

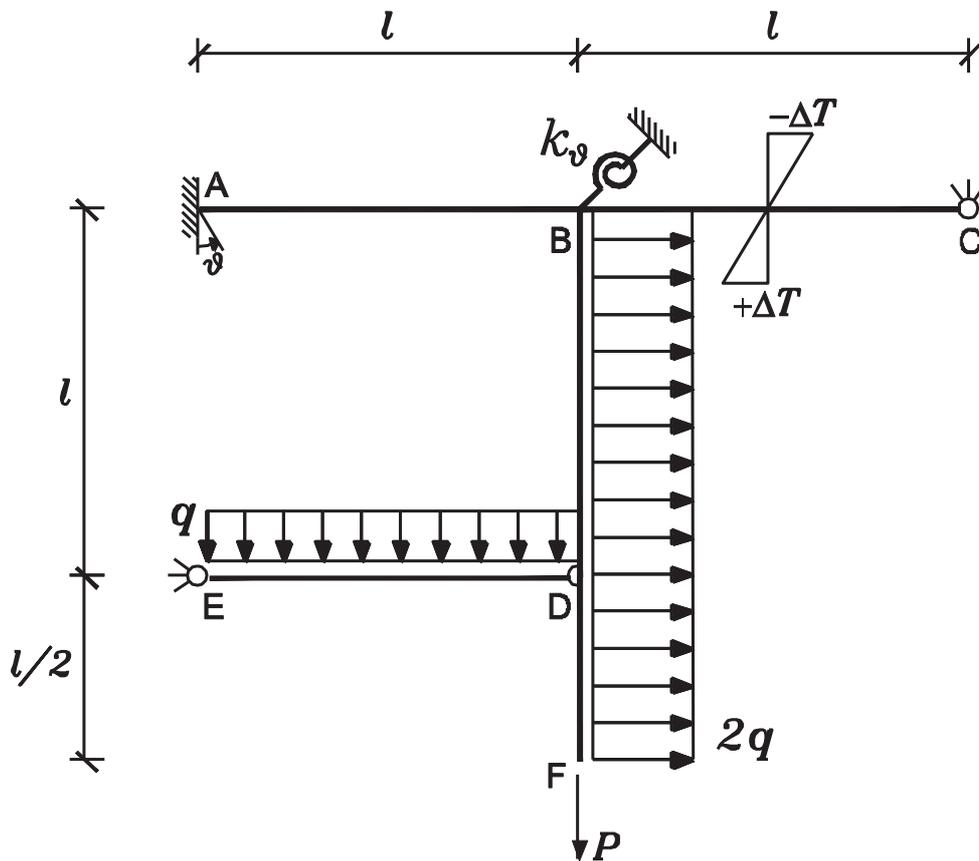
TECNICA DELLE COSTRUZIONI

TEMA ESAME DEL 21 MARZO 2016

DOCENTE: PROF. FAUSTO MINELLI

ESERCITATORE: ING. LUCA FACCONI

Esercizio



$$g = \frac{1}{6} \frac{ql^3}{EJ};$$

$$P = \frac{43}{16} ql;$$

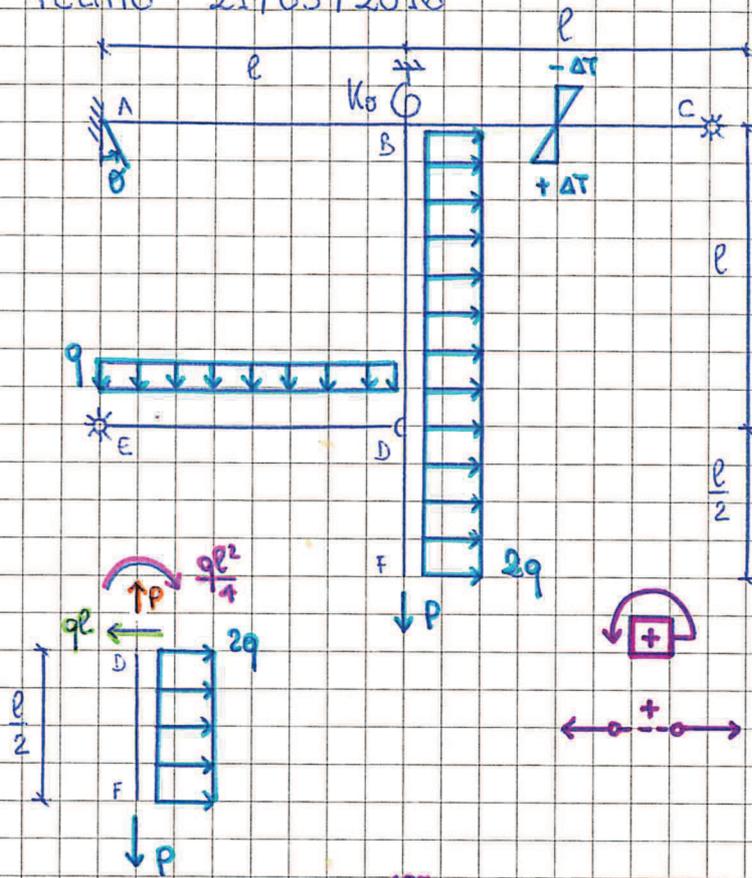
$$\frac{\alpha \Delta T}{h} = \frac{1}{24} \frac{ql^2}{EJ};$$

$$K_\phi = \frac{10}{3} \frac{EJ}{l}$$

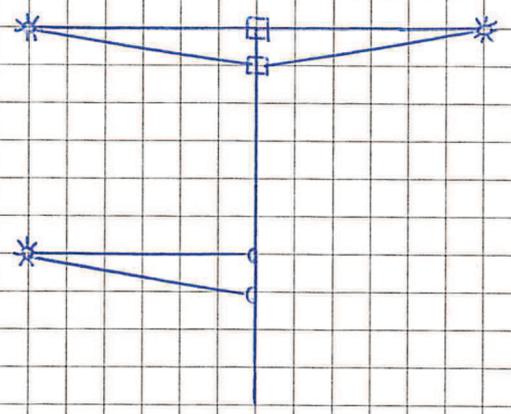
Dato il telaio in figura

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.

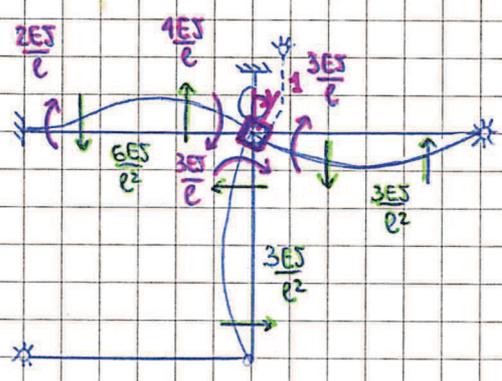


NODI SPOSTABILI:



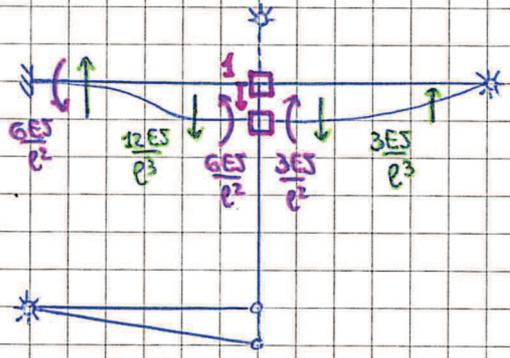
$$\begin{cases} m_{BP} \varphi_B + m_{Bq} \varphi_B + m_{Bc} = 0 \\ h_{BP} \varphi_B + h_{Bq} \varphi_B + h_{Bc} = 0 \end{cases}$$

$\varphi_B = 1$



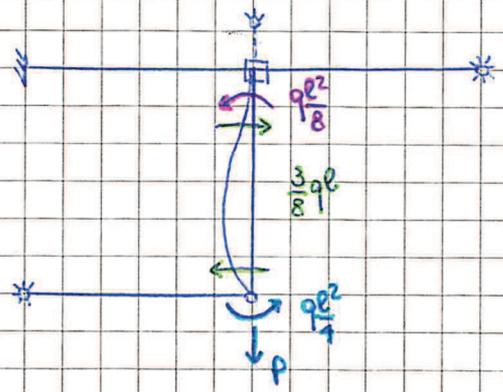
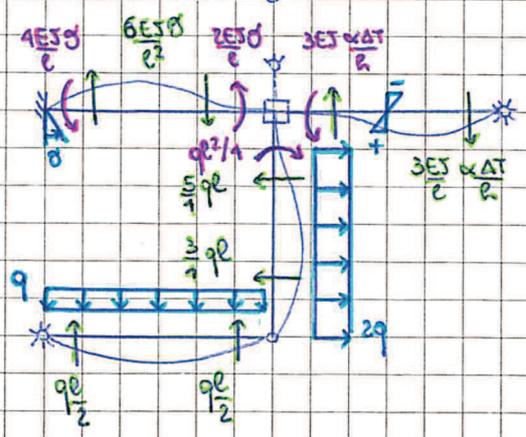
$$\begin{cases} m_{B\varphi} = (3+3+4) \frac{EJ}{l} + K_B = 10 \frac{EJ}{l} + K_B \\ h_{B\varphi} = (6-3) \frac{EJ}{l^2} = 3 \frac{EJ}{l^2} \end{cases}$$

$M_B = 1$



$$\begin{cases} m_{B\varphi} = (3-6) \frac{EJ}{l^2} = -3 \frac{EJ}{l^2} \\ h_{B\varphi} = (-12-3) \frac{EJ}{l^3} = -15 \frac{EJ}{l^3} \end{cases}$$

$q; P; \vartheta; \Delta T \neq 0$



DAI CARICHI ESTERNI RISULTA:

$$\begin{cases} m_{sp} = -3ES \frac{\alpha \Delta T}{R} + \frac{q l^2}{4} - \frac{2ES \theta}{l} - \frac{q l^2}{8} \\ P_{eq} = \frac{3ES \alpha \Delta T}{R} - \frac{6ES \theta}{l^2} + \frac{q l}{2} + P \end{cases}$$

SISTEMA:

$$\begin{cases} \left(10 \frac{ES}{l} + K_0\right) \varphi_B - 3 \frac{ES}{l^2} M_B - 3ES \frac{\alpha \Delta T}{R} + \frac{q l^2}{4} - \frac{2ES \theta}{l} - \frac{q l^2}{8} = 0 \\ 3 \frac{ES}{l^2} \varphi_B - 15 \frac{ES}{l^3} M_B + 3 \frac{ES}{l} \frac{\alpha \Delta T}{R} - \frac{6ES \theta}{l^2} + \frac{q l}{2} + P = 0 \end{cases}$$

- $\theta = \frac{1}{6} \frac{q l^3}{ES}$
- $P = \frac{43}{16} q l$
- $\frac{\alpha \Delta T}{R} = \frac{1}{24} \frac{q l^2}{ES}$
- $K_0 = \frac{10}{3} \frac{ES}{l}$

$$\begin{cases} \left(10 \frac{ES}{l} + \frac{10 ES}{3} \frac{ES}{l}\right) \varphi_B - 3 \frac{ES}{l^2} M_B - 3ES \cdot \frac{1}{24} \frac{q l^2}{ES} + \frac{q l^2}{4} - \frac{2ES}{l} \cdot \frac{1}{6} \frac{q l^3}{ES} - \frac{q l^2}{8} = 0 \\ 3 \frac{ES}{l^2} \varphi_B - 15 \frac{ES}{l^3} M_B + 3 \frac{ES}{l} \cdot \frac{1}{24} \frac{q l^2}{ES} - \frac{6ES}{l^2} \cdot \frac{1}{6} \frac{q l^3}{ES} + \frac{q l}{2} + \frac{43}{16} q l = 0 \end{cases}$$

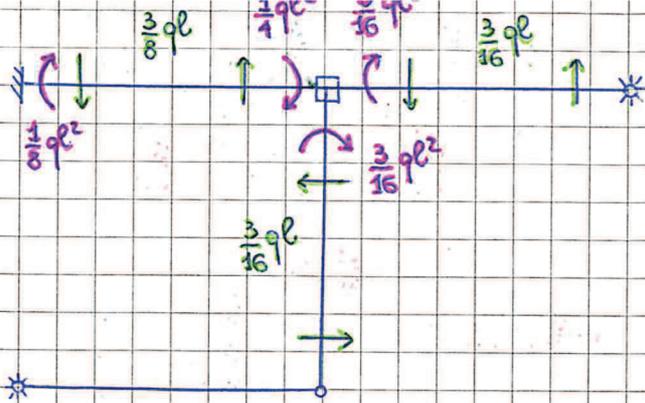
$$\begin{cases} \frac{40}{3} \frac{ES}{l} \varphi_B - 3 \frac{ES}{l^2} M_B - \frac{1}{3} q l^2 = 0 \\ 3 \frac{ES}{l^2} \varphi_B - 15 \frac{ES}{l^3} M_B + \frac{37}{16} q l = 0 \end{cases}$$

$\frac{40}{3}$	-3	-	$\frac{1}{3}$	x5	$\frac{200}{3}$	-15	-	$\frac{5}{3}$)	-	$\left(\frac{3-200}{3}\right) \varphi_B + \left(\frac{37}{16} - \frac{5}{3}\right) = 0$
3	-15	+	$\frac{37}{16}$	x1	3	-15	+	$\frac{37}{16}$			

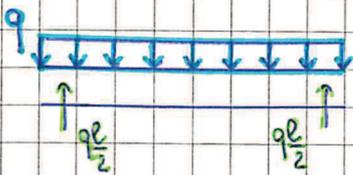
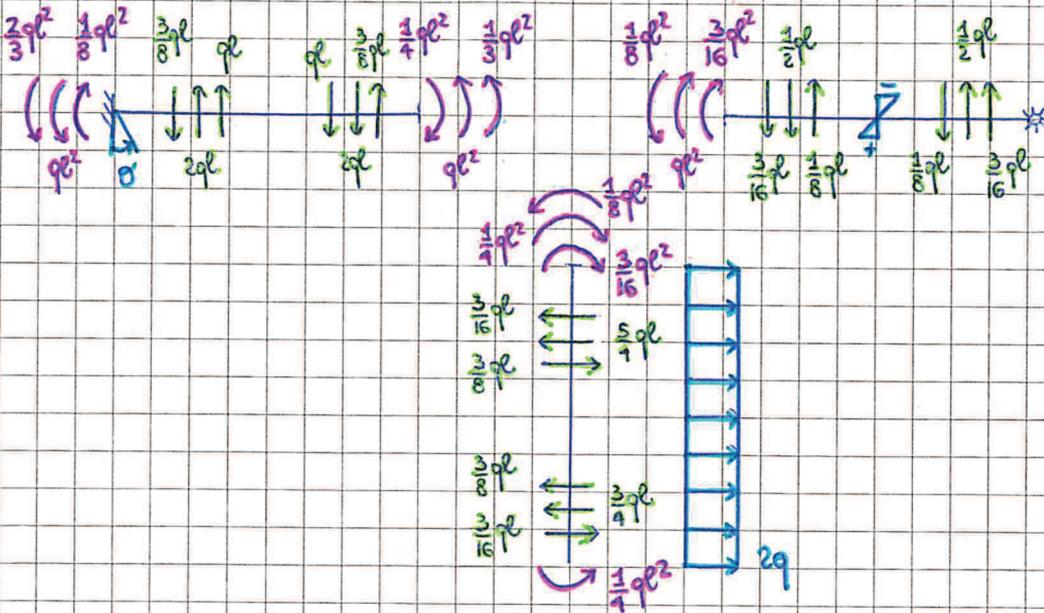
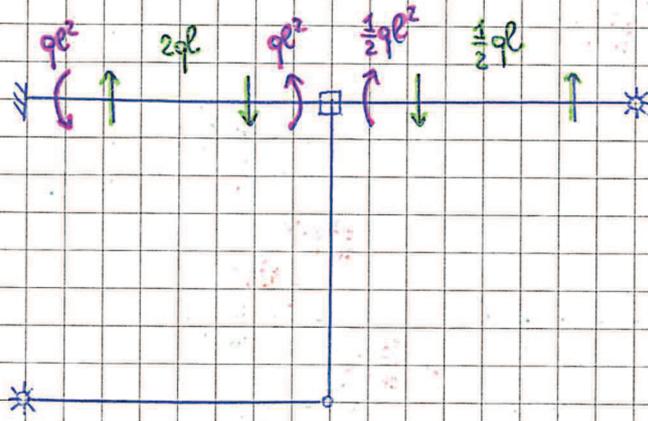
$$\varphi_B = \frac{137}{16} \cdot \frac{1}{137} = \frac{1}{16} \frac{q l^3}{ES} \quad \text{praccia}$$

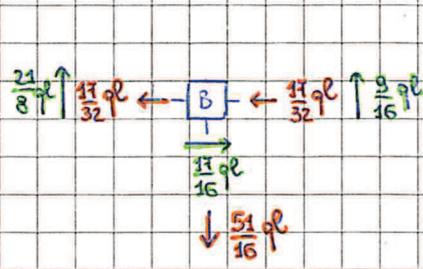
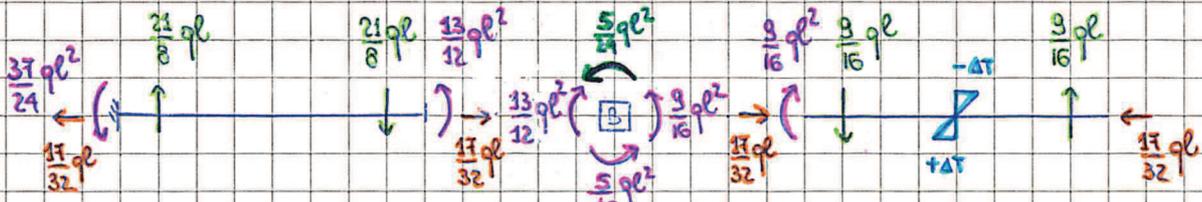
$$M_B = \left(\frac{40}{3} \frac{ES}{l} \cdot \frac{1}{16} \frac{q l^3}{ES} - \frac{1}{3} q l^2 \right) \cdot \frac{l^2}{3ES} = \frac{1}{6} \frac{q l^4}{ES} \quad \text{verso il basso}$$

$$\varphi_B = \frac{1}{16} \frac{q l^3}{EJ}$$



$$M_B = \frac{1}{6} \frac{q l^4}{EJ}$$

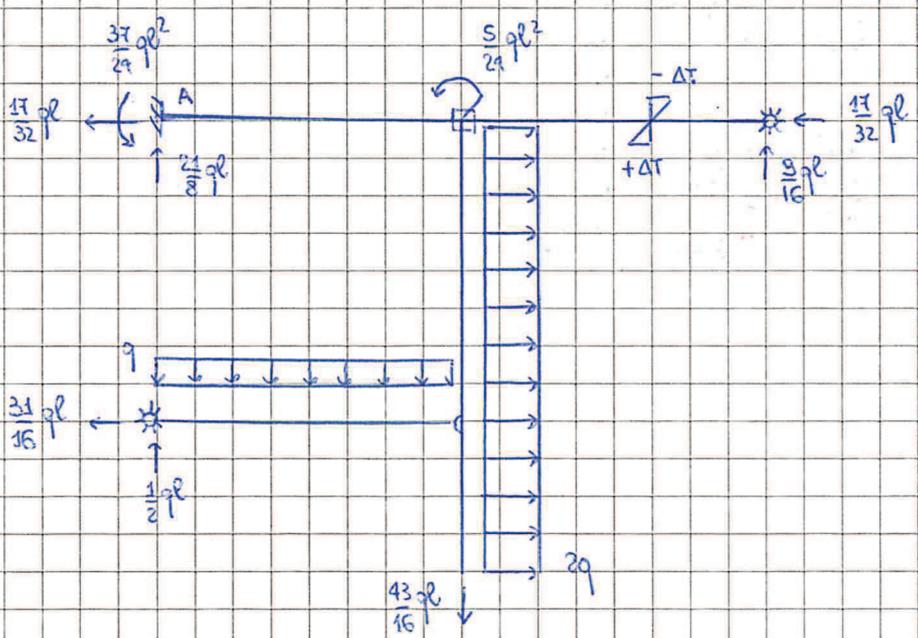
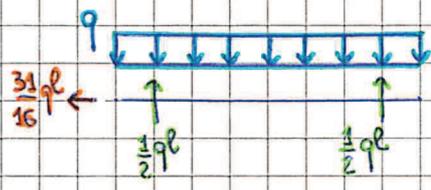
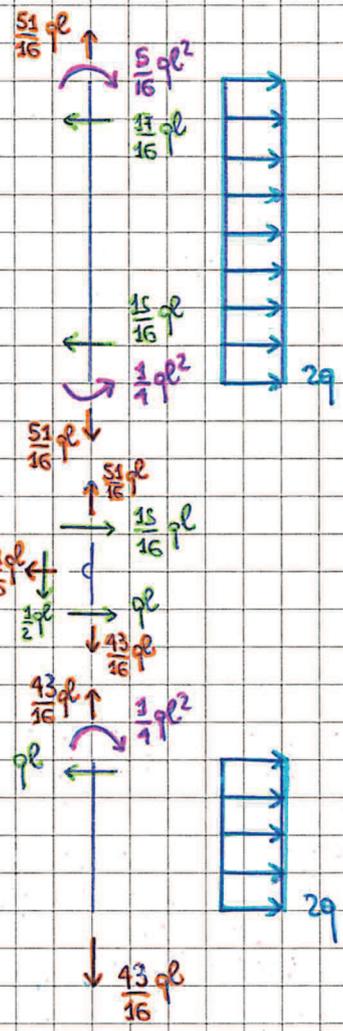




MOMENTO NELLA MOLLA:

$$M_B = \varphi_B \cdot k_B = \frac{1}{16} \frac{ql^3}{EJ} \cdot \frac{10EJ}{3l} = \frac{5}{24} ql^2$$

ANTIORARIO!

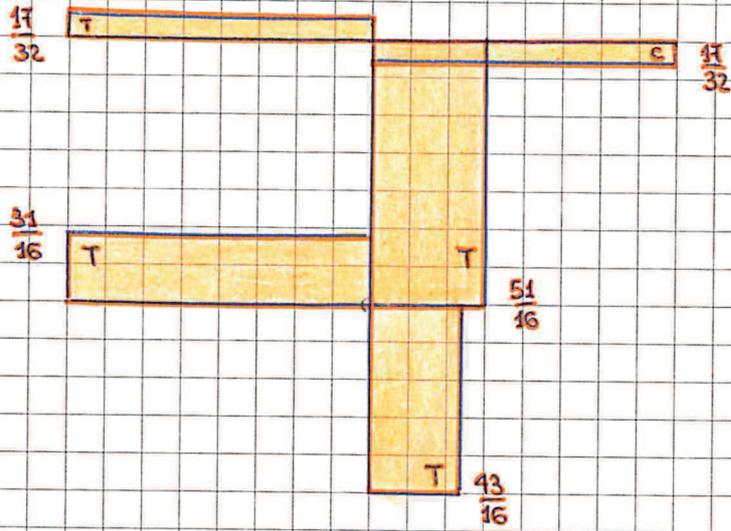


$$\sum F^{\rightarrow} = 2q \cdot \frac{3l}{2} - \frac{17}{32} pl - \frac{17}{32} pl - \frac{31}{16} pl = 0$$

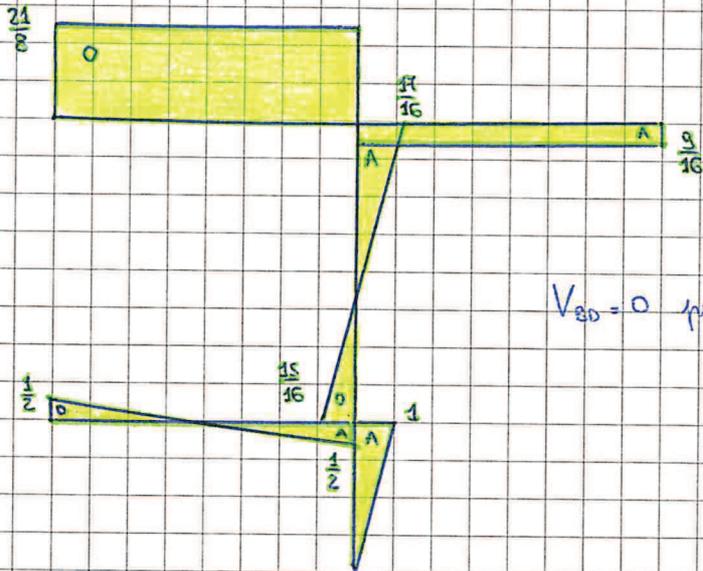
$$\sum F^{\uparrow} = \frac{21}{8} ql + \frac{9}{16} ql - ql + \frac{1}{2} ql - \frac{43}{16} ql = 0$$

$$\sum M^{\curvearrowright} = -\frac{37}{24} ql^2 - \frac{5}{24} ql^2 - \frac{9}{16} ql \cdot 2l + \frac{31}{16} pl \cdot l + ql \cdot \frac{l}{2} + \frac{43}{16} ql \cdot l - 2q \cdot l \cdot \frac{l}{2} - 2q \cdot \frac{l}{2} \cdot \frac{3l}{4} = 0$$

(N)

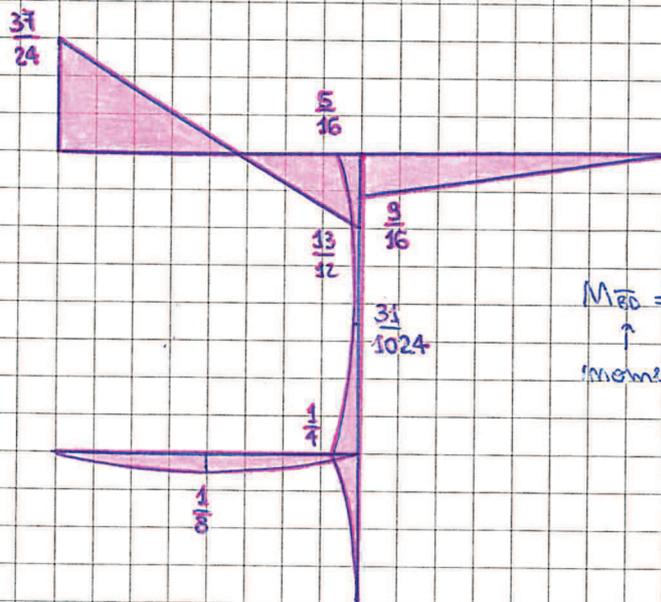


(V)

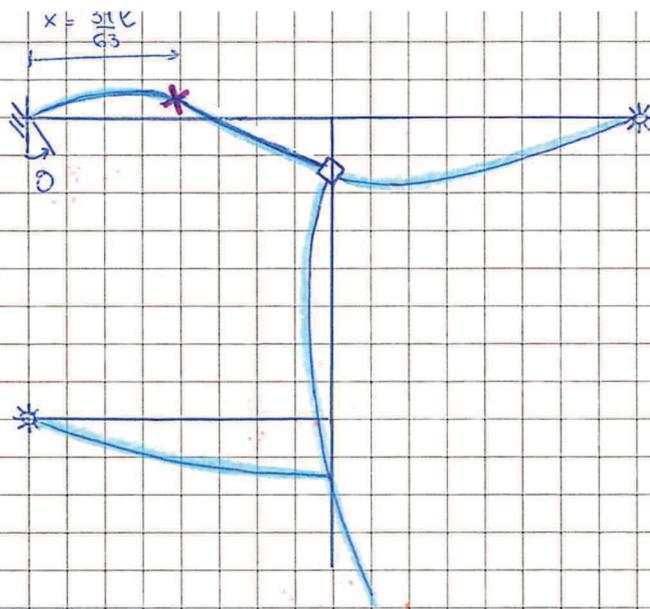


$V_{80} = 0$ per $x = \frac{17}{32} l$ da B

(M)



$M_{80} = \frac{5}{16} ql^2 - \frac{17}{16} ql \frac{17l}{32} + 2q \frac{17l}{32} \frac{17l}{64} = \frac{31}{1024} ql^2$
 ↑
 momento massimo

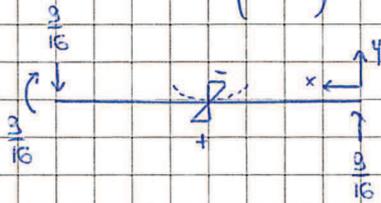


FLESSI :

*) asta \overline{AB}

$$\frac{37}{24} - \frac{13}{12} = \frac{37}{24} (l-x) = \frac{13}{12} x \rightarrow \frac{21x}{8} = \frac{37l}{24} \rightarrow x = \frac{37l}{63}$$

*) asta \overline{BC}



$$M(x) = -\frac{3}{16} qx \Rightarrow y'' = \frac{3}{16} \frac{qx}{ES} + 2 \cdot \frac{1}{24} \frac{ql^2}{ES} > 0$$

$$x \geq -\frac{4l}{21} \quad \forall x$$

↓
NO FLESSO!