Introduction to Strength of Materials

Strength of materials, is concerned with methods for finding internal forces, stresses, and deflections/deformations in deformable bodies when subjected to loads. This branch of science helps to understand the behavior of a material under load, and determines its range of useful applications, Moreover, explains properties of a material by manufacturing processes or the composition of the material itself.

1.Types of Materials

Ductile Materials:

Materials that can be plastically twisted with no crack. They have the tendency to hold the deformation that occurs in the plastic region. Examples: Aluminum, Copper, and Steel.

Brittle Materials:

Materials when subjected to stress, it breaks without significant plastic deformation. Brittle materials absorb relatively little energy prior to fracture, even those of high strength. Examples: Chalk, Concrete, ceramics and glass.

2. Important Definitions

Strength: is the ability of the material to resist the influence of the external forces acting upon it.

Stress: when a force is applied to a certain cross-sectional area of an object, stress can be defined as the internal distribution of forces within the object that balance and react to the force applied to it.

Strain: is defined as the amount of deformation in the direction of the applied force divided by the initial length of the material.

Stiffness: is the ability of the object to resist the strains caused by the external forces acting upon it

Stability: is the object's property to keep its initial equilibrium position.

Durability: is the object's property to save its strength, stiffness, and stability during its lifetime.

Toughness: is the ability of a material to absorb energy and plastically deform without fracturing.

3.Types of loadings

Transverse loadings: forces applied perpendicular to the longitudinal axis of a member. Transverse loading causes the member to bend and deflect from its original position, with internal tensile and compressive strains accompanying the change in curvature of the member. Transverse loading also induces shear forces that cause shear deformation of the material and increase the transverse deflection of the member.

Axial loading: the applied forces are collinear with the member's longitudinal axis. The forces cause the member to either stretch or shorten.

Torsional loading: twisting action caused by a pair of externally applied equal and oppositely directed force couples acting on parallel planes or by a single external couple applied to a member that has one end fixed against rotation.

References

Strength of Materials Lab, Al-Khateeb L., Philadelphia University.