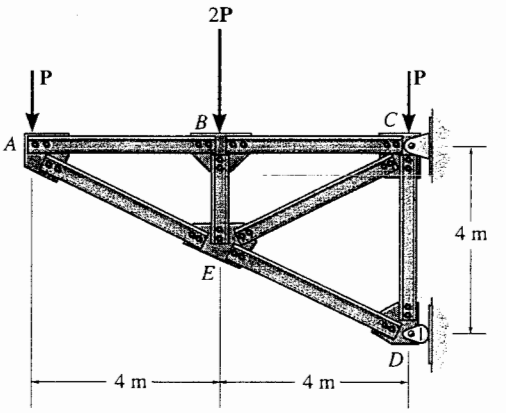
CE-201-2 (041)
H.W. # 8

Prob. 6-6 (P-269)

Given:

The truss shown in Fig. mass per length = 4 kg/m and P=0.



Req.d:

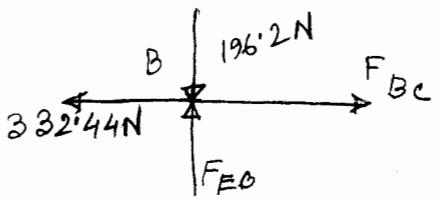
Force in each member.

Soln.

Member name	Length (m)	Mass (kg) @ 4 kg/m	A (kg)	B (kg)	C (kg)	D (kg)	E (kg)
AB	4	4*4 = 16	8	8			
BC	4	16		8	8		
AE	4·4721	17·888	8·9442				8·9442
ED	4·4721	17·888				8·9442	8·9442
BE	2	8		4			4
CE	4·4721	17·888			8·9442		8·9442
CD	4	16			8	8	
Total Mass (m) kg =			16·9442	20	24·9442	16·9442	30·832
Total mg (N) =			166·22	196·2	244·70	166·22	302·46

..... Contd, Prob 6-6.

Taking Joint "B"



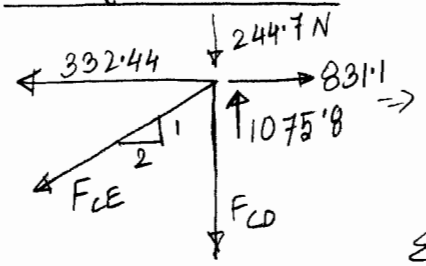
$\Sigma F_x = 0$

$\therefore F_{BC} = 332.44\ N\ (T)$

$\Sigma F_y = 0$

$F_{EB} = 196.2\ N\ (C)$

Taking Joint "C"



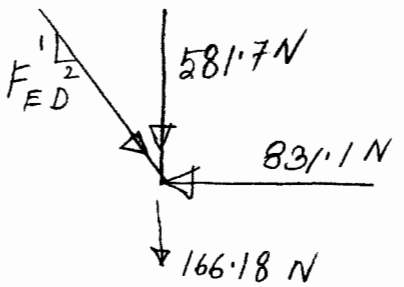
$\Sigma F_x = 0$; $831.1 - 332.4 - F_{CE} * \frac{2}{\sqrt{5}} = 0$

$\Rightarrow F_{CE} = 557.56\ N\ (T)$

$\Sigma F_y = 0$; $-557.56 * \frac{1}{\sqrt{5}} - 244.7 - F_{CD} + 1075.8 = 0$

$\Rightarrow F_{CD} = 581.75\ N\ (T)$

Taking Joint "D"

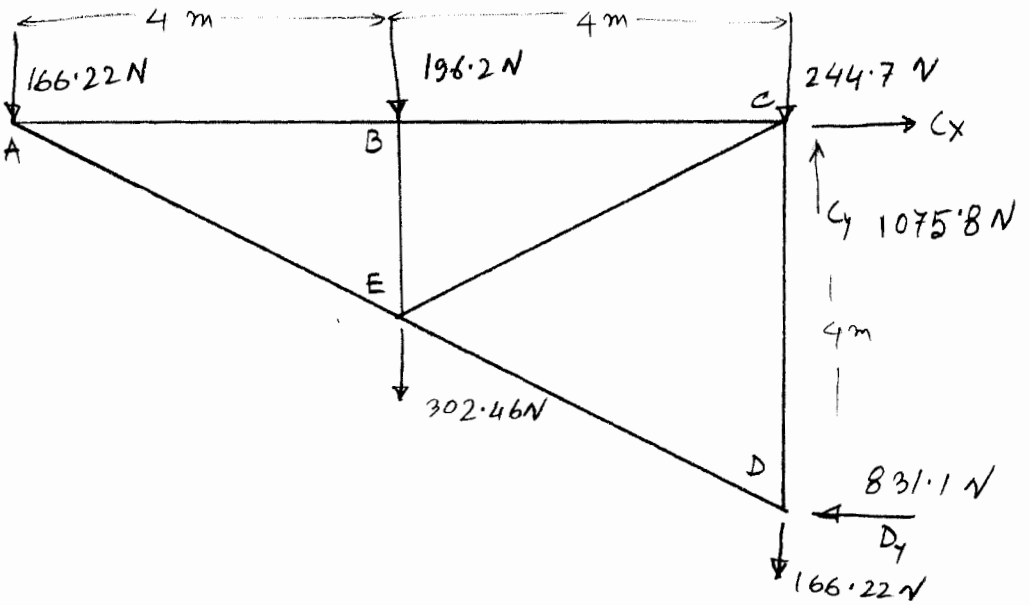


$\Sigma F_x = 0$

$\Rightarrow F_{ED} * \frac{2}{\sqrt{5}} - 831.1 = 0$

$\Rightarrow F_{ED} = 929.2\ N\ (C)$

...Conti. Prob6-6



↑ +

$\Sigma F_y = 0$

$C_y - 166.22 - 196.2 - 302.46 - 244.7 - 166.22 = 0$

$\Rightarrow C_y = 1075.8\ N \uparrow$

$\circlearrowleft \Sigma M_C = 0$

$\Rightarrow 166.22 * 8 + (196.2 + 302.46) * 4 - D_y * 4 = 0$

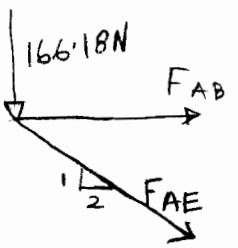
$\Rightarrow D_y = 831.1\ N \leftarrow$

$\pm \rightarrow \Sigma F_x = 0$

$\Rightarrow C_x - 831.1\ N = 0$

$\Rightarrow C_x = 831.1\ N \rightarrow$

Taking Joint "A"



$\Sigma F_y = 0$; $-\frac{F_{AE}}{\sqrt{5}} * 1 - 166.22N = 0$

$\Rightarrow F_{AE} = 371.68\ N\ (C)$

$\Sigma F_x = 0$; $-371.68 * \frac{2}{\sqrt{5}} + F_{AB} = 0$

$\Rightarrow F_{AB} = 332.44\ N\ (T)$

Prob: 6-17 (P-271)

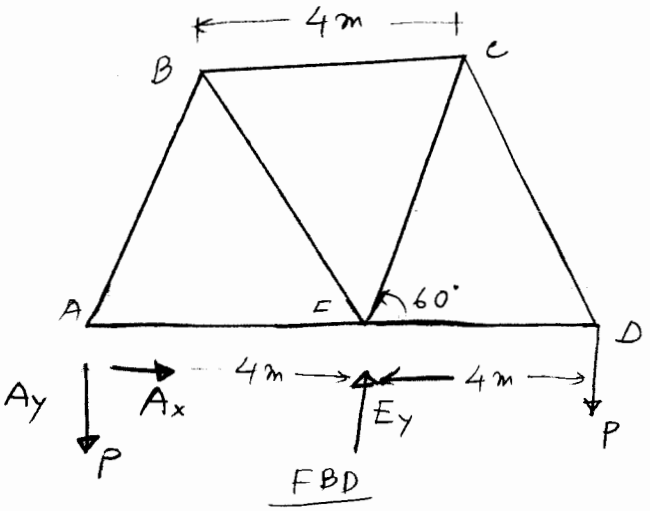
Given:

Force shown in Fig.

Max. tension 8 kN & Max. compression 6 kN in each member.

Req.d:

Max. force P.



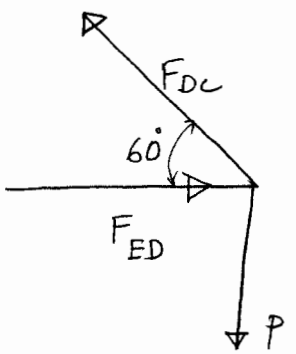
Soln.

$\Sigma F_x = 0 \Rightarrow A_x = 0$

$+\circlearrowleft \Sigma M_E = 0 \Rightarrow$

$A_y = P \downarrow$

At Joint D



$\Sigma F_y = 0$

$\Rightarrow F_{DC} \sin 60 - P = 0$

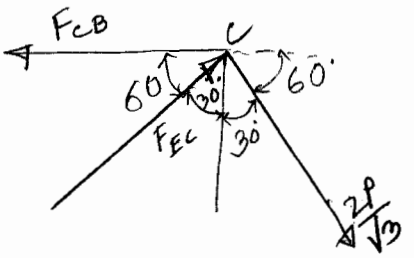
$\Rightarrow F_{DC} = \frac{P}{\sin 60^\circ} = \frac{2P}{\sqrt{3}}$ (T)

$\Sigma F_x = 0$

$\Rightarrow F_{ED} - F_{DC} \cos 60^\circ = 0$

$\Rightarrow F_{ED} = \frac{2P}{\sqrt{3}} \left(\frac{1}{2}\right) = \frac{P}{\sqrt{3}}$ (C)

At Joint C



$\Sigma F_y = 0$

$\Rightarrow F_{EC} = \frac{2P}{\sqrt{3}}$ (C)

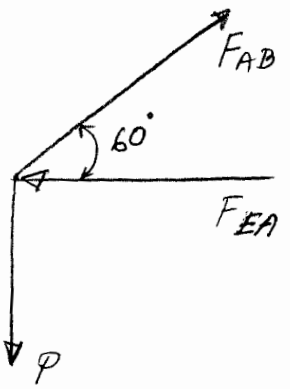
$\Sigma F_x = 0$

$\Rightarrow F_{EC} * \cos 60^\circ + \frac{2P}{\sqrt{3}} \cos 60 = F_{CB}$

$\Rightarrow F_{CB} = \frac{4P}{\sqrt{3}} * \cos 60^\circ = 2P/\sqrt{3}$ (T)

Contd... Prob 6-17

At joint "A"



$\Sigma F_y = 0$

$\Rightarrow F_{AB} \sin 60^\circ - P = 0$

$\Rightarrow F_{AB} * \frac{\sqrt{3}}{2} - P = 0$

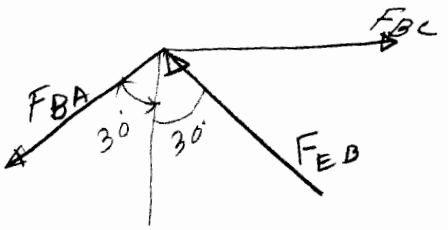
$\therefore F_{AB} = \frac{2P}{\sqrt{3}}$ (T)

$\Sigma F_x = 0 \Rightarrow F_{EA} = F_{AB} \cos 60^\circ$

$\therefore F_{EA} = \frac{2P}{\sqrt{3}} * \frac{1}{2} = \frac{P}{\sqrt{3}}$

$\therefore F_{EA} = \frac{P}{\sqrt{3}}$ (C)

At joint "B"



$\Sigma F_y = 0$

$\Rightarrow F_{EB} = F_{BA} = \frac{2P}{\sqrt{3}}$

$\therefore F_{EB} = \frac{2P}{\sqrt{3}}$ (C)

Here we see that Max. Tension $= \frac{2P}{\sqrt{3}}$ and also compression is $\frac{2P}{\sqrt{3}}$

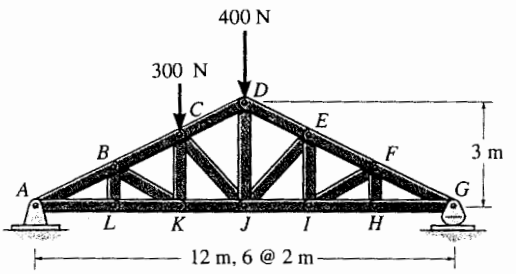
So $\frac{2P}{\sqrt{3}} = 6\,kN$ [compression controls here]

$\therefore P = 5.2\,kN$

Prob. 6-19 (P.-271)

Given:
Forces shown in Fig.

Req. d:
Determine zero force members and explain.



Prob. 6–19

Soln:

In general, if three members form a truss joint for which two of the members are collinear, the third member is a zero-force member provided no external force or support reaction is applied to the joint.

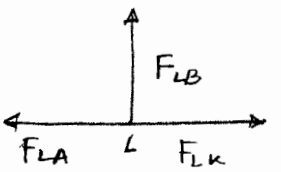
By this rule, BL, HF, BK, FI, CK, IE, EJ members are zero force members.

Explanation:

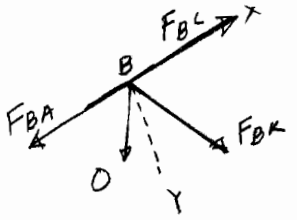
At joint "L"

$\Sigma F_y = 0$

$\Rightarrow F_{LB} = 0$



At joint "B"



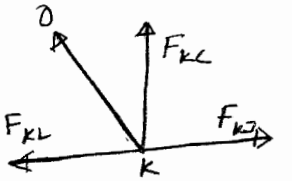
$\Sigma F_y = 0$

$\Rightarrow F_{BK} = 0$

At joint "K"

$\Sigma F_y = 0$

$F_{KC} = 0$



Contd.... Prob 6-19

At joint 'H'

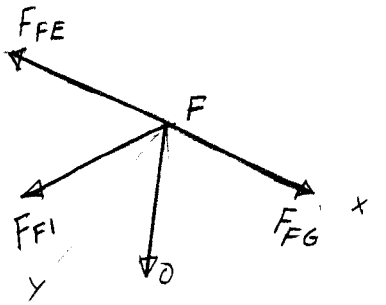
$\Sigma F_y = 0$

$\Rightarrow F_{HF} = 0$

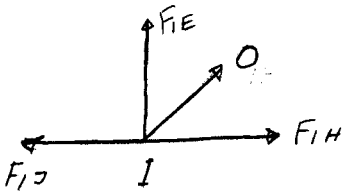
At joint "F"

$\Sigma F_y = 0$

$\Rightarrow F_{FI} = 0$



At joint "I"



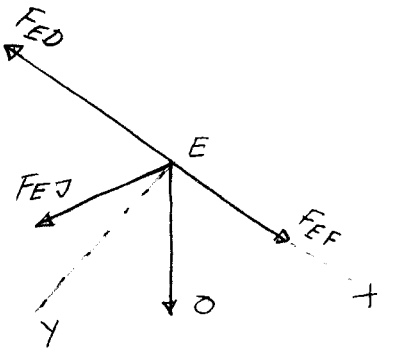
$\Sigma F_y = 0$

$\Rightarrow F_{IE} = 0$

At joint "E"

$\Sigma F_y = 0$

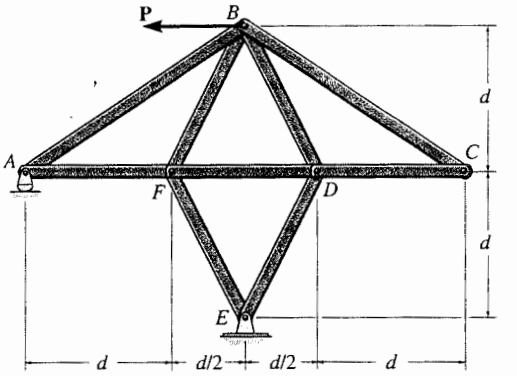
$\therefore F_{EJ} = 0$



Prob. 6-27 (P.-272)

Given: Force shown in Fig.

Req.d:
The forces in each member.



Soln:

$+\circlearrowleft \Sigma M_E = 0$

$P * 2d - A_y * \frac{3}{2}d = 0$

$\Rightarrow A_y = \frac{2Pd * 2}{3d}$

$\therefore A_y = \frac{4}{3}P$

$\Sigma F_y = 0$

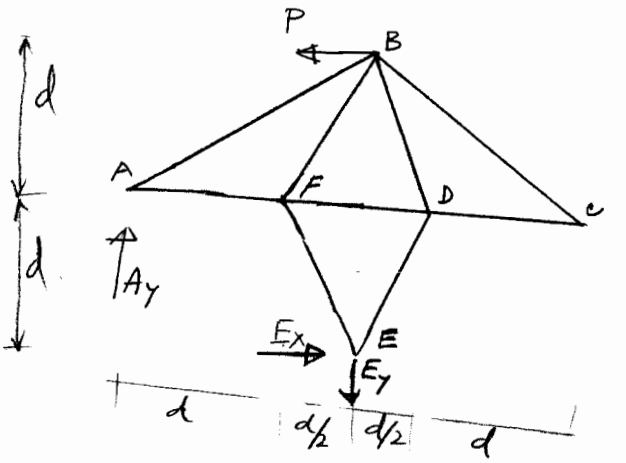
$\Rightarrow A_y - E_y = 0$

$\Rightarrow E_y = A_y = 4/3\,P$

$\Sigma F_x = 0$

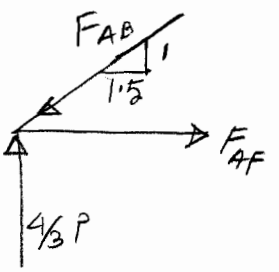
$\Rightarrow E_x - P = 0$

$\therefore E_x = P$



FBD

Taking joint "A"



$\Sigma F_y = 0$

$\Rightarrow \frac{4}{3}P - F_{AB} * \frac{1}{\sqrt{3.25}} = 0$

$\Rightarrow \boxed{F_{AB} = 2.404\,P\ (C)}$

$\Sigma F_x = 0$

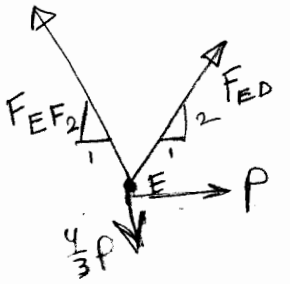
$\Rightarrow F_{AF} - 2.404\,P * \frac{1.5}{\sqrt{3.25}} = 0$

$\Rightarrow \boxed{F_{AF} = 2P\ (T)}$

Note that F_{AC} can be assumed T

Conti.... Prob. 6-27

Taking joint "E"



$\Sigma F_y = 0$

$\Rightarrow F_{EF} * \frac{2}{\sqrt{5}} + F_{ED} * \frac{2}{\sqrt{5}} = \frac{4}{3}P$

$\Rightarrow F_{EF} + F_{ED} = \frac{4P}{3} * \frac{\sqrt{5}}{2}$

$\Rightarrow F_{EF} + F_{ED} = \frac{2\sqrt{5}P}{3}$ ---- (I)

$\Sigma F_x = 0 \Rightarrow P + F_{ED} * \frac{1}{\sqrt{5}} - F_{EF} * \frac{1}{\sqrt{5}} = 0$

$\Rightarrow F_{EF} - F_{ED} = \sqrt{5}P$ ---- (II)

(I) + (II) $\Rightarrow 2F_{EF} = \sqrt{5}P\left(\frac{2}{3}+1\right)$

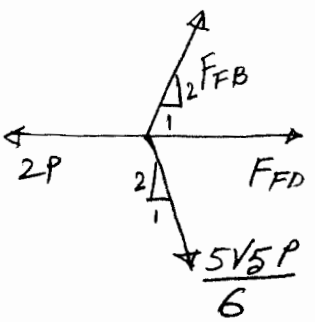
$\Rightarrow 2F_{EF} = \sqrt{5}P * \frac{5}{3}$

$\Rightarrow \boxed{F_{EF} = \frac{5\sqrt{5}P}{6} \text{ (T)}}$

(II) $\Rightarrow F_{ED} = \frac{5\sqrt{5}P}{6} - \sqrt{5}P = \frac{-\sqrt{5}P}{6}$

$\boxed{F_{ED} = \frac{\sqrt{5}P}{6} \text{ (C)}}$

Taking joint "F"



$\Sigma F_y = 0$

$\Rightarrow F_{FB} - 5\sqrt{5}P/6 = 0$

$\Rightarrow \boxed{F_{FB} = 5\sqrt{5}P/6 \text{ (T)}}$

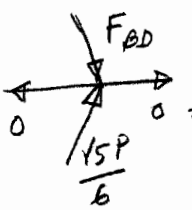
$\Sigma F_x = 0$

$\Rightarrow \frac{2*5\sqrt{5}P}{6} * \frac{1}{\sqrt{5}} + F_{FD} - 2P = 0$

$\Rightarrow \boxed{F_{FD} = 0.33P}$

Taking Joint "D"

$\boxed{F_{BC} = 0}$
$\boxed{F_{DC} = 0}$ As They are Zero force member



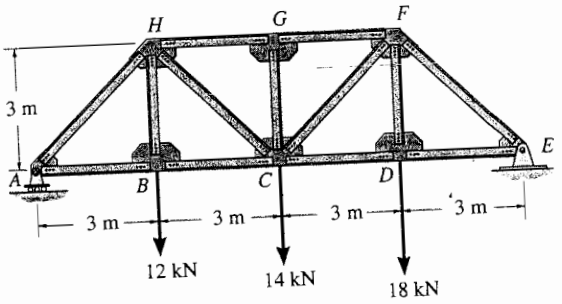
$\Sigma F_y = 0$

$\Rightarrow \boxed{F_{BD} = \frac{\sqrt{5}P}{6} \text{ "C"}}$

Prob. 6-31 (P.-279)

Given: Forces are shown in fig.

Req.d: Force in members GF, CF and CD.



Soln:

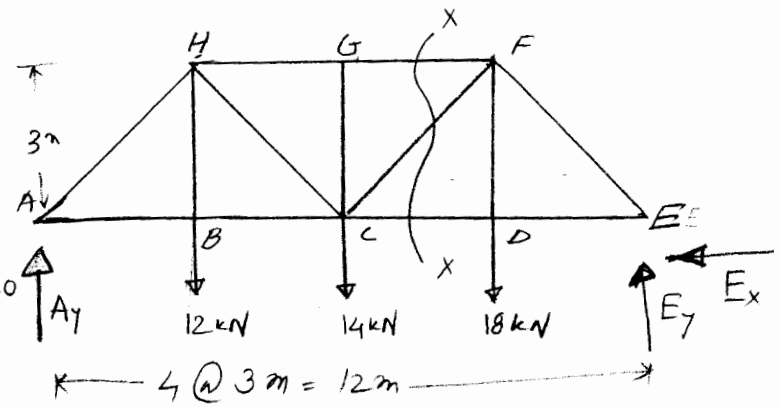
$\circlearrowleft \Sigma M_A = 0$

$\Rightarrow E_y * 12 - 12 * 3 - 14 * 6 - 18 * 9 = 0$

$\Rightarrow E_y = 23.5 \text{ kN}$

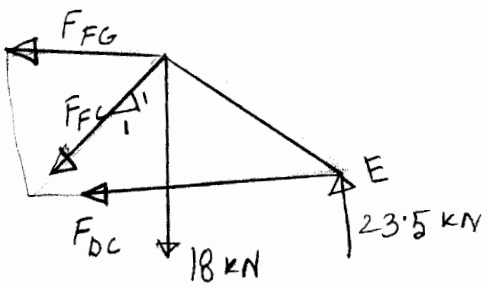
$\Sigma F_x = 0$

$\therefore E_x = 0$



FBD

At the section x-x



$\Sigma F_y = 0$

$\Rightarrow 23.5 - 18 - F_{FC} \times \frac{1}{\sqrt{2}} = 0$

$\Rightarrow \boxed{F_{FC} = 7.778 \text{ kN (T)}}$

$\Sigma F_x = 0$

$\Rightarrow -F_{DC} - 7.778 * \frac{1}{\sqrt{2}} + 29 = 0$

$\Rightarrow F_{DC} = 23.5 \text{ kN (T)}$

$\circlearrowleft \Sigma M_C = 0$

$\Rightarrow F_{FG} * 3 - 18 * 3 + 23.5 * 6 = 0$

$\therefore F_{FG} = -29 \text{ kN}$ $\therefore \boxed{F_{FG} = 29 \text{ kN (C)}}$