SRM VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF AGRICULTURAL ENGINEERING

LAB MANUAL

Regulation : 2023
Branch : B.E. – Agricultural Engineering
Year & Semester : II Year / IV Semester

1902406- STRENGTH OF MATERIALS LABORATORY

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SRM VALLIAMMAI ENGINEERING COLLEGE
SRM Nagar, Kattankulathur – 603 203
DEPARTMENT OF AGRICULTURALENGINEERING

AG3433- STRENGTH OF MATERIALS LABORATORY

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:
To expose the students to the testing of different materials under the action of various forces and determination of their characteristics experimentally.

LIST OF EXPERIMENTS

1. Tension test on steel rod.
2. Compression test on wood.
3. Double shear test on metal.
4. Torsion test on mild steel rod.
5. Impact test on metal specimen (Izod and Charpy).
6. Hardness test on metals (Rockwell and Brinell Hardness Tests).
7. Deflection test on metal beam.
8. Compression test on helical spring.
9. Deflection test on carriage spring.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to:
1. Find the stress distribution and strains in regular and composite structures subjectedto axial loads.
2. Assess the shear force, bending moment and bending stresses in beams
3. Apply torsion equation in design of circular shafts and helical springs

REFERENCES:

1. Strength of Materials Laboratory Manual, Anna University, Chennai - 600 025.
2. IS1786-2008 (Fourth Revision, reaffirmed 2013), 'High strength deformed bars and wires for concrete reinforcement – Specification', 2008.

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INSTRUCTIONS

1. Students should report to the labs concerned as per the timetable.
2. Students who **turn up late** to the labs will in **no case be permitted** to perform the experiment scheduled for the day.
3. Students need to **submit lab permission form** if they are **ABSENT** for the laboratory class.
4. After completion of the experiment, certification of the staff in-charge concerned in the observation book is must.
5. Students should bring a notebook of about 100 pages and should enter the readings/observations/results into the notebook while performing the experiment.
6. The record of observations (Record and Observation note) along with the detailed experimental procedure of the experiment performed in the immediate previous session should be submitted and certified by the staff member in-charge.
7. Not more than **4 students in a group** are permitted to perform the experiment on a set up.
8. The group-wise division made in the beginning should be adhered to, and no mix up of student among different groups will be permitted later.
9. The components required pertaining to the experiment should be collected from technical assisting staff after duly filling in the register maintained.
10. When the experiment is completed, students should return all the components/instruments taken for the purpose.
11. Any damage of the equipment or burnout of components will be viewed seriously either by putting **penalty** for individual or for total group.
12. Students should be present in the labs for the total scheduled duration.
13. Students are expected to prepare thoroughly well before the lab session to perform the experiment.
14. **DRESS CODE:**

    BOYS - Lab uniform with formal shoes (**Others shoes not allowed**)

    GIRLS - Formal Salwar Kameez with lab coat and formal shoes

    Without ID card, students will not be permitted to the laboratory

INTRODUCTION

Strength is particular mean by which a body or thing is strong. Strength of material is the property of the material by virtue of which the material can resist external force applied to it per unit of its cross sectional area. Greater this force with which the external force is resisted by unit cross sectional area of the material is its strength.

The external force acting on a body is called loads. Structure and machines are designed on the basis of loads. The units of load are the same as that of force. The load according to the manner of their member is dead load, live loads. The effect produced on a member is tensile load, compressive load, shearing loads, torsion loads, bending loads.

Stress as a load per unit area. Stress may be either tensile or compressive or shear according to whether member is being stretched, compressed or sheared.

The strength relies on three different type analytical method, strength stiffness and stability.

Strain is a measure of the deformation caused by the loaded body. The ratio of change in dimension of the body to the original dimension.

Mechanical properties can be described as the behavior of material under external loads. The important properties are strength, elasticity, plasticity, ductility, brittleness, malleability, toughness, hardness.

A structural member which carries lateral or transverse forces is termed as beam joint.

For example in grain boundary strengthening, although yield strength is maximized with decreasing grain size, very small sizes make the material.

It is determined by dividing the load at the time of fracture or breaking by the original cross sectional area

EX.NO:1

DATE:

TENSION TEST ON MILD STEEL BAR

AIM:

To conduct a tension test on given mild steel specimen for finding the following:

1. Yield stress
2. Ultimate stress
3. Nominal breaking stress
4. Actual breaking stress
5. Percentage Elongation in length
6. Percentage reduction in area

APPARATUS REQUIRED:

1. Universal testing machine (UTM)
2. Mild steel specimen
3. Scale
4. Vernier caliper

PROCEDUER:

1. Measure the length (L) and diameter (d) of the specimen.
2. Mark the center of the specimen using dot punch.
3. Mark two points P and Q at a distance of 150mm on either side of the center mark so that the distance between P and Q equal to 300mm.
4. Mark two point A and B at a distance of 2.5 times the rod distance on the either side of the center mark so that that the distance between A,B will be equal to 5 times the rod diameter andis known as initial gauge length of rod.
5. Apply the load gradually and continue the application of load. After some times, there will be slightly pause in the increase of load .the load at this points is noted as yield point.
6. Apply load continually till the specimen fails and note down the ultimate load (p_a) and breaking load (p_b) from the digital indicator. Measure the diameter of the rod at neck (d_n)

FORMULA:

$$\text{Yield stress} = \frac{\text{yield point}}{\text{Initial area}}$$

$$\text{Ultimate stress} = \frac{\text{uitimate load}}{\text{Initial area}}$$

$$\text{Normal breaking stress} = \frac{\text{breaking load}}{\text{Initial area}}$$

$$\text{Actual breaking stress} = \frac{\text{breaking load}}{\text{Neck area}}$$

$$\text{Elongation in length} = \frac{\text{final length} - \text{initial length}}{\text{Initial length}} \text{X}100$$

$$\text{Reduction in area} = \frac{\text{Initial area} - \text{neck area}}{\text{initial length}} \text{X}100$$

OBSREVATION:

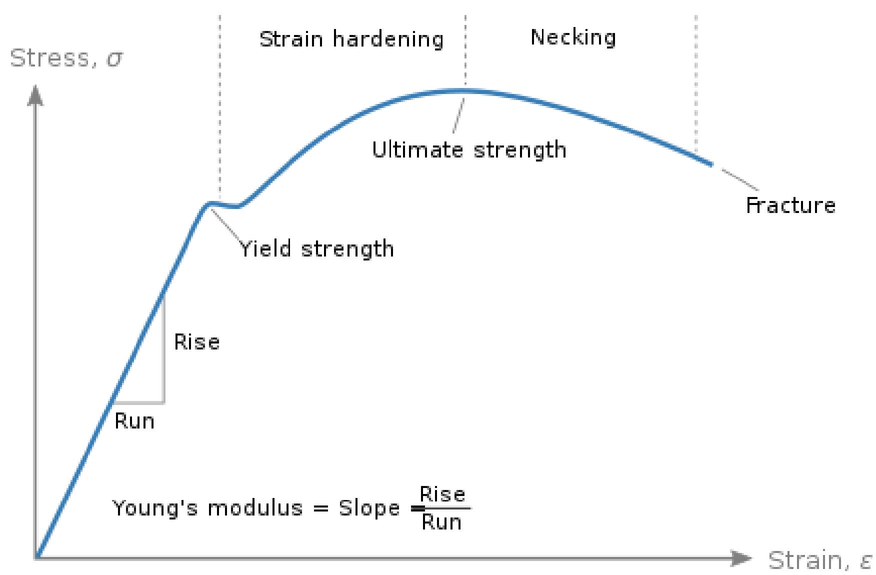
1. Material of the specimen = ________________
2. Length of specimen , L =_______________mm
3. Diameter of the specimen ,d =_______________mm
4. Initial gauge length of the specimen, L_I =_______________mm
5. Final gauge length of specimen, l_F =_______________mm
6. Diameter at neck, d_n =_______________mm
7. Yield point, Py =_______________kN
8. Ultimate load ,p_u =_______________kN
9. Breaking load, p_b =_______________kN

CALCULATION:

TABULATION:

S.I NO	Load	Area	Elongation	Stress	Strain	Young's Modulus
SYM & Unit						

GRAPH:



RESULT:

1. Yield stress = _______________ ***N/mm²***
2. Ultimate stress = _______________ ***N/mm²***
3. Nominal breaking stress = _______________ ***N/mm²***
4. Actual breaking stress = _______________ ***N/mm²***
5. Percentage elongation in length =_______________***%***
6. Percentage reduction in area =_______________***%***

EX.NO:2

DATE:

DOUBLE SHEAR TEST ON STEEL BAR

AIM:

To determine the maximum shear strength of the given bar by conducting double shear test.

APPARATUS AND SPECIMEN REQUIRED:

1. Universal testing machine (UTM)
2. Mild steel specimen.
3. Device for double shear test.
4. Vernier caliper /screw gauge

PROCEDURE:

1. Measure the diameter (d) of the given specimen.
2. The inner diameter of the hole in the shear stress attachment is slightly greater than ofthe specimen.
3. Fit the specimen in the double shear device and place whole assembly in the UTM.
4. Apply the load till the specimen fails by double shear.
5. Note the down the load the specimen fails (p).
6. Calculate the maximum shear strength of the given specimen by using .

FORMULA:

$$\text{Maximum shear strength} = \frac{P}{2 \times A}$$

P= load at failure, N

A= cross-sectional area of bar, mm^2

$A=2 \times \pi D^2/4$

OBSERVATION: (D0UBLE SHEAR TEST)

1. Material of the specimen =____________________

2. Diameter of the specimen (d) =__________________*mm*

3. Cross sectional area (A) = __________________*mm^2*

4. Load at failure (p) =____________________kN

1. Material of the specimen =____________________

2. Diameter of the specimen (d) =__________________*mm*

3. Cross sectional area (A) = __________________*mm^2*

4. Load at failure (p) =____________________kN

RESULT:

The maximum shear strength of the given specimen

Specimen 1 = ________________ ***N/mm^2***

Specimen 2 = ______________ ***N/mm^2***

EX.NO:3

DATE:

TORSION TEST ON MILD STEEL BAR

AIM:

To conduct torsion test on mild steel round rod and to the value of modulus rigidity and maximum shear stress.

APPARATUS REQUIRED:

1. Torsion testing machine.
2. Venire caliper
3. Steel rule
4. Specimen

PROCEDURE:

1. Before testing, adjust the measuring range according to the capacity of the test piece.
2. Hold the test specimen driving chuck with the help of handles.
3. Adjust the angle measuring dial at zero position, block pointer at the starting position and pen its required position.
4. Bring the red dummy pointer in the line with black pointer.
5. Start the machine and now the specimen will be subjected to torsion.
6. Take the value of the torque from the indicating dial for particular value of angle of twist.
7. Repeat the experiment until the specimen breaks into two pieces. Note the value of torque at this breaking point.
8. Tabulate the reading and draw graph between angle of twist and torque.
9. Find the value of T/θ from the graph and find the value of modulus of rigidity.
10. Find the maximum shear stress.

OBSERVATION: (TORSION TEST ON MILD STEEL)

1. **RECORD THE FOLLOWING:**

- Initial diameter of specimen =___________*mm*
- Length of the specimen =___________*mm*

SI.NO	Angle of twist ***degrees***	Angle of twist in radian ***θ (π/180)***	Torque ***N-mm***

TABULATION:

SI.NO	Radius of the Specimen ***mm***	Torque ***N-mm***	Angle of twist (θ) ***radian***	Shear stress ***N/mm^2***	Modulus of rigidity of material ***N/mm^2***	Strain energy ***N/mm***

FORMULA:

The general torsion theory for circular specimen:

$$\frac{T}{J} = \frac{\tau}{r} = \frac{G \times \theta}{L}$$

Where,

T =applied torque, (Nm)

J=Polar second moment of area, (mm^2)

G= modulus of rigidity, (N/mm^2)

θ=angle of twist, (radians)

L= gauge length,(mm)

CALCULATION:

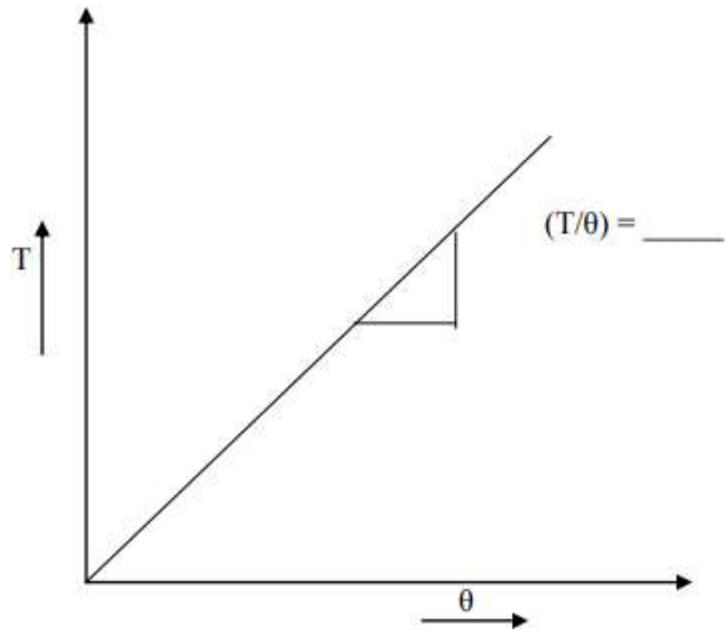
i. Polar Moment of Inertia (J) $= (\pi/32) \times d^4$

ii. Modulus of Rigidity, (C) $= \frac{T \times L}{J \times \theta}$ N/mm^2

iii. Maximum Shear Stress, (τ) $= \frac{T \times R}{J}$ N/mm^2

iv. Strain Energy, (U) $= [\tau^2 / 4G] \times$ Volume N.mm

GRAPH:



RESULT:

1. Shear stress = ____________ N/mm^2
2. Modulus of rigidity = ____________ N/mm^2
3. Strain energy = ____________ N/mm
4. Ultimate shear stress = ____________ N/mm^2

EX.NO:4

DATE:

COMPRESSIVE STRENGTH ON WOOD

AIM:

To perform compression test of wood and determine compressive strength using UTM.

APPARATUS:

A UTM or A compression testing machine ,cylindrical or cube shaped specimen of cast iron, aluminum or mild steel ,vernier caliper, liner scale , dial gauge .

PROCEDURE:

1. Dimension of test piece is measured at three different places along its height/length to determine the average cross sectional area.
2. Ends of the specimen should be plane for that the ends are tested on a bearing plate
3. The specimen is placed centrally between the two compression plate such that the centre of moving head is vertically above the centre of specimen.
4. Load is applied on the specimen by moving the movable head.
5. The load and corresponding contraction are measured at different intervals. The load interval may be as 500kg.
6. Load is applied until the specimen fails.

OBSERVATION :(compression test on wood)

Initial length/height of specimen, L/h =______mm

Initial depth of specimen, d =_______mm

Initial width of specimen, w =_______mm

S.I NO	Breaking Load (N)	Area of Specimen (A) mm^2	Recorded change in length mm	Compressive Strength

CALCULATION:

- ❖ Original cross section area A_o = ____________ ***mm^2***
- ❖ Final cross section area A_f =_____________ ***mm^2***
- ❖ Stress = ____________ ***N/mm^2***
- ❖ Strain =_______________

RESULT:

The compressive strength of given specimen =_________________ ***N/mm^2***

EX.NO:5

DATE:

IZOD IMPACT TEST

AIM:

To determine the impact strength of the given specimen by conducting IZOD impact test.

APPARATUS AND SPECIMEN REQUIRED:

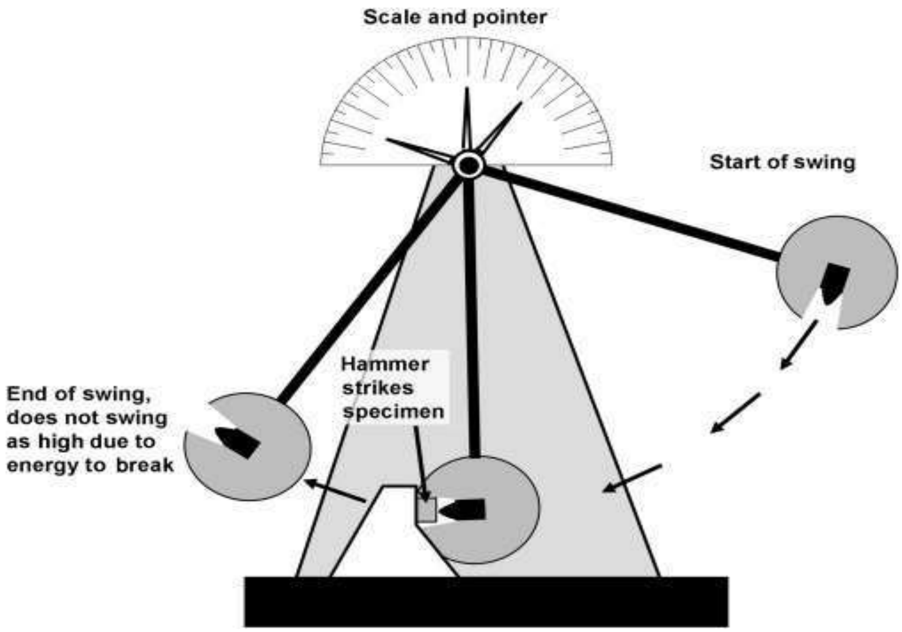
1. Impact testing machine with attachment for IZOD test.
2. Given specimen
3. Vernier caliper
4. Scale

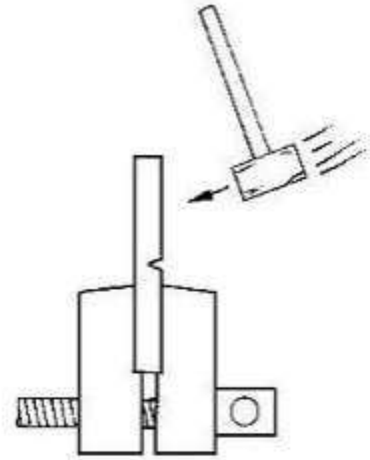
PROCEDURE:

1. Measure the length (l), breath (b), depth (d) of the given specimen.
2. Measure the position of notch from the end, depth of groove, and top width of groove in the given specimen.
3. Lift the pendulum and keep it in the position meant for IZOD test.
4. Adjust the pointer to coincide with initial position in the IZOD scale.
5. Release the pendulum using the lever and note down the initial reading in the IZOD scale.
6. Place the specimen vertically upwards such that the shorter distance between one ends of the specimen and groove will be protruding length and also the groove in the specimen should face the striking end of the hammer.
7. Release the pendulum again using the and note down the final reading in the izod scale
8. Find the impact strength of the given specimen by using the following relation;

Energy Observed = (final izod scale reading – initial izod scale reading)

DIAGRAM:





DIRECTION OF IMPACT

SPECIFICATION OF M/C AND SPECIMEN DETAILS :

Its specifications along-with their typical values are as follows:

• Impact capacity = 164.6 joule

• Least count of capacity (dial) scale = 2 joule

• Weight of striking hammer = 21..7 kg.

• Swing diameter of hammer = 1600mm.

• Angle of hammer before striking = 90°

• Distance between supports = 40mm.

• Striking velocity of hammer = 5.6m/sec.

OBSERVATION :(IZOD IMPACT TEST)

1. Material of the given specimen =____________
2. Type of notch =____________
3. Length of the specimen ,L =___________mm
4. Breath of the specimen , b =___________mm
5. Depth of the specimen ,d =__________mm
6. Position of groove from one end, =__________mm
7. Depth of groove =__________mm
8. Width of groove =__________mm

TABULATION:

SI.NO	Initial Energy (E1) in joule	Residual Energy (E2) in joule	Absorb Energy (E1-E2) in joule	Impact strength J/mm^2

RESULT:

The strain energy in the test specimen is =_______________ ***J***

The impact strength of the given specimen is = _______________***J/mm²***

EX.NO:6

DATE:

CHARPY IMPACT TEST

AIM:

To determine the impact strength of the given specimen by conducting charpy impact test.

APPARATUS AND SPECIMEN REQUIRED:

1. Impact testing machine with attachment for charpy test.
2. Given specimen
3. Vernier caliper
4. Scale

THEORY:

An impact test of material that is ability of material to absorb energy during plastic deformation. The impact test measures the necessary to fracture a standard notch bar by applying an impact load.

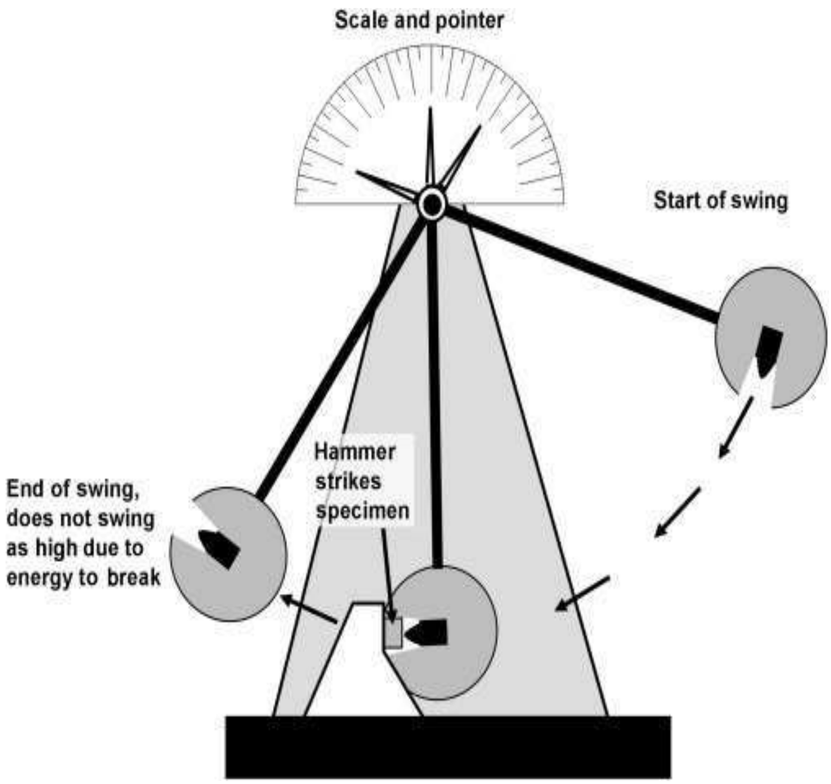
PROCEDURE:

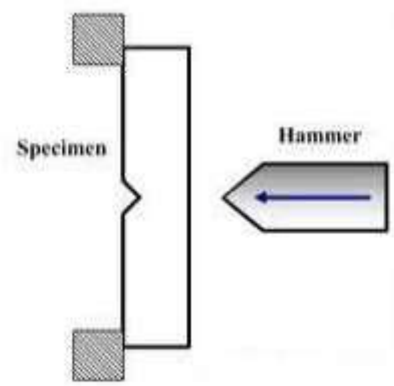
1. Measure the length (l), breath (b), depth (d) of the given specimen.
2. Measure the position of notch from the end, depth of groove, and top width of groove in the given specimen.
3. Lift the pendulum and keep it in the position meant for charpy test.
4. Adjust the pointer to coincide with initial position in the charpy scale.
5. Release the pendulum using the lever and note down the initial reading in the charpy scale.
6. Place the specimen vertically upwards such that the shorter distance between one ends of the specimen and groove will be protruding length and also the groove in the specimen should face the striking end of the hammer.
7. Release the pendulum again using the and note down the final reading in the charpy scale

8. Find the impact strength of the given specimen by using the following relation;

Energy Observed = (final izod scale reading – initial izod scale reading)

DIAGRAM:





DIRECTION OF IMPACT

SPECIFICATION OF M/C AND SPECIMEN DETAILS :

Its specifications along-with their typical values are as follows:

- Impact capacity = 307.6 joule
- Least count of capacity (dial) scale = 2 joule
- Weight of striking hammer = 21.7 kg.
- Swing diameter of hammer = 1600mm.
- Angle of hammer before striking = 160°
- Distance between supports = 40mm.
- Striking velocity of hammer = 5.6m/sec.

OBSERVATION: (CHARPY IMPACT TEST)

1. Material of the given specimen =_______________
2. Type of notch =_______________
3. Length of the specimen ,L =_____________mm
4. Breath of the specimen , b =_____________mm
5. Depth of the specimen ,d =_____________mm
6. Position of groove from one end, =_____________mm
7. Depth of groove =_____________mm
8. Width of groove =_____________mm

TABULATION:

SI.NO	Initial Energy (E1) in joule	Residual Energy (E2) in joule	Absorb Energy (E1-E2) in joule	Impact strength J/mm^2

RESULT:

The strain energy in the test specimen is =_______________ ***J***

The impact strength of the given specimen is = _______________***J/mm^2***

EX.NO:7

DATE:

ROCKWELL HARDNESS TEST

AIM:

To study the Rockwell hardness testing machine and perform the Rockwell.

APPARATUS:

1. Rockwell hardness test
2. Diamond cone intender (Apex angle 120^0)
3. Ball indender (Diameter : 1/16th of an inch)
4. Hard steel/ Brass/ Aluminium/ Copper Specimen

PROCEDURE:

1. Clean the test piece and place on the special of machine.
2. Make the specimen surface by removing dust, dirt, oil and grease etc.
3. Make the contact between the specimen surface and the ball by rotating the jack adjusting wheel.
4. Push the required button for loading.
5. Pull the load release lever wait for minimum 15second. The load will automatically apply gradually.
6. Remove the specimen from support table and locate the indentation so made.

B scale ball intender -100kg

C scale diamond intender- 150kg

TABULATION: (ROCKWELL HARDNESS TEST)

SI. NO	Specimen	Specimen scale	Load (Kg)	Intender Type & dial	Dial reading *mm*			Average (HR)
					T1	T2	T3	

RESULT:

Rockwell hardness number

Specimen 1 =______

Specimen 2 =______

Specimen 3 =______

Specimen 4 =______

EX.NO:8

DATE:

BRINELL HARDNESS TEST

AIM:

To study the Brinell hardness testing machine and the given specimen

APPARATUS:

1. Brinell hardness testing machine
2. Steel/ Brass/ Aluminium/Copper Specimen
3. Ball indenter
4. Microscope
5. Vernier Caliper & Emery Paper

SPECIFICATION:

- ❖ Ability to determine hardness up to 500 BHN
- ❖ Diameter of ball d= 2.5mm, 5mm, 10mm.
- ❖ Maximum application of load=3000kgf
- ❖ Method of load application=Lever type
- ❖ Capacity of testing the lower hardness range=1 BHN on application of $0.5D^2$ load.

PROCEDURE:

1. Clean the test piece and place on the special of machine.
2. Make the specimen surface by removing dust, dirt, oil and grease etc.
3. Make the contact between the specimen surface and the ball by rotating the jack adjusting wheel.
4. Push the required button for loading.
5. Pull the load release lever wait for minimum 30second. The load will automatically apply gradually.
6. Remove the specimen from support table and locate the indentation so made.

FORMULA:

Brinell hardness number (BHN) = load/area of indentation of steel ball

$$HB = \frac{2P}{\pi D\left(D - \sqrt{D^2 - d^2}\right)}$$

Where,

P-load applied on the indenter, Kgf

D-Diameter of steel ball indenter, mm.

d- Diameter of ball impression, mm

TABULATION:

Specimen material	Diameter of ball intender ***mm***	Load (P) ***Kgf***	Diameter of ball impression			Average Diameter ***mm***	Brinell hardness number **HB (no unit)**
			d_1 ***mm***	d_2 ***mm***	d_3 ***mm***		

RESULT:

Brinell hardness number of given material

Specimen 1 =______

Specimen 2 =______

Specimen 3 =______

Specimen 4 =______

EX.NO:9

DATE:

DEFLECTION TEST ON BEAM

AIM:

To determine young's modulus of elasticity of material of beam simply supported at ends.

APPARATUS:

1. Deflection of beam apparatus.
2. Pan
3. Weights
4. Beam of different cross section and material(steel beam)

PROCEDURE:

1. Adjust cast iron block the bed so that they are symmetrical with respect to the length of thebed.
2. Place the beam on the knife edges on the block so as to project equally beyond each knifeedge. See that the load is applied at the centre of the beam.
3. Note the initial reading of venire scale.
4. Add a weight of 20 N and again note the reading of venire scale.
5. Find the deflection in each case by subtracting the initial reading of venires caliper

FORMULA:

Bending moment M = $\frac{Wl}{4}$

Bending stress $\sigma_Y = \frac{m\bar{y}}{I}$

Young's modulus of elasticity E= $\frac{wl^3}{48\delta I}$

OBSERVATION: (DEFLECTION TEST ON BEAM)

1. Material of the specimen =____________
2. Length of the specimen =__________mm
3. Breath of the specimen =__________mm
4. Depth of the specimen =__________mm
5. Span of the specimen =__________mm
6. Dial gauge least count =__________mm

TABULATION:

Sl.No	Load (P)		Deflection (δ)	Bending moment (M)	Bending stress (σ_b)	Young's modulus (E)	Stiffness
	Kg	***N***	***mm***	***N-mm***	***N/mm²***	***N/mm²***	***N/mm***

RESULT:

The young's modulus for steel beam is found to be = ______________ ***N/mm²***

The Stiffness for steel beam is found to be =______________________***N/mm***

EX.NO:10

DATE:

COMPRESSION TEST ON SPRING

AIM:

To determine the modulus of rigidity and stiffness of the given compression spring specimen.

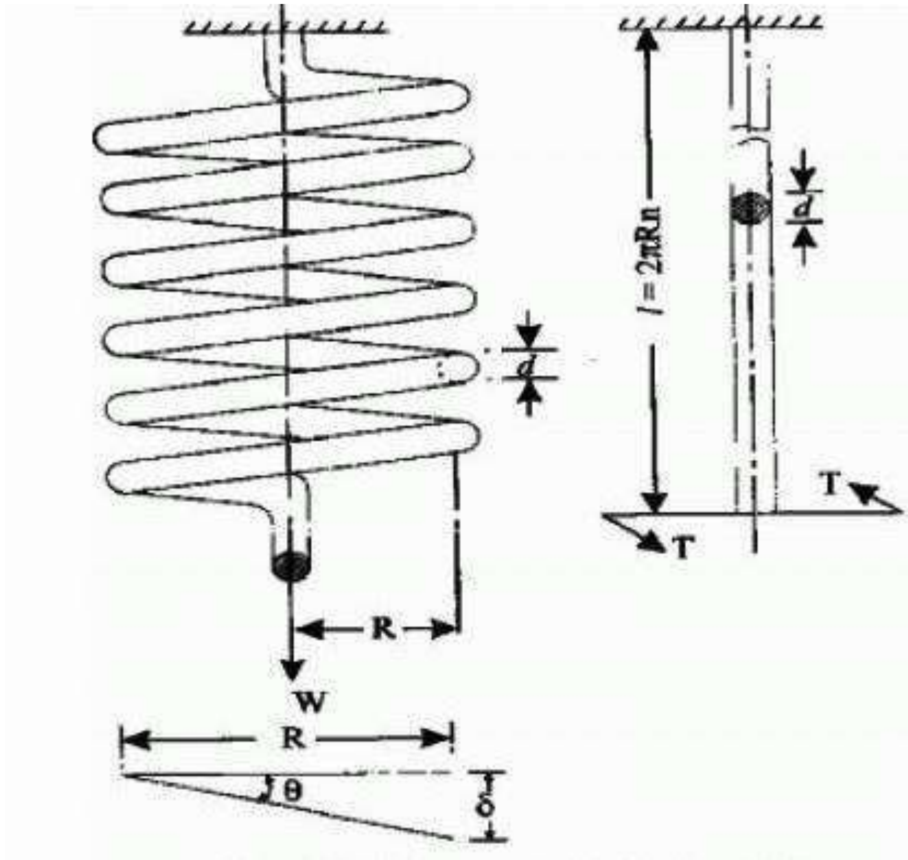
APPARATUS:

1. Spring test machine
2. Compression spring specimen
3. Vernier caliper

PROCEDURE:

1. Measure the outer diameter (D) and diameter of the spring coil for the given compression spring.
2. Count the number of turns. i.e. Coil in the given compression specimen.
3. Place the compression spring at the centre of the bottom beam of the spring testing machine.
4. Rise the bottom beam by rotating right side wheel till the spring top roaches the middle cross beam.
5. Note down the initial reading from the scale in the machine.
6. Apply a load of 25kg and note down the scale reading. Increase the load at the rate of 25kg up to a maximum of 100kg and note down the corresponding scale reading.
7. Find the actual deflection of the spring for each load by deducting the initial scale reading from the corresponding scale reading.

DIAGRAM



OBSERVATION: (COMPRESSION TEST ON SPRING)

Material of the springs specimen	=			
Outer diameter of the springs, D	=	mm		
Diameter of the springs coil, d	=	mm		
Number of coils/turns	=	nos.		
Initial scale reading	=	cm	=	mm

FORMULAE USED:

1. ***Close coil Helical Spring***

$$\delta = \frac{64WR^3n}{Nd^4}$$

2. ***Open coil Helical Spring***

$$\delta = \frac{64WR^3n\sec\alpha}{d^4}\left[\frac{\cos^2\alpha}{N} + \frac{2Sin^2\alpha}{E}\right]$$

3. ***Stiffness, k=*** $\frac{p}{\delta}$

Where,

W or P = load in, N

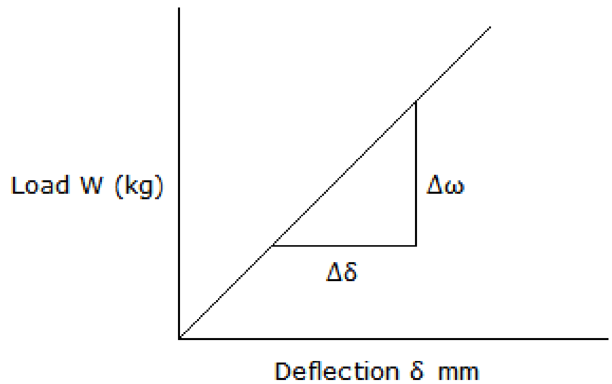
R=mean radius of the spring, mm (D-d/2)

d= diameter of the spring coil, mm

δ=deflection of the spring, mm

D=outer diameter of the springs, mm

GRAPH:



Load - Deflection Graph

TABULATION:

Sl.No	Applied load		Scale reading		Actual deflection	Modulus of elasticity	Stiffness
	Kg	***N***	***cm***	***mm***	***mm***	***N/mm²***	***N/mm***

RESULT:

1. The modulus of rigidity of the given spring =________________ ***N/mm²***
2. The Stiffness of the given spring

Experimental =____________ ***N/mm***

Graphically =____________ ***N/mm***

EX.NO:

DATE:

MAXWELL'S RECIPROCAL THEOREM

AIM:

To verify clerk Maxwell's reciprocal theorem

APPARATUS :

Clerk Maxwell's Reciprocal Theorem apparatus, Weight's, Hanger, Dial Gauge, ScaleVerniar caliper.

THEORY:

Maxwell theorem in its simplest form states that deflection of any point A of any elastic structure due to load P at any point B is same as the deflection of beam due to same load applied at A. It is, therefore easily derived that the deflection curve for a point in a structure is the same as the deflected curve of the structure when unit load is applied at the point for which the influence curve was obtained.

PROCEDURE:

- Apply a load either at the centre of the simply supported span or at the free end of the beam, the deflected form can be obtained.
- Measure the height of the beam at certain distance by means of a dial gauge before and after loading and determine the deflection before and after at each point separately.
- Now move a load along the beam at certain distance and for each positions of the load, the deflection of the point was noted where the load was applied in step1.This deflection should be measured at each such point before and after the loading, separately.
- Plot the graph between deflection as ordinate and position of point on abssica the plot for graph drawn in step2 and 3.These are the influence line ordinates for deflection of the beam.

Observation Table :

Distance from the pinned end	Load at central point/ cantilever end		Deflection of various points (mm) 2-3	Load moving along beam		Deflection of various points (mm) 5-6
	Beam unloaded Dial gauge reading (mm)^{2}	Beam loaded Dial gauge reading (mm)^{3}	Beam unloaded Dial gauge reading (mm)^{5}	Beam unloaded Dial gauge reading (mm)^{5}	Beam loaded Dial gauge reading (mm)^{6}	

Result: - The Maxwell reciprocal theorem is verified experimentally and analytically.

VIVA QUESTIONS

- Modulus of Elasticity for Mild Steel, Copper, Aluminum, Cost Iron etc.
- Examples for Ductile Materials
- Examples for Brittle Materials
- Examples for Malleable Materials .
- Failure of Ductile Material under Tension
- Failure of Brittle Material under Tension.
- Applications of Rockwell Hardness A – Scale, B-Scale, C-Scale.
- Type of Indentor used in the Three Different Scales of Rockwell Hardness Test.
- Different Types of Hardness Testing Methods.
- Size of the Ball to be used in Ball Indentor of Rockwell Hardness Test.
- Diameters of the different Balls used in Brinell Hardness Test.
- Which steel have you tested? What is its carbon content?
- What general information is obtained from tensile test regarding the properties of a material?
- Which stress have you calculated: nominal stress or true stress?
- What kind of fracture has occurred in the tensile specimen and why?
- Which is the most ductile metal? How much is its elongation?
- What is the deflection formula of cantilever beam?
- What is the difference between cantilever and simply supported beam?
- Write types of loads?
- Contra flexure means?
- Types of beams.
- What is deflection?
- Write the equation for the Slope for a cantilever beam with point load

- Write the deflection equation for the simply supported beam with point load at the center
- How many types of bending are there?
- What is torque?
- What is torsion equation?
- What is flexural rigidity?
- Define Section modulus.
- What is meant by stiffness?
- What are different types of springs
- Define helical spring
- What is the strain energy stored in the springs?
- In what way the values of impact energy will be influenced if the impact tests are conducted
- on two specimens, one having smooth surface and the other having scratches on the surface
- What is the effect of temp? On the values of rupture energy and notch impact strength?
- What is resilience? How is it different from proof resilience and toughness?
- What is the necessity of making a notch in impact test specimen?
- If the sharpness of V-notch is more in one specimen than the other, what will be its effect on
- the test result ?
- Does the shear failure in wood occur along the 45° shear plane?
- What is single & double shear?
- What is finding in shear test?
- What is unit of shear strength?
- What is resilience? How is it different from proof resilience and toughness?
- The ability of the material to resist stress without failure is called?
- The impact test is done to test_______of a material?
- In Charpy impact test, the specimen is kept as________________?

- In charpy test specimen, the angle of v-notch section is?
- What is the Maxwell's reciprocal theorem or define the Maxwell's reciprocal theorem?
- What are the purpose of providing dial gauge and magnetic base in the apparatus?
- Maxwell reciprocal theorem in structural analysis can be applied in-

  A. all elastic structures B. plastic structure C. symmetrical structures only D. prismatic element structure only

- What is the difference B/W Maxwell's reciprocal theorem and betties
- Define the following terms

1. Elasticity.	16. Strain Hardening.
2. Plasticity	17. Proof Stress.
3. Rigidity	18. Modulus of Resilience.
4. Ductility	19. Resilience.
5. Toughness	20. Percentage Elongation
6. Brittleness	21. Percentage Reduction in Area
7. Stress.	22. True Stress
8. Strain	23. True Strain
9. Tensile Stress	24. Ultimate Strength
10. Shear Stress	25. Breaking Strength
11. Limit of Proportionality	26. Elastic Constants
12. Elastic Limit	27. Young's Modulus
13. Yield Point	28. Shear Modulus
14. Upper Yield Point	29. Bulk Modulus
15. Lower Yield Point	30. Poissons/Ratio