

Structural Mechanics (2)

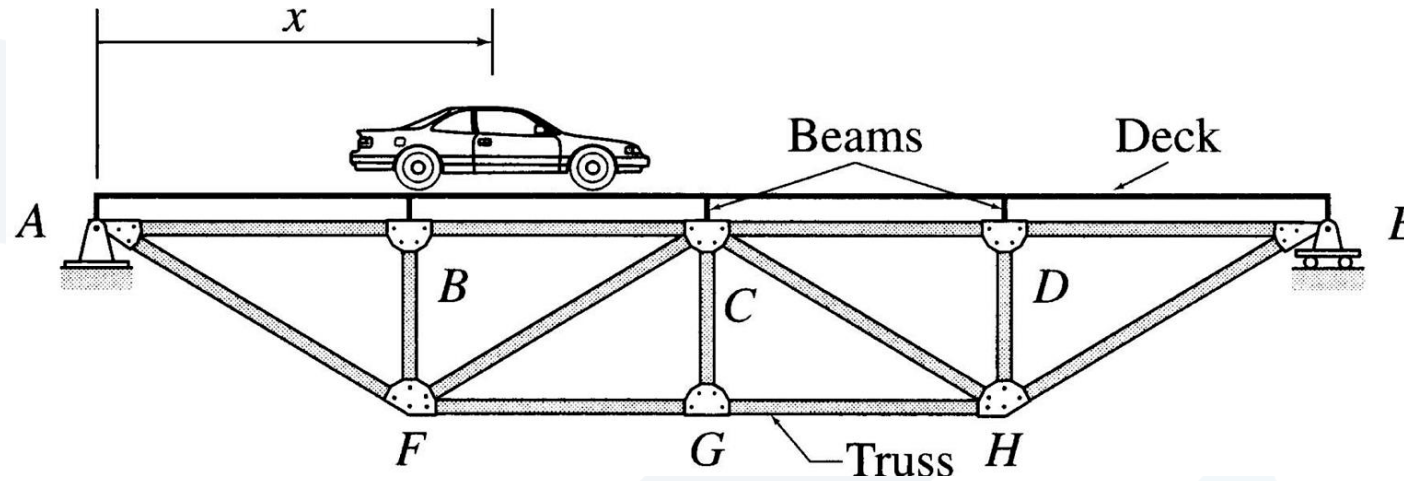
Lecture No-06

Part-01

Influence Lines

- **Influence Lines for Beams & Frames by Equilibrium Method.**
- **Muller-Breslau's Principle and Qualitative Influence Line.**
- **Influence Lines for Girders with Floor Systems.**
- **Influence lines for Trusses.**
- **Influence Lines for Deflections.**

Introduction



The analysis of structures for variable loads consists of two steps:

- (1) determining the position(s) of the load(s) at which the response function of interest (e.g., a reaction, shear or bending moment at a section of a beam, or force in a truss member) becomes maximum and
- (2) computing the maximum value of the response function.

An important concept used in the analysis of structures subjected to variable loads is that of the *influence lines*, initially introduced by E. Winkler in 1867. An *influence line* is a graph of a response function of a structure as a function of the position of a downward unit load moving across the structure.

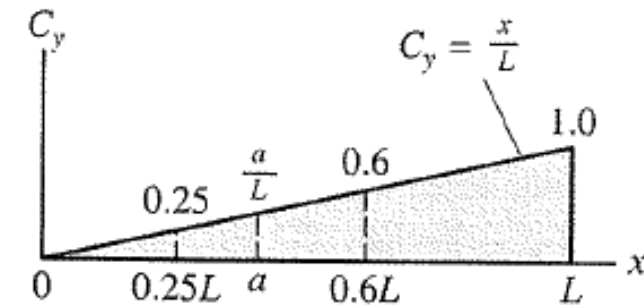
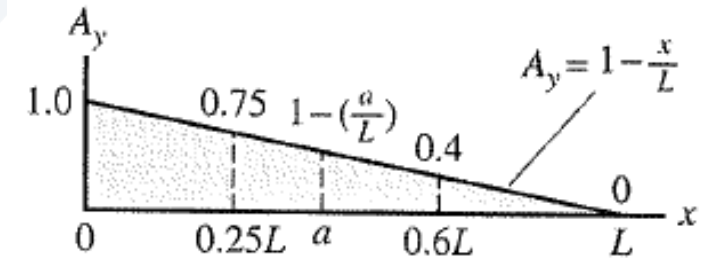
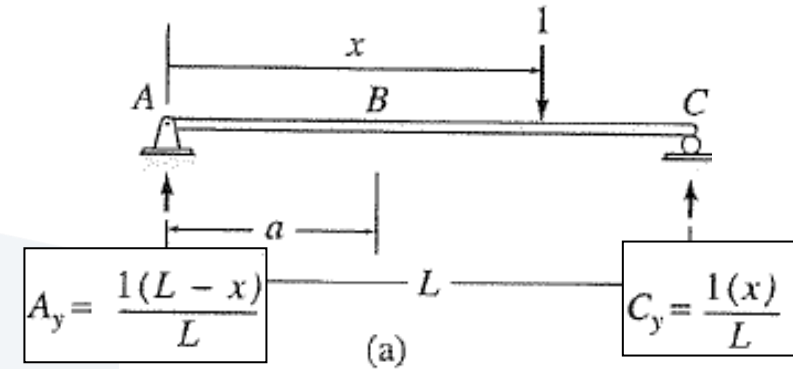
Influence Lines for Beams & Frames by Equilibrium Method.

The position of the unit load is defined by the coordinate x measured from the left end A of the beam. Suppose that we wish to draw the influence lines for the vertical reactions at supports A and C and the shear and bending moment at point B, which is located at a distance a from the left end of the beam.

Influence Lines for Reactions

$$\begin{aligned} \curvearrowright + \sum M_C = 0 &\Rightarrow -A_y(L) + 1(L-x) = 0 \Rightarrow \\ &A_y = (L-x)/L \end{aligned}$$

$$\begin{aligned} \curvearrowright + \sum M_A = 0 &\Rightarrow +C_y(L) - 1(x) = 0 \Rightarrow \\ &C_y = x/L \end{aligned}$$



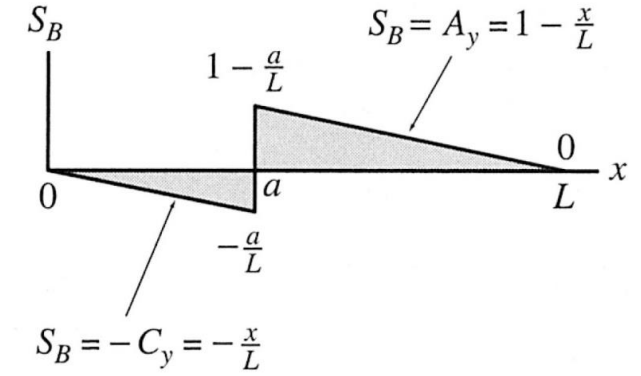
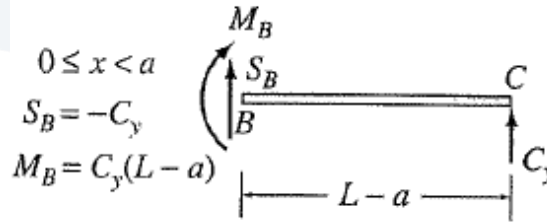
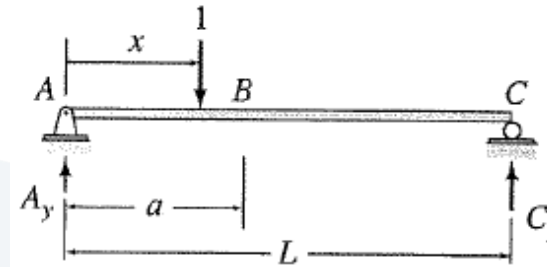
Influence Lines for Beams & Frames by Equilibrium Method.

Influence Lines for **Shear** and **Bending Moment** at B

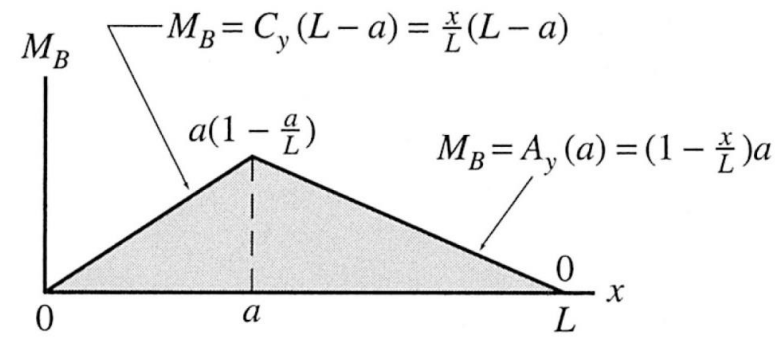
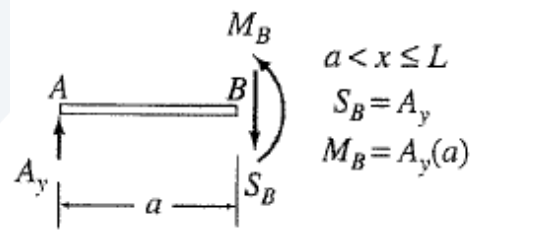
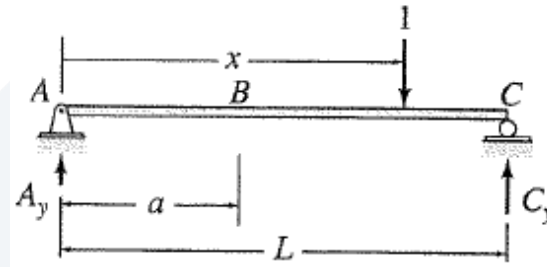
14/04/2024

B. Haidar

Structural Mechanics (2)



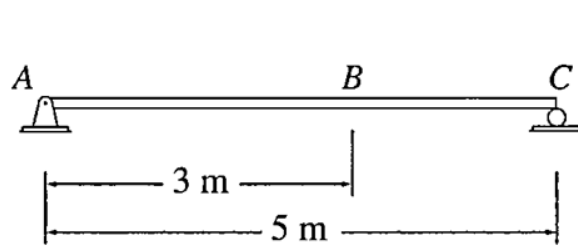
(e) Influence Line for S_B



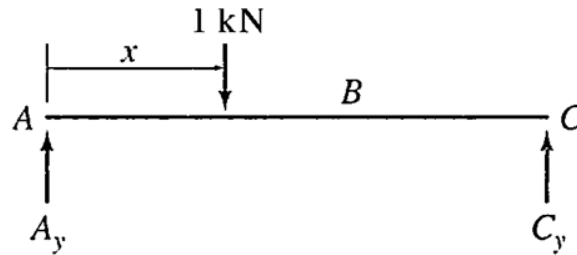
(f) Influence Line for M_B

Example-01

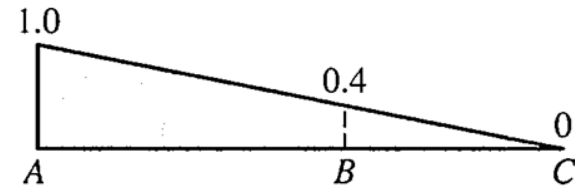
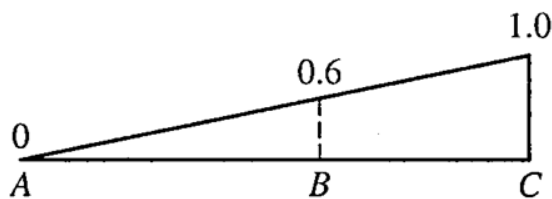
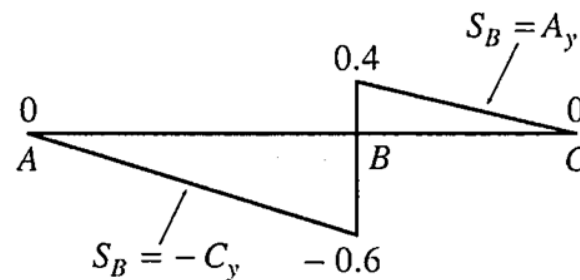
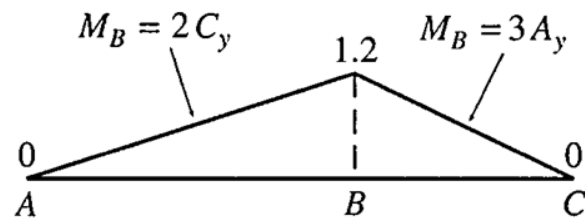
Draw the influence lines for the vertical reactions at supports A and C, and the shear and bending moment at point B, of the simply supported beam shown in following figure.



(a)

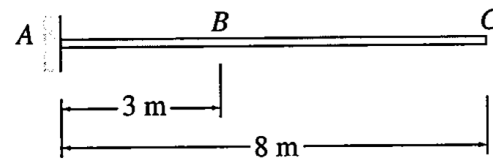


(b)

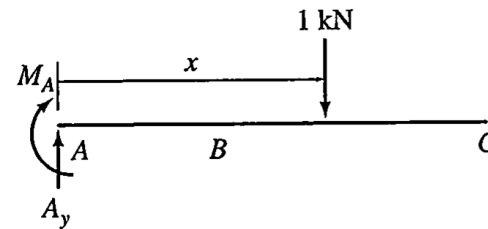
(c) Influence Line for A_y (kN/kN)(d) Influence Line for C_y (kN/kN)(e) Influence Line for S_B (kN/kN)(f) Influence Line for M_B (kN-m/kN)

Example-02

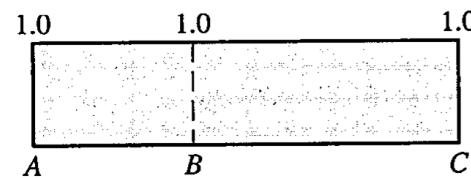
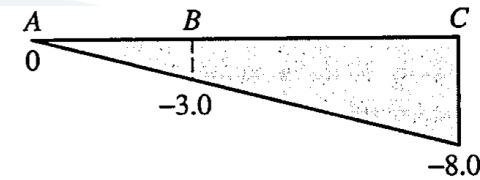
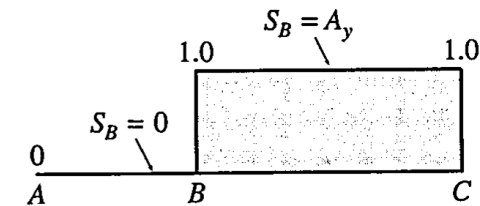
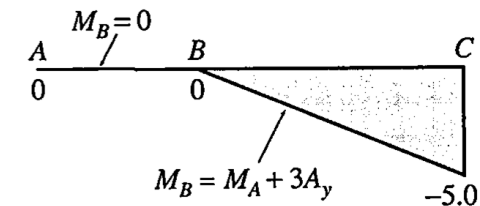
Draw the influence lines for the vertical reaction & the reaction moment at support A and the shear and bending moment at point B of the cantilever beam shown in following figure.



(a)



(b)

(c) Influence Line for A_y (kN/kN)(d) Influence Line for M_A (kN · m/kN)(e) Influence Line for S_B (kN/kN)(f) Influence Line for M_B (kN-m/kN)

Structural Mechanics (2)

Lecture No-06

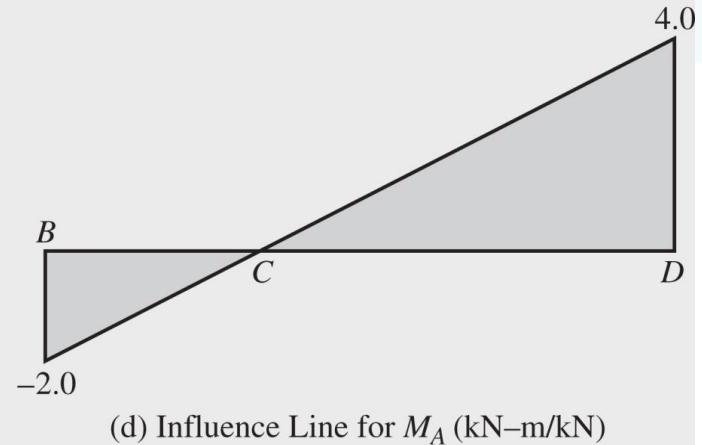
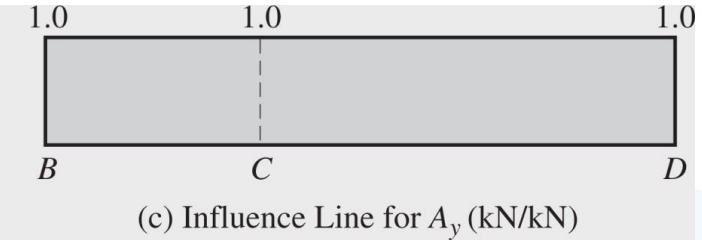
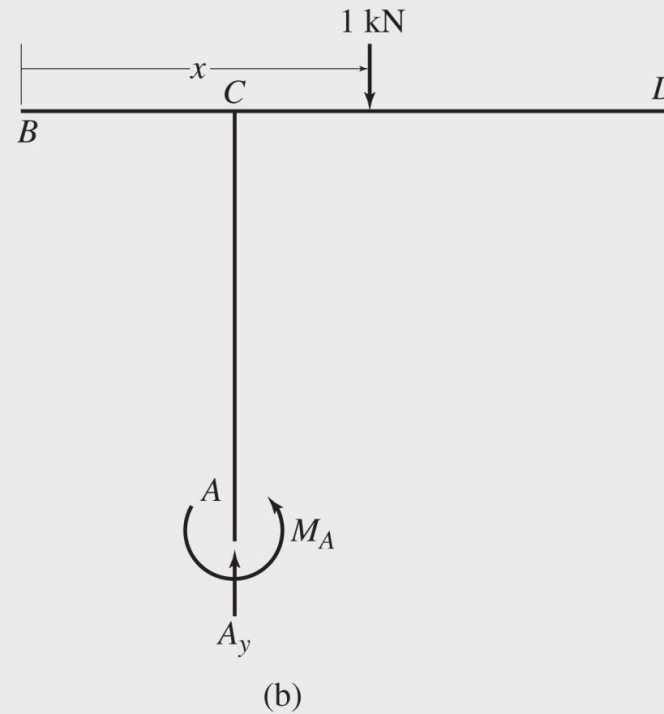
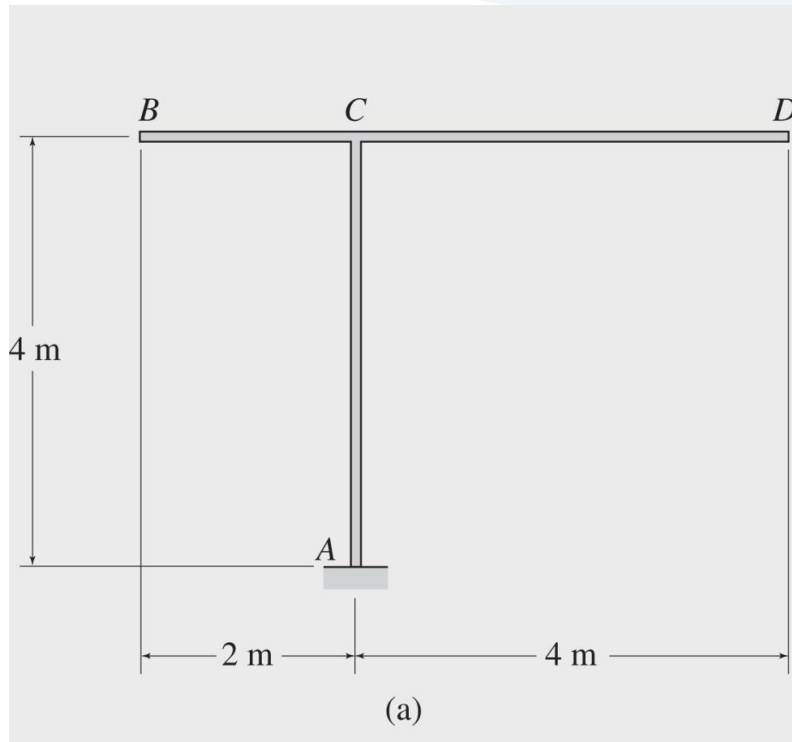
Part-02

Influence Lines

- **Influence Lines for Beams & Frames by Equilibrium Method.**
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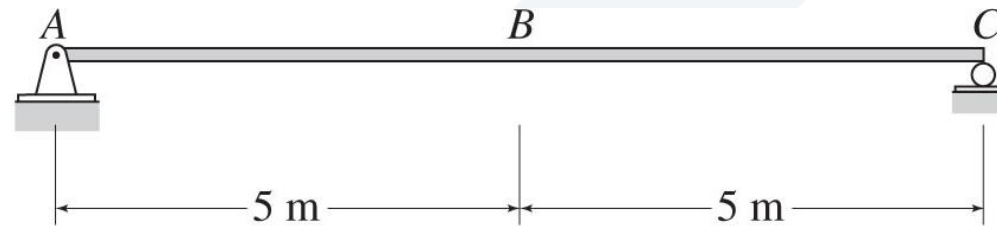
Example-03

Draw the influence lines for the vertical reaction and the moment reaction at support A for the bridge frame shown in following figure.



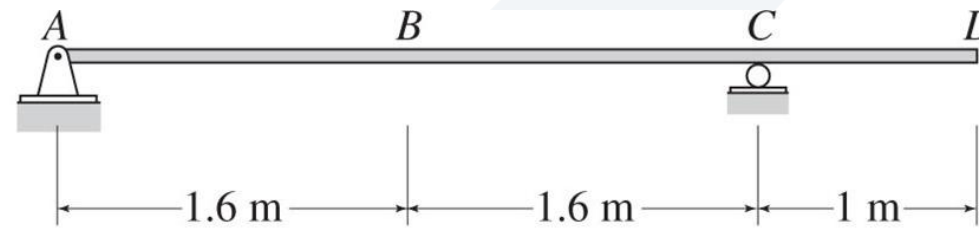
Homework-01

Draw the influence lines for vertical reactions at supports A & C and the Shear force and bending moment at point B.



Homework-02

Draw the influence lines for vertical reactions at supports A & C and the Shear force and bending moment at point B.



Homework-03

Draw the influence lines for vertical reactions at supports A & E and the Shear force and bending moment at point D.

