

Module 2 : Analysis of Statically Determinate Structures

Lecture 6 : Internal Force Diagrams

Objectives

In this course you will learn the following

- Why we need internal force diagrams for structural members.
- The use of internal force diagrams in structural analysis and design.

2.6 Internal Force Diagrams

Let us consider the beam-column AB of the previous example with the same loading condition, but a different cross-section $b - b$ (Figure 2.11). Following the same procedure as in the previous example we can find the internal forces at $b - b$. The values of internal forces at $b - b$ are not same as of those at $a - a$.

$$P = -2kN$$
$$V = 0.5kN$$
$$M = 8kNm$$

Thus, internal forces vary according to the cross-section under consideration.

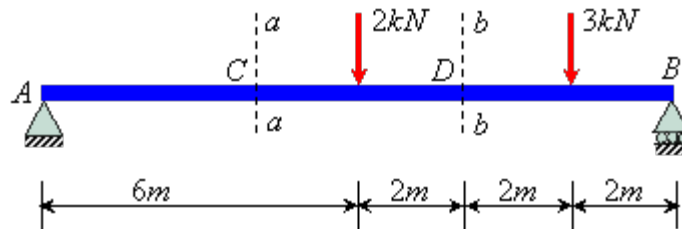
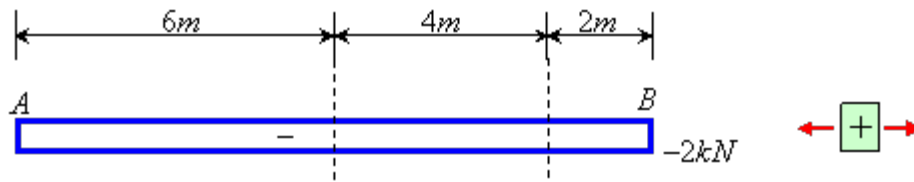


Figure 2.11 Cross-section $b - b$ of beam column AB

A structural member should be able to carry the internal forces at each section without failure so as to perform its intended function. So, in order to check the integrity or effectiveness of a structural member, one needs to check its capacity against internal forces at its each and every cross-section. This makes the study of the variation of internal forces in a member very important to Structural Mechanics. Such a study is best done through internal force diagrams, which provide, at one glance, several critical information on these internal forces.

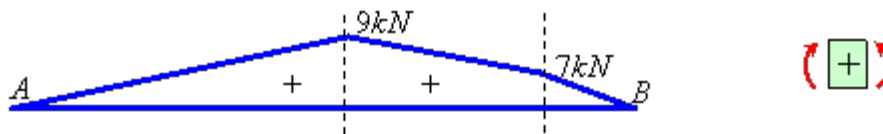
We use individual diagrams for each type of internal force. Thus we have *axial force diagram*, *shear force diagram* and *bending moment diagram* for a beam. For the beam-column AB of Figure 2.7, we can find internal forces at each cross section and obtain the internal force diagrams. Figure 2.12 shows three internal force diagrams for this beam.



(a) Axial force diagram



(b) Shear force diagram



(c) Bending moment diagram

Figure 2.12 Axial force (a), shear force (b) and bending moment (c) diagrams for AB

Note that, we have marked +ve and -ve signs in these diagrams and also put our sign convention to define the direction of the internal force under consideration. In addition to that, it is also important that we label these diagrams with values at key points (that means, the maximum positive and negative value points, zero-value points, points where the variation changes, for example from linear to parabolic).

Recap

In this course you have learnt the following

- Why we need internal force diagrams for structural members.
- The use of internal force diagrams in structural analysis and design.