resistance of the material to deformation takes place permanently.

Concept of Stress & Strain, ~~Tensile test~~

We have already established that the strength of a material is the ability to withstand load without failure. A load applied to a mechanical member will induce internal forces within the member. The internal forces are called stresses within the member.

The stresses acting on the material cause deformation of the material in various manner. The deformation of the material is called strain.

$$\text{Strain} = \frac{\text{change in length}}{\text{original length}}$$

The force of resistance per unit area offered by a body against deformation is known as stress. The load is applied on the body while the stress is induced in the material of the body. A loaded member remains in equilibrium when the resistance offered by the member against deformation and the applied load are equal.

Mathematically,

σ - sigma

$$\text{Stress } \sigma = \frac{P}{A}$$

σ = Stress (Intensity of stress)
P = External Force (Applied load)
A = Cross-section Area

The unit of stress depends upon the unit of load and the unit of area. The S.I unit is N/m^2 and can also be expressed as N/mm^2.

$1kN = 1000\,N$, $1MN = 10^6\,N$

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

$1N/mm^2 = 1$ Pascal (1Pa)

$1KN = 1000\,N$; $1GN = 10^9\,N$; $1TN = 10^{12}\,N$.

Strain

When a body is subjected to some external force there is some change of dimension of the body. The ratio of change of dimension of the body to the original dimension is known as strain. Strain may be Tensile strain, compressive strain, volumetric strain and shear strain.

If there is some an increase in length of a body due to external force then the ratio of increase in length to the original length is called Tensile strain but if there [illegible] length ~~for~~ a body due

due to an external force then the ratio of decrease in length to the original length is called compressive strain.

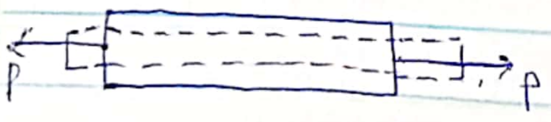
The ratio ~~of~~ of change of volume of a body to the original volume is called volumetric strain.

The strain produce by shear stress is known as shear strain.

TYPES OF STRESS.

- Normal stress
- Shear stress

Normal stress is the stress which acts in the direction perpendicular to the area. It is represented by sigma (σ). The normal stress is further divided into tensile stress and compressive stress.



Tensile stress

This is the stress induced in the body when subjected to two equal and opposite pulls as a result of which there is an increase in length. ~~#~~ The ratio of increase ~~of~~ in length to the original length is Tensile strain.

The tensile stress act normal to the area and it pulls on the area. ~~to~~

Let P = Pull (or force) acting on the body.

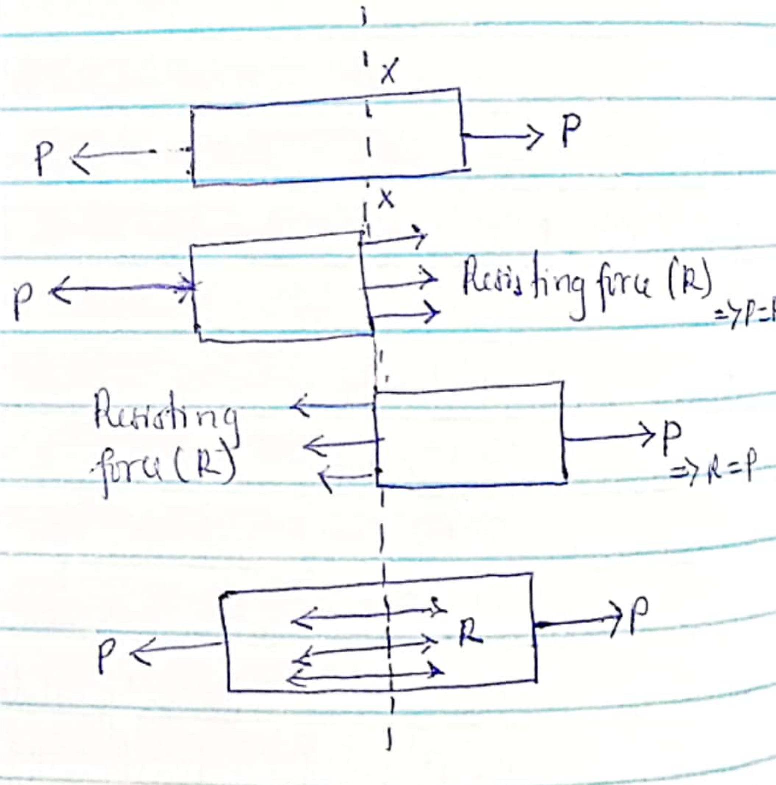
A = cross-sectional area of the body

L = original length of the body.

dL = Increase in length due to pull acting on the body.

σ = stress induced in the body.

e = strain (i.e tensile strain).



Consider a section x-x which divides the bar into two parts. The part left to section x-x will be in equilibrium if $P=R$.

Similarly, the part right to section x-x will be in equilibrium if $R=P$.

is known as stress or stress Intensity or Intensity of stress.

Tensile stress, $\sigma = \dfrac{\text{Resisting force 'R'}}{\text{Cross-sectional Area 'A'}}$

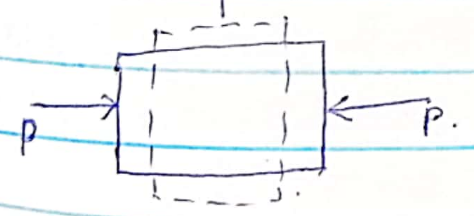
$\sigma = \dfrac{\text{Tensile load P}}{A}$

$\sigma = \dfrac{P}{A}$.

Tensile strain $e = \dfrac{\text{Increase in length}}{\text{Original length}}$

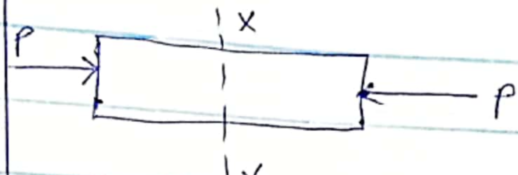
i.e $e = \dfrac{dL}{L}$.

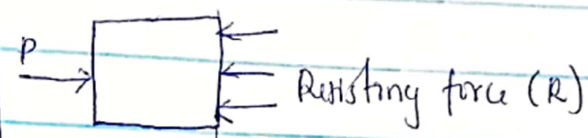
Compressive stress.-

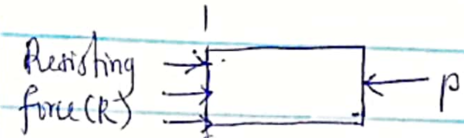


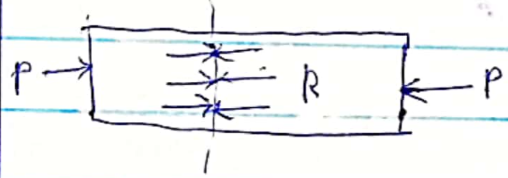
Stress induced in a body when subjected to two equal ~~and~~ but opposite pushes as a result of which, there is a decrease in length of the body is known as compressive stress. The ratio of decrease in length to the original length is known as Compressive strain.

The Compressive stress act normal to the area and it pushes on the area.









Let an axial push (P) acting on the body with cross-sectional area ~~capital~~ 'A' due to external load let the original length of the body decrease by dL.

Mathematically;

Compressive stress $\sigma = \dfrac{R}{A} = \dfrac{P}{A}$

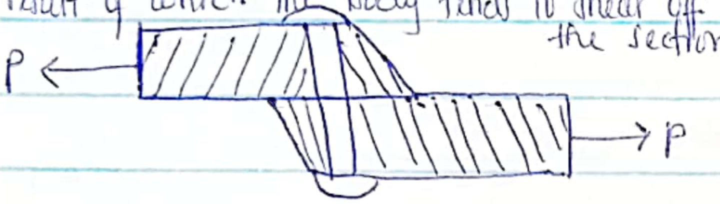
Compressive strain e

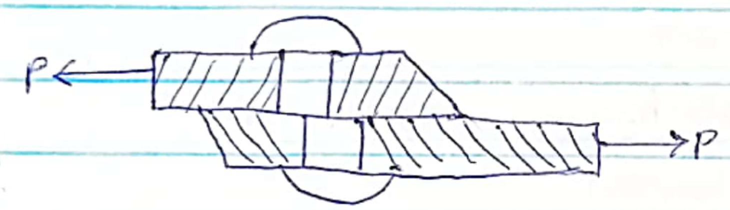
$e = \dfrac{\text{Decrease in length}}{\text{Original length}} = \dfrac{dL}{L}$

CVE-204 [continuation]

Shear Stress

The stress induced in a body when subjected to ~~when subjected~~ to two equal and opposite forces which are acting tangentially across the resisting section are shown in the figure as a result of which the body tends to shear off across the section.



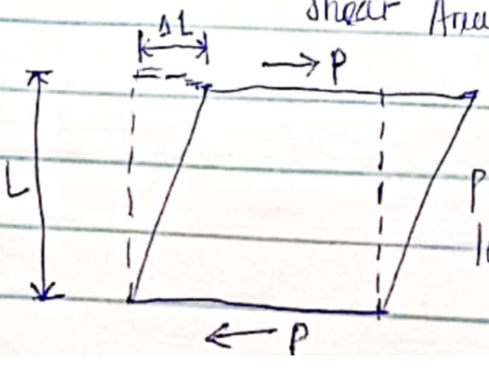


The Corresponding strain is known as shear strain. The Shear stress is the stress which act tangential to the area. ~~It is too referred~~
It is represented as tau (τ).

τ = shear stress

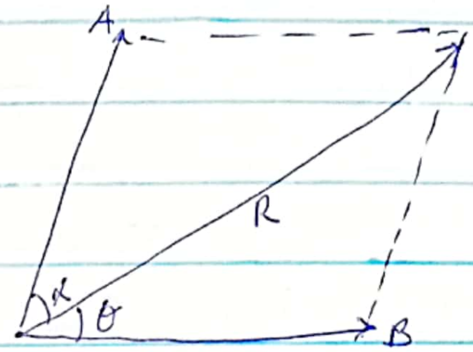
Mathematically

Shear stress $\tau = \dfrac{\text{Shear Resistance}}{\text{Shear Area}} = \dfrac{R}{A}$



Parallelogram law of forces

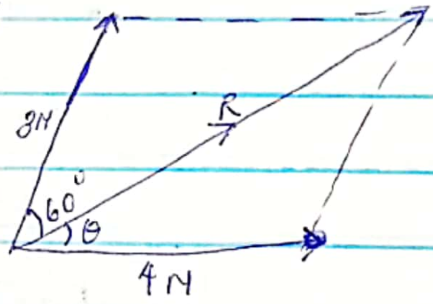
τ



$R^2 = A^2 + B^2 + 2AB\cos\alpha$

$R = \sqrt{A^2 + B^2 + 2AB\cos\alpha}$

2.9



$R^2 = 3^2 + 4^2 + 2(3)(4)\cos 60$

$R = 6.08N$ magnitude.

The Direction of R is given by θ

$\tan\theta = \dfrac{A\sin 60}{B + A\cos 60}$

$\tan\theta = \dfrac{3\sin 60}{7\cos 60} = \dfrac{2.59}{3.5}$

$\tan\theta = 0.74$

$\theta = \tan^{-1} 0.74$

$\theta = 36.5°$

10 x10x0

10m

$10\,cm^2$

$\frac{10}{10\times10}$ 10x

Elasticity and Elastic limit

When an external force act 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 (which means the deformation disappears completely), the body is known as elastic body. This property of which certain materials return back to their original position after the removal of external force is called elasticity. There is a limit value of force up to and within which the deformation entirely disappears from the removal of force.

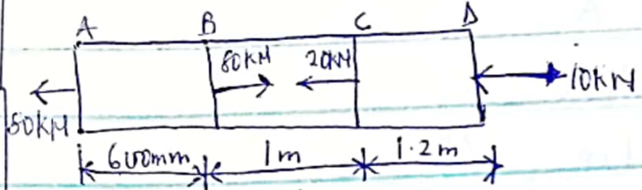
Principle of Super-position

When a number of loads are acting on a body, the resulting strain according to principle of superposition will be algebraic sum of ~~all~~ ~~the~~ strain caused by individual loads.

While using this principle for an elastic body, which is subjected to a number of direct forces (tensile and compressive) at different section along the length of the body. First, the free body diagram of the individual section is drawn. Second, the deformation of each section is obtained. Last, the total deformation of the body will be then equal to the algebraic sum of the individual section.

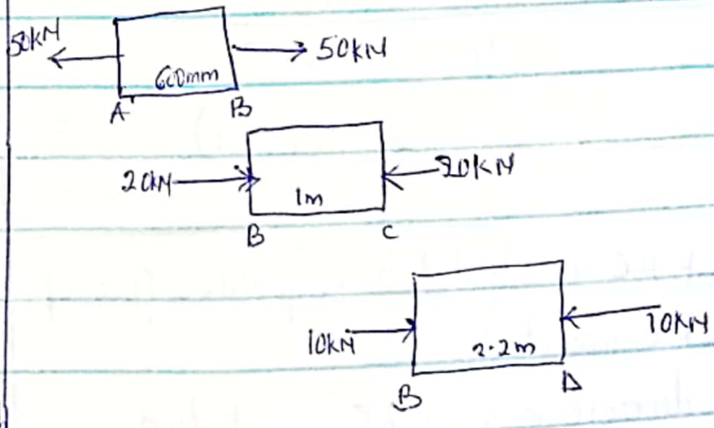
Example 1:

A brass bar having cross-sectional area of $1000\,mm^2$ is subjected to axial forces as shown in the figure below. Find the total elongation of the bar. Take $E = 1.05 \times 10^5\,N/mm^2$.



Solution

(1) Draw the free body diagram



Part AB is subjected to tensile force 50KN magnitude

Increase in length AB = Elongation

$L_{AB} = 600mm$

$P = 50KN = 50{,}000N$

$$e = \left(\frac{dL_{AB}}{L_{AB}}\right)$$

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

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

$\frac{dL_{AB}}{L_{AB}} = \frac{\sigma}{E}$

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

i.e $\frac{dL_{AB}}{L_{AB}} = \frac{P}{AE}$

$\delta L_{AB} = \frac{PL_{AB}}{AE}$

$dL_{AB} = \frac{50,000 \times 600}{1000 \times 1.05 \times 10^5}$

$= 0.2857 mm \ (+)$

Part BC is subjected to compressive force of 20KN magnitude

decrease in length BC = reduction

$L_{AB} = 1000 mm$

$dL_{AB} = \frac{20,000 \times \cancel{1000}}{\cancel{1000} \times 1.05 \times 10^5}$

$= 0.1905 mm \ (-)$

Part BD is subjected to compressive force of 10KN magnitude

decrease in length BD = reduction

$dL_{BD} = \frac{22,000 \times 1000}{1000 \times 1.05 \times 10^5}$

$= 0.2095 mm \ (-)$

(B) Total elongation of the bar = algebraic sum of elongation or deformation as the case may be of the individual sections.

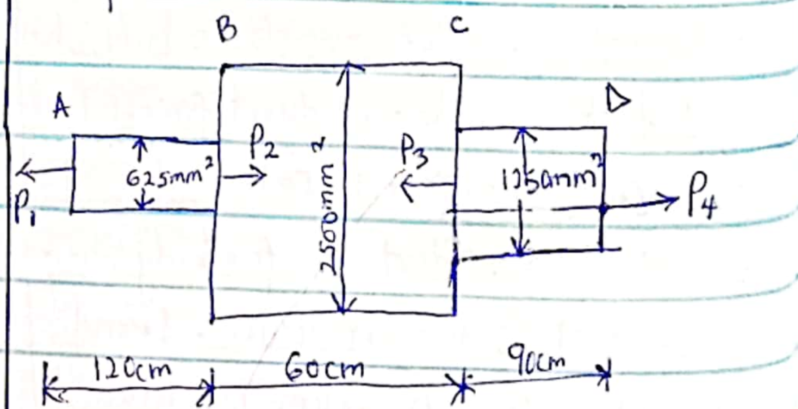
$\delta L = \delta L_{AB} + \delta L_{BC} + \delta L_{BD}$

$= +0.2857 - 0.1904 - 0.2095$

$\delta L = -0.1142 mm$

The brass bar has been shortened by 0.1142 mm

Example 2:



A member A,BCD is subjected to point load P_1, P_2, P_3 and P_4. Calculate the force P_2 necessary

necessary for equilibrium if $P_1 = 45KN$, $P_3 = 450KN$
$P_4 = 130KN$, determine

the total elongation of the member assuming the modulus of elasticity $= 2.1 \times 10^5 N/mm^2$.

value of P_2 necessary for equilibrium

EEE 204

Types of Resistors

1) Carbon composition
2) deposited Carbon
3) High voltage ink film
4) Metal film
5) Metal glaze
6) Wire wound

Carbon Composition.

It is a combination of carbon particles and a binding resin with a different proportion ~~of~~ for providing desired resistance.

Deposited Carbon.

This resistors consist of ceramic rods which have a carbon film deposited on them.

High Voltage Ink Film

These resistors consist of a ceramic base on which a special resistive ink is laid down in a helical band

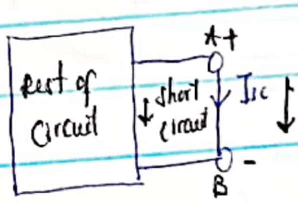
Metal Film - These are resistors made by depositing vapourized metal in vacuum on a ceramic - core rod.

Metal glaze - These resistors consists of a metal glass mixture which is applied as a thick film to a ceramic substrate and then fired to form a film.

Short and Open Circuit.

Short Circuit - When two points of a circuit are connected together by a thick metallic wire, they are said to be short-circuited. They have no resistance, no voltage can come across it and have large current.

The current is high because resistance equals to 0. The current through it is called short-circuit current is very large (theoretically infinity).



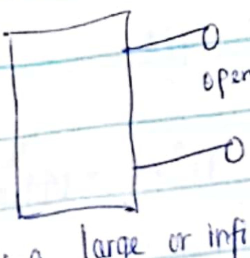
$V_{AB} = 0$
$I_{sc} = I_{AB}$
$I_{sc} = \infty$

① $R = 0$

② $V = 0$ since $V = IR = I_{sc} \times 0 = 0$.

Open Circuit

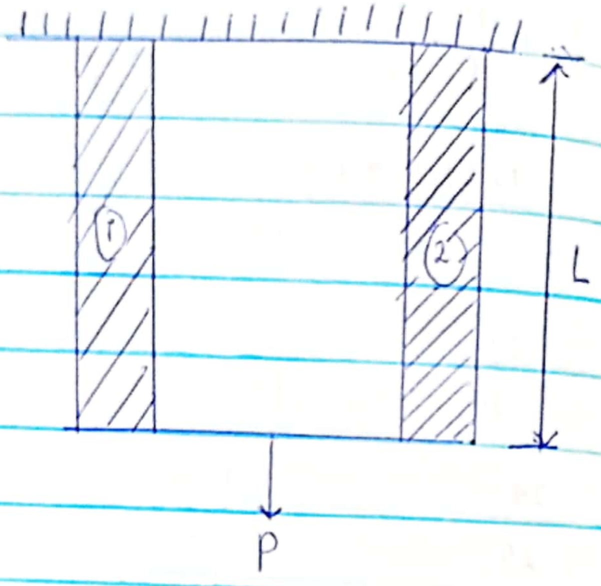
Two points are said to be open circuited when there is no direct connection between them



It has a large or infinite resistance. Since resistance is infinite Current $= 0$.

CVE 204

ANALYSIS OF BARS OF COMPOSITE SECTION



A bar made up of two or more parts of equal length of equal length but of different natural rigidly fixed with each other and behaving as one unit for extension or compression when subjected to an axial tensile or compressive force is called a composite bar.

For composite bar the following two points are important.

(i) The extension or compression in each bar is equal. Hence, deformation per unit length i.e strain in each part is equal

(2) The total external load on the composite bar is equal to the sum of the load carried by each different material.

Let P = Total load on the composite.

L = length of composite bar and also length of bars of different materials.

A_1 = Area of cross-section of bar 1

A_2 = Area of x-section of bar 2.

E_1 = Young Modulus of bar 1

E_2 = Young Modulus of bar 2.

P_1 = load shared by bar 1

P_2 = load shared by bar 2.

σ_1 = stress induced by bar 1

σ_2 = Stress induced by bar 2.

Now total load on a composite bar is equal to the sum of the load carried by the two bar.

i.e.

$$P = P_1 + P_2 \quad \text{——(1)}$$

Stress in bar 1 = $\dfrac{\text{load carried by bar 1}}{\text{Area of x-section of bar 1}}$

i.e. $\sigma_1 = \dfrac{P_1}{A_1}$

or $P_1 = \sigma_1 A_1$ ——(2)

Similarly,

$P_2 = \sigma_2 A_2$ ——(3)

From eqn(1) $\Rightarrow P = P_1 + P_2$

i.e $P = \sigma_1 A_1 + \sigma_2 A_2$ ——(4)

Since the ends of the two bars are rigidly connected, each bar will change in length by the same amount.

Also, the length of each bar is same and hence the ratio of change in length to the original length (strain) would be the same for each bar. ~~but strain~~

But

Strain in bar 1 = $\dfrac{\text{Stress in bar 1}}{\text{Young modulus of bar 1}}$

$= \dfrac{\sigma_1}{E_1}$

Strain in bar 2 = $\dfrac{\sigma_2}{E_2}$.

Since strain is the same;

$$\frac{\sigma_1}{E_1} = \frac{\sigma_2}{E_2} \quad \text{——(5)} \Rightarrow \frac{E_1}{E_2} = \frac{\sigma_1}{\sigma_2}$$

From eqn (4) and (5), the stresses (σ_1) and (σ_2) can be determine by substituting the value of σ_1 and σ_2 in eqn (2) and (3). The load carried by different materials ~~will~~ be completed.

The ratio - $\dfrac{E_1}{E_2}$ is called the modular ratio of first material to the second.

Example

A reinforced concrete circular column section of 50,000 mm^2, cross-sectional area carried 6 reinforcing bars whose total area is $500mm^2$, If the concrete is not to be stressed more than 3.5MPa. Find the safe load the column can carry. Take modular ratio for steel and concrete as 18.

Soln

Given: Area of Column = $50,000mm^2$

No of reinforcing bars = 6

Total area of steel bars $A_s = 500mm^2$.

Maximum stress in Concrete $\sigma_c = 3.5MPa$

Modular ratio $\frac{E_s}{E_c} = 18$.

Area of concrete is given as A_c

Area of concrete + Area of steel = Area of column.

$A_c + A_s$ = Area of column.

$A_c = 50,000 - 500$

$= 49,500mm^2$

Stress in steel

$$\frac{\sigma_1}{E_1} = \frac{\sigma_2}{E_2}$$

$$\frac{\sigma_s}{E_s} = \frac{\sigma_c}{E_c}$$

$$\sigma_s = \frac{E_s}{E_c} \cdot \sigma_c$$

$\sigma_s = 18 \times 3.5$

$= 63MPa$.

Safe load the column can carry.

$P = P_1 + P_2$

$P = P_c + P_s$.

$P = \sigma_c A_c + \sigma_s A_s$

$= (3.5 \times 49500) + (63 \times 500)$

$= 204750N$

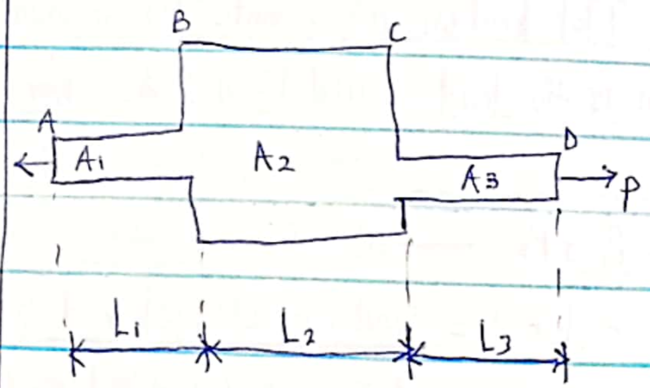
$= 204.75KN$

$\rightarrow 1MPa = 1N/mm^2$

~~Stresses in bars of different sections:~~

Stresses in bars of Different Sections,

Elongation of bars of varying x-section.



Sometimes a bar is made up of different length having different cross-sectional area as shown above. In such cases, the stresses, strain and hence, changes in length for each section is worked out separately as usual. The total change in length = Sum of change of all the individual length. It may be noted that each section is subjected to the same axial push or pull

Let P = Force acting on the body
E = Young modulus of the body.
L_1 = Length of Section 1
A_1 = X-sectional area of section 1
L_2, A_2, L_3, A_3 = corresponding values for section 2, 3.... and so on.

$$\delta L = \frac{PL}{AE}.$$

Section 1

$$\delta L_1 = \frac{PL_1}{A_1E}$$

Section 2 =

$$\delta L_2 = \frac{PL_2}{A_2E}$$

Section 3

$$\delta L_3 = \frac{PL_3}{A_3E}$$

Total deformation

$$dL = \delta L_1 + \delta L_2 + \delta L_3 + \cdots$$

$$\delta L = \frac{PL_1}{A_1E} + \frac{PL_2}{A_2E} + \frac{PL_3}{A_3E} + \cdots$$

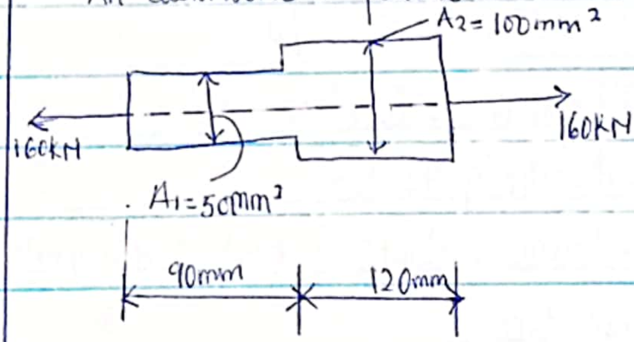
$$\delta L = \frac{P}{E}\left[\frac{L_1}{A_1} + \frac{L_2}{A_2} + \frac{L_3}{A_3} + \cdots\right]$$

Sometimes modulus of elasticity is different for different sections. In such cases, deformation will be;

$$\delta L = P\left[\frac{L_1}{A_1E_1} + \frac{L_2}{A_2E_2} + \frac{L_3}{A_3E_3} + \cdots\right]$$

Example

An automobile component shown below



is subjected to a tensile load of 160KN, determine the total elongation of the component If $E = 200GPa$.

Soln

$$\delta L = \frac{P}{E}\left[\frac{L_1}{A_1} + \frac{L_2}{A_2}\right]$$

$$\delta L = \frac{160,000}{200 \times 10^3}\left[\frac{90}{50} + \frac{120}{100}\right]$$

$$= \frac{16}{20}\left[\frac{9}{5} + \frac{12}{10}\right]$$

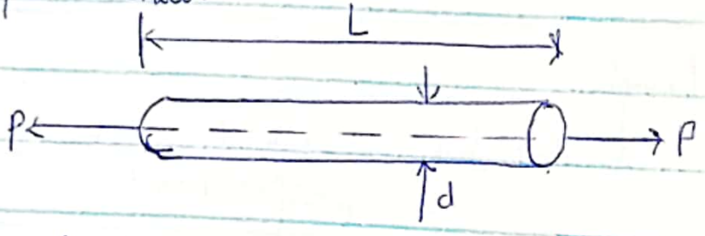
$$0.8(3)$$

$$\delta L = 2.4mm$$

Poisson Ratio

We have already discussed that whenever some external force act on a body it undergoes deformation.

Consider a circular bar subjected to tensile force as shown.



L = length of the bar.
d = diameter of the bar
dL = Increase in length of the bar as a result of tensile force.

When there is tensile force (Pull) on a material the length increases but cross sectional area of the material decreases (Decrease of diameter).

The total deformation of the bar per unit length in the direction of the force i.e $\frac{dL}{L}$ is known as

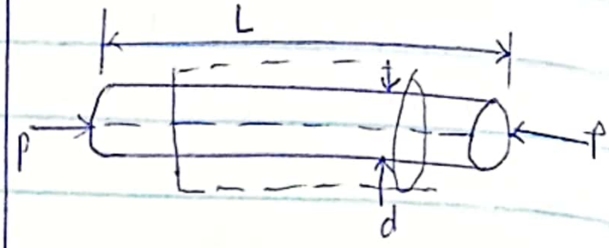
Primary strain or linear strain or longitudinal strain. If we actually studied the deformation of the bar, you will find that the bar has extended through length dL which will be followed by decrease of diameter (D)

extension of the bar

from $L \longrightarrow L + \delta L$

diameter of the bar has been decreased

from $d \longrightarrow d - \delta d$.



Similarly, If the bar is subjected to compr force.

Compression of the bar

from $L \rightarrow L - \delta L$

diameter of the bar has been increased

from $d \longrightarrow \delta + \delta d$.

It is obvious that every direct stress always accompanied by a strain in it own direction and an opposite kind of strain in every direction at right angles to it. Such strain is known as secondary or lateral strain

The ratio of lateral strain to linear strain is always constant

$$\frac{\text{Lateral strain}}{\text{Linear strain}} = \text{Constant}.$$

The constant is known as Poisson ratio

Alternatively'

$\frac{\text{Secondary strain}}{\text{Primary strain}} = \frac{\text{lateral strain}}{\text{Linear strain (longitudinal)}} = \mu$

Example:

A steel bar 2m long, 40mm wide and 20mm thick, is subjected to an axial pull of 160KN in the direction of its length, find the changes in length, width and thickness of the bar. Take E = 200GPa and Poisson ratio = 0.3.

(1) $\delta L = \frac{PL}{AE}$.

Strain $e = \frac{\delta L}{L}$ = linear strain

$\mu = \frac{\text{lateral strain}}{\text{linear strain}}$

(2) Change width

$db = b \times$ lateral strain

(3) Change in thickness

$dt = t \times$ lateral strain.

* * * Note

Area = $b \times t$ because length has already been considered

GPa $\rightarrow N/mm^2 = \left(\frac{200 \times 10^9}{10^6}\right) N/mm^2 = 200 \times 10^3 N/mm^2$

Young Modulus = Modulus of elasticity

$E = \frac{\text{stress}}{\text{strain}} \quad \frac{P}{A} \times \frac{L}{dL}$

$E = \frac{PL}{AdL}$

$dL = \frac{PL}{AE}$.

CVE 204 (Strength of Materials)

Poisson Ratio Contd

Example 1:

A steel bar 2m long, 40mm wide and 20mm thick is subjected to an axial pull of 160KN in the direction of its length. Find the changes in length, width and thickness of the bar. Take E = 200GPa (E = modulus of elasticity) and poisson ratio = 0.3.

Soln

Length $L = 2m = 2000mm$ $(2 \times 10^3 mm)$

width $b = 40mm$

Thickness $t = 20mm$

Axial pull $= 160KN = 160 \times 10^3 N$

Young Modulus $E = 200 GPa = 200 \times 10^9 Pa$

$= 200 \times 10^3 N/mm^2$

(1) Change in length δL. $\delta L = \frac{PL}{AE}$

$= \frac{(160 \times 10^3) \times (2 \times 10^3)}{(40 \times 20) \times 200 \times 10^3} = 2mm$

$\delta L = 2mm$

To find width, we need linear strain

Linear strain $\varepsilon = \frac{\delta L}{L} = \frac{2}{2 \times 10^3}$

$\varepsilon = 0.001$

Scanned with CamScanner

Lateral strain = Poisson's ratio × linear strain

Lateral strain $= \mu \varepsilon$

$= 0.3 \times 0.001$

$= 0.0003$

(ii) Change in width δb. = b × lateral strain

$= 40 \times 0.0003$

$= 0.012mm$

(iii) Change in thickness δt = t × lateral strain

$= 20 \times 0.003$

$= 0.006mm$

Example 2: A metal bar 50mm by 50mm in section is subjected to an axial compressive load of 500KN. If the contraction of 200mm guage length was found to be 0.5mm and the increase in thickness 0.04mm. Find the young modulus and the poisson ratio for the bar material.

Soln

Width (b) = 50mm

thickness (t) = 50mm

Axial compressive load (P) = 500KN

$= 500 \times 10^3 N$

Length L = 200mm

Δ in length $\delta L = 0.5mm$

Δ in thickness $\delta t = 0.04mm$

$E = ?$

$\mu = ?$

(i) Young Modulus $E = \frac{PL}{A\delta L}$

$E = \frac{(500 \times 10^3) \times 200}{(50 \times 50) \times 0.5}$

$E = 80 \times 10^3 N/mm^2$

(ii) Poisson's ratio (μ)

linear strain $\varepsilon = \frac{\delta L}{L}$

$= \frac{0.5}{200} = 0.0025$

lateral strain $= \mu \times \varepsilon$

Recall that δt = t × lateral strain

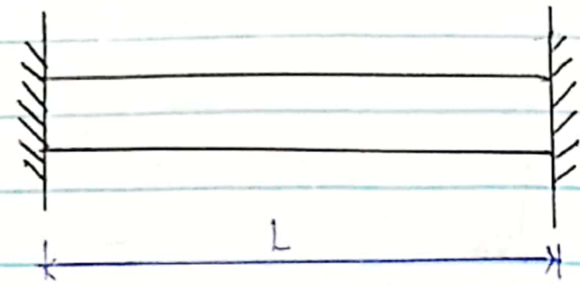
∴ lateral strain $= \frac{0.04}{50} = 0.0008$

$\mu = \frac{\text{lateral strain}}{\text{linear strain}} = \frac{0.0008}{0.0025}$

$= 0.32$.

Temperature Stresses

Materials expand or contract with rise or fall in temperature. However, if this expansion or contraction is wholly or partially resisted, stresses set up in the body. Consider a bar of length (L) restrained (fixed) at both ends undergoing variation in temperature.



Let L = Original length of the bar

t = Increase in temperature

α = Coefficient of linear expansion

The increase in length due to increase in temperature is given as

$$\delta L = L \cdot \alpha \cdot t$$

If the ends of the bar are fixed to rigid support so that its expansion is prevented, then compressive strain induced in the bar.

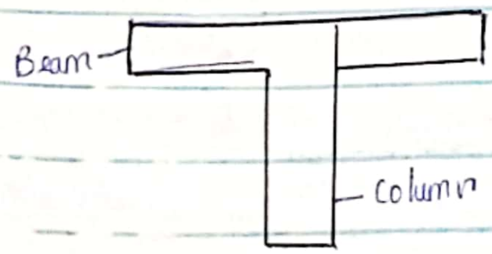
Compressive strain:

$$\varepsilon = \frac{\delta L}{L} = \frac{L\alpha t}{L}$$

$$\varepsilon = \alpha t.$$

Stress $\sigma = \varepsilon E$

$$\sigma = \alpha t E$$



Example:

A rod is 2m long at a temperature of 10°c. Find the expansion of the rod when the temperature is raised to 80°c. If the expansion is prevented, then find the stress in the material of the rod (Take $E = 100GPa$, $\alpha = 0.000012/°c$)

linear expansivity

soln.

Given: Length $(L) = 2m = 2 \times 10^3 mm$

Temp $t = 80 - 10 = 70°c$

Expansion of the rod

$$\delta L = L \cdot \alpha \cdot t$$

$$\delta L = 2 \times 10^3 \times 0.000012 \times 70$$

$$= 1.68 mm$$

$$\sigma = \alpha t E$$

$$= 0.000012 \times 70 \times 100 \times 10^3$$

$$= 84 N/mm^2$$

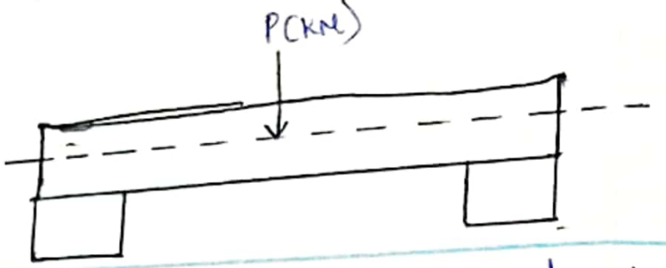
$$= 84 MPa.$$

Shear Force and Bending Moment

General Background

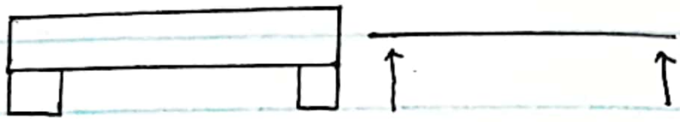
Beam

Beam is a structural member loaded perpendicular to its longitudinal axis.



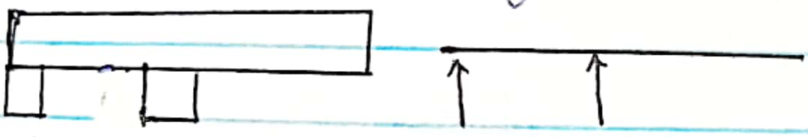
Beams transmit loads by the development of bending moment (BM) and shear force (SF) at different sections. Beams can be classified in many ways

① Simply supported beam (SSB)

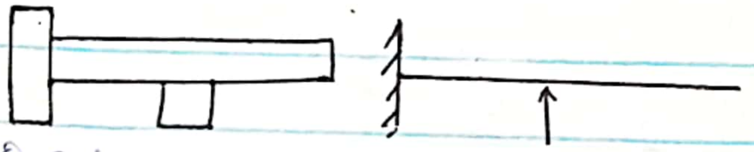


② Cantilever beam

③ Simply supported with overhangs



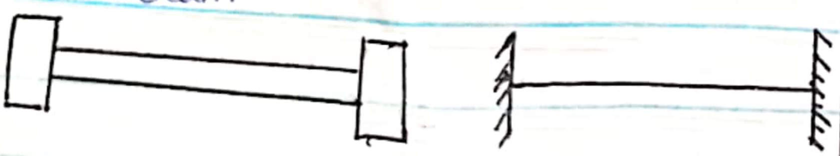
④ Propped cantilever



⑤ Continuous beam

Horizontal structural member is a beam.

⑥ Fixed beam

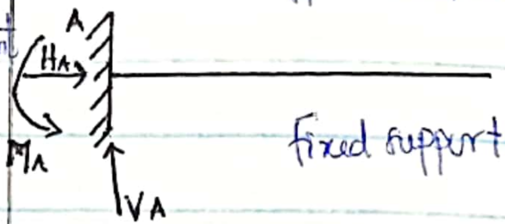


Types of support in Beam structure

Many forms of loads are dealt with in structural analysis.

The support in beams (formed structures) supply the necessary reactive forces to maintain the structure in equilibrium as a result of applied load. There are many types of support from which a system of support can result. Some of these supports are:

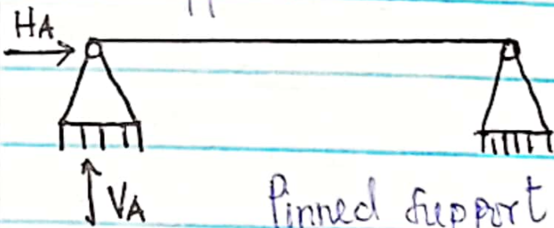
(1) Fixed end support / built in / Encastive



Fixed support

Three supports are capable of supplying three reactive forces: Horizontal (HA), Vertical (VA), and a fixing Moment (MA). This type of support is fixed so that it cannot move or rotate under the action of superimposed load.

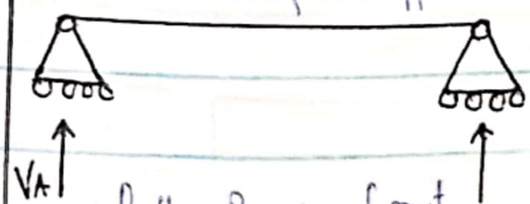
(2) Pin support.



Pinned support

This is assumed to be free to rotate under the applied load but cannot move either vertically or horizontally. This type of support can produce two support reaction. These are Horizontal HA and Vertical VA forces.

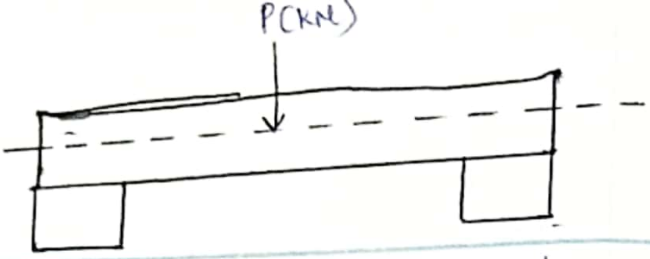
(3) Roller / Rocker support.



Roller Bearing support

This can only supply one vertical reaction VA.

This is the case when a beam simply rests on a



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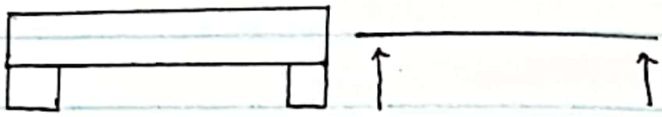

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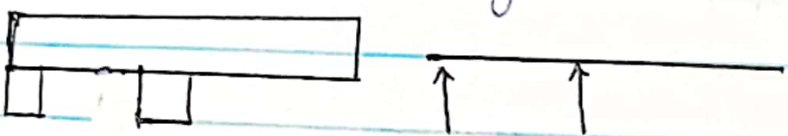
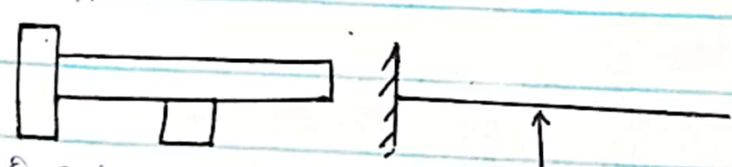
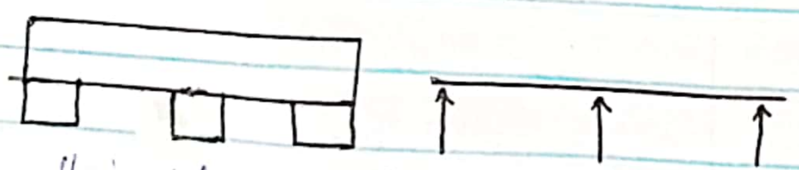


④ Propped cantilever

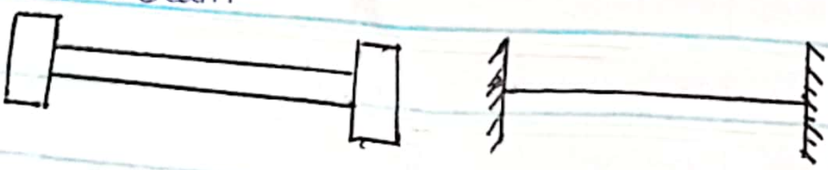


⑤ Continuous beam



Horizontal structural member is a beam.

⑥ fixed beam



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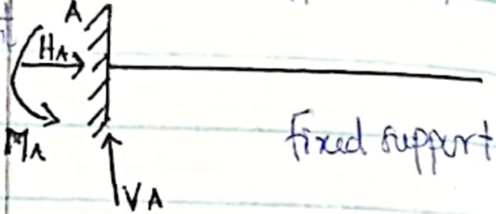
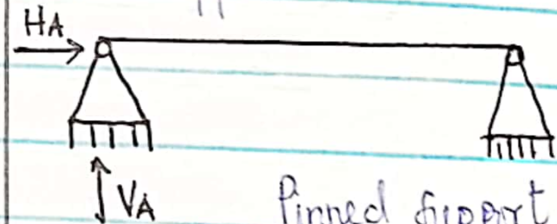


fixed support

These supports are capable of supplying three reactive forces: Horizontal (HA), Vertical (VA), and a fixing Moment (M_A). This type of support is fixed so that it cannot move or rotate under the action of superimposed load.

(2) Pin support.



Pinned Support

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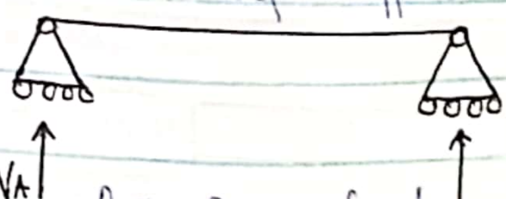
(3) Roller / Rocker support.



Roller Bearing Support

This can only supply one vertical reaction

This is the case when a beam simply rest

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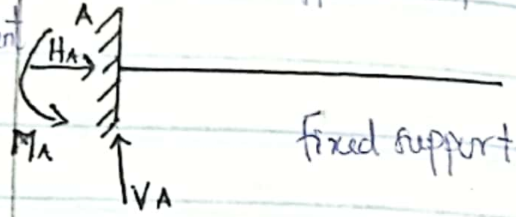

fixed support

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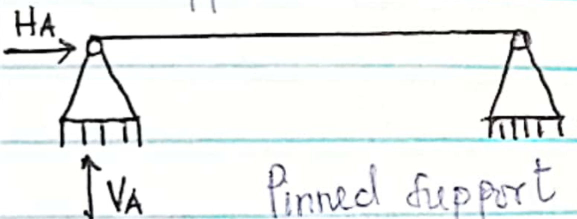
(2) Pin support.



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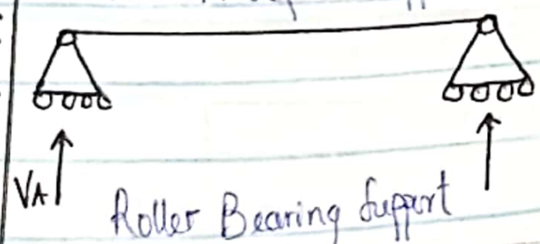
(3) Roller / Rocker support.



Roller Bearing support

This can only supply one vertical reaction VA. This is the case when a beam simply rest on a support, The beam can rotate, It can move horizontally but it is restrained in the vertical direction only. When we sit down on a chair this is the type of support that is developed.

ME 208

Engineering Drawing.