SNS COLLEGE OF ENGINEERING

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UNIT – I PROPERTIES OF MATTER

TOPIC – IX : Problems

1.A metallic cube of side 100 cm is subjected to a uniform force acting normal to the whole surface of the cube. The pressure is 106 pascal. If the volume changes by 1.5 x 10-5 m3, calculate the bulk modulus of the material.

Solution

By definition, $\quad K = \dfrac{\dfrac{F}{A}}{\dfrac{\Delta V}{V}} = P\dfrac{V}{\Delta V}$

$K = \dfrac{10^6 \times 1}{1.5 \times 10^{-5}} = 6.67 \times 10^{10}\,N\,m^{-2}$

2.A metal cube of side 0.20 m is subjected to a shearing force of 4000 N. The top surface is displaced through 0.50 cm with respect to the bottom. Calculate the shear modulus of elasticity of the metal.

Solution

Here, L = 0.20 m, F = 4000 N, x = 0.50 cm
= 0.005 m and Area A = L2 = 0.04 $m2$
Therefore, Shear modulus

$\eta_R = \dfrac{F}{A} \times \dfrac{L}{x} = \dfrac{4000}{0.04} \times \dfrac{0.20}{0.005} = 4 \times 10^6\,N\,m^{-2}$

3.A wire of length 2 m with the area of cross-section $10\text{-}6\,m2$ is used to suspend a load of 980 N. Calculate i) the stress developed in the wire ii) the strain and iii) the energy stored.

Given: $Y = 12 \times 10^{10} N\,m^{-2}$.

Solution

(i) stress $= \dfrac{F}{A} = \dfrac{980}{10^{-6}} = 98 \times 10^{7}\,N\,m^{-2}$

(ii) $strain = \dfrac{stress}{Y} = \dfrac{98 \times 10^{7}}{12 \times 10^{10}} = 8.17 \times 10^{-3}$
(no unit)

(iii) Since, volume $= 2 \times 10^{-6} m^{3}$

$Energy = \dfrac{1}{2}(stress \times strain) \times volume \Rightarrow$

$\dfrac{1}{2}(98 \times 10^{7}) \times (8.17 \times 10^{-3}) \times 2 \times 10^{-6} = 8\,joule$