

PHASE I

APPLICATION OF THE THREE MOMENTS EQUATION AND SLOPE DEFLECTION METHOD IN CONTINUOUS BEAM STRUCTURES

A structure is designed for clean water distribution, requiring a bridge as shown in **Figure 1.1**. The bridge, constructed to support the water supply pipeline, has a total length of $L = \dots$ m and is supported by two abutments. However, after a period of operation, a foundation settlement occurred at one of the bridge supports by $H = \dots$ mm, as illustrated in **Figure 1.1**.

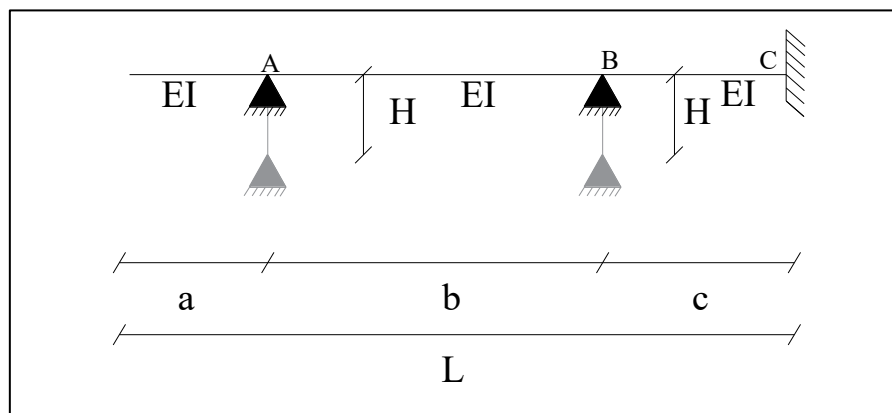


Figure 1.1 Idealization of Bridge Structures

The Questions:

1. Draw and calculate the Fixed End Moments (FEM) resulting from the loads acting on each span of the released structure.
2. Determine the area and the centroid of the internal force diagrams for each span.
3. Calculate the end moments using the Three-Moment Equation (TME) method, then compare these values with the results obtained from the Slope Deflection method.
4. Determine the support reactions using ordinary statics and draw the freebody diagram for each structural element, complete with the forces at the ends of the members.
5. Determine the internal forces and angular rotations at each support in the Real Structure and draw the internal force diagrams and the elastic curve of the structure.

PHASE II

APPLICATION OF THE CROSS METHOD TO UNSTABLE STATIC PORTAL STRUCTURES

Task 1

A Pedestrian Overpass (JPO) is constructed across a highway with a height of $H = \dots$ m. The structure is designed with multiple spans, where the distances between the columns (span lengths) are a , b , and c , respectively, as illustrated in the figure below.

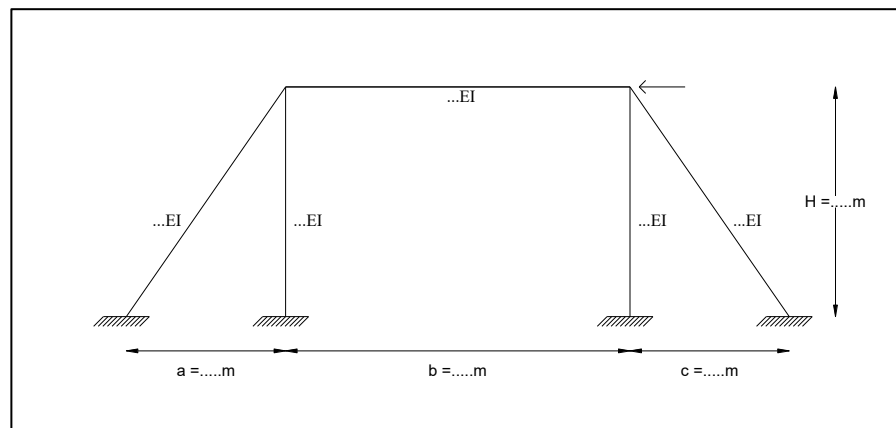


Figure 2.1 Idealization of the Inclined Portal Structure

The Question:

Use the Cross Method for portals with sway, calculate:

- Fixed End Moment (FEM) for each span due to external loads.
- Stiffness factor.
- Distribution factor.
- Moment distribution calculation (Use a minimum of 5 iterations).
- End moment values for each span.
- Structural support reactions by drawing the freebody diagram for each span.
- Calculate and draw the internal force diagram and determine the maximum internal force point.

Task 2:

Use SAP2000 software to verify manual calculation results.

PHASE III

APPLICATION OF THE UNIT LOAD METHOD TO INDETERMINATE STATIC TRUSSES

A train operated by PT Kereta Api Indonesia (KAI) came to a sudden stop on a steel through-truss bridge in Lhokseumawe, Aceh, due to an emergency signal on the track. The train load, which was initially distributed through the rails and the bridge deck, is transferred to the transverse girders (cross beams). In the structural analysis, this load is modeled as concentrated loads (point loads) acting on the bottom chord nodes of the truss. The bridge has a total span length of $L = \dots$ m and a truss height of $H = \dots$ m

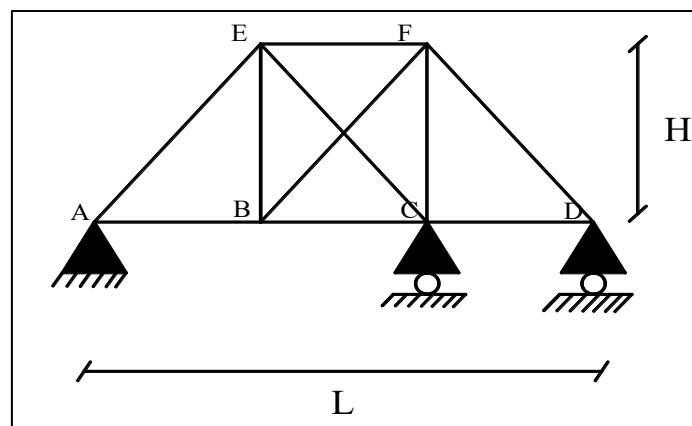


Figure 3.1 Idealization of Truss Bridge Structures

The Question:

1. Perform an external and internal static indeterminacy check of the truss structure.
2. Calculate the support reactions and internal forces of the detached structure.
3. Calculate the support reactions and internal force values due to external loads and a unit load in the same direction as the redundancy on the detached structure. (External Uncertainty Structure).
4. Calculate the support reactions and internal forces due to external loads and a single unit load parallel to the redundant member on the detached structure. (Internal Uncertainty Structure).
5. Calculate the actual support reactions and internal forces of the structure.
6. Calculate the deflection at point B using the Unit Load method.