EXPERIMENT NO. 1

Tension test on mild steel bar

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

1) Elastic Limit,
2) Yield Strength,
3) Ultimate Strength,
4) Young's Modulus,
5) Percentage Elongation,
6) Percentage Reduction in area.

Material and Equipment :

1) Universal Testing Machine (Fig. 1),
2) Mild steel specimen, TOR steel bar

Theory :

The tensile test is most applied one, of all mechanical tests. In this test ends of a 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 (Fig. 2), 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 deformation is essentially entirely elastic is known as the yield strength of material. In some materials (like m.s.) 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. As 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.

Usually a tension test is conducted at room temperature and the tensile load is applied slowly. During this test either round or flat specimens may be used. The round specimens may have smooth, shouldered or threaded ends. The load on the specimen is applied mechanically or hydraulically depending on the type of testing machine. Fig. 1 shows a hydraulically operated tensile testing machine (Universal Testing Machine).

Fig. 2 shows the stress-strain curve for a ductile material.

Limit of Proportionality : It is defined as that stress at which the stress-strain curve begins to deviate from the straight line. From point 'O' to 'A' is a straight line, which represents that the stress is proportional to strain. Beyond 'A' the curve slightly deviates from the straight line.

Elastic Limit : Even if the load is increased beyond point 'A' upto point 'B', the material will regain its original shape and size when the load is removed. This point is called elastic limit.

Yield Point : If the material is stressed beyond point 'B', the plastic stage will reach, i.e. on removal of the load the material will not be able to recover its original size and shape. Point 'C' and 'D' are called Upper and Lower Yield Points.

Ultimate Stress : At 'E', the stress attains its maximum value known as ultimate stress. It is the largest value of stress obtained in the tension test.

Breaking Stress : After the specimen has reached the ultimate stress a neck is formed, which decreases the cross sectional area of specimen. At point 'F' specimen breaks.

Procedure : 1) Measure the original length and diameter of the specimen. The length may either be length of gauge section, which is marked in 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.

Observations :

1. Record the data in the following table :

   Material :

   Original dimensions : Length = _______ mm, Diameter = ______ mm, Area = ________ mm2 . Final dimensions : Length = _______ mm, Diameter = ______ mm, Area = __________ mm2 .

Sr.No.	Load(N)	Extension(mm)	Stress=Load/Area (N/MM^2)	Strain=Change in length/Original length
1				
2				
3				
4				
5				
6				
7				

2. Plot the stress - strain curve (Refer fig. 2) and determine the following :

1) Elastic Limit = Load at elastic limit/ Original area of cross-section = ____________ N/mm2

2) Yield Strength = Yield load/ Original area of cross-section = ____________ N/mm2

3) Ultimate Strength = Maximum tensile load /Original area of cross-section = ____________ N/mm2 .

4) Young's Modulus,E = Stress below proportionality limit/ Corresponding strain = __________ N/mm2

5) Percentage elongation = Final length (at fracture) - Original length/ Original length = ________ %

6) Percentage reduction in area = Original area - Area at fracture /Original area = ________ %.

Fig 1 Universal Testing Machine

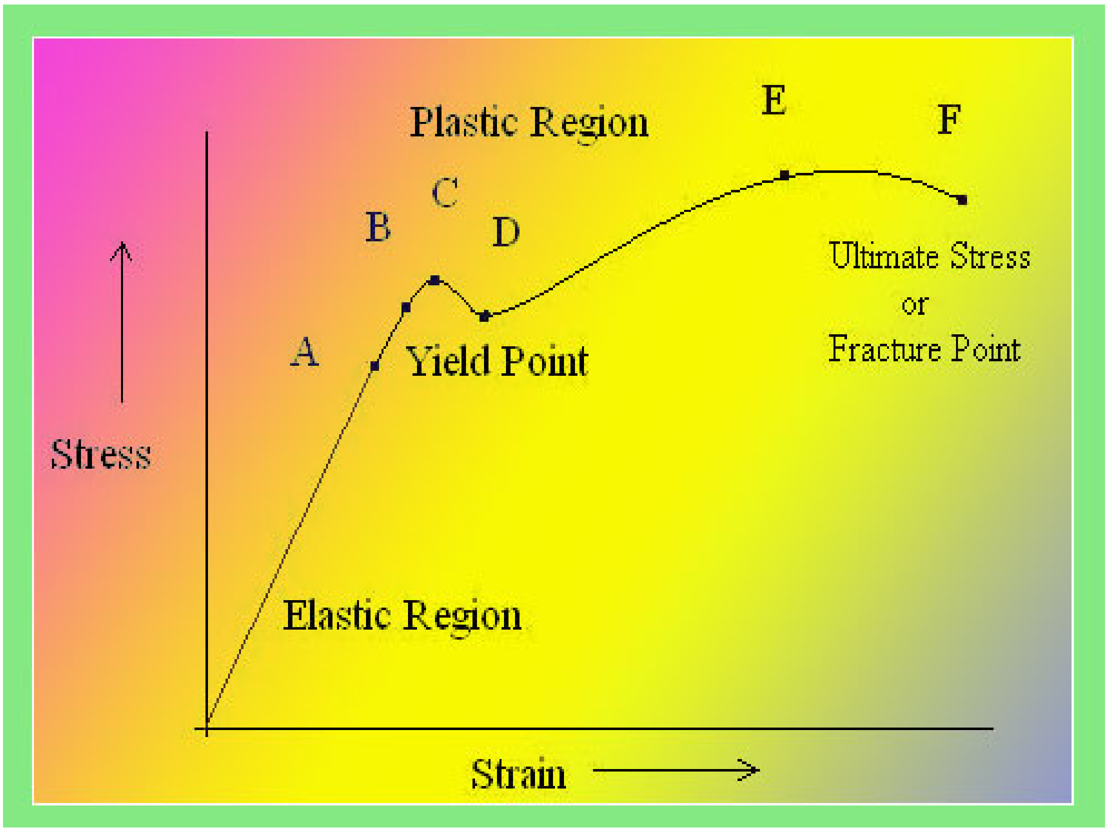


Fig-2 Stress-Strain Curve

EXPERIMENT NO. 2

Impact Test on metals

Objective: ***To determine the impact strength of steel by***

a) Izod test; and b) Charpy test.

Material and Equipment:

1) Impact testing machine (Fig. 1),
2) Striker for Izod test,
3) Striker for Charpy test,
4) A steel specimen 75 mm x 10 mm x 10 mm for Izod test,
5) A steel specimen 55 mm x 10 mm x 10 mm for Charpy test.

Theory :

An Impact test signifies toughness of material that is *ability of material to absorb energy during plastic deformatoin.* Static tension tests of unnotched specimens do not always reveal the susceptibility of a metal to brittle fracture. This important factor is determined by impact test. Toughness takes into account both the strength and ductility of the material. Several engineering materials have to withstand impact or suddenly applied loads while in service. Impact strengths are generally lower as compared to strengths achieved under slowly applied loads. Of all types of impact tests, the notched bar tests are most extensively used. Therefore, the impact test measures the energy necessary to fracture a standard notch bar by applying an impulse load. The test measures the notch toughness of material under shock loading. Values obtained from these tests are not of much utility to design problems directly and are highly arbitrary. Still it is important to note that it provides a good way of comparing toughness of various materials or toughness of the same material under different conditions.

Izod Test :

1.For conducting Izod test, clamp firmly the Izod striker at the bottom of the hammer with the help of clamping piece.

2.Conduct a test for determining the frictional loss in the machine. Adjust reading pointer with pointer carrier to 150 J dial reading, Raise the hammer by hands ($85^{0}21^{|}$) and latch in. Release the hammer by operating lever, then the pointer will indicate the energy loss due to friction.

3.Now raise the hammer by hands and latch in. Place the specimen firmly in the support (as shown in fig.2) such that notch should face the pendulum striker.

4.After ascertaining that there is no person in the range of swinging pendulum, release the hammer by operating lever, now the pendulum will be free fand the specimen will be smashed. Carefully retard the swinging pendulum by operating the pendulum brake. Read off position of reading pointer on dial and note down indicated value.

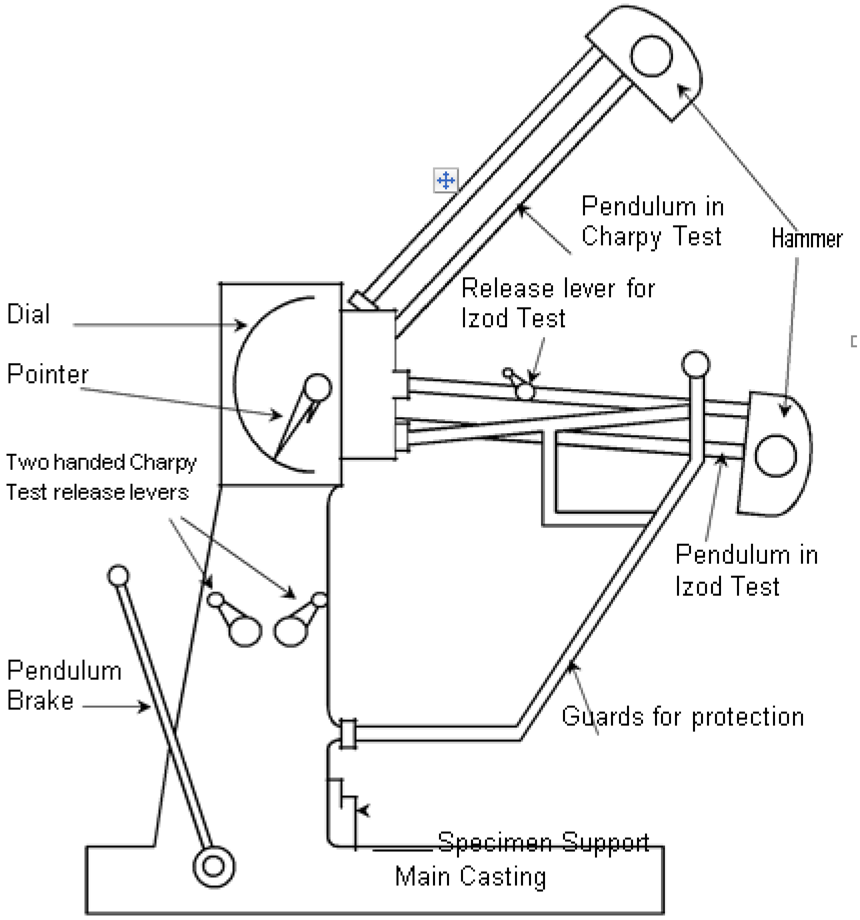
Charpy Test :

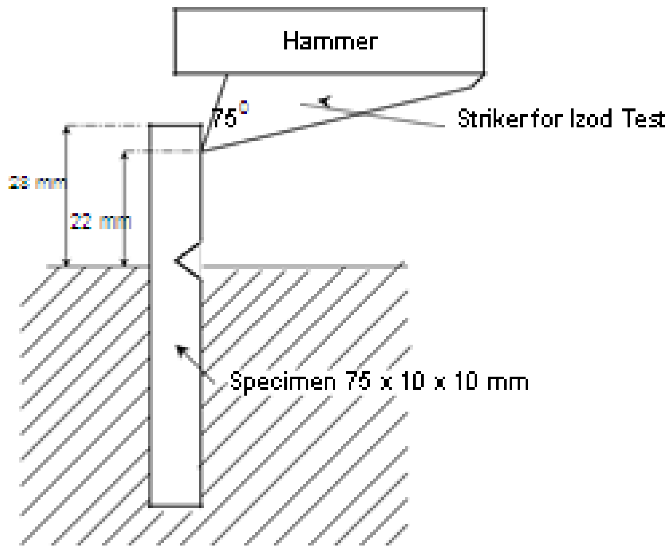
1.For conducting Charpy test, clamp firmly the Charpy striker at the bottom of the hammer with the help of clamping piece.

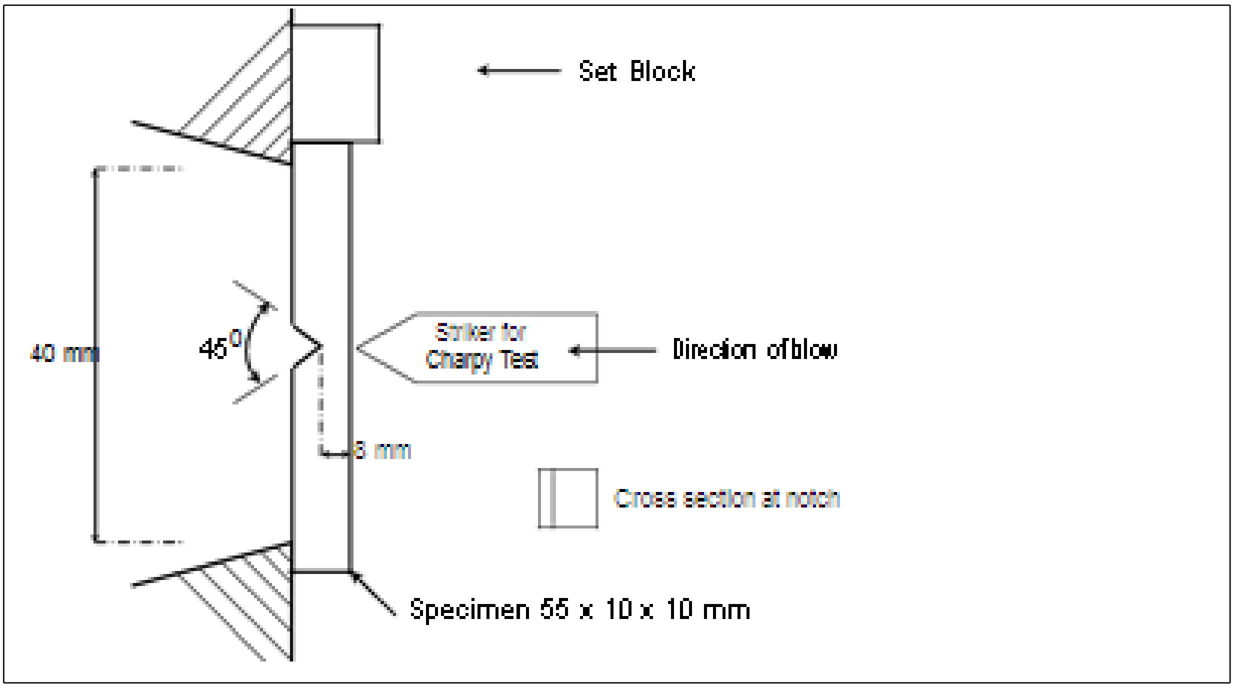
2.Conduct a test for determining the frictional loss in the machine. Adjust reading pointer with pointer carrier to 300 J dial reading, Raise the hammer by hands (140^0) and latch in. Release the hammer by operating lever, then the pointer will indicate the energy loss due to friction.

3.Now raise the hammer by hands and latch in. Place the specimen firmly in the support (as shown in fig.3) touching end stop, such that notch should averted to the direction of impact of the pendulum.

After ascertaining that there is no person in the range of swinging pendulum, release the hammer by operating lever, now the pendulum will be free fand the specimen will be smashed. Carefully retard the swinging pendulum by operating the pendulum brake. Read off position of reading pointer on dial and note down indicated value.


Pendulum in
Charpy Test
Hammer
Release lever for
Izod Test
Dial
Pointer
Two handed Charpy
Test release levers
Pendulum in
Izod Test
Pendulum
Brake
Guards for protection
Specimen Support
Main Casting


Hammer
75°
Striker for Izod Test
28 mm
22 mm
Specimen 75 x 10 x 10 mm



Technical Data for Izod test and Charpy test

	Izod Test	**Charpy Test**
Maximum impact energy of pendulum	150 Joules	300 Joules
Angle of drop of pendulum	$85^0 21^I$	140
Angle of striking edge	$75^0 + 1^0$	$30^0 + 1^0$

Observations for Izod Test :

Area of cross section of specimen below the notch : ________ mm^2.

Energy absorbed :

Sr. No.	Specimen	Initial Reading	Final Reading	Energy absorbed (Joules)
1				
2				
3				
Average Energy Absorbed (Joules)				

Calculations :

Impact strength of notch :

$I = K/A$ Joules/mm^2

Where I = Impact strength in Joules/mm^2.

K = Impact energy absorbed in Joules.

A= Area of cross section of specimen below the notch in mm^2.

EXPERIMENT NO.3

Flexural test on beam (central point load)

Objective :

To find out the bending strength of wooden beam.

Material and Equipment :

1) Universal testing machine,
2) Bending test attachment,
3) Wooden beam specimen.

Observations :

Width of the beam b = _______ mm.

Depth of the beam d = _______ mm.

Moment of Inertia I = ______________ mm4.

Load at breaking point W = ________ N.

Effective length of the beam (between two supports) L = ________ mm.

Bending Moment at the section M =_________________ Nmm.

Distance of extreme fibre from N-A (i.e. x-x axis) y = mm.

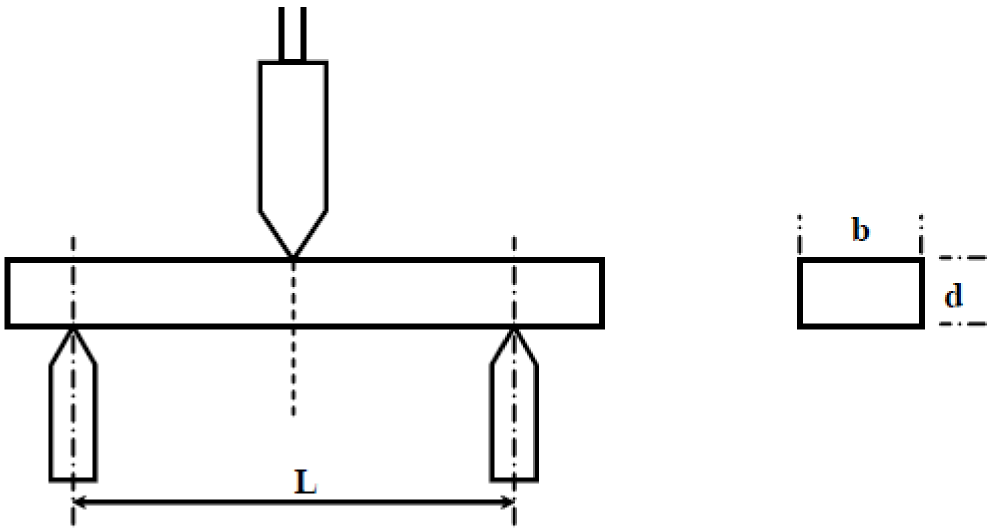
Stress at failure (bending stress) σ= N/mm^2

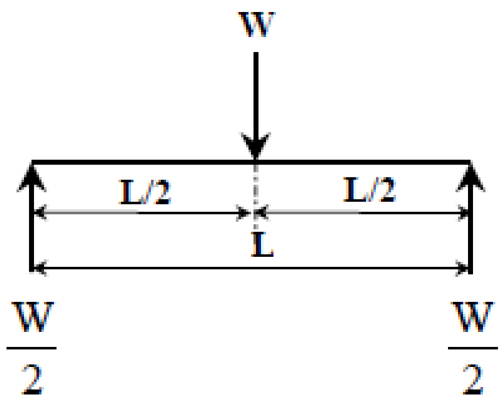
Procedure :

1) Measure the dimensions of the wooden beam (*depth of the beam should be greater than width of the beam*).
2) Fix the beam (depthwise) symmetrically on rollers.
3) Measure the distance (center to center) between the roller supports.
4) Set the load indicator at zero.
5) Increase the load gradually till the wooden beam fails.
6) Note down the load indicated by the pointer at which the beam fails.
7) Stop the machine and remove the beam.

Result :

Bending strength of wooden beam = ___________ N/mm^2





M=W/2*L/2

M=WL/4