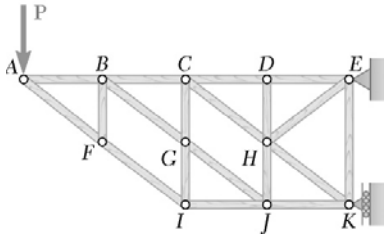
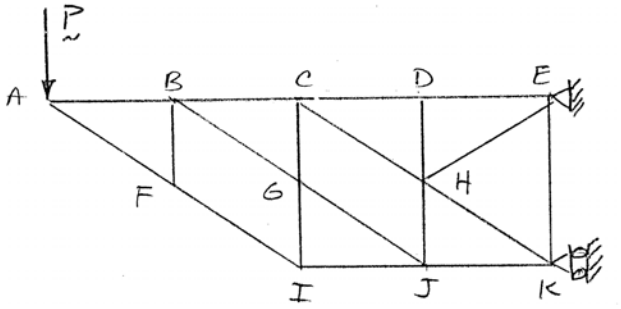
PROBLEM 6.33



For the given loading, determine the zero-force members in the truss shown.

SOLUTION



By inspection of joint F: $F_{BF} = 0$ ◀

Then by inspection of joint B: $F_{BG} = 0$ ◀

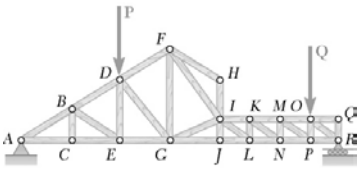
Then by inspection of joint G: $F_{GJ} = 0$ ◀

Then by inspection of joint J: $F_{HJ} = 0$ ◀

By inspection of joint D: $F_{DH} = 0$ ◀

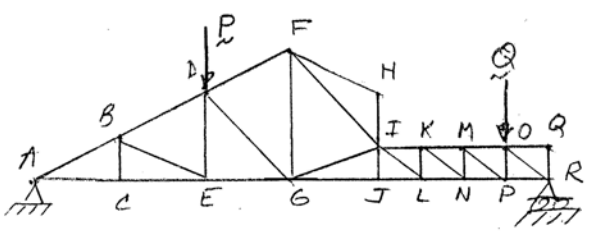
Then by inspection of joint H: $F_{HE} = 0$ ◀

PROBLEM 6.34



For the given loading, determine the zero-force members in the truss shown.

SOLUTION



By inspection of joint C: $F_{BC} = 0$ ◀

Then by inspection of joint B: $F_{BE} = 0$ ◀

Then by inspection of joint E: $F_{DE} = 0$ ◀

By inspection of joint H: $F_{FH} = 0$ ◀

and $F_{HI} = 0$ ◀

By inspection of joint Q: $F_{OQ} = 0$ ◀

and $F_{QR} = 0$ ◀

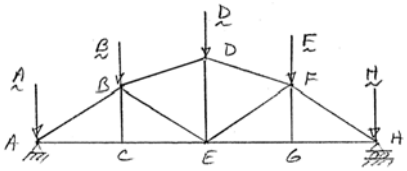
By inspection of joint J: $F_{IJ} = 0$ ◀

PROBLEM 6.35

Determine the zero-force members in the truss of (*a*) Prob. 6.9, (*b*) Prob. 6.19.

SOLUTION

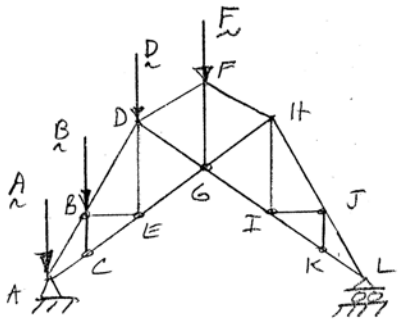
Truss of 6.9:



By inspection of joint *C*: $F_{BC} = 0$ ◀

By inspection of joint *G*: $F_{FG} = 0$ ◀

Truss of 6.19:

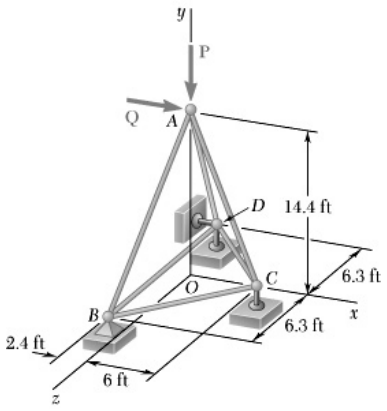


By inspection of joint *C*: $F_{BC} = 0$ ◀

By inspection of joint *K*: $F_{JK} = 0$ ◀

Then by inspection of joint *J*: $F_{IJ} = 0$ ◀

Then by inspection of joint *I*: $F_{HI} = 0$ ◀

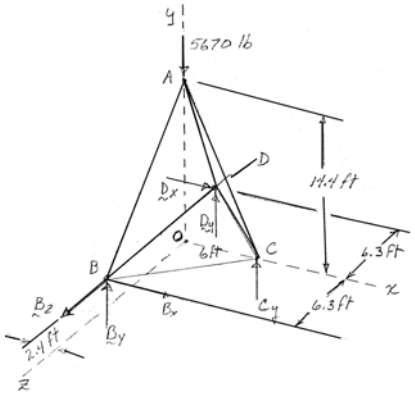


PROBLEM 6.36

The truss shown consists of six members and is supported by a ball and socket at *B*, a short link at *C*, and two short links at *D*. Determine the force in each of the members for $\mathbf{P} = (-5670 \text{ lb})\,\mathbf{j}$ and $\mathbf{Q} = 0$.

SOLUTION

FBD Truss:



$\swarrow \Sigma F_z = 0$: $\mathbf{B}_z = 0$

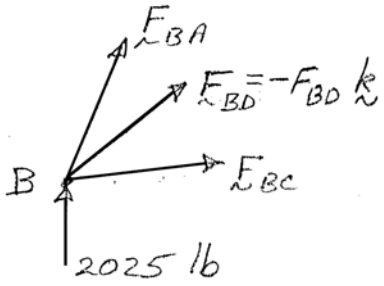
$\circlearrowright \Sigma M_{BD} = 0$: $(2.4 \text{ ft})(5670 \text{ lb}) - (8.4 \text{ ft})C_y = 0$ $\quad \mathbf{C}_y = (1620 \text{ lb})\,\mathbf{j}$

$\leftarrow \Sigma M_x = 0$: $(6.3 \text{ ft})D_y - (6.3 \text{ ft})B_y = 0$ $\quad B_y = D_y$

$\uparrow \Sigma F_y = 0$: $B_y + D_y - 5670 \text{ lb} + 1620 \text{ lb} = 0$ $\quad \mathbf{B}_y = \mathbf{D}_y = (2025 \text{ lb})\,\mathbf{j}$

$\left.\begin{array}{l} \circlearrowleft \Sigma M_y = 0: (6.3 \text{ ft})B_x - (6.3 \text{ ft})D_x = 0 \\ \searrow \Sigma F_x = 0: B_x + D_x = 0 \end{array}\right\}$ $\mathbf{B}_x = \mathbf{D}_x = 0$

Joint *B*:



Where $\mathbf{F}_{BA} = F_{BA}\dfrac{2.4\mathbf{i} + 14.4\mathbf{j} - 6.3\mathbf{k}}{15.9}$

$= F_{BA}(0.1509\mathbf{i} + 0.9057\mathbf{j} - 0.3962\mathbf{k})$

$\mathbf{F}_{BC} = F_{BC}\dfrac{8.4\mathbf{i} - 6.3\mathbf{k}}{10.5} = F_{BC}(0.8\mathbf{i} - 0.6\mathbf{k})$

$\uparrow \Sigma F_y = 0$: $0.9057F_{BA} + 2025 \text{ lb} = 0$

$F_{BA} = -2236 \text{ lb}$ $\quad F_{BA} = 2.24 \text{ kips C} \blacktriangleleft$

By symmetry $F_{AD} = 2.24 \text{ kips C} \blacktriangleleft$

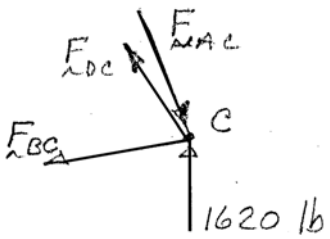
$\searrow \Sigma F_x = 0$: $0.1509(-2236 \text{ lb}) + 0.8F_{BC} = 0$

$F_{BC} = 422 \text{ lb T} \blacktriangleleft$

By symmetry $F_{DC} = 422 \text{ lb T} \blacktriangleleft$

PROBLEM 6.36 CONTINUED

Joint *C*:

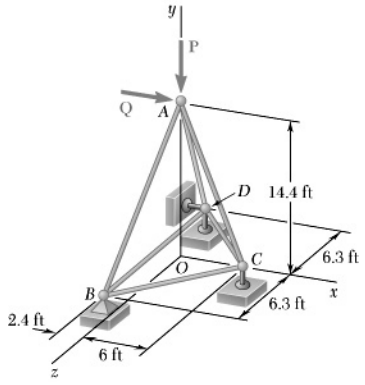


$$\swarrow \Sigma F_z = 0: -0.3962(-2236\text{ lb}) - F_{BD} - 0.6(422\text{ lb}) = 0$$

$$F_{BD} = 633\text{ lb T} \blacktriangleleft$$

$$\mathbf{F}_{AC} = F_{AC}\frac{6\mathbf{i} - 14.4\mathbf{j}}{15.6} = F_{AC}(0.3846\mathbf{i} - 0.9231\mathbf{j})$$

$$\uparrow \Sigma F_y = 0: 1620\text{ lb} - (0.9231)F_{AC} = 0 \qquad F_{AC} = 1755\text{ lb C} \blacktriangleleft$$

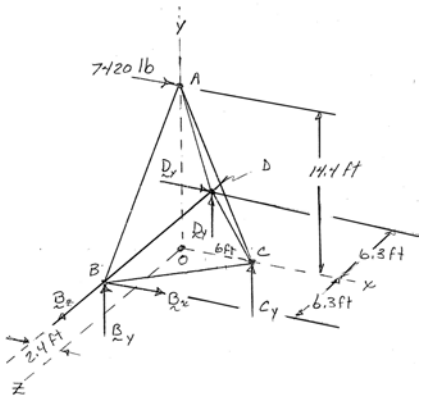


PROBLEM 6.37

The truss shown consists of six members and is supported by a ball and socket at *B*, a short link at *C*, and two short links at *D*. Determine the force in each of the members for $\mathbf{P} = 0$ and $\mathbf{Q} = (7420 \text{ lb})\mathbf{i}$.

SOLUTION

FBD Truss:



$$\swarrow \Sigma F_z = 0: \mathbf{B}_z = 0$$

$$\curvearrowright \Sigma M_{BD} = 0: (8.4 \text{ ft})C_y - (14.4 \text{ ft})(7420 \text{ lb}) = 0$$

$$\mathbf{C}_y = (12720 \text{ lb})\mathbf{j}$$

$$\leftrightarrow \Sigma M_x = 0: (6.3 \text{ ft})(D_y - B_y) = 0 \qquad D_y = B_y$$

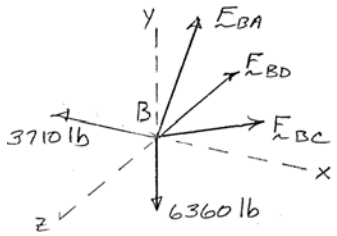
$$\uparrow \Sigma F_y = 0: B_y + D_y + C_y = 0; \qquad 2D_y + 12720 \text{ lb} = 0$$

so $$\mathbf{B}_y = \mathbf{D}_y = -(6360 \text{ lb})\mathbf{j}$$

$$\curvearrowleft \Sigma M_y = 0: (6.3 \text{ ft})(B_x - D_x) = 0; \qquad B_x = D_x$$

$$\searrow \Sigma F_x = 0: \ B_x + D_x + 7420 \text{ lb} = 0; \qquad \mathbf{B}_x = \mathbf{D}_x = -(3710 \text{ lb})\mathbf{i}$$

Joint FBDs:



$$\mathbf{F}_{BA} = F_{BA}\frac{(2.4 \text{ ft}\,\mathbf{i} + 14.4 \text{ ft}\,\mathbf{j} - 6.3 \text{ ft}\,\mathbf{k})}{15.9 \text{ ft}}$$

$$= F_{BA}(0.1509\mathbf{i} + 0.9057\mathbf{j} - 0.3962\mathbf{k}) \qquad \mathbf{F}_{BD} = F_{BD}\mathbf{k}$$

$$\mathbf{F}_{BC} = F_{BC}\frac{(8.4 \text{ ft}\,\mathbf{i} - 6.3 \text{ ft}\,\mathbf{j})}{10.5 \text{ ft}} = F_{BC}(0.8\mathbf{i} - 0.6\mathbf{j})$$

$$\uparrow \Sigma F_y = 0: 0.9057F_{BA} - 6360 \text{ lb} = 0 \qquad F_{BA} = 7022 \text{ lb}$$

$$F_{BA} = 7.02 \text{ kips T} \blacktriangleleft$$

By symmetry $$F_{DA} = 7.02 \text{ kips T} \blacktriangleleft$$

$$\searrow \Sigma F_x = 0: 0.1509(7022 \text{ lb}) + 0.8F_{BC} - 3710 \text{ lb} = 0 \qquad F_{BC} = 3313 \text{ lb}$$

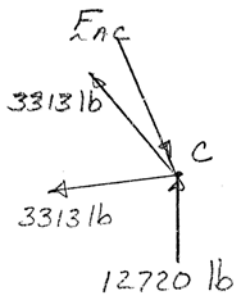
so $$F_{BC} = 3.31 \text{ kips T} \blacktriangleleft$$

By symmetry $$F_{DC} = 3.31 \text{ kips T} \blacktriangleleft$$

$$\swarrow \Sigma F_z = 0: -0.3962(7022 \text{ lb}) + 0.6(3313 \text{ lb}) - F_{BD} = 0$$

$$F_{BD} = -4770 \text{ lb} \qquad F_{BD} = 4.77 \text{ kips C} \blacktriangleleft$$

PROBLEM 6.37 CONTINUED

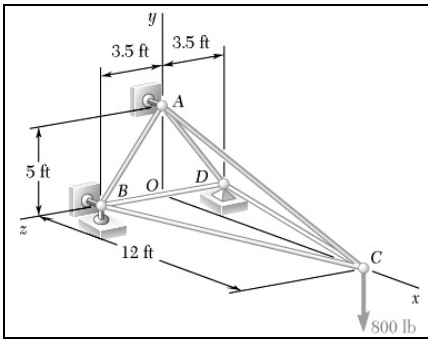


$$\mathbf{F}_{AC} = F_{AC}\frac{(6\text{ ft}\,\mathbf{i} - 14.4\text{ ft}\,\mathbf{j})}{15.6\text{ ft}}$$

$$= F_{AC}(0.3846\mathbf{i} - 0.9231\mathbf{j})$$

$\uparrow \Sigma F_y = 12720\text{ lb} - 0.9231\,F_{AC} = 0;$ $\qquad F_{AC} = 13780\text{ lb}$

$F_{AC} = 1.378\text{ kips}$ C ◀

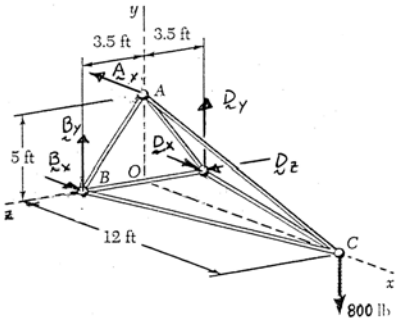


PROBLEM 6.38

The truss shown consists of six members and is supported by a short link at *A*, two short links at *B*, and a ball and socket at *D*. Determine the force in each of the members for the given loading.

SOLUTION

FBD Truss:



$\swarrow \Sigma F_z = 0$: $\mathbf{D}_z = 0$

$\curvearrowright \Sigma M_z = 0$: $(5\text{ ft})A_x - (12\text{ ft})(800\text{ lb}) = 0$ $\quad \mathbf{A}_x = (1920\text{ lb})\mathbf{i}$

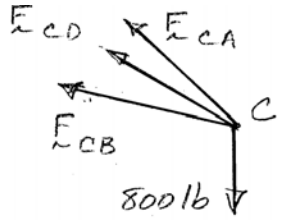
$\curvearrowleft \Sigma M_y = 0$: $(3.5\text{ ft})(B_x - D_x) = 0$; $\quad B_x = D_x$

$\searrow \Sigma F_x = 0$: $B_x + D_x - 1920\text{ lb} = 0$ $\quad$ so $\quad \mathbf{B}_x = \mathbf{D}_x = (960\text{ lb})\mathbf{i}$

$\curvearrowleft \Sigma M_x = 0$: $(3.5\text{ ft})(D_y - B_y) = 0$; $\quad D_y = B_y$

$\uparrow \Sigma F_y = 0$: $B_y + D_y - 800\text{ lb} = 0$ $\quad$ so $\quad \mathbf{B}_y = \mathbf{D}_y = (400\text{ lb})\mathbf{j}$

Joint FBDs:



$$\mathbf{F}_{CA} = F_{AC}\frac{(-12\text{ ft}\,\mathbf{i} + 5\text{ ft}\,\mathbf{j})}{13\text{ ft}} = \frac{F_{AC}}{13}(-12\mathbf{i} + 5\mathbf{j})$$

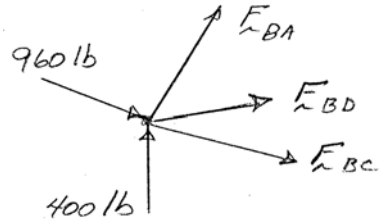
$$\mathbf{F}_{CD} = F_{CD}\frac{(-12\text{ ft}\,\mathbf{i} - 3.5\text{ ft}\,\mathbf{k})}{12.5\text{ ft}} = \frac{F_{CD}}{12.5}(-12\mathbf{i} - 3.5\mathbf{k})$$

Similarly $$F_{CB} = \frac{F_{CB}}{12.5}(-12\mathbf{i} + 3.5\mathbf{k})$$

$\swarrow \Sigma F_z = 0$: $\dfrac{3.5}{12.5}(F_{CB} - F_{CD}) = 0$; $\quad F_{CB} = F_{CD}$

$\uparrow \Sigma F_y = 0$: $F_{AC}\left(\dfrac{5}{13}\right) - 800 = 0$ $\quad F_{AC} = 2080\text{ lb}$

$F_{AC} = 2.08\text{ kips T}$ ◀



$$\mathbf{F}_{BA} = F_{BA}\frac{(5\text{ ft}\,\mathbf{j} - 3.5\text{ ft}\,\mathbf{k})}{6.1033\text{ ft}} = \frac{F_{BA}}{6.1033}(5\mathbf{j} - 3.5\mathbf{k})$$

$$\mathbf{F}_{BD} = -F_{BD}\mathbf{k}$$

$$\mathbf{F}_{BC} = -\mathbf{F}_{CB} = \frac{F_{CB}}{12.5}(+12\mathbf{i} - 3.5\mathbf{k})$$

PROBLEM 6.38 CONTINUED

$$\uparrow \Sigma F_y = 0: \frac{5F_{BA}}{6.1033} + 400 \text{ lb} = 0 \qquad F_{BA} = -488 \text{ lb}$$

so $F_{BA} = 488$ lb C ◀

By symmetry: $F_{AD} = 488$ lb C ◀

$$\rightarrow \Sigma F_x = 0: F_{BC}\left(\frac{12}{12.5}\right) + 960 \text{ lb} = 0 \qquad F_{BC} = -1000 \text{ lb}$$

$F_{BC} = 1.000$ kip C ◀

By symmetry: $F_{CD} = 1.000$ kip C ◀

$$\swarrow \Sigma F_z = 0: -F_{BD} - 488 \text{ lb}\left(\frac{3.5}{6.1033}\right) + (1000 \text{ lb})\frac{3.5}{12.5} = 0$$

$F_{BD} = -559.9$ lb $\qquad F_{BD} = 560$ lb C ◀