Fixed End Moment

The fixed end moment is the end resisting moment of a member induced over the fixed support. It is used to find out the variation of moments along the span of members. In the moment distribution method of analysis, the fixed end moment is calculated, then balanced for any support.

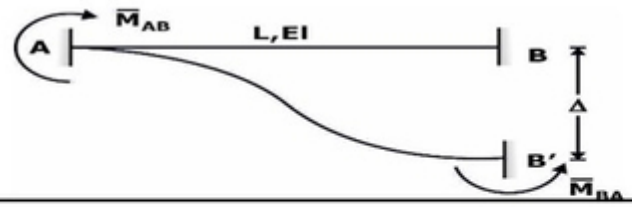
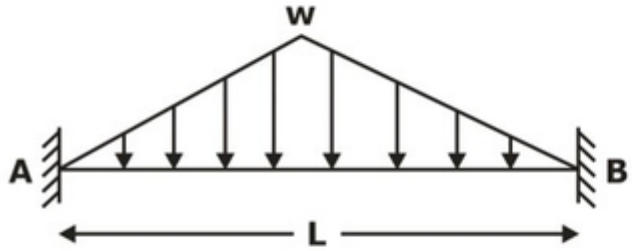
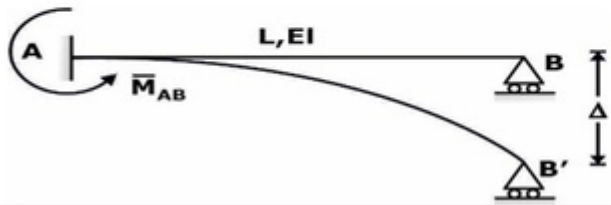
Variation of fixed end moment over the member is represented by a diagram known as the fixed end moment diagram. This diagram can be of any shape, depending on the loading and support condition of the member. The fixed end-moment diagram always varies linearly because it contains only the end values.

Fixed End Moment Formula

The formula for fixed end moment will depend upon the many parameters like variation of load over the member and type of supports. It will not depend upon the beams' cross-sectional properties or material properties. A fixed end moment in the beam will generate when an external load is applied over it.

Fixed End Moment Table

Here values of fixed end moments of some beams are given in the tabular form, which will help to solve the questions.

	$M_A = \frac{6EI\Delta}{L^2}$ $M_B = \frac{6EI\Delta}{L^2}$
	$M_A = \frac{5wL^2}{96}$ $M_B = \frac{5wL^2}{96}$
	$M_A = \frac{3EI\Delta}{L^2}$, $M_B = 0$

Fixed End Moment Equations

Fixed end moment values are subject to the external loading and beam dimensions like the length. So, it can be calculated only after knowing these parameters. These fixed-end moment values will help find the slope deflection equations used to calculate the deflection in beams.

Fixed end moment equations are the equations that are used to calculate the value of fixed end moments. These equations are the function of load intensity and the length of the beam. In the case of differential settlement of the beam, it also depends on the deflection. Here few slope deflection equations are given that depend upon fixed end moment values.

$$M_{AB} = M_{FAB} + \frac{4EI}{L}\theta_A + \frac{2EI}{L}\theta_B - \frac{6EI\delta}{L^2}$$

$$\Rightarrow M_{AB} = M_{FAB} + \frac{2EI}{L}\left(2\theta_A + \theta_B - \frac{3\delta}{L}\right)$$

$$M_{BA} = M_{FBA} + \frac{2EI}{L}\theta_A + \frac{4EI}{L}\theta_B - \frac{6EI\delta}{L^2}$$

$$\Rightarrow M_{BA} = M_{FBA} + \frac{2EI}{L}\left(\theta_A + 2\theta_B - \frac{3\delta}{L}\right)$$

Fixed End Moment for Continuous Beam

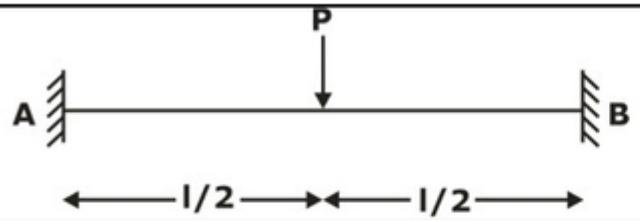
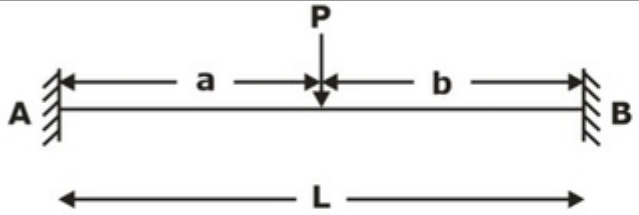
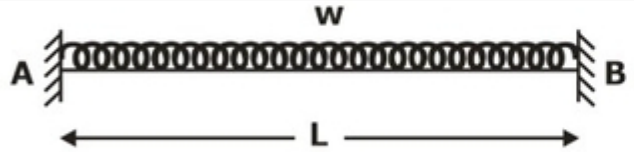
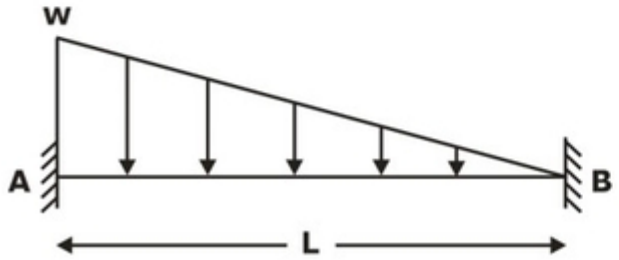
As we discussed, that fixed end moment value depends on the type of loading and its intensity irrespective of the beam type. It can be calculated only after knowing the value of loading intensity. So, let's consider first a continuous beam having a uniformly distributed load.

A continuous beam is a beam having more than one support. For the purpose of analysis, the intermediate support of the continuous beam is treated as the fixed support, and an end portion of such beam is considered the propped cantilever beam. So, the fixed end moment for the continuous beam subjected to UDL can be calculated by considering the fixed beam and propped cantilever beam accordingly.

Nature of Fixed End Moment for a Fixed Beam

A fixed beam is a beam that has fixed support at both ends, and fixed end moment values will depend on the loading over the span of the beam. Generally, the nature of fixed end moment at the fixed end is hogging in nature, which creates tensile stress on the top of the beam.

Here some fixed end moment values for different loading conditions on a fixed beam are given:

Beam	Fixed End Moments
	$M_A = M_B = \frac{Pl}{8}$
	$M_A = \frac{Pb^2a}{L}$ $M_B = \frac{Pa^2b}{L}$
	$M_A = \frac{wL^2}{12}$ $M_B = \frac{wL^2}{12}$
	$M_A = \frac{wL^2}{20}$ $M_B = \frac{wL^2}{30}$

Difference between Fixed End Moment and Bending Moment

The bending moment will generate when a structure is subjected to external loading. It is the effect of transverse loading over the member of a structure. Fixed end moment and bending moment both cause the bending effect over the member, But the effect of both may be different for the beams, which depends on the loading conditions and support conditions of beams. Here a few difference is provided between these moments.

- Fixed end moment itself, a bending moment just its cause is different.
- The fixed end moment only generates at the end support of the beam, but the bending moment can occur throughout the whole span.
- The fixed end moment generates due to the resistive property of the supports, while the bending moment is due to the resistive property of the member itself.