Module 6 : Influence Lines

Lecture 4 : Using Influence Lines for Uniformly Distributed Load

Objectives

In this course you will learn the following

- How to use influence lines for distributed loading cases.

6.4 Using Influence Lines for Uniformly Distributed Load

Consider the simply-supported beam *AB* in Figure 6.5, of which the portion *CD* is acted upon by a uniformly distributed load of intensity *w/unit length* . We want to find the value of a certain response function *R* under this loading and let us assume that we have already constructed the influence line of this response function. Let the ordinate of the influence line at a distance *x* from support *A* be $F_R(x)$. If we consider an elemental length *dx* of the beam at a distance *x* from *A* , the total force acting on this elemental length is *wdx* . Since *dx* is infinitesimal, we can consider this force to be a concentrated force acting at a distance *x* . The contribution of this concentrated force *wdx* to *R* is:

$$dR = (wdx)F_R(x)$$

Therefore, the total effect of the distributed force from point *C* to *D* is:

$$R = \int_C^D dR = \int_{x_1}^{x_2} wF_R(x)dx$$

$$= w\int_{x_1}^{x_2} F_R(x)dx = w \text{ (area under the influence line from } C \text{ to } D\text{)}$$

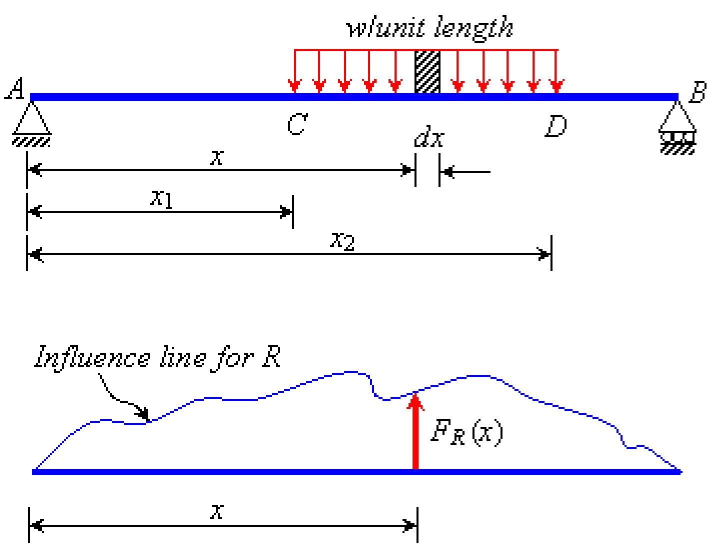

Figure 6.5 Using influence line for a uniformly distributed loading

Thus, we can obtain the response parameter by multiplying the intensity of the uniformly distributed load with the area under the influence line for the distance for which the load is acting. To illustrate, let us consider the uniformly distributed load on a simply supported beam (Figure 6.6). To find the vertical reaction at the left support, we can use the influence line for R_A that we have obtained in Example 6.1. So we can calculate the reaction R_A as:

$$R_A = 2kN/m \times \{0.5(3/4 + 1/4) \times 4m\} = 4kN$$

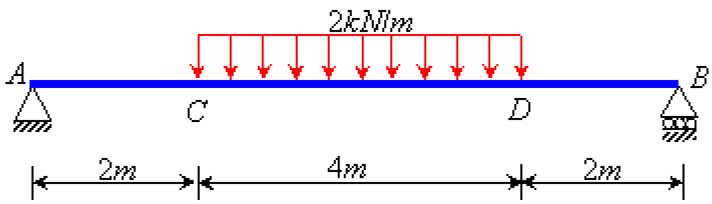

Figure 6.6 Uniformly distributed load acting on a beam

Similarly, we can find any other response function for a uniformly distributed loading using their influence lines as well.

For non-uniformly distributed loading, the intensity *w* is not constant through the length of the distributed load. We can still use the integration formulation:

$$R = \int_C^D dR = \int_{x1}^{x2} wF_R(x)dx$$

However, we cannot take the intensity *w* outside the integral, as it is a function of *x* .

Recap

In this course you have learnt the following

- How to use influence lines for distributed loading cases.