10°) = 17.204 \text{ ft}$$

$$\frac{q_h - 23.9904}{17.204 - 15} = \frac{25.4016 - 23.9904}{20 - 15}$$

$$q_h = 24.612 \text{ psf}$$

External pressure on windward wall:

$p_{0-15} = q_z GC_p = 23.9904(0.85)(0.8) = 16.3 \text{ psf}$ **Ans.**

External pressure on leeward wall: $\dfrac{L}{B} = \dfrac{50}{100} = 0.5$

$p = q_h GC_p = 24.612(0.85)(-0.5) = -10.5 \text{ psf}$ **Ans.**

External pressure on side walls:

$p = q_h GC_p = 24.612(0.85)(-0.7) = -14.6 \text{ psf}$ **Ans.**

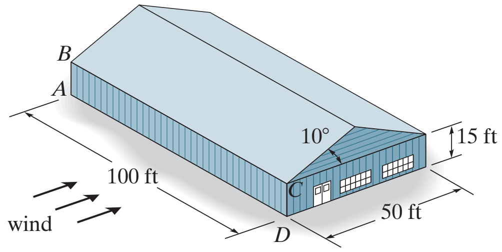
Internal pressure:

$p = -q_h(GC_{pi}) = -24.612(\pm 0.18) = -4.43 \text{ psf or } 4.43 \text{ psf}$ **Ans.**

Ans:
For external External pressure on windward wall,
$p_{0\text{-}15} = 16.3$ psf
For external External pressure on leeward wall,
$p = -10.5$ psf
For external External pressure on side walls,
$p = -14.6$ psf
For internal pressure,
$p = -4.43$ psf or 4.43 psf

1–25.

Wind blows on the side of the fully enclosed agriculture building located on open flat terrain where $V = 105$ mi/h. Determine the external pressure acting on the roof. Also, what is the internal pressure in the building which acts on the roof? Use linear interpolation to determine q_h and C_p in Fig. 1–13. Take $K_e = 1.0$.



SOLUTION

Since $K_{zt} = 1.0$, $K_d = 1.0$, and $K_e = 1.0$, then

$$q_z = 0.00256 K_z K_{zt} K_d K_e V^2$$
$$= 0.00256 K_z (1.0)(1.0)(1.0)(105)^2$$
$$q_{0-15} = 0.00256(0.85)(1.0)(1.0)(1.0)(105)^2 = 23.9904 \text{ psf}$$
$$q_{20} = 0.00256(0.90)(1.0)(1.0)(1.0)(105)^2 = 25.4016 \text{ psf}$$
$$h = 15 + \frac{1}{2}(25 \tan 10°) = 17.204 \text{ ft}$$
$$\frac{q_h - 23.9904}{17.204 - 15} = \frac{25.4016 - 23.9904}{20 - 15}$$
$$q_h = 24.612 \text{ psf}$$

External pressure on windward side of roof:

$$p = q_h G C_p$$
$$\frac{h}{L} = \frac{17.204}{50} = 0.3441$$
$$\frac{-0.9 - (-0.7)}{0.5 - 0.25} = \frac{-0.9 - C_p}{0.5 - 0.3441}$$
$$C_p = -0.7753$$
$$p = 24.612(0.85)(-0.7753) = -16.2 \text{ psf}$$ **Ans.**

External pressure on leeward side of roof:

$$\frac{-0.5 - (-0.3)}{0.5 - 0.25} = \frac{-0.5 - C_p}{0.5 - 0.3441}$$
$$C_p = -0.3753$$
$$p = q_h G C_p$$
$$= 24.612(0.85)(-0.3753) = -7.85 \text{ psf}$$ **Ans.**

Internal pressure:
$p = -q_h(GC_{pi}) = -24.612(\pm 0.18) = -4.43$ psf or 4.43 psf **Ans.**

Ans:
For external pressure on windward side of roof,
$p = -16.2$ psf
For external pressure on leeward side of roof,
$p = -7.85$ psf
For internal pressure,
$p = -4.43$ psf or 4.43 psf