PROPERTIES OF SOLID

Stress →

$$\text{Longitudinal Stress} = \frac{F_{\perp}}{A}$$

$$\text{Shear Stress} = \frac{F_{\parallel}}{A}$$

Volumetric Stress = Pressure of fluids or molecules

Strain

1) Longitudinal :- $\boxed{\dfrac{\Delta L}{L}}$

2) Shear :- $\boxed{\theta = \dfrac{x}{h}}$

3) Volumetric :- $\boxed{\dfrac{\Delta V}{V}}$

Hooke's Law

$$\boxed{\text{Modulus of Elasticity} = \frac{\text{Stress}}{\text{Strain}}}$$

* Young's Modulus

$$Y = \frac{\text{long. Stress}}{\text{long. Strain}}$$

$$\boxed{Y = \frac{FL}{A\Delta L}}$$

ESTIMATE

Shear Modulus / Modulus of Rigidity

$$\eta = \frac{\text{Shear Stress}}{\text{Shear Strain}}$$

$$\boxed{\eta = \frac{F_{\parallel}}{A\,\theta}}$$

Bulk Modulus (B)

$$\boxed{B = -\frac{dP}{dV/V}}$$

Compressibility:

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

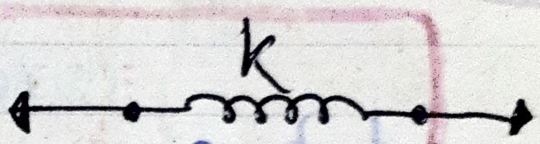
—x—x—x—

$$\boxed{B_{\text{isothermal process}} = P}$$

$$\boxed{B_{\text{adiabatic process}} = \gamma P}$$

In materials like Aluminium & Copper,
Shear Modulus < Young's Modulus < Bulk modulus

Young's Modulus (Y)



$F = kx$

$$\boxed{k = \frac{YA}{L}}$$

A rod is equi to spring of spring constant k.

Elastic Potential Energy

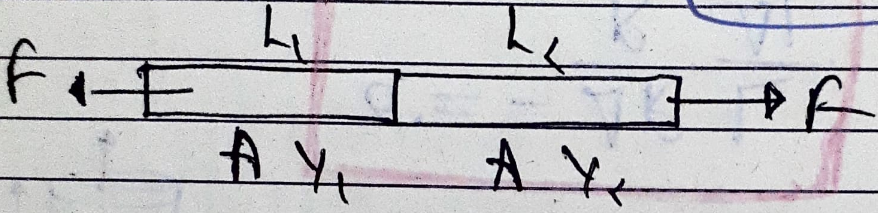
$$U = \frac{1}{2} \times \text{Stress} \times \text{Strain} \times \text{Volume}$$

$$U = \frac{1}{2} \times Y (\text{Strain})^2 \times \text{Vol.}$$

$$U = \frac{1}{2} \times \frac{(\text{Stress})^2}{Y} \times \text{Vol.}$$

Combination of Springs / RODS :-

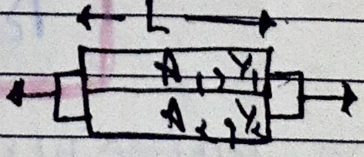
1) In Series :- $\boxed{\dfrac{1}{K_{eff}} = \dfrac{1}{K_1} + \dfrac{1}{K_2}}$



★ $$\boxed{Y_{eff.} = \frac{(L_1 + L_2)\, Y_1 Y_2}{L_1 Y_2 + L_2 Y_1}}$$

$$\boxed{\frac{\upsilon_1}{\upsilon_2} = \frac{L_1 Y_2}{L_2 Y_1}}$$

2) In Parallel :-



$$\boxed{Y_{eff.} = \frac{Y_1 A_1 + Y_2 A_2}{A_1 + A_2}}$$

$$\boxed{\frac{\upsilon_1}{\upsilon_2} = \frac{Y_1 A_1}{Y_2 A_2}}$$

Total Elongation in Rod due to its Own Mass

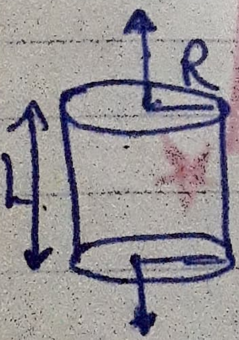
$$\boxed{\Delta L = \frac{MgL}{2AY}}$$

Energy stored in this case is,

$$\boxed{U = \frac{1}{6}\frac{M^2 g^2 L}{AY}}$$

Poisson's Ratio

$$\sigma = \frac{\text{Lateral strain}}{\text{Longitudinal strain}}$$

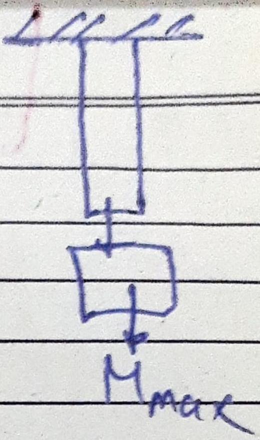


$$\boxed{\sigma = -\frac{\Delta R}{R}\frac{L}{\Delta L}}$$

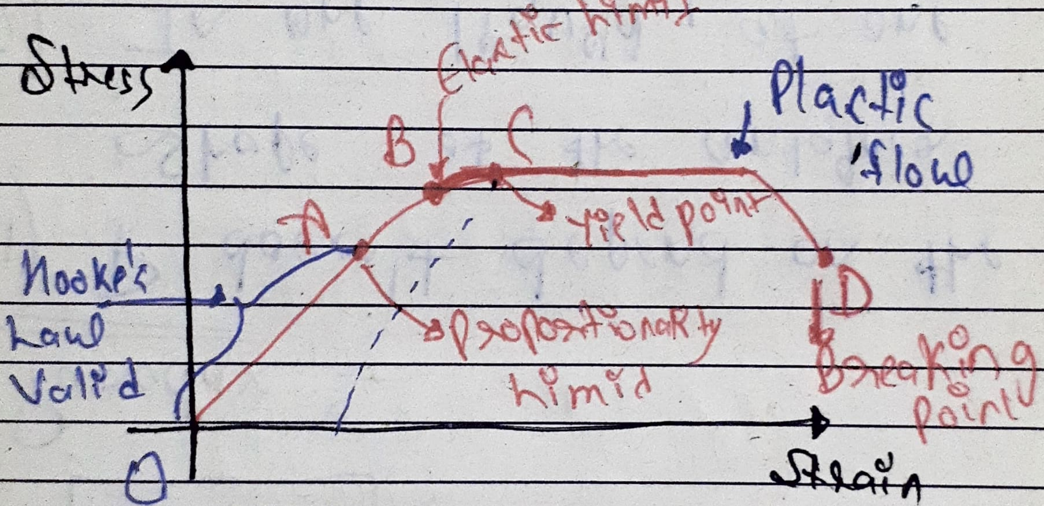
BREAKING STRESS / ELASTIC LIMIT

ESTIMATE

$$\boxed{M_{max} = \frac{A\sigma_{max}}{g} - M}$$



Stress – Strain Curve



Greater Plastic flow = Malleable Material

$\boxed{Y = \text{Slope of OA Region}}$

Steel is more elastic than rubber bcoz restoring force in steel is much greater than rubber