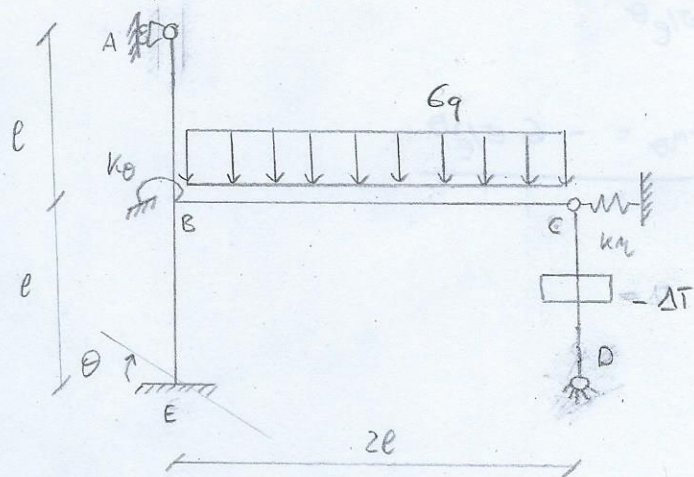
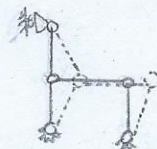


GDL: 6 } 4 VOLTI IPERUNCOLATA
GDU: 10

STRUTTURA A NODI SPORSTABILI



CONVENZIONI:

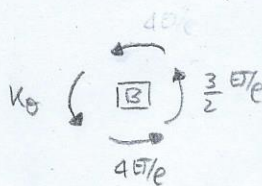
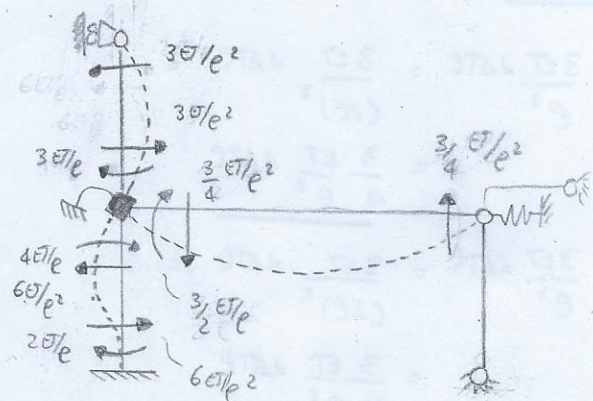


INCOGNITE:

φ_B ; M_C ; ΔT ; u_C ; k_θ ; θ

CASO $\varphi_B = 1$

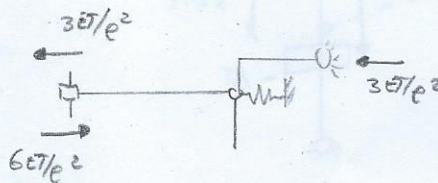
$$k_\theta \varphi_B = k_\theta$$



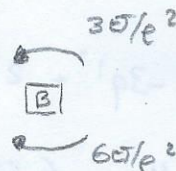
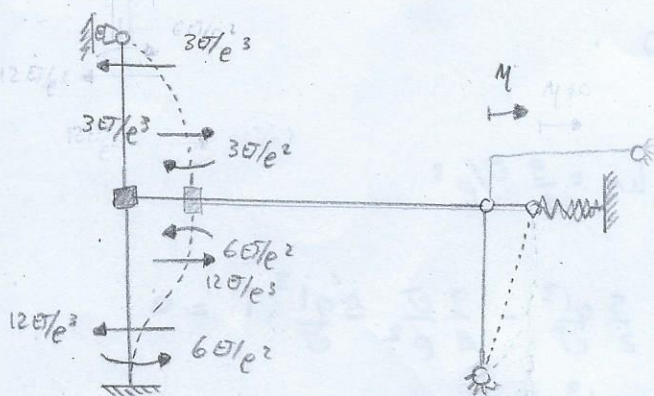
$$M_{BB} = 7EI/e + \frac{3}{2}EI/e + k_\theta$$

$$= \frac{17}{2}EI/e + k_\theta$$

$$h_{uB} = -3EI/e^2$$

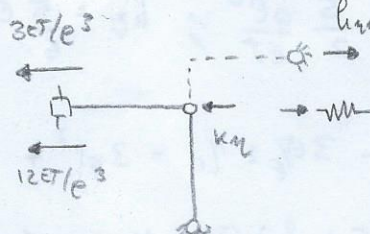


CASO $M = 1$

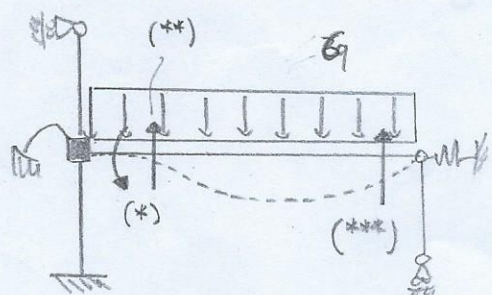


$$M_{BB} = (3 - 6)EI/e^2 = -3EI/e^2$$

$$h_{uB} = 15EI/e^3 + k_\theta$$



CASO $q \neq 0$



$$(*) \quad \frac{p e^2}{8} = \frac{6q(2e)^2}{8} = \frac{6q \cdot 4e^2}{8} = 3q l^2$$

$$(**) \quad \frac{5}{8} p e = \frac{5}{8} \cdot 6q \cdot 2e = \frac{15}{2} q l$$

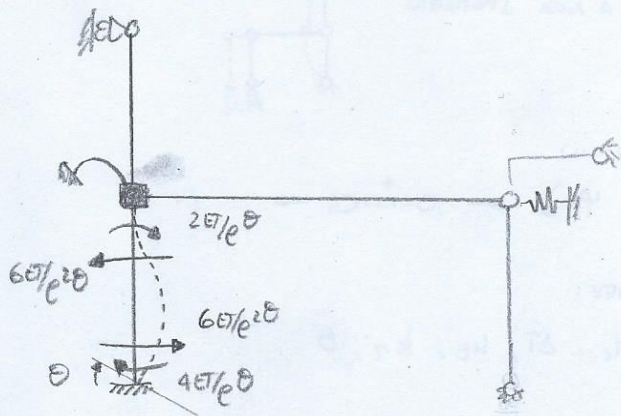
$$(***) \quad \frac{3}{8} p e = \frac{3}{8} \cdot 6q \cdot 2e = \frac{9}{2} q l$$

$$3q l^2$$

$$u_q = -3q l^2$$

$$h_q = 0$$

CASO $\theta \neq 0$

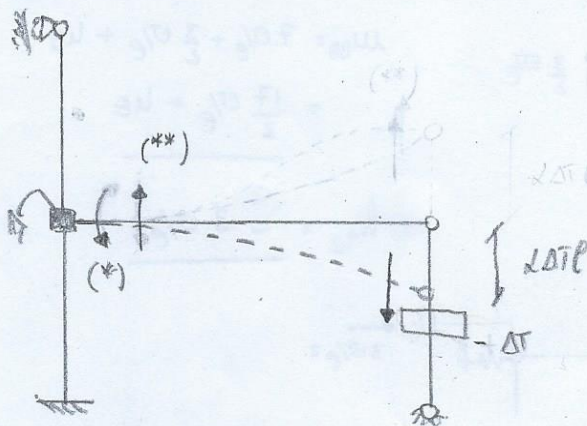


$$\boxed{B} \quad \frac{2EI}{e} \theta$$

$$\underline{M_{B\theta} = 2EI/e \theta}$$

$$\underline{h_{M\theta} = -6EI/e^2 \theta}$$

CASO $\Delta T \neq 0$



$$\underline{M_{B\Delta T} = -\frac{3EI}{4e^2} \Delta T e}$$

$$\boxed{B} \quad \frac{3EI}{4e^2} \Delta T e$$

$$\underline{h_{M\Delta T} = 0}$$

$$(*) \quad \frac{3EI}{e^2} \Delta T e = \frac{3EI}{(2e)^2} \Delta T e = \frac{3EI}{4e^2} \Delta T e$$

$$(**) \quad \frac{3EI}{e^3} \Delta T e = \frac{3EI}{(2e)^3} \Delta T e = \frac{3EI}{8e^2} \Delta T e$$

EQUAZIONI RIUNITE

$$\begin{cases} \left(\frac{17}{2} \frac{EI}{e} + h_B \right) \varphi_B - 3 \frac{EI}{e^2} M_C - 3q^1 + 2 \frac{EI}{e} \theta - \frac{3}{4} \frac{EI}{e^2} \Delta T e = 0 \\ -3 \frac{EI}{e^2} \varphi_B + \left(15 \frac{EI}{e^3} + h_M \right) M_C - 6 \frac{EI}{e^2} \theta = 0 \end{cases}$$

$$\Delta T = \frac{8}{5} \frac{q^1}{e}; \quad \theta = \frac{5}{2} \frac{q^1}{EI}; \quad h_B = \frac{5}{6} \frac{EI}{e}; \quad h_M = \frac{9}{4} \frac{EI}{e^2}$$

$$\begin{cases} \left(\frac{17}{2} \frac{EI}{e} + \frac{5}{6} \frac{EI}{e} \right) \varphi_B - 3 \frac{EI}{e^2} M_C - 3q^1 + 2 \frac{EI}{e} \frac{5}{2} \frac{q^1}{EI} - \frac{3}{4} \frac{EI}{e^2} \frac{8}{5} \frac{q^1}{e} \cdot 1 = 0 \\ -3 \frac{EI}{e^2} \varphi_B + \left(15 + \frac{9}{4} \right) \frac{EI}{e^3} M_C - 6 \frac{EI}{e^2} \frac{5}{2} \frac{q^1}{EI} = 0 \end{cases}$$

$$\begin{cases} \frac{56}{6} \frac{EI}{e} \varphi_B - 3 \frac{EI}{e^2} M_C - 3q^1 + 5q^1 - 6q^1 = 0 \\ -3 \frac{EI}{e^2} \varphi_B + \frac{69}{4} \frac{EI}{e^3} M_C - 15q^1 = 0 \end{cases}$$

$$\begin{cases} \frac{56}{6} \frac{EI}{e} \varphi_B - 3 \frac{EI}{e^2} M_C - 4q^1 = 0 \\ -3 \frac{EI}{e^2} \varphi_B + \frac{69}{4} \frac{EI}{e^3} M_C - 15q^1 = 0 \end{cases}$$

$$3 \frac{EI}{e^2} \varphi_C = \frac{56}{6} \frac{EI}{e} \varphi_B - 4q l^2$$

$$\frac{EI}{e^2} \varphi_C = \frac{56}{18} \frac{EI}{e} \varphi_B - 4/3 q l^2$$

$$\varphi_C = \frac{56}{18} \varphi_B - 4/3 \frac{q l^2}{EI}$$

$$-3 \frac{EI}{e^2} \varphi_B + \frac{69}{4} \frac{EI}{e^3} \cdot \left(\frac{56}{18} \varphi_B - 4/3 \frac{q l^2}{EI} \right) - 15 q l = 0$$

$$-3 \frac{EI}{e^2} \varphi_B + \frac{161}{3} \frac{EI}{e^2} \varphi_B - 23 q l^2 - 15 q l = 0$$

$$-9 \frac{EI}{e^2} \varphi_B + 161 \frac{EI}{e^2} \varphi_B - 69 q l - 45 q l = 0$$

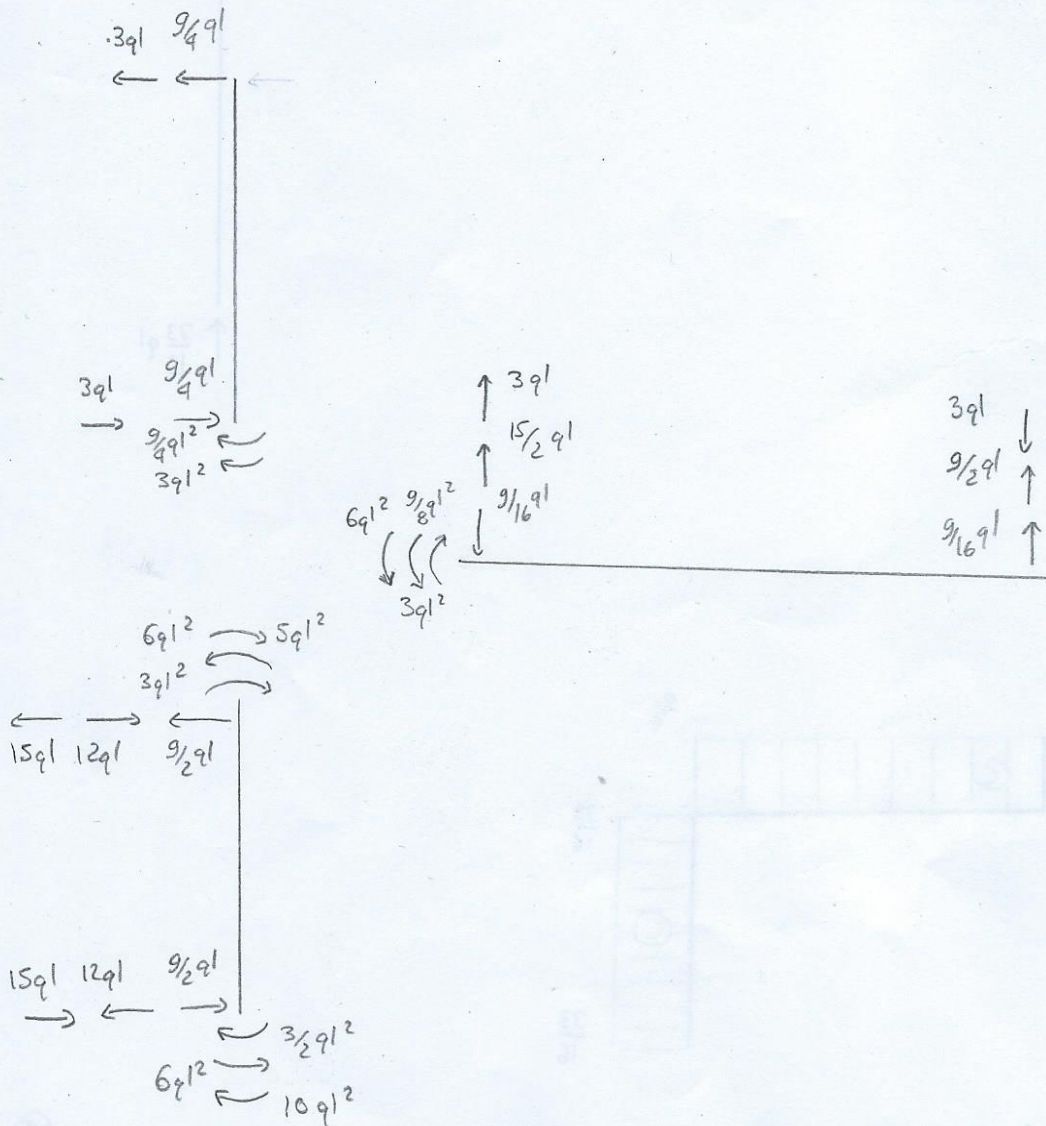
$$152 \frac{EI}{e^2} \varphi_B - 114 q l = 0 \rightarrow \varphi_B = \frac{114}{152} \frac{q l^3}{EI} \rightarrow \boxed{\varphi_B = \frac{3}{4} \frac{q l^3}{EI}}$$

$$\varphi_C = \frac{56}{18} \varphi_B - 4/3 \frac{q l^2}{EI} = \left(\frac{7}{3} - \frac{4}{3} \right) \frac{q l^2}{EI} \rightarrow \boxed{\varphi_C = \frac{q l^2}{EI}}$$

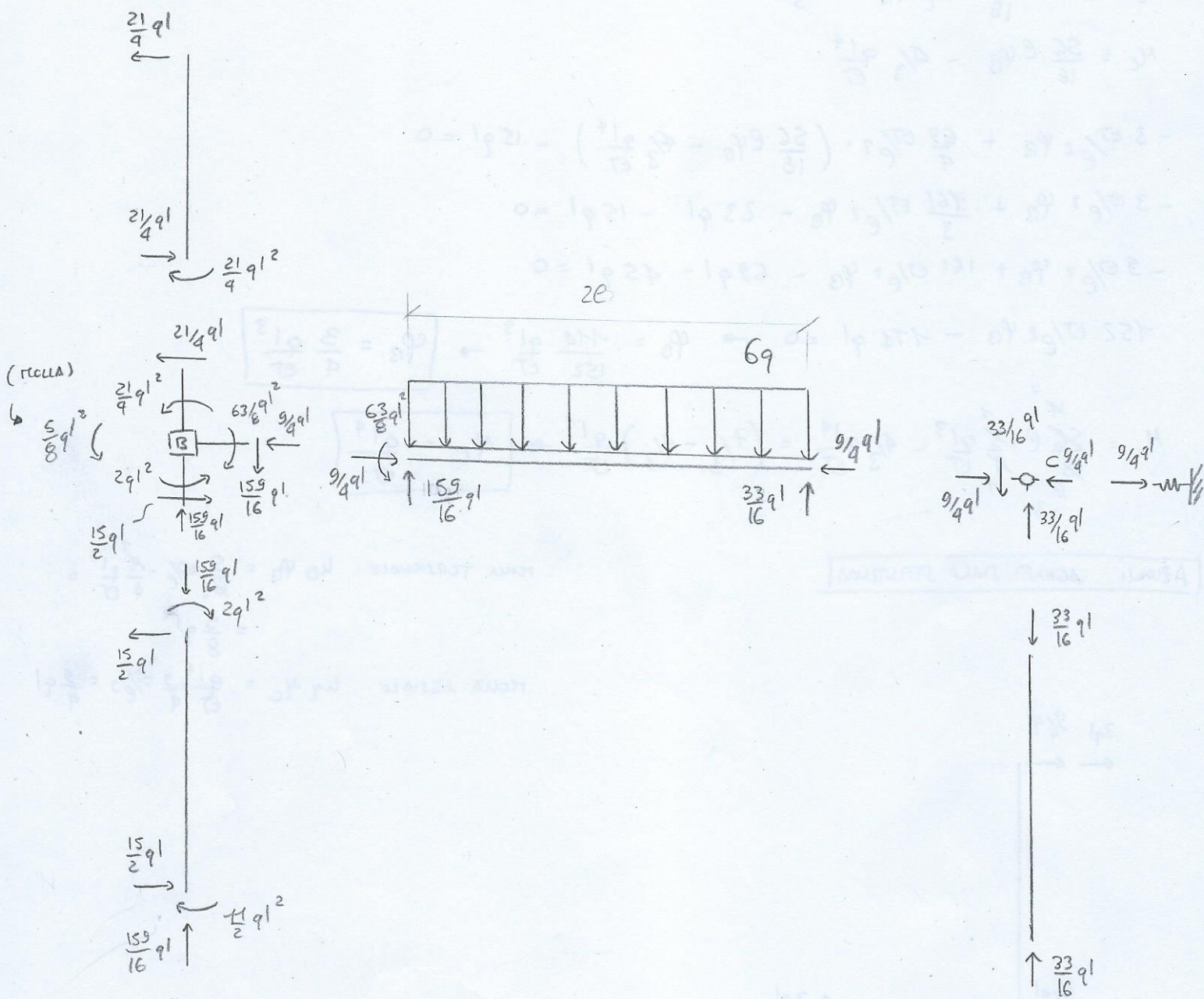
AZIONI AGENTI SULLA STRUTTURA

$$\text{MOCA TORSIONALE: } u_0 \varphi_B = \frac{5}{8} \frac{EI}{e} \cdot \frac{3}{4} \frac{q l^3}{EI} = \frac{5}{8} q l^2$$

$$\text{MOCA TRASLAZIONALE: } u_4 \varphi_C = \frac{q l^2}{EI} \cdot \frac{9}{4} \frac{EI}{e^3} = \frac{9}{4} q l$$

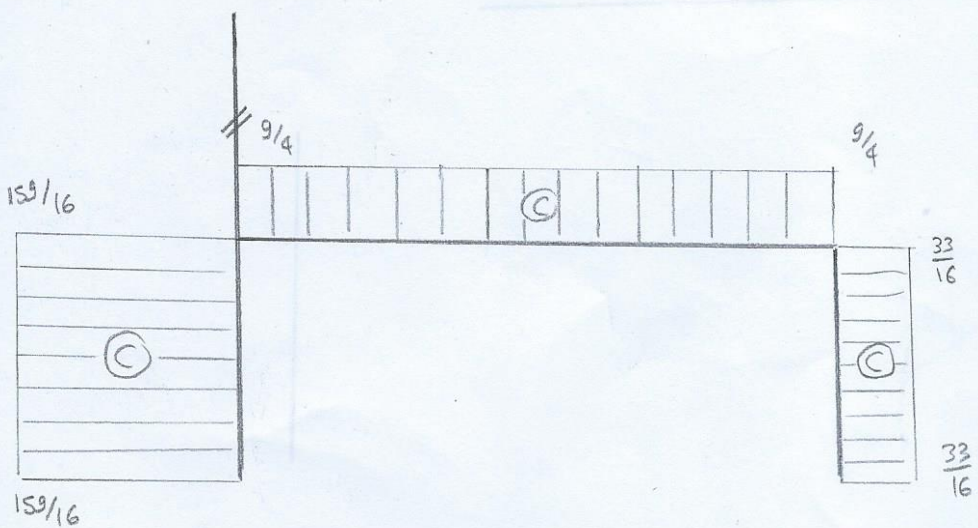


$$\sum M_{CB} = 0 \quad \text{⑤}$$



DIAGRAMMI

$\frac{N}{ql}$



$\frac{V}{q l}$

PUNTO DI ANNULLAMENTO DEL TAGLIO x_1 :

$$\frac{33}{16} q l - 6 q x_1 = 0$$

$$\frac{33}{16} q l = 6 q x_1 \rightarrow x_1 = \frac{11}{32} l$$

$$\begin{aligned} M_{\max} &= \frac{33}{16} q l x_1 - 6 q x_1 \frac{x_1}{2} = \\ &= \frac{33}{16} q l \frac{11}{32} l - 6 q \frac{11}{32} \frac{11}{32} l^2 = \\ &= \frac{363}{512} q l^2 - \frac{363}{1024} q l^2 \\ &= \frac{726 - 363}{1024} = \frac{363}{1024} q l^2 \end{aligned}$$

PUNTO DI FLESSO ASTA $\overline{BE}$ (x_2)

$$\frac{11}{2} q l^2 - \frac{15}{2} q l x_2 = 0$$

$$x_2 = \frac{11}{15} l$$

PUNTO DI ANNULLAMENTO DEL MOMENTO ASTA $\overline{BC}$ (FLESSO x_3)

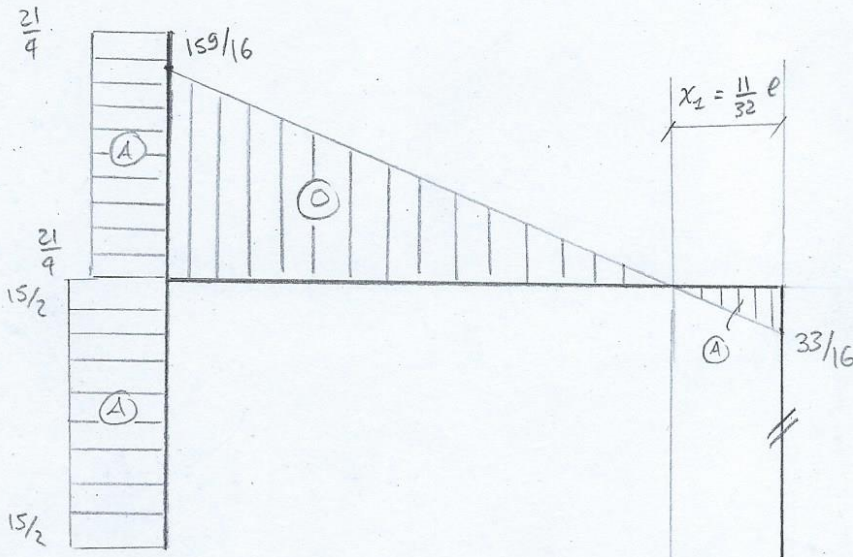
$$\frac{33}{16} q l x_3 - 6 q x_3 \frac{x_3}{2} = 0$$

$$\frac{33}{16} q l x_3 - 3 q x_3^2 = 0$$

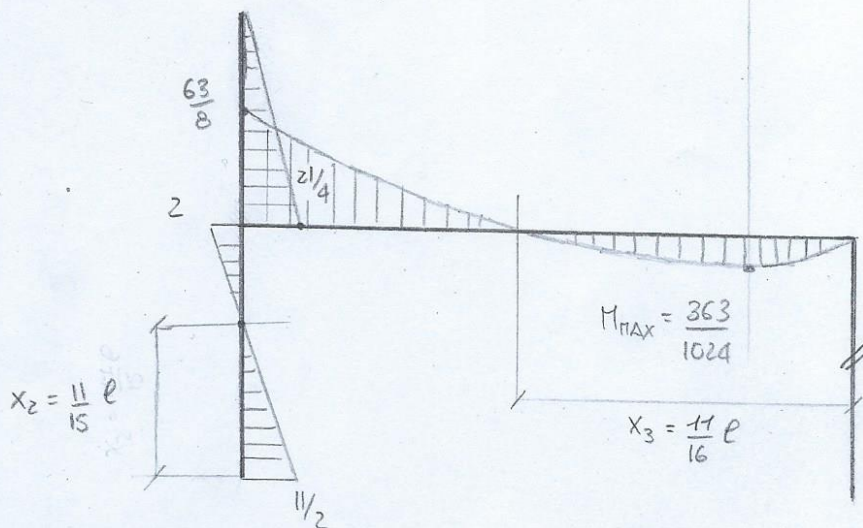
$$x_3 = 0 \text{ (PUNTO C)}$$

$$\frac{33}{16} l - 3 x_3 = 0$$

$$x_3 = \frac{11}{16} l$$



$\frac{M}{q l^2}$



DEFORMATA QUADRATIVA

