Strength of materials

Chapter one

Basic Concepts and Simple Stresses

1.1 **Introduction:**

Mechanics of materials (or strength of materials): is a branch of mechanics that studies the relationship between the external loads and the intensity of internal forces acting on a deformable body.

The objective will be the determination of stresses, strains and deformations for all levels of the applied load up to failure (collapse).

Definitions:

Rigid Body: which have no changes in volume or shape.

Prismatic Member: is a straight member having a constant cross-section.

prismatic   **Non- prismatic**

Homogenous Material: has the same physical and mechanical properties through its volume (brick, timber, steel,…)

Isotropic Material: has the same properties in all directions (brick, steel, concrete).

Anisotropic material: has different properties in different directions (timber, polymers, glass, fiber,…)

1.2 Analysis of Internal Forces

1.2.1 Equilibrium

Can be defined as that physical state of a body with no motion (rotation or linear translation). That is to say resultant equal to (zero). ($\mathcal{E}$F=0 , $\mathcal{E}$M$_i$ =0)
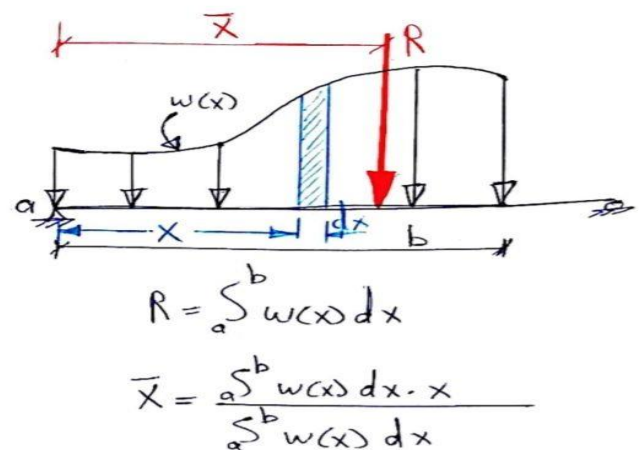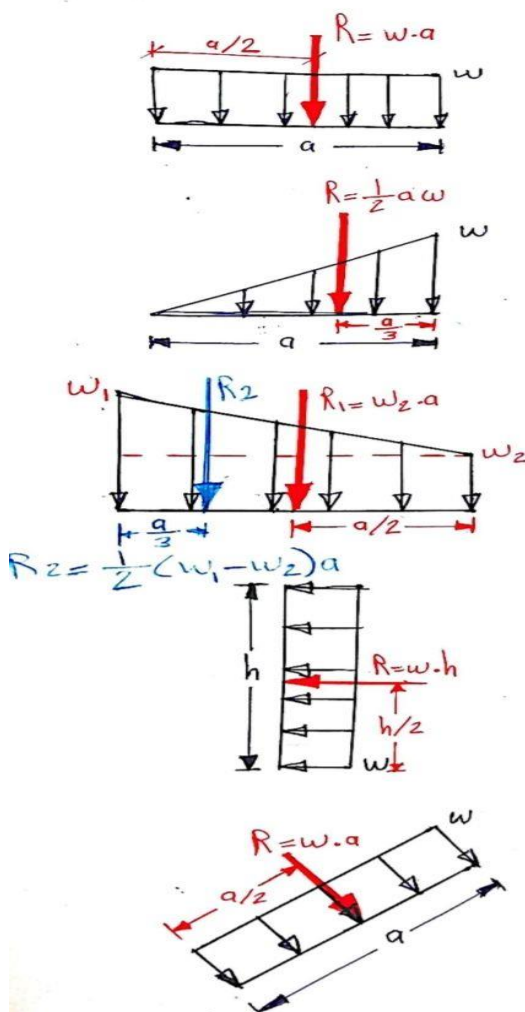
1.2.2 Types of External Loads

A body can be subjected to several types of external loads:

a. Concentrated Force:

When the loaded area is small in comparison with the total surface.
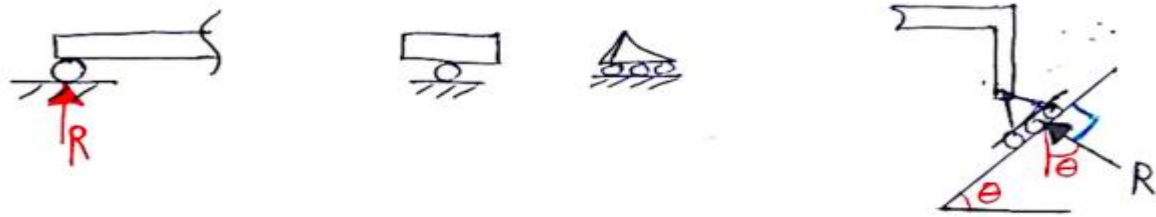
b. Linear Distributed Load w(x):

The resultant force (R) is equivalent to the area under the distributed loading curve, and acts through the centroid of the area.
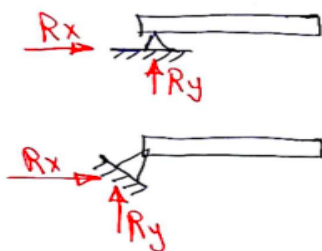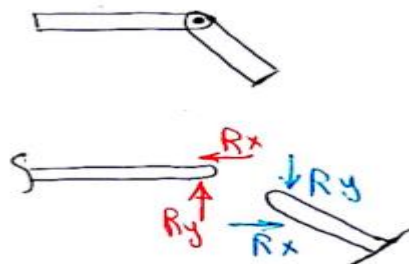

$$R = \int_{a}^{b} w(x)\, dx$$

$$\bar{x} = \frac{\int_{a}^{b} w(x)\, dx \cdot x}{\int_{a}^{b} w(x)\, dx}$$

c. **Body Force:**
   Without contact between bodies as for earth's gravitation. In this case the force is called the (weight).
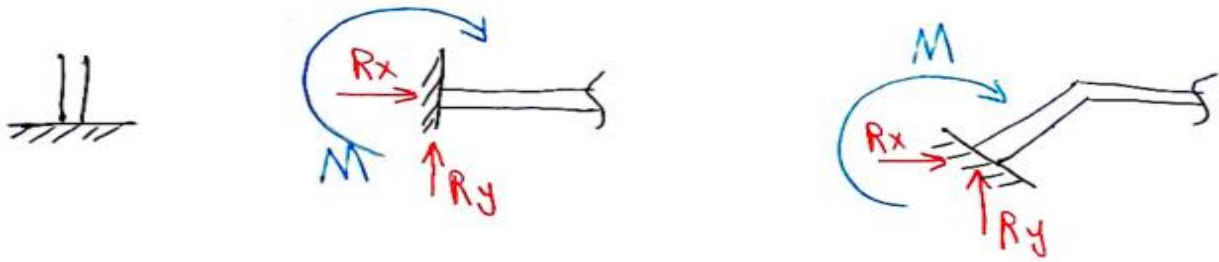
1.2.3 Types of Reactions

Roller

Only **one** unknown reaction normal to the direction of motion.

External pin (or hinge)   **Internal pin (or hinge)**

Two unknowns components in perpendicular directions (x,y)

Fixed Support

Two unknowns components in perpendicular directions (x,y) **and** unknown couple (M).

Cable, Chain, Strand

One unknown axial tensile force in the direction of cable.