Structural Mechanics (2)

Week No-02

Slope-Deflection for Beams and Frames

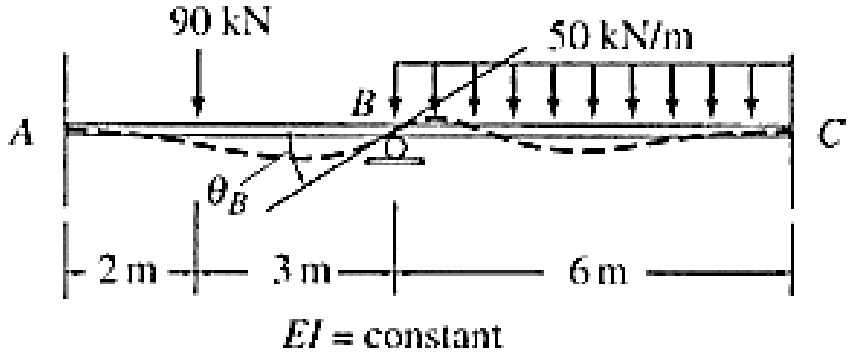
B. Haidar

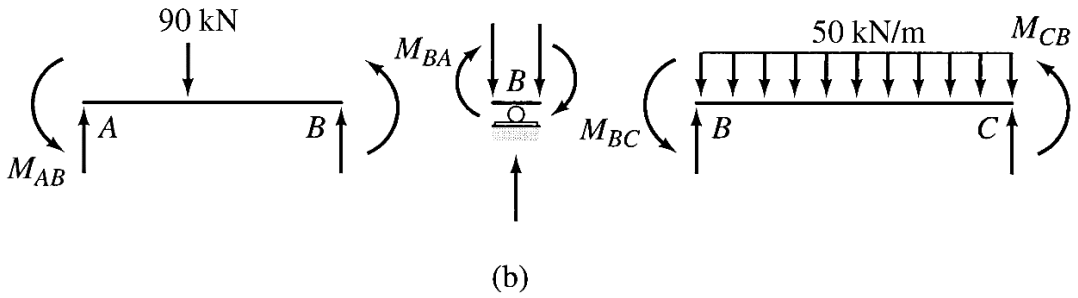
Slope-Deflection Method for Beams and Frames

- Basic Concept of the Slope-Deflection Method and Slope-Deflection Equations.
- Analysis of Continuous Beams.
- Analysis of Frames without Sidesway.
- Analysis of Frames with Sidesway.

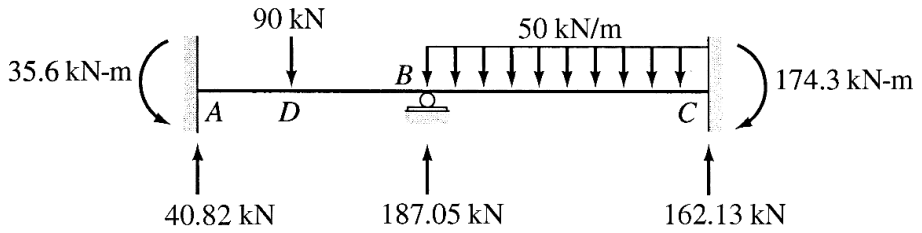
Ex.3: Compute the reactions then draw the SF & BM diagrams

$\theta_A = \theta_D = 0$
$\&\Delta = 0$
$\theta_B \neq 0$

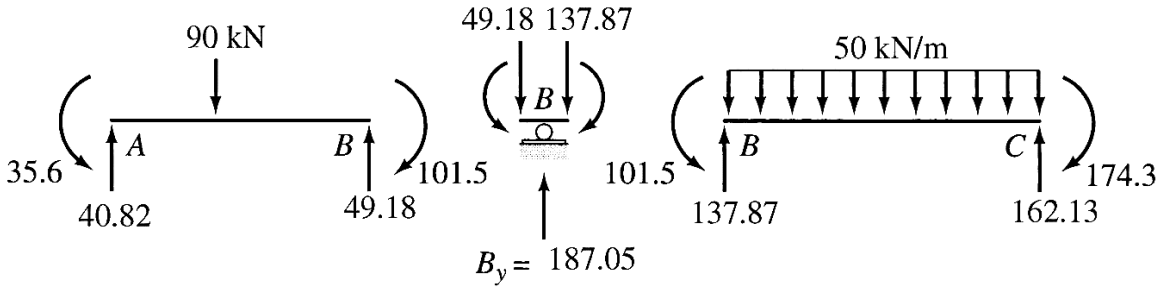




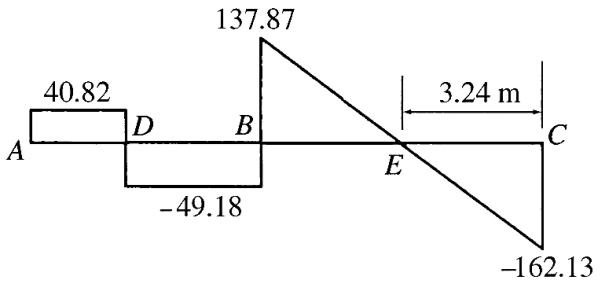
(b)



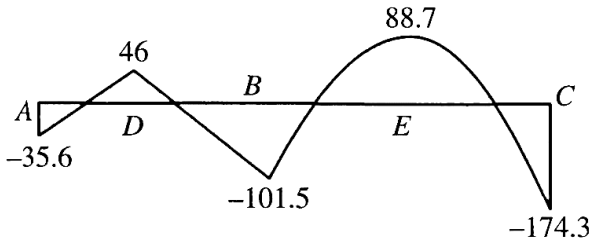
(d) Support Reactions



(c) Member End Moments and Shears



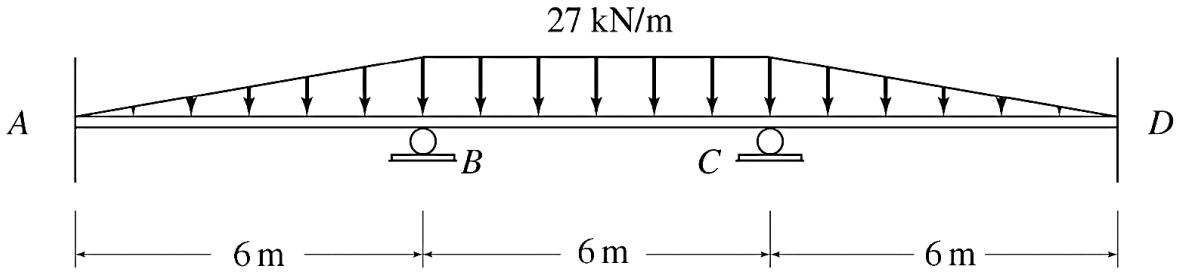
(e) Shear Diagram (kN)



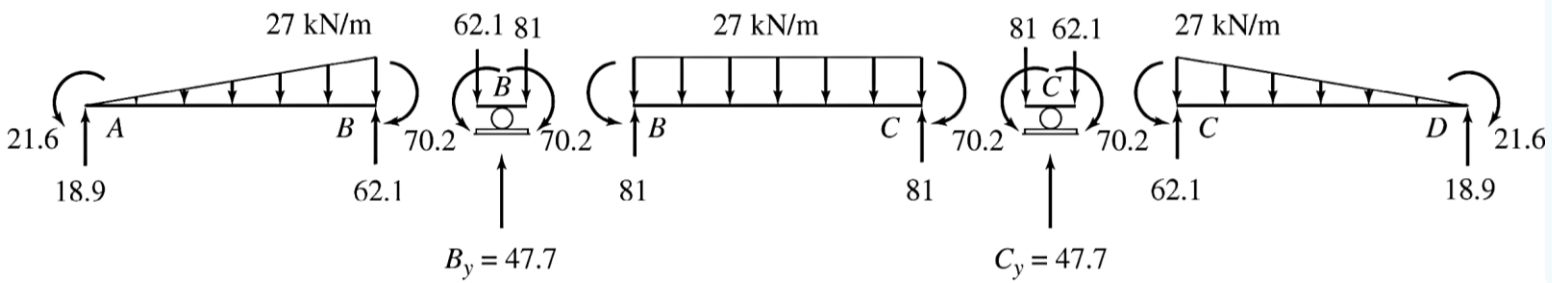
(f) Bending Moment Diagram (kN-m)

Ex.4: Compute the reactions then draw the SF & BM diagrams

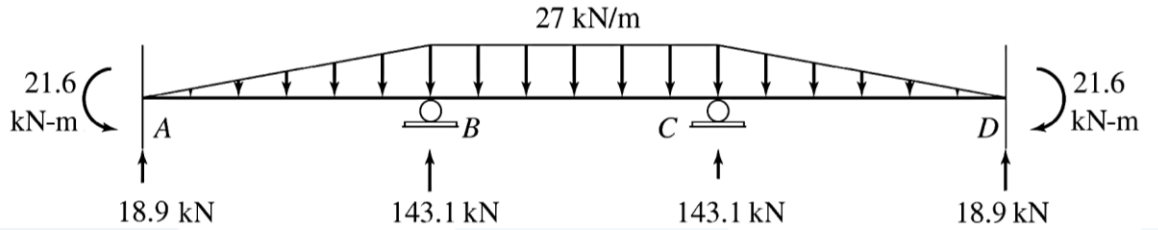
$\theta_A = \theta_D = 0$
$\&\Delta = 0$
$\theta_B \neq 0 \ , \theta_C \neq 0$



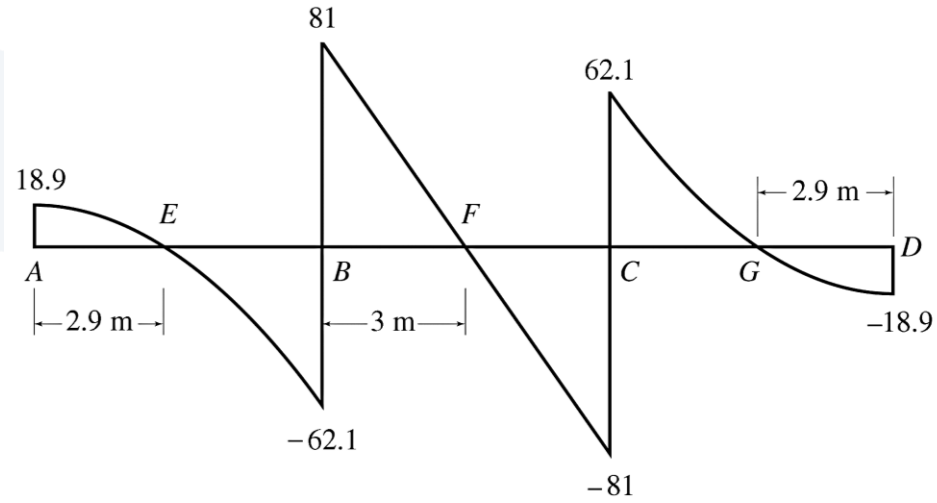
EI = constant



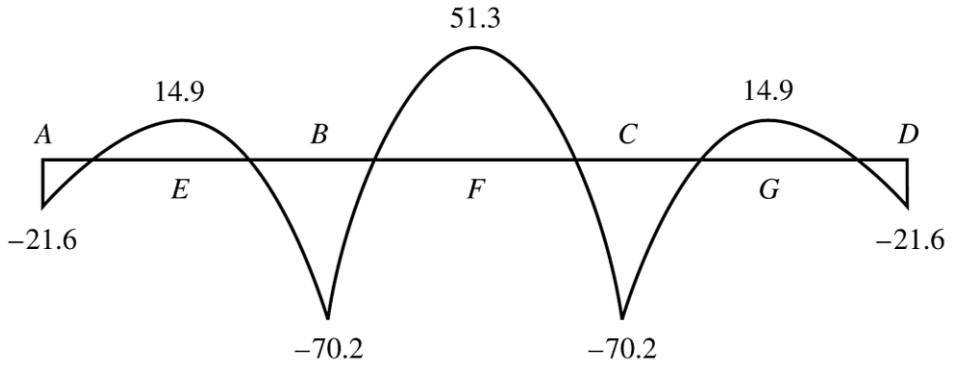
(c) Member End Moments and Shears



Ex.4: Compute the reactions then draw the SF & BM diagrams

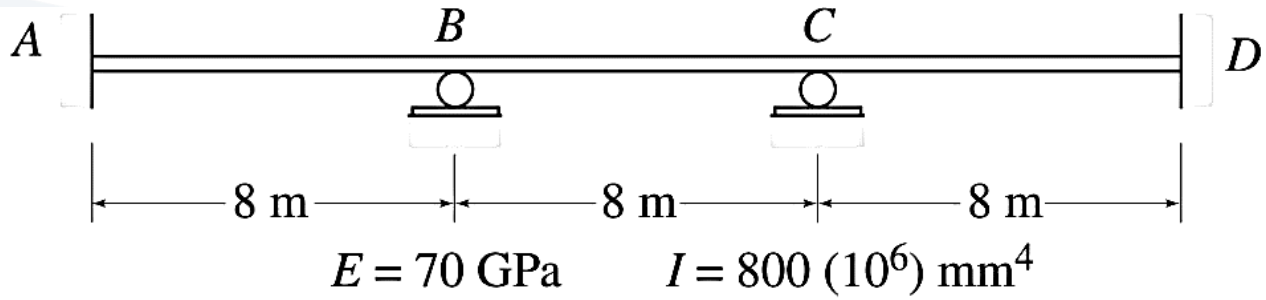


(e) Shear Diagram (kN)



(f) Bending Moment Diagram (kN-m)

Ex.5: Determine the reactions and draw the shear and bending moment diagrams for the continuous beam shown in figure due to a settlement of 20 mm at support B.



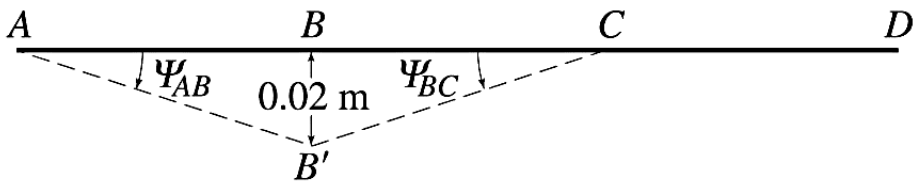
Degrees of freedom:

$\theta_A = 0 \;\&\; \theta_D = 0$

$\theta_B \neq 0 \;\&\; \theta_C \neq 0$

Fixed-End Moments: ?????

Chord rotations:

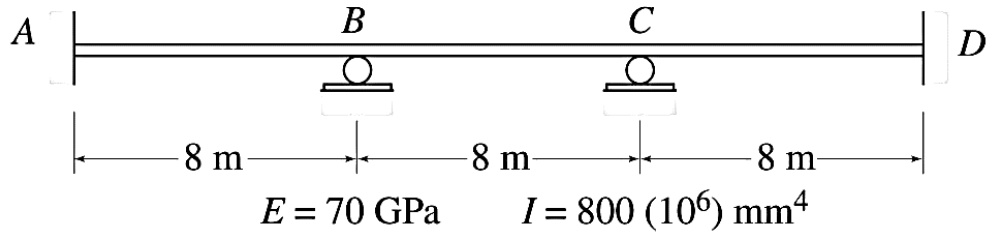


$$\psi_{AB} = -\frac{0.02}{8} = -0.0025$$

$$\psi_{CB} = \frac{0.02}{8} = 0.0025$$

$$\psi_{CD} = 0$$

Ex.5: Determine the reactions and draw the shear and bending moment diagrams for the continuous beam shown in figure due to a settlement of 20 mm at support B.



Slope Deflection Equations:

$$M_{AB} = \frac{2EI}{8}(\theta_B + 0.0075)$$

$$M_{BA} = \frac{2EI}{8}(2\theta_B + 0.0075)$$

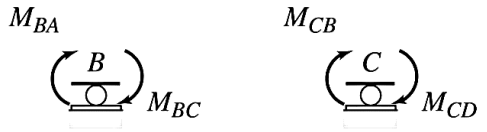
$$M_{BC} = \frac{2EI}{8}(2\theta_B + \theta_C - 0.0075)$$

$$M_{CB} = \frac{2EI}{8}(\theta_B + 2\theta_C - 0.0075)$$

$$M_{CD} = \frac{2EI}{8}(2\theta_C)$$

$$M_{DC} = \frac{2EI}{8}(\theta_C)$$

Equilibrium Equations:



$$M_{BA} + M_{BC} = 0$$

$$M_{CB} + M_{CD} = 0$$

$$4\theta_B + \theta_C = 0$$

$$\theta_B + 4\theta_C = 0.0075$$

$$\theta_B = -0.0005\ rad$$

$$\theta_C = 0.002\ rad$$

Member End Moments:

$M_{AB} = 98$ kN. m ↶

$M_{BA} = 91$ kN. m ↶

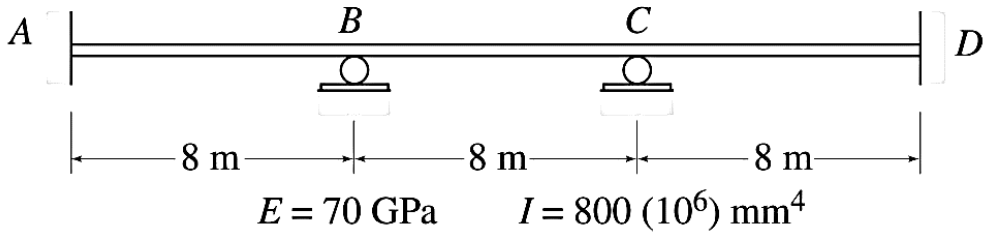
$M_{BC} = -91$ kN. m (**91 kN. m** ↷)

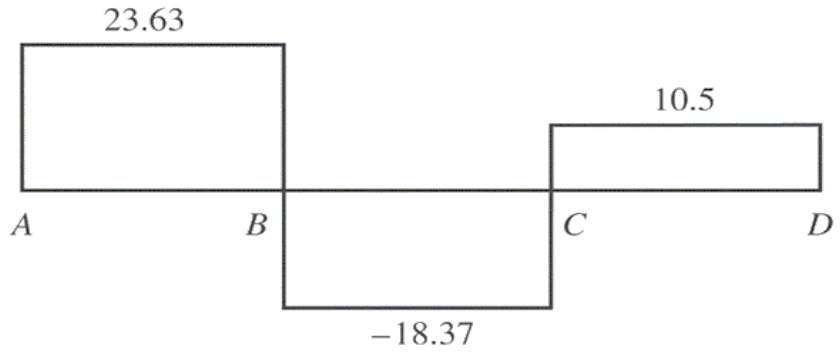
$M_{CB} = -56$ kN. m (**56 kN. m** ↷)

$M_{CD} = 56$ kN. m ↶

$M_{DC} = 28$ kN. m ↶

Ex.5: Determine the reactions and draw the shear and bending moment diagrams for the continuous beam shown in figure due to a settlement of 20 mm at support B.





(f) Shear Diagram (kN)