ENSC 2113
Engineering Mechanics: Statics

Chapter 1:

General Principles

(Sections 1.1-1.6)

Chapter 1 Outline:

1.1 Mechanics

1.2 Fundamental Concepts

1.3 Units of Measurement

1.4 The International System of Units

1.5 Numerical Calculations
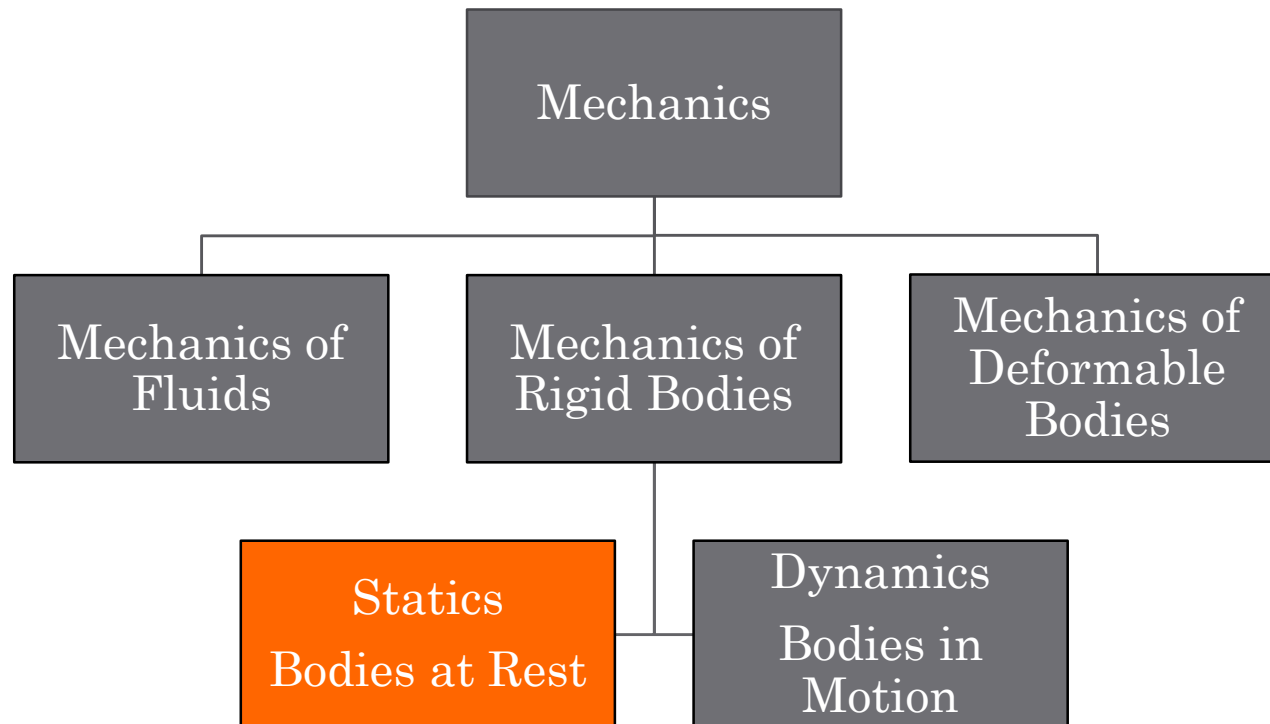
1.6 General Procedure for Analysis

Chapter 1 Objectives:

- To provide an introduction to the basic quantities and idealizations of mechanics

- To give a statement of Newton's Laws of Motion and Gravitation

- To review the principles for applying the SI system of units

- To examine the standard procedures for performing numerical calculations

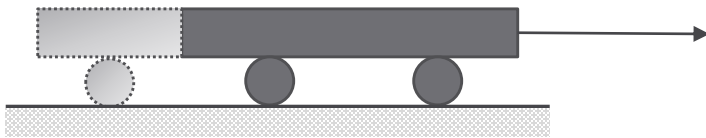- To present a general guide for solving problems
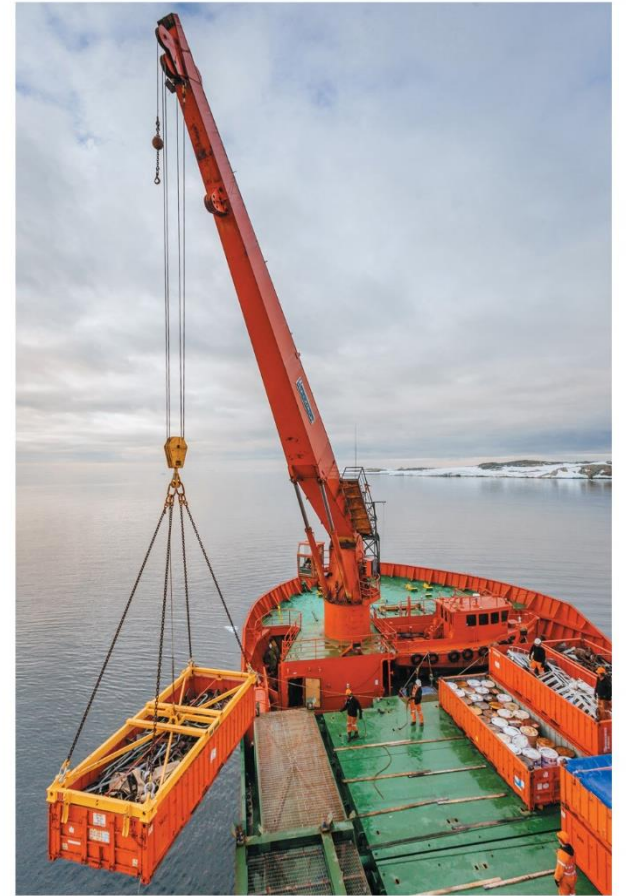
1.1 Mechanics:

Mechanics involves the rest or motion of bodies that are subjected to the action of forces.

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                    ┌─────────────┐
                    │  Mechanics  │
                    └─────────────┘
         ┌─────────────────┼─────────────────┐
  ┌─────────────┐   ┌─────────────┐   ┌─────────────┐
  │ Mechanics of│   │ Mechanics of│   │ Mechanics of│
  │   Fluids    │   │ Rigid Bodies│   │ Deformable  │
  │             │   │             │   │   Bodies    │
  └─────────────┘   └─────────────┘   └─────────────┘
                     ┌──────┴──────┐
              ┌─────────────┐ ┌─────────────┐
              │   Statics   │ │  Dynamics   │
              │Bodies at Rest│ │ Bodies in   │
              │             │ │   Motion    │
              └─────────────┘ └─────────────┘
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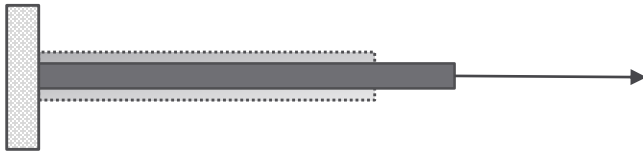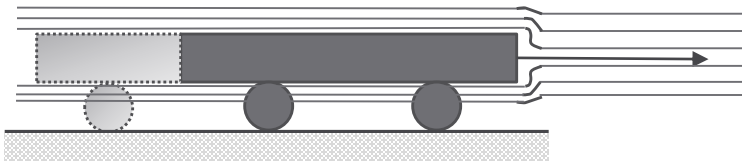
1.1 Mechanics:

Statics
Bodies at Rest

Dynamics
Bodies in Motion

Mechanics of Deformable Bodies

Mechanics of Fluids

1.2 Fundamental Concepts:

Quantities used in Rigid Body Mechanics include:

- <u>Length</u> - Used to describe location and size.

- <u>Mass</u> - Property that produces effects of gravitation force.

- <u>Force</u> - "Push" or "Pull" exerted from one body to another.

- <u>Time</u> - Not a Statics concern (used in Dynamics).

Models to visualize bodies in Rigid Body Mechanics include:

- <u>Particle</u> - Element w/ mass where size is not important.

- <u>Rigid Body</u> - Element w/ mass where size affects forces.

- <u>Concentrated Force</u> - Load applied at fixed location(s).
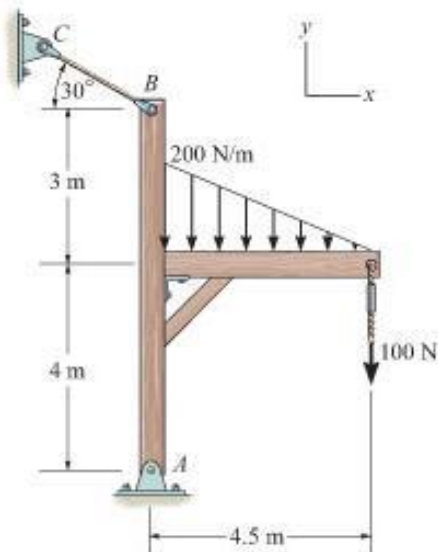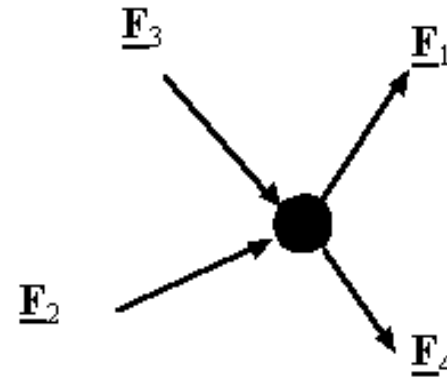
1.2 Fundamental Concepts

Models are used to simplify theory application

Models include:
  Particles
  Rigid Bodies
  Concentrated Forces

$\mathbf{F}_3$ $\mathbf{F}_1$

$\mathbf{F}_2$ $\mathbf{F}_4$

200 N/m
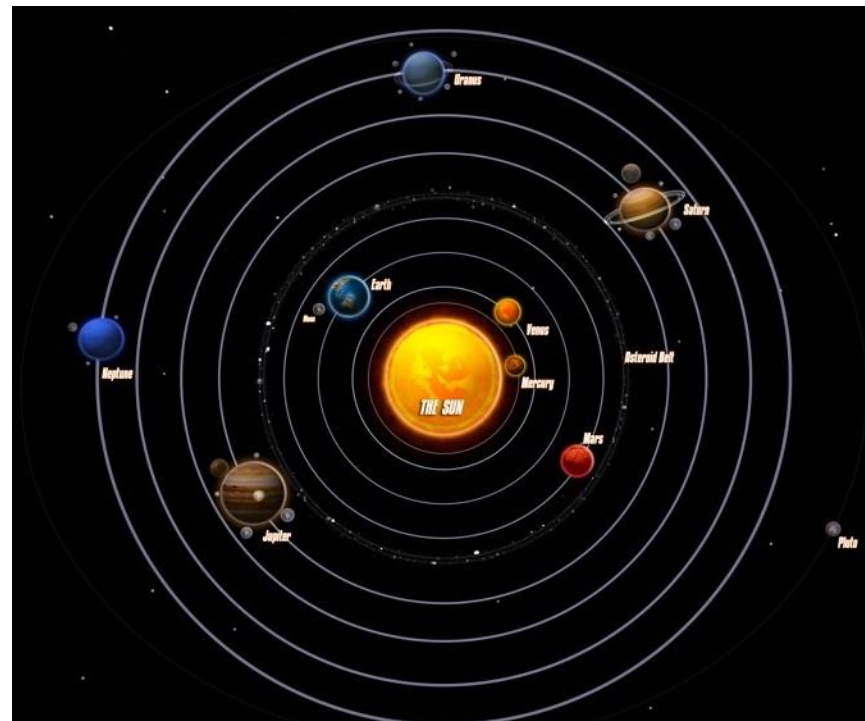
30°

3 m

4 m

100 N

4.5 m
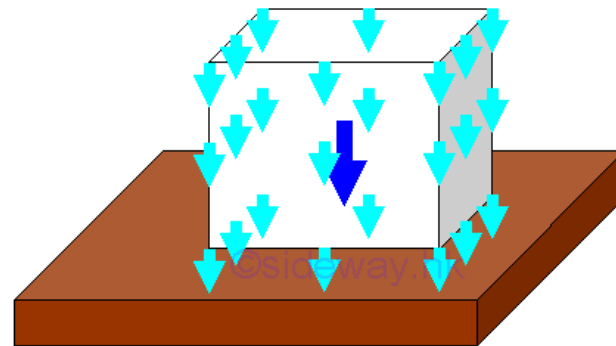
1.2 Fundamental Concepts
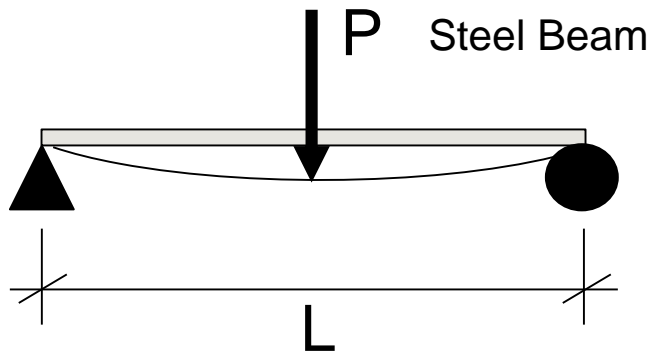
Particle:

Size (and sometimes mass) are neglected

For example, Earth is very large, yet insignificant when compared to the size of orbit. Therefore, Earth can be modeled as a particle.
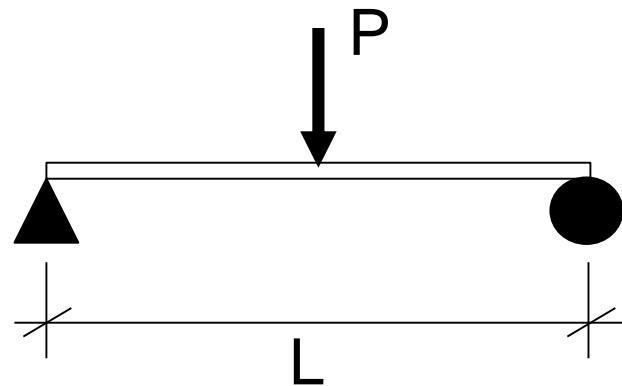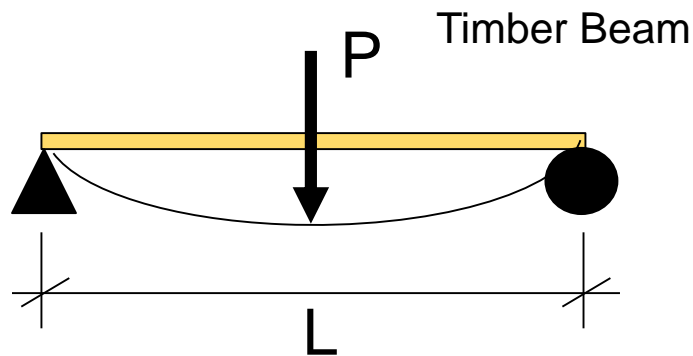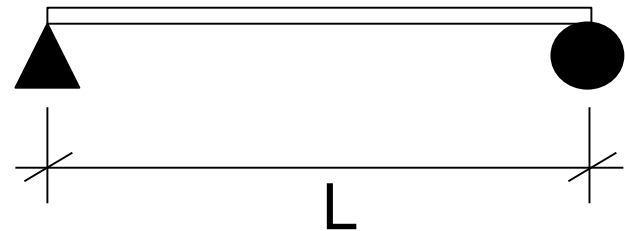
1.2 Fundamental Concepts:

Rigid Body:

A combination of a large number of particles that stay at a fixed distance from one another before and after applying load.
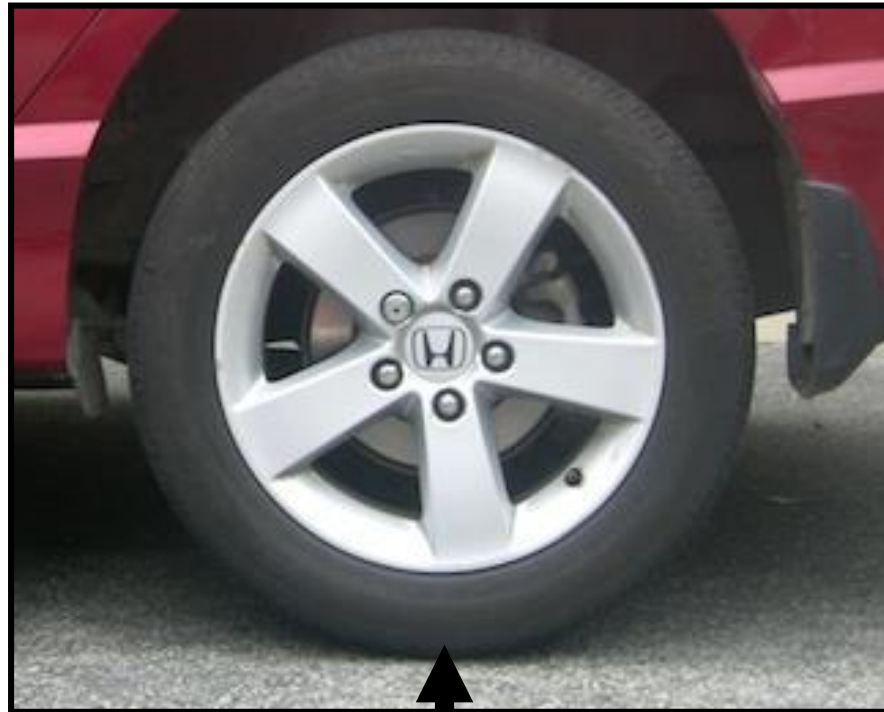
1.2 Fundamental Concepts

Concentrated Force:

Represents the effect of a loading which is assumed to act at a point on a body when the area over which the load is applied is small compared to the body.
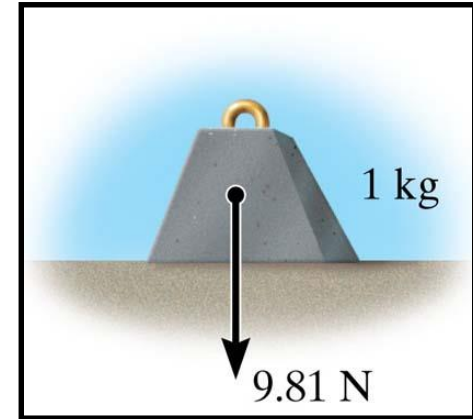
1.3-1.4 Units:

- ## SI Units

  Mass is typically given, thus weight must be calculated by the equation:
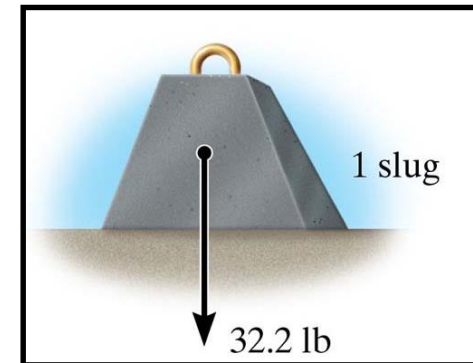
  W = m g (N = newton)

     where,   m = mass (kg)

            g = gravitational constant

            (9.81 m/s^2)

 1 kg

  9.81 N

- ## U.S. Customary Units

  Typically given in pounds-force, no conversion is required

  1 slug

  32.2 lb

1.6 General Procedure for Analysis:

The following is a guide for solving a statics problem:

- Read carefully to understand the problem.

- Draw all diagrams & tabulate problem data.

- Apply theory in equation form.

- Solve equations and determine answer.

- Review completed problem – ***Does the answer make sense?***
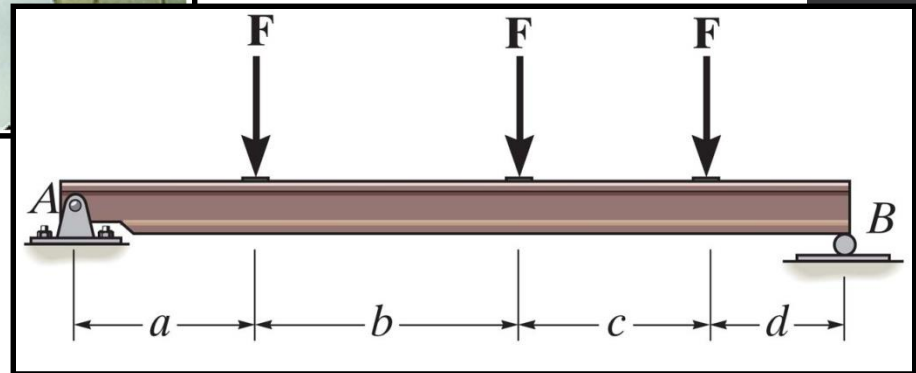
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