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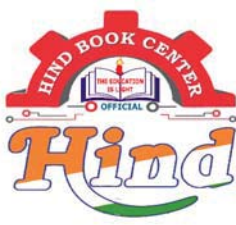
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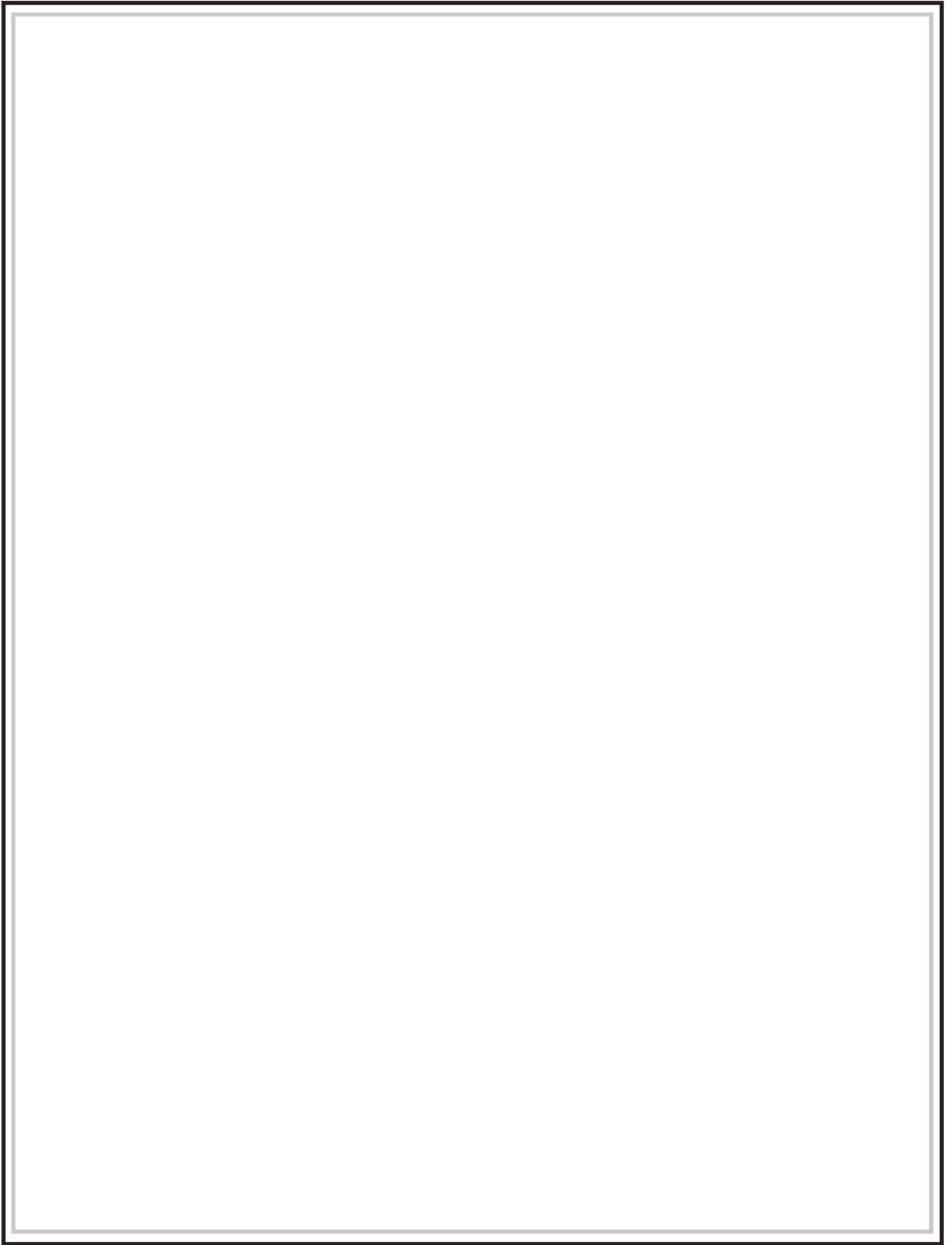
MECHANICAL ENGINEERING

Strength of Materials

[Student Problem Set]

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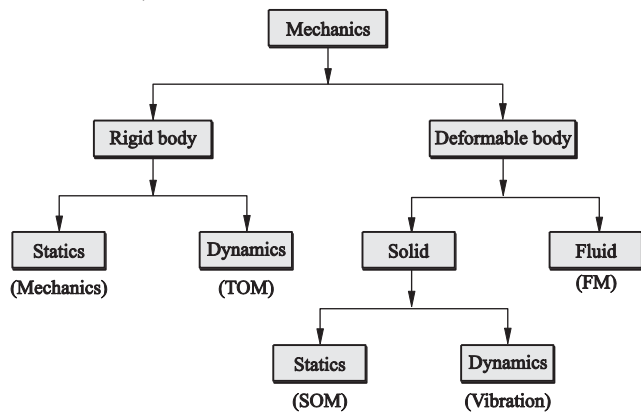


Chapter-1

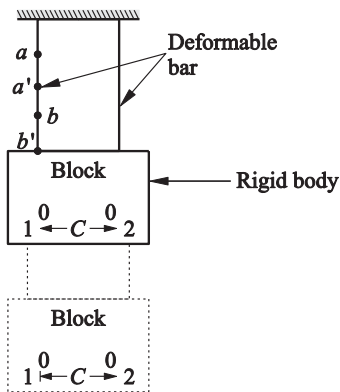
STRESS, STRAIN & ELASTIC CONSTANTS

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

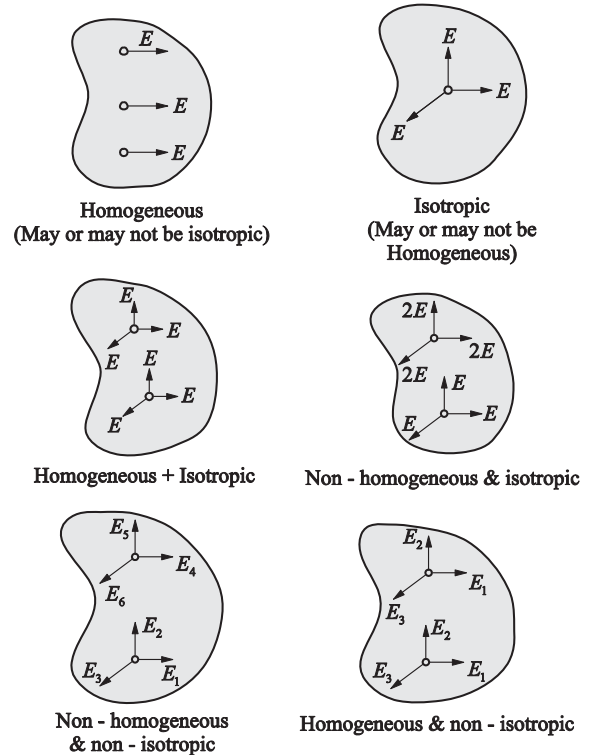
- SOM is also known as solid mechanics, or mechanics of solids or mechanics of deformable bodies.

❖ 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

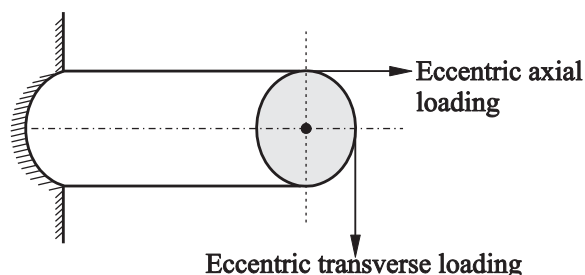
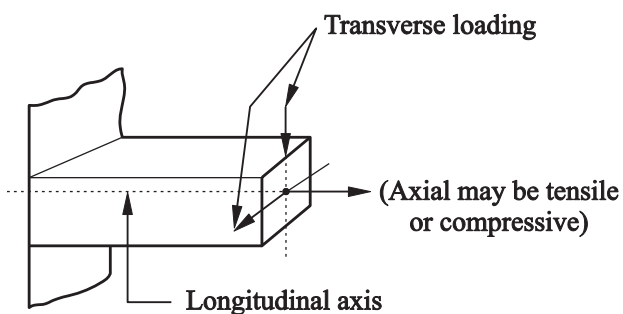
- Every homogeneous material need not be isotropic and similarly every isotropic material need not be homogeneous.
- Fortunately, most of the common engineering material are both homogeneous and isotropic.
- Wood, crystal are anisotropic material i.e., these material have different properties in different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

1.2 Load

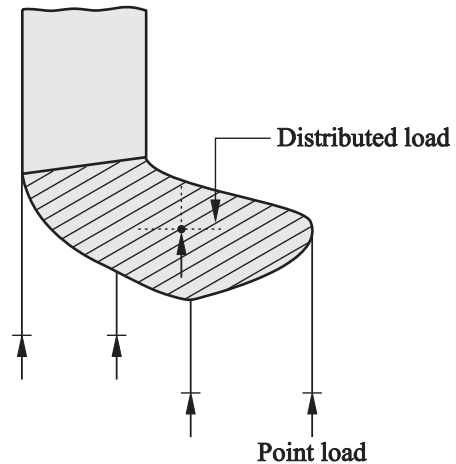
Load is an external force or moment experienced by the member.

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.