UNIT – I PROPERTIES OF MATTER

TOPIC – I : Elasticity – Stress & Strain Diagram & its Uses

Introduction

A body can be changed in shape or size by the suitable application of external force on it. ***The property of a body to regain its original state on the removal of the applied force is called elasticity.***

The materials which have elasticity are known as elastic materials.

Classification of Elastic Materials

Elastic materials are classified into the following two categories:

- Elastic materials
- Plastic materials

Elastic material If materials regain their original shape or size, when the applied forces are removed are called as elastic materials.

Example: Quartz fiber.

Plastic materials If materials does not regain their original shape or size, when the applied forces are removed are called as plastic materials.

Example: Glass.

Stress

The restoring force per area is known as stress.

$$\text{Stress} = \frac{\text{Force}}{\text{Area}} = \frac{F}{A}$$

Its dimensions are $ML^{-1}T^{-2}$. Its unit is Nm^{-2}.

Stress is classified as,

- Shearing stress
- Tangential stress
- Compressive or expansive stress

Strain

The ratio of the change in any dimension to its original dimension is called as

strain. It has no unit.

Strain is classified as,

- Longitudinal strain
- Shearing strain
- Bulk Strain

Hooke's Law

Robert Hooke introduced a relation between stress and strain. This law states that ***stress is proportional to strain within the elastic limit***.

Stress α strain

$$\frac{stress}{strain} = E(constant)$$

This constant is called as coefficient of elasticity or modulus of elasticity. It depends on the nature of the material.

The dimension formula of E is $ML^{-2}T^{-2}$ and unit is Nm^{-2}.

Stress – Strain Diagram

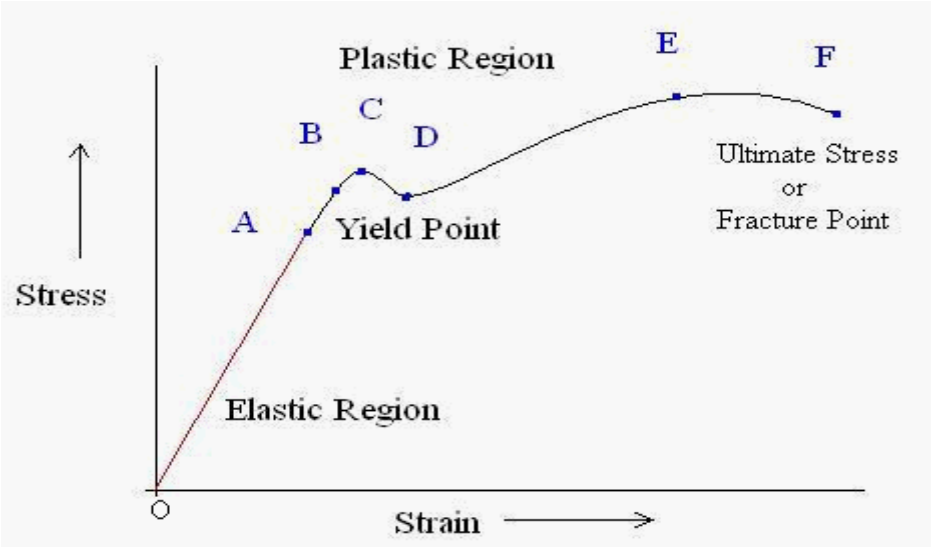

Fig.1 Stress – Strain Diagram

A fig.1.shows the graph plotted between stress and strain. In this diagram, the part *OA*, which is straight, the extension is proportional to the load and the wire obeys Hook's law. In this range, the wire remains its original when unloaded and so it is called the range of perfectly elasticity. At *A* the wire reaches **elastic limit.**

If the wire is loaded beyond *OA*, the wire not obeys Hook's law. Region *AB* is known as partially elastic and partially plastic. The strain *OC* is called as residual strain and it acquires a permanent set. At point *B*, the small addition of load causes large elongation. This point is known as **yield point.**

The region beyond point *D* and up to *F* is called plastic region. After this point, the

extension increases very rapidly depends on the time for which the load acts. The maximum load to which the wire cab be subjected, divided by its original cross sectional area is called the breaking stress. At point *E,* the solid finally breaks and this is known as the **breaking point.**

From stress – strain curve it is understand that Hooke's law is valid in elastic limit only.