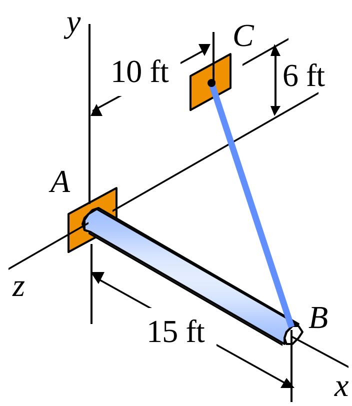
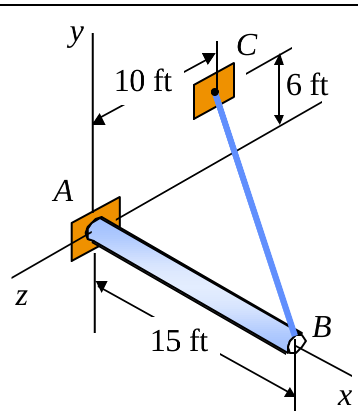
Problem 3.149



The 15-ft boom *AB* has a fixed end *A*. A steel cable is stretched from the free end *B* of the boom to a point *C* located on the vertical wall. If the tension in the cable is 570 lb, determine the moment about *A* of the force exerted by the cable at *B*.



Problem 3.149

Solving Problems on Your Own

The 15-ft boom *AB* has a fixed end *A*. A steel cable is stretched from the free end *B* of the boom to a point *C* located on the vertical wall. If the tension in the cable is 570 lb, determine the moment about *A* of the force exerted by the cable at *B*.

1. *Determine the rectangular components of a force defined by its magnitude and direction.* If the direction of the force is defined by two points located on its line of action, the force can be expressed by:

$$\mathbf{F} = F\boldsymbol{\lambda} = \frac{F}{d}\,(d_x\,\mathbf{i} + d_y\,\mathbf{j} + d_z\,\mathbf{k})$$

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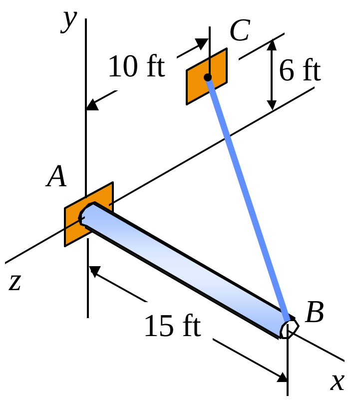


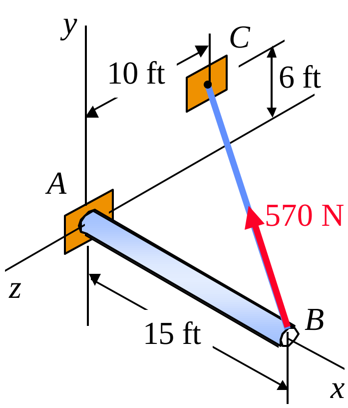
Solving Problems on Your Own

The 15-ft boom AB has a fixed end A. A steel cable is stretched from the free end B of the boom to a point C located on the vertical wall. If the tension in the cable is 570 lb, determine the moment about A of the force exerted by the cable at B.

2. Compute the moment of a force in three dimensions. If $\mathbf{r}$ is a position vector and $\mathbf{F}$ is the force the moment $\mathbf{M}$ is given by:

$$\mathbf{M} = \mathbf{r} \times \mathbf{F}$$

Problem 3.149 Solution



Determine the rectangular components of a force defined by its magnitude and direction.

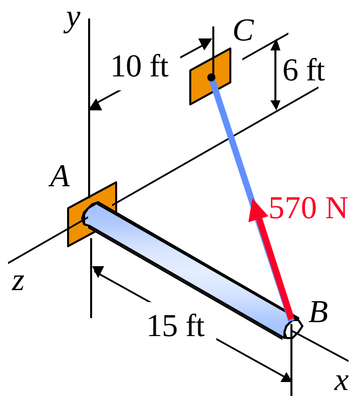
First note:

$$d_{BC} = \sqrt{(-15)^2 + (6)^2 + (-10)^2}$$

$$d_{BC} = 19 \text{ ft}$$

Then:

$$\mathbf{T}_{BC} = \frac{570 \text{ lb}}{19}(-15\,\mathbf{i} + 6\,\mathbf{j} - 10\,\mathbf{k}) = -(450 \text{ lb})\,\mathbf{i} + (180 \text{ lb})\,\mathbf{j} - (300 \text{ lb})\,\mathbf{k}$$



Compute the moment of a force in three dimensions.

Have:

$\mathbf{M}_A = \mathbf{r}_{B/A} \times \mathbf{T}_{BC}$

Where: $\mathbf{r}_{B/A} = (15 \text{ ft})\,\mathbf{i}$

Then:

$\mathbf{M}_A = 15\,\mathbf{i} \times (-450\,\mathbf{i} + 180\,\mathbf{j} - 300\,\mathbf{k})$

$\boxed{\mathbf{M}_A = (4500 \text{ lb}\cdot\text{ft})\,\mathbf{j} + (2700 \text{ lb}\cdot\text{ft})\,\mathbf{k}}$