

Chapter Two

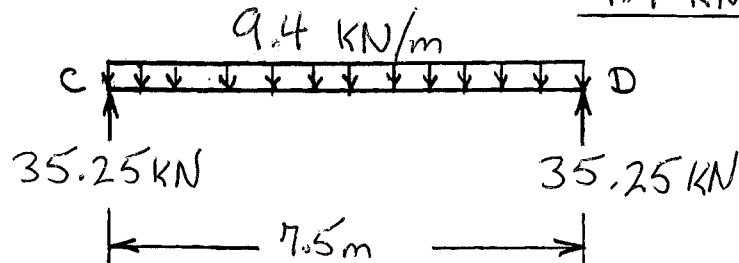
Loads on Structures

Pg 2

CHAPTER 2

2.1 Beam CD

$$\begin{aligned} \text{Uniformly distributed load} &= 23.6(3.6)\left(\frac{100}{1000}\right) + 77\left(\frac{11,800}{1,000,000}\right) \\ &= \underline{9.4 \text{ kN/m}} \end{aligned}$$



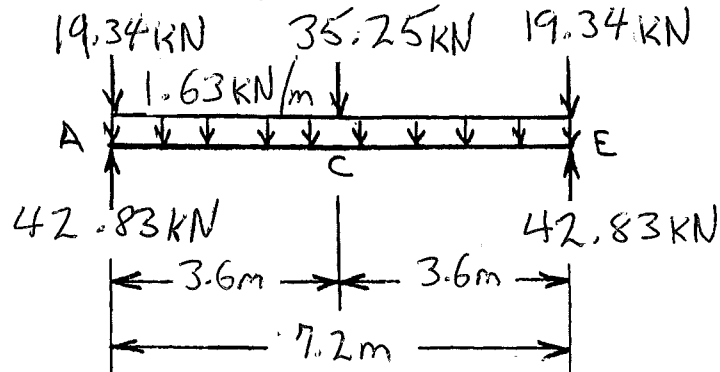
Girder AE

$$\text{Uniformly distributed load} = 77\left(\frac{21,100}{1,000,000}\right) = \underline{1.63 \text{ kN/m}}$$

$$\text{Concentrated load at C} = 35.25 \text{ kN}$$

Concentrated loads at A and E

$$= \left[150(1.8)\left(\frac{4}{12}\right) + 77\left(\frac{11,800}{1,000,000}\right) \right] \left(\frac{7.5}{2}\right) = 19.34 \text{ kN}$$



2.2 See solution of Problem 2.1

Beam CD Uniformly distributed load
 $= 9.4 + 18.9 \left(\frac{150}{1000} \right) (2.1) = 9.4 + 5.9 = \underline{15.3 \text{ kN/m}}$

Girder AE Uniformly distributed load = $\underline{1.63 \text{ kN/m}}$

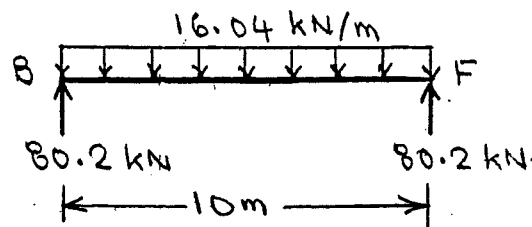
Concentrated load at C = $35.25 + 5.9 \left(\frac{7.5}{2} \right) = \underline{57.4 \text{ kN}}$

Concentrated loads at A and E = $\underline{19.34 \text{ kN}}$

2.3 Beam BF

Uniformly distributed load

$$= 23.6 (5) \left(\frac{130}{1000} \right) + 77 \left(\frac{9100}{106} \right) = \underline{16.04 \text{ kN/m}}$$



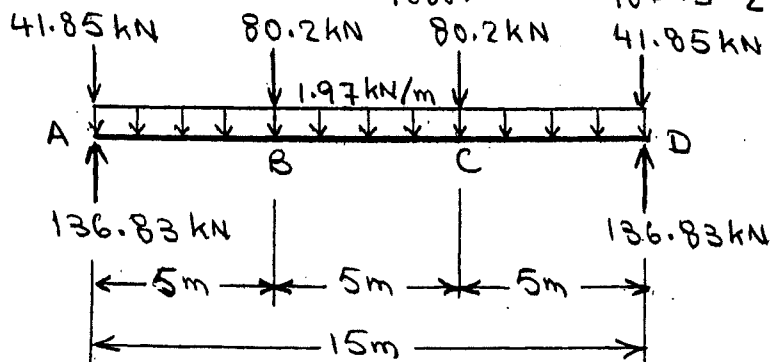
Girder AD

Uniformly distributed load = $77 \left(\frac{25600}{106} \right) = \underline{1.97 \text{ kN/m}}$

Concentrated loads at B and C = $\underline{80.2 \text{ kN}}$

Concentrated loads at A and D

$$= \left[23.6 (2.5) \left(\frac{130}{1000} \right) + 77 \left(\frac{9100}{106} \right) \right] \frac{10}{2} = \underline{41.85 \text{ kN}}$$



2.4

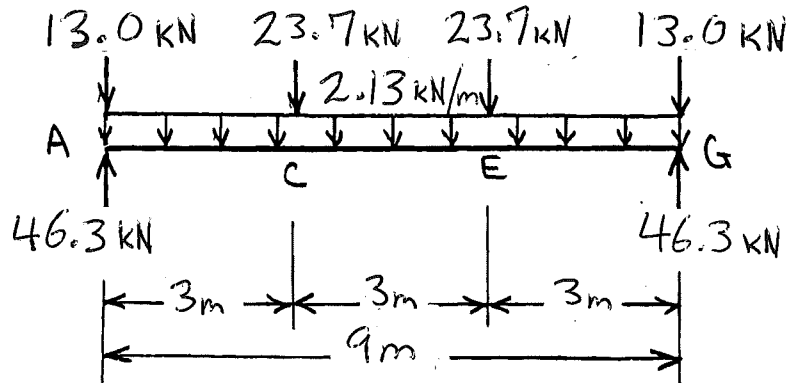
Uniformly distributed load $77 \left(\frac{27,700}{1,000,000} \right) = 2.13 \text{ kN/m}$

Concentrated loads at A and G

$$= \left[23.6(3) \left(\frac{100}{1000} \right) + 77 \left(\frac{10,450}{1,000,000} \right) \right] \left(\frac{6}{2} \right) = 13.0 \text{ kN}$$

Concentrated loads at C and E

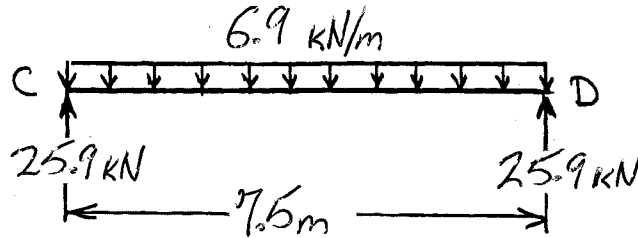
$$= \left[23.6(3) \left(\frac{100}{1000} \right) + 77 \left(\frac{10,450}{1,000,000} \right) \right] \left(\frac{6}{2} \right) = 23.7 \text{ kN}$$



2.5 Live load = 1.92 kN/m^2

Beam CD

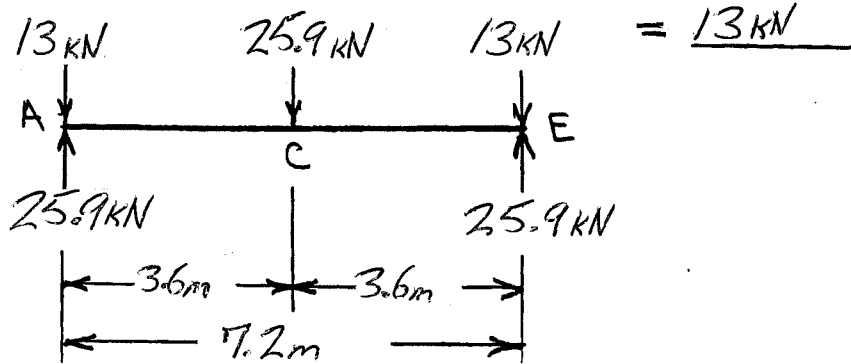
Uniformly distributed load = $1.92(3.6) = \underline{6.9 \text{ kN/m}}$



Girder AE

Concentrated load at C = 25.9 kN

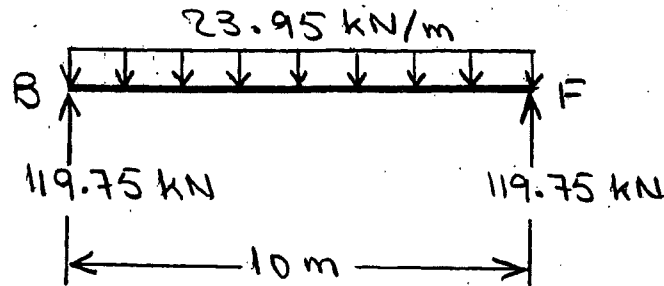
Concentrated loads at A and E = $[1.92(1.8)]\left(\frac{7.5}{2}\right)$



2.6 Live load = 4.79 kPa = 4.79 kN/m²

Beam BF

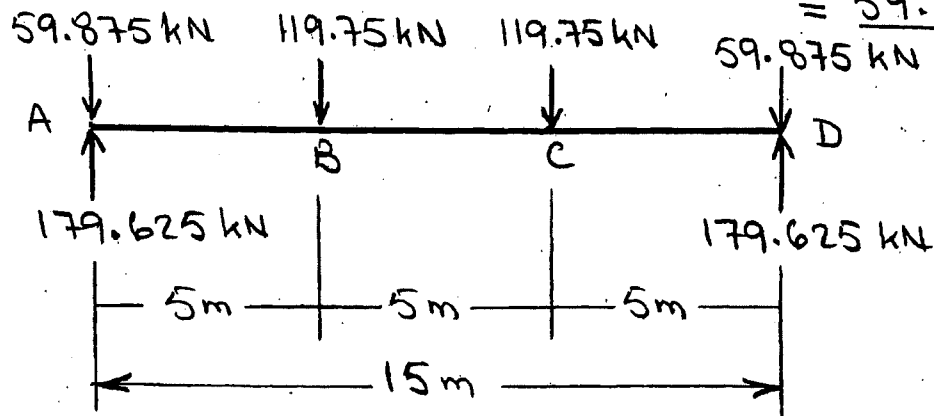
Uniformly distributed load = $4.79(5) = \underline{23.95 \text{ kN/m}}$



Girder AD

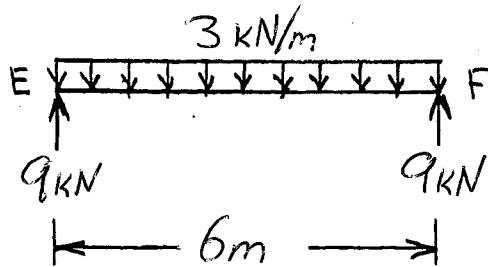
Concentrated loads at B and C = $\underline{119.75 \text{ kN}}$

Concentrated loads at A and D = $[4.79(2.5)] \frac{10}{2}$
 $= \underline{59.875 \text{ kN}}$



2.7 Beam EF

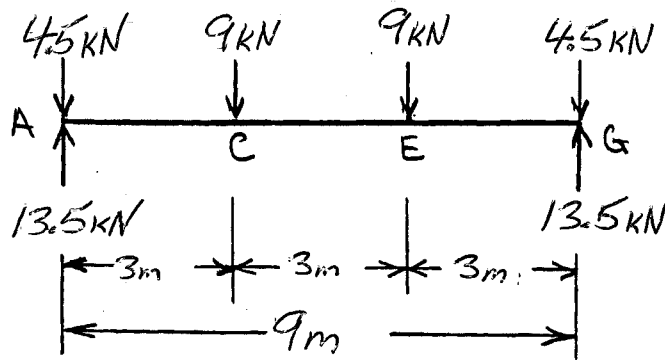
Uniformly distributed load = $1 \cdot (9) = \underline{3 \text{ kN/m}}$



Girder AG

Concentrated loads at C and E = $\underline{9 \text{ kN}}$

Concentrated loads at A and G = $9 \cdot 12 = \underline{4.5 \text{ kN}}$



Column A Concentrated load = $\underline{13.5 \text{ kN}}$

2.8 $V = 38 \text{ m/s}$, $h = 12 + (5/2) = 14.5 \text{ m}$,
 $I = 1.0$, $z_g = 365.76 \text{ m}$, $\alpha = 7.0$, $K_{zt} = 1$
 and $K_d = 1$

$$K_h = 2.01 \left(\frac{14.5}{365.76} \right)^{2.7} = 0.8$$

$$q_h = 0.613(0.8)(1)(1)(38)^2(1) = 0.71 \text{ kN/m}^2$$

$$G = 0.85$$

For $\theta = 45^\circ$ and $h/L = 14.5/10 = 1.45$:

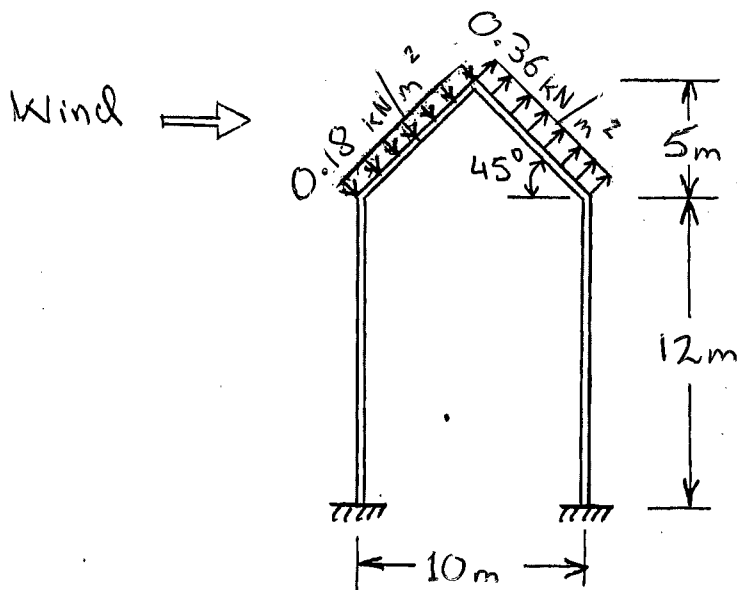
$C_p = 0.3$ for windward side

$C_p = -0.6$ for leeward side

Thus, the wind pressures are:

$$P_h = 0.71(0.85)(0.3) = \underline{0.18 \text{ kN/m}^2} \text{ for windward side}$$

$$P_h = 0.71(0.85)(-0.6) = \underline{-0.36 \text{ kN/m}^2} \text{ for leeward side}$$



2.9 $V = 40 \text{ m/s}$, $h = 12 + \frac{5}{2} = 14.5 \text{ m}$
 $I = 1.15$, $z_g = 366 \text{ m}$, $\alpha = 7.0$, $K_{zt} = 1$
 and $K_d = 1$

$$K_h = 2.01 \left(\frac{14.5}{366} \right)^{2/7} = 0.8$$

$$q_h = 0.613 (0.8) (1) (1) (40)^2 (1.15) = 902.34 \text{ N/m}^2$$

$$G = 0.85$$

Roof slope: $\theta = \tan^{-1} (5/6) = 39.8^\circ$

$$\frac{h}{L} = \frac{14.5}{12} = 1.21$$

$C_p = -0.1$ and 0.25 for windward side

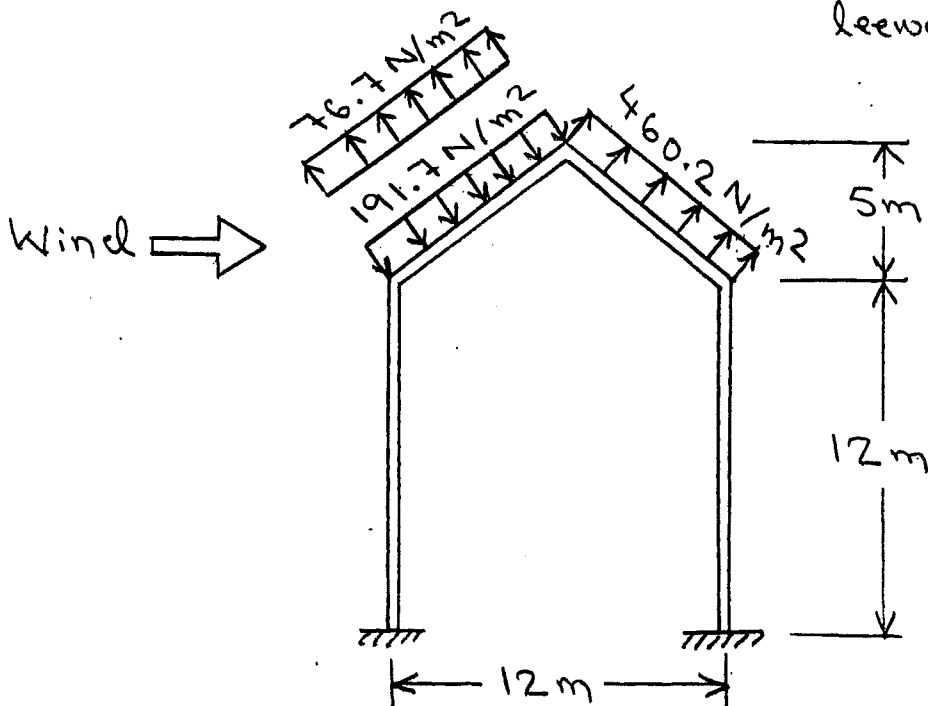
$C_p = -0.6$ for leeward side

Thus, the wind pressures are:

$$p_h = (902.34)(0.85)(-0.1) = -76.7 \text{ N/m}^2 \quad \left. \begin{array}{l} \text{for} \\ \text{windward} \\ \text{side} \end{array} \right\}$$

$$p_h = (902.34)(0.85)(0.25) = 191.7 \text{ N/m}^2$$

$$p_h = (902.34)(0.85)(-0.6) = -460.2 \text{ N/m}^2 \quad \text{for leeward side}$$



2.10

$$V = 40 \text{ m/s}, \quad h = 10 + \frac{4}{2} = 12 \text{ m}$$

$$I = 1.15, \quad z_g = 274.32 \text{ m}, \quad \alpha = 9.5, \quad k_{zt} = 1$$

$$\text{and } k_d = 1$$

$$K_h = 2.01 \left(\frac{12}{274.32} \right)^{2/9.5} = 1.04$$

$$q_h = 0.613 (1.04) (1) (1) (40)^2 (1.15) = 1.17 \text{ kN/m}^2$$

$$G = 0.85$$

$$\text{Roof slope: } \theta = \tan^{-1}(4/6) = 33.7^\circ$$

$$\frac{h}{L} = \frac{12}{12} = 1.0$$

$C_p = -0.2$ and 0.2 for windward side

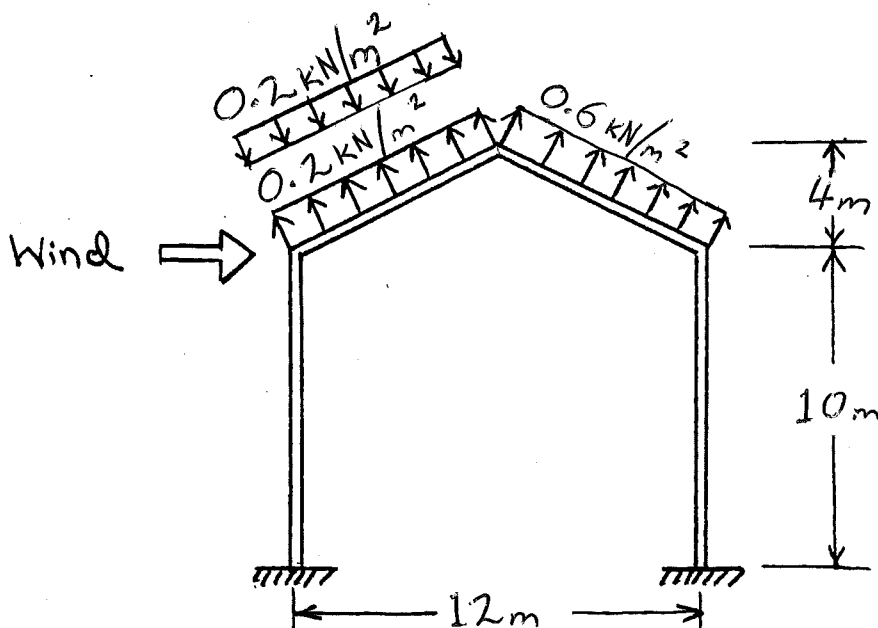
$C_p = -0.6$ for leeward side

Thus, the wind pressures are:

$$P_h = 1.17 (0.85) (-0.2) = -0.2 \text{ kN/m}^2 \quad \text{for windward side}$$

$$P_h = 1.17 (0.85) (0.2) = 0.2 \text{ kN/m}^2 \quad \text{side}$$

$$P_h = 1.17 (0.85) (-0.6) = -0.6 \text{ kN/m}^2 \quad \text{for leeward side}$$



2.11 $V = 40 \text{ m/s}$, $I = 1.15$, $z_g = 274.32 \text{ m}$, $\alpha = 9.5$

From the solution of Problem 2.10:

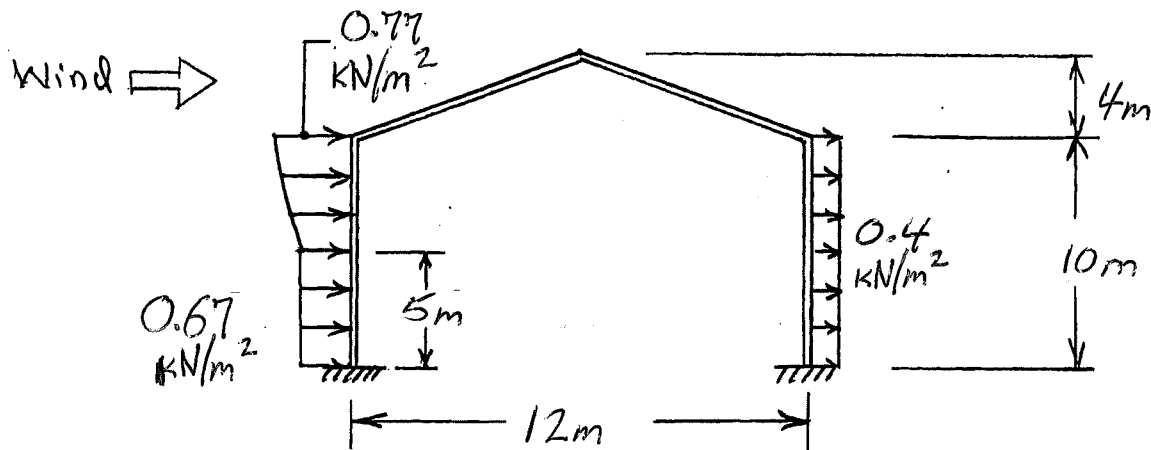
$$q_h = 1.17 \text{ kN/m}^2 \quad \text{and} \quad G = 0.85$$

Leeward wall: For $L/B = 12/10 = 1.2$, $C_p = -0.4$

$$\begin{aligned} \text{Thus, the wind pressure, } p_h &= 1.17 (0.85) (-0.4) \\ &= \underline{-0.4 \text{ kN/m}^2} \end{aligned}$$

Windward wall: $C_p = 0.8$

z (m)	K_z	q_z (kN/m ²)	p_z (kN/m ²)
10	1.00	1.128	0.77
7.5	0.94	1.06	0.72
6.0	0.90	1.02	0.70
5.0	0.87	0.98	0.67



2.12 $p_g = 1 \text{ kN/m}^2$, $C_e = 1$, $C_t = 1$, $I = 1.2$

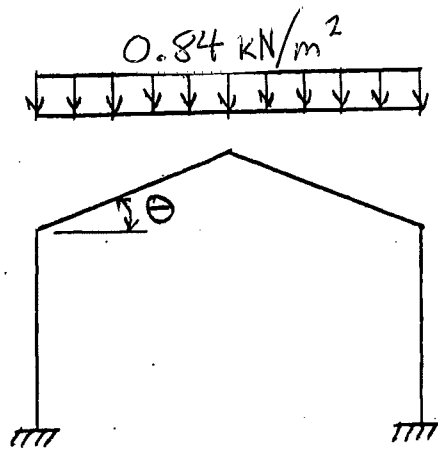
$$p_f = 0.7 C_e C_t I p_g = 0.7 (1)(1)(1.2)(1) = 0.84 \text{ kN/m}^2$$

$$\theta = \tan^{-1}(4/6) = 33.7^\circ, \quad \frac{21.3}{W} + 0.5 = \frac{21.3}{6} + 0.5 = 4^\circ$$

Therefore, the minimum values of p_f need not be considered.

$$C_s = 1$$

$$\text{Balanced load} = p_s = C_s p_f = 1(0.84) = \underline{0.84 \text{ kN/m}^2}$$



Balanced
Snow Load

2.13 $p_g = 1.2 \text{ kN/m}^2$, $C_e = 1$, $C_t = 1$, $I = 1.1$

$$p_f = 0.7 C_e C_t I p_g = 0.7 (1) (1) (1.1) (1.2) = 0.92 \text{ kN/m}^2$$

$$\theta = \tan^{-1}(5/6) = 39.8^\circ, \quad W = 6\text{m}$$

$$\frac{70}{W} + 0.5 = \frac{70}{19.7} + 0.5 = 4.1^\circ$$

Therefore, the minimum values of p_f need not be considered.

$$C_s = 1 - \frac{\theta - 30^\circ}{40^\circ} = 0.76$$

$$\text{Balanced Load} = p_s = C_s p_f = 0.76 (0.92) = \underline{0.7 \text{ kN/m}^2}$$

