Job # 8

To perform impact test on different steel samples

Objective:

To determine the modulus of toughness of steel in tension and in bending.

Apparatus:

- Charpy impact testing machine
- Steel samples, circular rod for tension test and specimen with square cross section for bending test

Theory:

- **Toughness**:

The ability of material to absorb energy in plastic range as load is increased from 0 to failure.

- **Modulus of toughness**:

It is the amount of work done on a unit volume of material as a simple tensile force is increased from 0 to failure.

- **Modulus of rupture:**

It is the maximum tensile stress which can be developed in the beam before failure. Or it is also amount of energy of specimen absorbed up to failure.

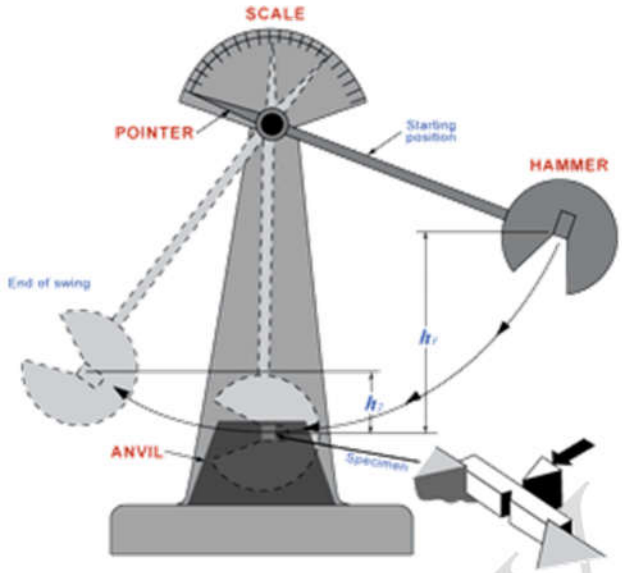
- **Modulus of elasticity:**

It is a ratio of stress and strain with in elastic limit. OR It is a energy absorbed by the specimen up to elastic limit.

Types of loads (w.r.t to magnitude):

- **Static load/dead load:** Loads which do not change their magnitude, direction and position. E.g. self-weight of anything.
- **Dynamic load/live load:** The loads which change their magnitude, direction and position. E.g. traffic load on roads, bridges.
- **Impact load**: The sudden application of the significant magnitude of load in a short interval of time. E.g. earth quack produces impact load.

impact



Components of Charpy testing machine

Absorbed energy by specimen:

$\Delta E = E_1 - E_2$

$= mgh_1 - mgh_{2\,s}$

$= mg(h_1 - h_2)$ (1)

$h_1 = h_0 + RSin(\theta_1 - 90)$

$= h0 - RCos\ 1$ (2)

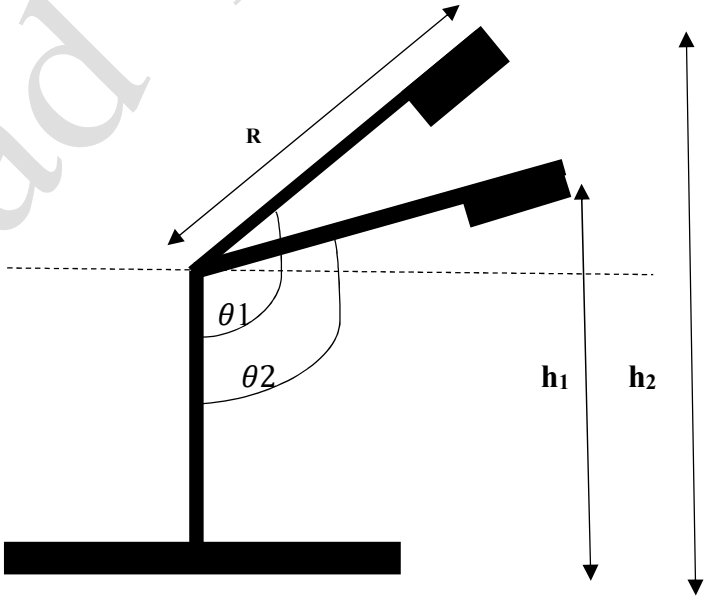
$h_2 = h_0 + RSin(\theta_2 - 90)$

$= h0 - RCos\ \theta\ 2$ (3)

Putting equations 2 and 3 in equation 1

$\Delta E = mg(h_0 - RCos\ \theta_1 - h_0 + RCos\ \theta_2)$

$\Delta E = mgR(Cos\ \theta_2 - RCos\ \theta_1)$



Procedure:

- Measure the dimensions of a specimen. Also, measure the dimensions of the fork i.e its radius and mass.

- Raise the hammer and note down initial reading from the dial, which will be energy to be used to fracture the specimen.
- Place the specimen for test and see that it is placed center with respect to hammer. Check the position of notch.
- 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.
- Repeat the test for specimens of other materials.
- Compute the energy of rupture of each specimen.

Observations and calculations

Mass of fork = 22.9 kg

Radius of fork = 0.7 m = 700 mm

Volume for tension test specimen = $0.25in^3 = 4065.91mm^3$

Volume for bending test specimen = $0.335\ in^3 = 6130.52\ mm^3$

Mass of specimen and hammer = 687g = 0.687 kg

Type of test	**Angle of fork (Degree)**		**ΔE = mgR(Cos θ 2 - RCos θ 1)**	**Volume**	**MOT= $\frac{\Delta E}{V}$**
	$\theta 1$	$\theta 2$	Nmm	mm^3	MPa
Tension	136	113	53243	4065.91	13.05
Bending	134	107	16045.17	6130.52	10.319

COMMENT

It is cleared from data that more difference between the angles will result in less modulus of toughness. From the observing the samples after experiment we can declare sample either ductile or brittle. Also we can make sample according to desired impact load by doing this experiment.