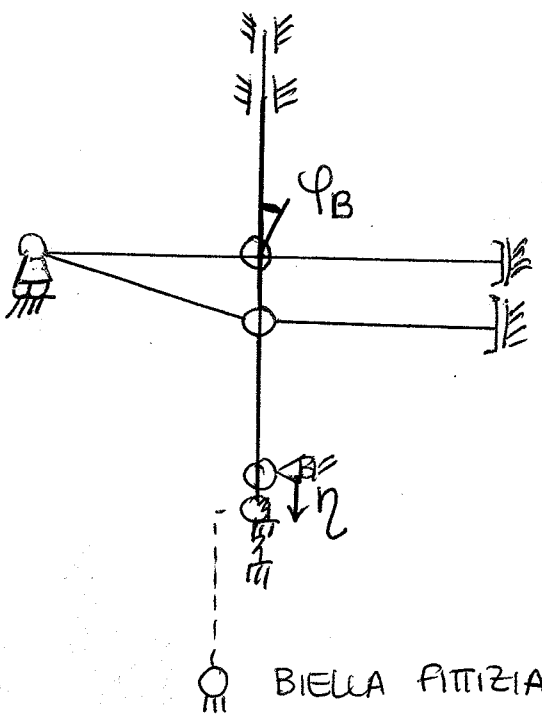


$P = 32 ql$ $k_{\theta} = 50 \frac{EJ}{l}$
 $N = \frac{1}{4} ql$ $k_{\eta} = 63 \frac{EJ}{l^3}$

$\frac{\alpha \Delta T}{t} = \frac{ql^2}{7EJ}$

↳ ASTA EF →
 APPENDICE ISOSTATICA,
 CORRISPONDE A
 UN CARRELLO,
 (M) e (V) NULLI

Voluto se il sistema è a NODI FISSI O SPOSTABILI



NODI SPOSTABILI IN DIREZIONE y
 AGGIUNGO UNA BIELLA FITIZIA

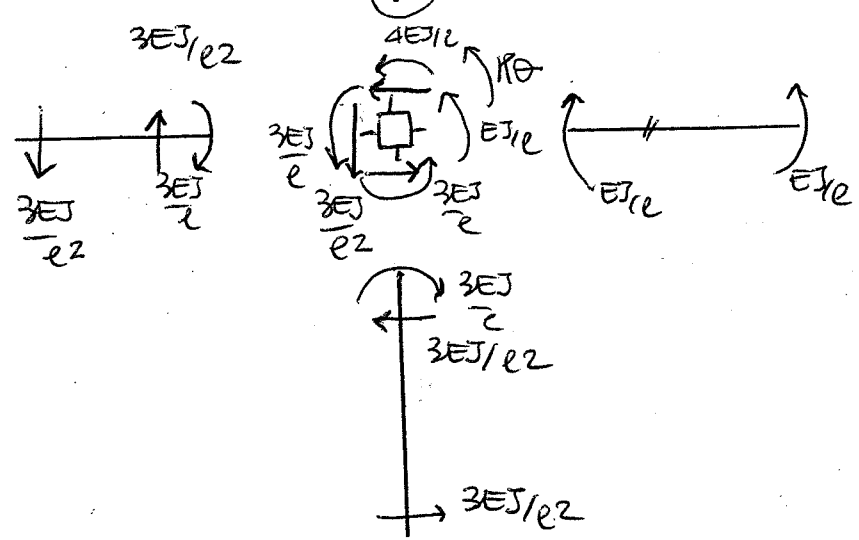
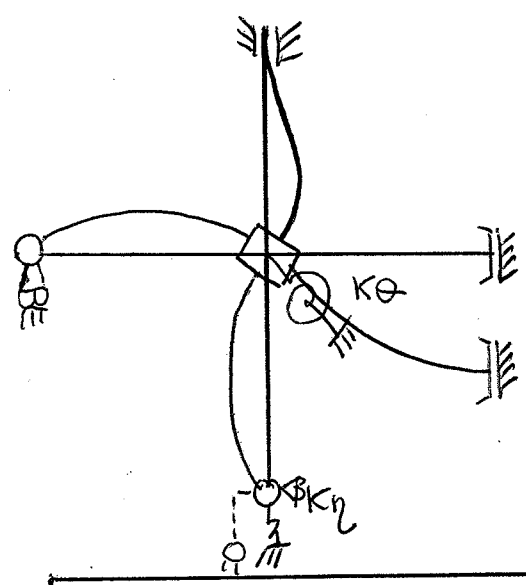
IL SISTEMA RISOLVENTE È IL SEGUENTE:

$$\begin{cases} m_{BB} \varphi_B + m_{B\eta} \eta + m_{B\theta} = 0 \\ h_{\eta B} \varphi_B + h_{\eta\eta} \eta + h_{\eta\theta} = 0 \end{cases}$$

CONVENZIONI DI SEGNO

↺ + MOMENTO SU NODO → ⊞ ← BIELLA

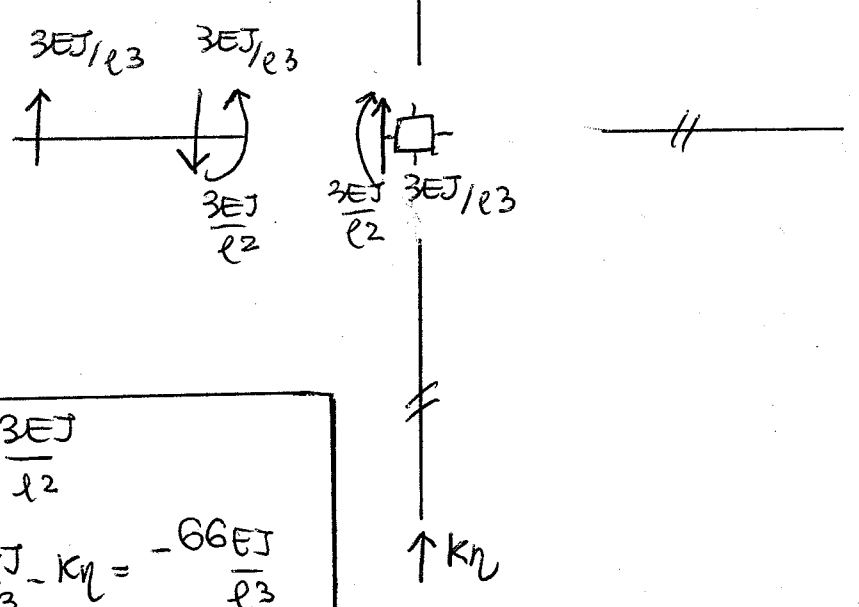
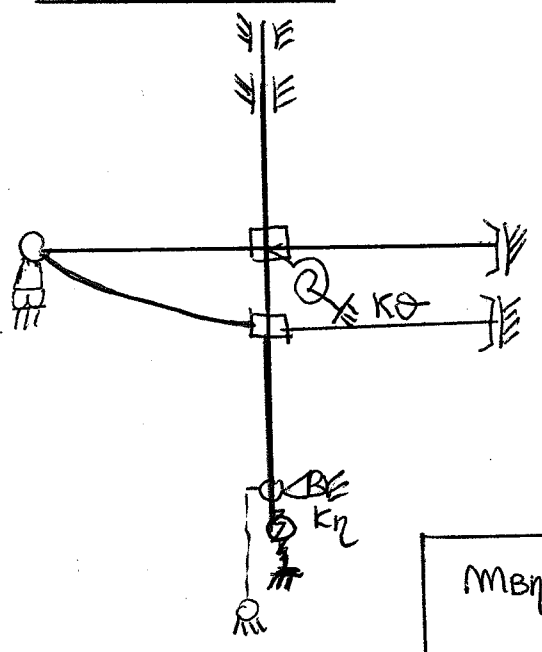
CASO 1: $\psi_B \neq 0$



$$M_{BB} = \frac{11EJ}{l} + K\theta = \frac{61EJ}{l}$$

$$H_{\eta B} = \frac{3EJ}{l^2}$$

CASO 2: $\eta \neq 0$

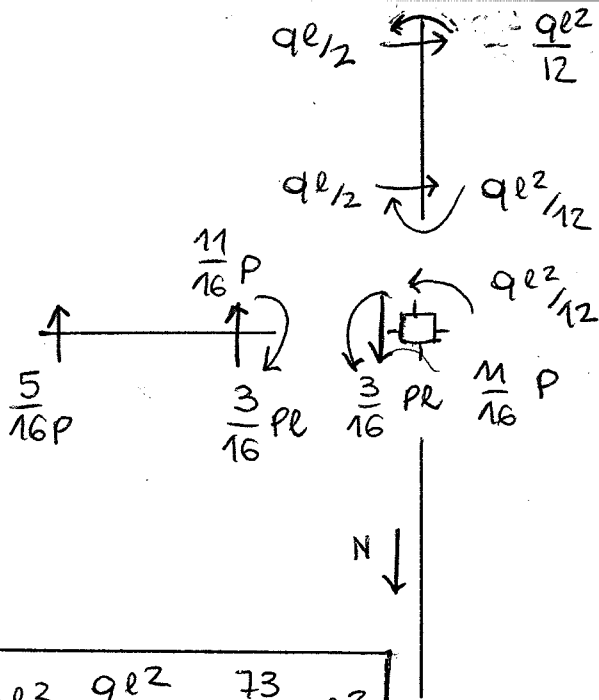
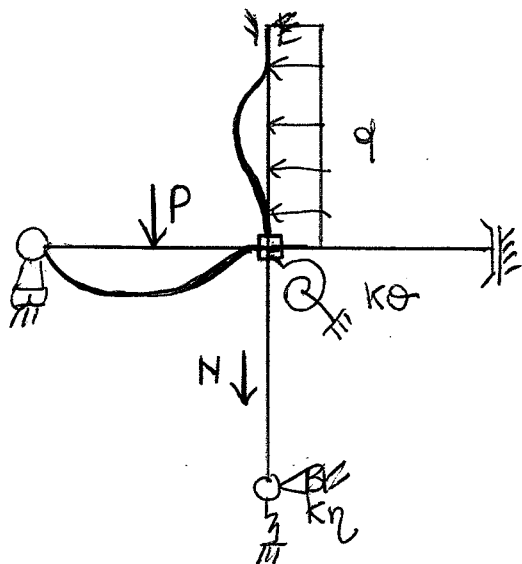


$$M_{B\eta} = -\frac{3EJ}{l^2}$$

$$H_{\eta\eta} = -\frac{3EJ}{l^3} - K\eta = -\frac{66EJ}{l^3}$$

CASO 3: CARICHI $\neq 0$

(3)



$$M_{B\phi} = \frac{3}{16} Pl + \frac{ql^2}{12} = \frac{3}{16} \cdot 3l^2 ql + \frac{ql^2}{12} = \frac{73}{12} ql^2$$

$$H_{\eta\phi} = N + \frac{11}{16} Pl = \frac{1}{4} ql + \frac{11}{16} \cdot 3l^2 ql = \frac{1}{4} ql + 22 ql = \frac{89}{4} ql$$

SISTEMA RISOLVENTE

$$\begin{cases} M_{BB}\phi_B + M_{B\eta}\eta + M_{B\phi} = 0 \\ H_{\eta B}\phi_B + H_{\eta\eta}\eta + H_{\eta\phi} = 0 \end{cases}$$

$$\begin{cases} \frac{61EJ}{l}\phi_B + \left(-\frac{3EJ}{l^2}\right)\eta + \frac{73}{12}ql^2 = 0 \\ \frac{3EJ}{l^2}\phi_B + \left(-\frac{66EJ}{l^3}\right)\eta + \frac{89}{4}ql = 0 \end{cases}$$

$$61\phi_B \cdot l - 3\eta = -\frac{73}{12} \frac{ql^4}{EJ} \quad \cdot 22$$

$$3\phi_B \cdot l - 66\eta = -\frac{89}{4} \frac{ql^4}{EJ}$$

$$\begin{cases} 1342\phi_B \cdot l - 66\eta = -\frac{73}{12} \cdot 22 \frac{ql^4}{EJ} \\ 3\phi_B \cdot l - 66\eta = -\frac{89}{4} \frac{ql^4}{EJ} \end{cases} \quad \ominus$$

$$1339\phi_B \cdot l = \left(-\frac{803}{6} + \frac{89}{4}\right) \frac{ql^4}{EJ} = \left(\frac{-1606 + 267}{12}\right) \frac{ql^4}{EJ} = -\frac{1339}{12} \frac{ql^4}{EJ}$$

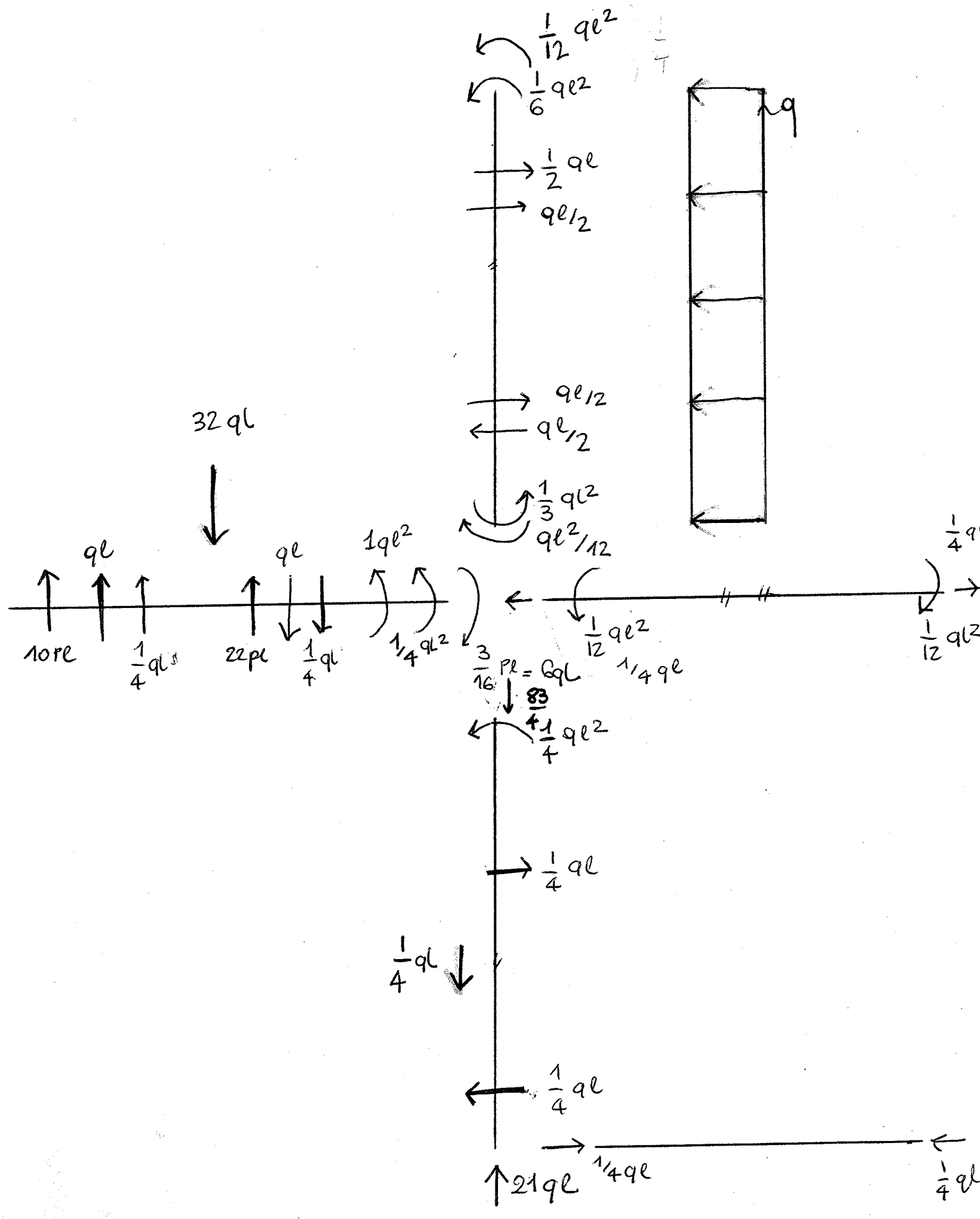
$$\phi_B = -\frac{1}{12} \frac{ql^3}{EJ}$$

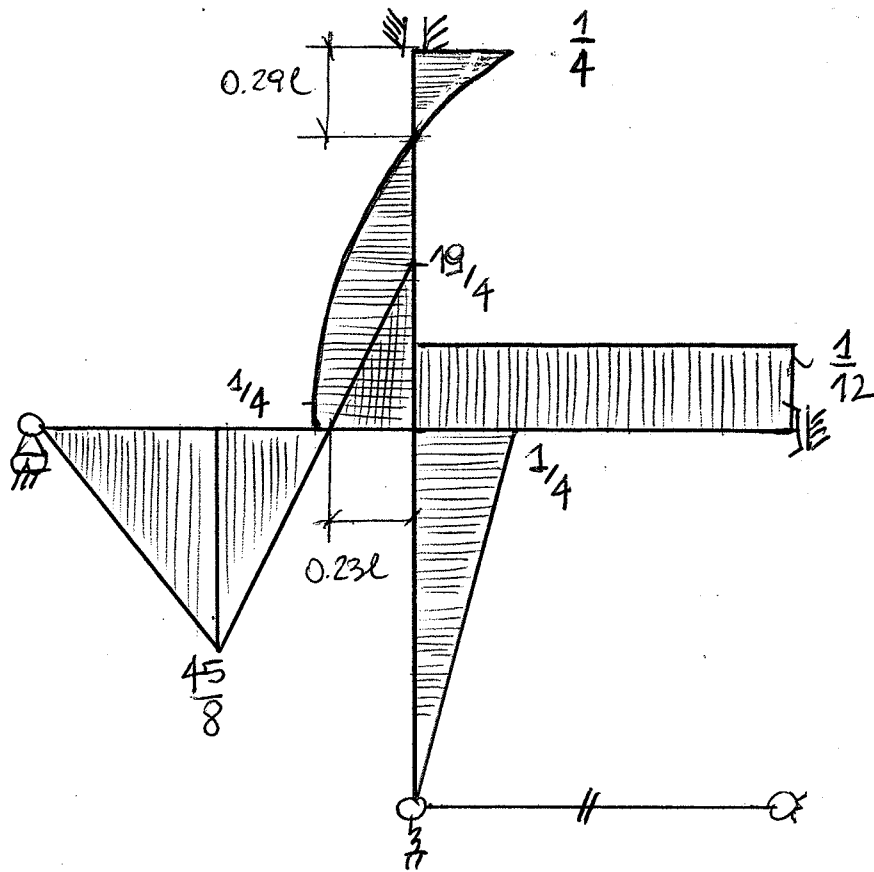
→ sostituendo → $\eta = \frac{1}{3} \frac{ql^4}{EJ}$

$$\begin{aligned} \phi_B &= -\frac{1}{12} \frac{ql^3}{EJ} \\ \eta &= \frac{1}{3} \frac{ql^4}{EJ} \end{aligned}$$

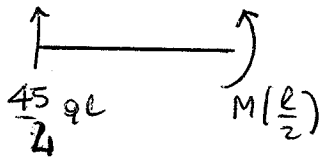
• AZIONE MOLLA ASSIALE: $63 \frac{EJ}{l^3} \cdot \frac{1}{3} \frac{ql^4}{EJ} = 21 ql \uparrow$

• AZIONE MOLLA TORSIONALE: $50 \frac{EJ}{l} \cdot \frac{1}{12} \frac{ql^3}{EJ} = \frac{25}{6} ql^2 \curvearrowright$





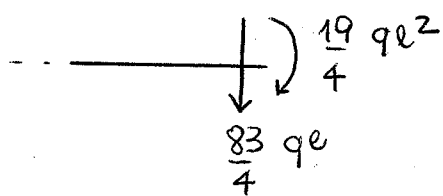
• CALCOLO M(l/2) ASTA AB



$$M\left(\frac{l}{2}\right) = \frac{45}{4} \cdot \frac{l}{2} ql = \frac{45}{8} ql^2$$

• CALCOLO DOVE SI ANNULLA MOMENTO:

- ASTA AB



$$\frac{19}{4} ql^2 - \frac{83}{4} ql x = 0$$

$$19l - 83x = 0$$

$$83x = 19$$

$$\boxed{x = \frac{19}{83} = 0.23l} \quad \rightarrow \text{FLESSO}$$

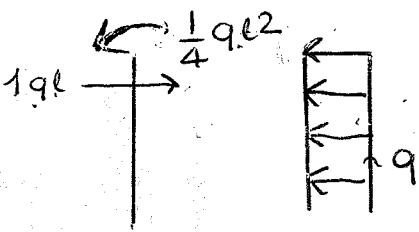
oppure

$$\left(\frac{19}{4} + \frac{45}{8}\right) \cdot \frac{l}{2} = \frac{19}{4} : x$$

$$\frac{83}{8} \cdot \frac{l}{2} = \frac{19}{4} : x$$

$$\rightarrow \frac{19}{4} \cdot \frac{l}{2} \cdot \frac{8}{83} = x = \frac{19}{83} l = 0.23l$$

- ASTA DB



$$\frac{1}{4} ql^2 + \frac{qx^2}{2} - qlx = 0$$

$$\frac{qx^2}{2} - qlx + \frac{1}{4} ql^2 = 0$$

$$x^2 - 2lx + \frac{1}{2} l^2 = 0$$

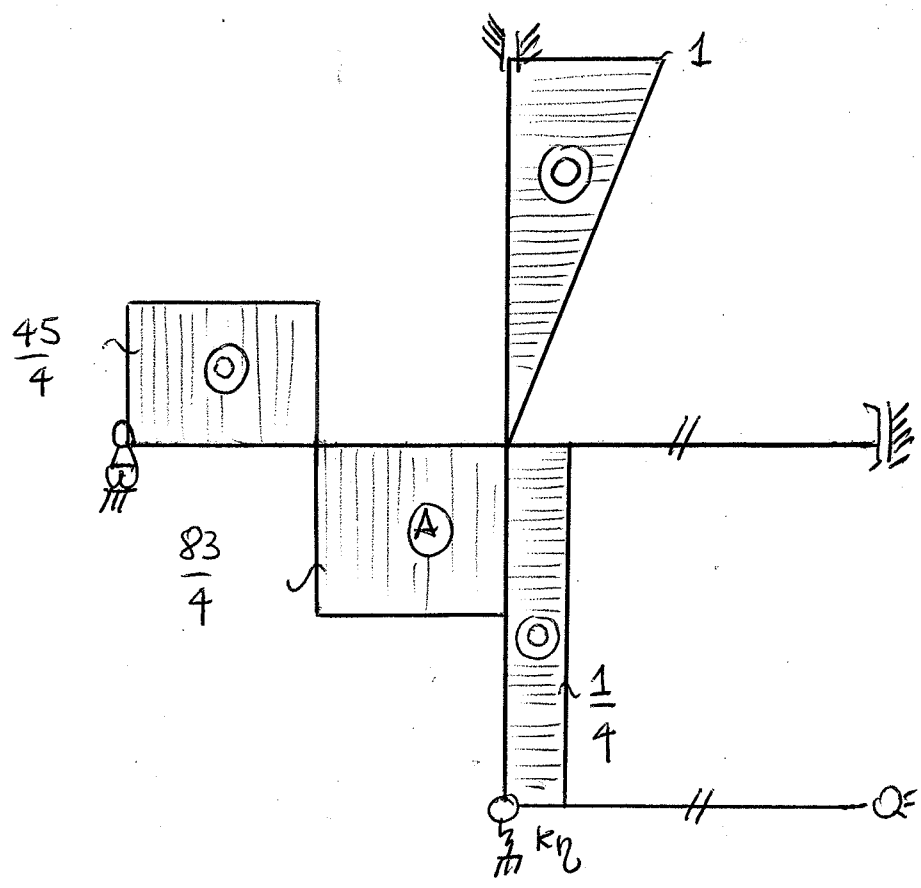
$$x_{1/2} = \frac{(+2 \pm \sqrt{4 - 4(1)(\frac{1}{2})})}{2} l$$

$$x_{1/2} = \frac{+2 \mp \sqrt{2}}{2} l$$

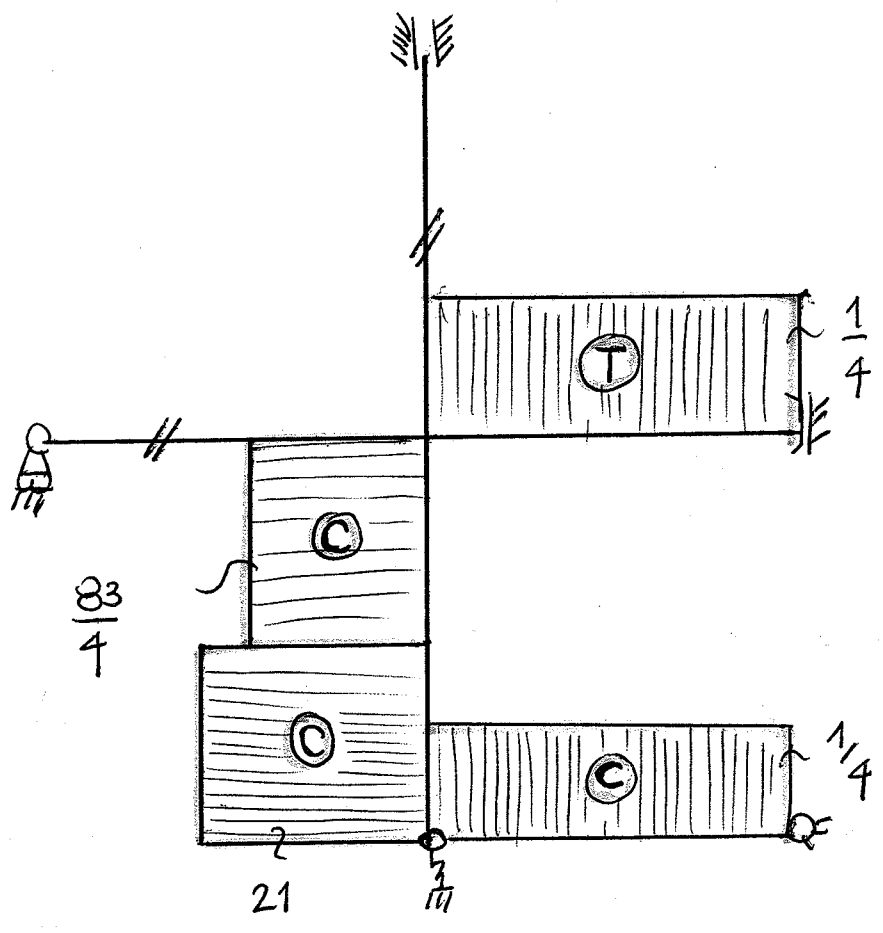
$$\rightarrow x = \frac{2 - \sqrt{2}}{2} l = \boxed{0.29l}$$

FLESSO

Y [qe]



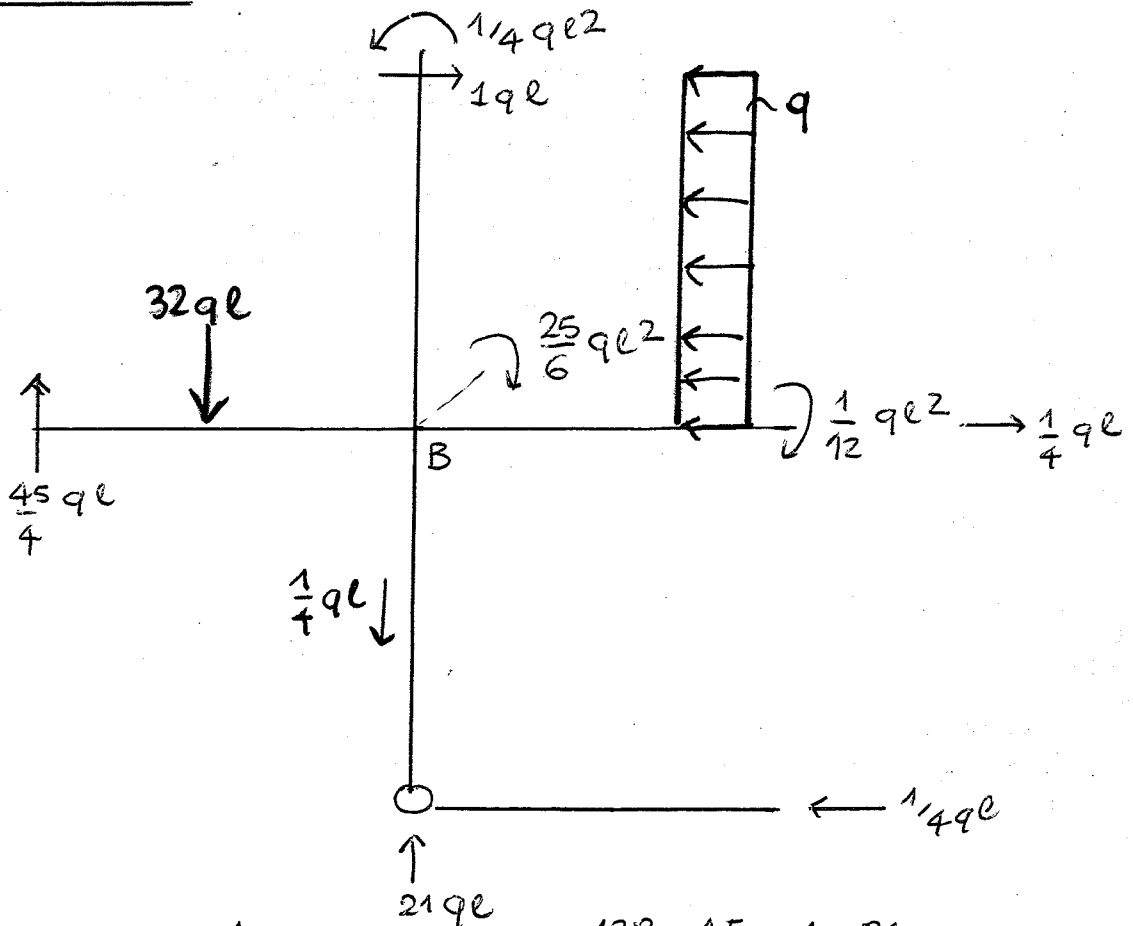
N [qe]



CONTROL EQUILIBRIO

• GLOBALE

(7)



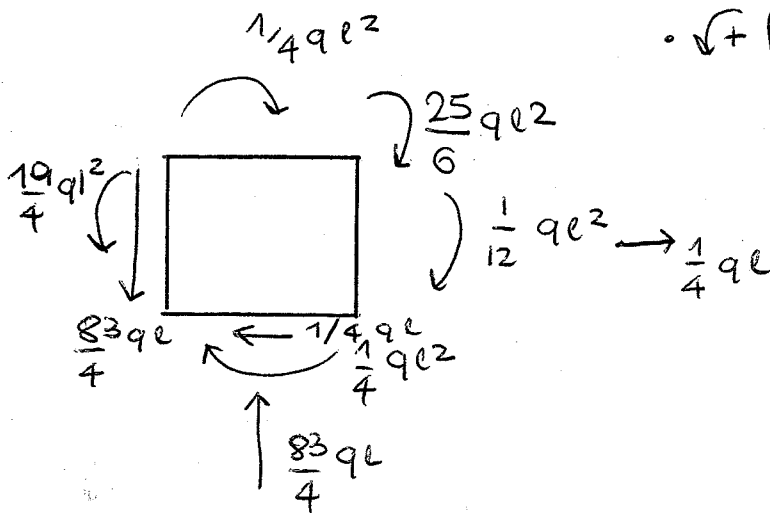
• $\downarrow +$) $32ql - \frac{45}{4}ql + \frac{1}{4}ql - 21ql = \frac{128 - 45 + 1 - 84}{4}ql = 0 \quad \text{OK!}$

• $\rightarrow +$) $ql - ql + \frac{1}{4}ql - \frac{1}{4}ql = 0 \quad \text{OK!}$

(+ \curvearrowright PUNTO B) $ql^2 - \frac{1}{4}ql^2 - \frac{ql^2}{2} + \frac{25}{6}ql^2 + \frac{1}{12}ql^2 + \frac{1}{4}ql^2 + \frac{45}{4}ql^2 - \frac{32}{2}ql^2 = 0$

$$\frac{12 - 3 - 6 + 50 + 1 + 3 + 135 - 192}{12} ql^2 = 0 \quad \text{OK!}$$

• NODO

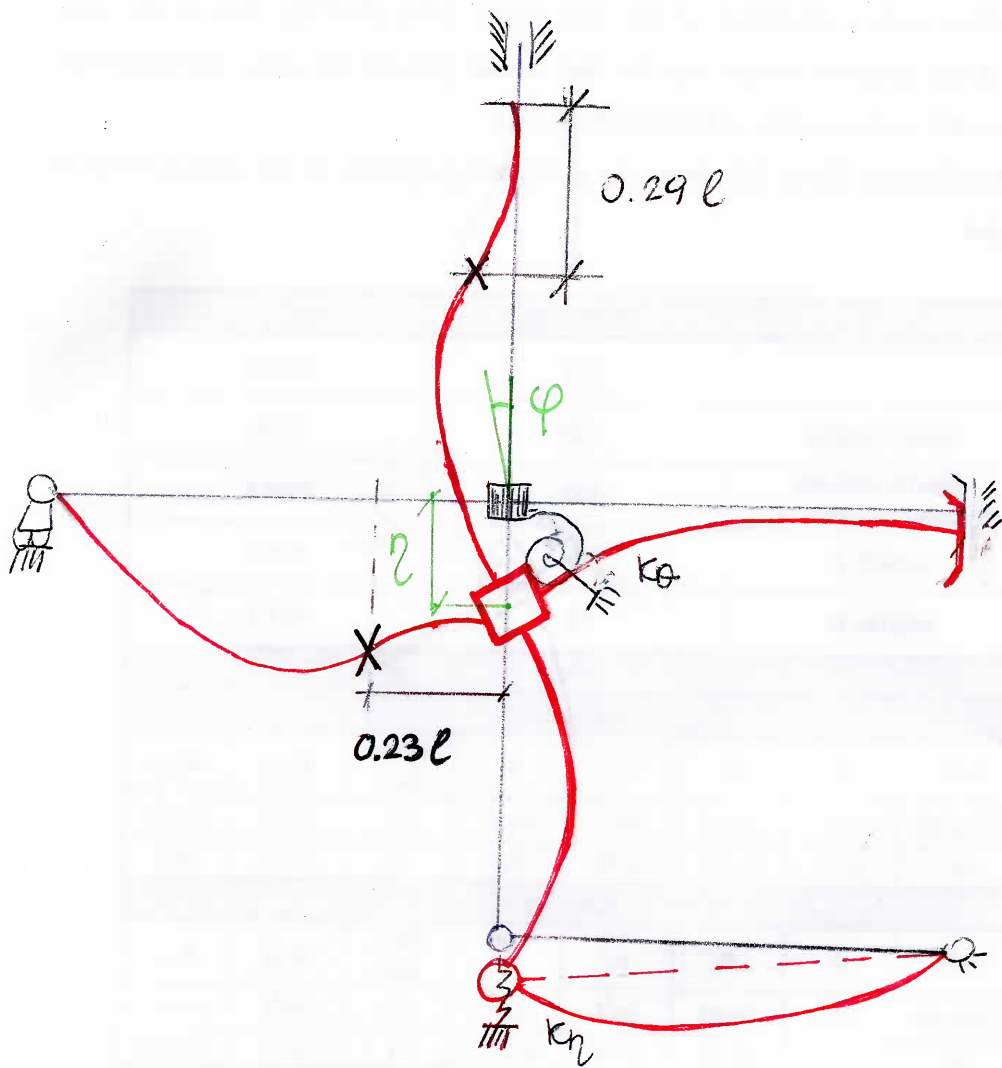


• $\sqrt{+}$ $\left(\frac{19}{4} - \frac{1}{4} - \frac{1}{12} - \frac{25}{6} - \frac{1}{4} \right) ql^2 = 0$

$$\frac{57 - 3 - 1 - 50 - 3}{12} = 0 \quad \text{OK}$$

• $+ \uparrow$) $\frac{83}{4}ql - \frac{83}{4}ql = 0 \quad \text{OK!}$

• $+ \rightarrow$) $\frac{1}{4}ql - \frac{1}{4}ql = 0 \quad \text{OK!}$



IL CARICO ΔT PRODUCE SOLO UN EFFETTO SULLA DEFORMATA E NON SULLE AZIONI INTERNE