DIGITAL EDUCATION
MARTCOST

CIVIL ENGINEERING

Strength of Material

Hand Notes For GATE, IES & PSUs

Hand Notes

Page Length : 174

Note : *We also providing GATE & IES Materials [Handnotes, Shortnotes & Books], All Reports [Seminar Reports & PPT]*

Goto : www.martcost.com

2nd JULY,
TUESDAY

STRENGTH OF MATERIALS (6-8)

Strength : resistance to failure is called strength. It is a material property.

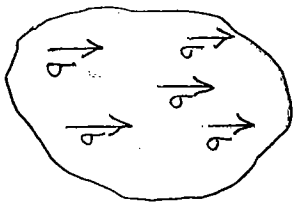
M20 ⇒ f_{ck} = 20 MPa
M15 ⇒ f_{ck} = 15 MPa
} @ failure, stress developed = streng

Stiffness : resistance against deformation is stiffness. This is a secondary design property. K↑ δ↓

Assumptions :

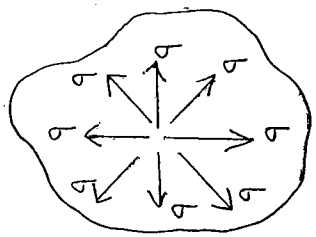
1. Material is continuous. (no voids or no cracks)
2. Material is homogenous and isotropic.

Homogenous (same origin) - Eg:- wood, iron, gold.
steel, brass, bronze (not homogenous).



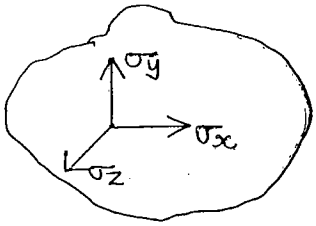
at any point in one direction, same prope

Isotropic (same directional property) - Eg:- fine grained material (iron, gold, stee
wood (non isotropic).

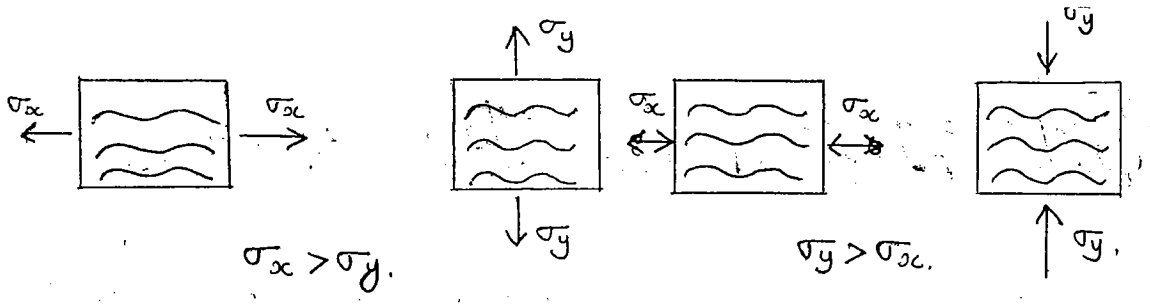


at ~~any~~ one point in any direction, same property.

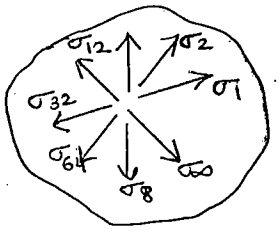
Orthotropic (1r directional property) - Eg:- Layered material (wood, sedimentary roc
marble, graphite, mica



at one point in 1r direction property are different.



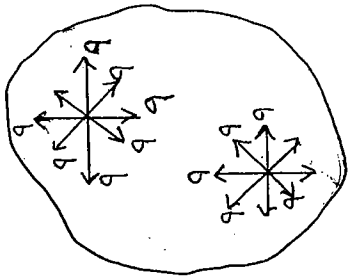
Anisotropic (Non-Isotropic) / Aleotropic



@ one point in different direction property different.

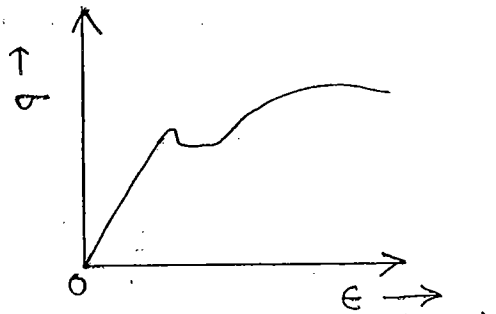
Eg:- Material with cracks and voids

Homogenous + Isotropic — Eg :- Iron, copper, gold.

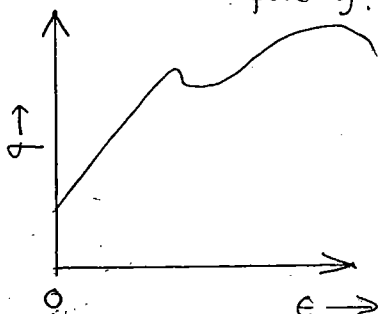


@ any point in any direction, same property

3. Self weight neglected (Stress vs Strain starts from origin due to this assumption).



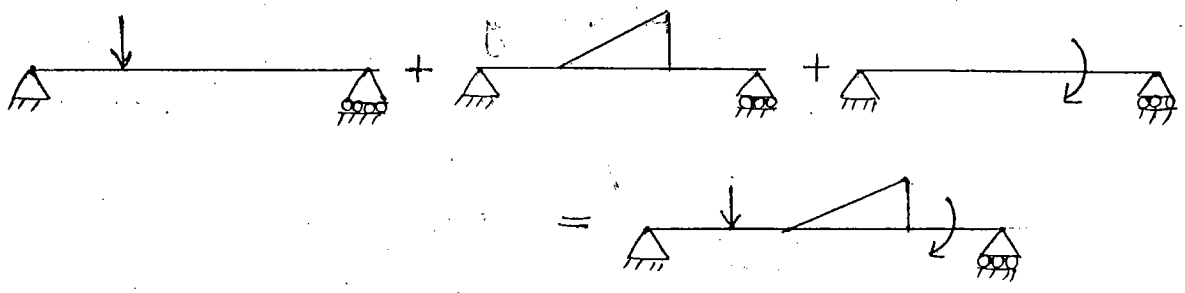
(without self weight)



(with self wt.)

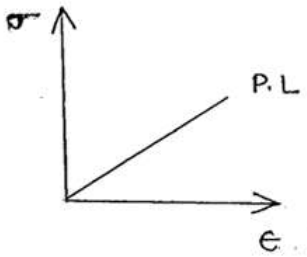
4. Superposition Principle is valid.

Algebraic sum of various effects is equal to the total effect.



Limitations of Superposition Principle :

(i) Linear elastic members.



Robert Hooke's law is valid.

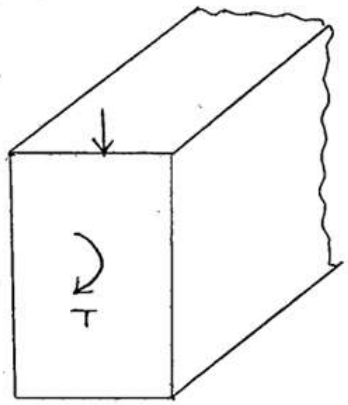
Loads must be upto P.L.

(ii) Deformations are very small.

Not valid for:

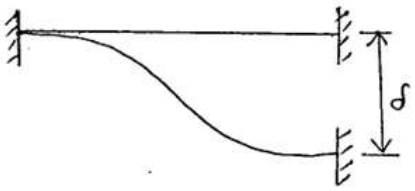
(i) Deep beam.

D > 750 mm.



In deep beams, torsion develops due to loading which causes distortion in shape

(ii) Sinking of supports.

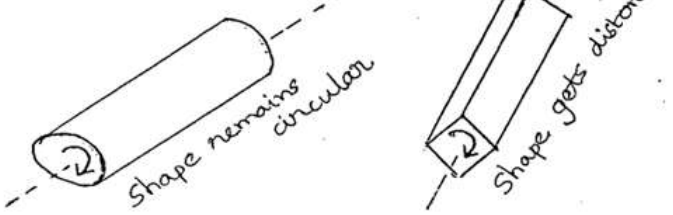


axis gets (curved) distorted.

(iii) Long Columns.

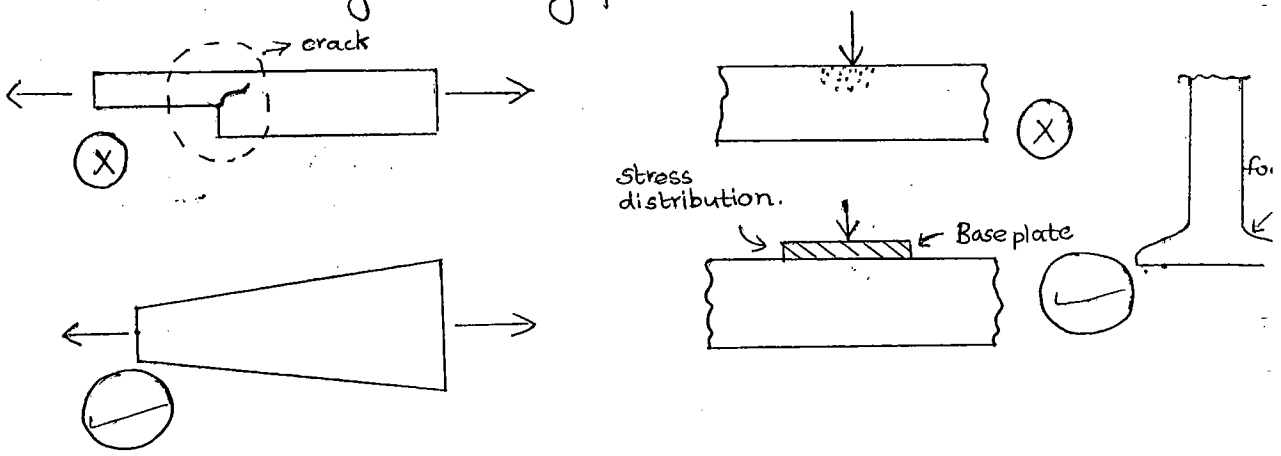
Buckling occurs.

(iv) Torsion of circular shaft



5. St. Venent's Principle is valid.

Sudden change in any parameter causes stress concentra



Stress

The Internal resistance developed against deformation per unit area. is called stress.

$$\sigma = \frac{\text{resisting force}}{\text{Unit area}} ;$$

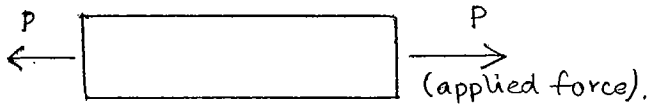
Unit of Stress = N/m^2

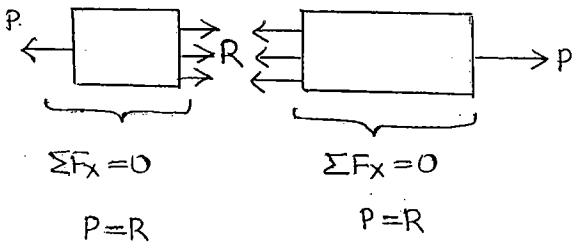
kPa = kN/m^2

* MPa = N/mm^2

GPa = 10^3 N/mm^2

= 10^3 MPa





$$\therefore \sigma = \frac{P}{A} = \frac{R}{A}$$

NOTE: ⊙ A member free to deform without showing reaction or resistance will have zero stress.

⊙ A member free to move away without any frictional resistance, stress developed is zero.

⊙ A member free to expand or contract due to temperature change, there will be no stress.