

Module 2 : Analysis of Statically Determinate Structures

Lecture 4 : Sign Convention and Notations for Internal Forces

Objectives

In this course you will learn the following

- Standard sign conventions and notations for internal forces through illustrations.

2.4 Sign Convention and Notations for Internal Forces

The sign convention for internal forces depends on the internal surface on which these forces are being considered. So, we need to define the internal surface first. Let us assume that the centroidal axis of a longitudinal structural member is aligned along the x -axis, and we consider the internal forces on an x -plane (or x -surface). If this cross-section is facing positive x -direction, then it is called a positive x -surface, and vice-versa. Figures 2.5a & b show the positive internal forces on positive and negative x -surfaces, respectively.

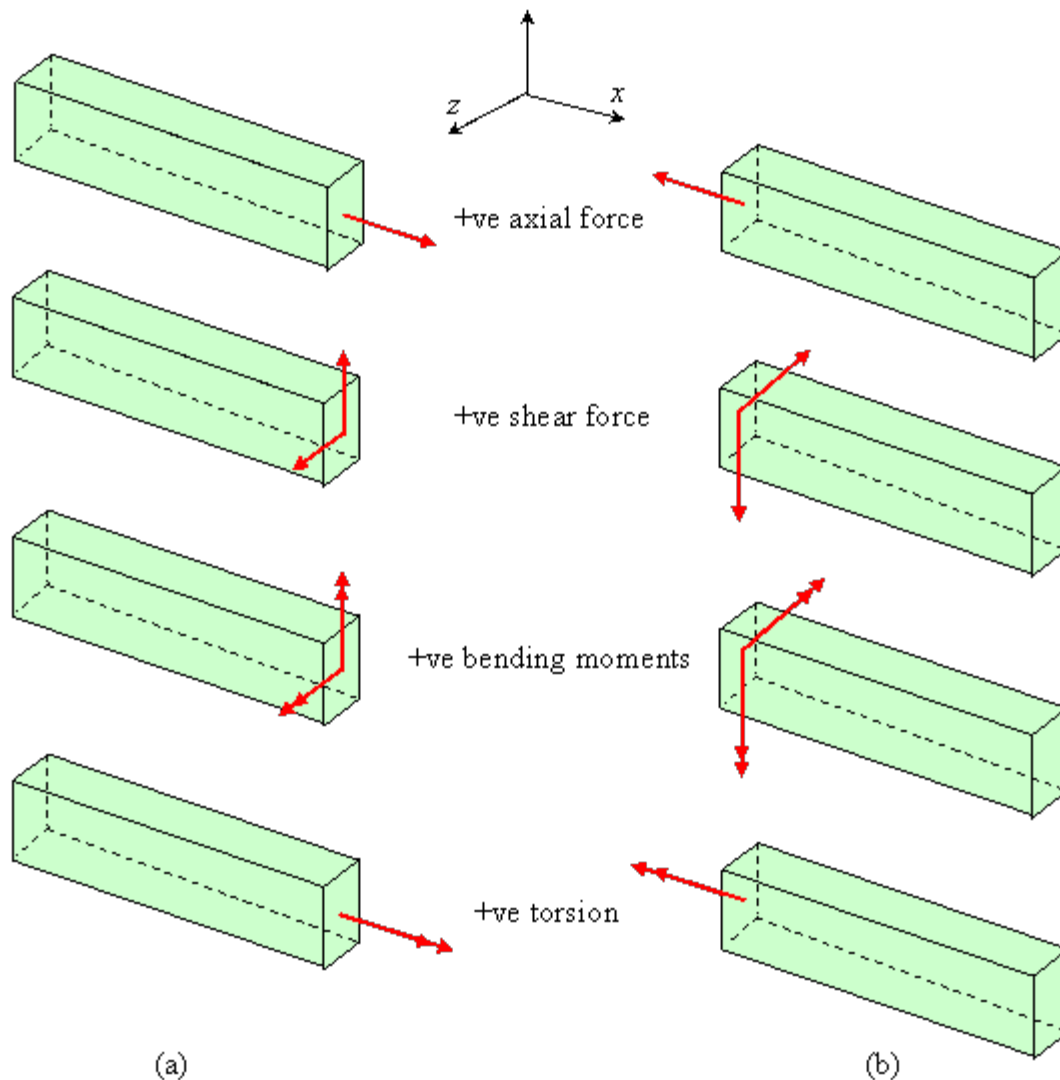


Figure 2.5 Direction of positive internal forces on a positive x -surface (a) and a negative x -surface (b)

This sign convention is followed throughout this course and relations involving these forces (and other parameters, such as stresses and deformations) are derived based on this sign convention. It will not be illogical to adopt any other sign convention for internal forces. However, in that case one will have to

develop the equations involving these forces independently following the new sign convention.

Let us restrict our discussion to planer loading (that is, two-dimensional) cases with no torsion. For an internal segment of a member, we can show the internal forces both on the positive and the negative internal surfaces. Positive directions for each internal force (an axial force, a shear force and a bending moment) are shown individually in Figure 2.6. This is an easy and standard way of defining sign conventions for two-dimensional cases, and students are encouraged to define (for each specific case) their adopted sign convention similarly.

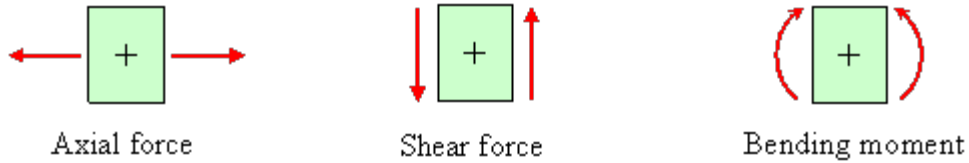


Fig. 2.6 Defining sign convention for internal forces in a planar system

Notations that we follow for these internal forces are: P for axial force, V for shear force, and M for bending moment. However, please note that in a three-dimensional case, we need suffixes to distinguish between the two shear forces and also between the two bending moments. General notation for torsion is T .

Recap

In this course you have learnt the following

- Standard sign conventions and notations for internal forces through illustrations.