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EXPERIMENT NO.-2

Object:- To determine modulus of elasticity (E) for the material of given beam (s) using deflection method.

Formula Used:- Deflection of simply supported beam under the load subjected to point load at mid span is given by:-

$$\Delta = \frac{WL^3}{48EI}$$

where W = Point Load
L = Length of span
E = Modulus of Elasticity (Kg/cm^2)
I = Moment of inertia of the beam section about the axis of rotation (cm^4)
$= \frac{bd^3}{12}$ (b = width, d = depth of beam in cm).

Apparatus Used:- Beam, supports, slotted weights, vernier calliper, metre gauge.

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Mech. (2nd Sem.)
11-MES-41

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OBSERVATION:-

For M.O.I. L.C. of V.C. = 0.002cm

S.No.	Reading of Mean Scale	Reading of Vernier Scale		Total Reading	
		Division	Value	Individual	Average
Width					
1:-	3.1	9	0.018	3.118	
2:-	3.1	4	0.008	3.108	3.115
3:-	3.1	10	0.02	3.102	
Depth					
1:-	0.5	16	0.032	0.532	
2:-	0.5	14	0.028	0.528	0.531
3:-	0.5	17	0.034	0.534	

S.No.	LOADING (mm)		UNLOADING		AVERAGE	
	LOAD (Kg)	DEFLECTION	LOAD	DEFLECTION	LOAD	DEFLECTION
1.	0.190	0.5	0.190	0.50	0.190	0.50
2.	0.375	1.00	0.375	1.02	0.375	1.01
3.	0.600	1.34	0.600	1.34	0.600	1.34
4.	0.690	2.05	0.690	2.06	0.690	2.055
5.	0.915	2.65	0.915	2.65	0.915	2.65

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Theory:- Elasticity is a property of the material due to which material show recovery in deformation after the load is left.

Condition for plastic elasticity.

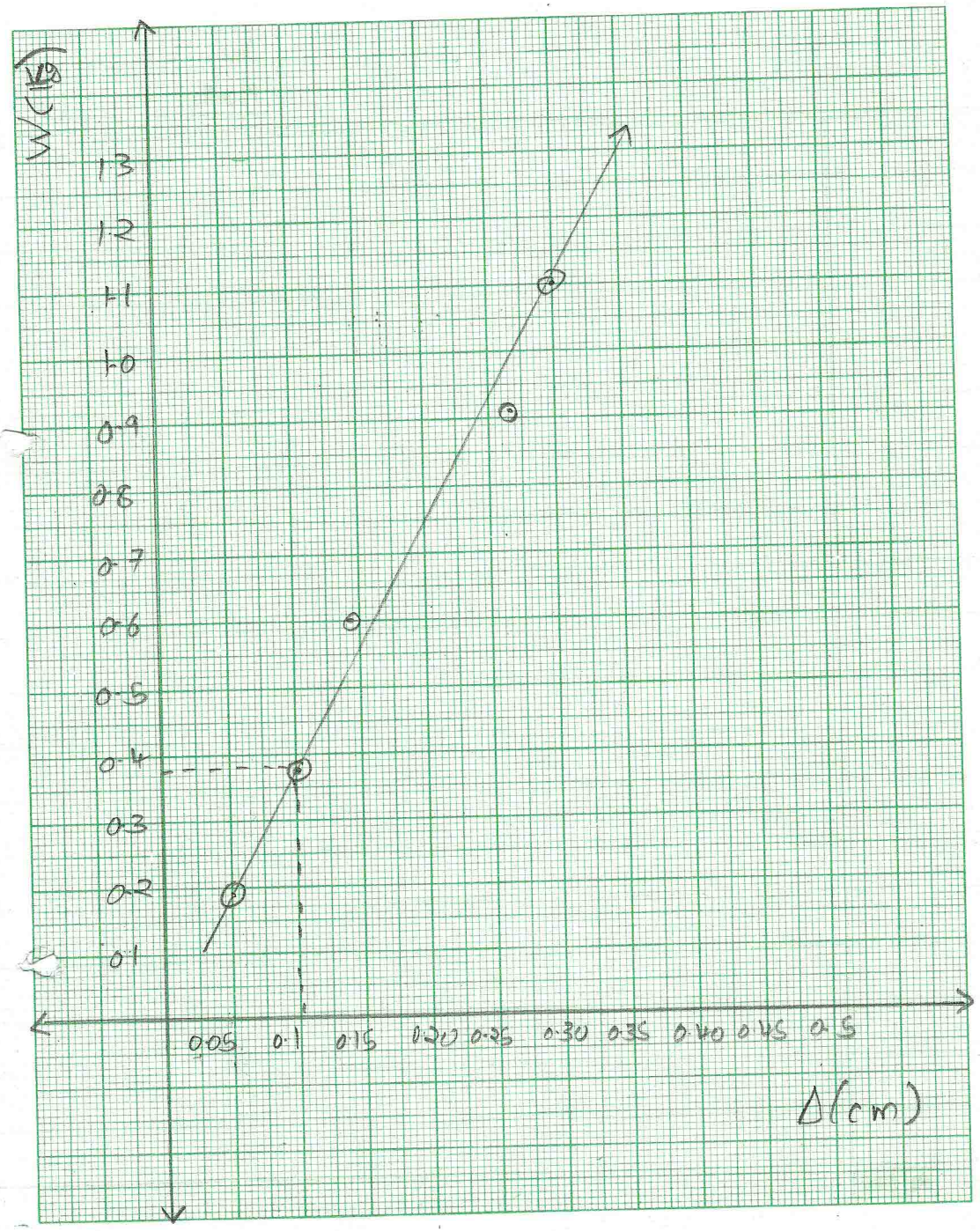
1:- Deformation & reformation should be instantaneous during loading & unloading.

2:- Recovery should be proper and immediate after unload.

3:- Loading and unloading vs deformation & reformation respectively curve should have the same shape.

Observations: For moment of inertia

S.No.	Reading of Main Scale	Reading of Vernier Scale		Total Reading	
Width		Divisions	Value	Individual	Average
1:-	3.1	9	0.018	3.118	
2:-	3.1	4	0.008	3.108	3.115
3:-	3.1	10	0.02	3.120	
Depth					
1:-	0.5	16	0.032	0.532	
2:-	0.5	14	0.028	0.528	0.531
3:-	0.5	17	0.034	0.534	


1/R (Ω⁻¹)
1·3
1·2
1·1
1·0
0·9
0·8
0·7
0·6
0·5
0·4
0·3
0·2
0·1
0·05
0·1
0·15
0·20
0·25
0·30
0·35
0·40
0·45
0·5
Δ(cm)

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For load deflection

S.No.	Loading		Unloading		Average	
	Load	Deflection	Load	Deflection	Load	Deflection
1:	0.190	0.5	0.190	0.50	0.190	0.50
2:	0.375	1.00	0.375	102	0.375	1.20
3:	0.600	1.34	0.600	1.34	0.600	1.34
4:	0.690	2.05	0.690	2.06	0.690	2.06
5:	0.915	2.65	0.915	2.65	0.915	2.65

Simple Calculations:

$$\text{Slope of line} = \frac{W}{\Delta} = \frac{0.375}{0.101} = 3.712 \text{ (Kg/cm)}$$

$$\text{Modulus of Elasticity of } E = \frac{L^3}{48 I} \times \text{Slope}$$

$$L^3 = 100^3 \text{ cm}^3$$

$$I = \frac{bd^3}{12} = \frac{3.115 \times (0.531)^3}{12}$$

$$= 0.038 \text{ cm}^4$$

Slope = 3.712 Kg/cm

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$$\therefore E = \frac{1000000 \times 3.712}{48 \times 0.038}$$

$$E = 2.035 \times 10^6 \text{ Kg/cm}^2$$

Experimental value of Modulus of Elasticity
$= 2.035 \times 10^6 \text{ Kg/cm}^2$

Theoretical value of modulus of elasticity
$= 2.1 \times 10^6 \text{ Kg/cm}^2$

RESULT:-
So, modulus of elasticity of the given beam material is $2.035 \times 10^6 \text{ Kg/cm}^2$

Discussion on result:- Experimental value of E of mild steel material ~~in~~ which is found to be closer than the real value. Experimental error is given by

$$\% \text{ error} = \frac{2.1 - 2.035}{2.1} \times 100 = 3.095\%$$

Industrial Use:
In civil engineering, we use such a material whose property is very much similar to elastic one (perfect).
According to their nature, we use specific elastic material. For eg:-

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1: We use highly elastic material in machine part ~~write~~ which undergoes high loading. Loading should be under elastic region.

2: We use highly elastic material in making beam in civil engineering in construction work because beams bear very high load.

3: In shock absorption, we use elastic material of high elastic limit.

4: In wire making, we use material which has more elastic limit because we want post elastic limit deformation.

Precautions:

* The beam should be loaded & unloaded slowly.
* The device for measuring deflection is very sensitive, therefore its middle should just point at zero weight.
* Zero error & least count of callipers should be kept in mind.