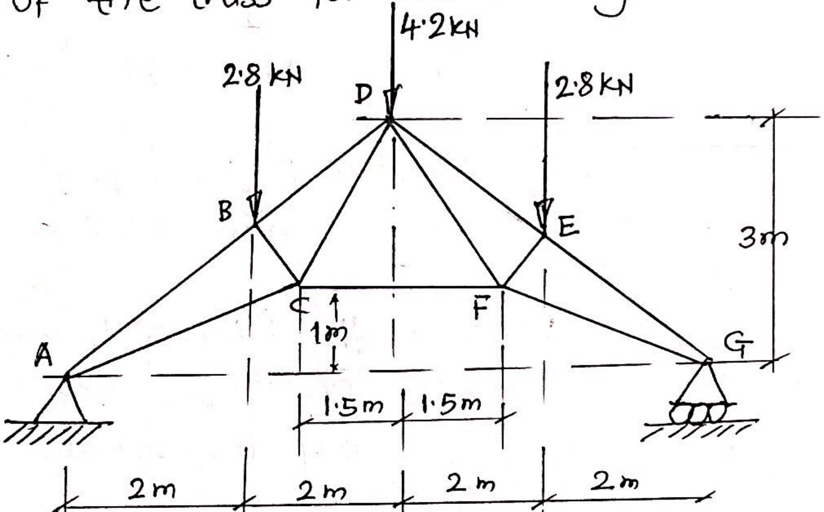
Method of Joints

Method of Section

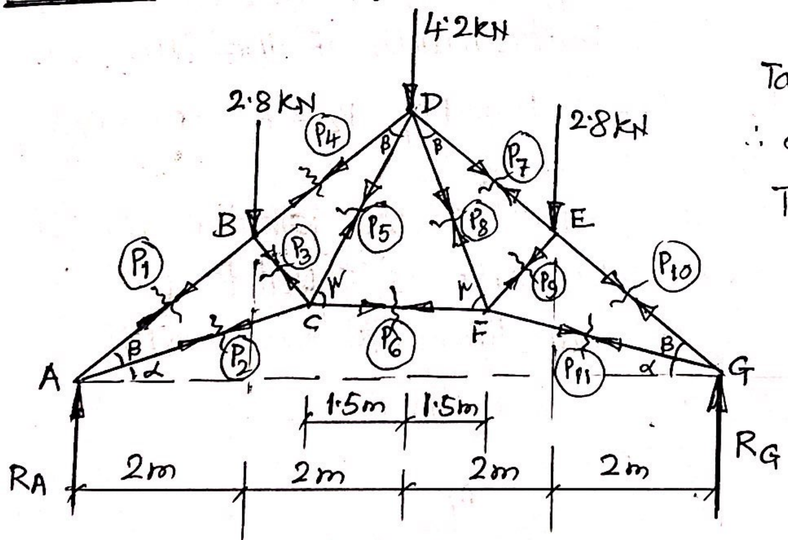
K

Trusses : Method of Joints

Ex. No. 6 Determine the forces in all the members of the truss for the loading shown in figure.



Solution: Consider the F.B.D. of the entire truss



$\tan(\alpha+\beta) = \frac{3}{4}$

$\therefore \alpha+\beta = 36.87^\circ$

$\tan\alpha = \frac{1}{2.5}$

$\therefore \alpha = 21.8^\circ$

$\therefore \beta = 15.07^\circ$

$\tan\gamma = \frac{2}{1.5}$

$\therefore \gamma = 53.13^\circ$

(i) **Check for perfect truss** :

Type : Simply Supported truss (one support hinge and other roller)

m = No. of members → = 11

j = No. of joints → = 7

R = No. of reaction components → = 3

$\boxed{m = 2j - R}$

$\therefore 11 = (2 \times 7) - 3$

As this equation is satisfied the given truss is a Perfect truss.

i) Support reactions :

Due to symmetry, $R_A = R_G = \left(\dfrac{\text{Total load on truss}}{2}\right)$

$$R_A = \frac{(2\times 2.8) + 4.2}{2}$$

$$\therefore R_A = 4.9 \text{ kN} = R_G \ (\uparrow)$$

iii) Zero force members :

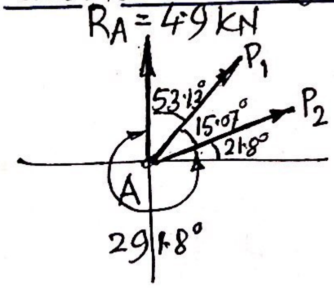
As per the 3 rules for detecting the zero force members, there is no zero force member in the above truss.

iv) Method of joints : Assume athe internal forces in all the members to be tensile and name them as $P_1, P_2, P_3, \ldots\ldots$ Show the arrows representing these tensile forces.

Due to the symmetry of loading as well as symmetry of configuration of the truss, we can get, $P_1 = P_{10}$, $P_2 = P_{11}$, $P_4 = P_7$, $P_3 = P_9$ and $P_5 = P_8$

Now, consider the F.B.D. of any joint at which maximum no. of unknowns is equal to two. We have joints A or G satisfying above condition.

Consider F.B.D. of join A:



Apply Lami's theorem to the F.B.D. of joint A.

$$\frac{4.9}{\sin 15.07^\circ} = \frac{P_1}{\sin 291.8^\circ} = \frac{P_2}{\sin 53.13^\circ}$$

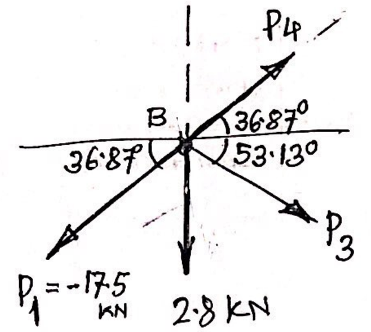
$$\therefore P_1 = -17.5 \text{ kN}$$

$$\therefore P_2 = 15.08 \text{ kN}$$

Now, again consider the F.B.D. of that joint at which no. of unknowns is equal to two. We have joints B and E satisfying this condition.

Consider F.B.D. of joint B:

$\Sigma F_x = 0$ gives,



$$P_4 \cos 36.87^\circ + P_3 \cos 53.13^\circ - (-17.5 \cos 36.87^\circ) = 0$$

$$(0.8)P_4 + (0.6)P_3 + 14 = 0 \longrightarrow (1)$$

$\Sigma F_y = 0$ gives,

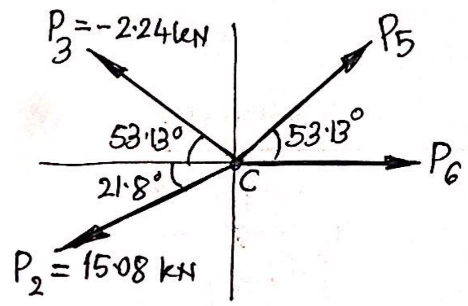
$$P_4 \sin 36.87^\circ - P_3 \sin 53.13^\circ - 2.8 - (-17.5 \sin 36.87^\circ) = 0$$

$$\therefore (0.6)P_4 - (0.8)P_3 - (2.8) + 10.5 = 0 \longrightarrow (2)$$

Solving (1) and (2) we get

$P_3 = -2.24$ kN and $P_4 = -15.82$ kN

Now, consider F.B.D. of joint C :



$\Sigma F_x = 0$ gives,

$$P_5 \cos 53.13^\circ + P_6 - (-2.24 \times \cos 53.13^\circ) - (15.08 \times \cos 21.8^\circ) = 0$$

$$\therefore (0.6)P_5 + P_6 + 1.344 - 14 = 0$$

$$\therefore (0.6)P_5 + P_6 = 12.656 \longrightarrow (3)$$

$\Sigma F_y = 0$ gives,

$$P_5 \sin 53.13^\circ + (-2.24 \times \sin 53.13^\circ) - (15.08) \sin 21.8^\circ = 0$$

$$\therefore (0.8)P_5 - (1.8) - (5.6) = 0$$

$$(0.8)P_5 = 7.4 \longrightarrow (4)$$

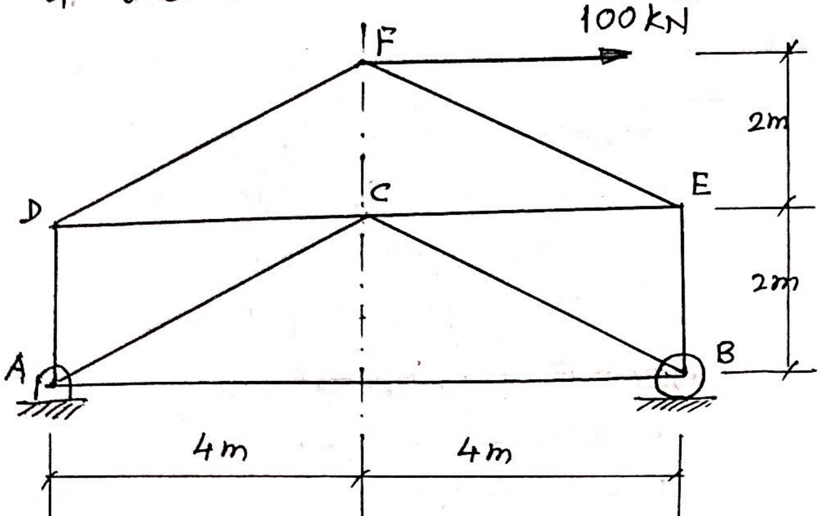
$\therefore P_5 = 9.25$ kN , $P_6 = 7.106$ kN

Finally, prepare the table representing the axial force (tensile or compressive) in all the members of the given truss. All positive answers represent tension and negative answers represent compression. But in the final table convert all −ve answers in to +ve and mention the nature of the force as compressive.

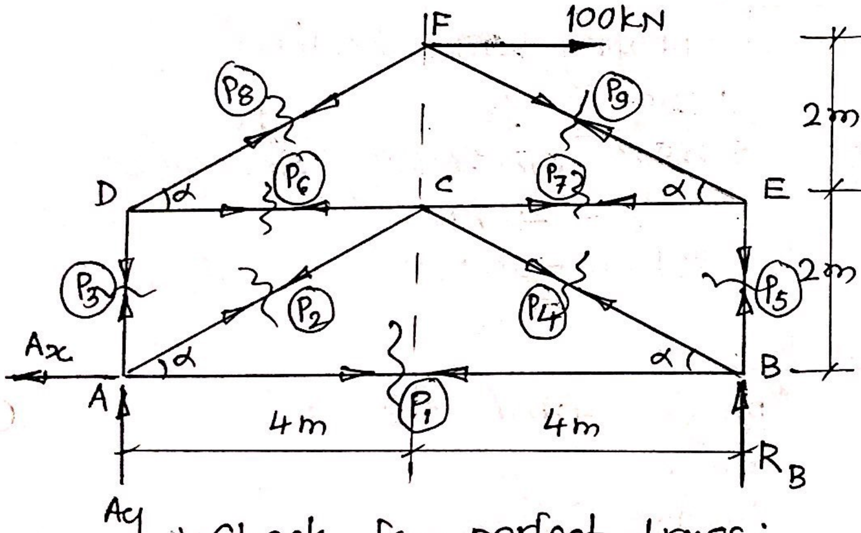
Ans :

Member	Axial Force (KN)	Nature of the force
AB	$P_1 = +17.5$	Compressive
AC	$P_2 = 15.08$	Tensile
BC	$P_3 = +2.24$	Compressive
BD	$P_4 = +15.82$	Compressive
CD	$P_5 = 9.25$	Tensile
CF	$P_6 = 7.106$	Tensile
DE	$P_7 = +15.82$	Compressive
DF	$P_8 = 9.25$	Tensile
EF	$P_9 = +2.24$	Compressive
EG	$P_{10} = +17.5$	Compressive
GF	$P_{11} = 15.08$	Tensile

Ex. No. 7 Determine the forces in all the members of the truss for the loading shown in figure.



Solution: Consider the F.B.D. of the entire truss.



$\tan\alpha = \frac{2}{4}$

$\therefore \alpha = 26.57^\circ$

(i) Check for perfect truss:

Type: Simply Supported Truss (one hinge & one roller)

$j = 6 \quad R = 3, \quad m = 9$

$\boxed{m = 2j - R}$ $\therefore 9 = (2\times6) - 3$ → satisfied hence perfect truss

(ii) Support reactions: Consider F.B.D. of entire truss,

$\Sigma F_x = 0$ gives, $A_x = 100$ kN (←)

$\Sigma F_y = 0$ gives, $A_y + R_B = 0$

$\Sigma M_A = 0$ gives, $8R_B - (100\times4) = 0 \quad \therefore R_B = 50$ kN (↑)

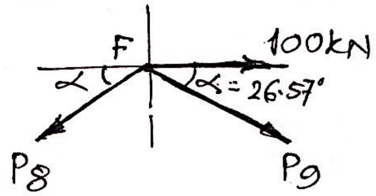
$\therefore A_y = 50$ kN (↓)

iii) Zero force members : No zero force member

iv) Method of joints :

Here, F is the joint at which maximum no. of unknowns are two.

Consider F.B.D. of F :



$\Sigma F_x = 0$ gives,

$100 + P_9 \cos 26.57° - P_8 \cos 26.57° = 0$

$\therefore 100 + (0.894)P_9 = (0.894)P_8$

$\therefore P_8 = 111.808 + P_9 \longrightarrow$ (i)

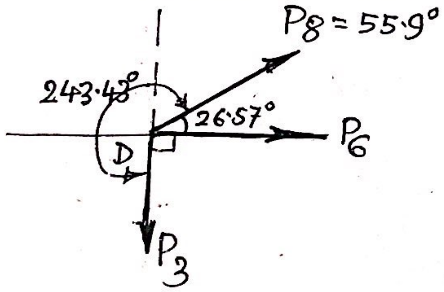
$\Sigma F_y = 0$ gives, $-P_8 \cdot \cancel{\sin 26.57°} - P_9 \cancel{\sin 26.57°} = 0$

$\therefore P_8 + P_9 = 0 \longrightarrow$ (ii)

$P_8 - P_9 = 111.808$

Solving (i) & (ii) we get, $P_8 = 55.9$ kN, $P_9 = -55.9$ kN

Consider F.B.D. of D :



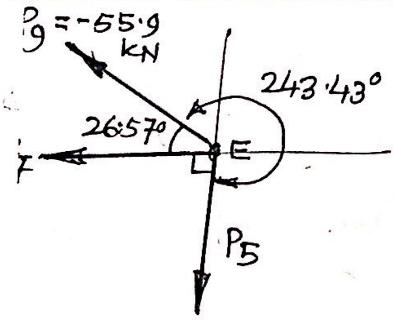
Applying Lami's theorem,

$$\frac{55.9}{\sin 90°} = \frac{P_3}{\sin 26.57°} = \frac{P_6}{\sin 243.43°}$$

$\therefore P_3 = 25$ kN

$\therefore P_6 = -50$ kN

Consider F.B.D. of E :



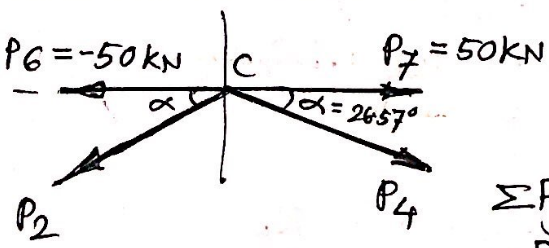
Applying Lami's theorem,

$$\frac{-55.9}{\sin 90°} = \frac{P_5}{\sin 26.57°} = \frac{P_7}{\sin 243.43°}$$

$\therefore P_5 = -25$ kN

$\therefore P_7 = 50$ kN

Consider F.B.D. of C :



$\Sigma F_x = 0$ gives,

$50 + 50 + P_4 \cos 26.57° = P_2 \cos 26.57°$

$P_2 = P_4 + 111.856 \longrightarrow$ (iii)

$\Sigma F_y = 0$ gives,

$-P_2 \sin \cancel{26.57°} - P_4 \sin \cancel{26.57°} = 0$

$P_2 + P_4 = 0 \longrightarrow$ (iv)

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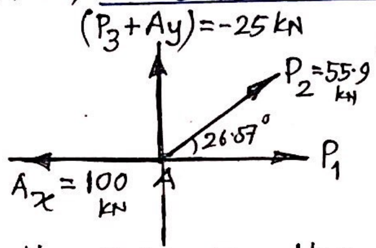
Solving (iii) and (iv) we get,

$P_4 = -55.9$ kN

$P_2 = 55.9$ kN

Now, consider F.B.D. of joint A :



$\Sigma F_x = 0$ gives,

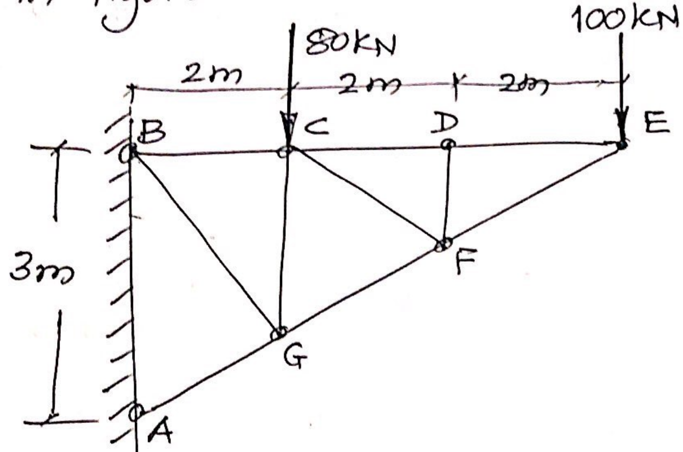
$P_1 + (55.9)\cos 26.57^\circ = 100$

$\therefore P_1 = 50$ kN

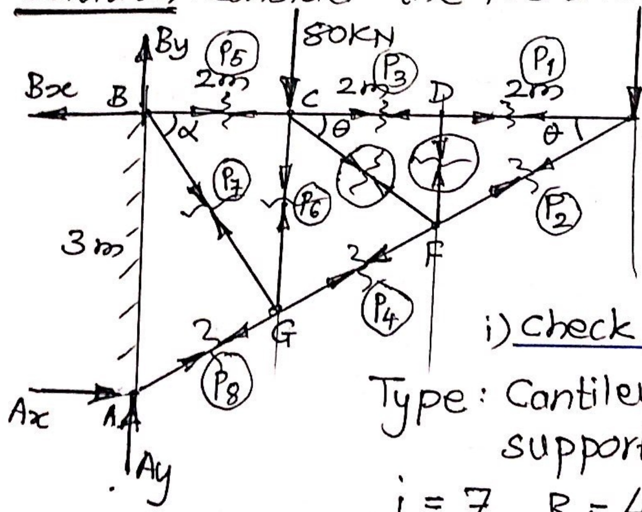
Ans : Finally prepare the table of forces.

Member	Axial Force (kN)	Nature
AB	$P_1 = 50$	Tensile
AC	$P_2 = 55.9$	Tensile
AD	$P_3 = 25$	Tensile
BC	$P_4 = +55.9$	Compressive
BE	$P_5 = +25$	Compressive
CD	$P_6 = +50$	Compressive
CE	$P_7 = 50$	Tensile
DF	$P_8 = 55.9$	Tensile
EF	$P_9 = +55.9$	Compressive

Ex. No. 8 Determine the forces in all the members of the truss for the loading shown in figure.



Solution: Consider the F.B.D. of the entire truss



$\tan\theta = \frac{3}{6}$

$\therefore \theta = 26.57^\circ$

$\tan\alpha = \frac{2}{2}$

$\therefore \alpha = 45^\circ$

i) Check for perfect truss:

Type: Cantilever truss (both the supports are hinged)

$j = 7,\ R = 4,\ m = 10$

$\boxed{m = 2j - R}$ $\therefore 10 = (2\times 7) - 4$ As this relation is satisfied, it is a perfect truss.

ii) Support reactions: As both the supports are hinges. There are 4 reaction components at the supports (i.e. A_x, A_y, B_x and B_y). With the help of 3 equations of equilibrium (i.e. $\Sigma F_x = 0$, $\Sigma F_y = 0$ and $\Sigma M = 0$), we can not get all these unknowns. But incase of every cantilever truss there is always at least one joint, at which maximum no. of unknowns are two. (For e.g. joint E in the above truss). Hence, without calculating the support reactions, one can start the solution from such a joint.

support reactions are calculated only if they are specifically asked.

iii) <u>Zero force members</u>:

At joint D, DF is a zero force member.

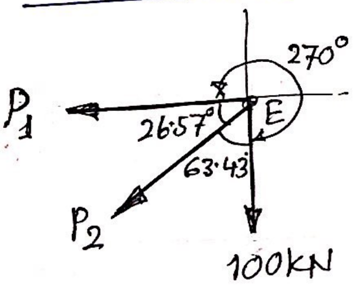
Similarly at joint F, FC is a zero force member.

iv) <u>Method of joints</u>:

<u>At joint D</u>, $P_1 = P_3$

<u>At joint F</u>, $P_2 = P_4$

<u>Consider F.B.D. of joint E</u>:



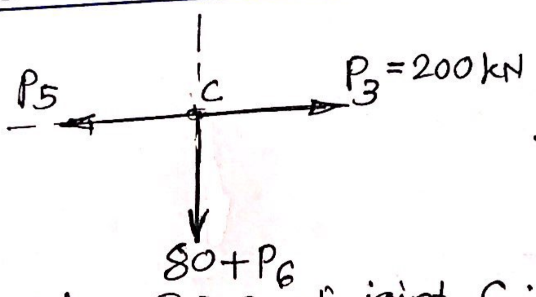
Applying Lami's theorem,

$$\frac{100}{\sin 26.57^\circ} = \frac{P_1}{\sin 63.43^\circ} = \frac{P_2}{\sin 270^\circ}$$

$\therefore P_1 = 200\ kN = P_3$

$\therefore P_2 = -223.57\ kN = P_4$

<u>Consider F.B.D. of joint C</u>:

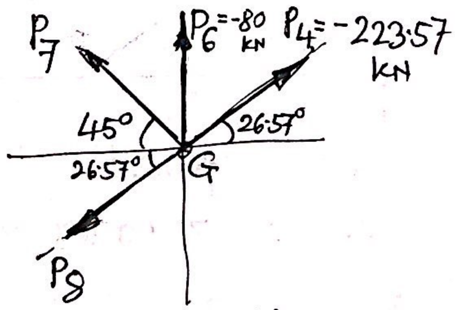


$\therefore P_3 = P_5 = 200\ kN$

$P_6 + 80 = 0$

$\therefore P_6 = -80\ kN$

<u>Consider F.B.D. of joint G</u>:



$F_x = 0$ gives,

$-(223.57)\cos 26.57^\circ - P_7 \cos 45^\circ - P_8 \cos 26.57^\circ = 0$

$\therefore -200 - (0.707)P_7 - (0.894)P_8 = 0 \longrightarrow$ (i)

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$\Sigma F_y = 0$ gives,

$$-(223.57)\sin 26.57^\circ + P_6 + P_7 \sin 45^\circ - P_8 \sin 26.57^\circ = 0$$

$$\therefore \quad -100 + P_6 + (0.707)P_7 - (0.447)P_8 = 0$$

$$\therefore \quad -100 - 80 + (0.707)P_7 - (0.447)P_8 = 0$$

$$\therefore \quad -180 + (0.707)P_7 - (0.447)P_8 = 0 \longrightarrow \text{(ii)}$$

solving equations (i) and (ii) we get,

$$\therefore \quad P_8 = -283.37 \text{ kN}$$

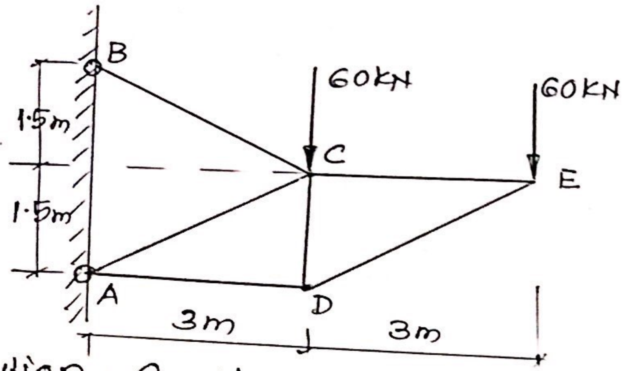
$$\therefore \quad P_7 = 75.44 \text{ kN}$$

Finally prepare the table of forces.

Ans:

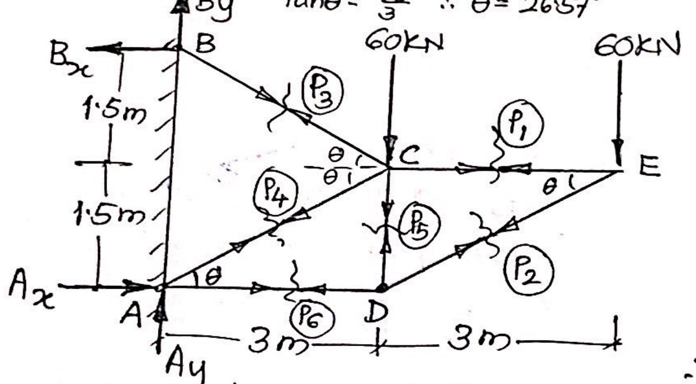
Member	Axial force (kN)	Nature
DF	0	—
CF	0	—
ED	$P_1 = 200$	Tensile
EF	$P_2 = +223.57$	Compressive
DC	$P_3 = 200$	Tensile
FG	$P_4 = +223.57$	Compressive
CB	$P_5 = 200$	Tensile
CG	$P_6 = +80$	Compressive
GB	$P_7 = 75.44$	Tensile
GA	$P_8 = +283.37$	Compressive

Ex. No. 9 Determine the forces in all the members of the truss for the loading shown in Figure. Also, find the reactions at the supports A and B.



Solution: Consider the F.B.D. of the entire truss

$\tan\theta = \frac{1.5}{3}$ $\therefore \theta = 26.57°$



(i) Check for perfect truss:

Type: Cantilever Truss

$j = 5$, $R = 4$, $m = 6$

$$\boxed{m = 2j - R}$$

$\therefore 6 = (2\times5) - 4$

As the above relation is satisfied, it is a perfect truss.

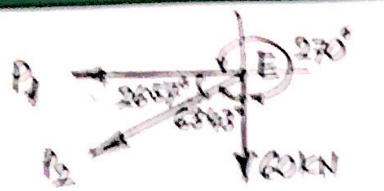
(ii) Support reactions: As it is a cantilever truss, we can not get all 4 components of the support reactions by considering the equilibrium of the entire truss. Hence, calculate these reactions after calculating the internal forces in all the members by the method of joints.

(iii) Zero force members: No zero force member.

(iv) Method of joints:

Consider F.B.D. of joint E

Applying Lamis theorem,



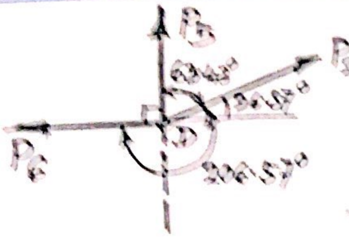
$$\frac{60}{\sin 26.57^\circ} = \frac{P_1}{\sin 63.43^\circ} = \frac{P_2}{\sin 270^\circ}$$

$\therefore P_2 = -134.14$ kN

$\therefore P_1 = 120$ kN

Consider F.B.D. of joint D:

Applying Lamis theorem,

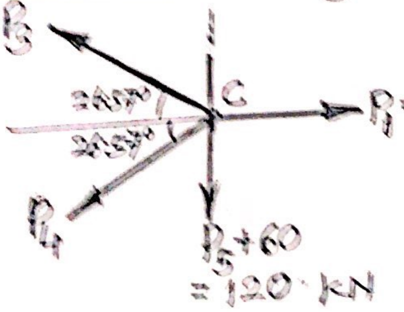


$$\frac{-134.14}{\sin 90^\circ} = \frac{P_5}{\sin 206.57^\circ} = \frac{P_6}{\sin 63.43^\circ}$$

$\therefore P_5 = 60$ kN

$\therefore P_6 = -120$ kN

Consider F.B.D. of joint C:



$\Sigma F_x = 0$ gives,

$120 - (P_3 + P_4)\cos 26.57^\circ = 0$

$P_3 + P_4 = 134.16$ kN $\longrightarrow$ (i)

$\Sigma F_y = 0$ gives, $P_3 \sin 26.57^\circ - P_4 \sin 26.57^\circ - 120 = 0$

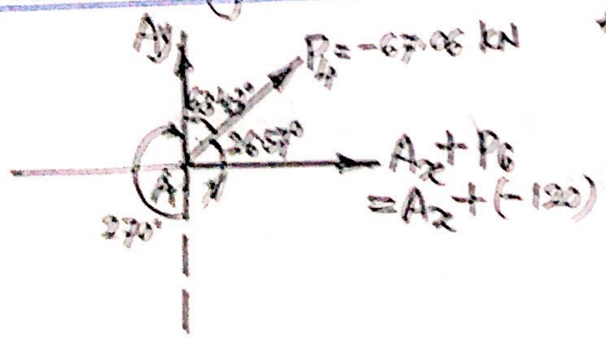
$\therefore P_3 - P_4 = 268.28 \longrightarrow$ (ii)

solving (i) and (ii) we get, $P_3 = 201.22$ kN

$P_4 = -67.06$ kN

Now, for the support reactions consider F.B.D.s of joints A and B.

Applying Lamis theorem,



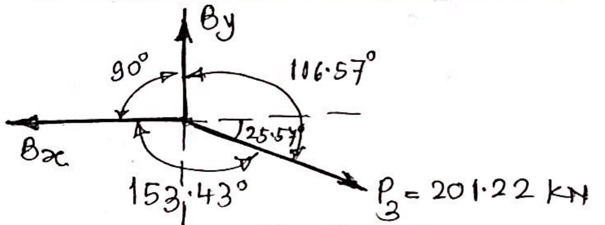
$$\frac{-67.06}{\sin 270^\circ} = \frac{A_y}{\sin 26.57^\circ} = \frac{A_x - 120}{\sin 63.43^\circ}$$

$\therefore A_x = 180$ kN

$A_x = 180$ kN $(\rightarrow)$

$A_y = 30$ kN $(\uparrow)$

Now, Consider F.B.D. of joint B



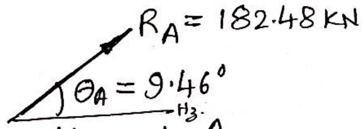
Applying Lami's theorem,

$$\frac{201.22}{\sin 90^\circ} = \frac{B_x}{\sin 116.57^\circ} = \frac{B_y}{\sin 153.43^\circ}$$

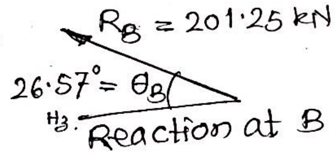
$\therefore$ $B_x = 180$ kN ($\leftarrow$)

$B_y = 90$ kN ($\uparrow$)

Ans :



Reaction at A

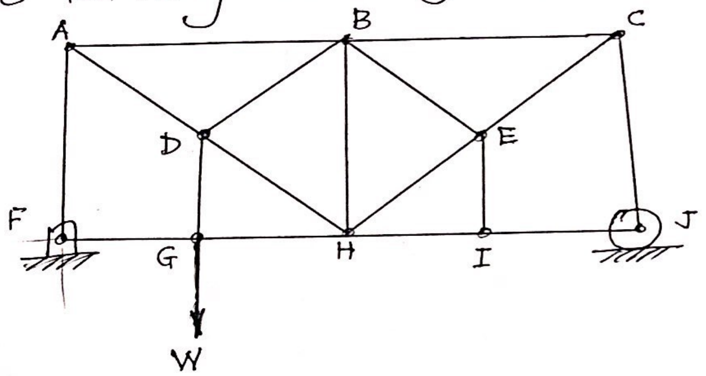


Reaction at B

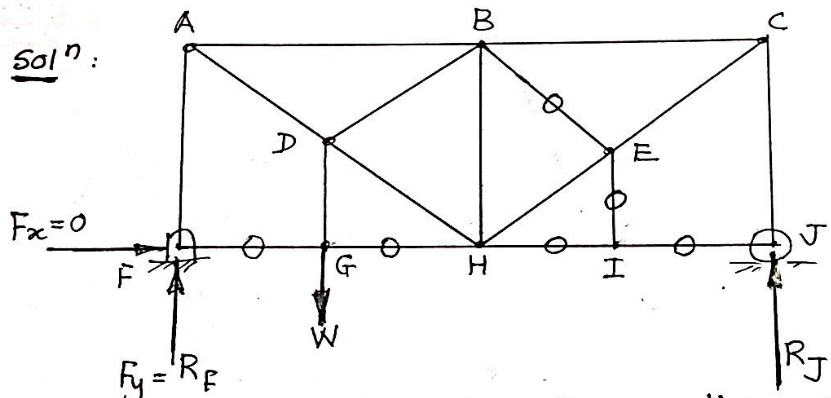
Table of forces:

Member	Axial force (kN)	Nature
EC	$P_1 = 120$	Tension
ED	$P_2 = +134.14$	Compression
CB	$P_3 = 201.22$	Tension
CA	$P_4 = +67.06$	Compression
CD	$P_5 = 60$	Tension
DA	$P_6 = +120$	Compression

Ex. No. (10) Locate the zero force members for the following truss by inspection.



Sol^n :



First show the directions of reactions at F and J.

<u>At joint J</u> : Member CJ is colinear to R_J hence IJ is a zero force member.

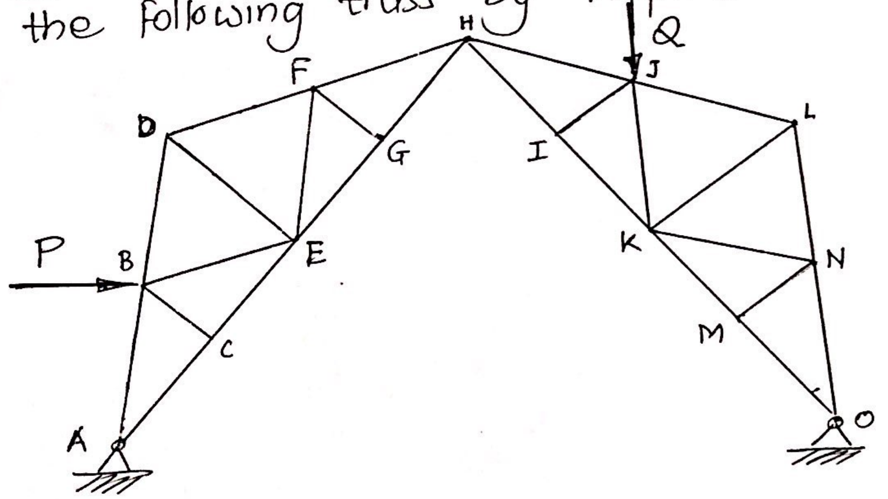
<u>At joint I</u> : Members HI and IJ are colinear hence force in HI = Force in IJ = 0, Then EI will be also zero force member.

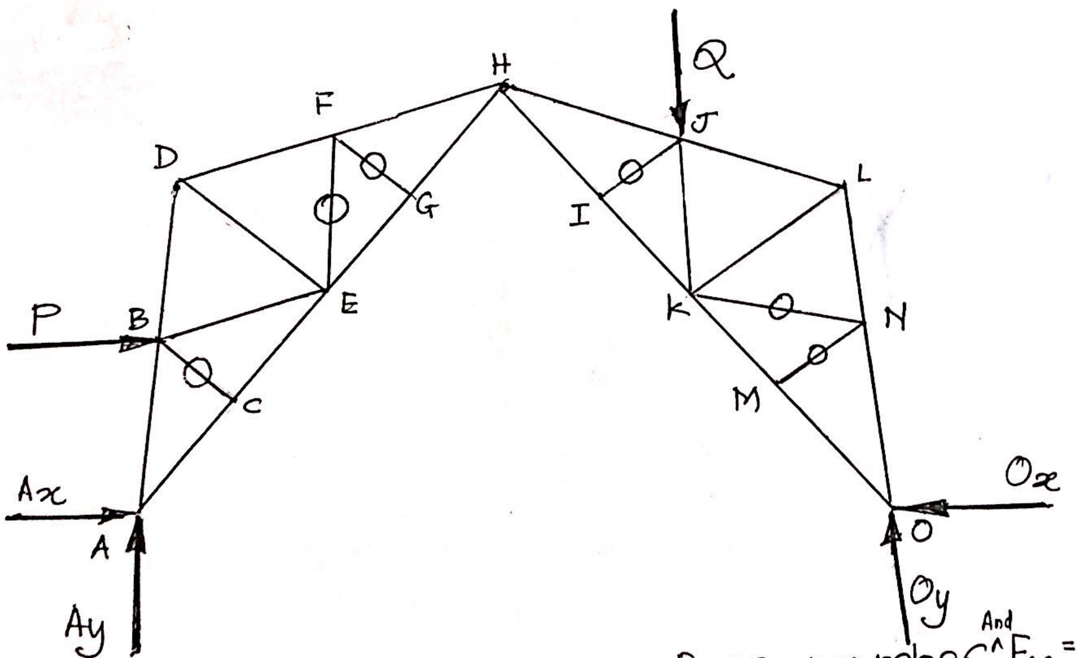
<u>At joint E</u> : Remove member E (as it is a zero force member). Now, member HE and CE are colinear hence Force in HE = force in CE. ∴ The third member at joint E i.e. BE will be a zero force member.

<u>At joint F</u> : Member AF is colinear to R_F, hence FG is a zero force member.

<u>At joint G</u> : FG and GH are colinear members. Hence, Force in FG = Force in GH = 0 (Both are zero force members)

Ex. NO. (11) Locate the zero force members for the following truss by inspection.





At joint C : BC is a zero force member. And $F_{AC} = F_{CE}$

At joint G : GF is a zero force member And $F_{EG} = F_{GH}$

At joint F : EF is a zero force member And $F_{DF} = F_{FH}$

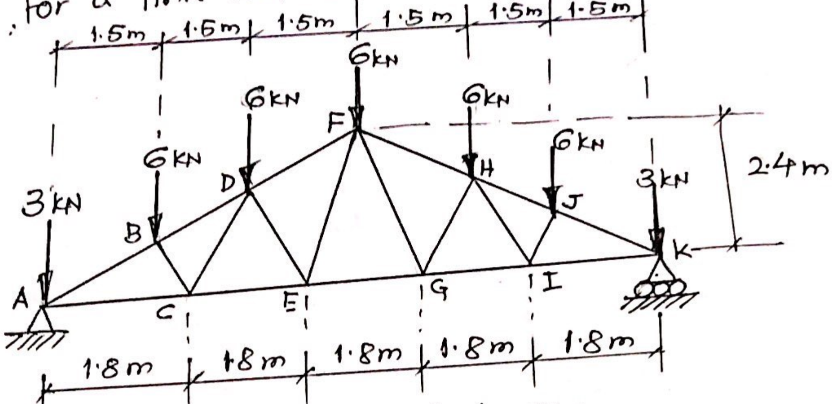
At joint I : IJ is a zero force member And $F_{HI} = F_{IK}$

At joint M : MN is a zero force member And $F_{KM} = F_{OM}$

At joint N : NK is a zero force member And $F_{LN} = F_{ON}$

Ex. No (12)   Trusses : Method of Sections

Determine the forces in members BD, CD and CE, for a fink roof truss loaded as shown in fig.

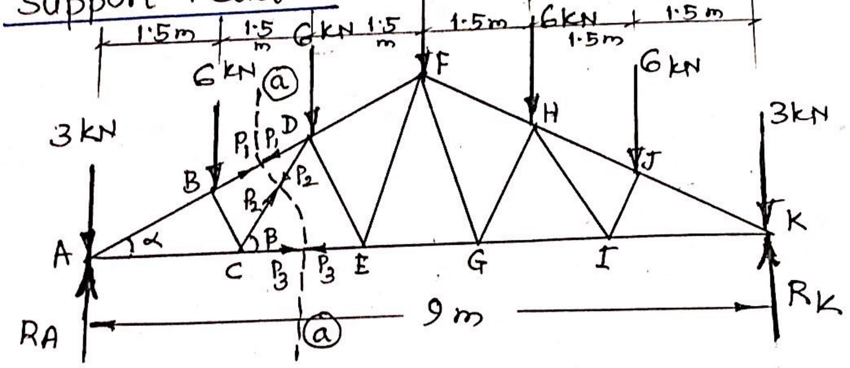


Solution: Check for perfect truss : $j = 11$, $R = 3$, $m = 19$

Type : Simply supported truss $\therefore$ Perfect Truss

$m = 2j - 3$ $\therefore$ $19 = (2 \times 11) - 3$

Support reactions : Consider F.B.D. of the entire truss.



$R_A + R_K = (2 \times 3) + (5 \times 6) = 36 \text{ kN} \longrightarrow$ (i)

$\Sigma M_A = 0$ gives, $9R_K - (3 \times 9) - (6 \times 7.5) - (6 \times 6) - (6 \times 4.5) - (6 \times 3) - (6 \times 1.5) = 0 \longrightarrow$ (ii)

$\therefore \quad R_K = 18 \text{ kN} (\uparrow) \quad \therefore \quad R_A = 18 \text{ kN} (\uparrow)$

$\tan\alpha = \left(\frac{2.4}{4.5}\right) \qquad \tan\beta = \left(\frac{1.6}{0.9}\right)$

$\therefore \quad \alpha = 28.07^\circ \qquad \therefore \beta = 60.64^\circ$

Consider section-line (a - a), cutting members BD, CD and CE as shown in figure.

Now, consider the L.H.S. of the section-line (a-a) and apply equations of equilibrium to it.

$\Sigma F_x = 0$ gives,

$$P_1 \cdot \cos(28.07^\circ) + P_2 \cdot \cos(60.64^\circ) + P_3 = 0 \longrightarrow ①$$

$$(0.882)P_1 + (0.49)P_2 + P_3 = 0$$

$\Sigma F_y = 0$ gives,

$$18 - 3 - 6 + P_1 \cdot \sin(28.07^\circ) + P_2 \cdot \sin(60.64^\circ) = 0 \longrightarrow ②$$

$$9 + (0.47)P_1 + (0.87)P_2 = 0$$

$\Sigma M_A = 0$ gives,

$$P_2 \cdot \sin(60.64^\circ) \times 1.8 - (6 \times 1.5) = 0 \longrightarrow ③$$

$$\therefore (0.87) P_2 \times 1.8 - 9 = 0$$

$$\therefore P_2 = 5.747 \text{ kN}$$

From eq^n ②, we get, $\therefore P_1 = -29.787$ kN

From eq^n ①, we get $\therefore P_3 = 23.45$ kN

Ans:

Member	Force	Nature
CD	$P_2 = 5.747$ kN	Tension
BD	$P_1 = 29.787$ kN	Compression
CE	$P_3 = 23.45$ kN	Tension

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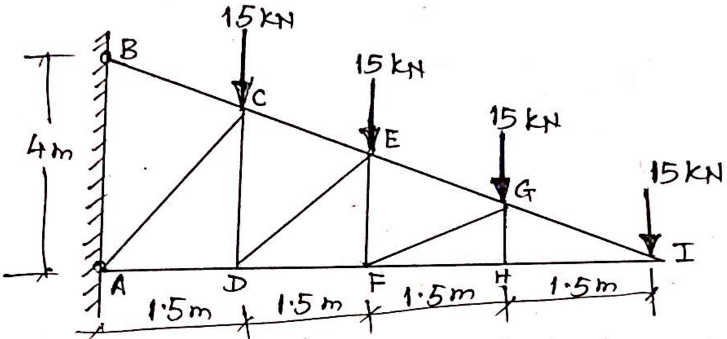
Ex. No. (13) Determine the forces in members CE, DE and DF of the truss loaded and supported as shown in Figure.



solution : check for perfect truss :

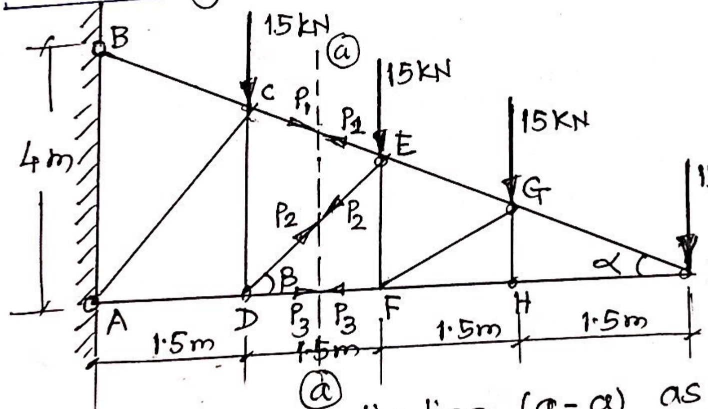
Type: Cantilever truss $j = 9$, $R = 4$, $m = 14$

$m = 2j - 4 \quad \therefore 14 = 2 \times 9 - 4 \quad \therefore$ Perfect truss

Since it is a cantelever truss, no need of calculating support reactions.

$\tan\alpha = \frac{4}{6} \quad \therefore \alpha = 33.69^\circ$

$\tan\beta = \frac{2}{1.5} \quad \therefore \beta = 53.13^\circ$



Consider a sectionline (a-a) as shown in figure. Consider R.H.S. of the sectionline and apply equations of equilibrium.

$\Sigma F_x = 0$ gives, $\longrightarrow$ (1)

$$-P_1 \cdot \cos(33.69^\circ) - P_2 \cdot \cos(53.13^\circ) - P_3 = 0$$

$$(0.832)P_1 + (0.6)P_2 + P_3 = 0$$

$\Sigma F_y = 0$ gives, $\longrightarrow$ (2)

$$+P_1 \cdot \sin(33.69^\circ) - P_2 \cdot \sin(53.13^\circ) - (3 \times 15) = 0$$

$$(0.555)P_1 - (0.8)P_2 - 45 = 0$$

$\Sigma M_I = 0$ gives,

$$(15 \times 1.5) + (15 \times 3) + P_2 \cdot \sin(53.13^\circ) \times 3 = 0 \longrightarrow (3)$$

$$67.5 + (2.4) P_2 = 0$$

$$P_2 = -28.125 \text{ kN}$$

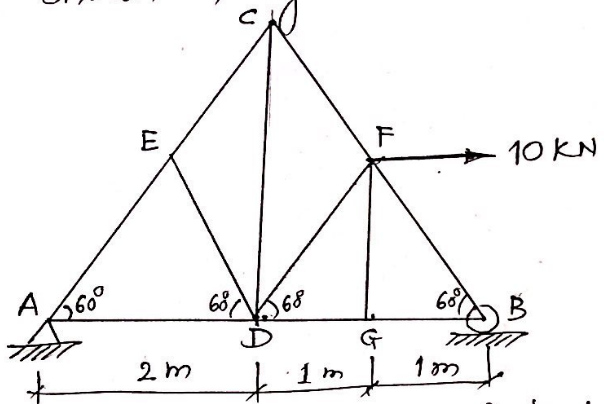
$$P_1 = 40.54 \text{ kN}$$

$$P_3 = -16.85 \text{ kN}$$

Ans:

Member	Force	Nature
CE	$P_1 = 40.54$ kN	Tension
DE	$P_2 = 28.125$ kN	Compression
DF	$P_3 = 16.85$ kN	Compression

Ex. No. (14) Determine the force in member CD of the simple truss supported and loaded as shown in Figure.



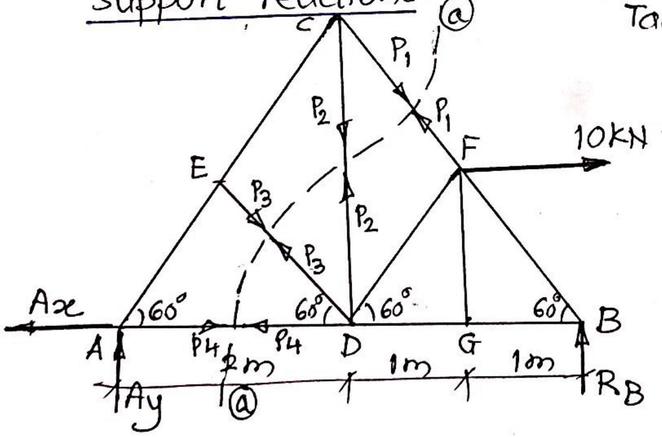
Solution : check for perfect truss

Type: Simply supported truss $\therefore m = 2j - 3$

$j = 7, \quad R = 3, \quad m = 11$

$\therefore \quad 11 = (2 \times 7) - 3 \quad \therefore$ perfect truss

support reactions:



$\tan 60^\circ = \frac{FG}{1}$

$FG = 1.732\,m$

Consider F.B.D. of the entire truss.

Applying equations of equilibrium, we get,

$10 - A_x = 0 \longrightarrow (i)$

$A_x = 10\ kN (\leftarrow)$

$A_y + R_B = 0 \longrightarrow (ii)$

$\Sigma M_A = 0$ gives, $4 R_B - (10 \times 1.732) = 0 \longrightarrow (iii)$

$\therefore R_B = 4.33\ kN (\uparrow) \quad \therefore A_y = 4.33\ kN (\downarrow)$

At joint E, member ED is a zero force member.

$\therefore \quad P_3 = 0$

Consider sectionline (a-a) cutting members CF, CD, ED and AD as shown in figure.

Consider R.H.S. of sectionline (a-a) and apply equations of equilibrium to it.

$\Sigma F_x = 0$ gives,

$$10 - P_1 \cdot \cos 60^\circ - \cancel{P_3 \cdot \cos 60^\circ} - P_4 = 0 \longrightarrow (i)$$

$$10 - (0.5) P_1 - P_4 = 0$$

$\Sigma F_y = 0$ gives,

$$4.33 + P_1 \cdot \sin 60^\circ + P_2 + \cancel{P_3 \cdot \sin 60^\circ} = 0 \longrightarrow (ii)$$

$$4.33 + (0.866) P_1 + P_2 = 0$$

$\Sigma M_D = 0$ gives,

$$(4.33 \times 2) + P_1 \cdot \sin 60^\circ \times 2 - (10 \times 1.732) = 0 \longrightarrow (iii)$$

$$(8.66) + (1.732) P_1 - (17.32) = 0$$

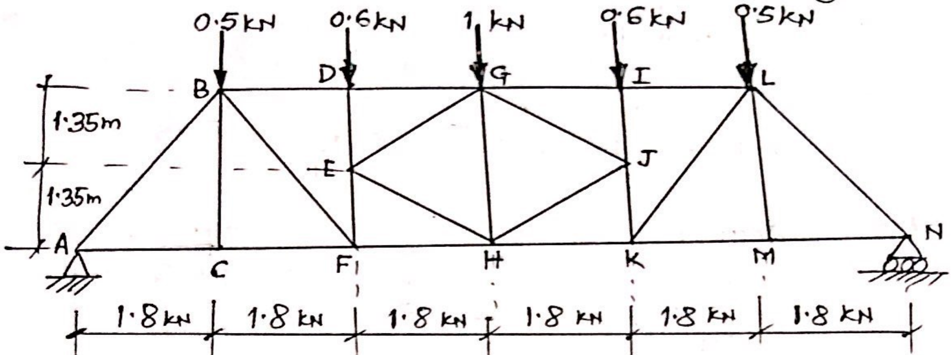
$$\therefore P_1 = 5 \text{ kN}$$

$$\therefore P_2 = -8.66 \text{ kN}$$

$$\therefore P_4 = 7.5 \text{ kN}$$

Ans: Force in member CD is 8.66 kN compressive

Ex. No. (15) Determine the forces in members DG and FH of the truss shown in fig.



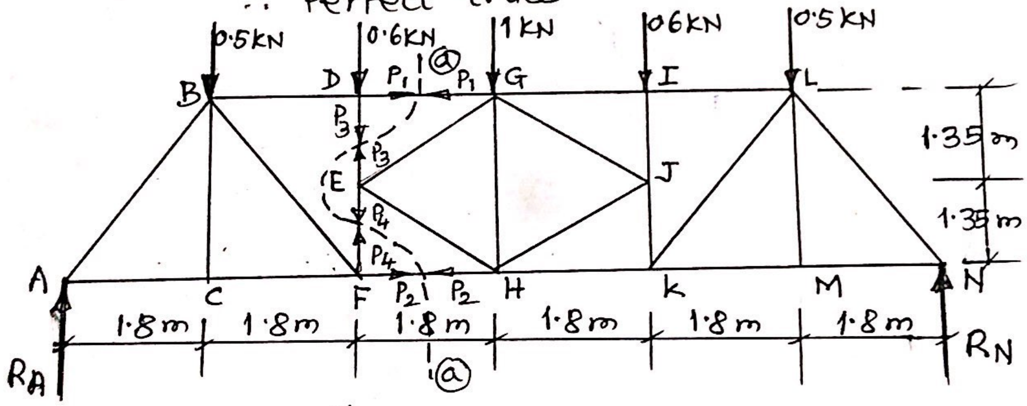
Solution : check for perfect truss

Type : simply supported truss

$j = 14$, $R = 3$, $m = 25$

$m = 2j - 3 \quad \therefore \; 25 = (2 \times 14) - 3$

$\therefore$ Perfect truss



Support reactions:

Due to symmetry, $R_A = R_N = \dfrac{\text{Total load}}{2}$

$= \dfrac{3.2}{2} = 1.6 \text{ kN } (\uparrow)$

Consider a sectionline (a-a) as shown in fig.

Consider L.H.S. of sectionline (a-a),

$\Sigma F_x = 0$ gives, $P_1 + P_2 = 0 \longrightarrow (1)$

$\Sigma F_y = 0$ gives, $1.6 + P_4 - P_3 - 0.6 - 0.5 = 0$

$\therefore \; P_3 = 0.5 + P_4 \longrightarrow (2)$

$\Sigma M_E = 0$ gives, $-(1.6 \times 3.6) + (1.35) P_2 + (0.5 \times 1.8)$

$- (1.35) P_1 = 0 \longrightarrow (3)$

$\therefore (1.35)(P_2 - P_1) - (5.76) + 9 = 0$

$P_2 - P_1 = -2.4$

But $P_1 + P_2 = 0$

$\therefore 2 \cdot P_2 = -2.4$

$\therefore P_2 = -1.2$ kN and $P_1 = +1.2$ kN

Ans:

Member	Force	Nature
DG	$P_1 = 1.2$ kN	compression
FH	$P_2 = 1.2$ kN	Tension