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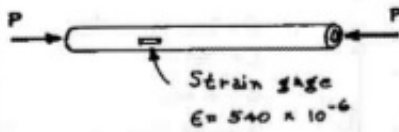
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1.2-4

Aluminum Tube in Compression



$L = 500 \text{ mm}$
 $d_2 = 60 \text{ mm}$
 $d_1 = 50 \text{ mm}$

(a) Shortening δ of the bar

$$\delta = \epsilon L = (540 \times 10^{-6})(500 \text{ mm}) = 0.270 \text{ mm}$$

(b) Compressive Load P

$$\sigma = 40 \text{ MPa}$$

$$A = \frac{\pi}{4}[d_2^2 - d_1^2] = \frac{\pi}{4}[(60 \text{ mm})^2 - (50 \text{ mm})^2]$$

$$= 863.9 \text{ mm}^2$$

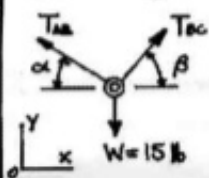
$$P = \sigma A = (40 \text{ MPa})(863.9 \text{ mm}^2)$$

$$= 34.6 \text{ kN}$$

1.2-5

Two Steel Wires Supporting a Lamp

Free-body Diagram of Point B



$\alpha = 35^\circ$ $\beta = 50^\circ$
 $d = 25 \text{ mils} = 0.025 \text{ in.}$
 $A = \frac{\pi d^2}{4} = 490.9 \times 10^{-6} \text{ in.}^2$

Equations of Equilibrium

$$\sum F_x = 0 \quad -T_{AB} \cos \alpha + T_{BC} \cos \beta = 0$$

$$\sum F_y = 0 \quad T_{AB} \sin \alpha + T_{BC} \sin \beta - W = 0$$

Substitute numerical values:

$$-T_{AB}(0.81915) + T_{BC}(0.64279) = 0$$

$$T_{AB}(0.57358) + T_{BC}(0.76604) = 15 \text{ lb}$$

CONT.

Solve the Equations:

$$T_{AB} = 9.679 \text{ lb} \quad T_{BC} = 12.324 \text{ lb}$$

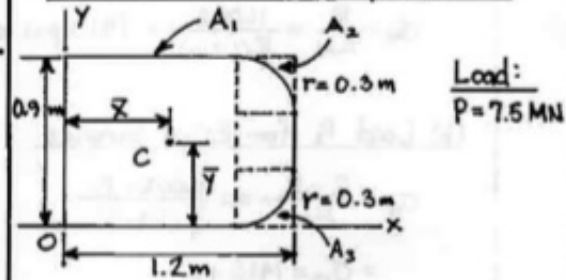
Tensile stresses in the wires

$$\sigma_{AB} = \frac{T_{AB}}{A} = 19,700 \text{ psi}$$

$$\sigma_{BC} = \frac{T_{BC}}{A} = 25,100 \text{ psi}$$

1.2-6

Concrete Pier in Compression



Use the following areas:

$$A_1 = \text{outer rectangle}$$

$$= (1.2 \text{ m})(0.9 \text{ m}) = 1.08 \text{ m}^2$$

$$A_2 = A_3 = \text{quarter-circular spandrel}$$

(Appendix D, Case 12)

$$A_2 = A_3 = (1 - \frac{\pi}{4}) r^2 = 0.019314 \text{ m}^2$$

Area of Pier

$$A = A_1 - A_2 - A_3 = 1.0414 \text{ m}^2$$

(a) Average compressive stress

$$\sigma_c = \frac{P}{A} = \frac{7.5 \text{ MN}}{1.0414 \text{ m}^2} = 7.20 \text{ MPa}$$

(b) Coordinates of Centroid C

From symmetry, $\bar{y} = \frac{1}{2}(0.9 \text{ m})$

$$= 0.45 \text{ m}$$

$$\bar{x} = \frac{\sum \bar{x}_i A_i}{A} \quad (\text{see Chapter 12, Section 12.3})$$

For Area 1: $\bar{x}_1 = \frac{1}{2}(1.2 \text{ m}) = 0.6 \text{ m}$

CONT.



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