chap 8

Problem 78

The mechanical equilibrium requires that both, the net force and the net torque exerted on the bridge should vanish.

if we choose the counterclockwise direction to be (+)
The net torque is equal to:

$$+\circlearrowleft \sum \tau_A = + F_{W_1} l_1 - F_{W_2} l_2 - F_{W_3} l_3 + F_{RB} l_4 = 0$$

where: $l_1 = 15\,m$, $l_2 = 35\,m$, $l_3 = 35 + 15 = 50\,m$

and $l_4 = 35 + 15 + 20 = 70\,m$

$F_{W_1} = 8000\,N$ $\quad F_{W_2} = 20\,000\,N$ $\quad F_{W_3} = 8000\,N$

$$F_{RB} = \frac{F_{W_2} l_2 + F_{W_3} l_3 - F_{W_1} l_1}{l_4} = \frac{20000 \times 35 + 8000 \times 50 - 8000 \times 15}{70}$$

$$\boxed{F_{RB} = 14\,000\,N = 14\,kN}$$

The net force is:

$$+\uparrow \sum F_y = F_{RA} + F_{RB} - F_{W_1} - F_{W_2} - F_{W_3} = 0$$

$$F_{RA} = F_{W_1} + F_{W_2} + F_{W_3} - F_{RB}$$

$$= 8000 + 8000 + 20000 - 14000$$

$$\boxed{F_{RA} = 22\,000\,N = 22\,kN}$$

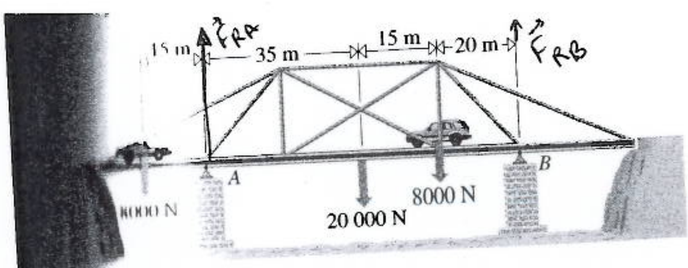


Figure P78

Problem 85 Chap 8

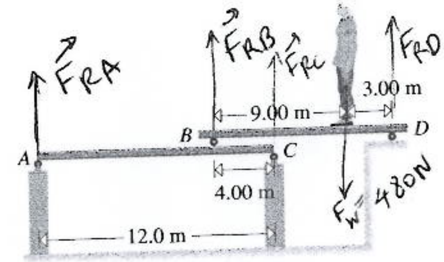


Figure P85

First, balance the forces and torques exerted on the top board.

Set the net torque about point B to be zero.

Counterclockwise is positive

$$\sum \tau_B = -(480\,N)(9\,m) - F_{RD}(9+3) = 0$$

$$\boxed{F_{RD} = 360\,N}$$

Now set

$$+\uparrow \sum F_y = F_{RB} + 360\,N - 480\,N = 0$$

$$\boxed{F_{RB} = 120\,N}$$

For the bottom board:

Set the torque about point A.

$$+\circlearrowleft \sum \tau_A = -\underbrace{(120\,N)}_{F_{RB}}(12-4) - F_{RC}(12) = 0$$

$$\boxed{F_{RC} = 80\,N}$$

Now set:

$$+\uparrow \sum F_y = F_{RA} + \underbrace{80\,N}_{F_{RC}} - \underbrace{120\,N}_{F_{RB}} = 0$$

$$\boxed{F_{RA} = 40\,N}$$

Problem 86.

chap 8

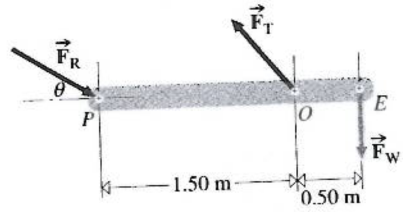
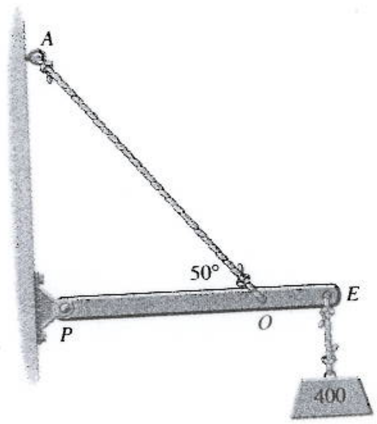


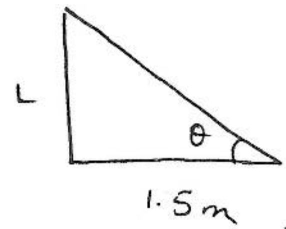
Figure P86 (b)



(a)

First consider the torques about point A.

$$\tan(\theta) = \frac{L}{1.5} \Rightarrow L = \tan(\theta) \times (1.5)$$



L is the Lever arm of $\vec{F}_R$

(Note that the vertical component of $\vec{F}_R$ does not produce a torque about point A). Thus.

$$+\circlearrowleft \sum \tau_A = -\underbrace{(400\,N)}_{\vec{F}_W}(2.0) - F_{Rx}(1.5)(\tan 50^\circ) = 0$$

↑ x componant of $\vec{F}_R$

$$\Rightarrow \boxed{F_{Rx} = 0.45\,kN}$$

Similarly, we set the torque about point O to be zero.

$$+\circlearrowleft \sum \tau_O = -(400\,N)(0.5) - F_{Ry}(1.5\,m) = 0$$

$$\boxed{F_{Ry} = 0.13\,kN}$$

$$\boxed{\vec{F}_R = (0.45\,\hat{i} + 0.13\,\hat{j})\,kN}$$

$$\|\vec{F}_R\| = \sqrt{(0.45)^2 + (0.13)^2}\ kN$$

$$\boxed{\|\vec{F}_R\| = 0.468\,kN}$$