

# PHYSICS PRACTICAL SHEETS

Date 2023/03/23

Class CE

Roll No. 25

Shift Morning

KV CAMPUS

Experiment No. 3

Group 1

Sub. Physics

Set .....

Object of the Experiment (Block Letter)

MEASUREMENT OF THE YOUNG'S MODULUS OF MATERIAL OF RECTANGULAR BAR USING METHOD OF BENDING

Apparatus Required:

- i) A uniform rectangular bar about 1m long
- ii) Two knife-edge fixed on rigid support
- iii) A stirrup with a hook and having a pointer.
- iv) Half kg weight.
- v) A meter scale
- vi) Travelling microscope.
- vii) Vernier callipers.

Theory:

Consider a bar supported on  $K_1$  and  $K_2$  1 meter apart in horizontal plane, so equal length of the bar project beyond knife edges. If a weight  $mg$  is suspended at middle, a depression  $\delta$  is produced. For a rectangular bar of breadth 'b' and thickness 'd', the depression is given by

$$\delta = \frac{mgl^3}{4Ybd^3}$$

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

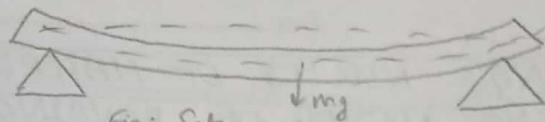


Fig. Schematic diagram showing the bending of a rectangular bar.

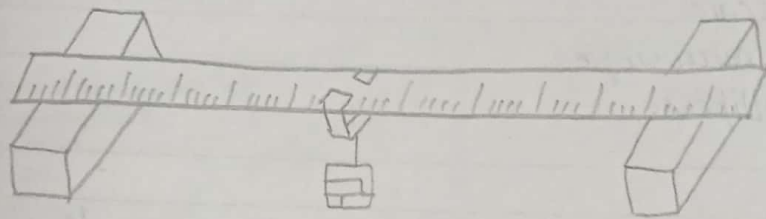


Fig. Schematic diagram of arrangement of bar to measure Young's modulus

## Observations:

Vernier constant of travelling microscope (VC) = 0.001 cm

No of obs	Load in kg	Microscope reading	Mean reading	Depression	Depression for 2 kg.
1	0				
2	1				
3	2				
4	3				
5	4				
6	5				
7	6				
8	7				
9	8				

## Result:

Mean depression for 2 kg (a) = 7.855 mm

Mean depression for 2 kg (b) = 3.7925 mm

∴ Mean of the means (S) =  $\frac{a+b}{2}$  = 3.824 mm = 0.003824 m

Length of bar (l) = 98.1 cm = 0.981 m

Breadth of bar (b) = 37.4 mm =  $37.4 \times 10^{-3}$  m

Thickness of bar (t) = 5.52 mm =  $5.52 \times 10^{-3}$  m

$$\begin{aligned} \text{Hence, } Y &= \frac{mg l^3}{4bd^3} = \frac{2 \times 9.8 \times (0.981)^3}{4 \times (37.4 \times 10^{-3}) \times (5.52 \times 10^{-3})^3} \\ &= 1.923 \times 10^{11} \text{ N/m}^2 \end{aligned}$$



Scale: Along x-axis,

10 small boxes = 1 kg

Along y-axis,

10 small boxes = 2 mm

Deflection in mm

20

18

16

14

12

10

8

6

4

2

0

1

2

3

4

5

6

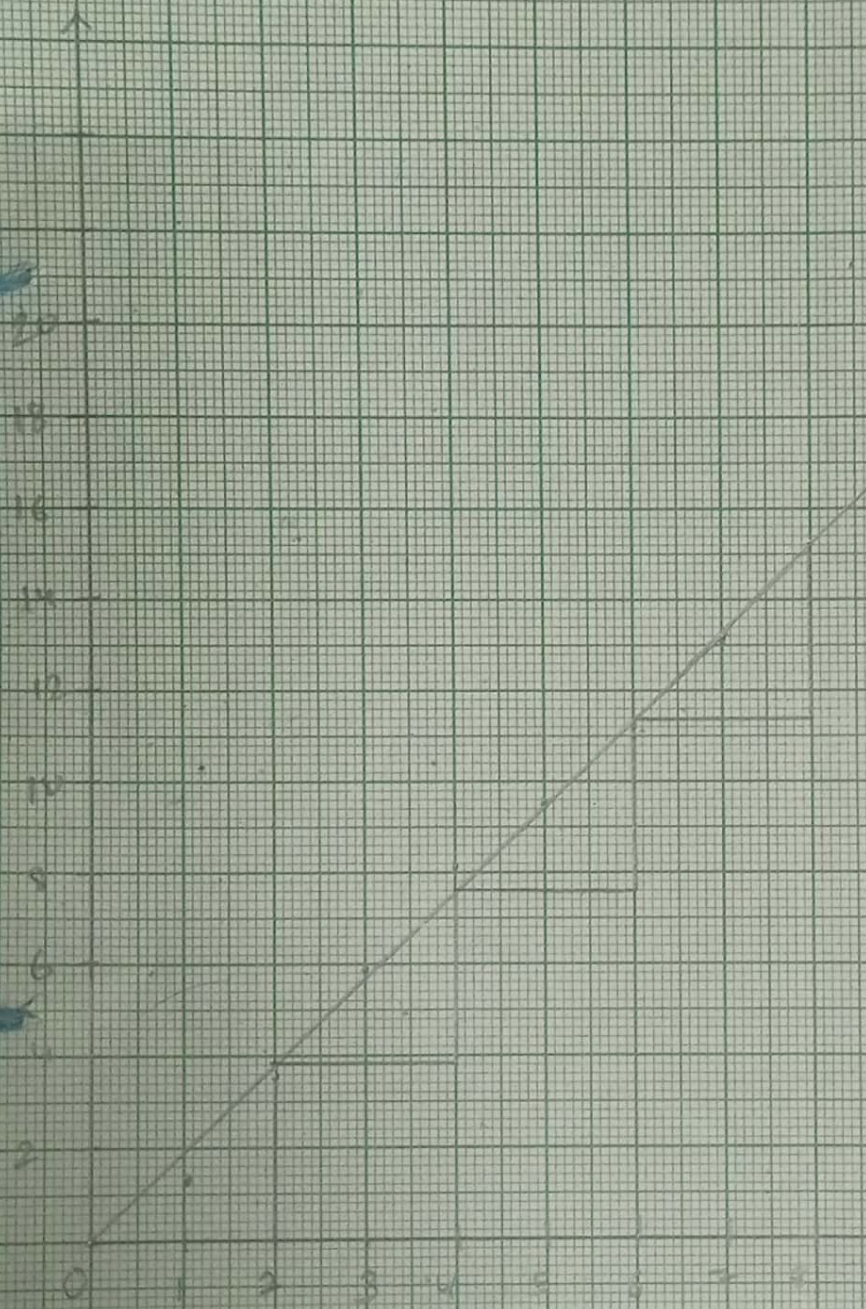
7

8

9

10

Load in kg



$$\begin{aligned} \% \text{ error} &= \left| \frac{1.9823 \times 10^{-11} - 1.9 \times 10^{-11}}{1.9 \times 10^{-11}} \right| \times 100 \% \\ &= 1.21 \% \end{aligned}$$

#### Precautions:

- i) The knife edge should be rigid.
- ii) The knife edges should be at equal distance from the center of the bar.
- iii) The maximum load shouldn't exceed the elastic limit.
- iv) The weights should be placed or removed from the hanger without disturbing the position of the bar on the knife edges.