UNIFORM BENDING

DEFINATION:

If the beam is loaded uniformly on its both ends,bending of the beam forms an arc of a circle,The elevation is produced in the beam .This type of bending is known as Uniform Bending.

Theory of Uniform Bending:

Consider a beam AB on two knife edges C and D such that AC= BD = a.

The beam is loaded with equal weights W at each ends A and B.

The reaction on the knife edges are acting vertically upward.

External Bending Moment = W(AF- CF)

= Wx AC

= Wa ----------(1)

Internal Bending Moment = $\frac{YI}{R}$ -------------(2)

Y – Youngs Modulus of the beam.

I- Geometrical Moment of Inertia of the Beam.

R- Radius of Curvature of the Beam.

In equilibrium position

External Bending Moment = External Bending Moment

$$Wa = \frac{YI}{R}$$

Let y is the elevation and l is the distance between the knife edges C &D. Then by

The property of Circles

CD = I

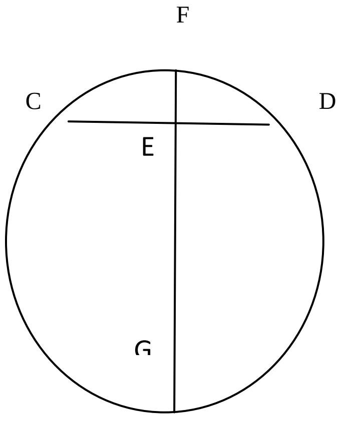
EF = Y

From the property of Circles

EF x EG = CE x ED ------------ (4)

EF (2R –EF) = CE^2

[Since CE = ED; EG = 2R- EF]



[EF = y and CE = $\frac{l}{2}$]

$y(2R - y) = (\frac{l}{2})^2$

$2yR - y^2 = (\frac{l}{2})^2$

$= \frac{l^2}{4}$

$2yR = \frac{l^2}{4}$

$y = \frac{l^2}{8R}$

$\frac{8y}{l^2} = \frac{1}{R}$

$$\frac{1}{R} = \frac{8y}{l^2}$$

Substituting (5) in (3)

$$Wa = \frac{8y}{l^2}\frac{YI}{R}$$

$Y = \frac{Wal^2}{8Iy}$

For Rectangular Cross Section

$I = \frac{bd^3}{12}$

Where b – breadth of beam

D – thickness of beam

W = Mg

Then $Y = \frac{Mgal^2}{8\frac{bd^3}{12}y}$

$Y = \frac{3}{2}\frac{Mgal^2}{ybd^3}$

From which Young's Modulus of the beam is determined.