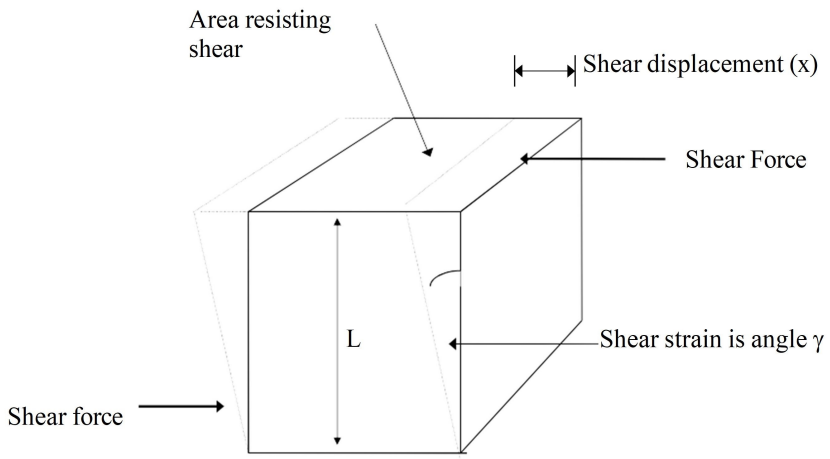
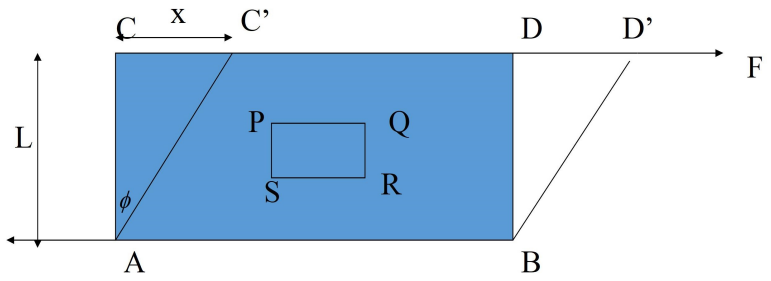
Shear stress and strain



Shear Stress and Shear Strain Contd.



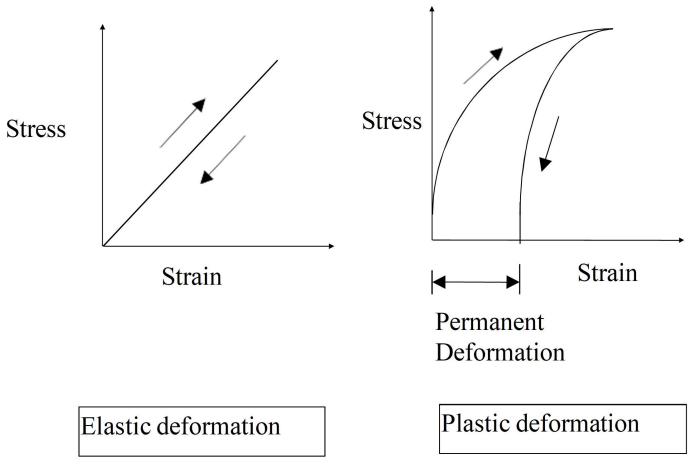
Shear strain is the distortion produced by shear stress on an element or rectangular block as above. The shear strain, γ (gamma) is given as:

$\gamma = x/L = \tan \phi$

Shear Stress and Shear Strain Concluded

- For small ϕ $\gamma = \phi$
- Shear strain then becomes the change in the right angle.
- It is dimensionless and is measured in radians.

Elastic and Plastic deformation



Elastic deformation

Plastic deformation

Modulus of Elasticity

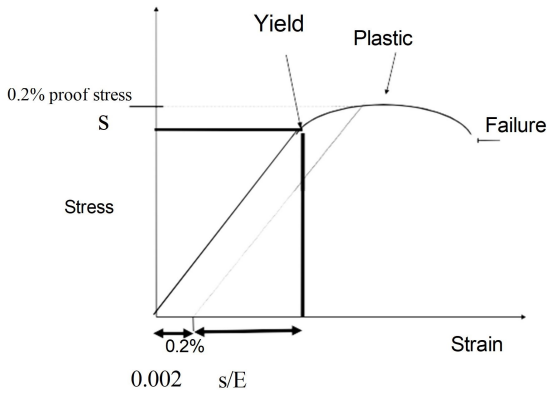
If the strain is "elastic" Hooke's law may be used to define

$$Youngs\ Modulus \quad E = \frac{Stress}{Strain} = \frac{W}{x} \times \frac{L}{A}$$

Young's modulus is also called the modulus of elasticity or stiffness and is a measure of how much strain occurs due to a given stress. Because strain is dimensionless Young's modulus has the units of stress or pressure

How to calculate deflection if the proof stress is applied and then partially removed.

If a sample is loaded up to the 0.2% proof stress and then unloaded to a stress s the strain x = 0.2% + s/E where E is the Young's modulus



Volumetric Strain

- Hydrostatic stress refers to tensile or compressive stress in all dimensions within or external to a body.
- Hydrostatic stress results in change in volume of the material.
- Consider a cube with sides x, y, z. Let dx, dy, and dz represent increase in length in all directions.
- i.e. new volume = (x + dx) (y + dy) (z + dz)

Volumetric Strain Contd.

Neglecting products of small quantities:

New volume = x y z + z y dx + x z dy + x y dz

Original volume = x y z

= z y dx + x z dy + x y dz

Volumetric strain, $\Delta V = \underline{z\ y\ dx + x\ z\ dy + x\ y\ dz}$

ε_v x y z

ε_v = dx/x + dy/y + dz/z

$$\varepsilon_v = \varepsilon_x + \varepsilon_y + \varepsilon_z$$