“Mechanics of Materials Lab”

Impact Test

- The impact test is a method for evaluating the relative toughness of engineering materials.

- Toughness a measure of the energy required to fracture a material and it depends on strength and ductility.

- Impact is a shock load which is applied for a very short time (less than one third of the lowest natural period of vibration of structure under consideration).

- Impact test is used to compare results for different types of materials.

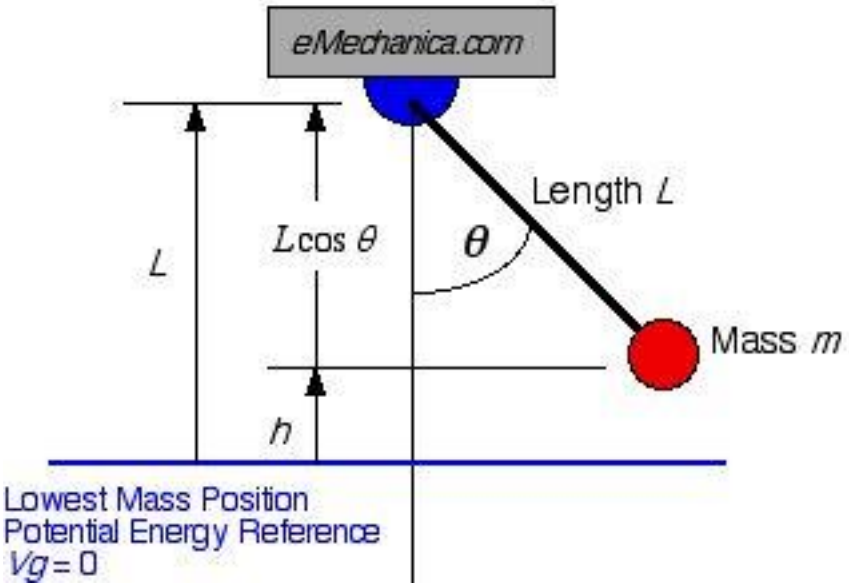
- The results obtained for a material from an impact test are sensitive to the following

1. Heat treatment
2. Compositions.
2. Sulfur and phosphorous content.

Pendulum Potential Energy

The figure below shows a pendulum of mass m and length *L* with angular psoition θ. The lowest point for the mass at zero angular position is considered as a reference for potential energy. The potential energy of the mass is found as follows

$$\begin{aligned} V_g &= \text{weight} * \text{height} \\ &= mgh = mg(L - L\cos\theta) \\ &= mgL(1 - \cos\theta). \end{aligned}$$



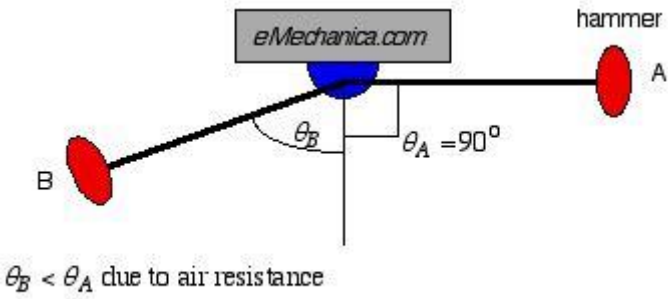
Click here to see the animation.

Impact Test using a Pendulum

Impact test is done with a pendulum whose end is a hammer (striker). The test is done in two steps. In step 1 we find the energy loss due to air resistance when the pendulum swings freely and in step 2 we calculate the energy needed to break a metallic test piece (specimen) mounted at the lowest point of the pendulum when the hammer strikes it.

Step 1: The hammer is released from a 90 degree angle (point A) and the maximum angle it swings to (point B) is recorded. The energy loss due to air resistance will be equal to the difference in potential energy between points A and B, that is

$$V_{gA} - V_{gB} = mgL(1 - \cos\theta_A) - mgL(1 - \cos\theta_B)$$
$$= mgL(\cos\theta_B - \cos\theta_A) = mgL\cos\theta_B.$$

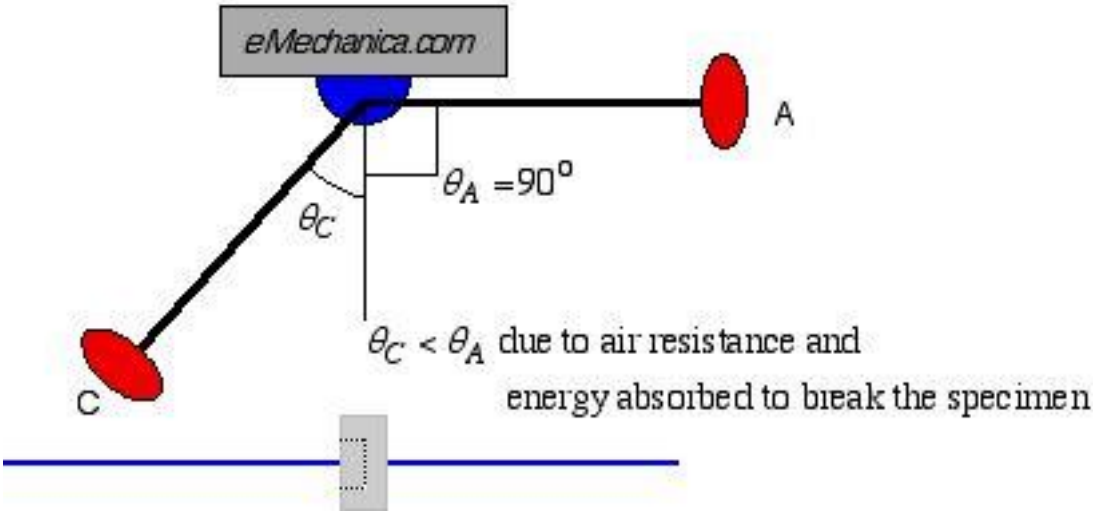


Click here to see the animation.

Step 2: Calculate the energy needed to break a specimen mounted at the lowest point of the pendulum when the hammer strikes it. In this case the pendulum swings to a

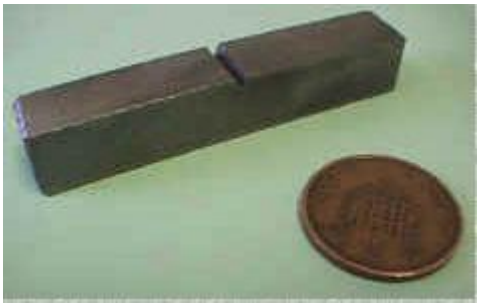
maximum height (point C) which is lower than point B above. The potential energy difference between points B and C is absorbed to break the specimen and is given as

$$V_{gB} - V_{gC} = mgL(1 - \cos\theta_B) - mgL(1 - \cos\theta_C)$$
$$= mgL(\cos\theta_C - \cos\theta_B).$$



Specimen (Test Piece)

There is a notch in the specimen as shown below in order to concentrate the stress during the impact test. This will assure that the absorbed energy will completely be used in breaking the specimen. In other words, there will be no extra energy consumed in plastic deformation of the specimen.

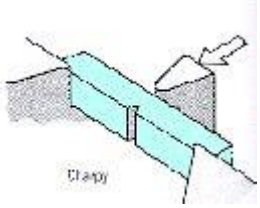
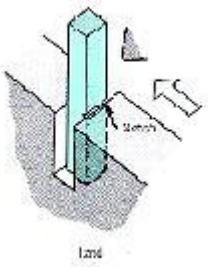


Types of impact tests

There are two types of impact tests

1. Charpy test
2. Izod test

The table below gives the differences between the two tests

Charpy	**Izod**
	
Notch opposes the hammer	Notch faces the hammer
Specimen is simply supported	Cantilever type specimen (clamped)
Simple and fast	More complicated and slower