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PHYSICS (H)-PAPER I

(ELASTICITY-III)

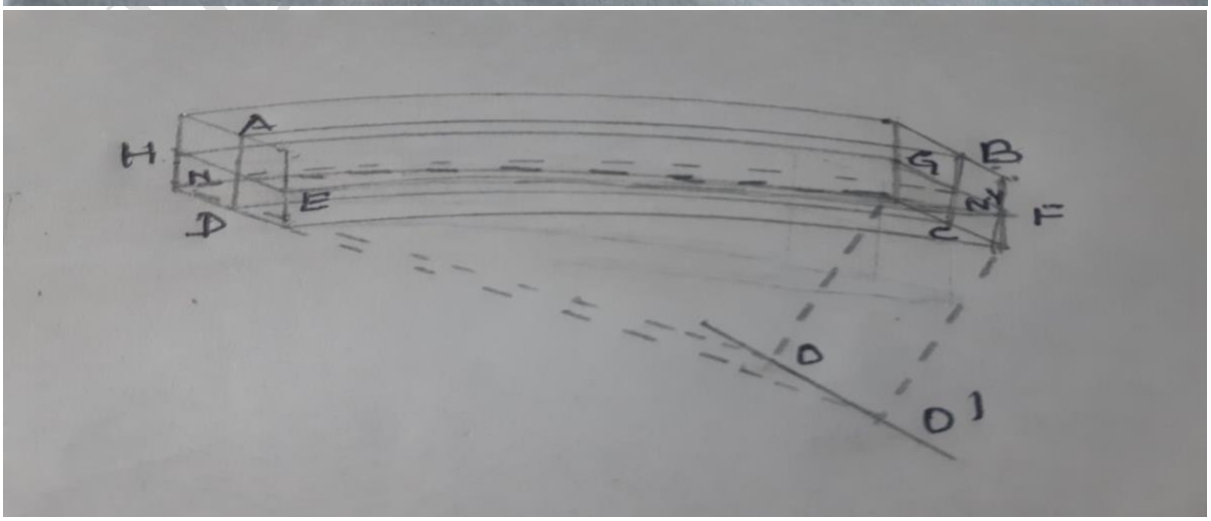
Elasticity

Bending of Beam.

Beam :– A rod (or bar) of Uniform rectangular or circular Cross-section, whose length is very large in comparision to its thickness or radius is called a beam.

NEUTRAL SURFACE :–

When a beam is clamped horizontally at one end and loaded at the other, it undergoes bending. The filaments (fibres) of outward side are lengthened and subjected to tension, While those of the innerside are shortened and compressed. In between these two portions, There is a layer or surface in which the filaments are ~~neigh~~ neither elongated nor shortened. Such a surface is called Neutral surface. In fig. EFGH is the neutral surface.



Plane of Bending

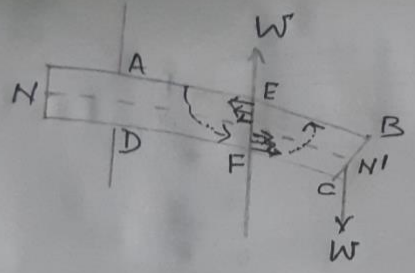
The beam has a plane of symmetry ABCD parallel to its length. This plane intersects every transverse section in a straight line, which is an axis of symmetry for that section.

If the bending is uniform, all longitudinal filaments are bend into circular arcs in planes parallel to the plane of symmetry ABCD. Then, plane ABCD may be called the plane of bending. The centres of curvature of the longitudinal filaments lie on a straight line perpendicular to the plane of bending. This straight line may be called as the axis of bending. In fig. line OO' is the axis of bending.

Neutral Axis :-

The line of inter-section of the plane of bending with neutral surface (both are perpendicular to each other) is called the neutral axis. In fig line NN' is the neutral axis.

Bending Moment :-



When a horizontal beam is fixed at one end and loaded at the other, a bending is produced due to moment of the load. In this position the beam remains in equilibrium, provided the limit of elasticity has not been exceeded.

Let ABCD represent a section of the beam fixed rigidly in wall at AD with the other end BC, loaded with a weight W. Such a beam is called cantilever.

Let us consider the equilibrium of a portion BCEF of the beam cut by a transverse plane EF across it. A force W acts downwards at the end BC, hence there is an equal and opposite reaction force equal to W at EF acting vertically upwards along FE. These two equal and opposite forces constitute a couple. This clockwise couple which bends the beam, is called bending couple and the moment of this couple is called the bending moment.