Theory of simple bending

2.6.1 Stresses developed in a beam due to transverse type of loading

Transverse type of loading

1. Bending stress (Due to Bending moment)

2. Shear stress (Due to Shear force)

2.6.2 Pure bending

Pure bending

If a length of a beam is subjected to a constant bending moment and no shear force, then only the bending stress (i.e., due to Bending moment) will be set up in that length of the beam. Such length of beam is said to be pure bending (or) simply bending.

Let us talk about assumptions made in the theory of pure bending

1.The material of the beam is homogeneous and Isotropic.

2.The transverse sections which were plane before bending remain plane after bending.

3.The value of Young's modulus of beam material is same in tension and compression.

4.The beam is initially straight and all longitudinal filaments bend into circular arcs with a common center of curvature.

5.Each layer of the beam is free to expand or contract, independently of the layer, above (or) below it.

Let us see simple bending equation

$$\textit{\textbf{Ans:}}\ \frac{M}{I} = \frac{f}{y} = \frac{E}{R}$$

Where,

M = Bending moment in N mm

I= Moment of inertia of beam section with respect to neutral axis in mm^4.

F = Bending stress in N/mm^2.

y = Distance of the fiber from neutral axis in mm.

E = Young’s modulus of beam material in N/mm^2.

R = Radius of curvature of beam in mm.

2.6.3 Section modulus

Section modulus

The ratio of moment of inertia of a section about the neutral axis to the distance of the outermost layer from the neutral axis is known as section modulus. It is denoted by the symbol Z.

Section modulus, Z = $\dfrac{\text{Moment of Inertia, I}}{\text{Y max}}$

Section modulus for Rectangular,Circular,Hollow circular section

i) ***Rectangular section***

$$Z = \frac{bd^2}{6}$$ where b = breadth, d = depth

ii) ***Circular section***

$$Z = \frac{\pi}{32}D^3$$ where D = Diameter of circle

iii) ***Hollow circular section***

$$Z = \frac{\pi}{32D}(D^4 - d^4)$$ where D = outer dia and d = Inner dia