

**UNIT - V**  
**MECHANICAL PROPERTIES AND DEFORMATION**  
**MECHANISM**

**5.2 TYPES OF FRACTURE :**

Fracture is the separation of a body into two or more parts under stress. The applied stress may be tensile, compressive, shear or torsional.

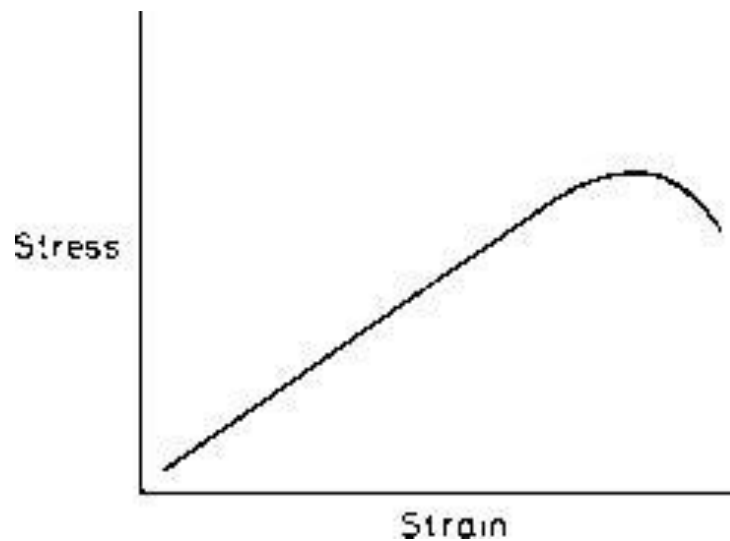
**Fracture are classified into two types :**

Brittle Fracture

Ductile Fracture

**Brittle Fracture :**

It process involves two steps crack formation and propagation. The mode of fracture is highly dependent on mechanism of crack propagation.



**Fig 5.6 Brittle Fracture**

Brittle fracture takes place without any deformation and by rapid crack propagation. In single crystals, brittle fracture occurs by fracture along a particular crystallographic planes. The failure in brittle materials was caused by many micro or fine elliptical cracks in the metal. Brittle Fracture it may occur in boilers, ships, airplanes and pipe lines.

## 2. Ductile Fracture :

It is a plastic deformation in the crack propagations. Strain energy is required high.

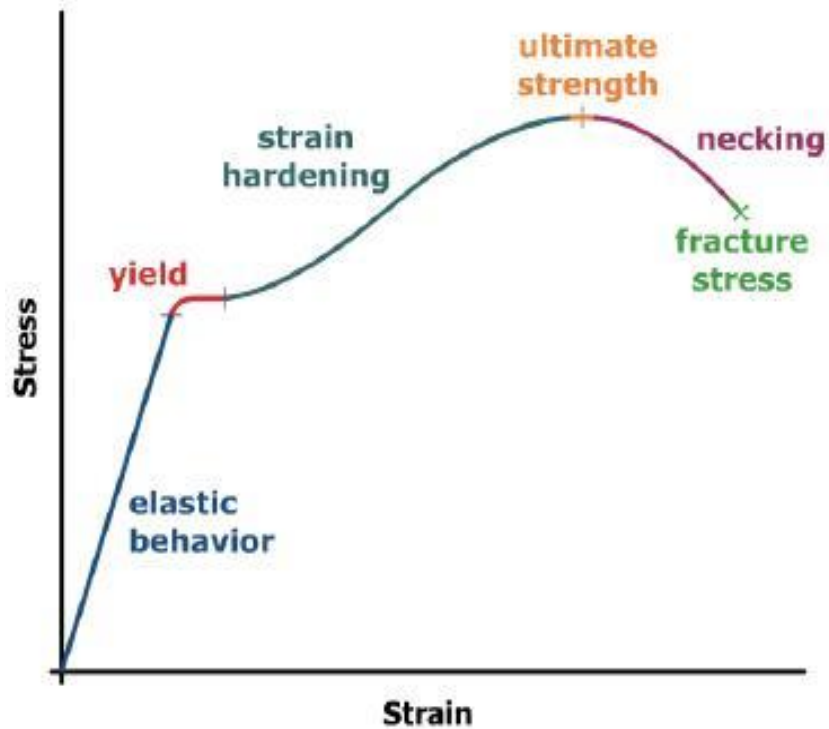


Fig 5.7 Stress strain curve for Ductile Fracture

### Ductile Fracture (Cup and Cone) :

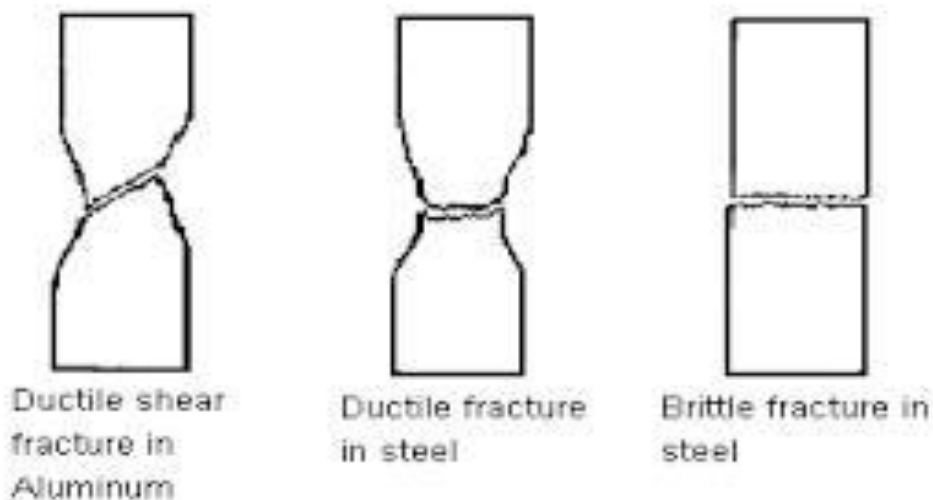


Fig 5.8 Ductile Fracture for Cup and cone

→ Neck Formation

→ Formation of crack

→ Propagation of crack

→ Final shear fracture at an angle 45° to the tensile direction.

Under tensile load, the neck formation first takes place. After necking, small cavities are formed. Next, as deformation continues, the crack continues to grow in a direction parallel to its major axis. Finally fracture occurs by the neck by shear fracture at an angle 45° to the tensile direction. A fracture having this type of surface contour is termed as cup and cone fracture because one of the mating surfaces is in the form of a cup, the other is like a cone.

### 5.6.1 COMPARISON BETWEEN BRITTLE AND DUCTILE

#### FRACTURE:

Brittle Fracture	Ductile Fracture
1. It occurs with negligible plastic Deformation	It occurs with large plastic deformation
2. Crack propagation rate is rapid	Crack propagation rate is slow
3. It follows the grain boundaries	It occurs through the grains
4. There is failure due to direct axial stress	There is failure due to shear stress.
5. It is characterized by the separations of normal to tensile stress.	It is characterized by the formation of cup and cone
6. The tendency of brittle fracture is increased with decreasing temperature and increasing strain rate.	The tendency of ductile fracture is increased with dislocations and other metal defects
7. Materials that undergo brittle fracture are glass, ceramics etc.	Materials that undergo ductile fracture are mild steel, brass etc.

**Fracture of a material by cracking may occur in many ways :**

**They are :**

Slow application of external loads (tension).

Rapid application of external loads (Impact).

Repeated cyclic loading (Fatigue).

Time and temperature dependent failure under a constant load( creep).

### **5.7 Griffith Theory :**

Griffith theorized that the failure in brittle materials was caused by the many micro or fine elliptical cracks in the metal.

