

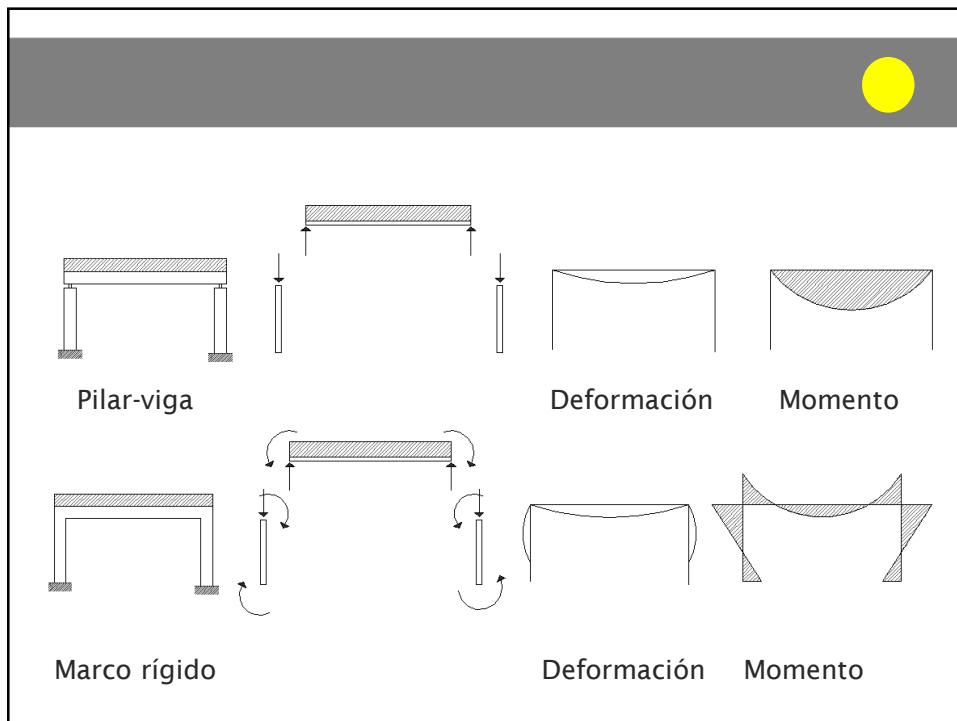
Marcos hiperestáticos

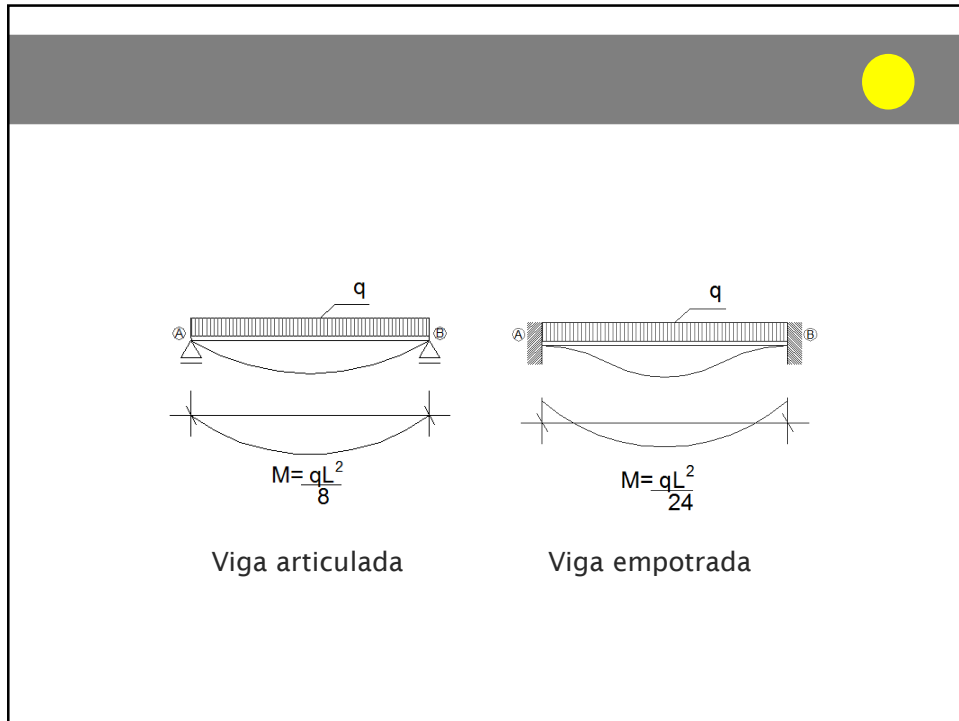
ESTRUCTURAS 2

3

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ayudante: Preeti Bellani





Método de Cross distribución de momentos

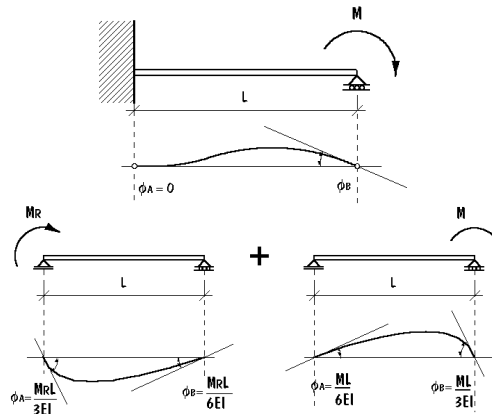
- a** Momento transmitido
- b** Rigidez
- c** Coeficiente de distribución

a) momento transmitido

$$\phi_A = 0$$

$$\frac{ML}{6EI} - \frac{M_R L}{3EI} = 0$$

$$M_R = \frac{M}{2}$$



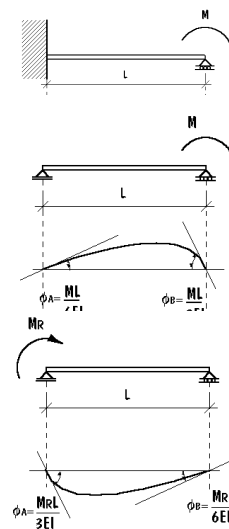
b) rigidez

$$\phi_B = \frac{ML}{3EI} - \frac{M_R L}{6EI}$$

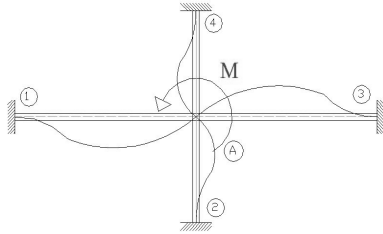
considerando $M_R = \frac{M}{2}$

$$\phi_B = \frac{ML}{3EI} - \frac{ML}{12EI} = \frac{ML}{4EI}$$

$$M = \phi_B \cdot \frac{4EI}{L} \quad M = \phi_B \cdot k$$



c) coeficiente de distribución



$$M = M_{A1} + M_{A2} + M_{A3} + M_{A4}$$

$$M = \phi_{A1}k_1 + \phi_{A2}k_2 + \phi_{A3}k_3 + \phi_{A4}k_4$$

$$\phi = \phi_{A1} = \phi_{A2} = \phi_{A3} = \phi_{A4}$$

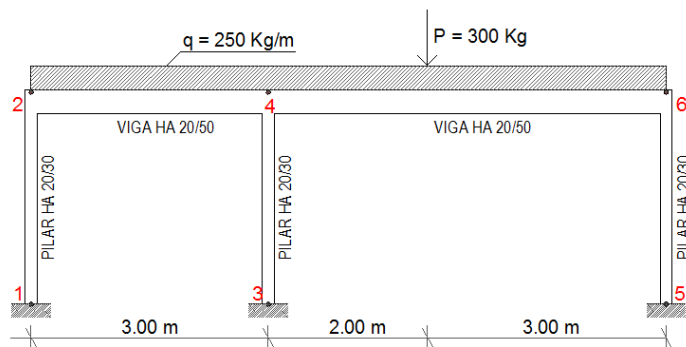
$$M = \phi(k_1 + k_2 + k_3 + k_4)$$

$$\phi = \frac{M}{k_1 + k_2 + k_3 + k_4} = \frac{M}{\sum k}$$

$$M = \phi * \sum k \quad M_{A1} = \phi * k_1$$

$$M_{A1} = \frac{M}{\sum k} * k_1 \quad M_{A1} = \frac{k_1}{\sum k} * M$$

Ejemplo Método de Cross



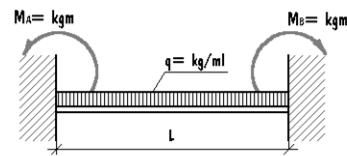
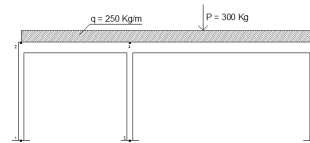
momento de empotramiento perfecto



VIGA 2-4

$$M_2 = \frac{qL^2}{12} = \frac{250 \cdot 3^2}{12} = 187,50 \text{ kgm}$$

$$M_4 = \frac{qL^2}{12} = \frac{250 \cdot 3^2}{12} = 187,50 \text{ kgm}$$



momento de empotramiento perfecto



VIGA 4-6

$$M_{4a} = \frac{qL^2}{12} = \frac{250 \cdot 5^2}{12} = 521 \text{ kgm}$$

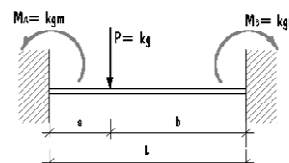
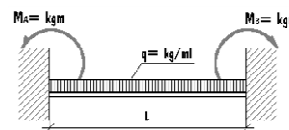
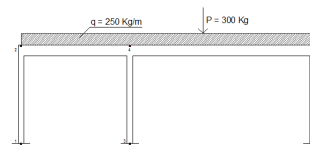
$$M_{4b} = \frac{Pab^2}{L^2} = \frac{300 \cdot 2 \cdot 3^2}{5^2} = 216 \text{ kgm}$$

$$M_4 = 737 \text{ kgm}$$

$$M_{6a} = \frac{qL^2}{12} = \frac{250 \cdot 5^2}{12} = 521 \text{ kgm}$$

$$M_{6b} = \frac{Pa^2b}{L^2} = \frac{300 \cdot 2^2 \cdot 3}{5^2} = 144 \text{ kgm}$$

$$M_6 = 665 \text{ kgm}$$



Rigidez de las barras Factor de distribución



$$k = \frac{4EI}{L} \quad E = \text{constante} \quad k = \frac{I}{L}$$

$$k_1 = \frac{20 \cdot 30^3}{12 \cdot 300} = 150$$

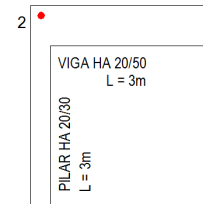
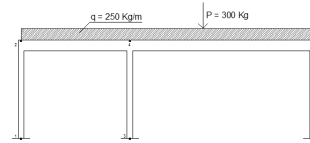
$$k_2 = \frac{20 \cdot 50^3}{12 \cdot 300} = 694,44$$

$$\frac{k_i}{\sum k} = \text{coef. de distribución}$$

NUDO 2

$$\%_{1-2} = \frac{150}{150 + 694,44} = 0,18$$

$$\%_{2-4} = \frac{694,44}{150 + 694,44} = 0,82$$



Rigidez de las barras Factor de distribución



$$k = \frac{4EI}{L} \quad E = \text{constante} \quad k = \frac{I}{L}$$

$$k_1 = \frac{20 \cdot 30^3}{12 \cdot 300} = 150$$

$$k_2 = \frac{20 \cdot 50^3}{12 \cdot 300} = 694,44$$

$$k_3 = \frac{20 \cdot 50^3}{12 \cdot 500} = 416,67$$

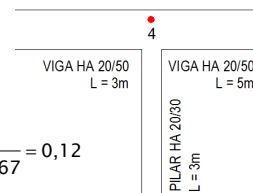
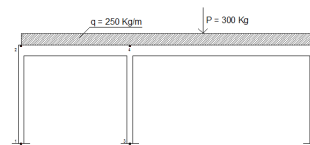
$$\frac{k_i}{\sum k} = \text{coef. de distribución}$$

NUDO 4

$$\%_{3-4} = \frac{150}{150 + 694,44 + 416,67} = 0,12$$

$$\%_{2-4} = \frac{694,44}{150 + 694,44 + 416,67} = 0,55$$

$$\%_{4-6} = \frac{416,67}{150 + 694,44 + 416,67} = 0,33$$



Rigidez de las barras Factor de distribución



$$k = \frac{4EI}{L} \quad E = \text{constante}$$

$$k = \frac{I}{L}$$

$$k_1 = \frac{20 \cdot 30^3}{12 \cdot 300} = 150$$

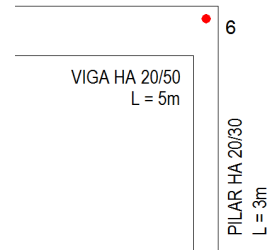
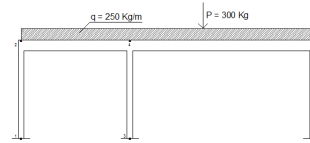
$$k_3 = \frac{20 \cdot 50^3}{12 \cdot 500} = 416,67$$

$$\frac{k_i}{\sum k} = \text{coef. de distribución}$$

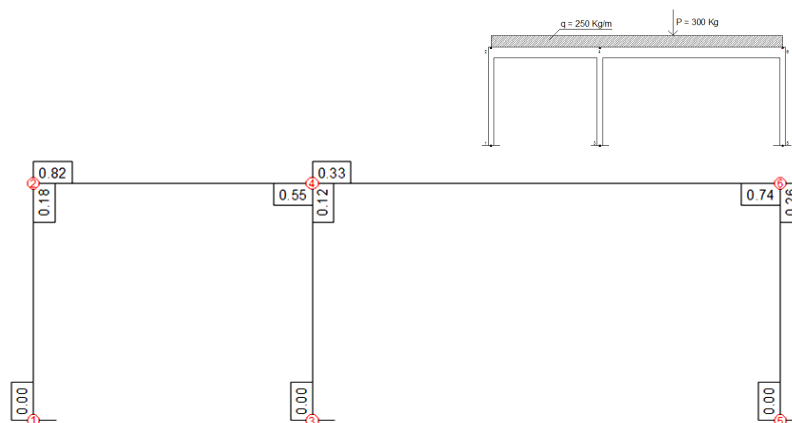
NUDO 6

$$\%_{5-6} = \frac{150}{150 + 416,67} = 0,26$$

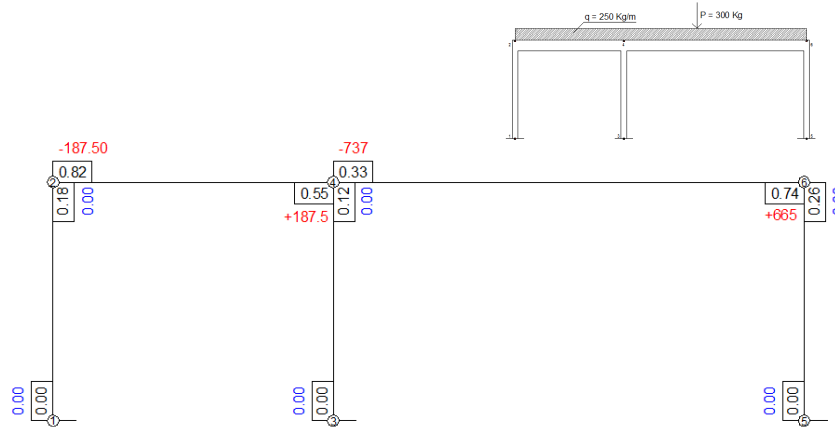
$$\%_{4-6} = \frac{416,67}{150 + 416,67} = 0,74$$



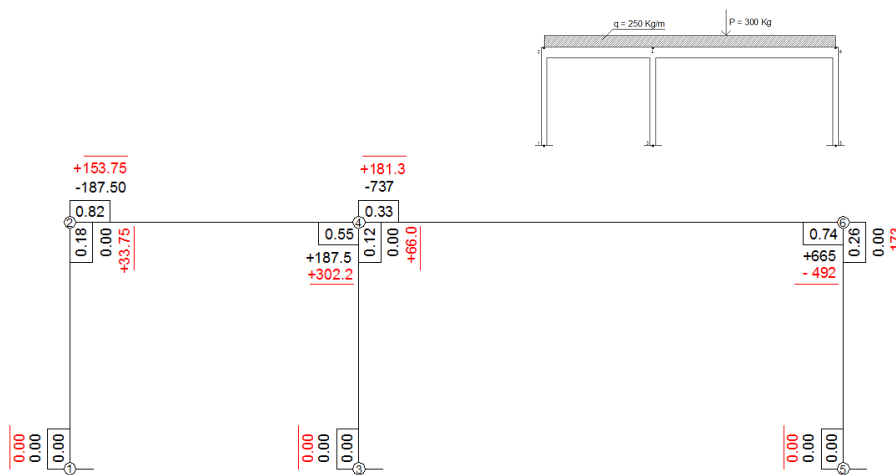
mailla factores de distribución



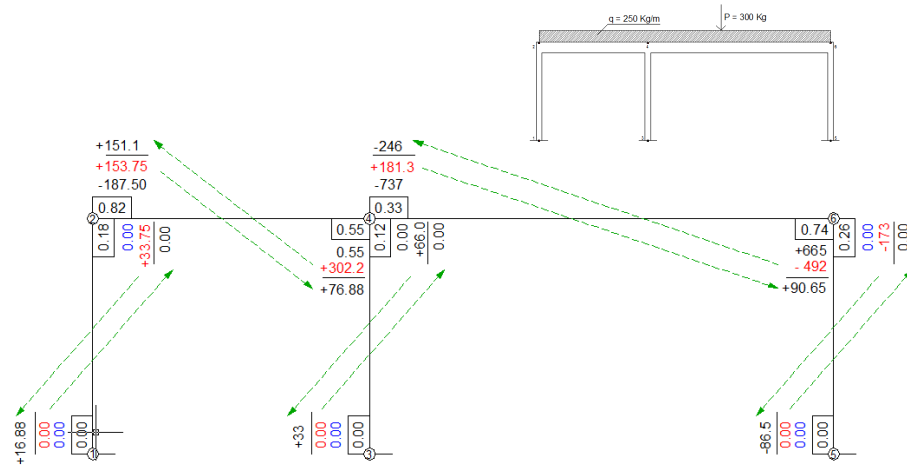
malla MEP iniciales



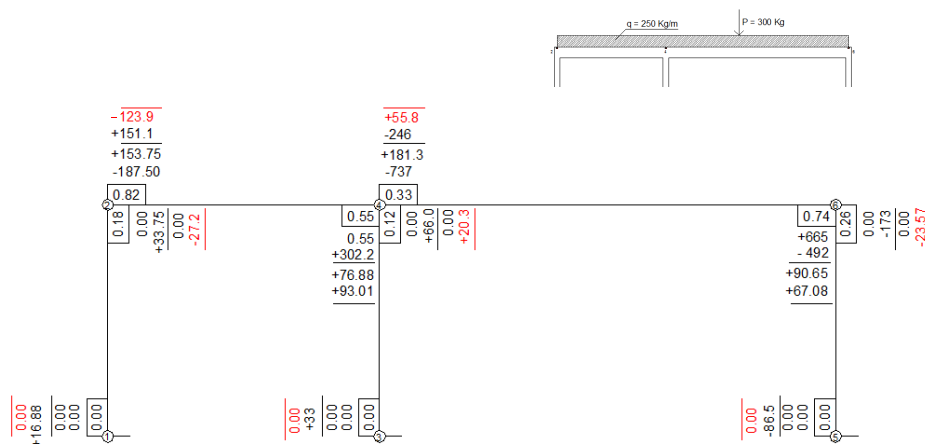
equilibrio



traspaso



equilibrio



momentos finales

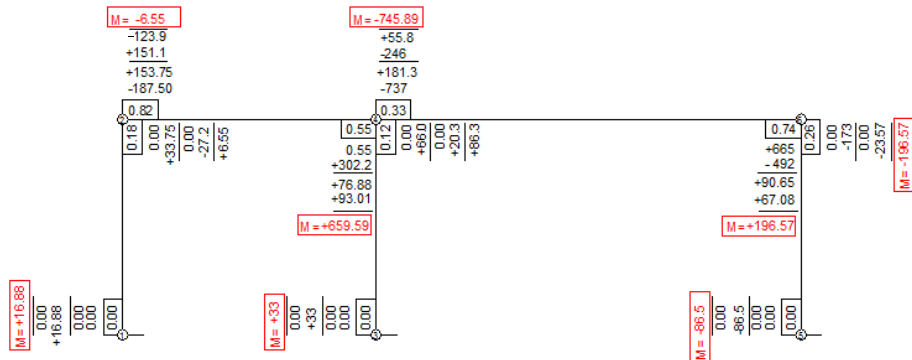


gráfico de momentos

