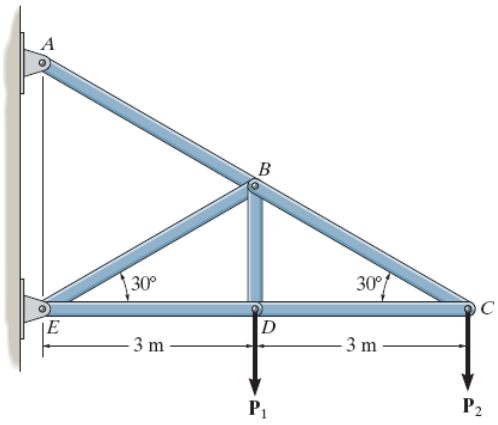
HW 8 SOLUTIONS

6–6. Determine the force in each member of the truss and state if the members are in tension or compression. Set $P_1 = 2$ kN and $P_2 = 1.5$ kN.



Method of Joints : In this case, the support reactions are not required for determining the member forces.

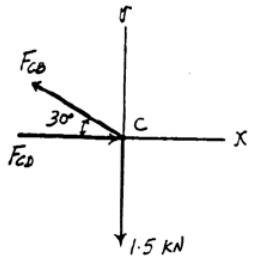
Joint *C*

$+\uparrow \Sigma F_y = 0;\quad F_{CB}\sin 30° - 1.5 = 0$

$F_{CB} = 3.00\ \text{kN (T)}$ **Ans**

$\overset{+}{\rightarrow} \Sigma F_x = 0;\quad F_{CD} - 3.00\cos 30° = 0$

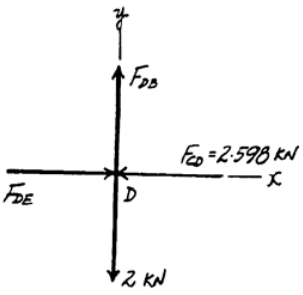
$F_{CD} = 2.598\ \text{kN (C)} = 2.60\ \text{kN (C)}$ **Ans**



Joint *D*

$\overset{+}{\rightarrow} \Sigma F_x = 0;\quad F_{DE} - 2.598 = 0 \quad F_{DE} = 2.60\ \text{kN (C)}$ **Ans**

$+\uparrow \Sigma F_y = 0;\quad F_{DB} - 2 = 0 \quad F_{DB} = 2.00\ \text{kN (T)}$ **Ans**



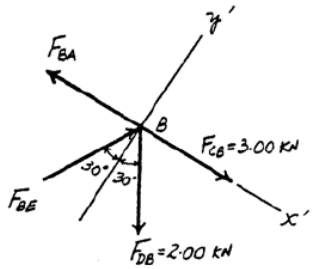
Joint *B*

$+\nearrow \Sigma F_{y'} = 0;\quad F_{BE}\cos 30° - 2.00\cos 30° = 0$

$F_{BE} = 2.00\ \text{kN (C)}$ **Ans**

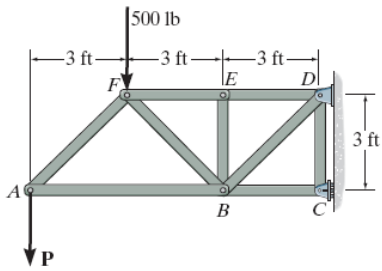
$\nwarrow + \Sigma F_{x'} = 0;\quad (2.00 + 2.00)\sin 30° + 3.00 - F_{BA} = 0$

$F_{BA} = 5.00\ \text{kN (T)}$ **Ans**



Note : The support reactions at support *A* and *E* can be determined by analyzing Joints *A* and *E* respectively using the results obtained above.

*6–8. Determine the force in each member of the truss, and state if the members are in tension or compression. Set $P = 800$ lb.



Method of Joints: We will analyze the equilibrium of the joints in the following sequence: $A \rightarrow F \rightarrow E \rightarrow B \rightarrow C$.

Joint A: From the free - body diagram in Fig. *a*,

$+\uparrow \Sigma F_y = 0;$ $F_{AF} \sin 45° - 800 = 0$

$F_{AF} = 1131.37 \text{ lb} = 1131 \text{ lb (T)}$ **Ans.**

$\overset{+}{\rightarrow} \Sigma F_x = 0;$ $1131.37 \cos 45° - F_{AB} = 0$

$F_{AB} = 800 \text{ lb (C)}$ **Ans.**

Joint F: From the free - body diagram in Fig. *b*,

$+\uparrow \Sigma F_y = 0;$ $F_{FB} \cos 45° - 1131.37 \cos 45° - 500 = 0$

$F_{FB} = 1838.48 \text{ lb} = 1838 \text{ lb (C)}$ **Ans.**

$\overset{+}{\rightarrow} \Sigma F_x = 0;$ $F_{FE} - 1838.48 \sin 45° - 1131.37 \sin 45° = 0$

$F_{FE} = 2100 \text{ lb (T)}$ **Ans.**

Joint E: From the free - body diagram in Fig. *c*,

$\overset{+}{\rightarrow} \Sigma F_x = 0;$ $F_{ED} - 2100 = 0$

$F_{ED} = 2100 \text{ lb (T)}$ **Ans.**

$+\uparrow \Sigma F_y = 0;$ $F_{EB} = 0$ **Ans.**

Joint B: From the free - body diagram in Fig. *d*,

$+\uparrow \Sigma F_y = 0;$ $F_{BD} \sin 45° - 1838.48 \sin 45° = 0$

$F_{BD} = 1838.48 \text{ lb} = 1838 \text{ lb (T)}$ **Ans.**

$\overset{+}{\rightarrow} \Sigma F_x = 0;$ $800 + 1838.48 \cos 45° + 1838.48 \cos 45° - F_{BC} = 0$

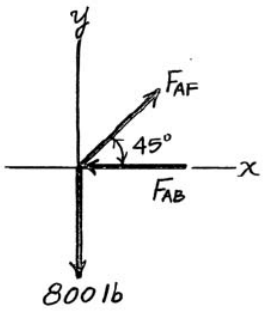
$F_{BC} = 3400 \text{ lb (C)}$ **Ans.**

Joint C: From the free - body diagram in Fig. *e*,

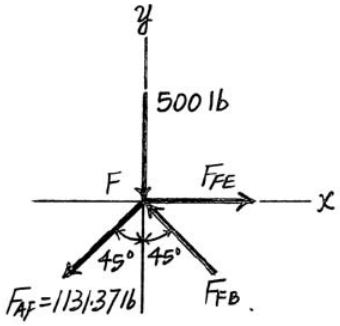
$+\uparrow \Sigma F_y = 0;$ $F_{CD} = 0$ **Ans.**

$\overset{+}{\rightarrow} \Sigma F_x = 0;$ $3400 - N_C = 0$

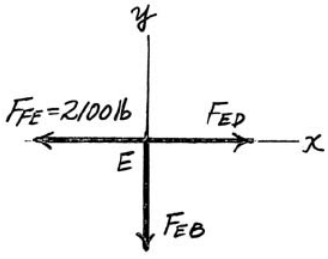
$N_C = 3400 \text{ lb}$



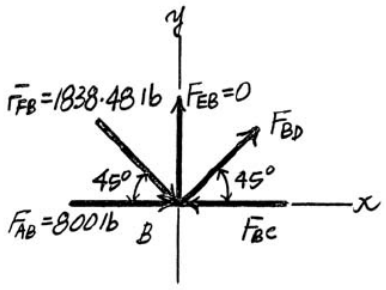
(a)



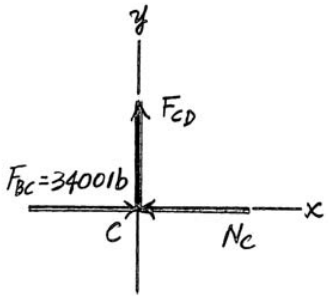
(b)



(c)

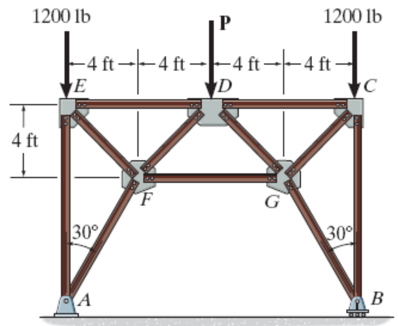


(d)



(e)

6–14. Determine the force in each member of the truss, and state if the members are in tension or compression. Set $P = 2500$ lb.



Support Reactions: Applying the moment equation of equilibrium about point A to the free-body diagram of the truss, Fig. a,

$\circlearrowleft + \Sigma M_A = 0;$ $\quad N_B(8+8) - 1200(8+8) - 2500(8) = 0$

$N_B = 2450 \text{ lb}$

Method of Joints: We will begin by analyzing the equilibrium of joint B, and then that of joints C and G.

Joint B**:** From the free-body diagram in Fig. b,

$\overset{+}{\rightarrow}\Sigma F_x = 0;$ $\quad F_{BG} = 0$ **Ans.**

$+\uparrow \Sigma F_y = 0;$ $\quad 2450 - F_{BC} = 0$

$F_{BC} = 2450 \text{ lb (C)}$ **Ans.**

Joint C**:** From the free-body diagram in Fig. c,

$+\uparrow \Sigma F_y = 0;$ $\quad 2450 - 1200 - F_{CG}\sin 45° = 0$

$F_{CG} = 1767.77 \text{ lb} = 1768 \text{ lb (T)}$ **Ans.**

$\overset{+}{\rightarrow}\Sigma F_x = 0;$ $\quad F_{CD} - 1767.77\cos 45° = 0$

$F_{CD} = 1250 \text{ lb (C)}$ **Ans.**

Joint G**:** From the free-body diagram in Fig. d,

$+\uparrow \Sigma F_y = 0;$ $\quad 1767.77\cos 45° - F_{GD}\cos 45° = 0$

$F_{GD} = 1767.77 \text{ lb} = 1768 \text{ lb (C)}$ **Ans.**

$\overset{+}{\rightarrow}\Sigma F_x = 0;$ $\quad 1767.77\sin 45° + 1767.77\sin 45° - F_{GF} = 0$

$F_{GF} = 2500 \text{ lb (T)}$ **Ans.**

Due to the symmetry of the system and the loading,

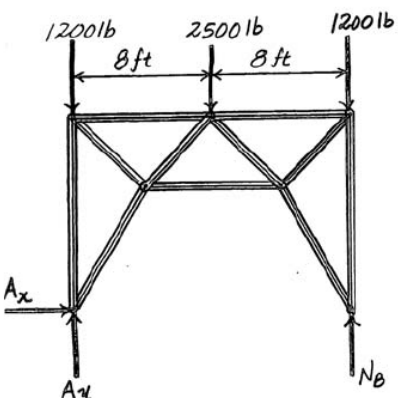
$F_{AE} = F_{BC} = 2450 \text{ lb (C)}$ **Ans.**

$F_{AF} = F_{BG} = 0$ **Ans.**

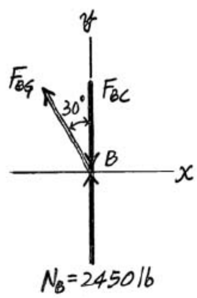
$F_{ED} = F_{CD} = 1250 \text{ lb (C)}$ **Ans.**

$F_{EF} = F_{CG} = 1767.77 \text{ lb} = 1768 \text{ lb (T)}$ **Ans.**

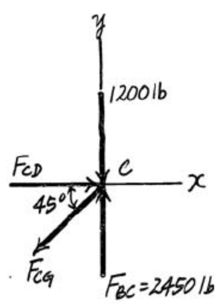
$F_{FD} = F_{GD} = 1767.77 \text{ lb} = 1768 \text{ lb (C)}$ **Ans.**



(a)



(b)



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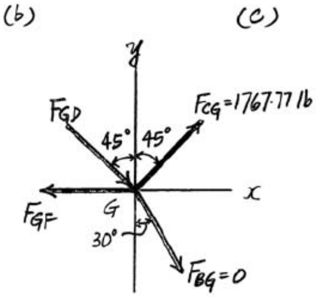
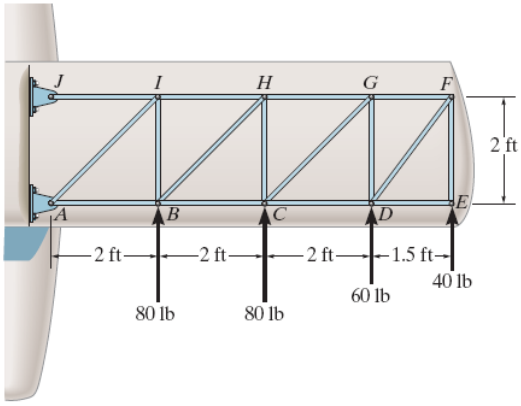
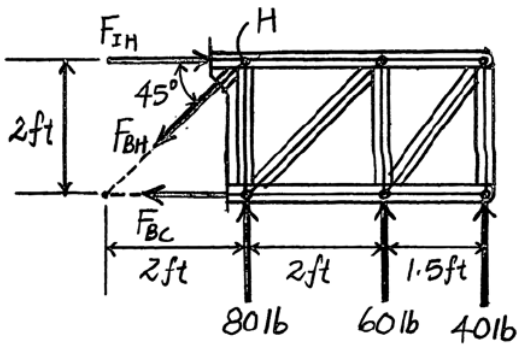


(d)

6–31. The internal drag truss for the wing of a light airplane is subjected to the forces shown. Determine the force in members BC, BH, and HC, and state if the members are in tension or compression.





$+\uparrow \Sigma F_y = 0;\quad 180 - F_{BH}\sin 45° = 0$

$F_{BH} = 255\text{ lb (T)}$ **Ans**

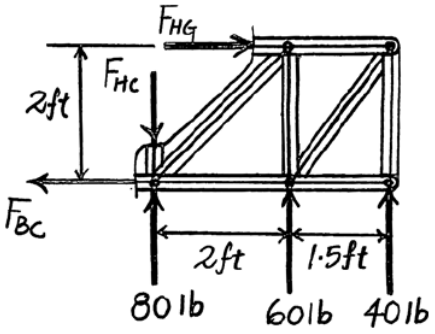
$(+\Sigma M_H = 0;\quad -F_{BC}(2) + 60(2) + 40(3.5) = 0$

$F_{BC} = 130\text{ lb (T)}$ **Ans**

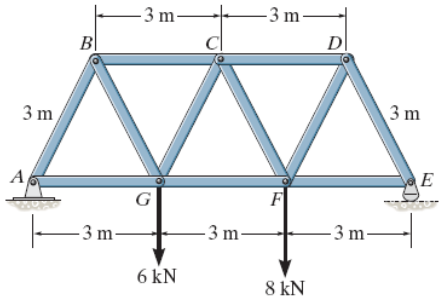
Section 2 :

$+\uparrow \Sigma F_y = 0;\quad 80 + 60 + 40 - F_{HC} = 0$

$F_{HC} = 180\text{ lb (C)}$ **Ans**



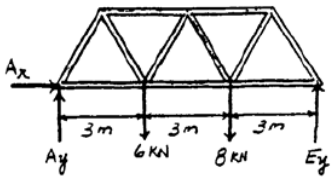
*6–36. Determine the force in members BC, CG, and GF of the *Warren* truss. Indicate if the members are in tension or compression.



Support Reactions :

$\curvearrowleft +\Sigma M_E = 0;\quad 6(6) + 8(3) - A_y(9) = 0 \quad A_y = 6.667\ \text{kN}$

$\overset{+}{\rightarrow} \Sigma F_x = 0;\quad A_x = 0$



Method of Sections :

$\curvearrowleft +\Sigma M_C = 0;\quad F_{GF}(3\sin 60°) + 6(1.5) - 6.667(4.5) = 0$

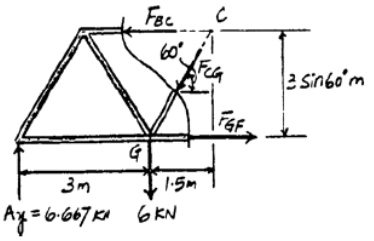
$F_{GF} = 8.08\ \text{kN (T)}$ **Ans**

$\curvearrowleft +\Sigma M_G = 0;\quad F_{BC}(3\sin 60°) - 6.667(3) = 0$

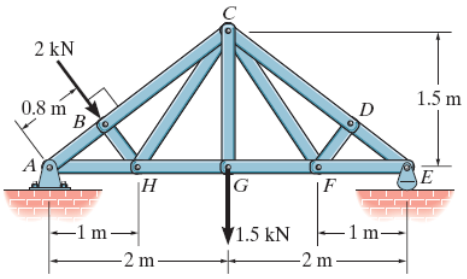
$F_{BC} = 7.70\ \text{kN (C)}$ **Ans**

$+\uparrow \Sigma F_y = 0;\quad 6.667 - 6 - F_{CG}\sin 60° = 0$

$F_{CG} = 0.770\ \text{kN (C)}$ **Ans**



6–46. Determine the force developed in members BC and CH of the roof truss and state if the members are in tension or compression.



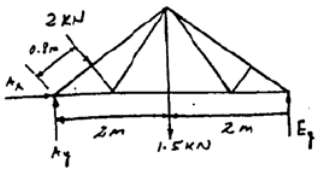
$\circlearrowleft +\Sigma M_A = 0;\quad E_y(4) - 2(0.8) - 1.5(2) = 0 \qquad E_y = 1.15\ \text{kN}$

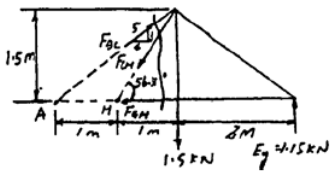
$\circlearrowleft +\Sigma M_H = 0;\quad 1.15(3) - 1.5(1) - \frac{3}{5}F_{BC}(1) = 0$

$F_{BC} = 3.25\ \text{kN}\ (C)$ **Ans**

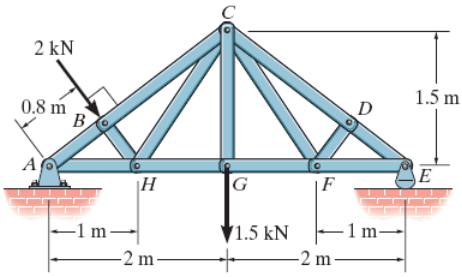
$\circlearrowleft +\Sigma M_A = 0;\quad 1.15(4) - 1.5(2) - F_{CH}\sin 56.31°(1) = 0$

$F_{CH} = 1.92\ \text{kN}\ (T)$ **An**





6–47. Determine the force in members CD and GF of the truss and state if the members are in tension or compression. Also indicate all zero-force members.



Entire truss :

$\zeta + \Sigma M_A = 0;$ $\quad -2\,(0.8) - 1.5\,(2) + E_y\,(4) = 0$

$E_y = 1.15$ kN

Section :

$\zeta + \Sigma M_F = 0;$ $\quad 1.15\,(1) - F_{CD} \sin 36.87°\,(1) = 0$

$F_{CD} = 1.92$ kN (C) **Ans**

$\zeta + \Sigma M_C = 0;$ $\quad -F_{GF}\,(1.5) + 1.15\,(2) = 0$

$F_{GF} = 1.53$ kN (T) **Ans**

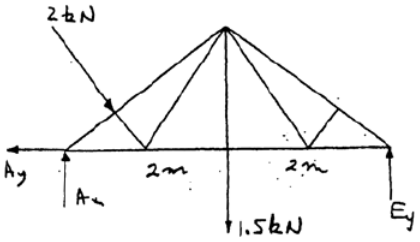
Joint D :

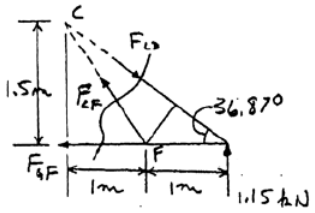
$+\!\!\uparrow \Sigma F_y = 0;$ $\quad F_{FD} = 0$ **Ans**

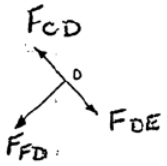
Joint F :

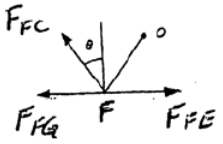
$+\!\uparrow \Sigma F_y = 0;$ $\quad F_{FC} \cos\theta = 0$

$F_{FC} = 0$ **Ans**

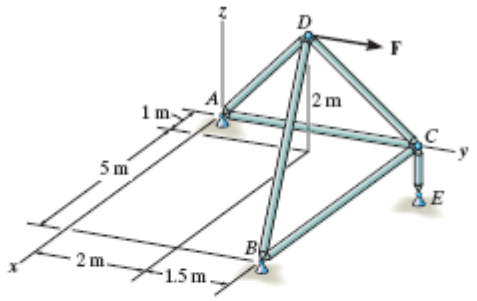


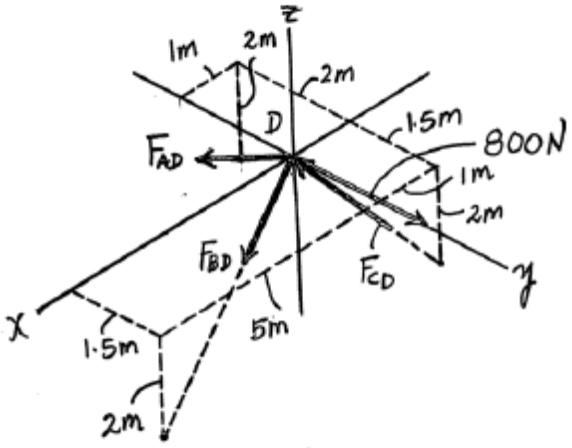






*6–56. Determine the force in each member of the space truss and state if the members are in tension or compression. The truss is supported by ball-and-socket joints at A, B, and E. Set $\mathbf{F} = \{800\mathbf{j}\}$ N. *Hint:* The support reaction at E acts along member EC. Why?





Joint D:

$\Sigma F_x = 0$: $\quad -\frac{1}{3}F_{AD} + \frac{5}{\sqrt{31.25}}F_{BD} + \frac{1}{\sqrt{7.25}}F_{CD} = 0$

$\Sigma F_y = 0$: $\quad -\frac{2}{3}F_{AD} + \frac{1.5}{\sqrt{31.25}}F_{BD} - \frac{1.5}{\sqrt{7.25}}F_{CD} + 800 = 0$

$\Sigma F_z = 0$: $\quad -\frac{2}{3}F_{AD} - \frac{2}{\sqrt{31.25}}F_{BD} + \frac{2}{\sqrt{7.25}}F_{CD} = 0$

$F_{AD} = 686$ N (T) Ans

$F_{BD} = 0$ Ans

$F_{CD} = 615.4 = 615$ N (C) Ans

Joint C:

$\Sigma F_z = 0$: $\quad F_{BC} - \frac{1}{\sqrt{7.25}}(615.4) = 0$

$F_{BC} = 229$ N (T) Ans

$\Sigma F_y = 0$: $\quad \frac{1.5}{\sqrt{7.25}}(615.4) - F_{AC} = 0$

$F_{AC} = 343$ N (T) Ans

$\Sigma F_x = 0$: $\quad F_{BC} - \frac{2}{\sqrt{7.25}}(615.4) = 0$

$F_{BC} = 457$ N (C) Ans