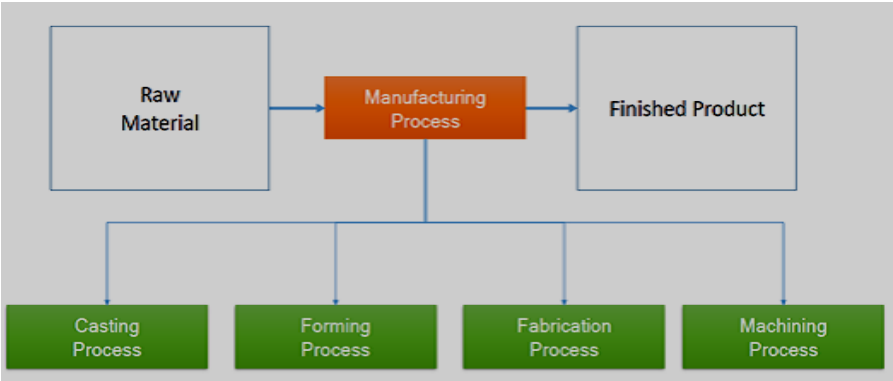
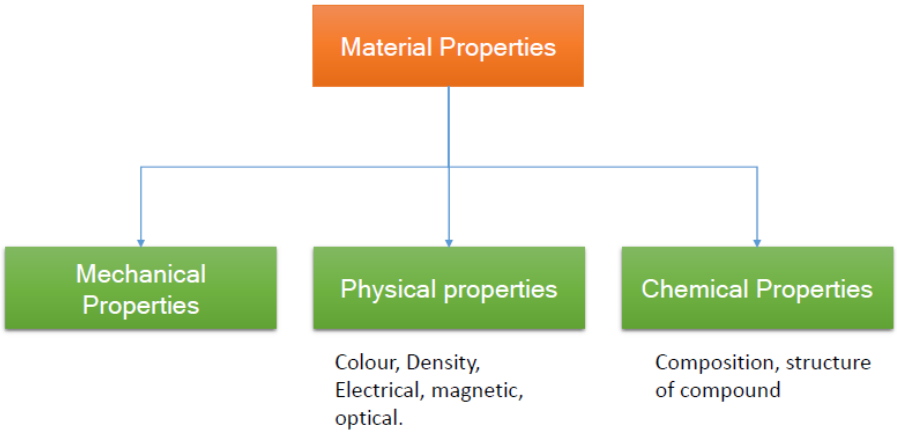
Introduction

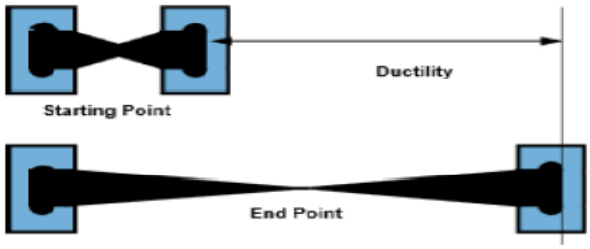


Material properties:



Mechanical properties:

1. **Ductility:** It is the measure of the amount of permanent deformation a material can undergo under tensile force without fracture. It is also termed as ability of material to be drawn into thin wires.



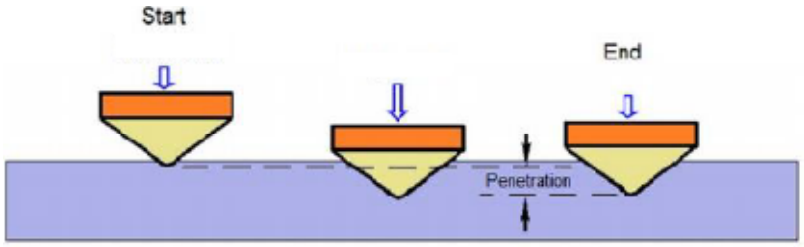
Example: Mild steel is a ductile material

2. **Brittleness:**
   It is the breaking or failure of the material without much permanent deformation. It is the property opposite to ductility.

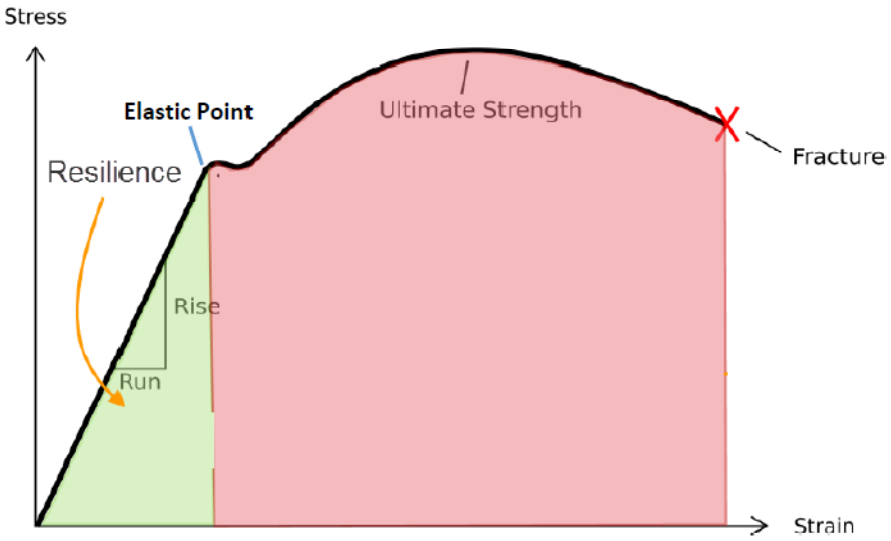
   Example: Cast Iron is brittle material

3. **Malleability:**
   It is the property of material to extend in all directions without fracture by pressing, hammering etc. It is also termed as ability of material to be drawn into thin sheets.
4. **Hardness:**
   It is the resistance offered by material to penetration when a compressive force is applied. Hardness is measured using “Rockwell hardness testing machine”.

   Example: Diamond is the hardest material



5. **Resilience:**
   It is the ability of the material to absorb energy when deformed elastically and return it when unloaded is called resilience. It is the area under the stress strain curve till elastic point.



6. **Toughness**:
   It is the ability of the material to absorb energy before it fractures. It is the total area under the stress strain curve till fracture point.

7. **Strength**:
   It is the ability of the material to resist the application of force without any fracture.

   Types of strength

   1. Tensile strength
   2. Compressive strength
   3. Shear strength
   4. Bending strength
   5. Torsion strength

8. **Fatigue:**

   When a body is subjected to repeated and fluctuating load it tends to develop a characteristic behavior under which failure occurs which is referred to as fatigue

It is weakening of a material due to repeatedly applied loads, in such condition the failure occurs below their normal strength.

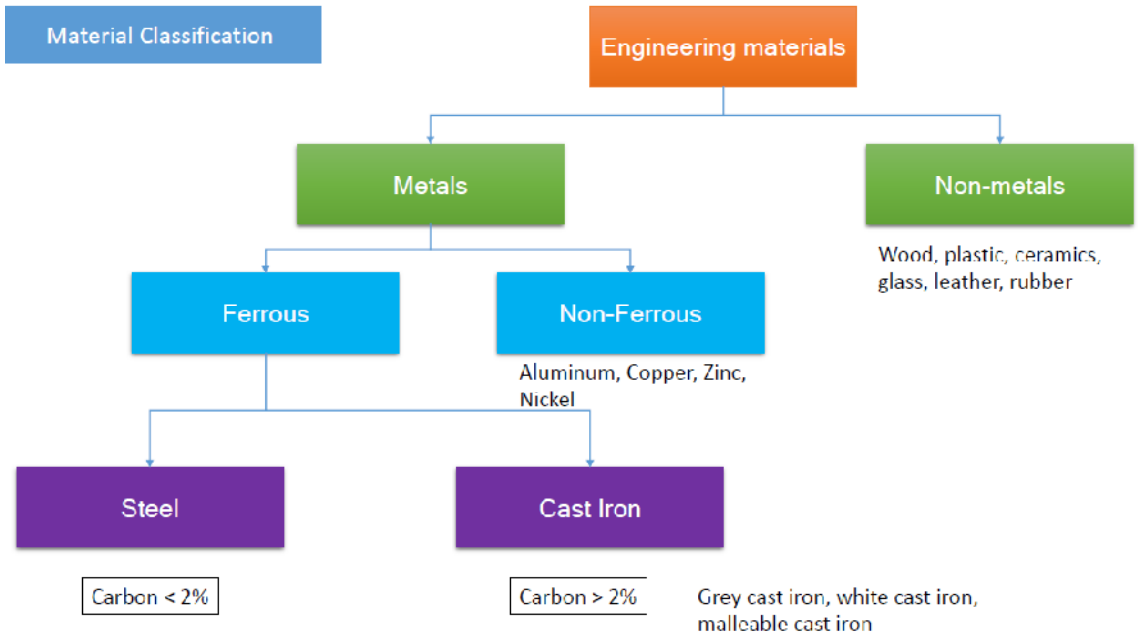
Example: Railway tracks

8. **Creep**:
   It is the property of material to progressively deform under constant force, at high pressure and temperature.

   Example: Turbine blades

9. **Stiffness:**
   It is the property of material to resist deformation till elastic limit.

Material classification:-



Stainless steel (12 to 24% chromium)

Plain Carbon Steel: Plain carbon steels are those which primarily contain Iron and carbon. Besides carbon it also contains other impurities like manganese, sulphur, phosphorous and silicon. The properties of plain carbon steel are greatly influenced by increase in carbon content.

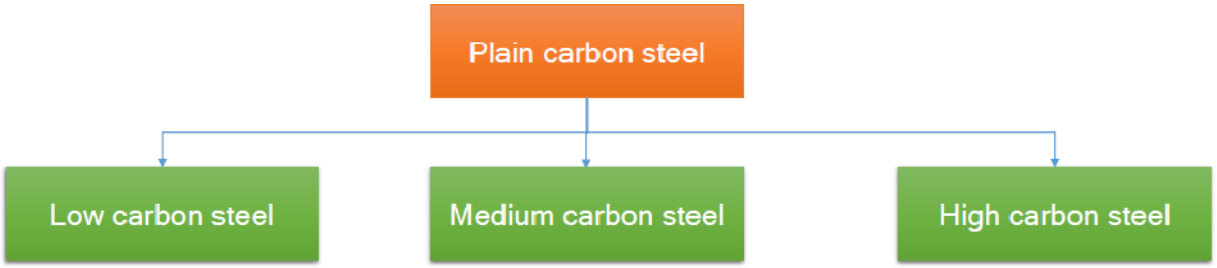
As the carbon content increases

1. Tensile strength increases
2. Hardness increases
3. Ductility decreases
4. Toughness decreases
5. Weldability decreases

Effect of impurities

1. **Sulphur:** It is harmful impurity in steel. It combines with iron to form iron sulphide which causes brittleness (or decreases ductility).
2. Manganese: It combines with sulphur to produce manganese sulphide and thus reduces the harmful effect of sulphur present in steel. It also contributes to strength and hardness but its effect is less than carbon.
3. Phosphorous: It is also harmful impurity in steel and causes brittleness. It increases resistance to corrosion. It also increases strength and hardness.

4. **Silicon:** It makes the steel tougher and harder. It decreases weldability,



Low Carbon Steel:

1. It is the cheapest engineering material and forms the largest percentage of steel produced
2. It has high ductility and low tensile strength

Carbon %	Hardness number	Tensile strength (MPa)
0.15-0.3	120to 150	400 to 500

Applications: Nails, nut, bolts, sheet metal, automobile body sheets.

Medium Carbon Steel:

1. These are less ductile, but harder than low carbon steels
2. It also has high tensile strength.

Carbon %	Hardness number	Tensile strength (MPa)
0.30 to 0.80	150to 500	700 to 1200

Applications: Hammers, crank shaft, connecting rod, springs, machine tool.

High Carbon Steel:

1. They have higher strength and hardness than other plain carbon steels.
2. They lose hardness at high temperatures, hence used as cutting tools at low cutting speed.

Carbon %	Hardness number	Tensile strength (MPa)
0.80 to 1.50	500to 750	1200 to 1300

Applications: Railway line, rock drills, metal cutting tool, hacksaw blades.