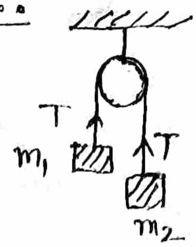
[2] Stress & Strain (elastic material)



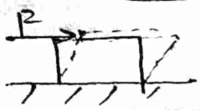
$T = \frac{2m_1 m_2 g}{m_1+m_2}$

$\Delta l = \frac{F}{A}\cdot\frac{l}{Y}$

Stress

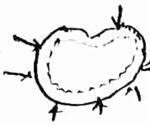
$\boxed{\text{Stress} = \frac{F_\perp}{A}}$

Shear stress

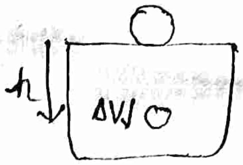


$\boxed{\text{Stress} = \frac{F_\parallel}{A}}$

Hydraulic stress



$\boxed{P_{\text{stress}} = \Delta P}$



$\Delta P = B\cdot\frac{\Delta V}{V}$

$h\rho g = B\frac{\Delta V}{V}$

$\frac{Vh\rho g}{B} = \Delta V$

Strain

Normal strain

$\boxed{\text{Strain} = \frac{\Delta L}{L}}$

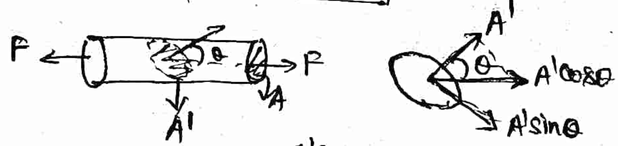
Shear

$\boxed{\text{Strain} = \theta = \frac{x}{h}}$

Vol^m

$\boxed{\text{Strain} = \frac{\Delta V}{V}}$

ex

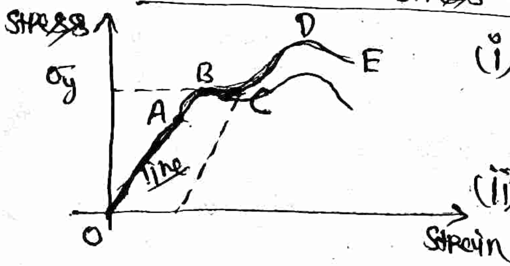


$A'\cos\theta = A$ $\boxed{A' = \frac{A}{\cos\theta}}$

Shear stress $= \frac{F\sin\theta\cos\theta}{A} = \frac{F\sin 2\theta}{2A}$

Tensile stress $= \frac{F\cos\theta\cos\theta}{A} = \frac{F\cos^2\theta}{A}$

[3.] Relation b/w stress & strain (Hook's law)



(i) $\boxed{O \to A}$: $\boxed{\text{Stress} \propto \text{Strain}}$

⇒ Stress $= K$ Strain (Y)

(ii) $\boxed{A \to B}$: non linear but still elastic

B pt. is elastic limit

σ_y is yield strength

(iii) $\boxed{B \to D}$: Strain ↑ rapidly and if deforming force removed. Strain ≠ 0] deform स्थिति।

(iv) D point ultimate tensile strength

(v) E point fracture pt.

Note: (a) Brittle if D & E are close

(b) Ductile if D & E are far

[4.] modulus of elasticity :

$Y = \frac{F_\perp}{A}\cdot\frac{l}{\Delta l}$ young

modulus of rigidity $\eta = \frac{F_\parallel}{A}\cdot\frac{h}{x}$

Bulk $B = \frac{\Delta P}{-\frac{\Delta V}{V}}$

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

[5.] Analogy with springs

like strn: $\frac{1}{K_{eq}} = \frac{1}{K_1} + \frac{1}{K_2}$

$K = \frac{YA}{L}$

[6.] P.E.

(a) energy density $u = \frac{1}{2}(\text{stress})(\text{strain})$

⇒ Energy $= \frac{1}{2}(\text{stress})(\text{strain}) \times \text{Vol}^m$

$U = \frac{1}{2}Kx^2 = \frac{1}{2}\frac{YA}{l}x^2$

[7.] elongation due to self weight :

$\Delta l = \frac{mg}{2}\cdot\frac{L}{AY}$ L, A, Y, m

take fav. of both ends

[8.] Poisson ratio (σ)

F ← → F, $d - \Delta d$

$\sigma = -\frac{\Delta d}{d}\cdot\frac{l}{\Delta l}$

[9.] Relation among Y, η & B

$B = \frac{Y}{3(1-2\sigma)}$

$\eta = \frac{Y}{2(1+\sigma)}$

$B = \frac{Y\eta}{9\eta - 3Y}$