

Esercizio 1.

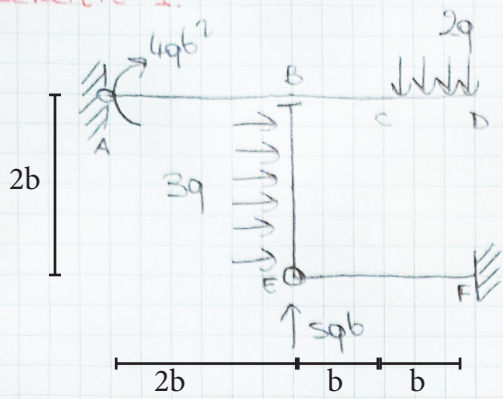
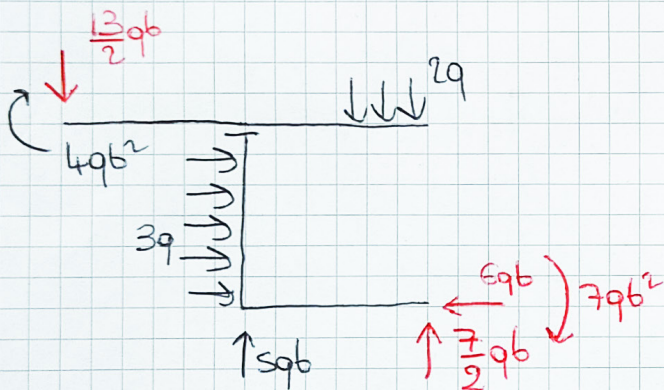
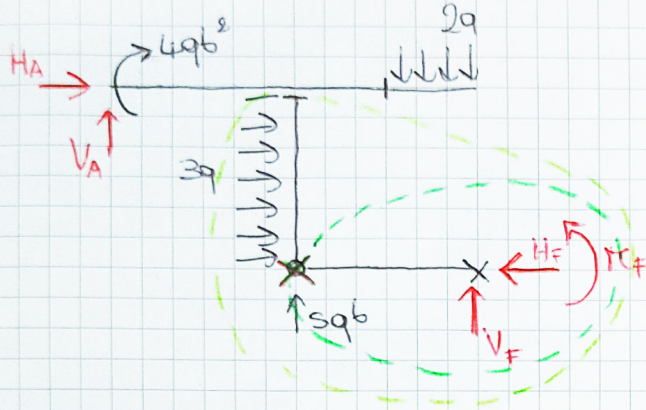


DIAGRAMMA CORPO LIBERO



STRUTTURA ISOSTATICA

①

$$GDL = 3+3+3=9$$

$$GDV = 2(A) + 2(B) + 2(E) + 3(F) = 9$$

$$GDL = GDV$$

$$\begin{cases} R_x = 0 \\ R_y = 0 \\ \pi_z(F) = 0 \end{cases}$$

Eq. CARB.

$$\begin{cases} H_A + 3q(2b) - H_F = 0 & [1] \\ V_A + 5qb + V_F - 2qb = 0 & [2] \\ 5qb(2b) + 6qb^2 - 2qb\left(\frac{b}{2}\right) + 4qb^2 + H_A 2b + V_A 4b - \pi_F = 0 & [3] \end{cases}$$

Eq. AUX.

$$\begin{cases} \pi_z(E) = 0 \quad V_F 2b + \pi_F = 0 & [4] \\ R_x = 0 \quad H_F - 3q(2b) = 0 \Rightarrow H_F = 6qb \end{cases}$$

$$[1] \quad H_A + 6qb - 6qb = 0 \Rightarrow H_A = 0$$

$$[2] \quad V_A + 3qb + V_F = 0 \Rightarrow V_A = -V_F - 3qb$$

$$[4] \quad \pi_F = -2V_F b$$

$$\begin{aligned} [3] \quad 10qb^2 + 6qb^2 - qb^2 + 4qb^2 + 2H_A b + 4V_A b - \pi_F &= 0 \\ 19qb^2 + 4(-V_F - 3qb) + 2V_F b &= 0 \\ 19qb^2 - 4V_F b - 12qb^2 + 2V_F b &= 0 \\ -2V_F + 7qb &= 0 \end{aligned}$$

$$V_F = \frac{7}{2}qb$$

$$[2] \quad V_A = -\frac{7}{2}qb - 3qb \quad V_A = -\frac{13}{2}qb$$

$$[4] \quad \pi_F = -7qb^2$$

REAZIONI VINCOLARI

$$H_F = 6qb$$

$$H_A = 0$$

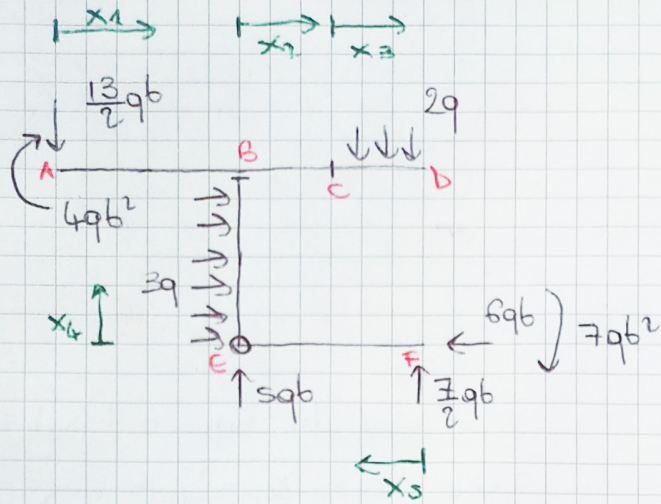
$$V_F = \frac{7}{2}qb$$

$$V_A = -\frac{13}{2}qb$$

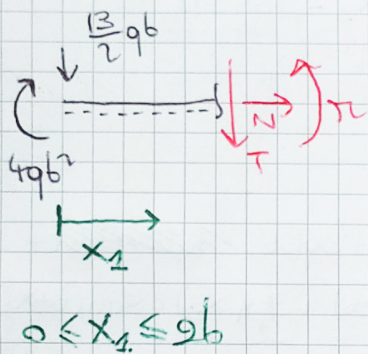
$$\pi_F = -7qb^2$$

Eq. Azioni INTERNE - PROCEDIMENTO 1

(2)



TRATTO AB



$$R_{//} = 0$$

$$N(x_1) = 0$$

$$R_{\perp} = 0$$

$$T(x_1) + \frac{13}{2} qb = 0 \quad T(x_1) = -\frac{13}{2} qb$$

$$\pi_2(x_1) = 0$$

$$\pi_2(x_1) + \frac{13}{2} qb x_1 - 4qb^2 = 0$$

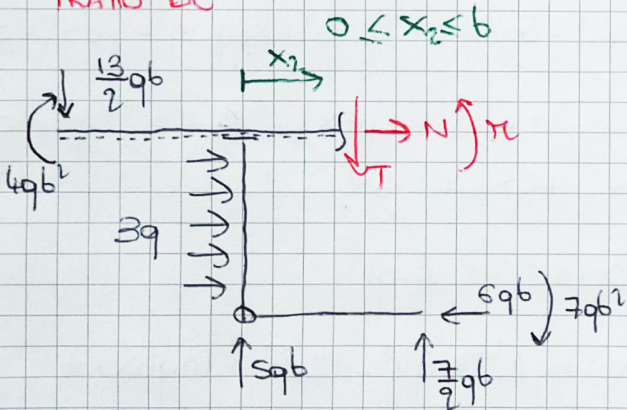
$$\pi_2(x_1) = 4qb^2 - \frac{13}{2} qb x_1$$

$$\bullet \pi_2(x_1=0) = 4qb^2$$

$$\pi_2(x_1=2b) = 4qb^2 - \frac{13}{2} qb(2b)$$

$$\bullet \pi_2(x_1) = -9qb^2$$

TRATTO BC



$$R_{//} = 0$$

$$N(x_2) - 6qb + 3q(2b) = 0 \quad N(x_2) = 0$$

$$R_{\perp} = 0$$

$$T(x_2) + \frac{13}{2} qb - 5qb - \frac{7}{2} qb = 0$$

$$\pi_2(x_2) = 0$$

$$T(x_2) + 3qb - 5qb = 0$$

$$T(x_2) = 2qb$$

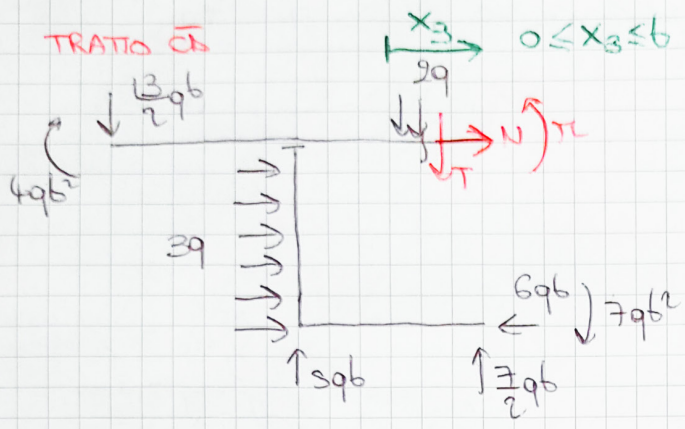
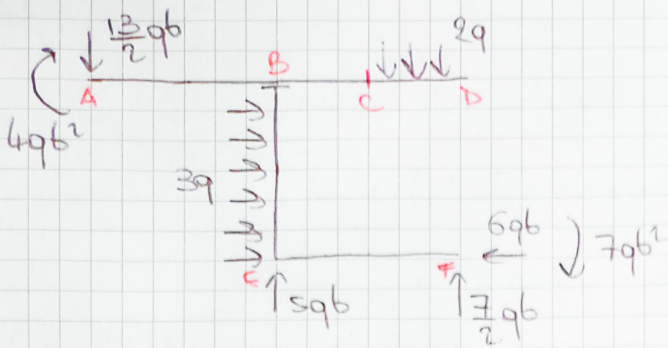
$$\pi_2(x_2) - 7qb^2 - 5qb(x_2) - 6qb(2b) + \frac{7}{2} qb(2b - x_2) + 3q2b^2 - 4qb^2 + \frac{13}{2} qb(2b + x_2) = 0$$

$$\pi_2(x_2) - 7qb^2 - 5qb x_2 - 12qb^2 + 7qb^2 - \frac{7}{2} qb x_2 + 6qb^2 - 4qb^2 + 13qb^2 + \frac{13}{2} qb x_2 = 0$$

$$\pi_2(x_2) - 2qb x_2 + 3qb^2 = 0$$

$$\pi_2(x_2) = 2qb x_2 - 3qb^2$$

$$\bullet \pi_2(x_2=0) = -3qb^2 \quad \bullet \pi_2(x_2=b) = 2qb^2 - 3qb^2 = -qb^2$$



$$R_1 = 0 \quad N(x_3) + 3q(2b) - 6qb = 0 \quad \boxed{N(x_3) = 0}$$

$$R_2 = 0 \quad T(x_3) + 2qx_3 + \frac{13}{2}qb - \frac{7}{2}qb - 6qb = 0$$

$$\pi_2(x_3) = 0 \quad T(x_3) - 5qb + 3qb + 2qx_3 = 0$$

$$\boxed{T(x_3) - 2qb + 2qx_3 = 0}$$

- $T(x_3=0) = 2qb$
- $T(x_3=b) = 0$

$$* \pi_2(x_3) - 4qb^2 - 7qb^2 + \frac{7}{2}qb(2b-x_3) - 6qb(2b) - 5qb(b+x_3) + 3q(2b^2) + \frac{13}{2}qb(2b+x_3) + 2qx_3^2 = 0$$

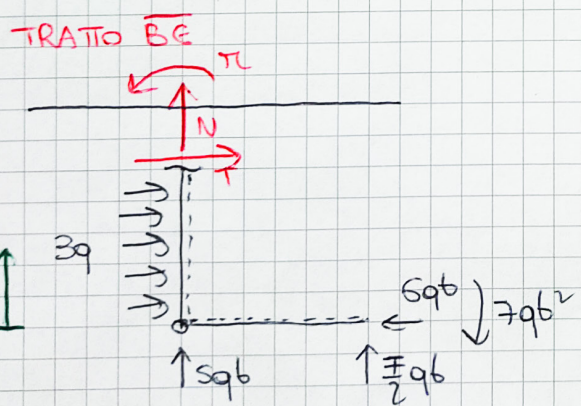
$$* \pi_2(x_3) - 11qb^2 + \frac{7}{2}qb^2 - \frac{7}{2}qb x_3 - 12qb^2 - 5qb^2 - 5qb x_3 + 6qb^2 + \frac{39}{2}qb^2 + \frac{13}{2}qb x_3 + 2qx_3^2 = 0$$

$$\pi_2(x_3) + \frac{46}{2}qb^2 - 16qb^2 - 6qb^2 + 3qb x_3 - 5qb x_3 + qx_3^2 = 0$$

$$\pi_2(x_3) + 23qb^2 - 22qb^2 - 2qb x_3 + qx_3^2 = 0$$

$$\boxed{\pi_2(x_3) + qb^2 - 2qb x_3 + qx_3^2 = 0}$$

$\pi_2(x_3=0) = -qb^2$ $\pi_2(x_3=b) = 0$



$$N(x_4) + 5qb + \frac{7}{2}qb = 0 \quad \boxed{N(x_4) = -\frac{17}{2}qb}$$

$$T(x_4) + 3q\left(\frac{x_4^2}{2}\right) - 6qb = 0$$

$$\boxed{T(x_4) + 3qx_4 - 6qb = 0}$$

- $T(x_4=0) = 6qb$
- $T(x_4=2b) = 0$

$$\pi(x_4) + 3q\left(x_4 \cdot \frac{x_4}{2}\right) + \frac{7}{2}qb(2b) - 6qb(x_4) - 7qb^2 = 0$$

$$\pi(x_4) + \frac{3}{2}qx_4^2 + 7qb^2 - 6qb x_4 - 7qb^2 = 0$$

$$\boxed{\pi(x_4) + \frac{3}{2}qx_4^2 - 6qb x_4 = 0}$$

- $\pi(x_4=0) = 0$
- $\pi(x_4=2b) = -\frac{3}{2}q(4b^2) + 6qb(2b) = -6qb^2 + 12qb^2 = 6qb^2$

TRATTO EF

4

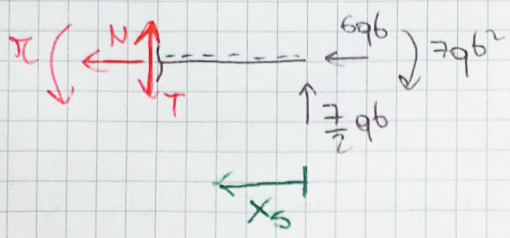
$$N(x_s) + 6qb = 0 \quad N(x_s) = -6qb$$

$$T(x_s) + \frac{7}{2}qb = 0 \quad T(x_s) = -\frac{7}{2}qb$$

$$N(x_s) - 7qb^2 + \frac{7}{2}qb x_s = 0$$

$$N(x_s=0) = 7qb^2$$

$$N(x_s=2b) = 0$$

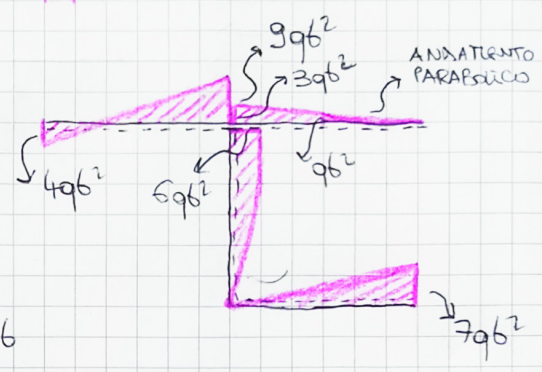
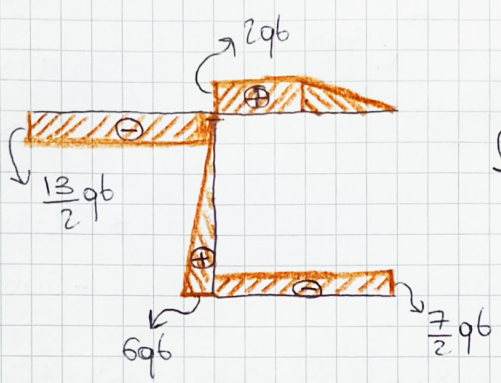
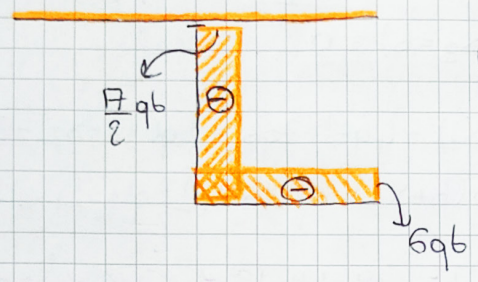


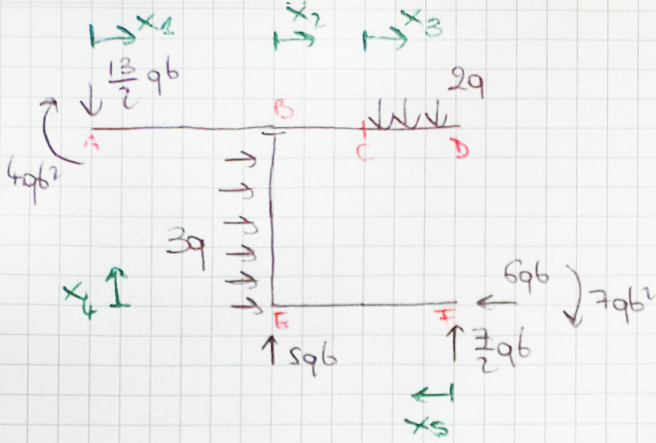
$$0 \leq x_s \leq 2b$$

N

T

M





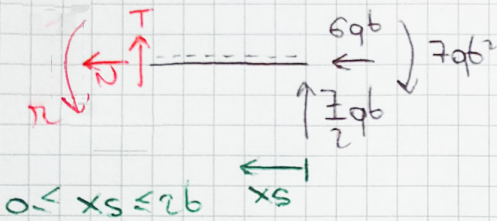
$F \rightarrow E$

$$N(x_5) = -6qb$$

$$T(x_5) = -\frac{7}{2}qb$$

$$\pi(x_5) = 7qb^2 - \frac{7}{2}qb x_4$$

- $\pi(x_5=0) = 7qb^2$
- $\pi(x_5=2b) = 0$



$E \rightarrow B$

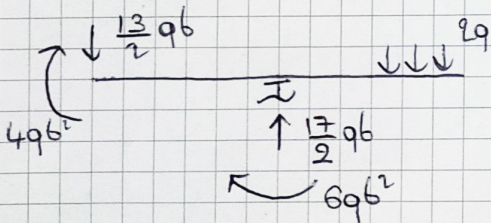
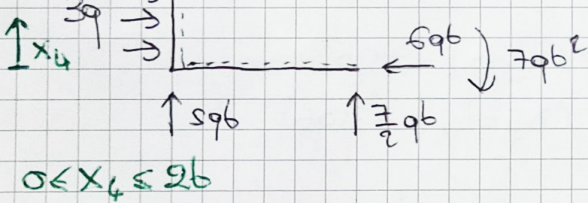
$$N(x_4) = -\frac{17}{2}qb$$

$$T(x_4) + 3x_4 - 6qb = 0$$

- $T(x_4=0) = 6qb$
- $T(x_4=2b) = 0$

$$\pi(x_4) + \frac{3}{2}qx_4^2 - 6qb x_4 = 0$$

- $\pi(x_4=0) = 0$
- $\pi(x_4=2b) = 6qb^2$



$B \rightarrow C$

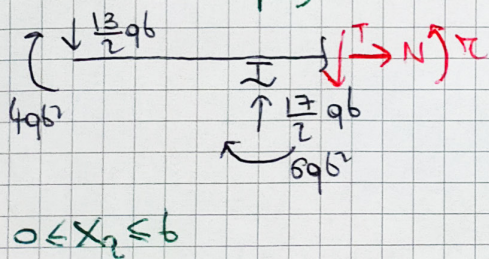
$$N(x_2) = 0$$

$$T(x_2) - \frac{17}{2}qb + \frac{13}{2}qb = 0 \Rightarrow T(x_2) = 2qb$$

$$\pi(x_2) - 4qb^2 - 6qb^2 + \frac{13}{2}qb(2b+x_2) - \frac{17}{2}qb x_2 = 0$$

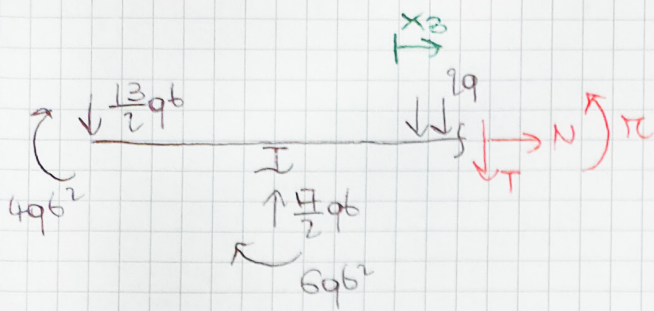
$$\pi(x_2) - 10qb^2 + 13qb^2 + \frac{13}{2}qb x_2 - \frac{17}{2}qb x_2 = 0$$

$$\pi(x_2) + 3qb^2 - 2qb x_2 = 0$$



$0 \leq x_2 \leq b$

⑥



$$0 \leq x_3 \leq b$$

$$N(x_3) = 0$$

$$T(x_3) - \frac{17}{2}qb + \frac{13}{2}qb + 2qx_3 = 0$$

$$T(x_3) - 2qb + 2qx_3 = 0$$

$$\pi(x_3) - 6qb^2 - 4qb^2 - \frac{17}{2}qb(b+x_3) + \frac{13}{2}qb(3b+x_3) + 2q\frac{x_3^2}{2} = 0$$

$$\pi(x_3) - 10qb^2 - \frac{17}{2}qb^2 - \frac{17}{2}qb x_3 + \frac{39}{2}qb^2 + \frac{13}{2}qb x_3 + qx_3^2 = 0$$

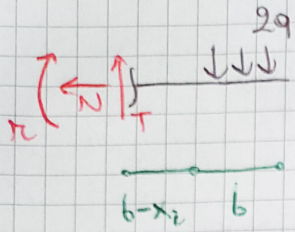
$$\pi(x_3) + qb^2 - 2qb x_3 + qx_3^2 = 0$$

PER IL TRATTO A → B PROCEDIMENTO 1

AZIONI INTERNE - PROCENTUALE 3

PER I TRATTI $A \rightarrow B$; $F \rightarrow E$; $E \rightarrow B$ PROCENTUALE 1

$B \rightarrow C$



$$0 \leq x_2 \leq b$$

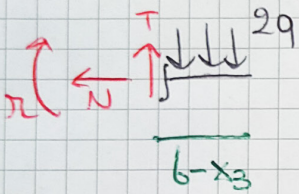
$$N(x_2) = 0$$

$$T(x_2) - 2qb = 0 \Rightarrow T(x_2) = 2qb$$

$$\pi(x_2) + 2qb \left(b - x_2 + \frac{b}{2} \right) = 0$$

$$\pi(x_2) + 3qb^2 - 2qb x_2 = 0$$

$C \rightarrow D$



$$0 \leq x_3 \leq b$$

$$N(x_3) = 0$$

$$T(x_3) - 2q(b - x_3) = 0$$

$$T(x_3) - 2qb + 2q x_3 = 0$$

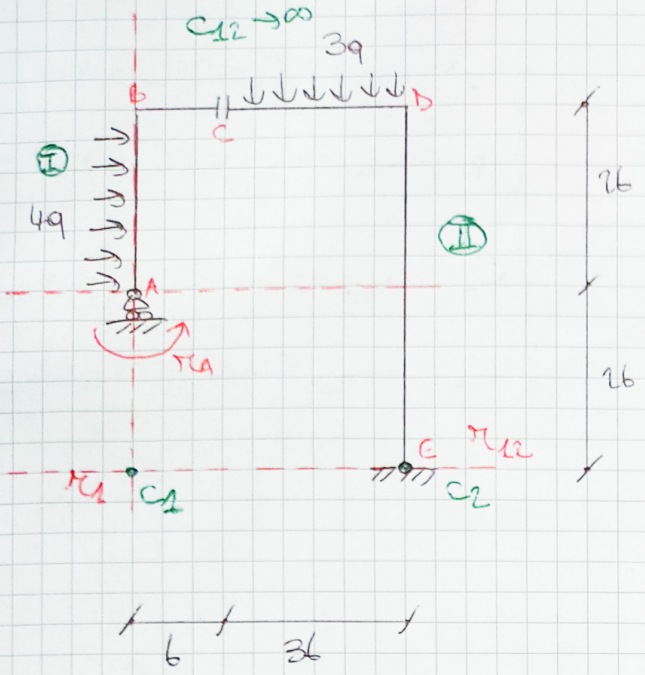
$$\pi(x_3) + 2q(b - x_3) \left(\frac{b - x_3}{2} \right) = 0$$

$$\pi(x_3) + (qb - qx_3)(b - x_3) = 0$$

$$\pi(x_3) + qb^2 - qb x_3 - qb x_3 + qx_3^2 = 0$$

$$\pi(x_3) + qb^2 - 2qb x_3 + qx_3^2 = 0$$

Esercizio 2



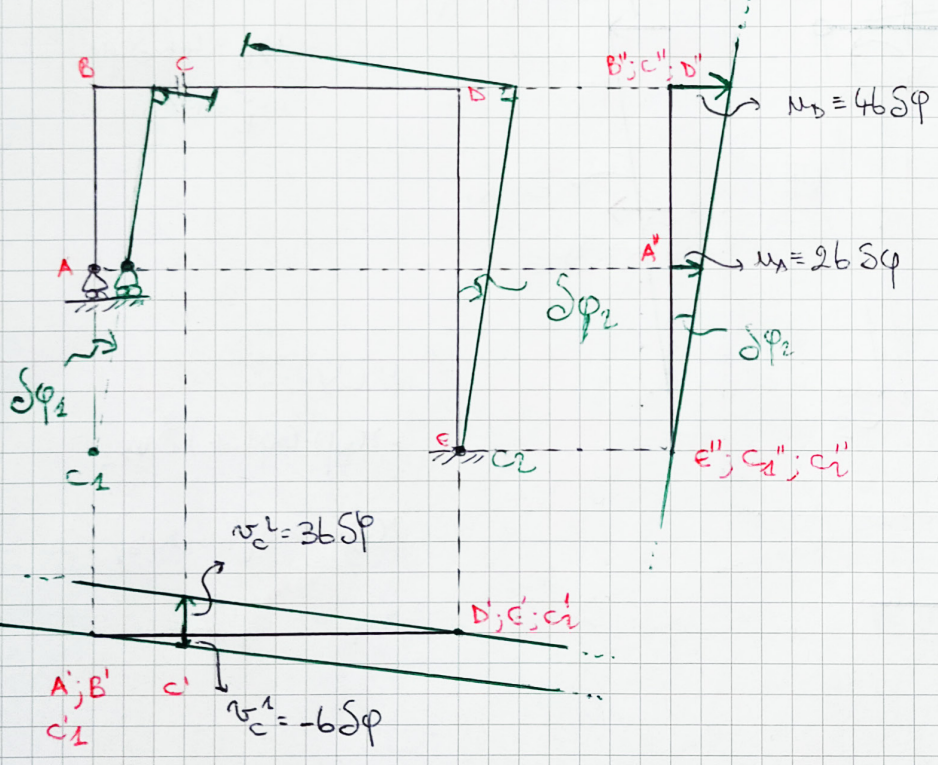
$$C_2 \equiv E \equiv (4b; -2b)$$

$$C_{12} \equiv (0; 0)$$

PER LE CONDIZIONI CINEMATICHE

$$\begin{cases} C_1 \in \chi_1 \\ C_1 \leftrightarrow C_{12} \leftrightarrow C_2 \end{cases}$$

$$C_1 \equiv (0; -2b)$$



$$W_B = 4b \delta \varphi_1$$

$$W_C^1 = -b \delta \varphi_1$$

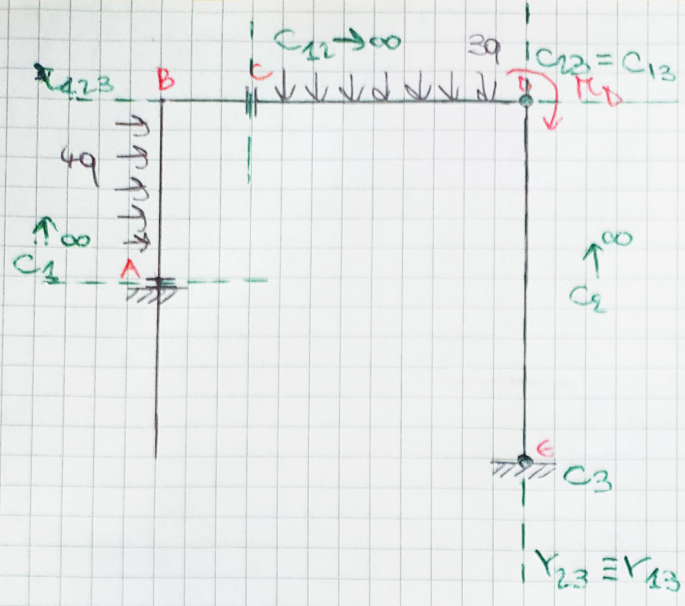
P.L.V

$$-R_A \delta \varphi_1 + 4q(2b)(3b \delta \varphi_1) +$$

$$-3q(3b) \left(\frac{3}{2} b \delta \varphi_1 \right) = 0$$

$$R_A - 24qb^2 + \frac{27}{2} qb^2 = 0$$

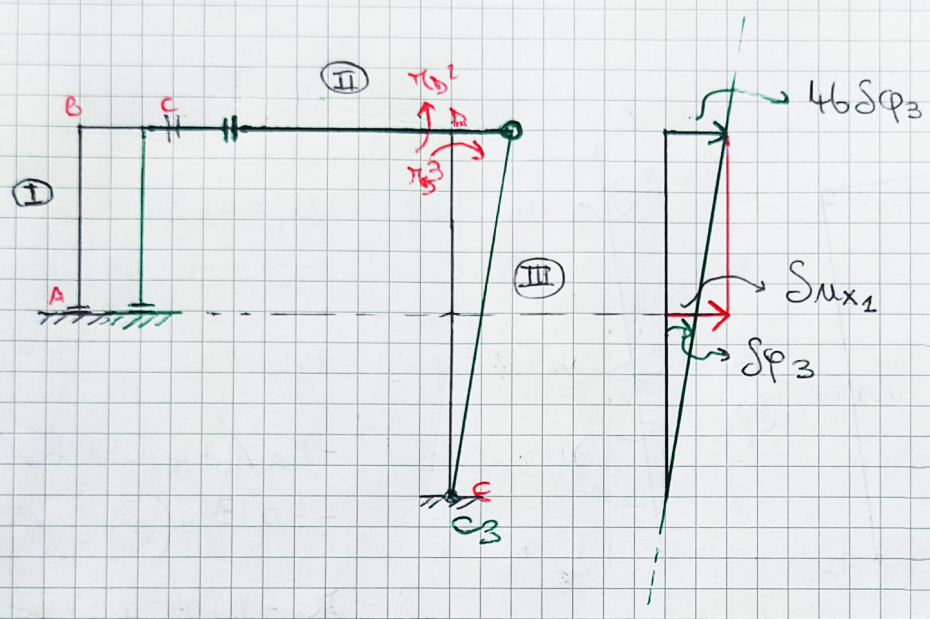
$$R_A = \frac{21}{2} qb^2$$



Condizioni

$$\begin{cases} C_1 \leftrightarrow C_{12} \leftrightarrow C_2 \Rightarrow C_1 \in \mathcal{V}_{12} \\ C_2 \leftrightarrow C_{23} \leftrightarrow C_3 \Rightarrow C_2 \in \mathcal{V}_{23} \end{cases}$$

$$\begin{cases} C_1 \leftrightarrow C_{13} \leftrightarrow C_3 \Rightarrow C_1 \in \mathcal{V}_{13} \\ C_{12} \leftrightarrow C_{23} \leftrightarrow C_{13} \Rightarrow C_{13} \in \mathcal{V}_{123} \end{cases}$$



$$\begin{aligned} S_{M_{x_1}} &= 46Sp_3 \\ M_B &= 46Sp_3 \\ r_B &= 0 \end{aligned}$$

PLV

$$\begin{aligned} \pi_b^3 Sp_3 + 4q(2b) S_{M_{x_1}} &= 0 \\ \pi_b^3 Sp_3 + 8qb S_{46Sp_3} &= 0 \\ \pi_b^3 + 32qb^2 &= 0 \\ \pi_b^3 &= -32qb^2 \end{aligned}$$