



Aircraft Materials -1

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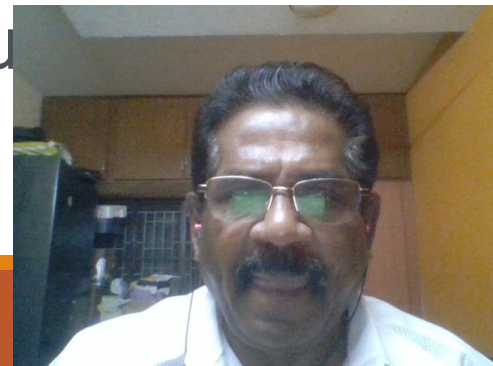
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What materials are used in aircraft construction?

- The main groups of materials used in aircraft construction nowadays are steel, aluminum alloys, titanium alloys, and fibre-reinforced composites.
- Titanium alloys possess high specific properties, have a good fatigue strength/tensile strength ratio with a high fatigue limit, and some retain considerable strength at temperatures up to 400-500 ° C.





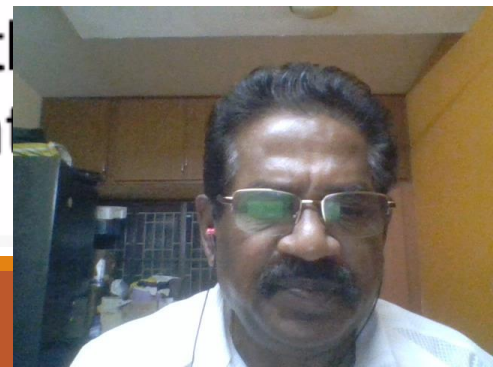
- Mechanical properties of materials:
 - ❖ Elasticity
 - ❖ Plasticity
 - ❖ Ductility
 - ❖ Brittleness
 - ❖ Hardness
 - ❖ Toughness
 - ❖ Stiffness
 - ❖ Resilience
 - ❖ Endurance
 - ❖ Strength
 - ❖ Creep





lasticity

- Elasticity is that property that enables a metal to return to its original size and shape when the force which causes the change of shape is removed.
- This property is extremely valuable because it would be highly undesirable to have a part permanently distorted after an applied load was removed.
- Each metal has a point known as the elastic limit, beyond which it cannot be loaded without causing permanent distortion.
- In aircraft construction, members and parts are so designed that the maximum loads to which they are subjected will not stress them beyond their elastic limits. This desirable property is present in **steel**.





Plasticity

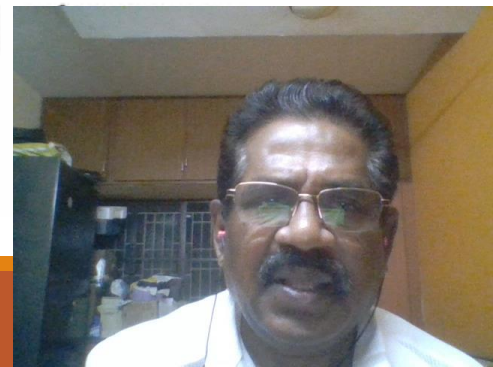
- It is defined as the property of a material by virtue of which, a permanent deformation (without fracture) takes place whenever it is subjected to action of external deforming forces or load.
- Thus, after the elastic limit if the load is increased, the material is no longer capable of regaining its shape and size and a permanent set of permanent deformation occurs.
- Metals like lead, copper, zinc possess good plasticity.
- By means of this property, metals can be shaped into components and machine parts without fracture and





Ductility

- Ductility is the property of a metal which permits it to be permanently drawn, bent, or twisted into various shapes without breaking.
 - This property is essential for metals used in making wire and tubing.
 - Ductile metals are greatly preferred for aircraft use because of their ease of forming and resistance to failure under shock loads.
 - For this reason, aluminium alloys are used for cowl rings, fuselage and wing skin, and formed or extruded parts, such as ribs, spars, and bulkheads.
 - Chrome molybdenum steel is also easily formed into desired
- Ductility is similar to malleability





Brittleness

- Brittleness is the property of a metal which allows little bending or deformation without shattering.
- A brittle metal is apt to break or crack without change of shape. Because structural metals are often subjected to shock loads, brittleness is not a very desirable property.
- Cast iron, cast aluminium, and very hard steel are examples of brittle metals.





Hardness

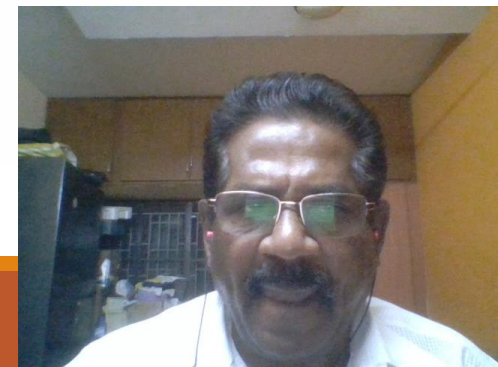
- Hardness refers to the ability of a material to resist abrasion, penetration, cutting action, or permanent distortion.
- Hardness may be increased by cold working the metal and, in the case of steel and certain aluminium alloys, by heat treatment.
- Structural parts are often formed from metals in their soft state and are then heat treated to harden them so that the finished shape will be retained.
- Hardness and strength are closely associated properties of metals.





Toughness

- Toughness is the property of a material by virtue of which it can absorb maximum energy before fracture takes place.
- Thus, it is capacity of material to withstand shock loads.
- A material which possesses toughness will withstand tearing or shearing and may be stretched or otherwise deformed without breaking.
- Toughness is a desirable property in aircraft metals.





Stiffness

- Stiffness is the property of material by virtue of which, it resists deformation.
- Modulus of elasticity is a measure of stiffness of a metal.
- Materials (steels) having high stiffness are used in spring controlled measuring instruments.

