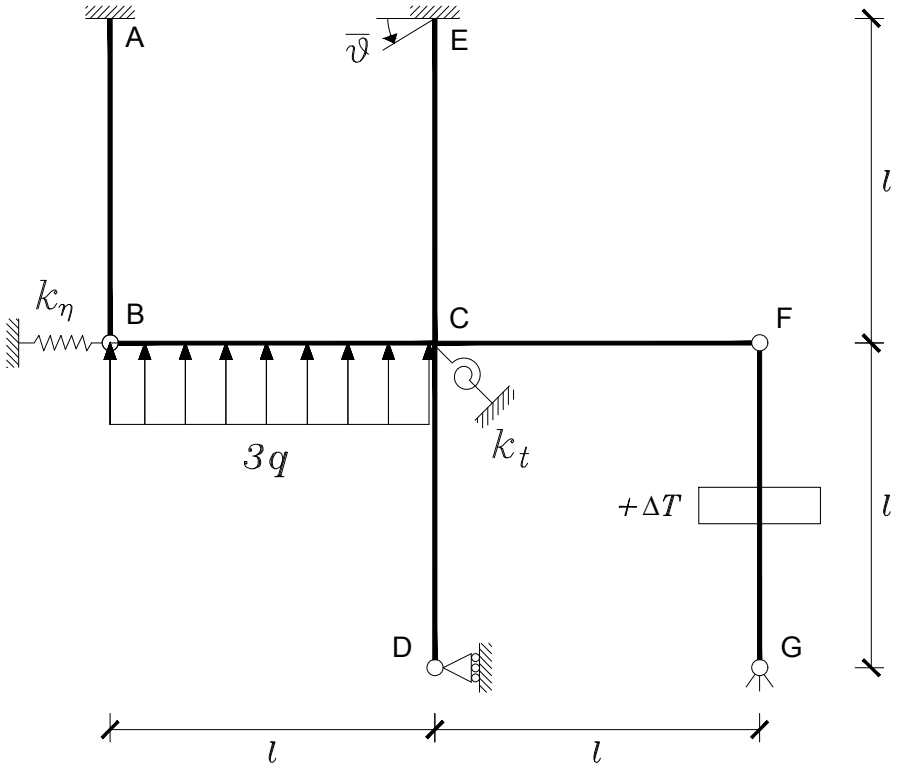
TECNICA DELLE COSTRUZIONI

TEMA ESAME DEL 20 APRILE 2020

DOCENTI:
PROF. GIOVANNI A. PLIZZARI

DURATA: **2 ORE.**



$$k_\eta = \frac{3}{2}\frac{EJ}{l^3} \qquad k_t = \frac{3}{2}\frac{EJ}{l} \qquad \alpha\Delta T = \frac{3}{4}\frac{ql^3}{EJ} \qquad \bar{\vartheta} = 5\frac{ql^3}{EJ}$$

Esercizio

Dato il telaio in figura, **si richiedono i grafici di:**

1. Momento flettente (con il valore e la posizione dei massimi);
2. Taglio;
3. Azione assiale;
4. Deformata qualitativa con posizione dei flessi.

Si assuma $EA \to \infty$, $EJ = costante$.

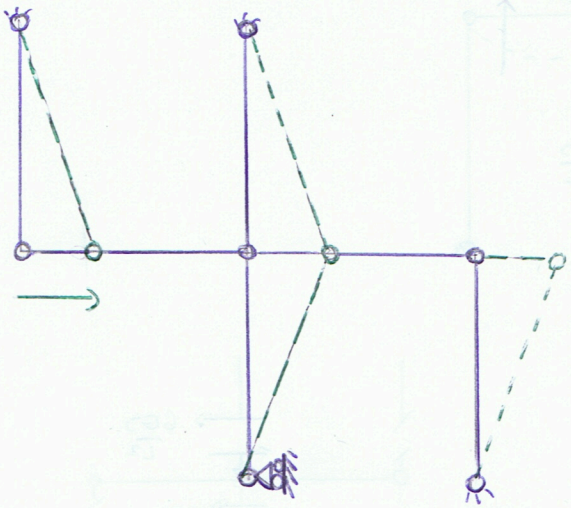
I grafici possono essere realizzati in matita, mentre i calcoli necessari per lo sviluppo del tema devono essere in tratto non cancellabile. Il tutto deve essere riportato chiaramente.

1) ANALISI CINEMATICA

9 GDL
15 GDV } 6 IPERVINCOLATA

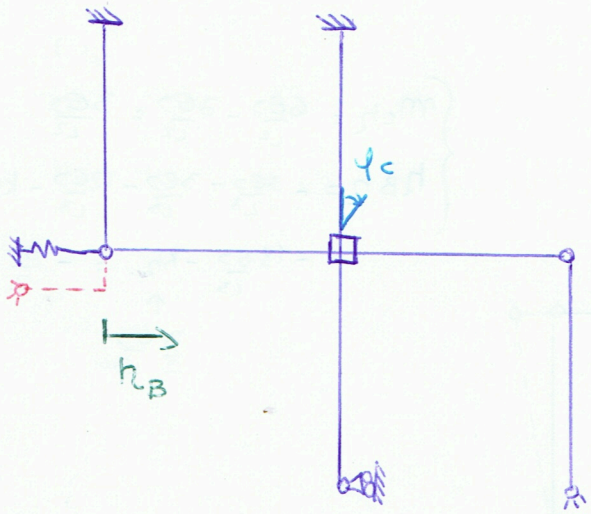
2) SPOSTABILITÁ DEI NODI

STRUTTURA A NODI SPOSTABILI



3) STRUTTURA DI SERVIZIO

SCELTA INCOGNITE



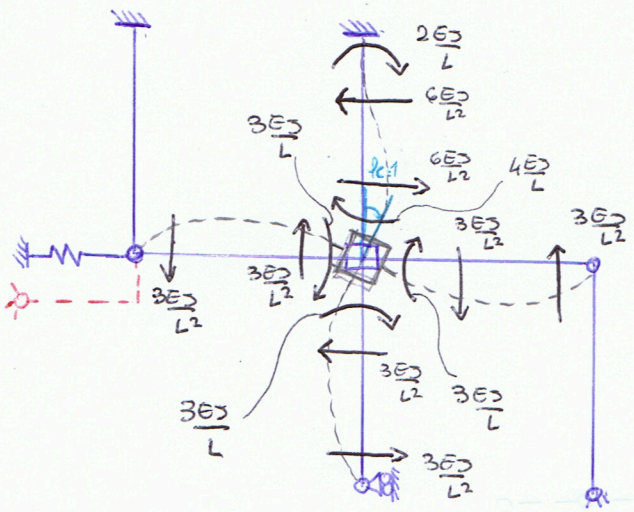
4) EQUAZIONI DI EQUILIBRIO

$$\begin{cases} \Sigma m_C = m_{C1}\varphi_C + m_{C2}h_B + m_{C\bar{q}+\Delta T+\Theta} = \phi \\ \Sigma h_B = h_{B1}\varphi_C + h_{B2}h_B + h_{B\bar{q}+\Delta T+\Theta} = \phi \end{cases}$$

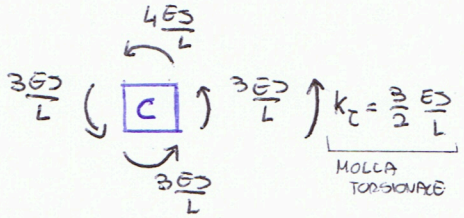
RISOLUZIONE

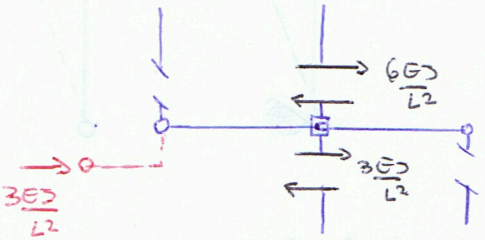
CONVENZIONE ADOTTATA $\varphi \circlearrowright$ $M_+ \circlearrowleft$ $\leftarrow \oplus \rightarrow$

$$\begin{cases} \varphi_C = 1 \\ \eta_B = q = \Delta T = \theta = \phi \end{cases}$$

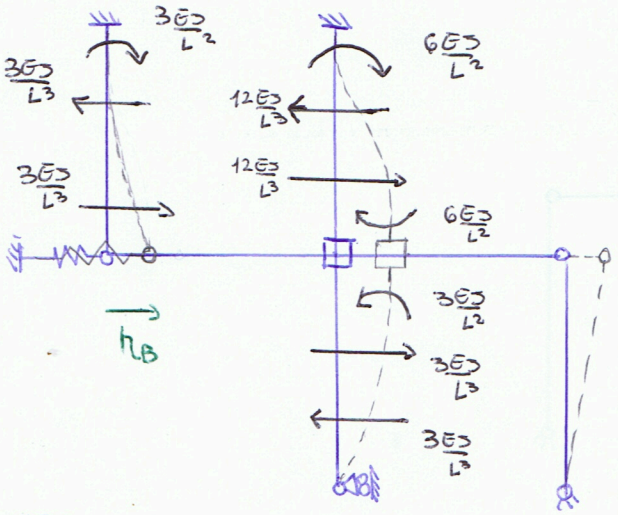


$$\begin{cases} m_C \varphi = \frac{3EJ}{L} + \frac{3EJ}{L} + \frac{3EJ}{L} + \frac{4EJ}{L} + \frac{3}{2}\frac{EJ}{L} = \frac{29}{2}\frac{EJ}{L} \\ \eta_B \varphi = +\frac{3EJ}{L^2} - \frac{6EJ}{L^2} = -\frac{3EJ}{L^2} \end{cases}$$

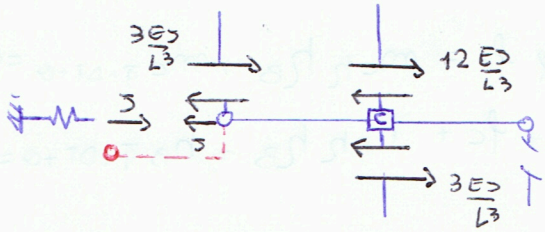




$$\begin{cases} \eta_B = 1 \\ \varphi_C = q = \Delta T = \theta = \phi \end{cases}$$



$$\begin{cases} m_C \eta = \frac{6EJ}{L^2} - \frac{3EJ}{L^2} = \frac{3EJ}{L^2} \\ \eta_B \eta = -\frac{3EJ}{L^3} - \frac{3EJ}{L^3} - \frac{12EJ}{L^3} - k_\eta \cdot 1 = \\ \quad = -\frac{18EJ}{L^3} - \underset{\uparrow \atop \frac{3}{2}\frac{EJ}{L^3}}{k_\eta} = -\frac{39}{2}\frac{EJ}{L^3} \end{cases}$$

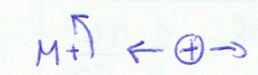


$$J = k_\eta \cdot 1 = \frac{3}{2}\frac{EJ}{L^3}$$

CARICHI

$\bar{q} \neq \phi$
$\Delta T \neq \phi$
$\theta \neq \phi$
$\varphi_C = h_B = \phi$

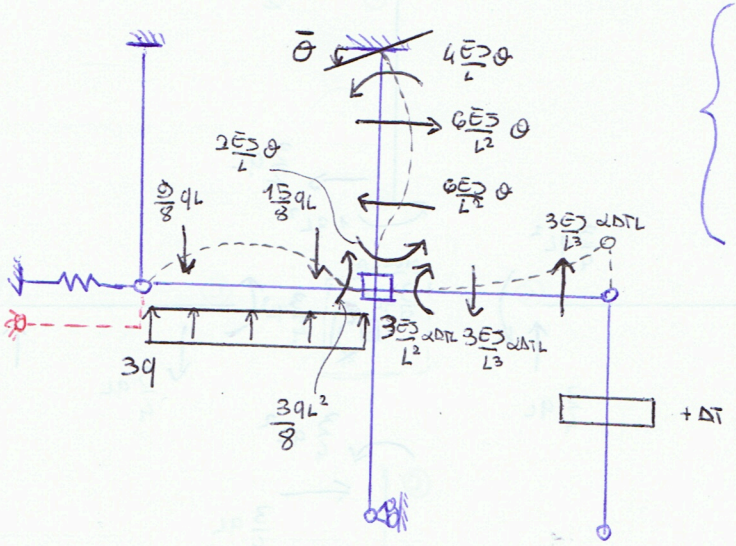
CONVENZIONE ADOTTATA.

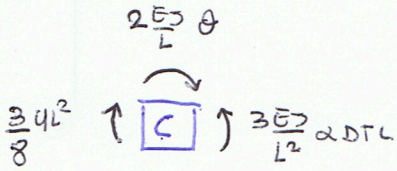


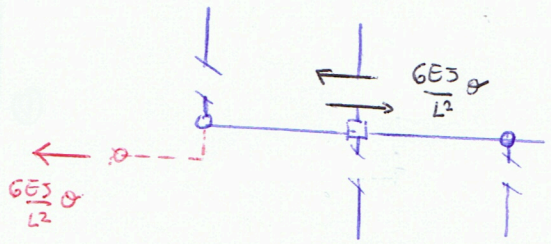
$\theta = 5\frac{qL^3}{EJ}$ $\quad \alpha\Delta T = \frac{3}{4}\frac{qL^3}{EJ}$

$$\begin{cases} m_C\,\bar{q}+\Delta T+\theta = -\frac{3}{8}qL^2 - 2\frac{EJ}{L}\theta + 3\frac{EJ}{L^2}\alpha\Delta T L = \\ \quad = -\frac{3}{8}qL^2 - 10qL^2 + \frac{9}{4}qL^2 = -\frac{65}{8}qL^2 \\ h_B\,\bar{q}+\Delta T+\theta = +6\frac{EJ}{L^2}\theta = +30qL \end{cases}$$

$\theta = 5\frac{qL^3}{EJ}$







SISTEMA RISOLVENTE

$$\begin{cases} \Sigma m_C = m_{C\varphi}\,\varphi_C + m_{Ch}\,h_B + m_C\,\bar{q}+\Delta T+\theta = \phi \\ \Sigma h_B = h_{B\varphi}\,\varphi_C + h_{Bh}\,h_B + h_B\,\bar{q}+\Delta T+\theta = \phi \end{cases}$$

$$\begin{cases} \text{(I)}\ \frac{29}{2}\frac{EJ}{L}\varphi_C + 3\frac{EJ}{L^2}h_B - \frac{65}{8}qL^2 = \phi \\ \text{(II)}\ -3\frac{EJ}{L^2}\varphi_C - \frac{39}{2}\frac{EJ}{L^3}h_B + 30qL = \phi \end{cases} \rightarrow \text{(II)}\quad \varphi_C = -\frac{13}{2}\frac{1}{L}h_B + 10\frac{qL^3}{EJ}$$

$$\text{(II)}-\text{(I)}\quad -\frac{377}{4}\frac{EJ}{L^2}h_B + 3\frac{EJ}{L^2}h_B + 143\,qL^2 - \frac{65}{8}qL^2 = \phi$$

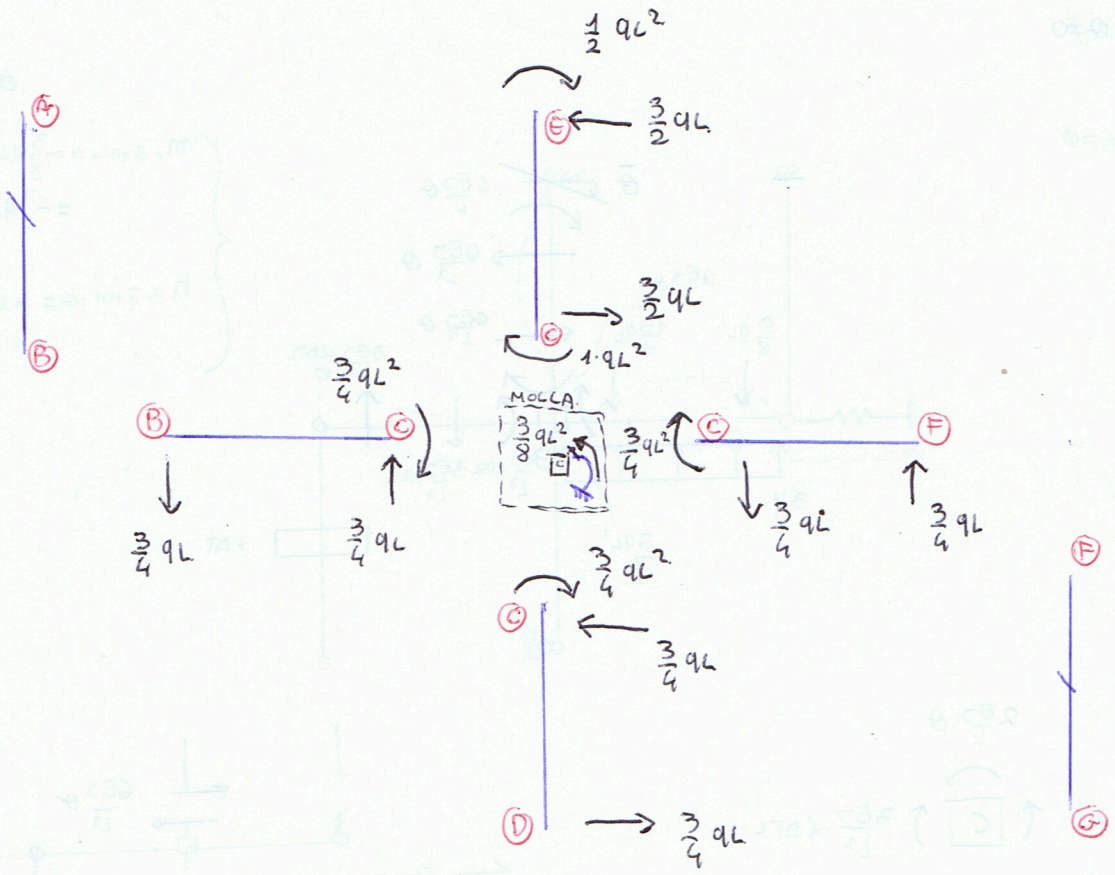
$$-\frac{365}{4}\frac{EJ}{L^2}h_B + \frac{1095}{8}qL^2 = \phi \rightarrow h_B = \frac{1095}{8}\frac{qL^4}{EJ}\frac{4}{365} = \frac{3}{2}\frac{qL^4}{EJ}$$

$$\begin{cases} \text{(II)}: \\ h_B = \end{cases} \longrightarrow \varphi_C = -\frac{13}{2}\frac{1}{L}\frac{3}{2}\frac{qL^4}{EJ} + 10\frac{qL^3}{EJ} = \frac{1}{4}\frac{qL^3}{EJ}$$

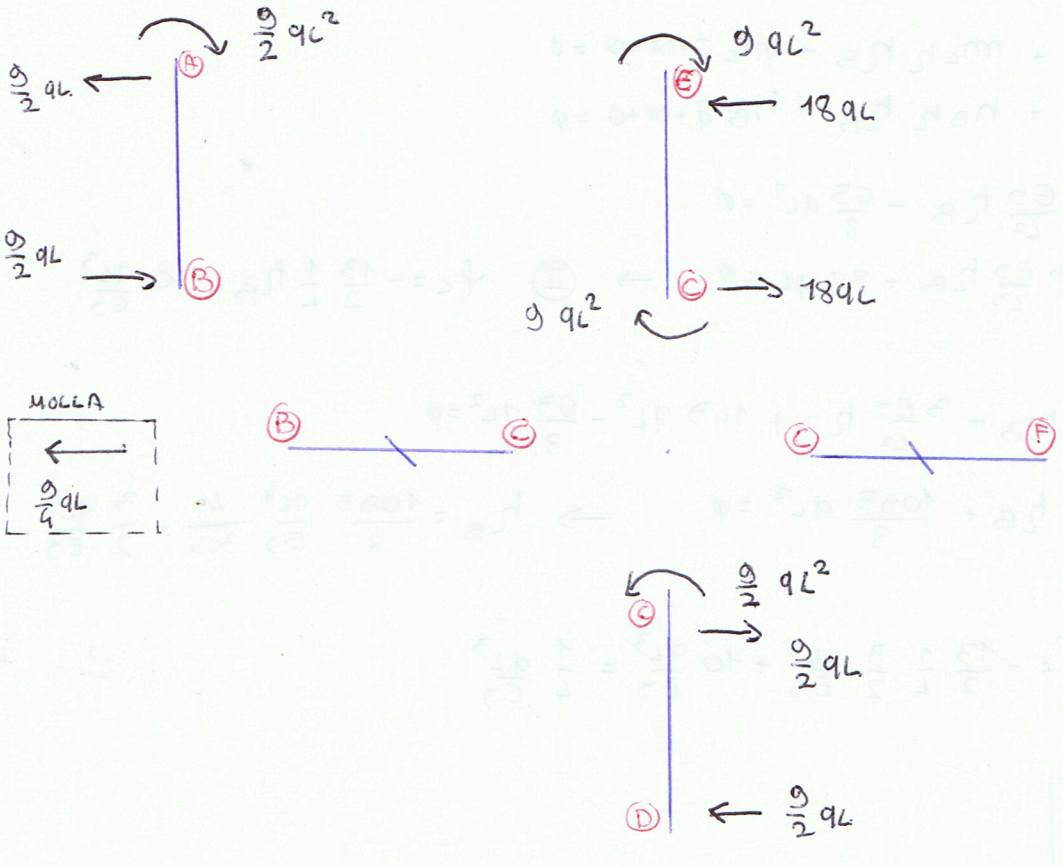
$$\boxed{\varphi_C = \frac{1}{4}\frac{qL^3}{EJ}}$$

$$\boxed{h_B = \frac{3}{2}\frac{qL^4}{EJ}}$$

$\varphi_C = \frac{1}{4}\frac{qL^3}{EJ}$

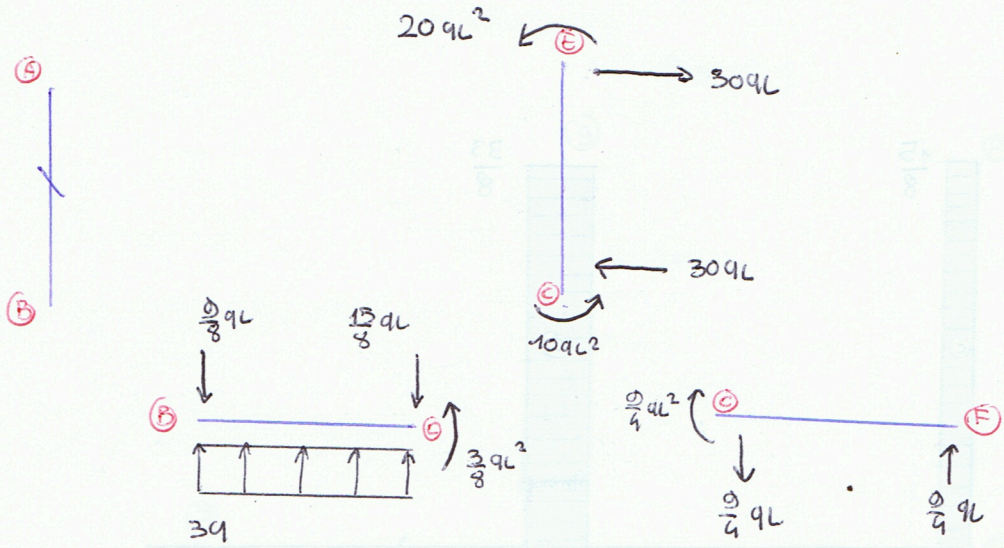


$h_B = \frac{3}{2}\frac{qL^4}{EJ}$

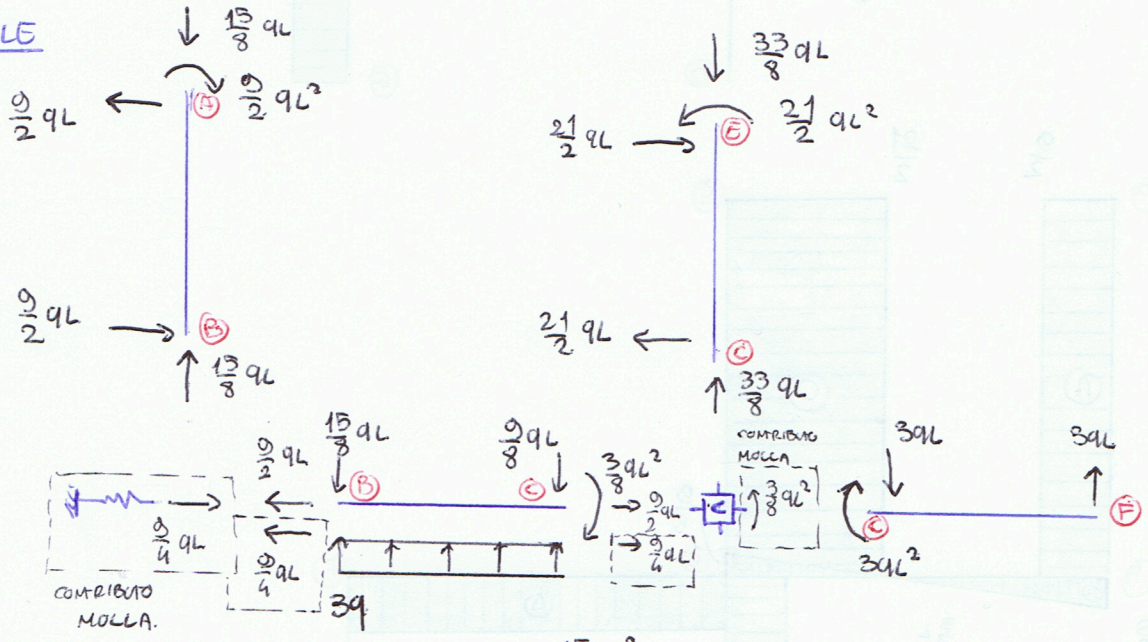


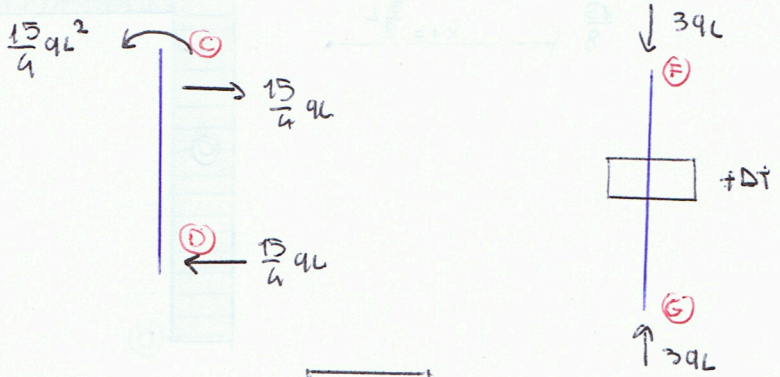
$\bar{q} \neq 0$
$\Delta T \neq 0$
$\sigma \neq 0$

CARICHI

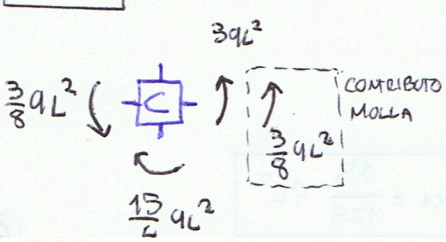


GLOBALE

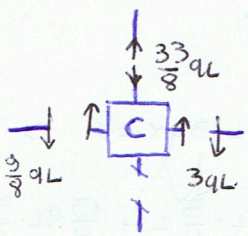




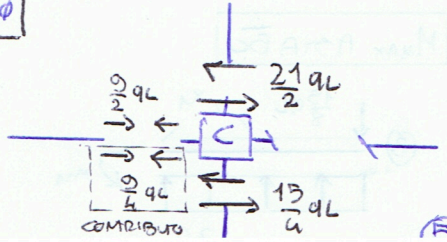
$\Sigma M^C = \phi$



$\Sigma_V^C = 0$

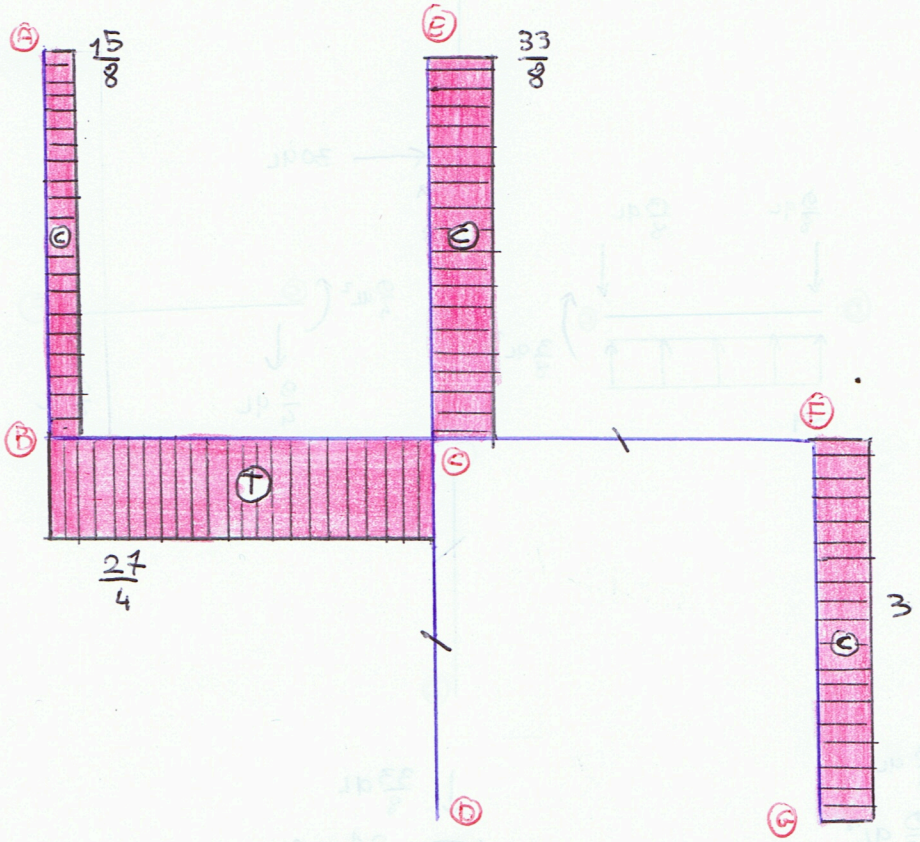


$\Sigma_H^C = \phi$

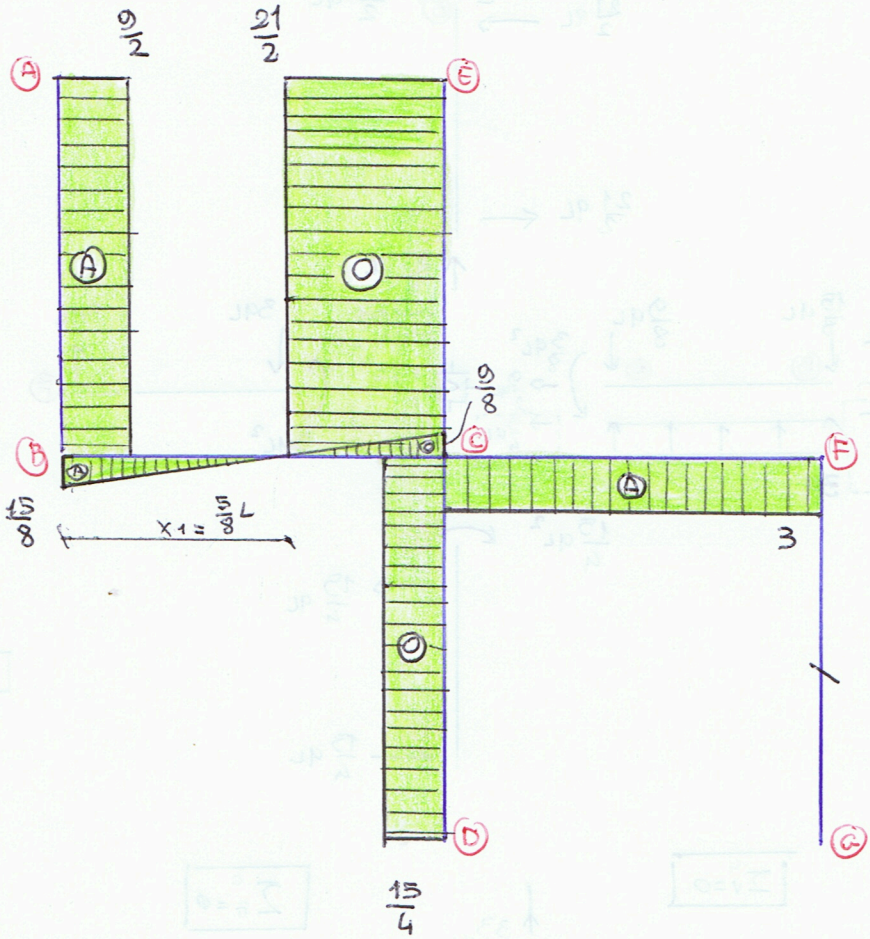


DIAGRAMMI AZIONI

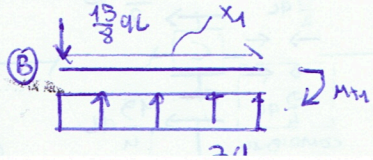
N / qL



V / qL



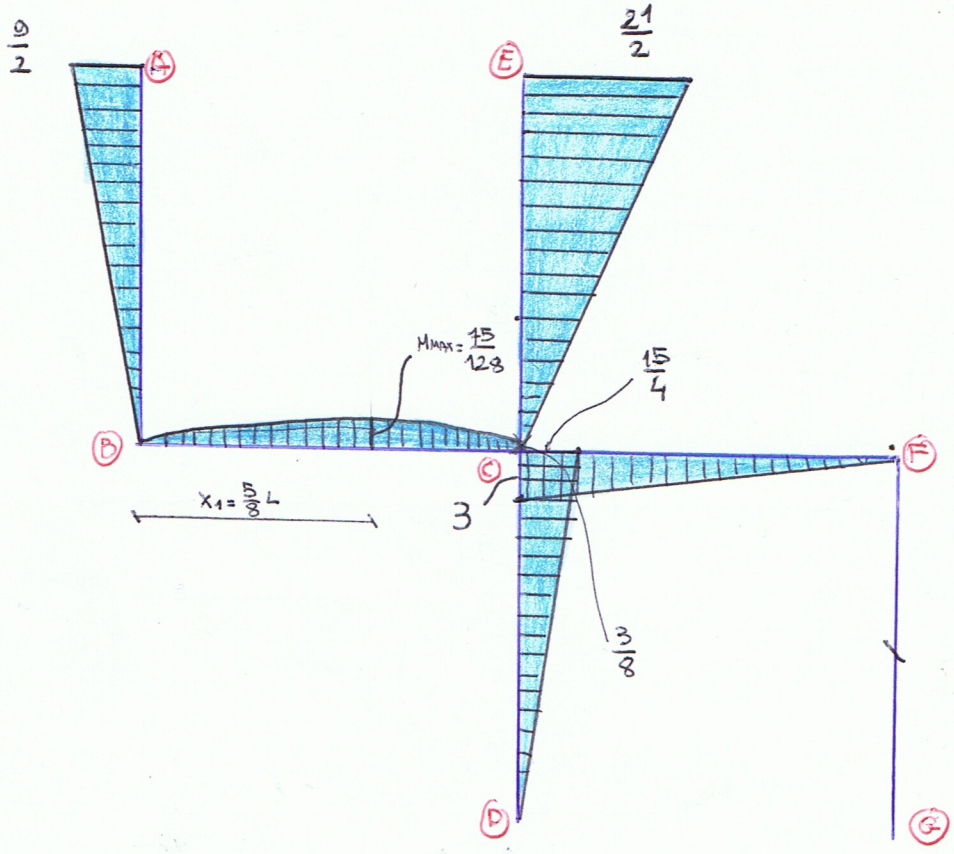
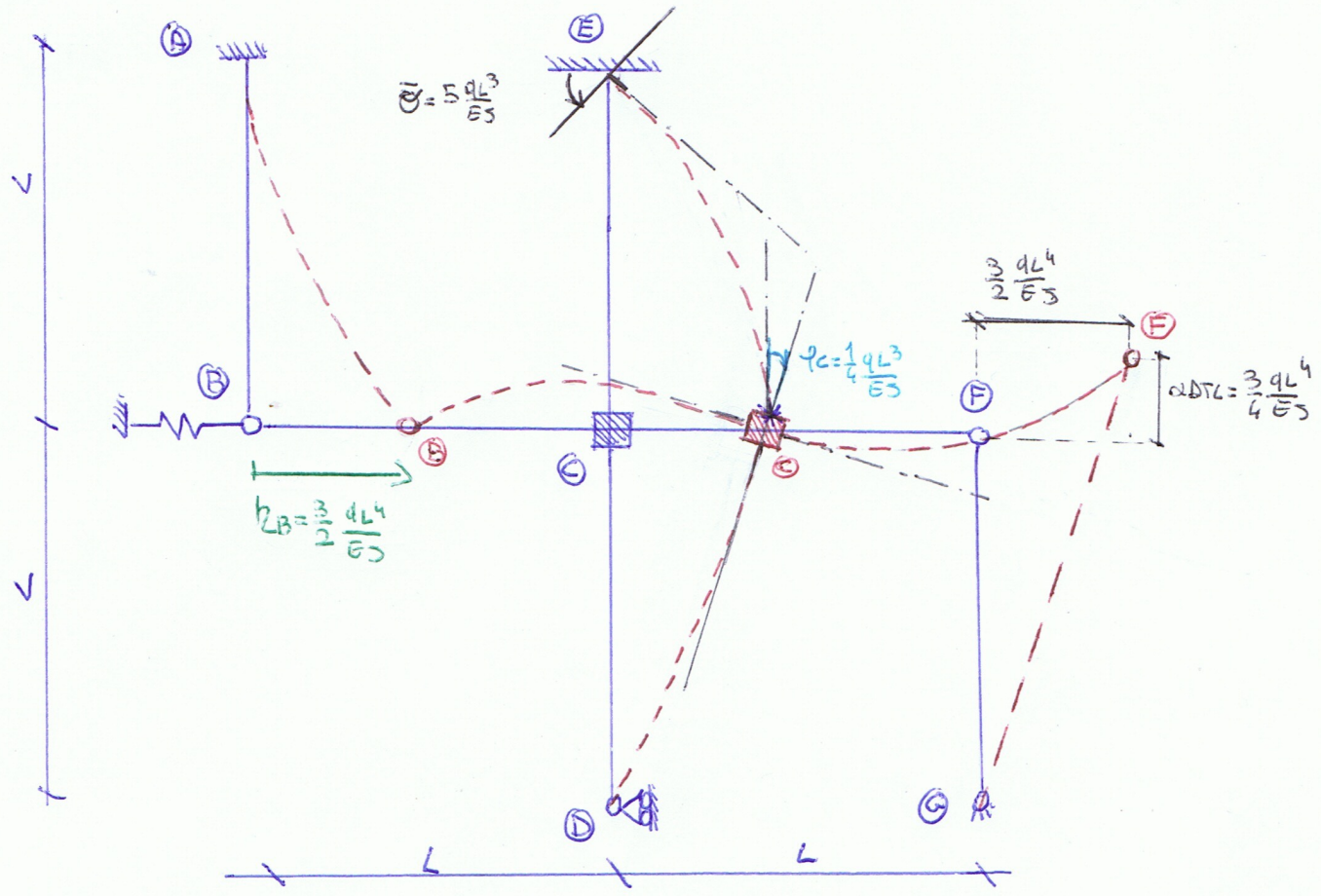
M_{MAX} ASTA $\overline{BC}$



- $\Sigma V = 0 \quad \frac{15}{8}qL - 3qX_1 = 0 \rightarrow \boxed{X_1 = \frac{5}{8}L}$

- $M_{X1} = -3q \cdot \frac{3}{8}L \cdot \frac{5}{16}L + \frac{15}{8}qL \cdot \frac{5}{8}L \Rightarrow \boxed{M_{X1} = \frac{15}{128}qL^2}$

$\frac{M}{qL^2}$



DEFORMATA QUALITATIVA