Chapter 1

PROPERTIES OF MATTER (ELASTICITY)

Day - 1

Elasticity: The property of matter by virtue of which a body tends to regain its original shape and size after the removal of deforming forces is called elasticity.

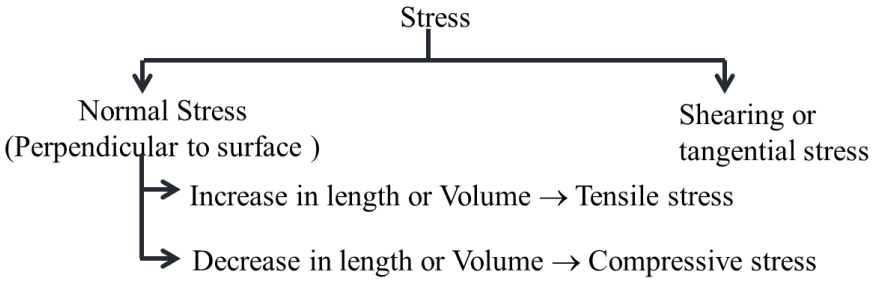
"If on the removal of deforming forces the body regains its original shape and size completely it is said to be perfectly elastic"

"If the body does not have tendency to recover its original shape and size (retains modified from) it is said to be perfectly plastic"

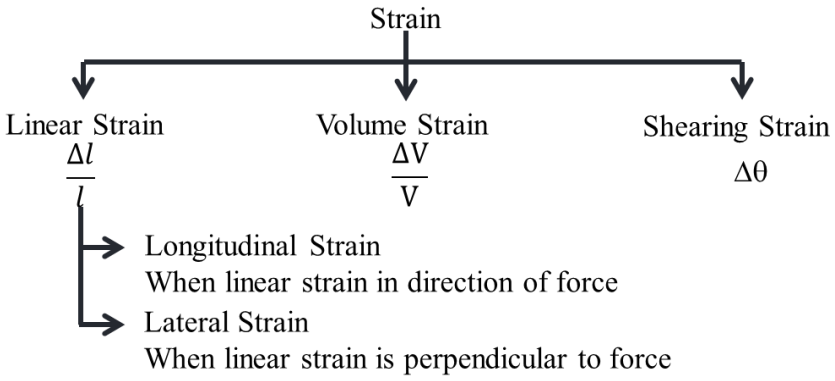
NOTE: There is no material which is either perfectly elastic or perfectly plastic.

Stress: $\text{Stress } (\sigma) = \frac{\text{Restoring force}}{\text{Area}}$

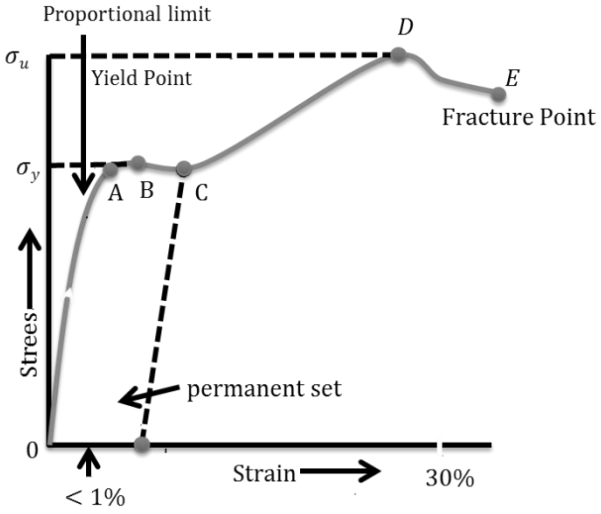
Internal restoring force per unit area



Strain: The relative change in dimensions or shape of a body when apply deforming force.



RELATION BETWEEN STRESS AND STRAIN



HOOKE's LAW

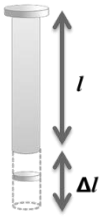
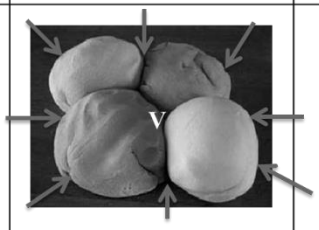
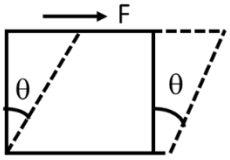
Within limit of proportionality (up to stress vs strain curve is straight line)

Stress $\propto$ Strain

Stress = E strain

Here E is modulus of Elasticity

Modulus of elasticity (E) Types

(1) Young's modulus (Y)	(2) Bulk modulus (B)	(3) Modulus of Rigidity (η)
		
$Y = \frac{\text{Normal stress (Tensile)}}{\text{Longitudinal strain}}$ $Y = \frac{F_\perp / A}{\Delta l / l}$ $Y = \frac{Fl}{A\,\Delta l}$ Here if F = mg A = πr^2 $Y = \frac{mgl}{\pi r^2 \Delta l}$	$B = \frac{\text{Volume Stress}}{\text{Volume Strain}}$ $B = \frac{\Delta p}{-\Delta V / V}$ $B = -\frac{\Delta p V}{\Delta V}$ $\text{Compressibility} = \frac{1}{B}$ $= -\frac{\Delta V}{(\Delta p) V}$	$\eta = \frac{Shearing\ Stress}{Shearing\ Strain}$ $= \frac{F/A}{\theta}$ $\eta = \frac{F}{A\theta}$

WORK DONE IN STRETCHING A WIRE

$Y = \frac{F/A}{x/l} \Rightarrow F = \frac{YA}{l}x$

$W = \int F\ dx$

$= \frac{YA}{l}\int_0^{\Delta l} xdx$

$W = \frac{YA}{l}\left(\frac{\Delta l}{2}\right)^2$

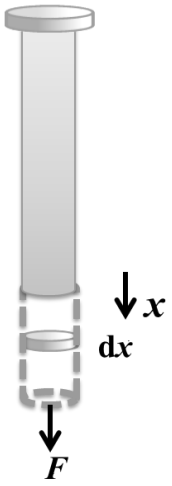
$W = \frac{1}{2}Y(Al)\left(\frac{\Delta l}{l}\right)^2$ Here $col - (v) = Al$

Work done per unit vol. $\frac{W}{vol.} = \frac{1}{2}y\ (strain)^2$

Or Energy per unit volume $u = \frac{1}{2}\ Y\ (strain)^2$

$= \frac{1}{2}\ \frac{Stress}{Strain}\ \times (Strain)^2$

$u = \ \mathbf{\frac{1}{2}}\ stress\ \times Strain$



Questions Practice Online