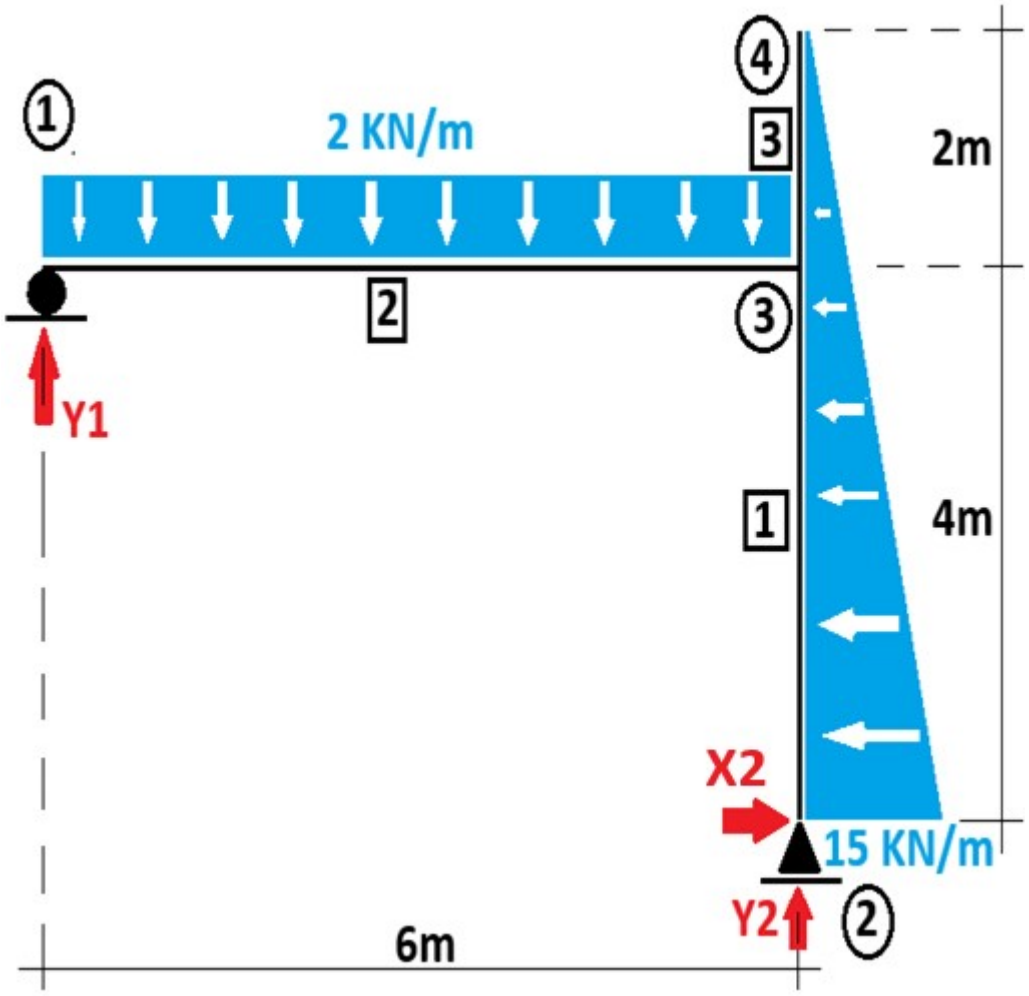
Resolver por el método de la Carga Unitaria Ficticia los desplazamientos del nudo 3:



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

Datos del ejercicio:

#2: $\left[E := 2 \cdot 10^{8},\ Ic := \frac{0.2^{4}}{12},\ Iv := \frac{0.1^{4}}{12}\right]$

#3: [y1 :=, x2 :=, y2 :=, x31 :=, y31 :=, m31 :=, x32 :=, y32 :=, m32 :=, MFv(x) :=, MFc1(x) :=, MFc2(x) :=]

Simplificación de expresiones con EI:

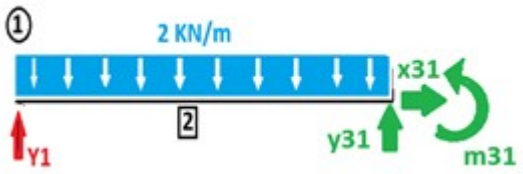
#4: [EIc := E·Ic, EIv := E·Iv]

Ecuaciones del equilibrio estático:

#5:
$$\begin{bmatrix} x2 - \frac{15 \cdot 6}{2} = 0 \\ y2 + y1 - 2 \cdot 6 = 0 \\ -y1 \cdot 6 + 2 \cdot 6 \cdot 3 + \frac{15 \cdot 6}{2} \cdot \frac{1}{3} \cdot 6 = 0 \end{bmatrix}$$

#6: $[x2 := 45, y1 := 21, y2 := -9]$

Diagramas de cuerpo libre de la viga:



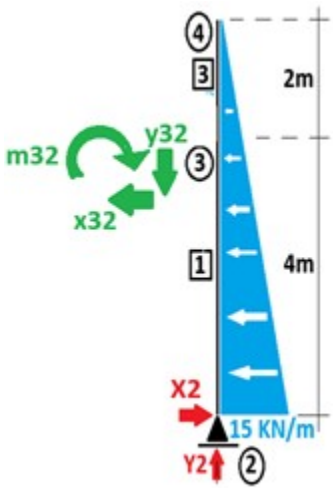
#7:
$$\begin{bmatrix} y1 + y31 - 2 \cdot 6 = 0 \\ x31 = 0 \\ y31 \cdot 6 - 2 \cdot 6 \cdot 3 + m31 = 0 \end{bmatrix}$$

#8: $[m31 := 90, x31 := 0, y31 := -9]$

Diagrama de cuerpo libre del nudo 3:

#9: $[x32 := x31, y32 := y31, m32 := m31]$

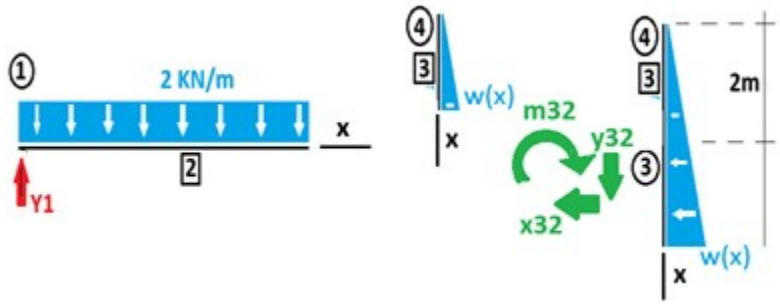
Chequeo de equilibrio con el diagrama de cuerpo libre de la columna:



$$\#10: \begin{bmatrix} x2 - x32 - \frac{15 \cdot 6}{2} = 0 \\ y2 - y32 = 0 \\ -m32 + 15 \cdot \frac{6}{2} \cdot \frac{1}{3} \cdot 6 = 0 \end{bmatrix}$$

$$\#11: \begin{bmatrix} \text{true} \\ \text{true} \\ \text{true} \end{bmatrix}$$

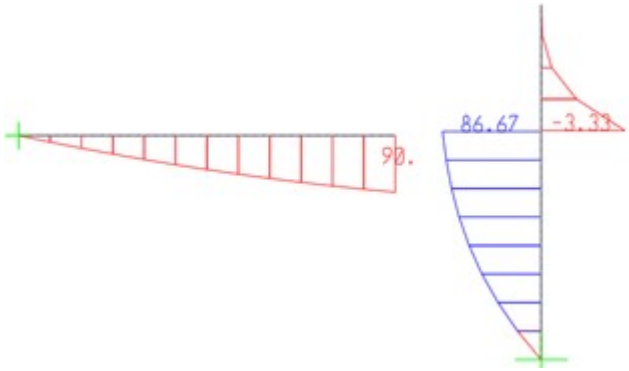
Diagramas de momento flector de la estructura con las cargas originales MF(x):



$$\#12: \quad w(x) := \frac{15}{6} \cdot x$$

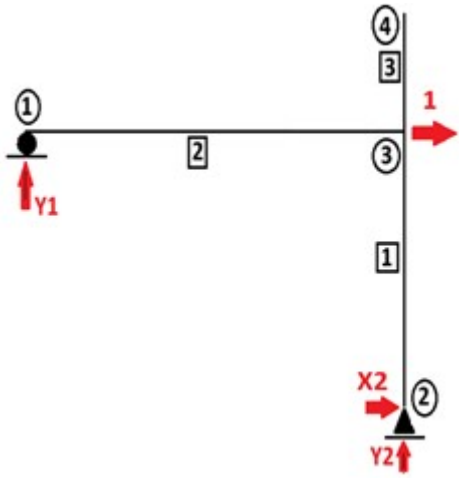
#13:
$$\begin{bmatrix} MFv(x) := y1 \cdot x - \frac{2 \cdot x^2}{2} \\ MFc1(x) := -\frac{w(x) \cdot x}{2} \cdot \frac{1}{3} \cdot x \\ MFc2(x) := -\frac{w(x) \cdot x}{2} \cdot \frac{1}{3} \cdot x - x32 \cdot (x - 2) + m32 \end{bmatrix}$$

#14:
$$\begin{bmatrix} MFv(x) := 21 \cdot x - x^2 \\ MFc1(x) := -\frac{5 \cdot x^3}{12} \\ MFc2(x) := 90 - \frac{5 \cdot x^3}{12} \end{bmatrix}$$



#15:
$$\begin{bmatrix} MFv(0) & MFv(6) \\ MFc1(0) & MFc1(2) \\ MFc2(2) & MFc2(6) \end{bmatrix} = \begin{bmatrix} 0 & 90 \\ 0 & -3.333333333 \\ 86.66666666 & 0 \end{bmatrix}$$

Estructura con la carga unitaria ficticia hacia la derecha en el nudo 3:



#16: [y1f :=, x2f :=, y2f :=, x31f :=, y31f :=, m31f :=, x32f :=, y32f :=, m32f :=, mfv(x) :=, mfc1(x) :=, mfc2(x) :=]

#17:
$$\begin{bmatrix} x2f + 1 = 0 \\ y2f + y1f = 0 \\ -y1f \cdot 6 - 1 \cdot 4 = 0 \end{bmatrix}$$

#18:
$$\left[x2f := -1,\ y1f := -\frac{2}{3},\ y2f := \frac{2}{3}\right]$$

Diagrama de cuerpo libre de la viga:

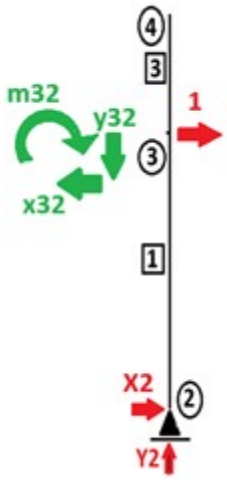
#19:
$$\begin{bmatrix} y1f + y31f = 0 \\ x31f = 0 \\ -y1f \cdot 6 + m31f = 0 \end{bmatrix}$$

#20:
$$\left[m31f := -4,\ x31f := 0,\ y31f := \frac{2}{3}\right]$$

Diagrama de cuerpo libre del nudo 3:

#21: [x32f := x31f, y32f := y31f, m32f := m31f]

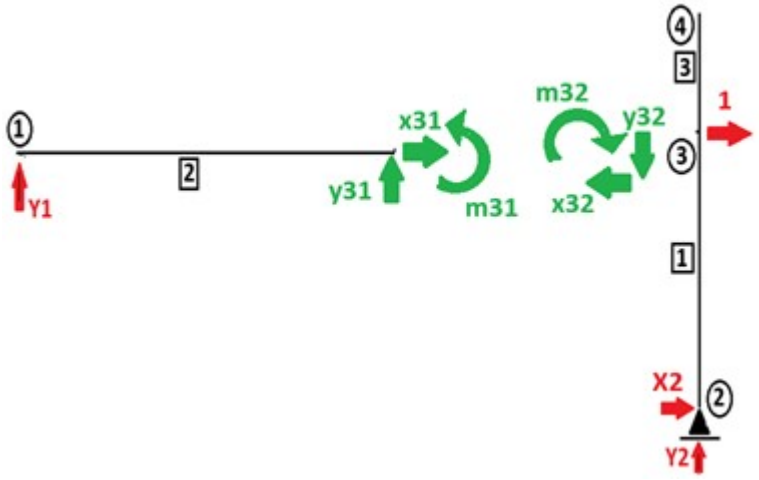
Diagrama de cuerpo libre de la columna para chequeo de equilibrio:



#22:
$$\begin{bmatrix} x2f - x32f + 1 = 0 \\ y2f - y32f = 0 \\ -m32f - 1 \cdot 4 = 0 \end{bmatrix}$$

#23:
$$\begin{bmatrix} \text{true} \\ \text{true} \\ \text{true} \end{bmatrix}$$

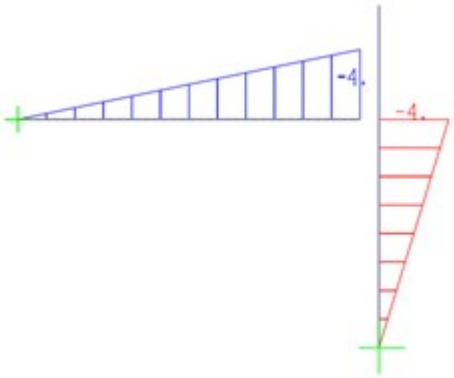
Momentos flectores de la estructura, cargada con la carga unitaria ficticia, usando los mismos ejes de coordenadas:



#24:
$$\begin{bmatrix} mfv(x) := y1f \cdot x \\ mfc1(x) := 0 \\ mfc2(x) := -x32f \cdot (x-2) + 1 \cdot (x-2) + m32f \end{bmatrix}$$

#25:
$$\begin{bmatrix} mfv(x) := -\frac{2 \cdot x}{3} \\ mfc1(x) := 0 \\ mfc2(x) := x - 6 \end{bmatrix}$$

#26:
$$\begin{bmatrix} mfv(x) := -0.6666666666 \cdot x \\ mfc1(x) := 0 \\ mfc2(x) := x - 6 \end{bmatrix}$$



#27:
$$\begin{bmatrix} mfv(0) & mfv(6) \\ mfc1(0) & mfc1(2) \\ mfc2(2) & mfc2(6) \end{bmatrix} = \begin{bmatrix} 0 & -4 \\ 0 & 0 \\ -4 & 0 \end{bmatrix}$$

Cálculo del desplazamiento del nudo 3, positivo hacia la derecha:

#28:
$$d3 = \frac{1}{EIv}\cdot\int_0^6 MFv(x)\cdot mfv(x)\,dx + \frac{1}{EIc}\cdot\int_0^2 MFc1(x)\cdot mfc1(x)\,dx + \frac{1}{EIc}\cdot\int_2^6 MFc2(x)\cdot mfc2(x)\,dx$$

#29:
$$d3 = \frac{1}{EIv}\cdot(-792) + \frac{1}{EIc}\cdot 0 + \frac{1}{EIc}\cdot\left(-\frac{1696}{3}\right)$$

#30:
$$d3 = -\frac{297}{625} + 0 + -\frac{53}{2500}$$

#31:
$$d3 = -0.4752 + 0 + -0.0212$$

#32:
$$d3 = -\frac{1241}{2500}$$

#33:
$$d3 = -0.4964$$