SNS COLLEGE OF TECHNOLOGY

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DEPARTMENT OF AEROSPACE ENGINEERING

19ASO301 BASICS OF AERONAUTICAL ENGINEERING

UNIT 3 – AIRPLANE STRUCTURES AND MATERIALS

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- ***Components & Functions***
- ***Aircraft Materials***
- ***Mechanical Properties***
- ***Definition – Mechanical Properties***

TEXT BOOK

- ***Anderson. J D, "Introduction to Flight", McGraw-Hill, 1995***

- ***Richard S. Shevel, "fundamentals of Flight", Prentice Hall, 2010***

Mechanical Properties

- *Elasticity*
- *Plasticity*
- *Ductility*
- *Brittleness*
- *Hardness*
- *Toughness*
- *Stiffness*
- *Resilience*
- *Endurance*
- *Strength*
- *Creep*

Elasticity

- *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 beyond their elastic limits.*

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 the components and machine parts without fracture.*

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, aluminum alloys are used for cowl rings, fuselage and wing skin, and formed or extruded parts, such as ribs, spares, 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 vey 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.*

Resilience

- *Resilience is the property of materials by virtue of which it stores energy and resists shocks and impacts.*
- *The resilience of the material is measured by the amount of energy that can be stored per unit volume after it is stressed up to the elastic limit.*

Endurance

- *The endurance is the property of a material by virtue of which it can withstand varying stresses or repeated application of stress.*
- *It is important property in the design and production of parts in a reciprocating machine or components subjected to vibrations.*
- *The endurance limit or fatigue strength is the maximum stress that can be applied for indefinitely large number of times without causing failure.*
- *The failure of a material under repeated loads is called fatigue failure.*