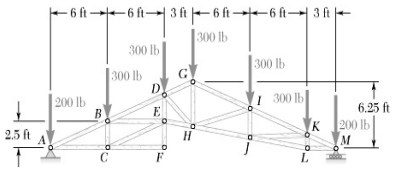
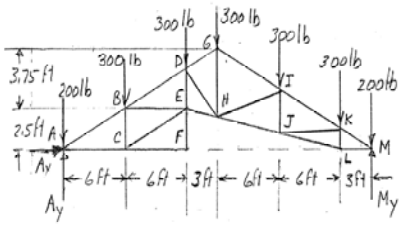


PROBLEM 6.25

For the roof truss shown in Fig. *P6.25* and *P6.26*, determine the force in each of the members located to the left of member *GH*. State whether each member is in tension or compression.

SOLUTION

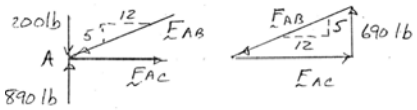
FBD Truss:



$$\circlearrowleft \Sigma M_M = 0: (3\text{ ft})(300\text{ lb}) + (9\text{ ft})(300\text{ lb}) + (15\text{ ft})(300\text{ lb}) + (18\text{ ft})(300\text{ lb}) + (24\text{ ft})(300\text{ lb}) + (30\text{ ft})(200\text{ lb}) - (30\text{ ft})(A_y) = 0 \qquad \mathbf{A}_y = 890\text{ lb} \uparrow$$

$$\rightarrow \Sigma F_x = 0: \ \mathbf{A}_x = 0$$

Joint FBDs:



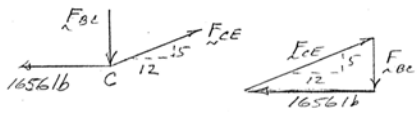
$$\frac{690\text{ lb}}{5} = \frac{F_{AC}}{12} = \frac{F_{AB}}{13}$$

$F_{AB} = 1794\text{ lb}$ C ◀

$F_{AC} = 1656\text{ lb}$ T ◀

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

$F_{EF} = 0$ ◀



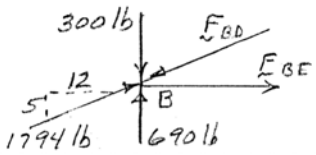
$$\frac{1656\text{ lb}}{12} = \frac{F_{CE}}{13} = \frac{F_{BC}}{5}$$

$F_{CE} = 1794\text{ lb}$ T ◀

$F_{BC} = 890\text{ lb}$ C ◀

$$\uparrow \Sigma F_y = 0: \frac{5}{13}(1794\text{ lb} - F_{BD}) + 690\text{ lb} - 300\text{ lb} = 0$$

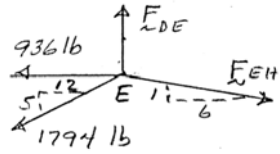
$F_{BD} = 2808\text{ lb}$ $\qquad F_{BD} = 2.81\text{ kips}$ C ◀



$$\rightarrow \Sigma F_x = 0: F_{BE} + \frac{12}{13}(1794\text{ lb} - 2808\text{ lb}) = 0 \qquad F_{BE} = 936\text{ lb}\ \text{T} \blacktriangleleft$$

$$\rightarrow \Sigma F_x = 0: \frac{6}{\sqrt{37}} F_{EH} - 936\text{ lb} - \frac{12}{13}1794\text{ lb} = 0$$

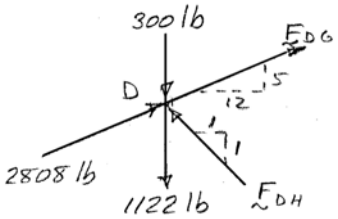
$F_{EH} = 432\sqrt{37}\text{ lb}$ $\qquad F_{EH} = 2.63\text{ kips}$ T ◀



$$\uparrow \Sigma F_y = 0: F_{DE} - \frac{5}{13}(1794\text{ lb}) - \frac{1}{\sqrt{37}}\left(432\sqrt{37}\text{ lb}\right) = 0$$

$F_{DE} = 1122\text{ lb}$ T ◀

PROBLEM 6.25 CONTINUED



$$\rightarrow \Sigma F_x = 0: \frac{12}{13}\left(2808 \text{ lb} + F_{DG}\right) - \frac{1}{\sqrt{2}} F_{DH} = 0$$

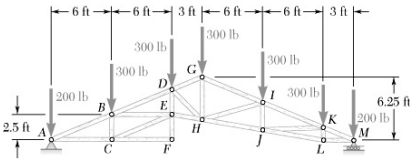
$$\uparrow \Sigma F_y = 0: \frac{5}{13}\left(2808 \text{ lb} + F_{DG}\right) + \frac{1}{\sqrt{2}} F_{DH} - 300 \text{ lb} - 1122 \text{ lb} = 0$$

Solving:

$$F_{DG} = 1721 \text{ lb T} \blacktriangleleft$$

$$F_{DH} = 1419 \text{ lb C} \blacktriangleleft$$

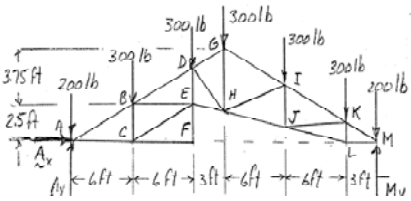
PROBLEM 6.26



Determine the force in member *GH* and in each of the members located to the right of *GH* for the roof truss shown. State whether each member is in tension or compression.

SOLUTION

FBD Truss:

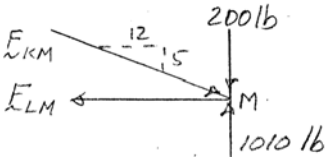


$$\circlearrowleft \Sigma M_A = 0: (30\text{ ft})M_y - (30\text{ ft})(200\text{ lb}) - (27\text{ ft})(300\text{ lb}) - (21\text{ ft})(300\text{ lb}) - (15\text{ ft})(300\text{ lb}) - (12\text{ ft})(300\text{ lb}) - (6\text{ ft})(300\text{ lb}) = 0$$

$$\mathbf{M}_y = 1010\text{ lb} \uparrow$$

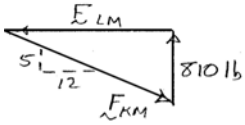
$$\frac{810\text{ lb}}{5} = \frac{F_{LM}}{12} = \frac{F_{KM}}{13}$$

Joint FBDs:



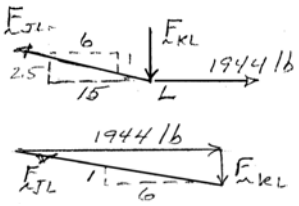
$$F_{KM} = 2106\text{ lb} \qquad F_{KM} = 2.11\text{ kips C} \blacktriangleleft$$

$$F_{LM} = 1944\text{ lb} \qquad F_{LM} = 1.944\text{ kips T} \blacktriangleleft$$



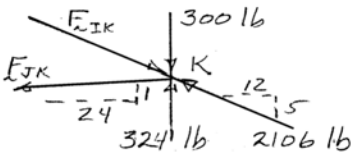
$$\frac{F_{JL}}{\sqrt{37}} = \frac{F_{KL}}{1} = \frac{1944\text{ lb}}{6} \qquad F_{KL} = 324\text{ lb C} \blacktriangleleft$$

$$F_{JL} = 1970.8\text{ lb} \qquad F_{JL} = 1.971\text{ kips T} \blacktriangleleft$$



$$\rightarrow \Sigma F_x = 0: \frac{12}{13}(F_{IK} - 2106\text{ lb}) + \frac{24}{\sqrt{577}}F_{JK} = 0$$

$$\uparrow \Sigma F_y = 0: \frac{5}{13}(-F_{IK} + 2106\text{ lb}) - \frac{1}{\sqrt{577}}F_{JK} + 24\text{ lb} = 0$$

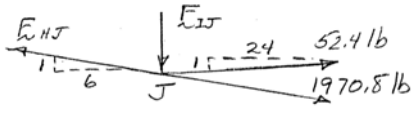


Solving: $F_{IK} = 2162.7\text{ lb} \qquad F_{IK} = 2.16\text{ kips C} \blacktriangleleft$

$$F_{JK} = 52.4\text{ lb T} \blacktriangleleft$$

$$\rightarrow \Sigma F_x = 0: \frac{6}{\sqrt{37}}(1970.8\text{ lb} - F_{HJ}) + \frac{24}{\sqrt{577}}(52.4\text{ lb}) = 0$$

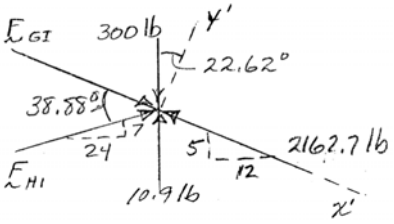
$$F_{HJ} = 2024\text{ lb} \qquad F_{HJ} = 2.02\text{ kips T} \blacktriangleleft$$



$$\uparrow \Sigma F_y = 0: \frac{1}{\sqrt{37}}(2024\text{ lb} - 1970.8\text{ lb}) + \frac{1}{\sqrt{577}}(52.4\text{ lb}) - F_{IJ} = 0$$

$$F_{IJ} = 10.90\text{ lb C} \blacktriangleleft$$

PROBLEM 6.26 CONTINUED

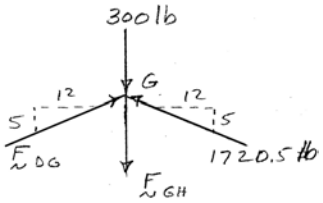


$$\nearrow \Sigma F_{y'} = 0: F_{HI}\sin 38.88° + (10.9 \text{ lb} - 300 \text{ lb})\cos 22.62° = 0$$

$$F_{HJ} = 425.1 \text{ lb} \qquad F_{HI} = 425 \text{ lb C} \blacktriangleleft$$

$$\searrow \Sigma F_{x'} = 0: F_{GI} + F_{HI}\cos 38.88° + (300 \text{ lb} - 10.9 \text{ lb})\sin 22.62°$$

$$-2162.7 \text{ lb} = 0 \qquad F_{GI} = 1720.5 \text{ lb} = 1.721 \text{ kips C} \blacktriangleleft$$



By symmetry $F_{DG} = 1720.5$ lb

$$\uparrow \Sigma F_y = 0: \frac{5}{13}2(1720.5 \text{ lb}) - 300 \text{ lb} - F_{GH} = 0$$

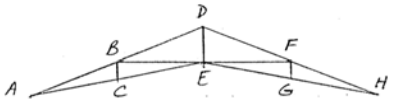
$$F_{GH} = 1023.46 \text{ lb} \qquad F_{GH} = 1.023 \text{ kips T} \blacktriangleleft$$

PROBLEM 6.27

Determine whether the trusses of Probs. 6.13, 6.14, and 6.25 are simple trusses.

SOLUTION

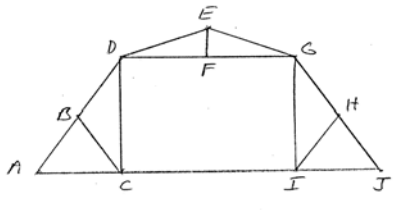
Truss of 6.13:



Start with ΔABC and add, in order, joints E, D, F, G, H

This is a simple truss. ◀

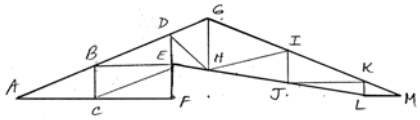
Truss of 6.14:



ABDC, *DEGF*, and *GHJI* are all individually simple trusses, but no simple extension (one joint, two members at a time) will produce the given truss:

$\therefore$ Not a simple truss. ◀

Truss of 6.25:



Starting with ΔABC, add, in order, joints $E, F, D, H, G, I, J, K, L, M$

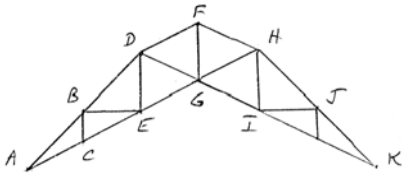
This is a simple truss. ◀

PROBLEM 6.28

Determine whether the trusses of Probs. 6.19, 6.21, and 6.23 are simple trusses.

SOLUTION

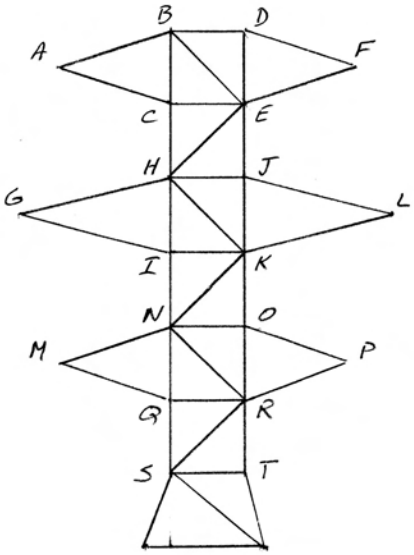
Truss of 6.19:



Start with ΔABC, and add, in order, *E*, *D*, *G*, *F*, *H*, *I*, *J*, *K*

$\therefore$ Simple truss ◀

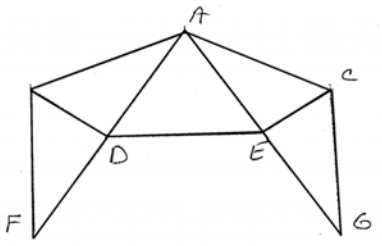
Truss of 6.21:



Start with ΔABC, and add, in order, *E*, *D*, *F*, *H*, *J*, *K*, *I*, *G*, *L*, *N*, *O*, *R*, *Q*, *M*, *P*, *S*, *T*, etc.

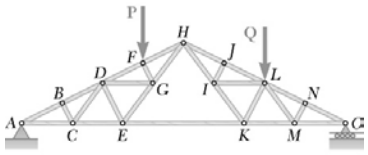
$\therefore$ Simple truss ◀

Truss of 6.23:



Start with ΔBDF, and add, in order, *A*, *E*, *C*, *G*.

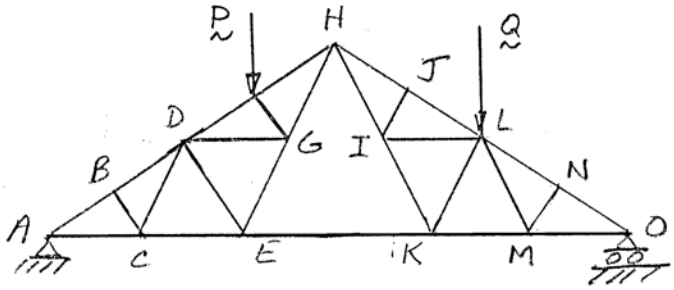
$\therefore$ Simple truss ◀



PROBLEM 6.29

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

SOLUTION



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

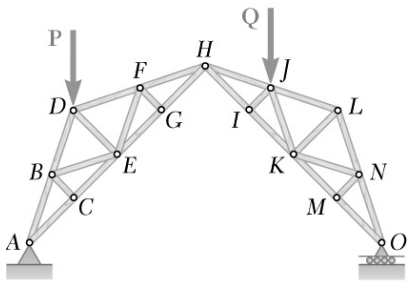
Then by inspection of joint C: $F_{CD} = 0$ ◀

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

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

By inspection of joint N: $F_{MN} = 0$ ◀

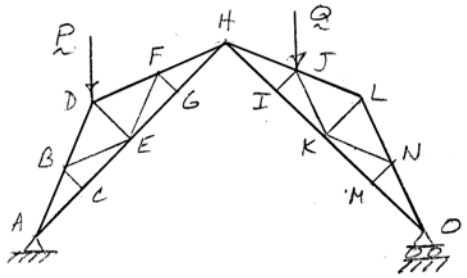
Then by inspection of joint M: $F_{LM} = 0$ ◀



PROBLEM 6.30

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: $F_{BE} = 0$ ◀

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

Then by inspection of joint F: $F_{EF} = 0$ ◀

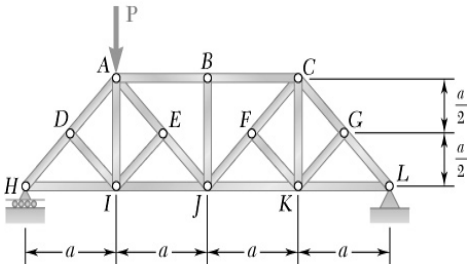
Then by inspection of joint E: $F_{DE} = 0$ ◀

By inspection of joint M: $F_{MN} = 0$ ◀

Then by inspection of joint N: $F_{KN} = 0$ ◀

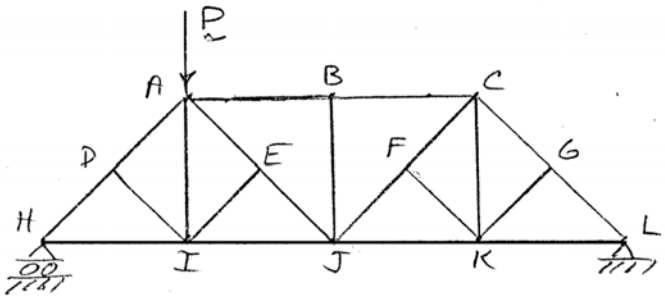
By inspection of joint I: $F_{IJ} = 0$ ◀

PROBLEM 6.31



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

SOLUTION



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

By inspection of joint *E*: $F_{EI} = 0$ ◀

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

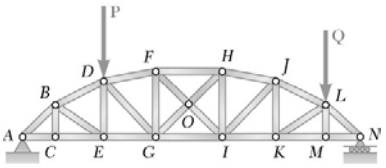
By inspection of joint *B*: $F_{BJ} = 0$ ◀

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

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

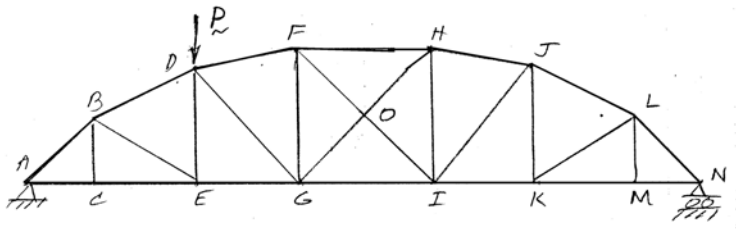
Then by inspection of joint *K*: $F_{CK} = 0$ ◀

PROBLEM 6.32



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

SOLUTION



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

By inspection of joint M: $F_{LM} = 0$ ◀