

Module 1 : Introduction : Review of Basic Concepts in Mechanics

Lecture 1 : Introduction

Objectives

In this course you will learn the following

- Introduction to structural mechanics, with respect to previous courses of engineering.
- Solid mechanics; scope of structural mechanics, example of different structure types and load types.

1.1 Introduction

Structural Mechanics can be briefly described as the study of the behaviour of structures using the knowledge of mechanics. Such a description needs some understanding of the terms “structure” and “mechanics”. Structures include a wide variety of systems, such as buildings, bridges, dams, aircrafts, etc., that are built to serve some specific human needs (for example, habitation, transportation, storage, etc.). Students of Structural Mechanics should already have some basic knowledge of mechanics through the prerequisite courses of Engineering Mechanics (or Rigid-body Mechanics or Vector Mechanics) and Solid Mechanics (Mechanics of Deformable Solids or Mechanics of Materials). In Structural Mechanics, we apply our knowledge of the mechanics of rigid bodies and of deformable solids to the understanding of the behaviour of engineered structures.

In Structural Mechanics, we mostly deal with mechanics of solids (i.e. deformable bodies). However, here we move on from studying the behaviour of structural members/materials (as in a course of Solid Mechanics) to studying the behaviour of real structures, or parts thereof. For example, instead of dealing with a beam or a column, we study how a building frame (Figure 1.1), composed of several beams and columns, behaves. In a similar way, we first learn about the loads that are applied to the whole structure, and not to individual members. Our knowledge of Structural Mechanics enables us to find the forces that act on individual members based on the loads that are acting on the whole structure. Stresses, strains, internal forces and deformations in members, then, can be obtained by using what we have already learned about the behaviour of deformable solids.

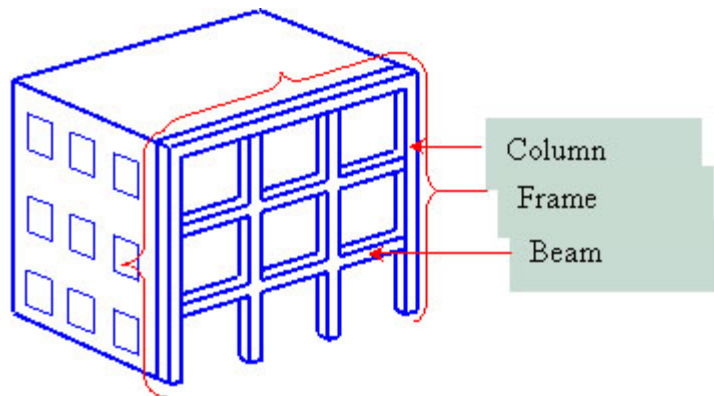


Fig. 1.1 Frame in a building

Contents of this course of Structural Mechanics will focus on Civil Engineering structures only. Such structures are classified into various categories depending on the system/mode of classification:

- (a) On the basis of its *intended function/usage*: Buildings, bridges, dams, industrial sheds, cable ways, chimneys, etc. (Figure 1.2)
- (b) On the basis of its *form/load transfer mechanism*: Beams, columns, floor slabs, arches, shells, trusses, frames, footings, etc. (Figure 1.3)
- (c) Considering the *analysis perspective*: 2-dimensional, 3-dimensional, determinate, indeterminate, etc. (Figure 1.4)



(a) Building



(b) Bridge



(c) Dams



(d) Industrial sheds

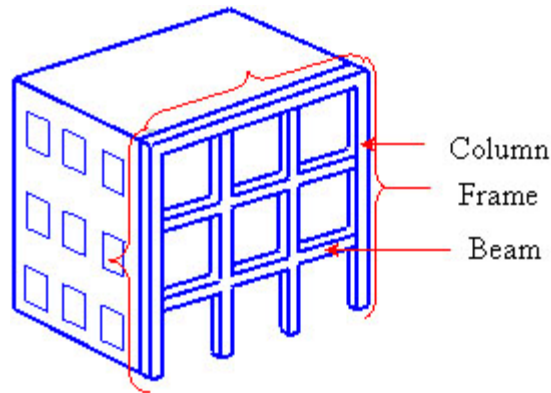


(e) Cable ways

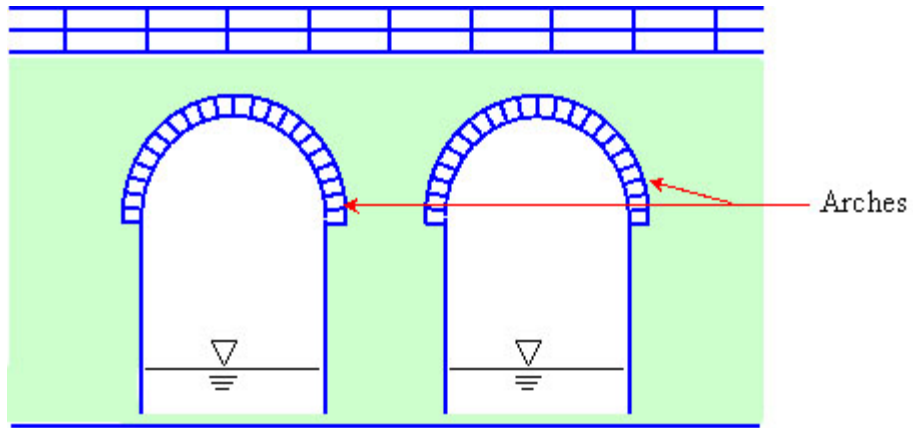


(f) Chimneys

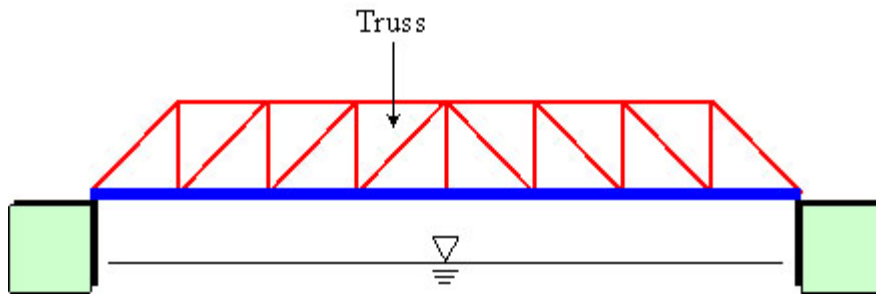
Figure 1.2 Various types of structures



(a) Building frame

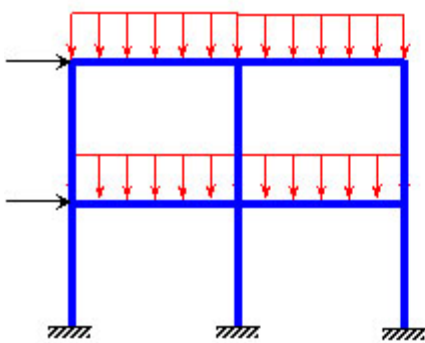


(b) Arched Bridge

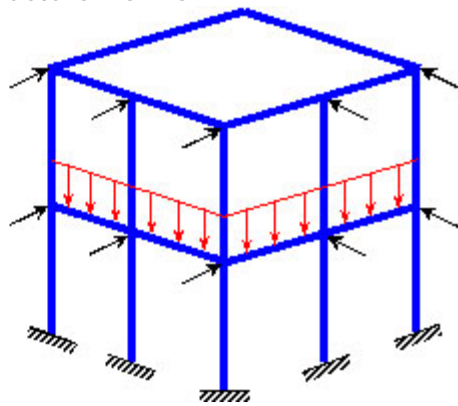


(c) Trussed Bridge

Figure 1.3 Various structural forms



(a) 2-dimensional structure



(b) 3-dimensional structure

Figure 1.4 2-dimensional and 3-dimensional model of structures

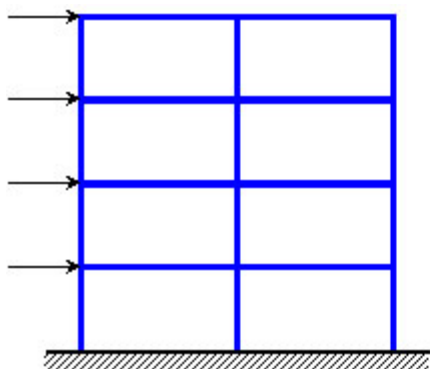
Similarly loads are also put into different categories, based on various criteria:

a(a) Based on the *source/origin*: Wind load, earthquake load, self weight, live load, blast load, temperature stress, etc.

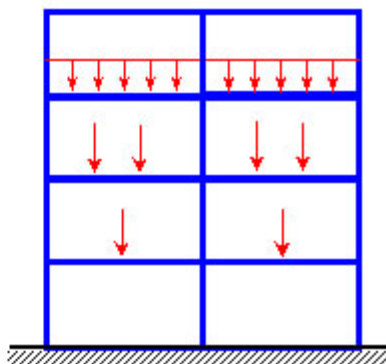
a(b) Based on the *direction of action*: Gravity loads, lateral loads, etc. (Figure 1.5)

a(c) Based on *time-variation*: Static, dynamic, impulse, pseudo-static, etc.

a(d) Based on the *mode of action/analysis point-of-view*: Concentrated or point load, distributed load, moment, pressure, etc. (Figure 1.6).



aaaa(a) Lateral loads

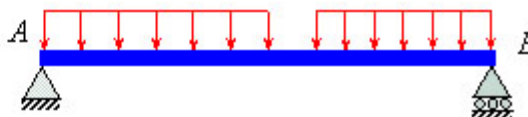


aaaa(b) Gravity loads

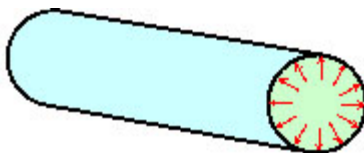
Figure 1.5 Load types based on direction of action



(a) Concentrated or point loads on a simply supported beam



(b) Distributed loads on a simply supported beam



(c) Pressure acting on inner surface of a cylinder

Figure 1.6 Load types based on analysis point of view

Recap

In this course you have learnt the following

- Introduction to structural mechanics, with respect to previous courses of engineering.
- Solid mechanics; scope of structural mechanics, example of different structure types and load types.