

# TECNICA DELLE COSTRUZIONI

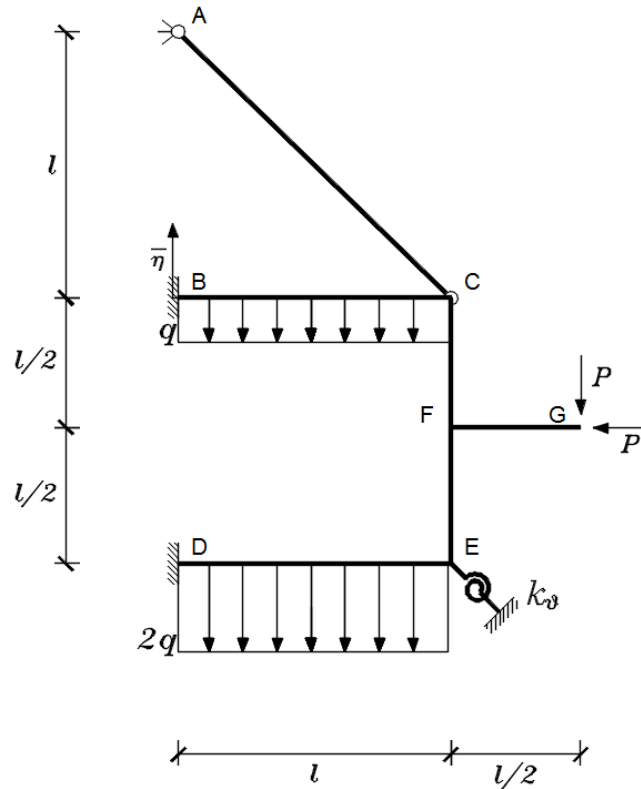
TEMA ESAME DEL 11 GIUGNO 2018

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PROF. FAUSTO MINELLI

ESERCITATORE: ING. LUCA FACCONI

DURATA: 2 ORE

## Esercizio



$$K_{\theta} = \frac{4 EJ}{3 l}$$

$$\bar{n}_l = \frac{5 ql^4}{48 EJ}$$

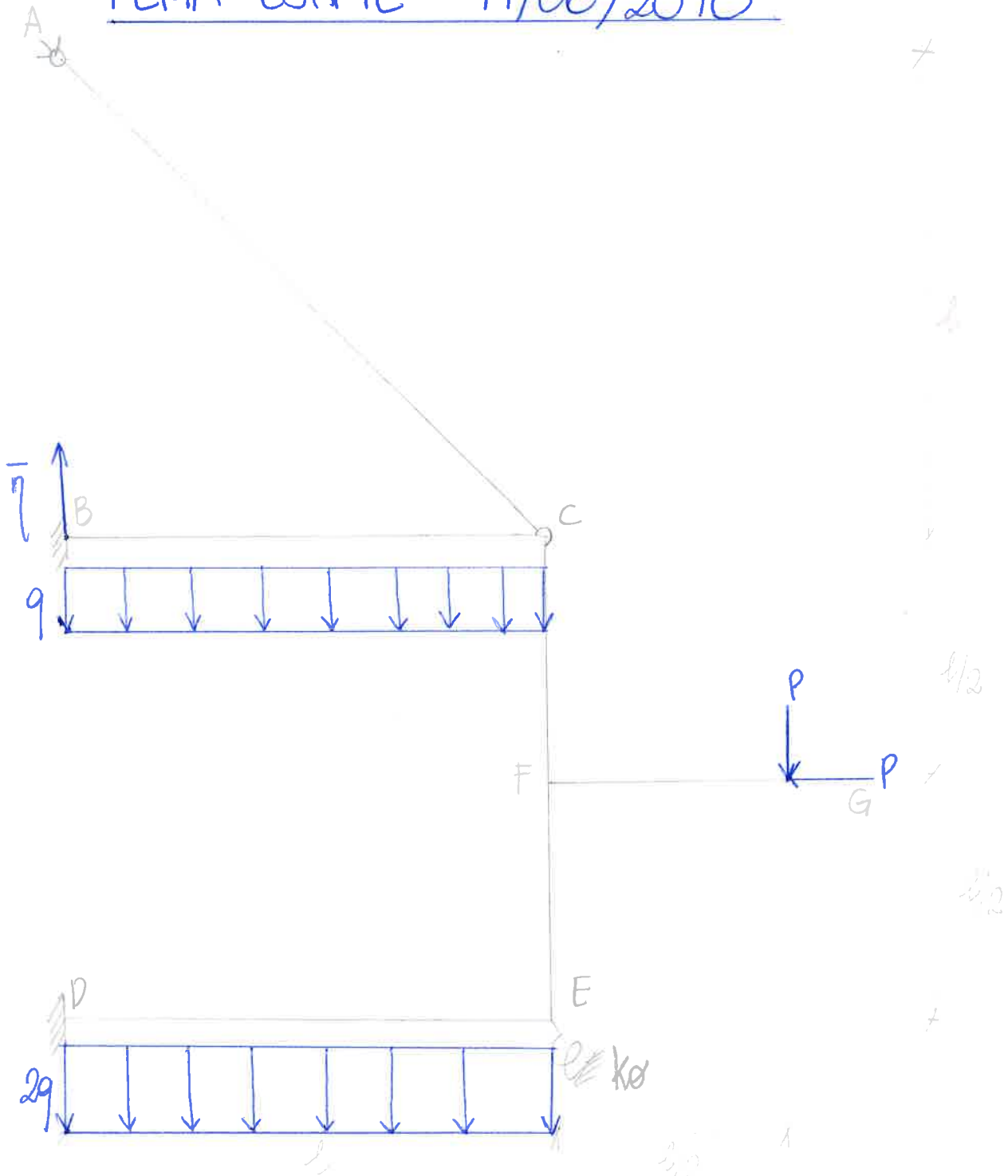
$$P = ql$$

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.

Quanto richiesto, ed i calcoli necessari per lo sviluppo del tema, vanno riportati nello stesso in maniera chiara e con tratto non cancellabile.

# TEMA ESAME 11/06/2018



DATI

$$k_{\theta} = \frac{4}{3} \frac{EJ}{l} \quad \bar{\eta} = \frac{5}{48} \frac{ql^4}{EJ} \quad P = ql$$

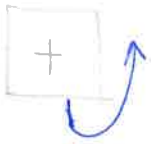
SI VALUTA IL GRADO DI IPERSTATICITA' DELLA STRUTTURA

$$GdL = 6$$

$$GdV = 8 + 1 + 1 = 10$$

TELAIO A NODI FISSI: BLOCCHETTO IN C E IN E

# CONVENZIONE DI SEGNO



MOMENTI AL NODO



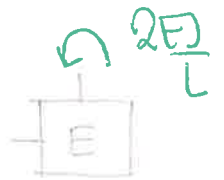
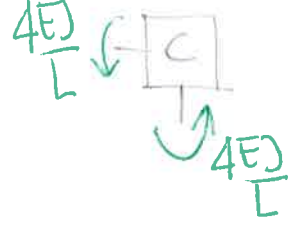
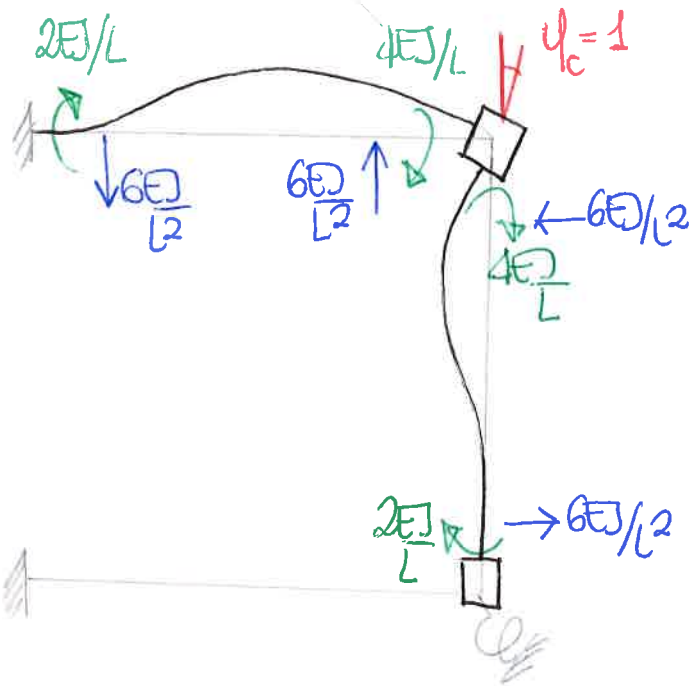
ROTAZIONI

IN SISTEMA RISOLVENTE

$$\begin{cases} M_{CC} \psi_C + M_{CE} \psi_E + M_{CO} = 0 \\ M_{EC} \psi_C + M_{EE} \psi_E + M_{EO} = 0 \end{cases}$$

$\psi_C = 1$

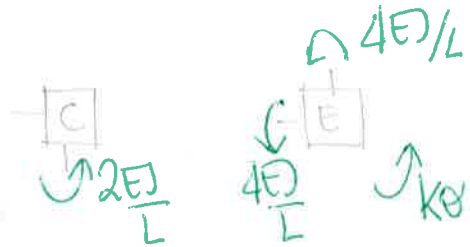
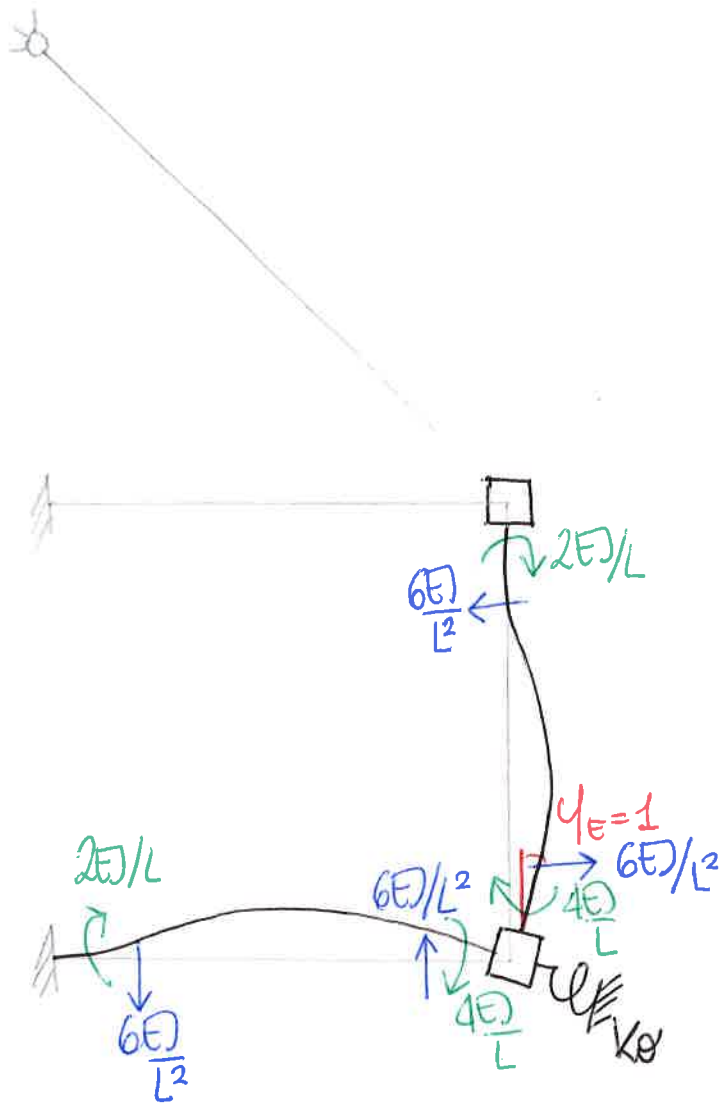
to



$$M_{CC} = \frac{8EJ}{L}$$

$$M_{EC} = \frac{2EJ}{L}$$

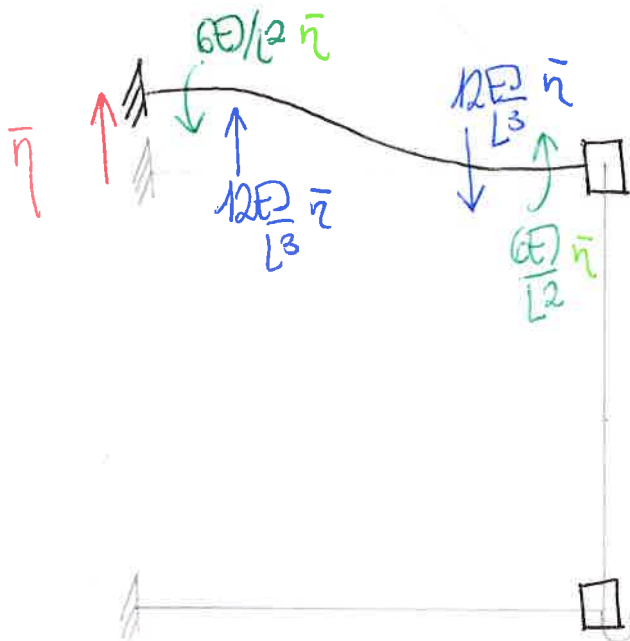
$\nu \psi_E = 1$



$M_{CE} = 2EJ/L$

$M_{EE} = \frac{8EJ}{L} + kx = \frac{28}{3} \frac{EJ}{L}$

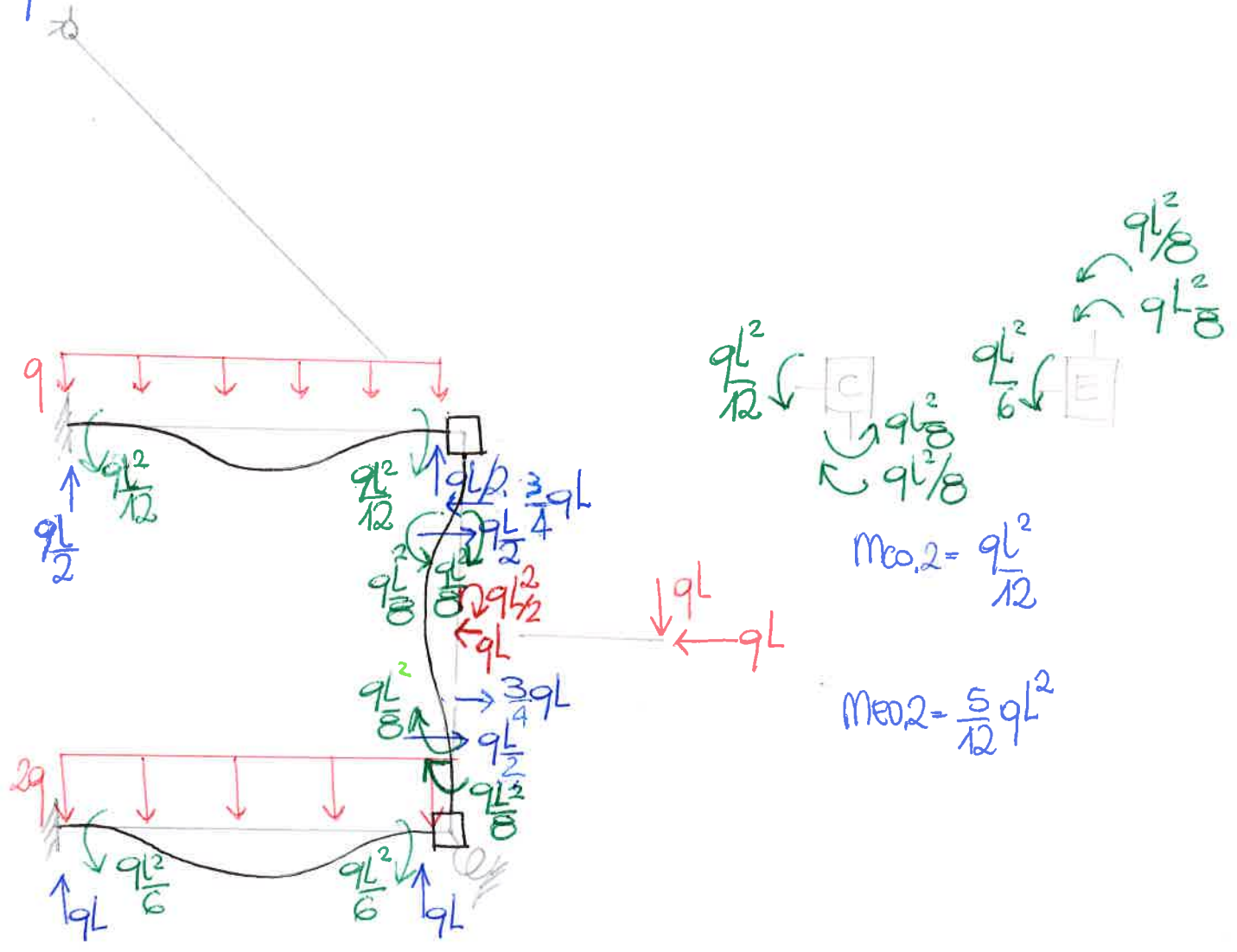
$\nu \bar{\eta} \neq 0$



$M_{C0,1} = \frac{6EJ}{L^2} \cdot \bar{\eta} = \frac{59}{8} \frac{L^2}{E}$

$M_{E0,1} = 0$

$N \neq 0$



$$M_{C,2} = \frac{qL^2}{12}$$

$$M_{E,2} = \frac{5}{12} qL^2$$

$$M_{C0} = -\frac{5}{8} qL^2 + \frac{qL^2}{12} = -\frac{13}{24} qL^2$$

$$M_{E0} = \frac{5}{12} qL^2$$

1 SISTEMA FIBLENTE

$$\begin{cases} 8EJ \psi_C + 2EJ \psi_E - \frac{13}{24} pL^2 = 0 & (1) \\ 2EJ \psi_C + \frac{28}{3} EJ \psi_E + \frac{5}{12} pL^2 = 0 & (2) \end{cases}$$

moltiplico per 4 (2)

$$8EJ \psi_C + \frac{112}{3} EJ \psi_E + \frac{5}{3} qL^2 = 0$$

(1)-(2)

$$\left(\frac{8EJ}{L} - \frac{8EJ}{L}\right)\psi_c + \left(\frac{2EJ}{L} - \frac{112EJ}{3L}\right)\psi_E + \left(-\frac{13}{24}qL^2 - \frac{5}{3}qL^2\right) = 0$$

$$-\frac{106EJ}{3L}\psi_E - \frac{53}{24}qL^2 = 0$$

$$\frac{106EJ}{3L}\psi_E = -\frac{53}{24}qL^2$$

$$\psi_E = -\frac{53}{24}qL^2 \cdot \frac{3L}{106EJ} = -\frac{159}{2544} \frac{qL^3}{EJ} = -\frac{1}{16} \frac{qL^3}{EJ}$$

SOSTITUISCO  $\psi_E$  NELLA ①

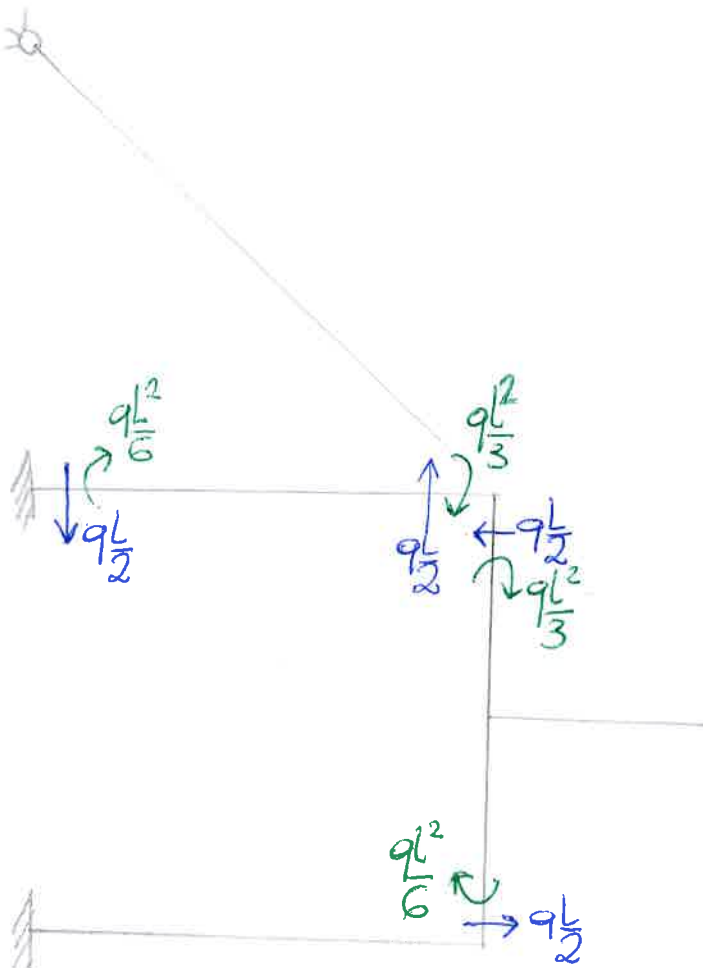
$$\frac{8EJ}{L}\psi_c - \frac{1}{8}qL^2 - \frac{13}{24}qL^2 = 0$$

$$\frac{8EJ}{L}\psi_c = \frac{16}{24}qL^2$$

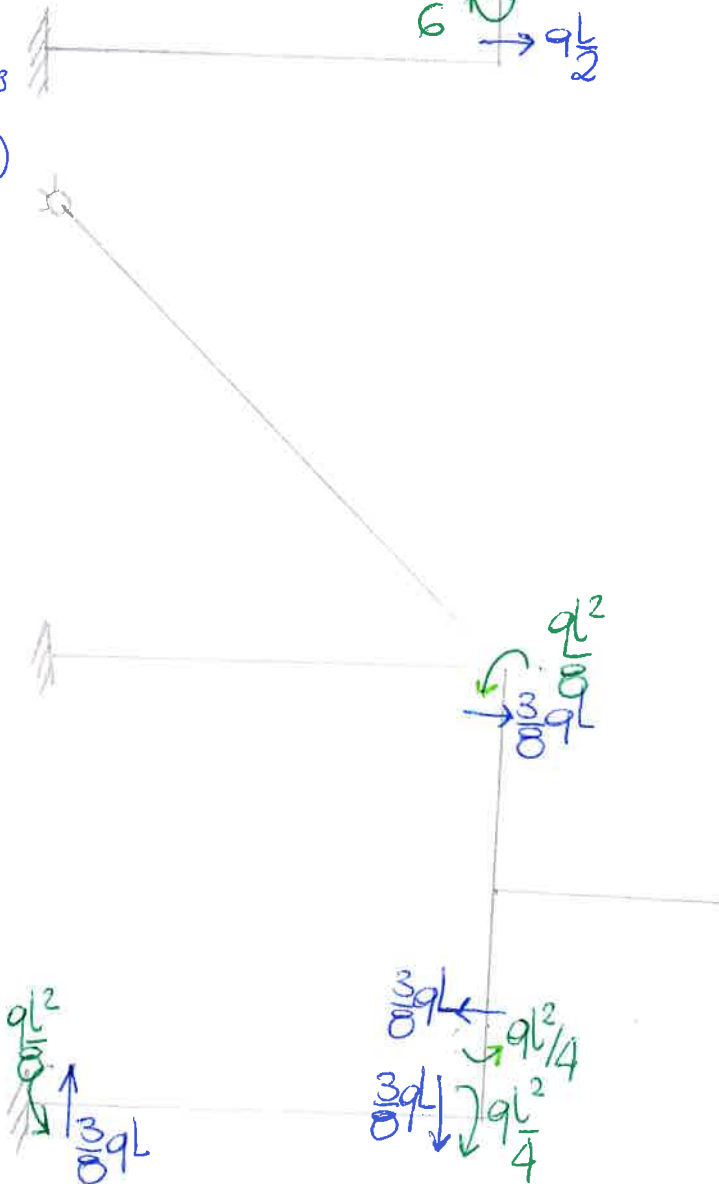
$$\psi_c = \frac{16}{24}qL^2 \cdot \frac{L}{8EJ} = \frac{1}{12} \frac{qL^3}{EJ}$$

$$\left\{ \begin{array}{l} \psi_c = \frac{1}{12} \frac{qL^3}{EJ} \\ \psi_E = -\frac{1}{16} \frac{qL^3}{EJ} \end{array} \right.$$

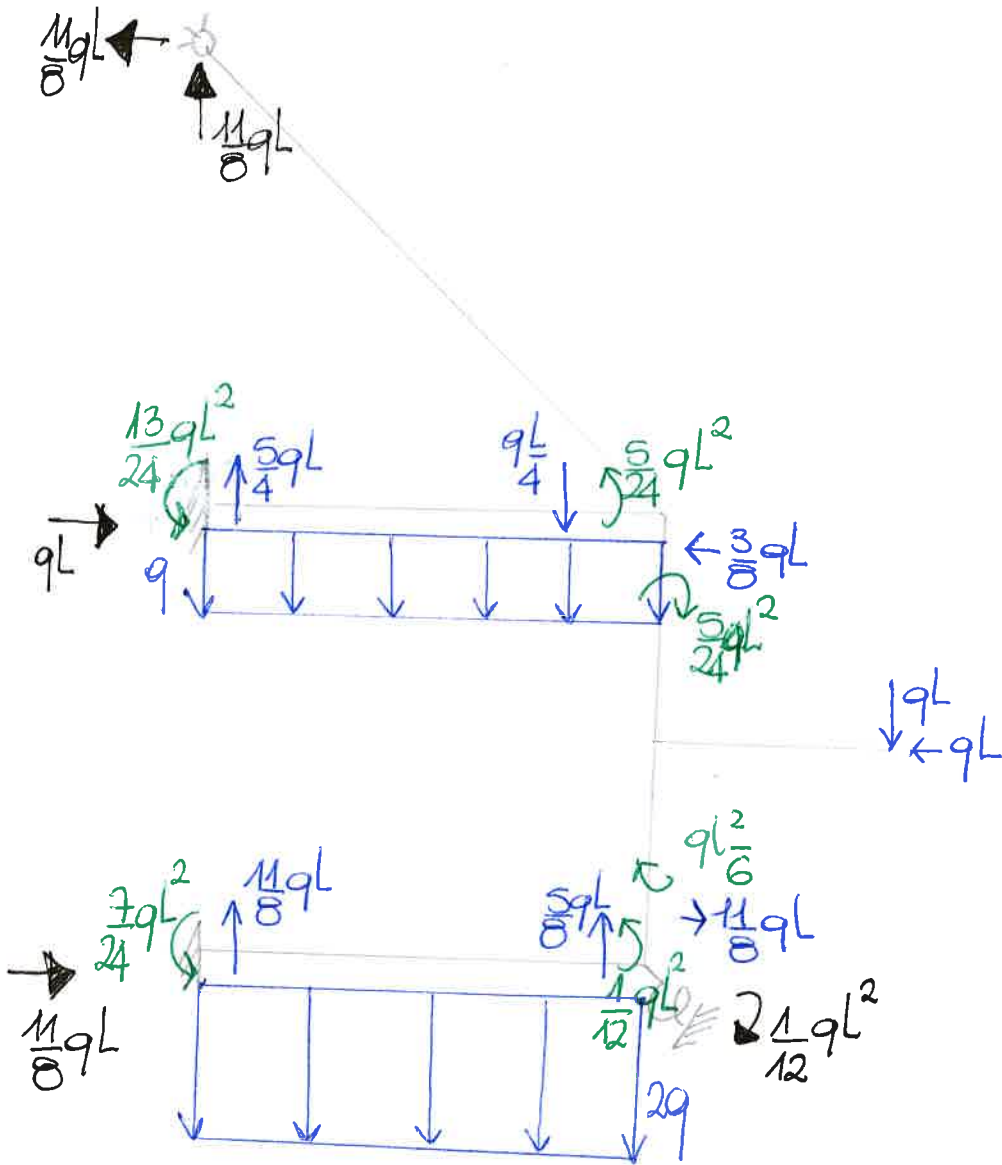
$$\psi_c = \frac{1}{12} \frac{ql^3}{EI}$$



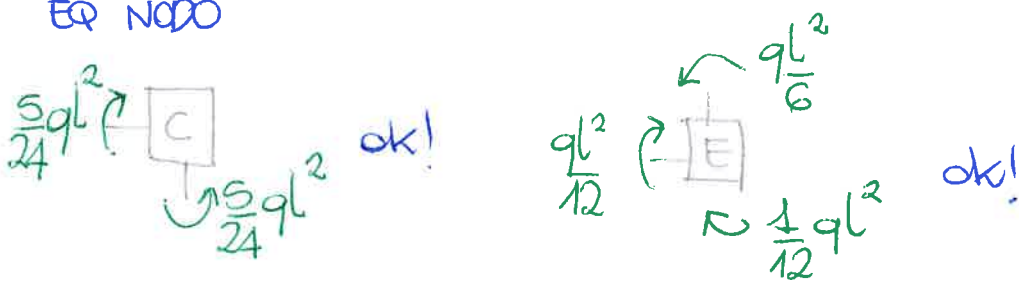
$$\psi_E = -\frac{1}{16} \frac{ql^3}{EI}$$



# IL CALCOLO DELLE AZIONI INTERNE



EQ NODO



EQ  $\uparrow = 0$

$$\frac{11qL}{8} - 2qL - qL - qL + \frac{11qL}{8} + \frac{5qL}{4} = 0 \quad \text{ok!}$$

EQ  $\rightarrow = 0$

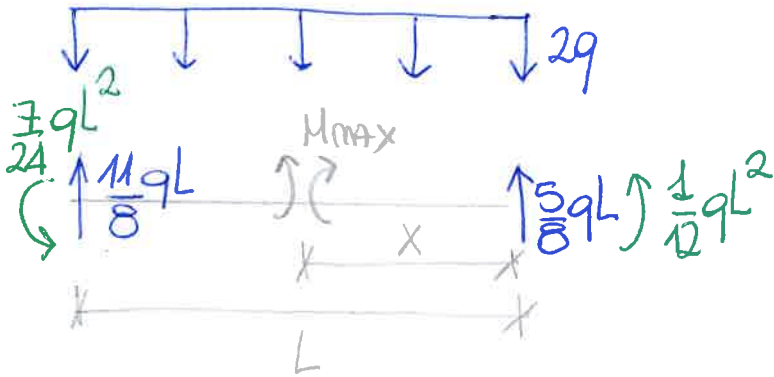
$$\frac{11qL}{8} - qL + qL - \frac{11qL}{8} = 0 \quad \text{ok!}$$



EQ  $\sum \varphi_B = 0$

$$-\frac{13}{24}qL + qL\frac{L}{2} - \frac{11}{8}qL - \frac{7}{24}qL^2 - \frac{11}{8}qLL + 2qL\frac{L}{2} + \frac{1}{12}qL^2 + qL\frac{3}{2}L + qL\frac{L}{2} = 0 \quad \text{ok!}$$

N MOMENTO MASSIMO

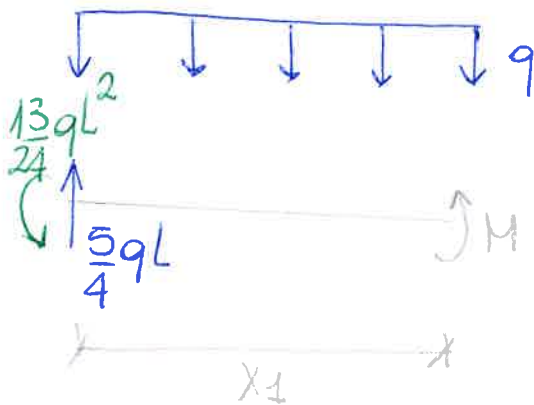


$$\begin{cases} +\frac{11}{8}qL - 2q(L-x) = 0 \\ +\frac{5}{8}qL - 2qx = 0 \end{cases} \rightarrow x = \frac{5}{16}L$$

$$M_{\max}(x = \frac{5}{16}L) = \frac{5}{8}qL \cdot \frac{5}{16}L + \frac{1}{12}qL^2 - 2q \cdot \frac{5}{16}L \cdot \frac{5}{16}L =$$

$$\frac{25}{128}qL^2 + \frac{1}{12}qL^2 - \frac{25}{256}qL^2 = \frac{139}{768}qL^2$$

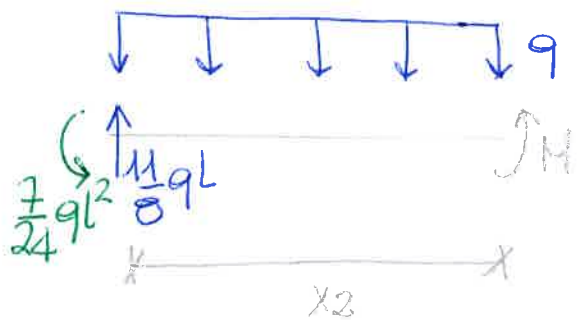
N FLESSO 1



$$M = \frac{5}{4}qL \cdot x_1 - \frac{13}{24}qL^2 - q \cdot \frac{x_1^2}{2} = 0 \rightarrow \frac{x_1^2}{2} - \frac{5}{4}x_1 + \frac{13}{24}L^2 = 0$$

$$x = 0,56L$$

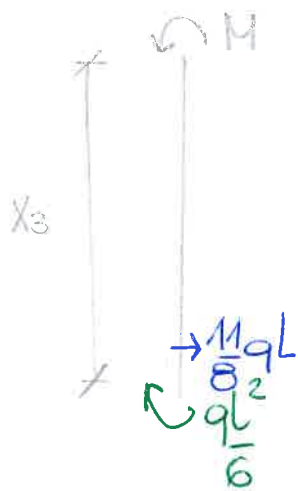
## N FLESSO 2



$$M = \frac{11}{8} qL x_2 - \frac{7}{24} qL^2 - q \frac{x_2^2}{2} = 0 \rightarrow \frac{x_2^2}{2} - \frac{11}{8} L x_2 + \frac{7}{24} L^2$$

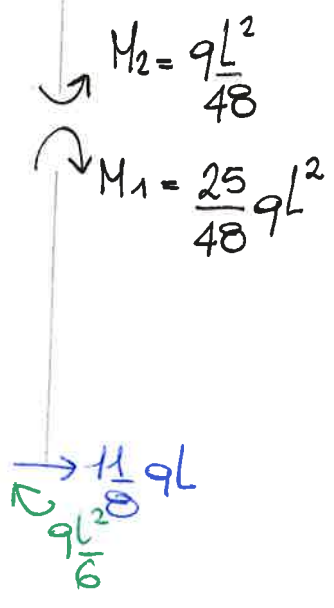
$$x = 0,26 L$$

## N FLESSO 3



$$M = -\frac{11}{8} qL x_3 + \frac{qL^2}{6} = 0 \rightarrow \frac{11}{8} q x_3 = \frac{L}{6} \quad x_3 = 0,12 L$$

N ASTA CE  
 $\frac{5}{24} qL^2$  ←  $\frac{3}{8} qL$

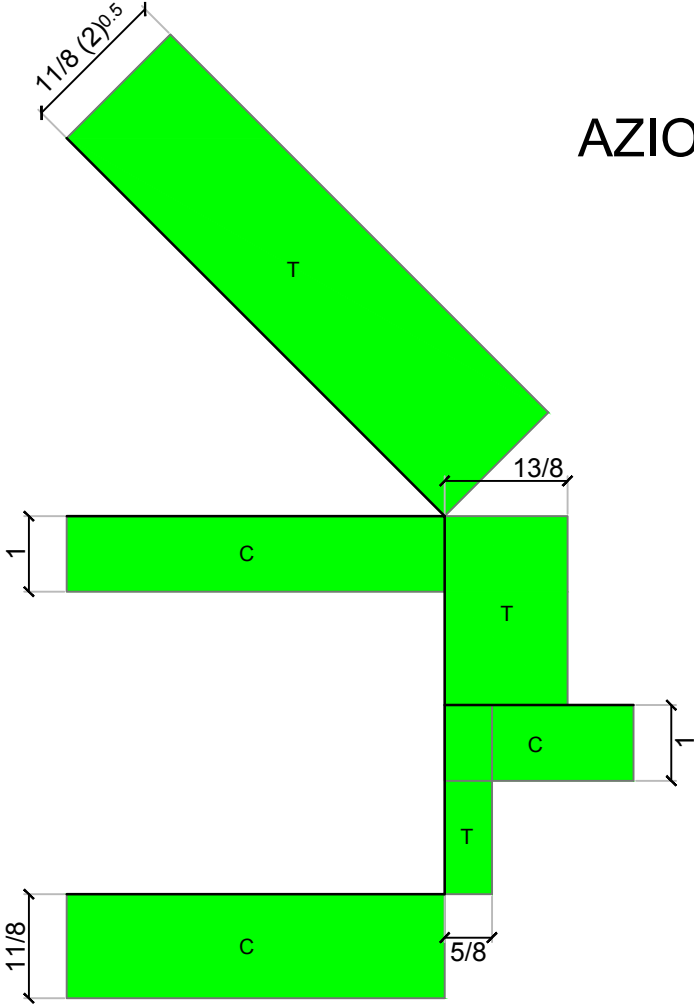


$$M_1 = -\frac{qL^2}{6} + \frac{11}{8} qL \cdot \frac{L}{2} = -\frac{qL^2}{6} + \frac{11}{16} qL^2 = \frac{25}{48} qL^2$$

$$M_2 = -\frac{3}{8} qL \cdot \frac{L}{2} + \frac{5}{24} qL^2 = \frac{3}{16} qL^2 + \frac{5}{24} qL^2 = \frac{1}{48} qL^2$$

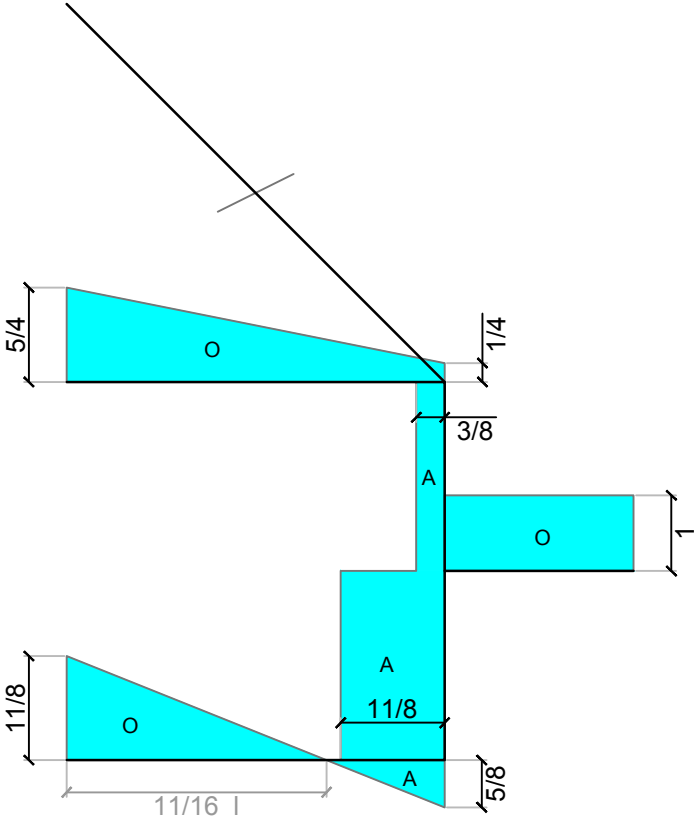
# AZIONE ASSIALE

U.D.M. ql



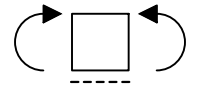
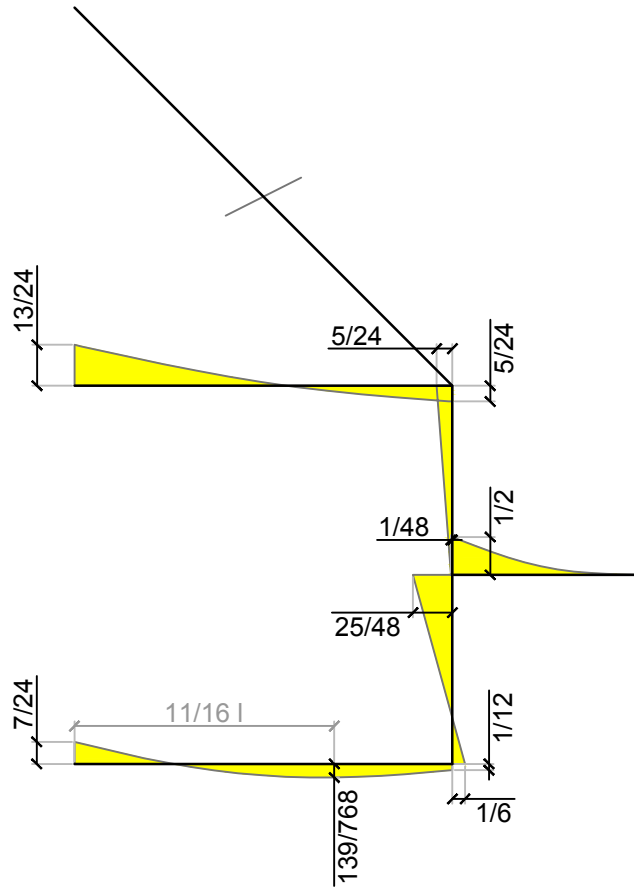
# TAGLIO

U.D.M. ql



# MOMENTO FLETTENTE

U.D.M.  $ql^2$



# DEFORMATA QUALITATIVA

U.D.M. Spostamenti  $ql^4/EJ$   
 U.D.M. Rotazioni  $ql^3/EJ$   
 U.D.M. Posizione flessi l

