STUDY OF YOUNG'S MODULUS OF TEAK AND MAHOGANY WOODEN BAR

A PROJECT REPORT

Submitted by

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Register Number: AB20PHY005

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(AUTONOMOUS) ERNAKULAM

2023

ST. TERESA'S COLLEGE
(AUTONOMOUS)

CERTIFICATE

This is to certify that the project report entitled **"STUDY OF YOUNG'S MODULUS OF TEAK AND MAHOGANY WOODEN BAR"** is anauthentic work done by **REBECCA MARTIN,** St. Teresa's College, Ernakulam, under my supervision at Department of Physics, St. Teresa's College for the partial requirements for the award of degree of Bachelor of Science in Physics during the academic year 2022-23. The work presented in this dissertation has not been submitted for any degree in this or any other university.

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ST. TERESA'S COLLEGE
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BSc. PHYSICS
PROJECT
REPORT

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Year of Work : 2022-23

This is to certify that the project report entitled "**STUDY OF YOUNG'S MODULUS OF TEAK AND MAHOGANY WOODEN BAR**" is an authentic work done by **REBECCA MARTIN.**

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Submitted for the university examination held at St. Teresa's College, Ernakulam.

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EXAMINERS: 24/04/23

DECLARATION

I **REBECCA MARTIN**, final year B.Sc. Physics student, Department of Physics, St. Teresa's College. Ernakulam do hereby declare that the project work entitled **"STUDY OF YOUNG'S MODULUS OF TEAK AND MAHOGANY WOODEN BAR"** has been originally carried out under the guidance and supervision of Dr. SUSAN MATHEW, Assistant Professor, Department of Physics, St. Teresa's College (Autonomous) Ernakulam in partial fulfillment for the award of the degree of Bachelor of Physics. I further declare that this project is not partially or wholly submitted for any other purpose and the data included in the project is collected from various sources and are true to the best of my knowledge.

PLACE: ERNAKULAM

DATE: 26/3/2023

REBECCA MARTIN

Rebecca.

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ABSTRACT

In Earlier days and modern times, there is a great demand for Teak and Mahogany wood in the furniture Industry. In this project, we focused on variation of young's modulus with woods and methods used. We have studied the young's modulus of two different woods. Teak and Mahogany. We used four different methods for the study.

METHODS USED:

Cantilever-Pin and microscope method

Optic lever method

Non-Uniform bending Method

Uniform bending Method.

We have taken the average value of young's modulus obtained from three methods and from the experimental results, it was also observed that non uniform bending could give better results and also other methods can be made accurate to the standard value by repeatedly doing each method by varying their parameters. Reasons behind usage of teak and mahogany woods in the furniture sector were also studied.

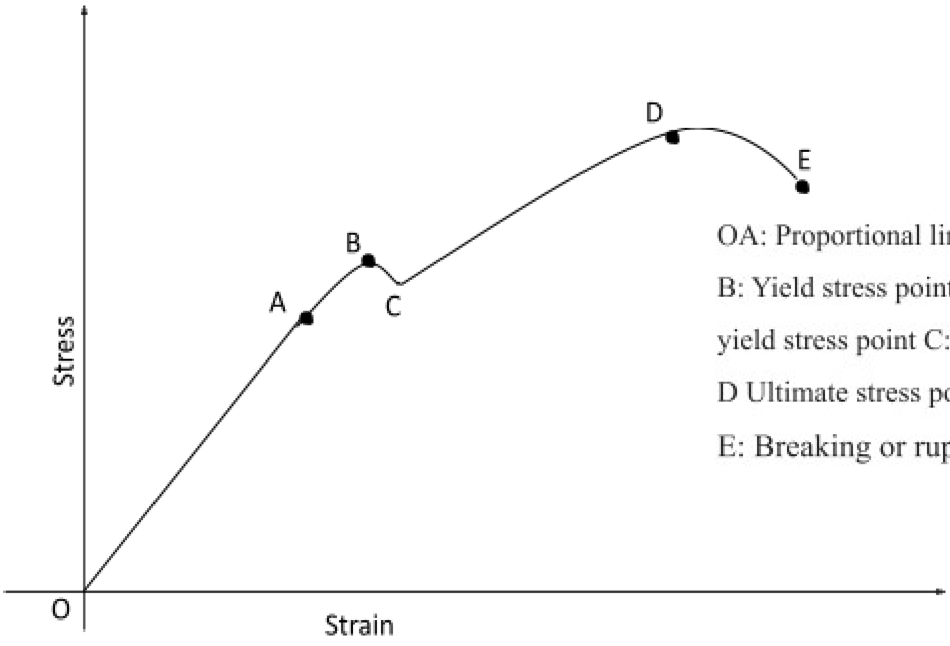
CONTENTS

CHAPTER-1

INTRODUCTION

In Physics, Elasticity is the ability of a body to resist a distorting influence and to return to its original size and shape when that influence or force is removed. Solid objects will deform when adequate forces are applied to them. If the material is elastic, the object will return to its initial shape and size when these forces are removed. The various elastic moduli measure the inherent elastic properties of a material as a resistance to deformation under an applied load. The various moduli apply to different kinds of deformation.

For instance, Young's modulus applies to extension compression of a body. It represents the factor of proportionality in Hooke's law, which relates the stress and strain. However, Hooke's law is only valid under the assumption of an elastic and linear response.



OA: Proportional limit A: Elastic limit
B: Yield stress point/upper
yield stress point C: Lower yield stress point
D Ultimate stress point
E: Breaking or rupture point

up inside the body per unit area. Strain is the ratio of the change in any dimension of the body to the original dimension. The relation between the stress by strain is explained in Hooke's law. It is the basic law of elasticity established by Robert Hooke in 1678. It states that within the elastic limit. Stress is proportional to strain.

$$\frac{Stress}{Strain} = \text{constant}$$

The constant is known as modulus of elasticity. Its value depends on the nature of the material and independent of the magnitude of the stress and strain. Elastic modulus or Young's modulus is a measure of the stiffness of an elastic material.

Woods are very complex material and it is made of several different types of cells which can run in axial, radial, circumferential directions in the tree trunk, in turn theme cats are made of multiple parts through the cell wall and the internal pressure and most contributions to the mechanical properties. In the simplest terms, the modulus of elasticity (MOE) measures wood's stiffness and is an overall good Indicator of its strength. Technically it's a measurement of the ratio of stress placed upon the wood compared to the strain (deformation) that the wood exhibits along the length.

CHAPTER-2

METHODS OF FINDING YOUNG'S MODULUS

CANTILEVER

PRINCIPLE

A cantilever beam is a structural element that extends horizontally and is supported on only one end. The unsupported end is known as the cantilever, and it extends beyond the support point.

For a cantilever

$$Y = \frac{Mgl^3}{31\delta}$$

Where,

δ = depression at the loaded end due to load M

M = mass loaded

g = acceleration due to gravity

l = length of the bar

For a rectangular bar

$$I = \frac{bd^3}{12}$$

Therefore,

$$Y = \frac{4Mg}{bd^3}\left(\frac{l^3}{\delta}\right)$$

$$Y = \frac{4l^3g}{bd^3}\left(\frac{M}{\delta}\right)$$

Where, d - thickness of the bar

M - mass loaded

l - length of the bar

b - breadth of the bar

PROCEDURE

The given bar is placed along the edge of a table and tightly clamped with a suitable length of the bar projecting beyond the table. A weight hanger is suspended from a pointer near the free end. A pin *P* is fixed vertically at this point. The bar is loaded and unloaded a number of times. It is to get in an elastic mood. A vernier microscope is focused at the tip of the pin with the dead load alone. The horizontal crosswire is made tangentially to the tip of the pm. The microscope reading is taken. Weights are loaded in equal steps of 50g, till the maximum load 250g is reached and the microscope reading is noted each time, then weights are removed in equal steps and readings are taken. The average of each load is found. The depression for a constant load is determined. The length of the cantilever is measured using the distance of the point of loading from the damped point. The experiment is repeated by changing length, hence ($\frac{l^3}{\delta}$) is calculated. It is found to be constant and its mean value is taken. The breadth (b) and thickness (d) of the bar are measured using vernier calipers and screw gauge respectively. Hence Young's modulus is calculated.

Fig 2.1

OPTIC LEVER METHOD

PRINCIPLE

An optical lever is a convenient device to magnify a small displacement and thus to make possible an accurate measurement for small displacement. To determine young's modulus, an optical lever is used to magnify the extension of a wire produced by a series of different loads.

In uniform bending. Young's modulus is given by

$$Y = \frac{MgPl^2}{8le}$$

1-Length of the bar between the knife edge.

P-distance of each load from the nearer knife edge.

e-elevation at the center due to load M.

I-Moment of inertia of the sectional area of the

bar. For a bar of rectangular cross section,

$$I = \frac{bd^3}{12}$$

If M and I are kept constant, l^2/e will be a constant.

Here the elevation (e) is measured using optic lever scale reading due to load M. D is the distance of the scale from the mirror & 'a' is the length of the optic lever.

$$Y = \frac{3MgPD}{bd^3a}\left(\frac{l^2}{S}\right)$$

If the distance of the telescope D is also kept constant (l^2/S) is constant.

PROCEDURE

The experimental bar has been supported symmetrically on two knife edges with a length in cm) between the knife edges. The weight hangers are suspended from points beyond knife edges equal distance from knife edges. The bar is brought to the elastic mood by loading & unloading a number of times. A vertical scale and a telescope are arranged at a distance of about one meter from the optic lever. The telescope is focused on the image of the scale in the mirror with the weight hangers along on either side. Telescope is adjusted to make horizontal cross wire that coincides with any scale division. The telescope reading is noted. The load is increased in equal steps of 50gms, telescope reading is noted each time. After the maximum load is reached, the load is decreased in equal steps of 50gms each time noting the telescope reading. The average telescope reading for each load is found. The mean shift in telescope reading (s) for a constant load (M) is calculated. The distance (p) of the weight hanger from the knife edges are also measured. The experiment is repeated changing ". by keeping P and D constant. The perpendicular of a single leg from the line joining the other two legs is measured as 'a'. This is the length of the optic lever. The breadth 'b' is measured using vernier calipers and thickness "d" using a screw gauge. Hence Young's modulus is calculated.

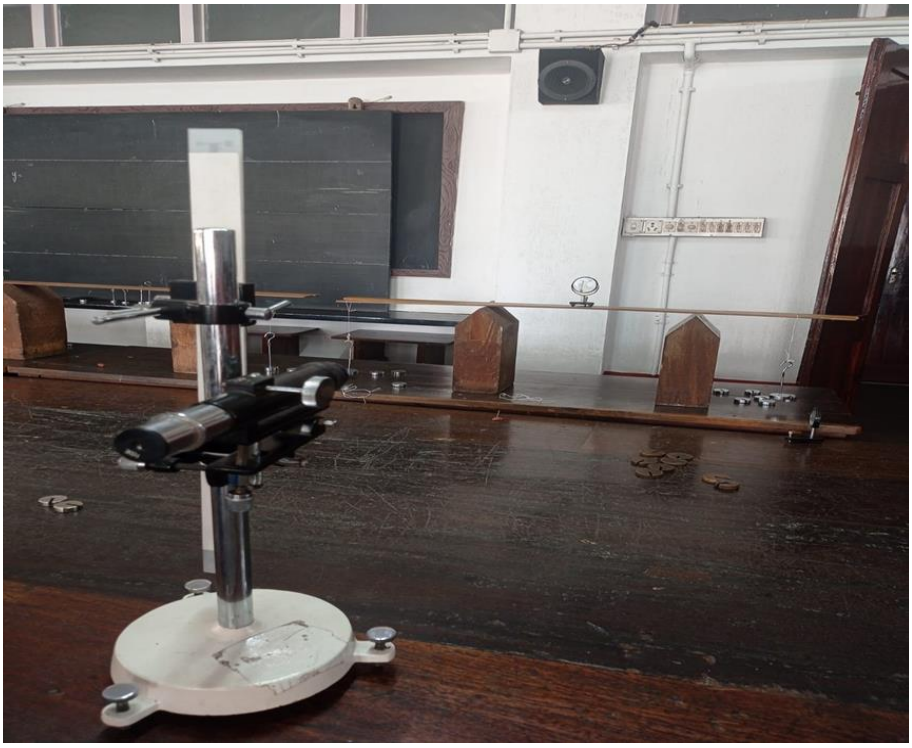


Fig 2.2

NON-UNIFORM BENDING

PRINCIPLE

Here the given beam(meter scale) is supported symmetrically on two knife edges and loaded at its centre. The maximum depression is produced at its centre. Since the load is applied only one point of the beam, the bending is not uniform throughout the beam and the bending of the beam is called non- uniform bending.

For a symmetrically supported beam and loaded at the center,
Young's modulus is given by,

$$Y = \frac{MgL^3}{48I\delta}$$

Where,
L-length of the bar between knife edges.

δ = depression at the center due to load M.

For a rectangular bar of breadth 'b' and thickness 'd',

$$I = \frac{bd^3}{12}$$

Then,

$$Y = \frac{4l^3 g}{bd^3}\left(\frac{M}{\delta}\right)$$

PROCEDURE

The bar is supported symmetrically on two knife edges. The length (l) of the bar is measured. The weight hanger is suspended from the center O. A pin *P* is fixed at the center. The bar is loaded and uploaded a number of times so as to bring it into the elastic mood. A vernier microscope capable of vertical motion is reversed at the tip of the pin. With dead load alone, the horizontal cross wire of the microscope is made to coincide with the tip of the pin. The readings on the vertical scale and vernier of the microscope are taken. Then slotted weights are added to the weight hanger. The microscope is again carefully adjusted so that the horizontal cross wire coincides with the tip of pin. The microscope reading is taken. Hence the elevation (s) of a constant load M is found. Then M/δ is calculated. The breadth of the bar is measured using vernier calipers and thickness using screw gauge. Hence Young's modulus is calculated.

Fig 2.3

UNIFORM BENDING

PRINCIPLE

In uniform bending, every element of the beam is bent with the same radius of curvature. In uniform bending, the beam is elevated due to load. The beam is loaded uniformly on its both ends, the bent beam forms an arc of a circle. An elevation in the beam is produced. This bending is called uniform bending.

In uniform Bending, the Young's modulus of the material of the bar is given by

$$Y = \frac{MgPl^2}{8Ie}$$

where

M = Mass at each end of the bar.

P = Distance between the point of suspension of the mass and nearer knife edge.

g = Acceleration due to gravity.

l = Length of the bar between the knife edges.

E = Elevation of the midpoint of the bar for a mass m at each end.

I = Moment of inertia.

For a bar of rectangular cross section,

$$Y = \frac{3MgPl^2}{2bd^3e}$$

Where, b is the breadth and d is the thickness of the bar

PROCEDURE

The bar is placed symmetrically on two knife edges. Two weight hangers are suspended at equal distance from the knife edges. The distance 1 between knife edges and distance p of the weight hunger from knife edges are measured. A pin is fixed vertically at the midpoint of the bar with its painted end upwards. The microscope is arranged in front of the pin and focused at the tip of the pin. The slotted weights are added one by one on both the weight hangers and removed one by one a number of times, so that the bar is brought into an elastic mood. With some "dead load" w0 on each weight hanger, the microscope is adjusted so that the image of the tip of the pin coincides with the point of intersection of cross wires. The reading of the vernier scale and vernier of the microscope are taken. Weights are added one by one and corresponding readings are taken. From these readings, the mean elevation (e) of the midpoint of the bar for a given mass is determined. The value is calculated. The breadth of the bar (b) is measured by using vernier calipers and thickness of the bar (d) is measured by using a screw gauge. Hence calculate the Young's modulus of the material bar.

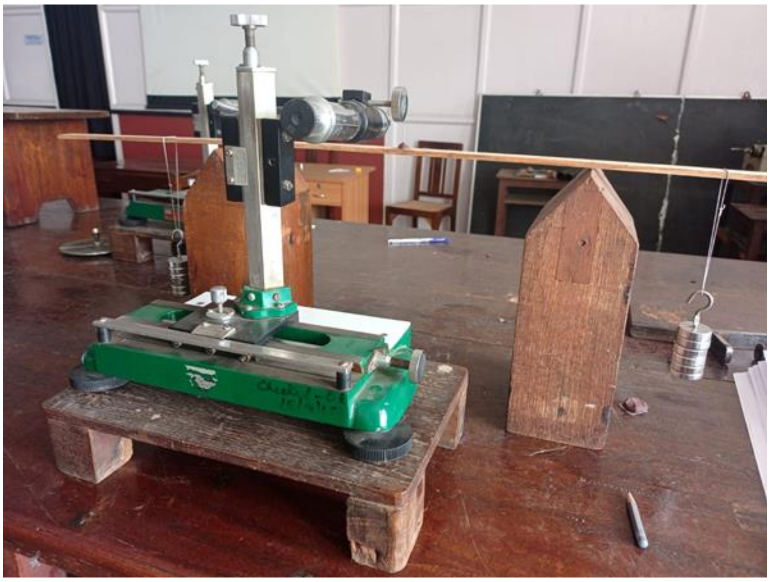


Fig 2.4

EXPERIMENTAL OBSERVATIONS

TEAK

BREADTH (b) USING VERNIER CALIPERS

Value of a main scale division = 1mm

Number of divisions on the vernier scale, n = 10

Least count (L.C) = $\frac{1}{n}$ = 0.01cm

TRIAL NUMBER	MSR (cm)	VSR (cm)	TOTAL READING = MSR + (VSR×L.C) (cm)
1	2.4	5	2.45
2	2.4	5	2.45
3	2.4	4	2.44
4	2.4	6	2.46
5	2.4	6	2.46
6	2.4	5	2.45

Mean breadth (b) = 0.02452m

THICKNESS (d) USING SCREW GAUGE

Value of a pitch scale division = 1 mm

Distance moved by the screw for 6 rotations = 6mm

Pitch = $\frac{Distance\ moved}{Number\ of\ rotations} = \frac{6}{6} = 1$mm

Least count (L.C) = $\frac{Pitch}{Number\ of\ divisions\ on\ head\ scale} = \frac{1}{100} =$ 0.01mm

Zero coincidence = 99

Zero error =-1

Zero correction =+1

TRIAL NUMBER	PSR (mm)	HSR (mm)	TOTAL READING = PSR + (HSR×L.C) (mm)
1	5	70	5.70
2	5	68	5.68
3	5	68	5.68
4	5	69	5.69
5	5	70	5.70
6	5	68	5.68

Mean thickness (d) = 0.0056883m

1.CANTILEVER

Weight (g)	Length (m)	Readings (m)						Mean (cm)	Depression δ (cm)	Mass M (g)	M/δ (g/cm)	Mean M/δ (g/cm)
		Loaded			Unloaded							
		MSR	VSR	TOTAL	MSR	VSR	TOTA L					
W_0		7.25	2	7.252	7.25	1	7.251	7.2515				
W_0+50		7.2	18	7.218	7.2	12	7.212	7.215	0.0365	50	1369.86	
W_0+100	0.20	7.15	38	7.188	7.15	31	7.181	7.1845	0.067	100	1492.54	1448.172
W_0+150		7.15	3	7.153	7.1	48	7.148	7.1505	0.101	150	1485.15	
W_0+200		7.1	14	7.114	7.1	12	7.112	7.113	0.1385	200	1444.04	
W_0+250		7.05	29	7.079	7.05	29	7.079	7.079	0.1725	250	1449.27	
W_0		7.1	11	7.111	7.1	10	7.11	7.1105				
W_0+50		7.05	22	7.072	7.05	15	7.065	7.0685	0.042	50	1190.48	
W_0+100	0.22	7	25	7.025	7	27	7.027	7.026	0.0845	100	1183.43	1158.036
W_0+150		6.95	33	6.983	6.95	24	6.974	6.9785	0.132	150	1136.36	
W_0+200		6.9	37	6.937	6.9	35	6.935	6.936	0.1745	200	1146.13	
W_0+250		6.85	40	6.89	6.85	40	6.89	6.89	0.2205	250	1133.78	
W_0		7.15	33	7.183	7.15	25	7.175	7.179				
W_0+50		7.1	26	7.126	7.1	23	7.123	7.1245	0.0545	50	917.431	
W_0+100	0.24	7.05	21	7.071	7.05	11	7.061	7.066	0.113	100	884.955	899.7606
W_0+150		7	10	7.01	7	8	7.008	7.009	0.17	150	882.35	
W_0+200		6.95	9	6.959	6.95	7	6.957	6.958	0.221	200	904.977	
W_0+250		6.9	4	6.904	6.9	4	6.904	6.904	0.275	250	909.09	

Young's modulus for length 0.20m

$Y_1 = \frac{4l^3g}{bd^3}(M/\delta)$

$= \frac{4x(0.20)^3x9.8}{0.0245167x(0.0056883)^3}x(144.8172)$

$=1.00644 \text{ x}10^{10} N/m^2$

Young's modulus for length 0.22m

$Y_2 = \frac{4l^3g}{bd^3}(M/\delta)$

$= \frac{4x(0.22)^3x9.8}{0.0245167x(0.0056883)^3}x\ (115.80362)$

$=1.071190601 \text{ x}10^{10} N/m^2$

Young's modulus for length 0.24m

$Y_3 = \frac{4l^3g}{bd^3}(M/\delta)$

$= \frac{4x(0.24)^3x9.8}{0.0245167x(0.0056883)^3}x(89.97606)$

$=1.080531102 \text{ x}10^{10} N/m^2$

Mean Y $= \frac{Y1 + Y2 + Y3}{3} = (\frac{1.006437264 + 1.071190601 + 1.080531102}{3}) \text{x } 10^{10}$

$=1.052719656 \text{ x } 10^{10} N/m^2$

2. NON UNIFORM BENDING

Least count of microscope = 0.001cm

Length (m)	Load (g)	Readings on						Mean (cm)	Mass (g)	Depression δ (cm)	M/δ (g/cm)
		Loading			Unloading						
		MSR (cm)	VSR	TR (cm)	MSR (cm)	VSR	TR (cm)				
0.40	W_0	7.4	16	7.416	7.4	12	7.412	7.414			
	W_0+50	7.4	0	7.4	7.4	1	7.401	7.4005	50	0.0135	3703.7
	W_0+100	7.35	39	7.389	7.35	39	7.389	7.389	100	0.025	4000
	W_0+150	7.35	25	7.375	7.35	27	7.377	7.376	150	0.038	3947.4
	W_0+200	7.35	11	7.361	7.35	9	7.359	7.360	200	0.054	3703.7
	W_0+250	7.35	1	7.351	7.35	1	7.351	7.351	250	0.063	3968.2

Mean M/δ = 3864.6 g/cm = 386.46 Kg/m

$(M/\delta)l^3$ = 24.73344 Kgm2

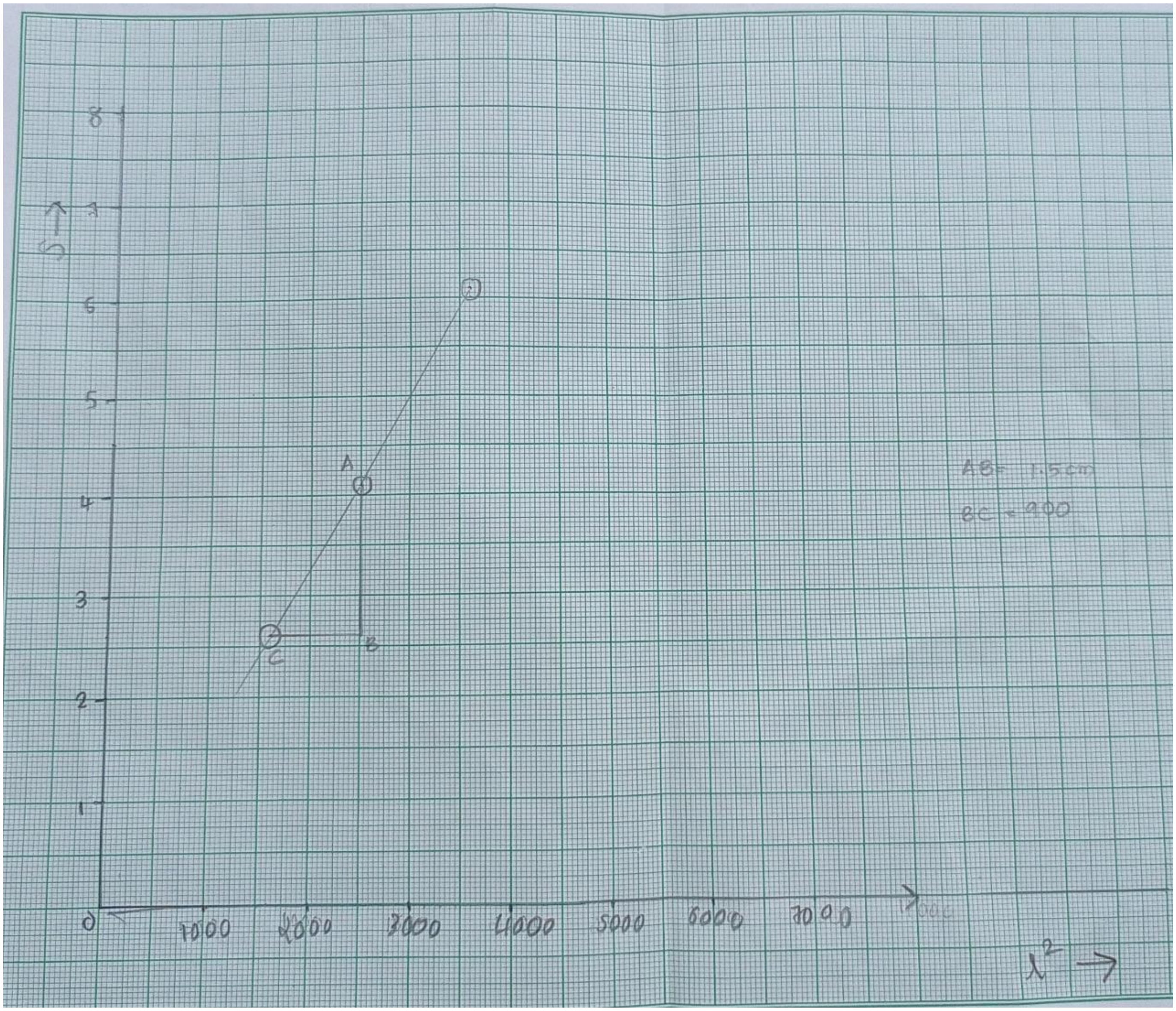
$$Y = \frac{(M/\delta)l^3 g}{4bd^3} = \frac{24.73344 \, x \, 9.8}{4 \, x \, 0.0245167 x (0.0056883)^3}$$

$= 1.34289 \text{ x}10^{10} N/m^2$

3.OPTIC LEVER METHOD

D = 1m, P = 10×10^{-2}m, a = 4.5×10^{-2}m

Length (m)	Load (gm)	Telescope Reading		Shift for 150gms (cm)	Mean S (cm)	l^2/S (m)
		Loading	Unloading			
0.4	W_0	16.8	16.7	2.6	2.6167	6.1146
	W_0+50	15.9	15.8			
	W_0+100	15	14.9	2.6		
	W_0+150	14.2	14.1			
	W_0+200	13.3	13.2	2.65		
	W_0+250	12.3	12.3			
0.5	W_0	15.5	15.5	4	4.1	6.097
	W_0+50	14.2	14.2			
	W_0+100	12.9	12.9	4.1		
	W_0+150	11.5	11.5			
	W_0+200	10.1	10.1	4.2		
	W_0+250	8.7	8.7			
0.6	W_0	17.7	17.8	6.2	6.183	5.8224
	W_0+50	16.4	16.2			
	W_0+100	14	13.9	6.1		
	W_0+150	11.5	11.6			
	W_0+200	10.1	10.3	6.25		
	W_0+250	7.7	7.7			



AB = 1.5cm
BC = 900
A
B
C

From table, l^2/S = 6.01133 m

A = 4.1

B = 2500

C = 1600

$\frac{BC}{AB} = \frac{900}{1.5}$ = 600 cm = 6 m

From graph,

l^2/S = 6 m

Mean $l^2/S = \frac{6.01133+6}{2}$ = 6.005665

$$Y = \frac{3MgPD}{bd^3a}(l^2/S)$$

$$= \frac{3\ x\ 0.15\ x\ 9.8\ x\ 0.1\ x\ 1}{0.0245167x(0.0056883)^3\ \ x\ (\ 4.5\times10^{-2})}(6.005665)$$

$= 1.30430058 \text{ x } 10^{10} N/m^2$

4.UNIFORM BENDING-PIN AND MICROSCOPE METHOD

Least count of microscope = 0.001cm

Weight (gm)	Length (m)	Readings on						Mean (cm)	Elevation e(cm)	Mass (g)	M/e (g/cm)	$Mean$ M/e (g/cm)
		Loading			Unloading							
		MSR (cm)	VSR	TR (cm)	MSR (cm)	VSR	TR (cm)					
W_0	0.40	7.4	16	7.416	7.4	17	7.417	7.4165				2154.64
W_0+50		7.4	42	7.442	7.4	42	7.442	7.442	0.0255	50	1960.8	
W_0+100		7.45	11	7.461	7.45	13	7.463	7.462	0.0455	100	2197.8	
W_0+150		7.45	34	7.484	7.45	36	7.486	7.485	0.0685	150	2189.8	
W_0+200		7.5	6	7.506	7.45	7	7.507	7.5065	0.09	200	2222.2	
W_0+250		7.5	30	7.53	7.5	30	7.53	7.53	0.1135	250	2202.6	

Mean M/e = 2154.64 g/cm =215.464 Kg/m

P = $10\times10^{-2} = 0.1m$

Young's modulus,

$$Y = \frac{3l^2Pg}{2bd^3}\left(\frac{M}{e}\right)$$

$$= \frac{3\ x\ (0.40)^2\ x\ 0.1\ x\ 9.8}{2\ x\ 0.0245167x(0.0056883)^3}x(215.464) = 1.123058926 \text{ x } 10^{10}\ N/m^2$$

MAHOGANY

Breadth (b) Using Vernier Calipers

Value of a main scale division = 1mm

Number of divisions on the vernier scale, n = 10

Least count (L.C) = $\frac{1mm}{10}$ = 0.01cm

TRIAL NUMBER	MSR (cm)	VSR	TOTAL READING = MSR + (VSR×L.C) (cm)
1.	2.5	5	2.55
2.	2.5	6	2.56
3.	2.5	4	2.54
4.	2.5	4	2.54
5.	2.5	5	2.55

Mean breadth (b) = 2.548cm = 0.02548m

Thickness (d) using Screw Gauge

Value of a pitch scale division = 1 mm

Distance moved by the screw for 6 rotations = 6mm

Pitch = $\frac{Distance\ moved}{Number\ of\ rotations} = \frac{6}{6} = 1$mm

Least count (L.C) = $\frac{Pitch}{Number\ of\ divisions\ on\ head\ scale} = \frac{1}{100} =$ 0.01mm

Zero coincidence = 98

Zero error = -2

Zero correction = +2

TRIAL NUMBER	PSR (cm)	HSR	TOTAL READING = PSR + (HSR×L.C) (cm)
1.	6	21	6.21
2.	6	24	6.24
3.	6	21	6.21
4.	6	25	6.25
5.	6	27	6.27

Mean thickness (d) = 6.236mm = 0.006236m

NON-UNIFORM BENDING – PIN AND MICROSCOPE METHOD

Least count of microscope = 0.001cm

Length (m)	Load (g)	Readings on						Mean M (g)	Mass M (g)	Depression δ (cm)	M/δ (g/cm)
		Loading			Unloading						
		MSR (cm)	VSR	TR (cm)	MSR (cm)	VSR	TR (cm)				
0.40	W_0	7.70	2	7.702	7.70	3	7.703	7.7025			
	W_0+50	7.65	40	7.690	7.65	39	7.689	7.6895	50	0.0130	3845.1
	W_0+100	7.65	29	7.679	7.65	25	7.675	7.677	100	0.0255	3921.5
	W_0+150	7.65	13	7.663	7.65	19	7.669	7.666	150	0.0365	4109.5
	W_0+200	7.65	2	7.652	7.65	5	7.655	7.6535	200	0.049	4081.6
	W_0+250	7.60	40	7.640	7.6	40	7.640	7.640	250	0.0625	4000

Mean M/δ = 3991.54g/cm = 399.154kg/m

$$(M/\delta)l^3 = 25.545kgm^2$$

$$Y = \frac{(M/\delta)l^3 g}{4bd^3} = 25.545$$

$$= \frac{25.545\times9.8}{4\times0.02548\times(0.006236)^3}$$

$$= 1.012\times10^{10}\ N/m^2$$

CANTILEVER – PIN AND MICROSCOPE

Weight (g)	Length (m)	Readings (m)						Depression δ (cm)	Mass M (g)	M/δ (g/cm)	Mean
		Loaded			Unloaded						
		MSR (cm)	VSR (div)	TOTAL	MSR (cm)	VSR (div)	TOTAL				
W_0	0.2	6.95	20	6.970	6.95	15	6.965	_		-	6.9675
W_0+50		6.90	35	6.925	6.90	38	6.921	0.0130	50	1612.90	6.9365
W_0+100		6.90	15	6.915	6.90	5	6.905	0.0575	100	1739.13	6.910
W_0+150		6.90	2	6.902	6.85	16	6.866	0.0835	150	1795.40	6.884
W_0+200		6.85	3	6.853	6.80	35	6.835	0.1235	200	1619.43	6.844
W_0+250		6.80	25	6.825	6.80	17	6.817	0.1465	250	1705.48	6.821
W_0	0.22	7.20	3	7.203	7.20	5	7.205	-			7.204
W_0+50		7.15	20	7.170	7.15	18	7.168	0.0350	50	1429.57	7.1609
W_0+100		7.13	6	7.126	7.10	37	7.137	0.0675	100	1481.48	7.1365
W_0+150		7.10	2	7.102	7.10	1	7.101	0.1025	150	1463.41	7.1015
W_0+200		7.05	16	7.066	7.05	8	7.058	0.1420	200	1409.45	7.062
W_0+250		7.00	26	7.026	7	26	7.026	0.1780	250	1404.49	7.026
W_0	0.24	7.15	20	7.170	7.15	27	7.177				7.1735
W_0+50		7.12	14	7.134	7.12	7	7.127	0.0430	50	1162.79	7.1305
W_0+100		7.09	1	7.019	7.08	8	7.088	0.0840	100	1190.47	7.0895
W_0+150		7.04	7	7.047	7.04	5	7.045	0.1275	150	1176.47	7.046
W_0+200		7	1	7.001	7	3	7.003	0.1715	200	1166.18	7.002
W_0+250		6.95	5	6.955	6.95	5	6.955	0.2185	250	1144.16	6.955

Least count of microscope = 0.001cm

Young's modulus for length 0.20m,

$$Y_1 = \frac{4l^3g}{bd^3}(M/\delta)$$

$$= \frac{4\times(0.2)^3\times9.8}{0.02548\times(0.006236)^3} \times 169.4468$$

$$= 0.859\times10^{10} N/m^2$$

Young's modulus for length 0.22m,

$$Y_2 = \frac{4l^3g}{bd^3}(M/\delta)$$

$$= \frac{4\times(0.22)^3\times9.8}{0.02548\times(0.006236)^3} \times 143.768$$

$$= 0.959\times10^{10} N/m^2$$

Young's modulus for length 0.24m,

$$Y_3 = \frac{4l^3g}{bd^3}(M/\delta)$$

$$= \frac{4\times(0.24)^3\times9.8}{0.02548\times(0.006236)^3} \times 116.8014$$

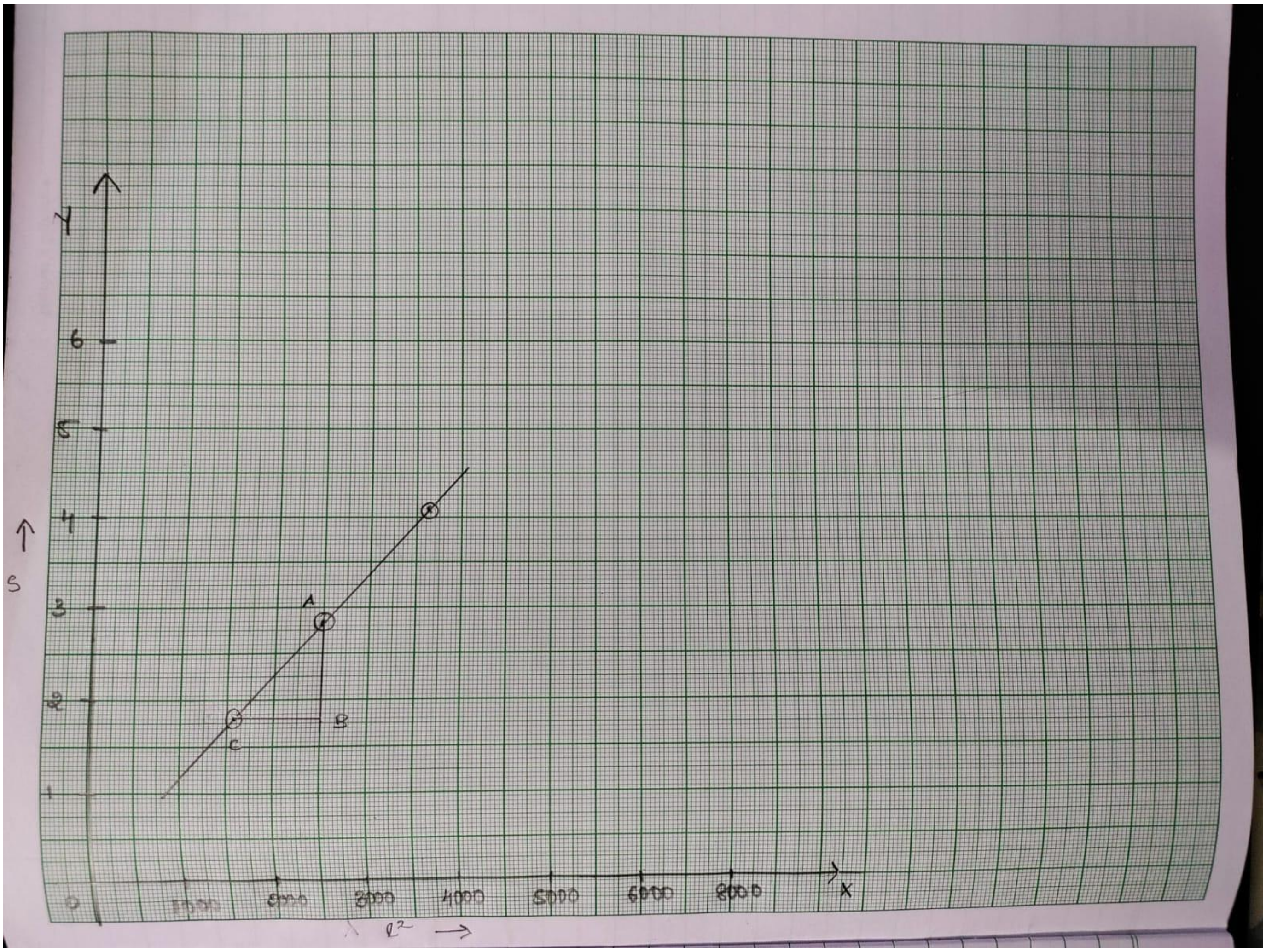
$$= 1.024\times10^{10} N/m^2$$

Mean Y = $\frac{Y1+Y2+Y3}{3} = 0.947\times10^{10} N/m^2$

OPTIC LEVER METHOD

D = 1m, P = 10×10^{-2}m, a = 4.5×10^{-2}m

Length (m)	Load (gm)	Telescope Reading			Shift for 150gms (cm)	Mean S (cm)	l^2/S (m)
		Loading	Unloading	Mean			
0.4	W_0	41.3	41.5	41.4	1.75	1.78	8.98
	W_0+50	41.8	42	41.9			
	W_0+100	42.4	42.6	42.5	1.85		
	W_0+150	43.1	43.2	43.15			
	W_0+200	43.7	43.8	43.75	1.75		
	W_0+250	44.3	44.2	44.25			
0.5	W_0	37.8	38	37.9	2.75	2.78	8.992
	W_0+50	38.7	38.9	38.8			
	W_0+100	39.6	39.9	39.75	2.8		
	W_0+150	40.6	40.7	40.65			
	W_0+200	41.5	41.7	41.6	2.8		
	W_0+250	42.7	42.6	42.55			
0.6	W_0	41.8	42	41.95	3.95	4.01	8.97
	W_0+50	43.2	43.5	43.35			
	W_0+100	44.5	44.8	44.65	4		
	W_0+150	45.8	46	45.9			
	W_0+200	47.2	47.5	47.35	4.1		
	W_0+250	48.7	48.8	48.75			


Y
6
5
4
3
2
1
0
A
B
C
S
1000
2000
3000
4000
5000
6000
8000
X
l^2

From table,

l^2/S = 8.987m

From graph,

A = 2.78

B = 2500

C = 1600

$\frac{BC}{AB} = \frac{900}{1}$ = 900m

From graph,

l^2/S = 900 cm = 9m

Mean $l^2/S = \frac{3MgPD}{bd^3a} \times (l^2/S)$

$$= \frac{3\times0.15\times9.8\times0.1\times1}{0.02548\times(0.006236)^3\times0.045} \times 8.987$$

$$= 1.425\times10^{10} N/m^2$$

UNIFORM BENDING – PIN AND MICROSCOPE METHOD

Least count of microscope = 0.001cm

Weight (gm)	Length (m)	Readings on						Mean (cm)	Elevation e (cm)	Mass (g)	M/e (g/cm)	Mean M/e (g/cm)
		Loading			Unloading							
		MSR (cm)	VSR	TR (cm)	MSR (cm)	VSR	TR (cm)					
W_0		7.60	36	7.636	7.60	40	7.640	7.6380				
W_0+50		7.65	7	7.657	7.65	3	7.653	7.6550	0.0170	50	2941.176	
W_0+100	0.4	7.65	18	7.668	7.65	21	7.671	7.6695	0.0315	100	3174.60	3066.968
W_0+150		7.65	35	7.685	7.65	38	7.688	7.6865	0.0485	150	3092.78	
W_0+200		7.70	4	7.704	7.70	2	7.702	7.7030	0.0650	200	3075.92	
W_0+250		7.70	20	7.720	7.70	20	7.720	7.7200	0.0820	250	3049.78	

P = $10\times10^{-2} = 0.1m$

Young's modulus,

$$Y = \frac{3l^2Pg}{2bd^3}\left(\frac{M}{e}\right)$$

$$= \frac{3\times(0.4)^2\times0.1\times9.8}{2\times0.02548\times(0.006236)^3} \times 306.6968$$

$$= 1.16\times10^{10} N/m^2$$

CHAPTER 4

RESULTS

The value of Young's Modulus obtained in various methods for Teak and Mahogany follows as:

	TEAK	**MAHOGANY**
Non-uniform bending	1.34289 X 10^{10} N/m^2	1.012X 10^{10} N/m^2
Optic lever method	1.3043X 10^{10} N/m^2	1.425X 10^{10} N/m^2
Cantilever	1.0527X 10^{10} N/m^2	0.947 X 10^{10} N/m^2
Uniform bending	1.12306 X 10^{10} N/m^2	1.16 X 10^{10} N/m^2

Actual value of Young's Modulus for Teak (Tectona grandis) is 1.228 X 10^{10} N/m^2

From the experiment results.

On taking the average, we get

Young's Modulus =1.20574 ×10^{10} N/m^2

Actual value of Young's Modulus for Mahogany (Cuban Mahogany) is 0.931-10 N/m

from the experiment results.

On taking the average, we get

Young's Modulus =1.136×10^{10} N/m^2

CHAPTER-5

CONCLUSION

	TEAK	MAHOGANY
OBTAINED VALUE	1.20574×10^{10} N/m	1.136×10^{10} N/m
STANDARD VALUE	1.228×10^{10}N/m	0.931×10^{10} N/m

Young's moduli of the material of different woods are studied. It is seen that Young's modulus varies with respect to the materials selected. The actual value of Young's modulus of Teak (Tectona grandis) is 1.228×10^{10} N/m^2 and the experimentally obtained value, which is the average value taken from 4 methods is found to be 1.20574×10^{10} N/m^2 Similarly, for Cuban Mahogany, the actual value is 0.931×10 N/m^2 and the experimental average value is 1.136×10^{10}N/m^2. On observing the experiment results, it can be seen that the non-uniform bending method yielded more accurate values of Young's modulus and that the results obtained in other methods could be improved by attempting to repeat the experiment a greater number of times by changing the experimental parameters 1, a, d. d etc.

The materials with high value of Young's modulus are more elastic if it returns to its original length when the deforming force is removed. Steel is an example of having a higher value of Young's modulus (210 Gpa). i.e. More force is required to deform it. Hence a material with higher young's modulus is more elastic than a material with lower young's modulus, more elastic materials are stable under a wide range of temperature without undergoing degradation, strong but not bulky. These materials also possess low flammability and no melting point. Materials having lower Young's modulus are less elastic. In such materials more de formation occurs and they are unable to return to their original shape when the deforming force is removed. For example, Lead has a very low value of modulus of elasticity. Flexible materials possess low young's modulus and cause more deformation. The materials with higher young's modulus bear higher stiffness materials than lower modulus materials. Also, it can be said that stress to strain ratio is higher for more elastic materials than lower elastic materials:

Teak is mainly preferred in the construction of boats, railing, outdoor furniture, cabin woodwork and decorative material indoors. It has rich oil content with high tensile strength when compared with other types of wood. Teak is mostly preferred in construction and is costly. It is very durable and can last for 100 years.

Mahogany wood is the most versatile and durable of all hardwoods and is expensive. It resists shrinking, splintering, and checking which makes mahogany a perfect wood for outdoor Satur is used for making musical instruments, doors, floors, pool cues, used in furniture industries etc.

There is also a wide range of application for Young's modulus. Elasticity is used widely in the design and analysis of structures such as beams, plates and shells. By measuring the properties such as Young's modulus, rigidity modulus etc. of kinds of wood, a great deal of uncertainty can be removed from the building processes. Finding Young's modulus of different woods is useful in construction works especially the field of construction works.

REFERENCES

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