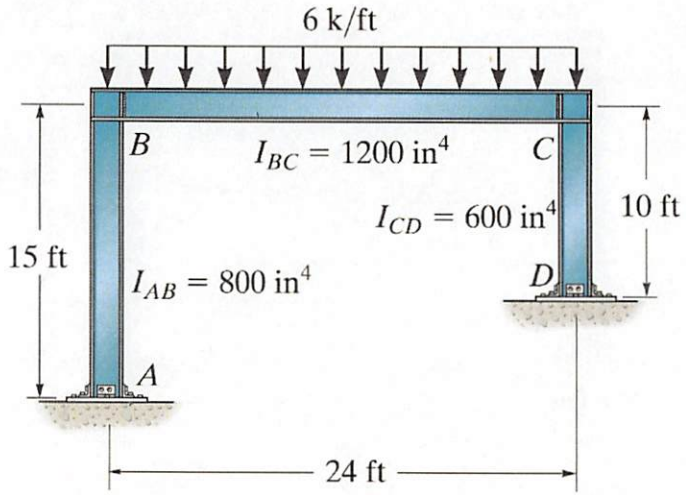
Problem 10c-2 – Determine the moments acting at the ends of each member. Assume the supports at *A* and *D* are fixed, and $E = 29(10^3)$ ksi.



$I_{AB} = 800\,IN^4 = 4/3\, I_{CD}$

$I_{BC} = 1200\,IN^4 = 2\, I_{CD}$

$I_{CD} = 600\,IN^4$

$$FEM_{BC} = \frac{WL^2}{12} = \frac{6k/ft\,(24ft)^2}{12} = \pm 288\,k\text{-}ft$$

SECTION AB – 2 EQNS.

$$\frac{2E(4/3\,I_{CD})}{L_{AB}}\left[\theta_B - 3\left(\Delta/L_{AB}\right)\right] = M_{AB} \quad (1)$$

$$M_{BA} = \frac{2E(4/3\,I_{CD})}{L_{AB}}\left[2\theta_B - 3\left(\Delta/L_{AB}\right)\right] \quad (2)$$

SECTION BC – 2 EQNS,

$$M_{BC} = \frac{2E(2I_{CD})}{L_{BC}}\left[2\theta_B + \theta_C\right] - 288\,k\text{-}ft \quad (3)$$

$$M_{CB} = \frac{2E(2I_{CD})}{L_{BC}}\left[2\theta_C + \theta_B\right] + 288\,k\text{-}ft \quad (4)$$

SECTION CD – 2 EQNS,

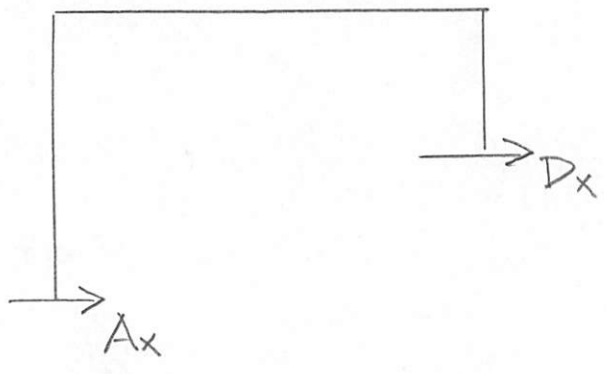
$$M_{CD} = \frac{2E\,I_{CD}}{L_{CD}}\left[2\theta_C - 3\left(\Delta/L_{CD}\right)\right] \quad (5)$$

$$M_{DC} = \frac{2E\,I_{CD}}{L_{CD}}\left[\theta_C - 3\left(\Delta/L_{CD}\right)\right] \quad (6)$$

JOINT B $\quad M_{BA} + M_{BC} = 0 \quad (7)$

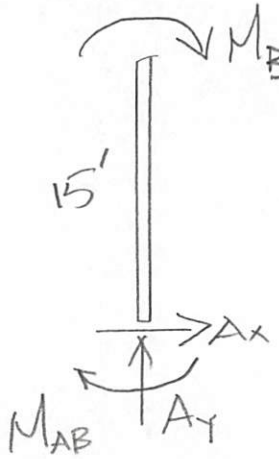
JOINT C $\quad M_{CB} + M_{CD} = 0 \quad (8)$

Problem 10c-2 – Determine the moments acting at the ends of each member. Assume the supports at *A* and *D* are fixed, and $E = 29(10^3)$ ksi.



$$\overset{+}{\rightarrow}\sum F_x = 0 = A_x + D_x$$

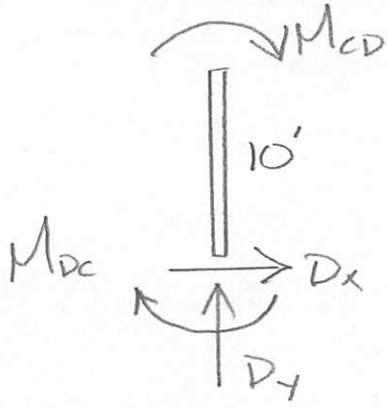
FBD AB



$$\overset{+}{\circlearrowleft}\sum M_B = 0$$

$$= -M_{BA} - M_{AB} + A_x(15') \qquad A_x = \frac{M_{BA} + M_{AB}}{15'}$$

FBD CD



$$\overset{+}{\circlearrowleft}\sum M_C = 0$$

$$= -M_{CD} - M_{DC} + D_x(10') \qquad D_x = \frac{M_{CD} + M_{DC}}{10'}$$

$$M_{AB} + M_{BA} + 1.5(M_{CD} + M_{DC}) = 0 \quad (9)$$

$$A_x + D_x = 0$$

Problem 10c-2 – Determine the moments acting at the ends of each member. Assume the supports at *A* and *D* are fixed, and $E = 29(10^3)$ ksi.

(7) $$M_{BA} + M_{BC} = 0 = \frac{2E(4/3 I_{CD})}{15'}\left[2\theta_B - \frac{3\Delta}{15'}\right] + \frac{2E(2I_{CD})}{24'}\left[2\theta_B + \theta_C\right] - 288\ k\text{-}ft$$

$$0.6889\,\theta_B + 0.1667\,\theta_C - 0.0356\,\Delta = \frac{288\ k\text{-}ft^2}{EI_{CD}} \quad (7a)$$

(8) $$M_{CB} + M_{CD} = 0 = \frac{2E(2I_{CD})}{24'}\left[2\theta_C + \theta_B\right] + 288\ k\text{-}ft + \frac{2EI_{CD}}{10'}\left[2\theta_C - \frac{3\Delta}{10'}\right]$$

$$0.1667\,\theta_B + 0.7333\,\theta_C - 0.06\Delta = -\frac{288\ k\text{-}ft^2}{EI_{CD}} \quad (8a)$$

(9) $$M_{AB} + M_{BA} + 1.5(M_{CD} + M_{DC}) = 0$$

$$\frac{2E(4/3 I_{CD})}{15'}\left[2\theta_B - \frac{3\Delta}{15'}\right] + \frac{2E(4/3 I_{CD})}{15'}\left[\theta_B - \frac{3\Delta}{15'}\right]$$

$$+1.5\left[\frac{2EI_{CD}}{10'}\left[2\theta_C - \frac{3\Delta}{10'}\right] + \frac{2EI_{CD}}{10'}\left[\theta_C - \frac{3\Delta}{10'}\right]\right] = 0$$

$$0.5333\,\theta_B + 0.9\,\theta_C - 0.2511\,\Delta = 0 \quad (9a)$$

Problem 10c-2 – Determine the moments acting at the ends of each member. Assume the supports at *A* and *D* are fixed, and $E = 29(10^3)$ ksi.

USING EXCEL, SOLVED 7a, 8a, & 9a

$$\theta_B = \frac{507.4804\,kft^2}{EI_{CD}} \qquad \theta_C = -\frac{594.1733\,kft^2}{EI_{CD}} \qquad \Delta = -\frac{1{,}051.8388\,kft^2}{EI_{CD}}$$

$$M_{AB} = \frac{2E(4/3 I_{CD})}{15'}\left[\theta_B - \frac{3\Delta}{15'}\right] = 127.62\,kft$$

$$M_{BA} = \frac{2E(4/3 I_{CD})}{15'}\left[2\theta_B - \frac{3\Delta}{15'}\right] = 217.84\,kft$$

$$M_{BC} = \frac{2E(2I_{CD})}{24'}\left[2\theta_B + \theta_C\right] - 288\,kft = -217.87\,kft$$

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

$$M_{CB} = \frac{2E(2I_{CD})}{24'}\left[2\theta_C + \theta_B\right] + 288\,kft = 174.52\,kft$$

$$M_{CD} = \frac{2EI_{CD}}{10'}\left[2\theta_C - \frac{3\Delta}{10'}\right] = -174.56\,kft$$

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

$$M_{DC} = \frac{2EI_{CD}}{10'}\left[\theta_C - \frac{3\Delta}{10'}\right] = -55.72\,kft$$