Department of Information Technology
Central University of Kashmir
Tullmulla, Ganderbal, J&K-191131
www.cukashmir.ac.in

UNIT 4

BT 205: Engineering Mechanics

Trusses and Framed Structure

Compiled by: Er Aman Sheheryar
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Framed Structures And Truss Analysis

"Analysis Is The Art Of Creation Through Destruction"

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Frames

- A frame may be defined as a structure, made up of several bars , riveted or welded together .
- These bars are made up of angle iron or channel sections, and are called members of the frame .
- A structure is called a frame if at least one of its individual members is a multiforce member .
- A multiforce member is defined as one with three or more forces acting on it, or one with two or more forces and one or more couples acting on it .

- Frames are structures which are designed to support applied loads and are usually fixed in position .

Frames :

1. Support loads.
2. Usually stationary.
3. Fully constrained.

Types Of Frames.

The frames may be classified into the following two groups :

1. **Perfect frame** : A structural frame that is stable under loads imposed upon it from any direction, but which would become unstable if one of its members were removed or one of its fixed ends became hinged.

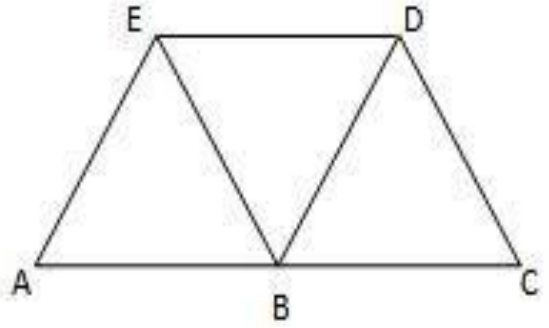


Fig.15.3 Perfect Frame

The no. of members in perfect frame is expressed by the relation :

$$n = (2j - 3)$$

where , n = No. of members

j = No. of joints

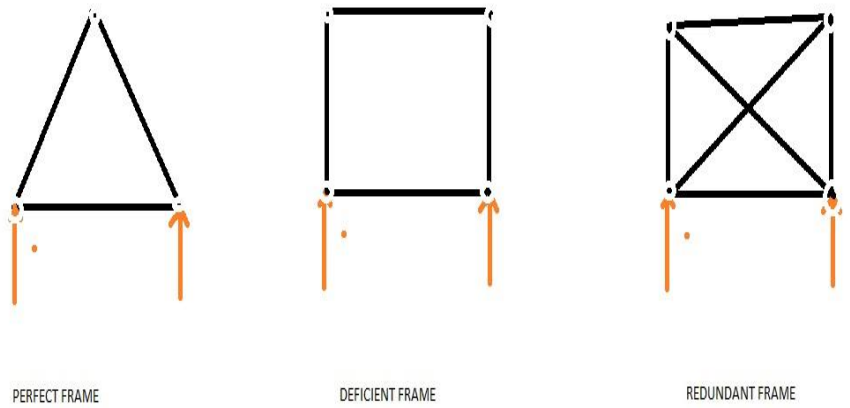
2. **Imperfect frame :** Frames which can't be analyzed to get the internal member force and external support reactions .

It doesn't satisfy the equation :

$$n = (2j-3)$$

Imperfect frames may be further classified into following types :

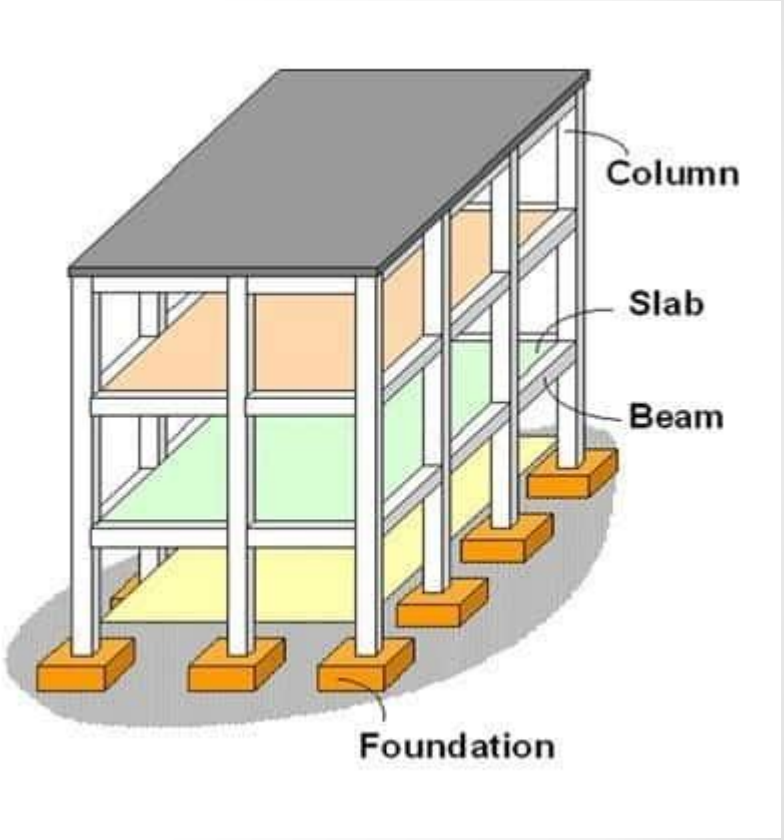
i. **Deficient frames:** An imperfect frame, in which the no. of members are less than (2j-3).



ii. **Redundant frames:** An imperfect frame, in which the no. of members are less than (2j-3).

Framed Structures.

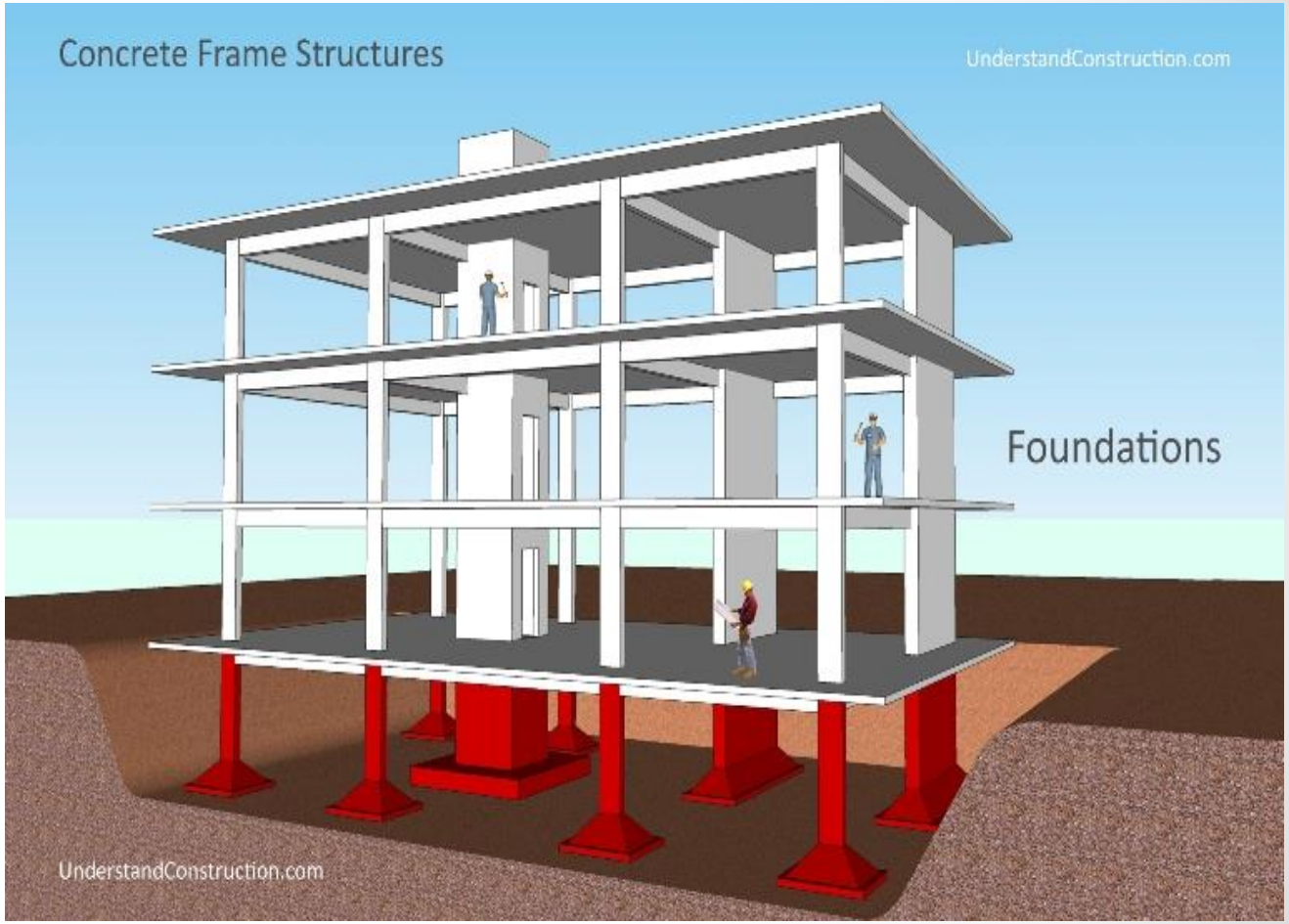
- Frame structures are the structures having the combination of beam, column and slab to resist the lateral and gravity loads .



- These structures are usually used to overcome the large moments developing due to applied loading .

- In framed structure, load transfer path is from slab to beam, beam to column and column to footing.

- Multi storey buildings can be constructed.
- Framed structure is more resistant to earthquake .
- The speed of construction is more .
- It is less material intensive .
- Cantilever elements can be easily included in the system .
- Construction of framed structure is simple .



Truss

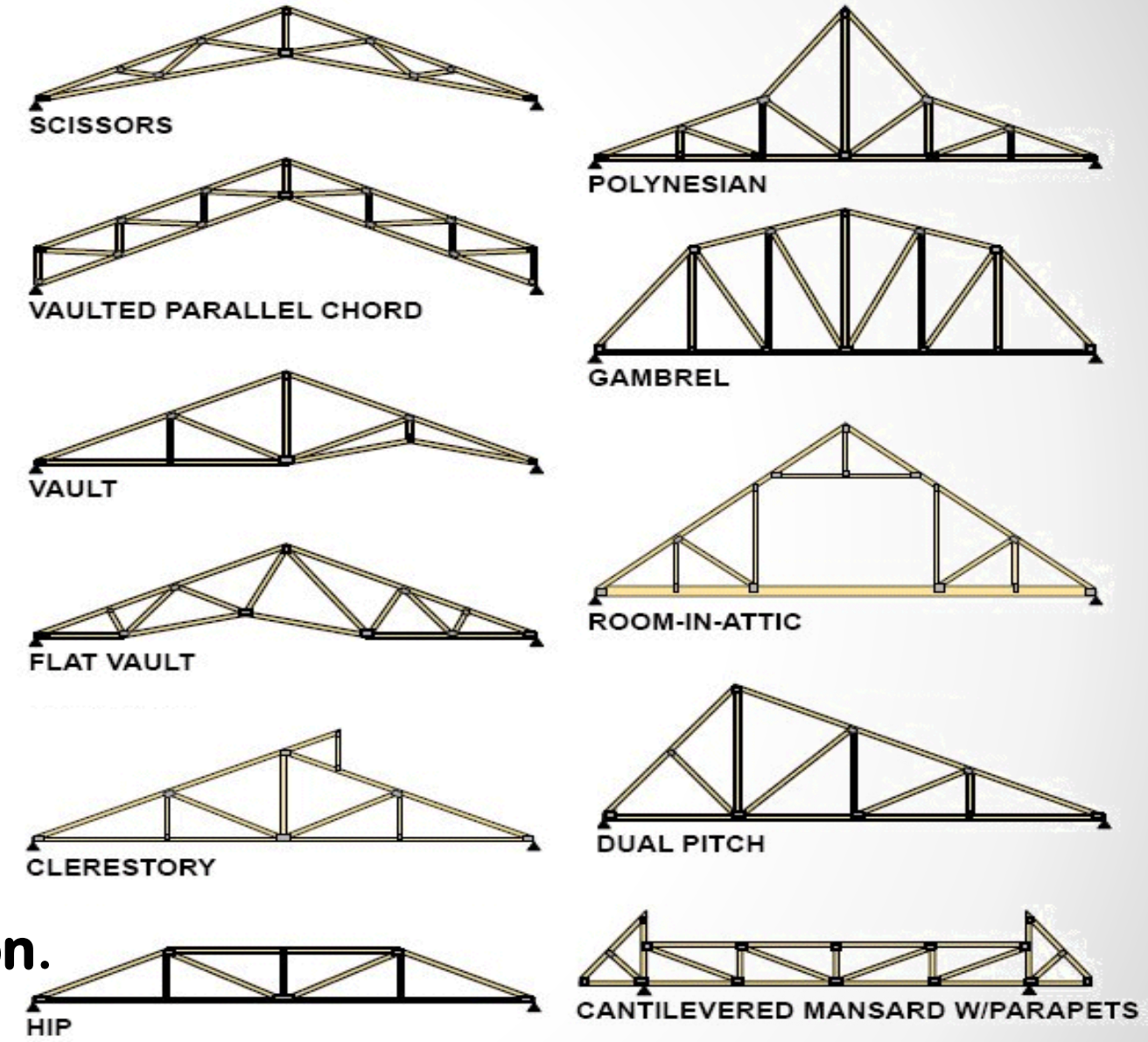
- Truss is a structure that consists of two-force members only, where the members are organized so that the assemblage as a whole behaves as a single object.
- Trusses are widely used in civil engineering applications such as bridges, steel buildings and roof structures.

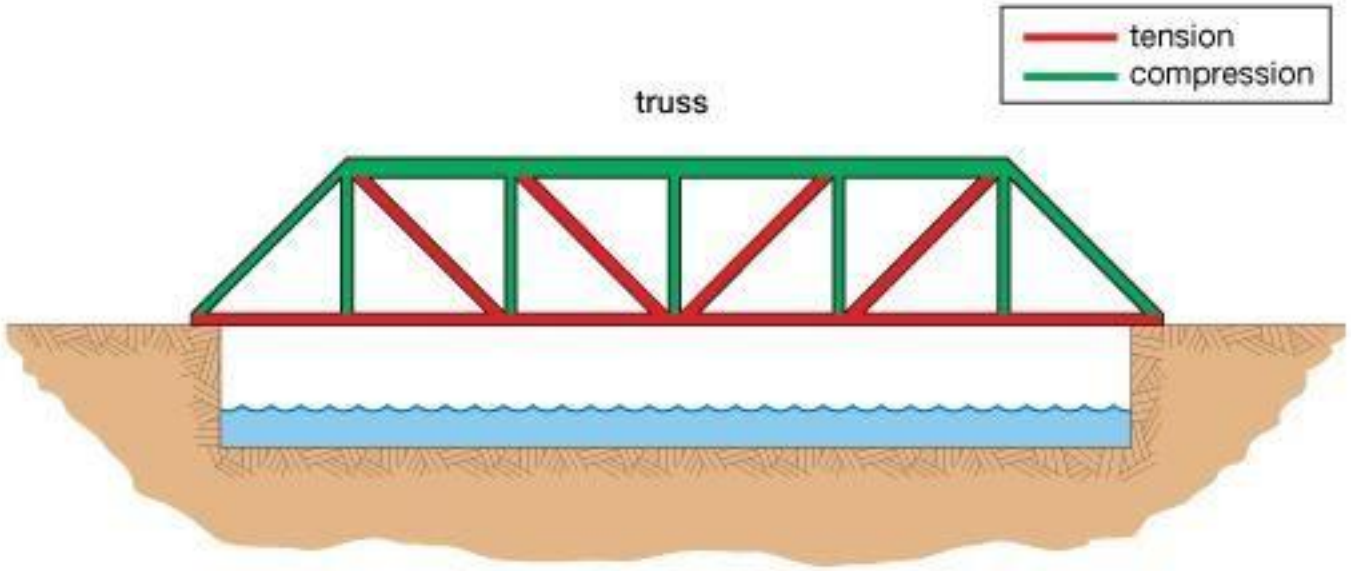
- A two force member is a structural component where force is applied to only two points.
- Trusses typically comprise five or more triangular units constructed with straight members whose ends are connected at joints referred to as nodes.

- A planar truss is one where all members and nodes lie within a two dimensional plane.

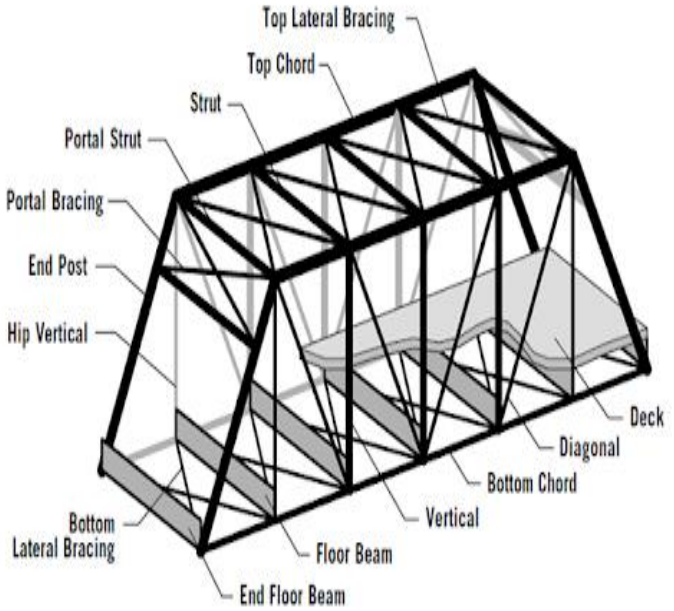
- A space truss has members and nodes that extend into three dimensions.

- The top beams in a truss are called ***top chords*** and are in **compression.**
- The bottom beams are called ***bottom chords*** and are in **tension.**




tension
compression
truss


RIGID FRAME STEEL BUILDING SYSTEM
RIGID FRAME
ROOF PURLIN
EAVE PURLIN
RIDGE
ROOF BRACING
ROOF SYSTEM
RIGID FRAME
PURLIN CLIPS
MULTISPAN FRAME
RAFTER
INTERIOR COLUMN
COLUMN
EAVE HEIGHT
POST & BEAM ENDWALL FRAME
CORNER COLUMN
WALL SYSTEM
WALL GIRT
WALL BRACING
BAY SPACING
GIRT CLIPS
ENDWALL COLUMN SPACING
SIDEWALL
ENDWALL


Top Lateral Bracing
Top Chord
Strut
Portal Strut
Portal Bracing
End Post
Hip Vertical
Deck
Diagonal
Bottom Chord
Vertical
Bottom Lateral Bracing
Floor Beam
End Floor Beam

Truss analysis

Why must we learn truss analysis ?

- First of all, if we plan to design and build a truss structure, such as roof structure for carrying external loads, we need to find out how much load is carried by each member of truss.
- Secondly, in the case of existing truss structure, we may need to replace one or a few members. In this case, we need to find the internal forces carried by those few members within the truss structure.

In both instances, the objective is to figure out and decide whether the members can sustain the force or not and what size members and what type of cross sections are required.

- For truss analysis it is assumed that :

  - Bars are pin-connected.
  - Joints are friction less hinges .
  - Loads are applied at joints only.
  - Stress at each member is constant along its length.

- The objective of truss analysis is to determine the reaction and member forces.

Methods of truss analysis

There are three methods of truss analysis :

1. The method of joints

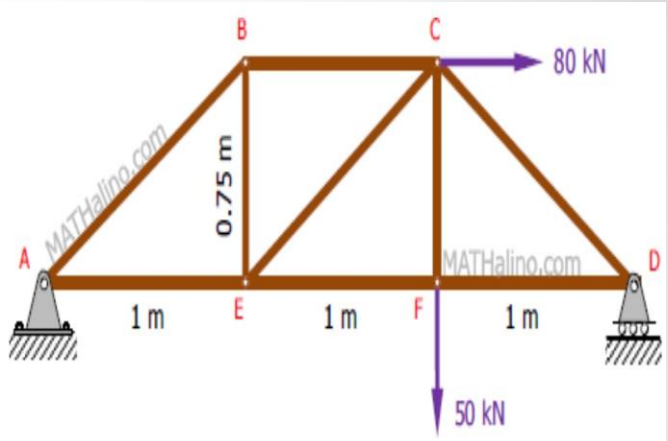
- This method uses the free body diagram of joints in the structure to

  determine the force on each member.
- The free body diagram of any joint is a concurrent force system in which the summation of moment will be of no help.
- Only two equilibrium equations can be written

$$\Sigma F_x = 0 \quad \text{and} \quad \Sigma F_y = 0$$

- This means to solve completely for the forces acting on a joint, we must select a joint with no more than two unknown forces involved.

Q. Find the force acting on members AB and AE of the truss shown in figure ?



Sol :

$$\Sigma M_D = 0$$

$$3A_V + 50(1) = 80(0.75)$$

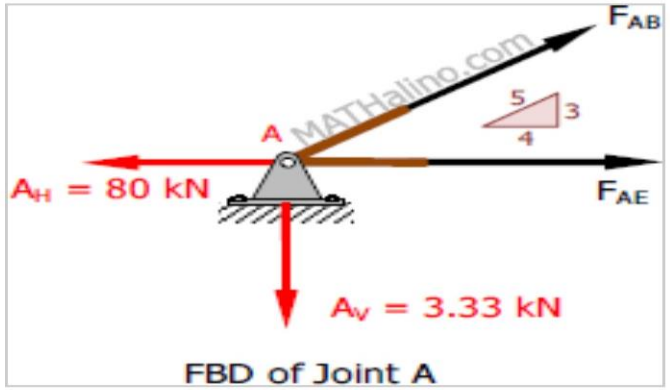
$$A_V = 3.33 \text{ kN}$$

$$\Sigma F_H = 0$$

$$A_H = 80 \text{ kN}$$

At joint A

$$\Sigma F_V = 0$$



$$\frac{3}{5}F_{AB} = 3.33$$

$$F_{AB} = 5.56 \text{ kN tension}$$

$$\Sigma F_H = 0$$

$$F_{AE} + \frac{4}{5}F_{AB} = 80$$

$$F_{AE} + \frac{4}{5}(5.56) = 80$$

$$F_{AE} = 75.56 \text{ kN tension}$$

2. Method of sections

The section method is an effective method when the forces in all member of a truss are to be determined. If only a few member forces of a truss are needed, the quickest way to find these forces is by the method of sections. In this method, an imaginary cutting line called a section is drawn through a stable and determinate truss.

3. Graphical method

The method of joints could be used as the basis for a graphical analysis of trusses. It was developed by force polygons drawn to scale for each joint, and then the forces in each member are measured from one of these force polygon.

Thanks !!!