

Usando el método "Pendiente-Deflexión" o "Slope-Deflexion" encontrar las incognitas:  $\theta_2, \theta_3, \theta_4, M_2, M_4$

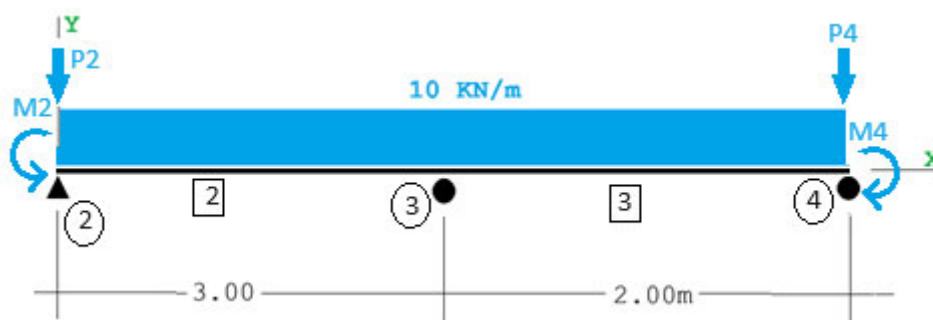
#1: [CaseMode := Sensitive, InputMode := Word]

#2: 
$$\left[ W := 10, L_1 := 1.5, L_2 := 3, L_3 := 2, L_4 := 1, I_1 := \frac{1}{12} \cdot 0.2 \cdot 0.1^3, I_2 := \frac{1}{12} \cdot 0.15 \cdot 0.1^3, E := (4700 \cdot \sqrt{21}) \cdot 1000 \right]$$

#3: 
$$\left[ W := 10, L_1 := \frac{3}{2}, L_2 := 3, L_3 := 2, L_4 := 1, I_1 := \frac{1}{60000}, I_2 := \frac{1}{80000}, E := 4700000 \cdot \sqrt{21} \right]$$

#4: 
$$\left[ W := 10, L_1 := 1.5, L_2 := 3, L_3 := 2, L_4 := 1, I_1 := 1.666666666 \cdot 10^{-5}, I_2 := 1.25 \cdot 10^{-5}, E := 2.153810576 \cdot 10^7 \right]$$

Se puede simplificar el ejercicio quitando los voladizos y reemplazando su carga y momento:

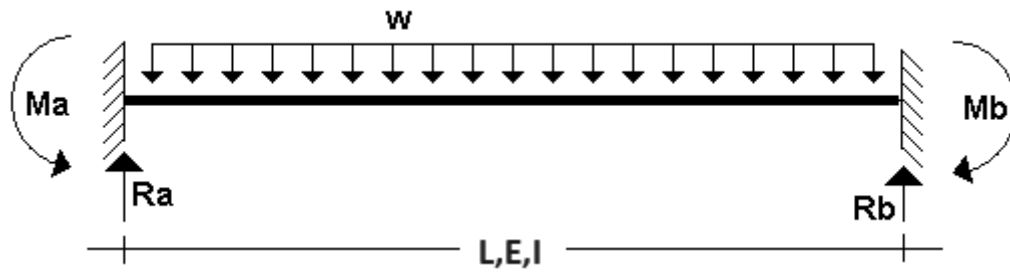


#5: 
$$\left[ P_2 := \frac{W \cdot L_1}{2}, M_2 := P_2 \cdot \frac{1}{3} \cdot L_1, P_4 := \frac{W \cdot L_4}{2}, M_4 := P_4 \cdot \frac{1}{3} \cdot L_4 \right]$$

#6: 
$$\left[ P_2 := \frac{15}{2}, M_2 := \frac{15}{4}, P_4 := 5, M_4 := \frac{5}{3} \right]$$

#7: 
$$[P_2 := 7.5, M_2 := 3.75, P_4 := 5, M_4 := 1.666666666]$$

Empotramiento perfecto general para carga distribuida a lo largo de toda la longitud:



$$\left[ \begin{array}{cc} \frac{2}{L} \cdot w & \frac{2}{L} \cdot w \\ Ma = \frac{2}{12} \wedge Mb = \frac{2}{12} \wedge Ra = \frac{L \cdot w}{2} \wedge Rb = \frac{L \cdot w}{2} \end{array} \right]$$

Empotramiento perfecto para las dos vigas con carga uniformemente distribuida a lo largo de toda la longitud:

#8: 
$$\left[ \begin{array}{cccc} MEP23 := \frac{W \cdot L^2}{12} & MEP32 := -\frac{W \cdot L^2}{12} & MEP34 := \frac{W \cdot L^3}{12} & MEP43 := -\frac{W \cdot L^3}{12} \\ YEMP23 := \frac{W \cdot L^2}{2} & YEMP32 := \frac{W \cdot L^2}{2} & YEMP34 := \frac{W \cdot L^3}{2} & YEMP43 := \frac{W \cdot L^3}{2} \end{array} \right]$$

#9: 
$$\left[ \begin{array}{cccc} MEP23 := \frac{15}{2} & MEP32 := -\frac{15}{2} & MEP34 := \frac{10}{3} & MEP43 := -\frac{10}{3} \\ YEMP23 := 15 & YEMP32 := 15 & YEMP34 := 10 & YEMP43 := 10 \end{array} \right]$$

Condiciones de los apoyos:  $v_2=v_3=v_4=0$

Incognitas:

#10:  $[\theta_2 :=, \theta_3 :=, \theta_4 :=, M_{23} :=, M_{32} :=, M_{34} :=, M_{43} :=, Y_{23} :=, Y_{32} :=, Y_{34} :=, Y_{43} :=]$

4 ecuaciones: fórmulas de momentos internos de Slope-Deflexion

3 ecuaciones:  $\sum$  de momentos internos =  $\sum$  de momentos externos

#11: 
$$\left[ \begin{array}{l} M_{23} = \frac{2 \cdot E \cdot I_1}{L_2} \cdot (2 \cdot \theta_2 + \theta_3) + MEP_{23} \\ M_{32} = \frac{2 \cdot E \cdot I_1}{L_2} \cdot (\theta_2 + 2 \cdot \theta_3) + MEP_{32} \\ M_{34} = \frac{2 \cdot E \cdot I_2}{L_3} \cdot (2 \cdot \theta_3 + \theta_4) + MEP_{34} \\ M_{43} = \frac{2 \cdot E \cdot I_2}{L_3} \cdot (\theta_3 + 2 \cdot \theta_4) + MEP_{43} \\ M_{23} = M_2 \\ M_{43} = -M_4 \\ M_{32} + M_{34} = 0 \end{array} \right]$$

#12: 
$$\left[ \begin{array}{l} M_{23} := \frac{15}{4}, M_{32} := -\frac{2825}{408}, M_{34} := \frac{2825}{408}, M_{43} := -\frac{5}{3}, \theta_2 := -\frac{659 \cdot \sqrt{21}}{268464}, \theta_3 := \frac{25 \cdot \sqrt{21}}{16779}, \theta_4 := -\frac{\sqrt{21}}{14382} \end{array} \right]$$

#13:  $[M_{23} = 3.75 \wedge M_{32} = -6.924019607 \wedge M_{34} = 6.924019607 \wedge M_{43} = -1.666666666 \wedge \theta_2 = -0.01124887278 \wedge$

Elemento 2:

$\sum \text{Fuerzas} = 0$

$\sum \text{Momentos respecto al nudo 2} = 0$

#14: 
$$\begin{bmatrix} Y_{23} + Y_{32} - W \cdot L_2 = 0 \\ Y_{32} \cdot L_2 + M_{23} + M_{32} - W \cdot \frac{L_2^2}{2} = 0 \end{bmatrix}$$

#15: 
$$\left[ Y_{23} := \frac{17065}{1224}, Y_{32} := \frac{19655}{1224} \right]$$

#16:  $[Y_{23} = 13.94199346 \wedge Y_{32} = 16.05800653]$

Elemento 3:

$\sum \text{Fuerzas} = 0$

$\sum \text{Momentos respecto al nudo 3} = 0$

#17: 
$$\begin{bmatrix} Y_{34} + Y_{43} - W \cdot L_3 = 0 \\ Y_{43} \cdot L_3 + M_{34} + M_{43} - W \cdot \frac{L_3^2}{2} = 0 \end{bmatrix}$$

#18: 
$$\left[ Y_{34} := \frac{3435}{272}, Y_{43} := \frac{2005}{272} \right]$$

#19:  $[Y_{34} = 12.62867647 \wedge Y_{43} = 7.371323529]$

Viga completa:

$\sum \text{Fuerzas internas} = \sum \text{Fuerzas externas}$

#20: 
$$\begin{bmatrix} Y_{23} = Y_2 - P_2 \\ Y_{32} + Y_{34} = Y_3 \\ Y_{43} = Y_4 - P_4 \end{bmatrix}$$

#21: 
$$\left[ Y_2 = \frac{26245}{1224} \wedge Y_3 = \frac{70225}{2448} \wedge Y_4 = \frac{3365}{272} \right]$$

#22:  $[Y_2 = 21.44199346 \wedge Y_3 = 28.686683 \wedge Y_4 = 12.37132352]$

Diagrama de fuerza cortante:

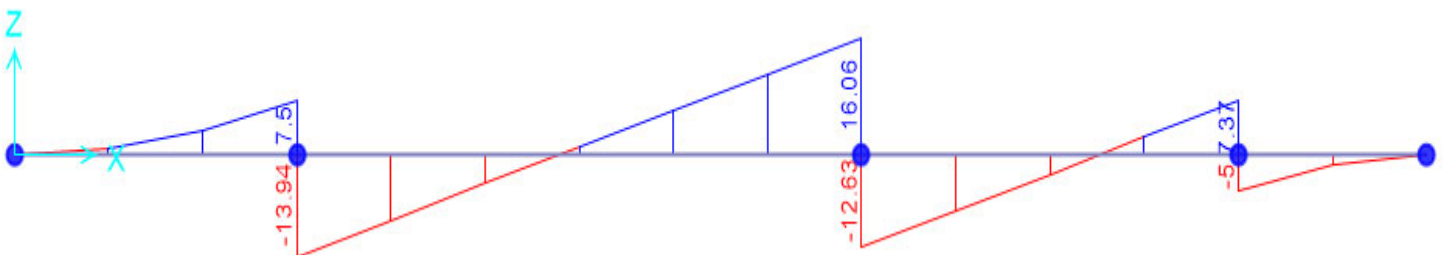
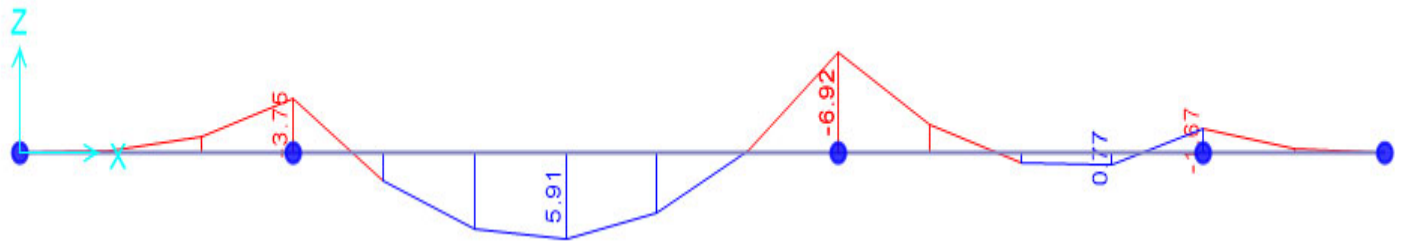


Diagrama de momento flector:



Curva de deformación (elástica):

