

Module 2 : Analysis of Statically Determinate Structures

Lecture 1 : Internal Force on a System

Objectives

In this course you will learn the following

- The concept of internal forces in a system.
- Understanding internal forces in a solid body.

2.1 Internal Force on a System

Internal forces (or moments) are generated within a solid body (or structural system) when it is acted upon by external forces (including support reactions and other contact forces as well). To illustrate how internal forces are generated or why they exist, let us consider a three-dimensional solid body (Figure 2.1a), supported at points A and B . P_1 , P_2 and P_3 are external loads applied on the system. To study the equilibrium of the whole body, we draw its free body diagram (Figure 2.1b). The supports are replaced by reactions R_A and R_B in the free body diagram. We consider an internal surface by taking an arbitrary cut through the system (Figure 2.1c). For equilibrium of the part at the right of the section, there has to be forces acting on the internal surface which balance the external loads P_3 and R_B (Figure 2.1d). I_1 and I_2 are internal forces acting on the surface of the cut.

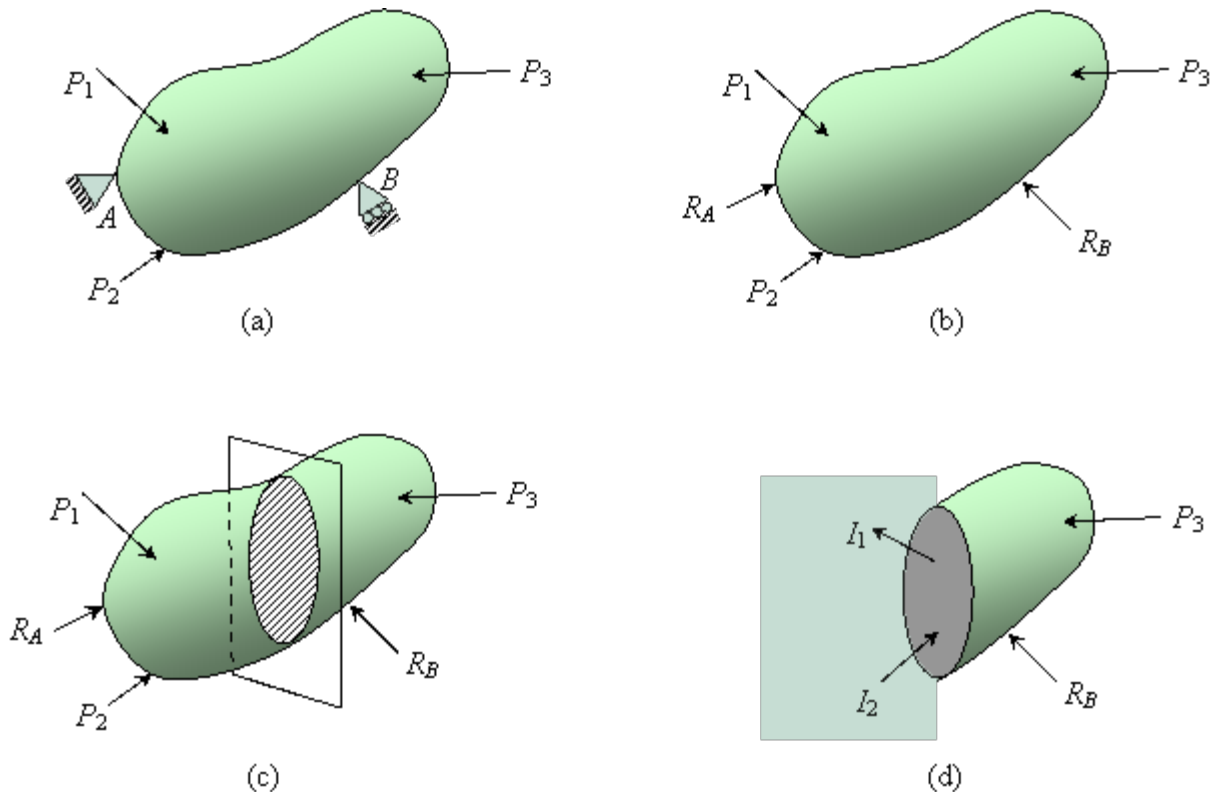


Figure 2.1 Internal forces at a cross-sectional surface of a solid body

It is important to know the internal forces acting at different sections of a system. The material, of which the body is made, should be strong enough to carry these forces. Otherwise the system fails (by crushing, breaking, etc.) under the loading condition.

The general procedure of obtaining internal forces includes these following steps:

Obtain the system configuration (dimension and support conditions) and external loadings applied on it.

1. Draw a free body diagram of the whole system.
2. Find the support reactions by using equations of (static) equilibrium.
3. Take a cut through the body where internal forces have to be obtained.
4. Consider equilibrium of the part of the system at any one side of the cut by drawing a free body diagram of that part.
5. Obtain the unknown internal forces acting on the cut surface by solving these equilibrium equations.

Recap

In this course you have learnt the following

- The concept of internal forces in a system.
- Understanding internal forces in a solid body.