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PROBLEM 2.46

The rigid bar AD is supported by two steel wires of $\frac{1}{4}$ -in. diameter (E = 29×10^6 psi) and a pin and bracket at D. Knowing that the wires were initially taut, determine (a) the additional tension in each wire when a 120-lb load P is applied at B, (b) the corresponding deflection of point B.

SOLUTION

Let δ be the rotation of bar ABCD.

Then $\delta = \theta$

$$P_B \delta = \frac{F_{AC} L_{AC}}{AE} \theta + \frac{F_{BD} L_{BD}}{AE} \theta$$

$$P_B \delta = \frac{EA}{L_{AC}} (29 \times 10^6) \left(\frac{1}{4} \right)^2 (24) \theta + \frac{EA}{L_{BD}} (29 \times 10^6) \left(\frac{1}{4} \right)^2 (8) \theta$$

$$P_B \delta = 142,353.10 \theta + 88,971.10 \theta$$

Using free body ABCD:

$$\sum M_D = 0: 24(42,353.10) + 16(20) + 8(88,971.10) \theta = 0$$

$$\theta = -0.40519 \times 10^{-3} \text{ rad}$$

(a) $F_{AC} = (42,353.10)(-0.40519 \times 10^{-3}) = -17.16 \text{ lb}$ $F_{BD} = 66.2 \text{ lb}$

(b) $\delta_B = (88,971.10)(-0.40519 \times 10^{-3}) = -35.84 \text{ lb}$ $\delta_B = 41.4 \text{ in}$

(c) $\delta = 16.16(0.40519 \times 10^{-3}) = 6.54 \times 10^{-3} \text{ in}$

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