MID Term Paper: "Mechanics of Materials"

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Q.No 2

Write briefly any three practical examples of shear stresses and normal stresses you have experienced in daily life?

Shear Stress:-

The stress produced due to shearing of two surfaces and is produced perpendicular to axis of member → it is denoted by τ

Examples:-

① Fluid flow:-

fluid in any form flow by shearing of layer on one another which produced shear stresses. when water flow in pipeline it apply shear stresses on the pipe

(ii) Sand failure:-

whenever someone steps on sand block it will always be a shear failure.

(iii) When Someone Cut any thing With Secissor it will always be Shear failure and Shear Stresses will be produced

Normal Stress:-

"Stress produce Perpedicular to Crossectional area of the member"

Examples:-

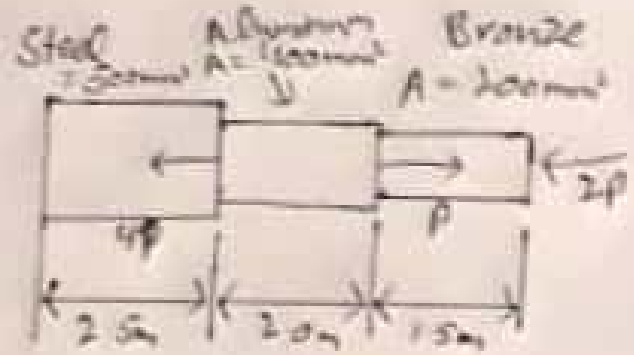
(i) When one Pushing or Pressing a tennis ball with thumb. Deformation will produced and normal Stress will develop

(ii) When one Stretch a wire, normal force will develop

P(3|9)

Q. No (2) P(1)

① An aluminium rod is rigidly attached between a steel rod and a bronze rod as shown in fig at below Axial loads are applied at the positions indicated. Find the maximum value of P that will not exceed a stress in steel of 150 MPa in aluminium of 100 MPa. or in bronze of 110 MPa.



Given Data:-

$\sigma_{Steel} = 150\ MPa$ $\sigma_{Al} = 100\ MPa$

$\sigma_{Br} = 110\ MPa$ $A_{St} = 500mm^2$ $A_{Al} = 1600mm^2$

$A_{Br} = 200\ mm^2$

Required ⇒

$P_{safe} = ?$

P(4|9)

Solution:-

For Steel

$$S_{steel} = \frac{P_{steel}}{A_{steel}}$$

$$150 \times 10^6 = \frac{3P_{steel}}{5cm \times 10^{-4}}$$

$$P_{steel} = 15000\ N$$

For Aluminium

$$S_{A_1} = \frac{P_{A_1}}{A_{A_1}}$$

$$P_{A_1} = S_{A_1} \times A_{net}$$

$$= 100 \times 10^6 \times 400 - 10^{-4}$$

$$P_{A_1} = 40000\ N$$

For Bronze:-

$$\sigma_c = \frac{P_b}{A_c}$$

$$P_b = \sigma_c \times A_c$$

$$= 110 \times 10^3 \times 200 \times 10^{-6}$$

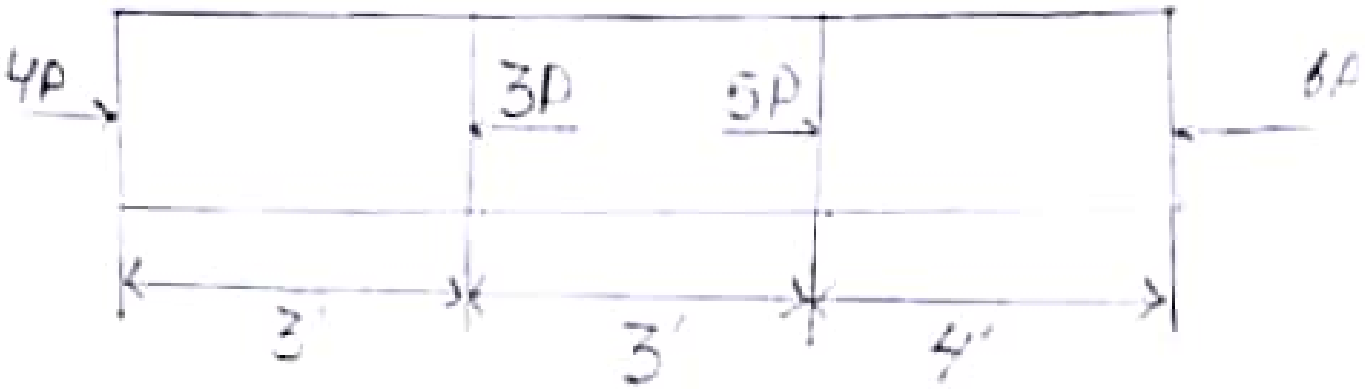
$$P_b = 22000 \text{ N}$$

So safe load for p for Bronze, Aluminium and steel is 15000N.

$$P_{safe} = 15 \text{ kN}$$

Q No 2 Part (ii) P(4/9)

An aluminum bar having a cross-sectional area of 1.5 in² carries the axial loads applied at the 2 ends. Assume the bar is suitably braced to prevent lateral buckling.



Given Data :=

$A = 1.5\ in^2$

$E = 10 \times 10^3\ PSi$

$P = 2000\ lb$

Required Data

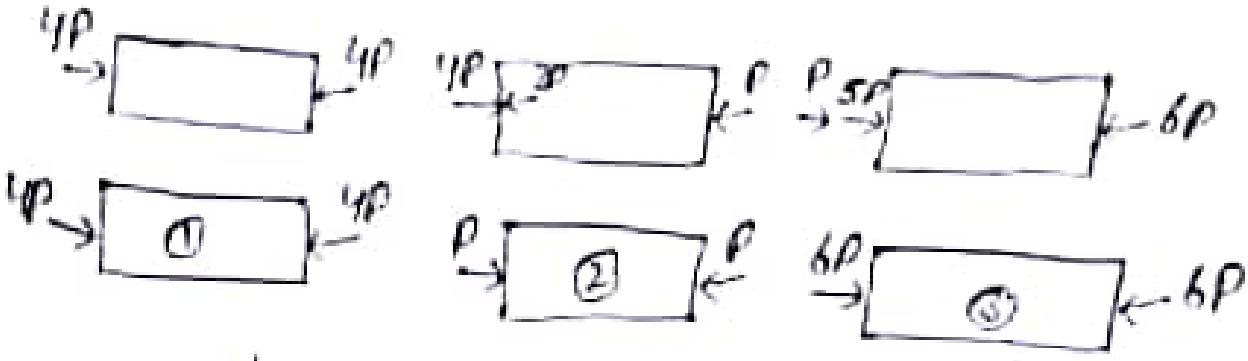
$\Delta L = ?$

Solution :=

$\Delta L = \Delta L_1 + \Delta L_2 + \Delta L_3$

$\Rightarrow \frac{P_1 L}{AE} + \frac{P_2 L}{AE} + \frac{P_3 L}{AE}$

$$\Rightarrow \frac{L}{AE}(P_1 + P_2 + P_3)$$



$$\Rightarrow \frac{L}{AE}(-P_1 - P_2 - P_3)$$

$$\Rightarrow \frac{L}{AE}(-4P - P - 6P) = \frac{-11PL}{AE}$$

$$\Rightarrow \frac{-11(2000)(3\times12)}{1.5\,in^2 \times 10\times10^6}$$

$$\Rightarrow \Delta l = 0.053\,in$$

$$\boxed{\Delta l = -0.053\,in}$$

— ve sign shows Compression in the bar

Q No (3)

A hollow steel tube with an inside diameter of 100mm must carry a tensile load of 640 kN. Determine the outside diameter of the tube if the stress is limited to 135 MN/m².

Given Data: $\delta = 135 \frac{MN}{m^2}$

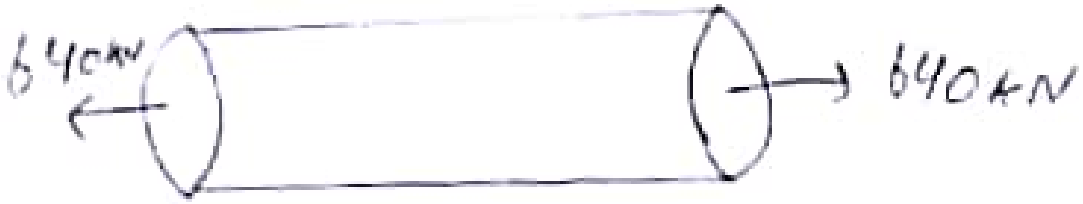
$P = 640$ kN (Tensile)

$D_i = 100$ mm

Required

$D_o = ?$

Solution:-



Solution:-

$$\delta = D \quad \frac{P}{A}$$

$$A = \frac{\pi}{4}(D_o^2 - D_i^2)$$

$$\delta = \frac{P}{\frac{\pi}{4}(D_o^2 - D_i^2)}$$

P(g|g)

$$P = 5 \times \frac{\pi}{4} D_o^2 - \frac{2\pi D_i^2}{4}$$

$$5\frac{\pi}{4} D_o^2 = P + \frac{5\pi}{4} D_i^2$$

$$D_o^2 = \frac{P + 5\frac{\pi}{4} D_i^2}{5\frac{\pi}{4}}$$

$$D_o = \sqrt{\frac{4P + 5\pi D_i^2}{\pi 5}}$$

$$\sqrt{\frac{4(640 \times 10^3) + (135 \times 10^6)(3.14)(1)^2}{3.14(135 \times 10^6}}$$

$D_o = 0.1266\,m$

$D_o = 126.64\,mm$