1.2. Stress – Strain diagram

Consider a wire which is rigidly fixed at one end and gradually loaded at the other end. The corresponding strain produced for the different loads are noted until the wire breaks down. A graph is plotted between strains along X- axis and stress along Y- axis. This graph is known as **stress - strain diagram**.

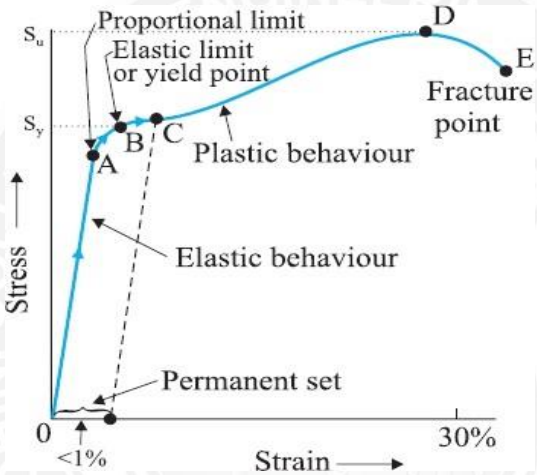

Fig.1.2.1 stress-strain diagram.

- In the region between O to A, the curve is linear. In this region, **Hooke's law** is obeyed and the solid behaves as an elastic body.
- In the region from A to B, stress and strain are not proportional. The point B in the curve is known as **yield point** (also known as **elastic limit**) and the corresponding stress is known as yield strength ($\mathbf{S_y}$) of the material.
- If the load is increased further, strain increases rapidly even for a small change in the stress. When the load is removed at point C, the body does not regain its original shape. In this case, even when the stress is zero, the strain is not zero. The material is said to have a **permanent set**. The deformation is said to **be plastic deformation**.

- At the point D on the graph, the stress developed is maximum, which is called as **ultimate tensile strength (S_u)** of the material.
- Beyond this point, additional strain is produced even by a reduced applied force and **fracture occurs at point E**. If the ultimate strength and fracture points **are close, the material is said to be brittle** and if they are **far, the material is said to be ductile**.

Uses of stress – strain diagram

1. It is used to categorize the materials (ductile, brittle and plastic).
2. It is used to found the amount of deformation.
3. It is used to calculate the strength of the materials

1.3. Factors affecting Elasticity

It is found that some bodies lose their elastic property even within the elastic limit, due to elastic fatigue. Therefore, the manufacturer should choose the material in such a way that it should regain its elastic property even when it is subjected to large number of cycles of stresses. *The temporary loss of elastic property of a body by the continuous applied strain or stress is called elastic fatigue*.

Apart from elastic fatigue, some materials will have change in their elastic property because of the following factors.

- Effect of stress
- Effect of change in temperature
- Effect of impurities
- Effect of hammering, rolling and annealing
- Effect of crystalline nature

- **Effect of stress**

When a material is subjected to large number of cycles of stresses, it loses its elastic property even within the elastic limit. Therefore, the working stress on the material should be kept lower than the ultimate tensile strength.

- **Effect of change in temperature**

  A change in temperature affects the elastic properties of a material. Normally the elasticity increases with the decrease in temperature and vice versa. For example, lead is not a good elastic material

- **Effect of impurities**

  1. The elastic property of a material is either increased or decreased due to the addition of impurities. It depends upon the elastic properties of the impurity.

  2. For example, an elastic property of gold is increases by the addition of potassium (or) copper in it.

- **Effect of hammering, rolling and annealing**

  1. The crystal grains are break up into small unit by hammering and rolling, which turns increase the elastic properties of a body.

  2. Annealing is a process to heat and cool the body gradually and it increase the crystalline size, which is ultimately reduces the elastic property of a body.

- **Effect of crystalline nature**

  The modulus of elasticity of a body is more when it is in single crystal and in polycrystalline state it is comparatively small.