

Elasticity - Continued ---
Q-1 (H & S) Paper I st.

Three types of Elasticity: Corresponding to the three types of strain, there are three types of elasticity

(i) Young's Modulus or Modulus of longitudinal elasticity

$$Y = \frac{\text{longitudinal stress}}{\text{longitudinal strain}}$$

$$= \frac{F/a}{l/L} = \frac{F \cdot L}{a \cdot l}$$

Now, if $l=1$, $a=1$ and $L=1$, we have

$$Y = F$$

In other words, if a material of unit length and unit area of cross-section could be pulled so as to increase its length by unity, i.e. to double its length, the force applied would measure the value of Young's modulus for it.

In case, where elongation produced is not proportional to the force applied, we can still determine the Young's modulus from the ratio

$$L \cdot dF / a \cdot dl$$

$$\text{or } Y = \frac{L}{a} \cdot \frac{dF}{dl}$$

(ii) Bulk Modulus. If F be the force applied uniformly and normally on a surface area a , the stress or pressure, is F/a or P ; and if ΔV be change the change in volume produced in an original volume V , the strain is $\Delta V/V$ and therefore

Bulk Modulus,

$$K = \frac{F/a}{\Delta V/V} = \frac{F \cdot V}{a \cdot \Delta V} = \frac{P \cdot V}{\Delta V}$$

If, however, the change in volume be not proportional to the stress or the pressure applied

$$K = \frac{a \cdot dP}{\Delta V} = \frac{P \cdot V}{\Delta V} = \frac{dP \cdot V}{dV}$$

Bulk modulus is sometimes referred to as incompressibility and hence its reciprocal is called compressibility.

(iii) Modulus of rigidity of the material of the cube is given by $\eta = \frac{F/a}{\theta} = \frac{F/a}{l/L} = \frac{FL}{a \cdot l}$