To Study the Effect of Load on Depression of a Suitably Clamped Metre Scale Loaded at (i) its end (ii) in the Middle

Aim

To study the effect of load on depression of a suitably clamped metre scale loaded at (i) its end (ii) in the middle.

Apparatus

A uniform straight wooden metre rod (scale). Two G clamp, pointer pin, thread, slotted weights of 50 g each, wax, vertical scale, clamp stand.

Theory

The depression (Buckling) δ produced in the wooden rod of length l.

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

m = Total mass of slotted weights

Y = Young modulus

b = breadth

d = depth

For a given rod, $\delta \propto mg$

i.e., the depression produced is directly proportional to the load (weight) suspended from one end.

Diagram

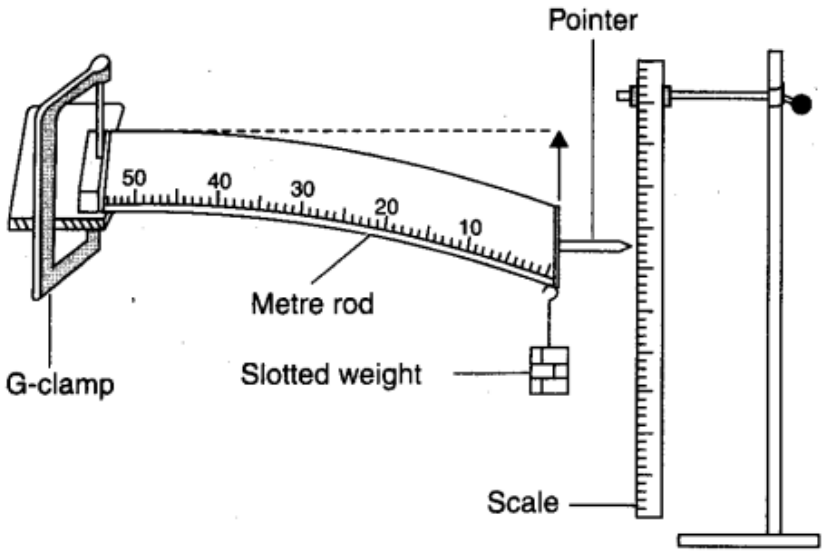


Fig. Load and depression relation, when metre rod is loaded at its end.

Procedure

(i) When metre scale is loaded at its end :

1. Clamp the metre scale firmly with G clamp at its one edge on the corner of table such that metre scale remains straight in horizontal plane.
2. The pointer pin or needle should be attached at free end of metre scale with wax.
3. Fix the scale on a stand vertically to take the reading.
4. Note the initial reading on vertical scale corresponding to the tip of the pointer when no weights is suspended.
5. Suspend the weights in steps at free end of metre scale with the help of a strong thread and note the corresponding readings on the vertical scale.
6. After taking 5-6 reading, start unloading the weights one by one and again note the reading on scale.

(ii) When metre scale is loaded in the middle :

7. Locate the C.G. of metre scale by suspending it with a thread.
8. Now, place the metre scale symmetrically on two knife edges them about 85 cm apart and check that metre scale is perfectly horizontal.
9. A pointer is attached at the mid point of the scale with the help of wax or adhesive tape to take the reading.
10. Repeat the steps 3 to 6 and record the observation in the table.

Observations

1. Initial reading of pointer on vertical scale without loading at free end = x_0 =……..cm

Table for load and depression when metre rod is loaded at its one end.

S. No.	*Load suspended (g wt)*	*Vertical scale reading (cm)*			*Depression* $\delta = x_0 - x$ *cm*
		Loading x_1	*Unloading* x_2	*Mean* $x = \frac{x_1 + x_2}{2}$	
1.	50				
2.	100				
3.	150				
4.	200				
5.	250				

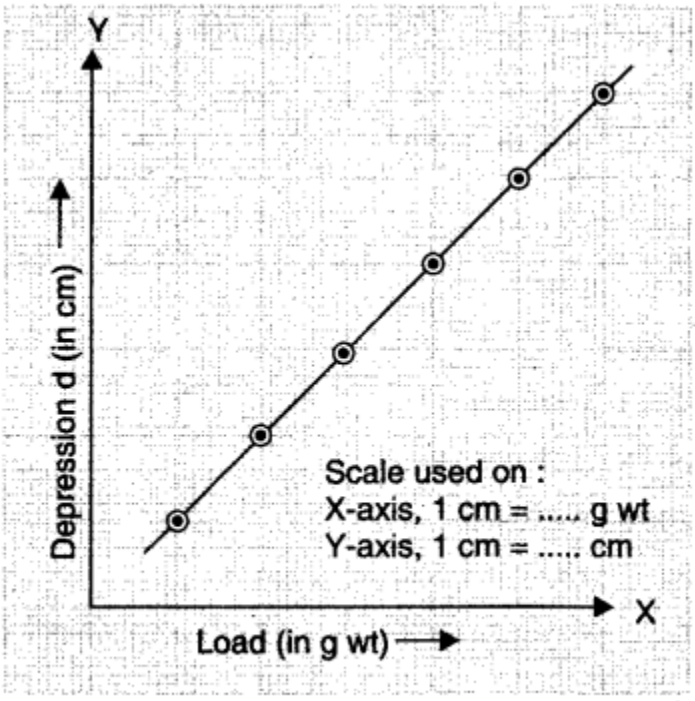
2. Initial reading of pointer on vertical scale without loading in the middle =x_0 =……cm

Table for load and depression when metre rod is loaded at its one end.

S. No.	Load suspended (g wt)	Vertical scale reading (cm)			Depression
		Loading x_1	Unloading x_2	Mean $x = \frac{x_1 + x_2}{2}$	$\delta = x_0 - x$ cm
1.	50				
2.	100				
3.	150				
4.	200				
5.	250				

Graph

Plot a graph between load and depression by taking load on X-axis and depression on Y- axis for both of cases. In both the cases, graphs come to be a straight line as shown below.



Graph between load and depression.

Result

The graph between load and depression are straight lines, which gives that depression is directly proportion to the load.

$$\delta \propto mg$$

Precautions

1. The metre scale should be straight and uniform and clamped firmly.
2. The tip of pointer should not touch the vertical scale.
3. The scale should not be loaded beyond the elastic limit.
4. Reading on metre scale should be taken carefully.

Sources of error

1. The metre scale may be non-uniform.
2. The tip of pointer may not be very sharp.