UNIT - 1 STRESS, STRAIN DEFORMATION OF SOLIDS

ELASTICITY

The force acts on a body, it undergoes some deformation and the molecules offer some resistance to the deformation. It will be interesting to know that when the external force is removed, the force of resistance also vanishes; and the body springs back to its original position. But it is only possible, if the deformation, caused by the external force, is within a certain limit. Such a limit is called elastic limit. The property of certain materials of returning back to their original position, after removing the external force, is known as elasticity. A body is said to be perfectly elastic, if it returns back completely to its original shape and size, after the removal of external forces. If the body does not return back completely to its original shape and size, after the removal of the external force, it is said to be partially elastic.

STRESS

Every material is elastic in nature. That is why, whenever some external system of forces acts on a body, it undergoes some deformation. As the body undergoes deformation, its molecules set up some resistance to deformation. This resistance per unit area to deformation, is known as stress. Mathematically stress may be defined as the force per unit area i.e., stress.

$$\sigma = \mathbf{P / A}$$

where P = Load or force acting on the body, and

A = Cross-sectional area of the body.

In S.I. system, the unit of stress is pascal (Pa) which is equal to 1 N/m2. In actual practice, we use bigger units of stress i.e., megapascal (MPa) and gigapascal (GPa), which is equal to N/mm2 or kN/mm2 respectively.

STRAIN

As already mentioned, whenever a single force (or a system of forces) acts on a body, it undergoes some deformation. This deformation per unit length is known as strain. Mathematically strain may be defined as the deformation per unit length. *i.e.*, strain

$$\varepsilon = \vartheta \boldsymbol{l} / \boldsymbol{l}$$

where $\vartheta\, l$ = Change of length of the body, and

l = Original length of the body.