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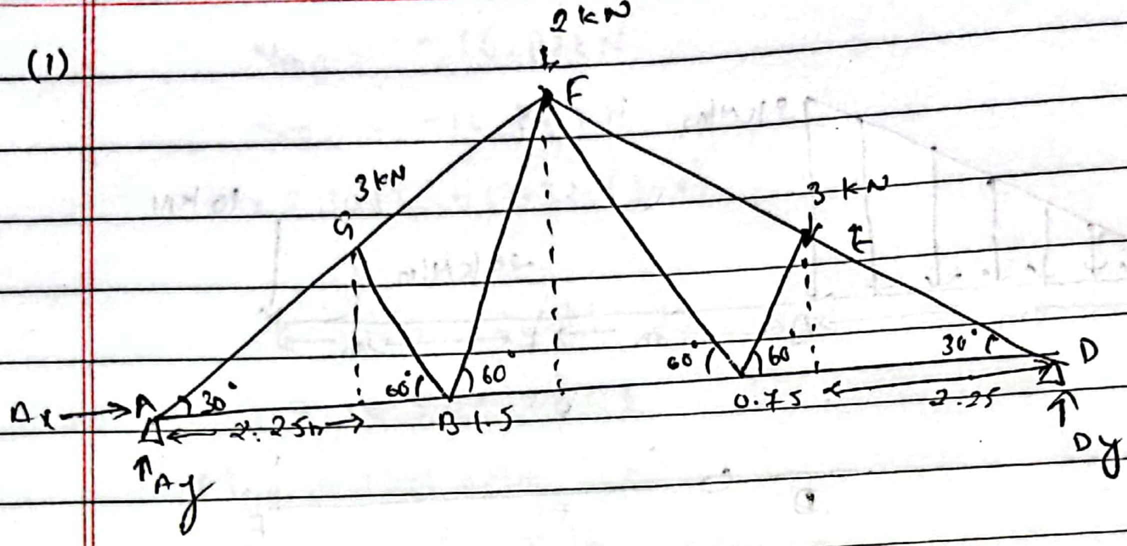
Truss

(1)



Here,
calculating reactional force.

$\Sigma F_x = 0$ | $\Sigma F_y = 0$

$A_x = 0$ | $A_y + D_y - 3kN - 2kN = 0$

$A_y + D_y = 8$ — (i)

Now,

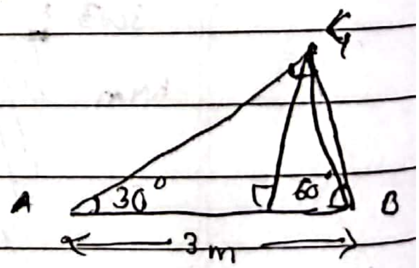
$\Sigma M_A = 0$

$3 \times 2.25 + 2 \times 4.5 + 3 \times 6.67 - 9D_y = 0.$

$9D_y = 36$

$D_y = 4kN$

$A_y = 8 - 4 = 4kN$



So this is symmetrical case

$\cos 30 = \frac{AG}{3}$

$\cos 30 = \frac{x}{3\sqrt{3}/2}$

$x = 2.25m$

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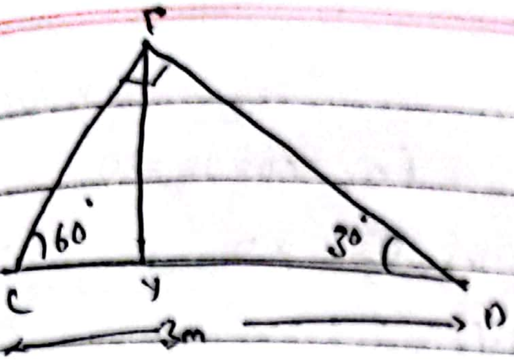


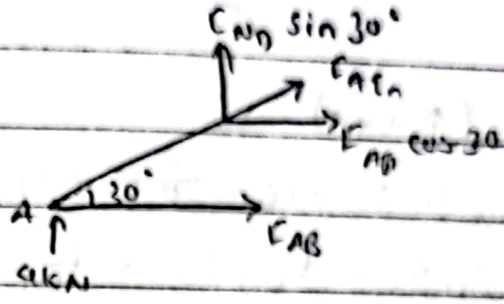
$\sin 30° = \frac{EC}{CD}$

$EC = 1.5$

ΔEYC cos

$EY = EC\cos = 0.75$

taking joint A



$\Sigma F_y = 0$ ($\uparrow$ +ve)

$4 + F_{AG}\sin 30° = 0$

$F_{AG}\frac{1}{2} = -4$

$F_{AG} = -8$

$F_{AG} = 8\ kN$ (C)

$\Sigma F_x = 0$ ($\rightarrow$ +ve)

$F_{AB} + F_{AG}\cos 30 = 0$

$F_{AB} - 8\cos 30 = 0$

$F_{AB} = 8 \times \frac{\sqrt{3}}{2}$

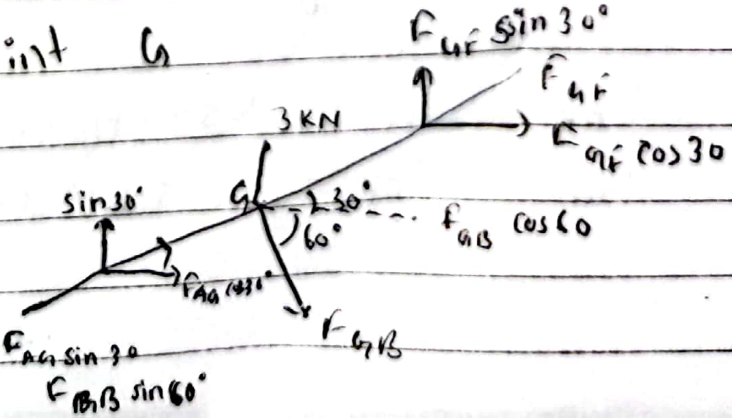
$F_{AB} = 4\sqrt{3}$ (T)

As the truss is symmetric

$F_{ED} = F_{AG} = 8\ kN$ (C)

$F_{AB} = F_{CD} = 4\sqrt{3}\ kN$ (T)

Taking joint G



$\Sigma f_x = 0$ ($\rightarrow$ +ve)

$F_{AG}\cos 30 + F_{GB}\cos 60^\circ + F_{GF}\cos 30 = 0$

$8\cos 30^\circ + F_{GB}\times\frac{1}{2} + F_{GF}\frac{\sqrt{3}}{2} = 0$

$\frac{1}{2}F_{GB} + \frac{\sqrt{3}}{2}F_{GF} = -4\sqrt{3}$

$F_{GB} + \sqrt{3}F_{GF} = -8\sqrt{3}$ — (i)

$\Sigma F_y = 0$ ($\uparrow$ +ve)

$-3 + F_{AG}\sin 30 - F_{GB}\sin 60 + F_{GF}\sin 30 = 0$

$3 + 8\sin 30 - F_{GB}\frac{\sqrt{3}}{2} + F_{GF}\times\frac{1}{2} = 0$

$-\frac{\sqrt{3}}{2}F_{GB} + \frac{1}{2}F_{GF} = -1 - 1$

$\sqrt{3}F_{GB} + F_{GF} = -2$ — (ii)

Solving (i) & (ii)

$F_{GB} = -2.598$ kN &.
$= 2.598$ kN (C)

$F_{GF} = -6.5$ kN
$= 6.5$ kN (C)

As the truss is symmetrical

$F_{GB} = F_{EC} = 2.598$ kN (C)

$F_{GF} = F_{EF} = 6.5$ kN (C)

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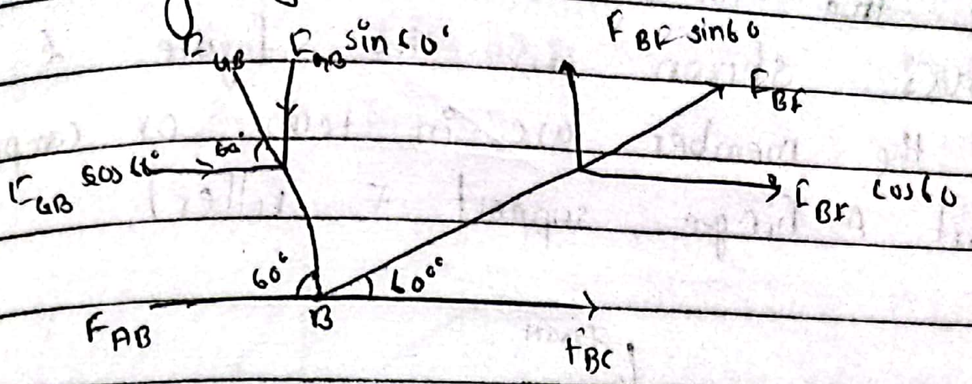
taking joint B.



$\Sigma F_y = 0$ (↑ +ve)

$F_{BF}\sin 60 - F_{GB}\sin 60° = 0$

$F_{BF}\sin 60° - 2.598\sin 60 = 0$

$F_{BF}\sin 60 = 2.598\sin 60°$

$F_{BC} = 2.598$ kN. (T)

$\Sigma F_x = 0$ (→ +ve)

$F_{BF}\cos 60 + F_{BC} + F_{GB}\cos 60 - F_{AB} = 0$

$F_{BC} + 2.598\cos 60 + 2.598\cos 60 - 4\sqrt{3} =$

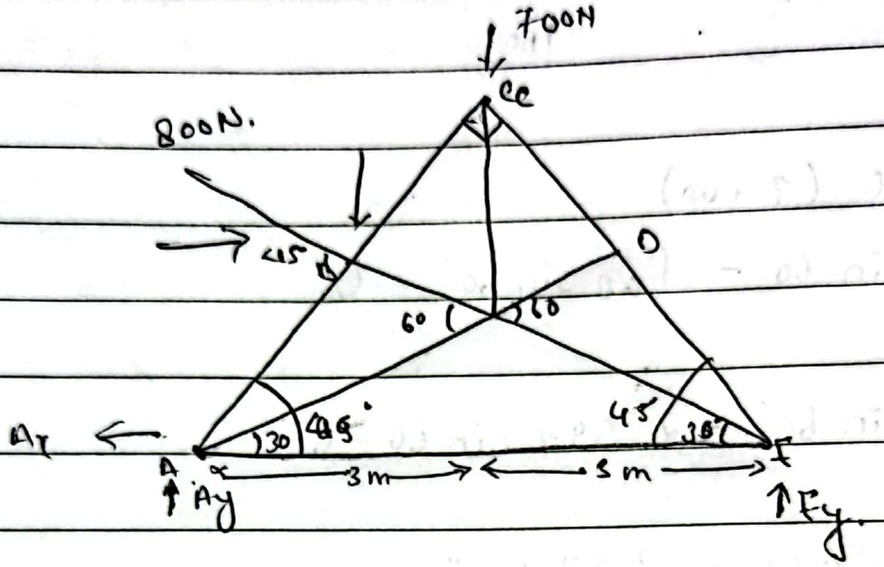
$F_{BC} + 2.598 - 4\sqrt{3} = 0$

$F_{BC} = 4.33$ kN (T).

As the truss is symetric

$F_{BF} = F_{FE} = 2.598$ kN (T)

3. Determine the force in each member of the roof truss shown in the figure & State if the member are in term or compression (support A hinge, support F roller).



calculation of reaction.

$\Sigma F_x = 0 \quad (\rightarrow +ve)$

$800 \cos 45 - A_x = 0$

$A_x = 565.68$ N.

In ΔAXC

$\cos 45 = \frac{AX}{AC}$

$AC = 3\sqrt{2}$ m.

$\Sigma F_y = 0 \quad (\uparrow +ve)$

$A_y + F_y - 800 \sin 45 - 700 = 0$

$A_y + F_y = 1265.68$ N.

In ΔBCF

$\tan 15° = \frac{BC}{CF}$

$BC = 3\sqrt{2} \tan 15$

$\Sigma M_A = 0 \quad (\circlearrowleft +ve)$

$800 \cos 45 \times 2.196 + 800 \sin 45 \times 2.196 + 700 \times 3 - F_y \times 6 = 0$

$6E_y = 4584.49$

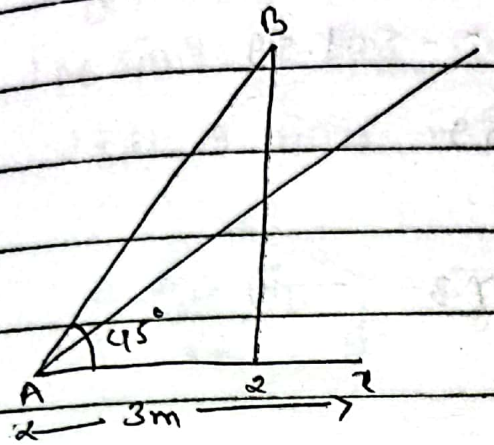
$F_y = 764.08\ N$

$A_y = 501.59$

Now,

$AB = AC - BC$

$AB = 3.105.$

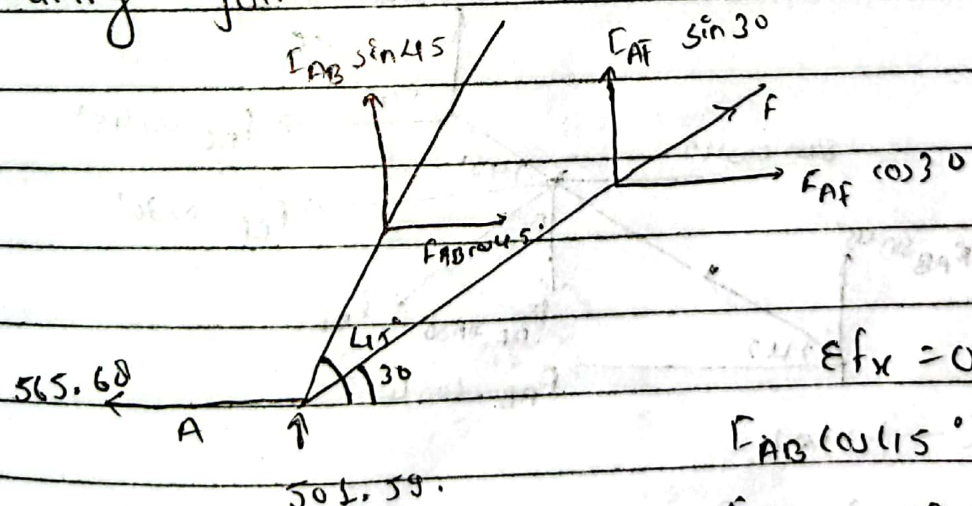


$\sin 45 = \frac{BZ}{AB}$ $\cos 45 = \frac{AZ}{AB}$

$BZ = 3.144 \sin 45$ $AZ = 3.144 \cos 45$

$BZ = 2.191\ m$ $AZ = 2.195\ m.$

taking joint A.



$\Sigma f_x = 0\ (\rightarrow +ve)$

$F_{AB}\cos 45° + F_{AF}\cos 30 - 800\cos 45 = 0$

$\frac{F_{AB}}{\sqrt{2}} + F_{AF} \times \frac{\sqrt{3}}{2} = 800 \times \frac{1}{\sqrt{2}}$

$\frac{2F_{AB} + \sqrt{6}F_{AF}}{2\sqrt{2}} = \frac{800}{\sqrt{2}}$

$2 F_{AB} + \sqrt{6} F_{AF} = 1600$ — (i)

$\Sigma F_y = 0$ (↑ +ve)

$F_{AB} \sin 45 + F_{AF} \sin 30 = -501.59$

$\frac{F_{AB}}{\sqrt{2}} + \frac{F_{AF}}{2} = -501.59.$

$2 F_{AB} + \sqrt{3} F_{AF} = -1418.73$ — (ii)

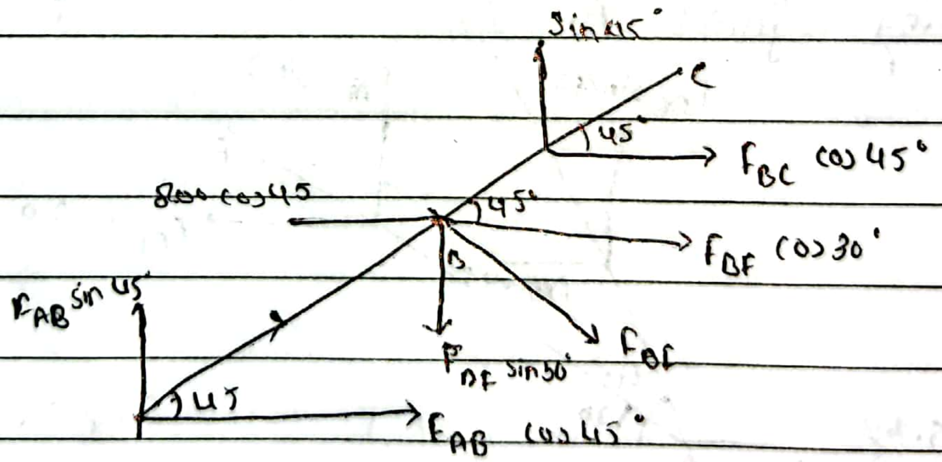
solving (i) & (ii)

$F_{AB} = -2771.19$ N

$F_{AB} = 2771.19$ (C)

$F_{AF} = 2915.86$ N (T)

taking joint B.



$\Sigma F_x = 0$ (→ +ve)

$F_{BC} \cos 45° + 800 \cos 45 + F_{BF} \cos 30° + F_{AB} \cos 45 = 0$

$\frac{F_{BC}}{\sqrt{2}} + 800 \cos 45 + F_{BF} \frac{\sqrt{3}}{2} + 2771.19 \cos 45 = 0$

$$\frac{F_{BC}}{\sqrt{2}} + F_{BF}\frac{\sqrt{3}}{2} = -2525.21 \quad \text{--- (iii)}$$

$\Sigma F_y = 0 \quad (\uparrow +ve)$

$F_{AB}\sin 45 - F_{BF}\sin 30 - 800\sin 45° + F_{BC}\sin 45° = 0$

$2771.19\sin 45 - 800\sin 45 + \frac{F_{BC}}{\sqrt{2}} - \frac{1}{2}F_{BF} = 0$

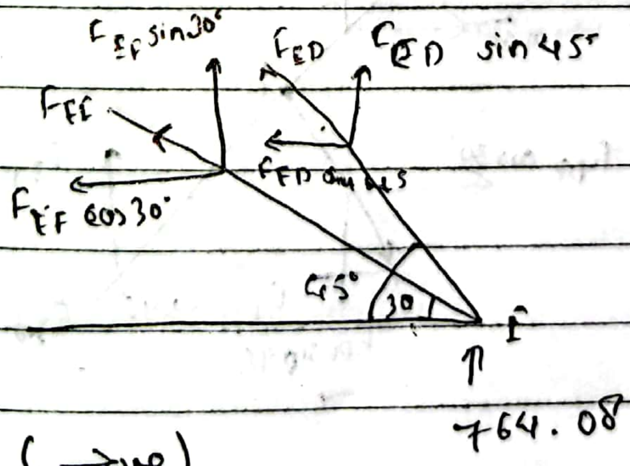
$$\frac{F_{BC}}{\sqrt{2}} - \frac{1}{2}F_{BF} = -1393.84 \quad \text{--- (iv)}$$

Solving (iii) & (iv)

$F_{BC} = -2556.82N$ $\quad\quad$ $F_{BF} = -828.22\ N$

$= 2556.82N(C)$ $\quad\quad$ $= 828.22\ N(C).$

Taking joint E.



$\Sigma F_x = 0 \quad (\rightarrow ve)$

$-F_{EF}\cos 30° - F_{ED}\cos 45° = 0$

$F_{EF}\cos 30 + F_{ED}\cos 45° = 0 \quad \text{--- (v)}$

$\Sigma F_y = 0 \quad (\uparrow +ve)$

$769.771 + F_{EF}\sin 30 + F_{ED}\sin 45 = 0$

$F_{EF}\sin 30 + F_{ED}\sin 45 = -764.08 \quad \text{--- (vi)}$

$\cancel{\Sigma F_y = 0 \quad (\uparrow +ve)}$

$\cancel{769.771 + F_{EF}\sin 30 + F_{ED}\sin 45 = 0}$

$\cancel{F_{EF}\sin 30 + F_{ED}\sin 45^\circ = -764.08}$ —

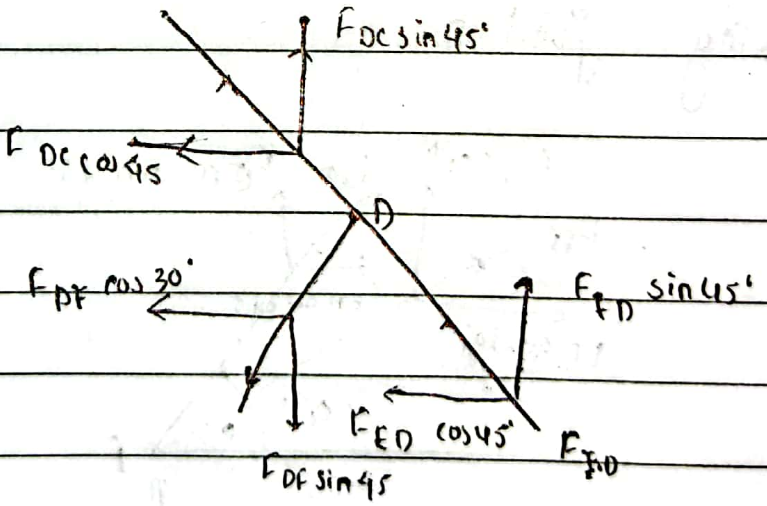
Solving (v) & (vi)

$F_{EF} = 2087.50\ N\ (T)$

$F_{ED} = -2556.16\ N$

$= 2556.16\ N\ (C)$

taking joint D.



$\Sigma F_x = 0 \quad (\longrightarrow +ve)$

$-F_{DC} \cos 45^\circ - F_{DF} \cos 30 - F_{ED} \cos 45 = 0$

$F_{DC} \cos 45 + F_{DF} \cos 30 = -1807.83$

$\Sigma F_y = 0$

$F_{DC} \sin 45^\circ - F_{DF} \sin 30 = -F_{ED} \sin 45^\circ$

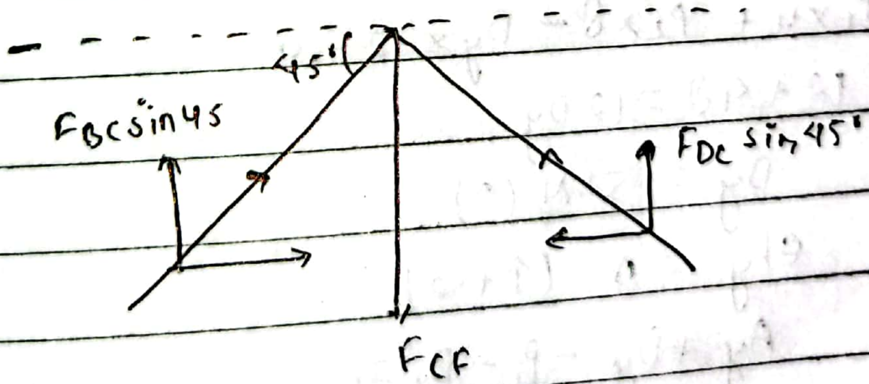
$F_{DC} \sin 45 - F_{DF} \sin 30 = -1807.83.$

Solving.

$F_{DC} = -2556.65N \qquad F_{DF} = 0N$

$= 2556.65 N (C)$

taking joint C

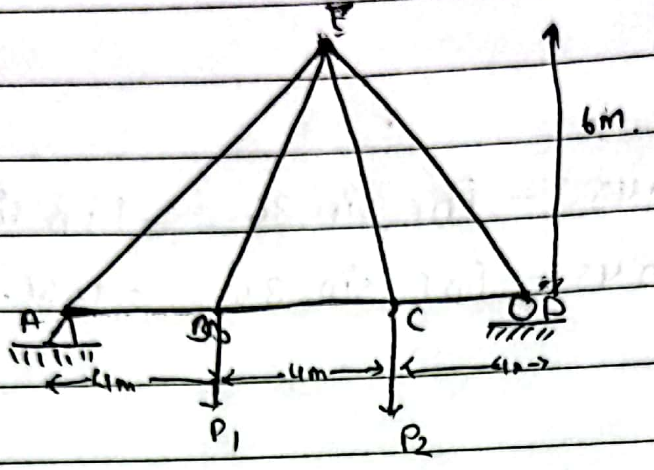


$\Sigma F_y = 0 \quad (\uparrow +ve)$

$F_{DC} \sin 45 + F_{DC} \sin 45 - F_{CF} = 0$

$\Rightarrow F_{CF} = 36115.77 N$

Q1) Determine the force in each member of the truss & state if the member are in tension or compression set $P_1 = 3kN$
$P_2 = 6KN$



calculating the reaction.

$\Sigma fx = 0 \quad (\rightarrow +ve)$

$Ax = 0$

$\Sigma M_A = 0 \quad (\circlearrowright +ve)$

$P_1 \times 4 + P_2 \times 8 - D_y \times 12 = 0$

$12 + 48 = 12 D_y$

$D_y = 5kN (\uparrow)$

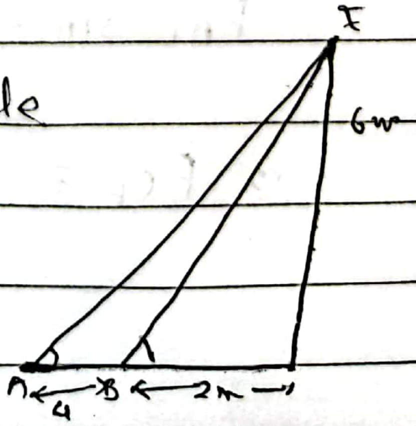
$\Sigma f_y = 0 \quad (\uparrow +ve)$

$A_y + D_y - P_1 - P_2 = 0$

$A_y + 5 - 3 - 6 = 0$

$A_y = 4kN$

Now, finding the angle



In ΔAXF

$\tan A = \frac{6}{6}$ $\therefore A = 45°$

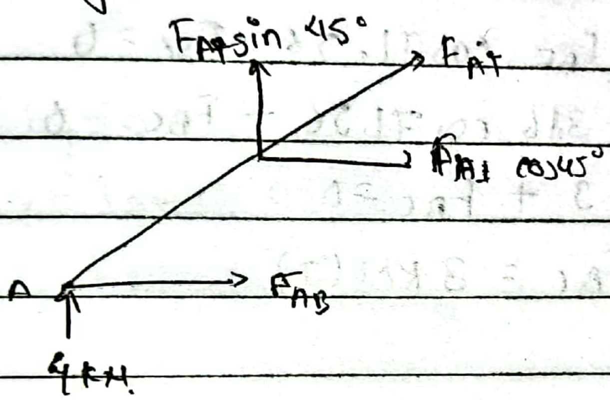
$||^{ly}$ $D = 45°$

In ΔBXF

$\tan B = \frac{6}{2}$ $B = 71.56$

$||^{ly}$ $C = 71.56$

taking joint A



$\Sigma F_y = 0$ $(\uparrow +ve)$

$4 + F_{AF} \sin 45 = 0$

$F_{AF} = -4\sqrt{2}$ KN

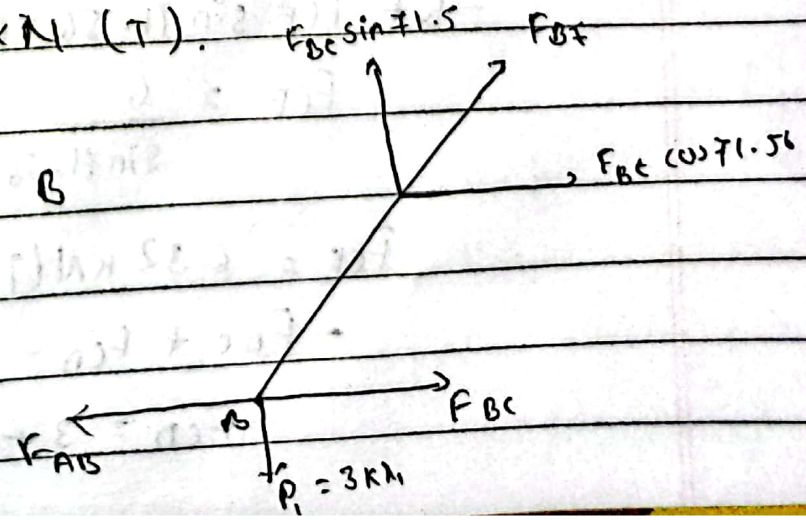
$F_{AF} = -4\sqrt{2}$ KN (C)

$\Sigma F_x = 0$ $(\rightarrow +ve)$

$F_{AB} + F_{AF} \cos 45 = 0$

$F_{AB} = 4$ KN (T).

taking joint B



$\Sigma f_y = 0 \quad (\uparrow +ve)$

$-3 + F_{BF} \sin(71.56) = 0$

$F_{BF} \sin(71.56) = 3$

$F_{BF} = \dfrac{3}{\sin(71.56)}$

$F_{BF} = 3.16 \text{ kN } (T).$

$\Sigma f_x = 0 \quad (\rightarrow +ve)$

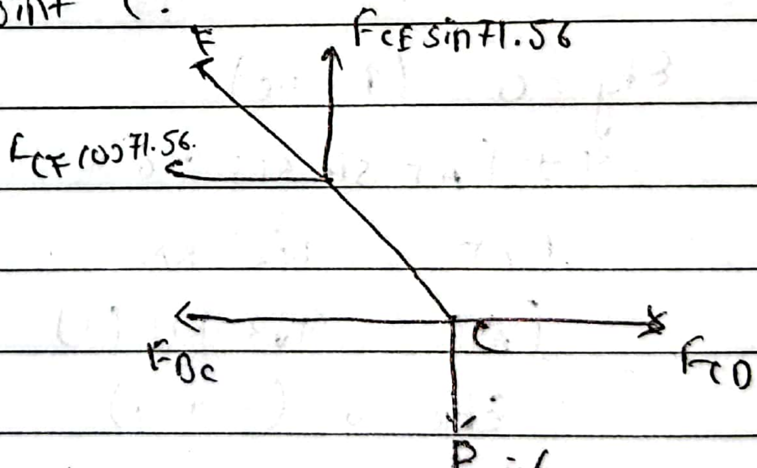
$-4 + F_{BF} \cos 71.56 + F_{BC} = 0$

$-4 + 3.16 \cos 71.56 + F_{BC} = 0$

$-4 - 3 + F_{BC} = 0$

$F_{BC} = 3 \text{ kN } (T)$

taking joint C.



$\Sigma f_y = 0 \quad (\uparrow +ve)$

$-6 + F_{CF} \sin 71.56 = 0$

$F_{CF} = \dfrac{6}{\sin 71.56}$

$F_{CF} = 6.32 \text{ kN } (T)$

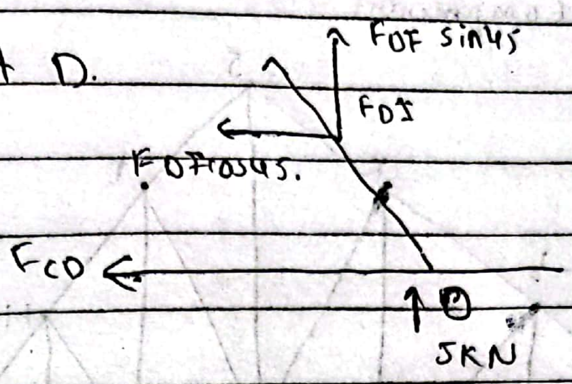
$-F_{BC} + F_{CD} - F_{CB} \cos 71.56 = 0$

$F_{CD} = 3 + 6.32 \cos 71.56$

$F_{CD} = 3+2$

$F_{CD} = 5KN(T)$

taking joint D.



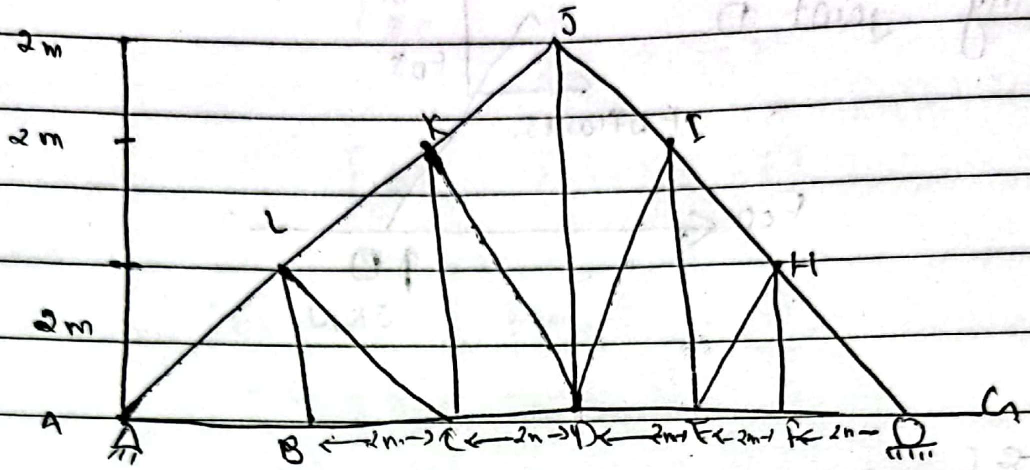
$\Sigma F_y = 0$

$5 + F_{DF}\sin 45 = 0$

$F_{DF} = -5/\sin 45$

$F_{DF} = 7.07 (C)$.

5) Determine the force in each member of the pratt truss & state if the member are in tension or compression



calculating the reaction

$\Sigma F_x = 0 \quad (\rightarrow +ve)$

$A_x = 0$

$\Sigma F_y = 0 \quad (\uparrow +ve)$

$A_y + G_y - 10 - 20 - 10 = 0$

$A_y + G_y = 40$ — (i)

$\Sigma M_A = 0 \quad (\circlearrowright +ve)$

$10 \times 4 + 20 \times 6 + 10 \times 8 - G_y \times 12 = 0$

$12 G_y = 240$

$G_y = 20 \text{ kN} (\uparrow)$

$A_y = 20 \text{ kN} (\uparrow)$

Thus, the truss is symmetrical

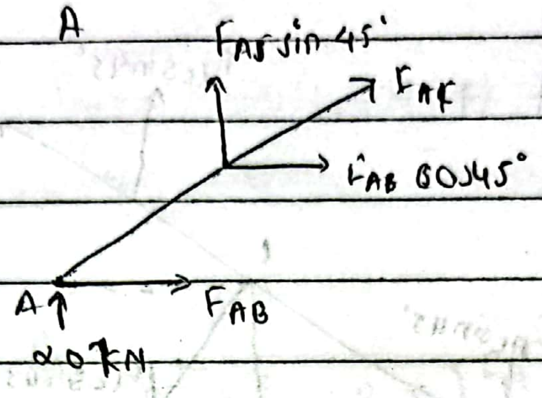
Using trigonometry

$\angle CAB = 45^\circ = \angle HGF$

$\angle LCB = 45^\circ = \angle HFF$

$\angle KDC = \tan^{-1}\left(\frac{4}{2}\right) = 63.43^\circ = \angle CDF$

taking joint A



$\Sigma F_y = 0$ (↑+ve)

$20 + F_{AC} \sin 45 = 0$

$F_{AC} \times \frac{1}{\sqrt{2}} = -20$

$F_{AC} = -20\sqrt{2}$ kN

$F_{AC} = 20\sqrt{2}$ kN (C).

$\Sigma F_x = 0$ (→+ve)

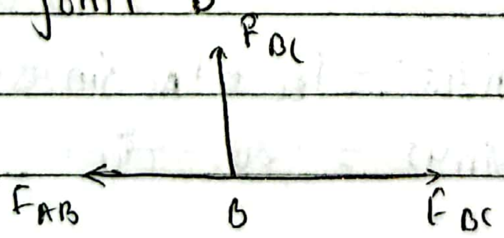
$F_{AB} + F_{AC} \cos 45 = 0$

~~$F_{AB} = 20$ kN (T)~~

$F_{AB} - 20\sqrt{2} \times \frac{1}{\sqrt{2}} = 0$

$F_{AB} = 20$ kN (T)

taking joint B



lly,

$F_{HG} = 20\sqrt{2}$ kN (C)

$F_{FG} = 20$ kN (T)

$\Sigma F_y = 0$ (↑+ve)

$F_{BC} = 0$

lly, $F_{FH} = 0$.

$\Sigma F_x = 0 \quad (\rightarrow +ve)$

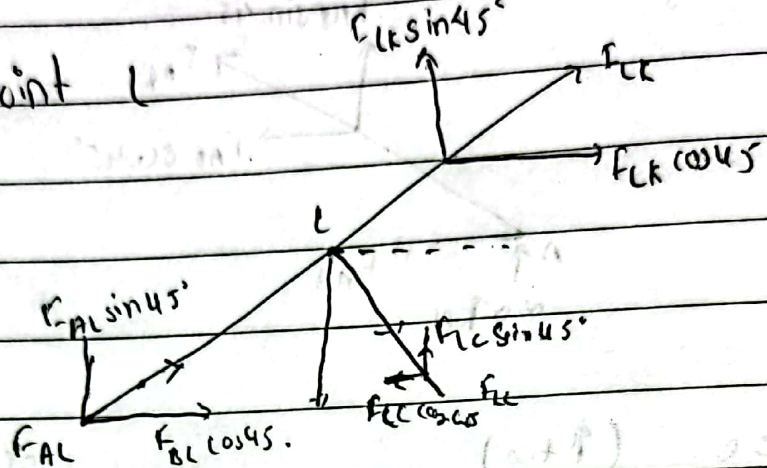
$-F_{AB} + F_{BC} = 0$

$F_{BC} = 20\ kN\ (T)$

$\text{Ily},$

$F_{FE} = 20\ kN\ (T)$

taking joint L



$\Sigma F_x = 0 \quad (\rightarrow +ve)$

$F_{AL} \cos 45° + F_{LC} \cos 45 + F_{LK} \cos 45 = 0$

$20\sqrt{2} \cos 45 + F_{LC} \cos 45 + F_{LK} \cos 45 = 0$

$F_{LK} \cos 45 + F_{LC} \cos 45 = -20 \quad \text{—(i)}$

$\Sigma F_y = 0 \quad (\uparrow +ve)$

$F_{LK} \sin 45 - F_{LC} \sin 45 - F_{BL} + F_{AL} \sin 45 = 0$

$F_{LK} \sin 45 - F_{LC} \sin 45 = -20 \quad \text{—(ii)}$

solving (i) & (ii)

$2 F_{LK} \cos 45 = -40$

$F_{LK} = -20\sqrt{2}\ kN$

$F_{LK} = 20\sqrt{2}\ kN\ (C)$

Then,

$-20\sqrt{2}\cos 45 + F_{LC}\cos 45° = -20$

$-20 + F_{LC}\frac{1}{\sqrt{2}} = -20$

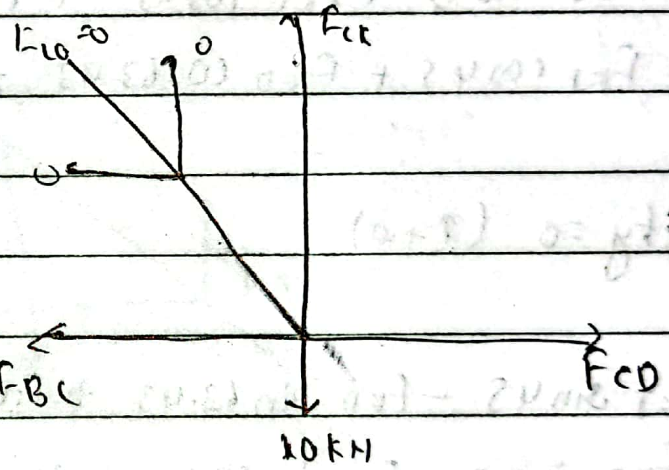
$F_{LC} = 0$

Ily,

$F_{HI} = 20\sqrt{2}$ kN (C)

$F_{HF} = 0$

taking joint C



$\Sigma f_y = 0$ (↑+ve)

$F_{CK} - 10 = 0$

$F_{CK} = 10$ kN (T)

Ily,

$F_{FI} = 10$ kN (T)

$\Sigma f_x = 0$ (→+ve)

$-F_{BC} + F_{CD} = 0$

$F_{CD} = 20$ kN (T)

Ily,

$F_{ED} = 20$ kN (T)

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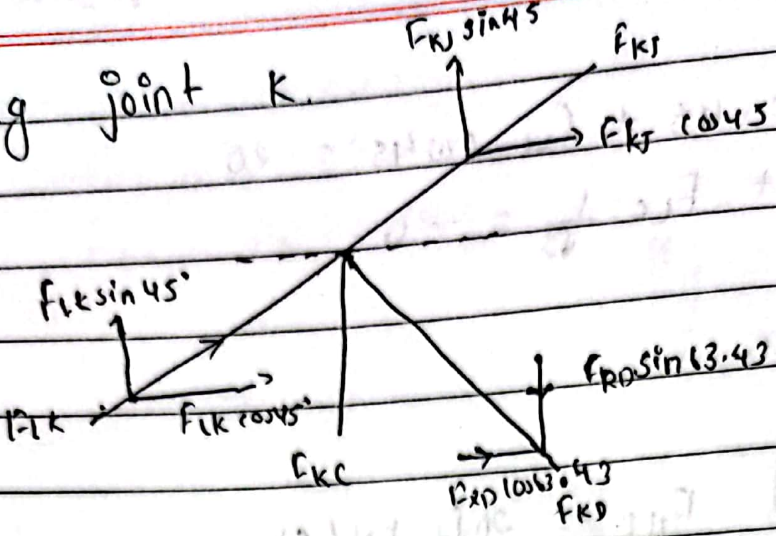
taking joint K.



$\Sigma f_x = 0$ $(\rightarrow +ve)$

$F_{IK}\cos 45 + F_{KD}\cos 63.43 + F_{KJ}\cos 45 = 0$

$20\sqrt{2}\cos 45 + F_{KJ}\cos 45 + F_{KD}\cos 63.43 = 0$

$F_{KJ}\cos 45 + F_{KD}\cos 63.43 = -20$ ——(iii)

$\Sigma f_y = 0$ $(\uparrow +ve)$

$F_{KJ}\sin 45 - F_{KD}\sin 63.43 + F_{IK}\sin 45 - F_{KC} = 0$

$F_{KJ}\sin 45 - F_{KD}\sin 63.43 + 20\sqrt{2}\sin 45 - 10 = 0$

$F_{KJ}\sin 45 - F_{KD}\sin 63.43 = -10$ ——(iv)

Solving (iii) & (iv)

$F_{KJ}\sin 45 + F_{KJ}\cos 45 = -30$

$F_{KJ}\left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right) = -30$

$F_{KJ}\left(\frac{2}{\sqrt{2}}\right) = -30$

$F_{KJ} = -15\sqrt{2}$ kN

$F_{KJ} = 15\sqrt{2}$ kN (C)

Scanned with CamScanner

Then,

$$-15\sqrt{2}\cos 45 + F_{KD}\cos 63.43 = -20$$

$$-F_{KD}\cos 63.43 = -5$$

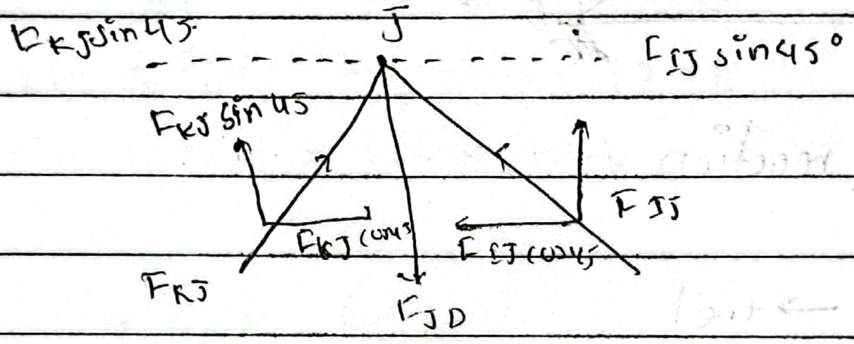
$$F_{KD} = 11.18\ KN\ (C).$$

Ily,

$$F_{IJ} = 15\sqrt{2}\ KN\ (C)$$

$$F_{ID} = 11.18\ KN\ (C)$$

taking joint J



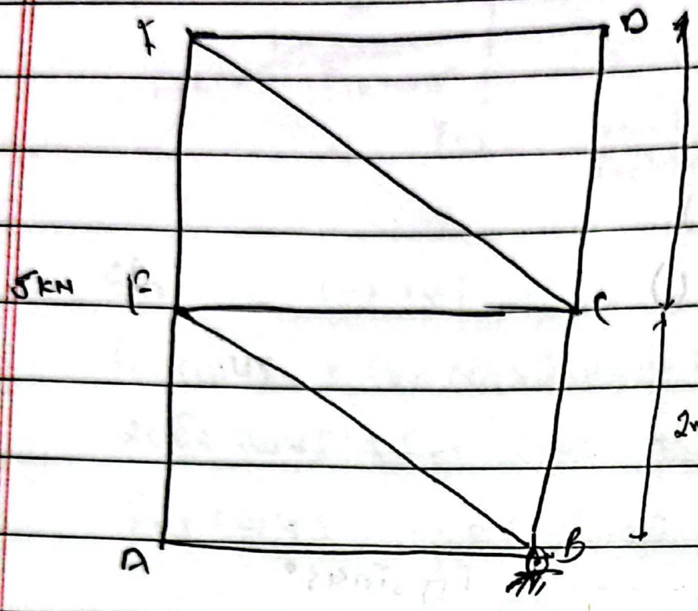
$\Sigma F_y = 0\ (\uparrow +ve)$

$$F_{KJ}\sin 45 - F_{JD} + F_{IJ}\sin 45 = 0.$$

$$F_{JD} = 15 + 15$$

$$F_{JD} = 30\,KN\ (T).$$

10) Determine the force in member AF, CF & BC & BC & state of the member are in tension or compression



calculating reaction

$\Sigma F_x = 0$ ($\rightarrow$ +ve)

$4 + 3 - A_x = 0$

$A_x = 12 KN (\leftarrow)$

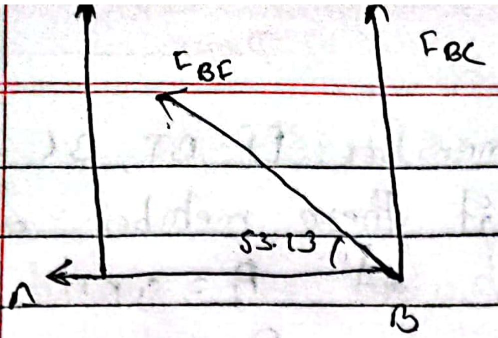
$\Sigma F_y = 0$ ($\uparrow$ +ve)

$A_y + B_y = 0$

As, no vertical force is applied

$A_y = 0$ & $B_y = 0$

taking the desired section



$\theta = \tan^{-1}\left(\frac{2}{1.5}\right) = 53.13°$

$\Sigma F_x = 0$ ($\rightarrow$ +ve)

$-12 - F_{BF}\cos 53.13 = 0$

$F_{BF}\cos 53.13 = -12$

$F_{BF} = 20\ kN$ (C)

$\Sigma F_y = 0$ ($\uparrow$ +ve)

$F_{AF} + F_{BF}\sin 53.13 + F_{BC} = 0$

$F_{AF} + F_{BC} - 20\sin 53.13 = 0$

$F_{AF} + F_{BC} = 16\ kN$ — (i)

$\Sigma M_B = 0$ ($\circlearrowleft$ +ve)

$1.5 \times F_{AF} = 0$

$F_{AF} = 0$

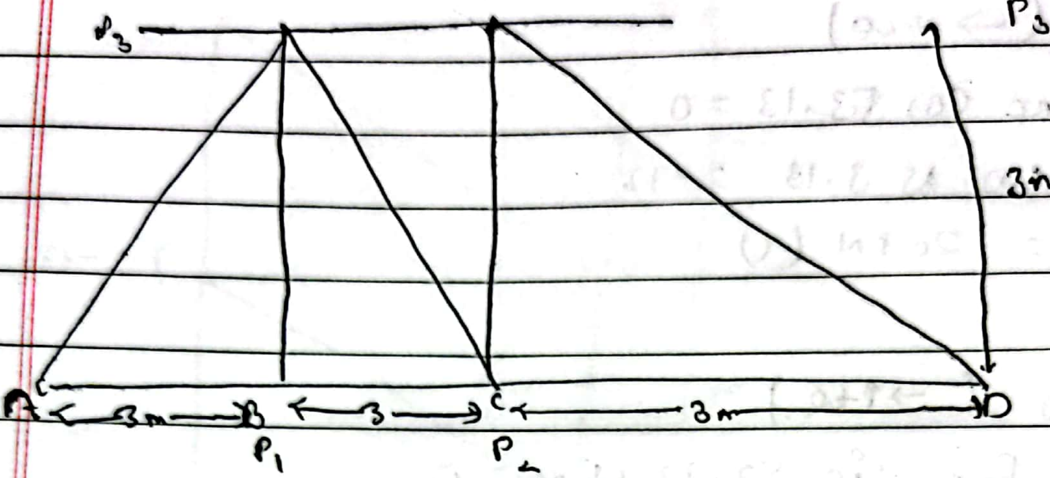
So,

$F_{BC} = 16\ kN$ (T)

11. Determine the force in member EF, BF, BC & BF & the truss & state if these member are in tension or compression set $P_1 = 9$ KN

$P_2 = 12$ KN

$P_3 = 6$ KN



calculating the reaction

$\Sigma f_x = 0 \ (\rightarrow +ve)$

$A_x + P_3 = 0$

$A_x = 6$ KN $(\leftarrow)$

$\Sigma f_y = 0$

$A_y + D_y - P_1 - P_2 = 0$

$A_y + D_y - 9 - 12 = 0$

$A_y + D_y = 21$ KN

$\Sigma M_A = 0$ (↺ +ve)

$P_3 \times 3 + P_1 \times 3 + P_2 \times 6 - D_y \times 9 = 0$

$6 \times 3 + 9 \times 3 + 12 \times 6 = 9 D_y$

$D_y = 13$ KN $(\uparrow)$

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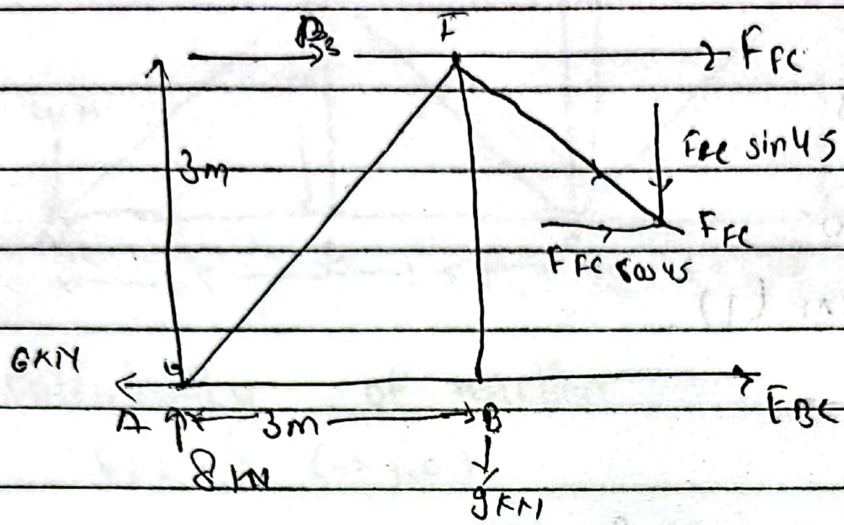
$A_y = 8kN (\uparrow)$

taking the desired section



$\Sigma f_x = 0$ ($\rightarrow$ +ve)

$P_0 + F_{EF} + F_{FC} \cos 45 + F_{BC} - 6kN = 0$

$F_{EF} + F_{FC} \cos 45 + F_{BC} = 0$

$\Sigma F_y = 0$ ($\uparrow$+ve)

$8 - 9 - F_{FC} \sin 45 = 0$

$F_{FC} = \sqrt{2}\, kN$ (C)

$\Sigma M_B = 0$ ($\circlearrowleft$+ve)

$8 \times 8 + 6 \times 3 + F_{EF} \times 3 - F_{FC} \cos 45 \times 3 = 0$

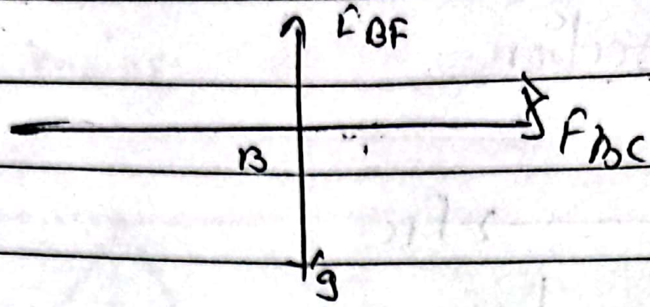
$24 + 18 + 3F_{EF} - 3 = 0$

$3F_{EF} = -39$

$F_{EF} = -13kN$

$F_{EF} = 13kN$ (C).

taking point B



$F_{BF} - 9 = 0$

$F_{BF} = 9\,kN$ (T).

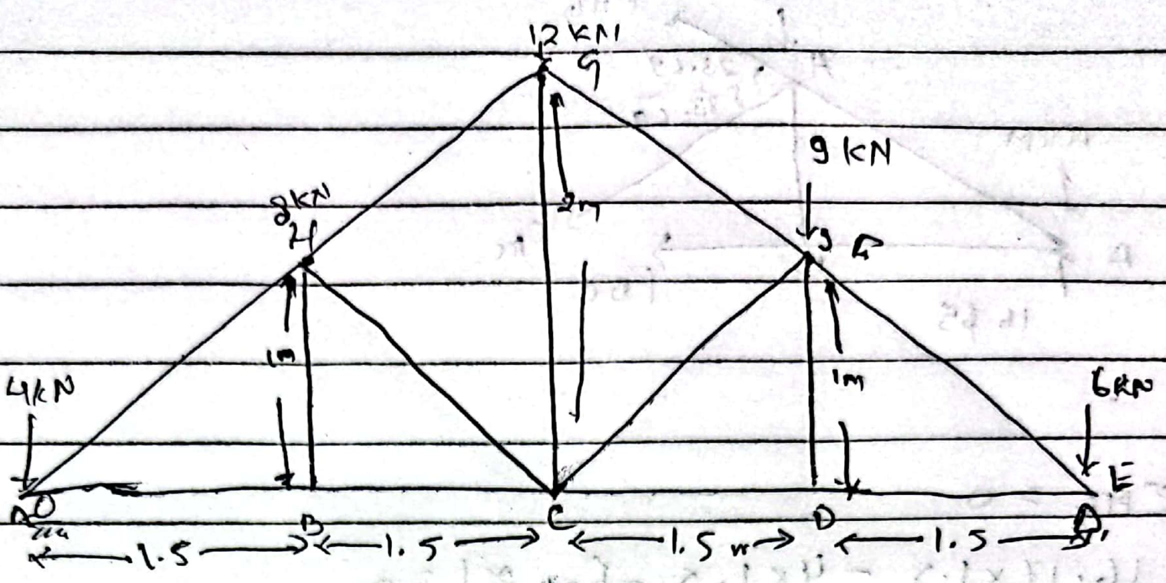
so,

$I_B + (-\sqrt{2})\cos 45^\circ + F_{BC} = 0$

$F_{BC} = 14\,kN$ (T).

Scanned with CamScanner

(4)



calculating of reaction

$\Sigma F_x = 0$ $(\rightarrow +ve)$

$E_x = 0$

$\Sigma F_y = 0$

$A_y + F_y - 4 - 6 - 12 - 9 - 6 = 0$

$A_y + F_y = 37\ kN$

$\Sigma M_F = 0$

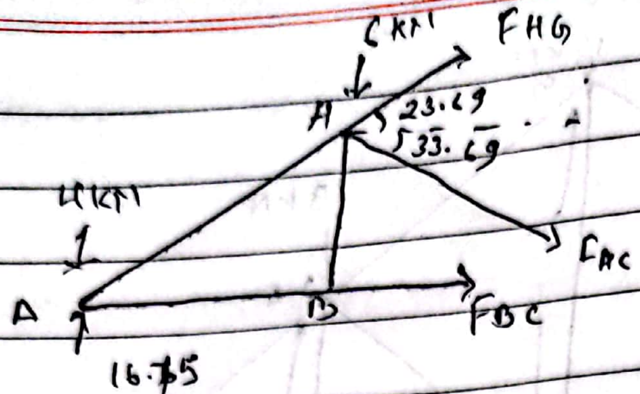
$A_y \times 6 - 9 \times 1.5 - 12 \times 3 - 6 \times 4.5 - 4 \times 6 = 0$

$6 A_y = 100.5$

$A_y = 16.75\ kN (\uparrow)$

$E_y = 20.25\ kN (\uparrow)$

taking desired section



$\Sigma M_H = 0$

$16.17 \times 1.5 - 4 \times 1.5 - F_{BC} \times 1 = 0$

$F_{BC} = +19.125$ kN

$F_{BC} = 19.125$ kN (T)

$\Sigma F_x = 0$ ($\longrightarrow$ +ve)

$19.125 + F_{HG} \cos 33.69 + F_{HC} \cos 33.69 = 0$

$F_{HG} \cos 33.69 + F_{HC} \cos 33.69 = -19.125$ kN —(i)

$\Sigma F_y = 0$ ($\uparrow$ +ve)

$16.75 - 4 - 6 + F_{HG} \sin 33.69 - F_{HC} \sin 33.69 = 0$

$F_{HG} \sin 33.69 - F_{HC} \sin 33.69 = -6.75$ —(ii)

Solving (i) & (ii)

$F_{HG} = -17.57$ kN $= 17.57$ kN (C)

$F_{HC} = -5.40$ kN $= 5.4$ kN (C).

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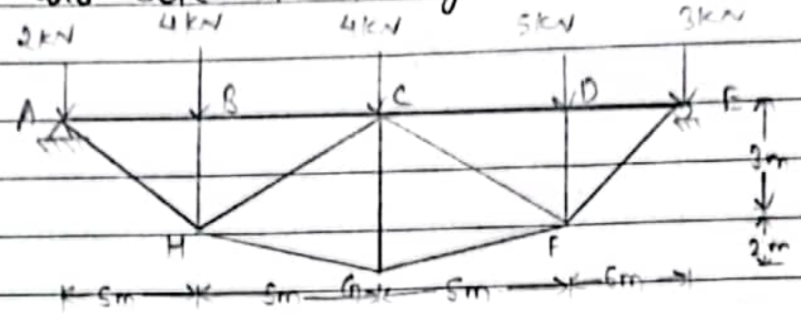
2. Determine the force in members BC, HC and HG of the truss and determine if they are in tension or compres



Calculation of reaction,

$\Sigma F_x = 0$ ($\rightarrow$ +ve)

$A_x = 0$

$\Sigma F_y = 0$ ($\uparrow$ +ve)

$A_y + E_y - 2 - 4 - 4 - 5 - 3 = 0$

$A_y + E_y = 18$ —(1)

$\Sigma M_A = 0$

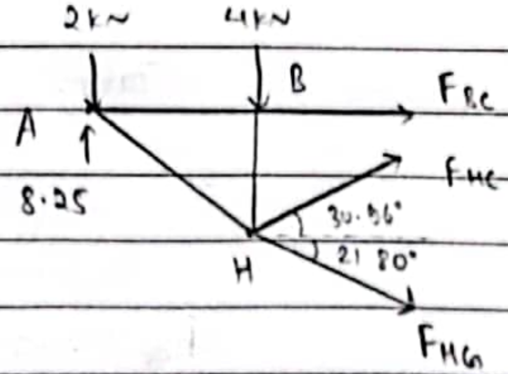
$4 \times 5 + 4 \times 10 + 5 \times 15 + 3 \times 20 - 20 \times E_y = 0$

$20 + 40 + 75 + 60 = 20 E_y$

$E_y = 9.75 kN (\uparrow)$

$A_y = 8.25 kN (\uparrow)$

Taking the desired section



$\Sigma F_x = 0$ ($\rightarrow$ +ve)

$F_{BC} + F_{HC} \cos 30.96^{\circ} + F_{HG} \cos 21.80 = 0$ —(i)

$\Sigma F_y = 0$ ($\uparrow$ +ve)

$-2 - 4 + 8.25 + F_{HC} \sin 30.96 - F_{HG} \sin 21.80 = 0$

$F_{HC} \sin 30.96 - F_{HG} \sin 21.80 = -2.25$ —(ii)

$\Sigma M_H = 0$ (R +ve)

$-2 \times 5 + 8.25 \times 5 + 3 \times F_{BC} = 0$

$-10 + 41.25 + 3F_{BC} = 0$

$3F_{BC} = -31.25$

$F_{BC} = 10.41$ kN (C)

Then,

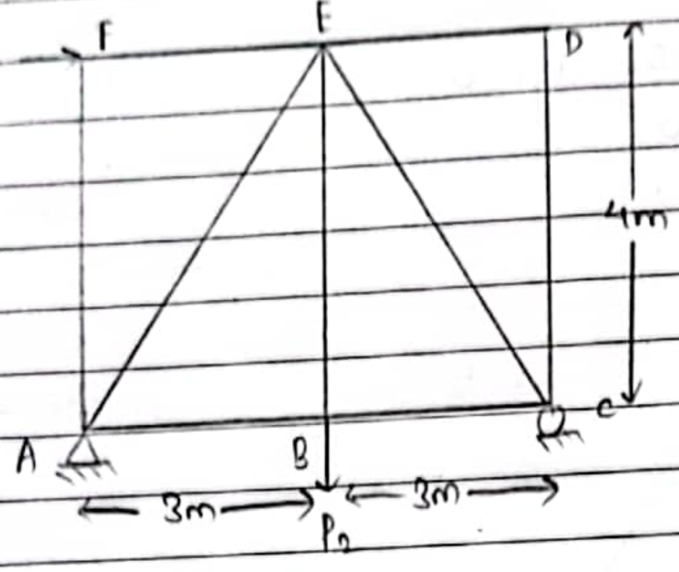
$F_{HC} \cos 30.96 + F_{HG} \cos 21.80 = 10.41$ —(iii)

solving (ii) and (iii)

$F_{HC} = \cancel{5.94 \text{ kN (T)}} = 2.23$ kN (T)

$F_{HG} = \cancel{14.29 \text{ kN (T)}} = 9.15$ kN (T)

Determine the force in each member of the truss an
if the members are in tension or compression. Set $P_1=$
$P2 = 15kN$



Calculating the reactions.

$\Sigma F_x = 0 \ (\rightarrow +ve)$

$-A_x + P_1 = 0$

$\therefore A_x = P_1$

$\therefore A_x = 9kN \ (\leftarrow)$

$\Sigma M_A = 0 \ (\circlearrowright +ve)$

$P_1 \times 4 + P_2 \times 3 - C_y \times 6 = 0$

$36 + 45 - 6C_y = 0$

$6C_y = 81$

$C_y = 13.5 \ kN \ (\uparrow)$

$\Sigma F_y = 0 \ (\uparrow +ve)$

$A_y + C_y - 15 = 0$

$A_y = 15 - 13.5$

$A_y = 1.5 \ kN \ (\uparrow)$

From ΔEBA

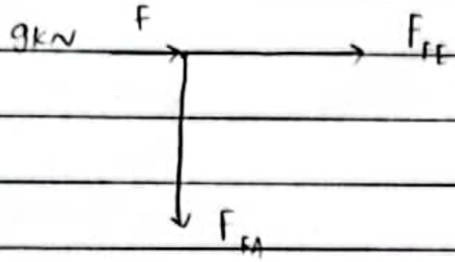
$\tan(\angle EAB) = \frac{4}{3}$

$\therefore \angle EAB = 53.10^\circ$

Similarly,

$\angle ECB = \angle EAB = 53.10^\circ$ [Symmetrical]

Taking joint F



$\Sigma F_x = 0$ ($\rightarrow$ +ve)

$9 + F_{FE} = 0$

$\therefore F_{FE} = -9$ kN

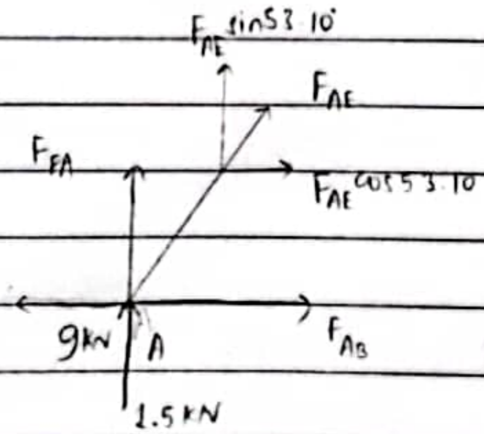
$\therefore F_{FE} = 9$ kN (C)

$\Sigma F_y = 0$ ($\uparrow$ +ve)

$-F_{FA} = 0$

$\therefore F_{FA} = 0$ kN

Taking joint A



$\Sigma F_y = 0$ ($\uparrow$ +ve)

$1.5 \cancel{R_{AE}} + F_{FA} + F_{AE}\sin 53.10^\circ$

$F_{AE} \times \frac{4}{5} + 1.5 + 0 = 0$

$F_{AE} \times \frac{4}{5} = -1.5$

$F_{AE} = \frac{-7.5}{4}$

$F_{AE} = -1.875$

$F_{AE} = 1.875\ kN\ (C)$

$\Sigma F_x = 0\ (\rightarrow +ve)$

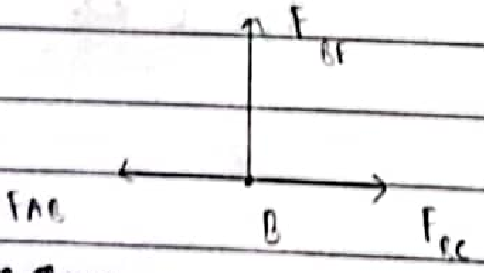
$-9 + F_{AB} + F_{AE} \cos 53.10' = 0$

$-9 + F_{AB} - 1.875 \times \frac{3}{5} = 0$

$F_{AB} = 9 + 1.125$

$F_{AB} = 10.125\ kN\ (T)$

Taking joint B



$\Sigma F_y = 0\ (\uparrow +ve)$

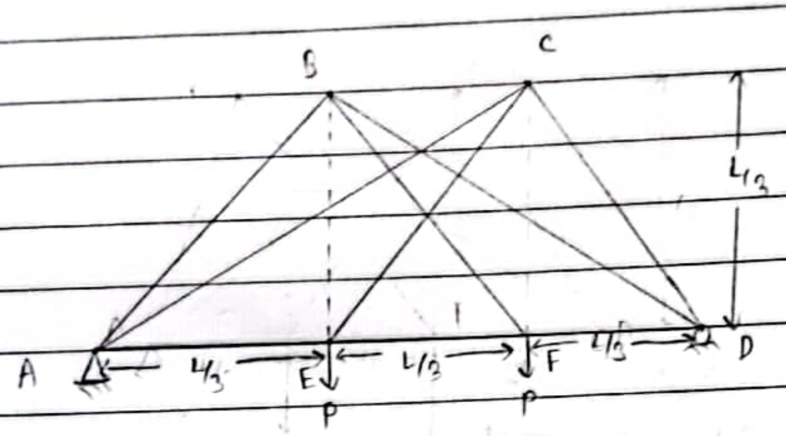
$F_{BF} = 0$

$\Sigma F_x = 0\ (\rightarrow +ve)$

$-F_{AB} + F_{BC} = 0$

$F_{BC} = 10.125\ kN\ (T)$

9 Determine the force in each member of the double scissor truss in terms of the load P and state if the members are in tension or compression



Sol^n: Calculation of reaction

$\Sigma F_x = 0$ ($\rightarrow$ +ve)

$A_x = 0$

$\Sigma F_y = 0$

$A_y + D_y - P - P = 0$

or, $A_y + D_y = 2P$ —(1)

$\Sigma M_A = 0$ (↻+ve)

or, $P \times \frac{L}{3} + \frac{2L}{3} \times P - D_y \times L = 0$

or, $D_y \times L = P\left(\frac{L}{3} + \frac{2L}{3}\right)$

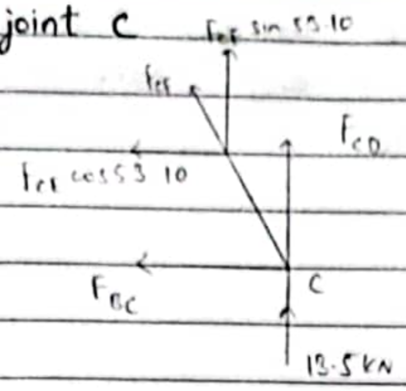
or, $D_y \times L = P \times L$

$\therefore$ $D_y = P$

So,

$A_y = P$

Taking joint C



$\Sigma F_y = 0$ (↑ +ve)

or, $F_{CE} \sin 53.10 + 13.5 + F_{CD} = 0$

or, $F_{CE} \times \frac{4}{5} + 13.5 + F_{CD} = 0$ — ①

$\Sigma F_x = 0$ (→ +ve)

$-F_{BC} - F_{CE} \cos 53.10 = 0$

or, $F_{CE} \times \frac{3}{5} = -10.125$

or, $F_{CE} = -16.875$ kN

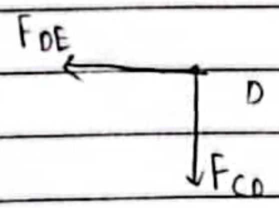
∴ $F_{CE} = 16.875$ kN (C)

Then,

$-16.875 \times \frac{4}{5} + 13.5 + F_{CD} = 0$

or, $F_{CD} = 0$

Taking joint D



$\Sigma F_x = 0$ (→ +ve)

$-F_{DE} = 0$ ∴ $F_{DE} = 0$ kN

In ΔAFC

$\tan(\angle CAF) = \frac{L/3}{2L/3}$

$\angle CAF = 26.56^\circ$ similarly $\angle BDE = 26.56^\circ$

In ΔABE

$\tan \angle BAE = \frac{L/3}{L/3}$

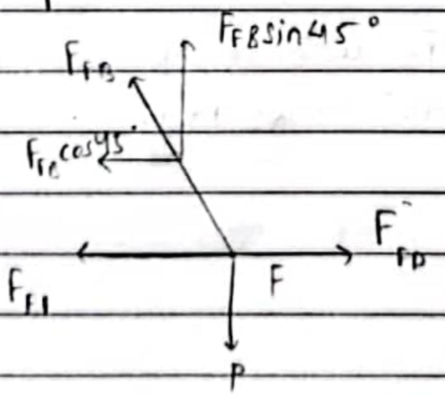
$\angle BAE = 45^\circ$ Similarly $\angle CDF = 45^\circ$

In ΔEFC

$\tan \angle CEF = \frac{L/3}{L/3}$

$\angle CEF = 45^\circ$ similarly $\angle BFP = 45^\circ$

Taking joint F



$\Sigma F_y = 0$ ($\uparrow$ +ve)

$F_{FB}\sin 45^\circ - P = 0$

$F_{FB} \times \frac{1}{\sqrt{2}} = P$

Similarly due to symmetry

$F_{FB} = \sqrt{2}P$ (T) $\qquad F_{EC} = \sqrt{2}P$ (T)

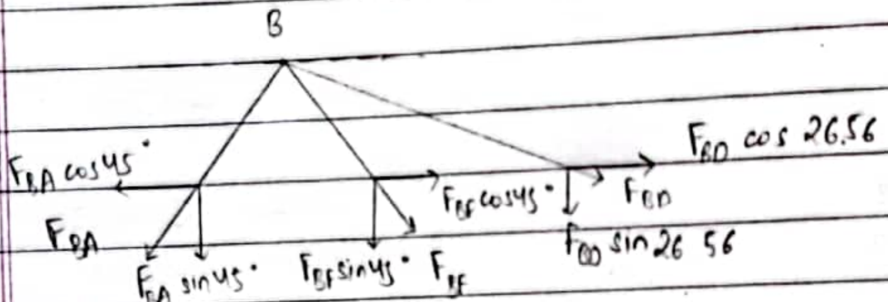
$\Sigma F_x = 0$ ($\rightarrow$ +ve)

or, $F_{FD} - F_{FE} - F_{FB} \cos 45^\circ = 0$

or, $F_{FD} - F_{FE} - \sqrt{2} P \times \frac{1}{\sqrt{2}} = 0$

$\therefore F_{FD} - F_{FE} = P$ — (i)

Taking joint B



$\Sigma F_x = 0$ ($\rightarrow$ +ve)

$-F_{BA} \cos 45^\circ + F_{BF} \cos 45^\circ + F_{BD} \cos 26.56^\circ = 0$

or, $F_{BD} \cos 26.56^\circ - F_{BA} \cos 45^\circ = -\sqrt{2} P \times \frac{1}{\sqrt{2}}$

$\therefore F_{BD} \cos 26.56^\circ - F_{BA} \cos 45^\circ = -P$ — (ii)

$\Sigma F_y = 0$ ($\uparrow$ +ve)

$-F_{BA} \sin 45^\circ - F_{BF} \sin 45^\circ - F_{BD} \sin 26.56 = 0$

$F_{BD} \sin 26.56 + F_{BA} \sin 45^\circ = -P$ — (iii)

Solving (ii) and (iii)

$F_{BD} \cos 26.56^\circ + F_{BD} \sin 26.56 = -2P$

or, $F_{BD} (\cos 26.56^\circ + \sin 26.56) = -2P$

or, $F_{BD} = \frac{-2P}{1.34}$

or, $F_{BD} = -1.49 P$

$\therefore F_{BD} = 1.49P$ (C)

similarly $F_{..} = 1.49P$ (C)

Then,

$F_{BD}\cos 26.56 - F_{BA}\cos 45^\circ = -P$

or, $-1.49P.\cos 26.56 - F_{BA}\cos 45 = -P$

or, $-1.332P + P = F_{BA}\cos 45$

or, $-0.332P = \frac{F_{BA}}{\sqrt{2}}$

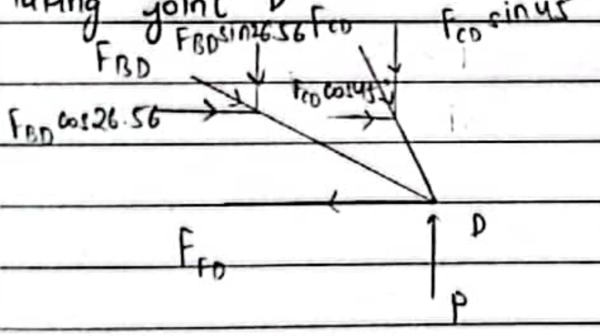
or, $F_{BA} = -0.47P$

$\therefore F_{BA} = 0.47P\ (C)$

Similarly,

$F_{CD} = 0.47P\ (C)$

Taking joint D



$\Sigma F_x = 0\ (\rightarrow +ve)$

$-F_{FD} + F_{BD}\cos 26.56 + F_{CD}\cos 45^\circ = 0$

or, $F_{FD} = 1.49P\cos 26.56 + 0.47P\cos 45^\circ$

$\therefore F_{FD} = 1.66P\ (T)$ Similarly,

$F_{AE} = 1.66P\ (T)$

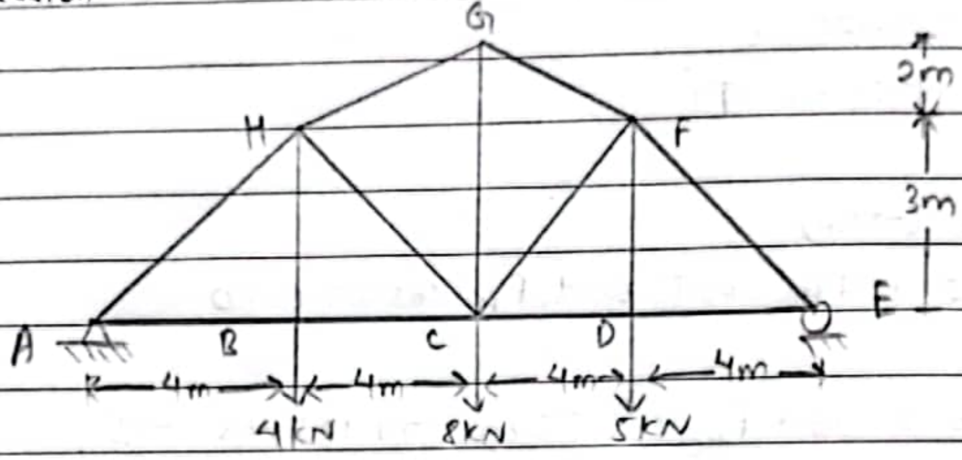
Then eq^n (1),

$1.66P - F_{FE} = P$

or, $1.66P - P = F_{FE}$

$\therefore F_{FE} = 0.66P\ (T)$.

15. Determine the force in members BC, CH, GH and CG the truss and state if the members are in tension or compression.



Soln: Calculation of reaction

$\Sigma F_x = 0 \ (\rightarrow +ve)$

$\therefore A_x = 0$

$\Sigma F_y = 0 \ (\uparrow +ve)$

or, $A_y + E_y - 4 - 8 - 5 = 0$

or, $A_y + E_y = 17 \text{ kN} \quad \text{--- (1)}$

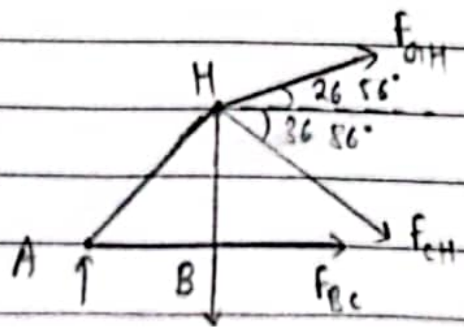
$\Sigma M_A = 0$

or, $4 \times 4 + 8 \times 8 + 5 \times 12 - E_y \times 16 = 0$

$\therefore E_y = 8.75 \text{ kN} (\uparrow)$

$\therefore A_y = 8.25 \text{ kN} (\uparrow)$

Taking the required section,



$\Sigma M_H = 0$ (↻ +ve)

or, $8.25 \times 4 - F_{BC} \times 3 = 0$

or, $3F_{BC} = 8.25 \times 4$

or, $F_{BC} = \frac{8.25 \times 4}{3}$

∴ $F_{BC} = 11\,kN$ (T)

$\Sigma F_x = 0$ (⟶ +ve)

or, $F_{BC} + F_{GH} \cos 26.56 + F_{CH} \cos 36.86 = 0$

or, $F_{GH} \cos 26.56 + F_{CH} \cos 36.86 = -11\,kN$ — (i)

$\Sigma F_y = 0$ (↑ +ve)

or, $-4 + 8.25 + F_{GH} \sin 26.56^\circ - F_{CH} \sin 36.86 = 0$

or, $F_{GH} \sin 26.56^\circ - F_{CH} \sin 36.86 = -4.25$ — (ii)

Solving (i) and (ii)

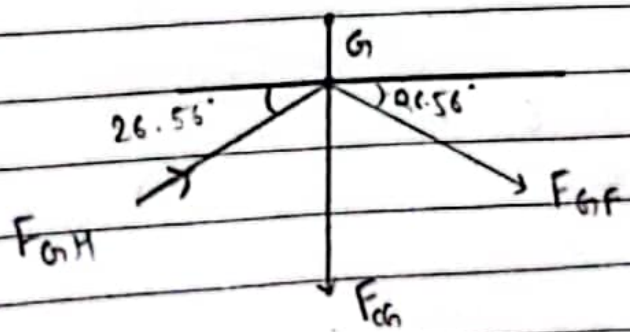
$F_{GH} = -11.18\,kN$

$= 11.18\,kN$ (C)

$F_{CH} = -1.24\,kN$

$= 1.24\,kN$ (C)

Taking joint G



$\Sigma F_x = 0$ ($\rightarrow$ +ve)

or $F_{GH} \cos 26.56 + F_{GF} \cos 26.56 = 0$

or $F_{GF} \cos 26.56 = -F_{GH} \cos 26.56$

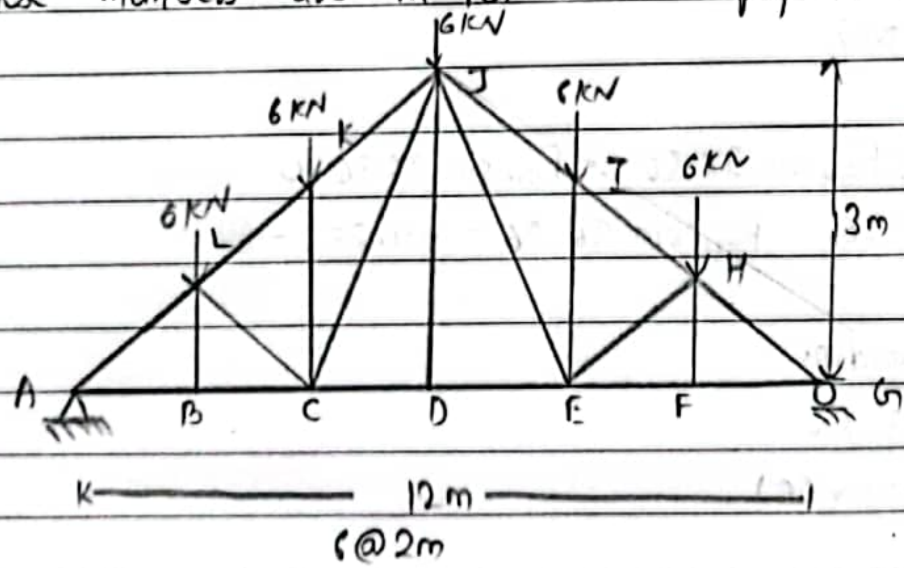
$\therefore$ $F_{GF} = 11.18$ kN (C)

$\Sigma F_y = 0$ ($\uparrow$ +ve)

$-F_{CG} + F_{GH} \sin 26.56 + F_{GF} \sin 26.56 = 0$

$\therefore$ $F_{CG} = 9.99$ kN (T)

16. Determine the force in members CD, CJ and KJ and state these members are in tension or compression.



Soln: Calculating the reactions

$\Sigma F_x = 0$ ($\rightarrow$ +ve)

$\therefore$ $A_x = 0$

$\Sigma F_y = 0$ ($\uparrow$ +ve)

$A_y + G_y - 6 - 6 - 6 - 6 - 6 = 0$

or $A_y + G_y = 30$ kN —(1)

$\Sigma M_A = 0$

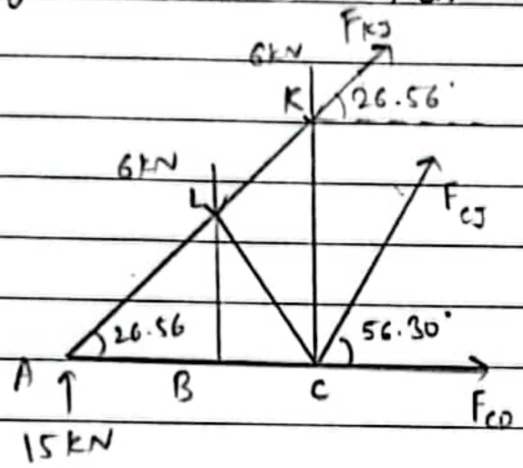
or, $6\times2 + 6\times4 + 6\times6 + 6\times8 + 6\times10 - G_y\times12 = 0$

or, $G_y\times12 = 180$

or, $G_y = 15\ kN(\uparrow)$

$\therefore A_y = 15\ kN(\uparrow)$

Taking the desired section



$\frac{CK}{AC} = \tan 26.56°$

$\therefore CK = 2m$

$\Sigma M_K = 0$ (↻+ve)

or, $15\times4 - 6\times2 - F_{CD}\times2 - F_{CJ}\cos 56.30°\times2 = 0$

or, $-2F_{CD} - 2F_{CJ}\cos 56.30° = -48$

or, $F_{CD} + F_{CJ}\cos 56.30° = +24$ — (i)

$\Sigma F_x = 0$ (→+ve)

$F_{CJ}\cos 56.30° + F_{CD} + F_{KJ}\cos 26.56° = 0$ — (ii)

$\Sigma F_y = 0$ (↑+ve)

$15 - 6 - 6 + F_{KJ}\sin 26.56 + F_{CJ}\sin 56.30° = 0$

or, $F_{CJ}\sin 56.30° + F_{KJ}\sin 26.56° = -3$ — (iii)

Solving (i), (ii) and (iii)

$F_{CD} = 18\ kN\ (T)$

$F_{CJ} = 10.81\ kN(T)$

$F_{KJ} = -26.83\ kN(C)$

$= 26.83\ kN\ (C)$.