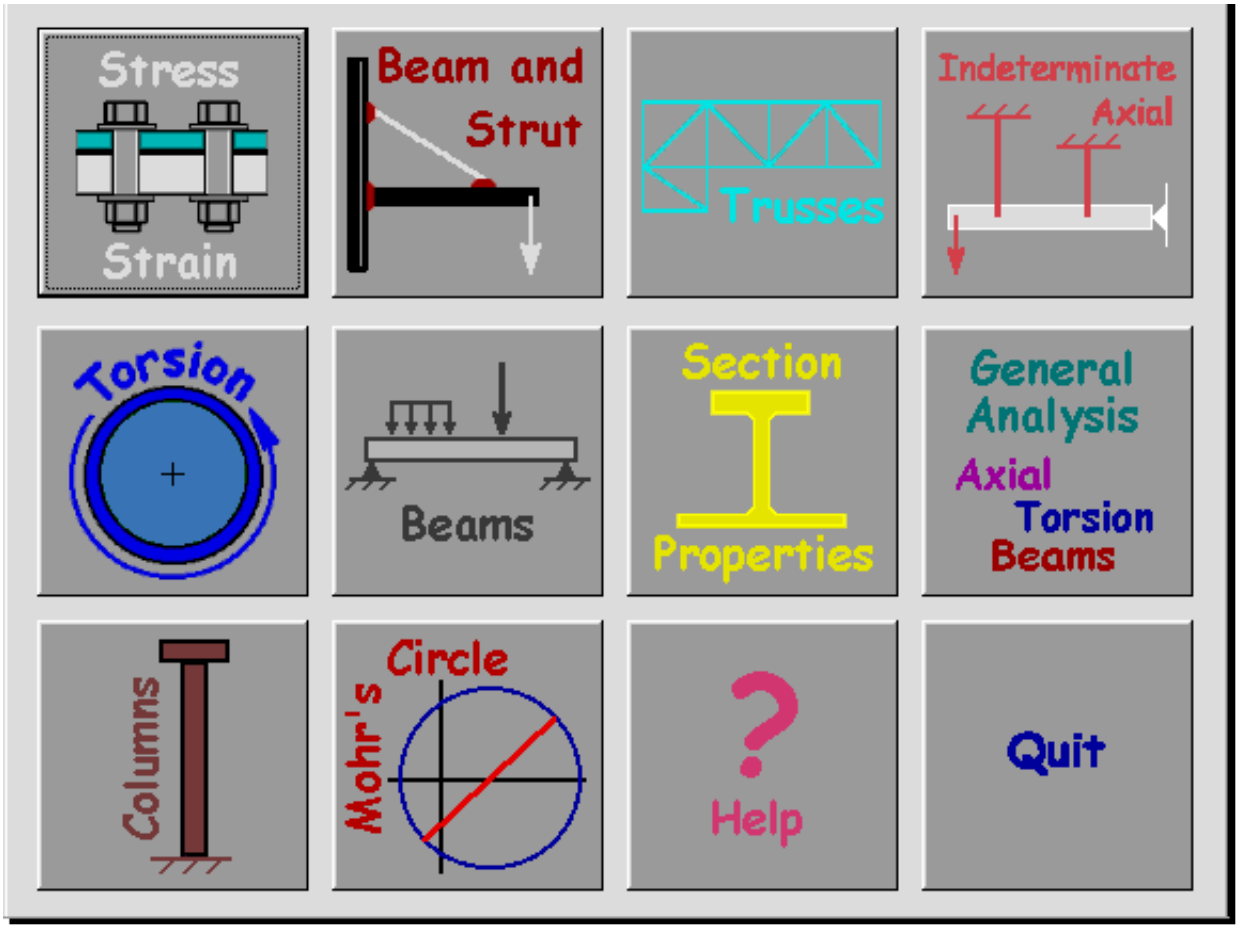
Chapter 1
INTRODUCTION

1.1 THE OBJECT OF MECHANICS OF MATERIALS

If Theoretical Mechanics deals with rigid (non-deformable) bodies, Mechanics of Materials (often called Strength of Materials) deals with *deformable bodies.*

The main objective of the Mechanics of Materials is to study the behavior of the construction elements under any actions and to establish mathematical relations which provide checking the strength, rigidity (deformations) and stability conditions. Otherwise, both the analysis and design of a given structure involve the determination of stresses and deformations.



Mechanics of Materials is a part of the group of disciplines called Applied Mechanics (or Construction Mechanics). The disciplines which form this important group are:

- *Theoretical Mechanics:* dealing with the study of rigid bodies
- *Mechanics (Strength) of Materials:* dealing with the study of bar elements
- *Theory of Elasticity:* supplies the main hypothesis regarding the deformable bodies and some fundamental relationships; it deals with the study of plates and massifs
- *Theory of Plasticity:* dealing with permanent deformations of the body
- *Static, Dynamic and Stability*
- *Mechanics of Soils*

1.2 CLASSIFICATION OF BODIES IN CONSTRUCTION

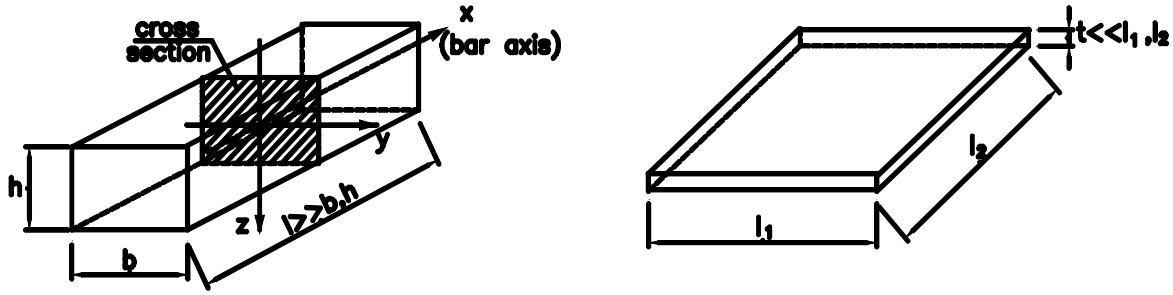
The solid bodies are classified according to their characteristic dimensions, into:

a. The bar: is a one-dimensional body (Fig.1.1.a), what means that one dimension (*the length*, which is parallel to the bar axis *x*) is much bigger than the other two, which form the *cross section* (their dimensions are parallel to axis *y* and *z*). The cross section is a plan cut perpendicular (normal) to the longitudinal axis of the bar.

E.g.: *beams, columns* (linear elements)

b. The plate: is a two-dimensional body (Fig.1.1.b), which has two dimensions much bigger than the third (generally, the plate *thickness*).

E.g.: plane plates: *lamellas, slabs,* curved plates: *shells* (surface elements)



a. b.

Fig. 1.1

c. The massive (solid): is a three-dimensional body which has all three dimensions comparable.

E.g.: *dams, retaining walls* (volume elements)

1.3 HYPOTHESES IN MECHANICS OF MATERIALS

Some hypotheses concerning the structure of the materials and their behavior should be considered in what follows:

a. The hypothesis of the continuous medium: Mechanics of Materials considers the materials as continuous, homogeny medium, which occupy the entire space given by their volume.

b. The hypothesis of the isotropy: the materials are *isotropic* if on any direction the elastic proprieties are identically (e.g.: the steel). Otherwise, they are *anisotropic or orthotropic* (e.g.: the wood).

c. The hypothesis of the small deformations: the deformations of the elastic bodies (elongations, sliding, displacements) are very small with respect to their characteristic dimensions.

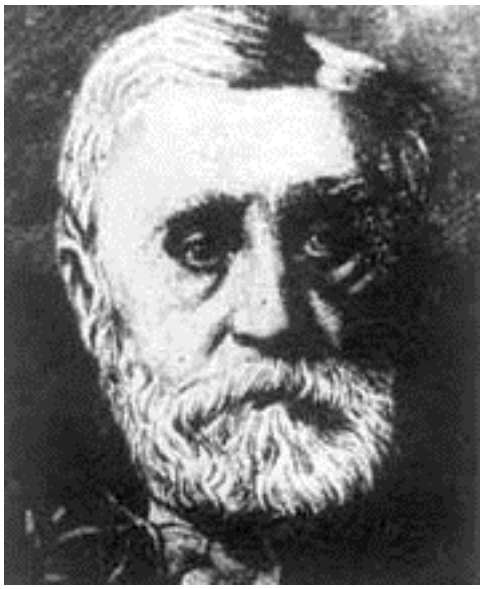
d. The linear relation between unit stresses and deformations: for elastic regime of solicitation *Hooke's law* is valid. For this reason *the principle of the superposition of effects* may be applied.

Robert Hooke (1635-1703)

e. Bernoulli's hypothesis (the plane-sections hypothesis): a plane section perpendicular to the bar axis before deformation, remains plane and perpendicular, also after deformation.

***Jakob Bernoulli (1654-1705*)**

f. Saint-Venant's principle: stress distribution may be assumed independent of the mode of load application except in the immediate vicinity of load application points.



Adhémar Jean Claude Barré de Saint-Venant (1797-1886)