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Various Methods of Calculating the Stresses and Strains in Structural Members

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The field of strength of materials, also called mechanics of materials, typically refers to varied methods of calculating the stresses and strains in structural members, like beams, columns, and shafts. The methods employed to predict the response of a structure under loading and its susceptibility to varied failure modes takes into account the properties of the materials like its yield strength, ultimate strength, Young's modulus, and Poisson's ratio. Additionally, the mechanical element's macroscopic properties (geometric properties) like its length, width, thickness, boundary constraints and abrupt changes in geometry like holes are considered.

The theory began with the consideration of the behavior of 1 and two dimensional members of structures, whose states of stress are often approximated as two dimensional, and was then generalized to three dimensions to develop a more complete theory of the elastic and plastic behavior of materials. An important founding pioneer in mechanics of materials was Stephen Timoshenko.

A uniaxial stress or force acts in one direction only .When a specimen is subjected to a uniaxial loading (along its primary axis) the force acting over the cross-sectional area generates a tensile stress and strain within the fabric. A uniaxial stress or force acts in one direction only.

Uniaxial stress may be a sort of loading during which the 11 (axial) component of stress is nonzero, while all other components of stress are zero.

When external loads act on a body, internal forces are found out which resist the external forces. This internal force per unit area at any section of the body is understood as unit stress or just stress. it's denoted by the Greek letter sigma (s). Mathematically, s = = Resisting force Cross-sectional area F A Thus, stress is defined because the internal resistance developed within the body thanks to external disturbances over an unit area of its cross section. Stress at a given point doesn't only depend upon the situation of the purpose but also on the plane passing through it.

Therefore, it's a second-order tensor. In SI units, stress is typically expressed in Pascal (Pa) such 1 Pa = 1 N/m2. In actual practice, we use bigger units of stress, that is, megapascal (MPa) and gigapascal (GPa), such 1 1 10 1 1 1 10 1 6 2 2 9 2 MPa N = ¥ / / m N = mm and GPa = ¥ = N m/ kN/mm2 State of Stresses 24 Design of Machine Elements When loads act perpendicular to the axis of the member, they're called normal loads and therefore the corresponding stresses are called normal stresses. Normal stresses are caused by (i) direct loading (may be tensile or compressive) and (ii) bending (both tensile and compressive). Poisson's Ratio: When a deformable body is subjected to an axial tensile force, elongation also as lateral contraction occurs. for instance , if a ingot is stretched, both the thickness and width decrease while the length increases. Likewise, the compressive force working on a body causes it to accept the direction of force and its sides expand laterally. Poisson's ratio is that the ratio of lateral strain to linear strain. Within the elastic range, Poisson's ratio lies between 0.25 and 0.33 for many engineering materials.