SHRI VAISHNAV INSTITUTE OF TECHNOLOGY AND SCIENCE
MECHANICAL ENGINEERING DEPARTMENT
STRENGTH & MECHANICS OF MATERIAL LABORATORY

SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE			
DEPARTMENT OF MECHANICAL ENGINEERING	**Number of experiment**		**Page No : … /**
	Code : DTME 303	**NO :**	**Roll No. : ……………………**

Sub Code :ME 303	Sub Name : STRENGTH & MECHANICS OF MATERIAL			Experiment NO. 01
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EXPERIMENT: 1

AIM

To determine the Tensile Strength of Specimen.

APPARATUS

01. Universal testing machine (fig1.a)
02. Specimen as shown in the(fig1.b) Of different ferrous and non ferrous materials.

Study Group : STRENGTH & MECHANICS OF MATERIAL	Code Of experiment : SOM 01
Created By : S. Pipleya	Modified by : **Sunil Pipleya**
Date of Creation : 20/01/2015	Approved by:

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DEPARTMENT OF MECHANICAL ENGINEERING	Number of experiment		Page No : … /
	Code : DTME 303	NO :	Roll No. : ……………………

Figure. 1a

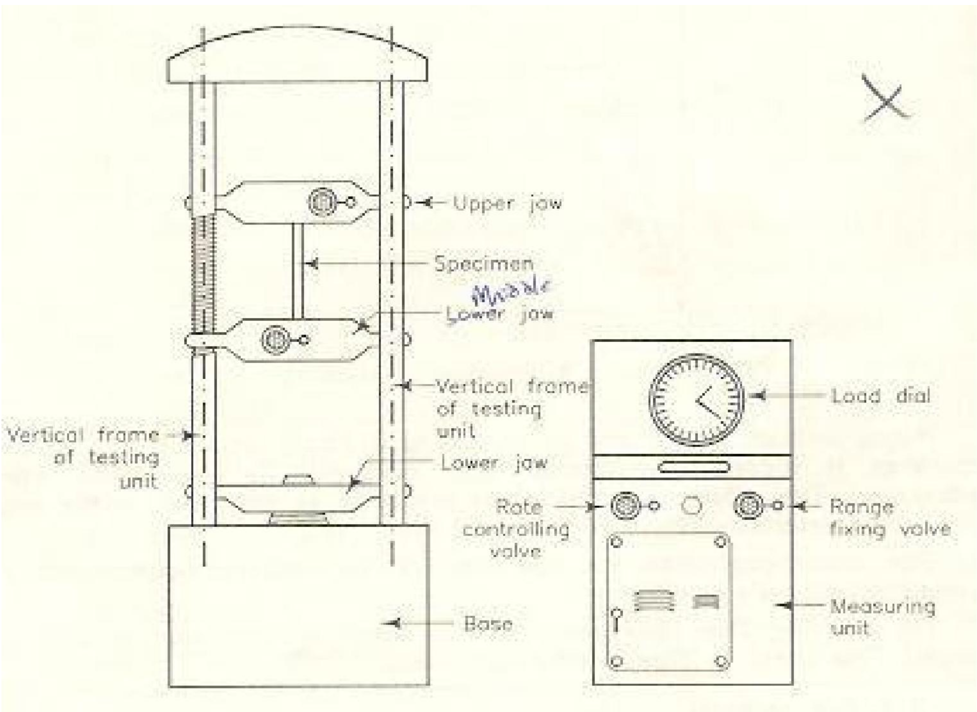
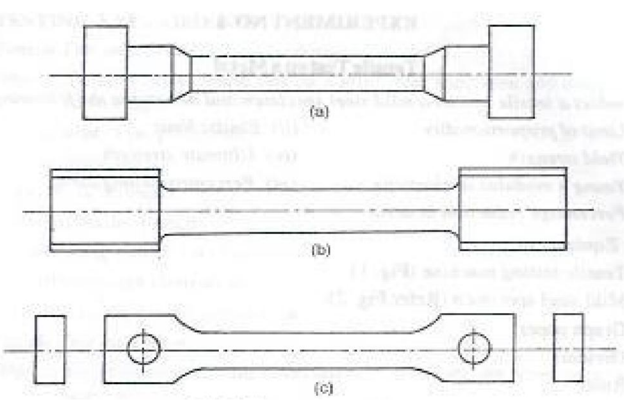


Figure.1b



THOERY

Various m/c and structure components are subjected to tensile loading in numerous application. For safe design of these components, there ultimate tensile strength and ductility one to be determine before actual use. Tensile test can be conducted on UTM. A material when subjected to a tensile load resists the applied load by developing internal resisting force. These resistances come due to atomic bonding between atoms of the material. The resisting force for unit normal cross-section area is known as stress. The value of stress in material goes on increasing with an increase in applied tensile load, but it has a certain maximum (finite) limit too. The minimum stress, at which a material fails, is called ultimate tensile strength. The end of elastic limit is indicated by the yield point (load). This can be seen during experiment as explained later in procedure with increase in loading beyond elastic limit original cross-section area (A_1) goes on decreasing and finally reduces to its minimum value when the specimen breaks.

SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE			
DEPARTMENT OF MECHANICAL ENGINEERING	Number of experiment		Page No : … /
	Code : DTME 303	NO :	Roll No. : ……………………

The tensile test provides information on the strength of a material under uniaxial tensile stress. It can be used to obtain the stress-strain curve of a material that will show the relationship between the stress and strain of that material as shown in Figure 1.

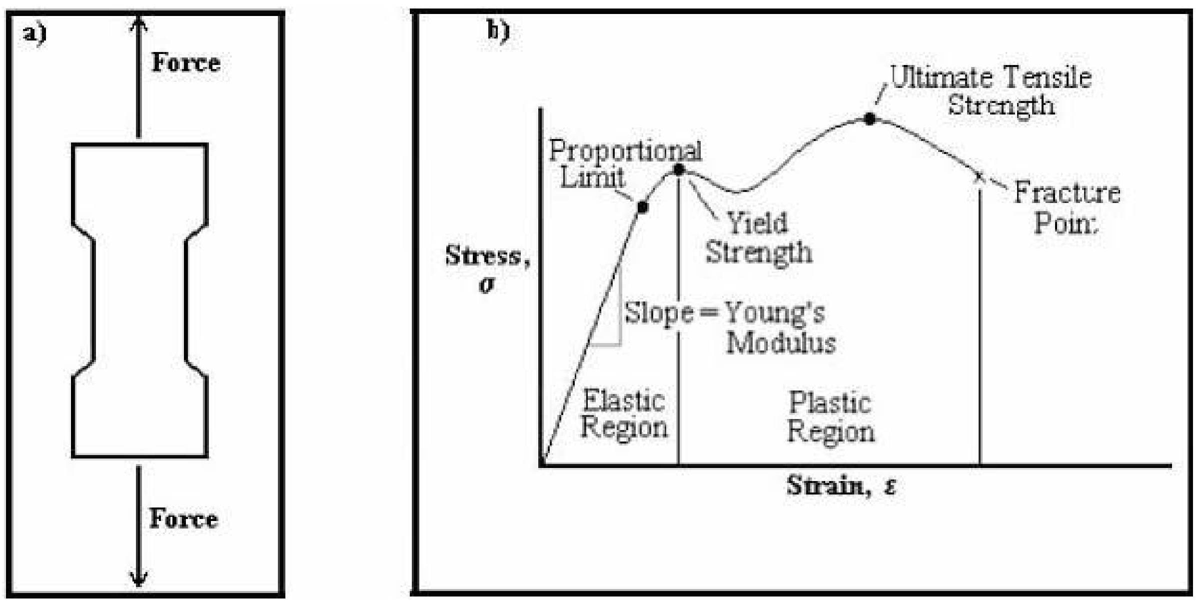


***Figure:* 1.1** *(a) Tensile test specimen and (b) A typical stress- strain curve for a ductile material*

From the stress-strain curve, various mechanical properties of the material, such as Young's Modulus (Modulus of Elasticity), Yield Strength, and the Ultimate Tensile Strength, can be determined.

1. Young's Modulus (Modulus of Elasticity): In the region on the stress-strain curve where the stress changes linearly with the strain, the Young’s modulus (Modulus of elasticity, E) is defined as the ratio of stress and strain. Value of the Young’s modulus is a constant for a given material.

2. Yield point: Yield point is a point on the stress-strain curve, after which there is a significant increase in strain with little or no increase in stress. The corresponding stress is called the Yield Strength of that material.

3. Proportional limit: Proportional limit is the value of stress on the stress-strain curve at which the curve first deviates from a straight line.

4. Elastic Limit: Elastic limit is the value of stress on the stress-strain curve after which the material deforms plastically that is, it will no longer return to its original size and shape after unloading it.

5. Ultimate tensile strength: Ultimate tensile strength is the highest value of apparent stress on the stress-strain curve.

6. Elastic Deformation: A material under loading is said to have undergone elastic deformation if it reverts back to its original shape and size upon unloading it.

7. Plastic Deformation: A material under loading is said to have undergone plastic deformation if it is permanently deformed upon unloading it.

Experiment:

A tensile testing machine applies a controlled load on a specimen slowly and steadily, stretching the specimen until it fractures. Fig 1.2 shows Universal Testing Machine. The user specifies test parameters such as type of test, units, preload, crosshead speed, and extensometer. The computer controls most of the testing process, including recording the applied load, strain and generating the stress-strain curve.

Students are required to perform tensile tests for two different materials (brittle and ductile), and then use the stress-strain data to calculate the material properties for each material. The calculated values should then be compared with published material properties. The two different materials used are brass and steel. Cast Iron (and Brass) is a brittle material where as Mild Steel is a ductile material.

SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE			
DEPARTMENT OF MECHANICAL ENGINEERING	**Number of experiment**		**Page No : … /**
	Code : DTME 303	**NO :**	**Roll No. : ……………………**

Equipment:

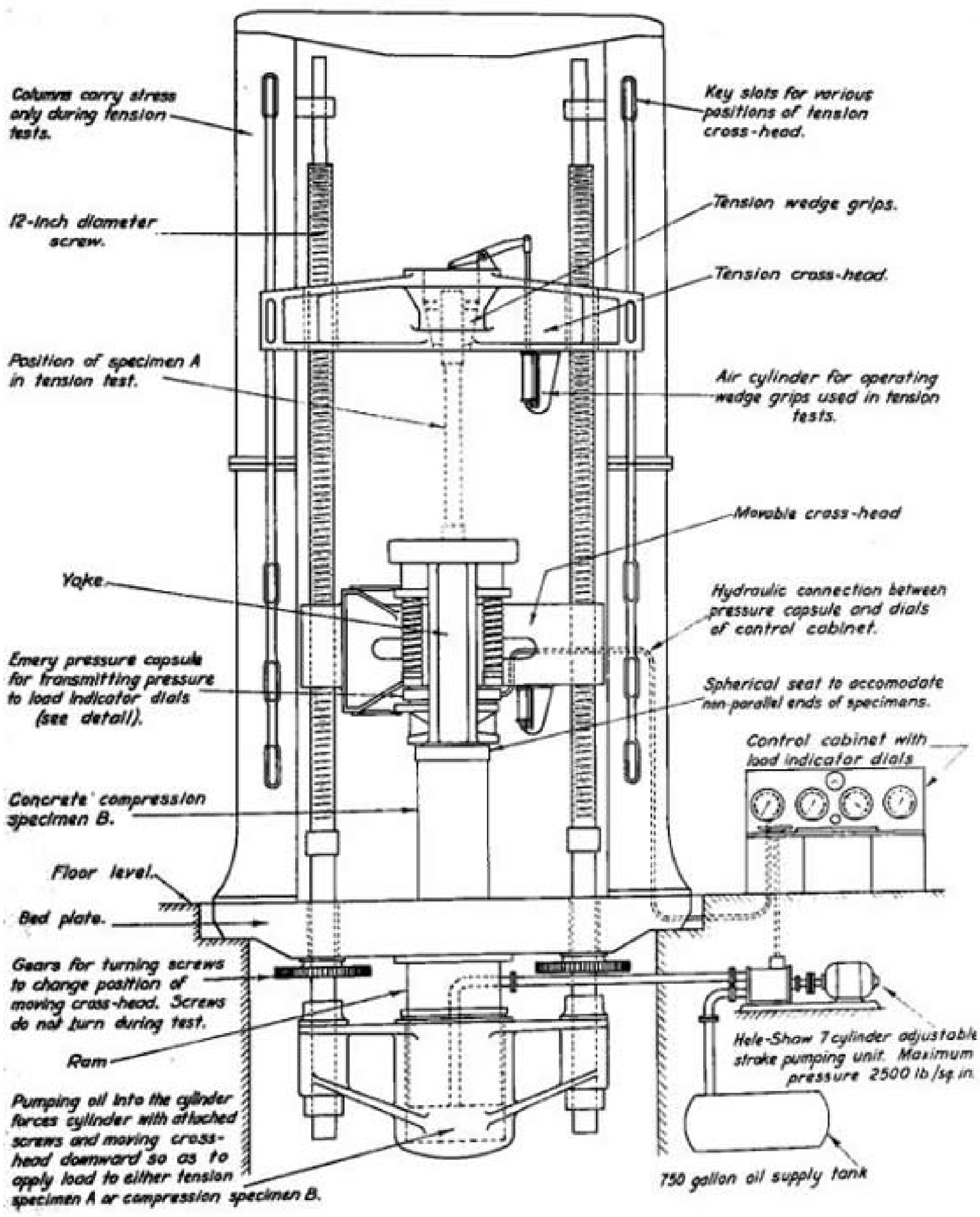
- Universal Test Machine (UTM)
- Extensometer - to measure the elongation in the mid-section of the specimen.
- Two test specimens (steel or Al and CI or Brass)
- Ruler and micrometer - to take measurements.

About the UTM (Universal Testing Machine):

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 =
2. ***Least count =***
3. Power supply =


Columns carry stress only during tension tests.
12-inch diameter screw.
Position of specimen A in tension test.
Yoke
Emery pressure capsule for transmitting pressure to load indicator dials (see detail).
Concrete compression specimen B.
Floor level.
Bed plate.
Gears for turning screws to change position of moving cross-head. Screws do not turn during test.
Ram
Pumping oil into the cylinder forces cylinder with attached screws and moving cross-head downward so as to apply load to either tension specimen A or compression specimen B.
Key slots for various positions of tension cross-head.
Tension wedge grips.
Tension cross-head.
Air cylinder for operating wedge grips used in tension tests.
Movable cross-head
Hydraulic connection between pressure capsule and dials of control cabinet.
Spherical seat to accomodate non-parallel ends of specimens.
Control cabinet with load indicator dials
Hele-Shaw 7 cylinder adjustable stroke pumping unit. Maximum pressure 2500 lb/sq.in.
750 gallon oil supply tank

Procedure:

There are five steps involved in each tensile test:

1. Specimen preparation
2. Setting test parameters
3. Running the tensile test on UTM.
   - The load pointer is set at zero, by adjusting the initial setting knob.
   - The dial gauge is fixed and the specimen for measuring elongation of small amounts.
   - Measuring the diameter of the test piece by vernier caliper at least at three places and determine the mean value also mark the gauge length.
   - Now the specimen is gripped between upper and middle cross head jaws of the m/c.
   - Set the automatic graph recording system.
   - Start the m/c and take the reading.
   - The specimen is loaded gradually and the elongation is noted until the specimen breaks.
4. Collecting stress-strain data
5. Calculating material properties and Evaluating experimental results

Test Parameters:

- Initial diameter of specimen Φ_1 = ---------------
- Total Length L = ---------------
- Initial gauge length of specimen l = ---------------
- Initial cross-section area of specimen A_1 = ---------------

- Load of yield point F = ---------------
- Ultimate load after specimen breaking F = ---------------
- Final length after specimen breaking L_2 = ---------------
- Diameter Of specimen at breaking place Φ_3 = ---------------
- Grip Diameter of Specimen Φ_4 = ---------------
- Cross section area at breaking place A_3 = ---------------

Published Values: *

Esteel = $28 \times 10^6 - 30 \times 10^6$ psi = 190-210 GPa

EAlunium = $10 \times 10^6 - 11.4 \times 10^6$ psi = 70-79 GPa

Ecast-iron = $12 \times 10^6 - 25 \times 10^6$ psi = 83-170 GPa

Ebrass = $14 \times 10^6 - 16 \times 10^6$ psi = 96-110 GPa

****Reference: "Mechanics of Material" by James M. Gere, Stephen P. Timoshenko, 1997***

Calculation and Graph:

a. Ultimate tensile strength = -----------
b. Percentage elongation % = -----------
c. Modulus of elasticity E = -----------
d. Yield stress = -----------
e. % Reduction in area = -----------

SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE			
DEPARTMENT OF MECHANICAL ENGINEERING	**Number of experiment**		**Page No : … /**
	Code : DTME 303	**NO :**	**Roll No. : ……………………**

Result: ____

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Conclusion: ____

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INVESTIGATION TO BE REPORTED

- Practical Application of UTM
- Stress Strain Diagram for MS, Cast Iron & Brittle Material

REPORT TO BE SUBMITTED BY STUDENTS :-

- Main cause of Error
- Specification of the equipments being used.
- Result

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DEPARTMENT OF MECHANICAL ENGINEERING	**Number of experiment**		**Page No : … /**
	Code : DTME 303	**NO :**	**Roll No. : ……………………**

Sub Code :ME 303	Sub Name : STRENGTH & MECHANICS OF MATERIAL						Experiment NO. 02
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Remarks and Grade by Tutor:							
Cross Grade	Exc	VG	G	Fr	M	F	Signature

EXPERIMENT: 02

AIM

To Perform compression test on UTM.

APPARATUS

Standard Compressive Test on concrete block, brick or wooden block.

Study Group : STRENGTH & MECHANICS OF MATERIAL	Code Of experiment : SOM 02
Created By : S. Pipleya & U. Gupta	Modified by : Sunil Pipleya
Date of Creation : 20/05/2013	Approved by:

THOERY

Several m/c and structure components such as columns and struts are subjected to compressive load in applications. These components are made of high compressive strength materials. Not all the materials are strong in compression. Several materials, which are good in tension, are poor in compression. Contrary to this, many materials poor in tension but very strong in compression. Cast iron is one such example. That is why determine of ultimate compressive strength is essential before using a material. This strength is determined by conduct of a compression test.

Compression test is just opposite in nature to tensile test. Nature of deformation and fracture is quite different from that in tensile test. Compressive load tends to squeeze the specimen. Brittle materials are generally weak in tension but strong in compression. Hence this test is normally performed on cast iron, cement concrete etc. But ductile materials like aluminium and mild steel which are strong in tension, are also tested in compression.

TEST SET-UP, SPECIFICATION OF M/C AND SPECIMEN DETAILS :

A compression test can be performed on UTM by keeping the test-piece on base block (see in fig.) and moving down the central grip to apply load. It can also be performed on a compression testing machine. A compression testing machine shown in fig. it has two compression plates/heads. The upper head moveable while the lower head is stationary. One of the two heads is equipped with a hemispherical bearing to obtain. Uniform distribution of load over the test-piece ends. A load gauge is fitted for recording the applied load.

SPECIMEN

In cylindrical specimen, it is essential to keep h/d ≤ 2 to avoid lateral instability due to bucking action. Specimen size = h ≤ 2d.

PROCEDURE

1. Dimension of test piece is measured at three different places along its height/length to determine the average cross-section 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 compressions plates, 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 500 kg.
6. Load is applied until the specimen fails.

OBSERVATION

1. Initial length or height of specimen h = ------mm.
2. Initial diameter of specimen do = ------------mm

S. No.	Applied load (p) in Newton	Recorded change in length (mm)

CALCULATION

- Original cross-section area Ao = -----
- Final cross-section area Af = --------
- Stress = -------
- Strain = -------

For compression test, we can

- Draw stress-strain (σ-ε) curve in compression,
- Determine Young's modulus in compression,
- Determine ultimate (max.) compressive strength, and
- Determine percentage reduction in length (or height) to the specimen.

PRECAUTIONS

- The specimen should be prepared in proper dimensions.
- The specimen should be properly to get between the compression plates.
- Take reading carefully.
- After failed specimen stop to m/c.

RESULT

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

CONCLUSION

VIVA-QUESTIONS

- Compression tests are generally performed on brittles materials-why?
- Which will have a higher strength: a small specimen or a full size member made of the same material?
- What is column action? How does the h/d ratio of specimen affect the test result?
- How do ductile and brittle materials in their behavior in compression test?
- What are bi-modulus materials? Give examples.

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DEPARTMENT OF MECHANICAL ENGINEERING	**Number of experiment**		**Page No : … /**
	Code : DTME 303	**NO :**	**Roll No. : ……………………**

Sub Code :ME 303	Sub Name : STRENGTH & MECHANICS OF MATERIAL			Experiment NO. 03
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Remarks and Grade by Tutor:							
Cross Grade	Exc	VG	G	Fr	M	F	Signature

EXPERIMENT: 03

AIM

To determine the Hardness of the given Specimen using Rockwell hardness test.

APPARATUS

1. Rockwell hardness testing machine.
2. Black diamond cone indenter,
3. Hard steel specimen.

Study Group : STRENGTH & MECHANICS OF MATERIAL	Code Of experiment : SOM 03
Created By : S. Pipleya & U. Gupta	Modified by : Sunil Pipleya
Date of Creation : 20/05/2013	Approved by:

THOERY

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.In this test indenter is forced into the surface of a test piece in two operations, measuring the permanent increase in depth of an indentation from the depth increased from the depth reached under a datum load due to an additional load.

Measurement of indentation is made after removing the additional load. Indenter used is the cone having an angle of 120 degrees made of black diamond.

PROCEDURE

For carrying out tests, the following procedure should be adopted very carefully. Any negligence may spoil the indenter.

1. Keep lever (Accentry Knob stud) at unload position 'A'.
2. Select the suitable indenter according to scale.
3. Select weights according to the scale.
4. Place the clamping cone at its place and hold the same lightly using the clamping screw.
5. Place the test block on testing table as requirement.
6. Turn the main screw nut clockwise direction to rise the test block making connect with the clamping come. Continue turning, first the block will get clamped with spring loaded clamping cone, turn the main screw nut so that test block pushes the indenter further turn the main screw nut until the long pointer of the dial gauge has made two and half turns then it stop at '0' on black scale and 'B-30' on red scale. Continue turning further till the small pointer reaches at red spot at '3' (**never across the red spot to avoid dial gauge damage.**)
7. Turn the lever (accentry knob stud) from unload position 'A' to load position 'B'. So

that total load is brought in to action.

8. When the long pointer of dial gauge reaches a steady position then take back the lever (accentry knob stud) to unload position 'A' slowly.
9. Read of the figure against the long pointer on proper scale. That is the direct reading of hardness test block.
10. Then turn anticlockwise the main screw nut to release the specimen and select next surface of test block and carry on the same procedure until dial gauge give reading marked on test block then release the test block and the machine is ready for the next test of your job.

Operation of the machine for superficial & Superficial Rockwell principle

A- Superficial Principle
1. Select the Major load 30 kgf.
2. Use diamond indenter & Read outer Scale Black figure for HRN-30
3. Use 1/16" Ball indenter & read outer scale Black figure for HRT-30
   Above sequence may be applied for 15 & 45 Kgf major load. There is minor load 3 Kgf. Which is preset?

B- Superficial Rockwell Principle
1. Select minor load 3 kgf.
2. Apply major load 30 kgf. (Aluminum Weights)
3. Use Diamond indenter & read outer scale for HRN.
4. Use 1/16" Ball indenter & read outer scale for HRT. Above Sequence can be applied for 15,30 & 45 kgf. Major load for Superficial Scale. The Minor load is selected 3 kgf.

C- Rockwell
1. Select minor load 10 kgf.
2. Select 150 kgf major load & diamond indenter for 'C' Scale, read middle scale.
3. Select 100 kgf. Major load & 1/16'' Ball indenter for 'B' scale. Read inner scale.

For all the test please note that

1. Loading lever should be pulled towards 'A'
2. Place the Specimen below the indenter, rotate the main screw nut clockwise direction till the big hand of dial gauge rests at 'O' while small hand at '3' Red spot.
3. Gently turn the lever towards 'B' & wait till the dial Shows a steady reading. Push the lever towards 'A' position. Note down the Reading.
4. Rotate screw nut anticlockwise to release the job.
5. Please take to or three reading initially to get set ready the indenter seats on to the holder.

Precautions

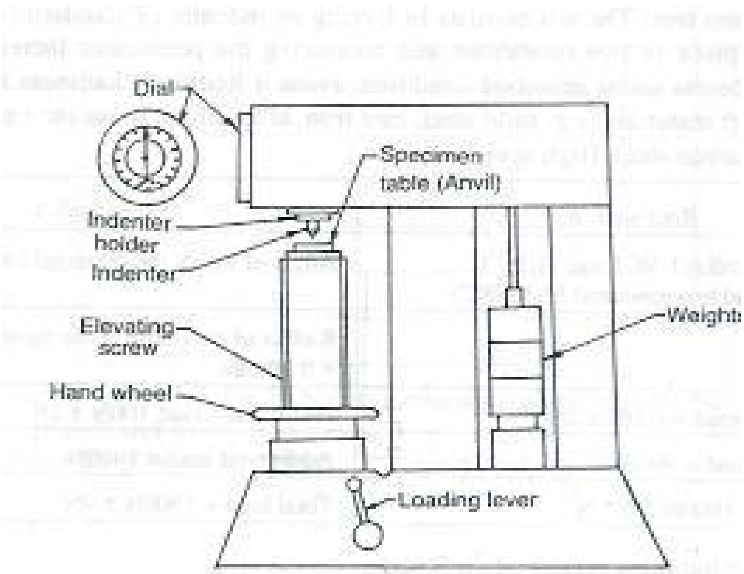
1. Thickness of the specimen should not be less than 8 times the depth of indentation to avoid the deformation to be extended to the opposite surface of a specimen.
2. Indentation should not be made nearer to the edge of a specimen to avoid unnecessary concentration of stresses. In such case distance from the edge to the center of indentation should be greater than 2.5 times diameter of indentation.
3. Rapid rate of applying load should be avoided. Load applied on the ball may rise a little because of its sudden action. Also rapidly applied load will restrict plastic flow of a material, which produces effect on size of indentation.

SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE			
DEPARTMENT OF MECHANICAL ENGINEERING	Number of experiment		Page No : … /
	Code : DTME 303	NO :	Roll No. : ……………………

Observation

1. Take average of five values of indentation of each specimen. Obtain the hardness number from the dial of a machine.
2. Compare Brinell and Rockwell hardness tests obtained.

Figure .1



Rockwell hardness test equipment

Result

Rockwell hardness of given specimen is--------------------------

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DEPARTMENT OF MECHANICAL ENGINEERING	**Number of experiment**		**Page No : … /**
	Code : DTME 303	**NO :**	**Roll No. : ……………………**

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EXPERIMENT: 04

AIM

To determine the hardness of the given specimen using Brinell hardness test.

APPARATUS

01. Brinell hardness tester (fig.2)
02. Aluminum specimen
03. Ball indenter.

Study Group : STRENGTH & MECHANICS OF MATERIAL	Code Of experiment : SOM 04
Created By : S. Pipleya & U. Gupta	Modified by : Sunil Pipleya
Date of Creation : 20/05/2013	Approved by:

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DEPARTMENT OF MECHANICAL ENGINEERING	Number of experiment		Page No : … /
	Code : DTME 303	NO :	Roll No. : ……………………

THOERY

Hardness of a material is generally defined as Resistance to the permanent indentation under static and dynamic load. When a material is required to use under direct static or dynamic loads, only indentation hardness test will be useful to find out resistance to indentation.

In Brinell 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).

PROCEDURE

For carrying out tests, the following procedure should be adopted very carefully. Any negligence may spoil the inde-ntor.

1. Keep lever (Accentry Knob stud) at unload position ‘A’.
2. Select the suitable indenter according to scale.
3. Select weights according to the scale.
4. Place the clamping cone at its place and hold the same lightly using the clamping screw.
5. Place the test block on testing table as re quirement.
6. Turn the main screw nut clockwise direction to raise the test block making connect with the clamping come. Continue turning, first the block will get clamped with spring loaded clamping cone, turn the main screw nut so that test block pushes the indentor further turn the main screw nut until the long pointer of the dial gauge has made two and half turns then it stop at ‘0’ on black scale and ‘B-30’ on red scale. Continue turning further till the small pointer reaches at red spot at ‘3’ (**never across the red spot to avoid dial gauge damage.**)
7. Turn the lever (accentry knob stud) from unload position ‘A’ to load position ‘B’. So

that total load is brought in to action.

8. When the long pointer of dial gauge reaches a steady position then take back the lever (accentry knob stud) to unload position ‘A’ slowly.
9. Read of the figure against the long pointer on proper scale. That is the direct reading of hardness test block.
10. Then turn anticlockwise the main screw nut to release the specimen and select next surface of test block and carry on the same procedure until dial gauge give reading marked on test block then release the test block and the machine is ready for the next test of your job.

Operation of the machine for superficial & Superficial Rockwell principle

D- Superficial Principle
1. Select the Major load 30 kgf.
2. Use diamond indenter & Read outer Scale Black figure for HRN-30
3. Use 1/16” Ball indenter & read outer scale Black figure for HRT-30
   Above sequence may be applied for 15 & 45 Kgf major load. There is minor load 3 Kgf. Which is preset.

E- Superficial Rockwell Principle
1. Select minor load 3 kgf.
2. Apply major load 30 kgf. (Aluminum Weights)
3. Use Diamond indenter & read outer scale for HRN.
4. Use 1/16” Ball indenter & read outer scale for HRT. Above Sequence can be applied for 15,30 & 45 kgf. Major load for Superficial Scale. The Minor load is selected 3 kgf.

F- Rockwell
1. Select minor load 10 kgf.
2. Select 150 kgf major load & diamond indenter for ‘C’ Scale, read middle scale.
3. Select 100 kgf. Major load & 1/16’’ Ball indenter for ‘B’ scale. Read inner scale.

SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE			
DEPARTMENT OF MECHANICAL ENGINEERING	Number of experiment		Page No : … /
	Code : DTME 303	NO :	Roll No. : ……………………

For all the test please note that

1. Loading lever should be pulled towards 'A'
2. Place the Specimen below the indenter, rotate the main screw nut clockwise direction till the big hand of dial gauge rests at 'O' while small hand at '3' Red spot.
3. Gently turn the lever towards 'B' & wait till the dial Shows a steady reading. Push the lever towards 'A' position. Note down the Reading.
4. Rotate screw nut anticlockwise to release the job.
5. Please take to or three reading initially to get set ready the indenter seats on to the holder.

Precautions

1. Thickness of the specimen should not be less than 8 times the depth of indentation to avoid the deformation to be extended to the opposite surface of a specimen.
2. Indentation should not be made nearer to the edge of a specimen to avoid unnecessary concentration of stresses. In such case distance from the edge to the center of indentation should be greater than 2.5 times diameter of indentation.
3. Rapid rate of applying load should be avoided. Load applied on the ball may rise a little because of its sudden action. Also rapidly applied load will restrict plastic flow of a material, which produces effect on size of indentation.

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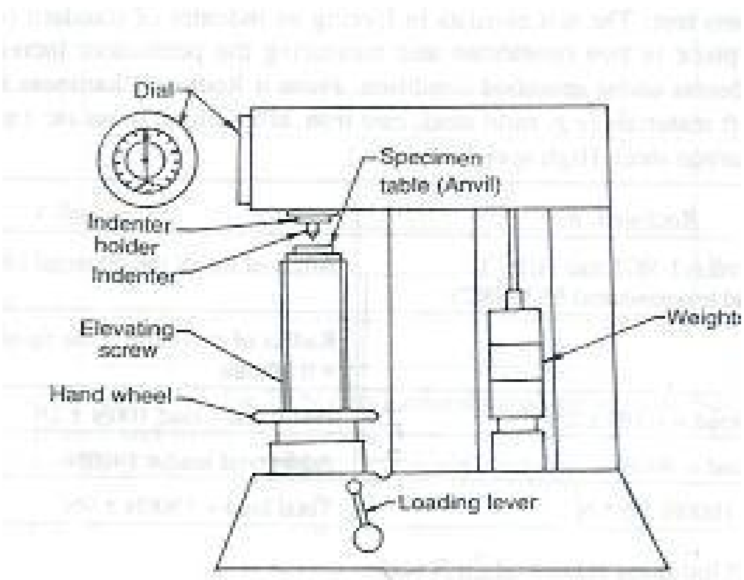
DEPARTMENT OF MECHANICAL ENGINEERING	Number of experiment		Page No : … /
	Code : DTME 303	NO :	Roll No. : ……………………

Observation

1. Take average of five values of indentation of each specimen. Obtain the hardness number from the dial of a machine.
2. Compare Brinell and Rockwell hardness tests obtained.

Figure .1



Brinell hardness test equipment

Result

Brinell hardness of given specimen is

SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE			
DEPARTMENT OF MECHANICAL ENGINEERING	**Number of experiment**		**Page No : … /**
	Code : DTME 303	**NO :**	**Roll No. : ……………………**

Sub Code :ME 303	Sub Name : STRENGTH & MECHANICS OF MATERIAL			Experiment NO. 05
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Remarks and Grade by Tutor:								
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EXPERIMENT: 05

AIM

To determine the Impact toughness (strain energy) through Izod test and Charpy test.

APPARATUS

1. Impact testing machine
2. Specimen of different ferrous and non ferrous materials.

Study Group : STRENGTH & MECHANICS OF MATERIAL	Code Of experiment : SOM 05
Created By : S. Pipleya & U. Gupta	Modified by : Sunil Pipleya
Date of Creation : 20/05/2013	Approved by:

Figure. 5a

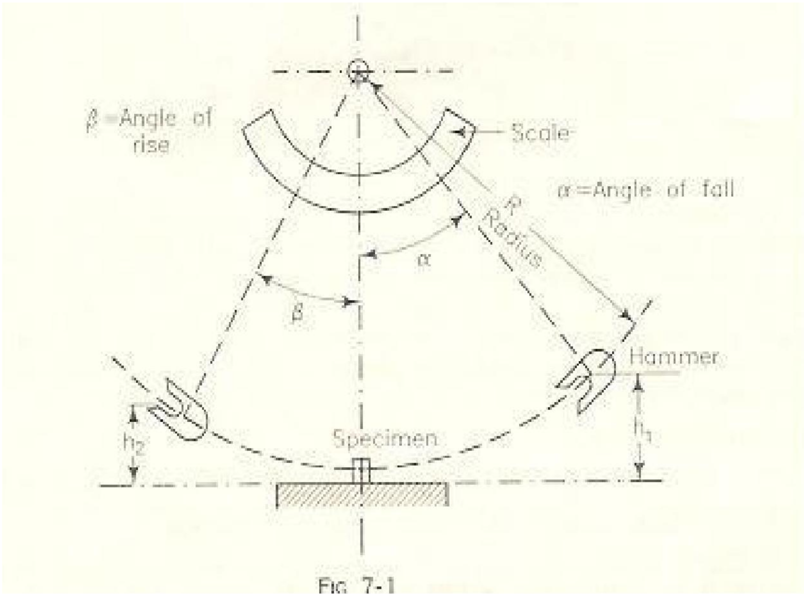
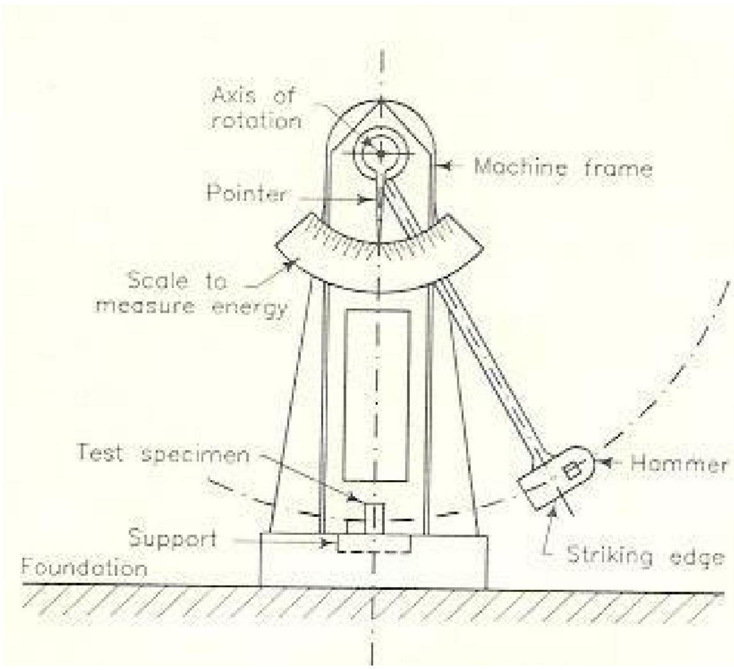


Figure.5b



THOERY

In a impact test a specially prepared notched specimen is fractured by a single blow from a heavy hammer and energy required being a measure of resistance to impact.

Impact load is produced by a swinging of an impact weight W (hammer) from a height h. Release of the weight from the height h swings the weight through the arc of a circle, which strikes the specimen to fracture at the notch.

Kinetic energy of the hammer at the time of impact is mv 2 /2, which is equal to the relative potential energy of the hammer before its release. (mgh),

where m is the v/gh∗√2 is its tangential velocity at impact, g is gravitational acceleration (9.806 m/s ^{2}) and h is the height through which hammer falls. Impact velocity will be 5.126 m/s or slightly less. Here it is interesting to note that height through which hammer drops determines the velocity and height and mass of a hammer combined determine the energy.

Energy used can be measured from the scale given. The difference between potential energies is the fracture energy. In test machine this value indicated by the pointer on the scale. If the scale is calibrated in energy units, marks on the scale should be drawn keeping in view angle of fall () and angle of rise (**Height h1 and h2 equals, h1= R (1cos) and h2= (1cos)**.

With the increase or decrease in values, gap between marks on scale showing energy also increase or decrease. This can be seen from the attached scale with any impact machine. Energy used in fracturing the specimen can be obtained approximately as Wh_1Wh_2 This energy value called impact toughness or impact value, which will be measured, per unit area at the notch.

Izod introduced Izod test in 1903. Test is as per the IS: 1598
Charpy introduced Charpy test in 1909. Test is as per the IS: 1499.

SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE			
DEPARTMENT OF MECHANICAL ENGINEERING	Number of experiment		Page No : … /
	Code : DTME 303	NO :	Roll No. : ……………………

a. Izod test

Specimen and equipment

1. Impact testing machine.(fig.3)
2. Specimen and v notch is shown in the fig.4. Size of the specimen is 10mm X 10mm X 75mm

Mounting of the specimen

Specimen is clamped to act as vertical cantilever with the notch on tension side. Direction of blow of hammer is shown in fig. (). Direction of blow is shown in fig

Figure 5c

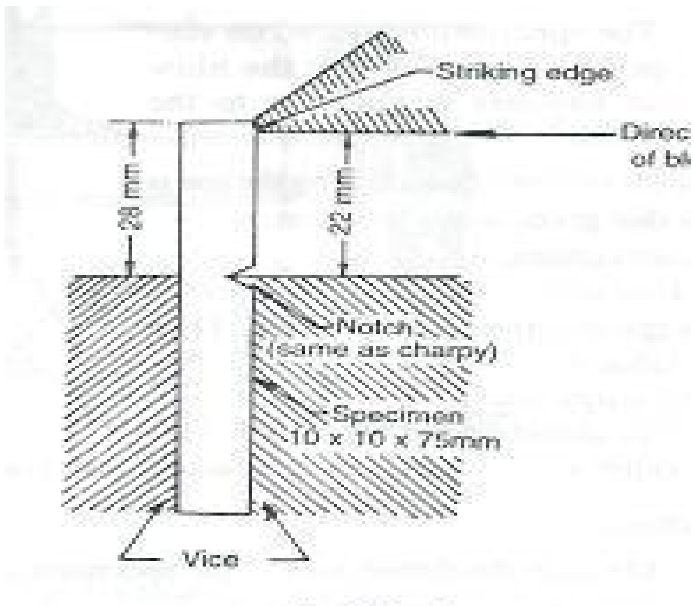


Fig. 10. Izod test.

Position of specimen for Izod test

Procedure

1. Measure the dimensions of a specimen. Also, measure the dimensions of The notch.
2. Raise the hammer and note down initial reading from the dial, which will be energy to be used to fracture the specimen.
3. Place the specimen for test and see that it is placed center with respect to hammer. Check the position of notch.
4. Release the hammer and note the final reading. Difference between the initial and final reading will give the actual energy required to fracture the Specimen.
5. Repeat the test for specimens of other materials.
6. Compute the energy of rupture of each specimen.

Observation

Initial and final reading of the dial.

Result

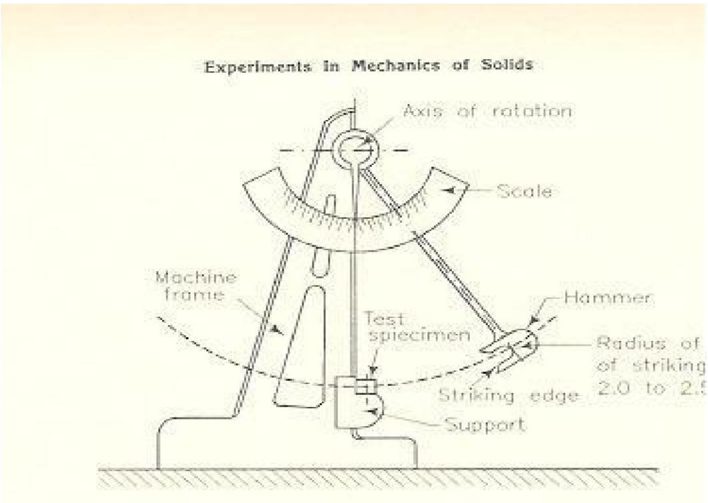
Strain energy of given specimen is

b. Charpy test

Specimen and equipment

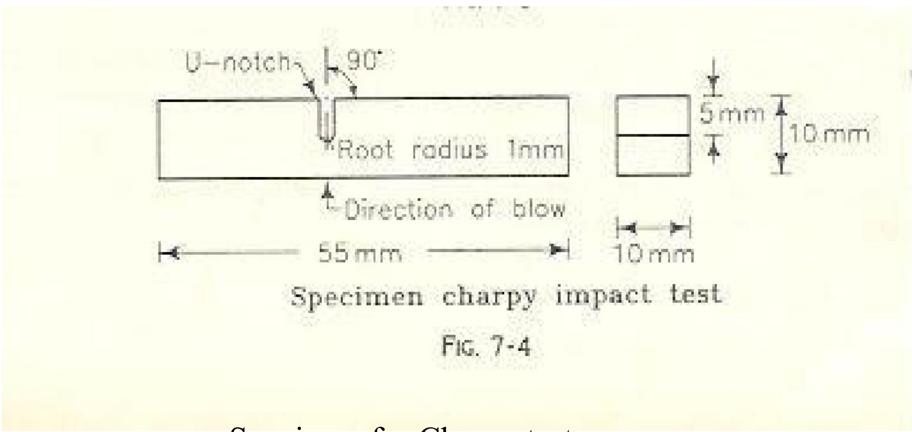
1. Impact testing machine. (Fig.5d)
2. U notch is cut across the middle of one face as shown in (fig.5e).Mounting of the

Figure 5d



Charpy impact testing equipment

Figure 5e

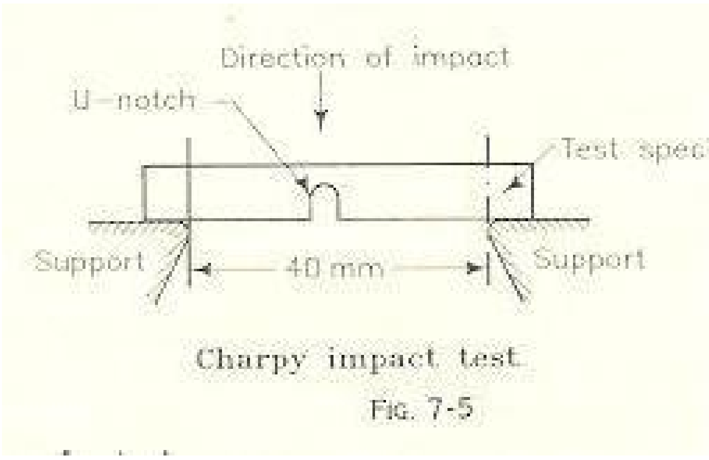


Specimen for Charpy test

Mounting of specimen

Specimen is tested as a beam supported at each end (fig.5f). Hammer is allowed to hit then specimen at the opposite face behind the notch.

Figure.5f



Mounting of specimen

Procedure

1. Measure the dimensions of a specimen. Also, measure the dimensions of the notch.
2. Raise the hammer and note down initial reading from the dial, which will be energy to be used to fracture the specimen.
3. Place the specimen for test and see that it is placed center with respect to hammer. Check the position of notch.
4. Release the hammer and note the final reading. Difference between the initial and final reading will give the actual energy required to fracture the Specimen.
5. Repeat the test for specimens of other materials.
6. Compute the energy of rupture of each specimen.

Observation

Initial and final reading of the dial.

Result

Strain energy of given specimen is

SHRI VAISHNAV VIDYAPEETH VISHWAVIDYALAYA, INDORE			
DEPARTMENT OF MECHANICAL ENGINEERING	**Number of experiment**		**Page No : … /**
	Code : DTME 303	**NO :**	**Roll No. : ……………………**

Sub Code :ME 303	Sub Name : STRENGTH & MECHANICS OF MATERIAL			Experiment NO. 06
Students Name :		Batch :	No. of pages	Date :

Details of submission & performance			
Performing		First Submission	Second submission
Extra turn	Regular turn		
Remarks and Grade by Tutor:			

Cross Grade	Exc	VG	G	Fr	M	F	Signature

EXPERIMENT: 06

AIM

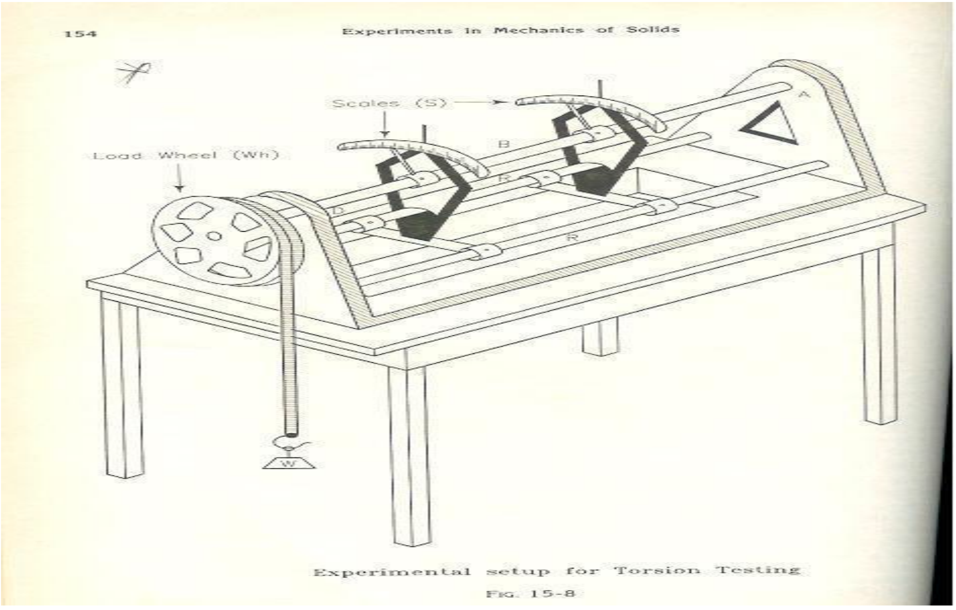
To find the modulus of rigidity.

APPARATUS

1. A torsion testing apparatus,
2. Standard specimen of mild steel or cast iron.
3. Twist meter for measuring angles of twist
4. A steel rule and calipers and micrometer.

Study Group : STRENGTH & MECHANICS OF MATERIAL	Code Of experiment : SOM 06
Created By : S. Pipleya & U. Gupta	Modified by : Sunil Pipleya
Date of Creation : 20/05/2013	Approved by:

Figure. 6a



Torsion equipment

THOERY

A torsion test is quite instrumental in determining the value of rigidity (ratio of shear stress to shear strain) of a metallic specimen. The value of modulus of rigidity can be found out through observations made during the experiment by using the torsion

equation:

Where

T	=	Torque applied,
Ip	=	Polar moment of inertia,
C	=	Modulus of rigidity,
	=	Angle of twist (radians), and
L	=	Gauge length.

In the torque equipment refer fig. One end of the specimen is held by a fixed support and the other end to a pulley. The pulley provides the necessary torque to twist the rod by addition of weights (w). The twist meter attached to the rod gives the angle of twist.

Procedure

1. Prepare the testing machine by fixing the two twist meters at some constant lengths from fixed support.
2. Measure the diameter of the pulley and the diameter of the rod.
3. Add weights in the hanger stepwise to get a notable angle of twist for T1 and T2
4. Using the above formula calculate C

Conclusion

Result

Modulus of rigidity of the shaft

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DEPARTMENT OF MECHANICAL ENGINEERING	**Number of experiment**		**Page No : … /**
	Code : DTME 303	**NO :**	**Roll No. : ……………………**

Sub Code :ME 303	Sub Name : STRENGTH & MECHANICS OF MATERIAL						Experiment NO. 07
Students Name :			Batch :	No. of pages			Date :
Details of submission & performance							
Performing		First Submission		Second submission			
Extra turn	Regular turn						
Remarks and Grade by Tutor:							
Cross Grade	Exc	VG	G	Fr	M	F	Signature

EXPERIMENT: 07

AIM

To find the values of bending stresses and young's modulus of the material of a beam (say a wooden or steel) simply supported at the ends and carrying a concentrated load at the center.

APPARATUS

1. Universal testing machine
2. Beam of different cross sections and materials (say wood or steel)

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Created By : S. Pipleya & U. Gupta	Modified by : Sunil Pipleya
Date of Creation : 20/05/2013	Approved by:

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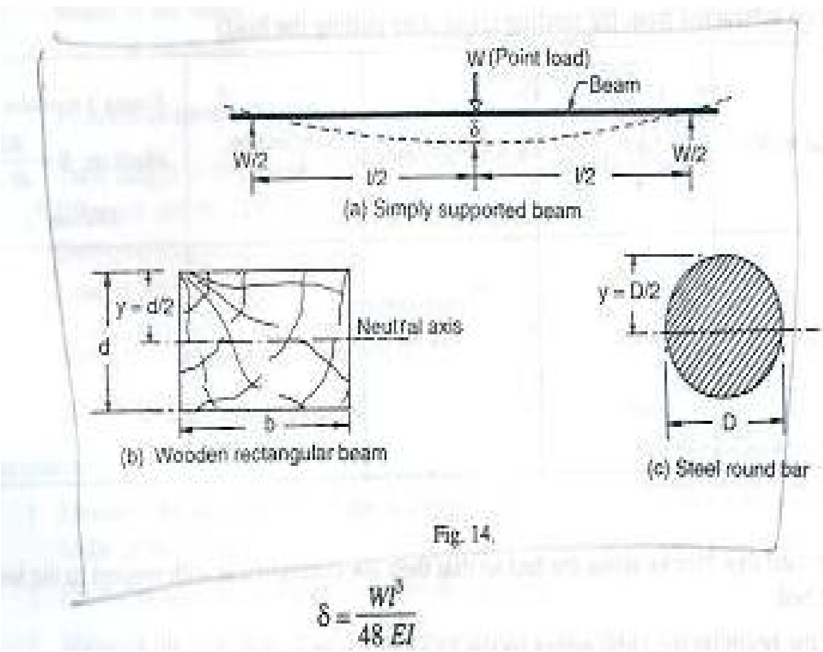
DEPARTMENT OF MECHANICAL ENGINEERING	**Number of experiment**		**Page No : … /**
	Code : DTME 303	**NO :**	**Roll No. : ……………………**

Figure. 7a



Specimen details and mounting

THOERY

If a beam is simply supported at the ends and carries a concentrated load at the center, the beam bends concave upwards. The distance between the original position of the beam and its position after bending is different at different points (fig) along the length if the beam, being maximum at the center in this case. This difference is called 'deflection'. In this type of loading the maximum amount of deflection () is given by the relation,

equation:

Max Deflection = $WL^3/48EI$

Where

W	=	load acting at the center, N
l	=	length of the beam between the supports, mm
E	=	young's modulus of material of the beam, N/mm^2
I	=	second moment of area of the cross section (moment of inertia) of the beam, about the neutral axis, mm^4

Bending stress

As per bending equation,

$$M/I=b/y$$

Where

M = Bending moment, Nmm
I = Moment of inertia, mm^4
B = Bending stress, N/mm^2
Y = Distance of the fiber of the beam from the neutral axis.

Observation

Width of the beam=………mm (for rectangular cross section)
Depth of the beam D=…mm (for circular cross section)
Moment of inertia of rectangular section= $bd^3/12$=…mm^4
Moment of inertia of circular section =$\pi/64D^4$………mm^4
Initial reading of the vernier= ….mm
(It should be subtracted from the reading taken after putting the load)

Sr. No.	Load W(n)	Bending Moment Wxl	Bending Stress b=My/I	Deflection of beam $WL^3/48EI$	Young's modulus of elasticity E
1					
2					
3					
4					
5					
6					

Precautions

1. Make sure that the beam and load is placed at the proper position.
2. Cross section of the beam should be large.
3. Note down the readings of the vernier scale carefully.

Procedure

1. Adjust the supports alone the UTM bed so that they are symmetrically with respect to the length of the bed.
2. Place the beam on the knifeedges on the blocks so as to project equally beyond each knife edge. See that the load is applied at the center of the beam.
3. Note the initial reading of vernier scale.
4. Apply a load and again note the reading of the vernier scale.
5. Go on taking reading applying load in steps each time till you have minimum 6 readings.
6. Find the deflection in each time by subtracting the initial reading of vernier scale.
7. Draw a graph between load (W) and deflection. On the graph choose any two convenient points and between these points find the corresponding values of W and Putting these values in the relation

   Max Deflection = $WL^3/48EI$

   Calculate the value of E.
8. Calculate the bending stresses for different loads using relation b = M/I=b/y given in the observation table.
9. Repeat the experiment for different beams.

Result

a. Bending stress………..units
b. Young's modulus………units

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MECHANICAL ENGINEERING DEPARTMENT
STRENGTH & MECHANICS OF MATERIAL LABORATORY

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DEPARTMENT OF MECHANICAL ENGINEERING	**Number of experiment**		**Page No : … /**
	Code : DTME 303	**NO :**	**Roll No. : ……………………**

Sub Code :ME 303	Sub Name : STRENGTH & MECHANICS OF MATERIAL			Experiment NO. 08
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Extra turn	Regular turn		
Remarks and Grade by Tutor:			

Cross Grade	Exc	VG	G	Fr	M	F	Signature

EXPERIMENT: 08

AIM

To find the shear strength of given specimen.

APPARATUS

1. Universal testing machine
2. Shear test attachment
3. Given specimen

Study Group : STRENGTH & MECHANICS OF MATERIAL	Code Of experiment : SOM 08
Created By : S. Pipleya & U. Gupta	Modified by : Sunil Pipleya
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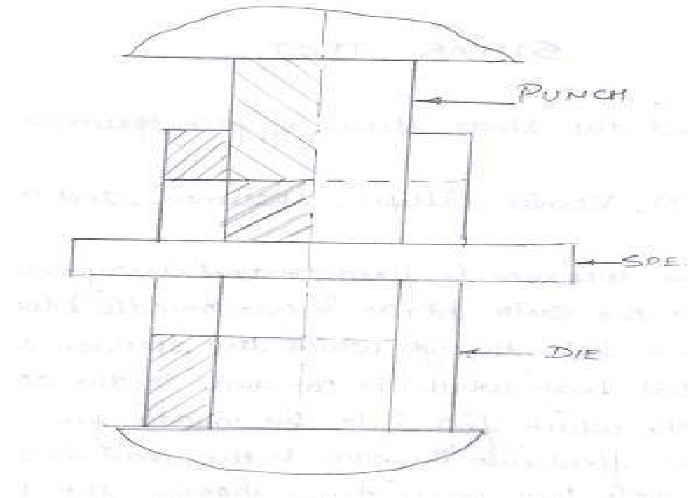
Figure. 8a



Shearing fixture

Observation

Diameter of the pin d =….mm

Cross sectional area of the pin(in double shear) $= 2 \times \pi/4 \times d^2 =$…. mm^2

Load taken by the specimen at the time of failure, W =. ……(N)

Strength of the pin against shearing (τ)

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.

Repeat the experiment with other specimens.

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 grater than the specimen.
3. Measure the diameter of the specimen accurately.

Result.

Shear strength of the specimen ………N/mm ^{2}