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23MCT204 – SOLID MECHANICS

UNIT I -SIMPLE STRESSES AND STRAINS

Hooke's Law

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HOOKE'S LAW

For elastic bodies, the ratio of stress to strain is constant and is known as Young's modulus or the modulus of elasticity and is denoted by E, i.e.,

$$\sigma \propto \varepsilon$$

$$\sigma = E\varepsilon$$

$$E = \frac{\text{Tensile stress}}{\text{Tensile strain}} \quad \text{or} \quad \frac{\text{Compressive stress}}{\text{Compressive strain}}$$

$$E = \frac{\sigma}{e}$$

Strain has no units as it is a ratio. Thus, E has the same units as stress.

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- Similarly, for elastic materials, the shear strain is found to be proportional to the applied shear stress within the elastic limit. Modulus of rigidity or shear modulus denoted by G is the ratio of shear stress to shear strain, i.e.,
- The ratio between the volumetric (Identical) stress and the volumetric strain is called Bulk modulus of elasticity and is denoted by K .

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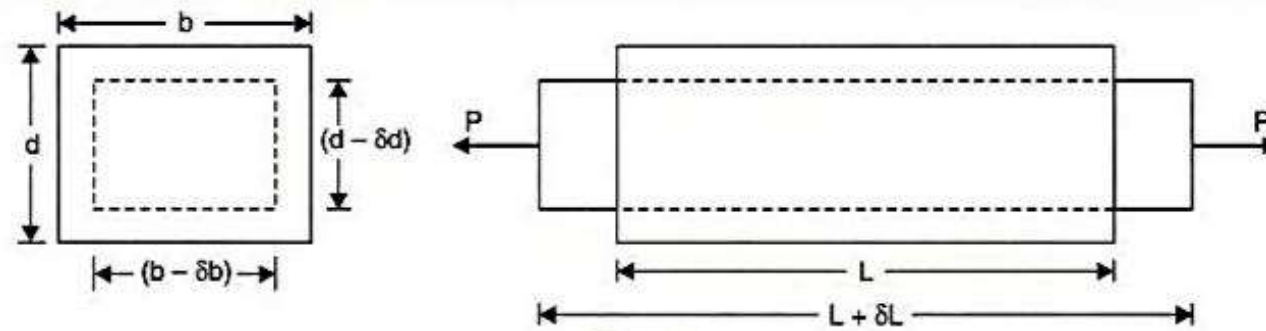
POISSON'S RATIO

The ratio of lateral strain to the longitudinal strain is a constant for a given material, when the material is stressed within the elastic limit. This ratio is called Poisson's ratio and it is generally denoted by μ or ν or $1/m$. Hence mathematically,

$$\text{Poisson's ratio, } \mu = \frac{\text{Lateral strain}}{\text{Longitudinal strain}}$$

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Longitudinal strain & Lateral strain:



$$\text{Longitudinal strain} = \frac{\delta L}{L}$$

$$\text{Lateral strain} = \frac{\delta b}{b} \text{ or } \frac{\delta d}{d}$$