

# Zero Force Member in a Truss

In a truss, zero force members are the members who have zero force for the given condition of loading over the structure. These are the structural members that give zero support to the external loading. Still, they can withstand the external load when loading conditions change, or any active member of the truss becomes inactive. Providing a zero force member in a truss has many advantages.

A zero force member in a truss is a redundant member for a particular type of loading and structural conditions. When the structural conditions like loading will change, or any existing member of the truss becomes useless, in such conditions, the existing zero force member in a truss can take the external loads.

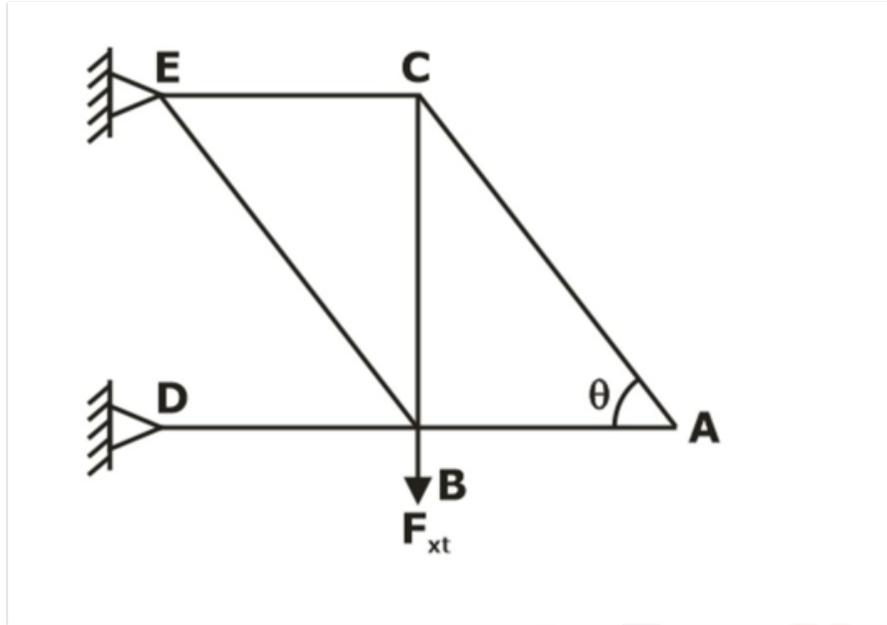
## How to Find Zero Force Members in a Truss?

A zero force member in a truss is a member who does not have any force in this. Two rules may be used to find zero-force members in a truss. They are as follows:

**Case 1:** At a two-member joint that is not parallel and there are no other external loads or reactions at the joint, both members are zero force members.

**Case 2:** At a three-member joint, if two of those members are parallel and there are no other external loads (or reactions) at the joint, then the member that is not parallel is a zero-force member.

**Example of Case 1:**



Using case 1

$$F_{AC} = 0$$

$$F_{AB} = 0$$

Proof of Case 1

$$\Sigma F_y = 0$$

$$\Rightarrow F_{AC} \sin\theta = 0$$

Since  $\sin\theta$  can not be zero

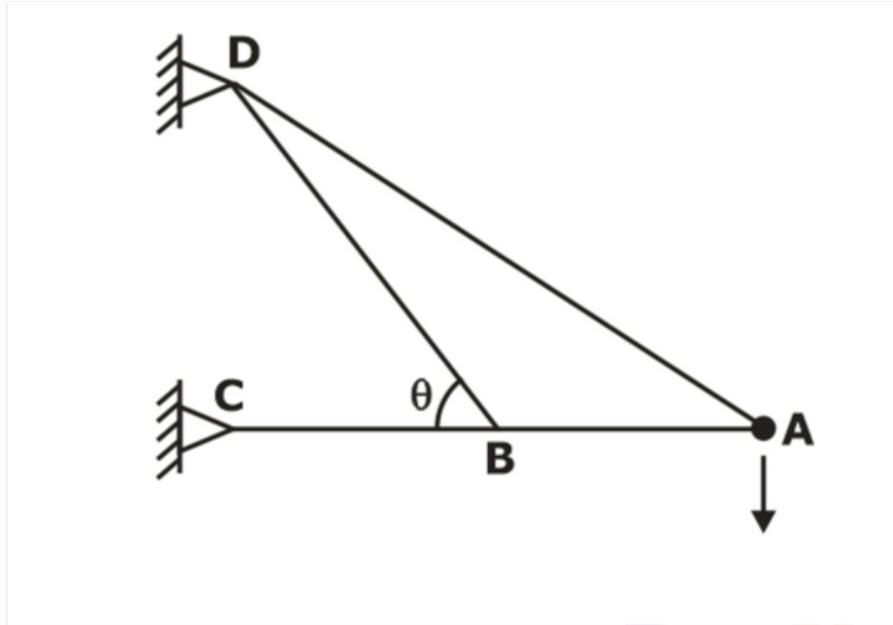
$$\Rightarrow F_{AC} = 0$$

$$\Sigma F_x = 0$$

$$F_{AB} + F_{AC} \cos\theta = 0$$

$$\Rightarrow F_{AB} = 0$$

**Example of case 2:**



Using case 2:  $F_{BD} = 0$

Proof of case 2

$$\begin{aligned}\Sigma F_y &= 0 \\ \Rightarrow F_{BD} \sin\theta &= 0\end{aligned}$$

Since  $\sin\theta$  cannot be zero

$$\therefore F_{BD} = 0$$

### Condition For a Zero Force Member in a Truss

With the help of the above-mentioned rules, a zero force member in a truss can be easily identified. These are the members who provide extra stability to the existing condition of the structure. Above mentioned rules for finding a zero force member in a truss are based on certain geometrical and loading conditions, which are explained below:

- If at any joint in the structure, only two non-collinear members are present. There should not be any external force acting on the joint; In such case, these non-collinear members will be the zero force members.
- If at any joint in the structure, two collinear members and only one non-collinear member is present, there should not be any external force acting on

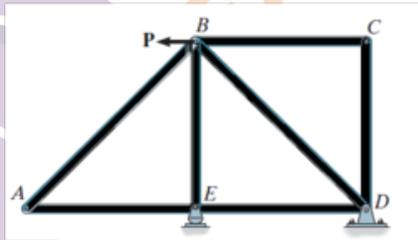
the joint; In such case, this non-collinear member is a zero force member. This condition can be extended when an external force like support reaction or any other external force is acting at any support and one member passes through the joint in the same direction as that of external force; then, in such condition, any non-collinear member at the joint will be the zero force member.

- A member between two hinge support will be the zero force member.

### Example of Zero Force Member in a Truss

Till now, we have understood how to identify the zero force member in a truss; These are the members in a truss structure which is earlier not required to withstand external loads, but when a member gets damaged, in such condition, these members will distribute the external loads and helps to maintain the overall stability of the structure. Let's solve an example to get more idea about the zero force member in a truss that helps to enhance the related concepts.

**Example:** Find the zero force member in the given truss structure



**Solution:** In the given truss,

At joint 'A', There are only two noncollinear members AB and AE, present; So, according to case 1, These members are the zero force members.

At joint 'C', There are only two noncolinear members, CB and CD, present; So, according to case 1, These members are the zero force members.

Member DE is connected between two hinge support, so it will also be a zero force member.

**Note:** If joint E would be supported by roller support, then in such case, member DE will also be a zero force member because roller support gives a vertical reaction in the direction of member BE and member DE will become a non-colinear member at the joint, So, it will be zero force member.

### Uses of Zero Force Member in a Truss

As we know, a zero force member in a truss is a member having no force. It will take loads only when an active member of the truss fails. Zero force member in a truss increases the overall rigidity and stability of the structure.

Zero-force members in a truss are used to withstand external loads when loading conditions are changed. Zero force members keep the structure in the same conditions even when loading patterns are changed, or any existing member gets damaged.

