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* Experiment - 4

Objective: Determination of Young's Modulus of elasticity of the given sample material by bending.

Equipments needed: Sample Stand, Weights of 500gm, Samples (Iron, Aluminum, Brass), DC Adaptor, Weight Holder, Spherometer stand with Buzzer.

Procedure:

1. Mount the setup by fixing two long round rods with U-tube brackets, tight the sample (iron) on sample stands & place it horizontally.

2. Tight the weight holder at the center of sample with help of screw & place the spherometer stand, beyond the centre of sample.
Note: Spherometer leg must be in contact by rotating the circular scale with the center of the sample.

3. Connect buzzer with adaptor & connect patch cord with banana terminal provided on the sample for buzzer connection.

4. Switch 'On' the supply for adaptor. Buzzer blows because at this spherometer leg is in contact with sample. Note the main scale (M.S) reading & Circular Scale (C.S) i.e., no. of divisions * 0.01 mm (least count) reading in observation table 1 & find total reading M.S + C.S = T_1

* Technical Specifications:-

Sample 1: Iron		Sample 2: Brass		Sample 3: Aluminium	
Length (l):	100cm	Length (l):	100 cm	Length (l):	100 cm
Breadth (b):	2.5cm	Breadth (b):	2.6cm	Breadth (b):	2.55cm
Depth (d):	0.6cm	Depth (d):	0.5cm	Depth (d):	0.5cm

* Observation Table -1:

Sr. No	Load (in kg)	Load increasing (in mm)			Displacement 'x' in mm	Load decreasing (in mm)			Displacement 'y' in mm	Mean of displacement (in mm)
		M.S	C.S * 0.01	T = M.S + C.S	$x_n = T_1 - T_{n+1}$	M.S	C.S * 0.01	T = M.S + C.S	$y_n = T_1 - T_{n+1}$	$d = (x+y)/2$
1	0	19	0.94	T_1 = 19.94		18	0.40	T_1 = 18.40		
2	0.5	15	0.09	T_2 = 15.09	X_1 = 4.85	13	0.18	T_2 = 13.18	Y_1 = 5.22	d_1 = 5.035
3	1.0	13	0.90	T_3 = 13.9	X_2 = 6.04	10	0.01	T_3 = 10.01	Y_2 = 8.39	d_2 = 7.215
4	1.5	10	0.43	T_4 = 10.43	X_3 = 9.51	10	0.43	T_4 = 10.43	Y_3 = +7.97	d_3 = 8.74

* Observation Table -2:

Sr. No.	Load (in kg)	Mean of Displacement (in mm)	Depression for 1kg (in mm)
1	0		
2	0.5 kg	d_1 = 5.035	
3	1.0 kg	d_2 = 7.215	$d_3 - d_1$ = 3.71
4	1.5 kg	d_3 = 8.745	$d_4 - d_2$ =

This reading is for NO load or initial reading.

5. Repeat the procedure for innocent of the loads 500gm, 1kg, 1.5kg ... & note the reading in observation table 1. For each increament load, rotate the circular scale so that buzzer blows.
Note: In case of Iron max. load should be 3kg. for Brass & Aluminium max. load should be 1.5kg.

6. Repeat the procedure for decreement of the loads from max. load; & note reading of M.S & C.S in table 1.
Note: Before you remove load from stand, rotate the spherometer fully anticlockwise.

7. Take the mean of displacements individually $d_1 = \frac{(x_1 + y_1)}{2}$ ... & so on.

8. In Observation table 2, insert all the values of Individual mean of displacements d_1, d_2, d_3 .... Find the depression of sample for particular amount of weight difference (for eg. 1kg). Take the mean of depression &.

9. Put all the readings in given formula & calculate the 'Y' Young's modulus of elasticity.

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* Calculation:-

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

$b = 2.6cm = 2.6 \times 10^{-2} m$

$d = 0.5 cm = 5 \times 10^{-3} m$

$l = 100cm = 1m$

$$= \frac{1 \times 9.8 \times (1)^3}{4 \times 2.6 \times 10^{-2} \times (5 \times 10^{-3})^3 \times 3.71 \times 10^{-3}}$$

$$= \frac{9.8 \times 10^2 \times 10^9}{4 \times 2.6 \times 125 \times 3.71} \times 10^3$$

$$= 0.00203 \times 10^{11} \times 10^3$$

$$= 2.3 \times 10^8 \times 10^3$$

$$= 2.3 \times 10^{11}$$

Spherometer:

Main Scale: 10-0-10 mm,
Circular Scale: 100 divisions
Least Count = $\frac{\text{Value of smallest div. on M.S}}{\text{Total no. of div. on C.S}}$ = 0.01 mm

Formula used:

$$Y = \frac{mgl^3}{4bd^3\delta} \ N/m^2$$

Precautions:

- After performing the experiment, remove all the weights from the weight holder.
- Switch off the supply after taking each reading from spherometer.
- For Iron max. load is 3kg. for Brass & Aluminium max. load is 1.5 kg.

Results:-

- The Young's Modulus for Aluminium is = 2.3×10^{11} N/m^2

Conclusion:-

- We can conclude that how we can find the value of Young's Modulus of elasticity and also it depends on material to material.