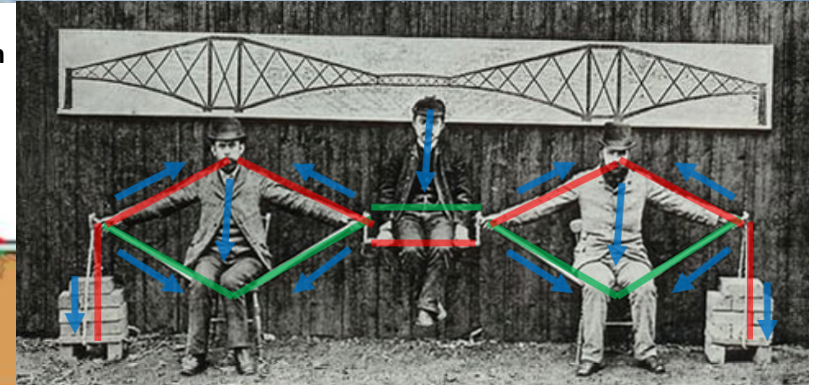
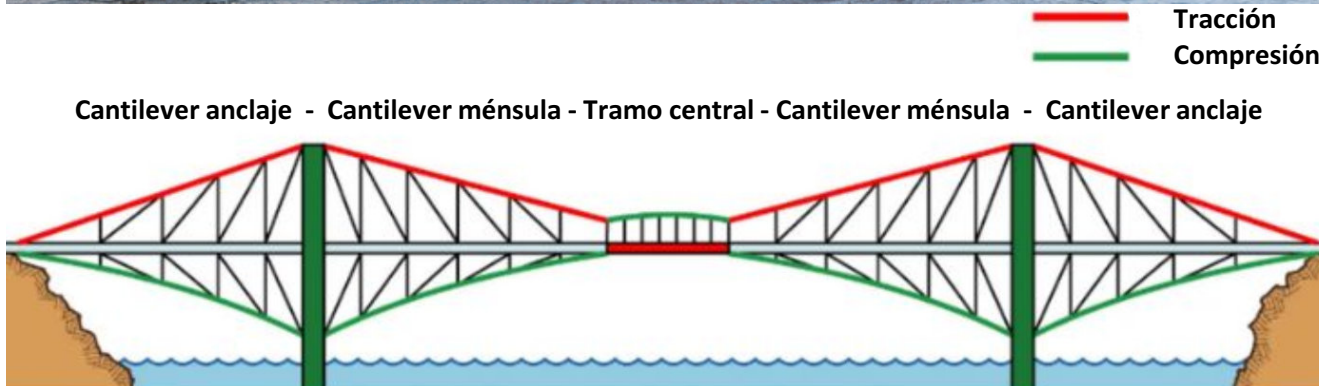


TB036 - ESTÁTICA



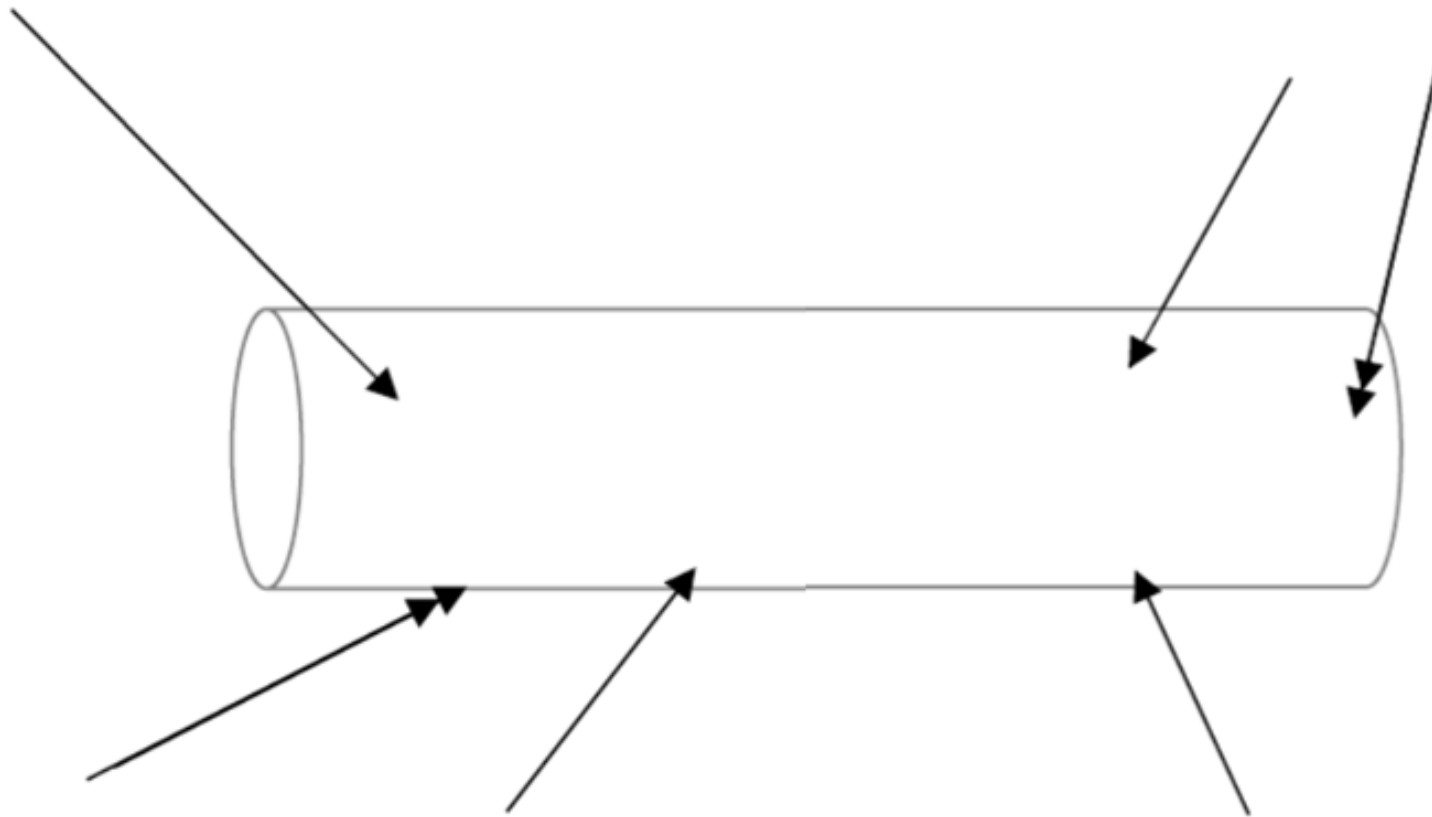
PUENTE FERROVIARIO FORTH - ESCOCIA



RETICULADOS Y ESTRUCTURAS MIXTAS

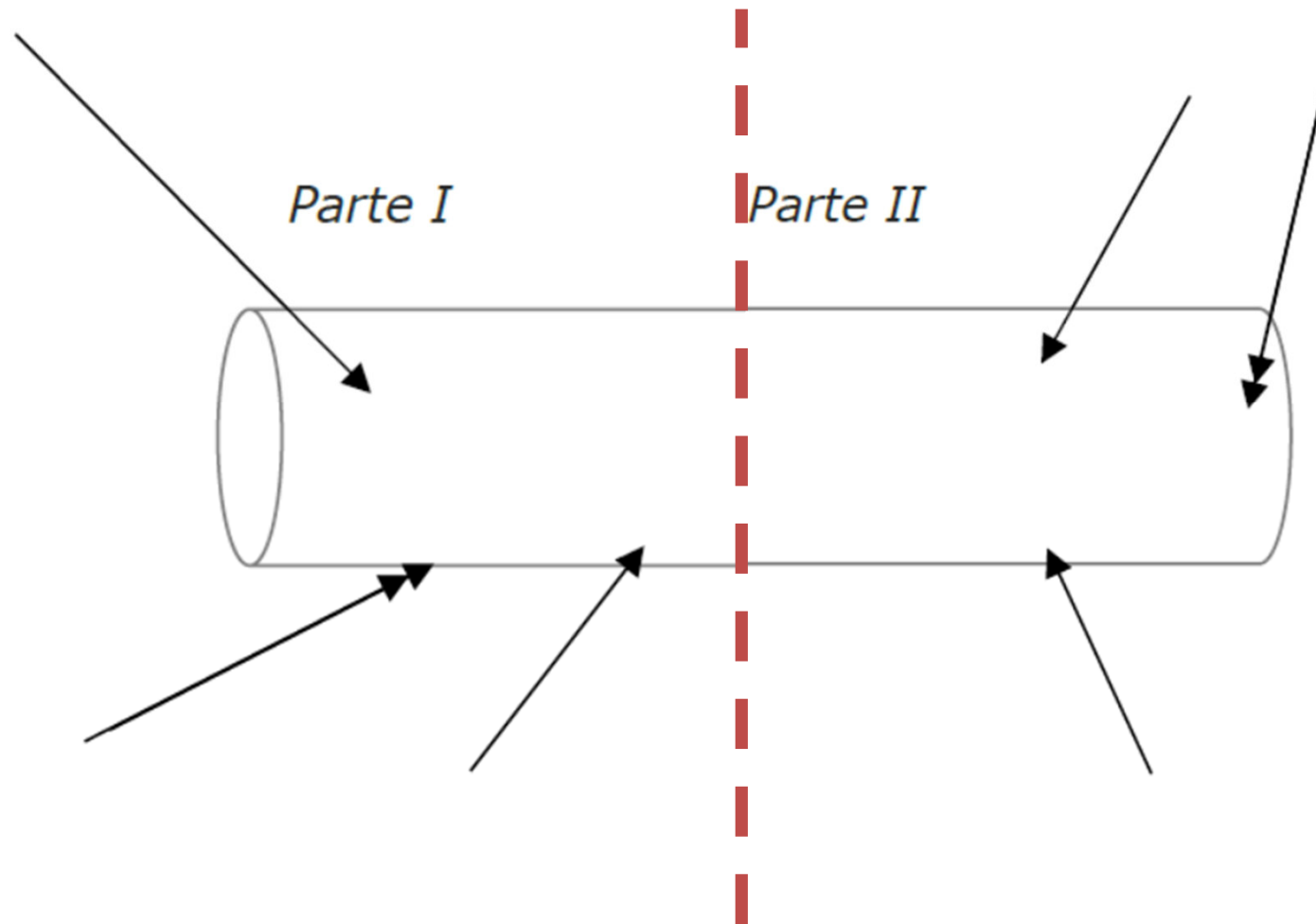
ESFUERZOS INTERNOS

Supongamos un sistema en equilibrio



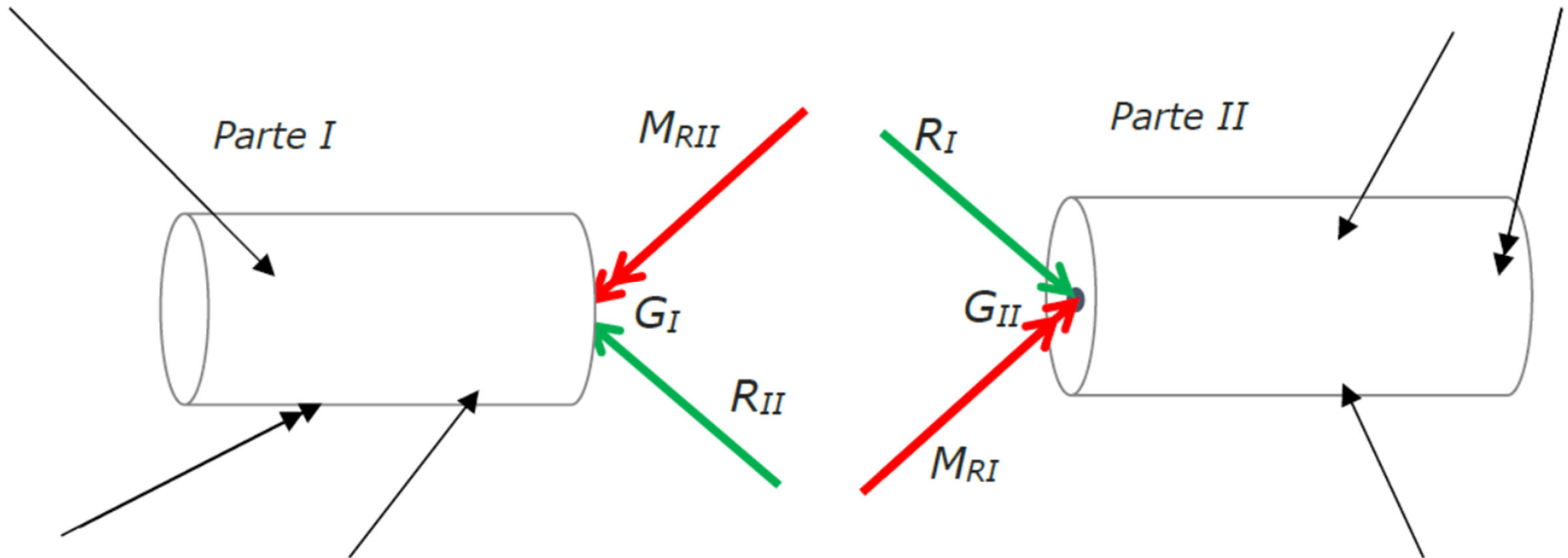
ESFUERZOS INTERNOS

Supongamos que cortamos al sistema en dos partes



ESFUERZOS INTERNOS

Cada parte alcanza el equilibrio con su interacción con la otra

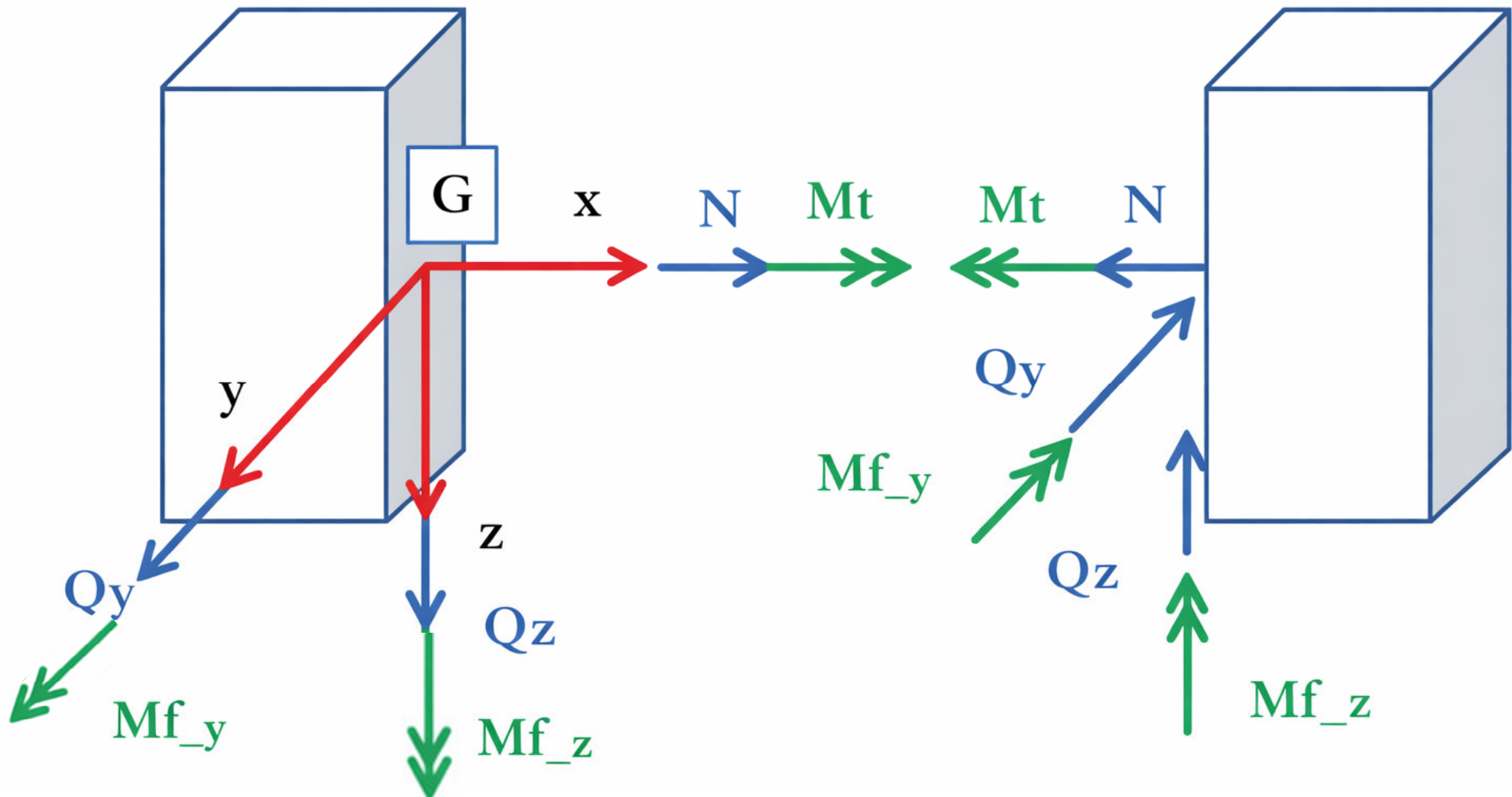


$$R_I = -R_{II}$$

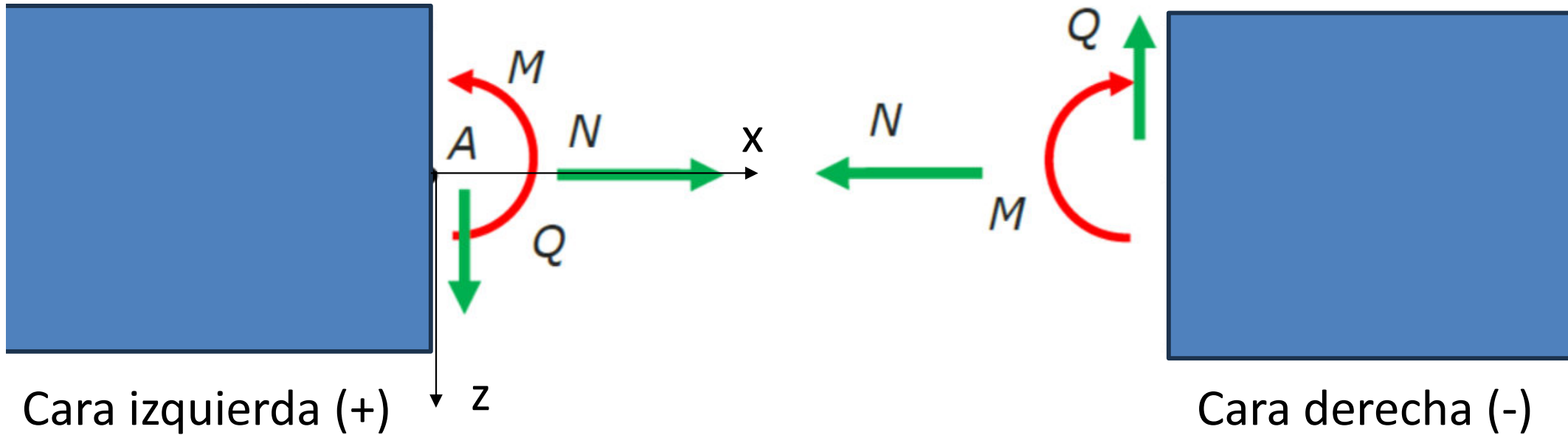
$$M_{RI} = -M_{RII}$$

ESFUERZOS INTERNOS

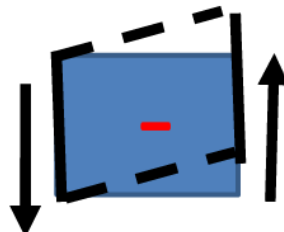
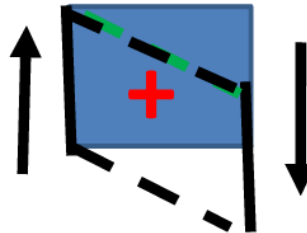
Podemos descomponer los esfuerzo en ejes cartesianos



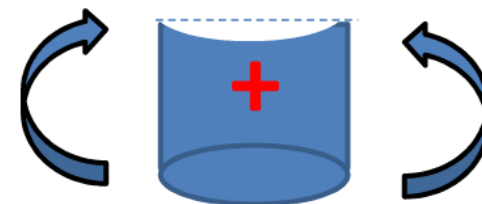
ESFUERZOS INTERNOS EN SISTEMAS PLANOS DE BARRAS



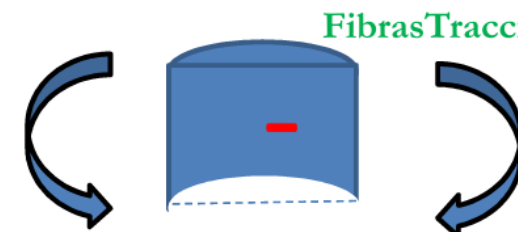
Normal



Corte



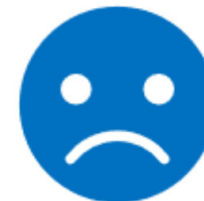
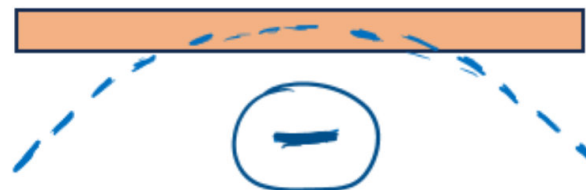
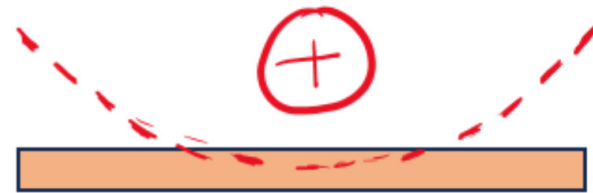
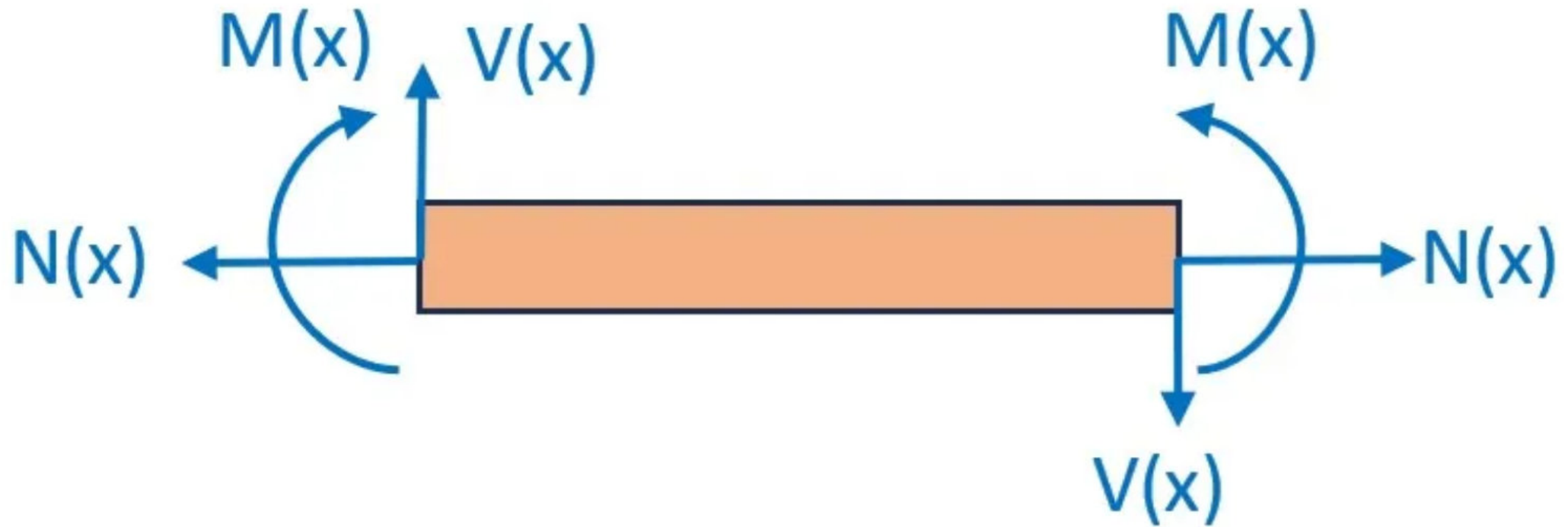
Fibras Traccionadas



Fibras comprimida

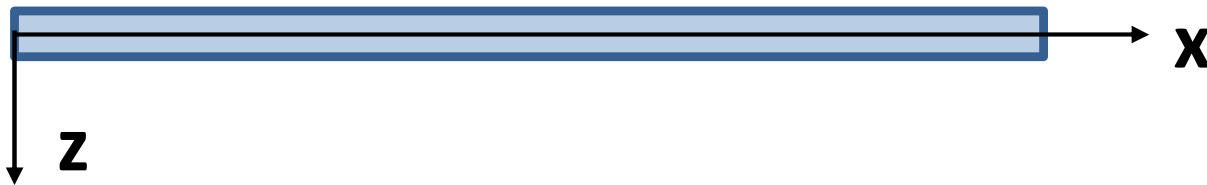
Momento

CONVENCIÓN DE SIGNOS – TERNA DERECHA

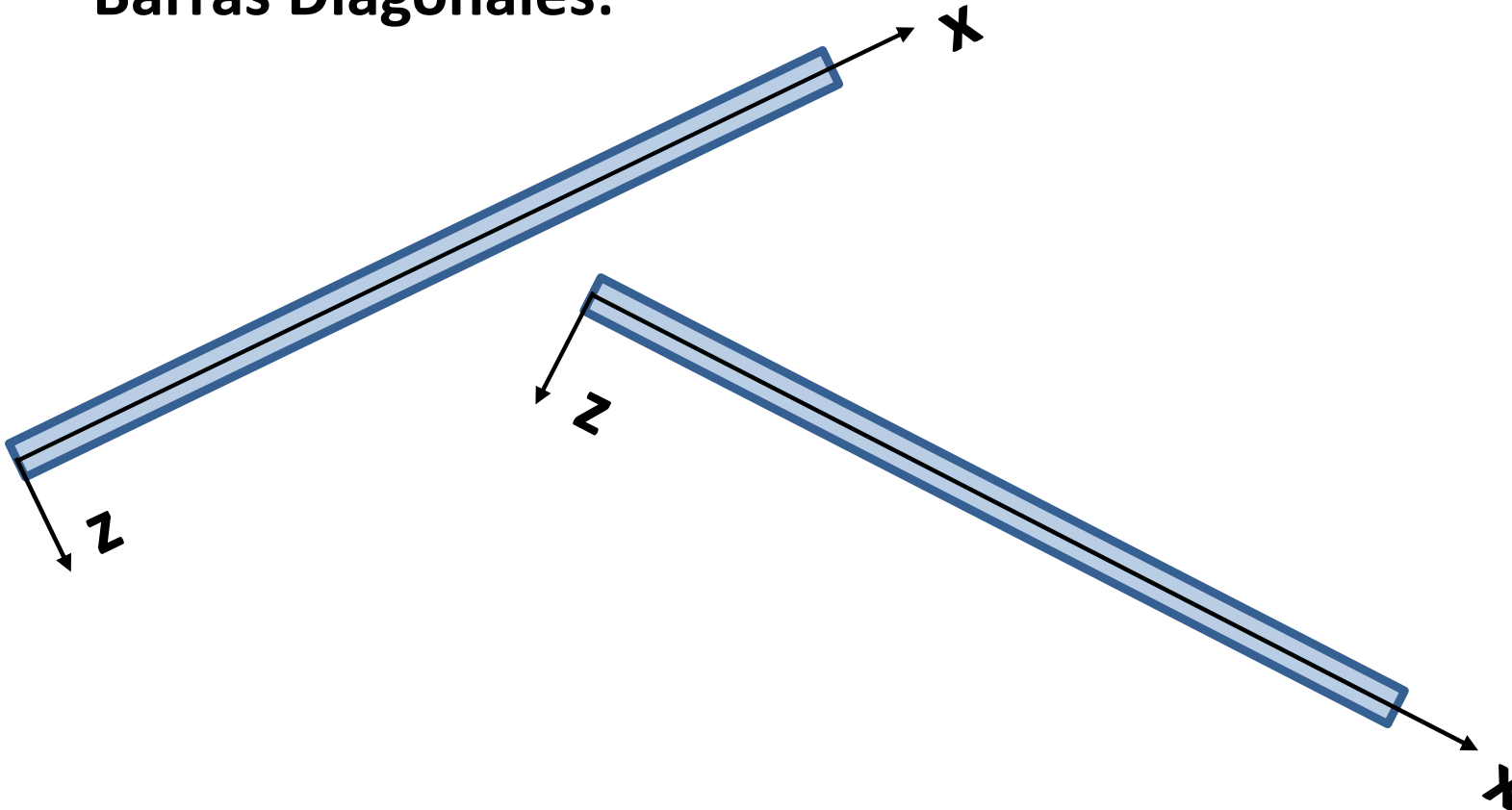


CONVENCIÓN DE EJES LOCALES

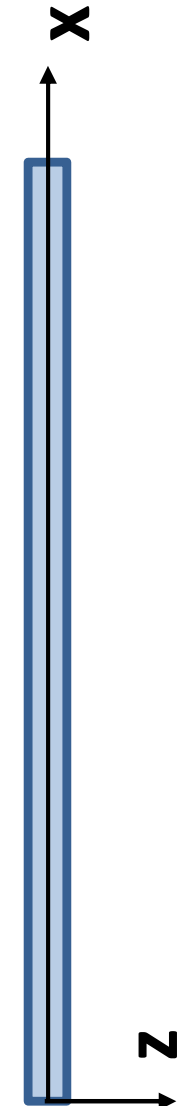
Barras Horizontales:



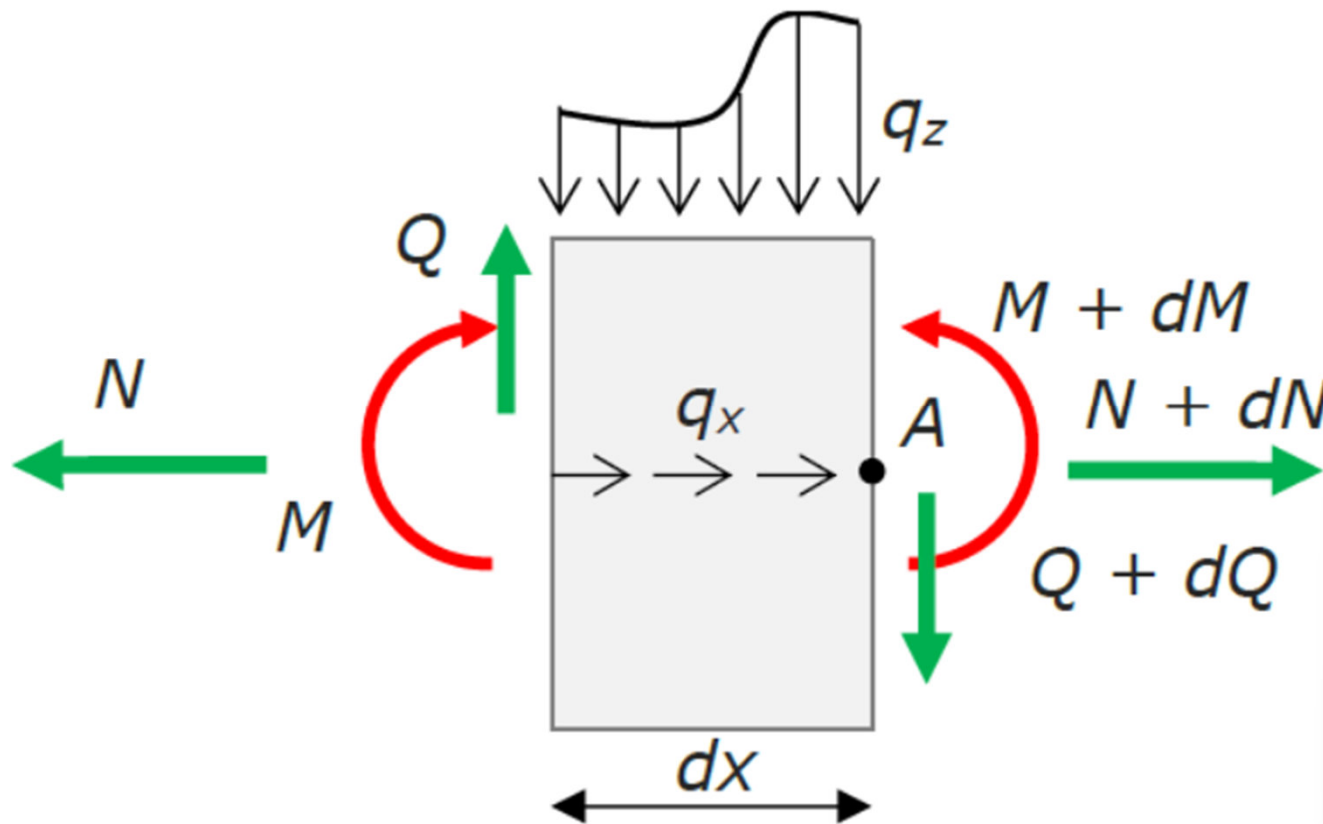
Barras Diagonales:



Barras Verticales:



RELACIONES DIFERENCIALES

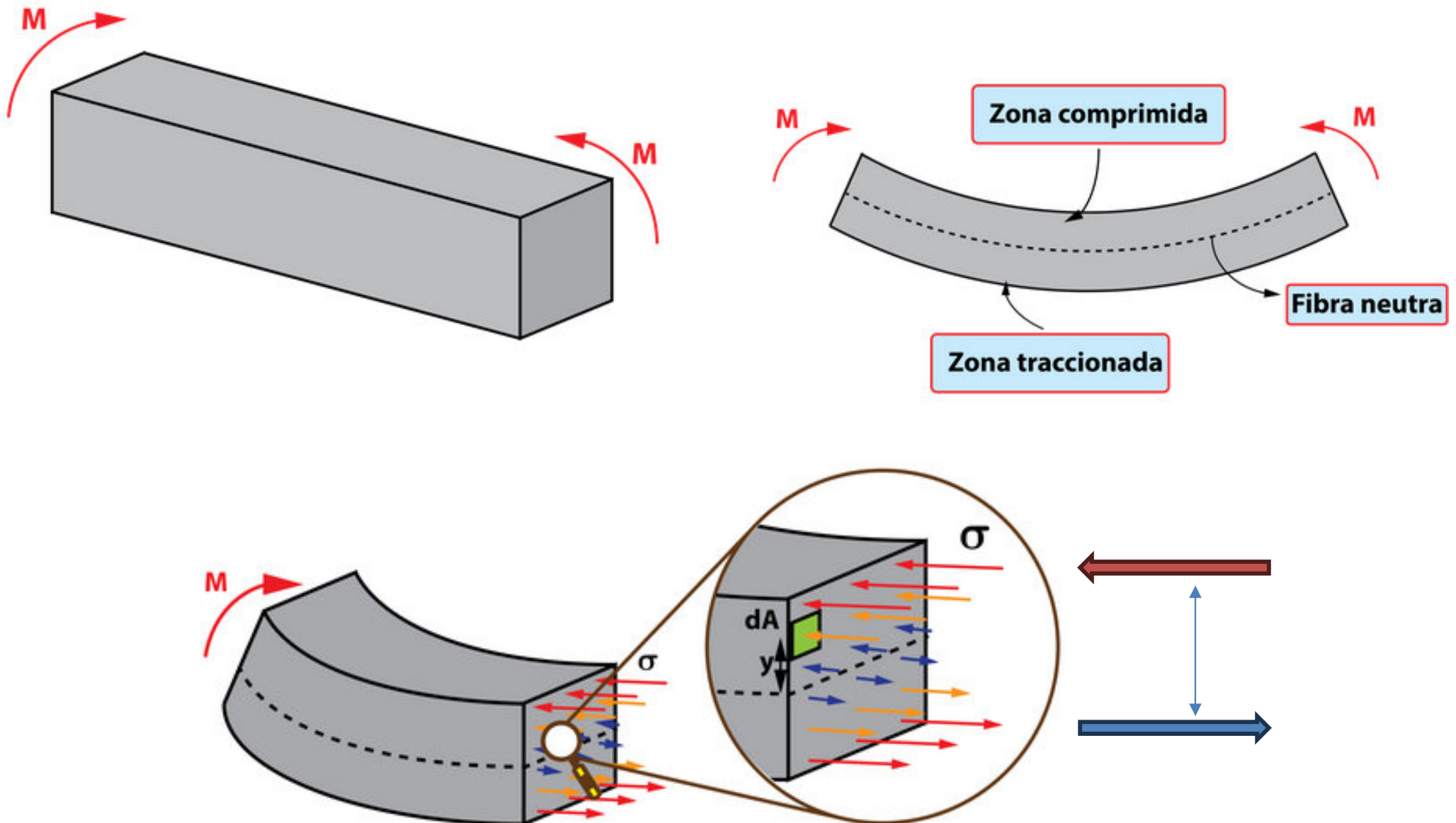


$$\frac{dN(x)}{dx} = -q_x(x)$$

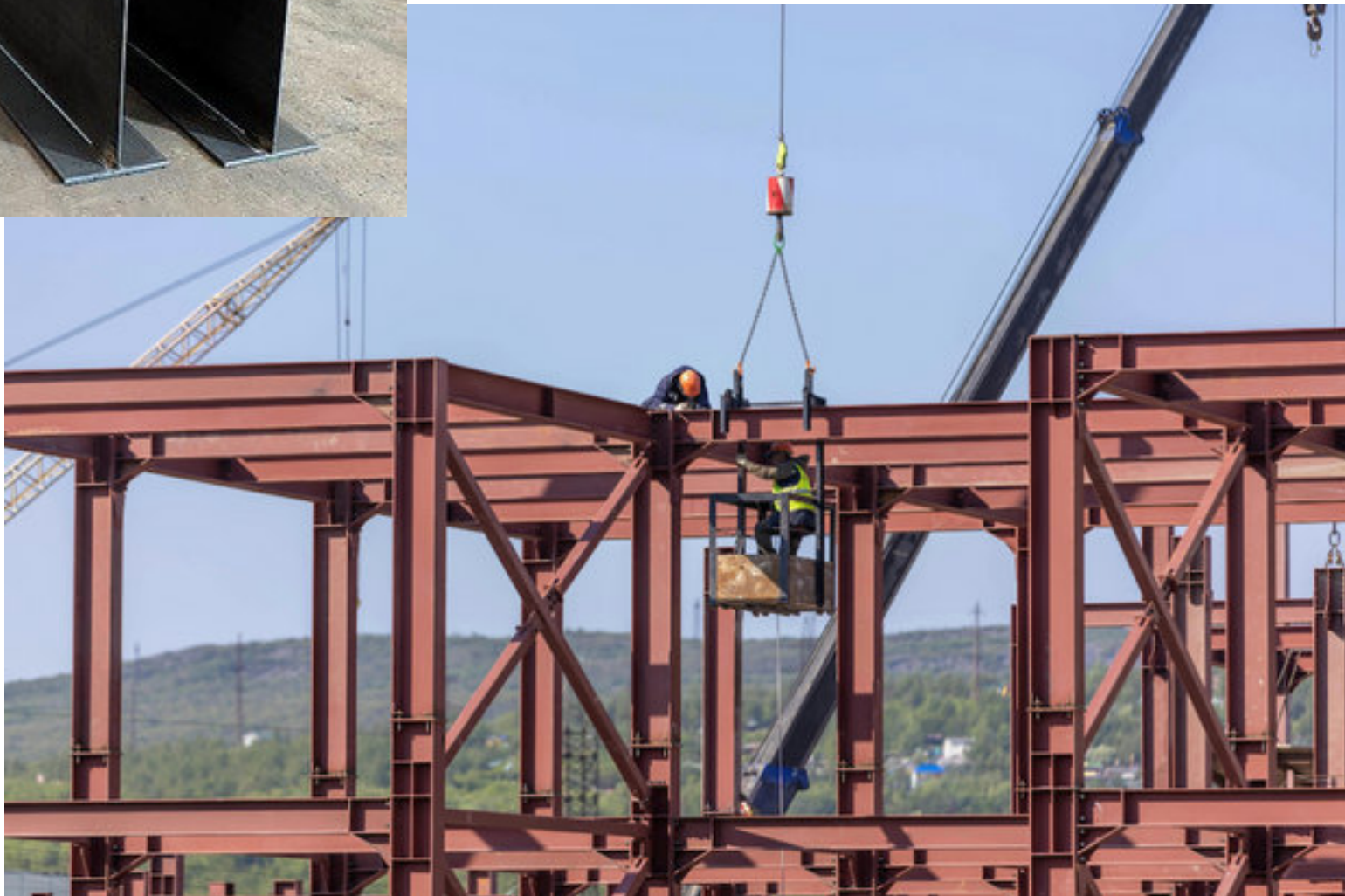
$$\frac{dQ(x)}{dx} = -q_z(x)$$

$$\frac{dM(x)}{dx} = Q(x)$$

EJEMPLO CASO DE FLEXIÓN EN VIGAS



EJEMPLO SISTEMAS DE ALMA LLENA



EJEMPLO SISTEMAS RETICULADOS O DE ALMA CALADA



EJEMPLO SISTEMAS RETICULADOS O DE ALMA CALADA



VIGA HOWE



VIGA VIERENDEL



VIGA WARREN



VIGA BROWN



VIGA PRATT

EJEMPLO VIGA VIERENDEL



OTROS EJEMPLOS DE SISTEMAS RETICULADOS

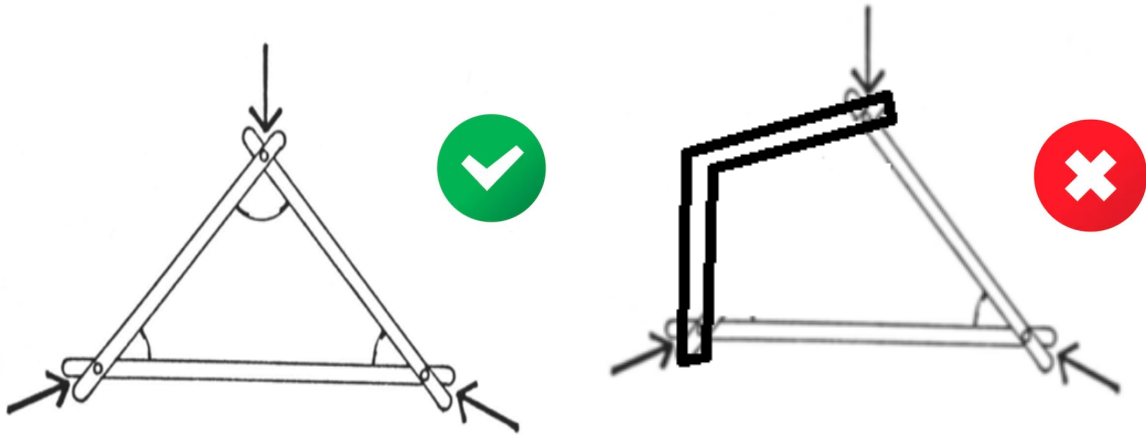


OTROS EJEMPLOS DE SISTEMAS RETICULADOS

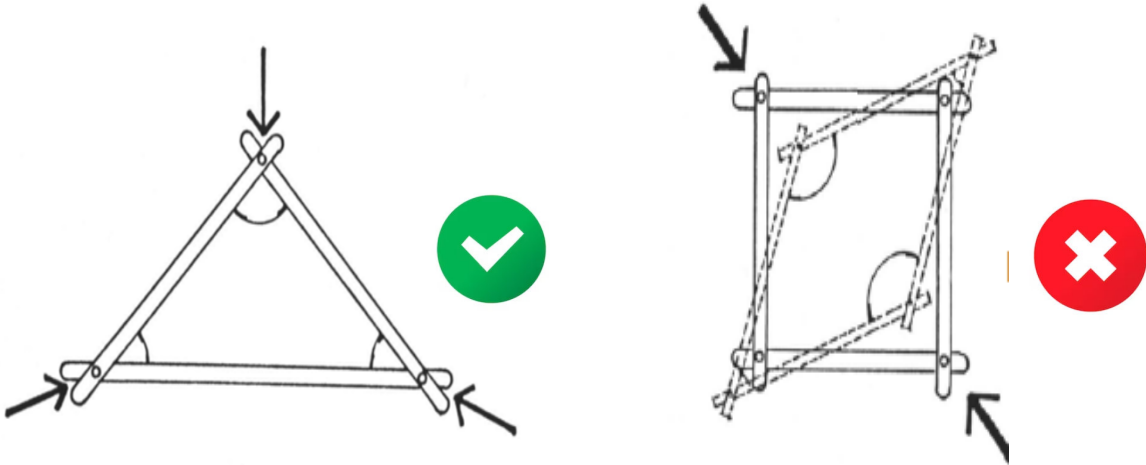


SISTEMAS RETICULADOS

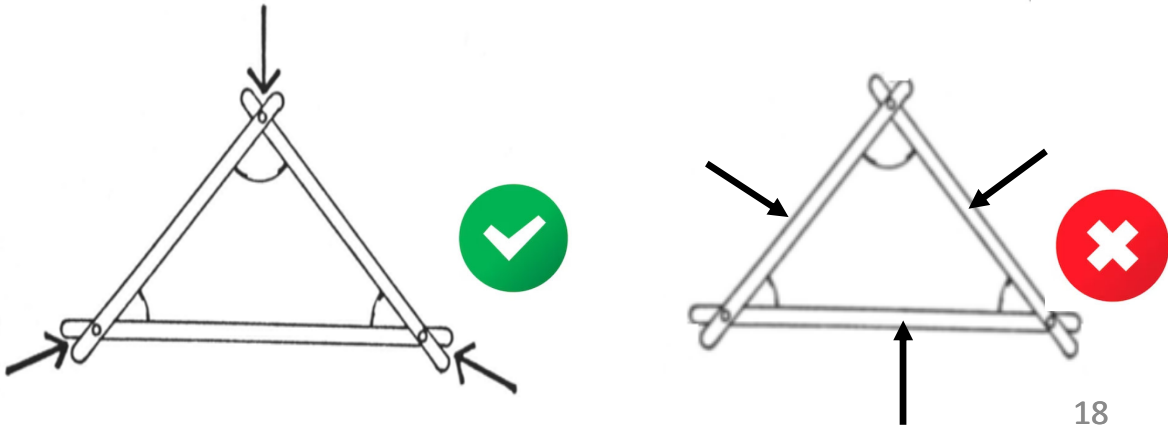
Barras rectas



Cadenas formando triángulos

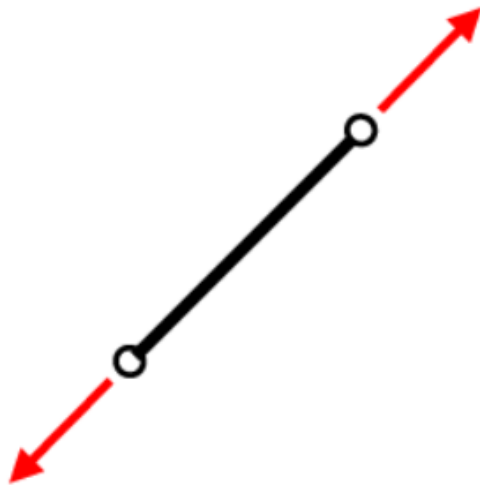


Cargas en los nudos

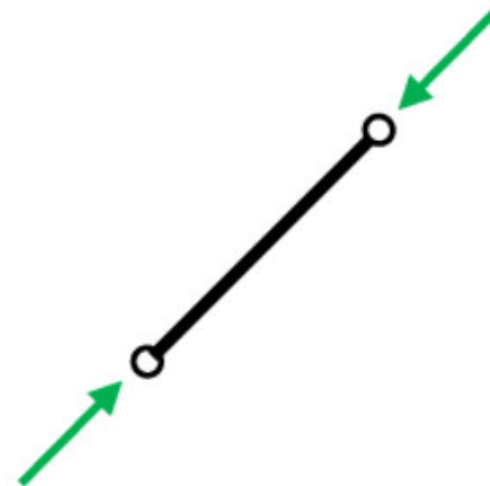


SISTEMAS RETICULADOS

En consecuencia las barras sólo tienen esfuerzos normales
(siempre y cuando las cargas estén aplicadas en los nodos)

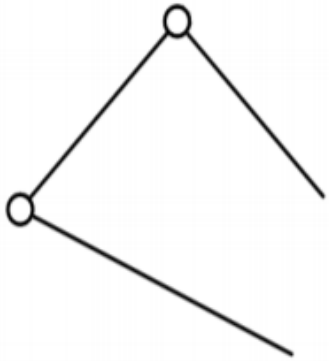


Tracción

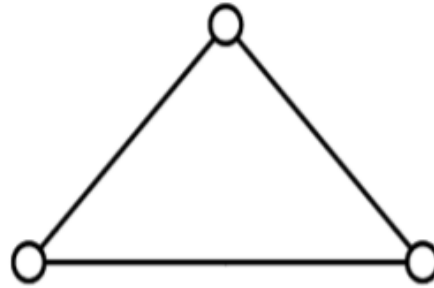


Compresión

ANÁLISIS CINEMÁTICO



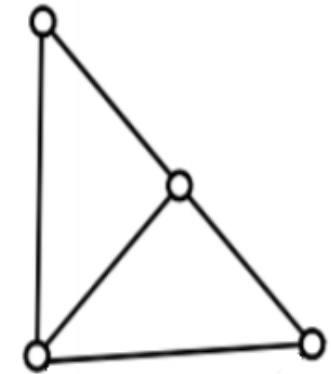
$$GL=5$$



$$GL=5-2=3$$



$$GL=5$$



$$GL=5-2=3$$

$$B = N^{\circ} \text{ de Barras}$$

$$N = N^{\circ} \text{ de Nudos}$$

$$B = 3 + 2P$$

$$N = 3 + P$$

$$B = 2N - 3$$

ANÁLISIS CINEMÁTICO

Si $B < 2N - 3 \Rightarrow$ Mecanismo

Si $B = 2N - 3 \Rightarrow$ Isostático

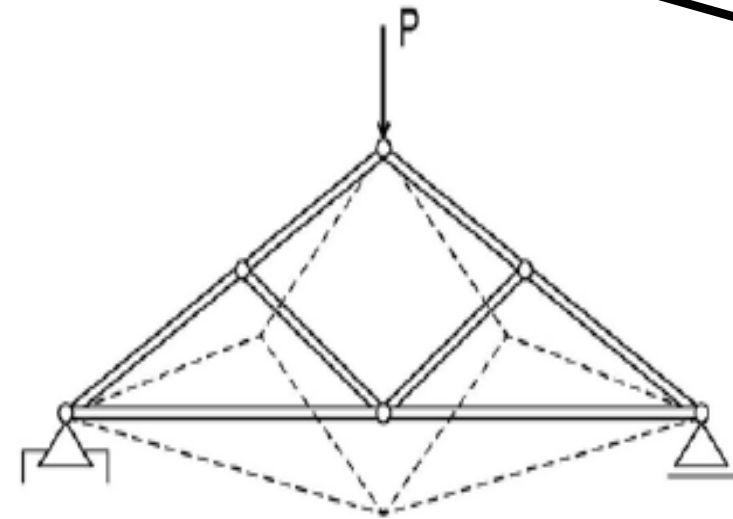
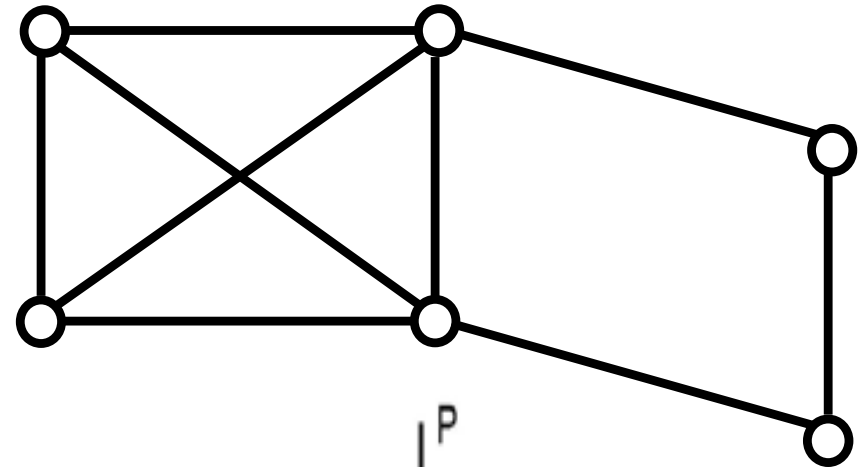
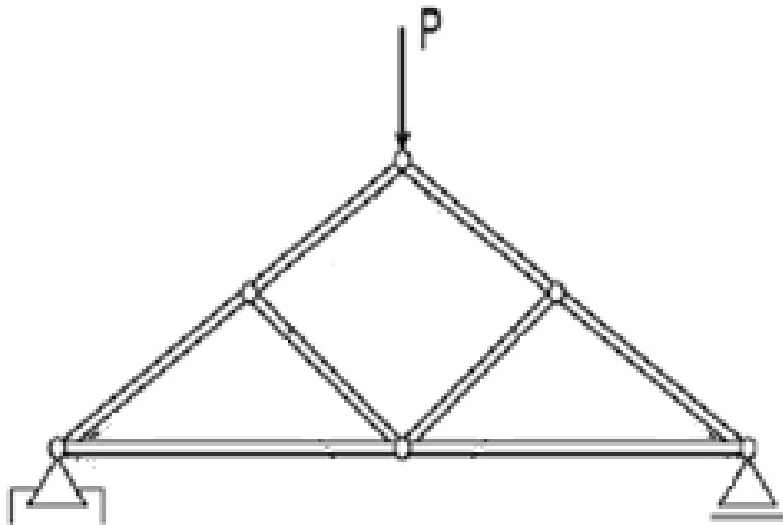
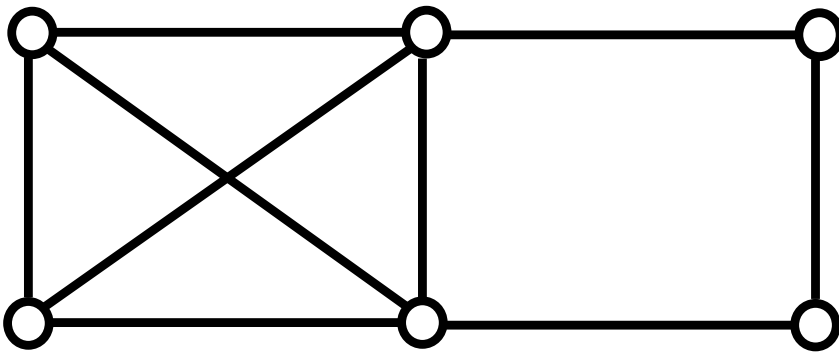
Condición necesaria, no suficiente.

Verificar que no haya vinculación aparente

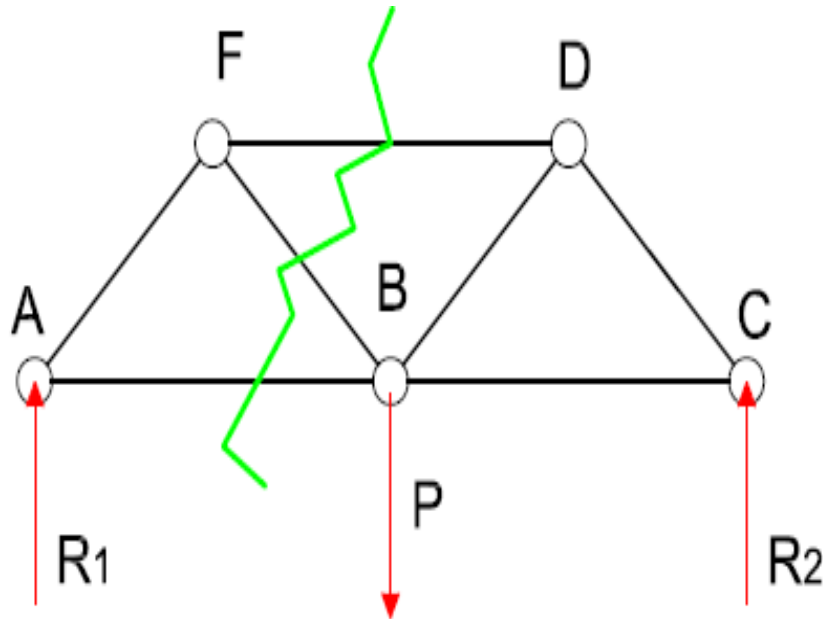
Si $B < 2N - 3 \Rightarrow$ Hiperestático por vínculo interno.

ANÁLISIS CINEMÁTICO

$$B = 2N - 3$$



MÉTODO DE LAS SECCIONES

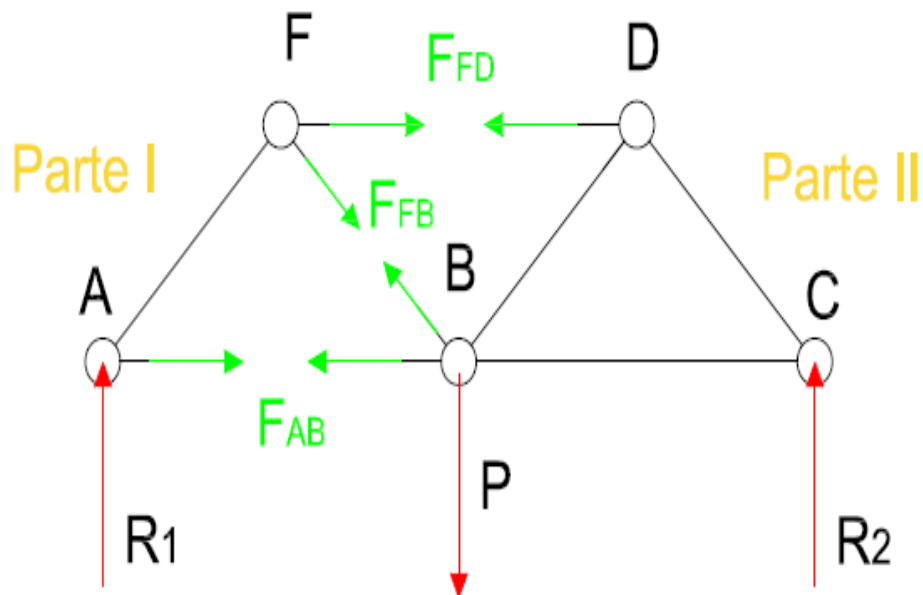


Equilibrio de la parte 1

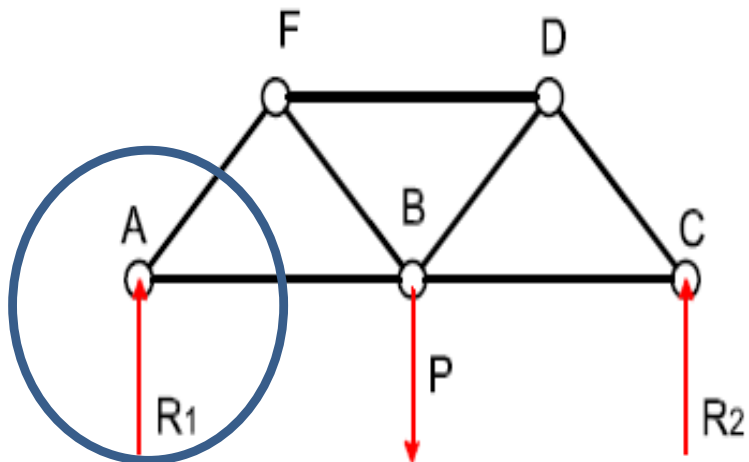
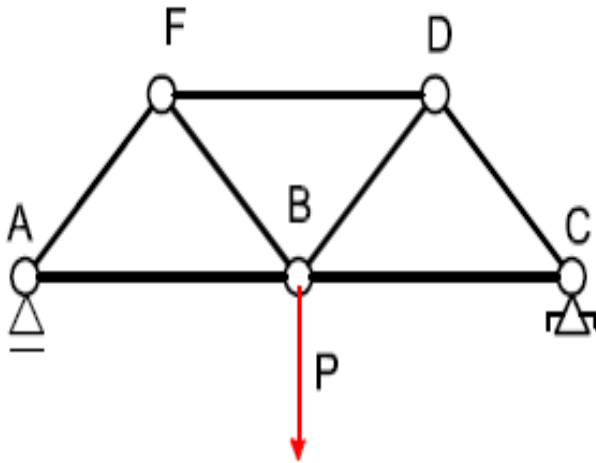
$$\sum M^F = 0 \Rightarrow F_{AB}$$

$$\sum M^B = 0 \Rightarrow F_{FD}$$

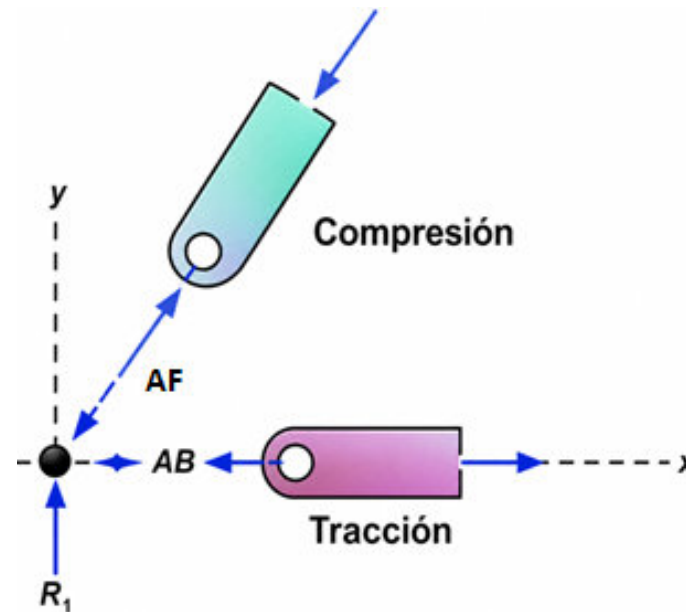
$$\sum \text{Proy}^{n-n} = 0 \Rightarrow F_{FB}$$



MÉTODO DEL EQUILIBRIO DE LOS NODOS



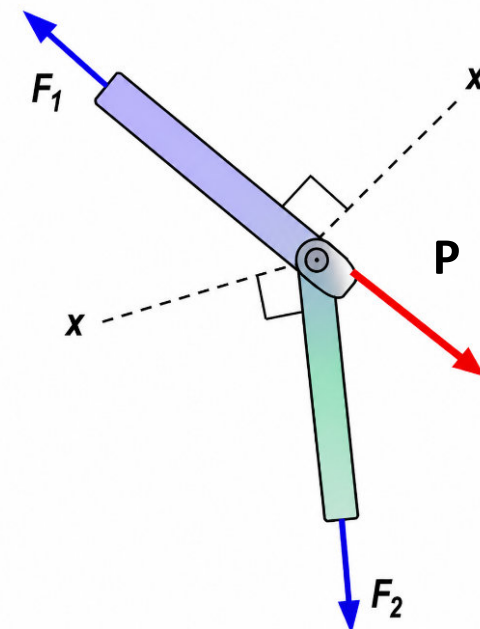
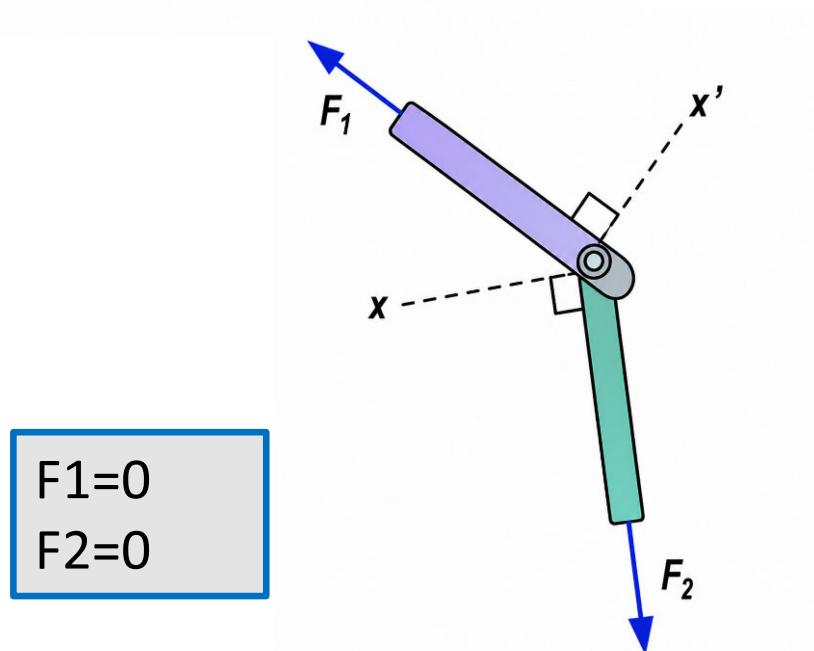
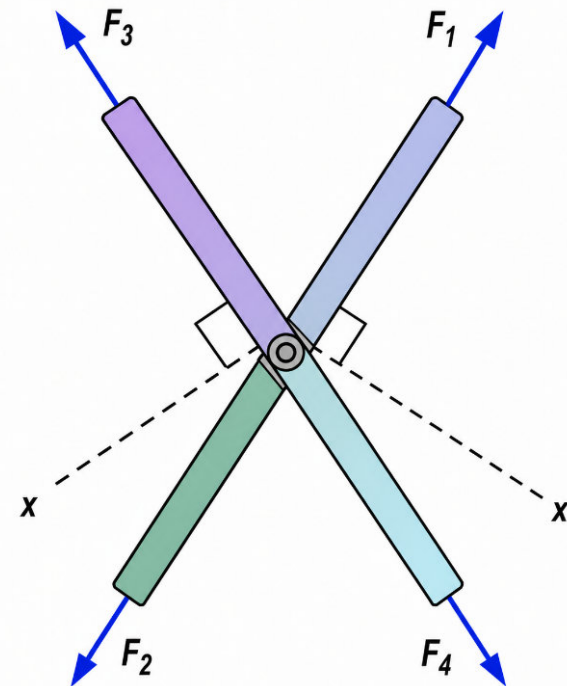
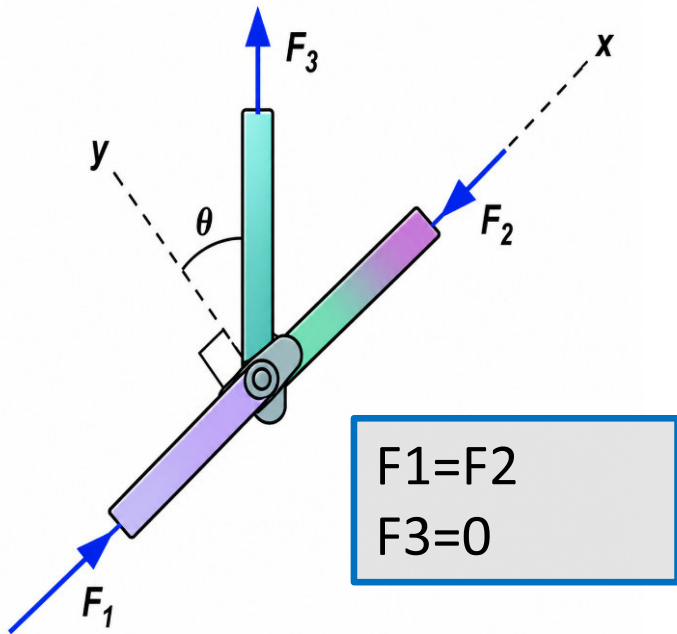
Equilibrio del Nodo A



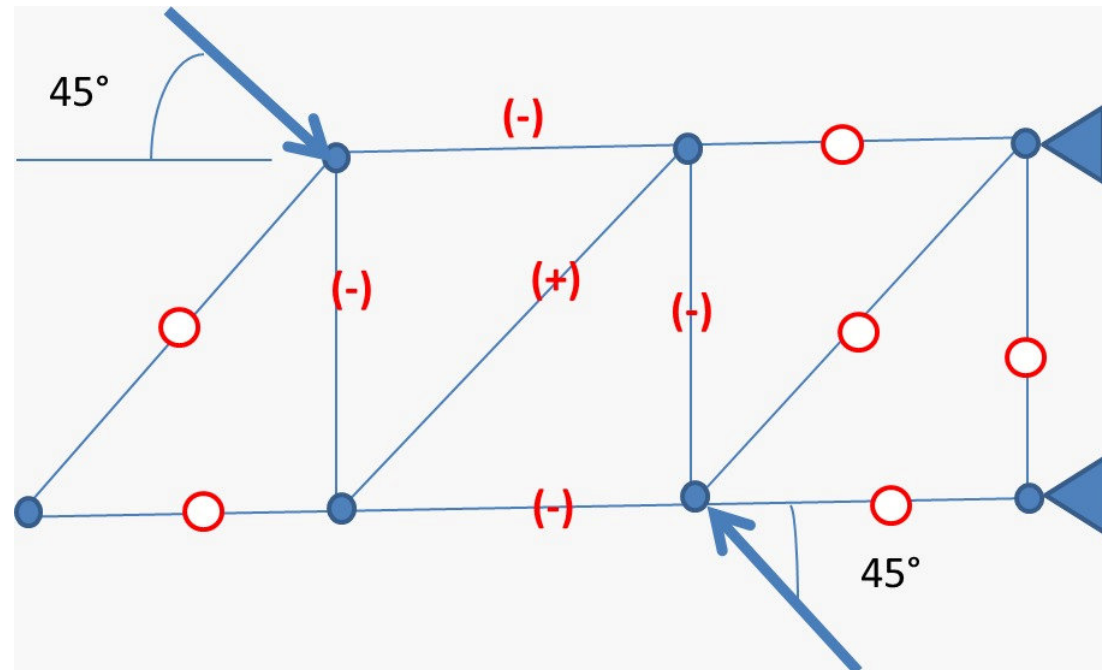
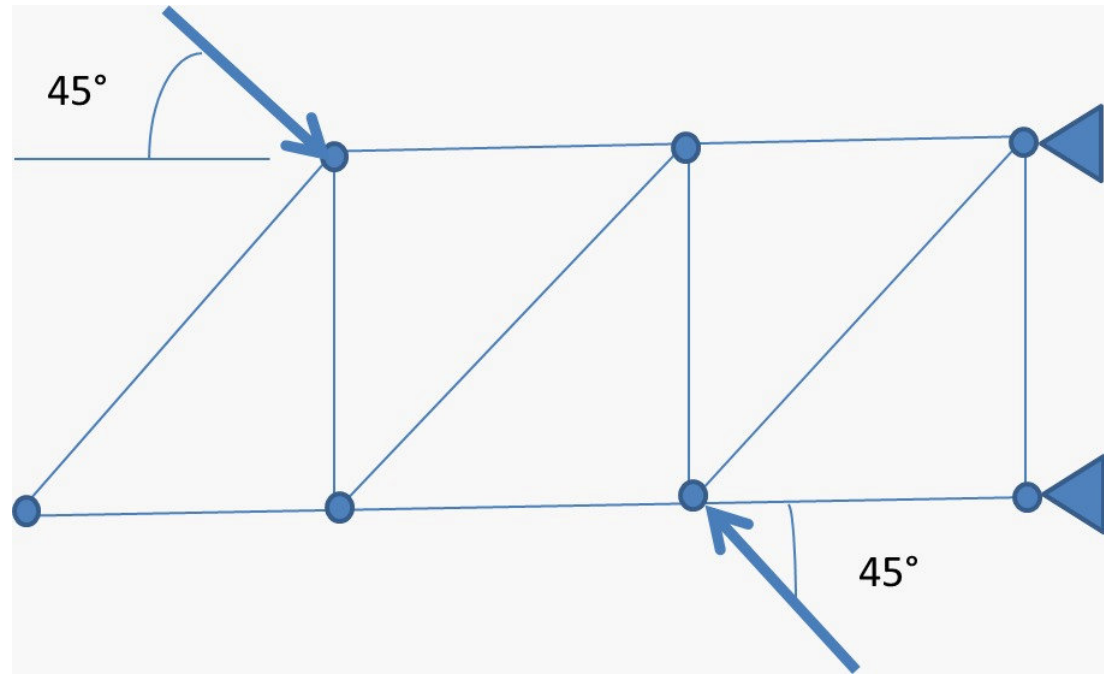
$$\sum F_x = 0$$

$$\sum F_y = 0$$

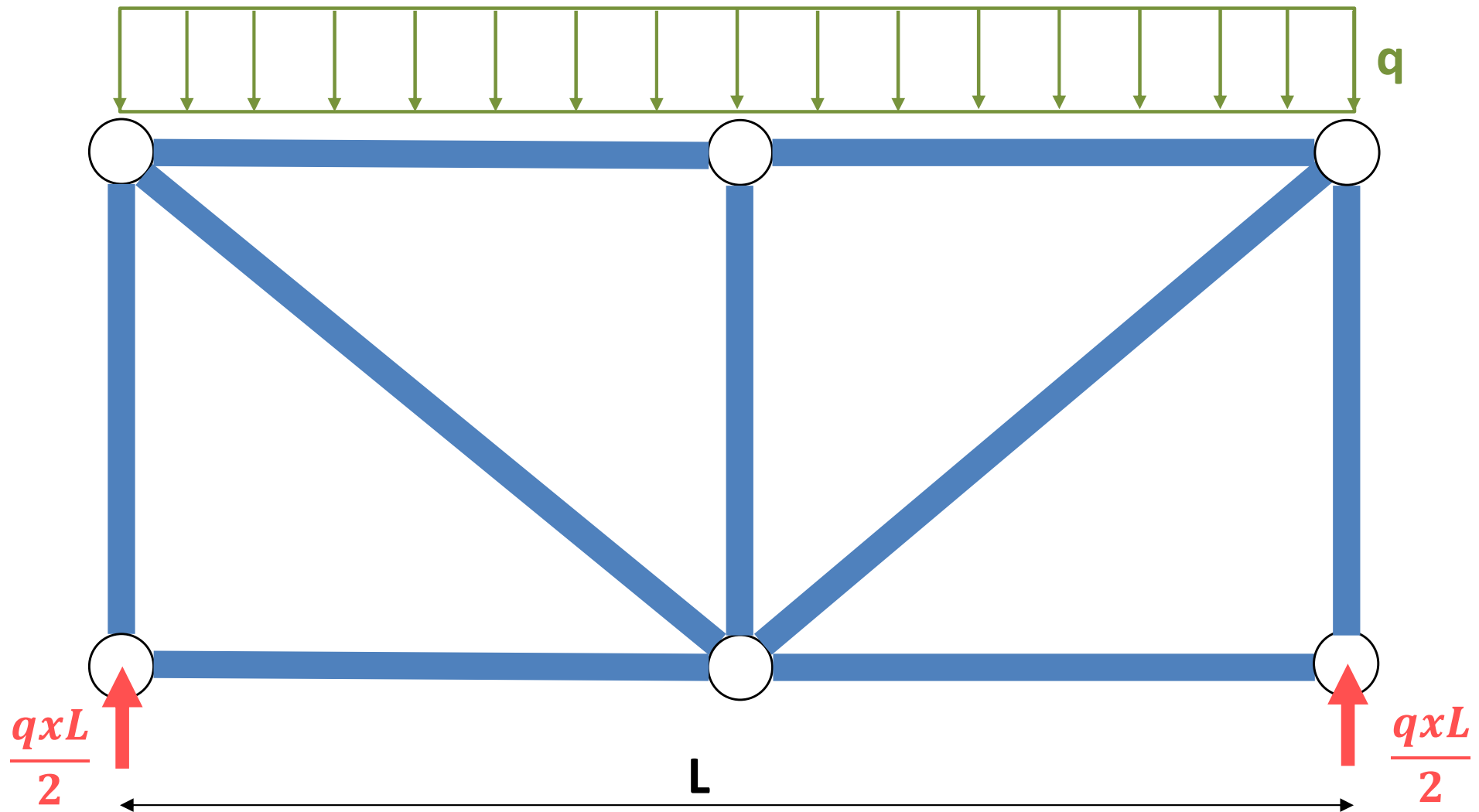
CASOS PARTICULARES



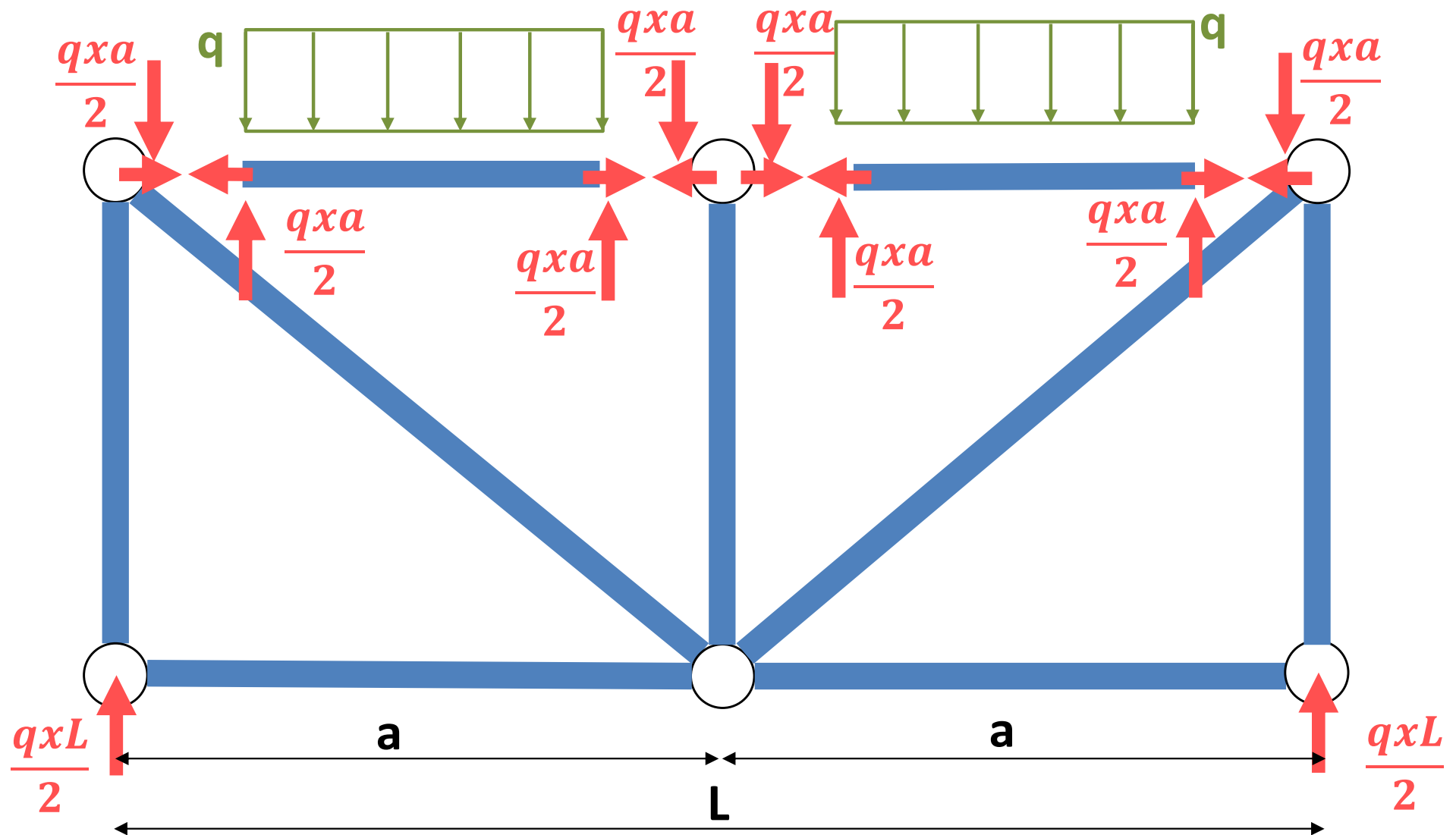
ESTUDIO DE BARRAS INACTIVAS



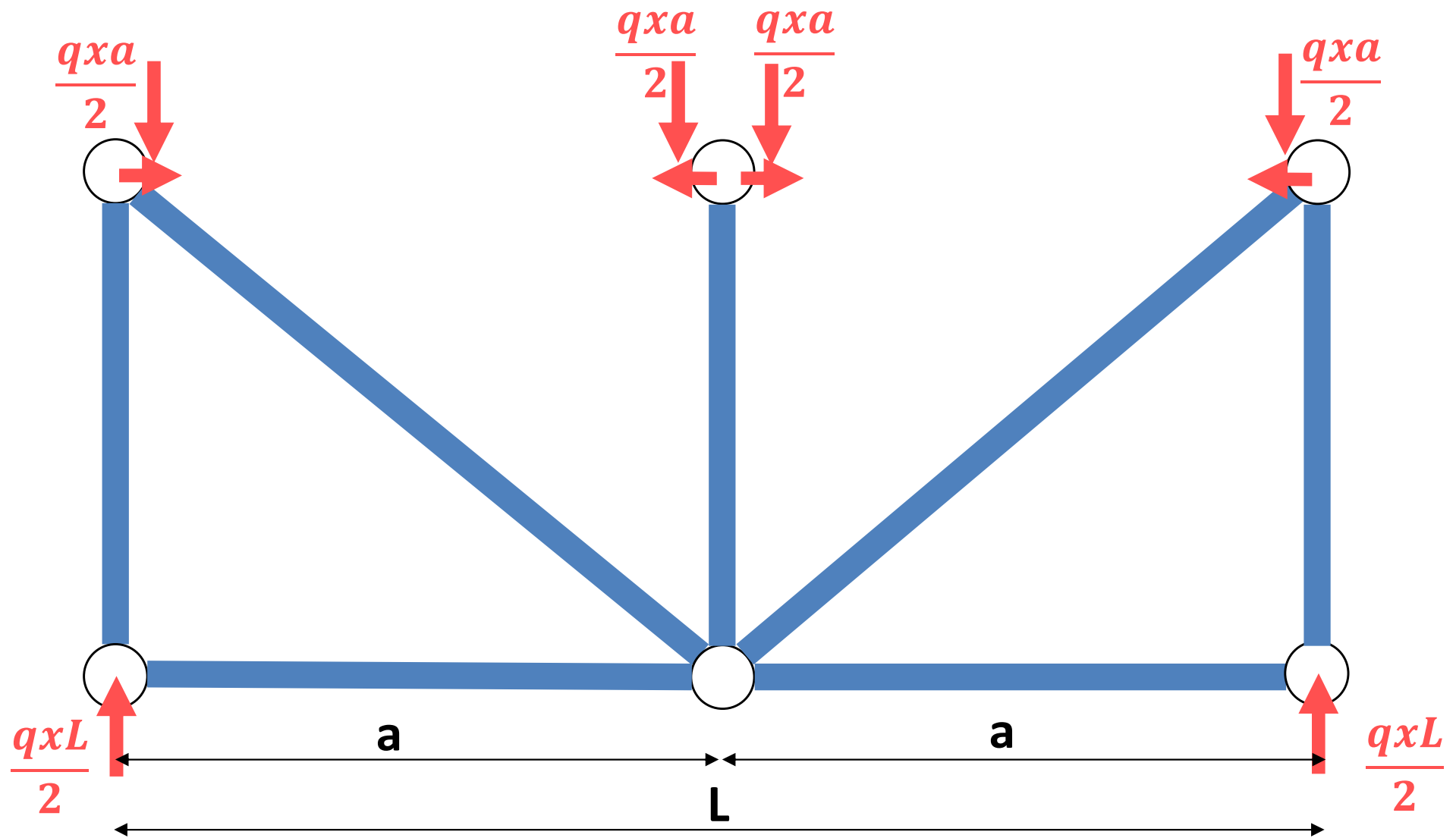
EJEMPLO CON CARGA DISTRIBUIDA



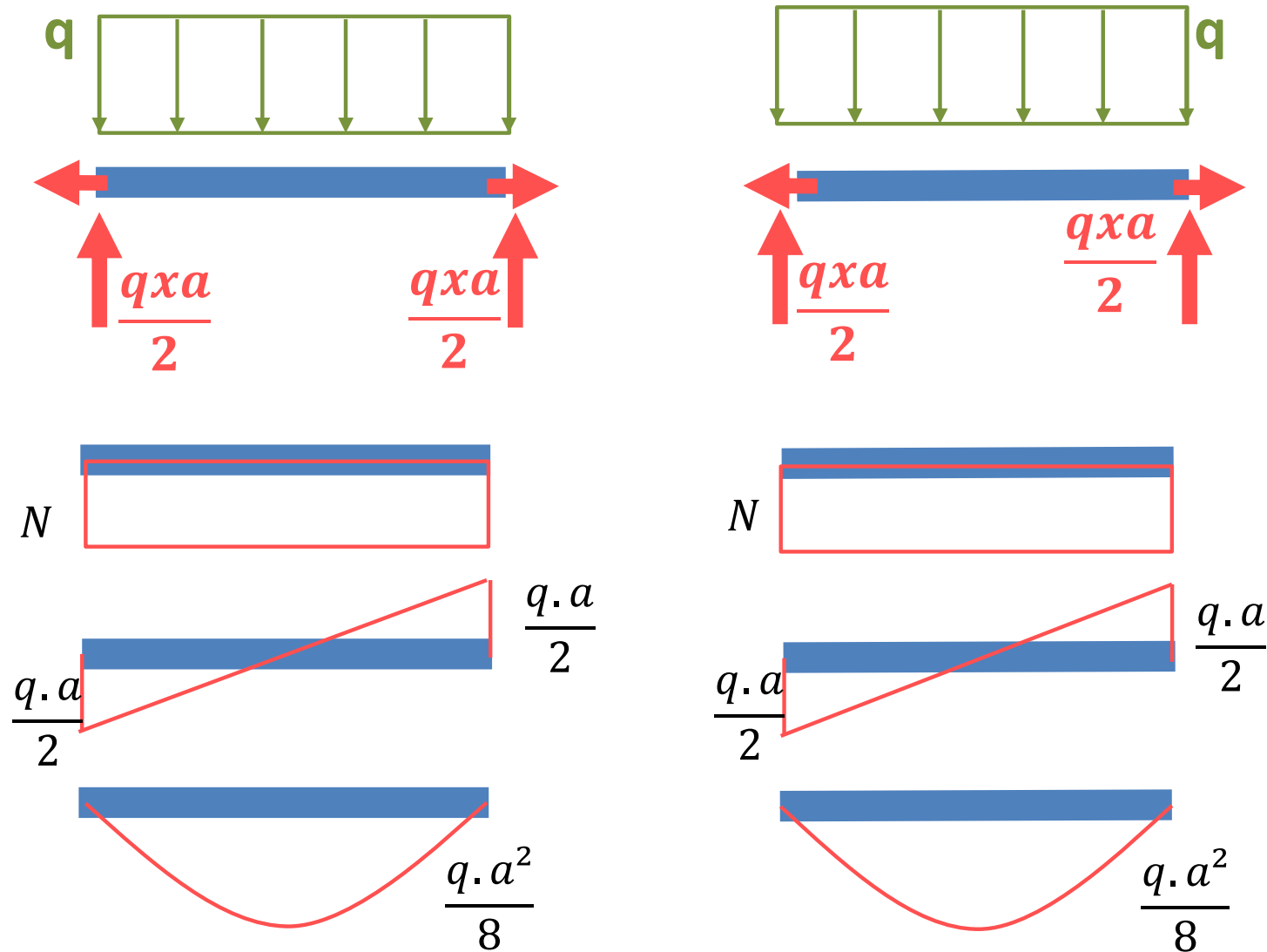
EJEMPLO CON CARGA DISTRIBUIDA



EJEMPLO CON CARGA DISTRIBUIDA



EJEMPLO CON CARGA DISTRIBUIDA



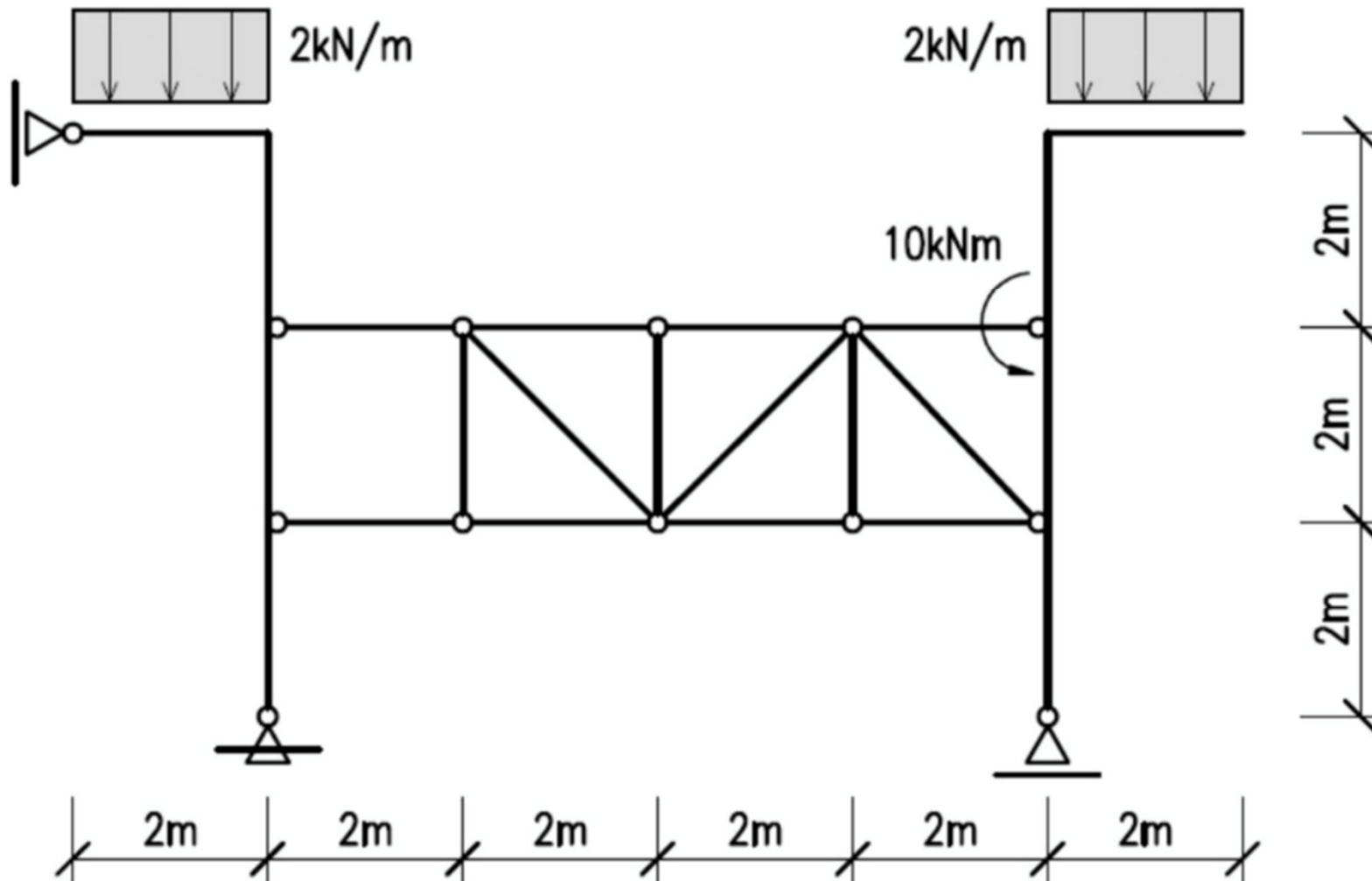
N lo calculé en el reticulado

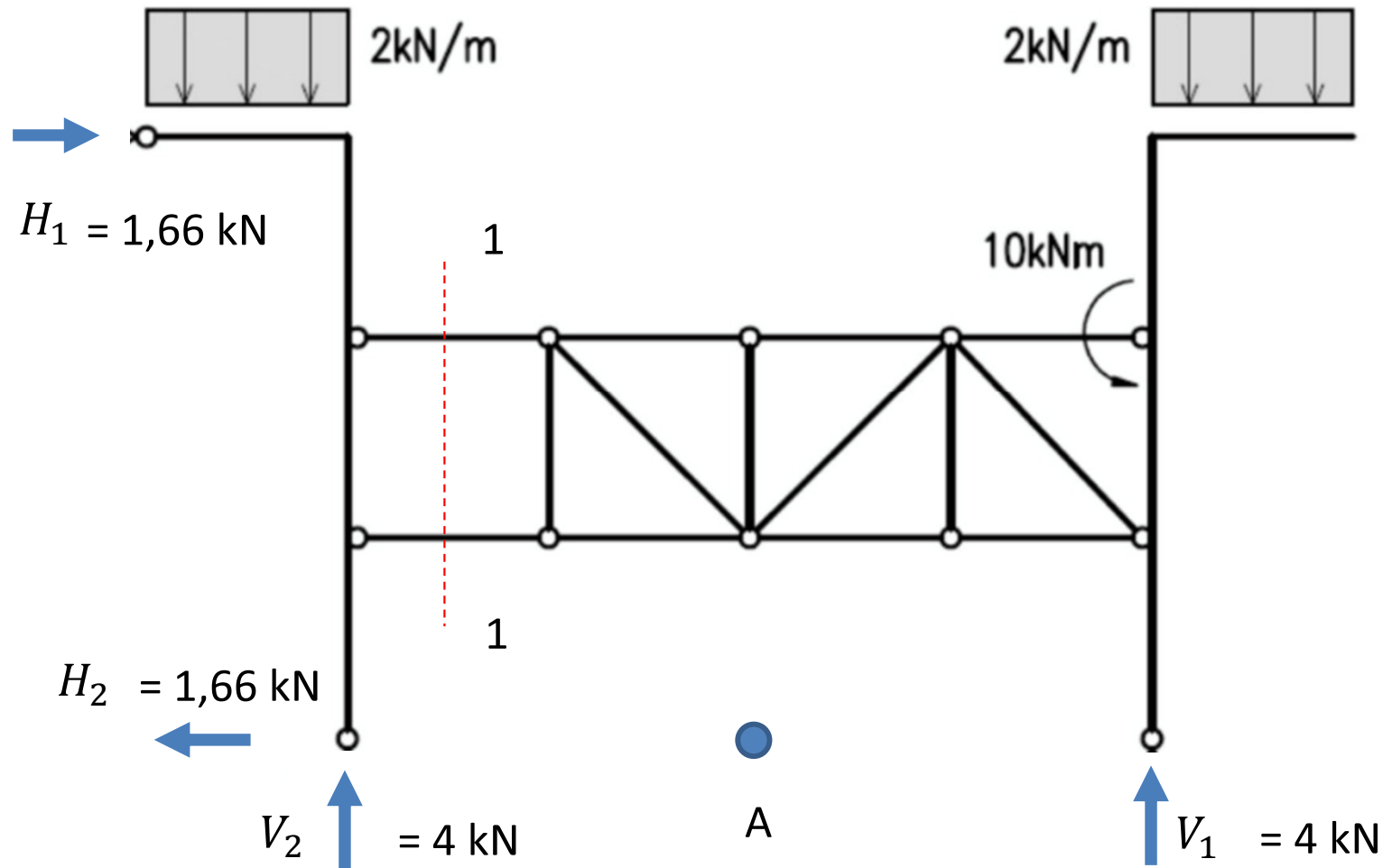
EJEMPLO: ESTRUCTURA MIXTA

Análisis cinemático

$$GL = ? \quad 4$$

$$CV = ? \quad 4$$



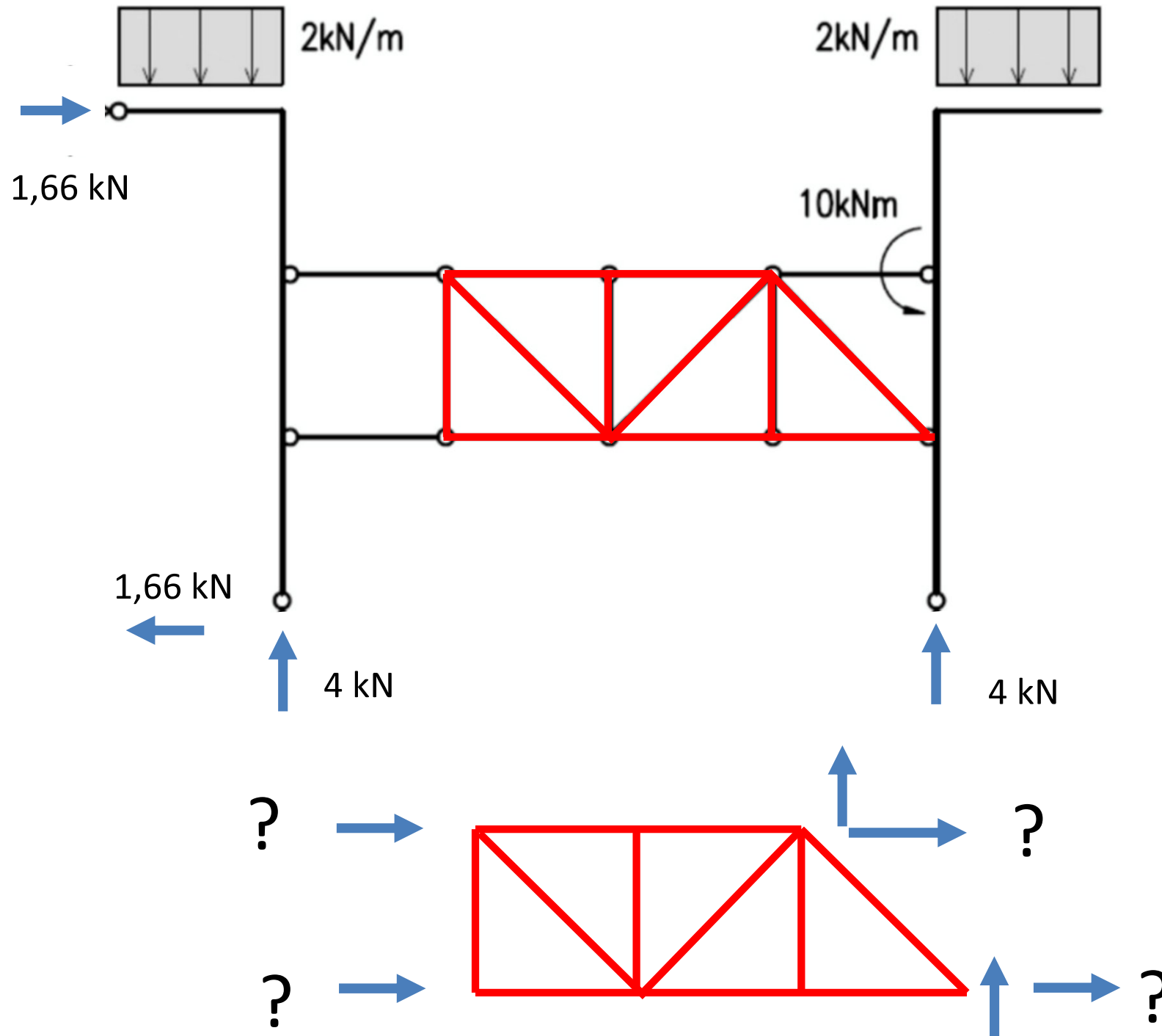


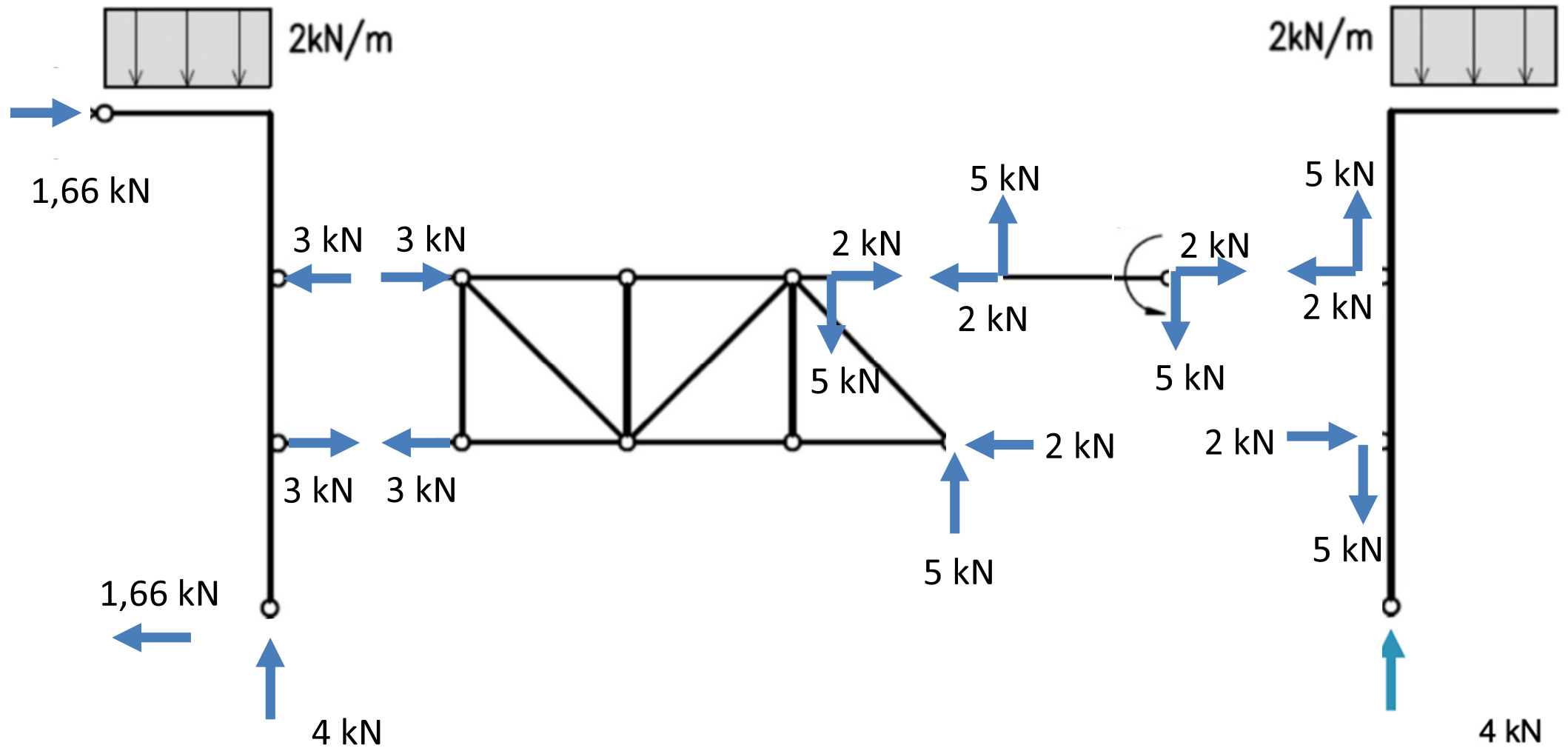
$$\sum F_v = 0 = -q * 2m - q * 2m + V_1 + V_2$$

$$\sum M_A = 0 = -10kNm + H1 * 6m \rightarrow H1 = 10kNm/6m$$

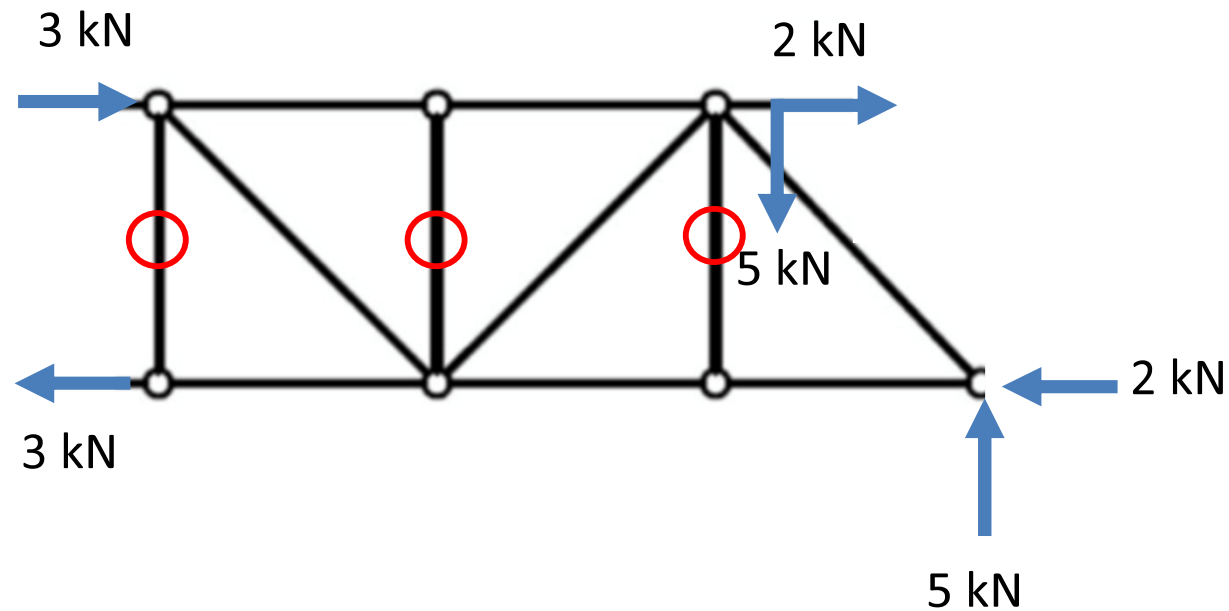
$$\sum F_h = 0 = H1 = H2$$

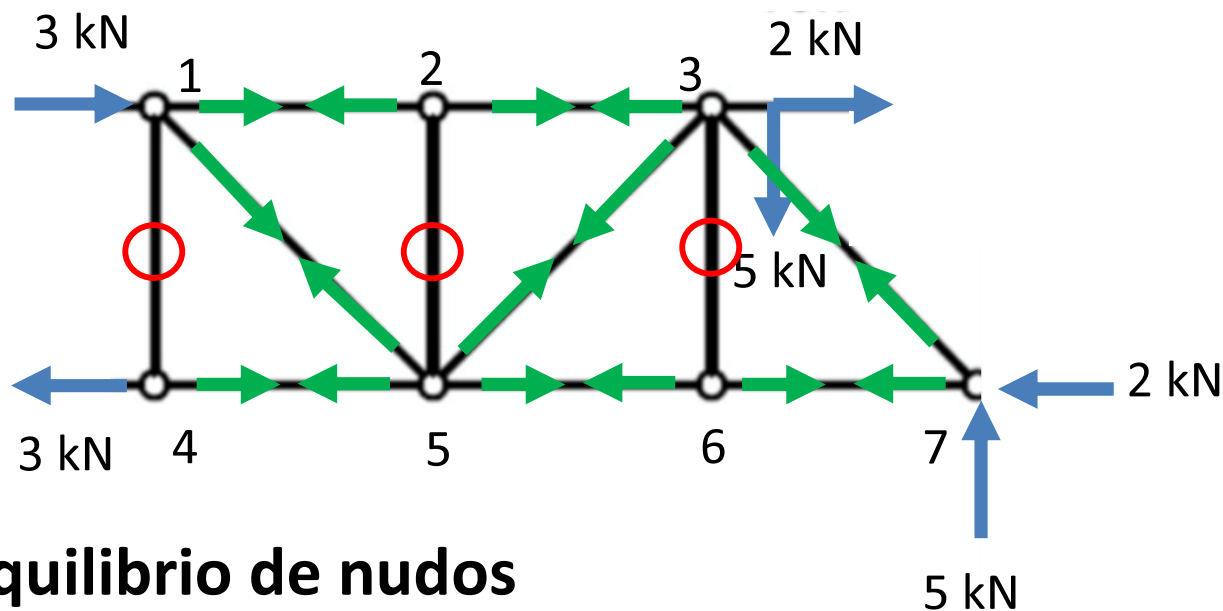
$$\sum F_v^{1-1} = 0 = V2 - q * 2m$$



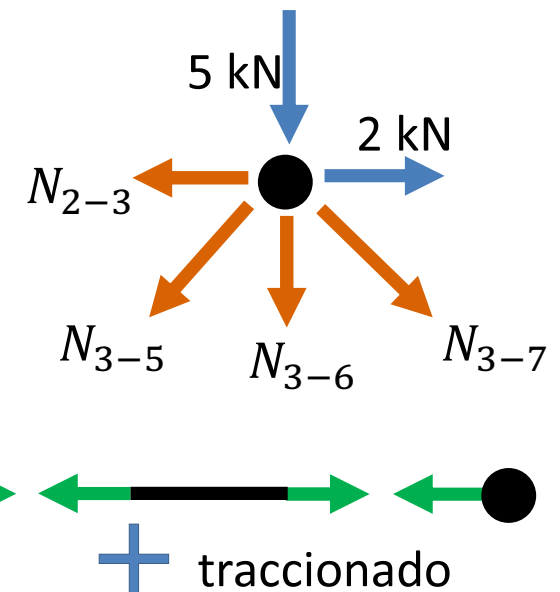


Barras inactivas





**NODO
3**



Equilibrio de nudos

$$\boxed{4} \quad \sum F_x = 0 \quad N_{4-5} - 3kN = 0$$

$$\rightarrow N_{4-5} = 3kN$$

$$\boxed{1} \quad \sum F_x = 0 \quad N_{1-2} + 3kN + N_{1-5} * \cos(\alpha) = 0$$

$$\rightarrow N_{1-2} = -3kN$$

$$\sum F_y = 0 \quad N_{1-5} * \sin(\alpha) = 0$$

$$\rightarrow N_{1-5} = 0$$

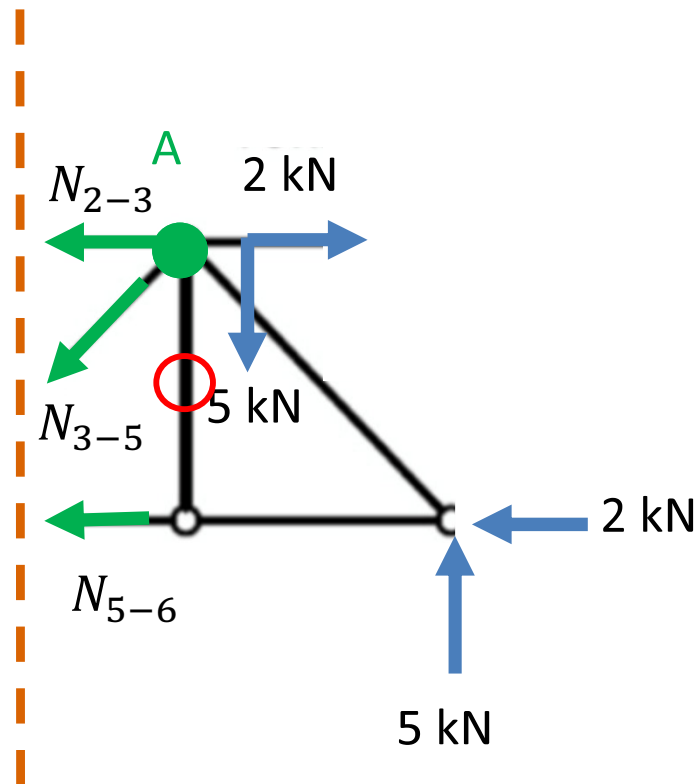
$$\boxed{7} \quad \sum F_x = 0 \quad -N_{6-7} - 2kN - N_{3-7} * \cos(\alpha) = 0$$

$$\rightarrow N_{6-7} = 3kN$$

$$\sum F_y = 0 \quad N_{3-7} * \sin(\alpha) + 5kN = 0$$

$$\rightarrow N_{3-7} = -7.05kN$$

MÉTODO DE RITTER



$$\sum F_v = 0$$

$$-N_{3-5} * \sin(\alpha) = 0$$

$$\rightarrow N_{3-5} = 0$$

$$\sum M_a = 0$$

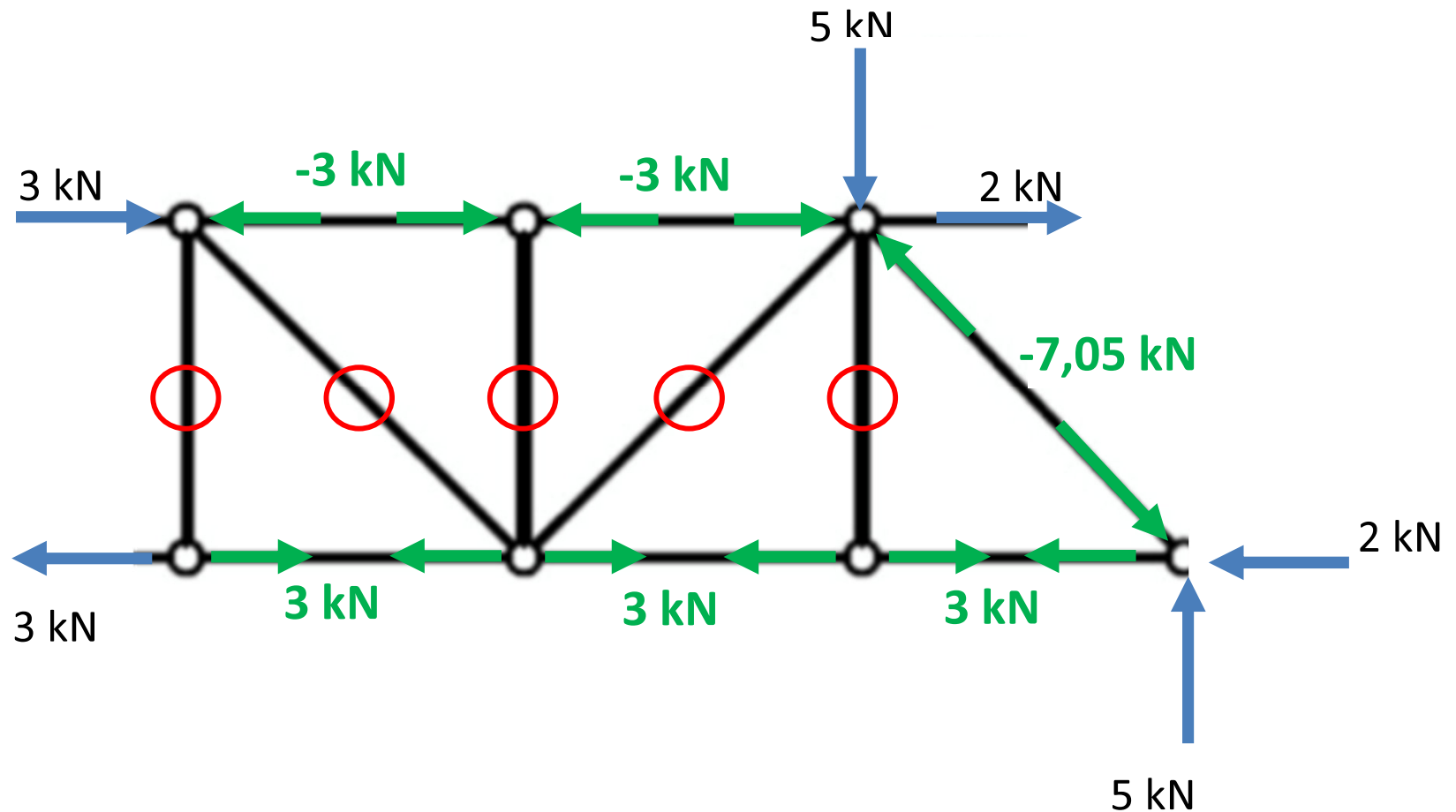
$$5kN * 2m - 2kN * 2m - N_{5-6} * 2m = 0$$

$$\rightarrow N_{5-6} = 3kN$$

$$\sum F_h = 0$$

$$-N_{5-6} - N_{2-3} = 0$$

$$\rightarrow N_{2-3} = -3kN$$



FRASE DEL DÍA

Las estructuras reticuladas nos enseñan que la verdadera fortaleza no siempre está en la masa, sino en cómo cada elemento encuentra su lugar para sostener al conjunto.

ChatGTP

¿CONSULTAS?

