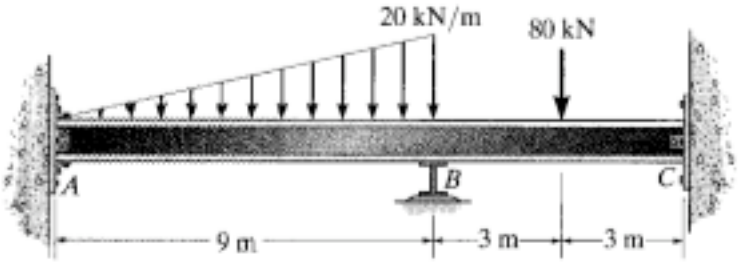
CE 371 - HOMEWORK NO. 9

Instructor: Varma, Section 1.

11–7. Determine the moments acting at A and B. Assume A is fixed supported, B is a roller, and C is a pin. EI is constant.



Prob. 11–7

Sol:

$FEM_{AB} = wL^2/30 = -54$, $FEM_{BC} = 3PL/16 = -90$

$FEM_{BA} = wL^2/20 = 81$ **(Points 2)**

$M_{AB} = 2EI(\theta_B)/9 - 54$

$M_{BA} = 2EI(2\theta_B)/9 + 81$

$M_{BC} = 3EI(\theta_B)/6 - 90$ **(Points 3)**

Moment equilibrium at B

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

$4EI(\theta_B)/9 + 81 + EI(\theta_B)/2 - 90 = 0$

$\theta_B = 9.529/EI$ **(Points 2)**

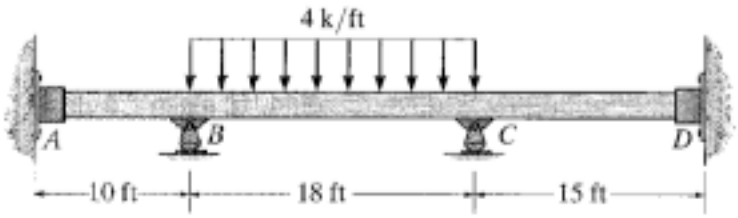
Thus,

$M_{AB} = -51.9$kN.m **Ans** **(Point 1)**

$M_{BA} = 85.2$kN.m **Ans** **(Point 1)**

$M_{BC} = -85.2$kN.m **Ans** **(Point 1)**

*11–8. Determine the moments at the supports, then draw the moment diagram. Assume A and D are fixed. EI is constant.



Prob. 11–8

Sol:

$FEM_{BC} = -wL^2/12 = -108$

$FEM_{CB} = wL^2/12 = 108$

$\theta_A = \theta_C = \Psi_{AB} = \Psi_{BC} = \Psi_{CD} = 0$

$M_N = 2EI(2\theta_N + \theta_F - 3\Psi)/L + FEM_N$

$M_{AB} = 2EI(\theta_B)/10$

$M_{BA} = 2EI(2\theta_B)/10$

$M_{BC} = 2EI(2\theta_B + \theta_C)/18 - 108$

$M_{CB} = 2EI(2\theta_C + \theta_B)/18 + 108$

$M_{CD} = 2EI(2\theta_C)/15$

$M_{DC} = 2EI(\theta_C)/15$

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

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

$2EI(2\theta_B)/10 + 2EI(2\theta_B + \theta_C)/18 - 108 = 0$

$28EI\theta_B + 5EI\theta_C = 4860$

$2EI(2\theta_C + \theta_B)/18 + 108 + 2EI(2\theta_C)/15 = 0$

$22\theta_C + 5\theta_B = -4860$

$\theta_C = -271.37/EI$

$\theta_B = 222.03/EI$

Thus,

$M_{AB} = 44.4$k.ft **Ans** **(Point 1)**

$M_{BA} = 88.8$k.ft **Ans** **(Point 1)**

$M_{BC} = -88.81$k.ft **Ans** **(Point 1)**

$M_{CB} = 72.37$k.ft **Ans** **(Point 1)**

M_{CD} = -72.4k.ft **Ans** **(Point 1)**

M_{DC} = -36.2k.ft **Ans** **(Point 1)**

Segment AB

$\circlearrowleft +\Sigma M_A = 0;$

$44.4 + 88.8 – V_{BL}(10) = 0$

V_{BL} = 13.32k

$\uparrow +F_Y = 0$

A_Y = 13.322k

Segment BC:

$\circlearrowleft +\Sigma M_B = 0;$

$72.37- V_{CL}(18) + 72(9) – 88.8 = 0$

V_{CL} = 35.619k

$\uparrow +\Sigma F_Y = 0$

V_{BR} = 36.381k

Segment CD:

$\circlearrowleft +\Sigma M_C = 0$

$D_Y(15) – 36.18 – 72.37 = 0$

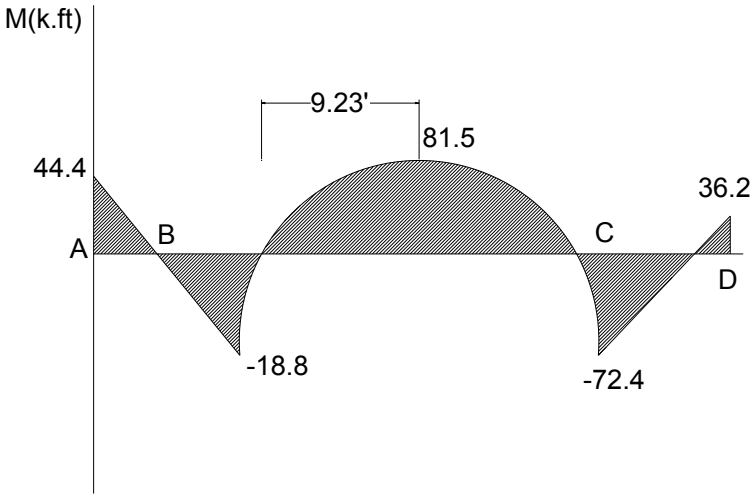
D_Y = 7.237k

$\uparrow +\Sigma F_Y = 0;$ V_{CR} = 7.237k

At B and C:

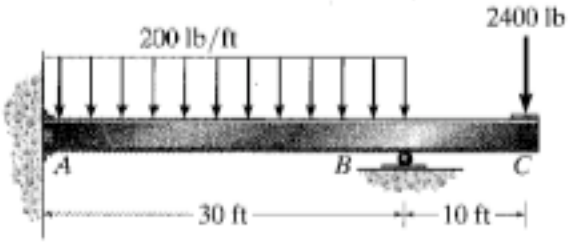
$B_Y = 36.381 + 13.32 = 49.603k$

$C_Y = 35.619 + 7.237 = 42.846k$



(Points 4)

11–10. Determine the moments at A and B, then draw the moment diagram for the beam. EI is constant.



Prob. 11–10

Sol:

$FEM_{AB} = -wL^2/12 = -200(30^2)/12 = -15kft$

$M_{AB} = 2EI(0 + \theta_B - 0)/30 - 15$

$M_{BA} = 2EI(2\theta_B + 0 - 0)/30 + 15$

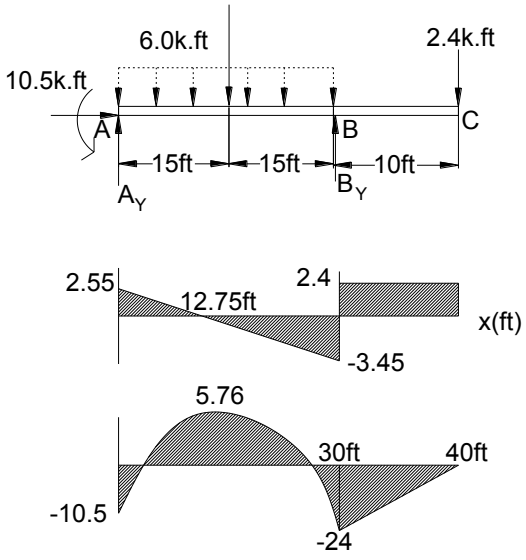
$\Sigma M_B = 0;$ $M_{BA} = 2.4(10)$

Solving

$\theta_B = 67.5/EI$

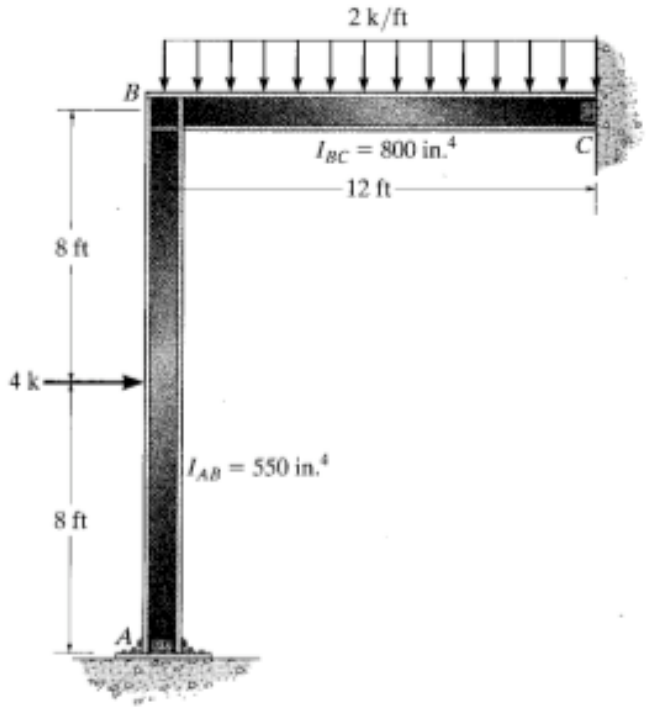
$M_{AB} = -10.5k.ft$ **Ans** **(Points 3)**

$M_{BA} = 24k.ft$ **Ans** **(Points 3)**



(Points 4)

11–13. Determine the moments at the ends of each member of the frame. Take $E = 29(10^3)$ ksi. The moment of inertia of each member is listed in the figure. Assume the joint at B is fixed, C is pinned, and A is fixed.



Prob. 11–13

Sol:

$FEM_{BC} = -wL^2/8 = -36$

$FEM_{AB} = -PL/8 = -8$, $FEM_{BA} = PL/8 = 8$ **(Points 2)**

$\theta_A = \Psi_{AB} = \Psi_{BC} = 0$

$M_N = 2EI(2\theta_N + \theta_F - 3\Psi)/L + FEM_N$

$M_{AB} = 2E(550)(2(0) + \theta_B - 3(0))/12^2(16) - 8$

$M_{BA} = 2E(550)(2\theta_B)/12^2(16) + 8$

$M_{BC} = 3E(800)(\theta_B)/12^2(12) - 36$

Moment equilibrium at B:

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

$\theta_B = 11.9467/E$ **(Points 2)**

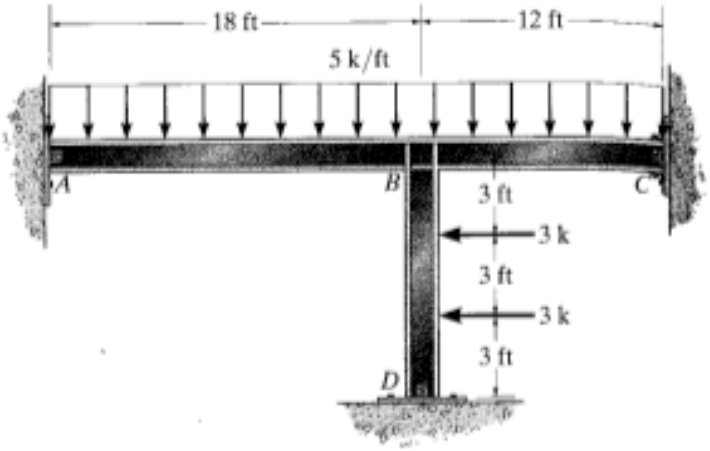
Thus,

$M_{AB} = -2.30$k.ft **Ans** **(Points 2)**

$M_{BA} = 19.4$k.ft **Ans** **(Points 2)**

$M_{BC} = -19.4$k.ft **Ans** **(Points 2)**

*11–16. Determine the moments acting at the ends of each member. Take $E = 29(10^3)$ ksi, $I_{ABC} = 700\ \text{in}^4$, and $I_{BD} = 1100\ \text{in}^4$. Assume A and D are pin supported and C is fixed.



Prob. 11–16

Sol:

$FEM_{BA} = wL^2/8 = 202.5$

$FEM_{BC} = -wL^2/12 = -60$

$FEM_{CB} = wL^2/12 = 60$

$FEM_{BD} = -PL/3 = -9$ **(Points 3)**

$\theta_C = \Psi_{AB} = \Psi_{BD} = \Psi_{BC} = 0$

$M_{BA} = 3E(700)(\theta_B)/18 + 202.5$

$M_{BC} = 2E(700)(2\theta_B)/12 - 60$

$M_{CB} = 2E(700)(\theta_B)/12 + 60$

$M_{BD} = 3E(1100)(\theta_B)/9 - 9$

Moment equilibrium at B:

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

$\theta_B = -0.18628/E$ **(Points 3)**

Thus,

$M_{BA} = 181$k.ft **Ans** **(Point 1)**

$M_{BC} = -103$k.ft **Ans** **(Point 1)**

$M_{CB} = 38.3$k.ft **Ans** **(Point 1)**

$M_{BD} = -77.3$k.ft **Ans** **(Point 1)**