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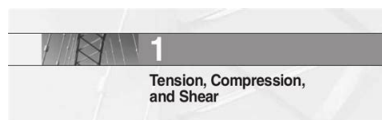


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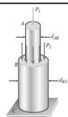
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Solution Of Problems In Strength Of Materials And Mechanics Of Solids

Normal Stress and Strain

Problem 1.2-1 A solid circular post ABC (see figure) supports a load $P_1 = 2500$ lb acting at the top. A second load P_2 is uniformly distributed around the shaft at B. The diameter of the upper and lower parts of the post are $d_{AB} = 1.25$ in. and $d_{BC} = 2.25$ in., respectively.



- (a) Calculate the normal stress σ_{AB} in the upper part of the post.
 (b) If it is desired that the lower part of the post have the same compressive stress as the upper part, what should be the magnitude of the load P_2 ?

Solution 1.2-1 Circular post in compression

$P_1 = 2500$ lb
 $d_{AB} = 1.25$ in.
 $d_{BC} = 2.25$ in.

Assume Section in Part (b)

$$\sigma_{BC} = \frac{P_1 + P_2}{A_{BC}} = \frac{P_1 + P_2}{3A_{AB}}$$

$$\sigma_{AB} = \frac{P_1}{A_{AB}} \quad \sigma_{BC} = \sigma_{AB}$$

$$\frac{P_1 + P_2}{3A_{AB}} = \frac{P_1}{A_{AB}} \quad P_2 = P_1 \left[\left(\frac{A_{BC}}{A_{AB}} \right) - 1 \right]$$

$$\frac{d_{BC}^2}{d_{AB}^2} = 1.8$$

$$\therefore P_2 = 2.24P_1 = 5600 \text{ lb}$$

(a) Normal stress in part AB

$$\sigma_{AB} = \frac{P_1}{A_{AB}} = \frac{2500 \text{ lb}}{1.547 \text{ in}^2} = 2000 \text{ psi}$$

(b) Load P_2 for equal stresses

$$\sigma_{BC} = \frac{P_1 + P_2}{A_{BC}} = \frac{2500 \text{ lb} + P_2}{2.227 \text{ in}^2}$$

$$\sigma_{BC} = 2000 \text{ psi}$$

$$\text{Solve for } P_2: P_2 = 5600 \text{ lb}$$

