Tensile/Compressive Stress

$$\sigma = \frac{P}{A_0}$$
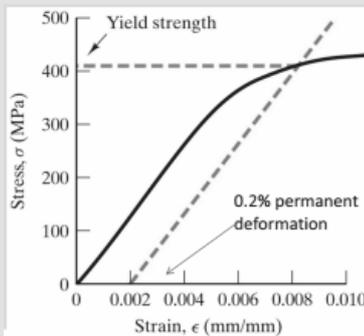
P: load
Ao: Original cross-sectional area before loading

Shear strain

$$\gamma = \frac{\Delta y}{z_0} = \tan \alpha$$
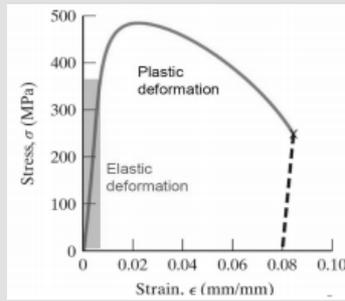
alpha: angular displacement
Strain is dimensionless

Yield strength

Shear stress

$$\tau = \frac{P_S}{A_0}$$

Stress vs. Strain Curve

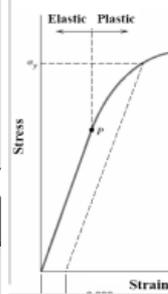
Tensile/Compressive strain

$$\epsilon = \frac{l - l_0}{l_0} = \frac{\Delta l}{l_0}$$

E: Tensile/compressive strain
l: length

Elastic/plastic deformation

Elastic deformation

Reversible: when the stress is removed, the material returns to the dimensions it had before the loading.

Usually strains are small (except for the case of some plastics, e.g. rubber).

Plastic deformation

Irreversible: when the stress is removed, the material does not return to its original dimensions.
The stress-strain curve is non-linear.