Chapter Two
Loads on Structures

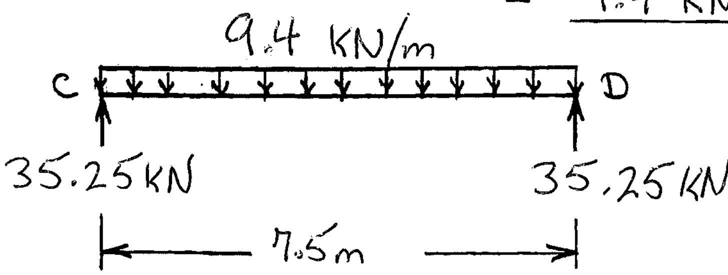
Pg 2

CHAPTER 2

2-1 Beam CD

Uniformly distributed load $= 23.6(3.6)\left(\frac{100}{1000}\right) + 77\left(\frac{11,800}{1,000,000}\right)$

$= \underline{9.4 \text{ kN/m}}$



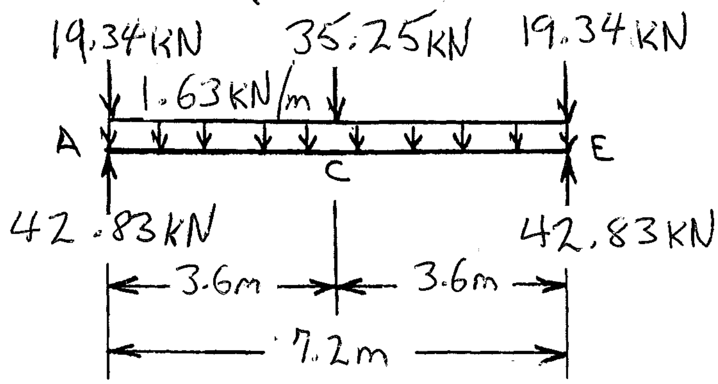
Girder AE

Uniformly distributed load $= 77\left(\frac{21,100}{1,0\,00,000}\right) = \underline{1.63 \text{ kN/m}}$

Concentrated load at C = 35.25 kN

Concentrated loads at A and E

$= \left[150(1.8)\left(\frac{4}{12}\right) + 77\left(\frac{11,800}{1,0\,00,000}\right)\right]\left(\frac{7.5}{2}\right) = 19.34 \text{ kN}$



2.2 See solution of Problem 2.1

<u>Beam CD</u> Uniformly distributed load

$= 9.4 + 18.8\left(\frac{150}{1000}\right)(2.1) = 9.4 + 5.9 = \underline{15.3 \text{ kN/m}}$

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

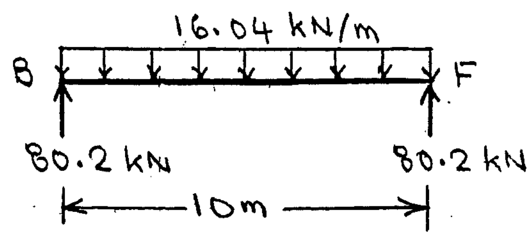
Concentrated load at C $= 35.25 + 5.9\left(\frac{7.5}{2}\right) = \underline{57.4 \text{ kN}}$

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

2.3 <u>Beam BF</u>

Uniformly distributed load

$= 23.6(5)\left(\frac{130}{1000}\right) + 77\left(\frac{9100}{10^6}\right) = \underline{16.04 \text{ kN/m}}$



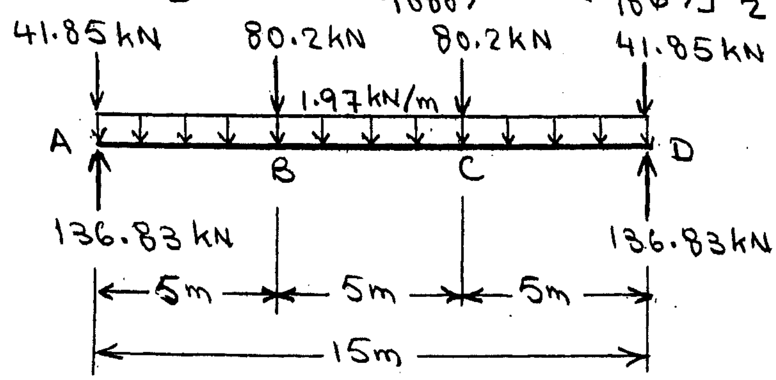
<u>Girder AD</u>

Uniformly distributed load $= 77\left(\frac{25600}{10^6}\right) = \underline{1.97 \text{ kN/m}}$

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

Concentrated loads at A and D

$= \left[23.6(2.5)\left(\frac{130}{1000}\right) + 77\left(\frac{9100}{10^6}\right)\right]\frac{10}{2} = \underline{41.85 \text{ kN}}$



2.4

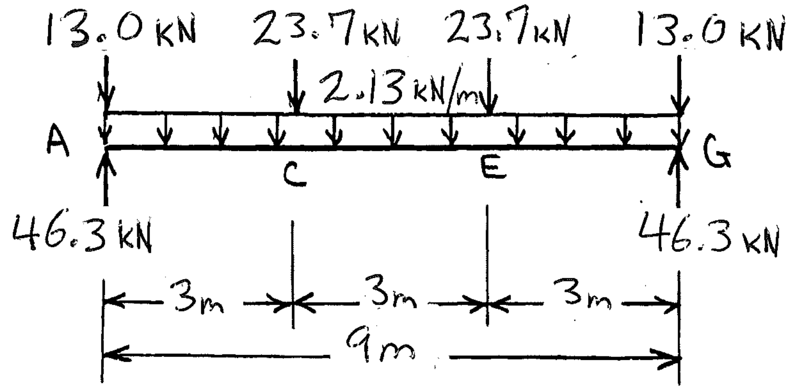
Uniformly distributed load $77\left(\frac{27,700}{1,000,000}\right) = 2.13\ \text{kN/m}$

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

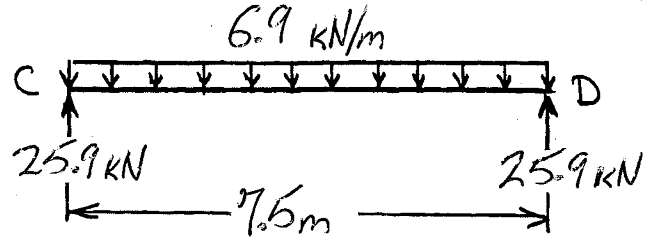
$$= \left[23.6(3)\left(\frac{100}{1000}\right) + 77\left(\frac{10,450}{1,000,000}\right)\right]\left(\frac{6}{2}\right) = 23.7\ \text{kN}$$



2.5 Live load = 1.92 kN/m^2

Beam CD

Uniformly distributed load = 1.92(3.6) = <u>6.9 kN/m</u>

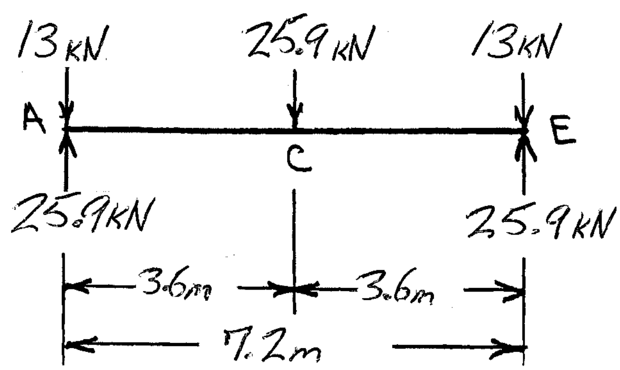


Girder AE

Concentrated load at C = <u>25.9 kN</u>

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

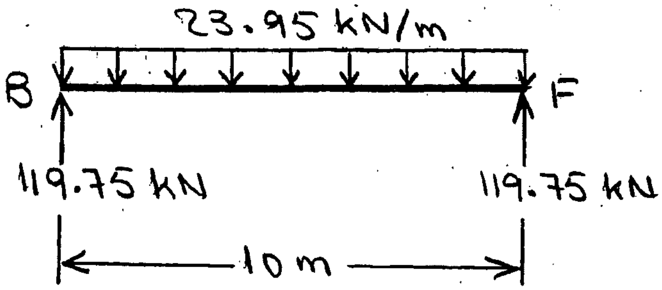
= <u>13 kN</u>



2.6 Live load = 4.79 kPa = 4.79 kN/m^2

Beam BF

Uniformly distributed load = 4.79(5) = 23.95 kN/m

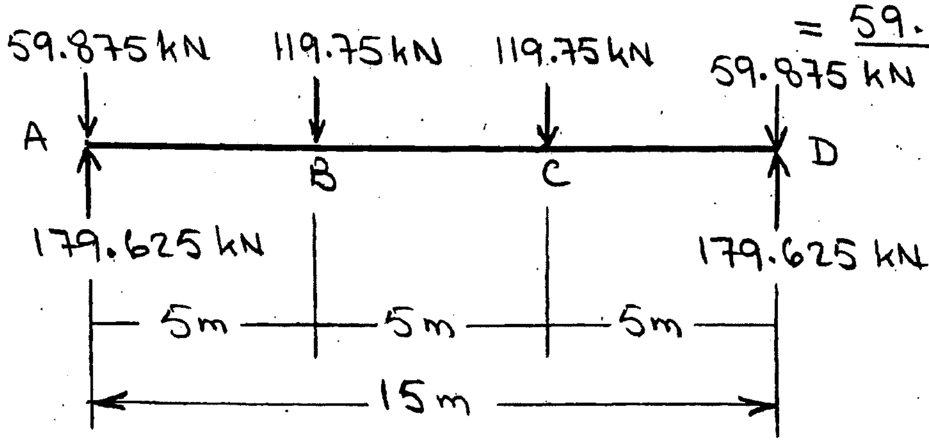


Girder AD

Concentrated loads at B and C = 119.75 kN

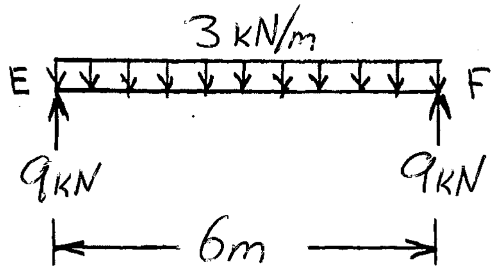
Concentrated loads at A and D = $[4.79(2.5)]\frac{10}{2}$

= 59.875 kN



2.7 Beam EF

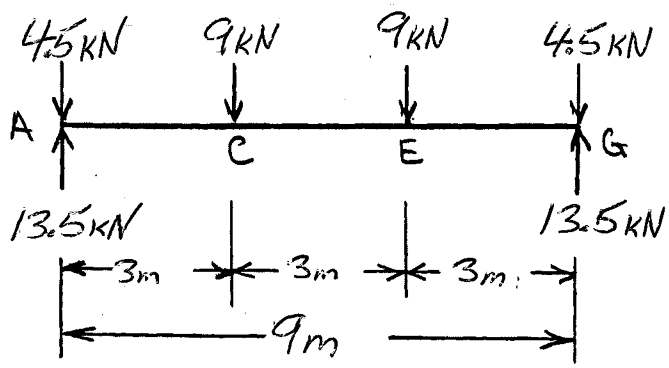
Uniformly distributed load $= 1\ (9) = \underline{3\ kN/m}$



Girder AG

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

~~Concentrated loads at~~ A ~~and~~ G $= 9/2 = \underline{4.5\ kN}$



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

2.8 $V = 38\,m/s$, $h = 12 + (5/2) = 14.5\,m$,

$I = 1.0$, $z_g = 365.76\,m$, $\alpha = 7.0$, $K_{zt} = 1$

and $K_d = 1$

$$K_h = 2.01\left(\frac{14.5}{365.76}\right)^{2/7} = 0.8$$

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

$G = 0.85$

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

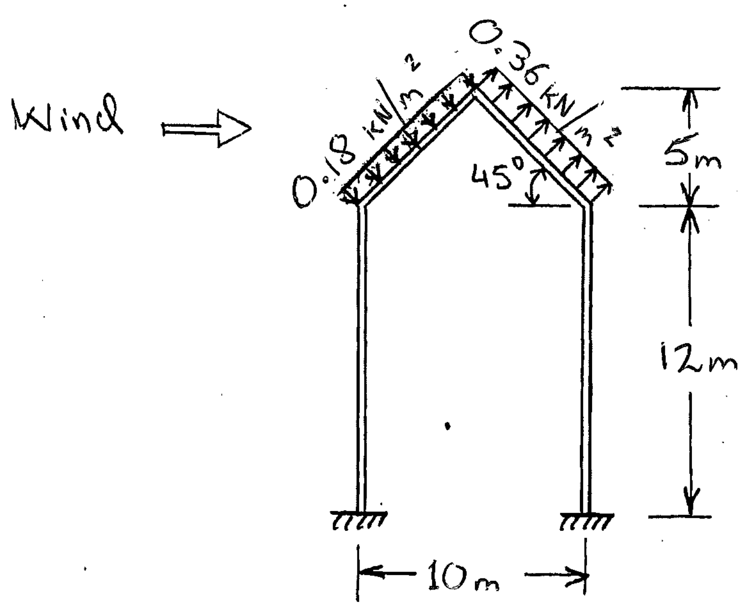
$C_p = 0.3$ for windward side

$C_p = -0.6$ for leeward side

Thus, the wind pressures are:

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

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



2.9 $V = 40\ m/s$, $h = 12 + \frac{5}{2} = 14.5\ m$

$I = 1.15$, $z_g = 366\ m$, $\alpha = 7.0$, $K_{zt} = 1$

and $K_d = 1$

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

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

$G = 0.85$

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

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

$C_p = -0.1$ and 0.25 for windward side

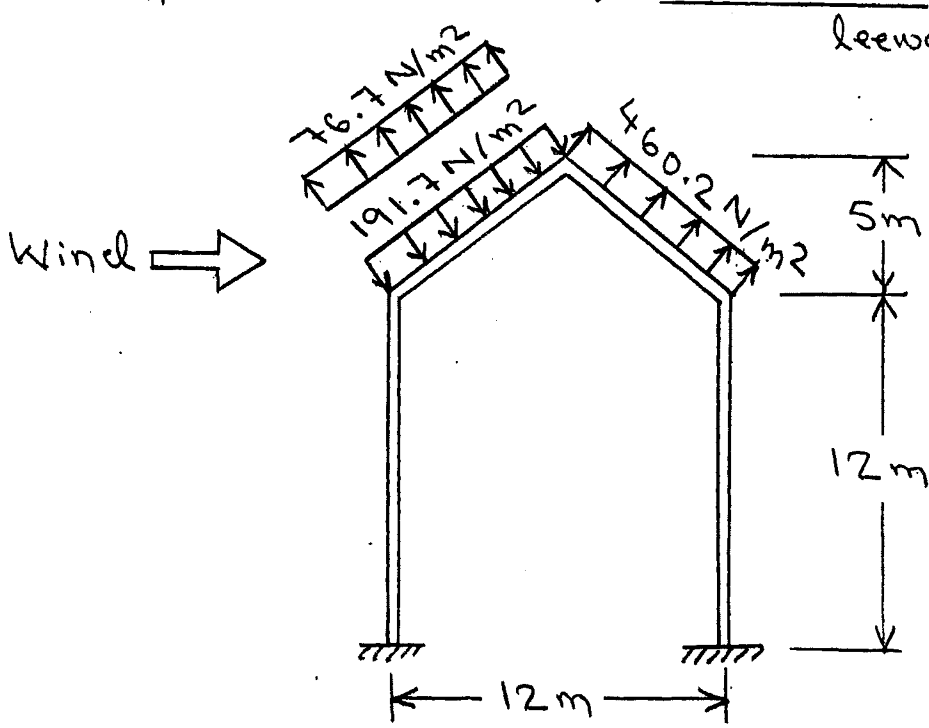
$C_p = -0.6$ for leeward side

Thus, the wind pressures are:

$p_h = (902.34)(0.85)(-0.1) = \underline{-76.7\ N/m^2}$ } for windward side

$p_h = (902.34)(0.85)(0.25) = \underline{191.7\ N/m^2}$ } for windward side

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



2.10 $V = 40\,m/s$, $h = 10 + \frac{4}{2} = 12\,m$

$I = 1.15$, $z_g = 274.32\,m$, $\alpha = 9.5$, $K_{zt} = 1$

and $K_d = 1$

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

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

$G = 0.85$

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

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

$C_p = -0.2$ and 0.2 for windward side

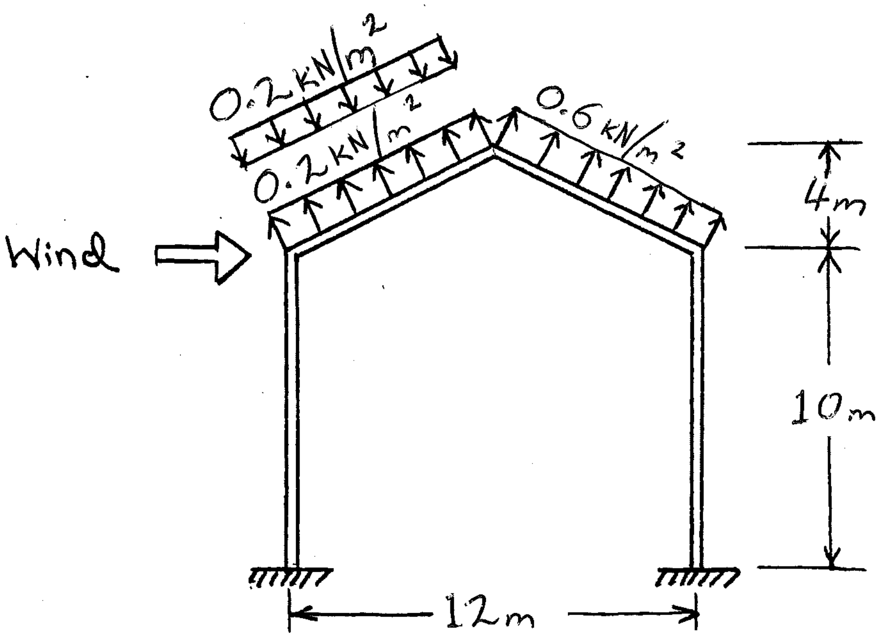
$C_p = -0.6$ for leeward side

Thus, the wind pressures are:

$p_h = 1.17\,(0.85)(-0.2) = -0.2\,kN/m^2$ } for windward side

$p_h = 1.17\,(0.85)(0.2) = 0.2\,kN/m^2$ } for windward side

$p_h = 1.17\,(0.85)(-0.6) = \underline{-0.6\,kN/m^2}$ for leeward side



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

From the solution of Problem 2.10:

$q_h = 1.17 \ kN/m^2$ and $G = 0.85$

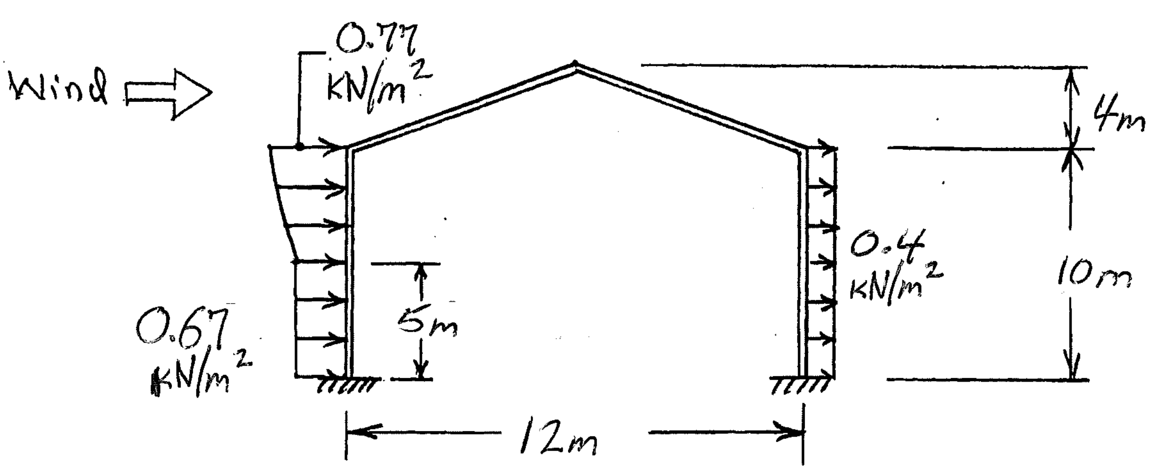
<u>Leeward wall:</u> For $L/B = 12/10 = 1.2$, $C_p = -0.4$

Thus, the wind pressure, $p_h = 1.17 \ (0.85)(-0.4)$

$= \underline{-0.4 \ kN/m^2}$

<u>Windward wall:</u> $C_p = 0.8$

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

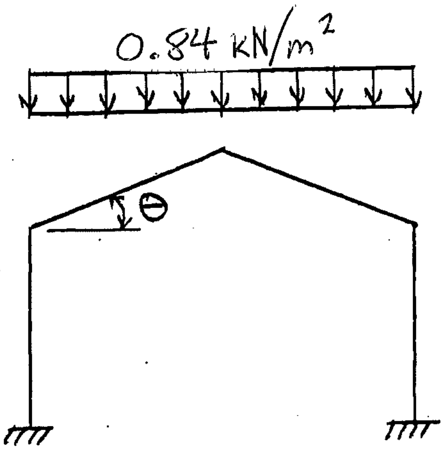
$p_f = 0.7\, C_e\, C_t\, I\, p_g = 0.7\,(1)(1)(1.2)(1) = 0.84\ \text{kN/m}^2$

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

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

$C_s = 1$

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



Balanced Snow Load

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

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

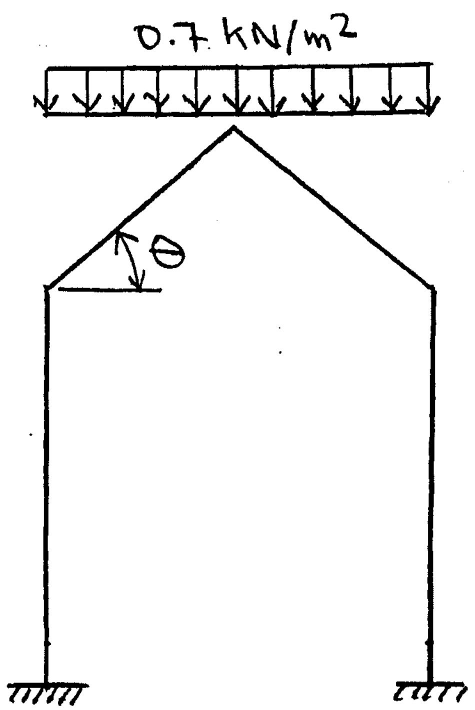
$$\theta = \tan^{-1}(5/6) = 39.8^\circ, \quad W = 6\text{m}$$

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

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

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

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



Balanced Snow Load