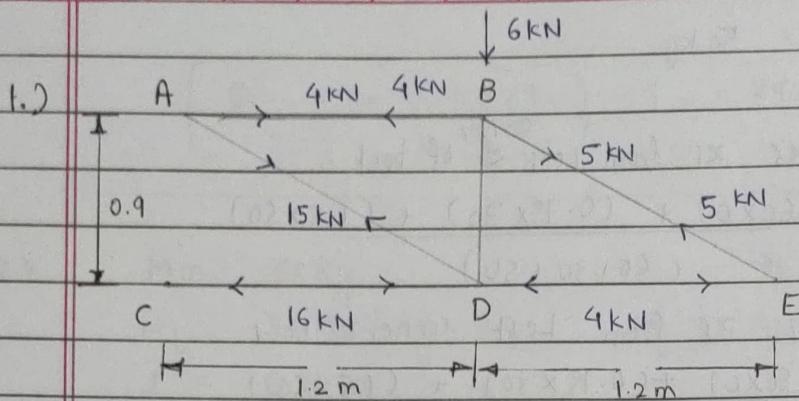


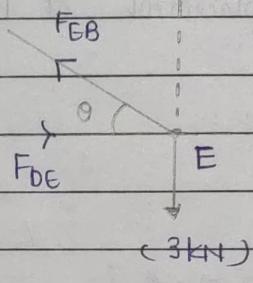
TRUSS ASSIGNMENT



POINT "E"

$$\tan \theta = \frac{0.9}{1.2} = \frac{3}{4}$$

$$\begin{aligned}\sum F_y &= 0 & F_{EB} \sin \theta &= 3 \\ F_{EB} &= \frac{3}{\sin \theta} = \frac{3}{0.75} = 4 \text{ kN} \end{aligned}$$

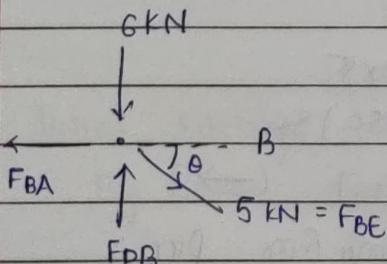


$$\sum F_x = 0 \quad F_{EB} \cos \theta = F_{DE}$$

$$(5) \times \left(\frac{4}{5}\right) = F_{DE}$$

$$[F_{DE} = 4 \text{ kN}] \quad (\text{C})$$

POINT "B"



$$\sum F_x = 0$$

$$F_{BE} \cos \theta = F_{BD}$$

$$5 \times \frac{4}{5} = F_{BA}$$

$$[F_{BA} = 4 \text{ kN}] \quad (\text{T})$$

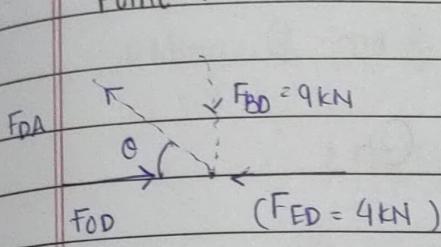
$$\sum F_y = 0 \quad 6 + F_{BE} \sin \theta = F_{DB}$$

$$6 + \left(5 \times \frac{3}{5}\right) = F_{DB}$$

$$[9 = F_{DB}] \quad (\text{C})$$

(U19CS012)

Point "D"



$$\sum F_y = 0 \quad F_{BD} = F_{DA} \sin \theta$$

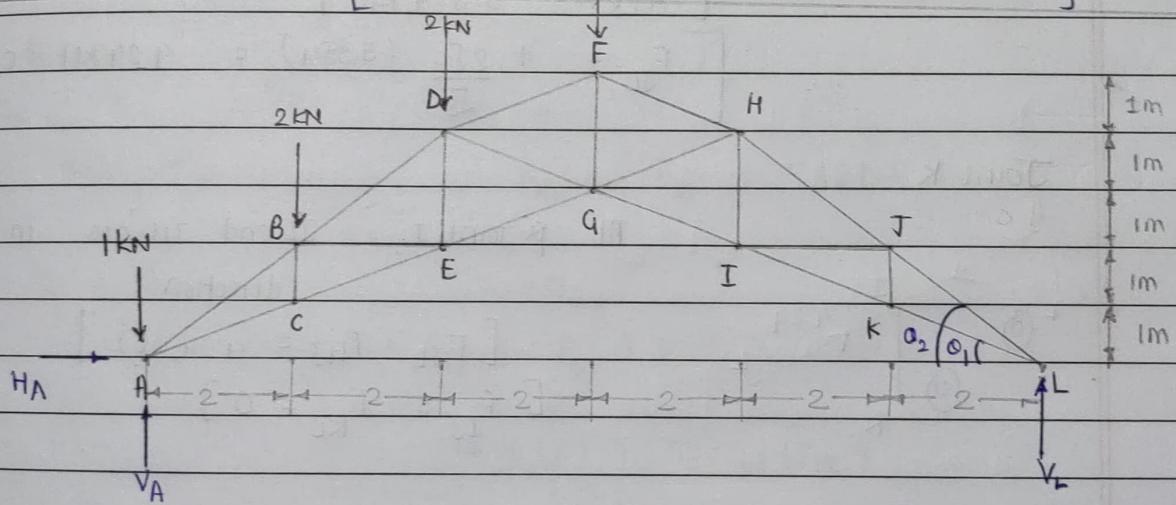
$$q = (F_{DA}) \times \left(\frac{3}{5}\right)$$

$$[F_{DA} = 15 \text{ kN}] \text{ (C)}$$

$$\sum F_x = 0$$

$$F_{CB} = F_{DA} \cos \theta + F_{ED}$$

$$[F_{CB} = 15 \times 4 + 4 = 16 \text{ kN (C)}]$$



$$\sum F_y \text{ system} = 0 \quad V_A + V_L = 1 + 2 + 2 + 1 = 6 \text{ kN} \quad \text{(1)}$$

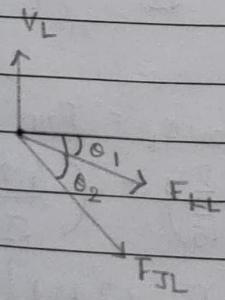
$$\sum M_A = 0 \quad (2 \times 2) + (2 \times 4) + (1 \times 6) = 12 \times V_L$$

$$[V_L = 1.5 \text{ kN}]$$

L Joint

$$\theta_1 = \tan^{-1}\left(\frac{1}{2}\right) \approx \tan \theta_1 = \frac{1}{2} \quad \sin \theta_1 = \frac{1}{\sqrt{5}} \\ \cos \theta_1 = \frac{2}{\sqrt{5}}$$

$$[\theta_2 = \tan^{-1}\left(\frac{2}{2}\right) = 45^\circ]$$



$$\sum F_y = 0 \quad V_L = F_{KL} \sin \theta_1 + F_{JL} \sin \theta_2$$

$$1.5 = F_{KL}\left(\frac{1}{\sqrt{5}}\right) + F_{JL}\left(\frac{1}{\sqrt{2}}\right)$$

$$[1.5\sqrt{10} = \sqrt{2} F_{KL} + \sqrt{5} F_{JL}] \quad \text{(1)}$$

(VIACSO12)

$$\sum F_x = 0 \quad \frac{F_{JL}}{\sqrt{2}} + \frac{F_{KL}}{\sqrt{5}} \cdot 2 = 0$$

$$F_{JL} = -\frac{2\sqrt{2}}{\sqrt{5}} F_{KL} \quad \textcircled{2}$$

Subs.

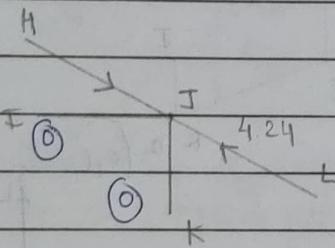
$$\text{Eq. } \textcircled{2} \text{ in } \textcircled{1} \quad 1.5\sqrt{10} = \sqrt{2} F_{KL} - \frac{1}{\sqrt{5}} \left(\frac{2\sqrt{2}}{\sqrt{5}} F_{KL} \right)$$

$$F_{KL} = -1.5\sqrt{5} = -3.354 \text{ kN}$$

$$[F_{KL} = 3.354 \text{ kN}]$$

$$[F_{JL} = +\frac{2\sqrt{2}}{\sqrt{5}} (3.354) = 4.24 \text{ kN (C)}]$$

Joint K



At joint J, JL and JH are in some direction

$$[F_{JL} = F_{HJ} = 4.24 \text{ (C)}]$$

$$[F_{IJ} = F_{KL} = 0]$$

Similarly at joint I, O

$$[F_{IG} = 3.35 \text{ kN}]$$

At joint H,

$$\sum F_y = 0$$

$$(4.24) = F_{JH} \sin \theta_2 + F_{GH} \sin \theta_1 = F_{FH} \sin \theta_1$$

$$\frac{4.24}{\sqrt{2}} = \frac{(F_{FH} - F_{GH})}{\sqrt{5}}$$

$$F_{FH} - F_{GH} = \frac{\sqrt{5}}{\sqrt{2}} (4.24) \quad \textcircled{3}$$

$$\sum F_x = 0$$

$$(F_{GH} + F_{FH}) \cos \theta_1 = F_{JH} \cos \theta_2$$

$$(F_{GH} + F_{FH}) \left(\frac{2}{\sqrt{5}} \right) = \left(\frac{4.24}{\sqrt{2}} \right)$$

$$[F_{GH} + F_{FH} = \frac{\sqrt{5}}{\sqrt{2}} (2.12)] \quad \textcircled{4}$$

(U19CS012)

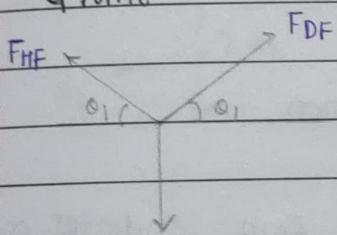
Adding ③ and ④

$$2F_{FH} = \frac{\sqrt{5}}{\sqrt{2}} (6.36)$$

$$[F_{HF} = 5.03 \text{ kN (C)}]$$

$$[F_{GH} = -1.68 \text{ kN (T)}]$$

G Point



$$\sum F_x = 0$$

$$F_{HF} = F_{DF} = 5.03 \text{ kN}$$

$$\sum F_y = 0$$

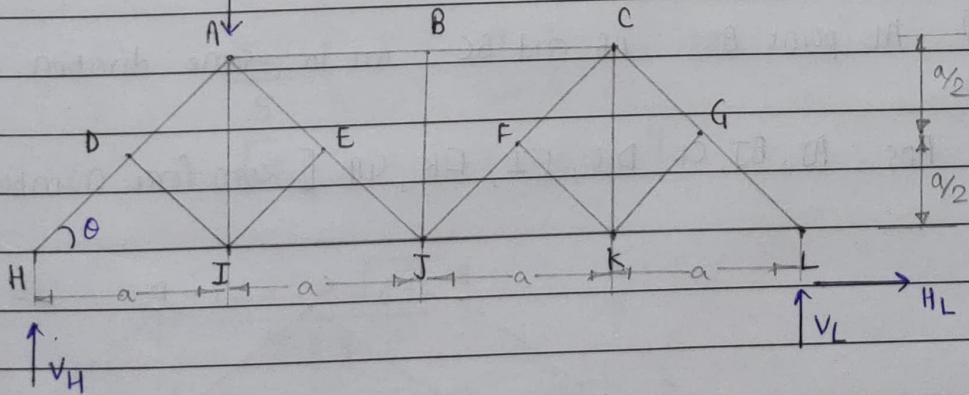
$$(F_{HF} + F_{DF}) \sin \theta_1 = 1 + F_{FG}$$

$$(10.06) \left(\frac{1}{\sqrt{5}} \right) = 1 + (F_{FG})$$

(P)

$$[F_{FG} = 3.5 \text{ kN}] \text{ (T)}$$

③



$$\sum F_y = 0$$

$$V_H + V_L = P$$

$$\theta = \tan^{-1} \left(\frac{a}{a} \right) = 45^\circ$$

$$\sum M_H = 0$$

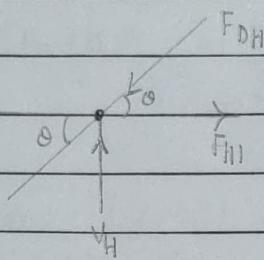
$$aP = (4a)V_L$$

$$[V_L = (P/4)]$$

$$[V_H = 3P/4]$$

(U19CS012)

Joint H



$$\sum F_y = 0 \quad V_H = F_{DH} \sin(45^\circ)$$

$$F_{DH} = \frac{3\sqrt{2}P}{4}$$

$$\sum F_x = 0 \quad F_{DH} \cos 45^\circ = F_{HI}$$

$$\frac{3P}{4} = F_{HI}$$

At point 'P', HD and NA are in same direction

$$\therefore [F_{AD} = F_{HD} = \frac{3\sqrt{2}P}{4}] \quad \& [F_{DE} = 0]$$

* Similarly at Joint E,

AE and EJ are in same direction

$$\therefore [F_{EJ} = 0]$$

* At Joint I, Force in DI and FE is zero, and HI and II in same direction

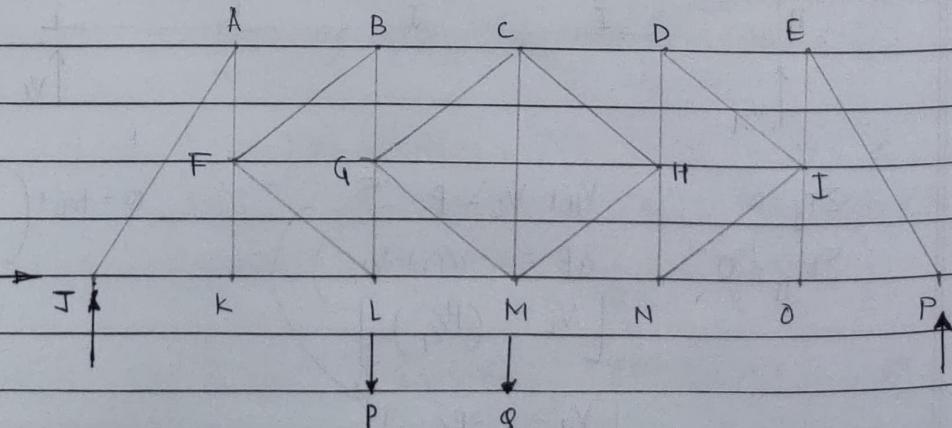
$$\text{So, } [F_{AI} = 0]$$

* At point F and G, (FJ and FC) & (GC and GL) are in same direction, so force in FK and GK is zero.

So, force in CK is also zero.

* At point B, AB and BC are in same direction so force in BJ=0.

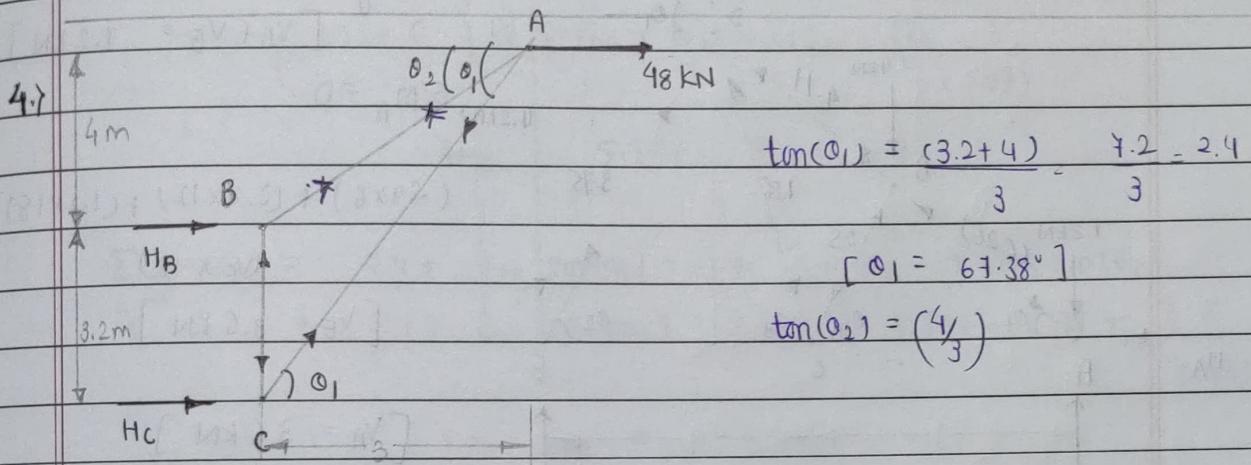
Ans: AI, BJ, CK, DI, EI, FK, GH [zero force members]



(CU19CS012)

At joints 'K' and 'O'; JK & KL and NO & OP are in same direction

∴ Force in FK and JO are zero.



Joint A :

$$\sum F_y = 0 \quad F_{AC} \sin(\theta_1) = F_{AB} \sin(\theta_2)$$

$$\left[F_{AC} = -\frac{F_{AB} \sin(\theta_2)}{\sin(\theta_1)} \right]$$

$$\sum F_x = 0$$

$$F_{AB} \cos(\theta_2) + F_{AC} \cos(\theta_1) = 48$$

$$F_{AB} \left(\cos(\theta_2) - \frac{\sin(\theta_2)}{\tan(\theta_2)} \right) = 48$$

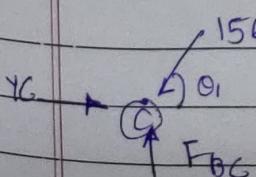
$$\frac{F_{AB}}{5} \left(3 - \frac{4}{2.4} \right) = 48$$

$$\left[F_{AB} = 180 \text{ kN (T)} \right]$$

$$F_{AC} = -\frac{180 \times 4 \times \sqrt{6.76}}{5 \times 2.4} = -156 \text{ kN}$$

$$\left[F_{AC} = 156 \text{ kN (C)} \right]$$

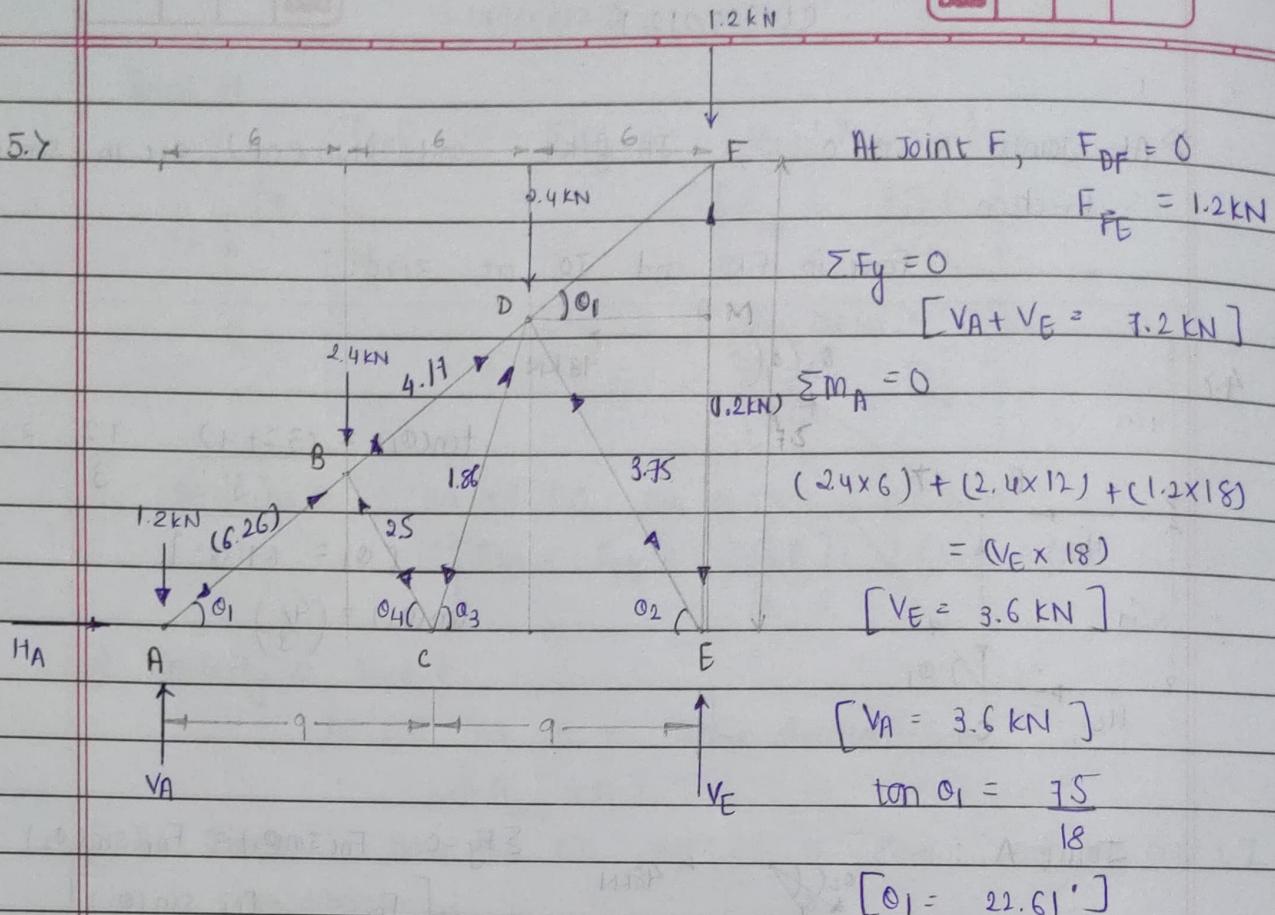
At joint 'C'



$$\sum F_y = 0 \quad 156 \sin(\theta_1) = F_{BC}$$

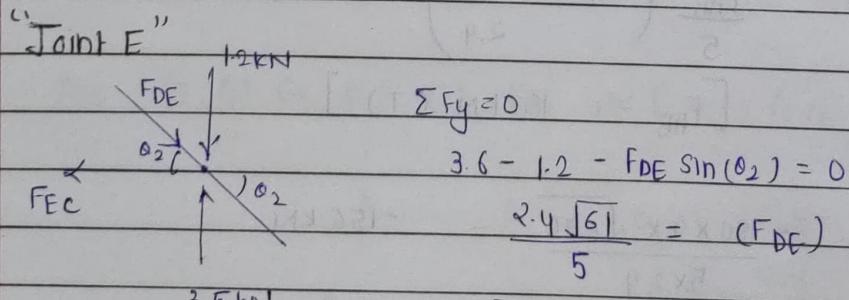
$$\left[F_{BC} = 156 \times \frac{(2.4)}{(2.6)} = 144 \text{ kN} \right]$$

5.7

In $\triangle FDM$, $\angle M = 90^\circ$ $\angle D = \alpha_1 = 22.61^\circ$

$$FM = DM \times \tan(\alpha_1) = \frac{8 \times 7.5}{18.3} = 2.5 \quad [\therefore ME = 5]$$

$$\tan(\alpha_2) = \left(\frac{5}{6}\right)$$



$$\sum F_x = 0 \quad F_{EC} - F_{DE} \cos(\alpha_2) = 0$$

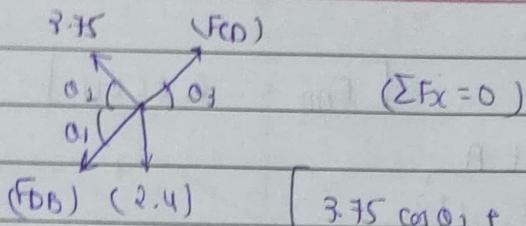
$$F_{EC} = (3.75) \times \frac{6}{\sqrt{61}}$$

$$[F_{EC} = 2.88 \text{ kN}] \quad (T)$$

(U19CS012)

At point 'D'

$$\tan(\theta_3) = \left(\frac{5}{3}\right)$$



$$(\sum F_x = 0)$$

$$3.75 \cos \theta_2 + F_{DB} \cos \theta_1 > F_{CD} \cos \theta_3$$

$$\left(\frac{3.75 \times 6}{\sqrt{1}} \right) + (F_{DB}) \cos(32.61) = F_{CD} \quad (5.83)$$

$$F_{CD} = 5.598 + F_{DB} (1.79)$$

$$\sum F_y = 0$$

$$2.4 + F_{DB} \sin(\theta_1) = 3.75 \sin(\theta_2) + F_{CD} \sin(\theta_3)$$

$$2.4 + F_{DB} (0.384) = 2.4 + (5.598 + 1.79 F_{DB}) \frac{5}{6} \quad (5.83)$$

$$1.34 F_{DB} = -5.598$$

$$[F_{DB} = -4.17 \text{ KN}] \quad (c)$$

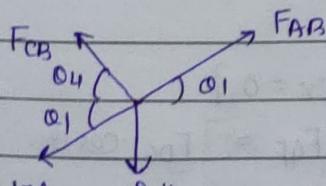
$$[F_{CD} = 1.86 \text{ KN}] \quad (T)$$

$$\tan(\theta_1) = \frac{7.5}{18} = \frac{BN}{18} \quad [BN = 2.5] \quad (6)$$

$$\tan(\theta_4) = \frac{2.5}{3} \quad (7)$$

(3.6)

At Joint 'B'



$$\sum F_y = 0$$

$$F_{CB} \sin(\theta_4) = 2.4 + 4.14 \sin(\theta_1)$$

$$[F_{CB} (0.64) + F_{AB} (0.384) = 4]$$

$$F_{AB} = 4 - (0.64)(F_{CB})$$

$$(0.384)$$

$$\sum F_x = 0 \quad 4.14 \cos(\theta_1) + F_{CB} \cos(\theta_4) = F_{AB} \cos(\theta_1)$$

$$3.85 + (0.718 F_{CB}) = 9.6 - 7.54 F_{AB}$$

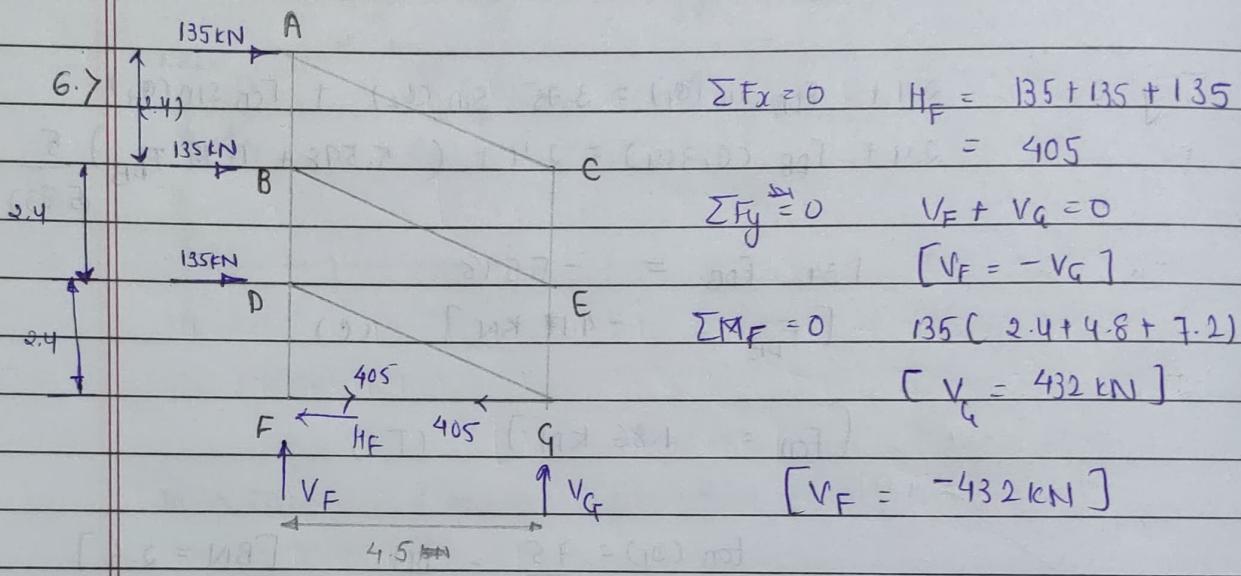
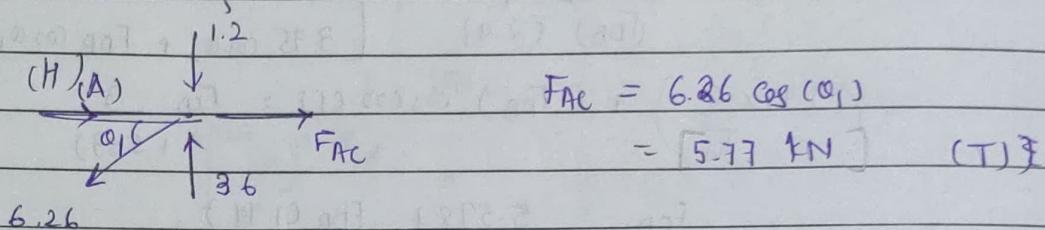
$$2.308 F_{CB} = 5.75$$

$$[F_{CB} = 2.49 \text{ KN}] \quad (c)$$

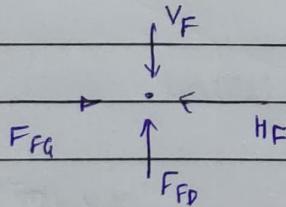
(U19CS012)

$$[F_{AB} = 6.26 \text{ kN}] \quad (\text{C})$$

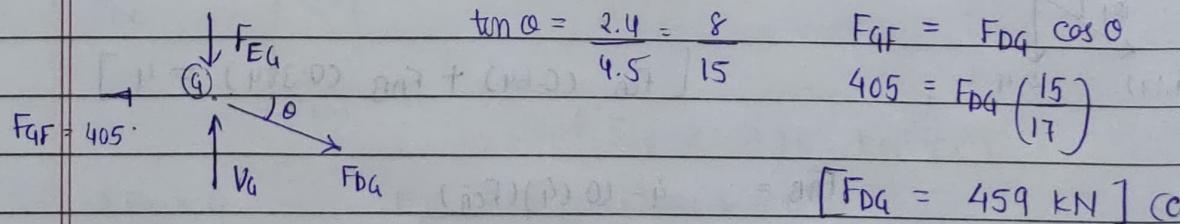
At Point A



At Joint F: $\sum F_x = 0$

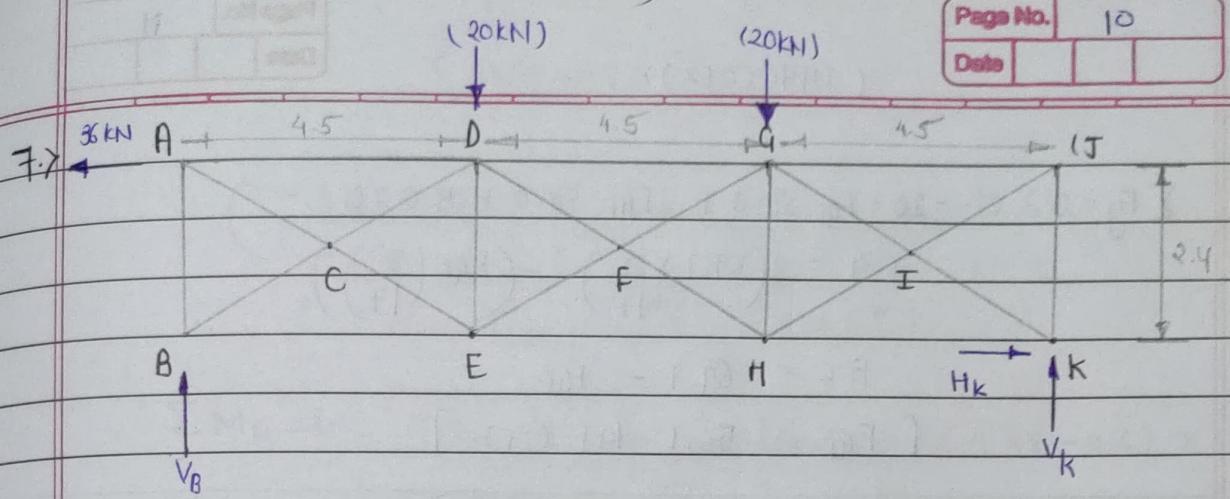


At Joint G: $\therefore [\sum F_x = 0]$



$$[\sum F_y = 0] \quad F_{EG} + F_{DG} \sin \theta = V_G$$

$$F_{EG} = 432 - 459 \times \frac{8}{17} = 216 \text{ kN} \quad (\text{C})$$



$$\sum F_x = 0$$

$$H_K = 36 \text{ kN}$$

$$\sum F_y = 0$$

$$V_K + V_B = 40 \text{ kN}$$

$$\sum M_K = 0$$

$$20(4.5) + 20(9) + 36(2.4) = V_B (13.5)$$

$$[V_B = 26.4 \text{ kN}]$$

$$[V_K = 13.6 \text{ kN}]$$

Using Method of Section;

$$\left[\tan \theta = \frac{2.4}{4.5} = \frac{8}{15} \right]$$

$$\left[\sin \theta = \frac{8}{17} \right]$$

$$\sum M_F = 0$$

$$(13.6 \text{ kN}) - F_{DG} \left(\frac{2.4}{2} \right) + 36 \times \left(\frac{2.4}{2} \right) + 13.6 \left(4.5 + \frac{4.5}{2} \right) - 20 \left(\frac{4.5}{2} \right) = 0$$

$$F_{DG} = -75 \text{ kN}$$

$$[F_{DG} = 75 \text{ kN (C)}]$$

$$\sum M_G = 0 \quad F_{HF} \cos(2.4) - (3.6 \times 2.4) - (13.6 \times 4.5) = 0$$

$$F_{HF} = \frac{1}{\cos(2.4)} \frac{147.6}{(2.4)} - \frac{10.5}{15} \times \frac{17}{(2.4)}$$

$$= [69.7 \text{ kN (C)}]$$

(U19CS012)

$$\sum F_y = 0 \quad -20 - F_{GF} \sin \theta + F_{HF} \sin \theta + 13.6 = 0$$

$$6.4 = \left(69.7 \times \frac{8}{17} \right) - \left(F_{GF} \left(\frac{8}{17} \right) \right)$$

$$13.6 = 69.7 - F_{GF}$$

$$[F_{GF} = 56.1 \text{ KN (T)}]$$

8.7

$$\sum F_y = 0 \quad V_A + V_o = 0.6 + 1.24 + 1.04 + 1 + 1.2 + 1 + 1.04 + 1.24 + 0.6$$

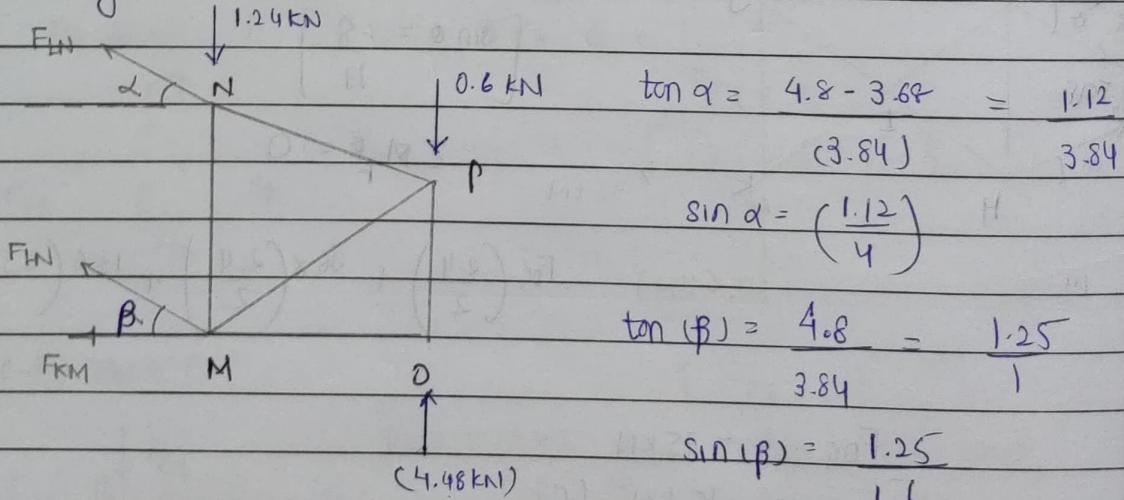
$$[V_A + V_o = 8.96 \text{ KN}] \quad \textcircled{1}$$

$$\sum M_A = 0$$

$$(1.24 \times 3.6) + (1.04 \times 7.44) + (9.84 \times 1) + (1.2 \times 13.44) + (1 \times 17.04) + (1.04 \times 19.44) + ((23.28) \times (1.24)) + (26.88 \times 0.6) = (26.88 \times V_o)$$

$$[V_o = 4.48 \text{ KN}] \quad \textcircled{2}$$

Using Method of Sections



$$\sum M_M = 0 \quad (F_{LN} \times \cos(\alpha) \times 3.68) + (4.48 - 0.6) \times (3.6) = 6$$

$$F_{LN} = -\frac{3.795}{3.84} \times (4)$$

$$[F_{LN} = -3.78 \text{ KN (C)}]$$

$$\sum F_y = 0 \quad F_{LN} \sin(\alpha) + F_{LM} \sin(\beta) - 1.24 - 0.6 + 4.48 = 0$$

(U19CS012)

$$\left(\frac{-3.95 \times 1.12}{4} \right) + \left(\frac{F_{LM} \times 1.25}{1.6} \right) = -2.64$$

$$F_{HM} = -1.963 \text{ KN} (\uparrow)$$

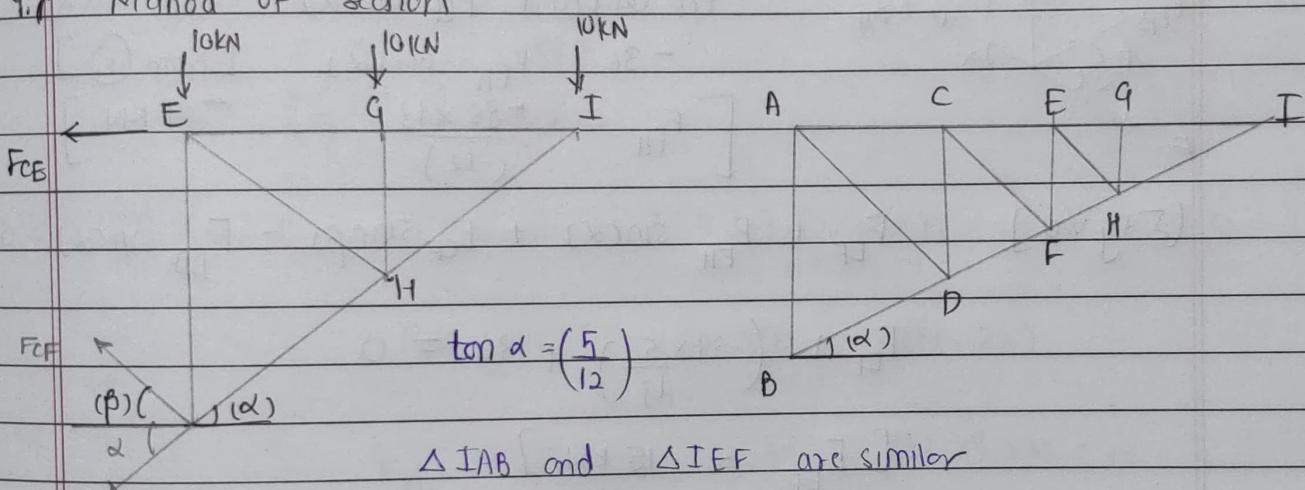
$$\sum M_N = 0 \quad (F_{LM} \cos(\beta) + F_{KM}) \times 3.68 - (4.48 - 0.6) \times 36 = 0$$

$$F_{KM} \times 3.68 = 4.516 + 13.964$$

$$= 18.48$$

$$[F_{km} = 5.02 (+) \text{ kN}]$$

9.7 Method of Section



$\triangle IAB$ and $\triangle IEF$ are similar

$$\therefore AB = EF$$

AJ 21 EI

$$\frac{5}{12} - \underline{\quad EF \quad}$$

$$[EF = 2.5]$$

$$\tan(\beta) = \frac{EF}{CE} = \frac{2.5}{3} \Rightarrow \sum M_F = 0$$

$$(F_c \times 2.5) = 10(3+6)$$

$$[F_{CE} = 36 \text{ kN (T)}]$$

$$\sum F_x = 0 \quad F_{CF} + F_{CF} \cos(\beta) + F_{FF} \cos(\alpha) = 0$$

$$36 + \frac{F_C F_x(3)}{(3-9)} + \frac{F_R x \frac{12}{(13)}}{6} = 0$$

$$F_{CF} = (1.3) \left(-3.6 - \frac{12 F_{PF}}{13} \right)$$

(U19CS012)

$$[\sum F_y = 0] \quad F_{CF} \sin(\beta) + F_{DF} \sin(\alpha) - 30 = 0 \quad \text{--- (2)}$$

$$(3.6 \times 13) + (1.2 \times F_{DF}) + \left(F_{DF} \times \frac{5}{13} \right) + 30 = 0$$

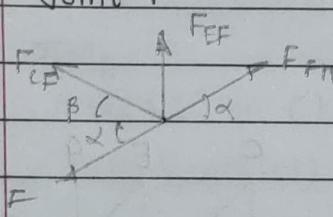
$$-76.8 - F_{DF}$$

$$(1.58)$$

$$[F_{DF} = -48.46 \text{ KN}]$$

$$[F_{CF} = 11.36 \text{ KN}]$$

Joint F'



$$\sum F_x = 0$$

$$F_{CF} \cos(\beta) + F_{EF} \cos(\alpha) = F_{FH} \cos(\alpha)$$

$$-36 = F_{FH} \cos(\alpha) \quad [\text{From (1)}]$$

$$[F_{FH} = \frac{-36 \times 13}{12} = -39 \text{ KN}]$$

$$[\sum F_y = 0]$$

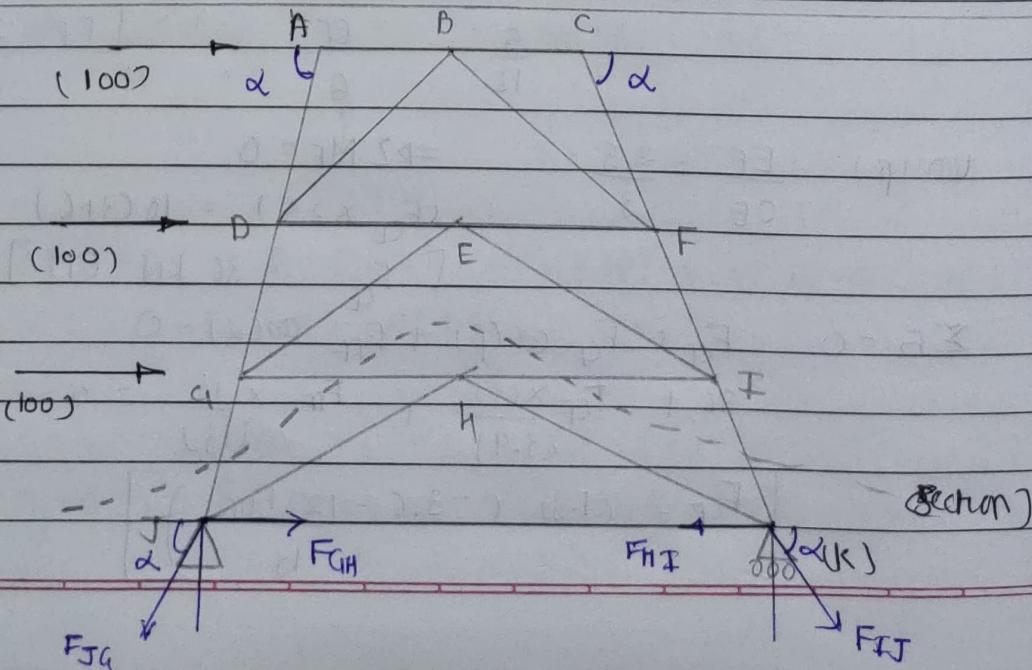
$$F_{EF} + F_{FH} \sin(\alpha) + F_{CF} \sin(\beta) - F_{DF} \sin(\alpha) = 0$$

$$F_{EF} + \left(-39 \times \frac{5}{13} \right) + 30 = 0$$

$$[F_{EF} = -15 \text{ KN (C)}]$$

$$[F_{EF} = 15 \text{ KN (C)}]$$

10.7



(U19CS012)

$$\tan(\alpha) = \frac{2.7 \times 3}{(2.4)} = \frac{9 \times 3}{8} = \frac{27}{8}$$

$$\frac{x + (2.7 \times 3)}{x} = \frac{7.5}{2.7} = \frac{25}{9}$$

$$9x + 72.9 = 25x$$

$$[x = 4.56 \text{ m}]$$

$\triangle OJK$ is similar to $\triangle OGI$,

$$\frac{x + (2.7 \times 3)}{x + (2.7 \times 2)} = \frac{7.5}{y}$$

$$[y = 5.9 \text{ m}]$$

$$\sum M_I = 0 \quad (F_{JG} \sin(\alpha) \times 5.9) - (100 \times 2.7) - (100 \times 5.4) = 0$$

$$F_{JG} \sin(\alpha) = \frac{80 \times 810}{(5.9)} - (137.28)$$

$$F_{JG} = \frac{137.28}{(2.7)} \times 28.16 = 143.19 \text{ kN (T)}$$

$$\sum M_G = 0 \quad (F_{IJ} \sin(\alpha) \times 5.9) + (100 \times 2.7) + (100 \times 5.4) = 0$$

$$[F_{IJ} = -143.19 \text{ kN}] (C)$$

X

Roll No: U19CS012
(D-12)