



LECTURE # 1

In this lecture you will learn about:

Mechanical Properties:

- Malleability
- Resilience
- Hardness
- Brittleness
- Creep
- Fatigue
- Strength
- Elasticity
- Plasticity
- Stiffness
- Ductility

Course Name:

“Material Testing, Repair & Maintenance”

Course Code: CT-245

Credit Hours: 3

Semester: Summer 2020

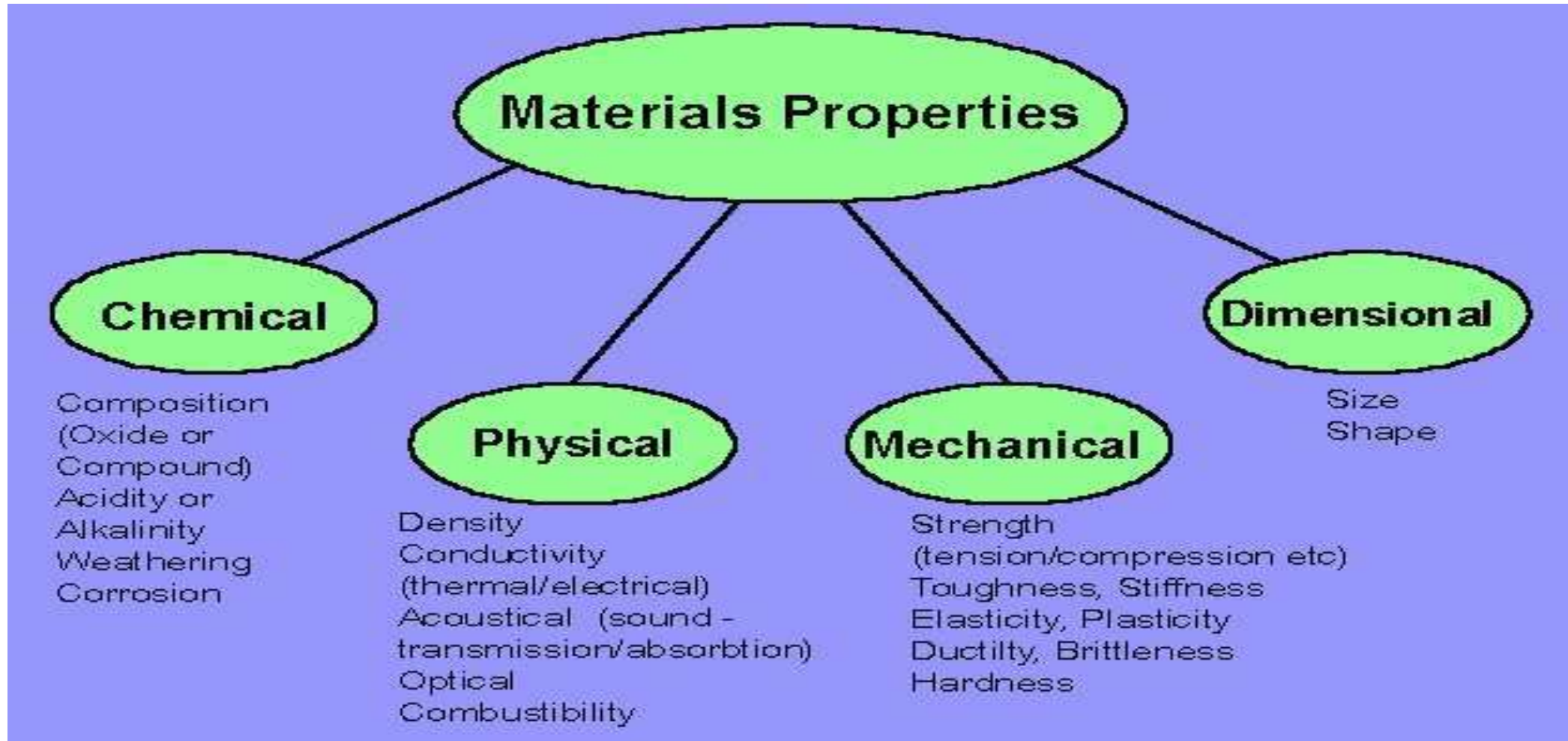


INTRODUCTION

- The practical application of engineering materials in manufacturing engineering depends upon a thorough knowledge of their particular properties under a wide range of conditions.
- The term "property" is a qualitative or quantitative measure of response of materials to externally imposed conditions like forces and temperatures.
- However, the range of properties found in different classes of materials is very large.



MATERIAL PROPERTIES





MECHANICAL PROPERTY

- The properties of material that determine its behaviour under applied forces are known as mechanical properties.
- They are usually related to the elastic and plastic behaviour of the material.
- These properties are expressed as functions of stress strain, etc.
- A sound knowledge of mechanical properties of materials provides the basis for predicting behaviour of materials under different load conditions and designing the components out of them.



STRESS AND STRAIN

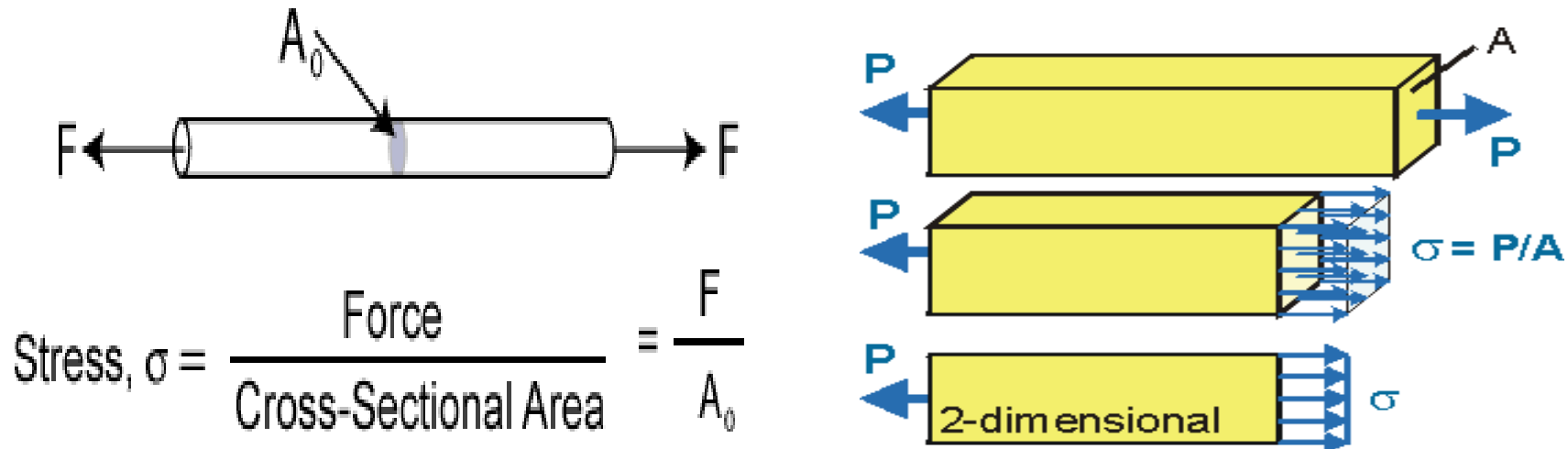
Experience shows that any material subjected to a load may either deform, yield or break, depending upon the

- The Magnitude of load
- Nature of the material
- Cross sectional dime.

CONTD....

The sum total of all the elementary interatomic forces or internal resistances which the material is called upon to exert to counteract the applied load is called stress.

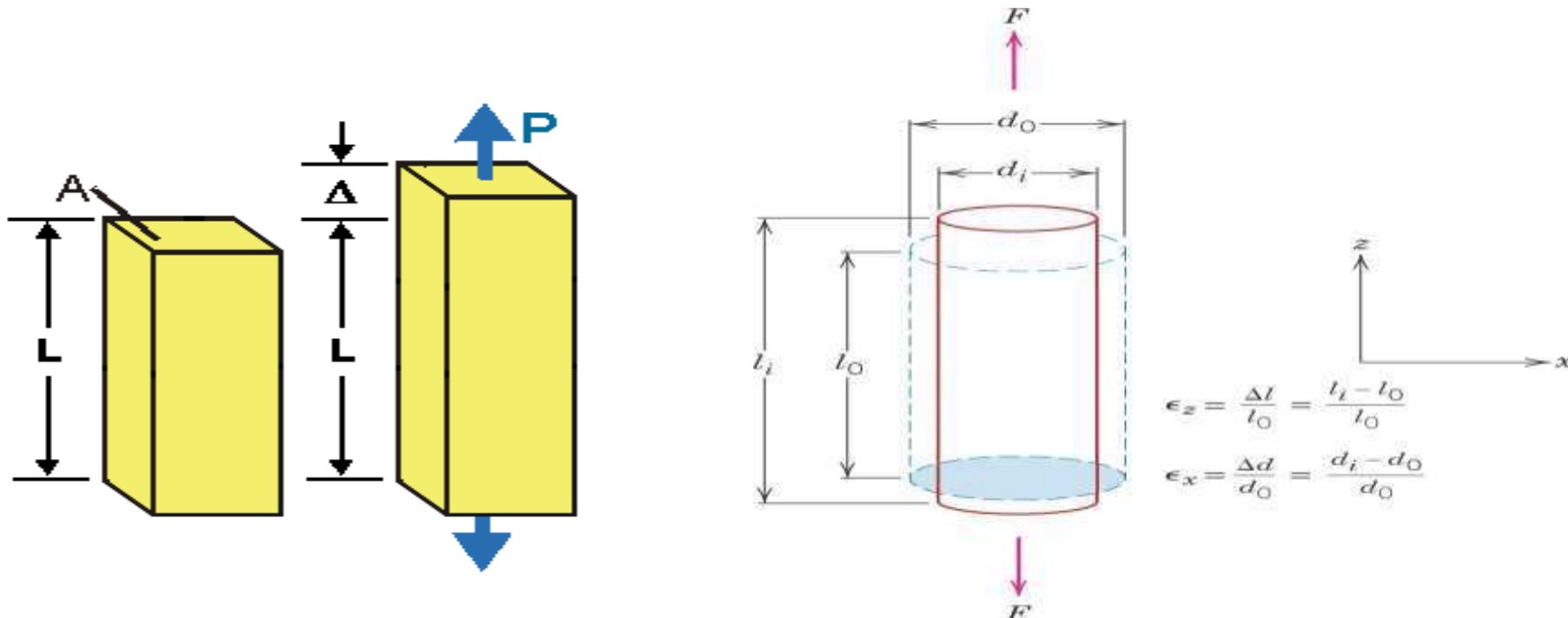
Mathematically, the stress is expressed as force divided by cross-sectional area.



CONTD....

Strain is the dimensional response given by material against mechanical loading/Deformation produced per unit length.

Mathematically Strain is change in length divided by original length.





STRENGTH

The strength of a material is its capacity to withstand destruction under the action of external loads.

It determines the ability of a material to withstand stress without failure.

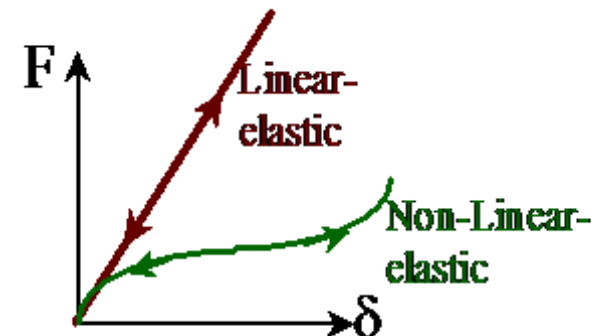
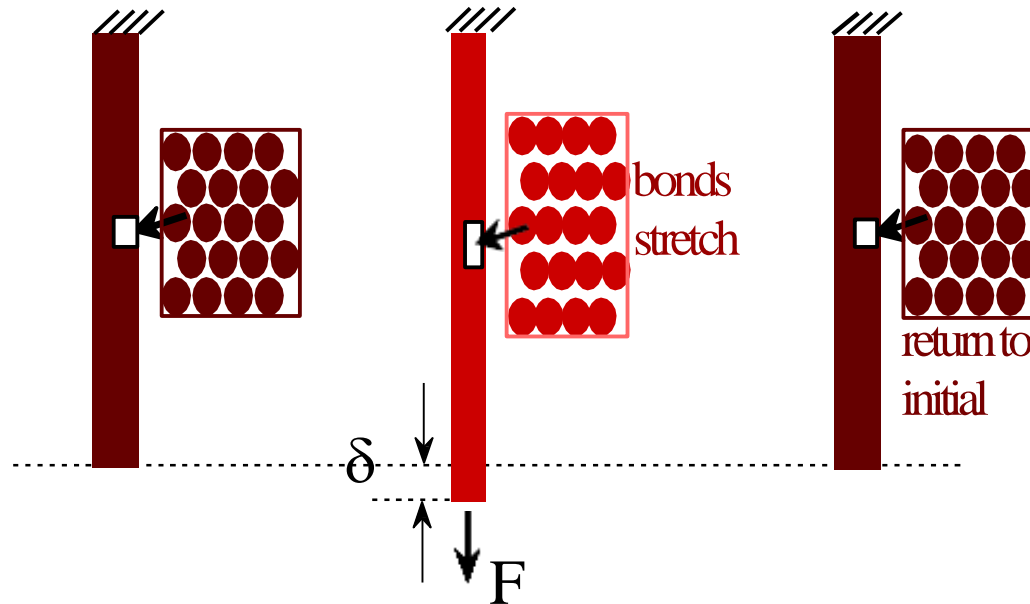
The maximum stress that any material will withstand before destruction is called ultimate strength.



ELASTICITY

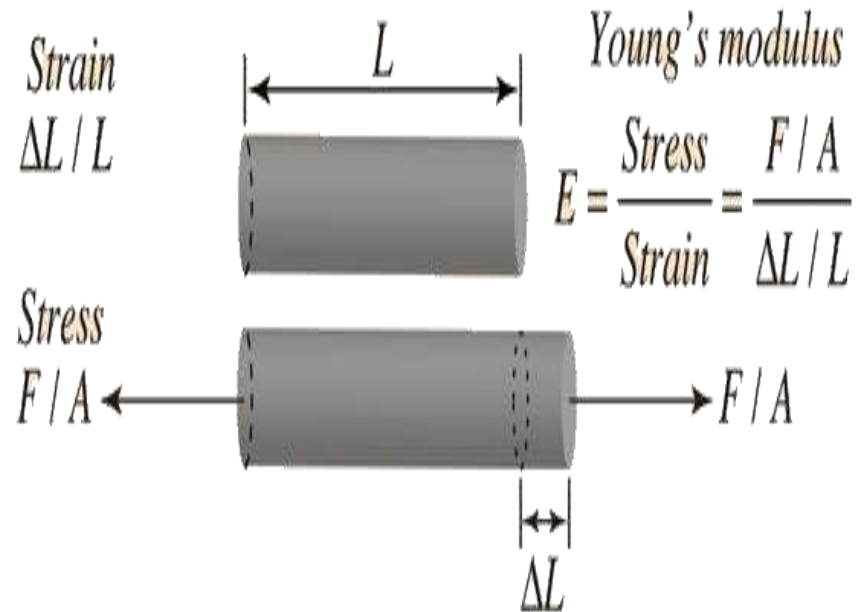
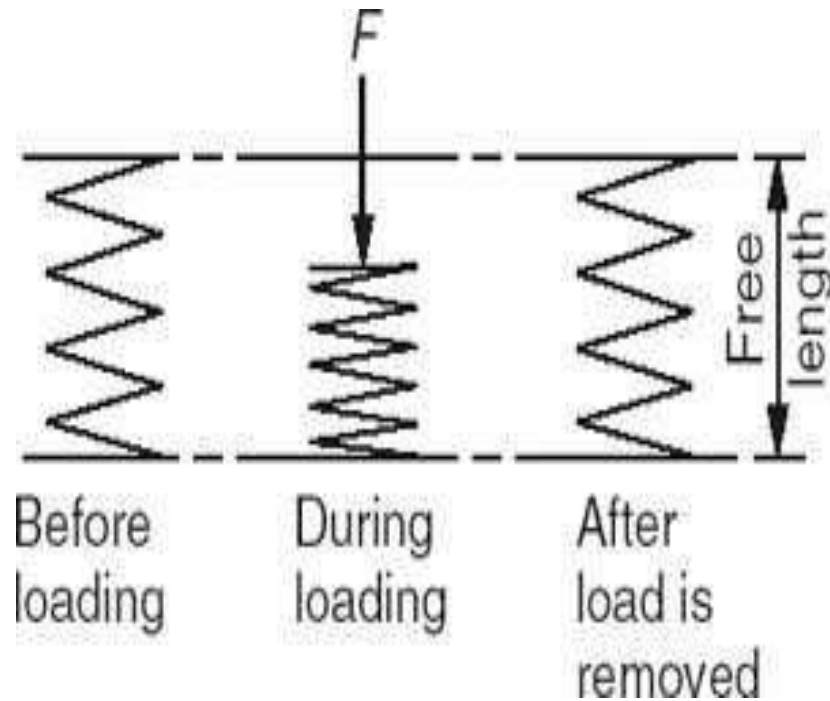
The property of material by virtue of which deformation caused by applied load disappears upon removal of load.

Elasticity of a material is the power of coming back to its original position after deformation when the stress or load is removed.



Elastic means **reversible**.

ELASTICITY

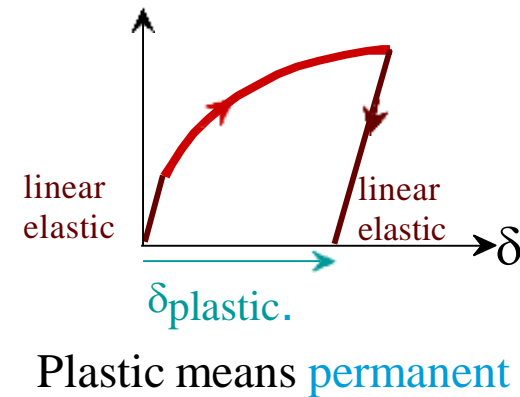
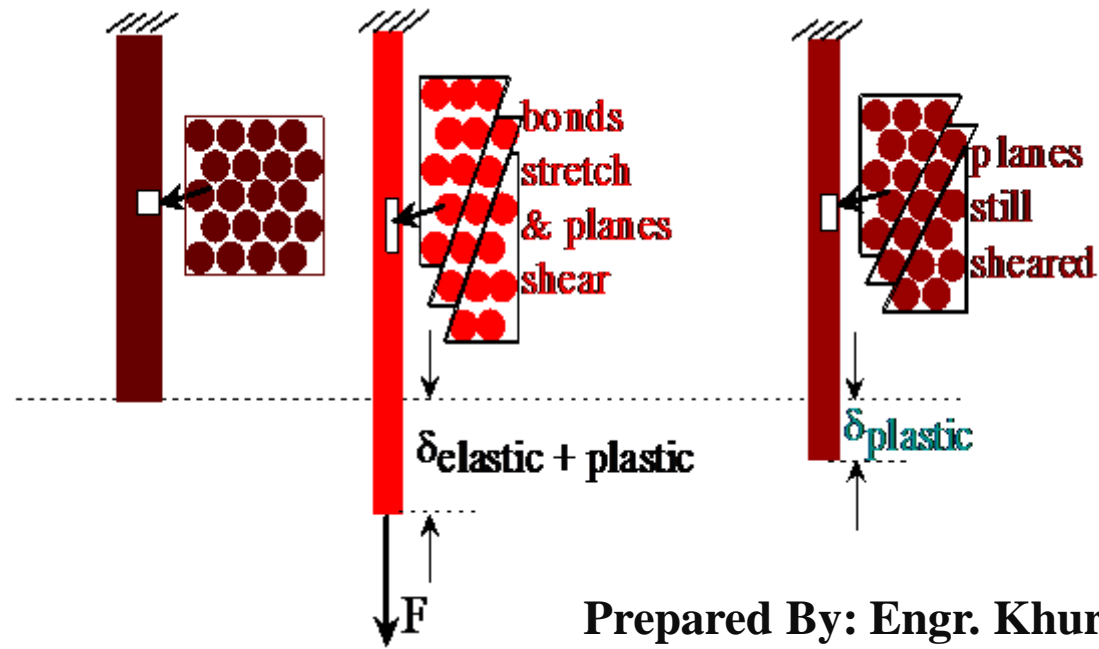


PLASTICITY

The plasticity of a material is its ability to undergo some degree of permanent deformation without rupture or failure.

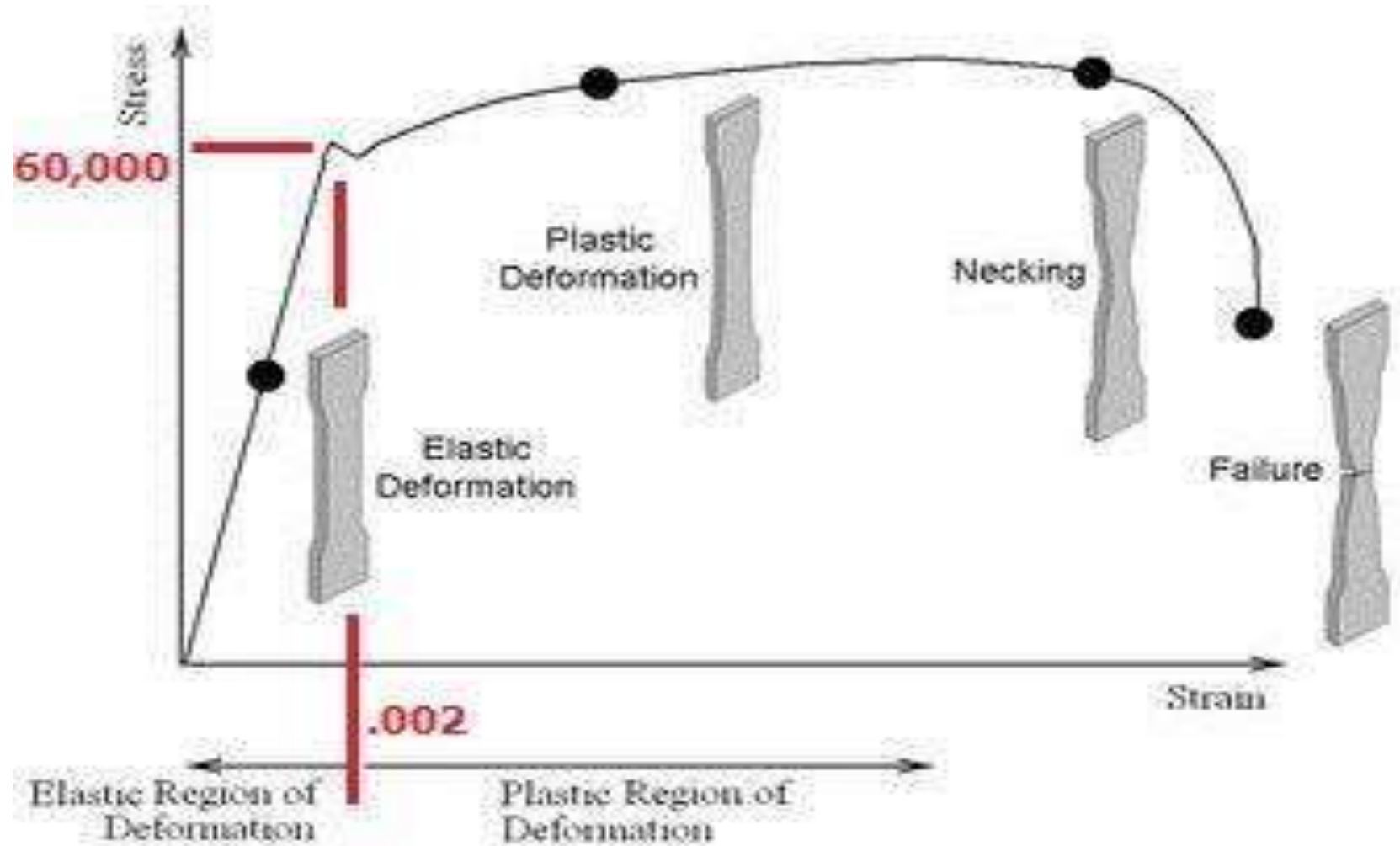
Plastic deformation will take only after the elastic limit is exceeded.

It increases with increase in temperature.





STRESS STRAIN CURVE SHOWS ELASTICITY AND PLASTICITY FOR MATERIALS





STIFFNESS

The resistance of a material to elastic deformation or deflection is called stiffness or rigidity.

A material which suffers slight deformation under load has a high degree of stiffness or rigidity.

E.g. Steel beam is more stiffer or more rigid than aluminium beam.

DUCTILITY

It is the property of a material which enables it to draw out into thin wires.

E.g. Mild steel is a ductile material.

The percent elongation and the reduction in area in tension is often used as empirical measures of ductility.

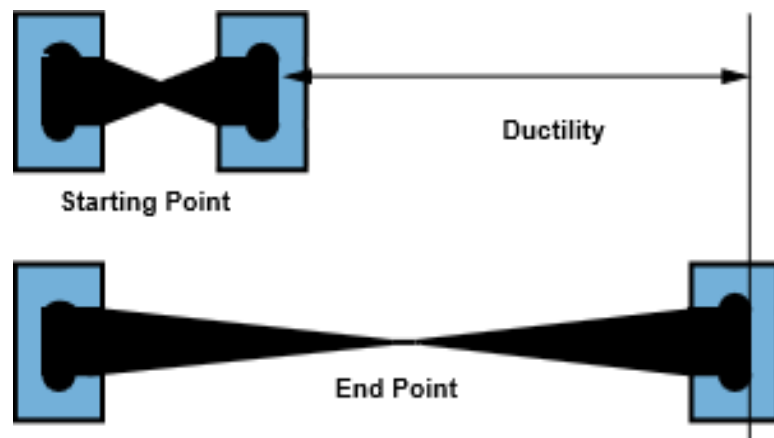
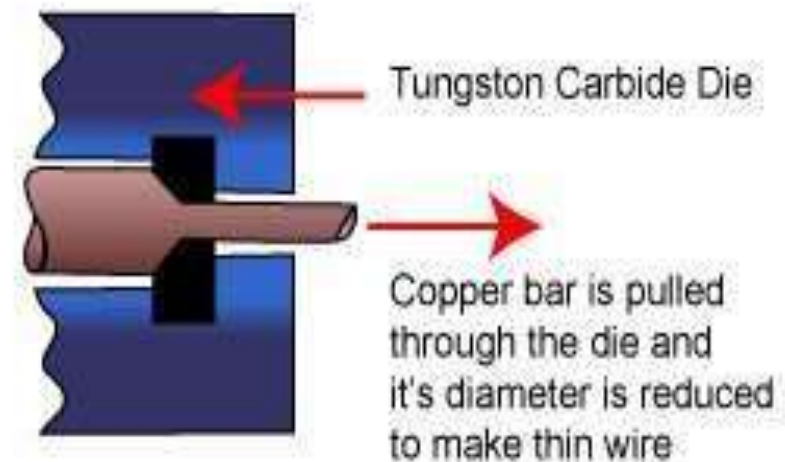
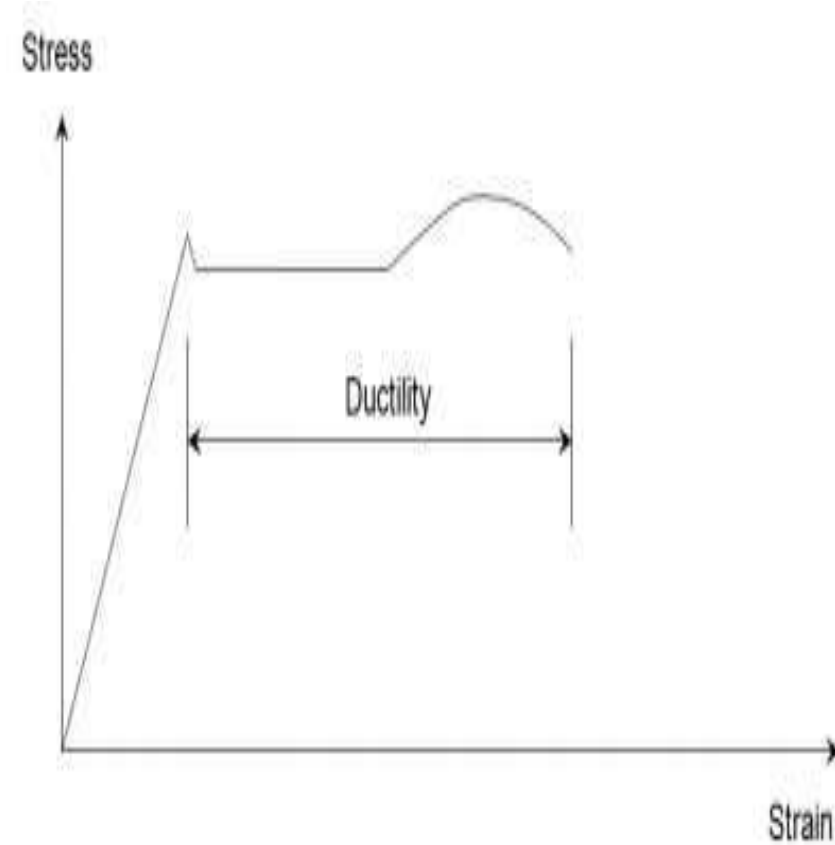
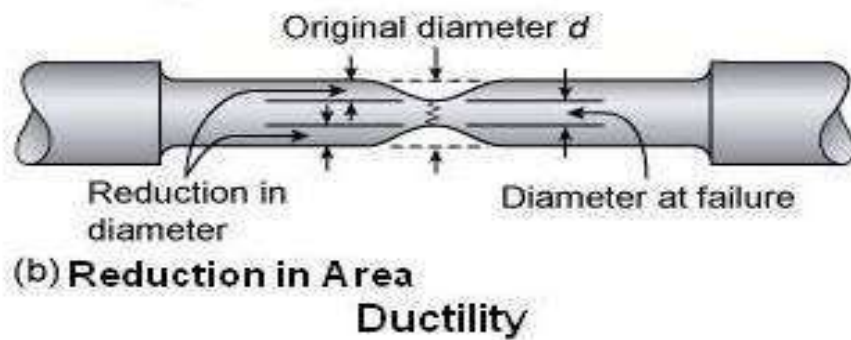
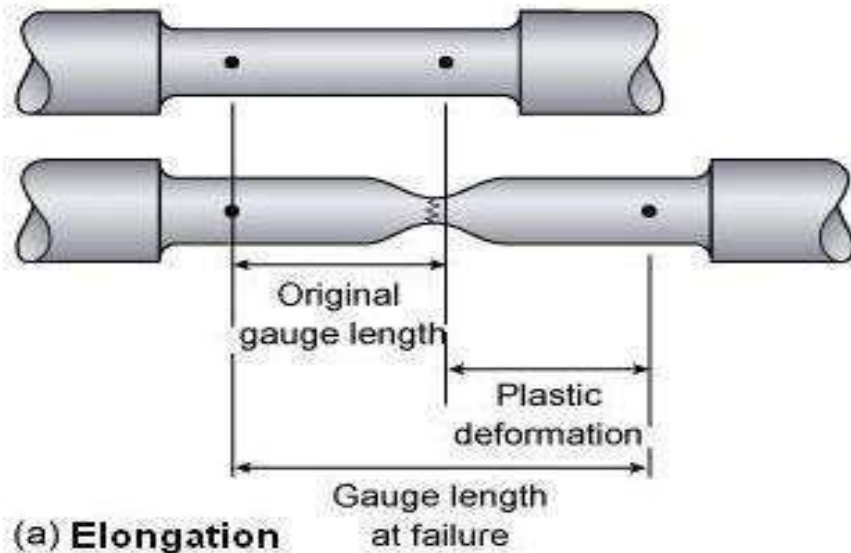


Figure 23:2: Ductility Test



DUCTILITY



MALLEABILITY

Malleability of a material is its ability to be flattened into thin sheets without cracking by hot or cold working.

E.g. Lead can be readily rolled and hammered into thin sheets but can be drawn into wire.





COMPARISON OF DUCTILITY AND MALLEABILITY

Ductility and Malleability are frequently used interchangeably many times.

Ductility is *tensile quality*, while malleability is *compressive quality*.



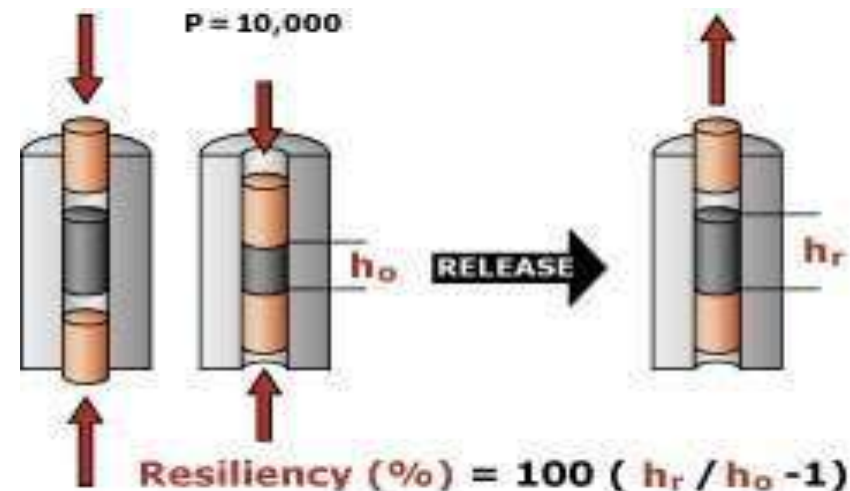
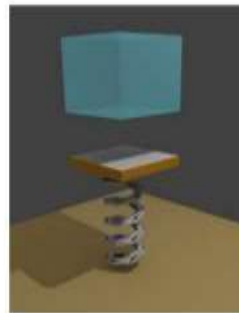
RESILIENCE

It is the capacity of a material to absorb energy elastically.

The maximum energy which can be stored in a body up to elastic limit is called the *proof resilience*, and the proof resilience per unit volume is called *modulus of resilience*.

The quantity gives capacity of the material to bear shocks and vibrations.

- Resilience
- It is the property of a material to absorb energy and to resist shock and impact loads. It is measured by the amount of energy absorbed per unit volume within elastic limit. This property is essential for spring materials.

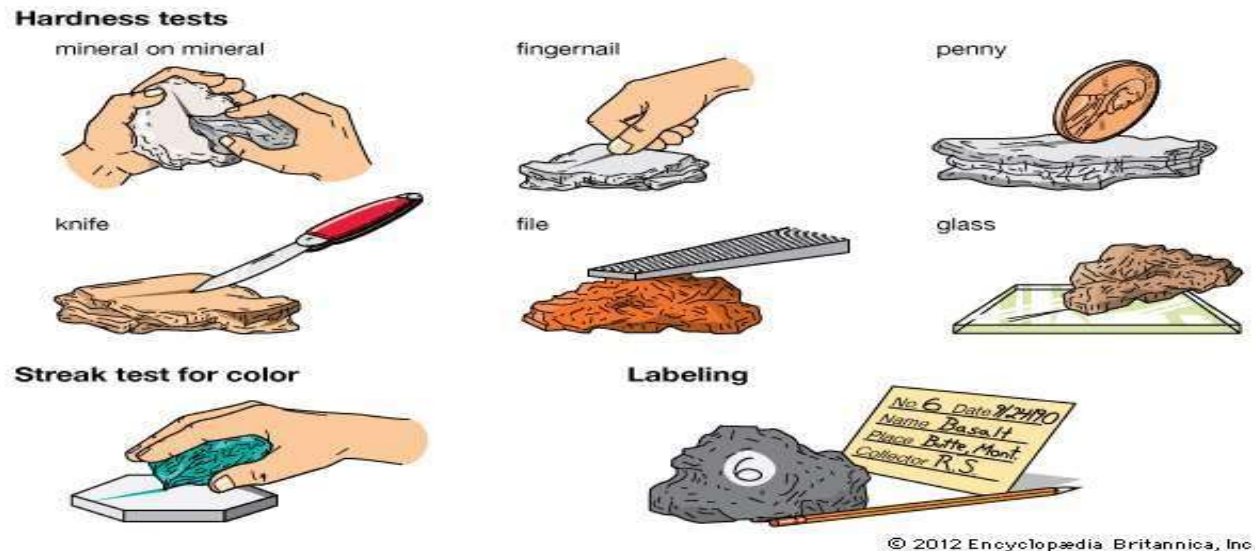


HARDNESS

Hardness is a fundamental property which is closely related to strength.

Hardness is usually defined in terms of the ability of a material to resist to *scratching, abrasion, cutting, indentation, or penetration*.

Methods used for determining hardness: Brinel, Rockwell ,Vickers.

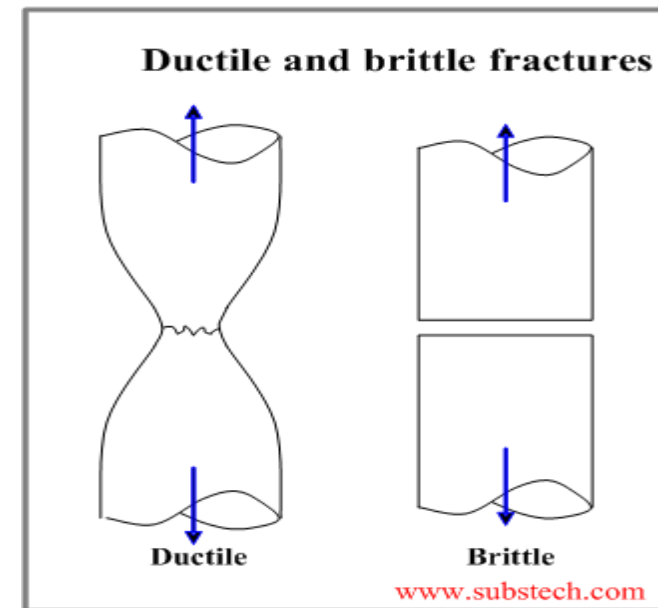
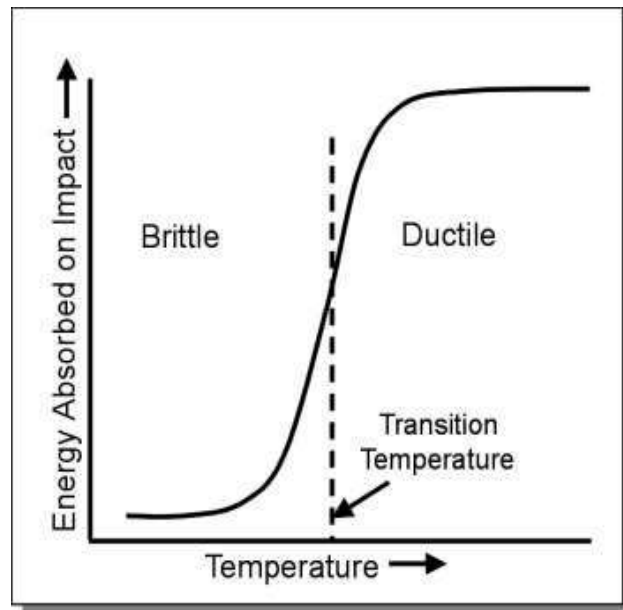


BRITTLENESS

It is the property of breaking without much permanent distortion.

Non-Ductile material is considered to be brittle material.

E.g. Glass, Cast iron, etc.



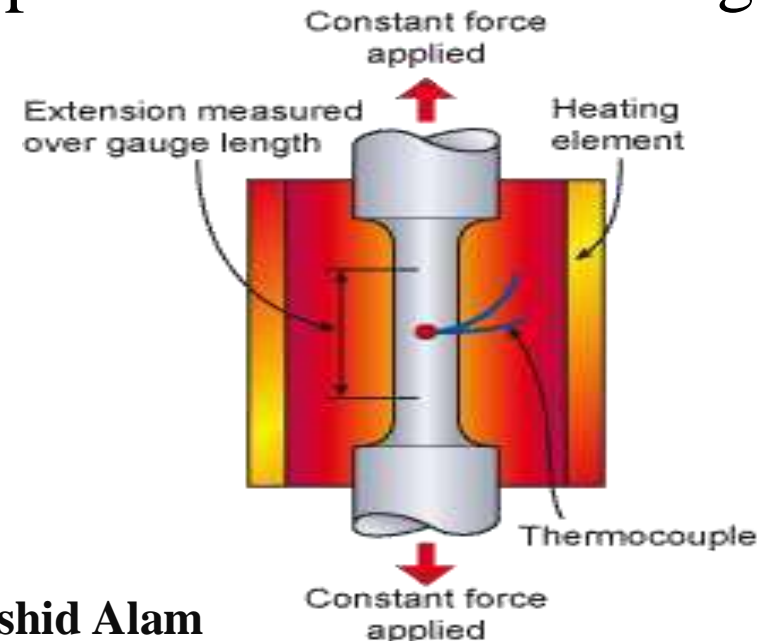


CREEP

The slow and progressive deformation of a material with time at constant stress is called creep.

Depending on temperature, stresses even below the elastic limit can cause some permanent deformation.

It is most generally defined as time-dependent strain occurring under stress.

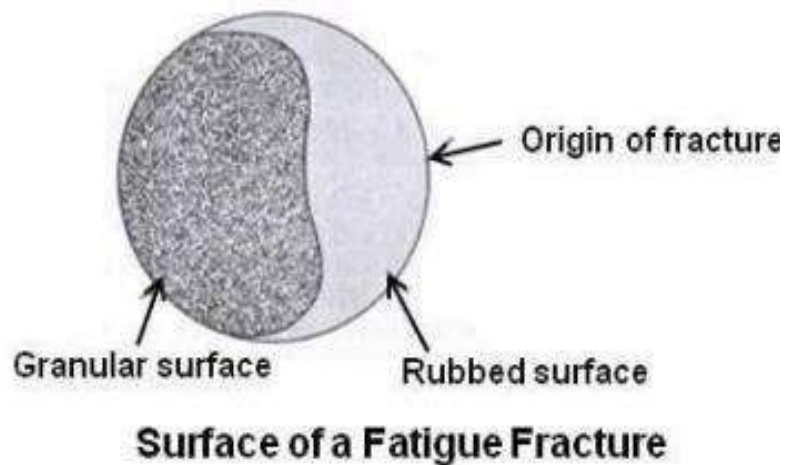


FATIGUE

This phenomenon leads to fracture under repeated or fluctuating stress.

Fatigue fractures are progressive beginning as minute cracks and grow under the action of fluctuating stress.

Many components of high speed aero and turbine engines are of this type.



Thank You