



**School of Mechanical and Building Sciences**

**BMEE 202 Strength of Materials**

**Unit 1**

**Stresses and Strains**

**By**

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# **STRENGTH OF MATERIALS**

**Study of behavior of bodies (Deformation, internal stress distributions ) before failure.**

# Outline

- Introduction
- Normal stress
- Shear stress
- Bearing stress
- Strain
- Stress-strain curves
- Elastic constants
- Poisson's ratio
- Relation between elastic constants
- Thermal stresses
- Strain energy

# Force applied

- **Rigid body** - No changes in -Shape & Size
- **Deformable bodies** -changes in size & shape

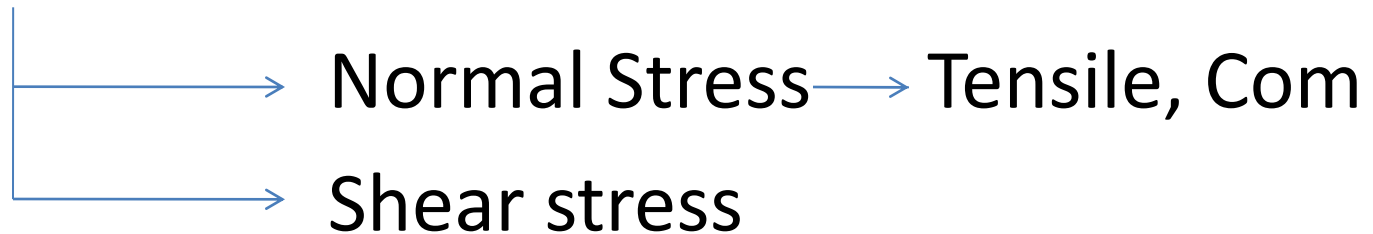
# stress

- **When a body subjected to external forces ,it get deformed. Internal forces are developed within the body which oppose deformation.**

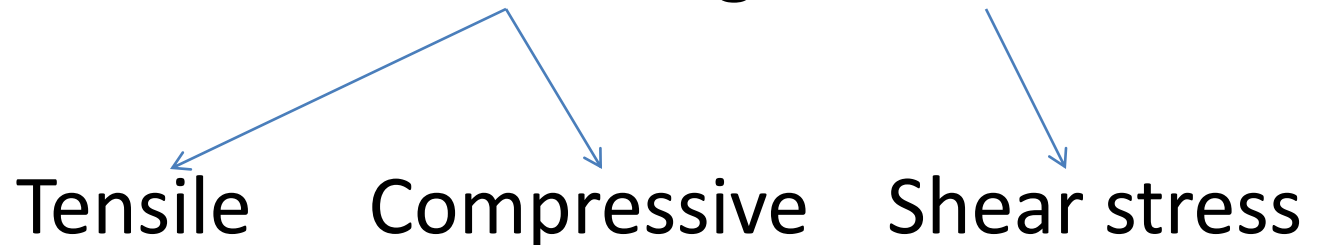


# Stress

- **Direct stress-** due to applied force



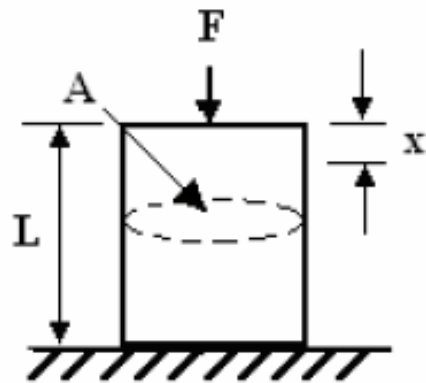
- **Indirect stress-** Due to bending & torsion



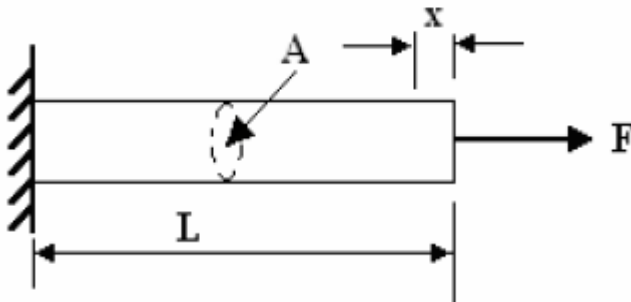
# Stress and strain

## DIRECT STRESS

When a force is applied to an elastic body, the body deforms. The way in which the body deforms depends upon the type of force applied to it.



Compression force makes the body shorter.



A tensile force makes the body longer



# stress

- The force of resistance offered by a body against the deformation is called **stress**.

$$\text{Stress} = \sigma = \frac{\text{Force}}{\text{Area}} = \frac{F}{A} = \text{N/m}^2$$

# strain

- When straight member is loaded axially, it undergoes a change in length.
  - The ratio of change in length to the original length of the member is called **strain**.
- strain**= Change in length/Original length

$$e = \Delta l / l$$

# Elasticity

- Property of material to regain its original shape and dimension after removing external *load*.

## Plasticity

Property of material to remain in its original shape and dimension permanently even after removing external *load*

## **Strength**

**Ability of material to resist failure under the action of load**

## **Hardness**

**Ability of material to resist surface abrasion or penetration by other bodies**

## **Toughness**

**Ability of material to absorb shock energy without failure.**

## **Stiffness**

**Property of a material to resist deformation under the action of external load**

## **Ductility**

**Property of material which allows it to be drawn into thin wires without breaking by applying a tensile force.**

## **Malleability**

**property of a material which allows it to be hammered into thin sheets without rupturing.**

## **Brittleness**

**Property of material to get ruptured without significant deformation on applying external load.**

## **Resilience**

**Ability of material to absorb energy within elastic limits.**

## **Creep**

**Permanent deformation of a material with time when subject to a constant load**

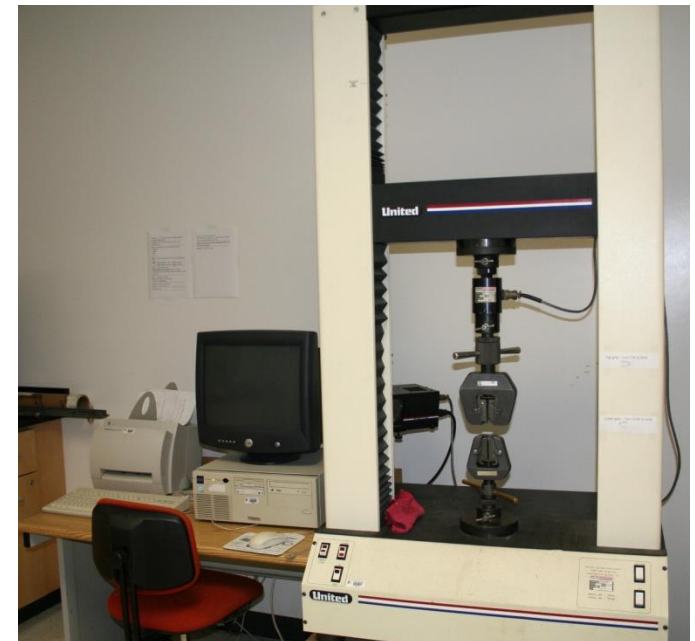
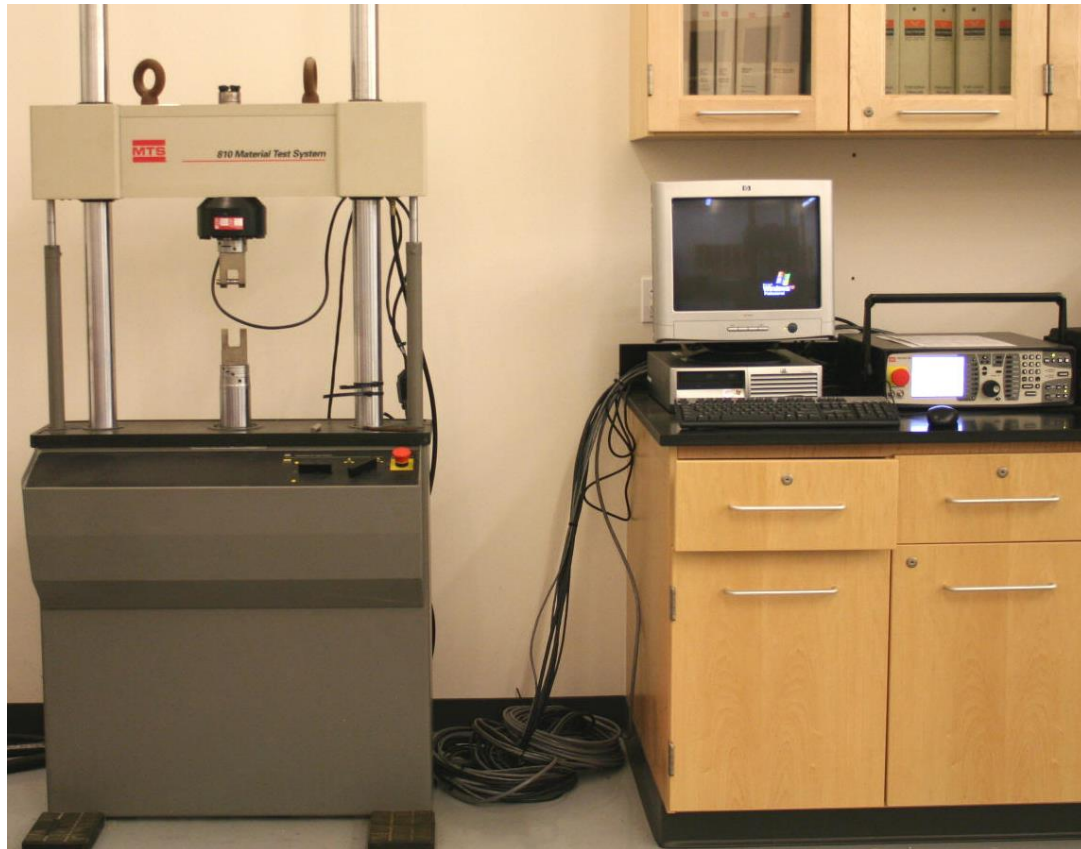
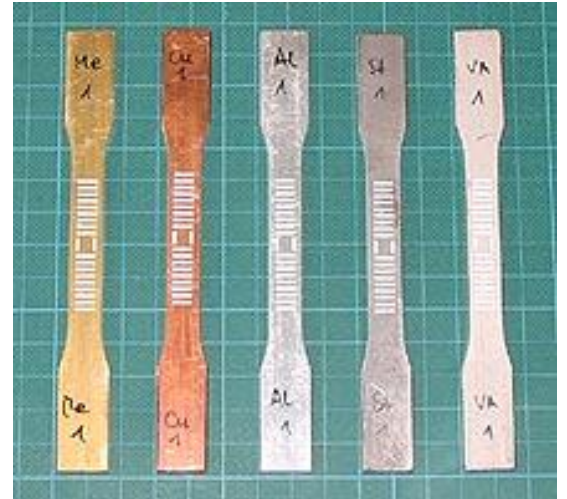
# **Fatigue**

**Failure of a material due to repeated cycles of loading and unloading.**

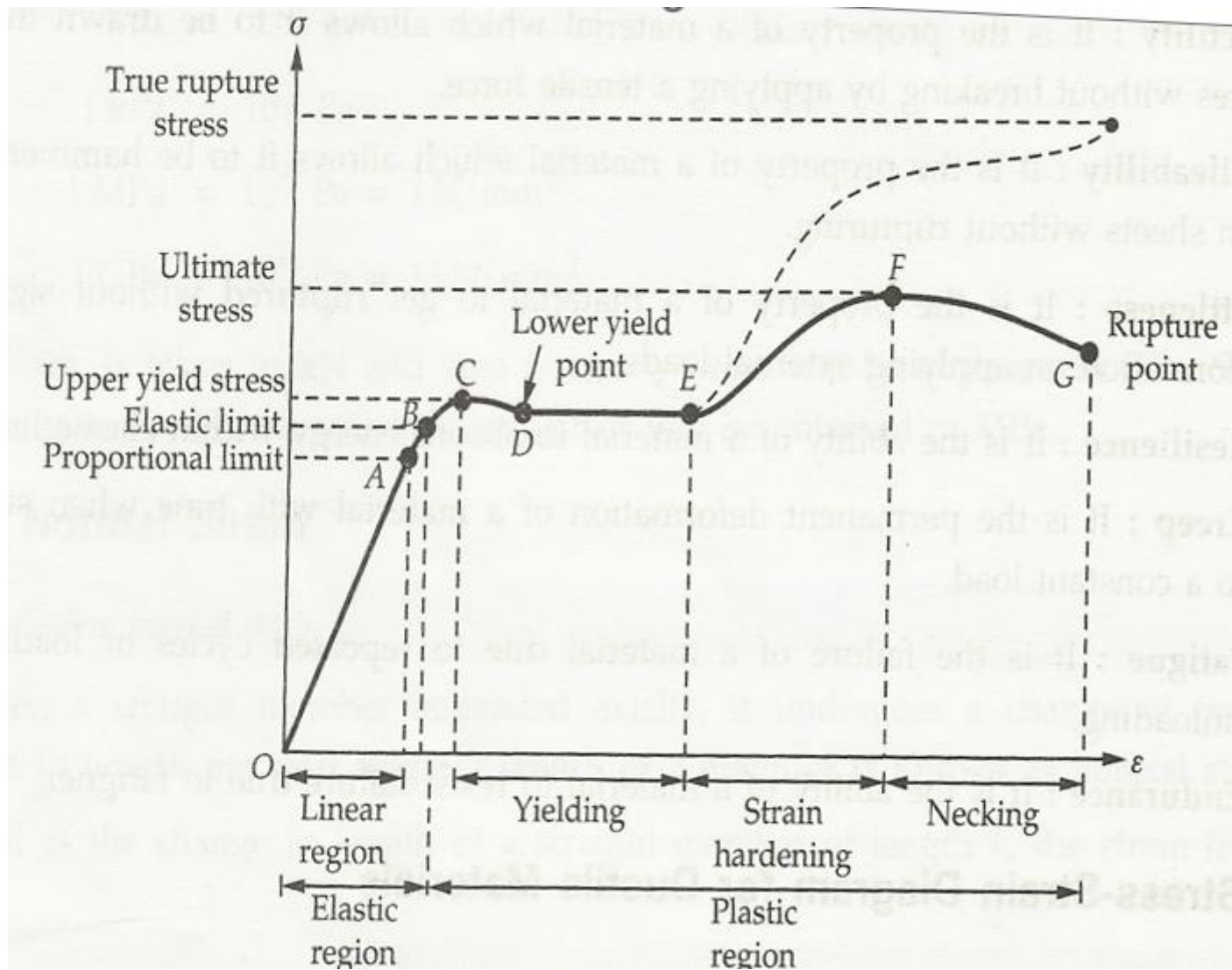
## **Endurance**

**Ability of material to resist failure due to fatigue.**

# Tensile Test







- **PROPORTIONAL LIMIT**
- STRESS IS PROPORTIONAL TO STRAIN
- **ELASTIC LIMIT**
- STRAIN DISAPPEARS COMPLETELY
- **UPPER YIELD POINT**
- LOAD STARTS REDUCING AND EXTENSION INCREASES
- **LOWER YIELD POINT**
- AT THIS STAGE STRESS REMAINS SAME BUT STRAIN INCREASES.
- **ULTIMATE STRESS**
- MAX STRESS THE MATERIAL CAN RESIST. NECK FORMATION STARTED.
- **BREAKING POINT**

# Strain Hardening

- Strain Hardening is when a metal is strained beyond the yield point.
- An increasing stress is required to produce additional plastic deformation and the metal apparently becomes stronger and more difficult to deform.