What are Truss and Frame?

Truss and frame are structural components of buildings and bridges. A truss is composed of thin, slender members. Pins connect these members at their endpoints, which are called nodes. A truss can take axial forces as compressive or tensile loads. However, it will never resist bending.

Frame are structures that consist of beams and columns in it. The frame can carry multiple forces simultaneously; due to this, it is also called a multi-force member of a structure. In addition, the frame provides flexible space utilization as it requires fewer columns in the structure.

Difference Between Truss and Frame

As we know, truss and frame are structures designed to withstand the effect of external loads. Although there are many similarities, few differences exist between them in terms of strength and the nature of the load, which are discussed below.

Truss VS Frame	
Truss	**Frame**
The truss is designed to take only axial load.	The frame can take the axial load as well as the transverse load.
The bending strength of the truss is zero.	The frame can resist bending moments.
Joints in a truss are pin type only.	Joints in a frame are either welded or rigidly connected.
Loads will be applied on nodes only.	Loads can be applied In any form like point load, Uniformly varying load, wind load, etc.
Members of the truss can rotate freely about the pin.	Members of the frame can not rotate as they are connected rigidly.

Assumptions in Truss Analysis

As we know that assumptions are the basis of the analysis of something. An analysis of a truss can be carried out to determine the forces in any truss members, which is a complex process in large truss and frames. So, we need to simplify this complex process. So we apply some assumptions in the truss analysis.

Here are some assumptions in the truss analysis which significantly simplify their analysis process, as all these assumptions can't be satisfied in a real truss structure. Therefore, these assumptions are designed for an ideal truss.

- All members of a truss are connected at their ends only.
- Frictionless pins connect all members at their joints.
- Every load must be applied only at joints.
- Self-weight of all the members is neglected.
- All members of a truss must be straight.
- A pinned connection represents all the joints in the structure, i.e., all the members can rotate freely at the joints.
- The members of a truss are rigidly connected by using a plate known as a gusset plate.
- Loads are never applied in the middle of the member because all the joints are pinned, and members cannot carry bending Moment as they can carry only tensile or compressive loads.
- Each joint of a truss must be in equilibrium. Therefore, the forces acting at each joint must be equal and opposite.

Types of Truss and Frame

Various types of truss and frame are used in the world of structures. Different designs carry loads in different ways. Here some of the types are described below.

Types of truss	Fan Roof Truss Fink Roof Truss King Post Truss Pratt Roof Truss Howe Roof Truss Howe Bridge Truss Modified Queen Roof Truss Pratt Bridge Truss Warren Bridge Truss Parker Bridge Truss K Bridge Truss Baltimore Bridge Truss
Types of frame	Braced frame system Portal structural frame R.C.C frame structures Pin-ended rigid structural frame Light frame structure Gabled structural frame

Types of Truss Based on Determinacy

If the number of unknown forces (reactions and internal forces) of a given structure is equal to equilibrium equations, the structure is known as a determinate structure. Determinacy is of two types; one is Internal Indeterminacy other is External Indeterminacy. Based on the determinacy, truss can be classified into two types, described below.

- Statically Determinate Truss
- Statically Indeterminate Truss

Statically Determinate Truss

In the statically determinate truss, all the support reactions and internal forces acting in the members of a truss are calculated by only equilibrium equations. Therefore, to design a truss, it is necessary to find the force in all the members. The main purpose of finding unknown forces is to check whether the members can resist the effect of the applied loads without fail or not. Therefore, for a planar truss to be statically determinate, the sum of the number of members and the number of support reactions must be less than twice the number of joints.

Statically Indeterminate Truss

In the statically indeterminate truss, all the support reactions and internal forces acting in the members of a truss are calculated with the help of compatibility equations and the available equilibrium equations. In planner structures, there are only three equations of equilibrium. In such structures, there is at least one more unknown force than the available equilibrium equations. Statically Indeterminate Structures can be analyzed by the Force method or Displacement method. In the Force method of analysis, redundant forces are treated as unknowns. While in the Displacement method, deformations are treated as unknown.

Rules to Find Zero Force Members in Truss

Finding the zero force members in both truss and frame is not required. It is only required in the case of truss. Some truss members don't carry any load; they are known as Zero Force Members. The purpose of Zero Force Members is to provide stability to the structure and to avoid failure because of unexpected loads. There are different ways to find these zero-force members. Some of them are explained here:

- In a pin joint, if the number of members is three and two are in the same line, the force in the third member is zero. (No load, No reaction at the joint)
- At the pin joint, if the number of members is 2 and they are in different lines, then the force on both members is zero. (No load, No reaction shall be present at that joint).