ENGINEERING MATERIALS

The substances which are useful in the field of engineering are called Engineering materials. A particular material is selected is on the basis of following considerations

1. Properties of material

- Mechanical properties - strength, ductility, toughness, hardness, strength to weight ratio etc.
- Physical properties - density, specific heat, thermal expansion, conductivity , melting point etc.
- Chemical properties - oxidation , corrosion, flammability, toxicity etc.
- Manufacturing properties - formed, casting, machined, welding

2. Cost of material

3. Availability of material (desired shape and size and quantity) & reliability of supply.

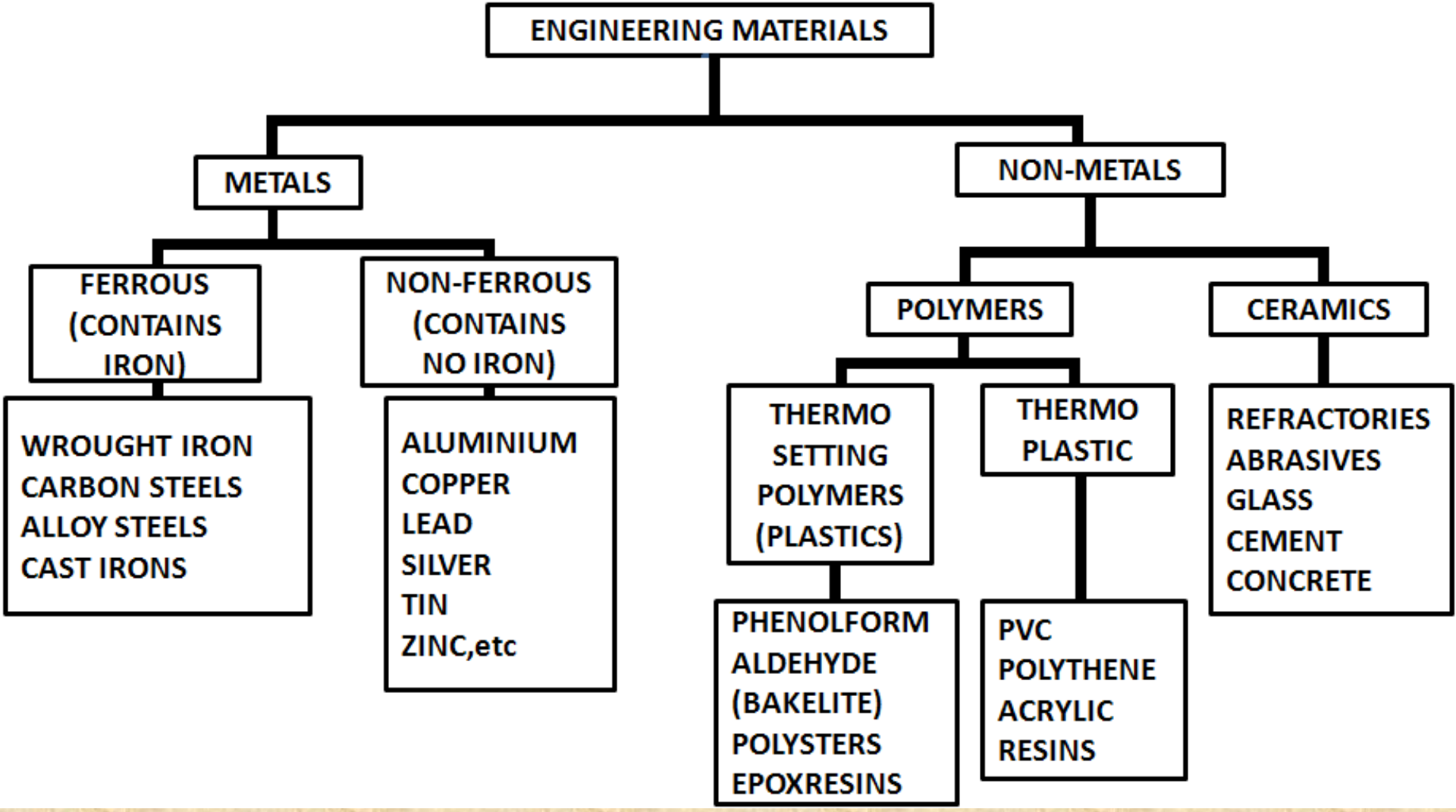
4. Service in life of material

- Dimensional stability of material wear, corrosion etc., shorten life

5. Appearance of material

- Color
- Surface texture etc.

CLASSIFICATION OF ENGINEERING MATERIALS



MECHANICAL PROPERTIES

The characteristics of material that describe the behavior under the action of external loads are referred as its mechanical properties. The common mechanical properties are as follows

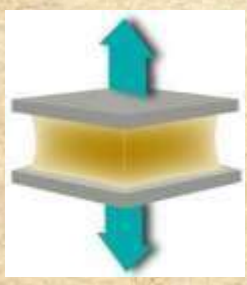
STRENGTH :

It is defined as the ability of a material to resist loads without failure.

It is usually expressed or measured in terms of maximum load per unit area(i.e maximum stress or ultimate strength) that a material can withstand failure and it varies according to the type of loading . Further the strength is divided into three types they are

Tensile Strength:

The tensile strength or tenacity is defined as the ability of material to resist a stretching (tensile) load without fracture.



Tensile strength

Compressive strength :

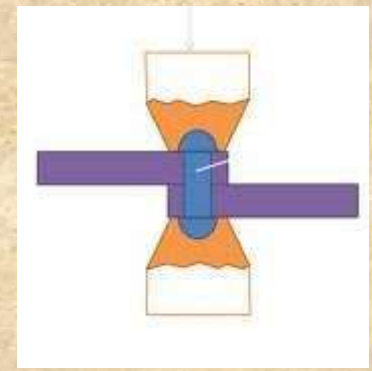
The ability of a material to resist squeezing (compressive) load without fracture is called compressive strength.

Shear strength :

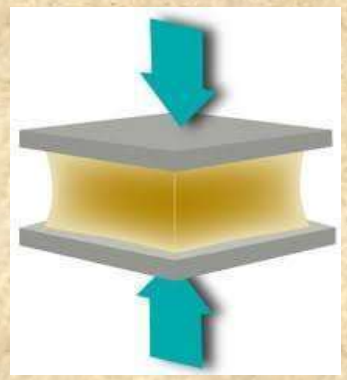
The ability of a material to resist transverse loads i.e. loads tending to separate (or cut) the material is called shear strength.

STIFFNESS :

It is the ability of material to resist deformation or deflection under load. Within the elastic limit, stiffness is measured by the modulus of elasticity.



Shear strength



Compressive strength

ELASTICITY :

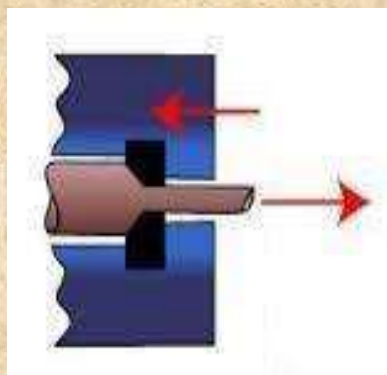
The ability of a material to deform under load and return to its original shape when the load is removed is called elasticity.

PLASTICTY :

The ability of a material to deform under load and retain its new shape when the load is removed is called plasticity.

DUCTILITY :

It is the ability of a material to be deformed plastically without rupture under tensile load. Due to this property material can drawn out into fine wire without fracture.



Ductility

MALLEABILTY :

It is the ability of a material to be deformed plastically without rupture under compressive load. Due to this property metals are hammered and rolled into thin sheets.

TOUGHNESS :

It is defined as the ability of the material to absorb energy up to fracture during the plastic deformation. Toughness of a metal offers the resistance to breaking when force is applied.

BRITTLENESS :

It is the property of sudden fracture without any visible permanent deformation.

Malleability

HARDNESS :

It is defined as the ability of a material to resist scratching or indentation by another hard body. Hardness is directly related to strength.

CREEP :

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

FATIGUE :

Failure of material under repeated or reversal stresses is called fatigue. Machine parts are frequently subjected to varying stresses and it is important to know the strength of materials in such conditions. The maximum stress at which the material will operate indefinitely without failure is known as the endurance limit or fatigue limit.

RESILIENCE :

It is a property of material to absorb energy and to resist shock and impact loads. It is measured by the amount of energy absorbed per unit volume within the elastic limit.

MACHINABILITY:

The ease with which a given material may be worked or shaped with a cutting tool is called machinability. Machinability depends on chemical composition, structure and mechanical properties.

WELDABILITY:

It is the ability of material to be joined by welding. Weldability depends on chemical composition, physical properties and heat treatment to which they are subjected.

CASTABILITY :

Castability of metal refer to the ease with which it can be cast into different shapes and is concerned with the behavior of metal in its molten state.

STRAIN HARDENING :

The strengthening effect produced in metals by plastic deformation(cold working) is called strain hardening or work hardening. Strain hardening reduces ductility and corrosion resistance but, raises the hardness and electrical resistance.