Course Code: ESC106A
Course Title: Construction Materials and Engineering Mechanics

Lecture No. 20:
Equilibrium of Structural Systems

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Lecture Intended Learning Outcomes

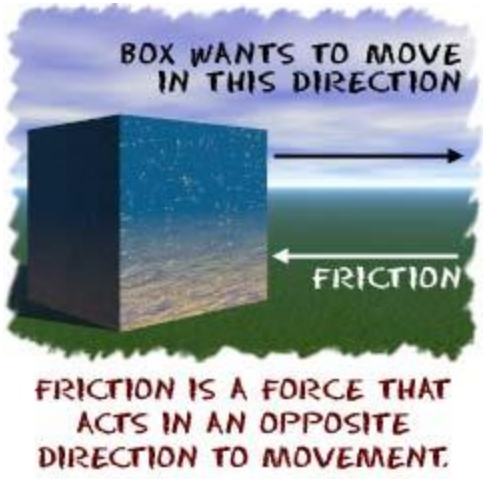
At the end of this lecture, students will be able to:

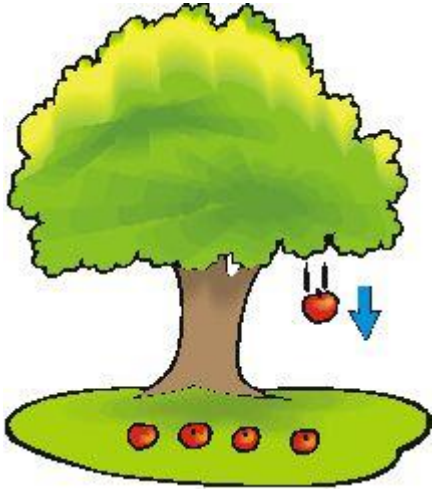
- Define types of forces
- Define Equilibrium and Equilibrant
- Describe conditions of equilibrium for concurrent and non concurrent force systems

Contents

Types of forces, equilibrium and equilibrant, conditions of equilibrium

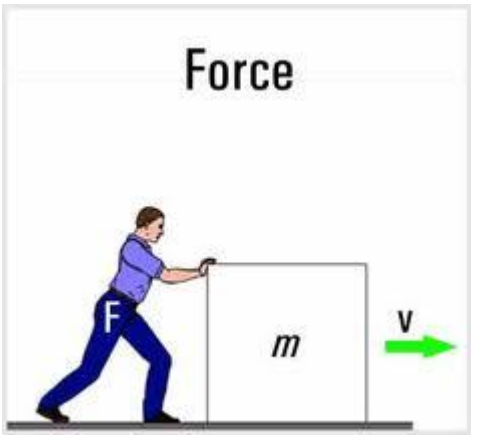
Types of forces



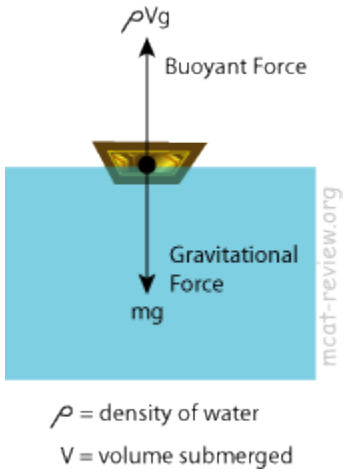


Gravity Force

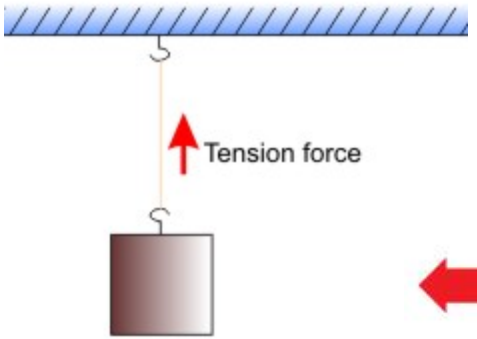
Magnetic Force



Applied Force



Buoyant Force



Tension Force

Drag Force

Spring Force

Types of forces acting on a body

Applied Forces

- Applied forces are the forces applied externally to a body
- Each of the forces has got a point of contact with the body

Ex: If a person stands on a ladder , his weight is an applied force

Types of forces acting on a body

Non-Applied Forces

- There are two types of non-applied forces

(a)Self Weight (b)Reactions

(a)Self Weight: Every body is subjected to gravitational acceleration and hence has a self-weight

W=mg

Where m is the mass of the body

And g is the gravitational acceleration

- Self-weight always acts in vertically downward direction
- When analyzing equilibrium of a body ,self weight is treated as acting through the centre of gravity of the body

Types of forces acting on a body

Non-Applied Forces

- There are two types of non-applied forces

(a)Self Weight (b)Reactions

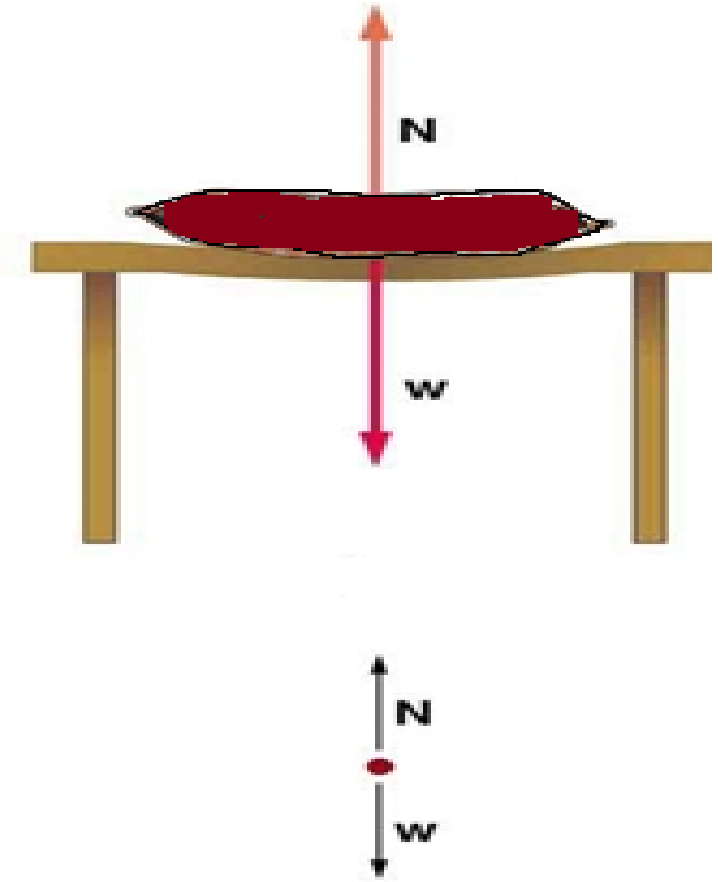
(b)Reactions:

- These are self-adjusting forces developed by the other bodies which come in contact with the body under consideration

Types of forces acting on a body

Applied force

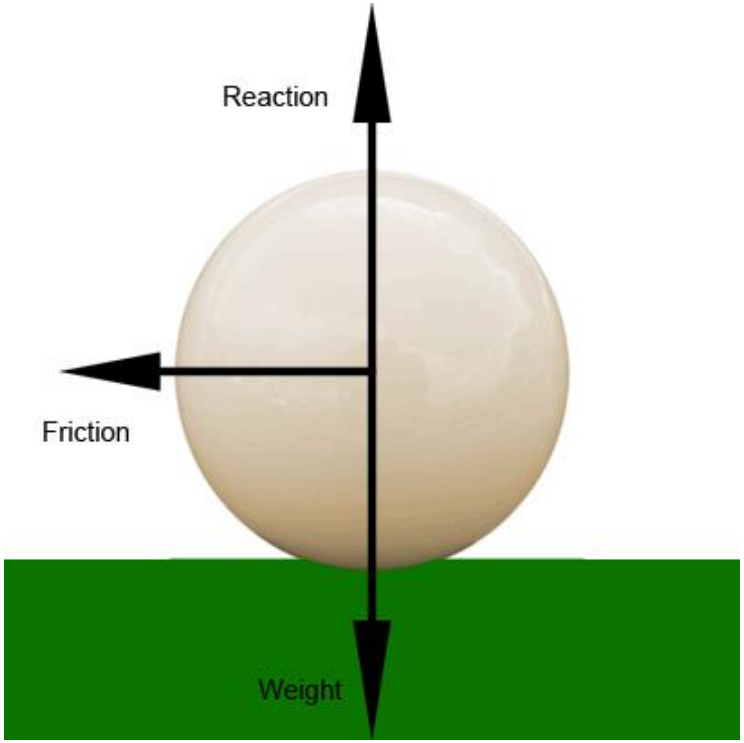
Non applied force



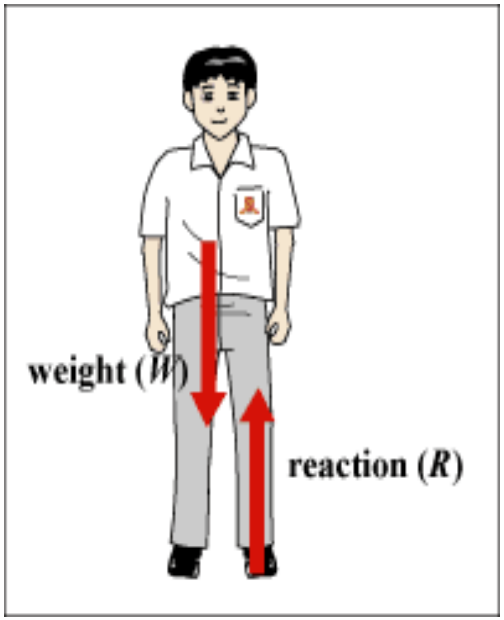
Types of forces acting on a body

Applied force

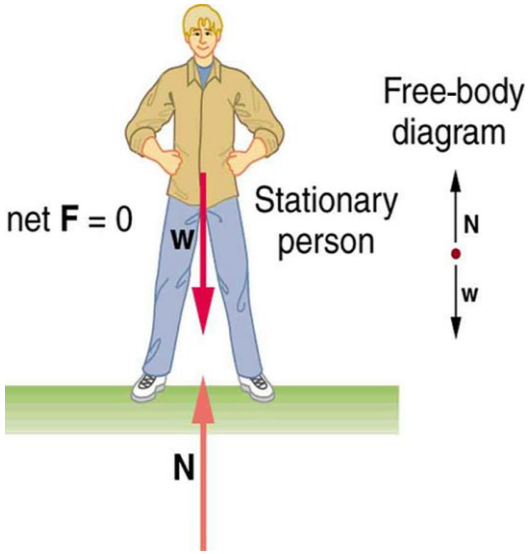
Non applied force



Equilibrium



- The term equilibrium implies that either the body is at rest or a body is in static equilibrium when the force system acting on it tends to produce no net translation or rotation of the body



Conditions of Equilibrium

- ΣV=0 or ΣFy=0

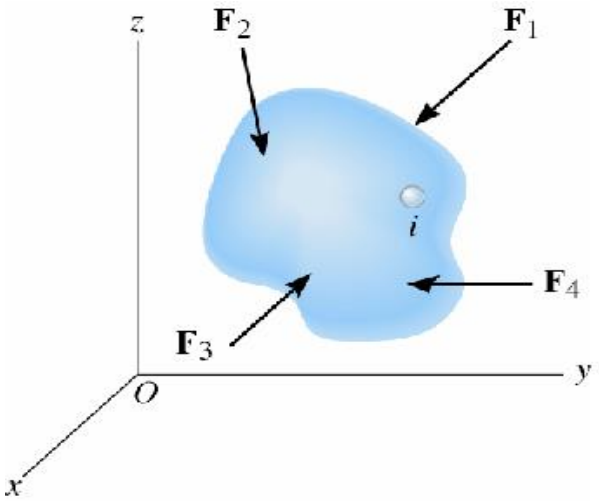
i.e Algebraic sum of all the vertical forces must be equal to zero

- ΣH=0 or ΣFx=0

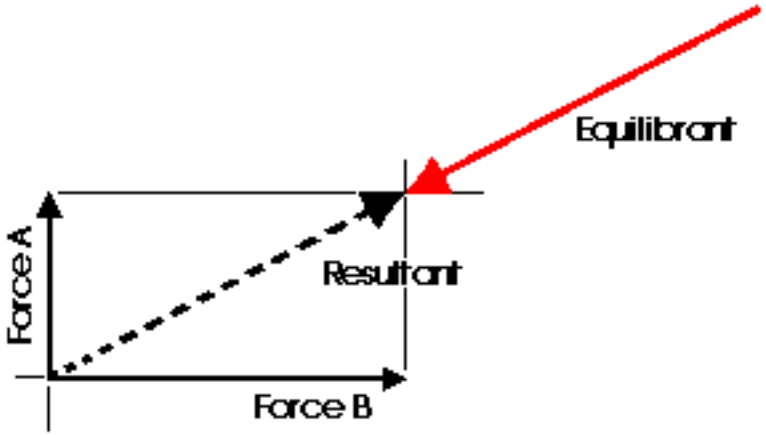
i.e Algebraic sum of all the horizontal forces must be equal to zero

- ΣM=0

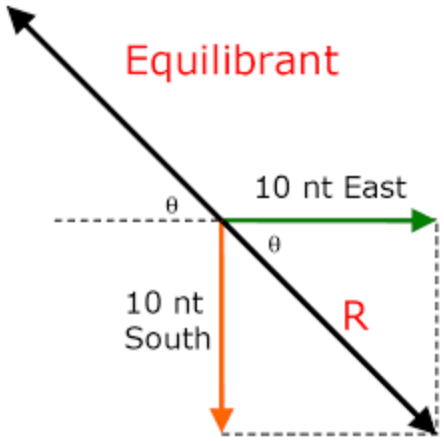
i.e Algebraic sum of moment of all the forces about any point must be equal to zero



Equilibrant



Force which is equal and opposite to the resultant force is called as Equilibrant



Summary

- Forces are broadly classified into applied and non applied forces
- A body is said to be in equilibrium when the force system acting on it tends to produce no net translation or rotation of the body
- Force which is equal and opposite to the resultant force is called as Equilibrant