

Chapter 5, Problem 6P

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Statics and Strength of Materials for Architecture and Building Construction | (3rd Edition)

Step-by-step solution

Step 1 of 6

(a)

Calculate the area of the member BD as follows:

$$A_{BD} = \frac{\pi}{4} (d_o^2 - d_i^2)$$

Here, the outer diameter of the member BD is d_o and the inner diameter of the member BD is d_i .

Substitute 2 in for d_o and 1 in for d_i .

$$A_{BD} = \frac{\pi}{4} (2^2 - 1^2)$$
$$= 2.3562 \text{ in}^2$$

Calculate the axial stress in the member BD as follows:

$$\sigma_{BD} = \frac{P_{BD}}{A_{BD}}$$

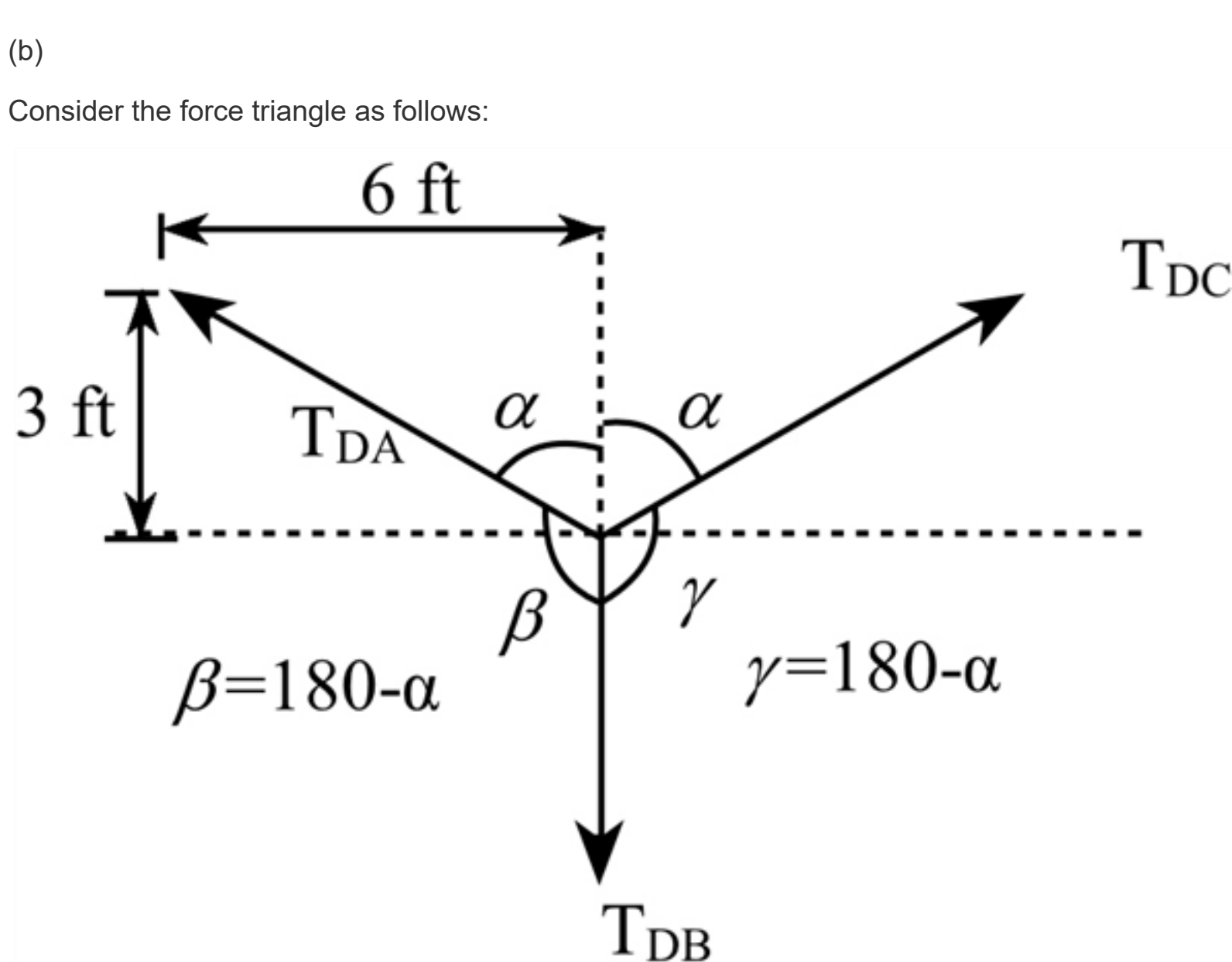
Here, the force exerted by member BD is P_{BD} and the area of the member BD is A_{BD} .

Substitute 10,000 # for P_{BD} and 2.3562 in² for A_{BD} .

$$\sigma_{BD} = \frac{10,000 \#}{2.3562}$$
$$= 4244.12 \text{ \#/in}^2$$

Therefore, the value of axial stress in the member BD is 4244.12 #/in².

Comment



Comment

Step 3 of 6

Calculate the value of α by considering $\triangle ABD$ as follows:

$$\alpha = \tan^{-1} \left(\frac{AB}{BD} \right)$$
$$= \tan^{-1} \left(\frac{6}{3} \right)$$
$$= 63.43^\circ$$

Calculate the value of β as follows:

$$\beta = 180 - \alpha$$
$$= 180 - 63.43$$
$$= 116.57^\circ$$

Calculate the value of γ as follows:

$$\gamma = 180 - \alpha$$
$$= 180 - 63.43$$
$$= 116.57^\circ$$

Comment

Step 4 of 6

Calculate the force in the member DC by using the sine rule as follows:

$$\frac{P_{DB}}{\sin(2\alpha)} = \frac{P_{DC}}{\sin \beta} = \frac{P_{DA}}{\sin \gamma}$$

Substitute 10,000 # for P_{BD} , 63.43° for α , and 116.57° for β .

$$\frac{10,000 \#}{\sin(2 \times 63.43^\circ)} = \frac{P_{DC}}{\sin(116.57^\circ)}$$
$$P_{DC} = 10,000 \# \times \frac{\sin(116.57^\circ)}{\sin(2 \times 63.43^\circ)}$$
$$= 10,000 \# \times (1.1178)$$
$$= 11178 \#$$

Calculate the axial stress in the member CD as follows:

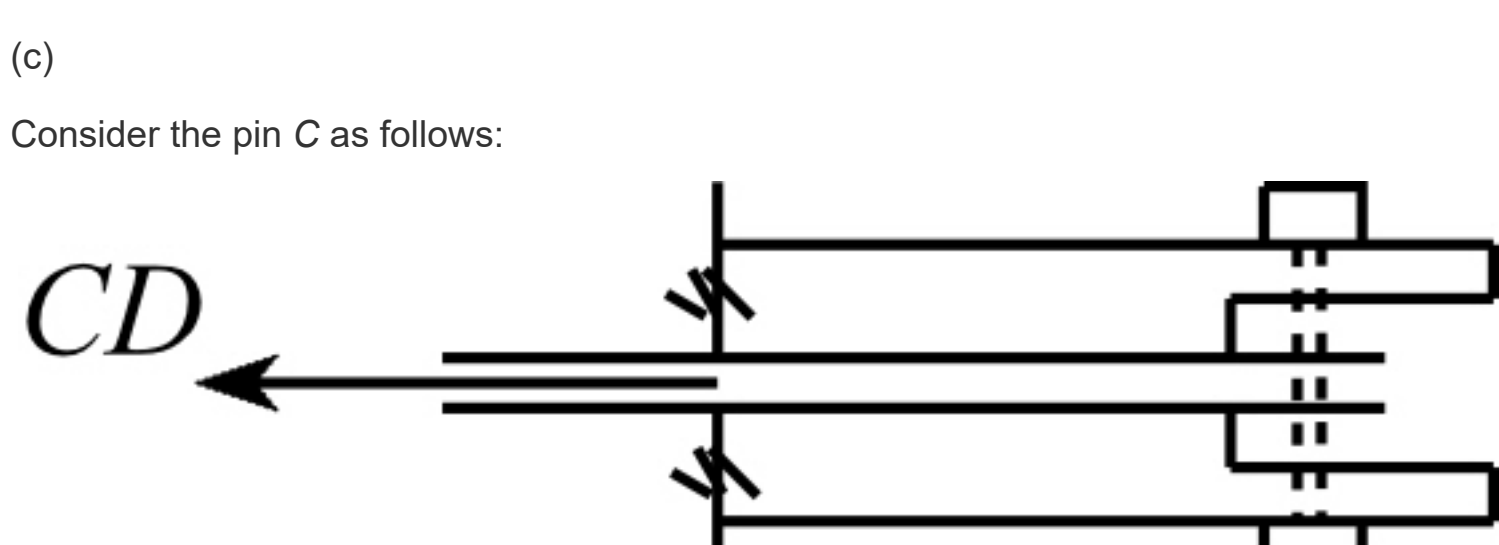
$$\sigma_{CD} = \frac{P_{CD}}{A_{CD}}$$

Substitute 11178 # for P_{CD} and 1 in² for A_{CD} .

$$\sigma_{CD} = \frac{11178 \#}{1 \text{ in}^2}$$
$$= 11178 \text{ \#/in}^2$$

Therefore, the value of axial stress in the member CD is 11178 #/in².

Comment



Comment

Step 6 of 6

Calculate the horizontal component of the force in the member CD as follows:

$$P_{CD(\text{horizontal})} = P_{CD} \cos(90 - \alpha)$$
$$= 11178 \times \cos(90 - 63.43)$$
$$= 9997.47$$
$$\approx 10,000 \#$$

Calculate the area of the pin as follows:

$$A_c = \frac{\pi}{4} d_c^2$$

Substitute 0.75 in for d_c .

$$A_c = \frac{\pi}{4} \times 0.75^2$$
$$= 0.44178 \text{ in}^2$$

Calculate the shearing stress in the pin C as follows:

$$\tau_c = \frac{P_{CD(\text{horizontal})}}{2 \times A_c}$$

Here, $2 \times A_c$ is because of double shear.

Substitute 10,000 # for $P_{CD(\text{horizontal})}$ and 0.44178 in² for A_c .

$$\tau_c = \frac{10,000}{2 \times 0.44178}$$
$$= 11317.85 \text{ \#/in}^2$$

Therefore, the value of shearing stress in the pin C is 11317.85 #/in².

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Chapter 5, Solution 20P

$P = 180 \text{ k}$

Given data: Axial load acting on the assembly, Length of the short hollow steel tube, Outside dimension of the hollow...

See solution

Chapter 5, Solution 7P

$(\delta) = 0.0024 \text{ in.}$

Given data: The specimen elongates, deformation Original length between two punch marks is given as

See solution

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