(PM1-6) Young`s Modulus for a Metallic Beam

Aim of experiment

Determination of young's modulus for iron ruler.

Apparatus

Iron Ruler Used as a Beam – Traveling Microscope or Strain gauge – Vernier – Scale pan – Loads, Meter Ruler.

Theory of experiment

If an iron ruler of length L is fixed at one end and the free end is loaded by loads of mass W=mg, see *figure 1*, the iron ruler will be bent in the vertical direction, D. This bend depends on the material and dimension of the ruler and also on the load; mg according to the following relation:

$$D = \frac{mg}{3}\frac{L^3}{YI} \qquad (1)$$

Where $I = bd^3/12$ is the moment of inertia of the ruler of width b and thickness d , Y is Young's modulus, which is a material dependent parameter.

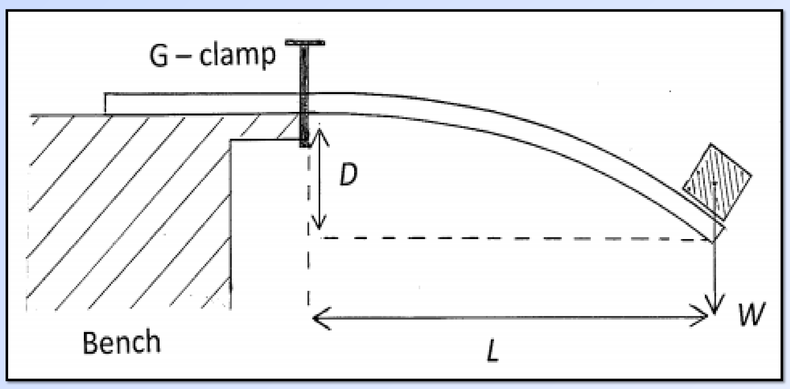

Figure 1 A Schematic diagram for a beam under loading

$$D = \frac{4mgL^3}{Ybd^3} \qquad (2)$$

The relation between D and m is a straight line of slope = $4gL^3/Ybd^3$
From which we can find that young modulus is given by

$$Y = \frac{1}{\text{slope}}\frac{4gL^3}{bd^3} \qquad (3)$$

Procedure

1. Fix the iron ruler horizontally at one end and hang the scale pan at the other end
2. Using the strain gauge find the zero reading
3. Put one load in the scale pan and find the reading of the gauge
4. Increase the mass and observe the reading.
5. Repeat your measurement, after finishing all loads you have, at least three times.
6. Draw the relation between m and D_{av} and find the slope
7. Calculate Young's modulus Y.

Results

Ruler length L =……..m
Ruler width b = ……..m
Ruler thickness d = ……..m

m (kg)	D_1 (m)	D_2 (m)	D_3 (m)	D_{av} (m)

Slope = ……. *kg/m*

Young modulus Y = ……N/m^2

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