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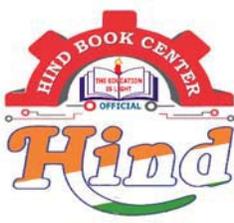
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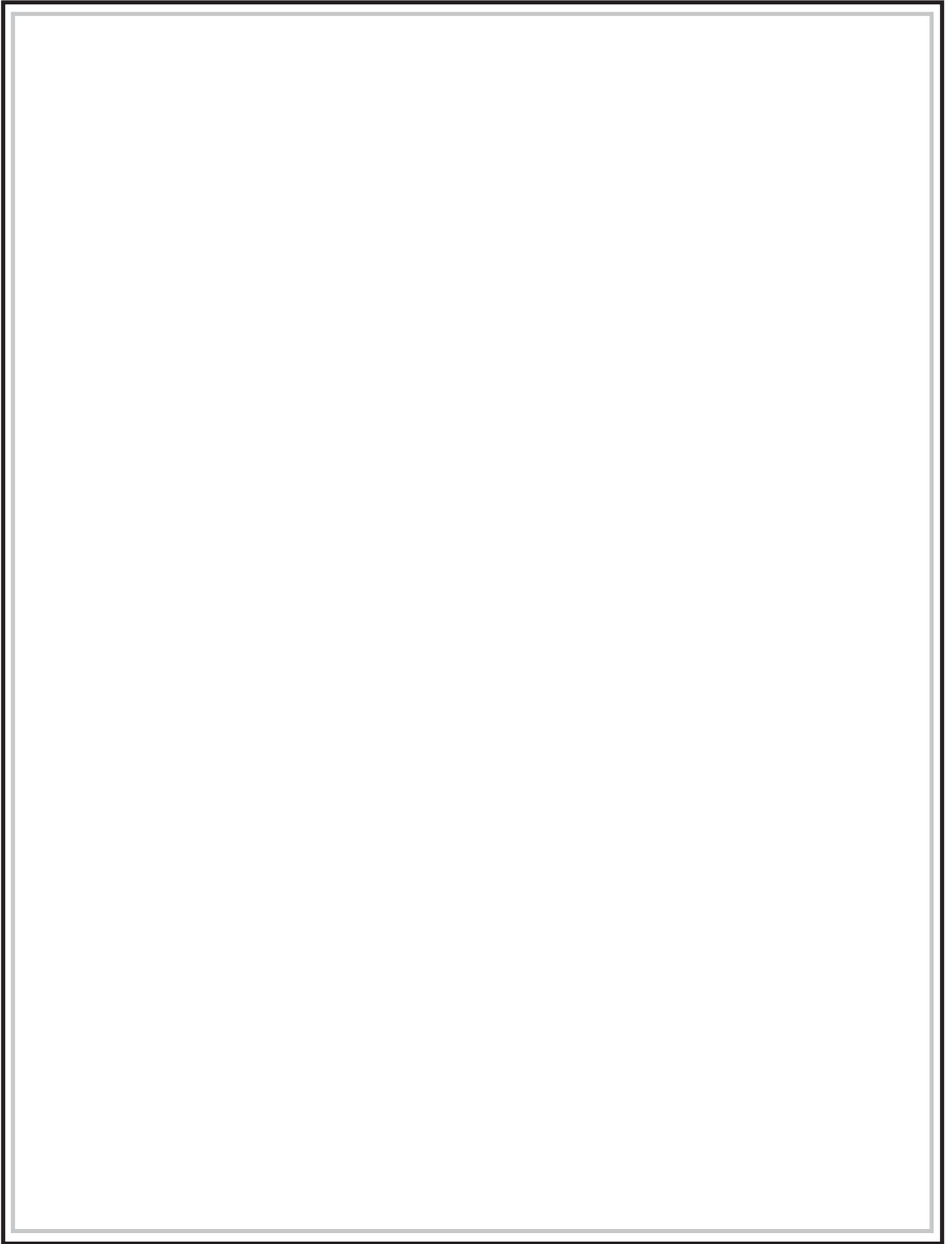
## **MECHANICAL ENGINEERING**

### **Strength of Materials**

**[Student Problem Set]**

# Table of Contents

<b>Sr.</b>	<b>Chapter</b>	<b>Pages</b>
<b>1.</b>	Stress, Strain and Elastic Constants	<b>1 to 32</b>
<b>2.</b>	Principal Stress & Strains - Mohr's Circle	<b>33 to 54</b>
<b>3.</b>	Thermal Stress	<b>55 to 66</b>
<b>4.</b>	Thin Shells	<b>67 to 78</b>
<b>5.</b>	Shear Force and Bending Moment Diagrams	<b>79 to 98</b>
<b>6.</b>	Torsion	<b>99 to 114</b>
<b>7.</b>	Columns	<b>115 to 126</b>
<b>8.</b>	Bending Stresses	<b>127 to 138</b>
<b>9.</b>	Shear Stress in Beams & Combine Loading	<b>139 to 150</b>
<b>10.</b>	Theory of Failure	<b>151 to 164</b>
<b>11.</b>	Strain Energy	<b>165 to 174</b>
<b>12.</b>	Deflection of Beams	<b>175 to 200</b>

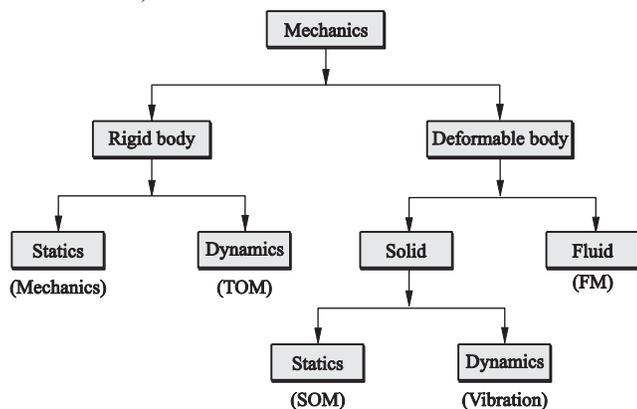


# Chapter-1

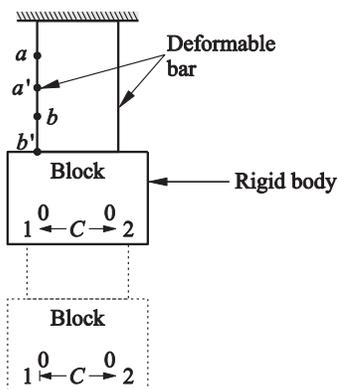
## STRESS, STRAIN & ELASTIC CONSTANTS

### 1.1 Introduction

Mechanics deals with forces (both internal and external) and their effects.



Ex :



A body is said to be a rigid body if the distance between any two points in the body or on the body, is invariant.

- In engineering mechanics we treat the body as rigid and we deal only with external forces. In SOM, the body is treated as a deformable body and we deal with internal forces.

**Aim :** The aim of SOM is to develop equations for stress, strain and to obtain the size by using mechanical properties.

### NOTE

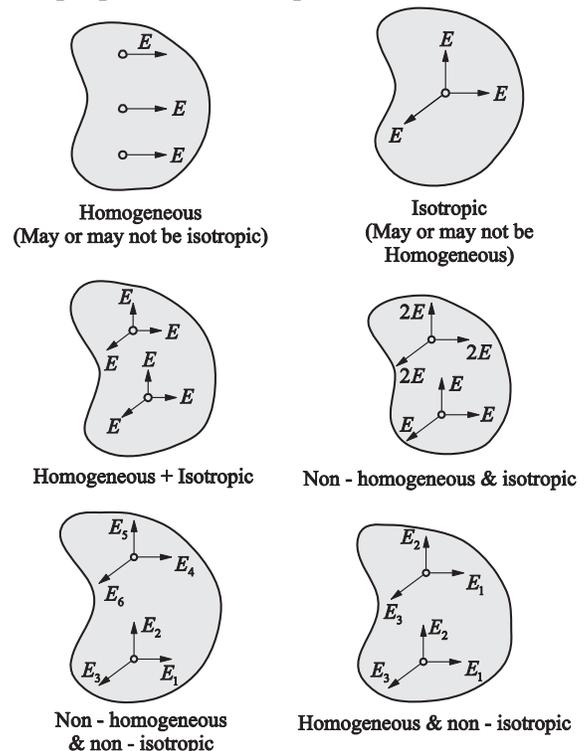
- SOM is also known as solid mechanics, or mechanics of solids or mechanics of deformable bodies.

#### ❖ Homogeneous Materials

A material is said to be homogeneous if it exhibits same properties (elastic properties  $E$ ,  $G$ ,  $K$ ) at any point in the given direction, i.e., for a homogeneous, material properties are independent of point.

#### ❖ Isotropic Materials

A material is said to be isotropic, if it exhibits same elastic properties in any direction at a given point i.e. for a isotropic material properties are independent of direction.



**NOTE**

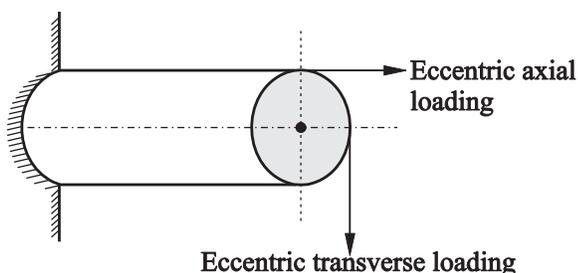
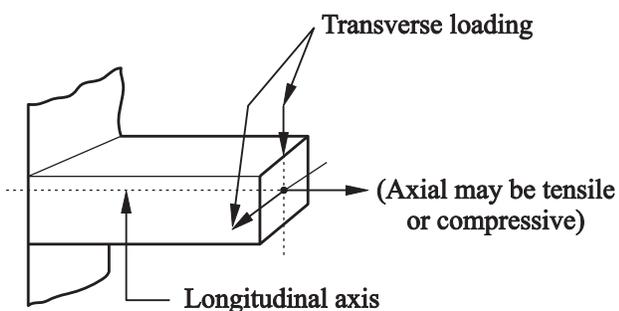
- Every homogeneous material need not be isotropic and similarly every isotropic material need not be homogeneous.
- Fortunately, most of the common engineering material are both homogeneous and isotropic.
- Wood, crystal are anisotropic material i.e., these material have different properties in different directions.
- Even if the body is not have homogeneous and isotropic, it is assumed to be homogeneous and isotropic.

**1.2 Load**

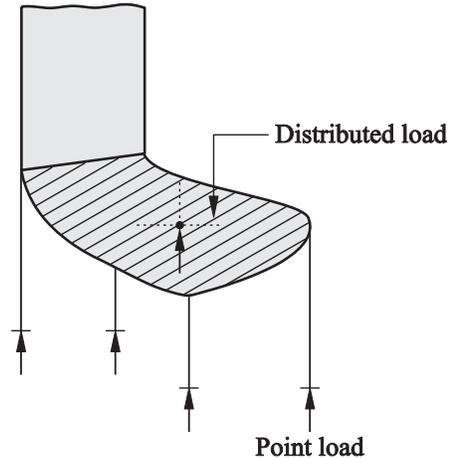
Load is an external force or moment experienced by the member.

**1.2.1 Type of Load****❖ Based on the direction of loading**

- Longitudinal (axial) (parallel to the axis)
- Transverse (perpendicular to the axis)

**❖ Based on the extent of loading :**

- Point load
  - Distributed load
- If the load acts on a very small area, then it is a point load.
  - If the load is distributed over a larger area then it is a distributed load.

**❖ Based on dimensions :**

- Force  $\propto$  Volume  
Ex : Buoyancy force, weight, centrifugal force etc.
- Force  $\propto$  Area  
Ex : Pressure force, drag force, etc.
- Force  $\propto$  Length  
Ex : Surface tension force, cylindrical roller bearing

**❖ Based on variation wrt time :**

- Static load
  - Dynamic load
- A load is said to be static load if the magnitude, direction and point of application (POA) does not change wrt time.  
Ex : Self weight
  - If any of the three (magnitude, direction and POA) changes wrt time then it is a dynamic load.  
Ex : Crank, connecting rod, piston, gears, cam and followers, bearings etc.