

# Structural Analysis

# Classification of Structures

- Skeletal structures :
  - Series of straight or curved lines
  - Eg: Roof Truss, lattice girder and building frames

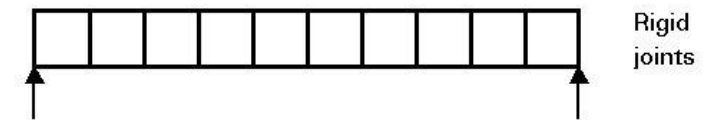
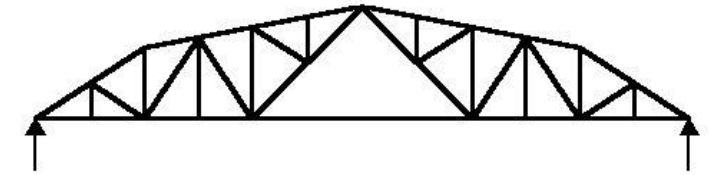
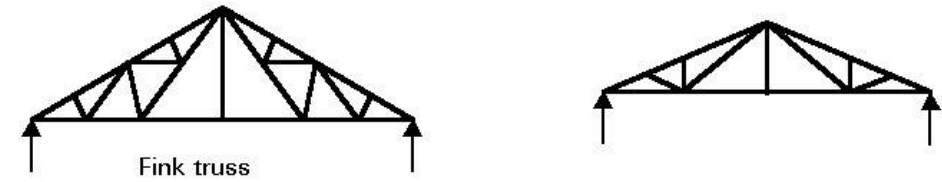
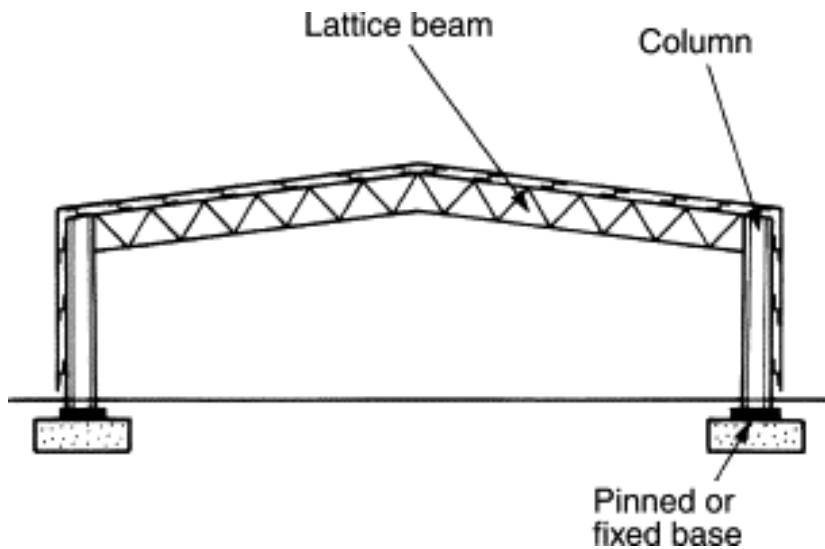
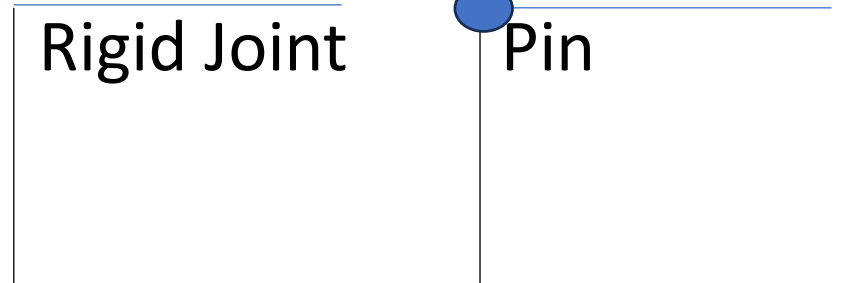


Figure 1 Trusses and lattice girders in buildings

# Types of skeletal structures

- Pin-Jointed frames
  - The members are connected by pin-supports.
  - These members support the applied force by developing the axial forces.
- Rigid- Jointed frames
  - The Joints resist the external forces by developing the axial force, shear force, bending moments and twisting moments(curved beam) in the members of the frame.
- Plane frames
  - Loads in one plane
- Space frame
  - Formed by combining series of plane frames

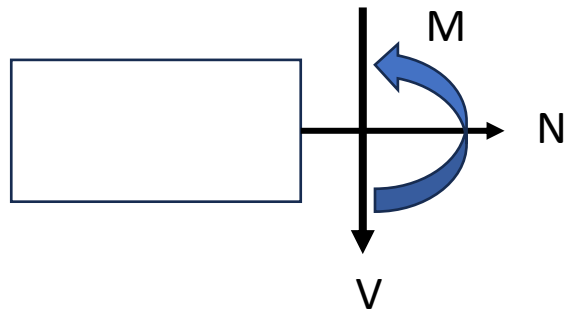


# Loads

- Dead Loads : **It** consist of the weights of the various structural members and the weights of any objects that are *permanently attached* to the structure.
- Live Loads
- Wind Load
- Earthquake Load

# Conditions of Equilibrium

- $\sum H = 0, \sum V = 0, \sum M = 0$
- These equations are applied in the free-body diagram of the beam.
- Internal forces in the member: normal force **N**, shear force **V**, and bending moment **M** as shown below



# Determinacy and stability

- **Statically determinate and Statically indeterminate.**
- The equilibrium equations provide both the *necessary and sufficient* conditions for equilibrium. When all the forces on a stable structure can be determined strictly from these equations, the structure is referred to as ***statically determinate***.
- Structures having more unknown forces than available equilibrium equations are called ***statically indeterminate***.
- A structure can be identified as being either statically determinate or statically indeterminate by drawing free-body diagrams of all its members, or selective parts of its members, and then comparing the total number of unknown reactive force and moment components with the total number of available equilibrium equations.

# Determinacy Equations

- For a coplanar stable structure there are at most *three* equilibrium equations for each part:
- $r = 3n$ , Statically Determinate and stable
- $r > 3n$ , Statically Indeterminate
- $r < 3n$ , Statically Unstable externally
- $n$  = Number of parts in member
- $r$  = number of force and moment reaction components
- The presence of internal hinge in member divides into two.
- Degree of Indeterminacy ,  $D = r - 3n$