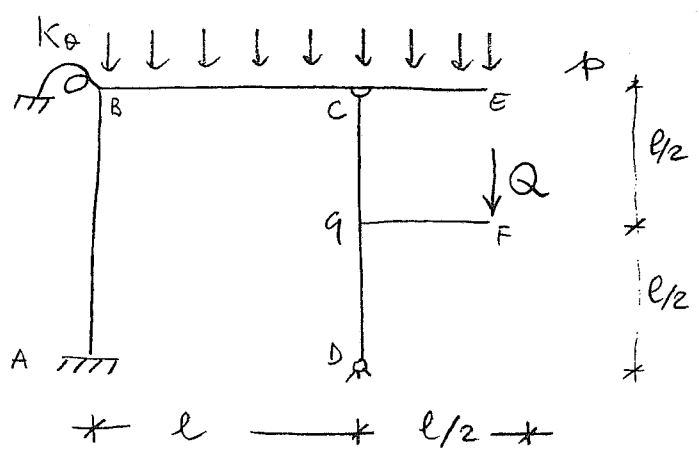


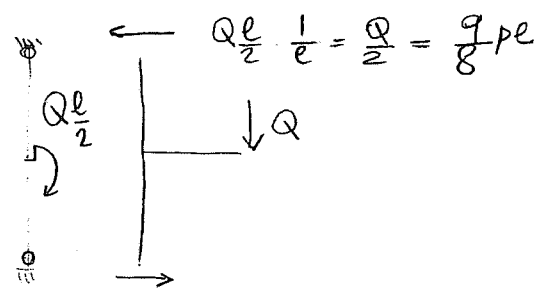
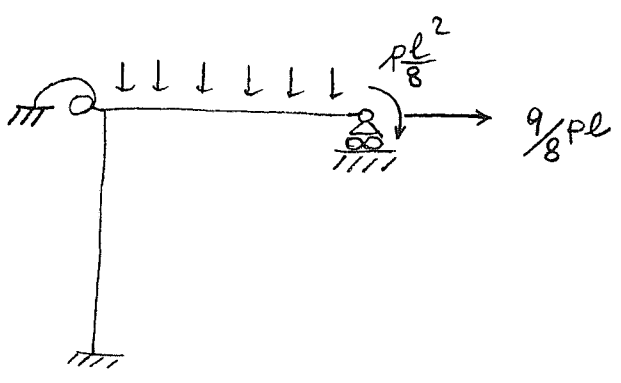
EX.



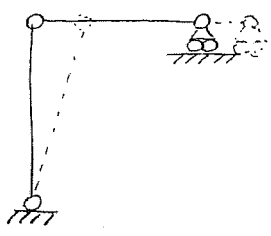
EA = +∞
 Kθ = $\frac{6EJ}{l}$
 Q = $\frac{q}{4} pl$

RICHIAMI

$\frac{3EJ}{l} \cdot \gamma$
 $q = \frac{pl}{24E}$

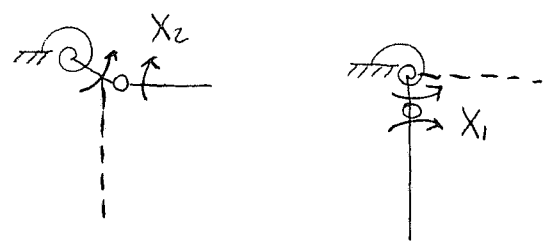
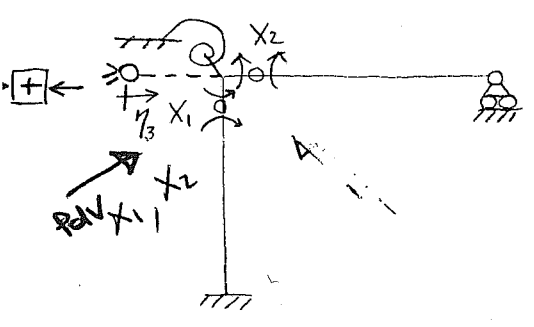


STR: NODI SPOSTABILI



Bielle Fittizio

- diviso la molla dalle aste

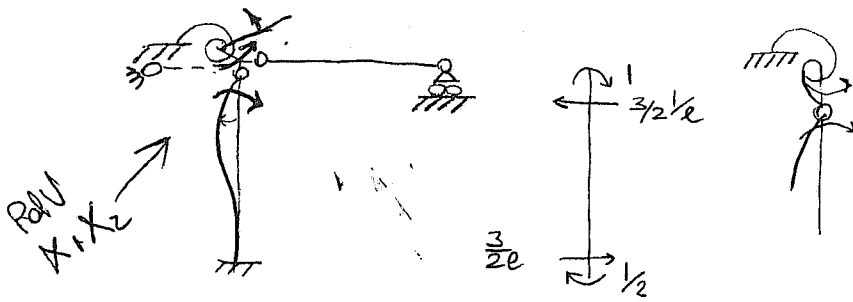


2 Eq. compatte + 1 equilibrio

$$\begin{cases} \varphi_{2d} - \varphi_{2s} = 0 \\ \varphi_{1d} - \varphi_{1s} = 0 \\ h_3 = 0 \end{cases} \quad \begin{cases} \varphi_{21} X_1 + \varphi_{22} X_2 + \varphi_{23} \eta_3 + \varphi_{20} = 0 \\ \varphi_{11} X_1 + \varphi_{12} X_2 + \varphi_{13} \eta_3 + \varphi_{10} = 0 \\ h_{31} X_1 + h_{32} X_2 + h_{33} \eta_3 + h_{30} = 0 \end{cases}$$

SOVRAPPOSIZIONE EFFETTI X CALCOLO COEFFICIENTI

1) $X_1 = 1$; $X_2 = \gamma_3 = p = 0$



AUMENTO NEL
SEGNO DI
M

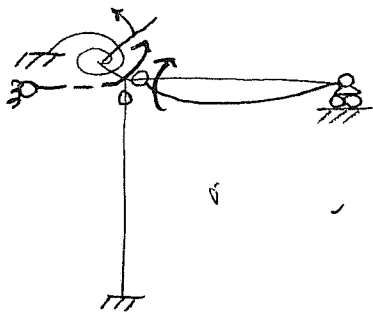
$$\varphi_{11} = +\frac{l}{4EJ} - \left(-\frac{1}{K}\right) \frac{10e}{24EJ}$$

$$= \frac{l}{4EJ} + \frac{l}{6EJ} = \frac{5l}{12EJ}$$

$$\varphi_{21} = 0 - \left(-\frac{1}{K}\right) = \frac{l}{6EJ}$$

$$h_{31} = -\frac{3}{2e}$$

2) $X_2 = 1$; $X_1 = p = 0$



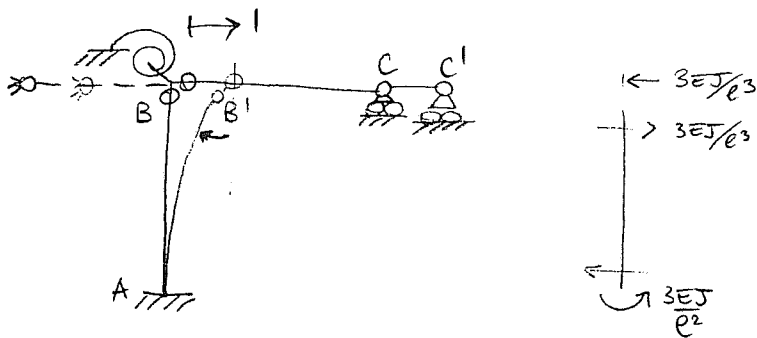
$$\varphi_{22} = \frac{l}{3EJ} - \left(-\frac{1}{K}\right) =$$

$$= \frac{l}{3EJ} + \frac{l}{6EJ} = \frac{l}{2EJ}$$

$$\varphi_{12} = 0 - \left(-\frac{1}{K}\right) = \frac{l}{6EJ}$$

$$h_{32} = 0$$

3) $\gamma_3 = 1$; $X_1 = X_2 = p = 0$

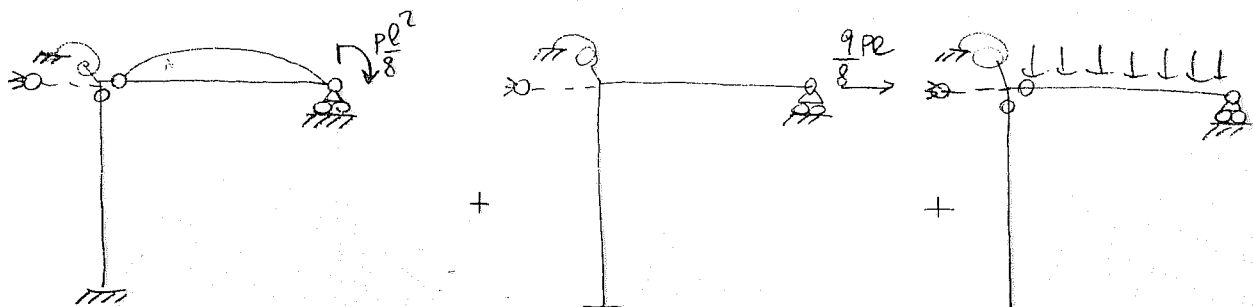


$$\varphi_{13} = \frac{3}{2e} - 0$$

$$\varphi_{23} = 0$$

$$h_{33} = +\frac{3eJ}{l^3}$$

4) $p \neq 0$; $X_1 = X_2 = \gamma_3 = 0$



$$\varphi'_{10} = 0$$

$$\varphi'_{20} = -\frac{l}{6EJ} \left(\frac{pl^2}{8}\right)$$

$$h'_{30} = 0$$

$$\varphi''_{10} = 0$$

$$\varphi''_{20} = 0$$

$$h''_{30} = -\frac{9pl}{8}$$

$$\left. \begin{array}{l} \varphi'''_{10} = 0 \\ \varphi'''_{20} = \frac{pl^3}{24EJ} \\ h'''_{30} = 0 \end{array} \right\} \begin{array}{l} \varphi_{10} = 0 \\ \varphi_{20} = +\frac{1}{48} \frac{pl^3}{E} \\ h_{30} = -\frac{9}{8} p \end{array}$$

Systeme Risolvente

$$\begin{cases} \frac{5}{12} \frac{l}{EJ} X_1 + \frac{l}{6EJ} X_2 + \frac{3}{2l} \eta_3 + 0 = 0 \\ \frac{l}{6EJ} X_1 + \frac{l}{2EJ} X_2 + 0 + \frac{pl^2}{48} = 0 \\ -\frac{3}{2l} X_1 + 0 + \frac{3EJ}{l^3} \eta_3 - \frac{9}{8} pl = 0 \end{cases} \quad \begin{cases} X_1 = -\frac{1}{2} pl^2 \\ X_2 = +\frac{1}{8} pl^2 \\ \eta_3 = \frac{1}{8} \frac{pl^4}{EJ} \end{cases}$$

Info Ai:

$$\begin{cases} \frac{5}{12} X_1 + \frac{1}{6} X_2 + \frac{3}{2} \frac{EJ}{l^2} \eta_3 = 0 & \text{(I)} \\ \frac{1}{6} X_1 + \frac{1}{2} X_2 + \frac{1}{48} pl^2 = 0 & \text{(II)} \\ -\frac{3}{2} X_1 + \frac{3EJ}{l^3} \eta_3 - \frac{9}{8} pl^2 = 0 & \text{(III)} \end{cases}$$

$$(\text{III} - 2\text{I}): \left(-\frac{3}{2} - \frac{5}{6}\right) X_1 - \frac{1}{3} X_2 - \frac{9}{8} pl^2 = 0$$

$$(\text{II}) : X_2 = -\frac{pl^2}{24} - \frac{X_1}{3}$$

Allora:

$$-\frac{9-5}{6} X_1 + \frac{1}{3} \frac{pl^2}{24} + \frac{1}{9} X_1 - \frac{9}{8} pl^2 = 0$$

$$\frac{20}{9} X_1 + \frac{1-81}{72} pl^2 = 0$$

$$X_1 = -\frac{\frac{80}{72} \cdot \frac{9}{20} pl^2}{\frac{8}{9}} = -\frac{1}{2} pl^2$$

$$\boxed{X_1 = -\frac{1}{2} pl^2}$$

$$X_2 = -\frac{pl^2}{24} - \frac{1}{3} \left(-\frac{1}{2} pl^2\right) =$$

$$= \frac{-1+4}{24} pl^2 = \frac{1}{8} pl^2$$

$$\boxed{X_2 = \frac{1}{8} pl^2}$$

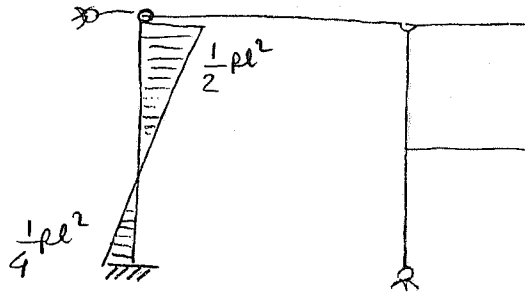
$$\eta_3 = \left[\frac{9}{8} pl + \frac{3}{2l} \left(-\frac{1}{2} pl^2\right) \right] \frac{l^3}{3EJ} =$$

$$= \left(\frac{9}{8} - \frac{3}{4}\right) \frac{pl^4}{3EJ} = \frac{3}{8} \cdot \frac{pl^4}{3EJ} = \frac{pl^4}{8EJ}$$

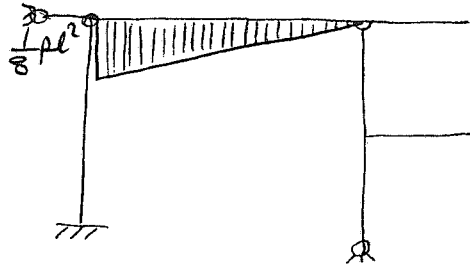
$$\boxed{\eta_3 = \frac{1}{8} \frac{pl^4}{EJ}}$$

Momenti flettenti

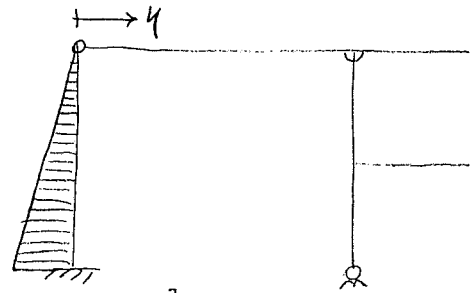
X_1 :



X_2 :

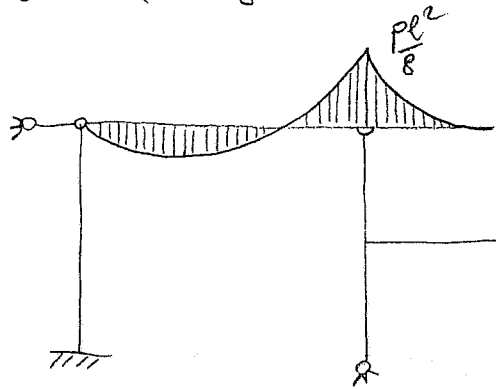


η_3 :

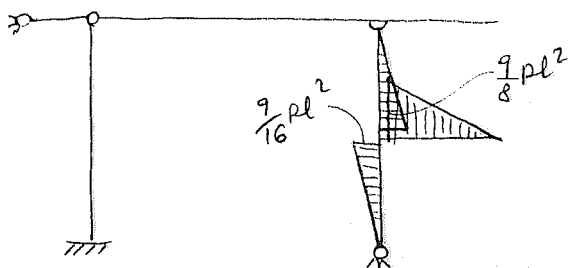


$$\frac{3 \cancel{pl^2}}{e^2} \cdot \frac{1 \cancel{pl^2}}{8 \cancel{pl^2}} \delta^2 = \frac{3}{8} pl^2 \delta^2$$

η_0 :



Q :

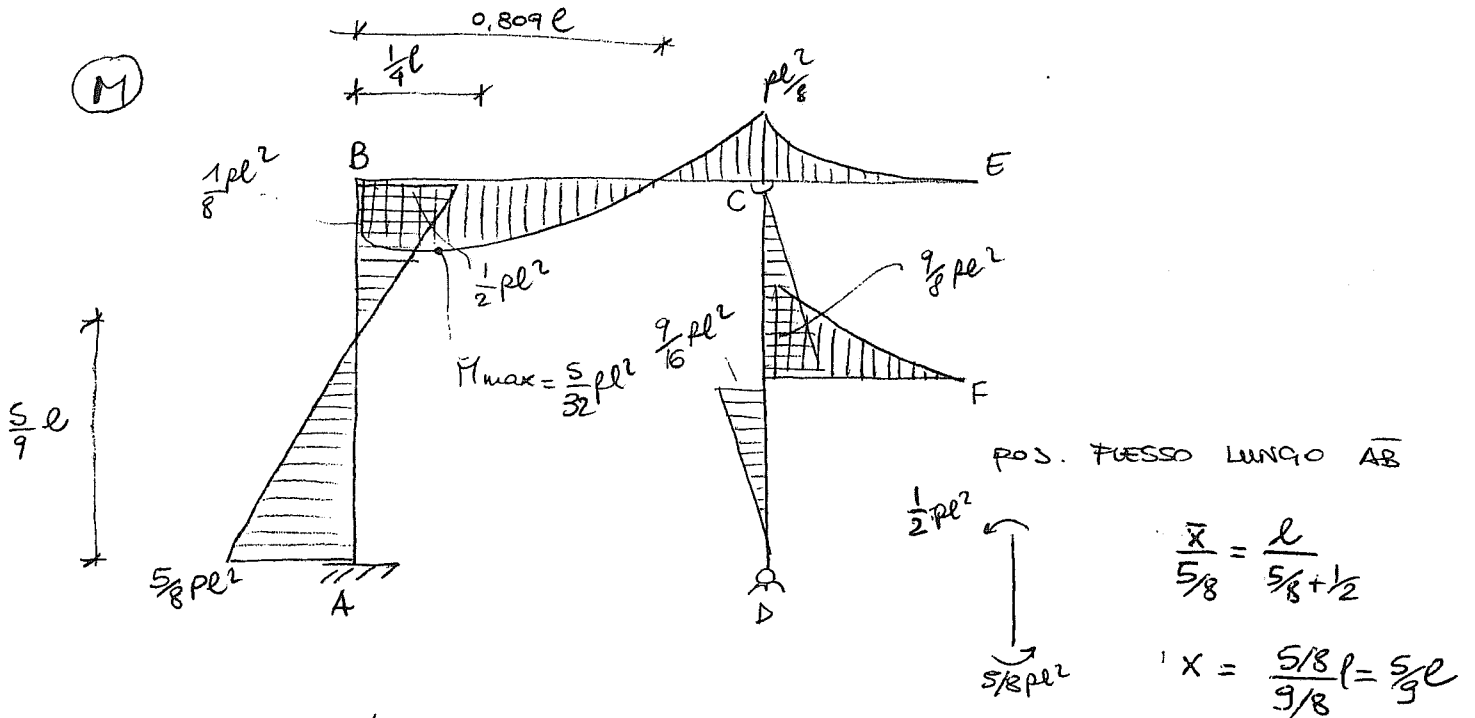


$$Q \cdot \frac{l}{4} =$$

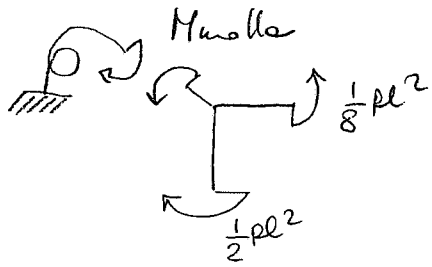
$$\left[\begin{array}{c} \curvearrowright \\ \curvearrowright \end{array} \right] Q \frac{l}{2} = \frac{9}{8} pl^2$$

$$\frac{Ql}{4} = \frac{9}{16} pl^2$$

(M)



Verifico l'equilibrio del nodo B:



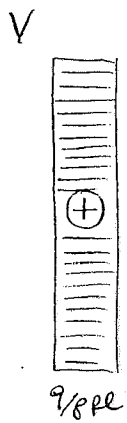
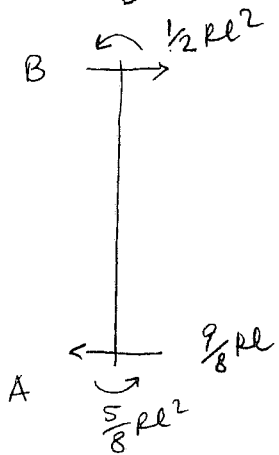
$$M_{molla} = -\frac{1}{8}pl^2 + \frac{1}{2}pl^2 = \frac{3}{8}pl^2$$

$$M_{molla} = |X_A + X_B|$$

✓ Tagli sulla struttura:

1 ⊕ ↓

TRATTO AB

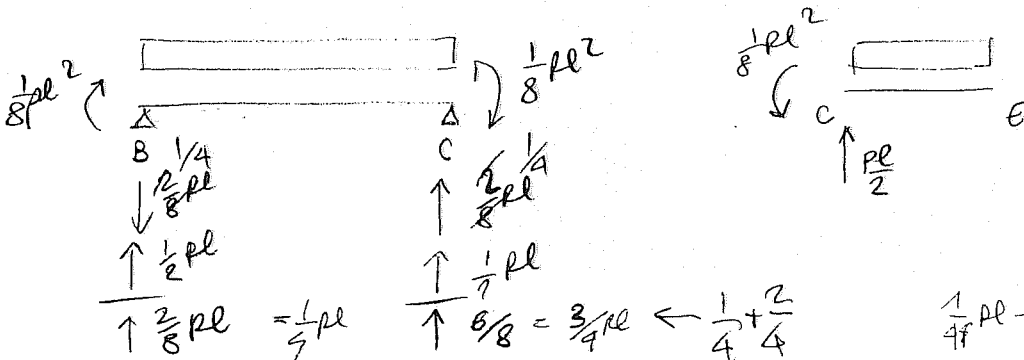


Fleso $M(x) = 0$

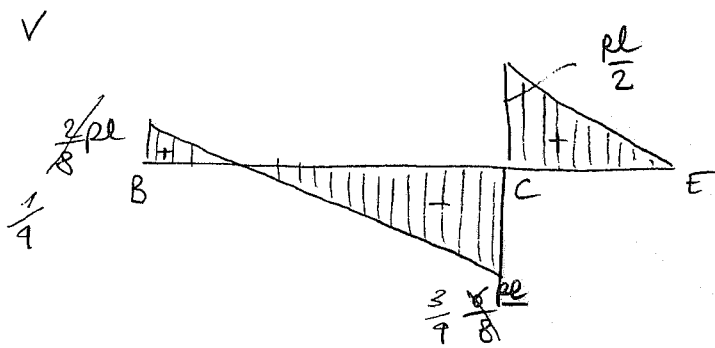
$$\frac{5}{8}pl^2 - \frac{9}{8}plx = 0$$

$$x = \frac{5}{9}l$$

TRATTO BE



$$\frac{1}{4}pl - px = 0 \quad x = \frac{1}{4}l$$



Mom. max

$$V(x) = 0$$

$$\frac{2}{8}pl - px = 0 \quad x = \frac{1}{4}l$$

$$M_{max} =$$

$$\frac{1}{4}pl \cdot \frac{1}{4}l + \frac{1}{8}pl^2 - p\left(\frac{1}{4}l\right)^2 \cdot \frac{1}{2}$$

$$= \frac{1}{32}pl^2 + \frac{4}{32}pl^2 = \frac{5}{32}pl^2$$

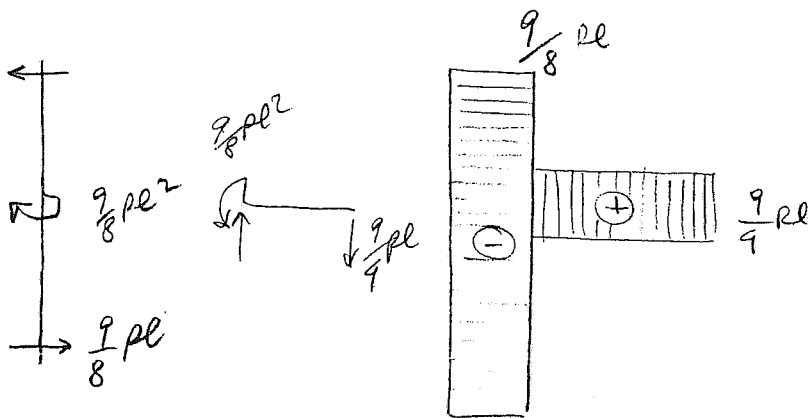
Punto di flesso:

$$M(x) = 0 : \frac{1}{4}plx + \frac{1}{8}pl^2 - p\frac{x^2}{2} = 0$$

$$x^2 - 0,5x - 0,25 = 0$$

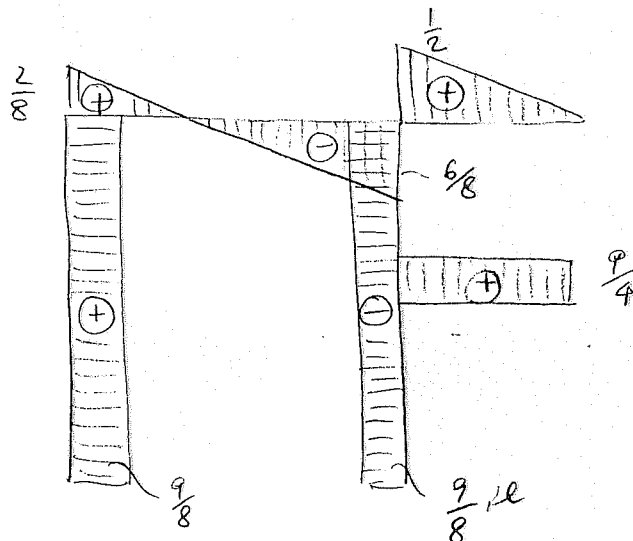
$$x = 0,809l$$

TRATTO CD

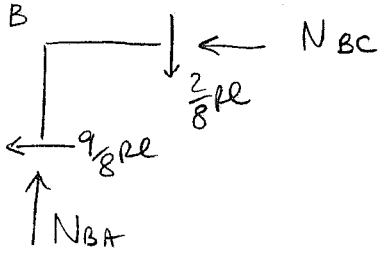


Alloce:

(V) [pl]

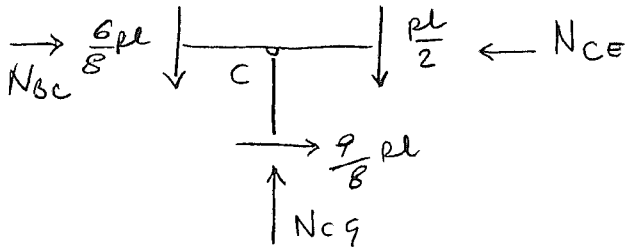


Azione Assiale ; Eq. nodi



$$N_{BC} = -\frac{9}{8} pl$$

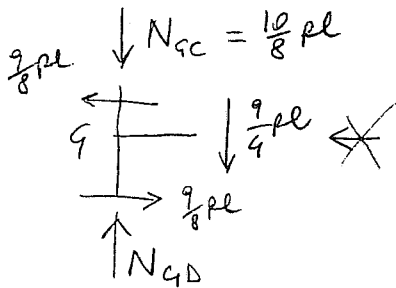
$$N_{CB} = +\frac{2}{8} pl$$



$$N_{CE} = 0 \quad (\text{MENSOLE ISOSTATICA})$$

$$N_{CB} = -\frac{9}{8} pl$$

$$N_{CG} = \frac{6}{8} + \frac{1}{2} = \frac{10}{8} pl$$

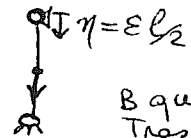


$$N_{GD} = \frac{10}{8} + \frac{18}{8} = \frac{28}{8} pl$$

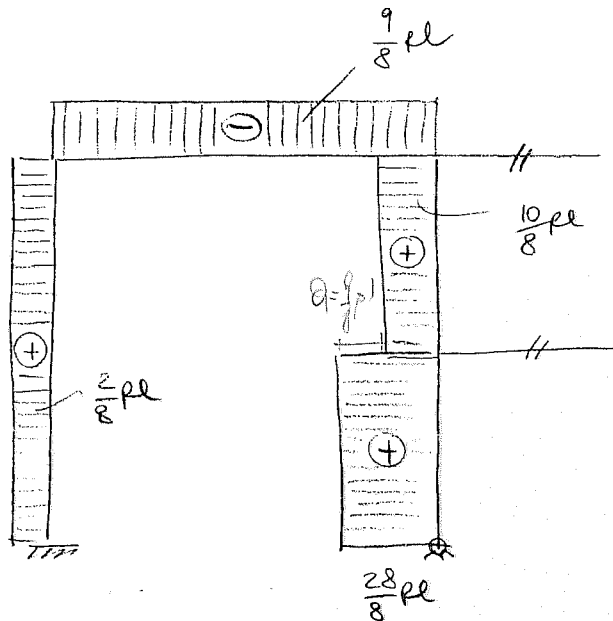
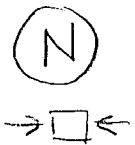
ATTENZIONE IL CASO È DIVERSO DA :

B
↓ P
A

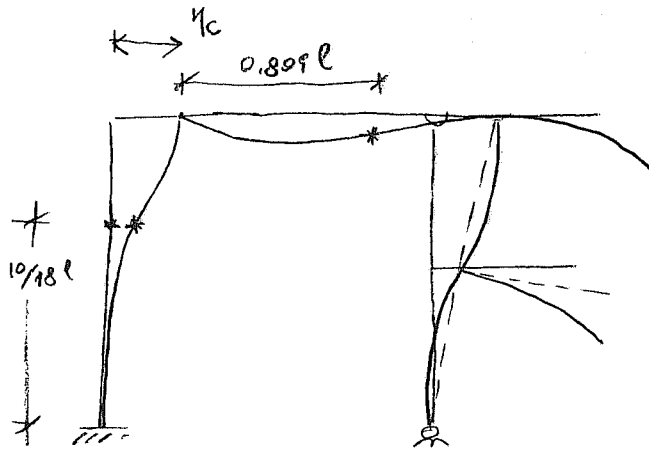
IPERST. ASSIALE dove A e B non possono traslare



B qui può Traslare di η pari all'accorcio delle 1/2 colonne compresse



Deformata Qualitativa



In assenza di
carichi fissici