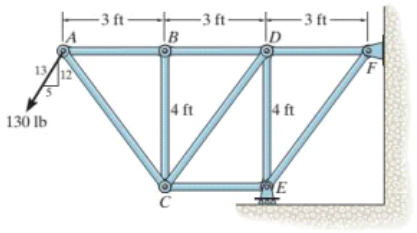
Homework 7

Monday, October 19, 2020 7:37 PM

"I pledge my honor I have abided by the Stevens Honor system."

- Alex Jaskins

5–3. Determine the force in each member of the truss and state if the members are in tension or compression.



A:

$F_y = 0$

$\frac{4}{5}(F_{AC}) - \frac{12}{13}(130) = 0$

$F_{AC} = 150$ lbs. in compression

$F_x = 0$

$F_{BA} = \frac{3}{5}F_{AC} - \frac{5}{13}(130) = 0$

$F_{AB} = 198$ lbs. in tension

B:

$F_x = 0$

$F_{BD} = 140$ lbs. in tension

$F_y = 0$

$F_{BC} = 0$ lbs.

C:

$F_y = 0$

$\frac{4}{5}F_{CD} - \frac{4}{5}F_{AC} = 0$

$F_{CD} = 150$ lbs. in tension

$F_x = 0$

$\frac{3}{5}F_{AC} + \frac{3}{5}F_{CD} - F_{CE} = 0$

$\frac{6}{5}(150) - F_{CE} = 0$

$F_{CE} = 180$ lbs. in compression

D:

$F_y = 0$

$F_{DE} - \frac{4}{5}F_{AC} = 0$

$F_{DE} = \frac{4}{5}(150)$

$F_{DE} = 120$ lbs. in compression

$F_x = 0$

$F_{DF} - F_{BD} - \frac{3}{5}F_{CD} = 0$

$F_{DF} = 140 + \frac{3}{5}(150)$

$F_{DF} = 230$ lbs. in tension

E:

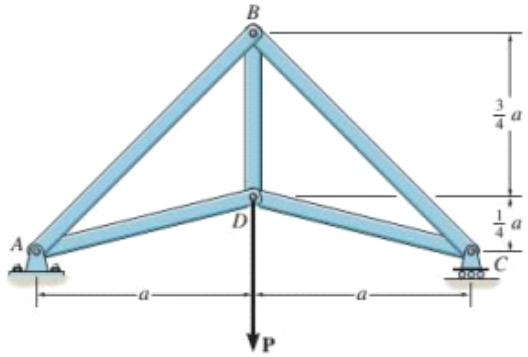
$F_x = 0$

$$F_x = 0$$

$$F_{CE} - \frac{3}{5} F_{EF} = 0$$

$F_{EF} = 300$ lbs. in compression

***5–8.** Determine the force in each member of the truss in terms of the load P and state if the members are in tension or compression.



$$M_A = 0$$

$$C_y + 2a - Pa = 0$$

$$C_y = \frac{P}{2}$$

$$F_y = 0$$

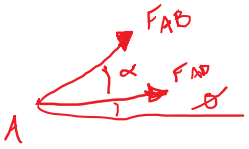
$$A_y + C_y - P = 0$$

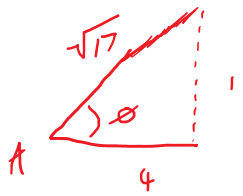
$$A_y + \frac{P}{2} - P = 0$$

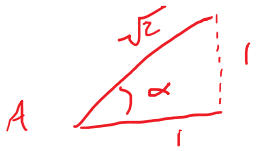
$$A_y = \frac{P}{2}$$

$$F_x = 0$$

$$A_x = 0$$







$$F_x = 0$$

$$F_{AD}\cos(\theta) + F_{AB}\cos(\alpha) = 0$$

$$F_{AD}\left(\frac{4}{\sqrt{17}}\right) + F_{AB}\left(\frac{1}{\sqrt{2}}\right) = 0$$

$$F_{AB} = -\frac{4\sqrt{2}}{\sqrt{17}} F_{AD}$$

$$F_y = 0$$

$$\frac{P}{2} + F_{AB}\sin(\alpha) + F_{AD}\sin(\theta) = 0$$

$$\frac{P}{2} + F_{AB}\frac{1}{\sqrt{2}} + F_{AD}\frac{1}{\sqrt{17}} = 0$$

$$P + \frac{1}{\quad}\left(-\frac{4\sqrt{2}}{\quad} F_{AD}\right) + \frac{1}{\sqrt{17}} = 0$$

$$F_{AB} = -\frac{4\sqrt{2}}{\sqrt{17}} F_{AD}$$

$$F_{AB} = -\frac{4\sqrt{2}}{\sqrt{17}} F_{AD}$$

$$F_{AB} = -\frac{4\sqrt{2}}{\sqrt{17}} (.687P)$$

$F_{AB} = .943P$ in compression

$F_{CD} = F_{AD}$

$F_{CD} = .687P$ in tension

$F_{CB} = F_{AB}$

$F_{CB} = .943P$ in compression

$$\frac{2}{2}\frac{P}{2} + \frac{1}{\sqrt{2}}\left(-\frac{4\sqrt{2}}{\sqrt{17}} F_{AD}\right) + \frac{1}{\sqrt{17}} = 0$$

$F_{AD} = .687P$ in tension

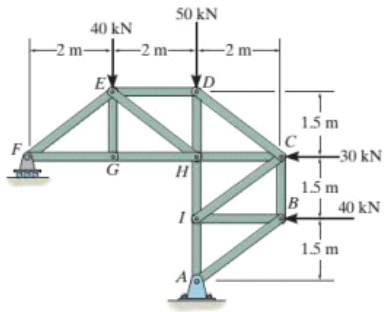
$\sum F_y = 0$

$F_{BD} - F_{CD}\sin(\theta) - F_{AD}\sin(\theta) - P = 0$

$F_{BD} - .687P\left(\frac{1}{\sqrt{17}}\right)(2) - P = 0$

$F_{BD} = 1.33P$ in tension

5–17. Determine the force in members *DC*, *HC*, and *HI* of the truss and state if the members are in tension or compression.



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

$\theta = 36.87°$

$\sum M_A = 0$

$40(1.5) + 30(3) + 40(2) - F_y(4) = 0$

$F_y = 57.5$ kN

$\sum M_B = 0$

$40(2) - F_x(4) - F_x(1.5) = 0$

$\sum F_x = 0$

$M_D = 0$

$40(2) - F_y(4) - F_{HC}(1.5) = 0$

$80 - (57.5)(4) - F_{HC}(1.5) = 0$

$F_{HC} = 100\ kN$ in tension

$F_x = 0$

$-F_{HC} - F_{CD}\cos(\theta) = 0$

$100 - F_{CD}\cos(36.87) = 0$

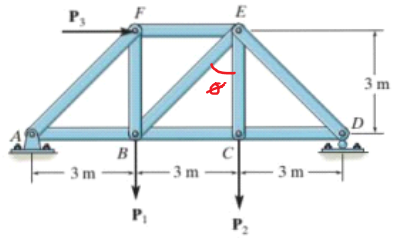
$F_{CD} = 125\ kN$ in compression

$F_y = 0$

$F_y + F_{HI} + F_{CD}\sin(\theta) - 40 - 50 = 0$

$F_{HI} = 42.5\ kN$ in tension

***5–28.** Determine the force in members BC, BE, and EF of the truss and state if these members are in tension or compression. Set $P_1 = 6$ kN, $P_2 = 9$ kN, and $P_3 = 12$ kN.



$\theta = \tan^{-1}\left(\frac{3}{3}\right)$

$\theta = 45°$

$M_A = 0$

$N_D(9) - P_2(6) - P_1(3) - P_3(3) = 0$

$N_D(9) - 54 - 18 - 36 = 0$

$N_D = 12\ kN$

$M_B = 0$

$N_D(6) - P_2(3) + F_{EF}(3) = 0$

$F_{EF} = 15\ kN$ in compression

$M_E = 0$

$N_D(3) - F_{BC}(3) = 0$

$F_y = 0$

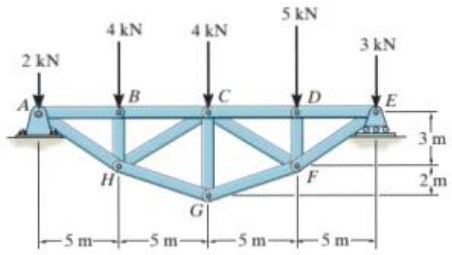
$$F_y = 0$$

$$N_D - P_2 - F_{BE}\cos(45) = 0$$

$$N_D - P_2 - F_{BE}\left(\frac{1}{\sqrt{2}}\right) = 0$$

$$F_{BE} = 4.24\ \text{kN in tension}$$

5–30. Determine the force in members *CD*, *CF*, and *CG* and state if these members are in tension or compression.



$$M_A = 0$$

$$E_y(20) - 3(20) - 5(15) - 10(4) - 4(5) = 0$$

$$E_y = 9.75\ \text{kN}$$

$$F_y = 0$$

$$A_y + E_y - 18 = 0$$

$$M_F = 0$$

$$F_{CD}(3) - 3(5) + E_y(5) = 0$$

$$F_{CD} = 11.25\ \text{kN in compression}$$

GF/

$$\theta = \tan^{-1}\left(\tfrac{2}{5}\right)$$

$$\theta = 21.8^\circ$$

C/

$$\alpha = \tan^{-1}\left(\tfrac{3}{5}\right)$$

$$\alpha = 30.96^\circ$$

$$F_x = 0$$

$$-F_{CD} - F_{CF}\cos(30.96) - F_{FG}\cos(21.8) = 0$$

$$F_{CF} = 13.12 - 1.08\,F_{FG}$$

$$F_y = 0$$

$$-5(3) + E_y + F_{CF}\sin(30.96) - F_{FG}\sin(21.8) = 0$$

$$-5(3) + E_y + (13.12 - 1.08\,F_{FG})\sin(30.96) - F_{FG}\sin(21.8) = 0$$

$$F_{FG} = 9.17\ \text{kN}$$

$F_{CF} = 13.12 - 1.08(9.17)$

$F_{CF} = 3.22$ in tension

$F_x = 0$

$-F_{GH}\cos(\theta) + F_{FG}\cos(\theta) = 0$

$F_{GH} = F_{FG}$

$F_{GH} = 9.17\ \mu N$

$F_{GH}\sin(\theta) + F_{FG}\sin(\theta) + F_{CG} = 0$

$F_{CG} = 6.81\ \mu N$ in compression