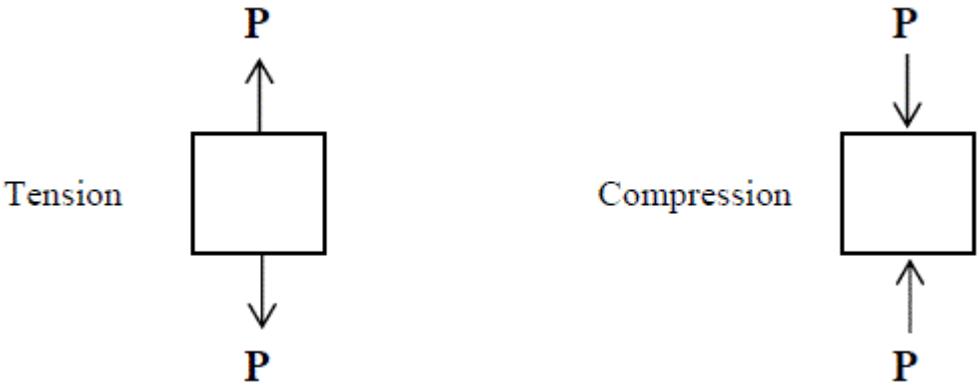
# Mechanical Properties of materials

**Stress (σ) : is the measurement of diffusion of forces in mass or body , or force per unite area**

**Stress(σ) = Force /Area = F/A , kg/cm$^2$ , N/ mm$^2$ , lb/in$^2$**

**There are two type of stress :-**
**- Compressive stresses when the load or force is compressive force.**
**- Tensile stresses when the load or force is tensile force.**




**Strength:- Strength is the greatest stress that a substance can bear under external forces (loads )without destruction .**
**Depending upon the type of load applied the strength can be tensile , compressive or shear**

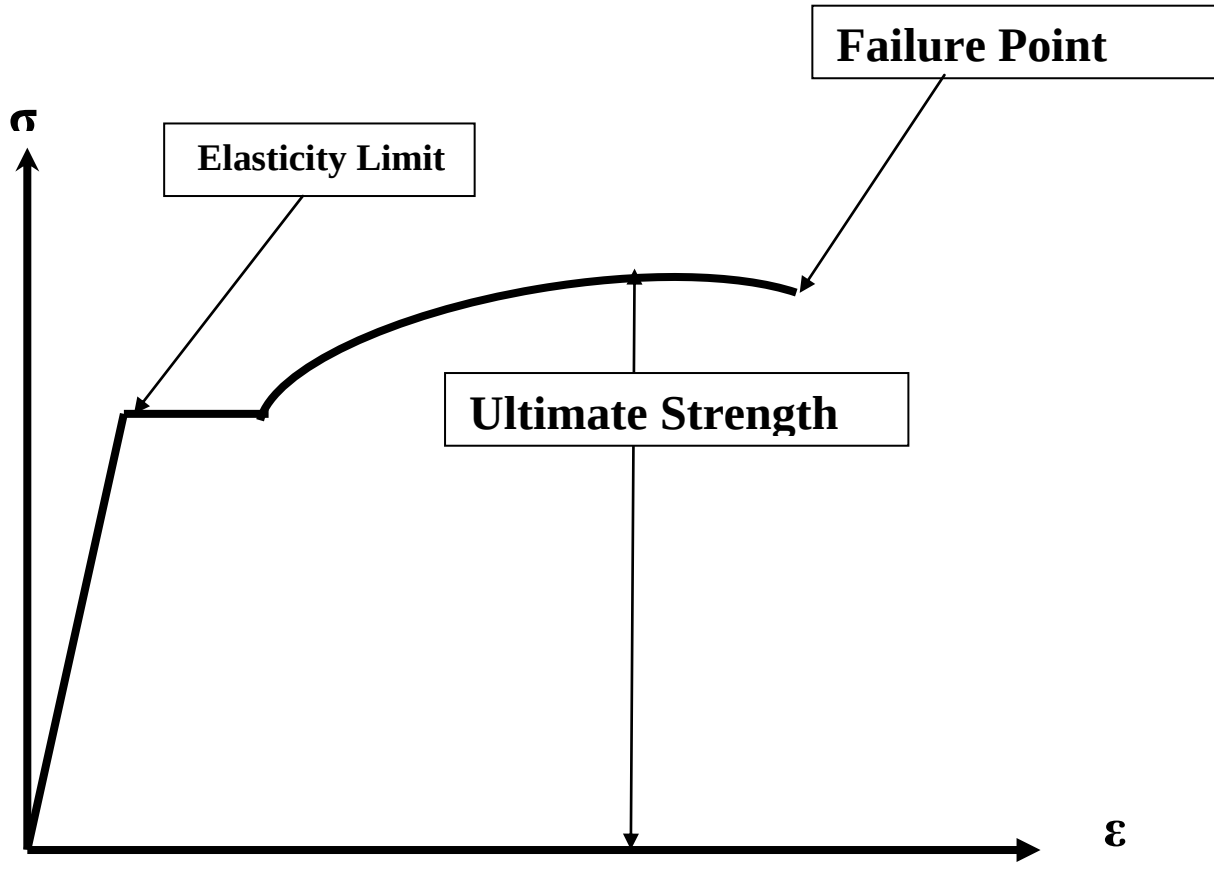
**Strain (ε):- is the measurement of deformation in the mass or body**

**Strain (ε) = Length change /Length = Δ L /L $10^{-6}$ ,**
**Micro Strain**

**Strain (ε) = Volume change / Volume = Δ V / V** $10^{-6}$
**Micro strain**

**Elasticity : it is property of a material to regain its original shape after deformation when the external force are removed**

**Plasticity: it is the property of a material which retains the deformation produced under load permanently**




**Relationship between tensile stress & strain for sample from wrought iron**

**Modulus of Elasticity(E): is stresses of unite strain in same direction of load.**
**The elastic modulus is a measure of the ability to resist deformation .**

**Modulus of Elasticity(E) = Stress/ Strain = $\sigma/\varepsilon$ kg/cm$^2$ , N/ mm$^2$ , lb/in$^2$**

**Poisson's Ratio : is ratio of lateral strain to the longitudinal strain for sample carry axial load**

**Poisson's Ratio($\upsilon$ )= Lateral Strain /Longitudinal Strain $= \varepsilon_x/\varepsilon_y$ unite less**

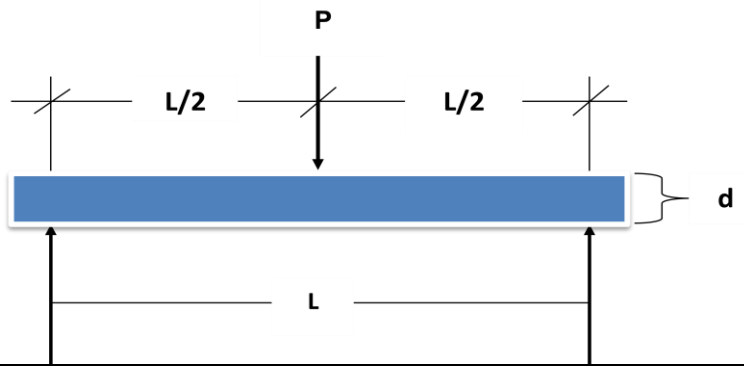
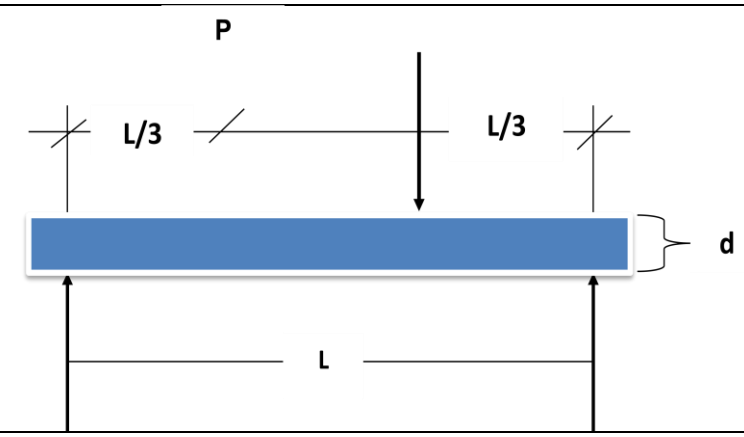
## Hooks Law

**We can find the strain in any direction when we know the stresses applied on the body at all direction .**

$$\varepsilon_x = \sigma_x/E - \upsilon\,\sigma_y/E - \upsilon\,\sigma_z/E$$
$$\varepsilon_y = \sigma_y/E - \upsilon\,\sigma_x/E - \upsilon\,\sigma_z/E$$
$$\varepsilon_z = \sigma_z/E - \upsilon\,\sigma_x/E - \upsilon\,\sigma_y/E$$

**Creep :is strain under sustain stress , or characteristic of strain in material with the effect of temperature and time under sustain stress**

**Modulus of Rupture: is strength of material under indirect tensile loads ,calculated by using the following equation for one point load or two point load .**

| | |
|---|---|
| $$= \frac{3PL}{M.O.R\ 2bd^2}$$ |  load at one point |
| $$= \frac{PL}{M.O.R\ bd^2}$$ |  load at two point |

**kg/cm$^2$ , N/ mm$^2$ , lb/in$^2$**

**Where :**
**M.O.R = Modulus of rupture in MPa**
**P= Maximum applied load indicating by the testing machine**
**L = Span length in mm**
**B= Width of specimen in mm**
**d = Depth of specimen in mm**

**Modulus of Rigidity (shear modulus ) : is the ratio between shear stress to shear strain**

$$G = E/2(1+\upsilon)$$

**kg/cm$^2$ , N/ mm$^2$ , lb/in$^2$**

- **$\sigma = F/A$** **Eq No. 1**
- **$\varepsilon = \Delta L / L$** **Eq No. 2**
- **$E = \sigma / \varepsilon$** **Eq No.3**

**Substituted the value of ($\sigma$) from eq.(1) and the value of ($\varepsilon$) from eq.(2) into eq.(3)**

**$E = (F/A) / (\Delta L / L)$**

**$\Delta L = (F*L)/(A*E)$** **Eq No.4**