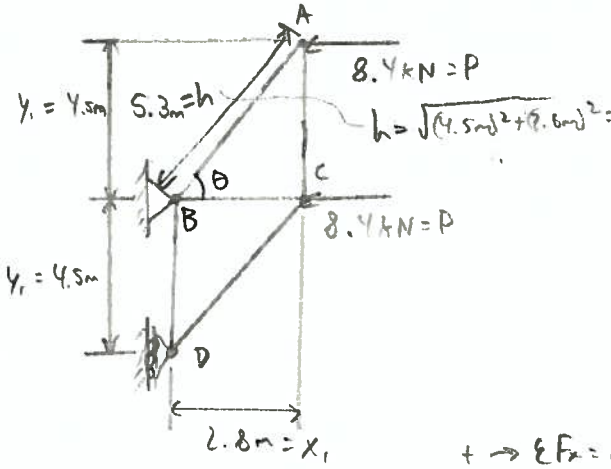
CH6

VECTOR MECHANICS FOR ENGINEERS – STATICS – 9TH EDITION

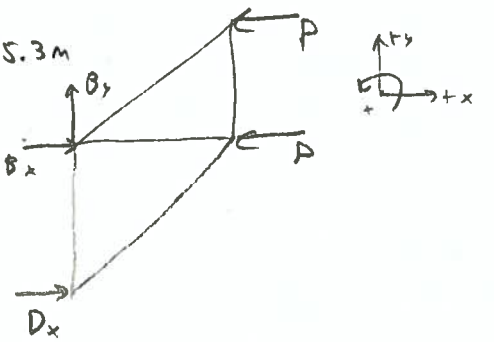
6.7) A loaded truss.

Given: The following diagram

Find: The Force in each member, state wether in tension or compression.



FBD of entire truss



$+\rightarrow \Sigma F_x = 0 \Rightarrow \quad B_x + D_x - P - P = 0$

$B_x = 2P - D_x \qquad B_x = 3P$

$+\uparrow \Sigma F_y = 0 \Rightarrow \quad B_y = 0$

$(+) \Sigma M_B = 0 \Rightarrow \quad D_x y_1 + P y_1 = 0, \quad D_x = -P$ or $D_x = P \leftarrow$

FBD of pin D:

$+\rightarrow \Sigma F_x = 0 \Rightarrow \quad -D_x + F_{DC}\cos\theta = 0$

$F_{DC} = \frac{D_x}{\cos\theta} = \frac{D_x}{\frac{x_1}{h}} = \frac{hD_x}{x_1} = \frac{hP}{x_1}$

$F_{DC} = \frac{(5.3m)(8.4kN)}{(2.8m)}$

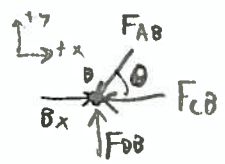
$F_{DC} = 15.90kN$ (T)

$+\uparrow \Sigma F_y = 0 \Rightarrow \quad F_{DC}\sin\theta - F_{DB} = 0$

$F_{DB} = F_{DC}\left(\frac{y_1}{h}\right), \quad F_{DB} = \frac{hP}{x_1}\left(\frac{y_1}{h}\right) = \frac{Py_1}{x_1}$

$F_{DB} = \frac{(8.4kN)(4.5m)}{(2.8m)}$, $F_{DB} = 13.50kN$ (C)

FBD of pin B



$+\uparrow \Sigma F_y = 0 \Rightarrow \quad F_{DB} - F_{AB}\sin\theta = 0$

$F_{AB} = \frac{F_{DB}}{\sin\theta} = \left(\frac{Py_1}{x_1}\right)\left(\frac{1}{\frac{y_1}{h}}\right) = \frac{Ph}{x_1}$

$F_{AB} = \frac{(8.4kN)(5.3m)}{(2.8m)} = 15.90kN$ (C) $= F_{AB}$

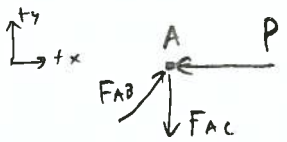
$+\rightarrow \Sigma F_x = 0 \Rightarrow \quad B_x - F_{CB} - F_{AB}\cos\theta = 0$

$F_{CB} = B_x - F_{AB}\cos\theta = B_x - \frac{Ph}{x_1}\left(\frac{x_1}{h}\right) = B_x - P = 3P - P = 2P$

$F_{CB} = 2(8.4kN)$, $F_{CB} = 16.80kN$ (C)

6.7 Part II)

FBD of pin A:



$+\uparrow \sum F_y = 0 \Rightarrow F_{AB}\sin\theta - F_{AC} = 0$

$F_{AC} = F_{AB}\sin\theta = \left(\frac{P_k}{x_1}\right)\left(\frac{y_1}{k}\right)$

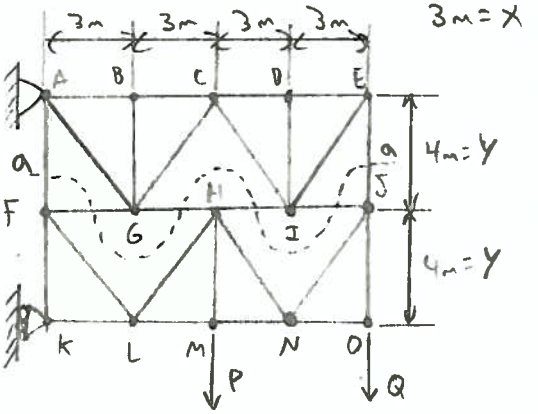
$F_{AC} = \frac{(8.4\,kN)(4.5\,m)}{(2.8\,m)}$

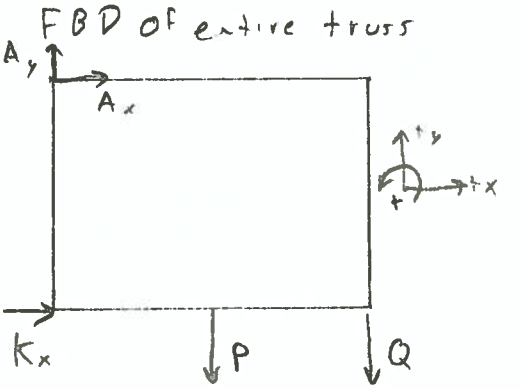
$\boxed{F_{AC} = 13.50\,kN \text{ (T)}}$

6.61)- A loaded truss

Given: $P = Q = 1.2\,kN$ (hinteuse section aa)

Find: F_{AF} & F_{EJ}





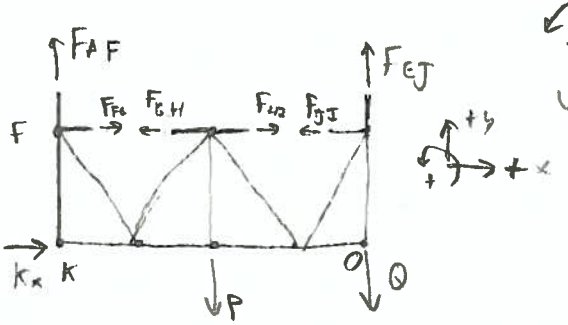
Finding K_x:

$\circlearrowleft_+ \sum M_A = 0 \Rightarrow (2y)K_x - (2x)P - (4x)Q = 0$ ($Q = P$)

$$y K_x = xP + 2xP$$

$$K_x = \frac{3xP}{y}$$

FBD of bottom part of Cut aa.



$\circlearrowleft_+ \sum M_F = 0 \Rightarrow (4x)F_{EJ} + (y)K_x - (2x)P - (4x)Q = 0$ ($K_x = \frac{3xP}{y}$, $Q = P$)

$4x F_{EJ} = 2xP + 4xP - y\left(\frac{3xP}{y}\right)$

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

$$F_{EJ} = \frac{3(1.2\,kN)}{4} = \boxed{0.900\,kN\ (T) = F_{EJ}}$$

$+\uparrow \sum F_y = 0 \Rightarrow F_{AF} + F_{EJ} - P - Q = 0$ ($Q = P$, $F_{EJ} = \frac{3P}{4}$)

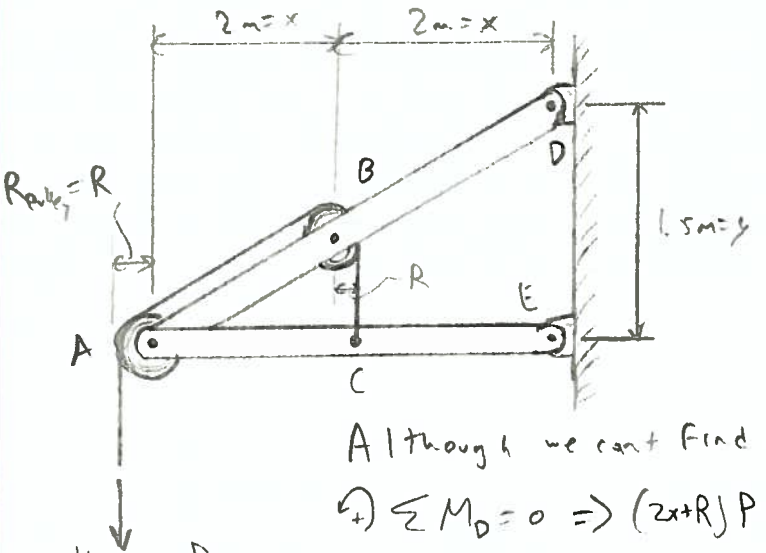
$$F_{AF} = P + P - F_{EJ} = 2P - \frac{3P}{4} = \frac{5P}{4}$$

$$F_{AF} = \frac{5(1.2\,kN)}{4} = \boxed{1.500\,kN\ (T) = F_{AF}}$$

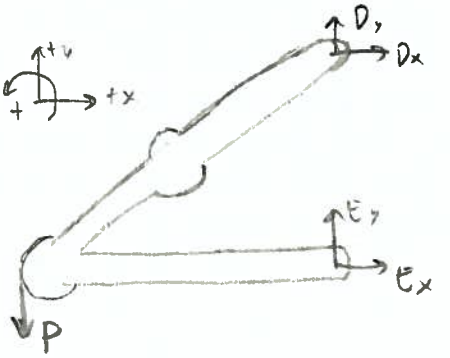
6.92) A Frame with two pulleys.

Given: $R_{pulley} = 0.25\,m$

Find: Rxns at D and E



FBD of entire Frame



Although we can't find all rxns with this FBD we can find 2 rxns.

$$\circlearrowleft + \sum M_D = 0 \Rightarrow (2x+R)P + yE_x = 0$$

$$E_x = -\frac{(2x+R)P}{y}$$

$E_x = 13.60\,kN \leftarrow$ (assumed dir. is wrong.)

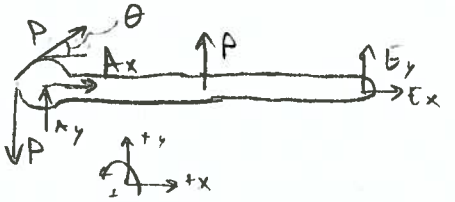
$$E_x = -\frac{(2(2m)+0.25m)(4.8kN)}{(1.5m)} = -13.60\,kN$$

$$+\rightarrow \sum F_x = 0 \Rightarrow D_x + E_x = 0$$

$$D_x = -E_x = -\left(-\frac{2(x+R)P}{y}\right) = \frac{2(x+R)P}{y}$$

$$D_x = 13.60\,kN \rightarrow$$

FBD of member ACE:



$$\circlearrowleft + \sum M_A = 0 \Rightarrow \cancel{RP} + (x+R)P + (2x)E_y \cancel{-RP} = 0$$

$$2x\,E_y = -RP - xP$$

$$E_y = -\frac{P}{2x}(R+x)$$

$$E_y = -\frac{(4.8kN)}{2(2m)}(0.25m + 2m)$$

$E_y = (-)2.70\,kN$ (assumed direction is wrong.) $\Rightarrow E_y = 2.70\,kN \downarrow$

Using $\sum F_y$ From the FBD of the entire Frame:

$$+\uparrow \sum F_y = 0 \Rightarrow D_y + E_y - P = 0, \quad D_y = P - E_y = 4.8kN - -2.70kN)$$

$D_y = 7.50\,kN \uparrow$

So, the rxns are:

$\bar{D} = (13.60kN, 7.50kN)$ & $\bar{E} = (-13.60kN, -2.70kN)$