EL-PUPU IRHOWENE

15/ENG06/027

MEE 510

1. Name of Product

Dual purpose impact testing machine

2. Material selections

Mild steel

Steel

Factors to be considered in choosing the materials

The number of the components to be made

The component size

The component weight

The precision required

The surface finish and appearance required

Freedom from defects

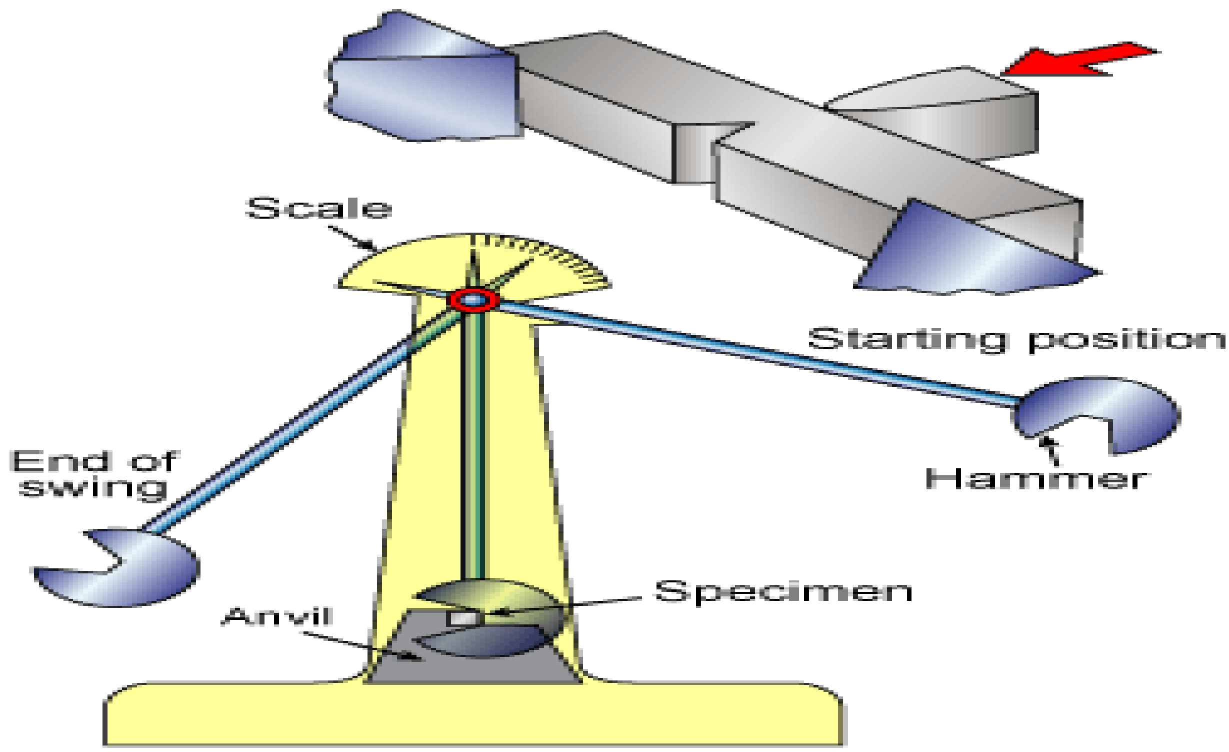
Surface finish

Dimensional accuracy and tolerances.

4. Design Specifications

H-channel 5x10 inches 1
2 channel 2 H-channel 4x7.7 inches 1
3 channel base plate 10mm mild steel plate 1
4 Base plate 10mm mild steel plate 1
5 Bearing 30mm pillow bearing 4
6 Support 10mm mild steel plate 1
7 Shaft 30mm mild steel rod 1
8 Charpy hammer 100kg hammer 1
9 Charpy fixture Mild steel block 1
10 Izod fixture Mild steel block 1
11 Display case 2mm mild steel plate 1
12 Charpy stopper 10mm mild steel plate 2
13 Charpy stopper key Mild steel rod 1
14 Izod stopper 10mm mild steel plate 1
15 Izod hammer 100kg hammer 1
16 Izod stopper key Mild steel rod 1

5. Details drawing



7. Design Calculations

Theoretical Explanation of Pendulum test

In a typical Pendulum machine, the mass of the hammer (striking edge) mass (m) is raised to a height (a). Before the mass (m) is released, the potential energy will be

$$E_p = m g a \text{ ---------------------------------------(1)}$$

After being released, the potential energy will decrease and the kinetic energy will increase. At the time of impact, the kinetic energy of the pendulum.

$$E_k = 1/2 \, m v^2 \text{ -----------------------------------(2)}$$

And the potential energy

$$E_p = m g a$$

Will be equal $E_k = E_p$

$$m g a = ½ \, m v^2$$

$$v^2 = 2 g a$$

And the impact velocity will be

$V = (2\ g\ a\ )^{1/2}$ --(3)

$a = R\ (1 – \cos \alpha)$

$b = R\ (1- \cos \beta)$

Initial energy = $E_i = m\ g\ R\ (1 – \cos \alpha) = W\ R\ (1 – \cos \alpha)$

Energy after the rupture = $E_r = m\ g\ R\ (1 – \cos \beta) = W\ R\ (1 - \cos \beta)$

Energy absorbed by the specimen = $E_{abs} = W\ R\ (\cos \beta - \cos \alpha)$

Or

Initial energy = $m\ g\ a = W\ a = E_i$

Energy after rupture = $m\ g\ b = W\ b = E_i$

Energy absorbed during impact = $m\ g\ (a – b) = W\ (a – b) = E_{abs}$

8. Design Process

An impact machine based on dropped weight principle was selected since it is able to provide impact velocity by using earth gravity. This machine is a cost effective solution compared to that using a gas gun. In the design, a specimen was fixed on top of a steel base. An impactor was elevated and then released at a certain height above the specimen. The impactor would hit the specimen with an impact speed that depends on the dropping height. The kinetic energy of the impactor was then absorbed by the progressive folding of the specimen wall, which reduced the kinetic energy of the impactor until it finally stopped. The crushing force of the specimen during the impact was sensed by using a load cell which was placed between the specimen and the steel base. The crushing force data was then recorded by a data acquisition system. A speed sensor was used to measure the speed of the impactor just before hitting the specimen. The crushing force data, the dropped weight mass and the impact speed were used in the validation of numerical analysis.

From the design principle and requirements, the dropped weight impact testing machine was designed. Based on the design objectives and following , several designs were considered and the best solution according to some previously set criteria was selected. final design of the impact testing machine which can be divided into 4 subsystems, namely: the frame that consists of guide columns, base plate and concrete block; the impactor assembly that consists of impactor frame, projectile, roller, and weighting mass; the clamp and hoist mechanism; and the instrumentation.