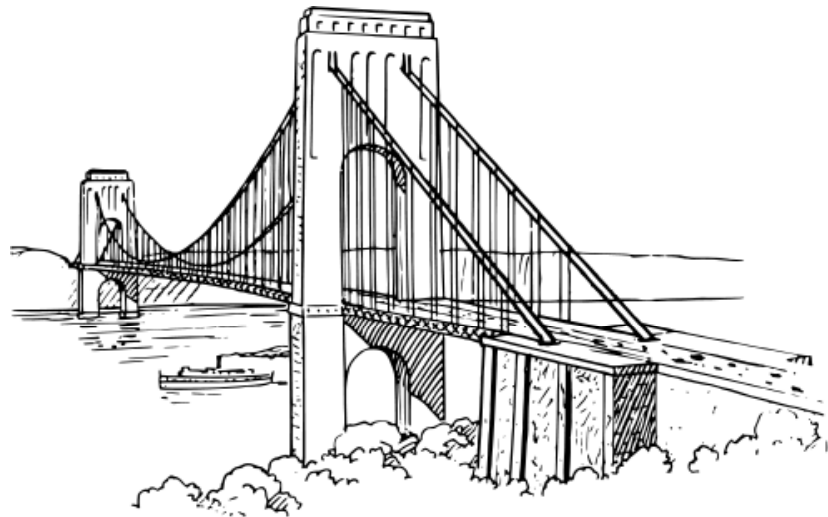


Mechanical properties of solids



Note : This PPT will NOT help you learn physics concepts. It is intended only as a quick revision of formulas, definitions, theorems and concepts before examinations. No physics can be learnt just by watching a few videos or going through a few slides of PPT.



Mechanical properties of solids

Define Hooke's law of elasticity, proportionality, permanent set, and breaking stress.

Within elastic limit, ratio of stress to strain is constant. The constant is called modulus of elasticity.

$$\frac{\text{stress}}{\text{strain}} = \text{constant}$$

Proportionally limit : It is the limit of strain up to which stress is proportional to strain and Hooke's law is obeyed.

Permanent set : If a body is subjected to strain beyond elastic limit the a certain amount of deformation is present in it even after deforming force is removed. This is called permanent set.

It is defined as the maximum stress a material can withstand before it breaks or fractures. It is also known as the ultimate tensile strength.

Mechanical properties of solids

Define modulus of elasticity, stress, strain and Poisson's ratio.

Modulus of elasticity :

Within elastic limit, ratio of stress to strain is constant. The constant is, in general, called modulus of elasticity.

Stress:

It is defined as the restoring force per unit area.

Its SI unit is Nm^{-2}

Strain :

It is defined as change in dimension per unit dimension of the body.

It is a dimensionless quantity.

It doesn't have any units

Poisson's ratio :

It is defined as the ratio of lateral strain to longitudinal strain.

$$\sigma = \frac{dr}{r} \times \frac{l}{dl}$$

Mechanical properties of solids

Define Young's modulus, Bulk modulus, and Shear modulus.

Young's modulus (Y) :

Ratio of longitudinal stress to longitudinal strain.

$$Y = \frac{F}{A} \times \frac{l}{dl}$$

Rigidity (or shearing) modulus : Ratio of shearing stress to shearing strain.

$$\eta = \frac{F}{A} \times \frac{l}{\Delta x}$$

Bulk modulus :

Ratio of bulk stress to bulk strain.

$$K = -P \times \frac{V}{dV}$$

SI unit of Y , η and K is Nm^{-2}

Dimensional formula of Y , η and K is $[\text{ML}^{-1}\text{T}^{-2}]$

Mechanical properties of solids

Define strain and explain the types of strain.

Strain : It is defined as the ratio of change in dimension per unit initial dimension of the body as it is subjected to deforming forces.

Longitudinal strain : Change in length per unit length

$$\text{strain} = \frac{dl}{l}$$

Shearing strain :

Ratio of relative displacement of opposite faces of an object per unit distance between the faces.

$$\text{shearing strain} = \frac{\Delta x}{l} = \tan(\theta)$$

Volume strain :

Ratio of change in volume to original volume.

$$\text{volume strain} = \frac{\Delta V}{V}$$

Mechanical properties of solids

Define stress and explain the types of stress.

Stress : It is the restoring force per unit area developed in the body in response to the deforming force acting on it.

Longitudinal stress : Restoring force per unit area developed along the length of the body and perpendicular to the surface.

$$\text{stress} = \frac{F}{A}$$

Shearing (or tangential) stress :

Restoring force per unit area developed tangential to the surface.

$$\text{stress} = \frac{F}{A}$$

Bulk stress :

Restoring force developed per unit area over the entire surface of the body and normal to it.

$$\text{stress} = \frac{F}{A}$$

Mechanical properties of solids

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