Kameshwar Narayan Singh Government Polytechnic, Samastipur

Branch – Civil Engg. **Sem – 3rd** **Sub- SOM Lab**



INDEX

S.No	Date	Name of the Activity/Experiment	Grade/ Marks	Faculty Signature

LIST OF EXPERIMENTS:.

1.Direct Tension test
2.Brinell's hardness test
3.Rockwell hardness test
4.Charpy impact test
5.Izod Impact test
6.Torsion test
7.Compression test on spring
8.Tension test on spring
9.Deflection test on simply supported beam
10.Deflection test on Cantilever beam
11.Shear test
12.Compressive Test on Cube

Note: Total 10 Experiments are to be conducted

COURSE OUTCOMES:

1 Analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials.
2 Understand the basic concepts of stress, strain, deformation, and material behavior under different types of loading (axial, torsion, bending).
3 Perform stress analysis and design of beams subjected to bending and shearing loads using several methods.
4 Calculate the stresses and strains in axially-loaded members subject to flexural loadings. **5** Ability to conduct compression tests and Fatigue of cast iron and steel.

CODE OF CONDUCT

1. Students should bring lab Manual/Record for every laboratory session and should enter the readings/observations in the manual while performing the experiment.
2. The group- wise division made in the beginning should be adhered to, and no mix up of students among different groups will be permitted later.
3. The components required pertaining to the experiment should be collected from stores in –charge after duly filling in the requisition form.
4. When the experiment is completed, students should disconnect the setup made by them, and should return all the components/instruments taken for the purpose.
5. Any damage to the apparatus that occurs during the experiment should be brought to the notice of lab in-charge, consequently, the cost of repair or new apparatus should be brought by the students.
6. After completion of the experiment, certification of the concerned staff in –charge in the observation book is necessary.

7. Students should be present in the labs for the total scheduled duration.
8. Students should not carry any food items inside the laboratory.
9. Use of cell phones and IPODs are forbidden.
10. Students should not write on or deface any lab desks, computers, or any equipment provided to them during the experiment.
11. Every student should keep his/her work area properly before leaving the laboratory.

STRENGTH OF MATERIALS LAB CONTENT

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1. DIRECT TENSION TEST

AIM: Determine tensile Strength of a given specimen using UTM.

OBJECT: To conduct a tensile test on a mild steel specimen and determine the following:

(i) Limit of proportionality

(ii) Elastic limit

(iii) Yield strength

(iv) Ultimate strength

(v) Young's modulus of elasticity

(vi) Percentage elongation (vii) Percentage reduction in area.

APPARATUS:

(i) Universal Testing Machine (UTM)

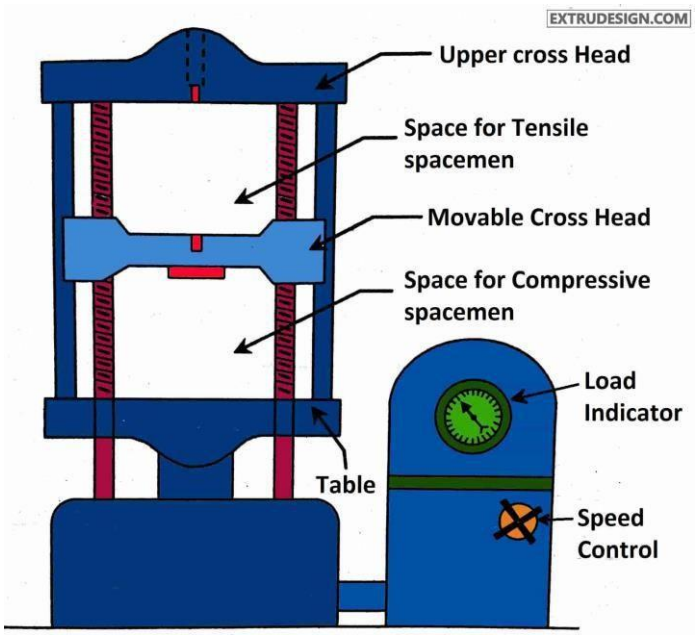
(ii) Mild steel specimens

(iii) Graph paper

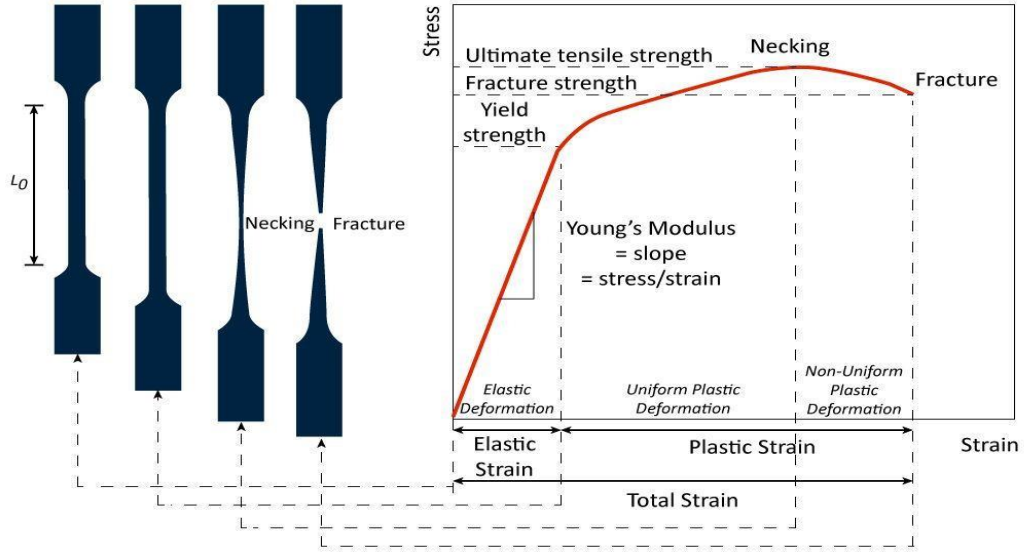
(iv) Scale

(v) Vernier Caliper

DIAGRAM:







THEORY:

The tensile test is most applied one, of all mechanical tests. In this test ends of test piece are fixed into grips connected to a straining device and to a load measuring device. If the applied load is small enough, the deformation of any solid body is entirely elastic. An elastically deformed solid will return to its original form as soon as load is removed. However, if the load is too large, the material can be deformed permanently. The initial part of the tension curve which is recoverable immediately after unloading is termed. As elastic and the rest of the curve which represents the manner in which solid undergoes plastic deformation is termed plastic. The stress below which the deformations essentially entirely elastic is known as the yield strength of material. In some material the onset of plastic deformation is denoted by a sudden drop in load indicating both an upper and a lower yield point. However, some materials do not exhibit a sharp yield point. During plastic deformation, at larger extensions strain hardening cannot compensate for the decrease in section and thus the load passes through a maximum and then begins to decrease. This stage the "ultimate strength"' which is defined as the ratio of the load on the specimen to original cross-sectional area, reaches a maximum value. Further loading will eventually cause 'neck' formation and rupture.

About of UTM

The tensile test is conducted on UTM. It is hydraulically operates a pump, oil in oil sump, load dial indicator and central buttons. The left has upper, middle and lower cross heads i.e; specimen grips (or jaws). Idle cross head can be moved up and down for adjustment. The pipes connecting the lift and right parts are oil pipes through which the pumped oil under pressure flows on left parts to more the cross -heads .

SPECIFICATIONS:

1. Load capacity = 0-40 Tones.
2. Least count = 8kgf
3.Overall dimension = 8kgf
4.Power supply = 440 V

PROCEDURE:

1. Measure the original length and diameter of the specimen. The length may either be length of gauge section which is marked on the specimen with a preset punch or the total length of the specimen 2.

Insert the specimen into grips of the test machine and attach strain-measuring device to it

3. Begin the load application and record load versus elongation data.
4. Take readings more frequently as yield point is approached.
5. Measure elongation values with the help of dividers and a ruler.
6. Continue the test till Fracture occurs.
7. By joining the two broken halves of the specimen together, measure the final length and diameter of specimen.

OBSERVATION:

(a) Initial diameter of specimen = D

(b) Initial gauge length of specimen = L1

(c) Initial cross-section area of specimen= A1

(d) Load of yield point = Y1

(e) Ultimate load after specimen breaking = Y2

(f) Final length after specimen breaking = L2

(g) Diameter of specimen at breaking place = D2

(h) Cross section area at breaking place = A2

OBESERVATION TABLE:

S.No	Load (N)	Original Gauge Length	Extension (mm)	Stress (N/mm2)	Strain

CALCULATION:

Ultimate tensile strength =……. $\frac{N}{mm^2}$

Elastic limit = $\frac{Load\ at\ elastic\ limit}{original\ area\ of\ cros\ s\ section}$ = …… $\frac{N}{mm^2}$

(iii) Modulus of Elasticity (E) = $\frac{stress\ below\ proportional\ limit}{corrsponding\ strain}$ =…… $\frac{N}{mm^2}$

(iv) Yield Strength = $\frac{yield\ load}{original\ cross\ sectional\ area}$ =……. $\frac{N}{mm_2}$

% Reduction in area = = $\frac{A_f - A_i}{A_i} \times 100$ × 100 = ……%

Percentage of elongation = = $\frac{l_i - l_f}{l_f} \times 100$ × 100 =……..%

Limit of Propagation = $\frac{Load\ at\ limit\ of\ proprtionality}{original\ cross\ sectional\ area}$

- Stress = $\sigma = \frac{Load}{Area} = \frac{P}{A}$ …….. $\frac{N}{mm^2}$

- Strain = $\epsilon = \frac{change\ in\ length}{original\ length}$ = ……..

Young's modulus= E = = E = $\frac{strss}{strain}$ ……$\frac{N}{mm^2}$

RESULT:

(i) Average Breaking Stress =

(ii) Ultimate Stress =

(iii) Average % Elongation =

APPLICATIONS:

1.In Aerospace

2.Automotive

3.Packaging

4.Sports

- Wide range of uses for tensile testing:

Aerospace: Turbine blades 

Automotive: Seatbelts/Bumpers/Mudflaps 

Packaging: Ring pulls/tight packaging 

Sport: Racquet strings 

PRECAUTIONS:

1.The specimen should be prepared in proper dimensions.

2.The specimen should be properly to get between the jaws.

3.Take reading carefully.

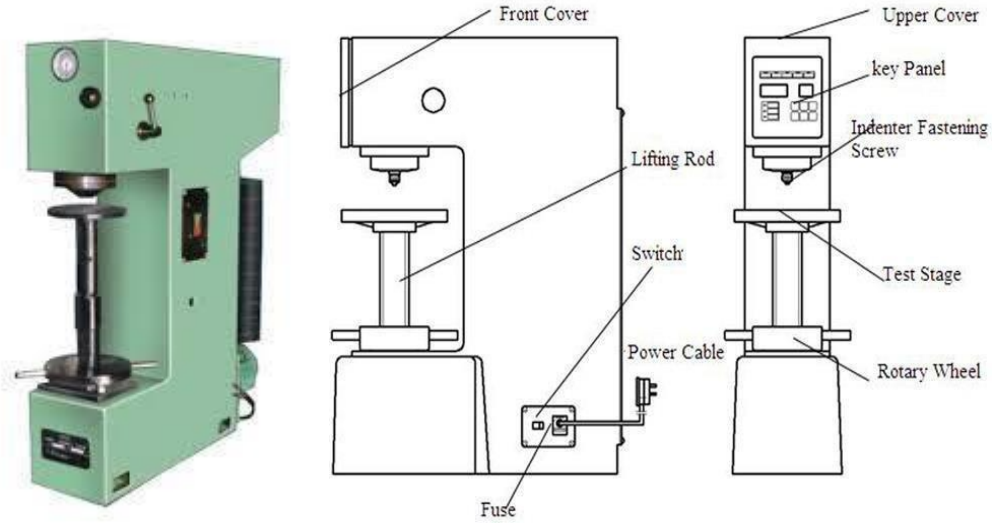
4.After breaking specimen stop to m/c.

2. BRINELL'S HARDNESS TEST

AIM: To determine the hardness of the given specimen using Brinell's hardness test.

APPARATUS: Brinell's hardness testing machine, Aluminum specimen, Ball indenter.

DIAGRAM:



THEORY:

In Brinell's hardness test, a steel ball of diameter (D) is forced under a load (F) on to a surface of test specimen. Mean diameter (d) of indentation is measured after the removal of the load (F).

Its specifications as follows:

1. Ability to determine hardness up to 500BHN.
2. Diameter of ball (as indenter) used D= 2.5mm, 5mm, 10mm.
3. Maximum application load= 3000kgf

.4. Method of load application= Lever type

5. Capability of testing the lower hardness range= 1BHN on application of 0.5D2 load.

PROCEDURE:

1. Insert ball of diameter 'D' in the ball holder of machine.
2. Make the specimen surface clean by oil, grease, dust etc.
3. Make contact between the specimen surface and ball using jack adjusting wheel.
4. Push the required button for loading.
5. Pull the load release level and wait for 15 seconds.

6. Remove the specimen from the support table and locate the Indentation.

7. View the indentation through microscope and measure the diameter 'd' of the indentation using Micrometer fixed on the microscope.
8. Repeat the procedure and take three readings.

OBSERVATIONS TABLE:

S.NO	Ball Diameter D in mm	Load applied F in kgf		Diameter of indentation	P	Remarks

BHN= $\dfrac{Load\ Applied\ (kgf)}{sperical\ surface\ area\ of\ indentation}$

BHN= $\dfrac{2P}{\pi D(D-\sqrt{(D^2-d^2)})}$

PRECAUTION:

1. Make sure that beam and load placed a proper position.
2. The cross- section of the beam should be large.
3. Note down the readings more carefully.

APPLICATIONS:

1. In manufacturing Industries



2. Bearing Manufacturing industries



3. ROCKWELL HARDNESS TEST

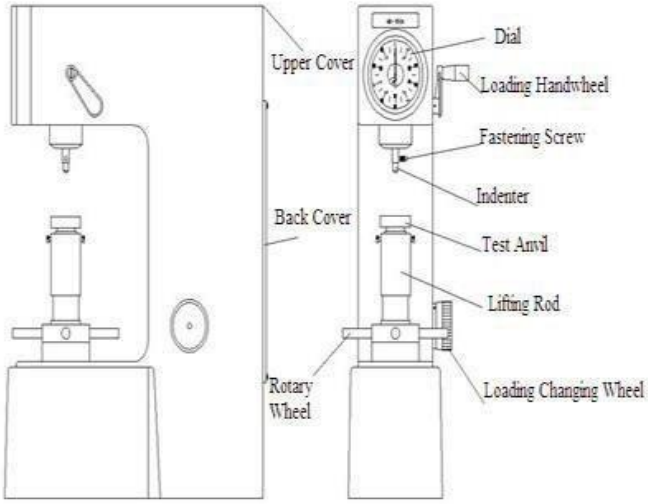
AIM: To determine the hardness of the given Specimen using Rockwell hardness test.

APPARATUS: Rockwell hardness testing machine,

MATERIAL: soft and hard mild steel specimens, brass, Aluminum etc., Black diamond cone indenter.

DIAGRAM:





THEORY:

Rockwell test is developed by the Wilson instrument co U.S.A in 1920. This test is an indentation test used for smaller specimens and harder materials. The test is subject of IS: 1586. The hardness of a material is resistance to penetration under a localized pressure or resistance to abrasion. Hardness tests provide an accurate, rapid and economical way of determining the resistance of materials to deformation. There are three general types of hardness measurements depending upon the manner in which the test is conducted:

a. Scratch hardness measurement,

b. Rebound hardness measurement

c. Indention hardness measurement.

In scratch hardness method the material are rated on their ability to scratch one another and it is usually used by mineralogists only. In rebound hardness measurement, a standard body is usually dropped on to the material surface and the hardness is measured in terms of the height of its rebound .The general means of judging the hardness is measuring the resistance of a material to indentation. The indenters usually a ball cone or pyramid of a material much harder than that being used. Hardened steel, sintered tungsten carbide or diamond indenters are generally used in

PROCEDURE:

1. Examine hardness testing machine (fig.1)
2. Place the specimen on platform of a machine. Using the elevating screw raise the platform and bring the specimen just in contact with the ball. Apply an initial load until the small pointer shows red mark.
3. Release the operating valve to apply additional load. Immediately after the additional load applied, bring back operating valve to its position.
4. Read the position of the pointer on the C scale, which gives the hardness number.
5. Repeat the procedure five times on the specimen selecting different points for indentation.

OBSERVATION TABLE:

S.NO	**Specimens**	**Reading (HRC/)**			**Mean**	
		1	2	3		
1	Mild Steel				HRB =	
2	High Carbon steel				HRC =	
3	Brass				HRB =	
4	Aluminum				HRB =	

PRECAUTIONS:

1. The specimen should be clean properly
2. Take reading more carefully and
3. The test should not be made on specimens so thin that the impression shows through the metal, nor should impression be made too close to the edge of a specimen.

APPLICATIONS:

1. In manufacturing Industries



2. Bearing Manufacturing industries



4. CHARPY IMPACT TEST

AIM: To perform the Charpy impact test on materials.

APPARATUS:

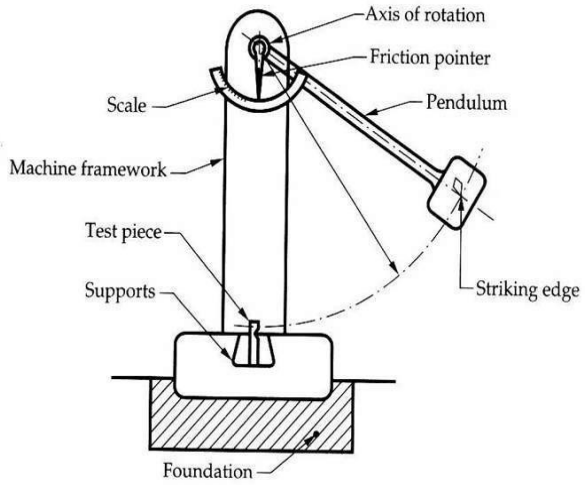
Izod Impact test machine, test specimen, Vernier calipers, and steel rule.

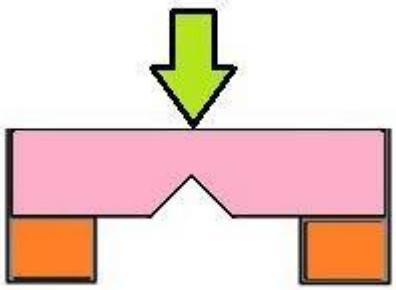
IMPACT STRENGTH:

The resistance of a material to fracture under sudden load Application.

MATERIALS:

Mild steel (Square test pieces)





(b) Charpy Test



THEORY:

An impact test signifies toughness of material that is ability of material to absorb energy during

plastic deformation. The type of test specimen used for this test is a Square Cross-section. The specimen may have single, two or three notches.

The testing machine should have the following specifications.

- The angle 0 between top face of grips and face holding the specimen vertical=90 ^{0}

The angle of tip of hammer =$75^0 \pm 1^0$

- The angle between normal to the specimen and underside face of the hammer at striking point= $10^0 \pm 1^0$

Speed of hammer at impact=3.99 m/sec

Striking energy=168N-m or Joules

Angle of drop 0of pendulum =90

Effective weight of pendulum=21.79kg

Minimum value of scale graduation=2 Joules.

Permissible total friction loss of corresponding energy=0.50%

Distance from the axis of rotation of distance between the base of specimen notch and the point of specimen hit by the hammer=22mm±0.5mm

The longitudinal axes of the test piece shall lie in the plane of swing of the center of gravity of the hammer. The notch shall be positioned so that it is in the plane of the hammer .the notch shall be positioned its plane of symmetry coincides with the top face of the grips .for setting the specimen the notch impact strength I is calculated according to the following relation. Where I= impact strength in joules/m^2

PROCEDURE:

1. For conducting charpy test, a proper striker is to be fitted firmly to the bottom of the hammer with the help of the clamming piece.
2. The latching take for charpy test is to be firmly fitted to the bearing housing at the side of the columns.
3. The frictional loss of the machine can be determined by free fall test, raise the hammer by hands and latch in release the hammer by operating lever the pointer will then indicate the energy loss due to friction. From this reading confirm that the friction loss not exceeding 0.5% of the initial potential energy. Otherwise frictional loss has to be added to the final reading.

4. The specimen for izod test is firmly fitted in the specimen support with the help of clamping screw and élan key. Care should be taken that the notch on the specimen should face to pendulum striker.

5. After ascertaining that there is no person in the range of swinging pendulum, release them pendulum to smash the specimen.

6. Carefully operate the pendulum brake when returning after one swing to stop the oscillations.

7. Read-off position of reading pointer on dial and note indicated value.

8. Remove the broken specimen by loosening the clamping screw.

9. The notch impact strength depends largely on the shape of the specimen and the notch.

10. The values determined with other specimens therefore may not be compared with each other.

TABLE:

S.NO	Area of cross section specimen (A)	Impact Energy (K)	I (Impact strength)

PRECAUTIONS:

1.Measure the dimensions of the specimen carefully.

2.Locate the specimen (Charpy test) in such a way that the hammer. Strikes it at the middle.

3.Note down readings carefully.

RESULT: The Impact strength of material by Charpy test……

APPLICATIONS:

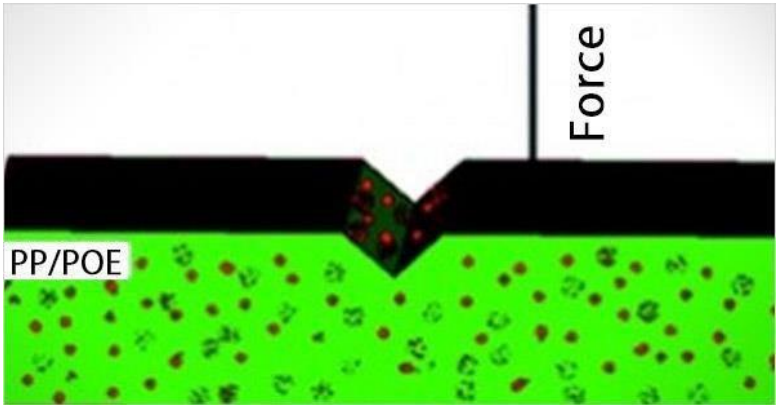
In forging industry:

The Charpy impact test can be used to determine the malleability and ductility of a material that is being forged.



In plastic industry:

The test is used for analyzing the breaking strength of a sample when it is subjected to a high impact from a pendulum. This helps in ensuring that the material is best for an application where it is subjected to such impacts.

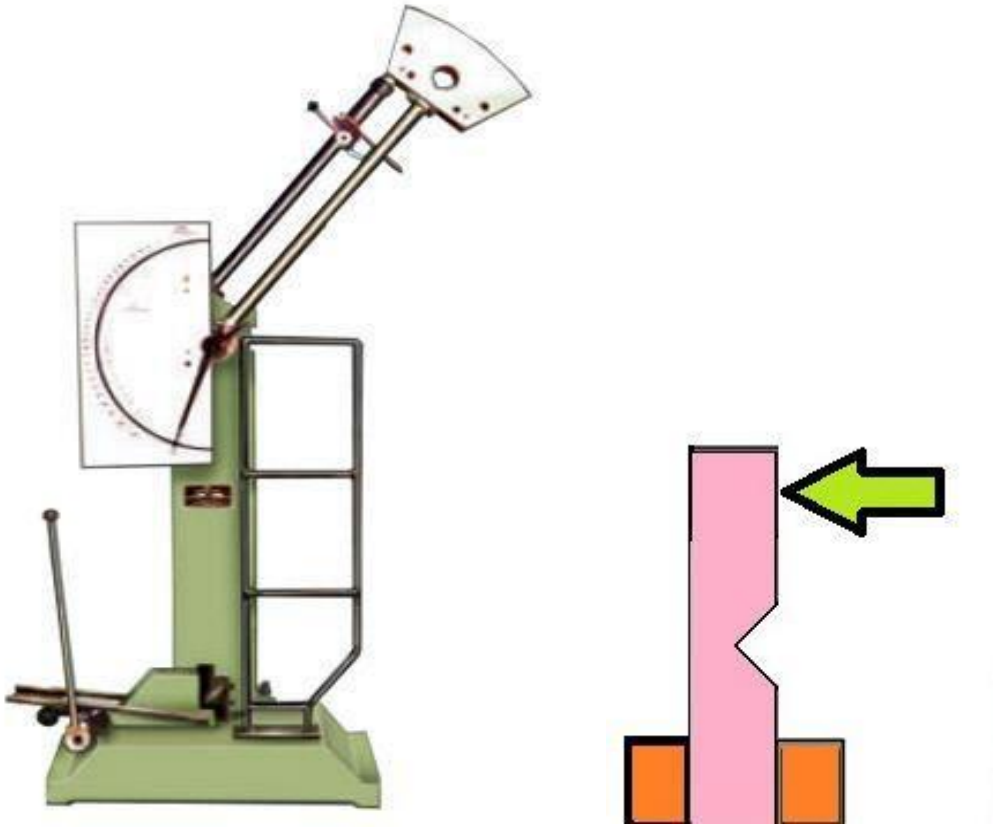


5. IZOD IMPACT TEST

AIM: To determine the Impact strength (Specific impact factor) through Izod test.

APARATUS: Impact testing machine, MS Specimen

DIAGRAM:



PROCEDURE:

1. For conducting charpy test, a proper striker is to be fitted firmly to the bottom of the hammer with the help of the clamming piece.
2. The latching take for charpy test is to be firmly fitted to the bearing housing at the side of the columns.
3. The frictional loss of the machine can be determined by free fall test, raise the hammer by hands and latch in release the hammer by operating lever the pointer will then indicate the energy loss due to friction. From this reading confirm that the friction loss not exceeding 0.5% of the initial potential energy. Otherwise frictional loss has to be added to the final reading.

4. The specimen for izod test is firmly fitted in the specimen support with the help of clamping screw and élan key. Care should be taken that the notch on the specimen should face to pendulum striker.
5. After ascertaining that there is no person in the range of swinging pendulum, release them

pendulum to smash the specimen.

6. Carefully operate the pendulum brake when returning after one swing to stop the oscillations.
7. Read-off position of reading pointer on dial and note indicated value.
8. Remove the broken specimen by loosening the clamping screw.

The notch impact strength depends largely on the shape of the specimen and the notch. the values determined with other specimens therefore may not be compared with each other.

TABLE:

S.NO	Area of cross section specimen (A)	Impact Energy (K)	I (Impact strength)

	Charpy Impact Testing	Izod Impact Testing
Materials Tested	Metals	Plastics & Metals
Types of Notches	U-notch and V-notch	V-notch only
Position of the Specimen	Horizontally, notch facing away from the pendulum	Vertically, notch facing toward the pendulum
Striking Point	Middle of the sample	Upper Tip of the sample
Common Specimen Dimensions	55 x 10 x 10 mm	64 x 12.7 x 3.2 mm (plastic) or 127 x 11.43 mm round bar (metal)
Common Specifications	ASTM E23, ISO 148, or EN 10045-1	ASTM D256, ASTM E23, and ISO 180

PRECAUTIONS:

1. Measure the dimensions of the specimen carefully.

2. Locate the specimen in such a way that the hammer. Strikes it at the middle.
3. Note down readings carefully.

RESULT:

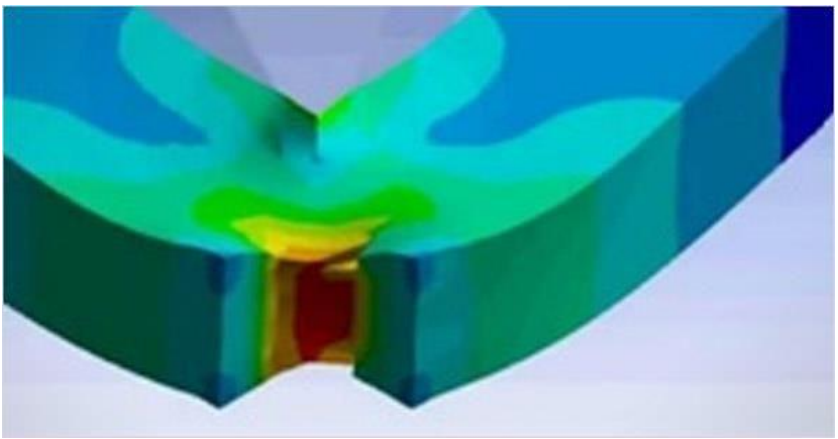
The Impact strength of the given specimen is ---------- $\frac{J}{m_2}$

APPLICATIONS:

1. in forging industry.



2. in the rubber industry.



6. TORSION TEST

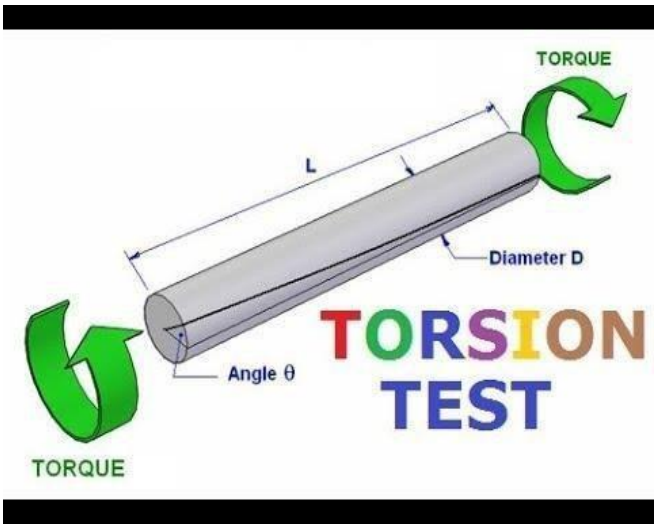
AIM: To conduct torsion test on mild steel specimen to find modulus of rigidity or to find angle of twist of the materials.

APPARATUS:

1. A torsion test machine along with angle of twist measuring attachment.
2. Standard specimen of mild steel or cast iron.
3. Steel rule.
4. Vernier caliper or a micrometer.

DIAGRAM:





THEORY:

For transmitting power through a rotating shaft it is necessary to apply a turning force. The force is applied tangentially and in the plane of transverse cross section. The torque or twisting moment may be calculated by multiplying two opposite turning moments. It is said to be in pure torsion and it will exhibit the tendency of shearing off at every cross section which is perpendicular to the longitudinal axis.

Torsion equation:

$$T/J = \tau/R = G\theta/L$$

- T = Torque
- J = Polar Moment of Inertia
- τ = Shear Stress
- R = Radius
- G = Modulus of Rigidity
- θ = Angle of Twist
- L = Length of Shaf

PROCEDURE:

1. Measure the diameter at about the three places and take average value.
2. Choose the appropriate loading range depending upon specimen.
3. Set the maximum load pointer to zero
4. Carry out straining by rotating the hand wheel or by switching on the motor.
5. Select the suitable grips to suit the size of the specimen and clamp it in the machine by Adjusting sliding jaw.
6. Load the members in suitable increments, observe and record strain reading.
7. Continue till failure of the specimen.
8. Calculate the modulus of rigidity C by using the torsion equation.
9. Plot the torque –twist graph (T vs θ)

OBSERVATIONS TABLE :

No g	Twisting Moment gf-m	Twisting Moment mm	Angle of Twist egrees)	Twist (Radians)	Modulus of rigidity (C)	Average

RESULT:

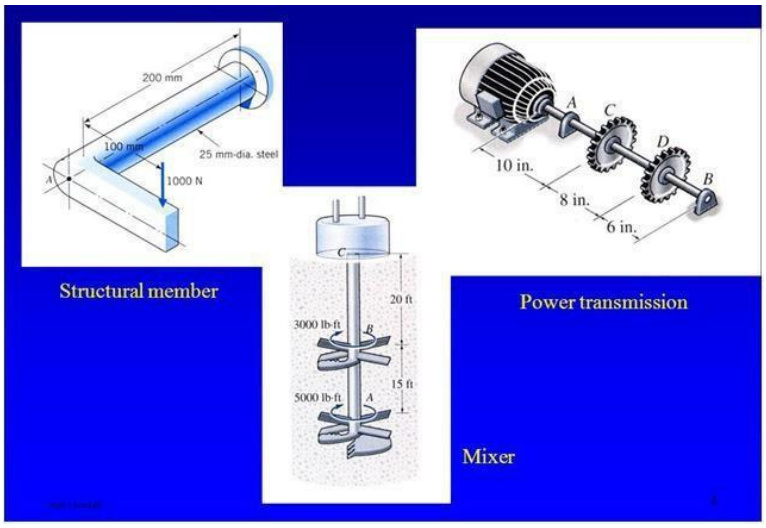
The modulus of rigidity of the given test specimen material is

APPLICATIONS:

1.Structural members

2.Powertransmission of shafts

3.Mixer



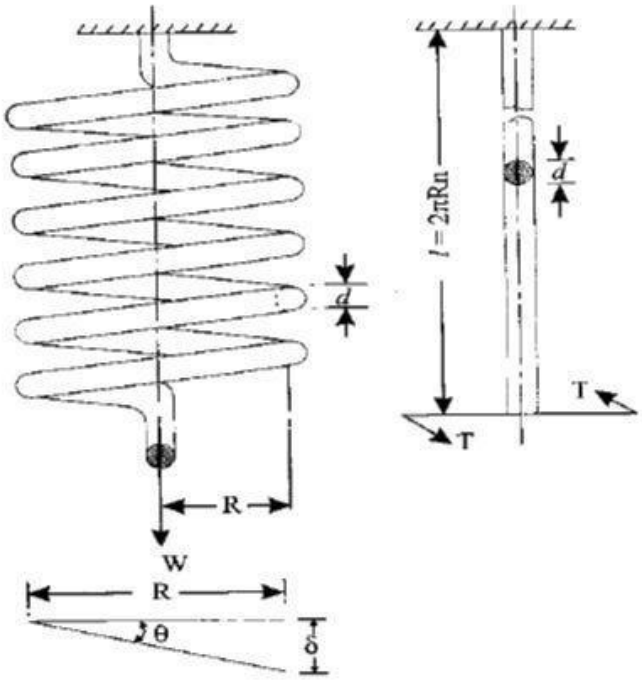
7. COMPRESSION TEST ON SPRING

AIM: Determine the stiffness of the spring and modulus of rigidity of the spring wire

APPARATUS:

i) Spring testing machine.
ii) A spring iii) Vernier caliper, iv) Scale.
v) Micrometer.

DIAGRAM:



Close-coiled helical spring.

THEORY:

Springs are elastic member which distort under load and regain their original shape when load is removed. They are used in railway carriages, motor cars, scooters, motorcycles, rickshaws, Governors etc. According to their uses the springs perform the following Functions:

1) To absorb shock or impact loading as in carriage springs.
2) To store energy as in clock springs.
3) To apply forces to and to control motions as in brakes and clutches.
4) To measure forces as in spring balances.

5) To change the variations characteristic of a member as in flexible mounting of motors.

The spring is usually made of either high carbon steel (0.7 to 1.0%) or medium carbon alloy steels.

Phosphor bronze, brass, 18/8 stainless steel and Monel and other metal alloys are used for

Corrosion resistance spring. Several types of spring are available for different application. Springs may classify as helical springs, leaf springs and flat spring depending upon their shape. They are fabricated of high shear strength materials such as high carbon alloy steels spring form elements of not only mechanical system but also structural system. In several cases it is essential to idealize Complex structural systems by suitable spring.

PROCEDURE:

1) Measure the diameter of the wire of the spring by using the micrometer.
2) Measure the diameter of spring coils by using the vernier caliper 3) Count the number of turns.
4) Insert the spring in the spring testing machine and load the spring by a suitable weight and note the corresponding axial deflection in compression.
5) Increase the load and take the corresponding axial deflection readings.
6) Plot a curve between load and deflection. The shape of the curve gives the stiffness of the Spring.

OBESERVATION

Least count of micrometer = ……mm

Diameter of the spring wire, d =…… mm (Mean of three readings)

Least count of vernier caliper = ……mm

Diameter of the spring coil, D = ……mm (Mean of three readings)

Mean coil diameter, Dm = D – d …… mm

Number of turns, n =……

TABLE:

=

No	Weight (in N)	deflection (δ) mm	stiffness $K=^{W}$	Modulus of rigidity(C)

PRECAUTIONS:

1) The dimension of spring was measured accurately.
2)Deflection obtained in spring was measured accurately.

ADVANTAGES:

1. To apply forces and to control motions as in brakes and clutches.
2. To store energy as in clock springs.
3. This test is conducted to find the material properties of the spring like modulus of rigidity. This can be obtained by observing the values of deflections of the spring with the application of

Different amounts of the load applied along the axis of the spring. The observed Values of Deflections are compared with the theoretical value for the deflection of the spring under the load and shear modulus is to be obtained.

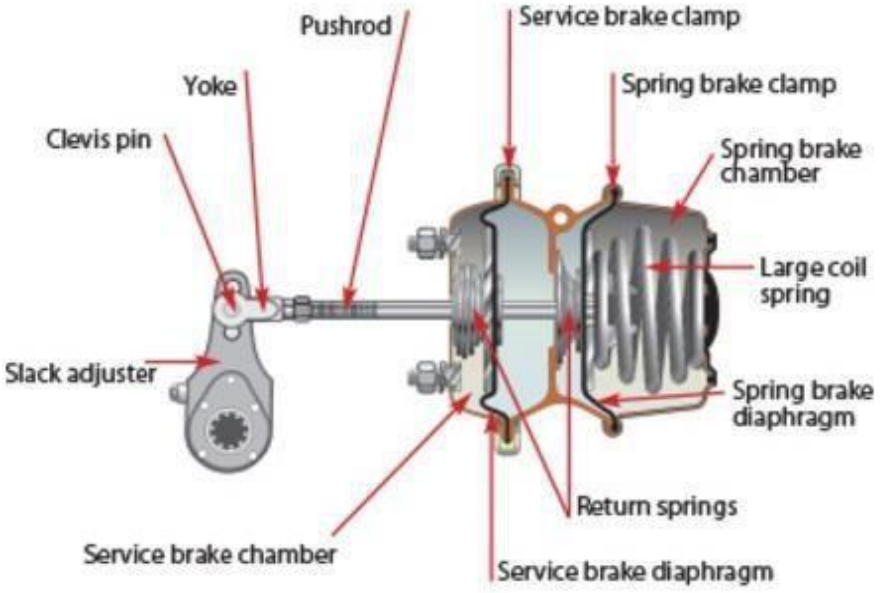
4. To reduce the effect of shock or impact loading as in carriage springs

RESULT:

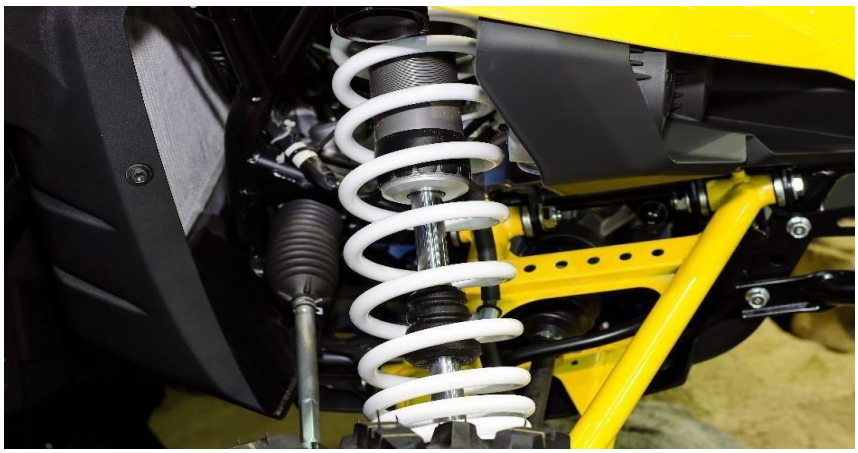
The value of spring constant k of closely coiled helical spring is found to be_____ N/ mm

APPLICATIONS:

1. To apply forces and controlling motion, as in brakes and clutches.



2. Used in suspension system



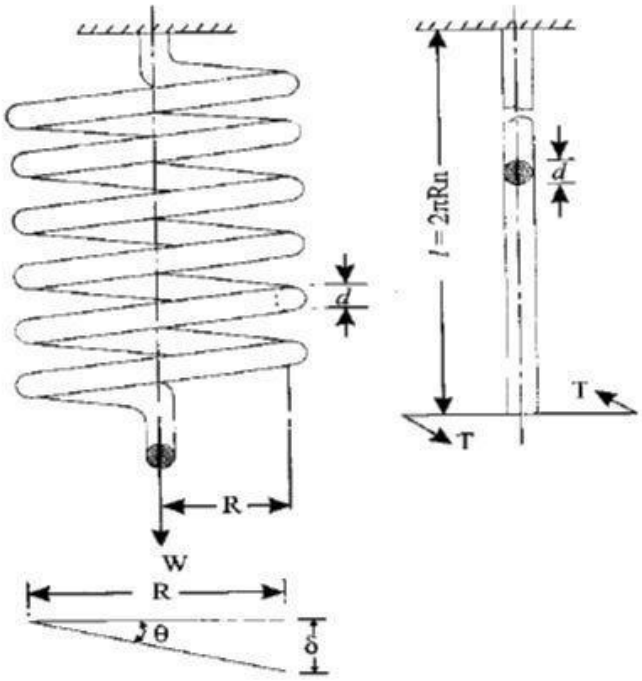
8. TENSION TEST ON SPRING

AIM: Determine the stiffness of the spring and modulus of rigidity of the spring wire

APPARATUS:

i) Spring testing machine.
ii) A spring
iii) Vernier caliper,
iv) Scale.
v) Micrometer.

DIAGRAM:



Close-coiled helical spring.

THEORY:

Springs are elastic member which distort under load and regain their original shape when load is removed. They are used in railway carriages, motor cars, scooters, motorcycles, rickshaws, Governors etc. According to their uses the springs perform the following Functions:

1) To absorb shock or impact loading as in carriage springs.
2) To store energy as in clock springs.

3) To apply forces to and to control motions as in brakes and clutches.

To measure forces as in spring balances.
5) To change the variations characteristic of a member as in flexible mounting of motors.

The spring is usually made of either high carbon steel (0.7 to 1.0%) or medium carbon alloy steels.

Phosphor bronze, brass, 18/8 stainless steel and Monel and other metal alloys are used for

Corrosion resistance spring. Several types of spring are available for different application. Springs may classify as helical springs, leaf springs and flat spring depending upon their shape. They are fabricated of high shear strength materials such as high carbon alloy steels spring form elements of not only mechanical system but also structural system. In several cases it is essential to idealize Complex structural systems by suitable spring.

PROCEDURE:

1) Measure the diameter of the wire of the spring by using the micrometer.
2) Measure the diameter of spring coils by using the vernier caliper 3) Count the number of turns.
4) Insert the spring in the spring testing machine and load the spring by a suitable weight and note the corresponding axial deflection in tension
5) Increase the load and take the corresponding axial deflection readings.
6) Plot a curve between load and deflection. The shape of the curve gives the stiffness of the Spring.

OBESERVATION

Least count of micrometer = ……mm

Diameter of the spring wire, d =…… mm (Mean of three readings)

Least count of vernier caliper = ……mm

Diameter of the spring coil, D = ……mm (Mean of three readings)

Mean coil diameter, Dm = D – d … mm

Number of turns, n =……

=

…

…

TABLE:

No	Weight (in N)	deflection (δ) mm	stiffness	Modulus of Rigidity

PRECAUTIONS:

1) The dimension of spring was measured accurately.
2) Deflection obtained in spring was measured accurately

ADVANTAGES:

1. To apply forces and to control motions as in brakes and clutches.
2. To store energy as in clock springs.
3. This test is conducted to find the material properties of the spring like modulus of rigidity. This can be obtained by observing the values of deflections of the spring with the application of Different amounts of the load applied along the axis of the spring. The observed Values of deflections are compared with the theoretical value for the deflection of the spring under the load and shear modulus is to be obtained.
4. To reduce the effect of shock or impact loading as in carriage springs

RESULT:

The value of spring constant k of closely coiled helical spring is found to be_____ N/ mm

APPLICATIONS:

1. To apply forces and controlling motion, as in brakes and clutches.

9. DEFLECTION TEST ON SIMPLY SUPPORTED BEAM

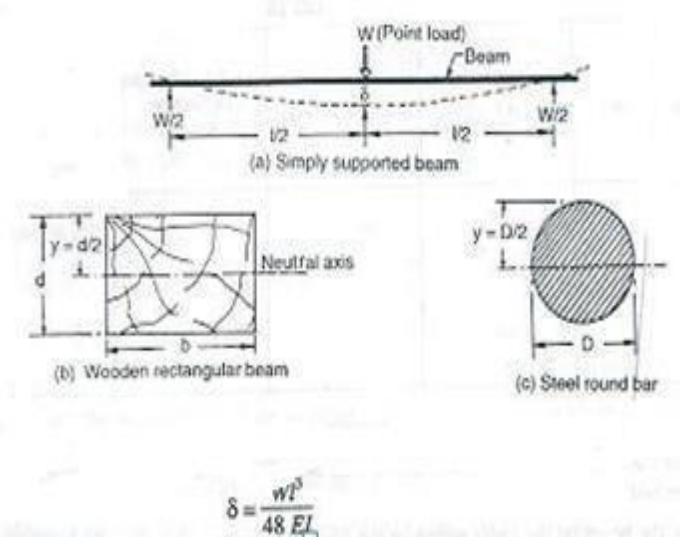
AIM: Determine the deflection and bending stress of simply supported subjected to concentrated load at the center.

APPARATUS:

Beam apparatus, Bending fixture, vernier caliper, meter rod, test piece & dial gauge.

DIAGRAM:





$$\delta = \frac{wl^3}{48\,EI}$$

THEORY:

Bending test is performing on beam by using the three point loading system. The bending fixture is supported on the platform of hydraulic cylinder of the UTM. The loading is held in the middle cross head. At a particular load the deflection at the center of the beam is determined by using a dial gauge.

The deflection at the beam center is given by:

$$\delta = WL_3 / 48EI$$

PROCEDURE:

1. Measure the length, width and thickness of test piece, by vernier caliper.
2. Place the bending fixture on the lower cross head of the testing machine.
3. Place the test piece on the rollers of the bending fixture.
4. By loading the dial gauge in a stand, make its spindle knob the test piece.
5. Start the m/c and note down the load and dial gauge readings.
6. Plot the graph between load and deflection.

OBSERVATIONS:

1. Least count of vernier caliper = -----
2. Length of beam (L) = ------
3. Width of beam (b) = ------
4. Thickness of beam (t) = ------

TABLE:

S.No	Load 'W' in N	Deflection 'δ' in mm.	Young's Modulus 'E'(N /mm^2)

CALCULATIONS:

1. $I=\frac{b\,t^3}{12}$
2. $\delta=\frac{WL^3}{48EI}$

PRECAUTIONS:

1. The length of the simply supported should be measured properly.
2. The dial gauge spindle knob should always touch the beam at the bottom of loading point.
3. Loading hanger should be placed at known distance
4. Al the errors should be eliminated while taking readings.
5. Beam should be positioned horizontally.

RESULT:

The Bending strength of given specimen = -------N/mm^2

APPLICATIONS:

1. for construction of bridges



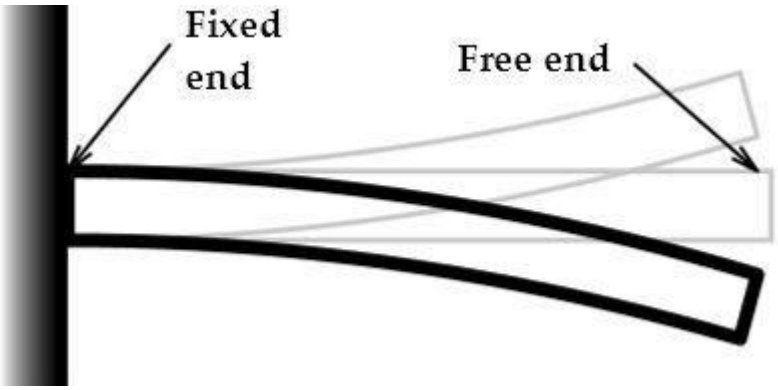
10. DEFLECTION TEST ON CANTILEVER BEAM

AIM: Determine the deflection and bending stress of cantilever beam.

APPARATUS:

Beam apparatus, Bending fixture, vernier caliper, meter rod, test piece & dial gauge.

DIAGRAM:



THEORY:

A Cantilever is a Beam one end of which is clamped and other end is free. A beam with a length L and is fixed at one end and the other end is free. Let the moment of inertia of the Beam is 'I' about its neutral axis and the Young's Modulus be 'E'.

Moment of inertia about the neutral axis

$$I = bh^3/12$$

Deflection at the end where point load is acting = δ

The deflection at the end (Max deflection) δ is related to the load 'W', length 'L' moment of Inertia 'I' and Young's Modulus 'E' through the equation.

$$\delta = \frac{WL^3}{3EI}$$

PROCEDURE:

1. Clamp the Beam horizontally on the clamping support at one end.
2. Measure the length of cantilever L (distance from clamp end to loading point)
3. Fix the dial gauge under the beam at the loading point to Read down-ward Moment and set o zero.

4. Hang the loading Pan at the free end of the cantilever.

5. Load the cantilever with different loads (W) and note the dial gauge readings (δ)

6. Change the length of cantilever for two more different lengths repeat the Experiment.

7. Change the position of cantilever and repeat he experiment for the other value of I for rectangular cross-section

OBSERVATION TABLE:

S.No	**Load 'W' in N**	**Deflection 'δ' in mm.**	**Young's Modulus 'E'(N/mm^2)**

CALCULATIONS:

1. $\mathbf{I}=b\,h^3/12$
2. $\boldsymbol{\delta}=WL^3/EI$

PRECAUTIONS:

1. The length of the cantilever should be measured properly.
2. The dial gauge spindle knob should always touch the beam at the bottom of loading point.
3. Loading hanger should be placed at known distance of cantilever length.
4. Al the errors should be eliminated while taking readings.
5. Elastic limit of the Beam should not exceed.
6. Beam should be positioned horizontally.

RESULT:

The Bending strength of given specimen = --------N/mm^2

APPLICATIONS:

1.In aircraft



2.Cantilever Cranes



11. SHEAR TEST

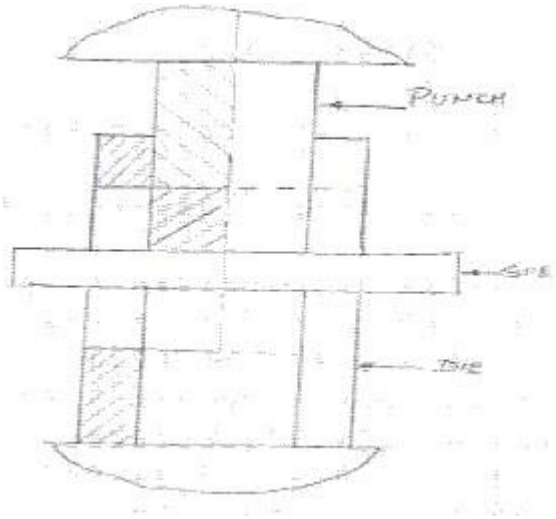
AIM: Find out the Shear strength of a given specimen using UTM.

APPARATUS: A UTM, Specimen, shearing attachment, vernier caliper etc.

THEORY: A type of force which causes or tends to cause two contiguous parts of the body to slide relative to each other in a direction parallel to their plane of contact is called the shear force The stress required to produce fracture in the plane of cross-section, acted on by the shear force is Called shear strength.

DIAGRAM:





PROCEDURE:

1. Insert the specimen in position and grip one end of the attachment in the upper portion and one end in the lower position
2. Switch on the UTM
3. Bring the drag indicator in contact with the main indicator.
4. Select the suitable range of loads and space the corresponding weight in the Pendulum and balance it if necessary with the help of small balancing weights
5. Operate (push) the button for driving the motor to drive the pump.
6. Gradually move the head control ever in left hand direction till the specimen shears.

7. Note down the load at which the specimen shears.
8. Stop the machine and remove the specimen.
9. Repeat the experiment with other specimens.

OBSERVATION:

1. Applied compressive force (F) = ---------kgf.
2. Diameter of specimen = -------mm.

3. Cross sectional area of the pin (in double shear) = $2\times\pi\times d^2/4$ mm^2
4. Load taken by the specimen at the time of failure, W = …… (N)
5. Strength of the pin against shearing (τ) = 4xW

PRECAUTIONS:

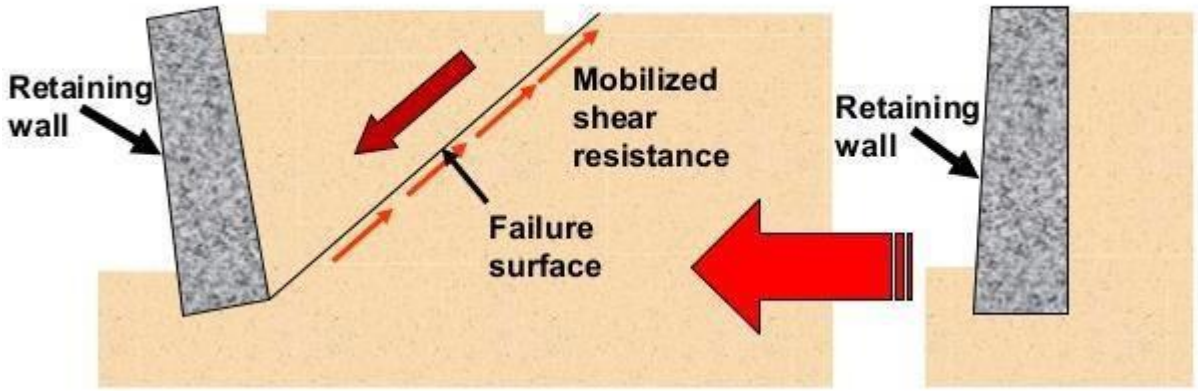
1. The measuring range should not be changed at any stage during the test.
2. The inner diameter of the hole in the shear stress attachment should be slightly greater than the specimen.
3. Measure the diameter of the specimen accurately.
4. The method for determining the shear strength consists of subjecting a suitable Length of steel specimen in full cross-section to double shear, using a suitable test rig, in a testing m/c under a compressive load or tensile pull and recording the maximum load 'F' to fracture.

RESULT:

Shear strength of specimen = --------

APPLICATIONS:

1.Shear failures of soils


Retaining wall
Mobilized shear resistance
Failure surface
Retaining wall

12. COMPRESSIVE TEST ON CUBE

AIM: To study the behavior of the given material under Compressive load and to following

Modulus of elasticity Maximum Compressive strength or ultimate stress

Percentage Decrease in length Percentage Increase in area

APPARATUS:

Universal Testing machine, Dial gauge, Vernier caliper and scale.

MATERIAL: Wood

THEORY:

Ductile materials attain a Bulge or a Barrel shape after reaching the maximum compression load. No fracture takes place and there is change in cross-section and compression value remains the same on reaching the maximum load as shown in the fig.1. For brittle Materials, there will be no change in the cross-sections or height of the specimen due to the compression load. On reaching the maximum compression load, the specimen suddenly fractures as shown in the Fig2

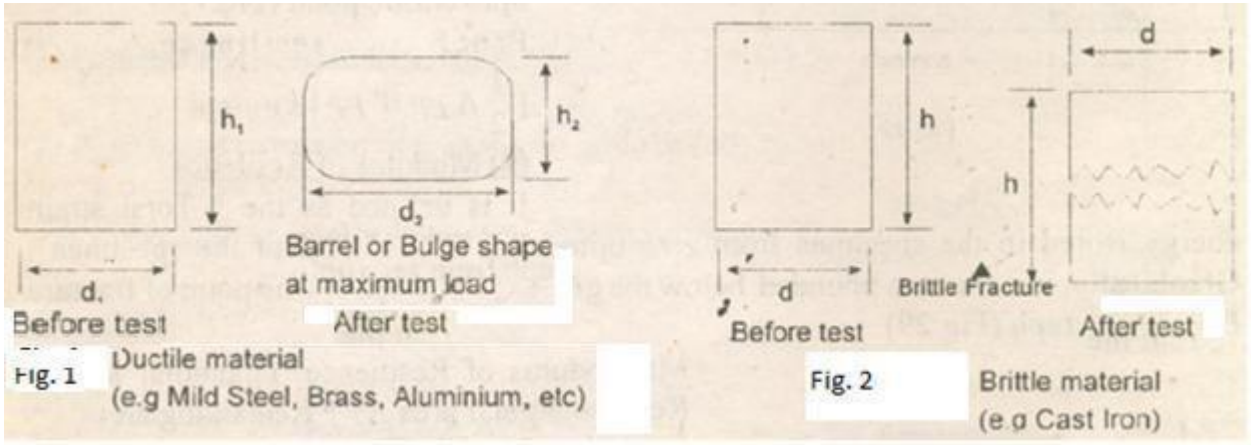
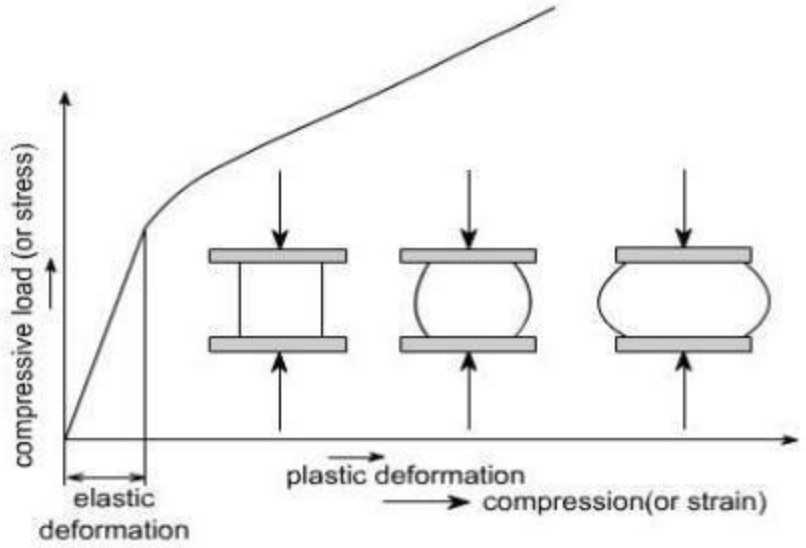


Fig. 1 Fig. 2

The compression test is just opposite to tension test, with regard to direction. However, there are certain practical difficulties which may induce error in this test. They are

Difficulty in applying truly axial load. There is always a tendency of the specimen to bend in addition to Contraction.

To avoid these errors, usually the specimen for this test shall be short in length (not more than 2 time the diameter) In a compression test, stress – strain curve is drawn up to the elastic limit of
Proportionality. Metals have approximately the same modulus of elasticity as in tension test. The curve, for ductile materials, continues almost without limit as there is no fracture of the material due to its ductility and cross sectional area increases continuously with increase in load. The specimen will shorten and bulge out. Compression test is mainly used for testing brittle
materials such as cast iron, concrete etc. Brittle materials commonly fail along a diagonal plane due to shearing.



Procedure:

1. The original dimensions of the specimen like original dia., gauge length etc.
2. The specimen is mounted on the Universal Testing machine between the fixed and movable jaws.
3. The load range in the machine is adjusted to its maximum capacity (300 kN)
4. The dial gauge is mounted on the machine at the appropriate positions and adjusted to zero.
5. The machine is switched on and the compressive load is applied gradually.
6. For every 10 kN of load, the readings of dial gauge is noted and tabulated.
7. Remove the dial gauge at slightly below the expected load at yield point.
8. Record the load at yield point, at the yield point the pointer on load scale will remain stationary for small interval of time and blue needle will come back by 1 or 2 divisions that point is lower yield point.

9. The specimen is loaded continuously up to the ultimate load (red needle will stops)which is to be noted.

10. The specimen is removed and final dimensions are measured.

OBSERVATION TABLE :

S.No	Load (P) in N	Area (A) mm^2	Stress (P /A)	E = Stress/Strain

CALCULATIONS:

Stress = σ = $Load/\ Area = P/\ A$…….N/mm^2

Strain = ϵ = $change\ in\ length\ /original\ length$ = …….. mm

Young's modulus= E = $stress/strain$ ……N/mm^2

% Decrease in Length = $l_i - l/lf \times$ 100=……..%

% Increase in area = $A_f - A_i/Ai \times$ 100=……%

Ultimate Compressive strength =……. N/mm^2

RESULTS:

1. Modulus of elasticity = E =……N/mm^2
2. Maximum Compressive strength or ultimate stress = …… N/mm^2

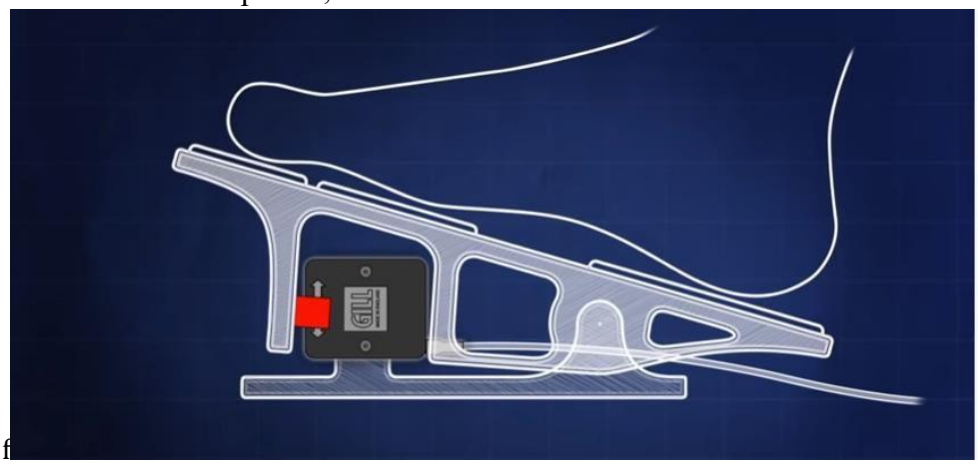
3. Percentage Decrease in length =……..%

4.Percentage Increase in area =……. %

APPLICATIONS:

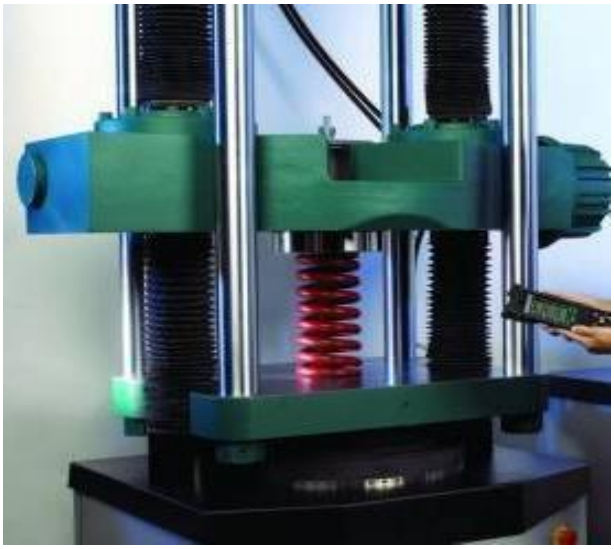
Applications of compression testing in the aerospace and automotive industry include:

Actuation tests on pedals, switches and solenoids



f

Spring testing

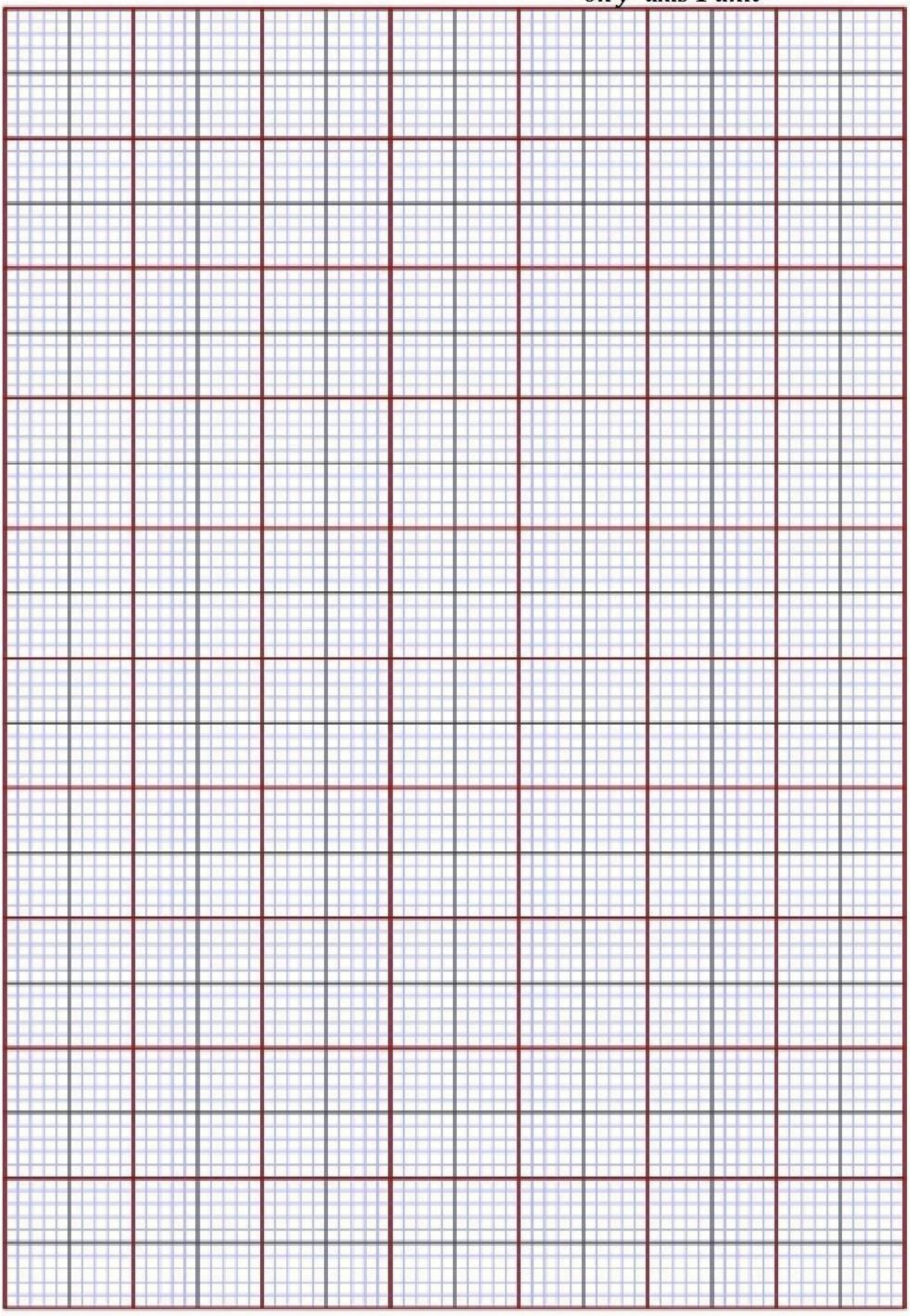


GRAPH

NAME OF THE EXPERIMENT: .....

on x-axis 1 unit =

on y- axis 1 unit =



GRAPH

NAME OF THE EXPERIMENT: .....

on x-axis 1 unit =

on y- axis 1 unit =

