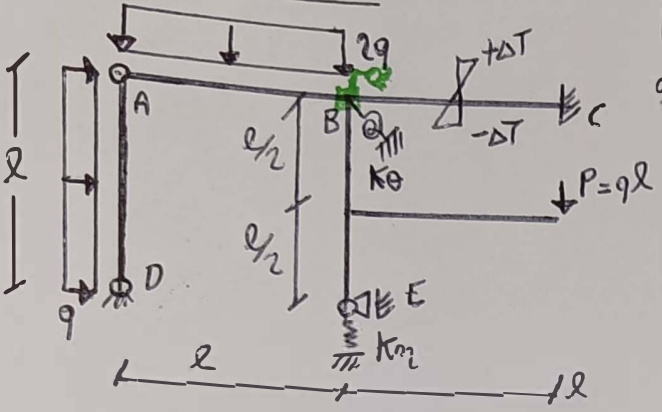


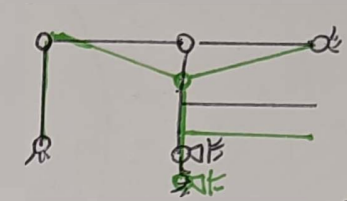


$$k_{\theta} = \frac{53}{8} \frac{EJ}{l}$$

$$k_{\eta} = 48 \frac{EJ}{l^3}$$

$$\frac{\alpha \Delta T}{H} = 8 \frac{ql^2}{EJ}$$

ANALISI CINEMATICA, TELAIO NODI FISSI O SPOSTABILI



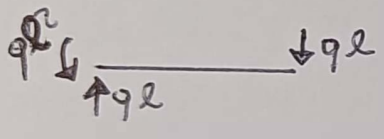
TELAIO A NODI SPOSTABILI IN Y $\Rightarrow$

BILANCIA FIRTIZIA IN B $\rightarrow \square + \square$ BILANCIA NODO

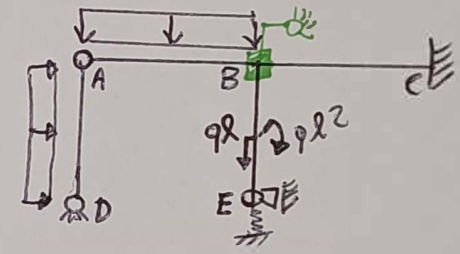
SISTEMA RISOLVENTE

$$\begin{cases} m_{B,B} \varphi_B + m_{B,\eta} \cdot \eta + m_{B,\phi} = 0 \\ h_{m,B} \varphi_B + h_{m,\eta} \cdot \eta + h_{m,\phi} = 0 \end{cases}$$

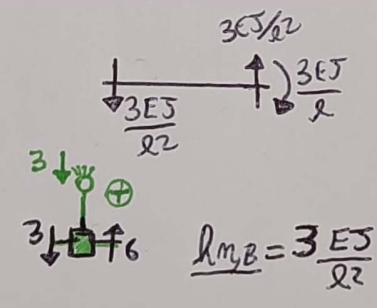
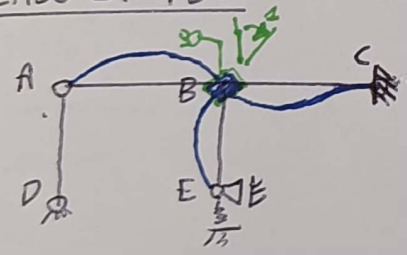
APPENDICE ISOSTATICA



$\Rightarrow$ RIPOSDI AZIONI SULLA STRUTTURA



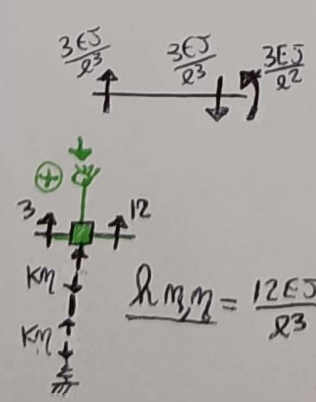
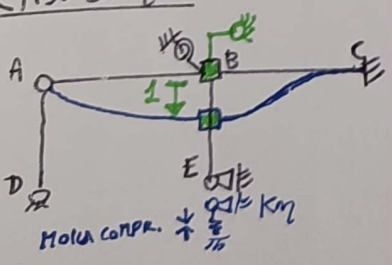
CASO 1: $\varphi_B = 1$



$$m_{BB} = \frac{3EJ}{l} + \frac{4EJ}{l} + \frac{3EJ}{l} + k_{\theta}$$

$$= \frac{133}{8} \frac{EJ}{l}$$

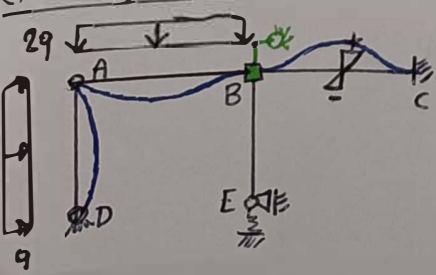
CASO 2: $\eta = 1$



$$m_{B,\eta} = \frac{6EJ}{l^2} - \frac{3EJ}{l^2} = \frac{3EJ}{l^2}$$

$$h_{m,\eta} = \frac{12EJ}{l^3} + \frac{3EJ}{l^3} + k_{\eta} = 63 \frac{EJ}{l^3}$$

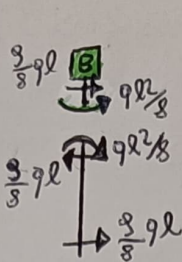
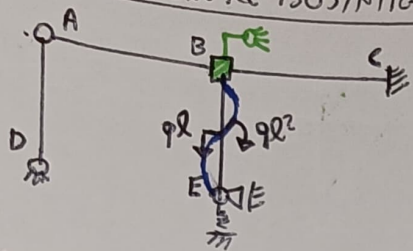
CASO 3 $q \neq 0; \Delta T \neq 0$



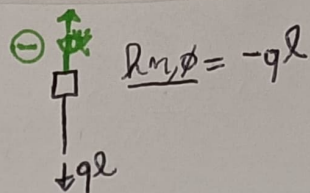
$$m_{B,\phi} = \frac{ql^2}{4} + 2EJ \frac{\alpha \Delta T}{H} = \frac{65ql^2}{4}$$

$$h_{m,\phi} = -\frac{5}{4} ql$$

CASO 4: APPENDICE ISOSTATICA



$$m_{B\phi} = \frac{ql^2}{8}$$



$$m_{B\phi} = -ql^2$$

SISTEMA

$$\begin{cases} \left(\frac{133ES}{8l}\right)\varphi_B + \left(\frac{3ES}{l^2}\right)\eta + \left(\frac{65}{4} + \frac{1}{8}\right)ql^2 = 0 \\ \left(\frac{3ES}{l^2}\right)\eta + \left(\frac{63ES}{l^3}\right)\eta - \left(\frac{5}{4} + 1\right)ql = 0 \end{cases} \cdot \left(-\frac{133}{24}\right)$$

$$\rightarrow \begin{cases} \left(\frac{133ES}{8l}\right)\varphi_B + \left(\frac{3ES}{l^2}\right)\eta + \frac{131}{8}ql^2 = 0 \\ \left(-\frac{133ES}{8l}\right)\varphi_B - \left(\frac{63 \cdot 133ES}{24l^2}\right)\eta + \frac{9}{4}\frac{133}{24}ql^2 = 0 \end{cases}$$

$$0 \cdot \varphi_B - \frac{2763}{8}\eta + \frac{923}{32} = 0$$

$$\Rightarrow \boxed{\eta = \frac{923}{32} \cdot \frac{8}{2763} = \frac{1}{12} \frac{ql^4}{ES}}$$

RICAVO φ :

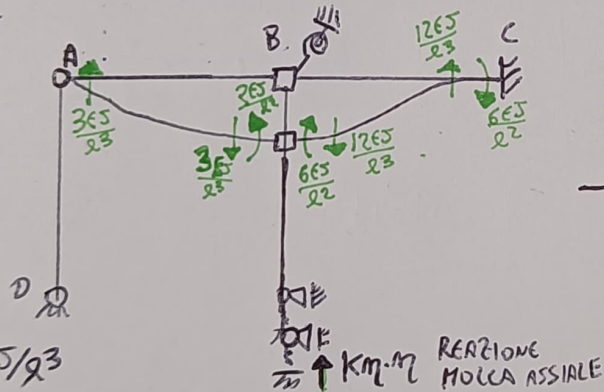
$$\left(\frac{133ES}{8l}\right)\varphi_B + \frac{3ES}{l^2} \cdot \frac{1}{12} \frac{ql^4}{ES} + \frac{131}{8}ql^2 = 0$$

$$\frac{133}{8} \frac{ES}{l} \varphi_B + \left(\frac{131}{8} + \frac{1}{4}\right)ql^2 = 0 \Rightarrow \boxed{\varphi_B = -\frac{1}{12} \frac{ql^3}{ES}}$$

ROTAZIONE ANTIORARIA

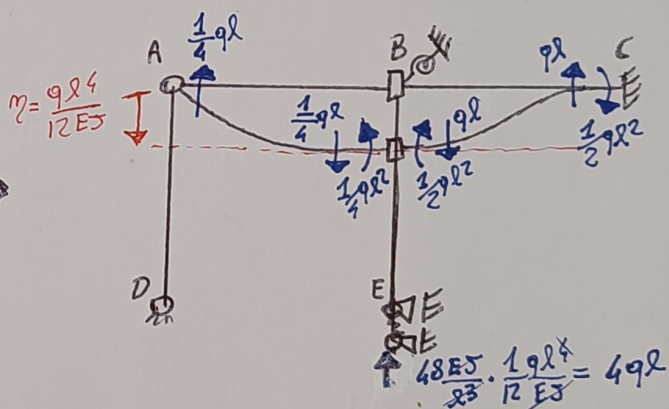
RIVALUTO η

($\eta=1$)



$$K\eta = 48ES/l^3$$

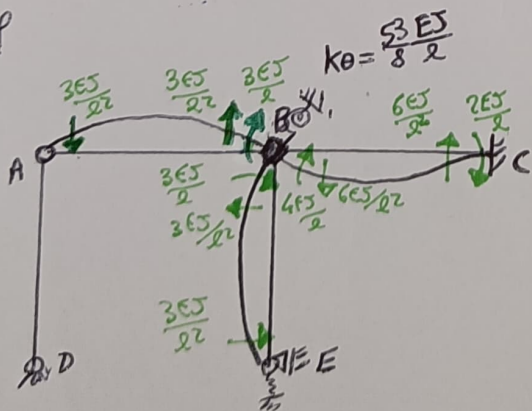
REAZIONE MOLLA ASSIALE



$$48ES \cdot \frac{1}{12} \frac{ql^4}{ES} = 4ql$$

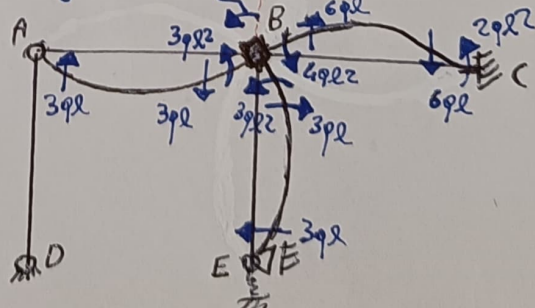
RIVALUTO φ

($\varphi=1$)

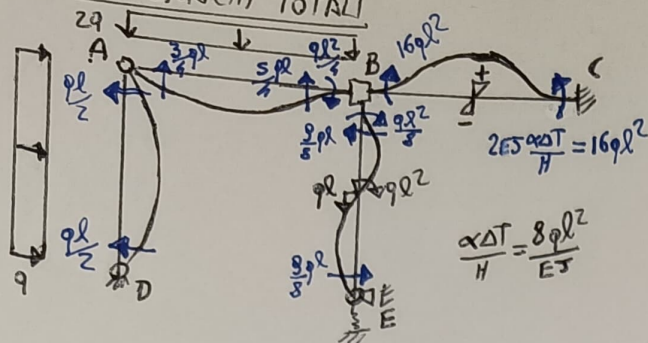


$$K\phi = \frac{53ES}{8l}$$

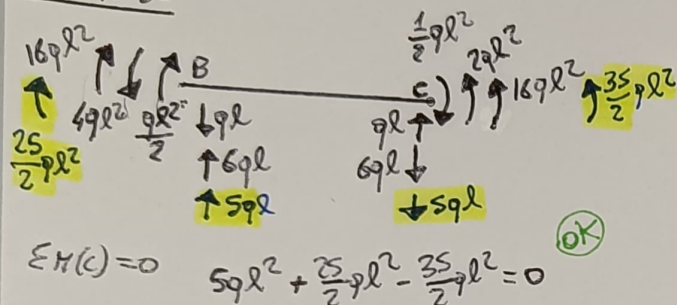
$$\text{REAZ. MOLLA TORSIONALE} = -\frac{53}{8}ql^2$$



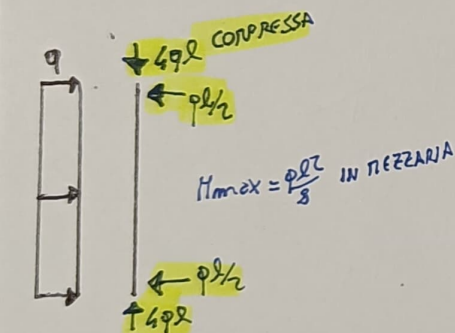
EFFETTO CARICHI TOTALI



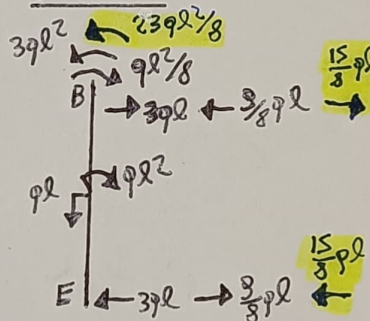
ASTA BC



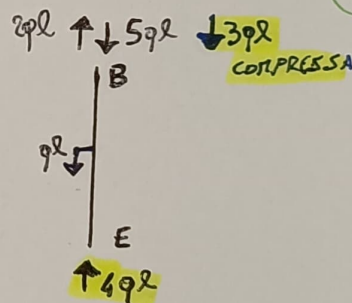
ASTA AD



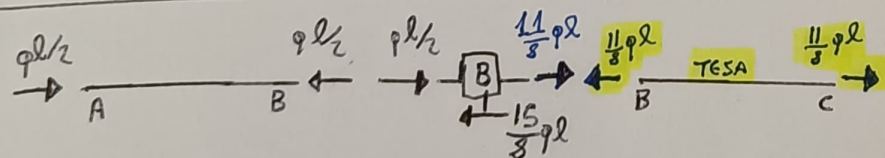
ASTA BE



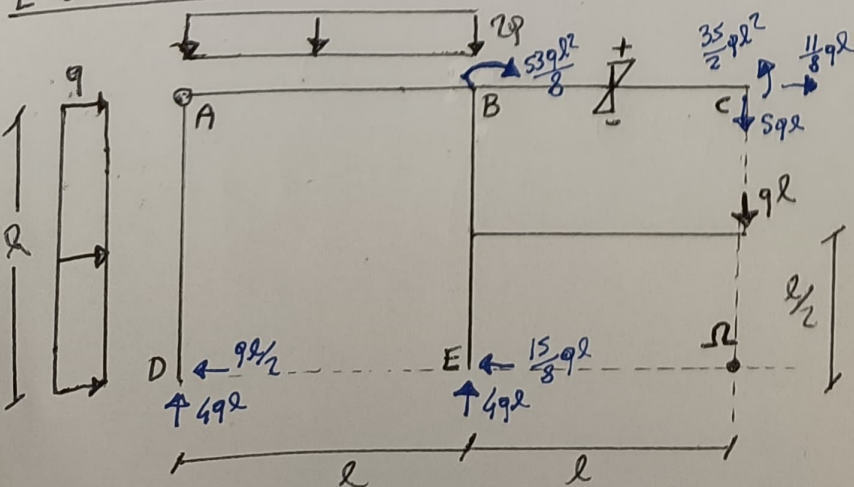
$\sum M(B) = 0 \quad \frac{15}{8} q l^2 + q l^2 - \frac{23}{8} q l^2 = 0$ (OK)



AZIONE ASSIALE TRATTO A-B-C



EQUILIBRIO GLOBALE



$(+\uparrow) \sum V = 0 \quad 4 q l + 4 q l - q l - 5 q l - 2 q l = 0$ (OK)

$(+\rightarrow) \sum H = 0 \quad q + \frac{11}{8} q l - \frac{q l}{2} - \frac{15}{8} q l = 0$ (OK)

$(\curvearrowright) \sum M(O) = 0$

$4 q l^2 + 8 q l^2 + \frac{q l^2}{2} - 2 q l \left(\frac{3}{2} l \right) - \frac{35}{2} q l^2 + \frac{11}{8} q l^2 + \frac{53}{8} q l^2 = 0$ (OK)

DIAGRAMMA $N/q\ell$

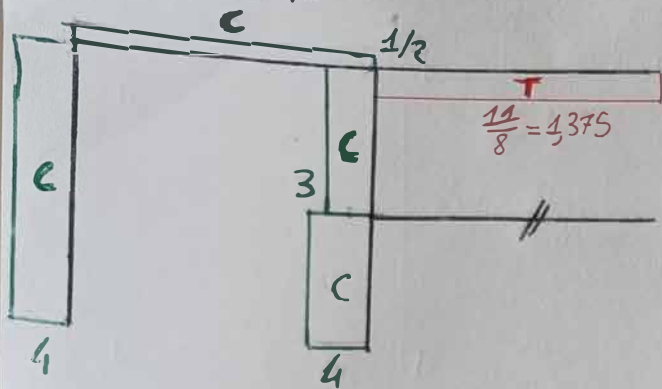


DIAGRAMMA $V/q\ell$

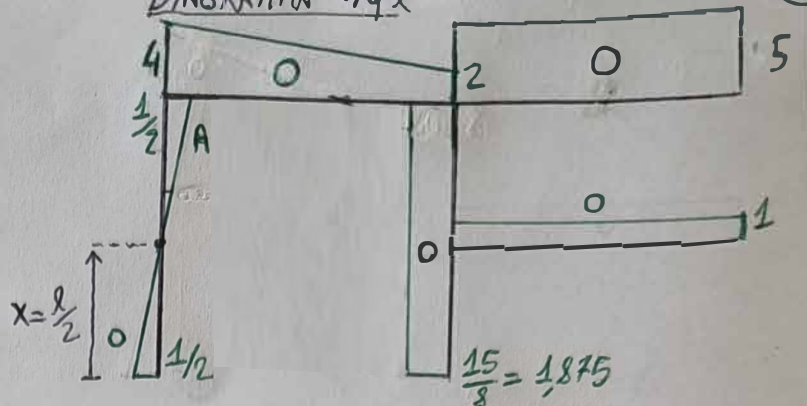
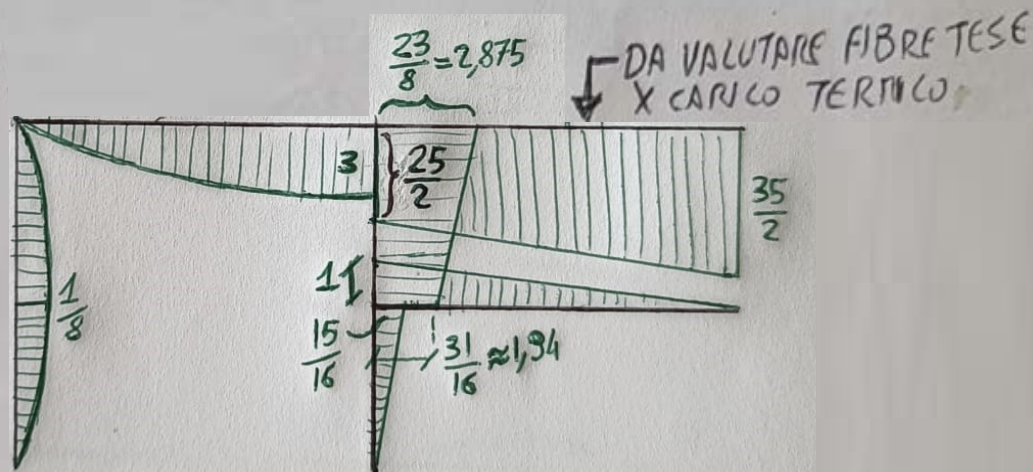
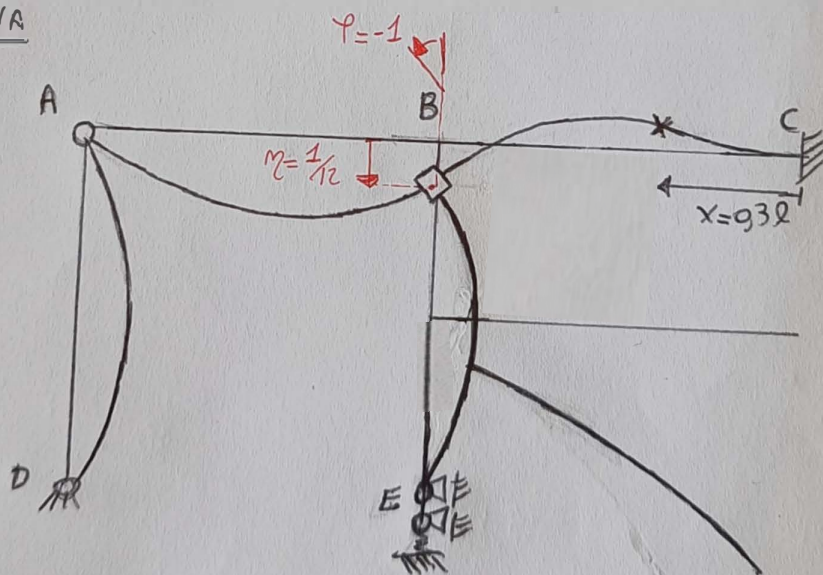


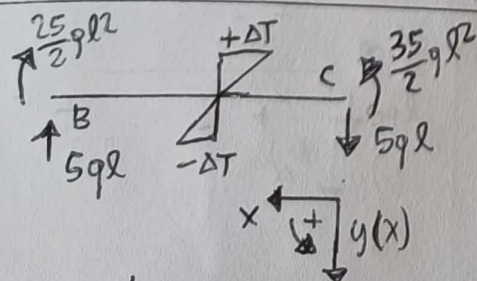
DIAGRAMMA $M/q\ell^2$



DEFORMATA QUALITATIVA



CURVATURA IN PRESENZA DI CARICO TERTICO (ASTA BC)



$$M(x) = 35/2 q\ell^2 - 5q\ell x \Rightarrow y''(x) = -\frac{M(x)}{EJ} + 2 \left(\frac{\alpha \Delta T}{H} \right) \rightarrow \frac{8q\ell^2}{EJ}$$

$$y''(x) = \frac{5q\ell x}{EJ} - \frac{35q\ell^2}{2EJ} + \frac{16q\ell^2}{EJ} \leadsto -\frac{3q\ell^2}{2EJ} + \frac{5q\ell x}{EJ} > 0$$

$$\forall x > \frac{3}{10} \ell = 0,3\ell$$

INDIVIDUATO ALTRO PUNTO DI FLESSO

