

TECNICA DELLE COSTRUZIONI

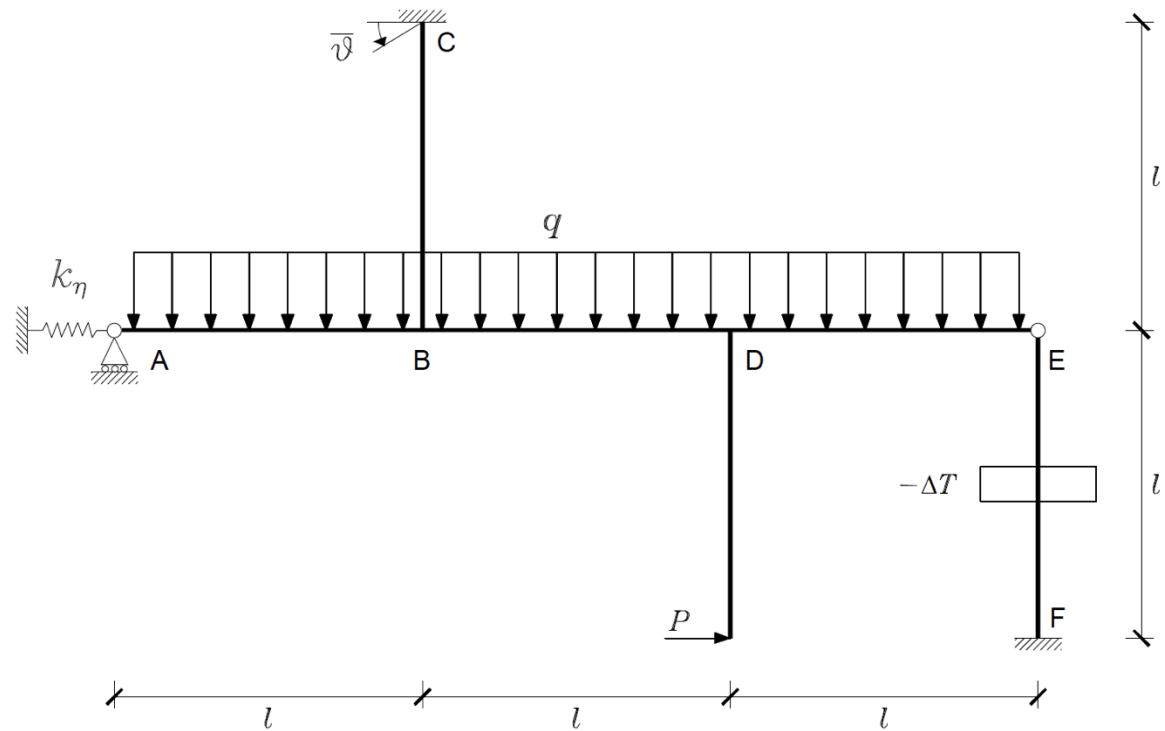
TEMA ESAME DEL 01 SETTEMBRE 2020

DOCENTI:

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DURATA: 2 ORE.



$$k_\eta = \frac{EJ}{l^3} \quad P = q \cdot l \quad \alpha \Delta T = 13 \frac{ql^3}{EJ} \quad \bar{\vartheta} = 2 \frac{ql^3}{EJ}$$

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 $EA \rightarrow \infty$, $EJ = \text{costante}$.

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.

$$P = ql$$

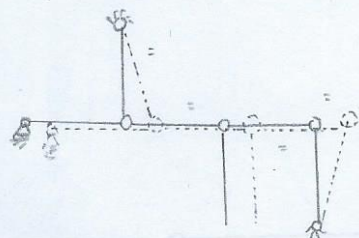
CARICO DISTRIBUITO = q

$6 qle$
 $10 qle$ } 4 volte
IPERSTATICA

INCOGNITE:

$$\varphi_B; \eta_A; \Delta T; \theta; k_H$$

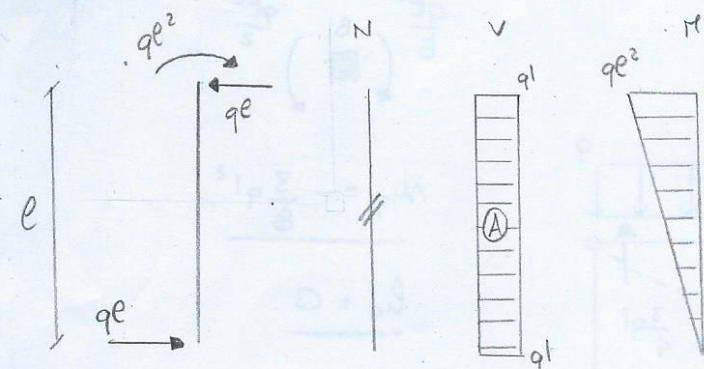
STRUTTURA A NODI
SPOSTABILI



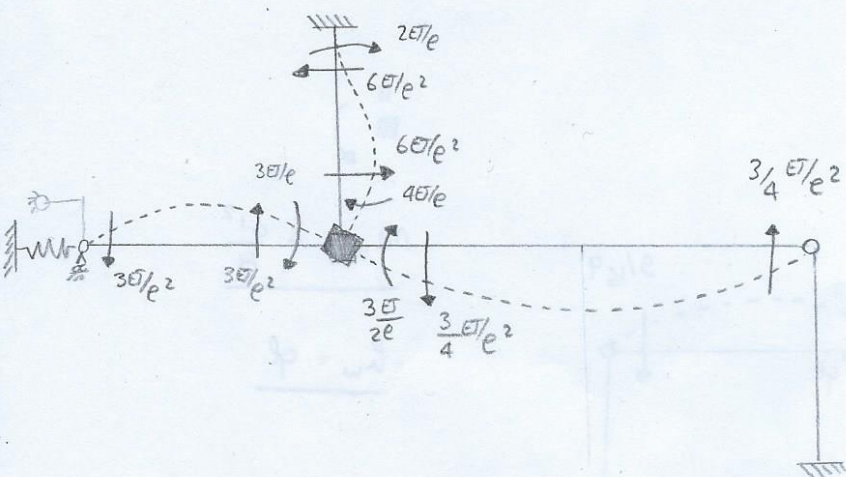
CONVENZIONI:

$$\oplus \curvearrowright \varphi + \quad \leftarrow \oplus \text{---} \oplus \rightarrow$$

ASTA DG APPENDICE ISOSTATICA



CASO $\varphi_B = 1$



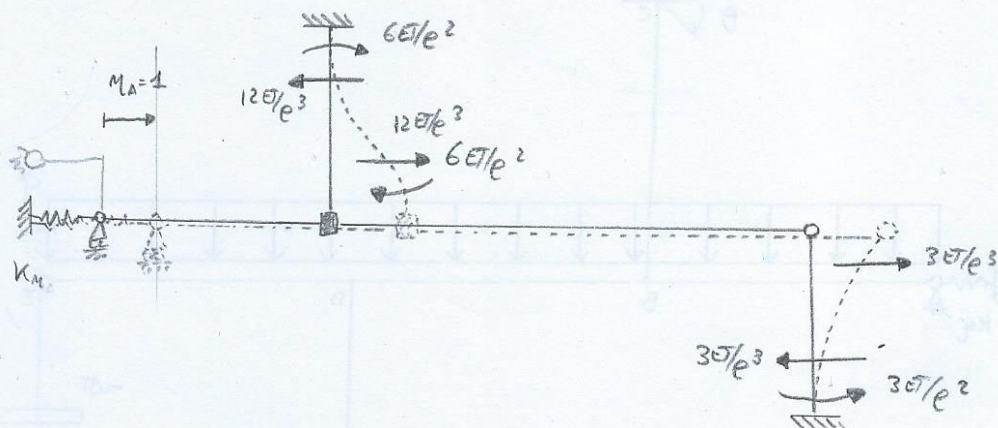
$$\begin{matrix} 4Et/e \\ 3Et/e \end{matrix} \quad \begin{matrix} \curvearrowright \\ \curvearrowleft \end{matrix} \quad \begin{matrix} \oplus \\ \ominus \end{matrix} \quad \begin{matrix} 3/2 Et/e \\ 3/2 Et/e \end{matrix}$$

$$M_{\varphi_B} = \frac{17}{2} \frac{Et}{e}$$

$$h_{\varphi_B} \rightarrow \begin{matrix} \rightarrow 6Et/e^2 \\ \leftarrow 6Et/e^2 \end{matrix}$$

$$h_{\varphi_B} = -6Et/e^2$$

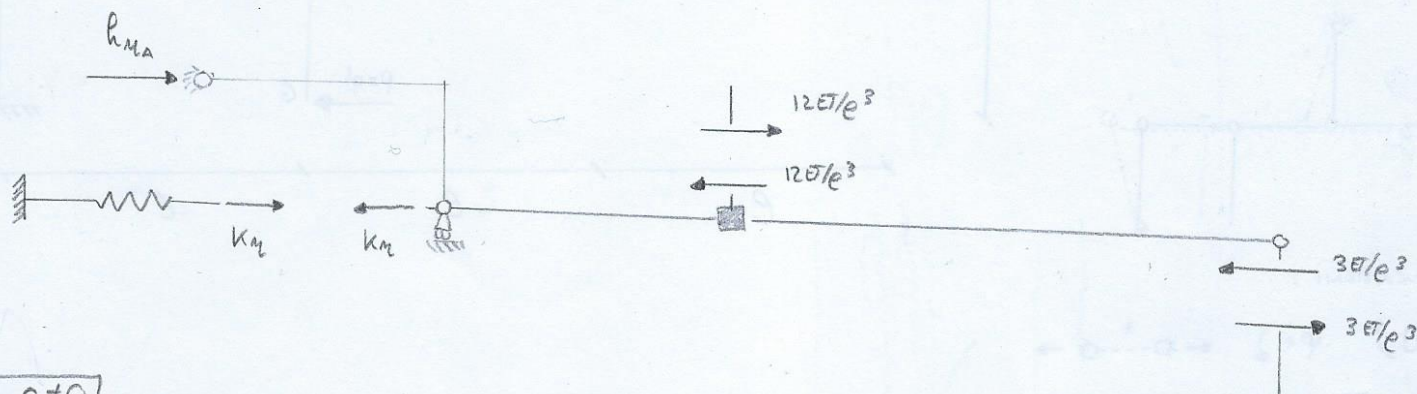
CASO $M_A = -1$



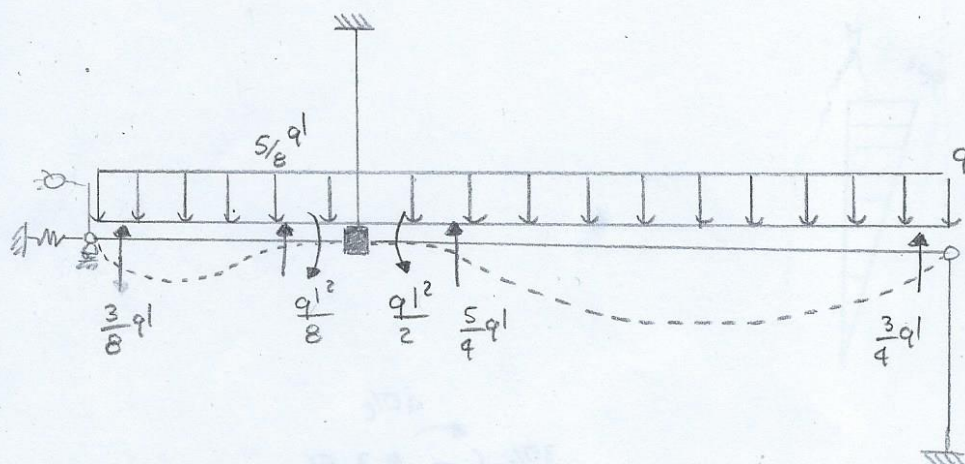
$$B \quad \frac{6EI}{e^2}$$

$$M_{MA} = \frac{6EI}{e^2}$$

$$h_{MA} = -\frac{15EI}{e^3} - k_M$$



CASO $q \neq 0$

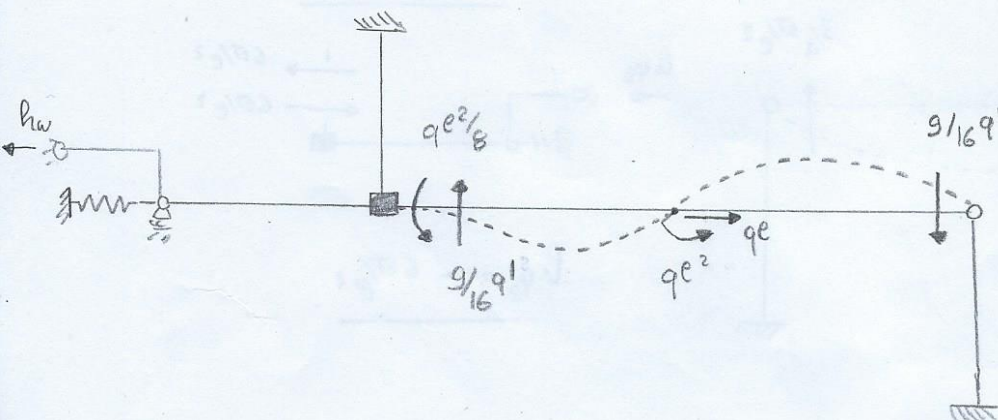


$$\frac{qe^2}{8} \quad B \quad \frac{qe^2}{2}$$

$$M_q = -\frac{3}{8} q l^2$$

$$h_q = 0$$

CASE TORRENTO CONCENTRATO IN D

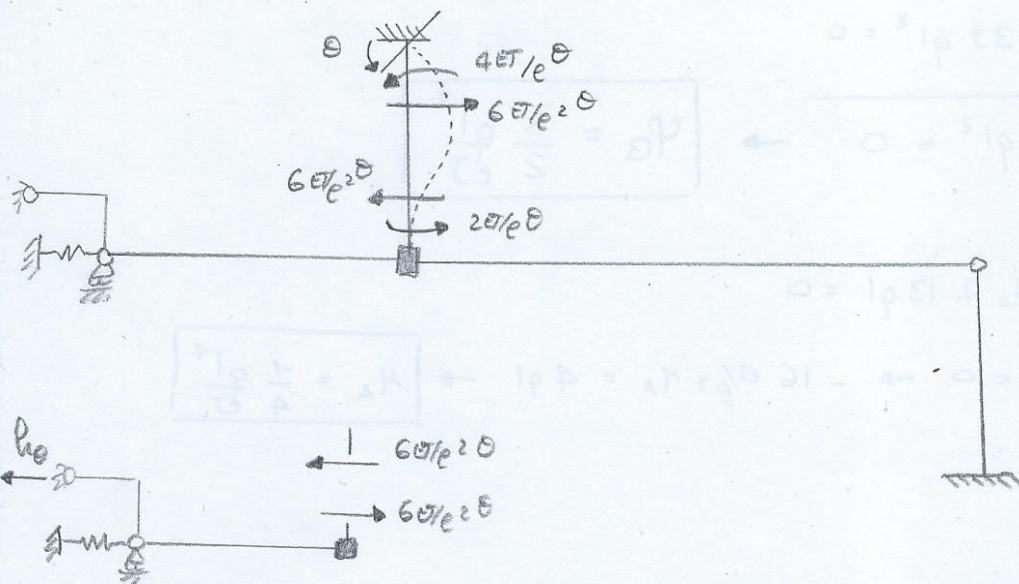


$$B \quad \frac{qe^2}{8}$$

$$M_w = -\frac{q l^2}{8}$$

$$h_w = q$$

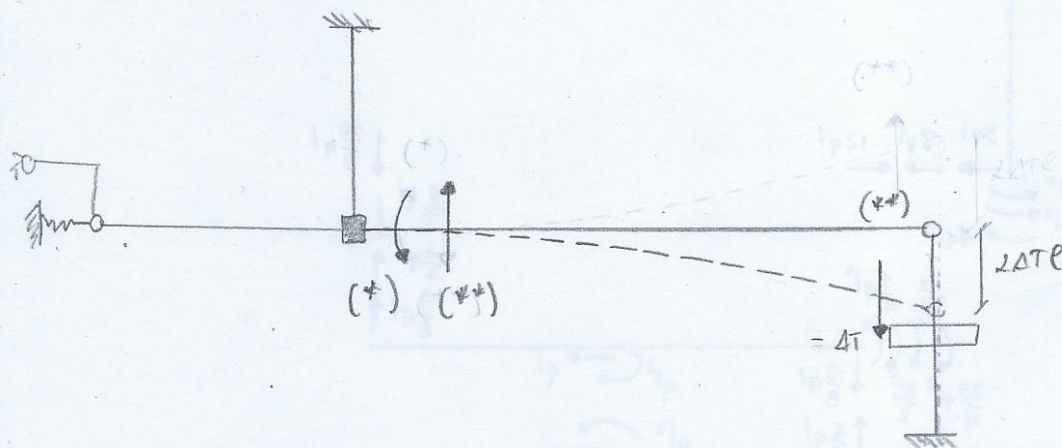
CASO $\theta \neq 0$



$$M_{B\theta} = -2ET/e \theta$$

$$h_{\theta} = 6ET/e^2 \theta$$

CASO $\Delta T \neq 0$



$$(*) \frac{3ET}{e^2} \Delta T$$

$$= \frac{3ET}{(2e)^2} \Delta T = \frac{3}{4} \frac{ET}{e^2} \Delta T$$

$$(**) \frac{3ET}{e^3} \Delta T$$

$$= \frac{3ET}{(2e)^3} \Delta T = \frac{3}{8} \frac{ET}{e^2} \Delta T$$

$$B \left(\frac{3}{4} \frac{ET}{e^2} \Delta T \right)$$

$$M_{\Delta T} = -\frac{3}{4} \frac{ET}{e^2} \Delta T$$

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

EQUAZIONI RISOLVENTI

$$-\frac{1}{2} q l^2$$

$$\begin{cases} \frac{17}{2} \frac{ET}{e} \varphi_B + 6ET/e^2 M_A - \frac{3}{8} q l^2 - \frac{q l^2}{8} - 2ET/e \theta - \frac{3}{4} \frac{ET}{e^2} \Delta T = 0 \\ -6ET/e^2 \varphi_B + (-\frac{15}{e^3} ET - K_M) M_A + 6ET/e^2 \theta + qe = 0 \end{cases}$$

$$K_M = 1ET/e^3 ; \Delta T = 13 \frac{q l^3}{ET} ; \theta = 2 \frac{q l^3}{ET}$$

$$\begin{cases} \frac{17}{2} \frac{ET}{e} \varphi_B + 6ET/e^2 M_A - \frac{1}{2} q l^2 - 4 q l^2 - \frac{39}{4} q l^2 = 0 \\ -6ET/e^2 \varphi_B + (-15ET/e^3 - 1ET/e^3) M_A + 12 q l + q l = 0 \end{cases}$$

$$\begin{cases} \frac{17}{2} \frac{ET}{e} \varphi_B + 6ET/e^2 M_A - \frac{57}{4} q l^2 = 0 & (\times 8) \\ -6ET/e^2 \varphi_B - 16ET/e^3 M_A + 13 q l = 0 & (\times 3e) \end{cases}$$

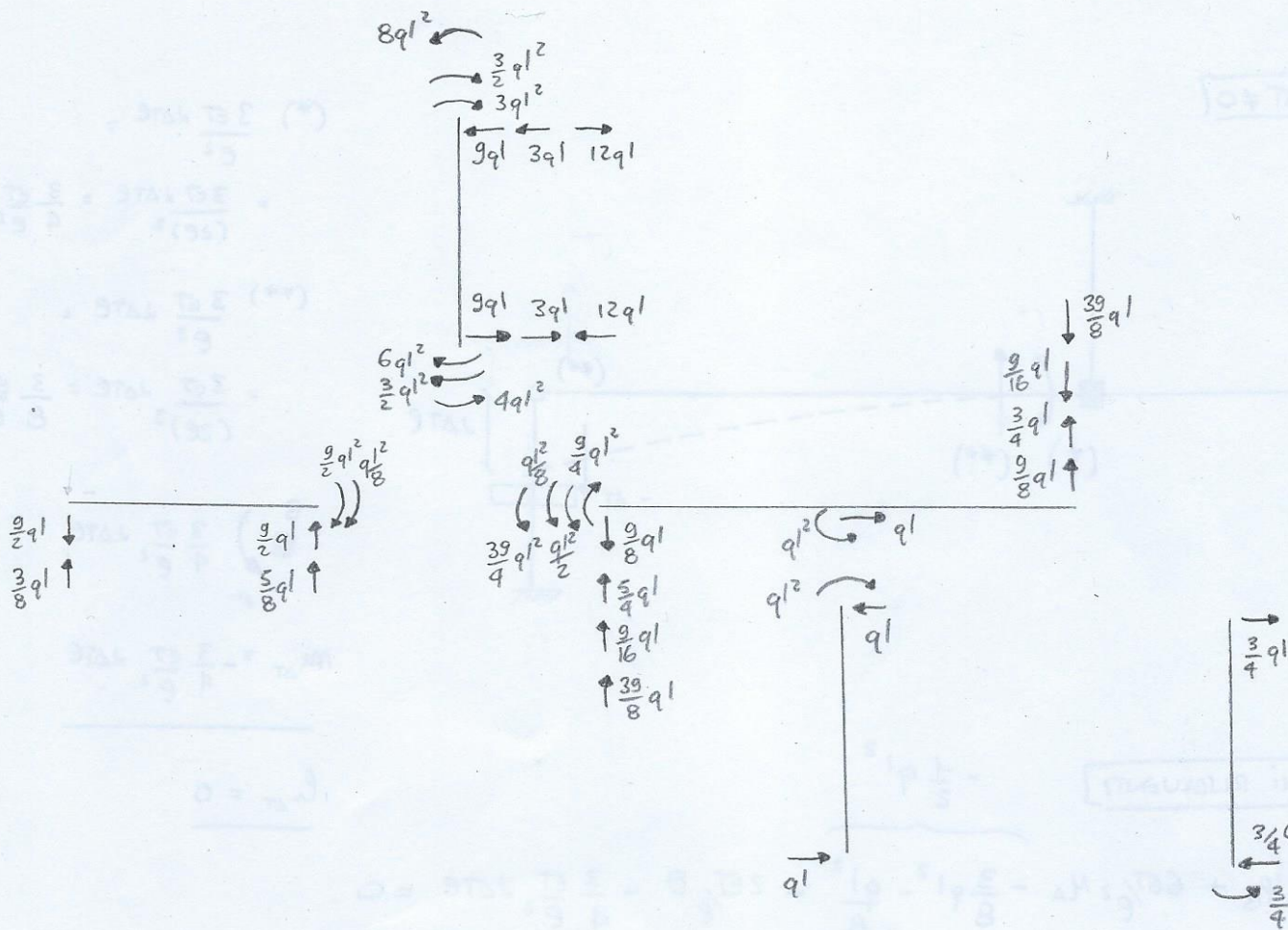
$$\begin{cases} 68 \text{ EJ/e } \psi_B + 48 \text{ EJ/e}^2 \chi_A - 114 q l^2 = 0 \\ -18 \text{ EJ/e } \psi_B - 48 \text{ EJ/e}^2 \chi_A + 39 q l^2 = 0 \end{cases}$$

$$\text{SO E/e } \varphi_B \quad // \quad -75 q^2 = 0 \quad \rightarrow \quad \boxed{\varphi_B = \frac{3}{2} \frac{q^3}{E}}$$

$$-6\epsilon_0/\epsilon^2 \cdot \frac{3}{2} \frac{q|}{\epsilon} - 16\epsilon_0/\epsilon^3 \eta_A + 13q| = 0$$

$$-9q_1 - 16 \epsilon / e^3 \mu_A + 13q_1 = 0 \rightarrow -16 \epsilon / e^3 \mu_A = 4q_1 \rightarrow \mu_A = \frac{1}{4} \frac{q_1^4}{\epsilon}$$

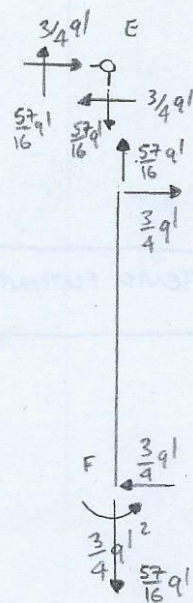
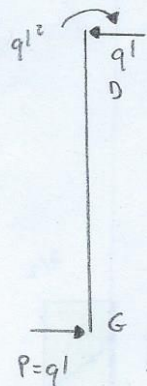
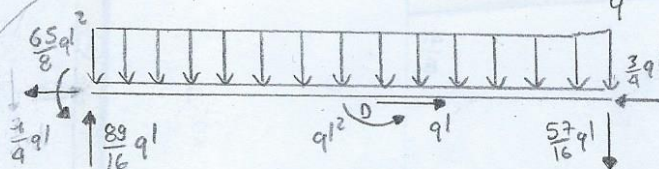
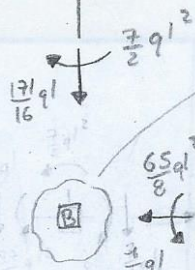
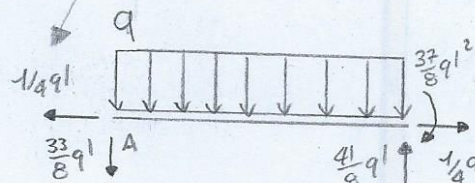
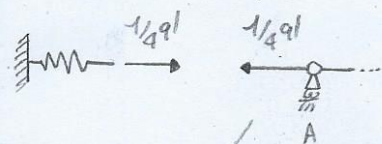
AZIONI AGENTI SUO STRUTTURA



$$k_A \cdot \Delta_A = 1 \cdot \frac{1}{4} = \frac{1}{4} q l$$

$$\frac{171}{16} q l \quad \frac{7}{2} q l^2$$

$$\begin{aligned} \sum' M_{CB} &= 0 \rightarrow \left(\frac{7}{2} + \frac{37}{8} - \frac{65}{8} \right) q l^2 = 0 \\ \sum' V_{CB} &= 0 \quad \checkmark \\ \sum' H_{CB} &= 0 \quad \checkmark \end{aligned}$$

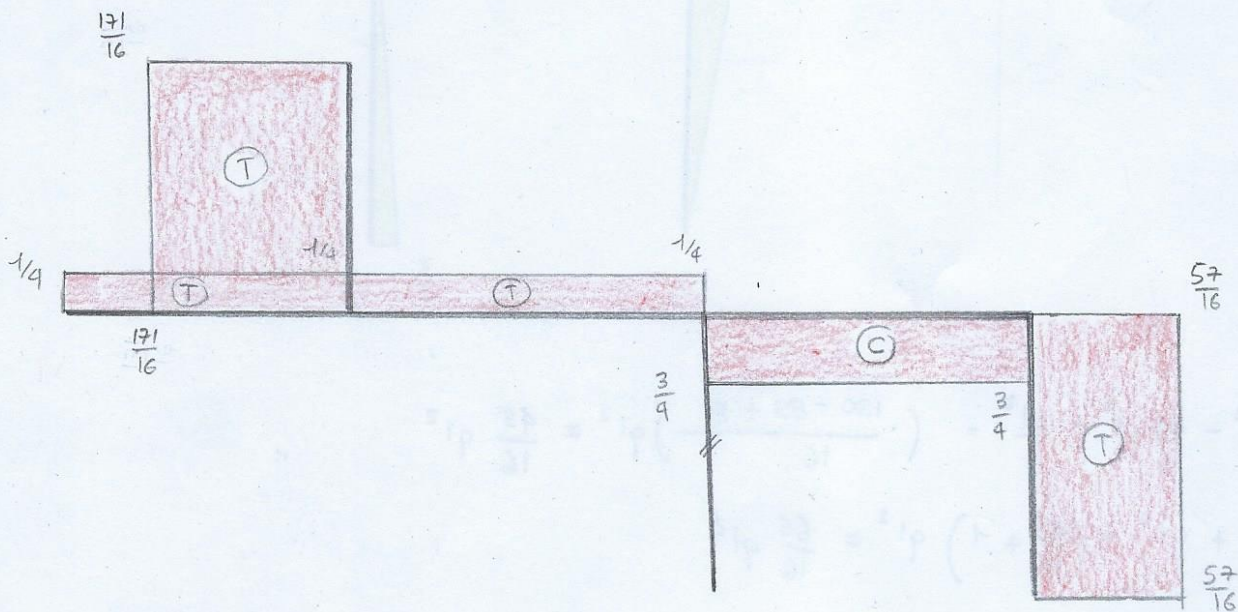


$$\sum' H_{GLOBALI} = 0 \quad \checkmark$$

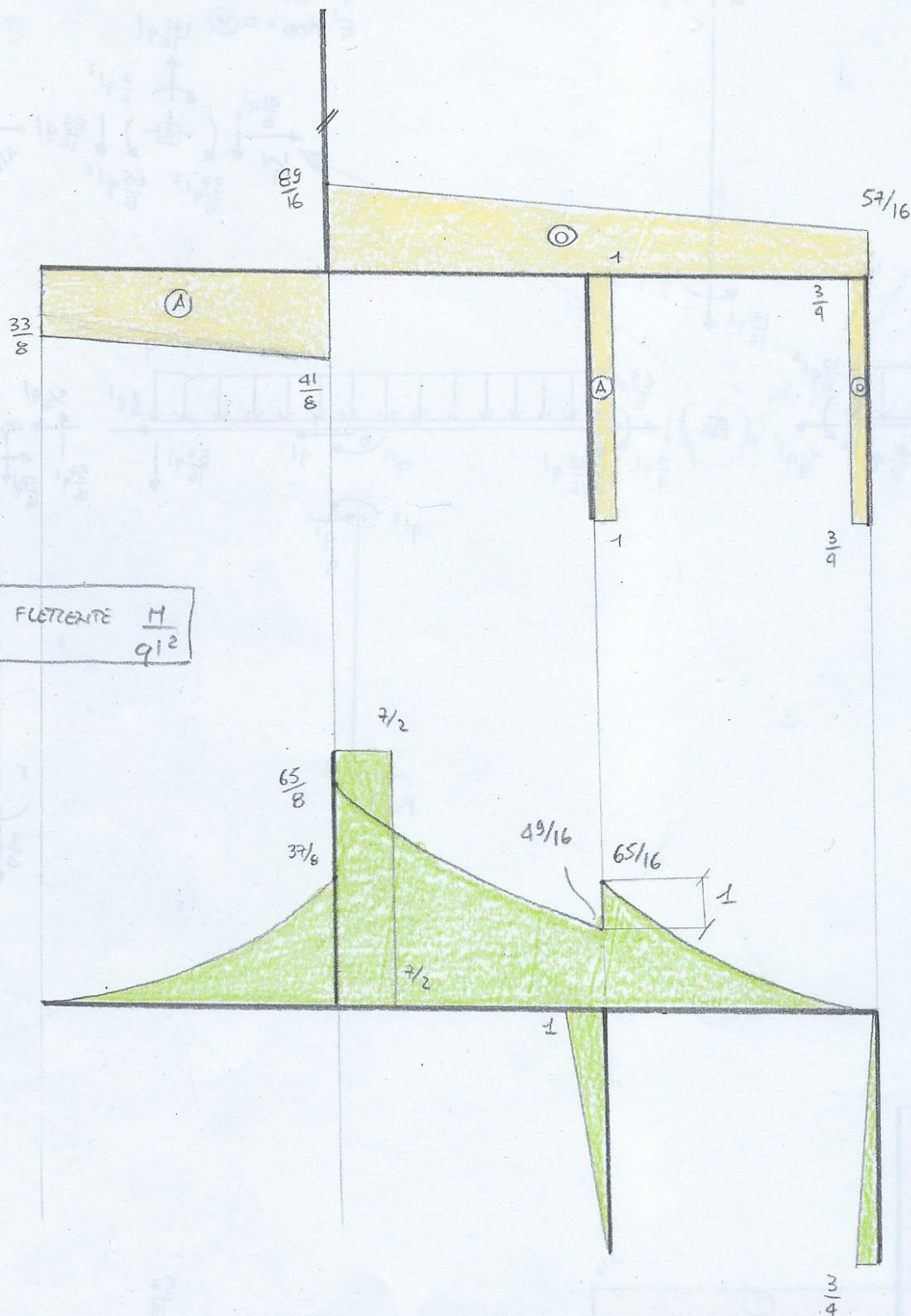
$$\sum' V_{GLOBALI} = 0 \quad \checkmark$$

GRAFICI

AZIONE ASSIALE $\frac{N}{q l}$



TAGLIO $\frac{V}{q l^2}$



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

$$M_{CO}sx = \frac{65}{8} q l^2 - \frac{89}{16} q l^2 + \frac{q l^2}{2} = \left(\frac{130 - 89 + 8}{16} \right) q l^2 = \frac{49}{16} q l^2$$

$$M_{CO}dx = M_{CO}sx + q l^2 = \left(\frac{49}{16} + 1 \right) q l^2 = \frac{65}{16} q l^2$$

