UNIT I
STRESS AND STRAIN

MECHANICS OF SOLIDS

UNIT-I

STRESS AND STRAIN

Stress and strain at a point - Tension, Compression, Shear Stress - Hooke's Law - Relation -ship among elastic Constants - Stress Strain Diagram for M.S, TOR Steel, Concrete - Ultimate stress - Yield stress - FOS - Thermal stresses - Thin cylinders & shells - Strain energy due to Axial force - Resilience - Stresses due to Impact & suddenly applied load - Compound bars.

Strength of Material:

When an external force acts on a body, the body tends to do undergo some deformation. Due to Cohesion between the molecules, the body resists deformation. This resistance by which material of the body opposes the deformation is known as Strength of Materials.

Elastic Stage:

Within a certain limit (ie. in the elastic stage) the resistance offered by the material is proportional to the deformation brought out on the material by the external force.

Within this limit the resistance is equal to the external force.

Inelastic Stage:

Beyond the elastic stage, the resistance offered by the material is less than the applied load. In such case, the deformation continues, until failure occurs.

Stress:

Force of resistance per unit area, offered by a body against deformation is known as stress or intensity of stress

The external force acting on the body is called the load.

Stress $p = \frac{P}{A}$

Where p - Stress
P - External force or load
A - C/s area

Units of Stress: kgf/m^2 or kgf/cm^2 – M.K.S

N/mm^2 or N/m^2 – S.I units

$N/m^2 = N/10^4 cm^2 = 10^{-4} N/cm^2$ or $10^{-6} N/mm^2$

$1 N/mm^2 = 10^6 N/m^2$

$1 N/m^2 = 1$ Pascal $= 1$ Pa

$1 N/mm^2 = 10^6 N/mm^2$.

Types of Stress:

1. Tensile stress
2. Compressive stress
3. Shear stress.

Various types of Stresses

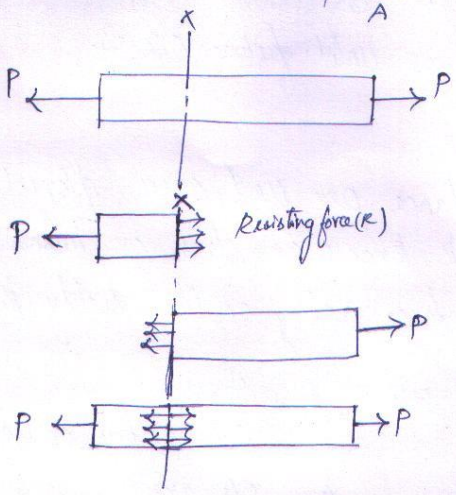
1. Simple or Direct Stress
   (i) Tension (ii) Compression (iii) Shear
2. Indirect stress (i) Bending
3. Combined stress

Tensile stress:

The stress induced in a body, when subjected to two equal and opposite pulls as a result of which there is an increase in length, is known as tensile stress.

$\therefore$ Tensile stress $= p = \frac{\text{Resisting force } (R)}{\text{Cross-sectional area}}$ or $\frac{\text{Tensile load } (P)}{A}$

$p = \frac{P}{A}$



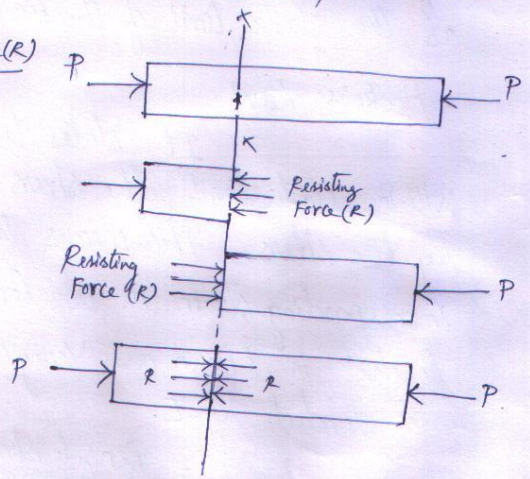
Compressive Stress:

The stress induced in a body, when subjected to two equal and opposite pushes as a result of which there is decrease in length of the body takes place is known as Compressive stress.

Compressive Stress (p) $= \frac{\text{Resisting Force (R)}}{\text{Area (A)}}$

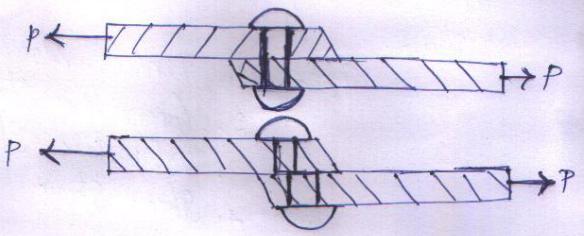
$= \frac{\text{Push (P)}}{\text{Area (A)}}$

$p = \frac{P}{A}$



Shear Stress:

The stress induced in a body, when subjected to two equal & opposite forces which are acting tangentially across the resisting section as a result of which the body tends to shear off across the section is known as Shear stress.



Elastic limit:

When an external force acts on a body, the body tends to undergo some deformation. If the external force is removed and the body comes back to its original shape and size then the body is known as elastic body.

The property, by virtue of which certain materials return back to their original position after the removal of the external force is called elasticity.