MIME 262, Lecture 21, April 4, 2012

Group # : 19

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Mechanicals properties

Engineering Stress: Pressure due to applied load.

Units for stress: Newtons/m^2

megapascal = 10^6 ,

1. $\sigma = F/A_0$ tensile[1] or compressive[2] stress.

A_0=Original cross section area.
F=Applied force.

- In tension and compression tests, the relevant area is that perpendicular to the force
- In shear or torsion tests, the area is perpendicular to the axis of rotation.
- Force divided by area is called stress.

2. $\tau = F/A_0$ shear[3] or torsion[4] stress
   - τ is the stress. This symbol is more used to describe shear and torsion stress.

Engineering Strain: Response of the material to stress (i.e. physical deformation), degree of deformation.

Strain is unit less .

$\varepsilon = (L_i - L_o)/ L_o$

L_i= instantaneous length, L_o=Original length

Pure Shear Strain: $\gamma = \tan\theta$

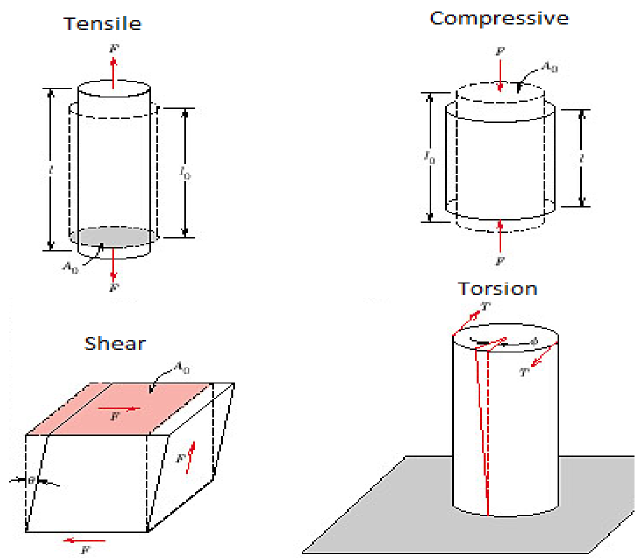
γ = strain θ is the angle

Stress and strain:

"Types of Loading"

1) Tension
2) Compression
3) Shear
4) Torsion

Stress and strain are positive for tensile loads, negative for compressive loads.



True Stress :

$$\sigma = F/A_i$$

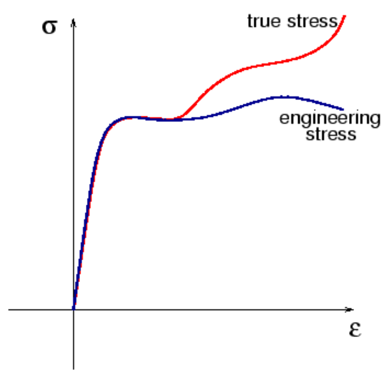
$A_{i=}$ Instantaneous Cross sectional area.

True Strain:

$$\varepsilon = \ln (L_i/L_o)$$

$L_{i\,=}$ *instantaneous length*

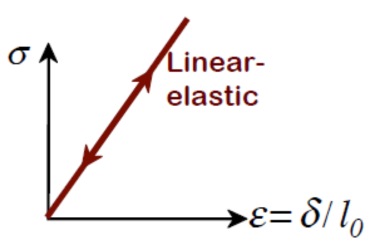
L_o*=Original length*



Stress-Strain Behavior

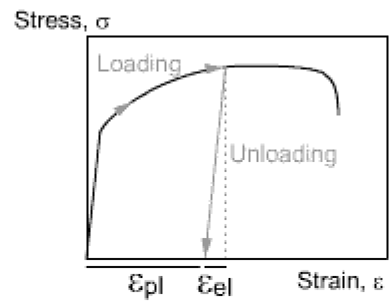
Elastic deformation

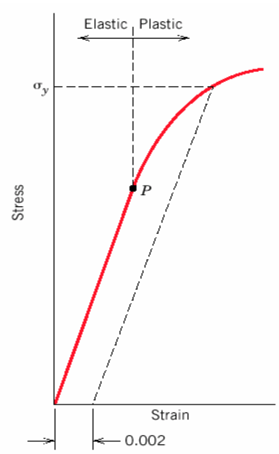
Reversible: When the stress is removed, the material regains its original dimensions before the loading.
Usually strains are small (except for some plastics and rubber).



Plastic deformation

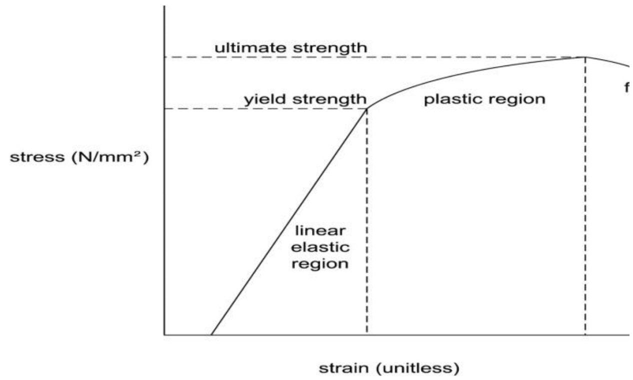
Irreversible: When the stress is removed, the material do not regains its original dimensions.





-Yielding strength: the point when a material "yields".
1) Start at 0.002 (for almost all metals)
2) Draw a line parallel to the linear region
3) σ_y Is where the dotted line cross the stress-strain curve

- Mixed Elastic-Plastic Behaviour beyond P

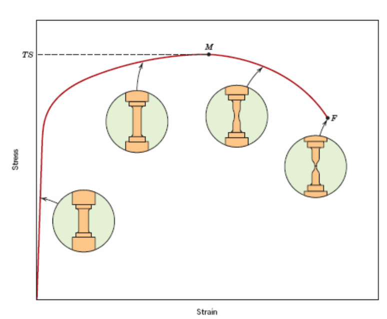


- Ultimate Tensile Strength(σ_u) indicates the strength of material and is a Maximum Engineering stress a material can sustain.

-However, it is only suitable for ductile materials.

-Metals: σ_u depend on the average size of flaw. (material property)

-Ceramics: σ_u depend on largest flaw (Not a material property)



-Beyond UTS necking starts and eventually material breaks at the fracture point

The stress-strain relationship is called Hooke's law:

$\sigma = E\,\varepsilon$

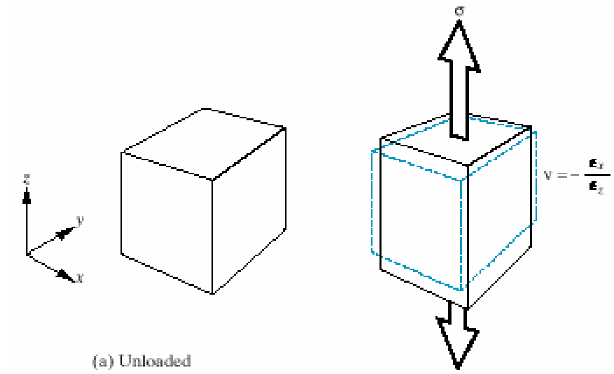
E = Young Modulus

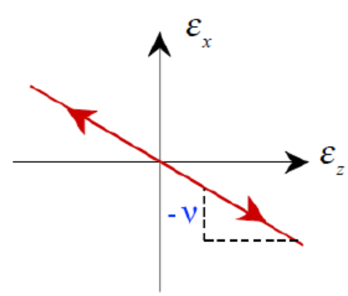
(Slope of Stress to Strain graph)

It is material resistance to elastic deformation.

Poisson`s ratio

The Poisson's ratio of a stable, isotropic, linear elastic material cannot be less than −1.0 nor greater than 0.5 due to the requirement that Young's modulus, the shear modulus and bulk modulus have positive values.





$V = -\varepsilon_x / \varepsilon_z = -\varepsilon_y / \varepsilon_z$

Range of V :-

-1<V<0.5

-V is dimensionless.