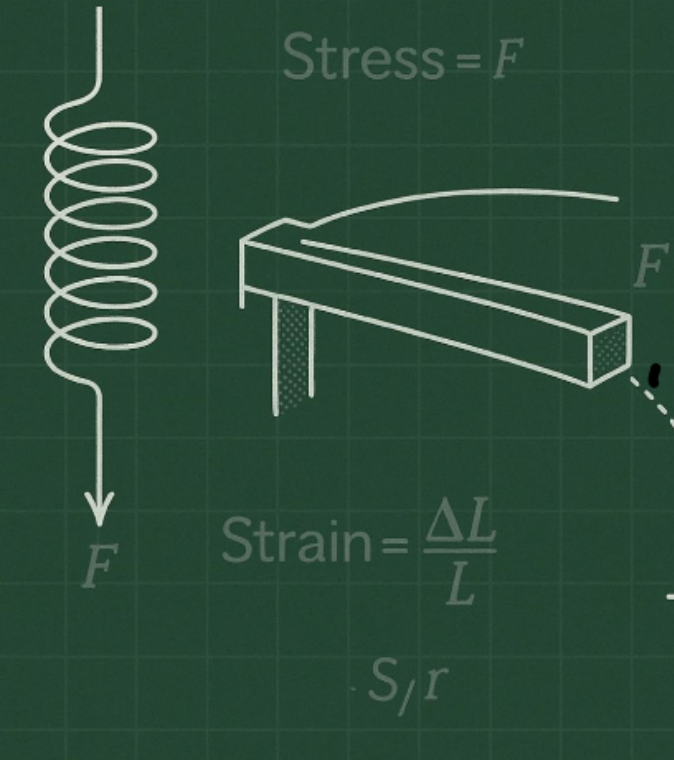
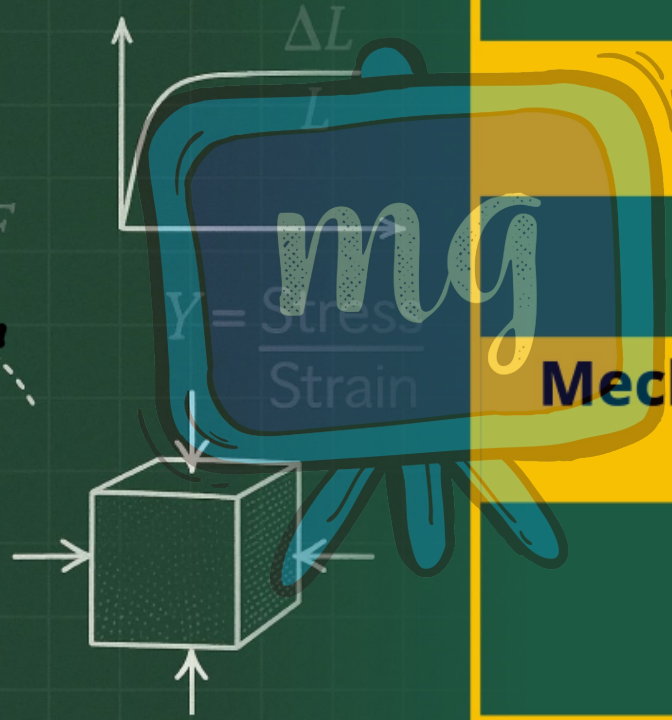




CLASS – 11

PHYSICS

Chapter – 8

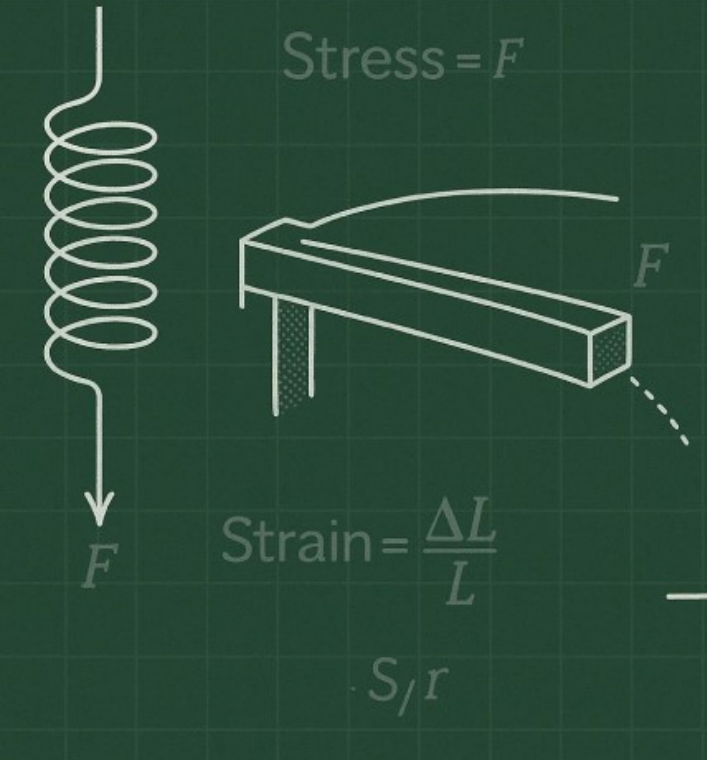
Mechanical Properties of Solid

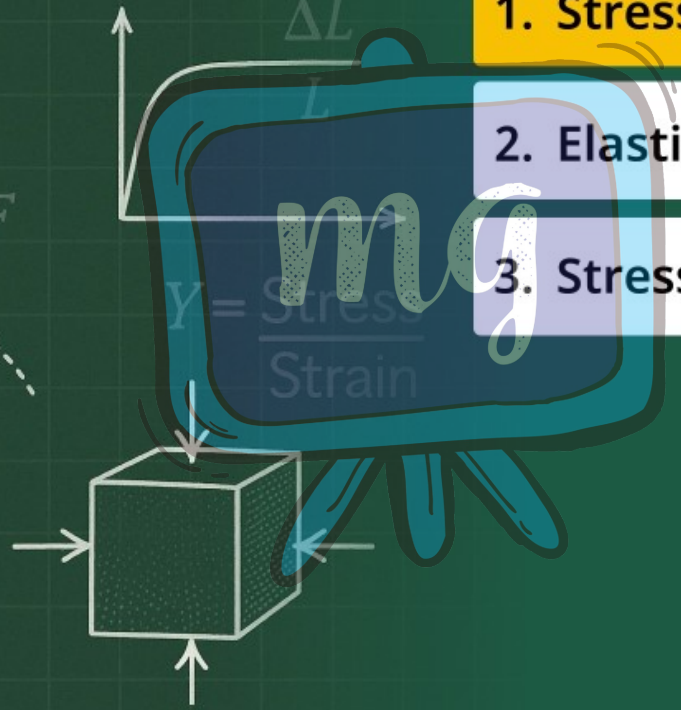
Part – 1

Stress and Strain

Alok Gaur

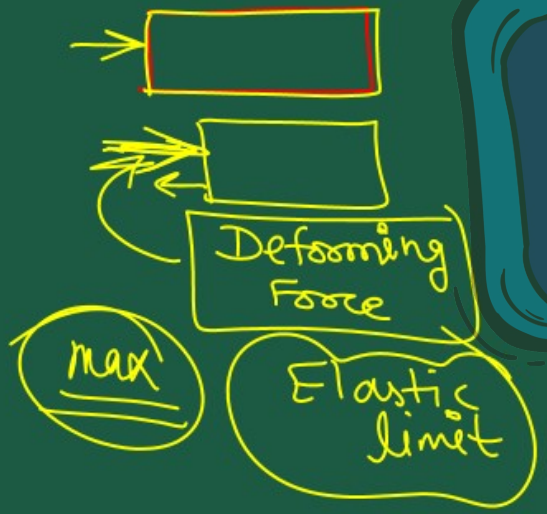
OVERVIEW





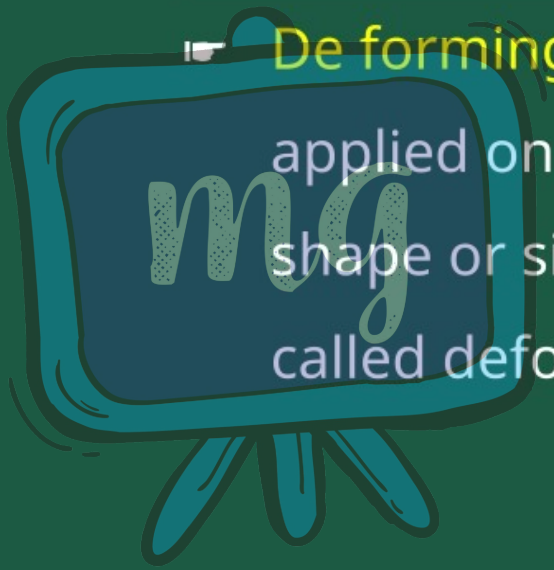
1. Stress and Strain
2. Elastic Moduli
3. Stress – Strain Curve

ELASTICITY



When external force is applied on a body it's shape or size changes ie the body be comes deformed when this force is removed the body again comes to it's original state. This property of the body is called elasticity.

DEFINITIONS



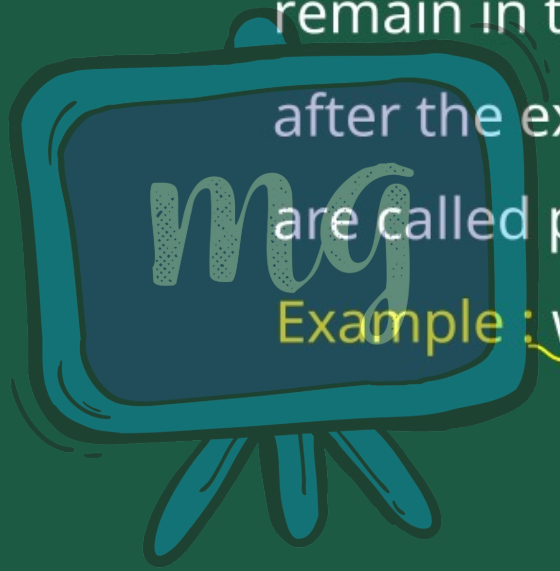
- De forming force : Any external force applied on an object due to which shape or size of the object change is called deforming force.

☛ **Perfectly elastic body :** If a body regains it's original size and shape completely and Immediately after the removal of deforming force, it is said to be a perfectly elastic body.

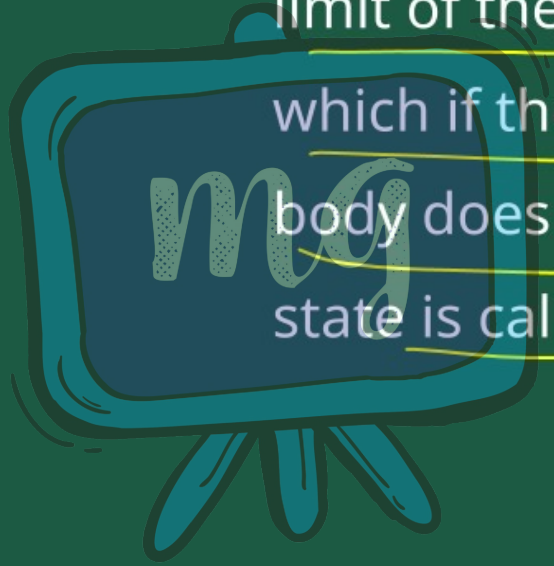
✧ The nearest approach to a perfectly elastic body is quartz.

☛ Plastic body : The bodies which remain in the deformed state, even after the external force is removed are called plastic bodies.

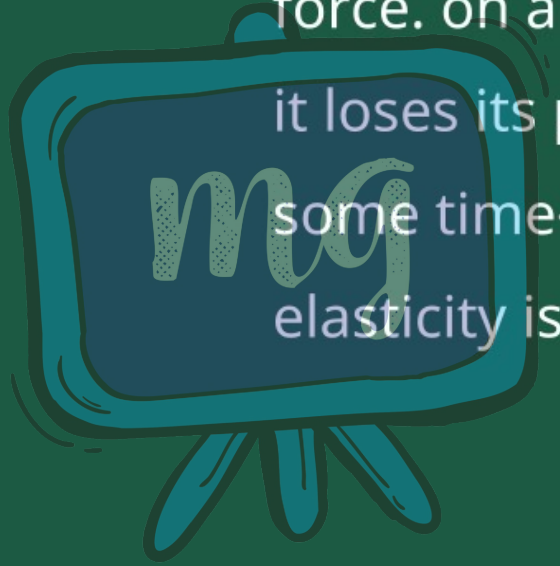
Example : wax, clay

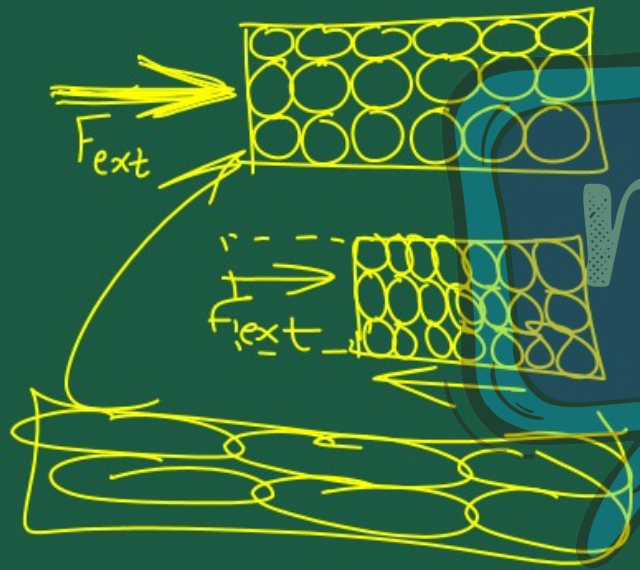


☛ **Limit of elasticity :** The maximum limit of the deforming force beyond which if the force is increased the body does not gain back it's original state is called the limit of elasticity.

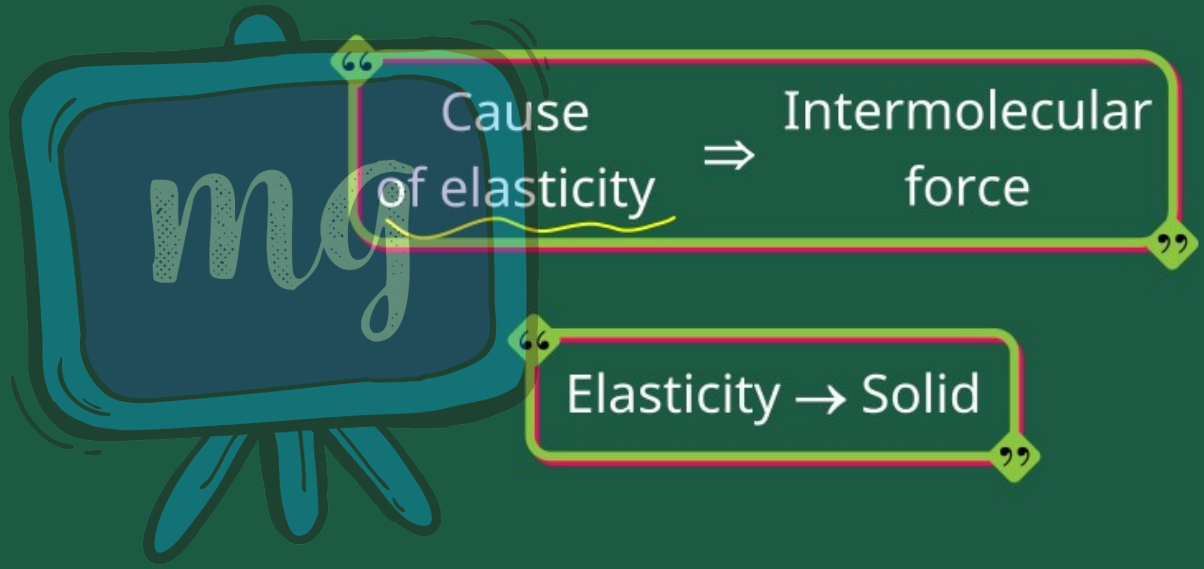


☛ Elastic fatigue : when an applied force. on a body is varied. frequently it loses its property of elasticity for some time-So this temporary loss of elasticity is called elastic fatigue.



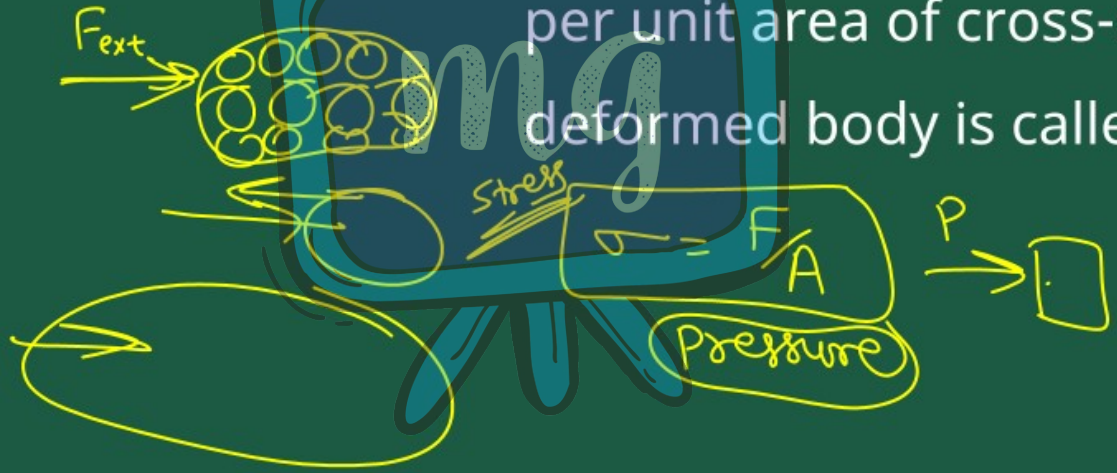


☛ **Restoring force** : when external force is applied on a body it becomes deformed. But at the same time due to the property of elasticity is an internal force is produced in the body which is equal to the external force but is opposite in direction called restoring force.

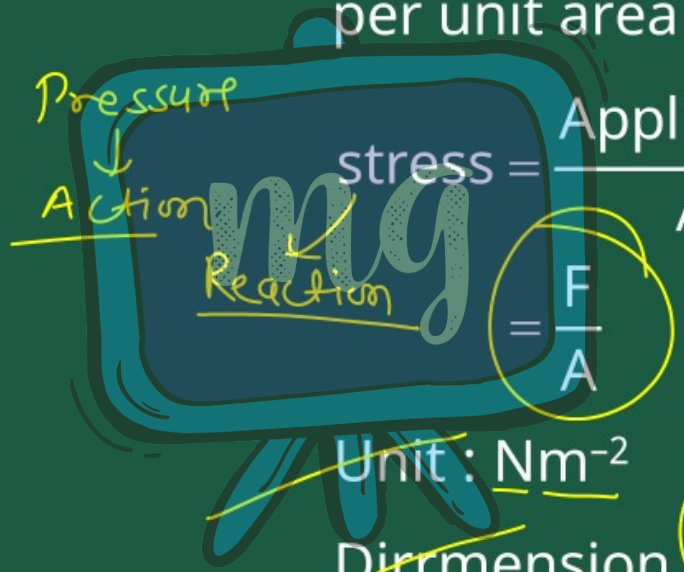


STRESS

☛ The internal restoring force setup per unit area of cross-section of the deformed body is called stress.



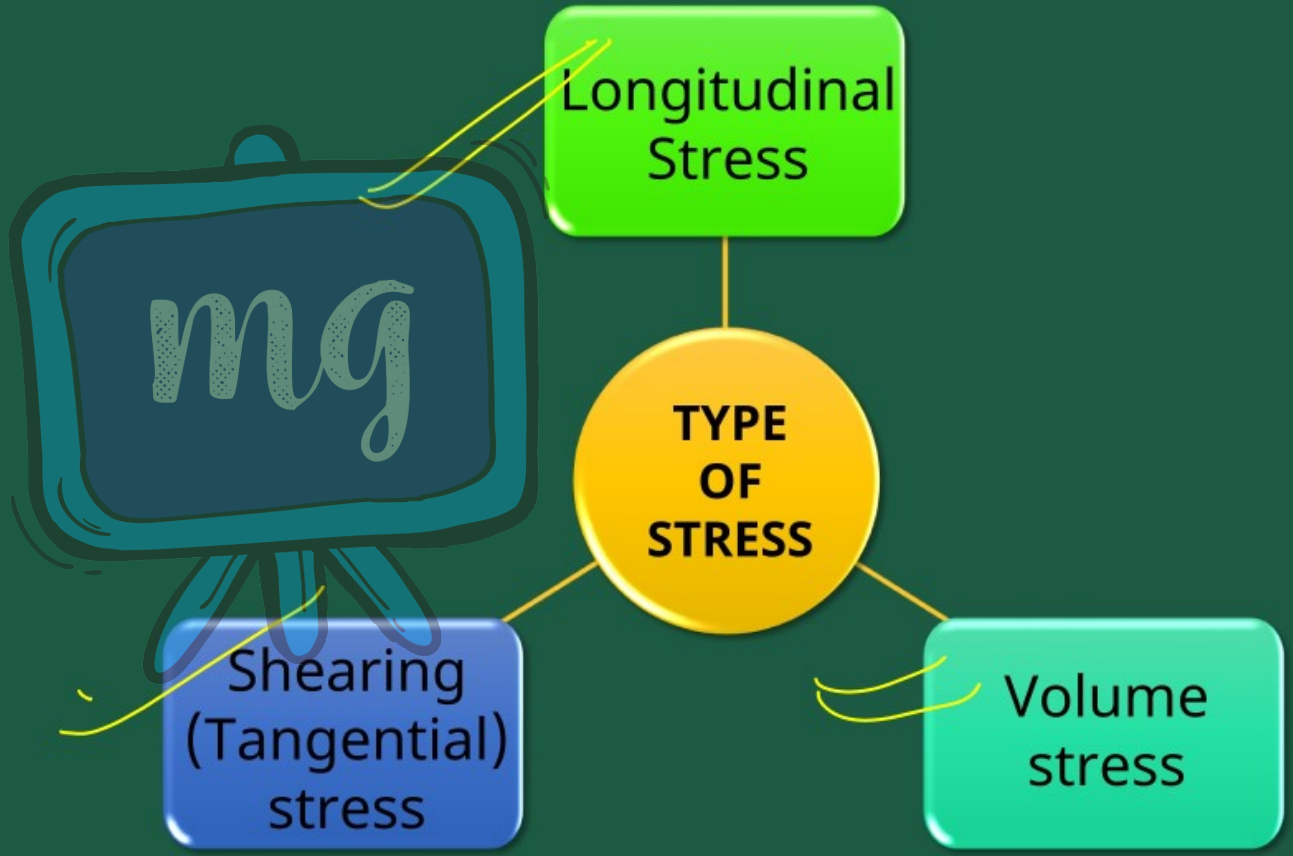
- Stress is equal to the external force per unit area of cross-section.



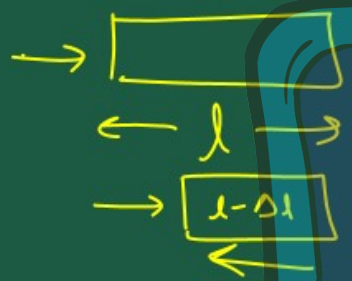
$$\text{stress} = \frac{\text{Applied force}}{\text{Area}} = \frac{F}{A}$$

Unit : Nm^{-2}

Dirrmension : $[ML^{-1}T^{-2}]$



i. LONGITUDINAL STRESS



Due to change in length

☛ When stress is applied normally to the surface of the body, it is called longitudinal stress.

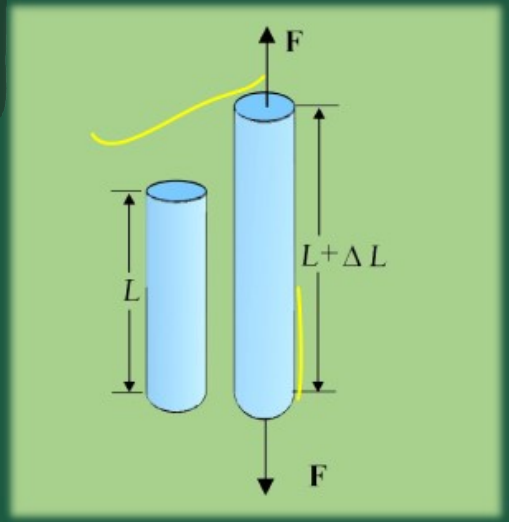
✧ It is found only in solids.

✧ It is of two types–

(a) Tensile stress (length ↑)

(b) Compressive stress (length ↓)

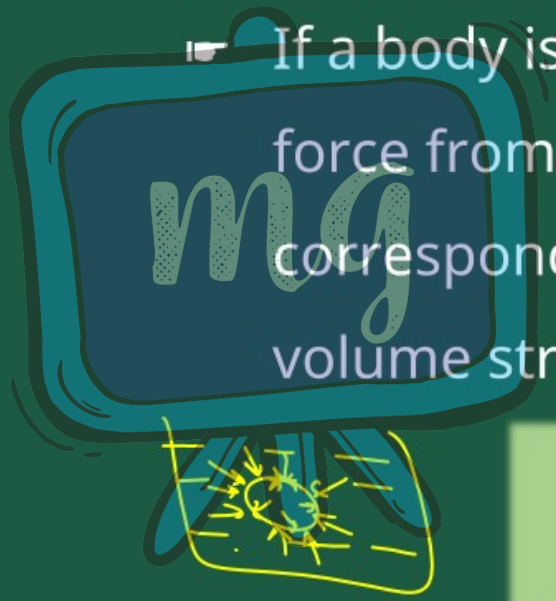
(a) Tensile stress : The longitudinal stress produced due to increase in the length of body is called tensile stress.

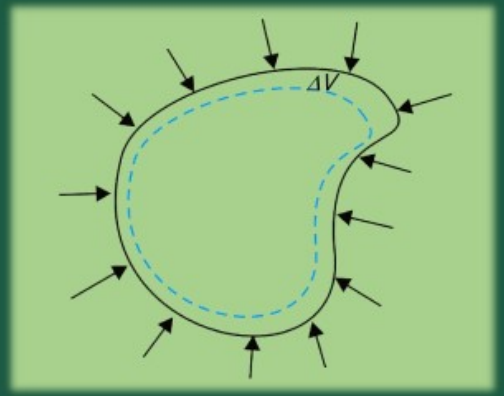


(b) Compressive stress : The longitudinal stress produced due to decrease in the length of body is called compressive stress.

ii. VOLUME STRESS

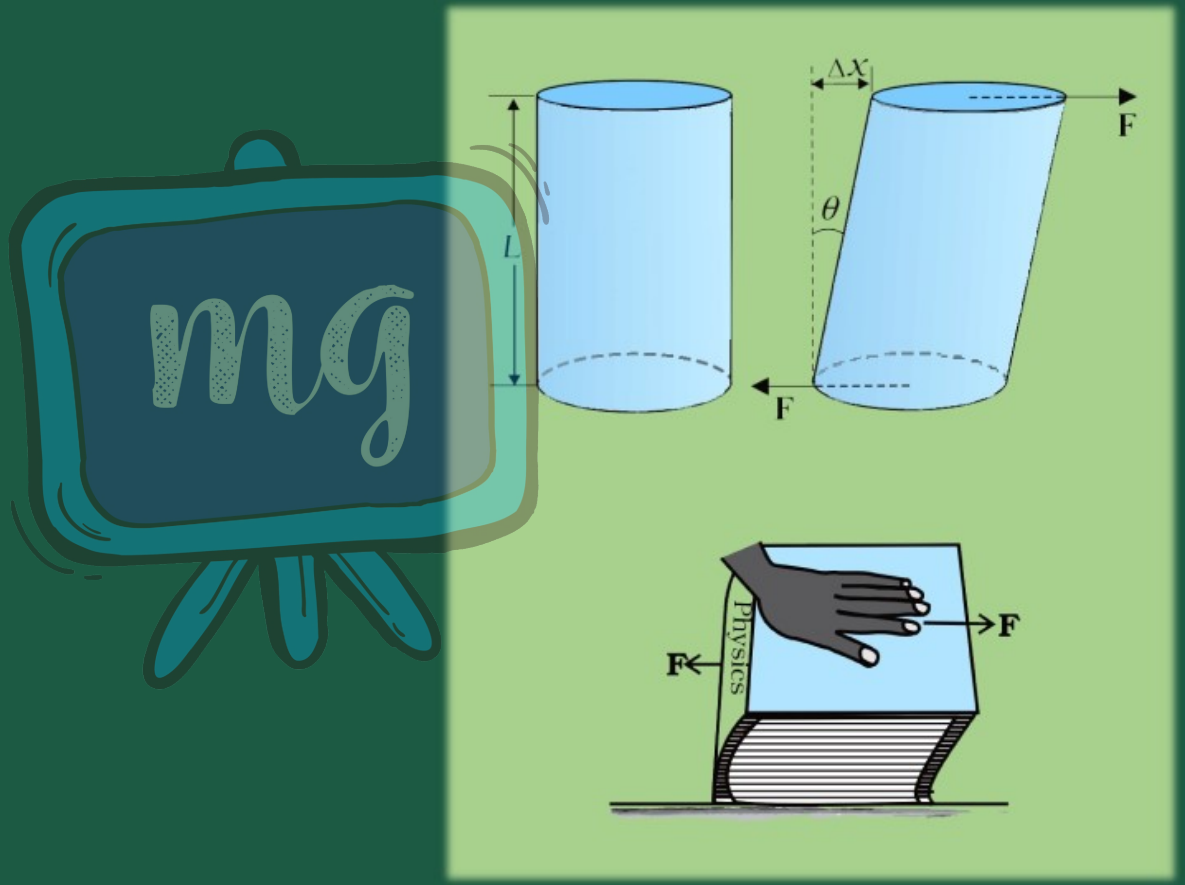
☛ If a body is subjected to a uniform force from all sides, them the corresponding stress is called volume stress or hydrostatic stress.





iii. TANGENTIAL OR SHEARING STRESS

- When a deforming force acts tangentially to the surface of a body, it produces a change in the shape of the body. The tangential force applied per unit area is equal to the tangential stress.



STRAIN

- When a deforming force acts on a body, the body undergoes a change in it's shape and size.
- The ratio of the change in any dimension produced in the body to the original dimension in called strain.

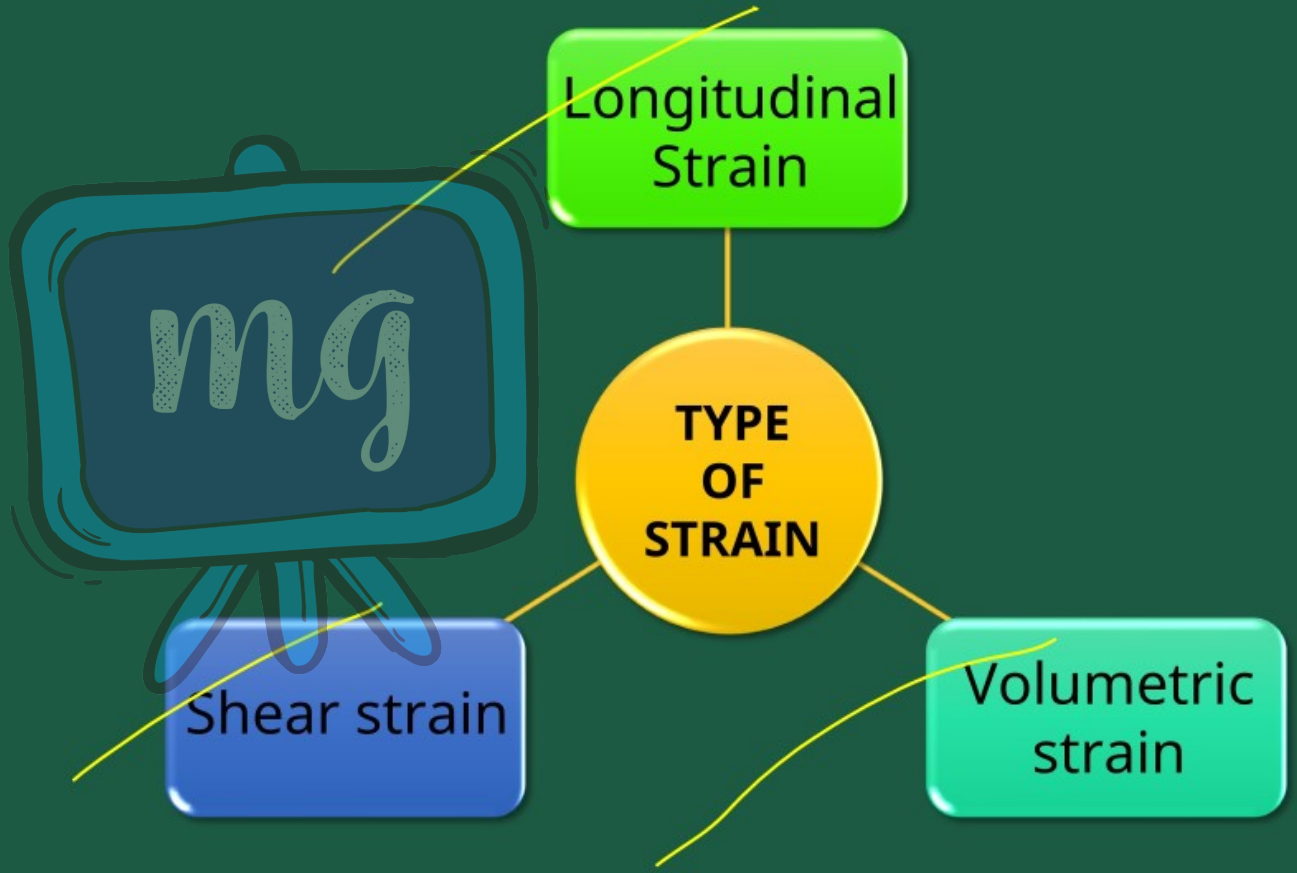
$$\text{strain} = \frac{\text{change in dimension}}{\text{Original dimension}}$$

(e)

$\frac{\Delta l}{l}$

☛ It has no units and dimensions.

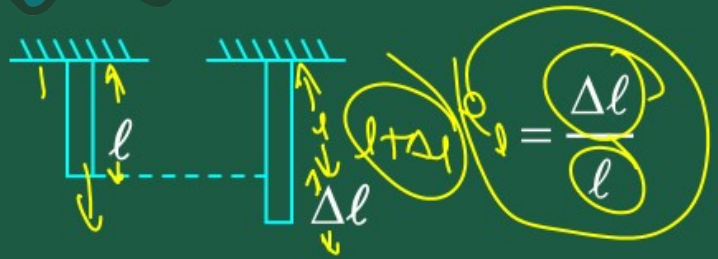
Unitless



i. LONGITUDINAL STRAIN

☛ It is defined as the increase in length per unit original length, when the body is deformed by external forces.

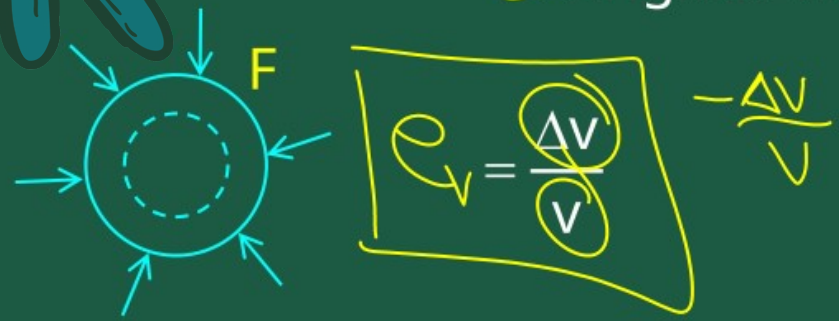
$$\text{Longitudinal strain} = \frac{\text{change in length}}{\text{Original length}}$$



ii. VOLUMETRIC STRAIN

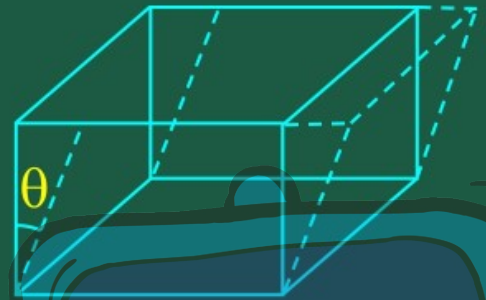
☛ It is a defined as the change in volume per unit original volume, when the body is deformed by external forces.

$$\text{Volumetric strain} = \frac{\text{change in volume}}{\text{Original volume}}$$



iii. SHEAR STRAIN

- It is defined as the angle θ (in radian), through which a face originally perpendicular to the fixed face gets turned on applying tangential deforming force.



Shear strain = $\theta = \tan\theta$

$$\text{Shear strain} = \frac{\text{Relative displacement between two parallel plant}}{\text{Distaince between parallel planes}}$$

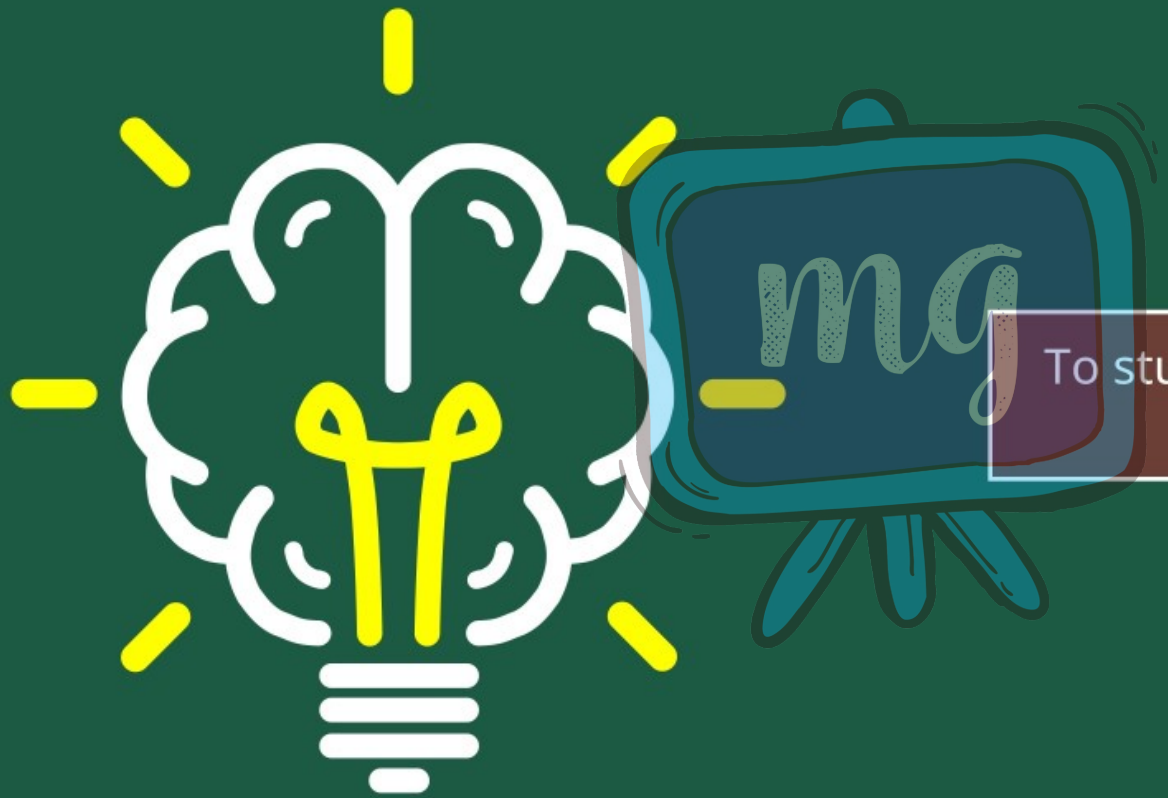
Special Facts :

S.No.	Pressure	Stress
1.	It is always perpendicular to the area	Stress can be perpendicular or tangential
2.	It is always compressive in nature	It can be compressive or tensile in nature

action

Reaction

LEARNING OUTCOMES



To study for ‘Elasticity’ ‘Stress’ and ‘Strain’

ASSESSMENT

1 When length is increased on applying force, then strain is called–

A Longitudinal

B Transverse

C Shearing

D Lateral

ASSESSMENT

2 Inter molecular force between two molecules–

A. Is always attractive force

B. Is always repulsive force

C. Is negligible at very large distance, attractive at small distance and repulsive force at very small distances.

D. Is repulsive force at large distances and attractive force at small distances.