UNIT - V

MECHANICAL PROPERTIES AND DEFORMATION MECHANISM

5.3 TESTING OF MATERIALS :

- Tension Test
- Compression Test
- Shear Load Test

1.Tension Test :

One of the most useful tests applied to metallic materials is the tensile test.

The test is conducted at room temperature by applying a gradual increasing tensile load to a standard test specimen.

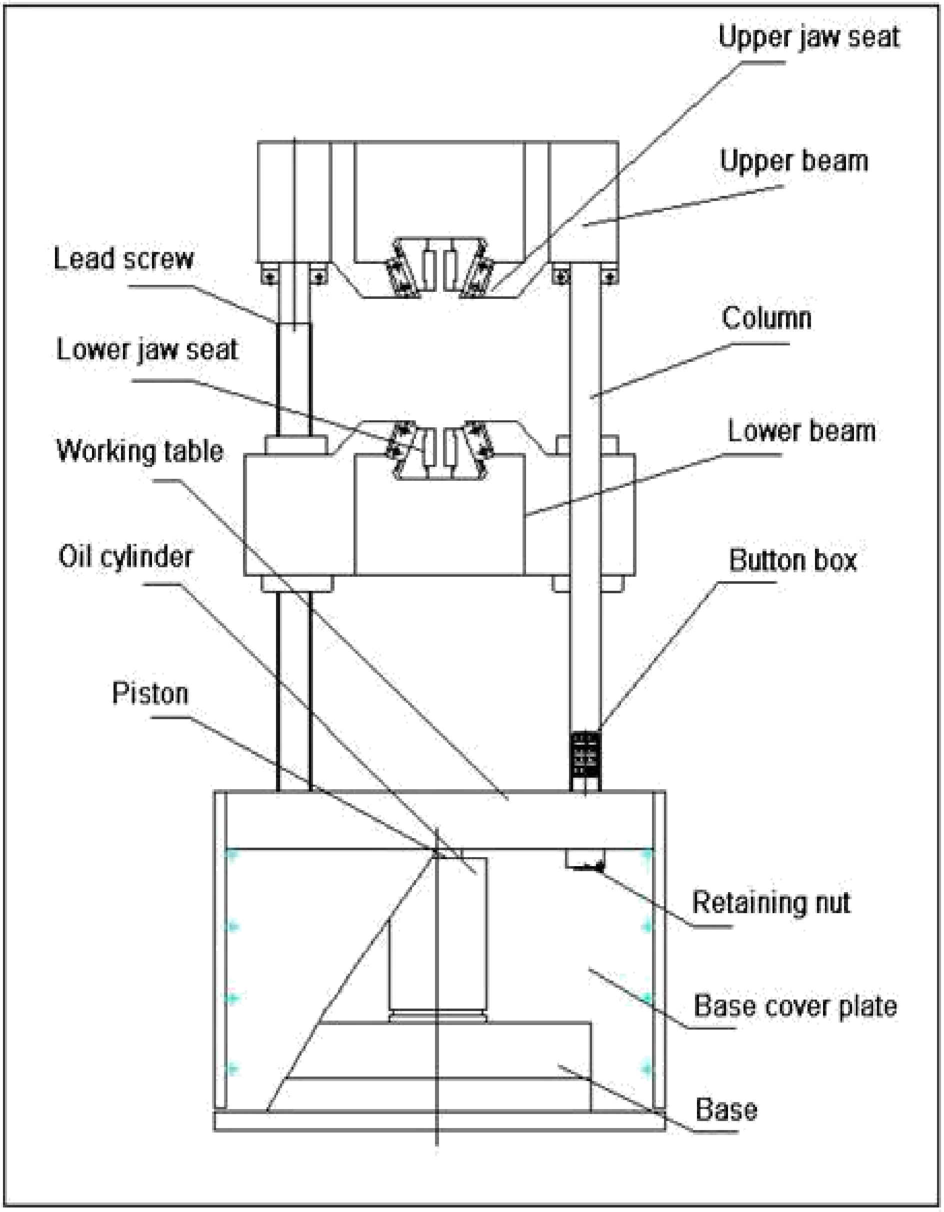

Fig 5.9 Universal Testing Machine

To conduct the test, the specimen is gripped between fixed and movable headers of universal testing machine.

In the test , load is increased gradually and corresponding stress –strain diagram is obtained with the aid of instrument , attached to the machine.

Stress –Strain diagram :

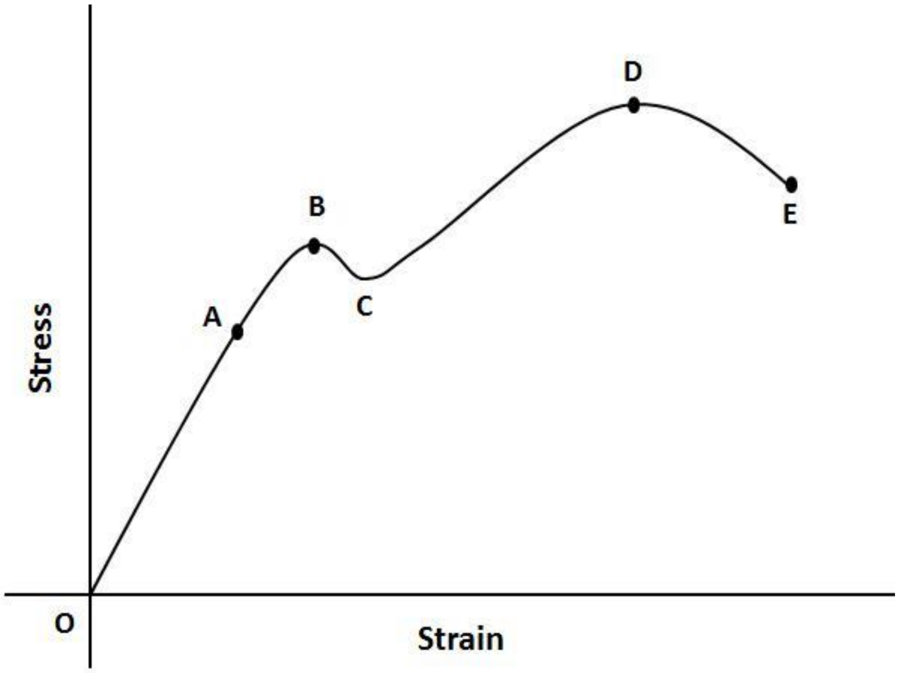

Fig 5.10 Stress-strain diagram for Tension test

A- Proportional

B- Elastic limit

C- yield point

D- tensile strength

E- Fracture

Proportional limit :

It is the maximum stress at which strain is directly proportional to the stress.

Elastic limit :

It is the maximum stress at which the specimen is deformed without fracture, under tensile load .

Yield point :

It is the minimum stress at which the specimen is deformed without an increase in load.

Tensile strength :

It is the maximum stress that a material can with stand, without fracture, under tensile load

3. Comprehension Test :

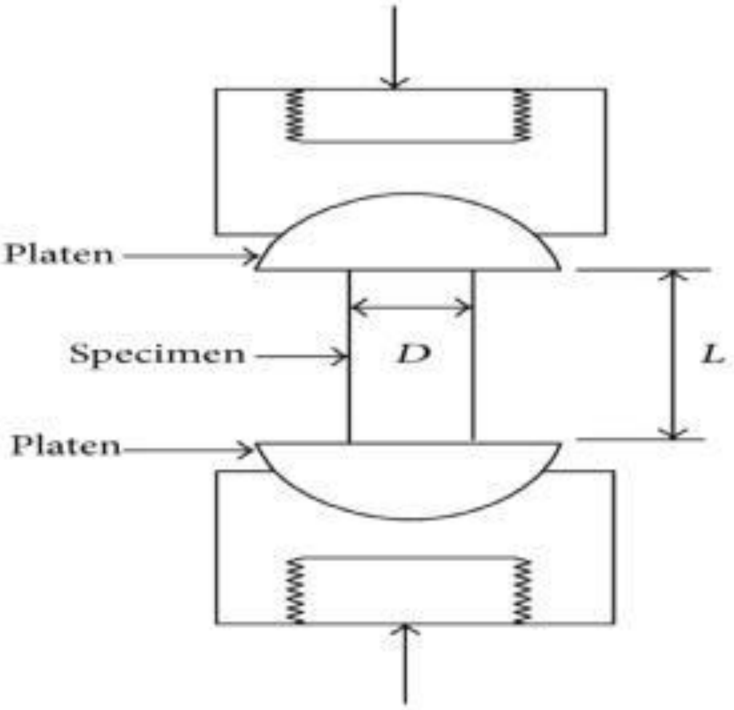

Fig 5.11 Compression test diagram

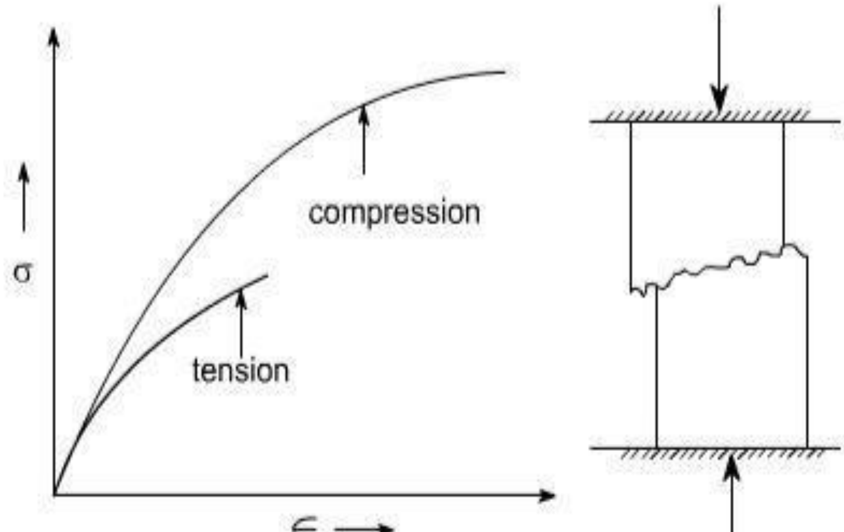

Fig 5.12 Stress strain curve for compression test

The comprehension test reverse the direction of the forces used in the tension test. In this test the stress increases rapidly hear the end of the test, due to an increase in area of the specimen. The specimen selected depends upon the metal being tested. To determine

compressive properties a specimen is usually chosen in which the length is three times the diameter.

4. Shear test:

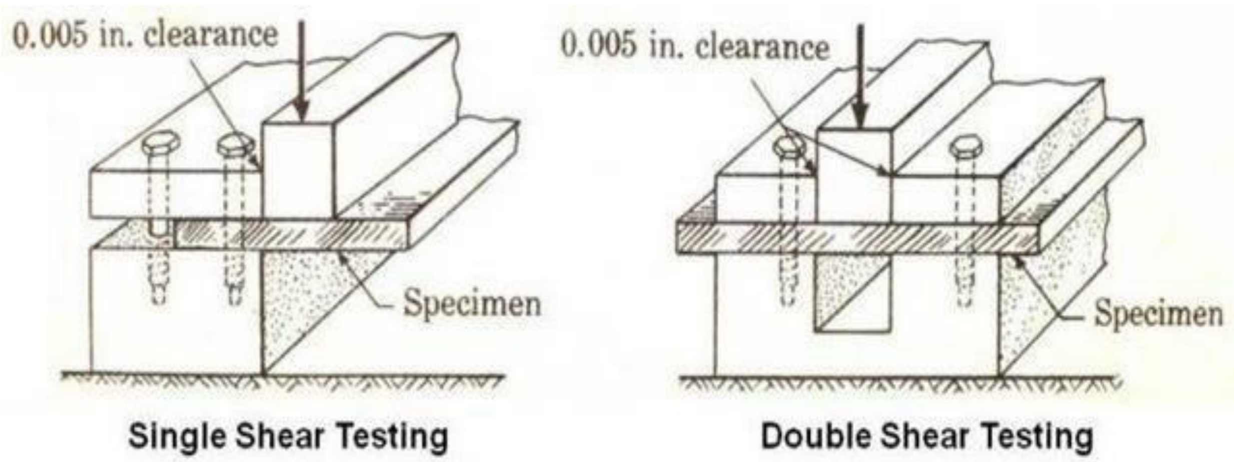

Fig 5.13 Shear test

Shear strength is the force required per unit area to produce fracture when impressed vertically upon the cross-section of a material. The methods of testing both single and double shear strength.

The percentage elongation (8) :

It is defined as the radio of the increase in the length of the specimen after fracture to its initial gauge length, expressed in percent.

$$\delta = \left(\frac{l-10}{10}\right)\times 100$$

l- length of the specimen after fracture× 10-gavge length

The percentage reduction in area (Φ) :

It is defined as the ratio of reduction in area of the necked portion of the fractured expressed in percent.

$$\Phi = \left(\frac{A_0 - A_7}{A_0} \right) \times 100$$

A_7 – cross –section area at fracture

A_0 – Initial cross –section area.

The percentage reduction in area and the percentage elongation are the two parameters to measure the ductility of the metal.

Stress – Strain diagram for various materials :

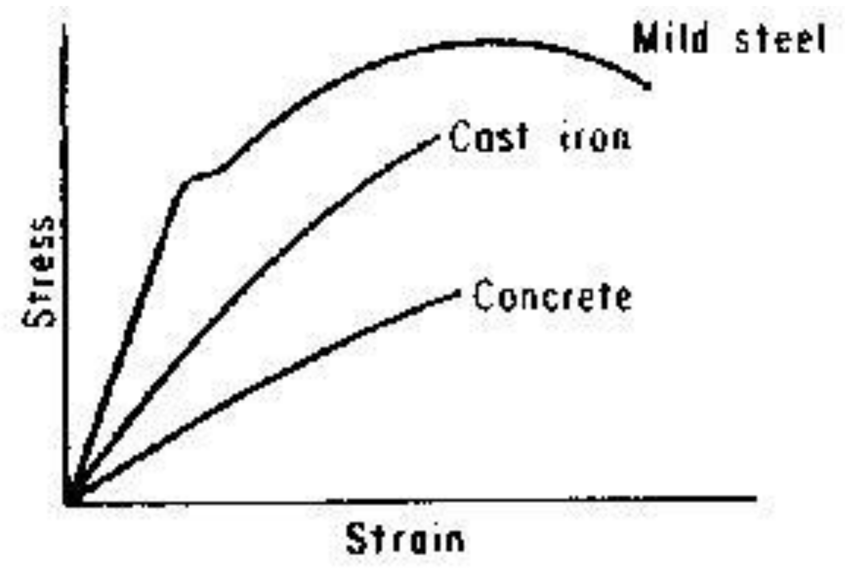

Fig 5.14 Stress-strain diagram for various materials

Shear strength may be calculated as the amount of force needed to make the shear over a given cross – sectional area.

Shear strength =

In double shear, the force and the area are doubled, resulting in the same shear strength.The shear stress is defined as the valve of load applied tangentially to same shear it off across the resisting section.

$$\text{Shear stress} = \tau = \frac{F}{A_0} \qquad \text{Shear strain, } \gamma = \tan\theta$$

F → Shear force applied along the upper and lower forces.

A_0 → Area of shear.