Properties of Solids

⇒ Stress $(S) = F/A$

strain $= \Delta x / x$

Modulus of elasticity $E = \frac{\text{stress}}{\text{strain}}$, Young's modulus $Y = \frac{Fl}{A\Delta l}$

Bulk modulus $B(K) = \frac{F/A}{\Delta V/V} = \frac{-\Delta P = \rho g h}{\Delta V/V}$ N/m^2

Shearing modulus or rigidity modulus $\eta = \frac{F/A}{\theta}$ $(\theta = l/x)$

→ liquids & gases have only bulk modulus

→ Every wire is like a spring whose force const $= \frac{YA}{l} = k$

Potential Energy in wire $U = \frac{1}{2} k (\Delta l)^2$

per volume $u = \frac{1}{2} \times \text{stress} \times \text{strain}$

→ solids, liquids bulk modulus is const but for gases it is process dependent $B = B_T = P$ for isothermal

$B = B_S = \gamma P$ for adiabatic

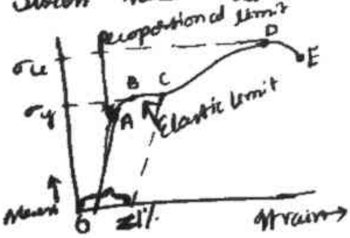
Compressibility $= 1/B$

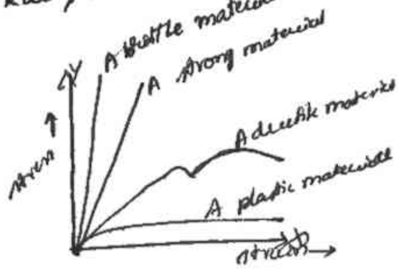
$W = Mg\Delta l$

$U = \frac{1}{2} Mg(\Delta l)$

only half of work stored in potential energy remaining is lost in form of heat, sound, etc.

→ Stress - strain curve.

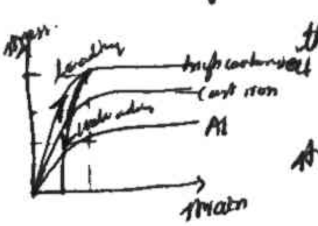




→ Poisson ratio

$\frac{\Delta V}{V} = (1 - 2\sigma) \Delta l / l$

$\sigma = \frac{\text{lateral strain}}{\text{longitudinal strain}}$

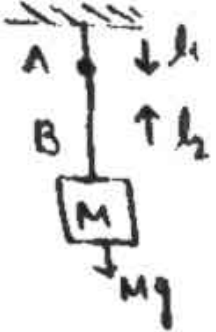


theoretical value of $\sigma = -1$ to 0.5 $\quad Y = 2\eta(1+\sigma)$

generally of $\sigma = 0.2$ to 0.4 $\quad Y = 3K(1-2\sigma)$

strain energy $= \frac{1}{2} Fe = \frac{(\text{stress})^2}{2Y}$

Series



$$Y_1 = \frac{Y_1 Y_2 (l_1 + l_2)}{Y_1 l_2 + Y_2 l_1}$$

Parallel

$$Y_p = \frac{Y_1 A_1 + Y_2 A_2}{A_1 + A_2}$$