EWCE 311

STRUCTURAL ANALYSIS & DESIGN I

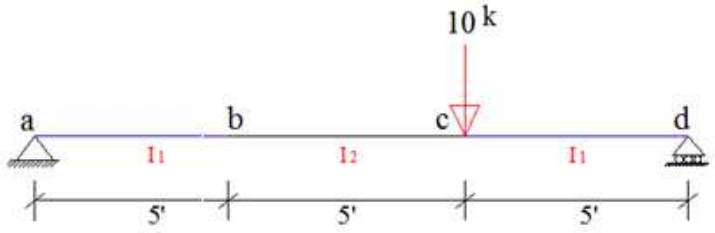
ANALYSIS OF DETERMINATE STRUCTURES:

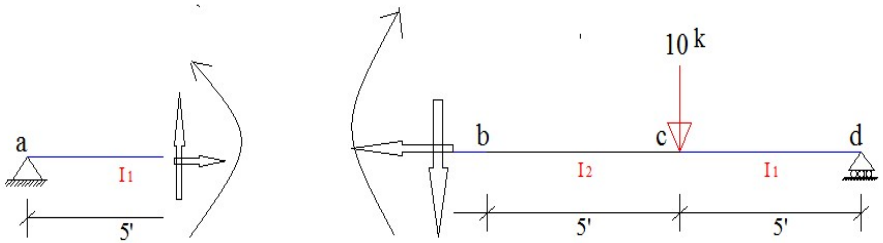
- 3 equations= 3 unknowns can be solved
- **Solving Beam:** Solve support reactions (External Forces)

  Draw SFD and BMD (Representation of Internal Forces)
- **Solving Truss:** Solve support reactions (External Forces)

  Find member forces (Representation of Internal Forces)
- **Solving Frame:** Solve support reactions (External Forces)

  Draw SFD, BMD and AFD (Representation of Internal Forces)





Internal Forces

Moment: Bending Moment
Vertical Force: Shear force
Horizontal Force: Axial Force

DETERMINATE & INDETERMINATE STRUCTURES

- **Determinate structures:**
  - analyzed just by using basic equilibrium equations
  - the unknown reactions are found for the further determination of stresses
- **Indeterminate structures:**
  - not capable of being analyzed by just using basic equilibrium equations
  - along with the basic equilibrium equations, some extra conditions are required to be used (like, compatibility conditions of deformations etc) to get the unknown reactions for drawing bending moment and shear force diagrams
- **Example of determinate structures:** simply supported beams, cantilever beams, single and double overhanging beams, three hinged arches, etc.
- **Examples of indeterminate structures:** fixed beams, continuous beams, fixed arches, two hinged arches, portals, multistoried frames, etc.

DETERMINATE & INDETERMINATE STRUCTURES

- **Determinate structures**
  - easy to solve
  - not easy to make
  - possibility of becoming unstable
- **Indeterminate structures**
  - not easy to solve
  - easy to make (compared to determinate structure)
  - take some times before failure
- **Example:** In portal method a point of inflection is considered at the middle portion of each beam and column. But in practical life in doing so, the structure become unstable and costly.

DEGREE OF DETERMINACY & INDETERMINACY

- 3m+r<3j+C Structure is statically unstable
- 3m+r=3j+C Structure is statically determinate
- 3m+r>3j+C Structure is statically indeterminate

Where,

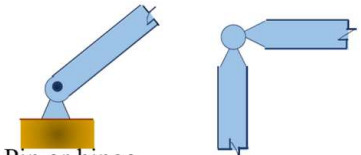
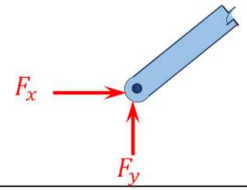
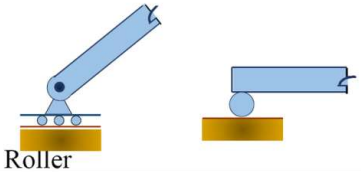
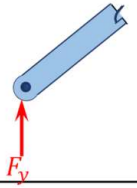
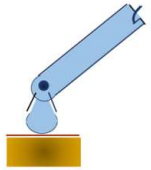
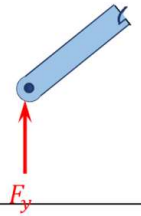
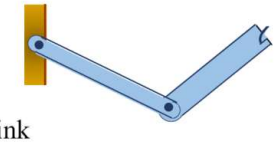
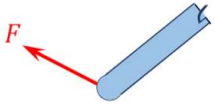
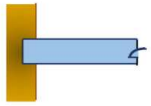
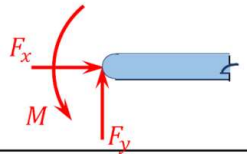
r = number of support reactions.

C = equations of condition (two equations for one internal roller and one equation for each internal pin).

m = number of members.

j = number of joints.

TABLE: TYPES OF SUPPORTS

Idealization of Support	Reaction	Characteristics
 Pin or hinge		Prevents movement in the vertical and horizontal direction but allows rotation.
 Roller		Prevents movement in the vertical direction but allows rotation and translation in the horizontal direction.
 Rocker		The characteristics of a rocker support are similar to that of a roller.
 Link		Prevents movement in the direction perpendicular to the axis of the link.
 Fixed		Does not allow translation in any direction and rotation.

PROBLEM 1: CLASSIFY THE BEAMS SHOWN IN FIGURE 1 AS STABLE, DETERMINATE, OR INDETERMINATE, AND STATE THE DEGREE OF INDETERMINACY WHERE NECESSARY.

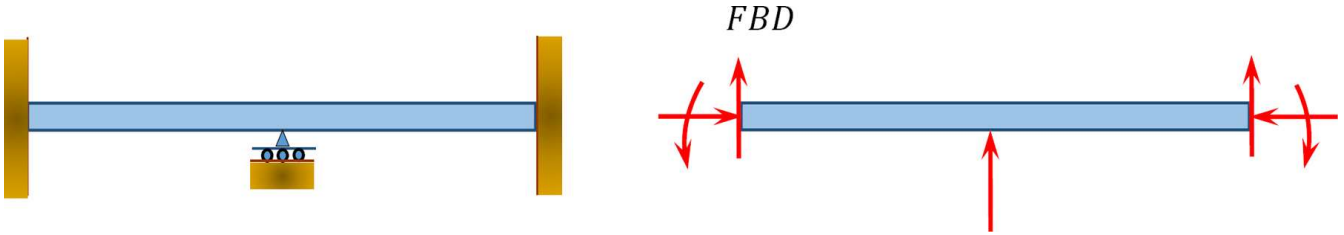


Figure: 1

PROBLEM 2: CLASSIFY THE BEAMS SHOWN IN FIGURE 2 AS STABLE, DETERMINATE, OR INDETERMINATE, AND STATE THE DEGREE OF INDETERMINACY WHERE NECESSARY.

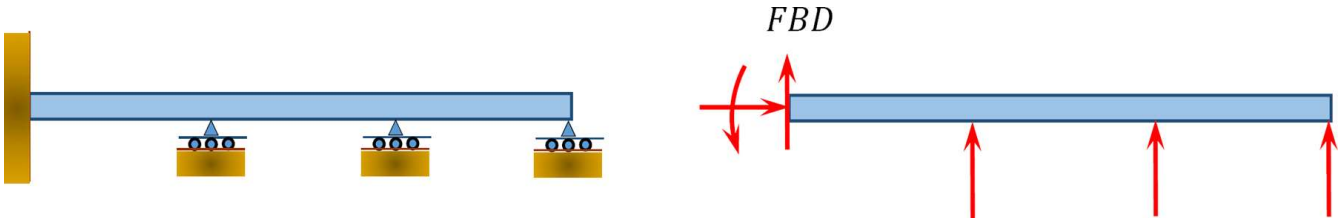


Figure: 2

PROBLEM 3: CLASSIFY THE BEAMS SHOWN IN FIGURE 3 AS STABLE, DETERMINATE, OR INDETERMINATE, AND STATE THE DEGREE OF INDETERMINACY WHERE NECESSARY.

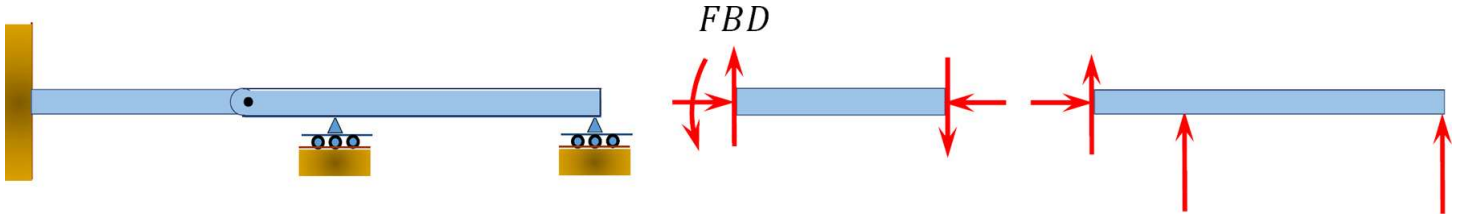


Figure: 3

PROBLEM 4: CLASSIFY THE BEAMS SHOWN IN FIGURE 4 AS STABLE, DETERMINATE, OR INDETERMINATE, AND STATE THE DEGREE OF INDETERMINACY WHERE NECESSARY

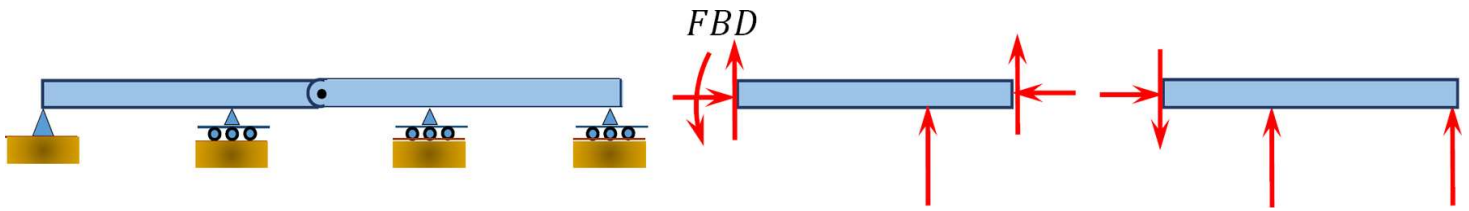


Figure: 4

PROBLEM 5: CLASSIFY THE BEAMS SHOWN IN FIGURE 5 AS STABLE, DETERMINATE, OR INDETERMINATE, AND STATE THE DEGREE OF INDETERMINACY WHERE NECESSARY

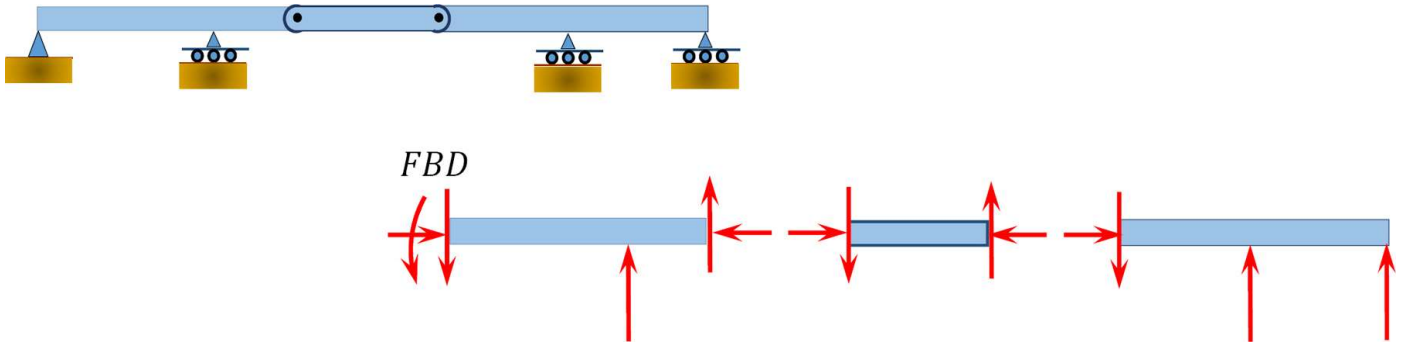


Figure: 5

PROBLEM 6: CLASSIFY THE FRAME SHOWN IN FIGURE 6 AS STABLE, DETERMINATE, OR INDETERMINATE, AND STATE THE DEGREE OF INDETERMINACY WHERE NECESSARY

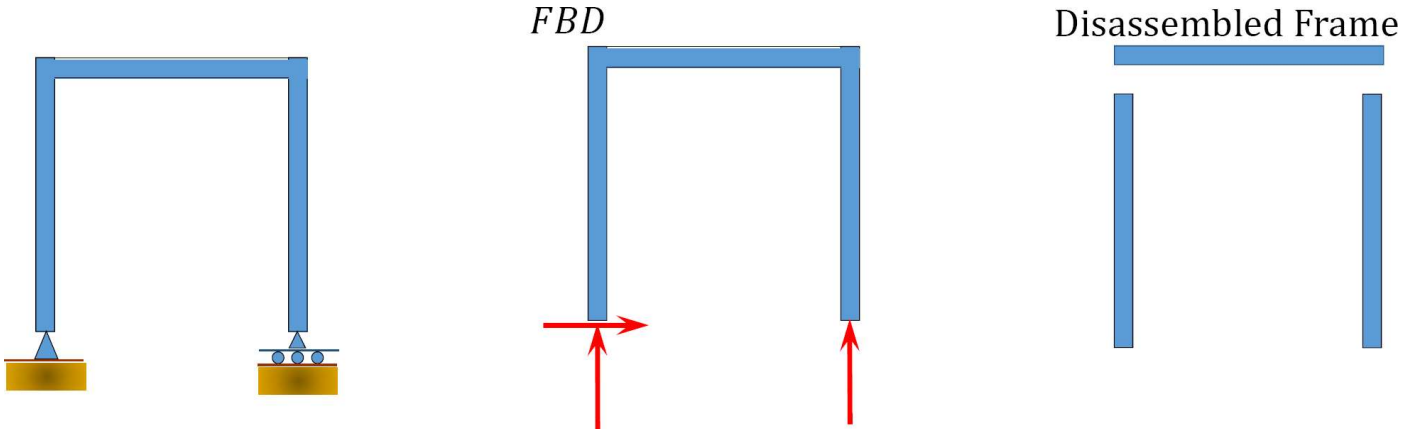


Figure: 6

PROBLEM 7: CLASSIFY THE FRAME SHOWN IN FIGURE 7 AS STABLE, DETERMINATE, OR INDETERMINATE, AND STATE THE DEGREE OF INDETERMINACY WHERE NECESSARY

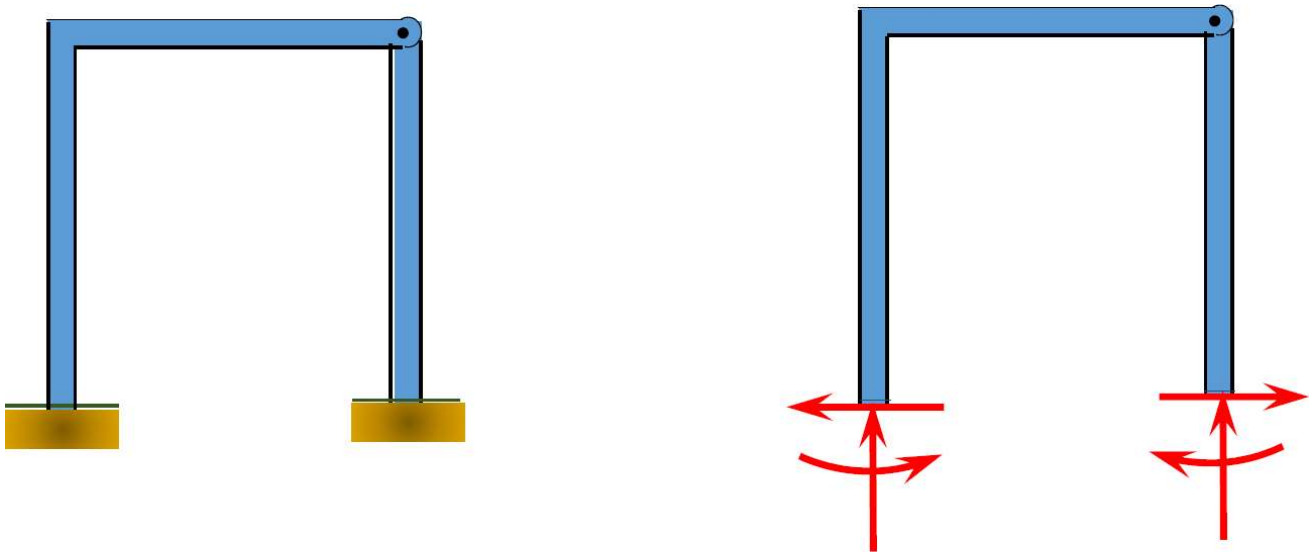


Figure: 7

PROBLEM 8: CLASSIFY THE FRAME SHOWN IN FIGURE 8 AS STABLE, DETERMINATE, OR INDETERMINATE, AND STATE THE DEGREE OF INDETERMINACY WHERE NECESSARY

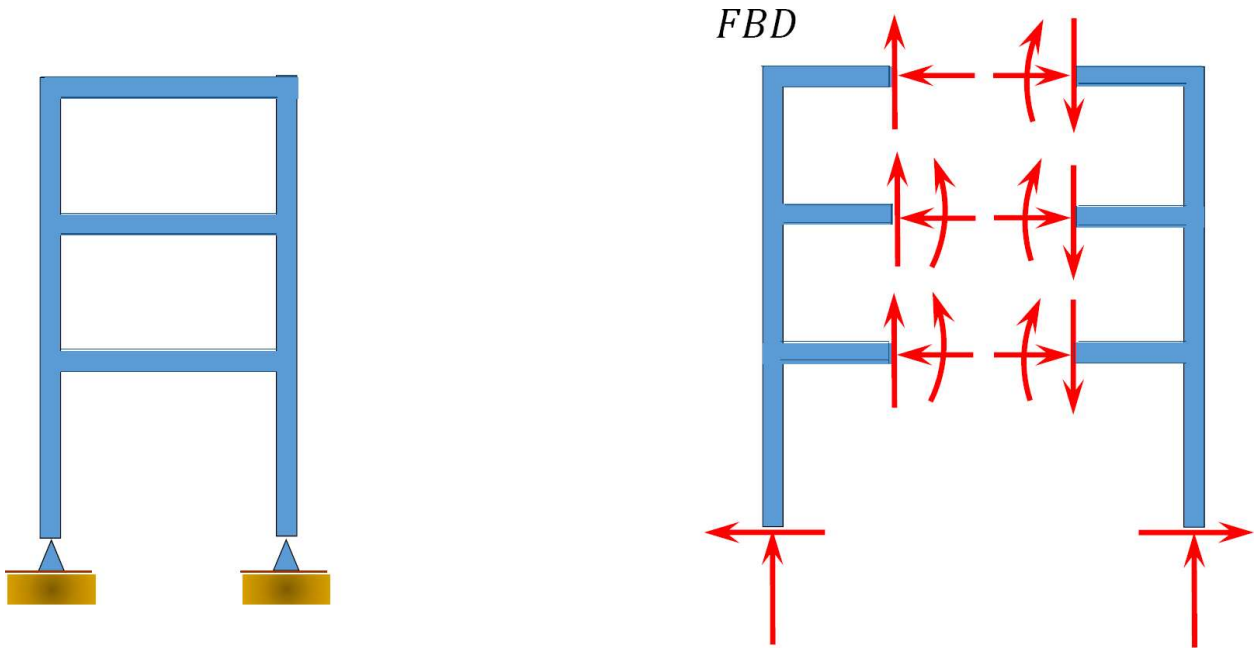


Figure: 8