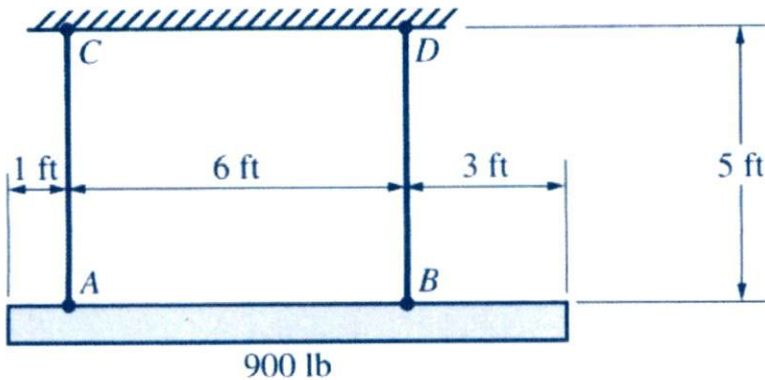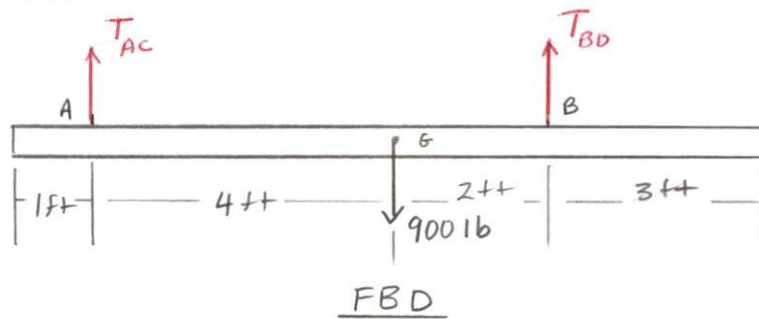10-12

The two wires shown in Fig. P10-12 support a heavy bar weighing 900 lb.
The wires AC and BD are identical, having the same ¾-in. diameter, the same 5-ft original length, and the same
modulus of elasticity E = 30 x 10⁶ psi. Determine the deformation of each wire.

Solution.

FBD

$ccw + M$ ↺
$cw - M$ ↻

Equilibrium Equations

$[\Sigma M_B = 0]$ $-T_{AC}\,(6ft) + 900\ lb\,(2ft) = 0$

$$T_{AC} = \frac{1800\ lb \cdot ft}{6\ ft} = 300\ lb\ (T)$$

$[\Sigma F_y = 0]$ $T_{AC} - 900\ lb + T_{BD} = 0$

$$T_{BD} = 900\ lb - 300\ lb = 600\ lb\ (T)$$

Deformation

$$A = \frac{\pi\,(3/4\ in)^2}{4} = 0.4418\ in.^2$$

$$\delta_{AC} = \frac{PL}{AE} = \frac{300\ lb\,(5ft \times \frac{12in}{ft})}{(0.4418\ in.^2)\,(30 \times 10^6\ lb/in.^2)} = 0.00136\ in.\ (elongation)$$

$$\delta_{BD} = \frac{PL}{AE} = \frac{600\ lb\,(5ft \times \frac{12in}{ft})}{(0.4418\ in.^2)\,(30 \times 10^6\ lb/in.^2)} = 0.00272\ in.\ (elongation)$$