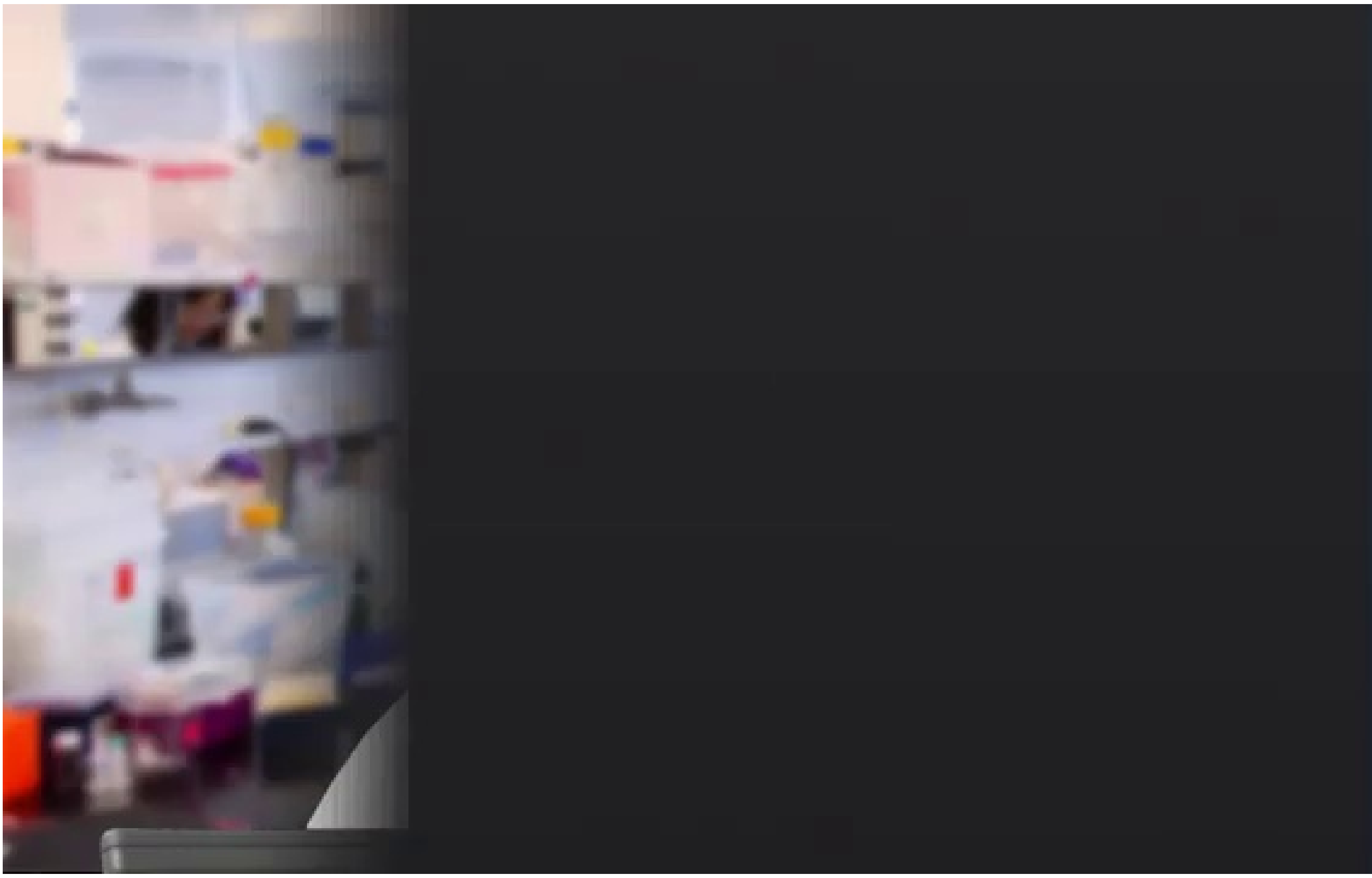


Types of Stress

Basically three different types of stresses can be identified.

Tensile Stress occurs when a material is subjected to pulling or stretching force.

Types of Stress

Basically three different types of stresses can be identified.

Tensile Stress occurs when a material is subjected to pulling or stretching force.

Compressive Stress is the stress that, when applied, acts towards the center of that material. When a material is subjected to compressive stress, then this material is under compression. Usually, compressive stress applied to bars, columns, etc. leads to shortening.

Types of Stress

Basically three different types of stresses can be identified.

Tensile Stress occurs when a material is subjected to pulling or stretching force.

Compressive Stress is the stress that, when applied, acts towards the center of that material. When a material is subjected to compressive stress, then this material is under compression. Usually, compressive stress applied to bars, columns, etc. leads to shortening.

Shear Stress is a stress state in which the shape of a material tends to change (usually by "sliding" forces) without particular volume change.

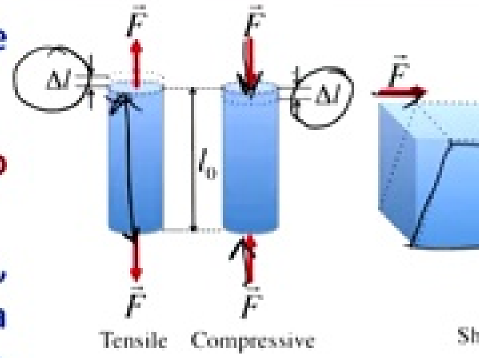
Types of Stress

Basically three different types of stresses can be identified.

Tensile Stress occurs when a material is subjected to pulling or stretching force.

Compressive Stress is the stress that, when applied, acts towards the center of that material. When a material is subjected to compressive stress, then this material is under compression. Usually, compressive stress applied to bars, columns, etc. leads to shortening.

Shear Stress is a stress state in which the shape of a material tends to change (usually by "sliding" forces) without particular volume change.



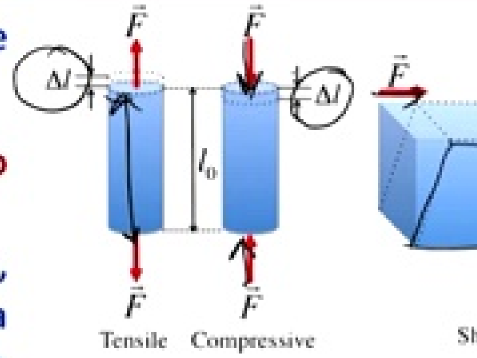
Types of Stress

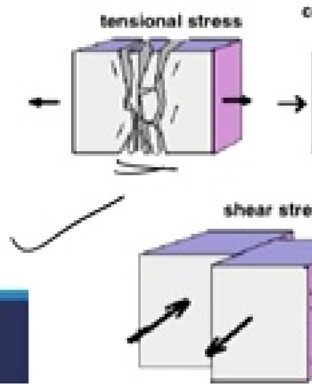
Basically three different types of stresses can be identified.

Tensile Stress occurs when a material is subjected to pulling or stretching force.

Compressive Stress is the stress that, when applied, acts towards the center of that material. When a material is subjected to compressive stress, then this material is under compression. Usually, compressive stress applied to bars, columns, etc. leads to shortening.

Shear Stress is a stress state in which the shape of a material tends to change (usually by "sliding" forces) without particular volume change.





Compressive Stress

Stress

The term stress (s) is used to express the loading in terms of force applied to a c
cross-sectional area of an object. From the perspective of loading, stress is the ap
force or system of forces that tends to deform a body.

Strain

Normal stress on a body causes change in length or volume and tange
stress produces change in shape of the body. The ratio of change produc
the dimensions of a body by a system of forces, in equilibrium, to its ori
dimensions is called strain.

Strain

Normal stress on a body causes change in length or volume and tang
stress produces change in shape of the body. The ratio of change produc
the dimensions of a body by a system of forces, in equilibrium, to its or
dimensions is called strain.

Strain

Normal stress on a body causes change in length or volume and tang
stress produces change in shape of the body. The ratio of change produc
the dimensions of a body by a system of forces, in equilibrium, to its or
dimensions is called strain.

$$\text{Strain} = \frac{\text{Change in Dimension}}{\text{Original Dimension}}$$

When a material is stretched, the change in length and the strai
positive. When it is compressed, the change in length and strai
negative.

Strain

Normal stress on a body causes change in length or volume and tang
stress produces change in shape of the body. The ratio of change produc
the dimensions of a body by a system of forces, in equilibrium, to its ori
dimensions is called strain.

$$\text{Strain} = \frac{\text{Change in Dimension}}{\text{Original Dimension}}$$

When a material is stretched, the change in length and the strai
positive. When it is compressed, the change in length and strai
negative.

This conforms with the signs of the stresses which would accom
these strains, tensile stresses being positive and compressive stre
negative.

Strain

Normal stress on a body causes change in length or volume and tang
stress produces change in shape of the body. The ratio of change produc
the dimensions of a body by a system of forces, in equilibrium, to its or
dimensions is called strain.

$$\text{Strain} = \frac{\text{Change in Dimension}}{\text{Original Dimension}}$$

When a material is stretched, the change in length and the strai
positive. When it is compressed, the change in length and strai
negative.

This conforms with the signs of the stresses which would accom
these strains, tensile stresses being positive and compressive stre
negative.

Volume Strain

- ✓ It is the ratio of the change in volume of a body to its or volume. If V is the original volume of a body and $V + \Delta V$ is the volu the body under the action of a normal stress.

Volume Strain

✓ It is the ratio of the change in volume of a body to its or volume. If V is the original volume of a body and $V + \Delta V$ is the volur the body under the action of a normal stress.

$$\text{Volume Strain} = \frac{\text{Change in Volume}}{\text{Original Volume}} = \frac{\Delta V}{V}$$

Stress-Strain Relationship

Induced Stresses

Elastic deformation is induced by a load such that when the load is removed, the part resumes its original shape. Under service conditions various parts of the equipment will be subjected to a variety of induced stresses. Various types of stresses are induced, depending upon the loading condition, and are classified as: tensile, compressive, shear, bending and torsion.

Materials undergo strain when they are subjected to stress.

Stress-Strain Relationship

Induced Stresses

Elastic deformation is induced by a load such that when the load is removed, the part resumes its original shape. Under service conditions various parts of the equipment will be subjected to a variety of induced stresses. Various types of stresses are induced, depending upon the loading condition, and are classified as: tensile, compressive, shear, bending and torsion.

Materials undergo strain when they are subjected to stress.

Stress-Strain Relationship

Induced Stresses

Elastic deformation is induced by a load such that when the load is removed, the part resumes its original shape. Under service conditions various parts of the equipment will be subjected to a variety of induced stresses. Various types of stresses are induced, depending upon the loading condition, and are classified as: tensile, compressive, shear, bending and torsion.

Materials undergo strain when they are subjected to stress.

Stress

The term stress (s) is used to express the loading in terms of force applied to a c
cross-sectional area of an object. From the perspective of loading, stress is the ap
force or system of forces that tends to deform a body.

Stress-Strain Relationship

Induced Stresses

Elastic deformation is induced by a load such that when the load is removed, the part resumes its original shape. Under service conditions various parts of the equipment will be subjected to a variety of induced stresses. Various types of stresses are induced, depending upon the loading condition, and are classified as: tensile, compressive, shear, bending and torsion.

Materials undergo strain when they are subjected to stress.

Stress-Strain Relationship

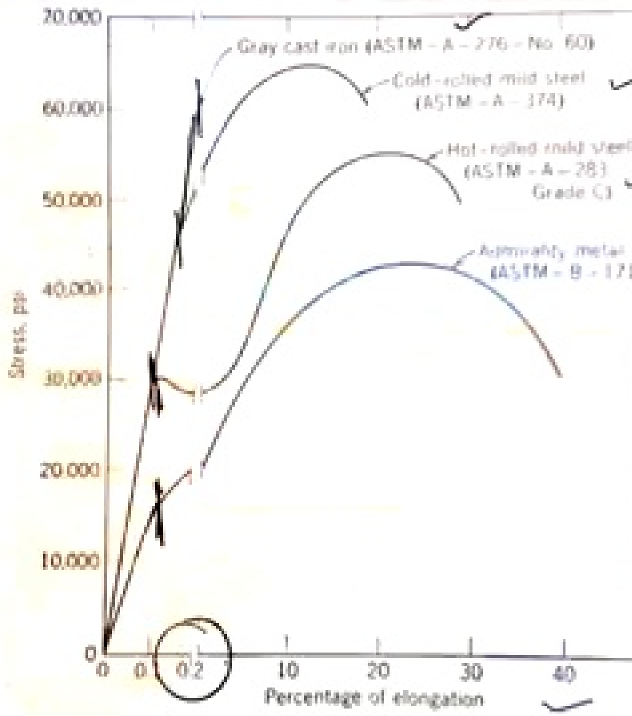
Induced Stresses

Elastic deformation is induced by a load such that when the load is removed, the part resumes its original shape. Under service conditions various parts of the equipment will be subjected to a variety of induced stresses. Various types of stresses are induced, depending upon the loading condition, and are classified as: tensile, compressive, shear, bending and torsion.

Materials undergo strain when they are subjected to stress.

Stress-Strain Relationship

Typical stress-strain curves for a few selected materials



Stress-Strain Relationship

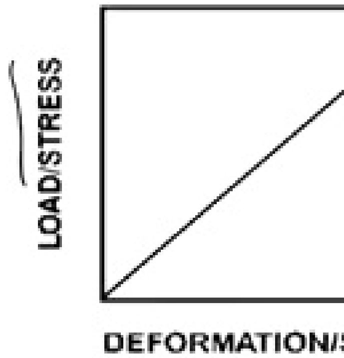
Suppose a material is subject to a uniaxial tensile load. It will deforn
manner characteristic of the material. Examples of possible behavic
linear where materials obey the behaviour, *linear elastic*.

Stress-Strain Relationship

Suppose a material is subject to a uniaxial tensile load. It will deform manner characteristic of the material. Examples of possible behavic linear where materials obey the behaviour, *linear elastic*.

This means that stresses and strains are assumed to be related by *Hooke's Law.* In its simplest form, Hooke's Law can be stated as:

where the constant is known as an *elastic modulus or simply a modulus.*



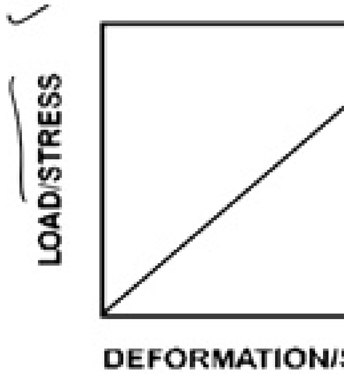
Stress-Strain Relationship

Suppose a material is subject to a uniaxial tensile load. It will deforn manner characteristic of the material. Examples of possible behavic linear where materials obey the behaviour, *linear elastic.*

This means that stresses and strains are assumed to be related by *Hooke's Law.* In its simplest form, Hooke's Law can be stated as:

$$\frac{\text{stress}}{\text{strain}} = \text{constant}$$

where the constant is known as an *elastic modulus or simply a modulus.*



Therefore, $$\frac{\sigma}{\varepsilon} = E$$

For normal stress along the x direction only $$\frac{\sigma_x}{\varepsilon_x} = E$$

Stress-Strain Relationship

Poisson's Ratio

Stress-Strain Relationship

Poisson's Ratio

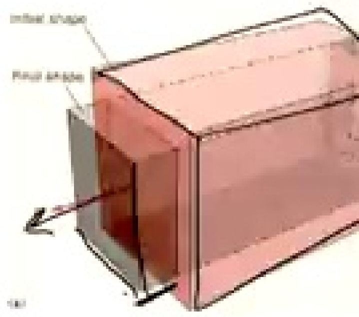
When a specified segment of metal is loaded in one direction only
resulting induced stress and corresponding strain, strain is also induc
a direction or directions at right angles to the induced stress.

Stress-Strain Relationship

Poisson's Ratio

When a specified segment of metal is loaded in one direction only resulting induced stress and corresponding strain, strain is also induc a direction or directions at right angles to the induced stress.

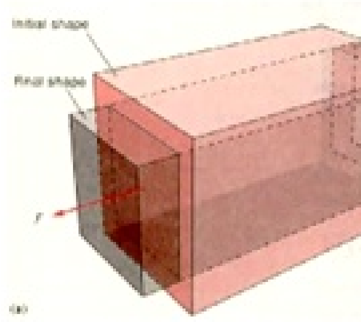
Suppose the stress is tensile, and the specimen of material is stretched along x. Then, it will get thinner across the direction of stretching, in the y and z directions,



Stress-Strain Relationship

Poisson's Ratio

Experiments have proved that such axial elongation is related to the correspor
lateral contraction. The ratio of these two deformations is a constant withi
elastic limit and is known as Poisson's ratio. The ratio is expressed as



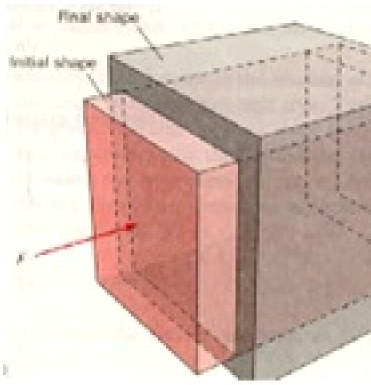
Stress-Strain Relationship

Poisson's Ratio

Experiments have proved that such axial elongation is related to the correspon
lateral contraction. The ratio of these two deformations is a constant withi
elastic limit and is known as Poisson's ratio. The ratio is expressed as

$$\mu = \frac{\varepsilon_c}{\varepsilon_e}$$

Where,
ε_c = unit lateral contraction
ε_e = unit axial elongation



This relationship may be used to calculate the lateral expansion resulting from axial compression of a material.

Stress

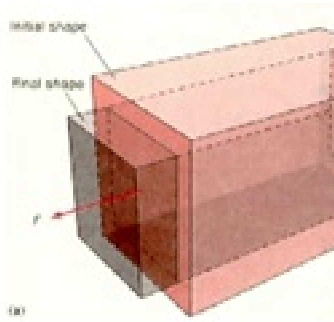
The term stress (s) is used to express the loading in terms of force applied to a c
cross-sectional area of an object. From the perspective of loading, stress is the ap
force or system of forces that tends to deform a body.

Stress is the internal distribution of forces within a body. The stress distributio
or may not be uniform, depending on the nature of the loading conditio
example, a bar loaded in pure tension will essentially have a uniform tensile
distribution. However, a bar loaded in bending will have a stress distributio
changes with distance perpendicular to the normal axis.

Stress-Strain Relationship

Biaxial stress

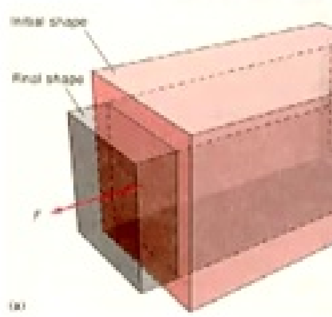
When a rectangular block of some material is subjected to tensile stresses in two perpendicular directions, the resultant elongation in one direction will depend not only upon the tensile stress in this direction but also upon the stress in the perpendicular direction.



Stress-Strain Relationship

Biaxial stress

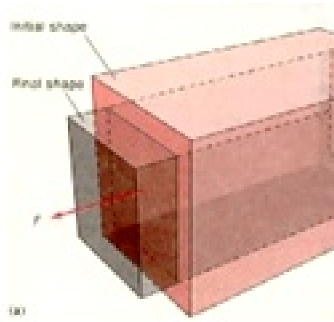
When a rectangular block of some material is subjected to tensile stresses in two perpendicular directions, the resultant elongation in one direction will depend not only upon the tensile stress in this direction but also upon the stress in the perpendicular direction.



Stress-Strain Relationship

Biaxial stress

When a rectangular block of some material is subjected to tensile stresses in two perpendicular directions, the resultant elongation in one direction will depend not only upon the tensile stress in this direction but also upon the stress in the perpendicular direction.



If one refers to one direction as x and other is y, the unit elongation in x axis due to tensile stress, σ_x, will be

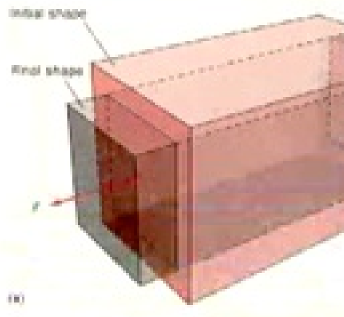
$$\varepsilon_1 = \frac{\sigma_x}{E}$$

The tensile stress in y direction, σ_y, will produce an elongation, ε_2, in y direction and a lateral contraction, ε_c, in x direction.

$$\varepsilon_2 = \frac{\sigma_y}{E}$$

Stress-Strain Relationship

Biaxial stress



The expressions of stresses as function of ε_1 and ε_2 are

$$\sigma_x = \frac{(\varepsilon_x + \mu\varepsilon_y)E}{1-\mu^2} \qquad \sigma_y = \frac{(\varepsilon_y + \mu\varepsilon_x)E}{1-\mu^2}$$

Stress-Strain Relationship

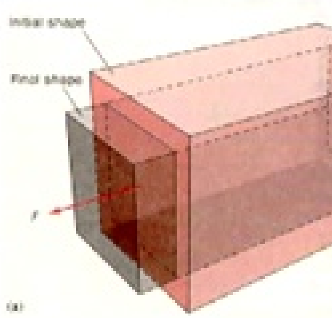
Tri-axial stress

The corresponding net unit elongation, ε_2, in y direction will be

$$\varepsilon_y = \frac{1}{E}\left(\sigma_y - \mu\left(\sigma_z + \sigma_x\right)\right)$$

The net unit elongation, ε_3, in z direction will be

$$\varepsilon_z = \frac{1}{E}\left(\sigma_z - \mu\left(\sigma_x + \sigma_y\right)\right)$$



Stress-Strain Relationship

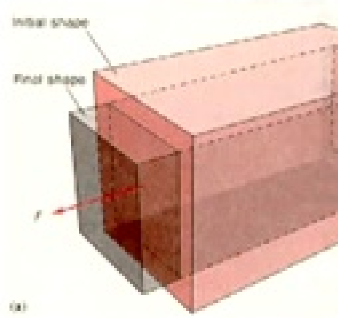
Tri-axial stress

The corresponding net unit elongation, ε_2, in y direction will be

$$\varepsilon_y = \frac{1}{E}\left(\sigma_y - \mu\left(\sigma_z + \sigma_x\right)\right)$$

The net unit elongation, ε_3, in z direction will be

$$\varepsilon_z = \frac{1}{E}\left(\sigma_z - \mu\left(\sigma_x + \sigma_y\right)\right)$$



All these equations are valid for compressive effects also. It is only necessa assign positive signs to elongations and tensile stresses, and, conver negative signs to contractions and compressive stresses.

Stress-Strain Relationship

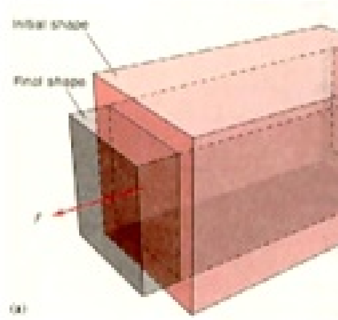
Tri-axial stress

The corresponding net unit elongation, ε_2, in y direction will be

$$\varepsilon_y = \frac{1}{E}\left(\sigma_y - \mu\left(\sigma_z + \sigma_x\right)\right)$$

The net unit elongation, ε_3, in z direction will be

$$\varepsilon_z = \frac{1}{E}\left(\sigma_z - \mu\left(\sigma_x + \sigma_y\right)\right)$$



All these equations are valid for compressive effects also. It is only necessa assign positive signs to elongations and tensile stresses, and, conver negative signs to contractions and compressive stresses.

Stress

The term stress (s) is used to express the loading in terms of force applied to a c
cross-sectional area of an object. From the perspective of loading, stress is the ap
force or system of forces that tends to deform a body.

Stress is the internal distribution of forces within a body. The stress distributio
or may not be uniform, depending on the nature of the loading conditio
example, a bar loaded in pure tension will essentially have a uniform tensile
distribution. However, a bar loaded in bending will have a stress distributio
changes with distance perpendicular to the normal axis.

The force acting per unit area is defined as stress $\sigma = \frac{F}{A}$


Types of Stress