Displacement Method

In the case of Indeterminate structures, all unknowns of structures cannot be found with the help of equilibrium equations; it requires some special procedure to solve these unknowns. The displacement method provides such a procedure for the analysis of indeterminate structures.

Displacements and slopes are the basic unknowns in the displacement method of analysis. In the displacement method of analysis, unknown structure parameters like forces and moments can be determined with the help of slope and deflections. This method is called the stiffness method because this method requires the stiffness value of members to find out the displacements and slopes. These stiffness values are represented in the form of a matrix known as the stiffness matrix.

What are the Different Methods of Analysis of Indeterminate Structures?

Analysis of structure means finding the unknown parameter of structures that are required to design. These parameters include various forces, support moments, shear forces, displacements, slopes, etc. In the case of determinate structures, these unknowns can be determined with the help of equilibrium equations alone. While indeterminate structures require compatibility equations along with equilibrium equations.

Various methods are available for solving this unknown of structures, But they can be broadly classified into two methods: force method and displacement method. The force method is also called the flexibility analysis method, and the displacement method is known as the rigidity or stiffness method.

Types of Displacement Method

As we discussed, the displacement method is one of the methods of analysis of indeterminate structures in which displacements are considered to be unknown parameters of structure. With the help of this, other structural parameters can be determined. So, all those methods in which displacement is considered to the unknown parameters are the type of displacement method. Here, a few such methods are listed below:

- Moment distribution method
- Kani's method

- Slope-deflection method
- Castigliano's first theorem method
- Stiffness matrix method

Displacement Method Examples

The displacement method of analysis is an analysis in which the primary unknowns are the displacements. In this method, first, we establish force displacement, and subsequently, equations are written satisfying the equilibrium conditions of the structure. Examples of displacement methods are as follows:

Slope Deflection Method

It is a classical method that analyzes indeterminate structures like continuous beams and plane frames. In this method, the unknown loads are written in terms of the displacement by using the load-displacement relations, and then these equations are solved for the displacements using the joint equilibrium conditions. After the computation of displacements, loads are computed using load-displacement relations.

Moment Distribution Method

It is a displacement method for analysis of statically indeterminate beams and frames developed by Hardy Cross. The process only accounts for flexural effects and ignores axial and shear effects. In this method, it is assumed in the beginning that all structure joints are fixed. Then by locking and unlocking each joint in succession, the internal moments are distributed such that each joint attains its final position.

Difference Between Force Method and Displacement Method

The force and displacement methods are the methods of analysis of indeterminate structures. these methods are used to determine the unknown parameters of the structure. Different types of unknowns are considered for structure analysis in these two methods. Here few points are given to understand the difference between force method and displacement method.

Force Method	Displacement method

In this method, Static indeterminacy of structure is considered.	In this method, Kinematic indeterminacy of structure is considered.
Compatibility equations are the main governing equations for structural analysis.	Equilibrium equations are the main governing equations for structural analysis.
Force displacement relations are represented in the flexibility matrix.	Force displacement relations are represented in the stiffness matrix.
Different forces are considered to be unknown.	Displacement and slopes are considered to the unknown.