EXPERIMENT ON FIXED BEAM

Objective : To perform deflection experiment on a beam fixed at both ends (Fixed Beam)

Theory: The expressions for the loadings (Point Loads) and the corresponding deflections for a fixed end beam are as indicated below for three cases namely:

Case 1 :

Fixed end beam loaded at the centre by a point load (W) and the corresponding deflection (δ) measured at the centre of the beam. (See Fig1 below)

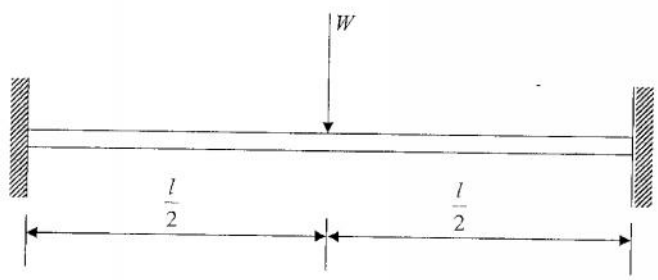

Fig 1

$$\delta = \frac{Wl^3}{192EI} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

where E is the Modulus of Elasticity of the beam and I the Second Moment of Area of the cross-section about a horizontal axis through the centre of gravity.

Case 2 :

Fixed end beam loaded by a point load W located at a point distance 'a' from the left-hand end and distance 'b' from the right-hand end, with the corresponding deflection 'δ' being measured at the point of application of the load.

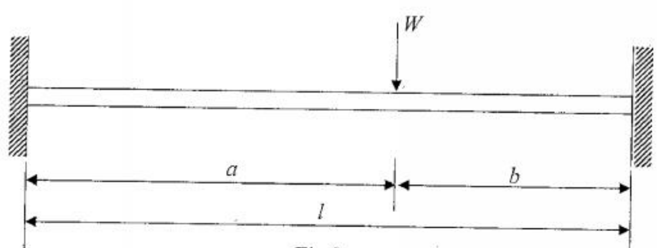

Fig 2

$$\delta = \frac{Wa^3b^3}{3l^3EI} \quad \text{...(2)}$$

Case 3 :

Fixed –end beam supporting two equal point loads each of magnitude W and positioned at equal distances 'a' from each end with the deflection measured at the centre of the beam.

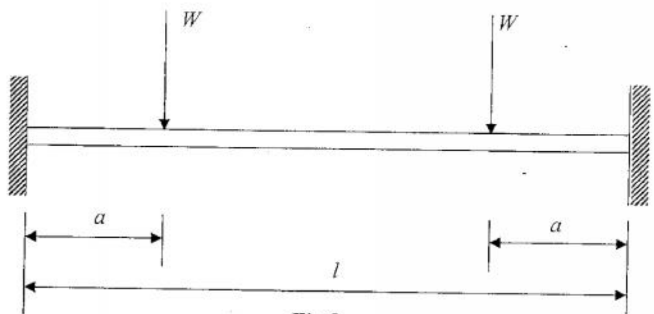

Fig 3

$$\delta = \frac{Wa^2}{24EI}(3l - 4a) \quad \text{...(3)}$$

Method :

Case 1 :

For a given fixed –end beam, measure the cross-sectional dimensions of the beam using a vernier caliper and measure the length 'l' of the beam using a ruler. Apply an increasing point load 'W' at the centre of the beam and measure the corresponding deflection using a dial gauge mounted on a magnetic stand. From the series of readings obtained of the load 'W' against deflection 'δ', draw a graph of the load 'W' against deflection 'δ'. From the slope (W/δ) of the graph obtained , calculate the value of the Modulus of Elasticity (E) of the beam from the re-arranged equation 1 as indicated below:

$$E = \left(\frac{W}{\delta}\right)\frac{l^3}{192I} \quad \text{..(4)}$$

Case 2 :

For a given fixed -end beam , establish the distance 'a' and distance 'b' along the Length of the beam. Apply an increasing point load 'W' (at a point distance 'a' From the left-hand support) and measure the corresponding deflection using a dial

Indicator mounted on a magnetic stand. From a series of readings obtained of the load 'W' and the corresponding deflection 'δ', draw a graph of the load 'W' against deflection 'δ'. From the slope $\left(W/\delta\right)$ of the graph obtained, calculate the value of the Modulus of Elasticity (E) of the beam from the re-arranged equation 2 as indicated below :

$$E = \left(\frac{W}{\delta}\right)\frac{a^3b^3}{3l^3I} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

Case 3 :

For a given fixed-end beam , establish the distance 'a' from the end. Apply increasing two equal loads W (at points 'a' from each end) and measure the corresponding deflection 'δ' at the centre of the beam using a dial indicator mounted on a magnetic stand. From a series of readings obtained of the two equal loads 'W' and the corresponding deflection 'δ', draw a graph of the load 'W' against deflection 'δ'. From the slope $\left(W/\delta\right)$ of the graph obtained, calculate the value of the Modulus of Elasticity (E) of the beam from the re-arranged equation 3 as indicated below:

$$E = \left(\frac{W}{\delta}\right)\frac{a^2(3l-4a)}{24I} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

Discussion :

Discuss the results obtained