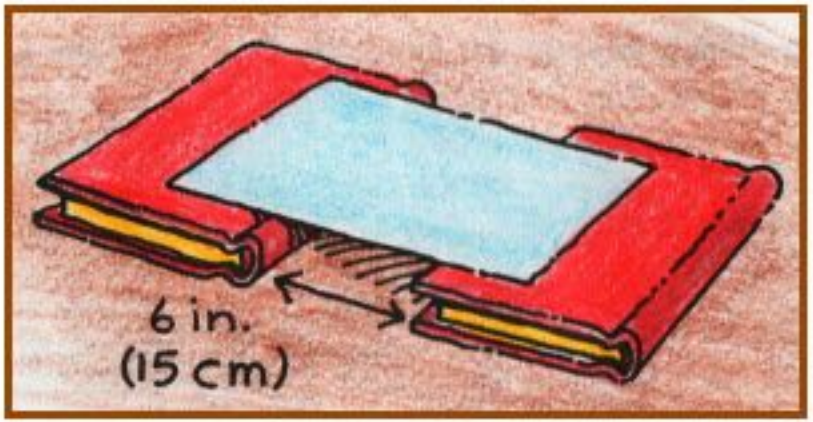
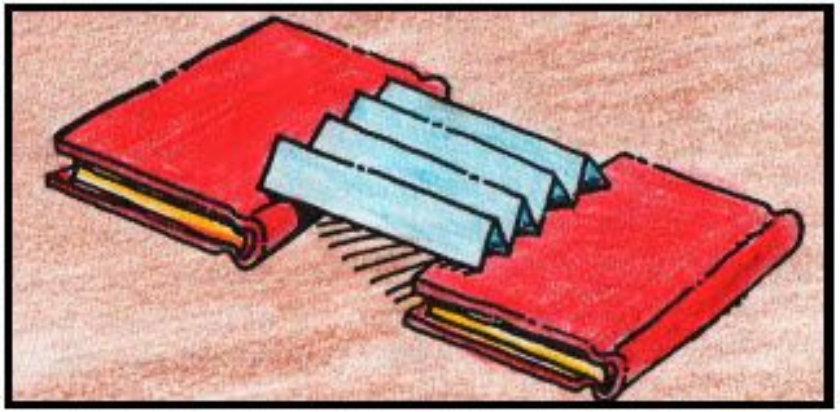
Understanding Bridge Structure: Enhancing Strength through Design

Today's Objectives:

- Define a simple truss.
- Determine the forces in members of a simple truss.
- Identify zero-force members.

Demonstration: Paper Bridge





Truss Applications

Trusses are commonly used in real life

The Advantages Of Trusses

- Trusses Are Quick And Easy To Install
- Trusses Span Longer Distances
- Trusses Create Ideal Load Distribution

Introduction to Truss System

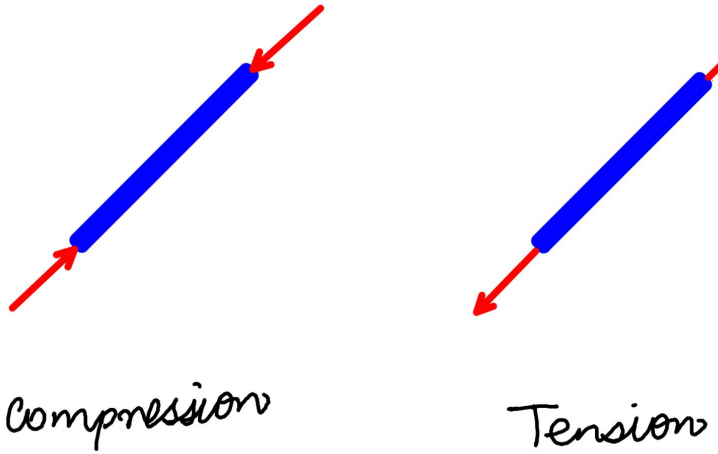
Definition: A truss is a structure that consists of

- All **straight** members
- Connected together with **pin joints**
- Connected **only at the ends** of the members
- All external forces (loads & reactions) must be applied **only at the joints**.

Truss Analysis: Force

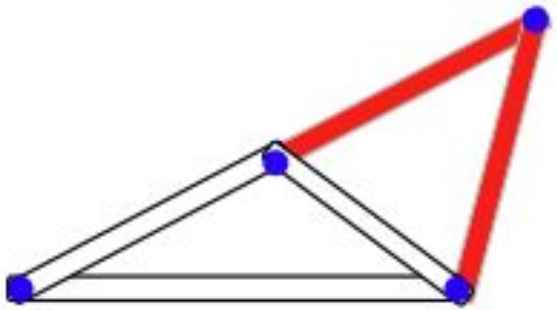
- **All loads are applied at the joints.** The weight of the truss members is often **neglected**.
- The members are joined together by **smooth pins**

- 2 force members:
  - **Compression**
  - **Tension**



Truss Analysis: Stable

- A stable truss follows
- **M = 2J - 3**
- M is the number of member
- J is the number of joints



Zero-Force Members

Zero-force members are structural elements that **do not carry any force** under certain loading conditions.

Why Zero-Force Members Matter?

- Simplifies calculations in structural analysis.
- Helps in designing efficient truss structures.
- Ensures stability and rigidity in construction.

Rule 1: Two Non-Collinear Members at a Joint

If only two **non-collinear members** meet at **a joint with no external load** or support reaction, both are zero-force members.

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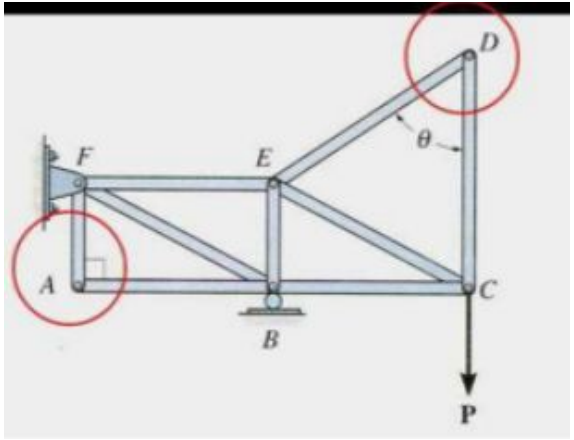

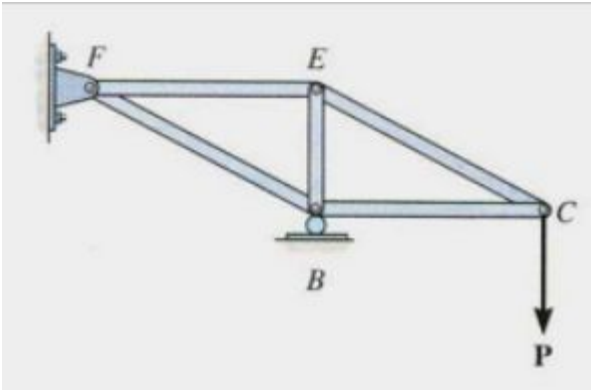

Rule 2: Three Members at a Joint (Two Collinear)

If **three members** meet at a joint and **two of them are collinear**, the **third member is a zero-force member** if no external load is applied at the joint.

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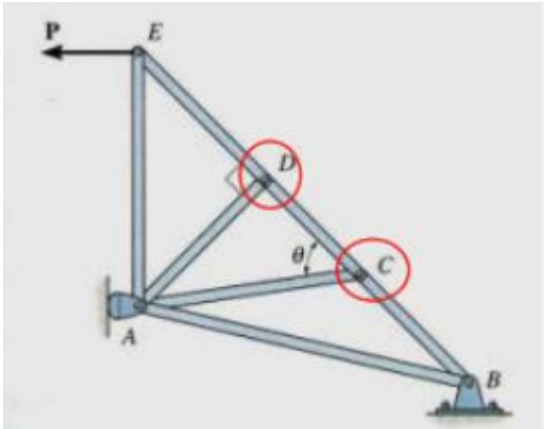
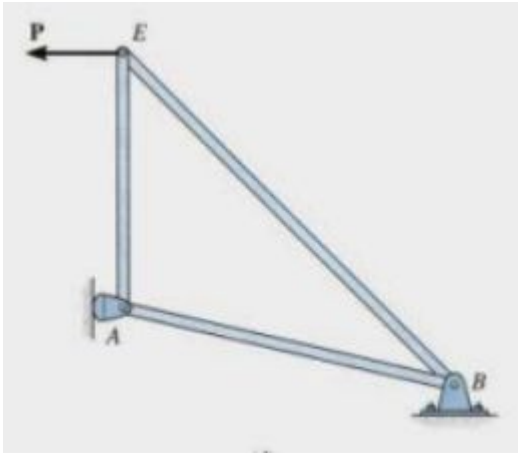


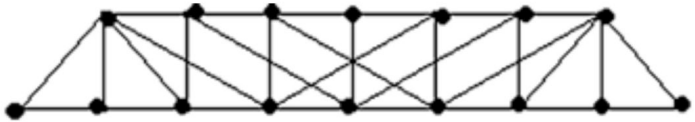


Why Keep Zero-Force Members?

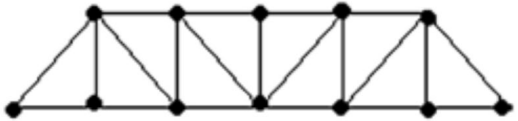
- **Structural Stability**: Prevents unwanted deformations and vibrations.
- **Handles Unexpected Loads**: Becomes active under wind, earthquakes, or shifting weights.
- **Redundancy for Safety**: Acts as a backup if key members fail.
- **Prevents Buckling**: Supports compression members to avoid bending.
- **Future Load Considerations:** Allows for future modifications or increased loads.

Types of Truss Structures

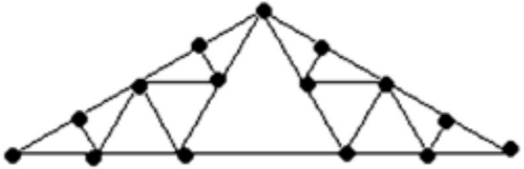
Howe



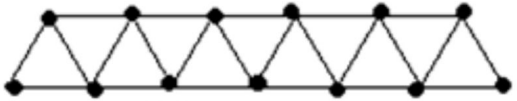
Whipple



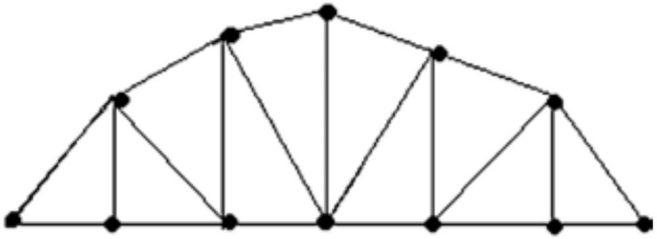
Pratt



Fink



Warren



Parker

Examples of Truss

The Howe Truss

The Pratt Truss