

MECH. PROPERTIES OF SOLIDS

Deformation - change in length, vol. and shape

Deforming force - Ext. force

Restoring Force

CHANGE IN
QUANTITY

LENGTH

VOLUME

SHAPE

STRESS

$$\bullet \frac{F}{A \text{ (c/s)}}$$

• longitudinal

• $F/A \rightarrow$ surface area

• change in pressure $\text{ss} = \frac{F}{A}$
(tangential)

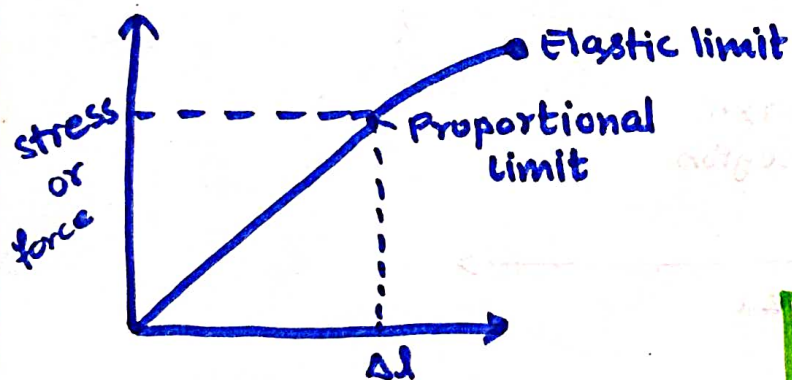
STRAIN

$$L. \text{ strain} = \frac{\Delta l}{l}$$

$$\text{Vol. strain} = \frac{-\Delta V}{V}$$

$$\text{Shear stress} = \tan \theta = \frac{\Delta x}{L}$$

HOOK'S LAW



$$\text{stress} \propto \text{strain}$$

$$E = \text{stress} / \text{strain}$$

Material or Temp.

$$Y = \frac{l \cdot \text{stress}}{l \cdot \text{strain}} = \frac{F/A}{\Delta l/l} = \frac{Fl}{A \Delta l}$$

[Change in length]

* Elongation due to self wt:

$$\Delta l = \frac{F_{\text{avg}} l}{AY}$$

* Breaking stress

$$F_B \propto A \text{ (c/s)}$$

$$F_B = PA \text{ (c/s)}$$

$$P = F_B / A \text{ (c/s)}$$

↓

material or Temp

* Bulk modulus : change in vol.
(K)

$$K = \frac{P}{-\frac{\Delta V}{V}}$$

$$C = \frac{1}{K}$$

* $P_0 =$ atm pressure

$$P_h = P_0 + \rho gh$$

$$\Delta P = \rho gh$$

SHEAR MODULUS (η)

$$\eta = \frac{F/A}{\theta}$$

$$\eta = \frac{FL}{A \Delta x} \text{ or } \frac{F}{A \theta}$$

RELATION BETWEEN γ , K & η

$$\frac{\gamma}{Y} = \frac{3}{\eta} + \frac{1}{K}$$

ELASTIC POTENTIAL ENERGY

$$U = \frac{1}{2} \times \text{Force} \times \text{elongation}$$

$$= \frac{1}{2} \frac{F}{A} \frac{\Delta l}{l} \times A \times l$$

$$U = \frac{1}{2} \text{ stress} \times \text{strain} \times \text{vol.}$$

$$[\text{stress} = Y \text{ strain}]$$

