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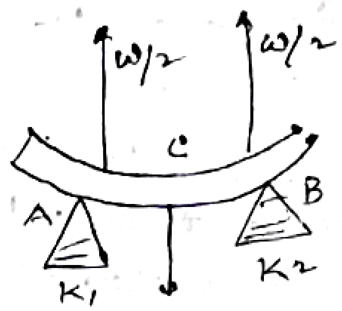
① Q/ What do you mean by a ~~Con~~ Cantilever.? Explain with theory how you determine the value of young's modulus of metal from the bending of a beam method; Also find out the effect of variation of temp on elasticity.

Ans A rod of bar of a circular a ~~o~~ rectangular cross section with its length very much greater than its thickness is called beam and such a beam rigidity fixed at one end and loaded at the other end is called a cantilever.

Determination of young's modulus by flexure of beam method :→

Young's modulus is determined by measuring the depression at the mid point of a beam supported at both ends and load at the middles.



Theory (Expression for depression):

Let AB be the experimental metallic beam of length L, breath b and depth d be supported at two knife-edges at its two ends A & B. Let the beam be loaded in the middle at C with weight W.

The reaction at each knife edge will clearly be V/2 in upward direction.

Since, the middle part of the beam is horizontal. The beam ~~m~~ may be considered as equivalent to inverted cantilevers fixed at C, the bending being produced by the load $\frac{W}{2}$ acts upwards at A & B.

Since L is the length of beam, the length of each cantilevers (AC or BC) is $\frac{L}{2}$ and the elevation of A or B above C is given by

$$\delta = \frac{\frac{W}{2}\cdot\left(\frac{L}{2}\right)^3}{3YI}$$

Here Y = Young's modulus of elasticity
I = Geometrical M.O.I

for □ bar of breath 'b' and thickness 'd',

$I = \frac{bd^3}{12}$ $\therefore \delta = \frac{WL^3}{48Y\times\frac{bd^3}{12}} = \frac{WL^3}{4Ybd^3}$

$$\therefore Y = \frac{WL^3}{4\delta bd^3} \quad \text{———} \quad (1)$$

<u>Experimental arrangement</u> :→

The beam AB is placed symmetrically on K_1 and K_2 at two knife edges suitable arranged in a horizontal plane. A pin is fixed with wax with its head down the middle part C of the beam and a hanger is also suspended from C by beams of a loop of thread. Load on the hanger is increased by equal instalments and the lowering of the pin point is observed by a microscope on its vertical eyepiece scale. Observations are observed by a microscope on its vertical eyepiece scale. Observation are ~~replaced~~ by repeated by ~~increasing~~ decreasing the load by equal instalments. Finally the scale in the microscope eye piece is calibrated. The length L between two knife edges is measured.

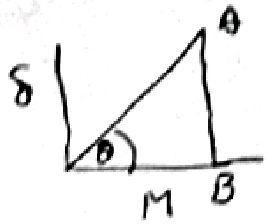
from eqn (1) Putting $W = mg$

$$Y = \frac{MgL^3}{4\delta bd^3}$$

$$\therefore Y = \frac{L^3 g}{4bd^3}\left(\frac{M}{\delta}\right) \quad \text{———} \quad (2)$$

A ~~graph~~ graph is now plotted by taking M along x-axis and δ along y axis. The graph is a straight line and the slope of the graph is given as

$$\frac{M}{\delta} = \frac{1}{\tan\theta} \qquad \therefore \cot\theta = \frac{OB}{AB}$$



Effect of temperature of Elasticity :-

The elastic constants generally decreases with rise in temp. For small temp range the variation is approximately linear. Schoefer showed that the temp from 15°c to that of liquid, air, the order of ascending temp Co-efficient for young's modulus is one of the order of increasing thermal expansion and decreasing M.P. Andrew shows that the temp of a within 150°c of M.P of the material of relation between T & Y was the form

$$Y = Y_1 e^{-b_1 T}$$

Here Y_1 is constant whose value is different for different temp ranges. Y for quartz changes only slightly over the range of temp 0°c to 800°c

Horton showed that for pure copper & Steel, the relation was linear and for Silver it was also nearly.