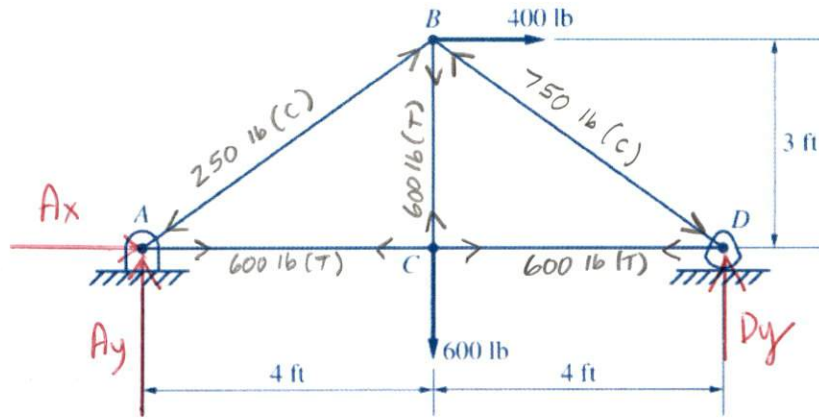4-1 to 4-10 Refer to Figs. P4-I to P4-10. Determine the forces in all members of the trusses shown using the method of joints. Indicate the results on the truss diagram using the arrow sign convention.

4-3

Solution.

FBD– Entire Truss

Equilibrium Equations

$[\Sigma F_x = 0]$ $A_x + 400\ \text{lb} = 0$

$$A_x = -400\ \text{lb} \rightarrow \quad \text{and} \quad \boxed{A_x = 400\ \text{lb} \leftarrow}$$
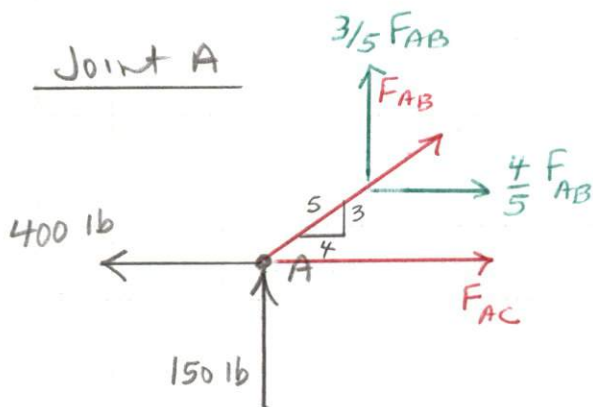
$[\Sigma M_A = 0]$ $-600\ \text{lb}\,(4\,\text{ft}) - 400\ \text{lb}\,(3\,\text{ft}) + D_y\,(8\,\text{ft}) = 0$

$$D_y = \frac{3600\ \text{lb}\cdot\text{ft}}{8\ \text{ft}} = \underline{\underline{450\ \text{lb} \uparrow}}$$

$[\Sigma F_y = 0]$ $A_y - 600\ \text{lb} + D_y = 0$

$$A_y = 600\ \text{lb} - 450\ \text{lb} = \underline{\underline{150\ \text{lb} \uparrow}}$$
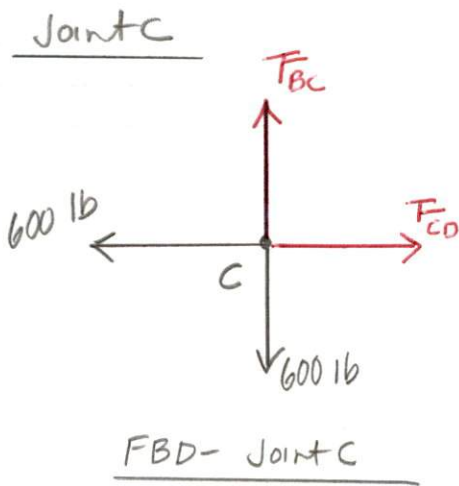
Joint A

FBD– Joint A

Equilibrium Equations

$[\Sigma F_y = 0]$ $150\ \text{lb} + \frac{3}{5} F_{AB} = 0$

$$F_{AB} = -\frac{5}{3}\,(150\ \text{lb})$$
$$= -250\ \text{lb}\ (T)$$

and $\boxed{F_{AB} = 250\ \text{lb}\ (C)}$

$[\Sigma F_x = 0]$ $-400\ \text{lb} + F_{AC} + \frac{4}{5} F_{AB} = 0$

$$F_{AC} = 400\ \text{lb} - \frac{4}{5}\,(-250\ \text{lb})$$
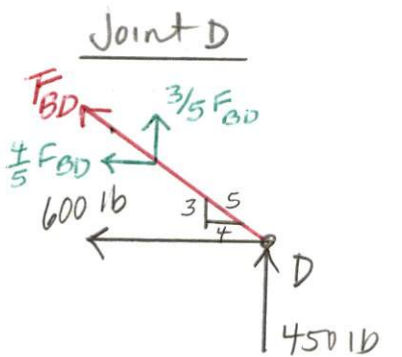$$= \underline{\underline{600\ \text{lb}\ (T)}}$$

1,

Joint C

FBD- Joint C

Equilibrium Equations

$[\Sigma F_x = 0]$ $-600 \text{ lb} + F_{CD} = 0$

$$F_{CD} = \underline{\underline{600 \text{ lb}}} \ (T)$$

$[\Sigma F_y = 0]$ $-600 \text{ lb} + F_{BC} = 0$

$$F_{BC} = \underline{\underline{600 \text{ lb}}} \ (T)$$

Joint D

FBD- Joint D

Equilibrium Equations

$[\Sigma F_x = 0]$ $-600 \text{ lb} - \dfrac{4}{5} F_{BD} = 0$

$$F_{BD} = -\dfrac{5}{4}(600 \text{ lb}) = -750 \text{ lb} \ (T)$$

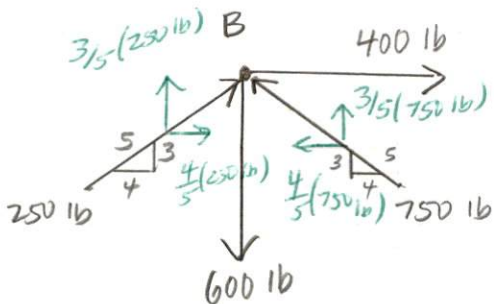and $\boxed{F_{BD} = 750 \text{ lb} \ (c)}$

Extra Force Eqn. (check)

$[\Sigma F_y = 0]$ $450 \text{ lb} + \dfrac{3}{5} F_{BD} = 0$

$$450 \text{ lb} + \dfrac{3}{5}(-750 \text{ lb}) = 0$$

$$450 \text{ lb} - 450 \text{ lb} = 0$$

$$0 = 0 \quad \checkmark$$

Spare Joint
Check Joint B

FBD- Joint B

Equilibrium Equations

$[\Sigma F_x = 0]$ $\dfrac{4}{5}(250 \text{ lb}) - \dfrac{4}{5}(750 \text{ lb}) + 400 \text{ lb} = 0$

$$200 \text{ lb} - 600 \text{ lb} + 400 \text{ lb} = 0$$

$$0 = 0 \quad \checkmark$$

$[\Sigma F_y = 0]$ $\dfrac{3}{5}(250 \text{ lb}) - 600 \text{ lb} + \dfrac{3}{5}(750 \text{ lb}) = 0$

$$150 \text{ lb} - 600 \text{ lb} + 450 \text{ lb} = 0$$

$$0 = 0 \quad \checkmark$$