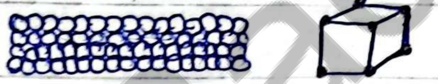
In the basis of microscopic level we catagorize solids into 3 main types.

Jab force lagate hein tou solids mein deformation aati he.

Crystaline Solids

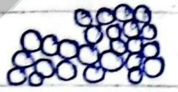
→ Specific arrangement of Particles

→ 

→ Anisotropy

Polycrystalline Solids

→ Solid material made up of many small crystals of random direction is called polycrystalline solid

→ 

Amorphous Solids

→ Solid materials, whose constituent particles are arranged in a random manner are called amorphous solids.

Isotropy

A material having uniform and identical Place/direction. The solid basically have regular and arranged pattern.

Anisotropy

Opp to isotropy

X-ray diffraction and Braggs Law

Unit cell :-

- A single cell
- combining unit cell makes crystal
- like a brick and Building
- Building Block of a crystal

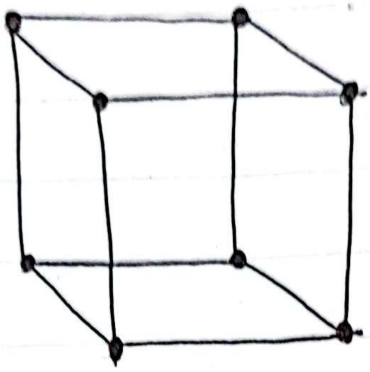
Xray diffraction and Brags Law is actually a technique used to determine the shape of crystal

Lattice :-

An imaginary geometrical framework to join basis is called Lattice.

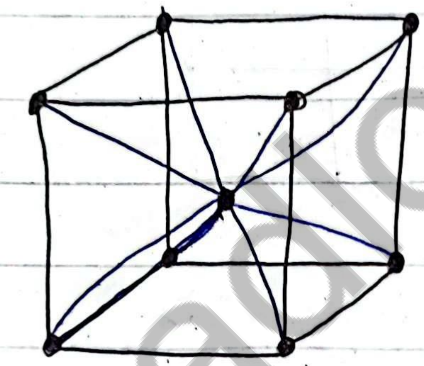
Crystal lattices - The structure of a crystal obtained by the repitition of the unit cell is called crystal lattice

Simple Cubic



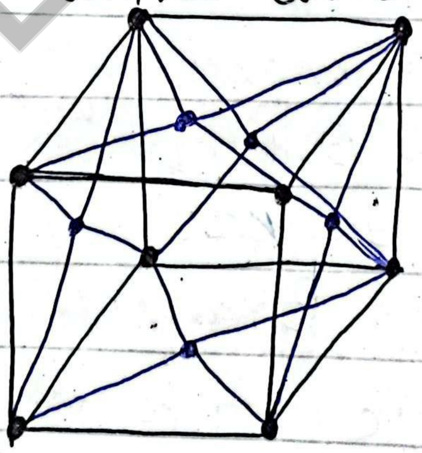
(SC)

Base Centred Cubic



(BSC)

Fase Centred Cubic



(FCC)

7.2 DEFORMATION IN Solids

16-Oct-2024

$kgms^{-2}m^{-2}$

The Change in Shape length or volume of a Solid, when it is Subjected to an external force, is called deformation

"Stress"

- Force acting per unit area
- In case of Stress & Pressure angle between Force & Area is 90°
- Only in Solids
- When a force acts on an area, Perpendicularly, then, it is called as Stress.
- Stress $(\sigma) = \frac{F}{A} = \frac{N}{m^2} = Nm^{-2}$
- Area zyada impact kam
  impact zyada Area kam

✝ One Dimensional (length)(m)

The one dimensional Streching force acting on the area ~~and of~~ of cross-section of a body, which produces linear deformation, then it is called Tensile stress.

✝ Two Dimensional (Area) (m^2)

The two dimensional Streching force acting on the area of cross sectional of a body, which produces linear deformation, then it is called Shear Stress

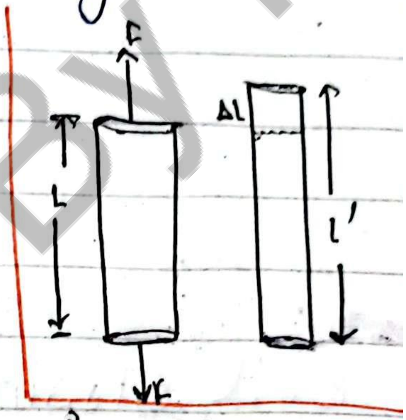
✝ Three Dimensional (volume) (m^3)

The three dimensional Streching force acting on the volume of a body, which produces linear deformation, then it is called volume strain

MODULE'S OF ELASTICITY

YOUNGS MODULES :-

Kisi object per force lagain aur us ki length mein change ai, Tou us case ka constant youngs modules he.



As stress is given by:-

$$\text{Stress} = \frac{F}{A} \quad -i$$

Tensile strain

$$\Rightarrow \Delta L = L' - L \quad -ii \qquad \text{T.Strain} = \Delta L / L \quad -iii$$

Since, the young's moduless-

$$\Rightarrow \text{Youngs Modules} = \frac{\text{stress}}{\text{strain}}$$

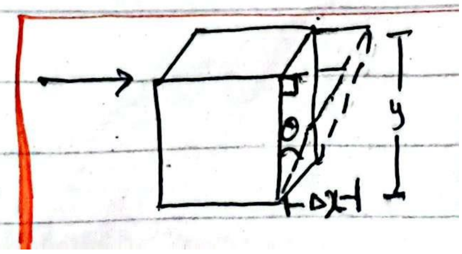
$$\Rightarrow \text{Young Modules} = \frac{F/A}{\Delta L/L}$$

$$= \frac{F}{A} \div \frac{\Delta L}{L}$$

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

So, its unit is Nm^{-2}

Shear MODULES :-



Since, $\tan(\theta) = \frac{\Delta x}{y} \quad -i$

Shear Strain ↑

here eq (i) shows shear strain.

$$\text{Stress} = \frac{F}{A} \quad \text{—— ii}$$

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

$$= \frac{F/A}{\Delta x/y}$$

$$= \frac{Fy}{A\Delta x}$$

(OR) $\frac{F/A}{\tan\theta} \approx \frac{F/A}{\theta}$

$\tan\theta \approx \theta$

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

BULK MODULES

$$\text{Bulk Strain} = -\frac{\Delta V}{V}$$

$$\text{Bulk Stress} = \frac{F}{A}$$

$$\text{Bulk Modules} = \frac{FV}{-A\Delta V}$$

"HOOK'S LAW"

Stress $\propto$ Strain

[Under the Elastic Limit]

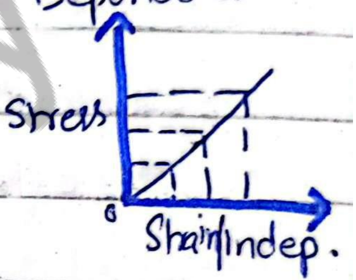
Stress = constant × strain

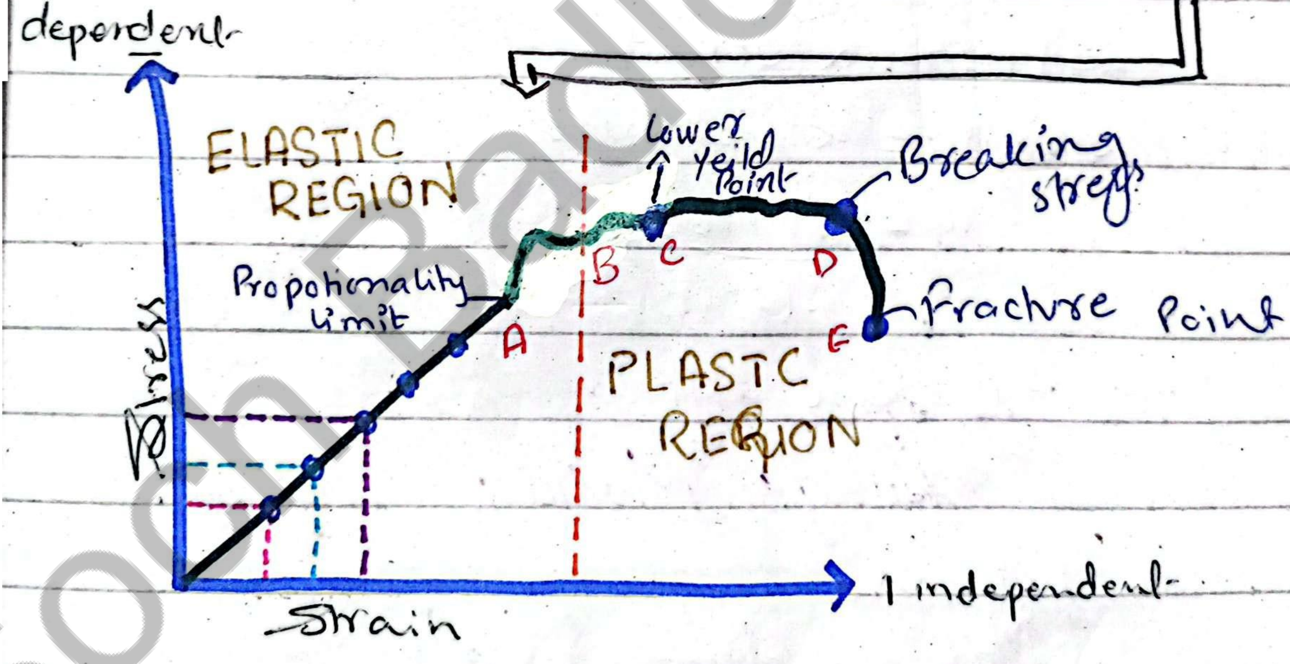
$$K = \frac{\text{Stress}}{\text{Strain}}$$

as, $$\text{Slope} = \frac{\text{Rise}}{\text{Run}}$$

$$\text{Slope} = \frac{\Delta y}{\Delta x}$$

Graphically





Q Point ABCDE Short ya overall 1 long

→SMCQ

"Elastic Potential Energy"

Q which one of the following has more elastic Potential Energy?

a- Steel ✓ b- rubber band c- none

→ stress to strain ratio steel ka zyada h

→ More Sheet Substance = More E.P.E

Modules of Metalic wire

$$Stress \propto Strain$$

$$stress = k \times strain$$

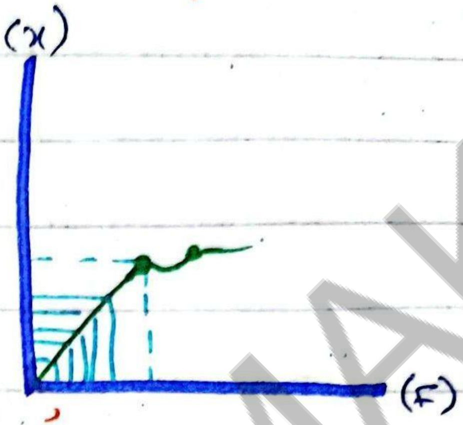
$$k = \frac{Stress}{Strain}$$

$$Stress - \underset{\underset{\text{Youngs Modules}}{\downarrow}}{F} = \underline{k}\,\underline{x} - strain$$

$$\text{Youngs Modules} = \frac{Force}{Area} \times \frac{Length}{\Delta\,length}$$

Work from Force extension graph

F	10	20	30	40	50
x	5	10	15	20	25
$K = F/x$	2	2	2	2	2



$$\boxed{\text{Area of } (Fx) = F_{avg} \times x} \quad - i$$

$$F_{avg} = \frac{F_1 + F_2}{2} = \frac{0 + F}{2} = \frac{F}{2}$$

$$\boxed{F_{avg} = F/2} \quad - ii$$

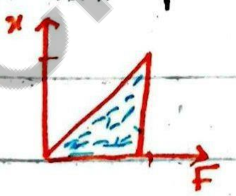
Putting -ii- in -i-

$$\text{Area of } (Fx) = F_{avg} \times x$$

$$\text{work} = \frac{F}{2} \times x$$

$$\boxed{\text{work} = \tfrac{1}{2} Fx} \quad - iii$$

Mak Special Tip :-



$$\text{Area of } \Delta = \tfrac{1}{2} \times \text{Base} \times \text{hight}$$

$$\text{work} = \tfrac{1}{2} \times F \times x$$

Q Value of F n x will be gvn and we hv to Prove the Formula

Elastic Potential Energy

Since, Work energy theorem:-

Elastic Potential Energy = Work done

Since from Hooks law

$$\boxed{F = kx} \text{ — iv}$$

As, $\text{work} = \boxed{\frac{1}{2} Fx} \text{ — v}$

Putting eq i in ii, then,

$$W = \frac{1}{2} \times (kx)x$$

$$W = \frac{1}{2} kx^2$$

$$\boxed{P.E_{(elastic)} = \frac{1}{2} kx^2} \text{ — vi}$$

On the Basis of work done

$$\text{work} = P.E_{(elastic)} = \frac{1}{2} Fx \text{ — vii}$$

as, $Y = \frac{F/A}{x/L}$

$$F = Y \times \frac{x}{l} \times A \text{ — viii}$$

Putting viii in vii

$$\boxed{P.E_{(elastic)} = \frac{1}{2} \left(\frac{YA}{L}\right) x^2} \text{ — ix}$$

On the Basis of Youngs Modules