01) Define S.F. and B.M. and derive the relation between shear force and bending moment.
02) Draw S.F.D and B.M.D for the overhanging beam shown in figure Find out the location of point of contraflexure and maximum moment.

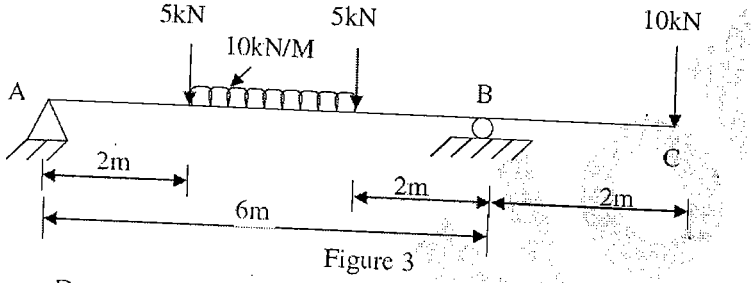
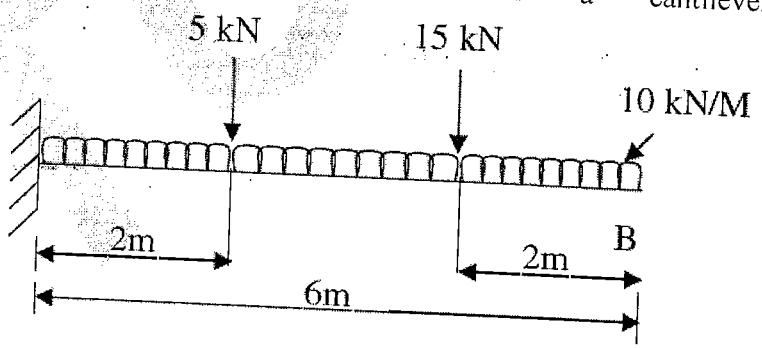
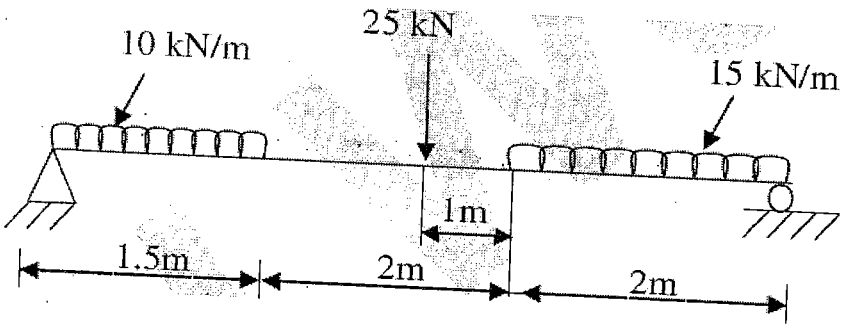


Figure 3

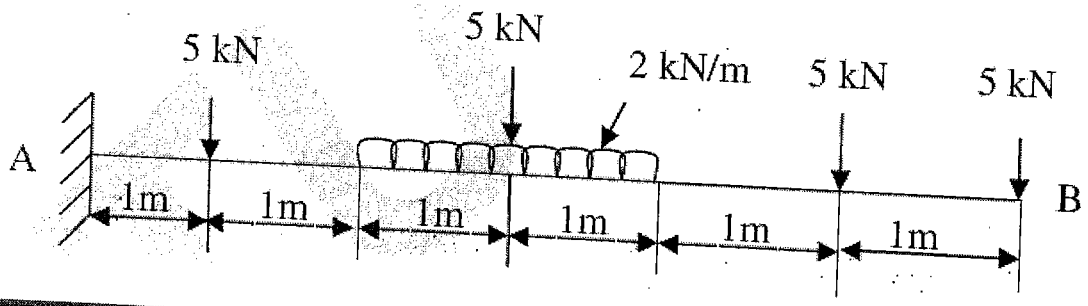
03) Draw SFD and BMD of a cantilever beam loaded as shown in Fig.



04) Draw SFD and BMD of a simple support beam as shown in Fig. Determine the maximum Bending moment in the beam.



05) Draw SFD and BMD of a Cantilever beam.



5. Shear Force and Bending moment diagrams

Critical values within the beam are most commonly annotated using as a Shear force and bending moment diagrams, where negative values are plotted to scale below a horizontal line and positive values are plotted above the line.

A Shear Force diagram is one which shows the variation of the shear force along the length of the beam and a bending moment diagram is one which shows the variation of the bending moment along the length of the beam.

5.1 Point of contraflexure

A point of zero bending moment within a beam is called as point of contraflexure – that is the point of transition from hogging to sagging or vice versa.

Note:

1.Bending Moment is maximum at the point where the Shear Force is zero or where it changes direction from +ve to -ve or vice versa.

2.The point of contra-flexure or point of inflexion is the point where the Bending moment changes its direction from +ve to -ve or vice versa. Where the magnitude of B.M. is zero.

3. Bending moment varies linearly over unloaded sections, and parabolically over uniformly loaded sections.

5.2 Relationship between intensity of load 'w' ,Shear Force 'V', and Bending Moment 'M' :

a) Rate of change of Shear Force is equal to Intensity of loading.

$$dV/dx = w$$

b) Rate of change of Bending Moment is equal to Shear force.

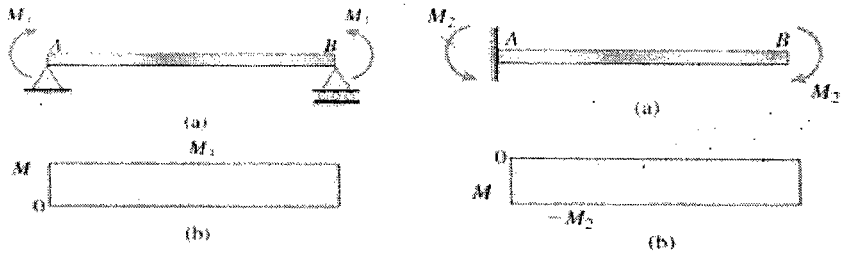
$$dM/dx = V$$

5.3 Pure Bending

The beam is subjected only bending moment without any shear force is called pure bending. Bending will be called as pure bending when it occurs solely because of coupling on its end. In that case there is no chance of shear stress in the beam. But, the stress that will propagate in the beam as a result will be known as normal stress.

Pure bending:

M = constant $\qquad V = dM / dx = 0$



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UNIT-2 **Prof. Kodali Srinivas, KHIT**

SHEAR FORCE - BENDING MOMENTS

1. Definition of a Beam

A beam is a bar subject to forces or couples that lie in a plane containing the longitudinal section of the bar.

1.1.Statically Determinate Beams

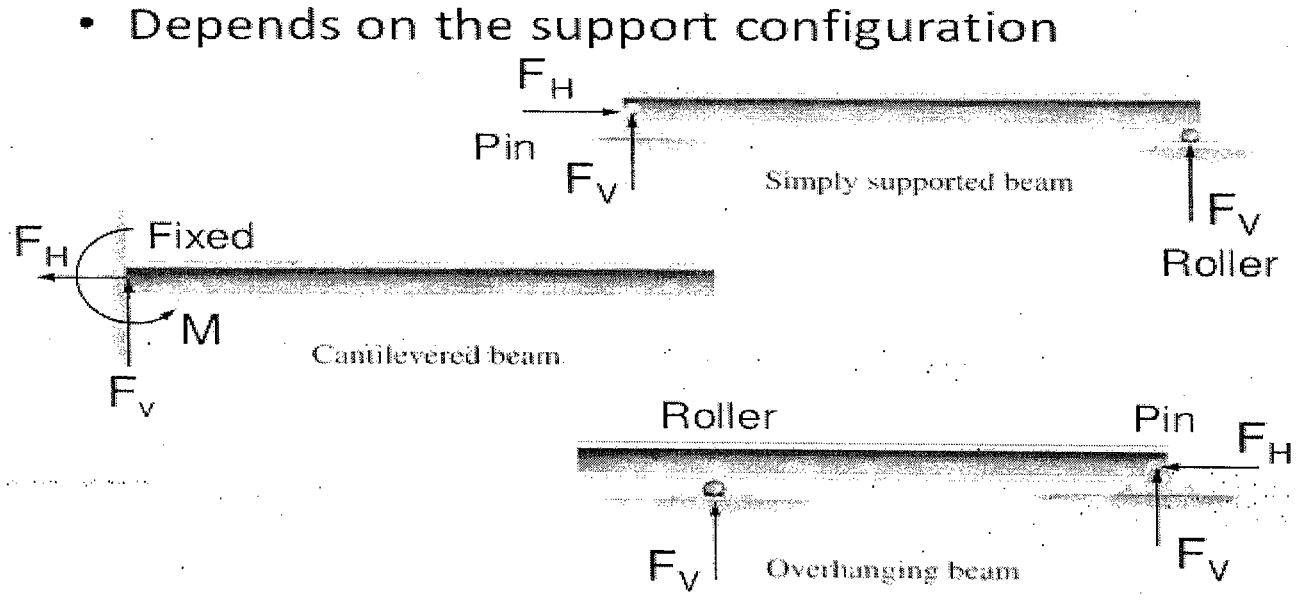
According to determinacy, a beam may be determinate or indeterminate.
Statically determinate beams are those beams in which the reactions of the supports may be determined by the use of the three static equilibrium equations .

1.2. Statically Indeterminate Beams

If the number of reactions exerted upon a beam exceeds the number of equations in static equilibrium, the beam is said to be statically indeterminate. In order to solve the reactions of the beam, the static equations must be supplemented by equations based upon the elastic deformations of the beam.
The degree of indeterminacy is taken as the difference between the umber of reactions to the number of equations in static equilibrium that can be applied.

1.3. Types of Supports

The supports of the beam may consists of
a) Simply support or Roller Support b) Hinge Support or Pinned Support
c) Fixed Support or Built in support

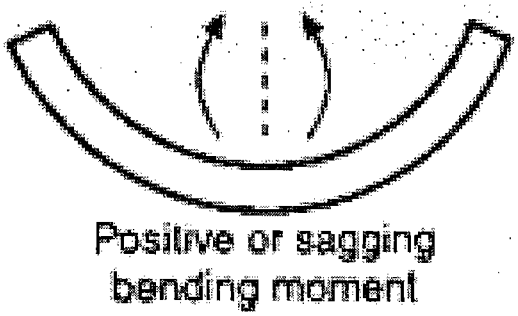


1.4. Types of Loading

Loads applied to the beam may consist of
a) concentrated load (load applied at a point), b)uniform distributed load (u.d.l.),
c) uniformly varying load,d) an applied couple or moment.

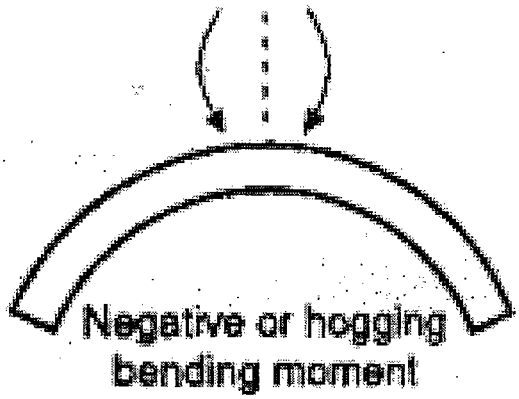
2. Shear Force

The internal vertical resistance is called Shear Force. (Vx)
The Shear Force at a section may be defined as "the algebraic sum of the total vertical forces on either side of the cross section".



3. Bending moment

The moment witch bends the beam is called Bending moment.
The Bending moment at a section through a structural element may be defined as "the algebraic sum of the moments about that section of all external forces acting to one side of that section". (Mx)



The forces and moments on either side of the section must be equal in order to counteract each other and maintain a state of equilibrium so the same bending moment will result from summing the moments, regardless of which side of the section is selected.

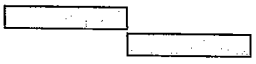
If left side clockwise bending moments and right side anti clockwise bending moments within an element will cause "sagging", and opposite moments will cause "hogging".
It is more common to use the convention that a clockwise bending moment to the left of the point under consideration is taken as positive.

Note:

1.Shear force at a section ,such that the portion to the right of the section slides up wards with respect to the left of the section are +ve and vice versa.
2.Bending moment at a section is +ve if it is sagging and -ve if it is hogging.


Positive Bending


Negative Bending


Positive Shear


Negative Shear