Numerical problems (on elasticity)

(Q.1) A bar of 30 mm diameter is subjected to pull of 60kN. The measured extension on gauge length of 200 mm is 0.1 mm and change in diameter is 0.004 mm. Calculate.

(a) Young's modulus (b) Poisson's ratio

(c) Bulk modulus.

Q.2 Determine the value of Young's modulus and Poisson's ratio of a metallic bar of length 30cm, breadth 4cm and depth 4 cm when the bar is subjected to an axial compressive load of 400 kN. The decrease in length is given as 0.075cm and increase in breadth is 0.003cm.

Hint:

Young's modulus (E) = $\frac{\text{Tensile Stress / Compressive stress}}{\text{Longitudinal strain}}$

Poisson's ratio (σ) = $\frac{\text{Lateral strain}}{\text{Longitudinal strain}}$

→ Longitudinal strain = $\frac{\text{stress}}{Y}$

Longitudinal strain = $\frac{0.075}{30} = 0.0025$

Lateral strain = $\frac{0.003}{4} = 0.00075$

Q.3 Find the Young's modulus of a rod of diameter 30mm and of length 300mm which is subjected to a tensile load of 60kN and the extension of the rod is equal to 0.4mm.

Q.4 The safe stress for a hollow steel column which carries an axial load of 2.1×10^3 kN is 125×10^6 N/m^2. If the external diameter of the column is 30cm, determine the internal diameter.

What. Safe stress → Stress within the elastic limit

stress = 125×10^6 N/m^2

Area = $\frac{\pi}{4}(R^2 - r^2)$, R → external diameter = 30cm = 0.30m

r → internal diameter

$$\text{Stress} = \frac{2.1 \times 10^3}{\text{Area}}$$

$$125 \times 10^6 = \frac{2.1 \times 10^3}{\frac{\pi}{4}((0.30)^2 - r^2)}$$

(Q.5) The safe stress for a hollow steel column which carries an axial load of 2.2×10^3 kN is 120×10^6 N/m^2. If the external diameter of the column is 25cm, determine the internal diameter.