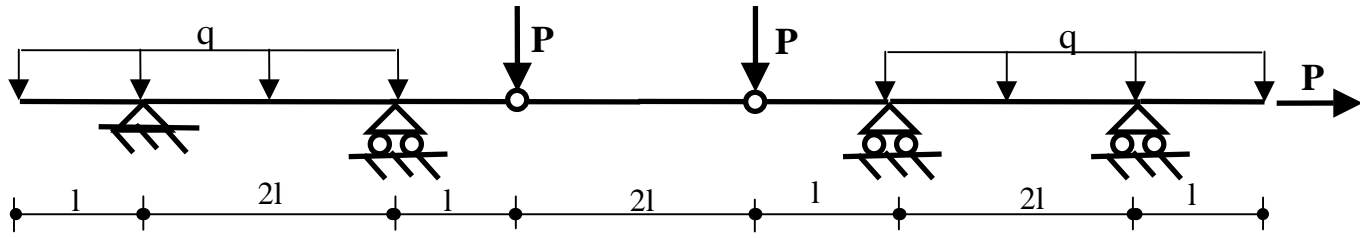
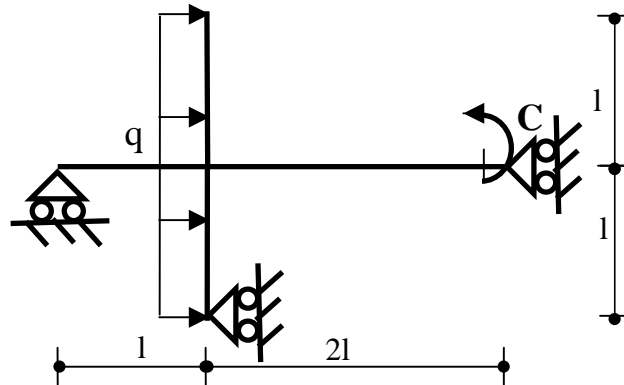


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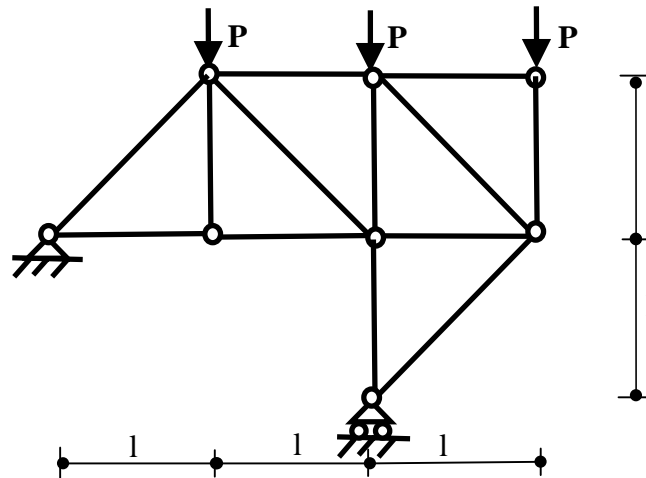
- 1) Disegnare i diagrammi quotati delle azioni interne (N, T, M) per $l=1\text{ m}$, $q=20\text{ kN/m}$, $P=10\text{ kN}$.



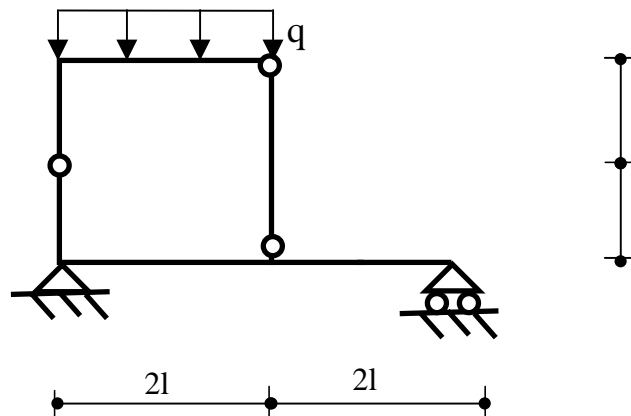
- 2) Disegnare i diagrammi quotati delle azioni interne (N, T, M) per $l=1\text{ m}$, $q=20\text{ kN/m}$, $C=20\text{ kN m}$.



- 3) Calcolare lo stato di sollecitazione per $l=1\text{ m}$, $P=10\text{ kN}$.

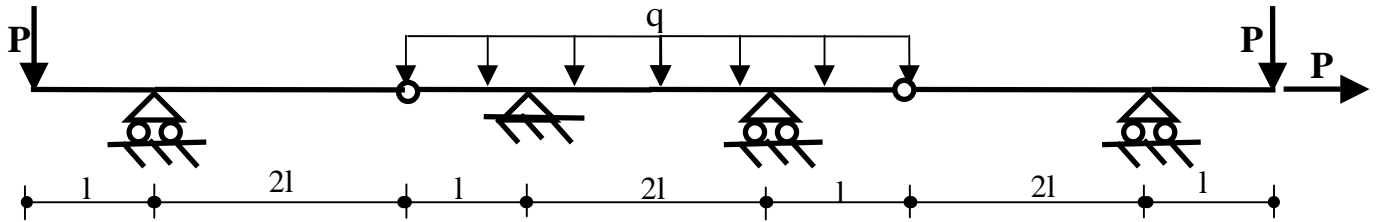


- 4) Disegnare i diagrammi quotati di (N,T,M) per $l=1\text{ m}$, $q=20\text{ kN/m}$.

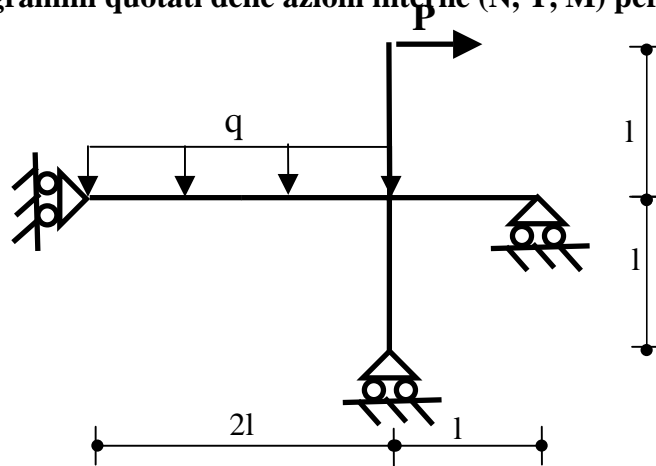


FERRARA, 19/11/2010

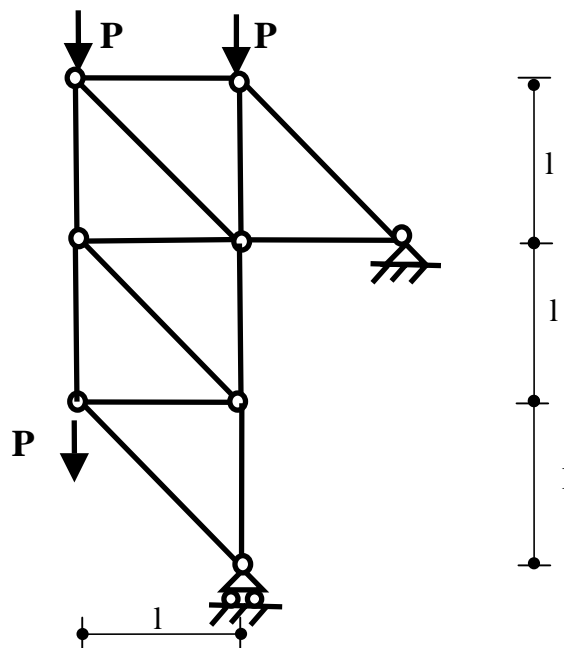
- 1) Disegnare i diagrammi quotati delle azioni interne (N, T, M) per $l=1$ m, $q=15$ kN/m, $P=10$ kN.



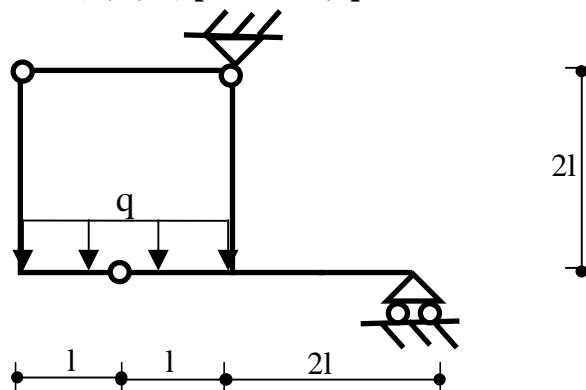
- 2) Disegnare i diagrammi quotati delle azioni interne (N, T, M) per $l=1$ m, $q=15$ kN/m, $P=15$ kN.

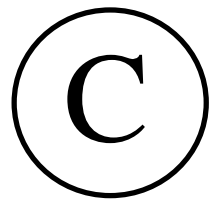


- 3) Calcolare lo stato di sollecitazione per $l=1$ m, $P=15$ kN.



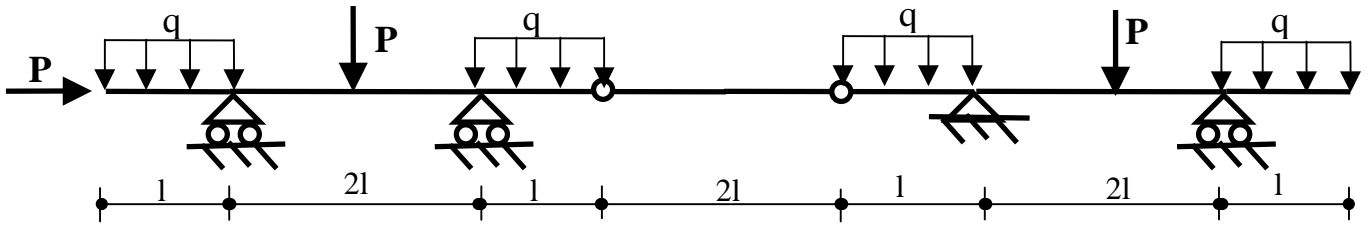
- 4) Disegnare i diagrammi quotati di (N,T,M) per $l=1$ m, $q=15$ kN/m.



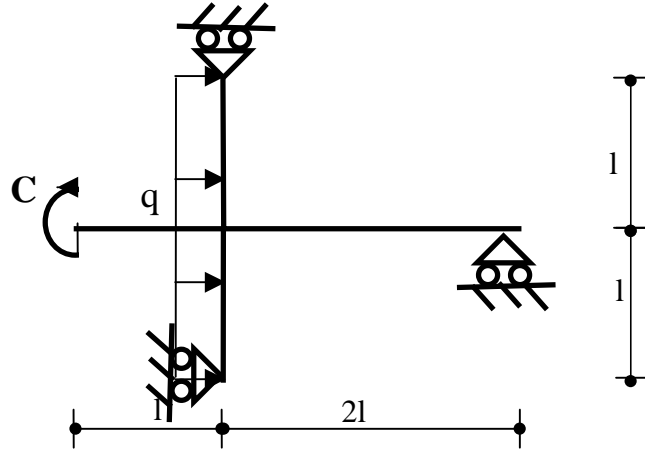


FERRARA, 19/11/2010

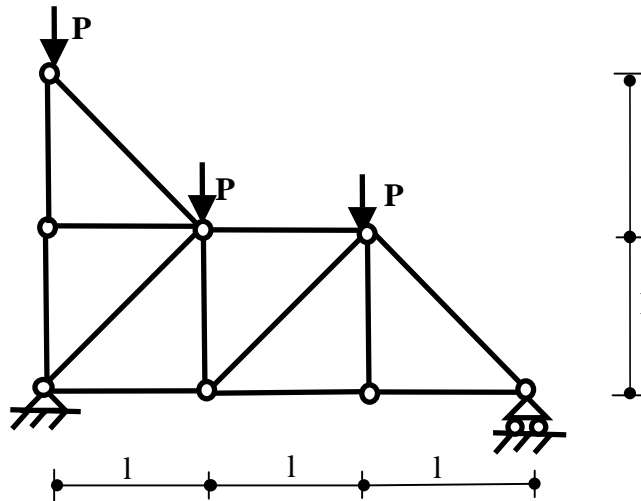
1) Disegnare i diagrammi quotati delle azioni interne (N, T, M) per $l=1\text{ m}$, $q=10\text{ kN/m}$, $P=20\text{ kN}$.



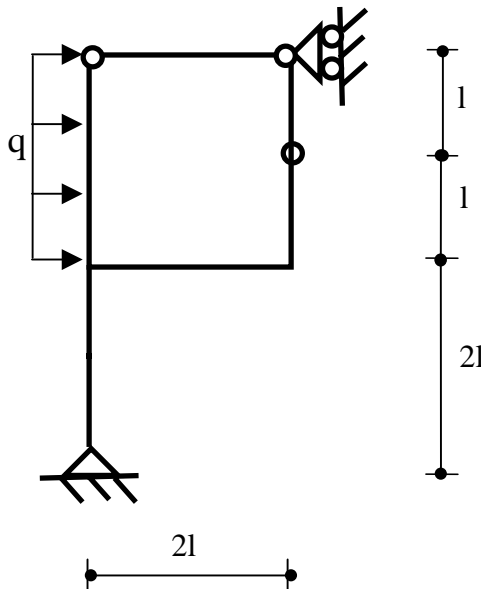
2) Disegnare i diagrammi quotati delle azioni interne (N, T, M) per $l=1\text{ m}$, $q=10\text{ kN/m}$, $C=15\text{ kN m}$.



3) Calcolare lo stato di sollecitazione per $l=1\text{ m}$, $P=20\text{ kN}$.

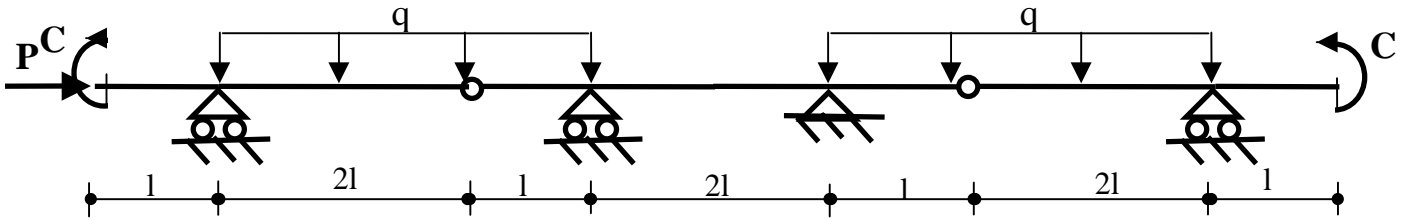


4) Disegnare i diagrammi quotati di (N,T,M) per $l=1\text{ m}$, $q=10\text{ kN/m}$.

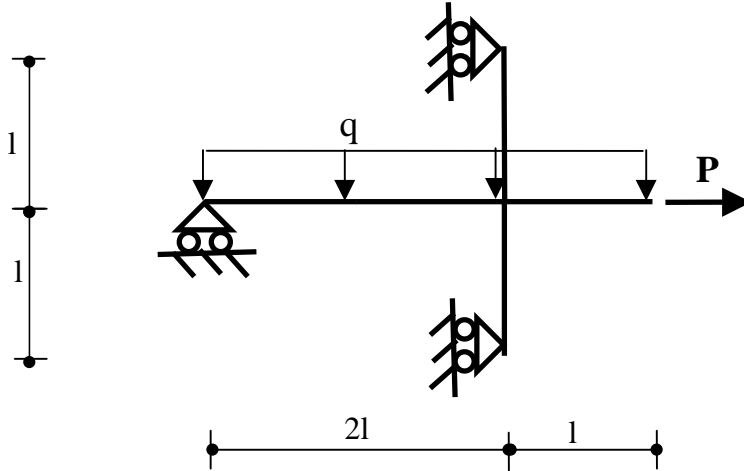


FERRARA, 19/11/2010

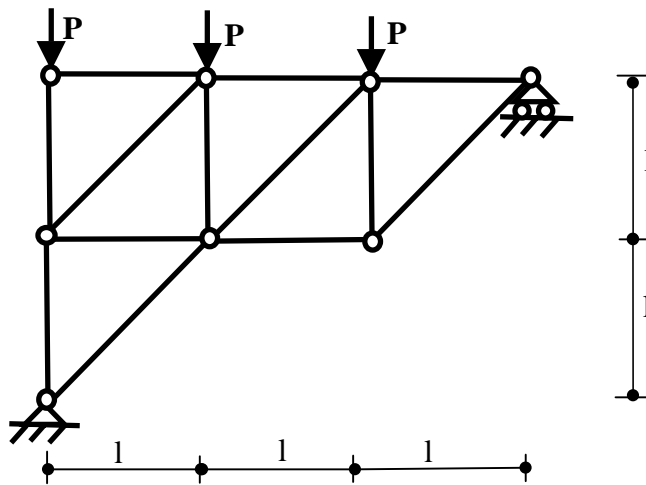
- 1) Disegnare i diagrammi quotati delle azioni interne (N, T, M) per $l=1$ m, $q=25$ kN/m, $P=10$ Kn, $C=10$ kNm.



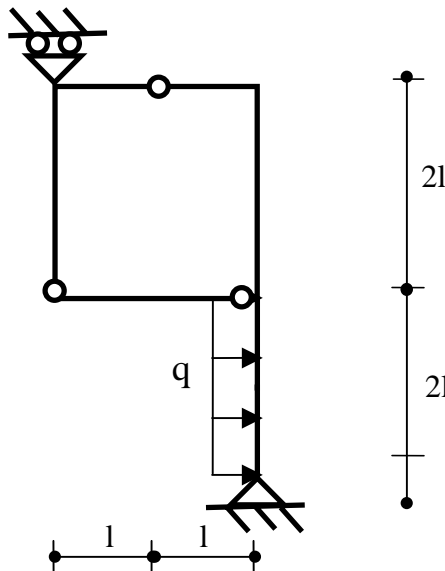
- 2) Disegnare i diagrammi quotati delle azioni interne (N, T, M) per $l=1$ m, $q=25$ kN/m, $P=5$ kN m.



- 3) Calcolare lo stato di sollecitazione per $l=1$ m, $P=5$ kN.

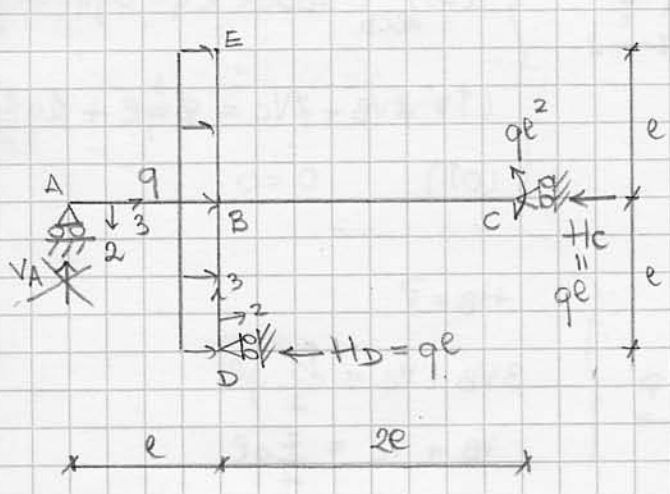


- 4) Disegnare i diagrammi quotati di (N,T,M) per $l=1$ m, $q=25$ kN/m.



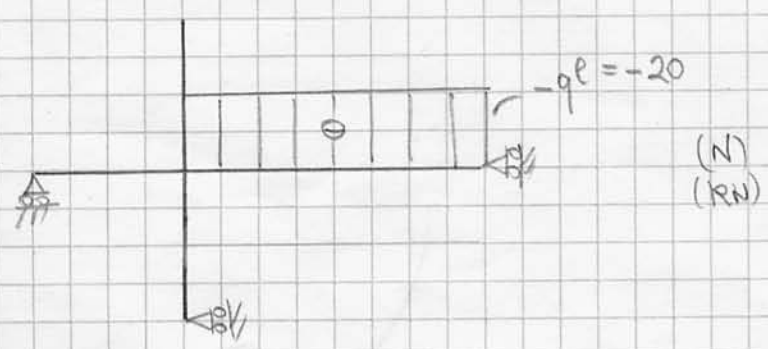
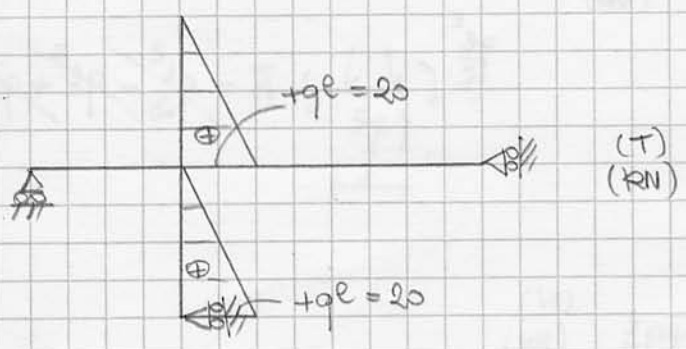
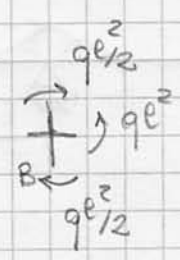
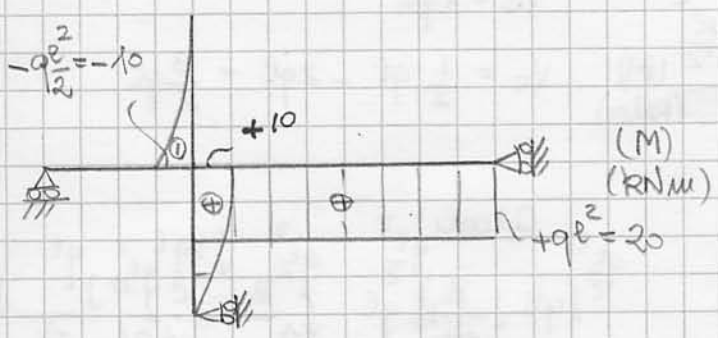
A2)

$I = 20 \text{ kNm} = ql^2$



$(\uparrow) V_A = 0$
 $(B \uparrow) +15e = ql^2$
 $(\rightarrow) H_c = 2ql - ql = ql$

Diagrammi delle c.s.:

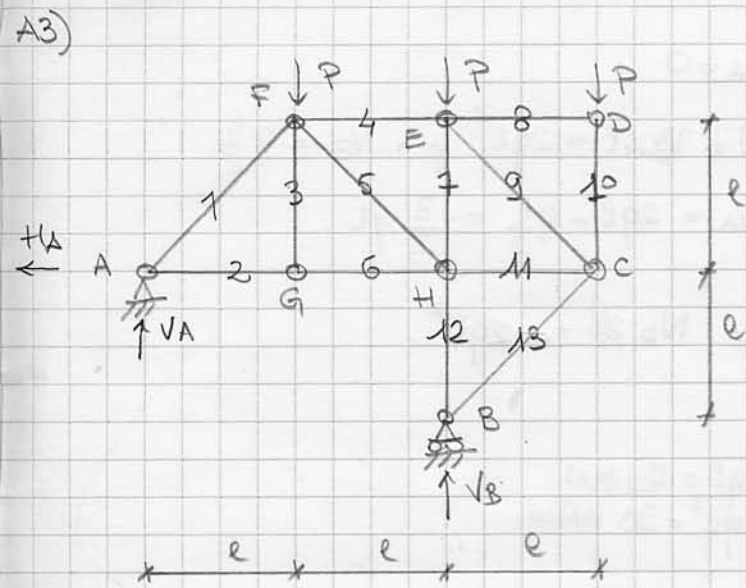


$$(\leftarrow) H_A = 0$$

$$(\uparrow) V_B 2e = Pe + P2e + P3e = 6Pe$$

$$\rightarrow V_B = 3P$$

$$(\uparrow) V_A = 3P - 3P = 0$$



Metodo dell'equilibrio ai nodi:

$$\begin{cases} N_1 = 0 \\ N_2 = 0 \end{cases}$$

$$\begin{cases} N_3 = 0 \\ N_6 = 0 \end{cases}$$

$$\begin{cases} N_5 \frac{\sqrt{2}}{2} = -P \rightarrow N_5 = -P\sqrt{2} \\ N_4 = -N_5 \frac{\sqrt{2}}{2} = P \end{cases}$$

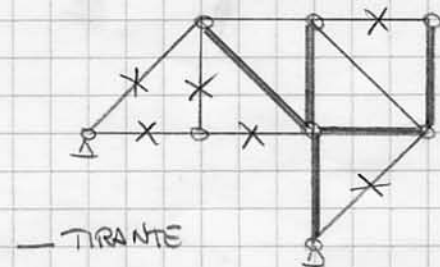
$$\begin{cases} N_8 = 0 \\ N_{10} = -P \end{cases}$$

$$\begin{cases} N_9 \frac{\sqrt{2}}{2} = P \rightarrow N_9 = P\sqrt{2} \\ N_7 = -P - N_9 \frac{\sqrt{2}}{2} = -2P \end{cases}$$

$$\begin{cases} N_{13} \frac{\sqrt{2}}{2} = -P + P\sqrt{2} \frac{\sqrt{2}}{2} = 0 \\ N_{11} = -P\sqrt{2} \end{cases}$$

$$\begin{cases} P\sqrt{2} \frac{\sqrt{2}}{2} = P \\ N_{12} = -P\sqrt{2} \frac{\sqrt{2}}{2} - 2P = -3P \end{cases}$$

ASTA	N	kN
1	0	0
2	0	0
3	0	0
4	P	10
5	-P√2	-14
6	0	0
7	-2P	-20
8	0	0
9	P√2	14
10	-P	-10
11	-P	-10
12	-3P	-30
13	0	0



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 — PUNTORE
 * SCARICA

A4)

$$H_A = 0$$

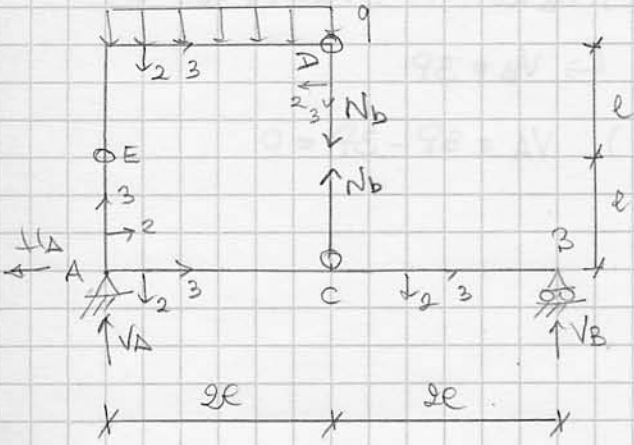
$$(A \uparrow) \quad V_B 4l = 2ql^2 \rightarrow V_B = \frac{ql}{2}$$

$$V_A = 2ql - \frac{ql}{2} = \frac{3}{2}ql$$

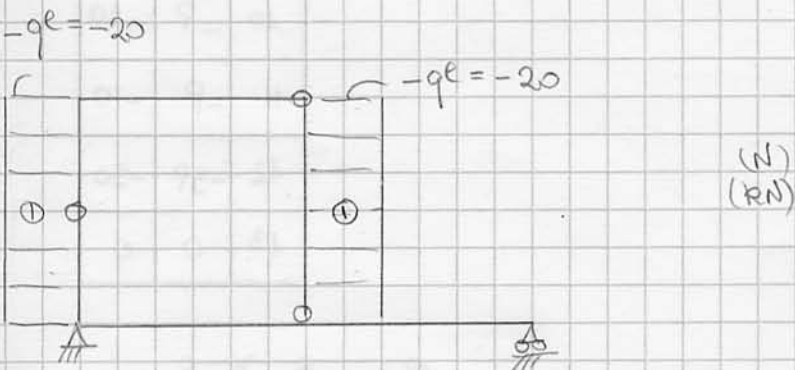
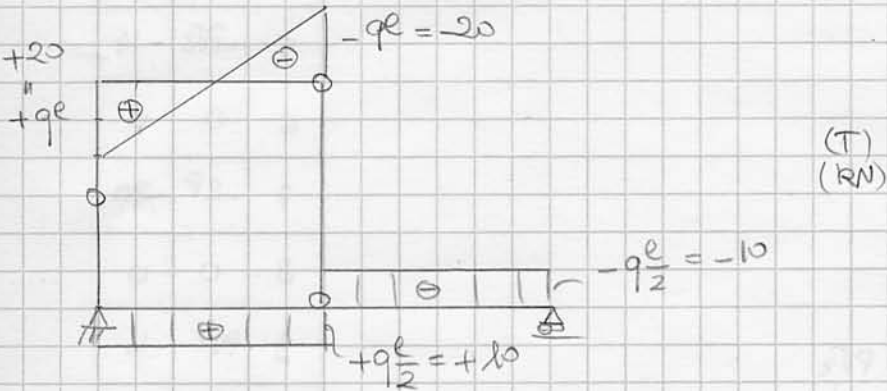
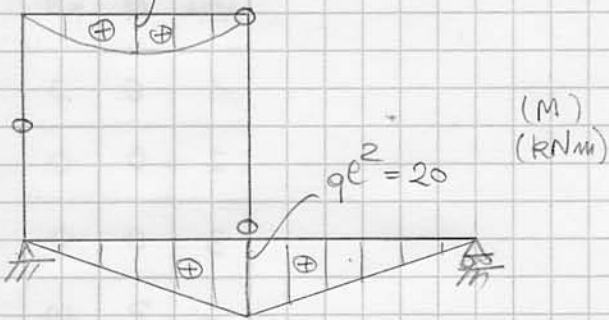
$$(E \uparrow)_{DE} \quad N_b \cancel{2l} = -2ql^2$$

$$ql = 20 \text{ kN}$$

$$ql^2 = 20 \text{ kNm}$$



$$\frac{q(2l)^2}{8} = \frac{ql^2}{2} = 10$$



B2)

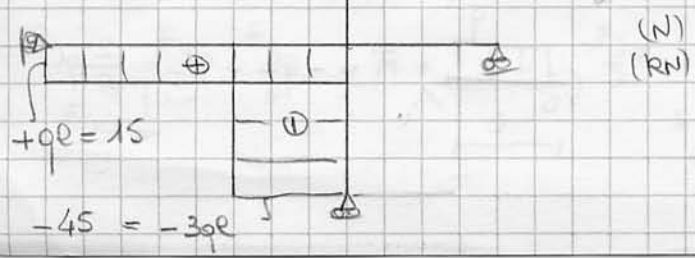
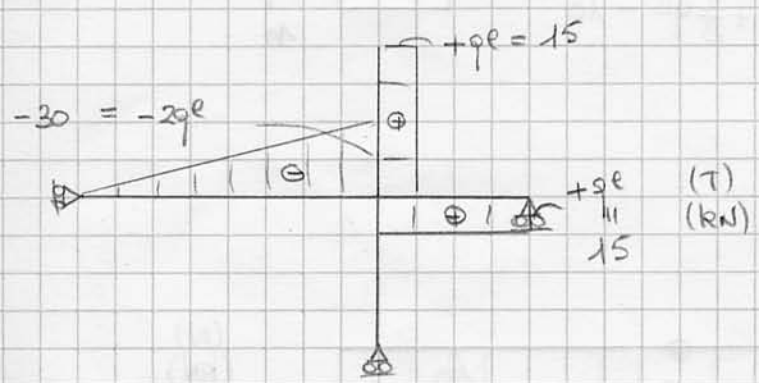
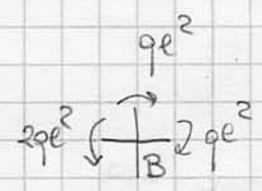
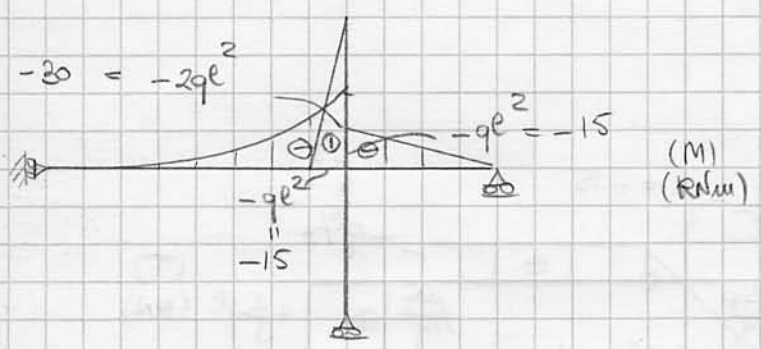
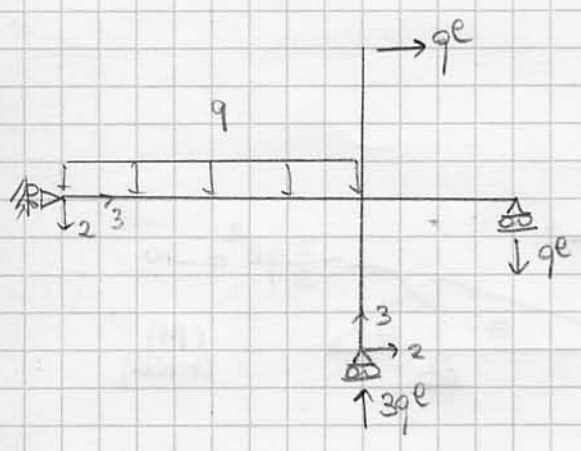
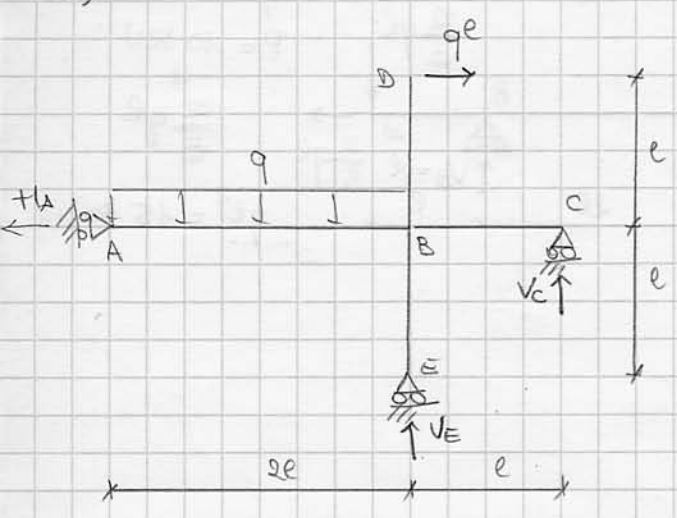
$H_A = ql$

$(B^+) V_{cl} = ql^2 - 2ql^2 \Leftrightarrow V_c = -ql$

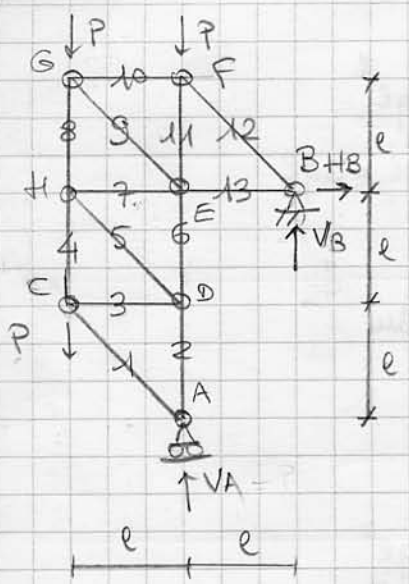
$(\uparrow) V_E = 3ql$

$ql = 15 \text{ kN}$

$ql^2 = 15 \text{ kNm}$



B3)



$(\rightarrow) H_B = 0$
 $(\curvearrowright) V_B \ell = -2P\ell$
 $(\uparrow) V_A = 5P$

Metodo delle equazioni ai nodi:

$N_1 \nearrow$
 $\begin{cases} \uparrow N_2 \\ \uparrow 5P \end{cases} \begin{cases} N_1 \frac{\sqrt{2}}{2} = 0 \\ N_2 = -5P \end{cases}$

$\begin{cases} \uparrow N_4 \\ \rightarrow N_3 \\ \downarrow P \end{cases} \begin{cases} N_3 = 0 \\ N_4 = P \end{cases}$

$N_5 \nearrow$
 $\begin{cases} \uparrow N_6 \\ \uparrow 5P \end{cases} \begin{cases} N_5 = 0 \\ N_6 = -5P \end{cases}$

$\begin{cases} \uparrow N_8 \\ \rightarrow N_7 \\ \downarrow P \end{cases} \begin{cases} N_7 = 0 \\ N_8 = P \end{cases}$

$\begin{cases} \downarrow P \\ \rightarrow N_{10} \\ \downarrow P \end{cases} \begin{cases} N_9 \frac{\sqrt{2}}{2} = -2P \\ N_{10} = -N_9 \frac{\sqrt{2}}{2} = 2P \end{cases} \quad N_9 = -2P\sqrt{2}$

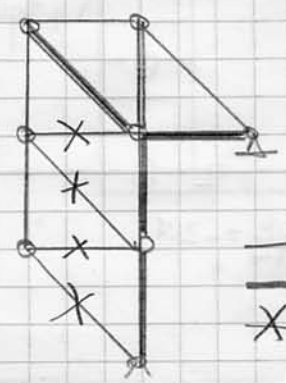
$\begin{cases} \downarrow 2P \\ \leftarrow N_{11} \\ \downarrow N_{12} \end{cases} \begin{cases} N_{12} \frac{\sqrt{2}}{2} = +2P \\ N_{11} = -P - N_{12} \frac{\sqrt{2}}{2} = -3P \end{cases} \quad N_{12} = +2P\sqrt{2}$

$\begin{cases} \leftarrow 2P\sqrt{2} \\ \downarrow 2P \end{cases} \begin{cases} \frac{2P\sqrt{2}}{2} = 2P \\ N_{13} = +2P\sqrt{2} \frac{\sqrt{2}}{2} \end{cases}$

ASTA	N	RN
1	0	0
2	-5P	-75
3	0	0
4	P	15
5	0	0
6	-5P	-75
7	0	0
8	P	15
9	-2P√2	42
10	2P	30
11	-3P	-45
12	2P√2	42
13	-2P	-30

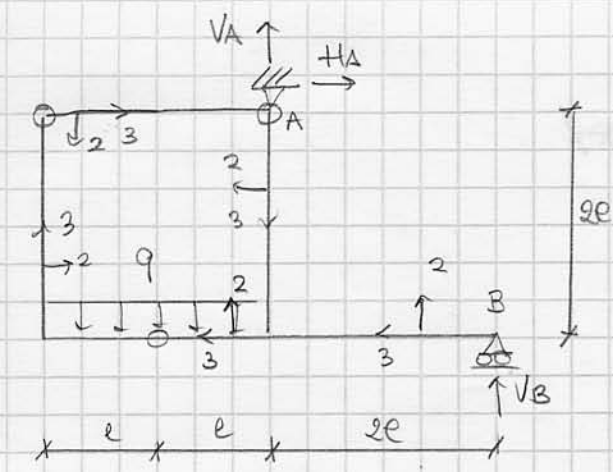
Verifica in E:

$\begin{cases} \downarrow 2P\sqrt{2} \\ \downarrow 3P \\ \leftarrow 2P \\ \uparrow 5P \end{cases} \quad \begin{cases} 2P\sqrt{2} \frac{\sqrt{2}}{2} = 2P \\ 2P\sqrt{2} \frac{\sqrt{2}}{2} + 3P = 5P \end{cases}$



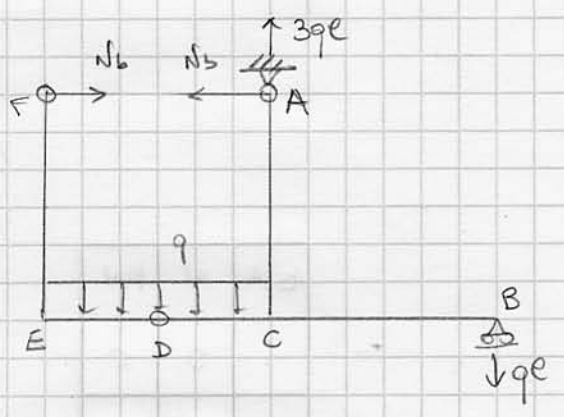
— TIRANTE
 - - - PUNTONE
 X SCARICA

B4)

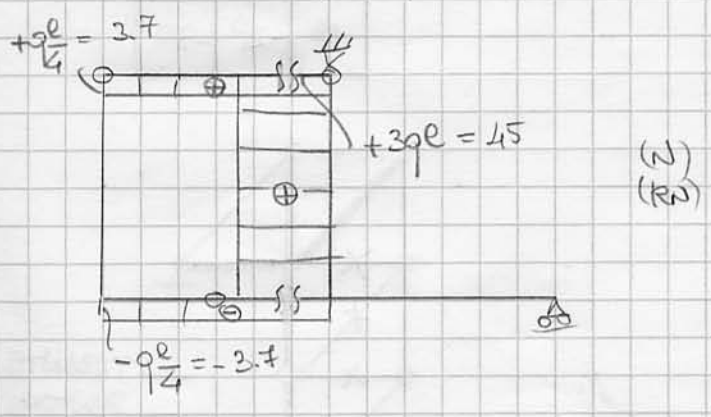
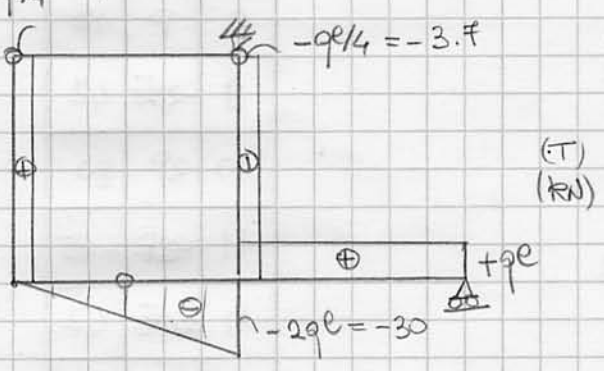
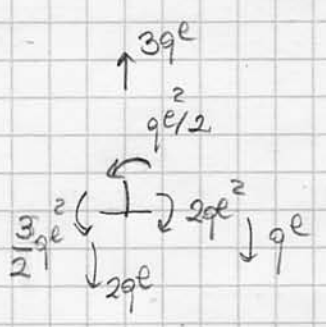
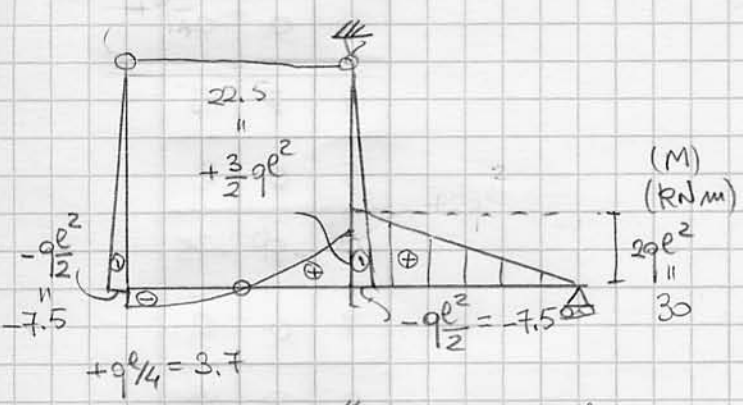


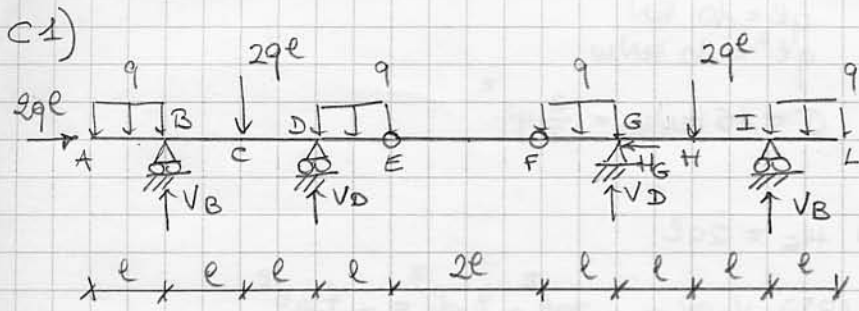
$H_A = 0$
 (A) $V_B = -9qe^2$
 (↑) $V_A = 2qe + 9e = 3qe$

$qe = 15 \text{ kN}$
 $qe^2 = 15 \text{ kNm}$



(D) FED $N_b 2e = qe^2/2$
 $N_b = qe/4$



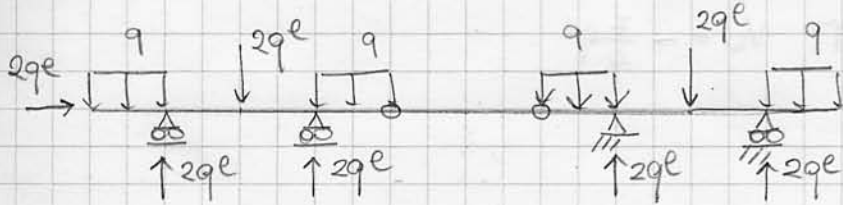


$$HG = 2ql$$

$$2V_B + 2V_D = 8ql$$

$$(\sum \uparrow)_{ABCDE} \quad V_B 3l + V_D l = 4ql + \frac{7}{2}ql^2 + \frac{ql^2}{2}$$

$$= 8ql^2$$



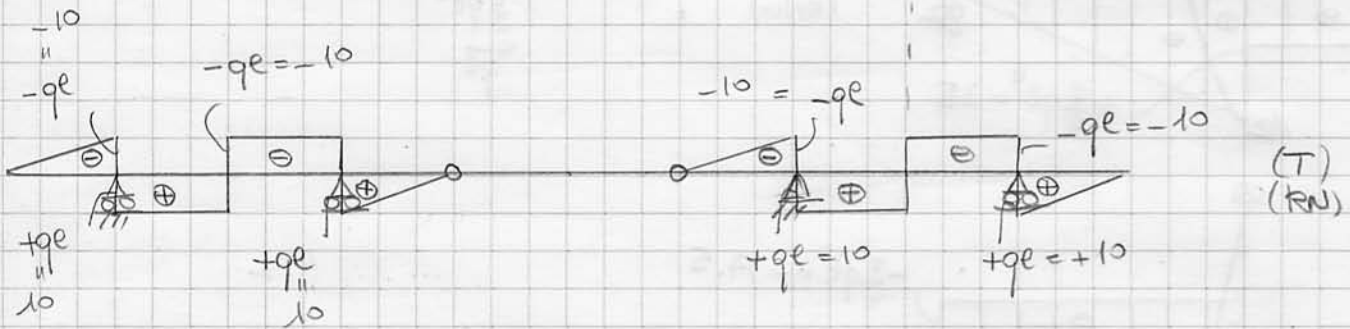
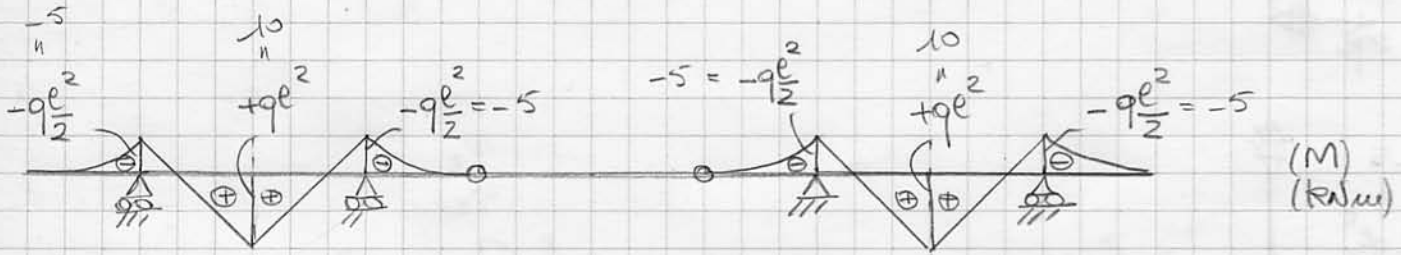
$$\begin{cases} V_B + V_D = 4ql \\ 3V_B + V_D = 8ql \end{cases}$$

$$\begin{aligned} ql &= 10 \text{ kN} \\ ql^2 &= 10 \text{ kNm} \end{aligned}$$

$$2V_B = 4ql$$

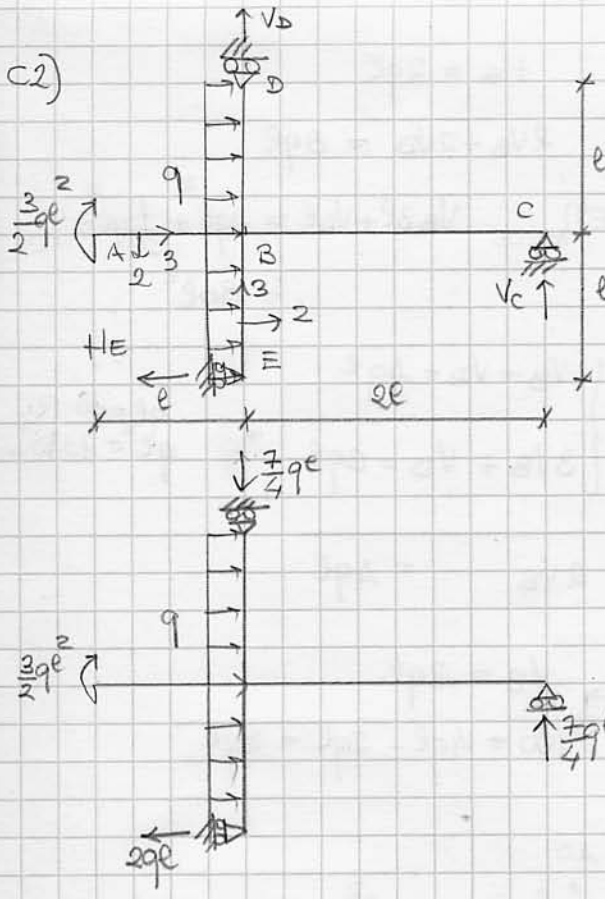
$$\rightarrow V_B = 2ql$$

$$V_D = 4ql - 2ql = 2ql$$



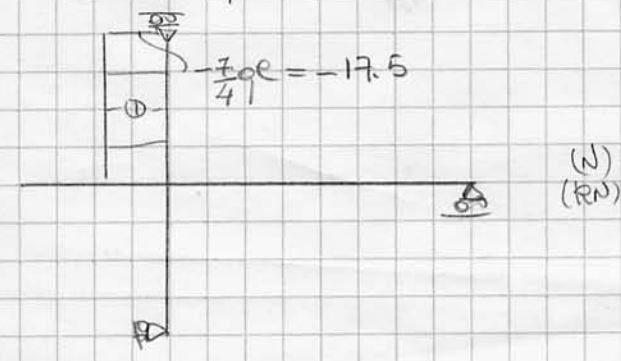
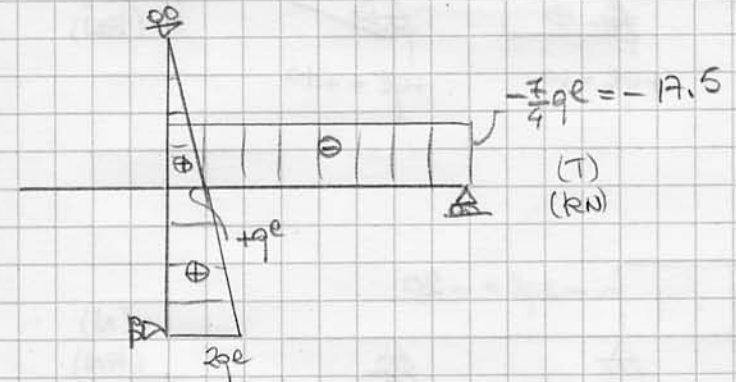
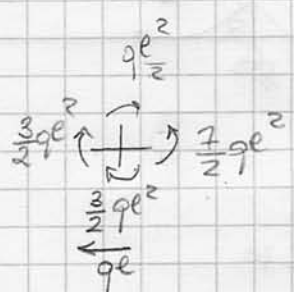
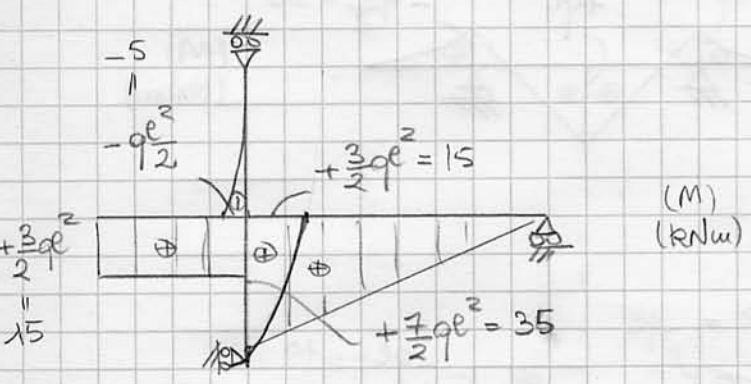
$$ql \uparrow \quad \bar{M} = ql^2$$

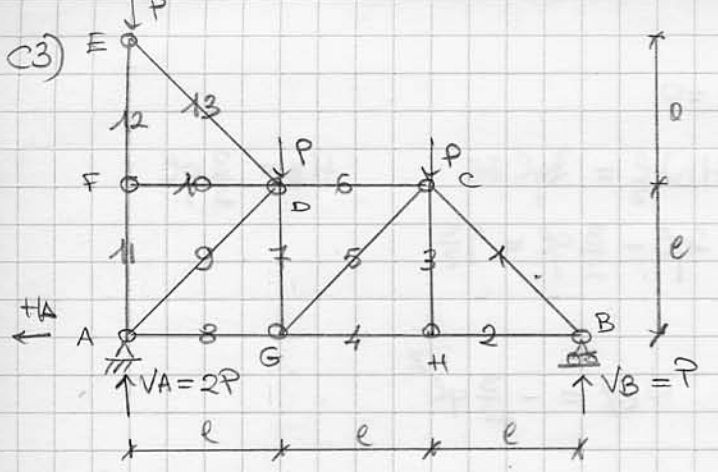
c2)



$qel = 10 \text{ kN}$
 $qel^2 = 10 \text{ kNm}$
 $I = 15 \text{ kNm} = \frac{3}{2} qel^2$

$H_E = 2qe$
 (B) $V_C 2e = + 2qe^2 + \frac{3}{2} qel^2 = + \frac{7}{2} qe^2$
 $\hookrightarrow V_C = + \frac{7}{4} qe$
 (A) $V_D = - \frac{7}{4} qe$





$H_A = 0$
 $(A) \quad V_{B3e} = P e + P 2e \rightarrow V_B = P$
 $(\uparrow) \quad V_A = 2P$

$$\begin{cases} N_1 \frac{\sqrt{2}}{2} = -P \\ N_2 = -N_1 \frac{\sqrt{2}}{2} = P \end{cases} \quad N_1 = -P\sqrt{2}$$

$$\begin{cases} N_3 = 0 \\ N_4 = P \end{cases}$$

$$\begin{cases} N_5 \frac{\sqrt{2}}{2} = -P + P \frac{\sqrt{2}}{2} = 0 \\ N_6 = -P \frac{\sqrt{2}}{2} \end{cases}$$

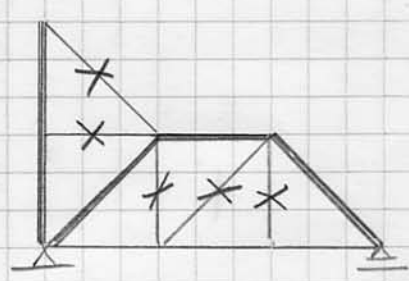
$$\begin{cases} N_7 = 0 \\ N_8 = P \end{cases}$$

$$\begin{cases} N_9 \frac{\sqrt{2}}{2} = -P \\ N_{11} = -2P - N_9 \frac{\sqrt{2}}{2} = -2P + P = -P \end{cases} \quad N_9 = -P\sqrt{2}$$

$$\begin{cases} N_{10} = 0 \\ N_{12} = -P \end{cases}$$

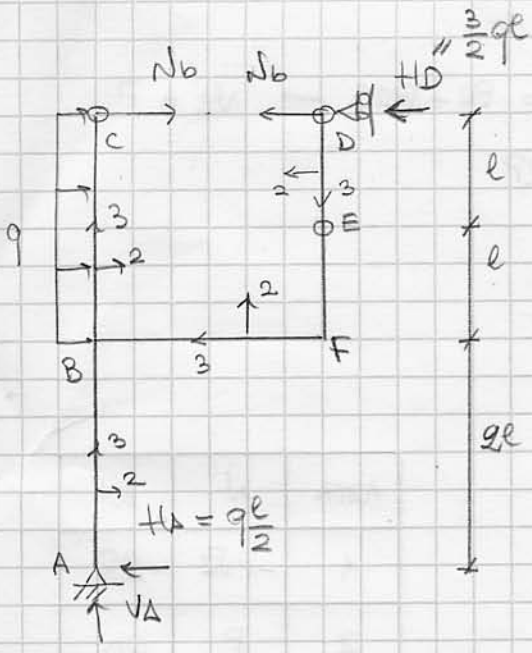
$$\begin{cases} N_{13} = 0 \\ P = P \end{cases}$$

ASTA	N	RN
1	$-P\sqrt{2}$	-28
2	P	20
3	0	0
4	P	20
5	0	0
6	-P	-20
7	0	0
8	P	20
9	$-P\sqrt{2}$	-28
10	0	0
11	-P	-20
12	-P	-20
13	0	0



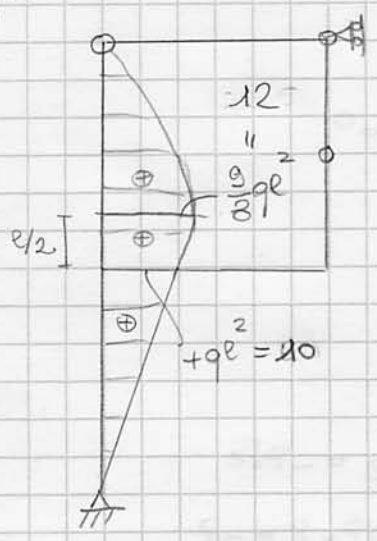
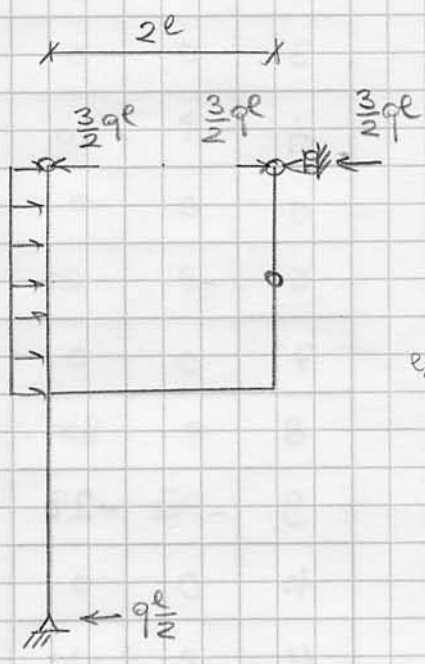
- TIRANTE
 - PUNZIONE
 x SCARICA

c4)

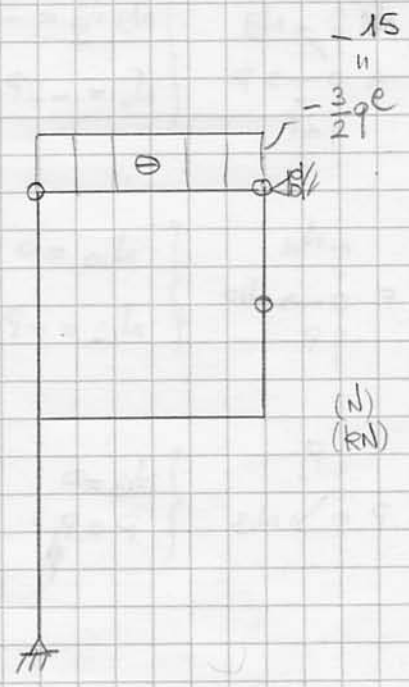
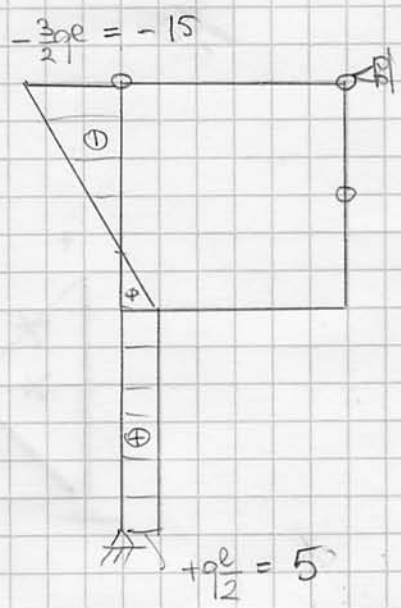


$(\uparrow) V_A = 0$
 $(A) H_D \cdot l = 3q \cdot l \cdot 2l \implies H_D = \frac{3}{2} q l$
 $H_A = 2q l - \frac{3}{2} q l = \frac{q l}{2}$

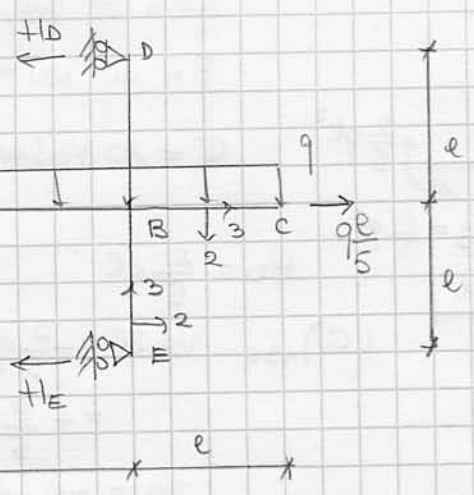
$(E) N_{DE} = N_{DF} = -\frac{3}{2} q l^2$



$$\bar{M} = +q l^2 + q l \frac{l}{4} - \frac{q l^2}{8} = \frac{9}{8} q l^2$$



D2)



$qe = 25 \text{ kN}$
 $P = 5 \text{ kN} = \frac{qe}{5}$

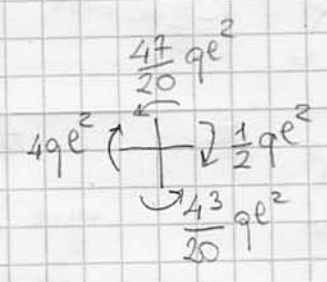
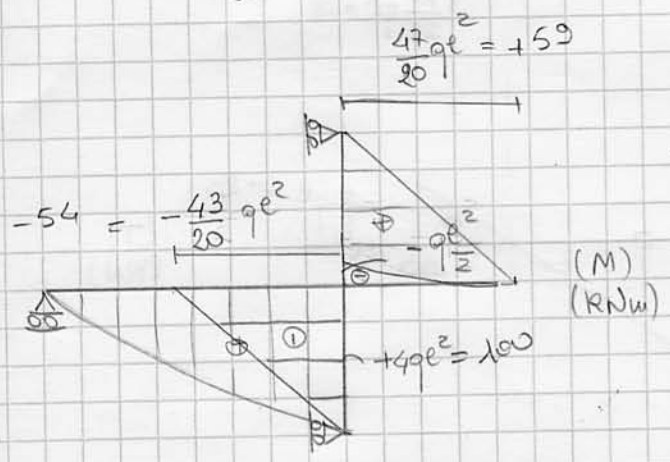
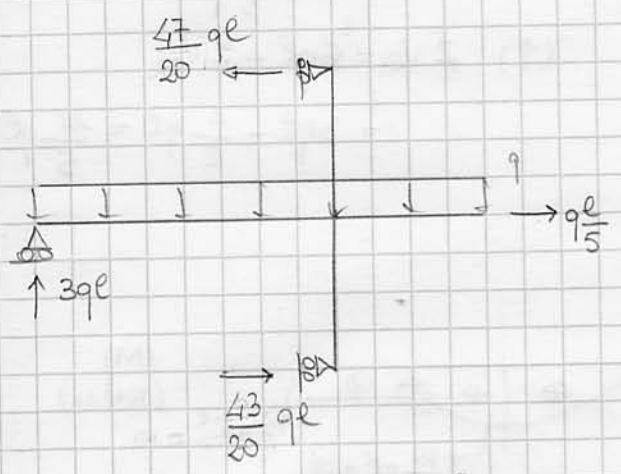
$N_A = 3qe$

(E) $H_D 2e = 6qe^2 + \frac{qe^2}{5} - 2qe^2 + \frac{qe^2}{2}$
 $= (4 + \frac{1}{5} + \frac{1}{2}) qe^2$
 $= \frac{40 + 2 + 5}{10} qe^2 = \frac{47}{10} qe^2$

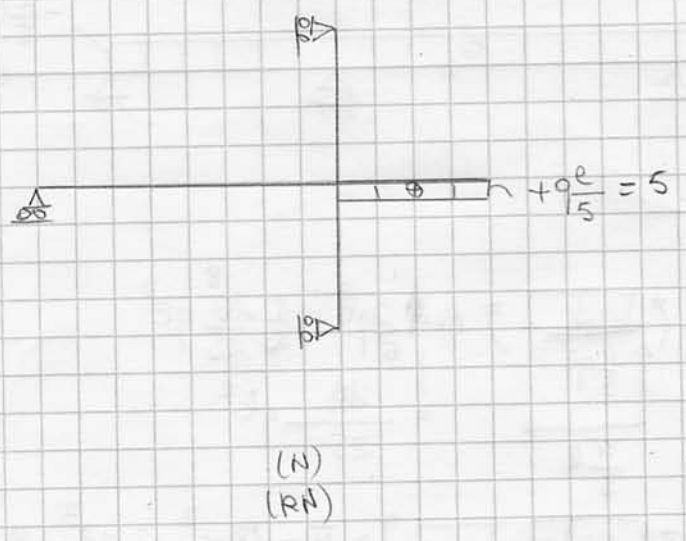
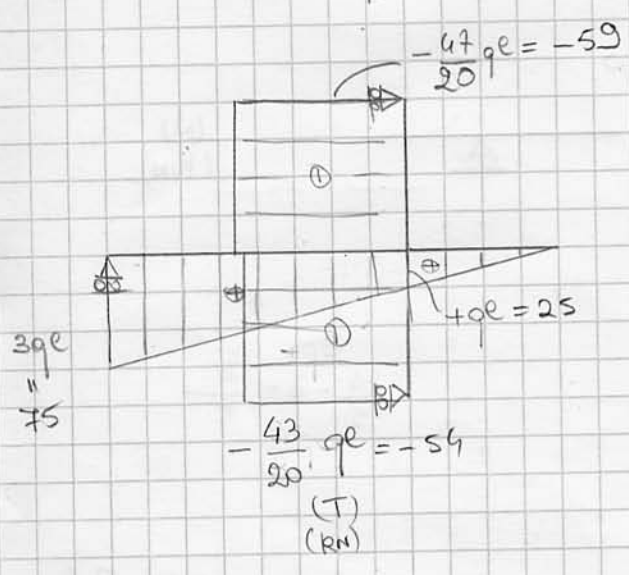
$H_D = \frac{47}{20} qe$

(←) $H_E = (\frac{47}{20} + \frac{4 \cdot 1}{4 \cdot 5}) qe = \frac{43}{20} qe$

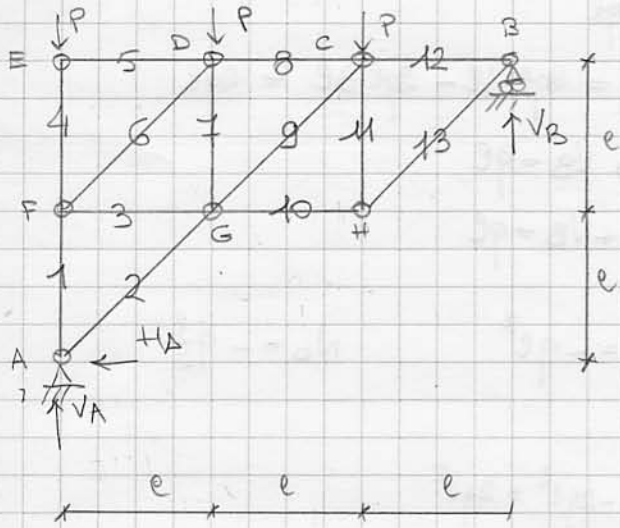
$M_B = 6qe^2 - 2qe^2 = 4qe^2$



$\frac{47}{20} + \frac{43}{20} = 4 + \frac{1}{2}$
 $\frac{90}{20} = \frac{9}{2} \text{ ok}$



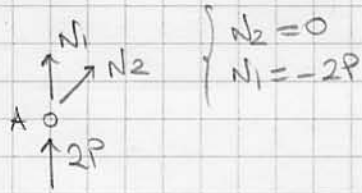
D3)



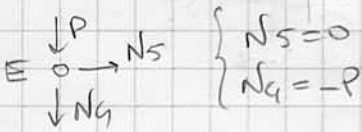
$H_A = 0$

(A) $V_{B3e} = Pe + 2Pe \rightarrow V_B = P$

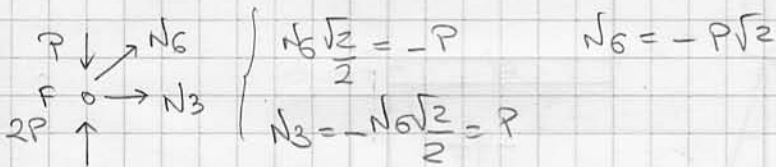
(↑) $V_A = 2P$



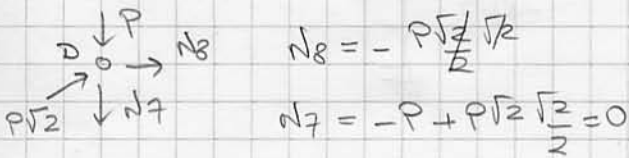
$N_2 = 0$
 $N_1 = -2P$



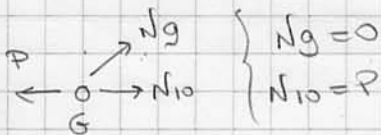
$N_5 = 0$
 $N_4 = -P$



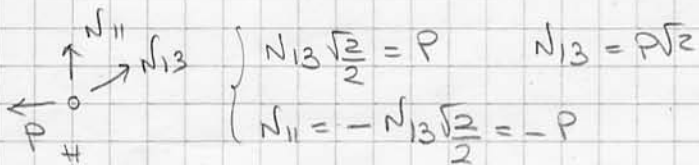
$N_6 \frac{\sqrt{2}}{2} = -P \rightarrow N_6 = -P\sqrt{2}$
 $N_3 = -N_6 \frac{\sqrt{2}}{2} = P$



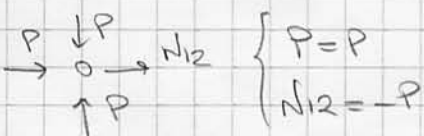
$N_8 = -\frac{P\sqrt{2}}{2}$
 $N_7 = -P + \frac{P\sqrt{2}}{2} \frac{\sqrt{2}}{2} = 0$



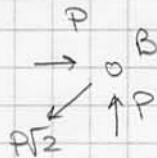
$N_9 = 0$
 $N_{10} = P$



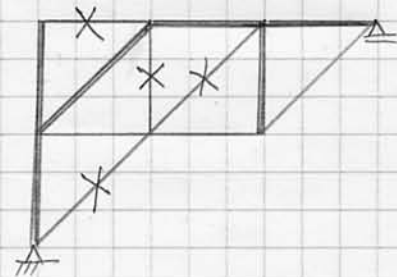
$N_{13} \frac{\sqrt{2}}{2} = P \rightarrow N_{13} = P\sqrt{2}$
 $N_{11} = -N_{13} \frac{\sqrt{2}}{2} = -P$



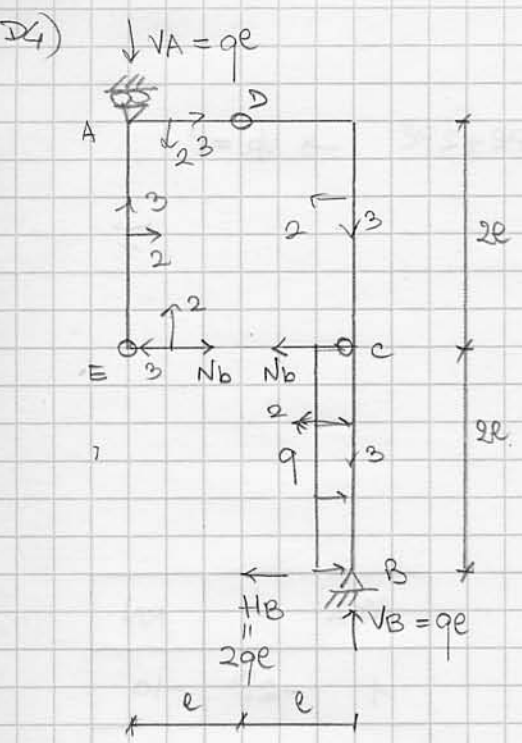
$N_{12} = P$
 $N_{12} = -P$



ASTA	N	RN
1	-2P	-10
2	0	0
3	P	5
4	-P	-5
5	0	0
6	-P√2	-7
7	0	0
8	-P	-5
9	0	0
10	P	5
11	-P	-5
12	-P	-5
13	P√2	7



- TIRANTE
- PUNTO NE
* SORCIA



$$H_B = 2qe$$

$$(A) \quad V_B 2e = 2qe \cdot e - 2qe \cdot 3e = 2qe$$

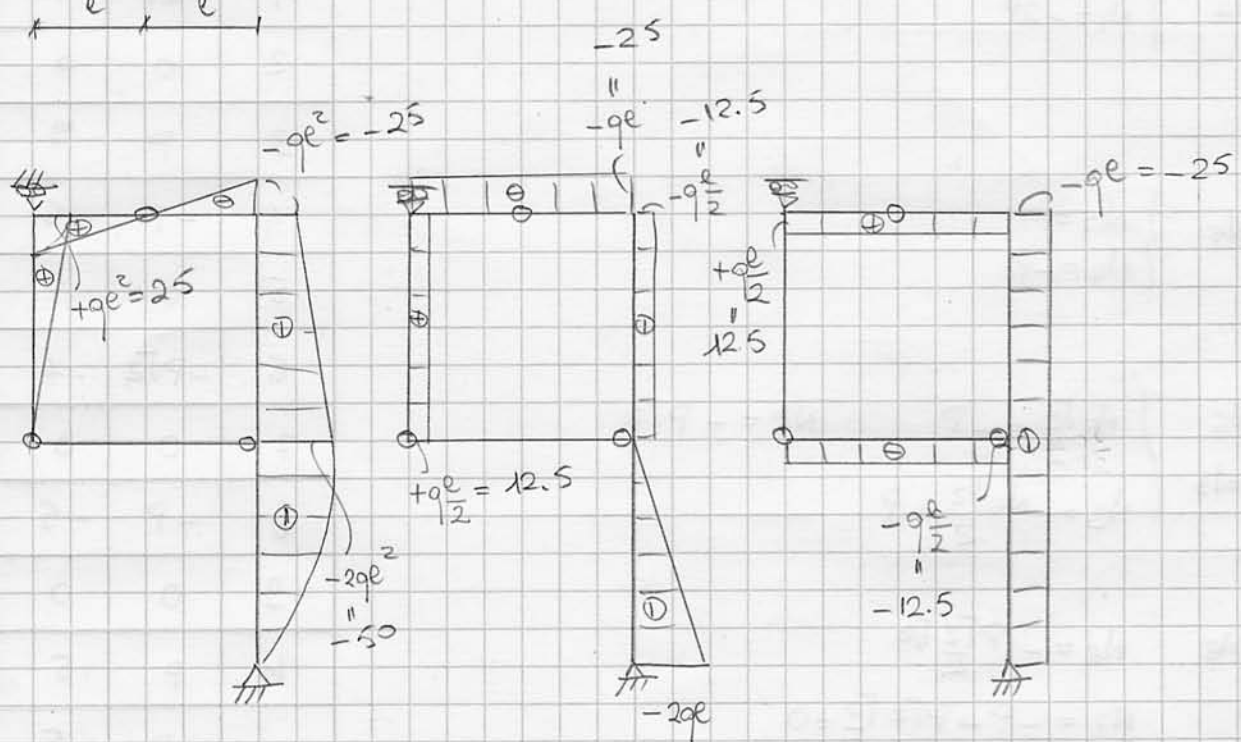
$$\rightarrow V_B = qe$$

$$V_A = +V_B = qe$$

$$(D) \quad N_B 2e = -qe^2$$

$$N_B = -\frac{qe}{2}$$

$$M_C = 4qe^2 - 2qe^2 = 2qe^2$$



(M)
(kNm)

(T)
(kN)

(N)
(kN)