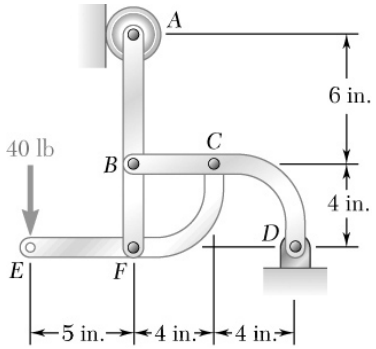
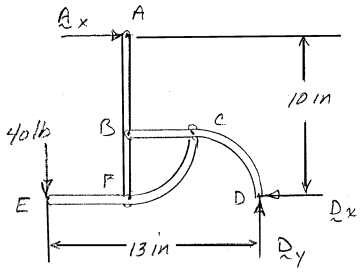


PROBLEM 6.163

For the frame and loading shown, determine the components of the forces acting on member *CFE* at *C* and at *F*.

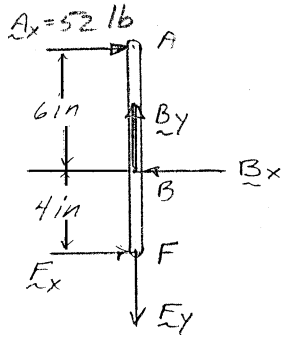
SOLUTION

FBD Frame:



$\circlearrowleft \Sigma M_D = 0$: $(13 \text{ in.})(40 \text{ lb}) - (10 \text{ in.})A_x = 0$ $\quad \mathbf{A}_x = 52 \text{ lb} \rightarrow$

FBD ABF:

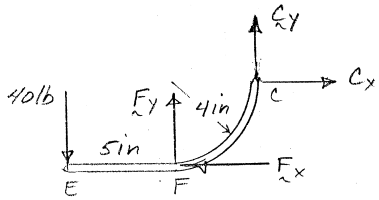


$\circlearrowleft \Sigma M_B = 0$: $(4 \text{ in.})F_x - (6 \text{ in.})(52 \text{ lb}) = 0$

$F_x = 78 \text{ lb} \rightarrow$ on *ABF*

on *CFE* from above $\quad \mathbf{F}_x = 78.0 \text{ lb} \leftarrow$ ◀

FBD CFE:



$\circlearrowleft \Sigma M_c = 0$: $(9 \text{ in.})(40 \text{ lb}) - (4 \text{ in.})F_y - (4 \text{ in.})(78 \text{ lb}) = 0$

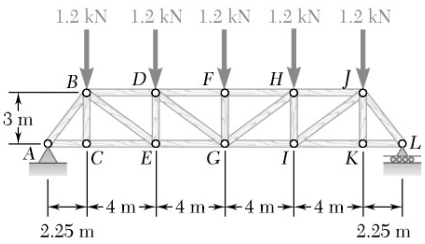
$\mathbf{F}_y = 12.00 \text{ lb} \uparrow$ ◀

$\circlearrowleft \Sigma F_x = 0$: $C_x - F_x = 0$ $\quad C_x = 78 \text{ lb}$

$\mathbf{C}_x = 78.0 \text{ lb} \rightarrow$ ◀

$\uparrow \Sigma F_y = 0$: $-40 \text{ lb} + F_y + C_y = 0$

$C_y = 40 \text{ lb} - 12 \text{ lb} = 28 \text{ lb}$ $\quad \mathbf{C}_y = 28.0 \text{ lb} \uparrow$ ◀

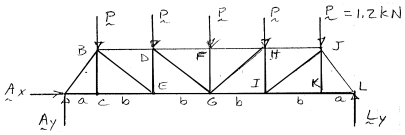


PROBLEM 6.164

A Mansard roof truss is loaded as shown. Determine the force in members *DF*, *DG*, and *EG*.

SOLUTION

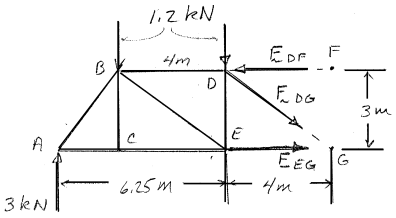
FBD Truss:



$$\rightarrow \Sigma F_x = 0: A_x = 0$$

By symmetry: $A_y = L_y = \dfrac{5P}{2}$ or $A_y = L_y = 3\text{ kN}\uparrow$

FBD Section:



$$\circlearrowleft \Sigma M_D = 0: (3\text{ m})F_{EG} + (4\text{ m})(1.2\text{ kN}) - (6.25\text{ m})(3\text{ kN}) = 0$$

$$F_{EG} = 4.65\text{ kN T} \blacktriangleleft$$

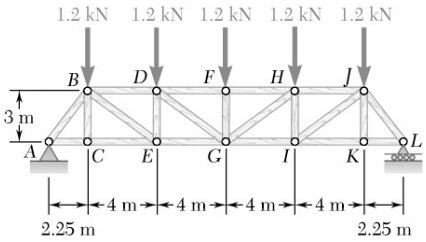
$$\uparrow \Sigma F_y = 0: 3\text{ kN} - 2(1.2\text{ kN}) - \frac{3}{5}F_{DG} = 0$$

$$F_{DG} = 1.000\text{ kN T} \blacktriangleleft$$

$$\rightarrow \Sigma F_x = 0: F_{EG} + \frac{4}{5}F_{DG} - F_{DF} = 0$$

$$F_{DF} = 4.65\text{ kN} + \frac{4}{5}(1\text{ kN}) = 5.45\text{ kN}$$

$$F_{DF} = 5.45\text{ kN C} \blacktriangleleft$$

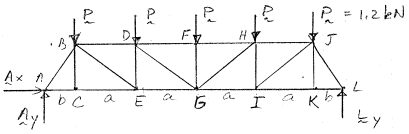


PROBLEM 6.165

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

SOLUTION

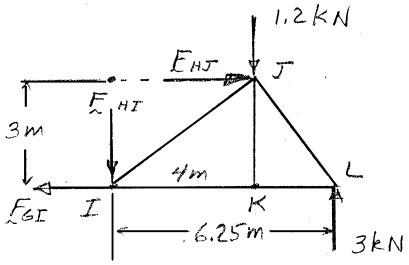
FBD Truss:



$\rightarrow \Sigma F_x = 0: A_x = 0$

By symmetry: $A_y = L_y = \dfrac{5P}{2}$ or $A_y = L_y = 3\text{ kN} \uparrow$

FBD Section:



$\circlearrowleft \Sigma M_I = 0: (6.25\text{ m})(3\text{ kN}) - (4\text{ m})(1.2\text{ kN}) - (3\text{ m})F_{HJ} = 0$

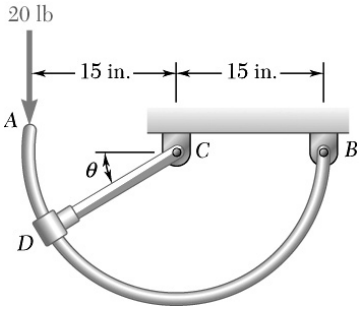
$F_{HJ} = 4.65\text{ kN C} \blacktriangleleft$

$\rightarrow \Sigma F_x = 0: F_{HJ} - F_{GI} = 0 \qquad F_{GI} = F_{HJ}$

$F_{GI} = 4.65\text{ kN T} \blacktriangleleft$

$\uparrow \Sigma F_y = 0: -F_{HI} - 1.2\text{ kN} + 3\text{ kN} = 0$

$F_{HI} = 1.800\text{ kN C} \blacktriangleleft$

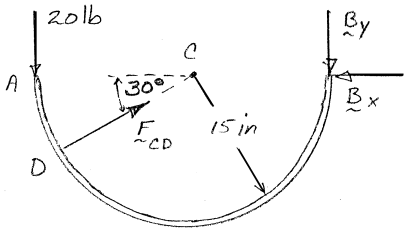


PROBLEM 6.166

Rod *CD* is fitted with a collar at *D* that can be moved along rod *AB*, which is bent in the shape of a circular arc. For the position when $\theta = 30°$, determine (*a*) the force in rod *CD*, (*b*) the reaction at *B*.

SOLUTION

FBD:



(*a*)

$$\circlearrowleft \Sigma M_C = 0: \ (15 \text{ in.})(20 \text{ lb} - B_y) = 0$$

$$\mathbf{B}_y = 20 \text{ lb} \downarrow$$

$$\uparrow \Sigma F_y = 0: \ -20 \text{ lb} + F_{CD} \sin 30° - 20 \text{ lb} = 0$$

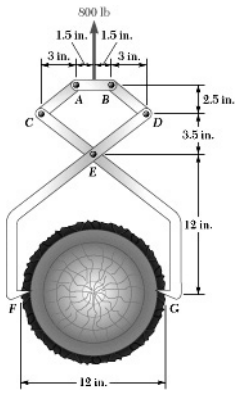
$$F_{CD} = 80.0 \text{ lb T} \blacktriangleleft$$

(*b*)

$$\rightarrow \Sigma F_x = 0: \ (80 \text{ lb}) \cos 30° - B_x = 0$$

$$\mathbf{B}_x = 69.282 \text{ lb} \leftarrow$$

$$\text{so } \mathbf{B} = 72.1 \text{ lb} \measuredangle 16.10° \blacktriangleleft$$



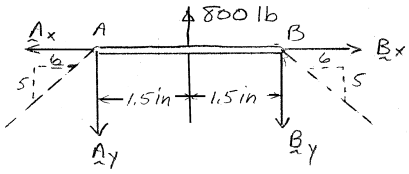
PROBLEM 6.167

A log weighing 800 lb is lifted by a pair of tongs as shown. Determine the forces exerted at *E* and at *F* on tong *DEF*.

SOLUTION

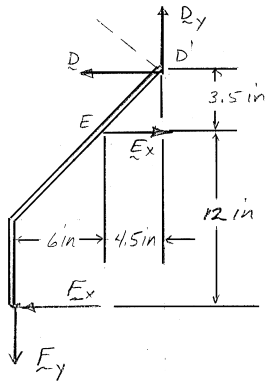
By symmetry: $A_y = B_y = 400$ lb

FBD AB:



and $A_x = B_x = \frac{6}{5}(400 \text{ lb}) = 480 \text{ lb}$

FBD DEF:



Note: $\mathbf{D} = -\mathbf{B}$ so $D_x = 480$ lb

$D_y = 400$ lb

$\circlearrowleft \Sigma M_F = (10.5 \text{ in.})(400 \text{ lb}) + (15.5 \text{ in.})(480 \text{ lb}) - (12 \text{ in.})E_x = 0$

$E_x = 970$ lb $\quad \mathbf{E} = 970 \text{ lb} \rightarrow$ ◀

$\rightarrow \Sigma F_x = 0: -480 \text{ lb} + 970 \text{ lb} - F_x = 0 \quad F_x = 490 \text{ lb}$

$\uparrow \Sigma F_y = 0: 400 \text{ lb} - F_y = 0 \quad F_y = 400 \text{ lb}$

$\mathbf{F} = 633 \text{ lb} \angle 39.2°$ ◀