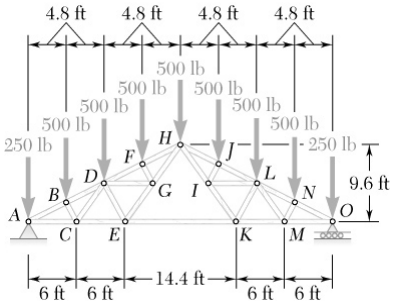
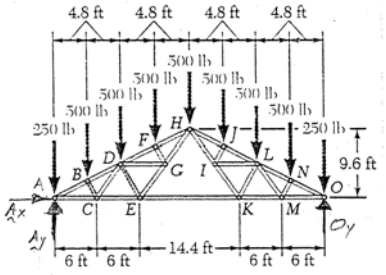
PROBLEM 6.54



A Fink roof truss is loaded as shown. Determine the force in members *DF*, *DG*, and *EG*. (*Hint:* First determine the force in member *EK*.)

SOLUTION

FBD Truss:

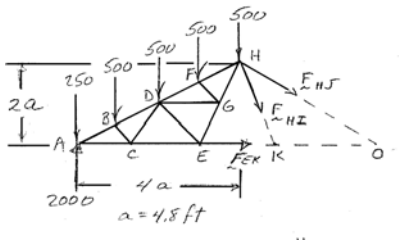


$\rightarrow \Sigma F_x = 0$: $\mathbf{A}_x = 0$

By symmetry: $\mathbf{A}_y = \mathbf{O}_y = 2000 \text{ lb} \uparrow$

FBD Sections:

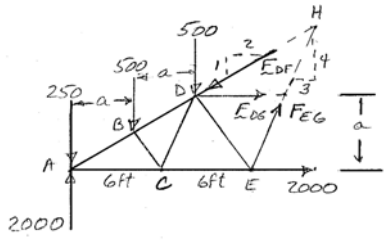
Forces in 1b



$\circlearrowleft \Sigma M_H = 0$: $(a + 2a + 3a)(500 \text{ lb}) + 4a(250 \text{ lb}) - 4a(2000 \text{ lb}) + 2aF_{EK} = 0$

$F_{EK} = 2000 \text{ lb T}$

$\circlearrowleft \Sigma M_D = 0$: $a(500 \text{ lb}) + 2a(250 \text{ lb}) - 2a(2000 \text{ lb}) + a(2000 \text{ lb}) + a\left(\frac{3}{5}F_{EG}\right) + (12 \text{ ft} - 2a)\left(\frac{4}{5}F_{EG}\right) = 0$



$F_{EG} = 1000 \text{ lb}$ $\qquad F_{EG} = 1.000 \text{ kip T} \blacktriangleleft$

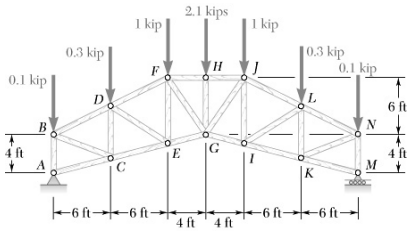
$\uparrow \Sigma F_y = 0$: $\frac{4}{5}(1000 \text{ lb}) - \frac{1}{\sqrt{5}}F_{DF} + (2000 - 250 - 500 - 500) \text{ lb} = 0$

$F_{DF} = 1550\sqrt{5} \text{ lb}$ $\qquad F_{DF} = 3.47 \text{ kips C} \blacktriangleleft$

$\rightarrow \Sigma F_x = 0$: $2000 \text{ lb} + \frac{3}{5}(1000 \text{ lb}) - \frac{2}{\sqrt{5}}\left(1550\sqrt{5} \text{ lb}\right) + F_{DG} = 0$

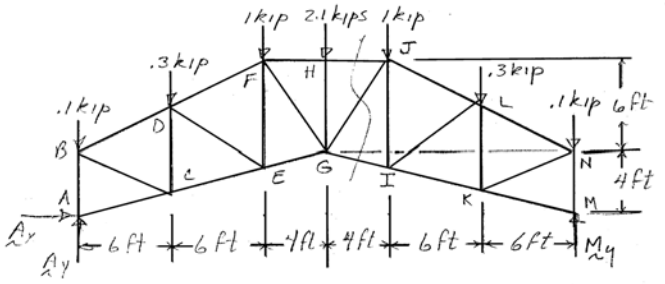
$F_{DG} = 500 \text{ lb T} \blacktriangleleft$

PROBLEM 6.55



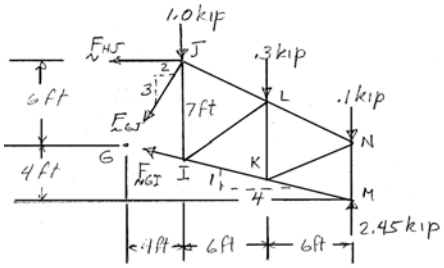
A roof truss is loaded as shown. Determine the force in members *FH*, *GJ*, and *GI*.

SOLUTION



By symmetry: $\mathbf{A}_y = \mathbf{M}_y = 2.45 \text{ kips} \uparrow$

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



$$\circlearrowleft \Sigma M_J = 6 \text{ ft}(0.3 \text{ kip}) - 12 \text{ ft}(2.35 \text{ kips}) + 7 \text{ ft}\left(\frac{4}{\sqrt{17}} F_{GI}\right) = 0$$

$$F_{GI} = 3.887 \text{ kips} \qquad F_{GI} = 3.89 \text{ kips T} \blacktriangleleft$$

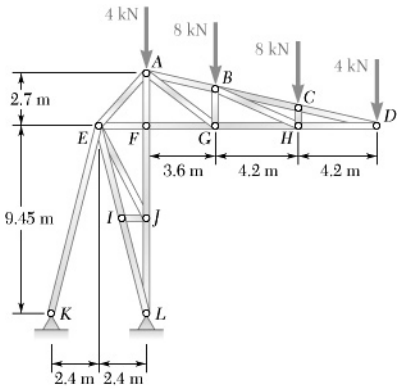
$$\circlearrowleft \Sigma M_G = (6 \text{ ft}) F_{HJ} - (4 \text{ ft})(1.0 \text{ kips}) - (10 \text{ ft})(0.3 \text{ kips}) - (16 \text{ ft})(0.1 \text{ kips})$$

$$+ (16 \text{ ft})(2.45 \text{ kips}) = 0 \qquad F_{HJ} = -5.10 = 5.10 \text{ kips C}$$

By inspection: $F_{FH} = F_{HJ} = 5.10 \text{ kips C} \blacktriangleleft$

$$\uparrow \Sigma F_y = 0: \frac{1}{\sqrt{17}}(3.887 \text{ kips}) + 2.45 \text{ kips} - 1.4 \text{ kips} - \frac{3}{\sqrt{13}} F_{GJ} = 0$$

$$F_{GJ} = 2.40 \text{ kips T} \blacktriangleleft$$

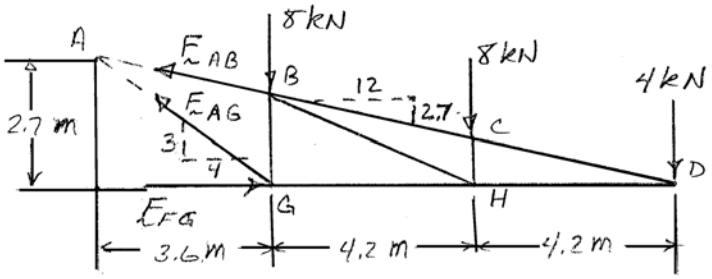


PROBLEM 6.56

A stadium roof truss is loaded as shown. Determine the force in members *AB*, *AG*, and *FG*.

SOLUTION

FBD Section:



Note: $\widehat{BG} = \dfrac{8.4}{12.0}(2.7\text{ m}) = 1.89\text{ m}$

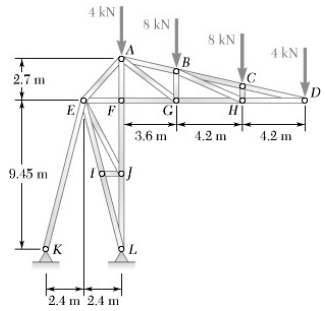
$$\circlearrowleft \Sigma M_A = 0: (2.7\text{ m})F_{FG} - (3.6\text{ m})(8\text{ kN}) - (7.8\text{ m})(8\text{ kN}) - (12\text{ m})(4\text{ kN}) = 0$$

$$F_{FG} = 51.56\text{ kN} \qquad F_{FG} = 51.6\text{ kN C} \blacktriangleleft$$

$$\circlearrowleft \Sigma M_G = 0: (1.89\text{ m})\left(\frac{12}{12.3}F_{AB}\right) - (4.2\text{ m})(8\text{ kN}) - (8.4\text{ m})(4\text{ kN}) = 0$$

$$F_{AB} = 36.44\text{ kN} \qquad F_{AB} = 36.4\text{ kN T} \blacktriangleleft$$

$$\circlearrowleft \Sigma M_D = 0: (4.2\text{ m})(8\text{ kN}) + (8.4\text{ m})(8\text{ kN}) - (8.4\text{ m})\left(\frac{3}{5}F_{AG}\right) = 0 \qquad F_{AG} = 20.0\text{ kN T} \blacktriangleleft$$

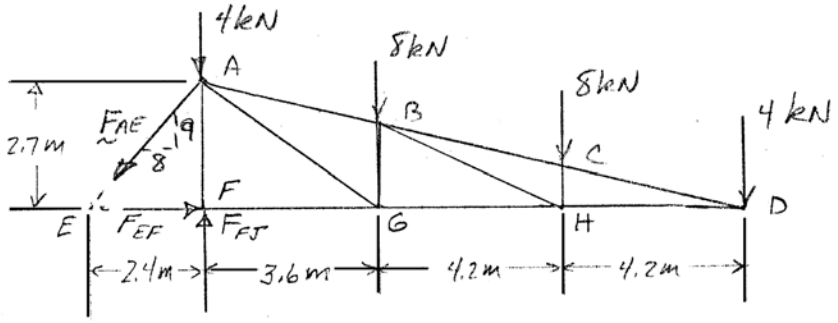


PROBLEM 6.57

A stadium roof truss is loaded as shown. Determine the force in members *AE*, *EF*, and *FJ*.

SOLUTION

FBD Section:



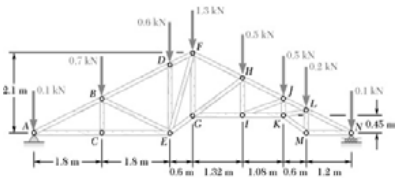
$$\circlearrowleft \Sigma M_F = 0: (2.7\text{ m})\left(\frac{8}{\sqrt{145}}F_{AE}\right) - (3.6\text{ m})(8\text{ kN}) - (7.8\text{ m})(8\text{ kN}) - (12\text{ m})(4\text{ kN}) = 0$$

$$F_{AE} = \frac{17.4}{2.7}\sqrt{145}\text{ kN} \qquad F_{AE} = 77.6\text{ kN T} \blacktriangleleft$$

$$\rightarrow \Sigma F_x = 0: F_{EF} - \frac{8}{\sqrt{145}}\left(\frac{17.4}{2.7}\sqrt{145}\text{ kN}\right) = 0$$

$$F_{EF} = 51.555\text{ kN} \qquad F_{EF} = 51.6\text{ kN C} \blacktriangleleft$$

$$\uparrow \Sigma F_y = 0: F_{FJ} - \frac{9}{\sqrt{145}}\left(\frac{17.4}{2.7}\sqrt{145}\text{ kN}\right) - (4 + 8 + 8 + 4)\text{ kN} = 0 \qquad F_{FJ} = 82.0\text{ kN C} \blacktriangleleft$$

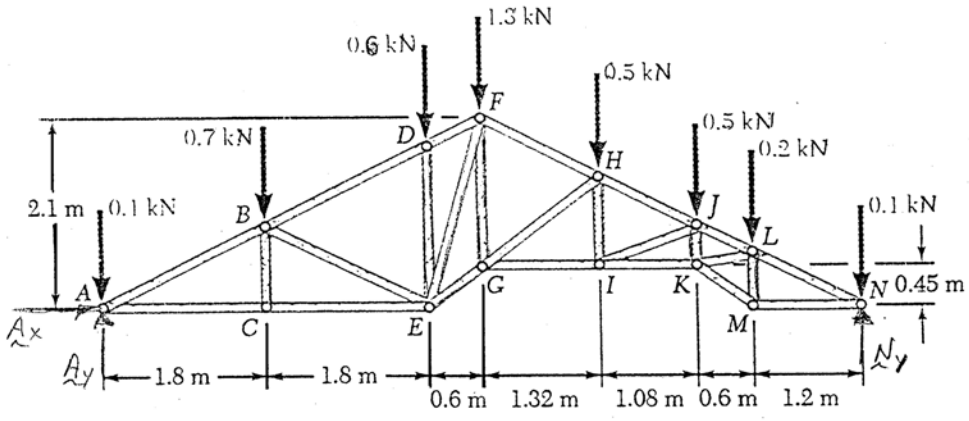


PROBLEM 6.58

A vaulted roof truss is loaded as shown. Determine the force in members *BE*, *CE*, and *DF*.

SOLUTION

FBD Truss:



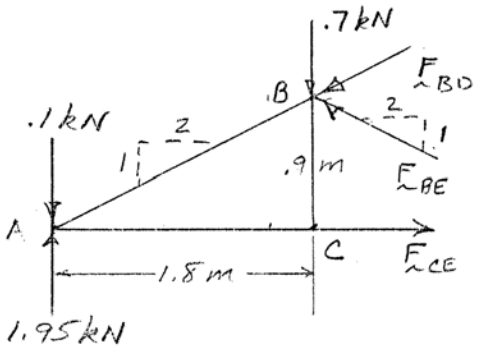
$$\circlearrowleft \Sigma M_N = 0: (1.2\text{ m})(0.2\text{ kN}) + (1.8\text{ m})(0.5\text{ kN}) + (2.88\text{ m})(0.5\text{ kN}) + (4.2\text{ m})(1.3\text{ kN})$$

$$+ (4.8\text{ m})(0.6\text{ kN}) + (6.6\text{ m})(0.7\text{ kN}) + (8.4\text{ m})(0.1\text{ kN}) - (8.4\text{ m})A_y = 0$$

$$\mathbf{A}_y = 1.95\text{ kN} \uparrow$$

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

FBD Section:



$$\circlearrowleft \Sigma M_B = 0: (0.9\text{ m})F_{CE} - (1.8\text{ m})(1.95\text{ kN} - 0.1\text{ kN}) = 0 \qquad F_{CE} = 3.70\text{ kN T} \blacktriangleleft$$

PROBLEM 6.58 CONTINUED

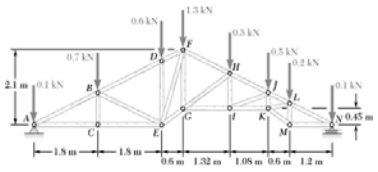
$$\circlearrowleft \Sigma M_A = 0: (1.8\text{ m})\left[\left(\frac{1}{\sqrt{5}}F_{BE}\right) - .7\text{ kN}\right] + (.9\text{ m})\left(\frac{2}{\sqrt{5}}F_{BE}\right) = 0$$

$$F_{BE} = 0.35\sqrt{5}\text{ kN} \qquad F_{BE} = 783\text{ N C} \blacktriangleleft$$

$$\rightarrow \Sigma F_x = 0: 3.70\text{ kN} - \frac{2}{\sqrt{5}}\left(0.35\sqrt{5}\text{ kN}\right) - \frac{2}{\sqrt{5}}F_{BD} = 0$$

$$F_{BD} = 1.5\sqrt{5}\text{ kN} = 3.35\text{ kN C}$$

Then by inspection of joint D: $F_{DF} = F_{BD}$ so $F_{DF} = 3.35\text{ kN C} \blacktriangleleft$

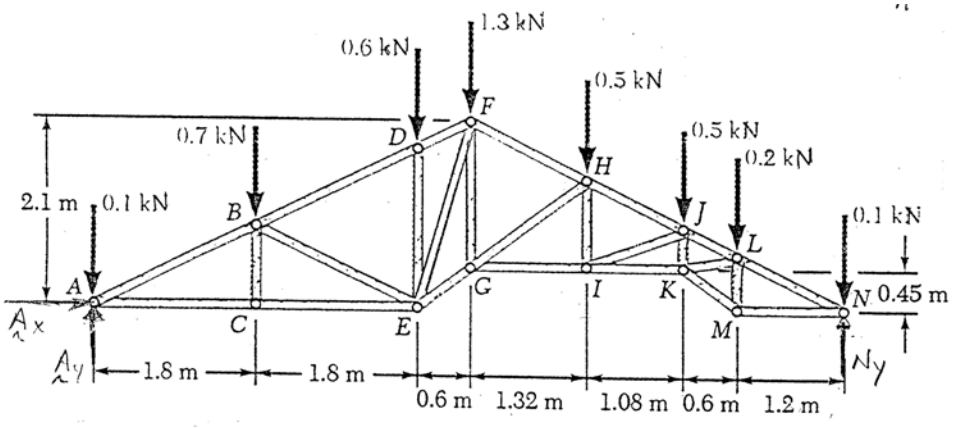


PROBLEM 6.59

A vaulted roof truss is loaded as shown. Determine the force in members *HJ*, *IJ*, and *GI*.

SOLUTION

FBD Truss:

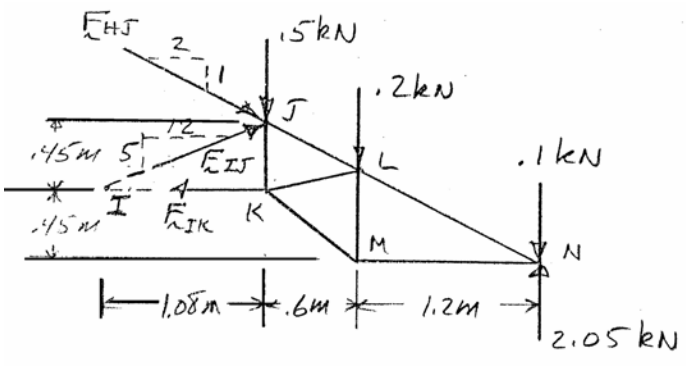


$$\circlearrowleft \Sigma M_A = 0: (1.8\text{ m})(0.7\text{ kN}) + (3.6\text{ m})(0.6\text{ kN}) + (4.2\text{ m})(1.3\text{ kN}) + (5.52\text{ m})(0.5\text{ kN})$$

$$+ (6.6\text{ m})(0.5\text{ kN}) + (7.2\text{ m})(0.2\text{ kN}) + (8.4\text{ m})(0.1\text{ kN}) - (8.4\text{ m})(N_y) = 0$$

$$\mathbf{N}_y = 2.05\text{ kN} \uparrow$$

FBD Section:



$$\circlearrowleft \Sigma M_J = 0: (1.8\text{ m})(2.05 - 0.1)\text{ kN} - (0.6\text{ m})(0.2\text{ kN}) + (0.45\text{ m})F_{IK} = 0$$

$$F_{IK} = 7.533\text{ kN} \qquad F_{IK} = 7.53\text{ kN T}$$

PROBLEM 6.59 CONTINUED

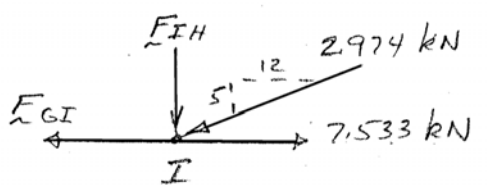
$$\circlearrowleft \Sigma M_I = 0: (2.88\text{ m})(2.05 - 0.1)\text{ kN} - (1.68\text{ m})(0.2\text{ kN}) - (0.45\text{ m})\left(\frac{2}{\sqrt{5}}F_{HJ}\right) - (1.08\text{ m})\left(\frac{1}{\sqrt{5}}F_{HJ}\right) = 0$$

$$F_{HJ} = 2.3939\sqrt{5}\text{ kN} \qquad F_{HJ} = 5.35\text{ kN C} \blacktriangleleft$$

$$\uparrow \Sigma F_y = 0: -\frac{1}{\sqrt{5}}\left(2.3939\sqrt{5}\text{ kN}\right) + \frac{5}{13}F_{IJ} + 2.05\text{ kN} - 0.5\text{ kN} - 0.2\text{ kN} - 0.1\text{ kN} = 0$$

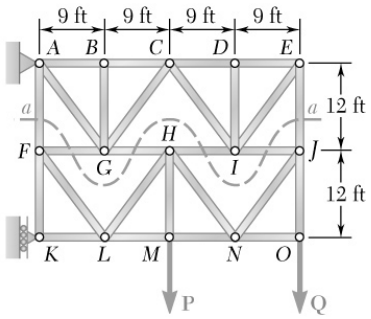
$$F_{IJ} = 2.974\text{ kN} \qquad F_{IJ} = 2.97\text{ kN C} \blacktriangleleft$$

FBD Joint:



$$\rightarrow \Sigma F_x = 0: -F_{GI} - \frac{12}{13}(2.974\text{ kN}) + 7.533\text{ kN} = 0$$

$$F_{GI} = 4.788\text{ kN} \qquad F_{GI} = 4.79\text{ kN T} \blacktriangleleft$$

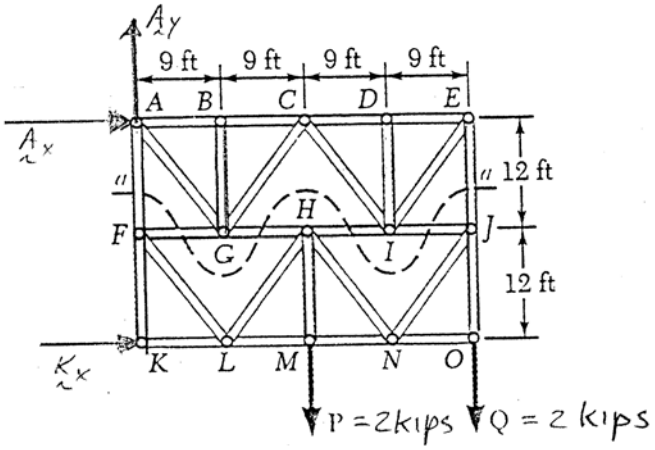


PROBLEM 6.60

Determine the force in members *AF* and *EJ* of the truss shown when $P = Q = 2$ kips. (*Hint:* Use section *aa*.)

SOLUTION

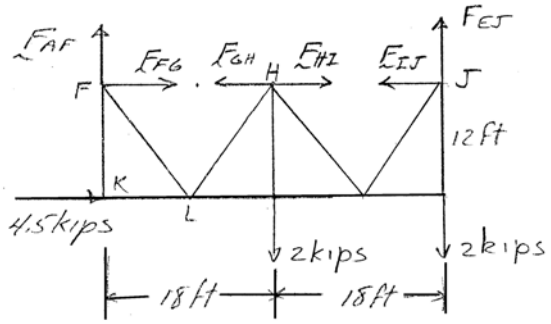
FBD Truss:



$$\circlearrowleft \Sigma M_A = 0: (24\text{ ft})K_x - (18\text{ ft})(2\text{ kips}) - (36\text{ ft})(2\text{ kips}) = 0$$

$$\mathbf{K}_x = 4.5\text{ kips} \rightarrow$$

FBD Section:

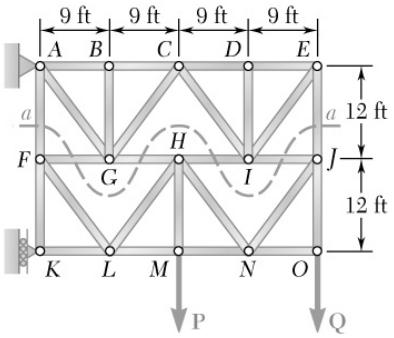


$$\circlearrowleft \Sigma M_F = 0: (12\text{ ft})(4.5\text{ kips}) - (18\text{ ft})(2\text{ kips}) - (36\text{ ft})(2\text{ kips}) + (36\text{ ft})F_{EJ} = 0$$

$$F_{EJ} = 1.500\text{ kips T} \blacktriangleleft$$

$$\circlearrowleft \Sigma M_J = 0: (18\text{ ft})(2\text{ kips}) + (12\text{ ft})(4.5\text{ kips}) - (36\text{ ft})F_{AF} = 0$$

$$F_{AF} = 2.50\text{ kips T} \blacktriangleleft$$

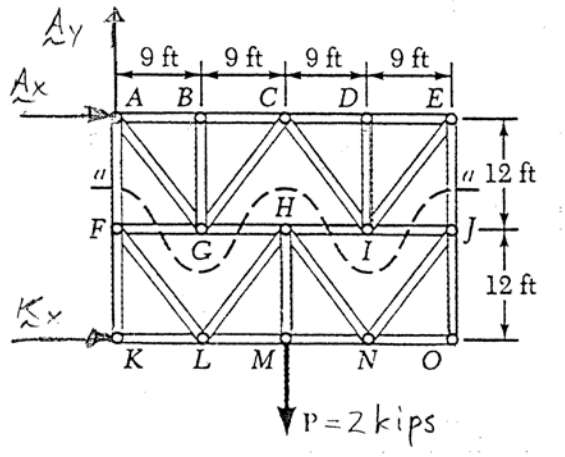


PROBLEM 6.61

Determine the force in members *AF* and *EJ* of the truss shown when $P = 2$ kips and $Q = 0$. (*Hint:* Use section *aa*.)

SOLUTION

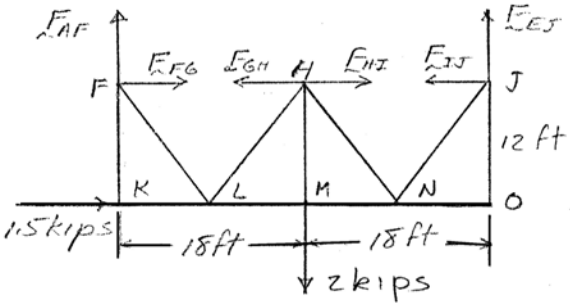
FBD Truss:



$$\circlearrowleft \Sigma M_A = 0: (24 \text{ ft})K_x - (18 \text{ ft})(2 \text{ kips}) = 0$$

$$\mathbf{K}_x = 1.5 \text{ kips} \rightarrow$$

FBD Section:



$$\circlearrowleft \Sigma M_F = 0: (12 \text{ ft})(1.5 \text{ kips}) - (18 \text{ ft})(2 \text{ kips}) + (36 \text{ ft})F_{EJ} = 0 \qquad F_{EJ} = 0.500 \text{ kip T} \blacktriangleleft$$

$$\circlearrowleft \Sigma M_J = 0: (18 \text{ ft})(2 \text{ kips}) + (12 \text{ ft})(1.5 \text{ kips}) - (36 \text{ ft})F_{AF} = 0 \qquad F_{AF} = 1.500 \text{ kips T} \blacktriangleleft$$