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FORCES ACTING ON AIRCRAFT

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Following Forces are acting on aircraft

1. Stress
   A. Tensile Stress
   B. Compressive Stress
2. Strain
   A. Tensile Strain
   B. Compressive Strain
3. Shear
4. Bending
5. Torsion
6. Fatigue

1.Stress

- **Stress is a quantity that describes the magnitude of forces that cause deformation. Stress is generally defined as *force per unit area*.**
- **σ=F/A**
- **where,**
- **σ (sigma) is the stress applied**
  _F_ is the force applied
  _A_ is the area of force application
- **The unit of stress is N/m2**

$$stress = \frac{F}{A}$$

Stress has Main Two Types

- ● Tensile Stress: It is the force applied per unit area which results in the increase in length (or area) of a body. Objects under tensile stress become thinner and longer.
  ● Compressive Stress: It is the force applied per unit area which results in the decrease in length (or area) of a body. The object under compressive stress becomes thicker and shorter

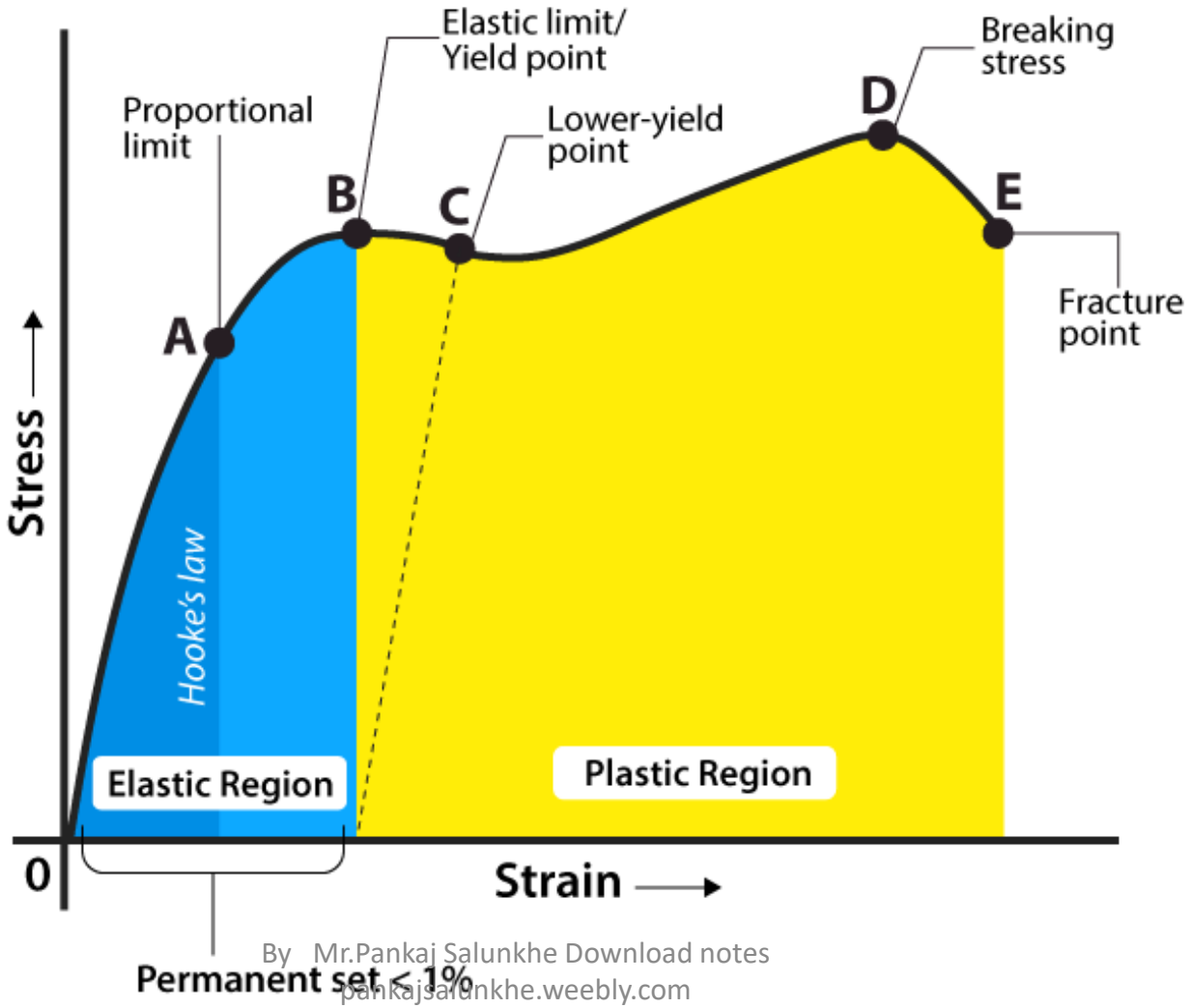
2.Strain

- According to the strain definition, it is defined as the amount of deformation experienced by the body in the direction of force applied, divided by initial dimensions of the body
- $\epsilon = \delta L / L$
- where,
- ϵ is the strain due to stress applied
  δl is the change in length
  L is the original length of the material.
- The strain is a dimensionless quantity as it just defines the relative change in shape

Strain has main two types

- **Tensile Strain: It is the change in length (or area) of a body due to the application of tensile stress.**
- **Compressive Strain: It is the change in length (or area) of a body due to the application of compressive strain**

Stress Strain Curve



The stress-strain graph has different points or regions as follows:

- **Proportional limit**
- **Elastic limit**
- **Yield point**
- **Ultimate stress point**
- **Fracture or breaking point**

(i) Proportional Limit

- It is the region in the stress-strain curve that obeys Hooke's Law. In this limit, the ratio of stress with strain gives us proportionality constant known as young's modulus. The point OA in the graph is called the proportional limit.

(ii) Elastic Limit

- It is the point in the graph up to which the material returns to its original position when the load acting on it is completely removed. Beyond this limit, the material doesn't return to its original position and a plastic deformation starts to appear in it.

(iii) Yield Point

- The yield point is defined as the point at which the material starts to deform plastically. After the yield point is passed, permanent plastic deformation occurs. There are two yield points (i) upper yield point (ii) lower yield point.

(iv) Ultimate Stress Point

- It is a point that represents the maximum stress that a material can endure before failure. Beyond this point, failure occurs.

(v) Fracture or Breaking Point

- It is the point in the stress-strain curve at which the failure of the material takes place.

Hooke's Law

- **Hooke's Law states that the strain of the material is proportional to the applied stress within the elastic limit of that material.**

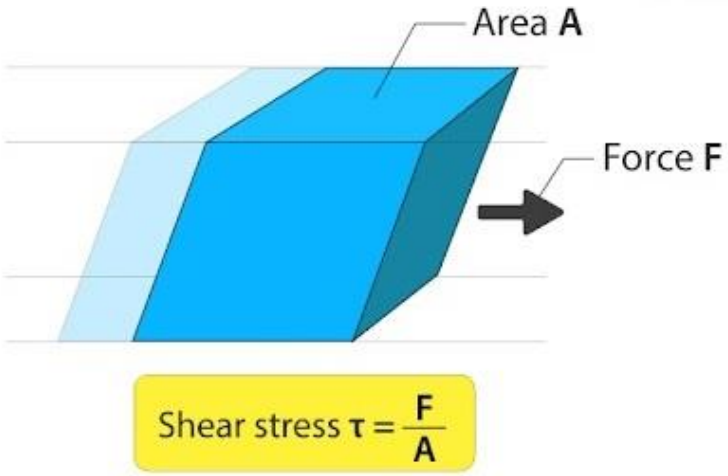
$$\sigma = E . \varepsilon$$

where

- σ is stress [Pa]
- ε is strain $= \frac{\Delta L}{L_0}$
- E is the modulus of elasticity [Pa]

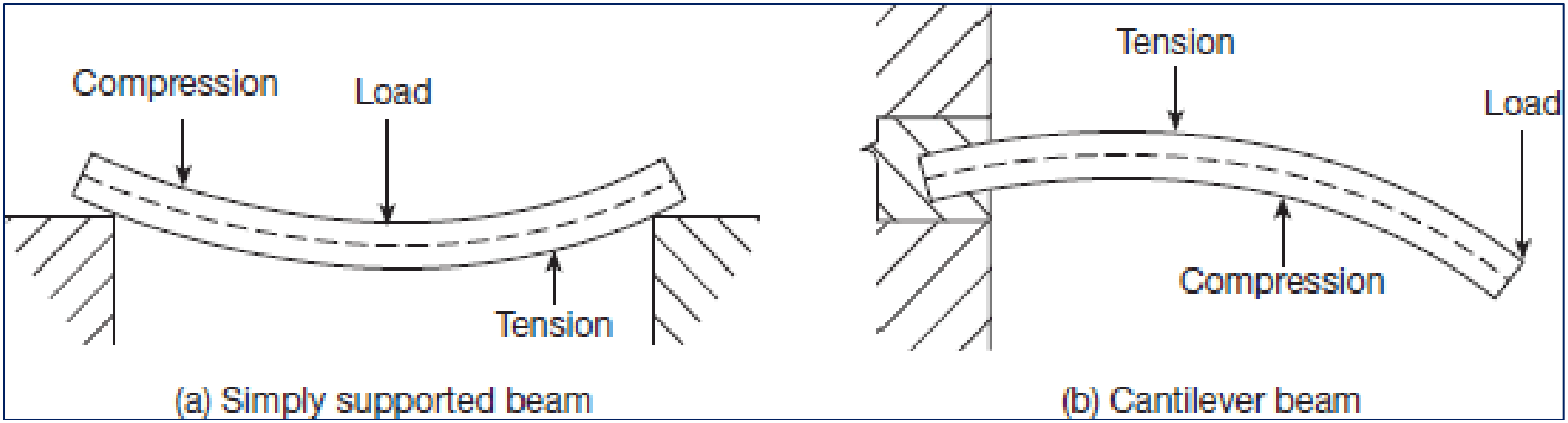
3.Shear Stress

- **Shear stress arises due to shear forces. They are the pair of forces acting on opposite sides of a body with the same magnitude and opposite direction.**



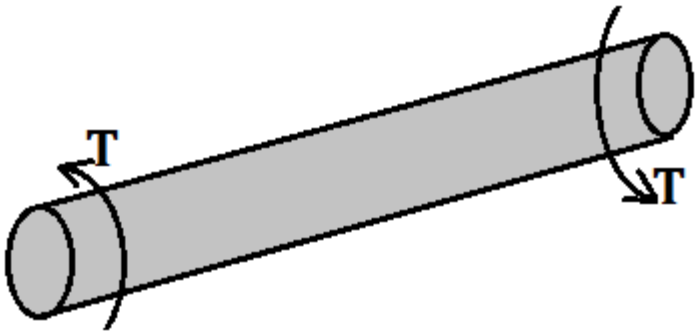
4.Bending Stress

- **Bending stress is a more specific type of normal stress. When a beam experiences load like that one the top fibers of the beam undergo a normal compressive stress.**
- **The stress at the horizontal plane of the neutral is zero. The bottom fibers of the beam undergo a normal tensile stress.**



5.Torsional stress

- **Torsional shear stress or Torsional stress is the shear stress produced in the shaft due to the twisting. This twisting in the shaft is caused by the couple acting on it**



6.Fatigue

- fatigue is the initiation and propagation of cracks in a material due to cyclic loading.
- Once a fatigue crack has initiated, it grows a small amount with each loading cycle, typically producing striations on some parts of the fracture surface.
- The crack will continue to grow until it reaches a critical size, which occurs when the stress intensity factor of the crack exceeds the fracture toughness of the material, producing rapid propagation and typically complete fracture of the structure.

Ghost Can Smell Things and love the smell of Lemons

धन्यवाद

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