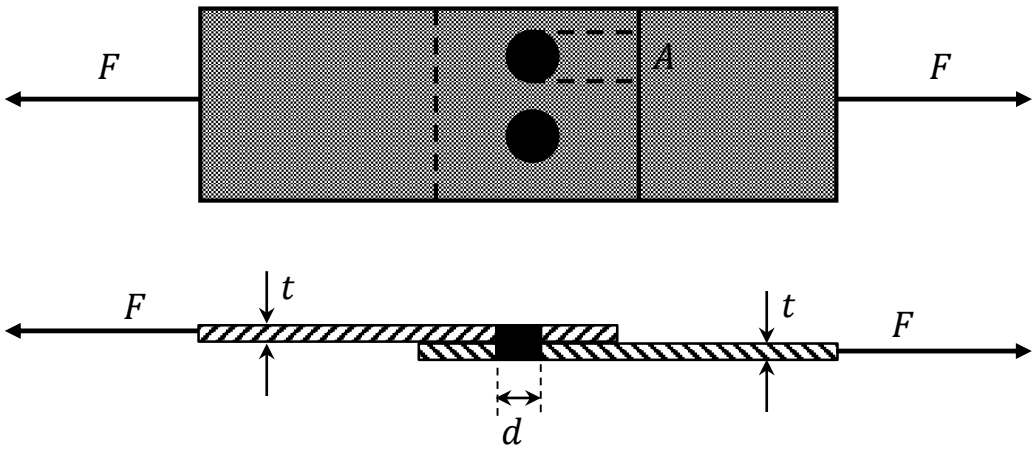
Answer on Question#49631 - Physics - Mechanics - Kinematics - Dynamics

The lap joint is fastened together using two bolts. Determine the required diameter of the bolts if the allowable shear stress for the bolts is $\tau = 60\text{MPa}$ and the allowable bearing stress in the plates is $\sigma = 110\text{MPa}$. Assume each bolt supports an equal portion of the load and the thickness of each plate is $t = 20\text{mm}$. Express the answer in millimeters.

Solution:



From the shearing of two bolts

$$F = 2 \cdot \tau \cdot A_{bolt}$$

where $A_{bolt} = \frac{\pi d^2}{4}$ is a cross-section of the bolt.

Therefore

$$F = \tau \cdot \frac{\pi d^2}{2} \qquad (1)$$

From bearing of plate material

$$F = 2 \cdot \sigma \cdot A$$

where $A = d \cdot t$ is a cross-section of the plate, which is born.

Therefore

$$F = 2 \cdot \sigma \cdot d \cdot t \qquad (2)$$

Using equations (1) and (2) we obtain

$$\tau \cdot \frac{\pi d^2}{2} = 2 \cdot \sigma \cdot d \cdot t$$

or, equivalently

$$d = \frac{4}{\pi}\frac{\sigma}{\tau}t = \frac{4}{\pi}\frac{110\text{MPa}}{60\text{MPa}}20\text{mm} = 47\text{mm}$$

Answer: $d = \frac{4}{\pi}\frac{\sigma}{\tau}t = 47\text{mm}.$

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