Module 3 : Cables

Lecture 1 : Introduction

Objectives

In this course you will learn the following

- Introduction to cables, how cables are different from other structural components.
- Use of cables in structural systems.

3.1 Introduction

Cables are flexible wire-like systems having no flexural (bending) stiffness, and they can carry only axial tension and no other type of force. Being fully flexible against bending the shape of a cable is determined by the external forces that are acting on the cable. Figure 3.1 illustrates how the shape of the cable between two supports *A* and *B* depends on the location and magnitude of the external forces P_1 and P_2 .

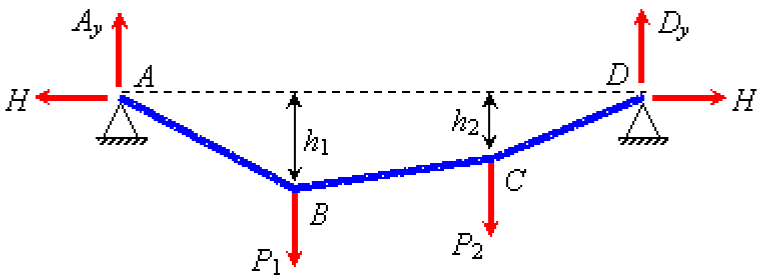

Figure 3.1 Shape of a cable is determined by external loads

A cable is unable to carry bending moment, shear force, torsion or axial compression. Nevertheless, cables can be very effectively used in achieving long-span light-weight systems, such as bridges or roofs for large arenas. Two kinds of bridge structural systems where cables are used are the *suspension-cable systems* and *cable-stayed systems* . Figures 3.2 and 3.3 show examples of suspension-cable bridge and cable-stayed bridge, respectively.

Figure 3.2 A suspension-cable bridge (Golden gate bridge, San Francisco , USA)

Figure 3.3 A cable-stayed bridge (ANZAC bridge, Sydney , Australia)

Cables are usually made of multiple strands of cold-drawn high-strength steel wires twisted together. Generally, they have strength four to five times that of structural steel and practically inextensible under operating loading conditions. Since cables carry only axial tension, full potential of the cable cross-section can be utilized in transferring forces. Therefore, cables are able to carry the same amount of force with a much smaller cross-section compared to other structural systems. This high strength-to-weight ratio makes cables very useful where light-weight systems are needed. On the other hand, a beam over a very long span would require a very large (and deep) cross-section, and most of its potential will be used in carrying internal forces due to its own weight. If we use cables replacing this beam or in combination with a beam in stead, a lighter structure will be required, whose self-weight will not add significantly to load effects.

The primary disadvantage with cables is due to their flexible geometry. As the loading on a cable system changes (as in the case of moving loads on a bridge) there can also be large change in the cable geometry, and subsequently on forces acting in the cable. Unexpected forces may destabilize a cable system, causing excessive deformations. A designer should be very careful on this regard while designing a cable system, along with other issues such as, large forces at the anchors, large oscillations, etc.

Recap

In this course you have learnt the following

- Introduction to cables, how cables are different from other structural components.
- Use of cables in structural systems.