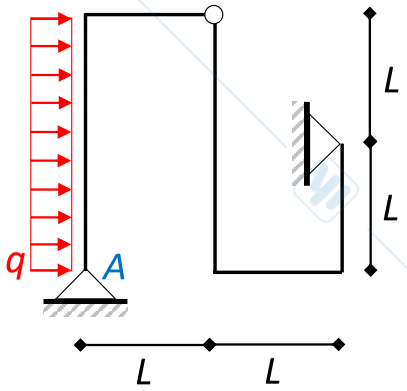
Prova totale – 16 settembre 2021 – Compito A

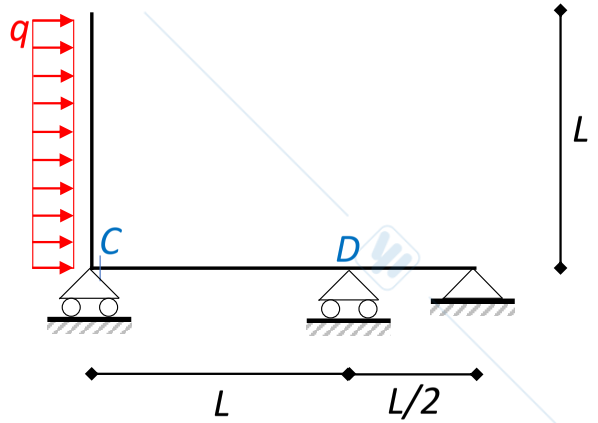
Esercizio A

1) Calcolare le reazioni vincolari della struttura in figura.
2) Definire la curva delle pressioni e tracciare i diagrammi delle caratteristiche della sollecitazione.
3) Tracciare la deformata elastica.
4) Valutare le reazioni vincolari in A con il procedimento delle catene cinematiche.



Esercizio B

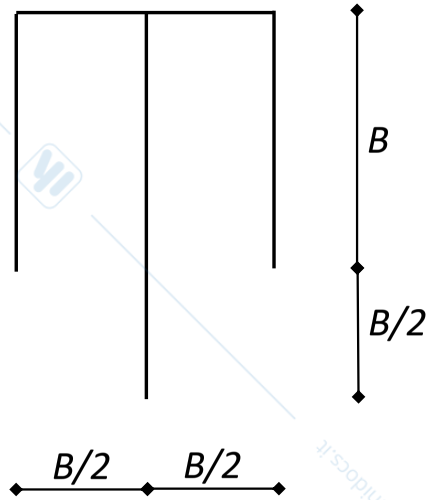
1) Calcolare le reazioni vincolari della struttura in figura.
2) Tracciare i diagrammi delle caratteristiche della sollecitazione.
3) Tracciare la deformata elastica.
4) Valutare la rotazione della sezione in D.



Esercizio C

Per la sezione C dell'esercizio B, rappresentata in figura:

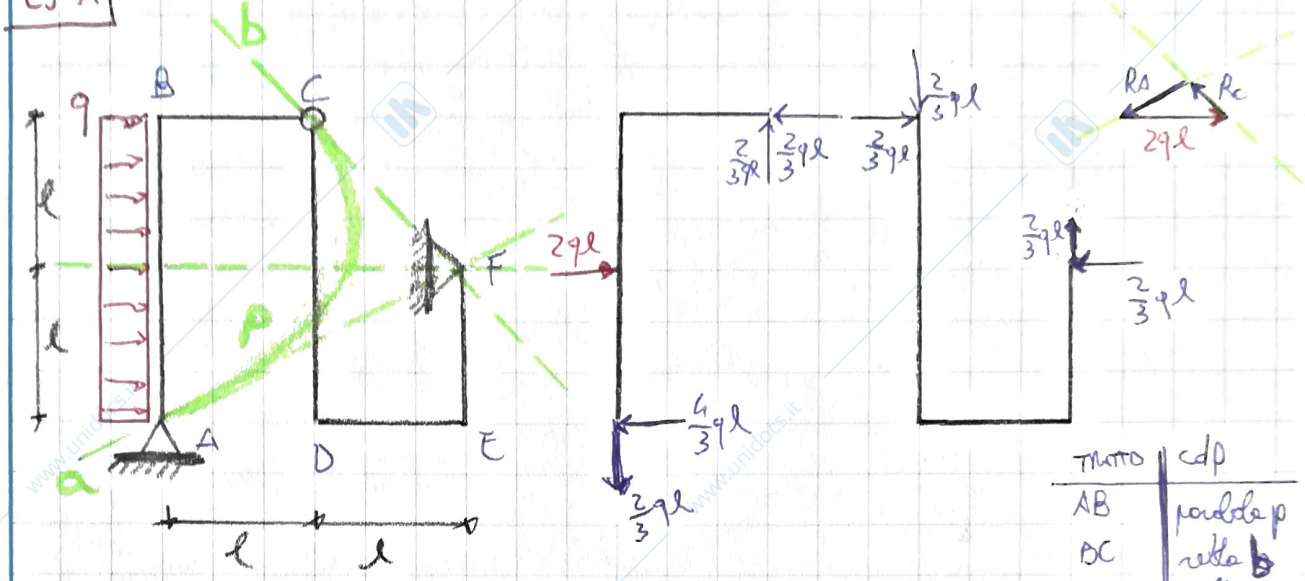
1) disegnare il diagramma delle tensioni tangenziali, assumendo B = 100 mm e spessore costante b = 1 mm;
2) eseguire la verifica di resistenza in accordo con il criterio di Mises, assumendo: q = 50 N/mm, L= 1000 mm, σ_{am} = 200 N/mm^2



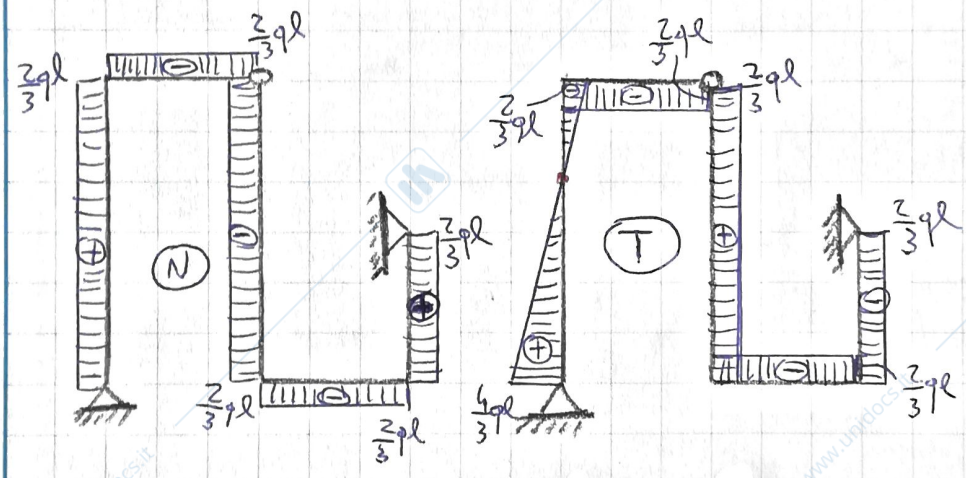
Al termine della prova, si richiede di scansionare la prova scritta in un unico file in formato .pdf (massimo 5Mb) nominandolo con il proprio cognome e di inviarlo via email utilizzando come oggetto *SdCA_COGNOME*, agli indirizzi stefano.demiranda@unibo.it e am.daltri@unibo.it

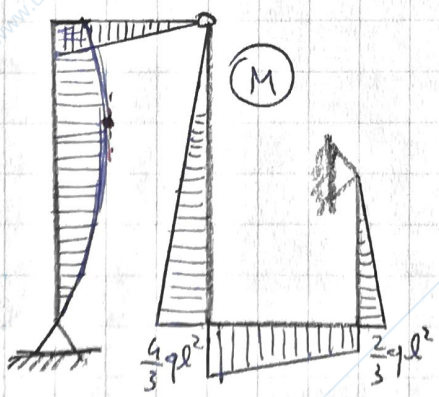
TOTALE 16/09/21 COMPITO A

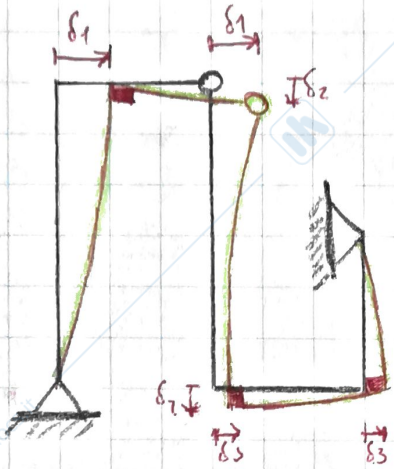
ES A

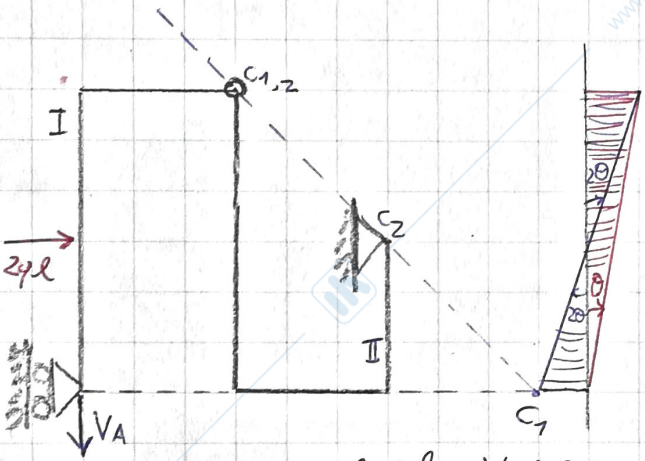


TRATTO	cdp
AB	parabola p
BC	retta b
CD	retta b
DE	retta b
EF	retta b



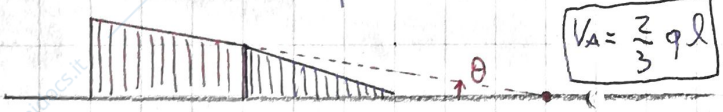


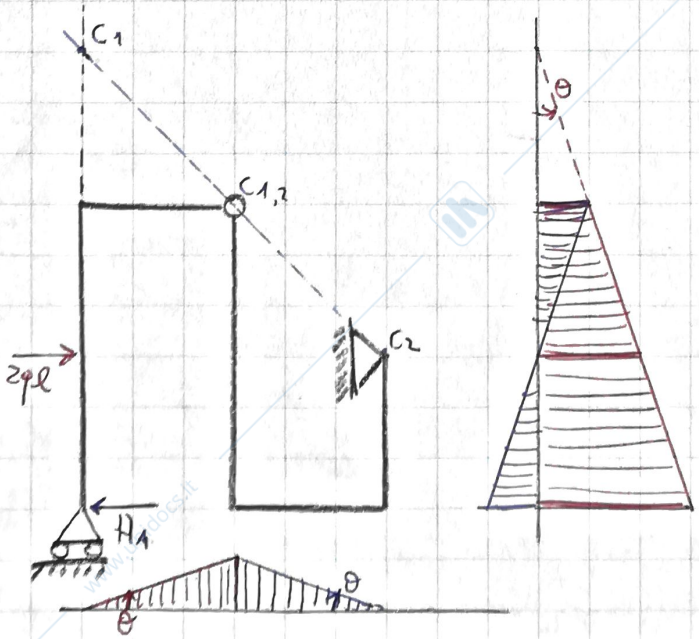




$$2ql\ \theta l - V_A\ 3\theta l = 0$$

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

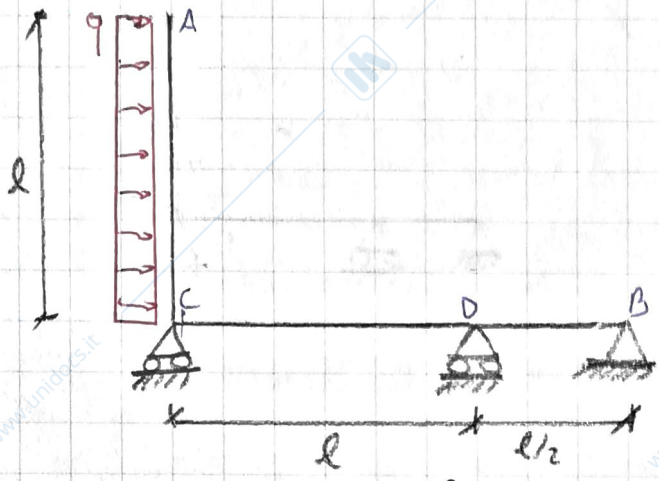




$$2ql\ 2\theta l - H_A\ 3\theta l = 0$$

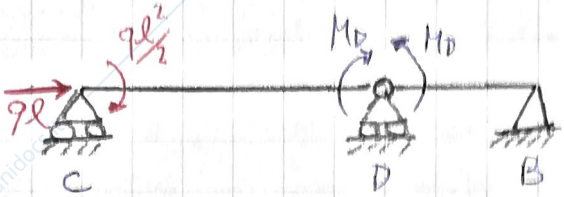
$$H_A = \frac{4}{3}ql$$

ES B



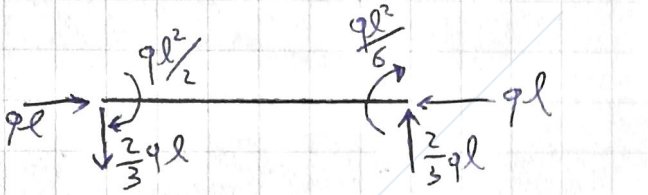
φ_+

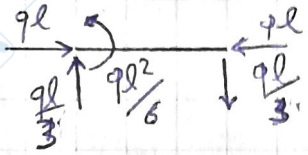
$\varphi_{DC} = \varphi_{DB}$

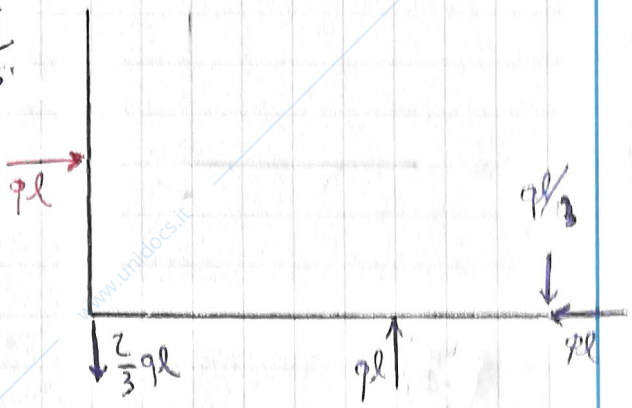


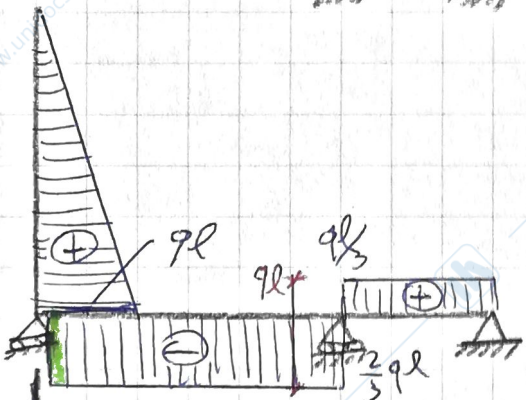
$$\frac{M_D \cdot l}{3EI} - \frac{ql^2/2 \cdot l}{6EI} = -\frac{M_D \cdot l/2}{3EI}$$

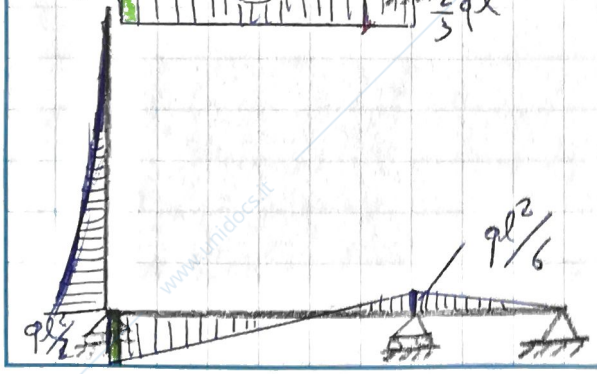
$$M_D = \frac{ql^2}{6}$$

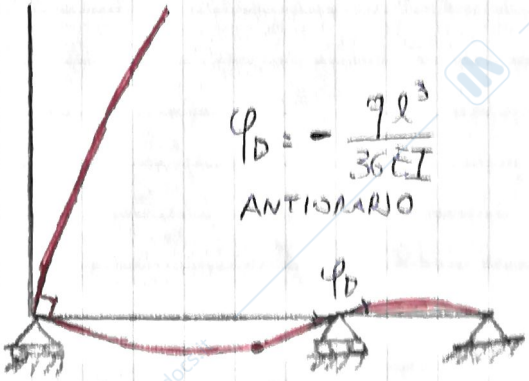












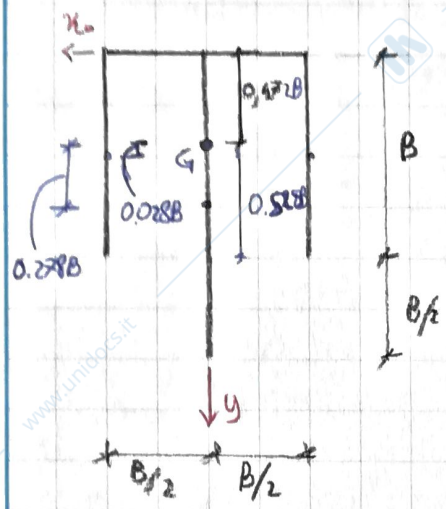
$$\varphi_D = -\frac{ql^3}{36EI}$$

ANTIORARIO

ESC

$N^c = -ql$ $\quad T^c = -\frac{2}{3}ql$ $\quad M^c = ql^2/2$

$N^c = -50\,kN$ $\quad T^c = -33{,}3\,kN$ $\quad M^c = 25\,10^6\,N_{mm}$

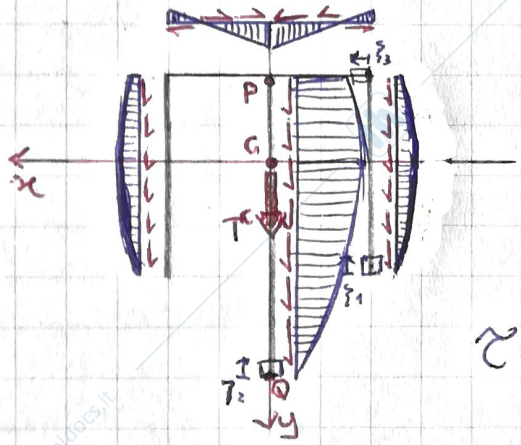


$Area = 4{,}5B$ $\quad y_c = \dfrac{2\left(Bb\frac{B}{2}\right) + 1{,}5Bb\frac{3}{4}B}{4{,}5B}$

$y_c = 0.472\,B$

$I_{xx} = 2\left(\frac{B^3b}{12} + Bb(0.028B)^2\right) + \frac{(1{,}5B)^3b}{12} + 1{,}5Bb(0{,}272B)^2$

$+ Bb(0.472B)^2 = 0.788\ B^3b$

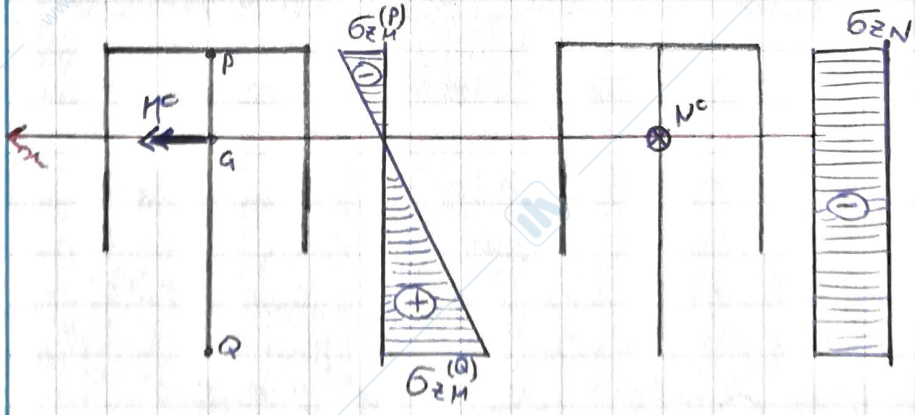


$S(\xi_1) = \xi_1 b\left(0.528B - \frac{\xi_1}{2}\right)$ → $S(\xi_1 = 0.528B) = 0.139B^2b$; $S(\xi_1 = B) = 0.028B^2b$

$S(\xi_2) = \xi_2 b\left(1{,}028B - \frac{\xi_2}{2}\right)$ → $S(\xi_2 = 1{,}028B) = 0.528B^2b$; $S(\xi_2 = 1{,}5B) = 0.417B^2b$

$S(\xi_3) = \xi_3 b\ 0.472B - 0.028B^2b = 0.208B^2b$

$\tau = \dfrac{T^c S}{I_{xx} b}$ → $\tau^{(Q)} = 0$; $\tau^{(G)} = 223\,MPa$; $\tau^{(P)} = 176\,MPa$



$\sigma_z^{(A)} = \dfrac{N^c}{Area} = -111\,MPa$

$\sigma_z^{(P)} = -\dfrac{M^c}{I_{xx}}0.472B - \dfrac{N^c}{Area} = 1608\,MPa$

$\sigma_z^{(Q)} = +\dfrac{M^c}{I_{xx}}1.028B - \dfrac{N^c}{Area} = 3150\,MPa$

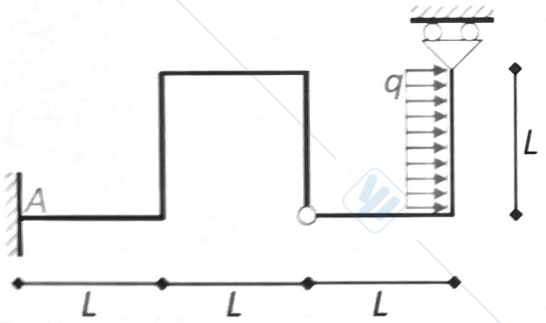
In P, G, Q la sezione non è verificata

$\sigma_{id} = \sqrt{\sigma_z^2 + 3\tau^2} > \sigma_{am}$

Prova totale – 15 settembre 2020

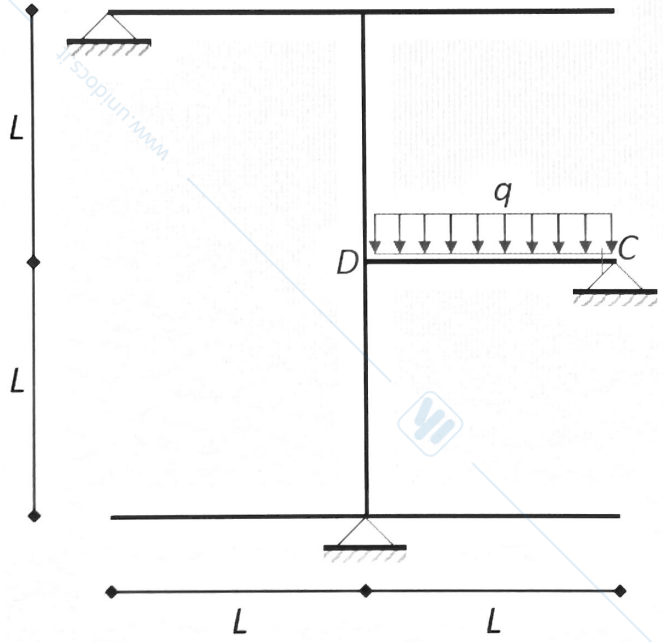
Esercizio A

1) Calcolare le reazioni vincolari della struttura in figura.
2) Definire la curva delle pressioni e tracciare i diagrammi delle caratteristiche della sollecitazione.
3) Tracciare la deformata elastica.
4) Valutare il momento dell'incastro in A con il procedimento delle catene cinematiche.



Esercizio B

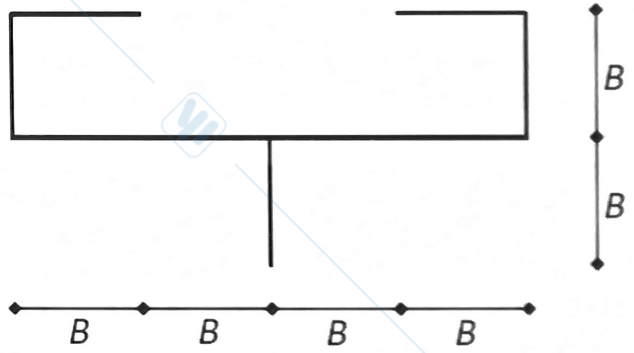
1) Calcolare le reazioni vincolari della struttura in figura.
2) Tracciare i diagrammi delle caratteristiche della sollecitazione.
3) Tracciare la deformata elastica.
4) Valutare la rotazione della sezione in D.



Esercizio C

Per la sezione C dell'esercizio B, rappresentata in figura:

1) disegnare il diagramma delle tensioni tangenziali, assumendo B = 100 mm e spessore costante b = 1 mm;
2) eseguire la verifica di resistenza in accordo con il criterio di Mises, assumendo: q = 50 N/mm, L= 1000 mm, σ_{am} = 200 N/mm^2.



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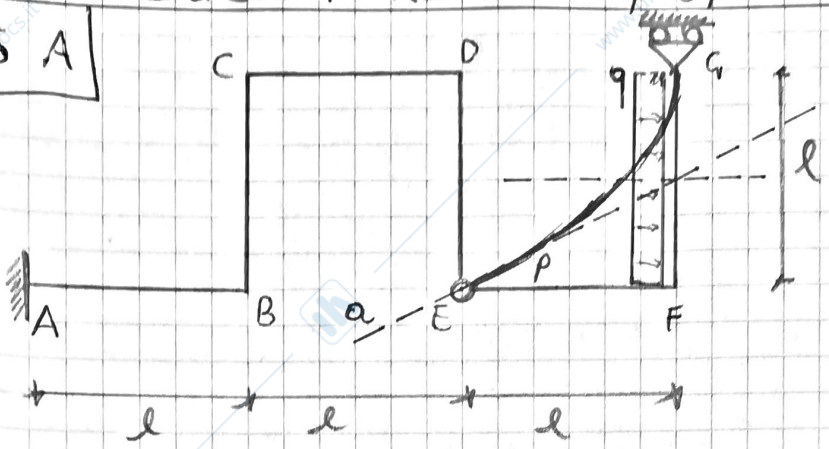
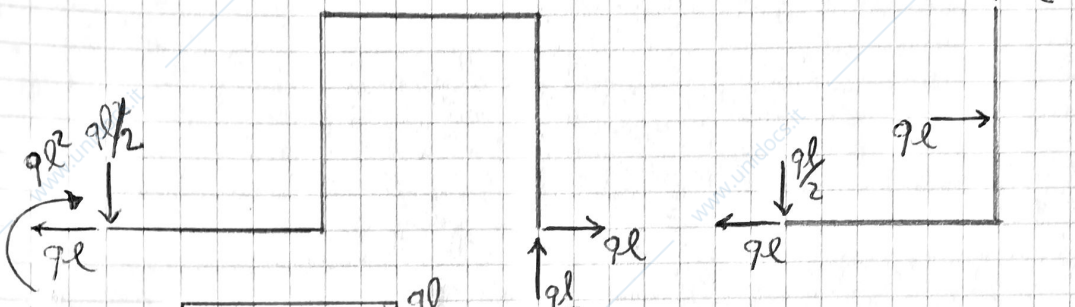
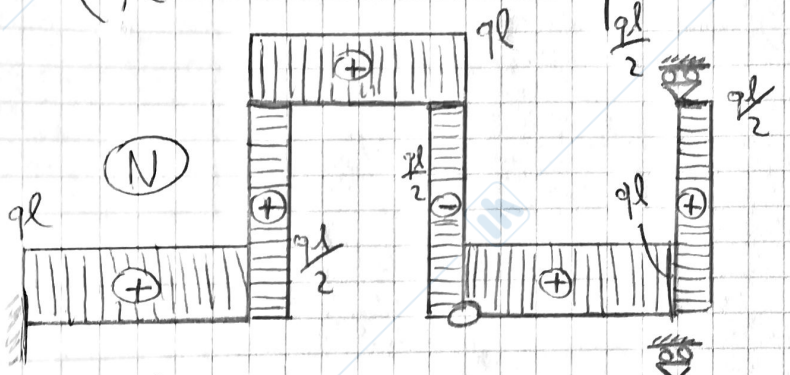
SdC TOTALE 15/09/20

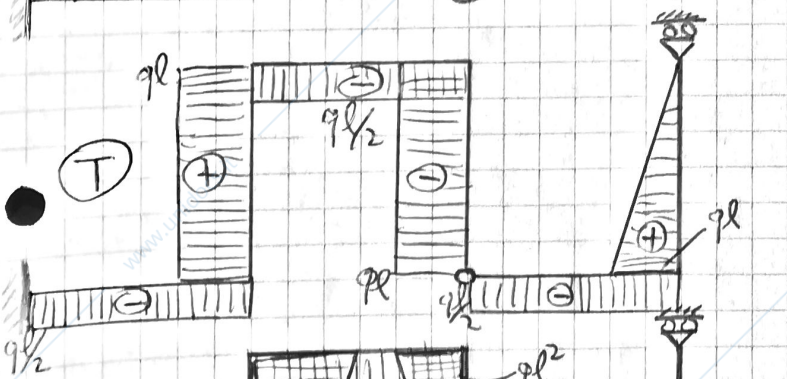
ES A

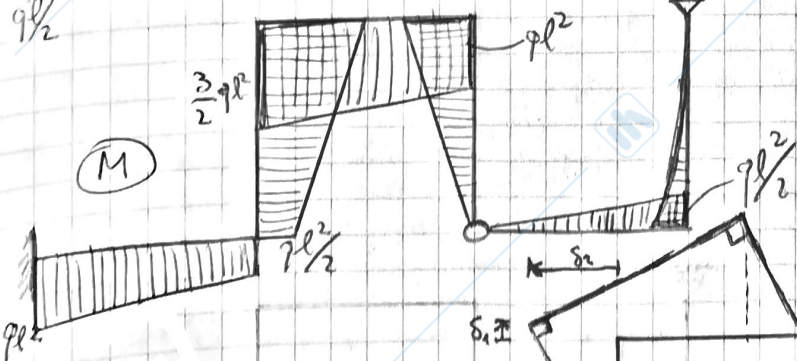


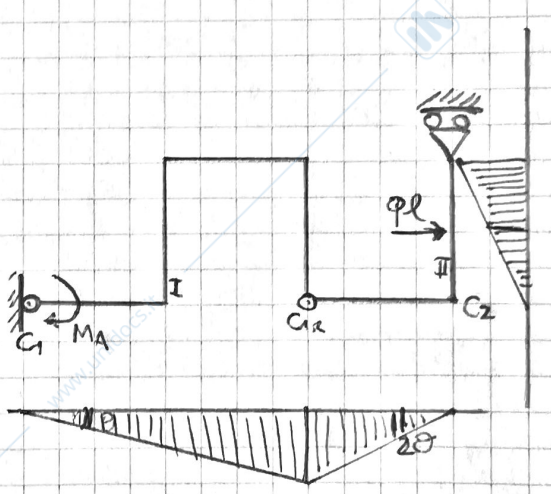
TRATTO	c/p
AB	retta a
BC	retta a
CD	retta a
DE	retta a
EF	retta a
FG	parabola p





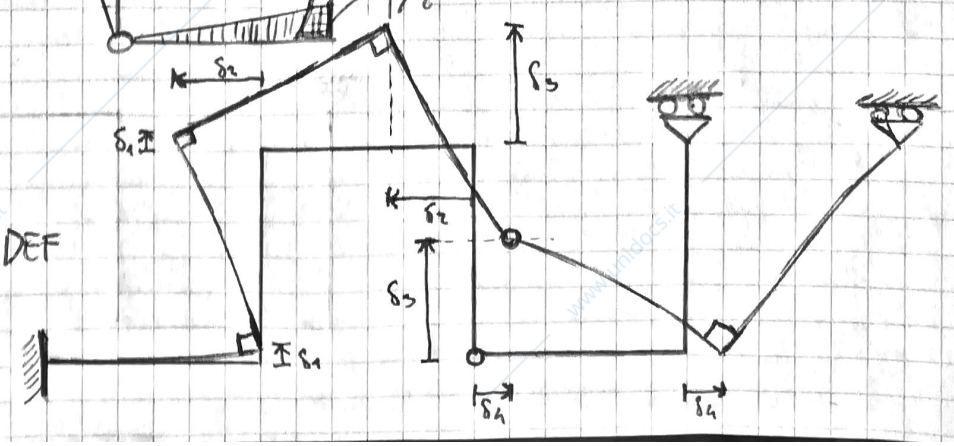






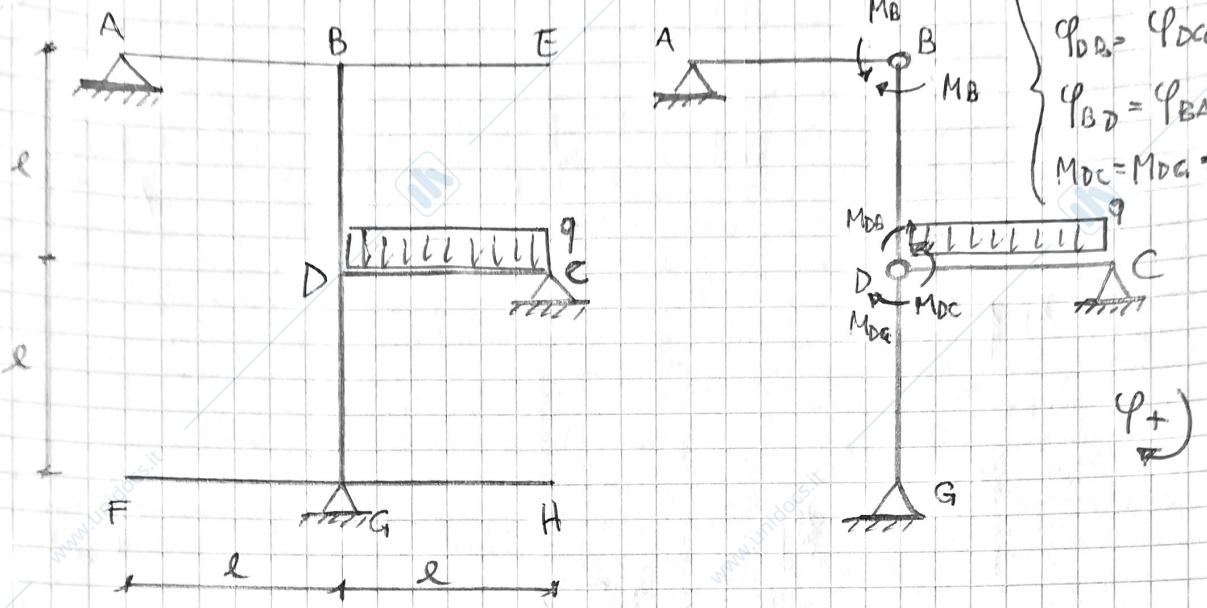
$$M_A\,\theta - ql\,2\theta\,\frac{l}{2} = 0$$

$$\boxed{M_A = ql^2}$$



SdC TOTALE 15/09/20

ESB



$\varphi_{DC} = \varphi_{DB}$
$\varphi_{DB} = \varphi_{DG}$
$\varphi_{BD} = \varphi_{BA}$
$M_{DC} = M_{DG} + M_{DB}$

$$\begin{cases} \frac{q\ell^3}{24EI} - \frac{M_{DC}\ell}{3EI} = \frac{M_{DB}\ell}{3EI} - \frac{M_B\ell}{6EI} \\ \frac{M_{DB}\ell}{3EI} - \frac{M_B\ell}{6EI} = \frac{M_{DG}\ell}{3EI} \\ \frac{M_B\ell}{3EI} - \frac{M_{DB}\ell}{6EI} = -\frac{M_B\ell}{3EI} \\ M_{DC} = M_{DG} + M_{DB} \end{cases}$$

$$\frac{7\ell^2}{24} - \frac{5}{8}M_{DB} = \frac{M_{DB}}{3} - \frac{M_{DB}}{24} \rightarrow \boxed{M_{DB} = \frac{9\ell^2}{22}}$$

$$\frac{M_{DG}}{3} = \frac{M_{DB}}{3} - \frac{M_{DB}}{24} \qquad M_{DG} = \frac{7}{8}M_{DB}$$

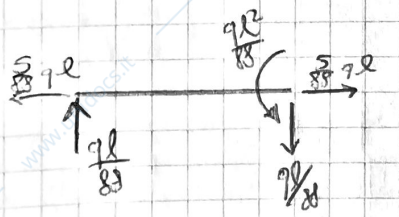
$$\boxed{M_{DG} = \frac{7}{176}q\ell^2}$$

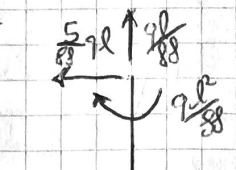
$$\frac{2}{3}M_B = \frac{M_{DB}}{6} \qquad M_B = \frac{M_{DB}}{4}$$

$$\boxed{M_B = \frac{9\ell^2}{88}}$$

$$M_{DC} = \frac{15}{8}M_{DB}$$

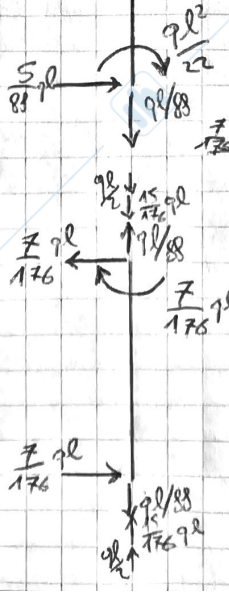
$$\boxed{M_{DC} = \frac{15}{176}q\ell^2}$$

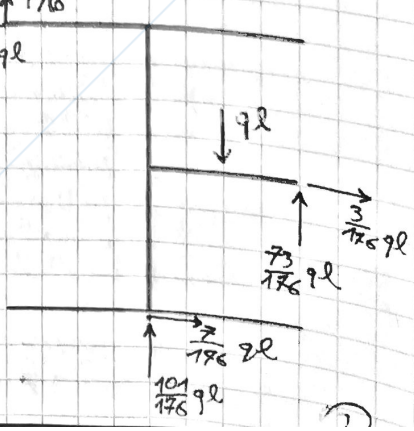




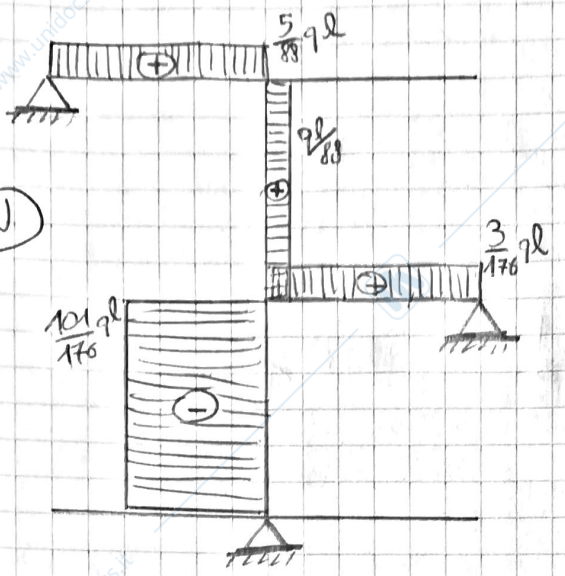
$$\varphi_D = \frac{M_{DG}\ell}{3EI} = \frac{7}{528}\frac{q\ell^3}{EI}$$

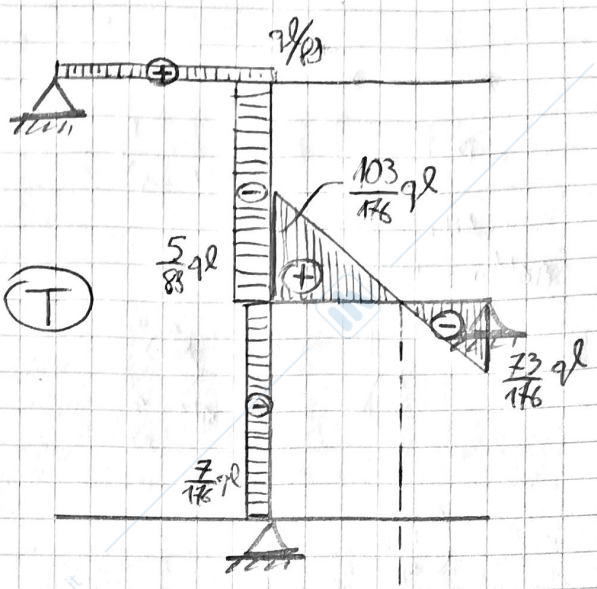
orario

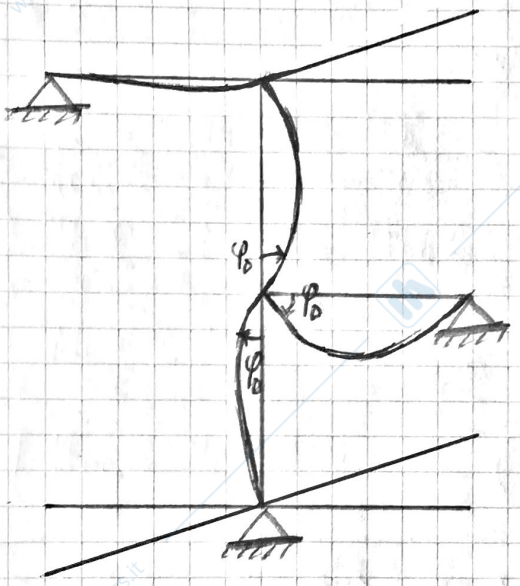


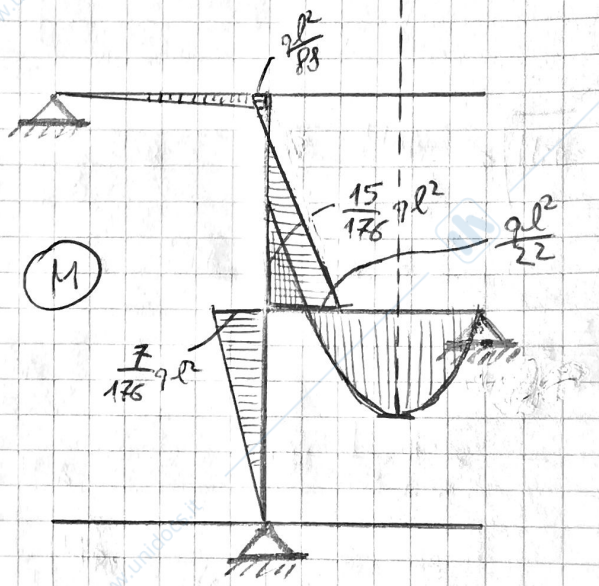


S.H. TOTALE 15/09/20



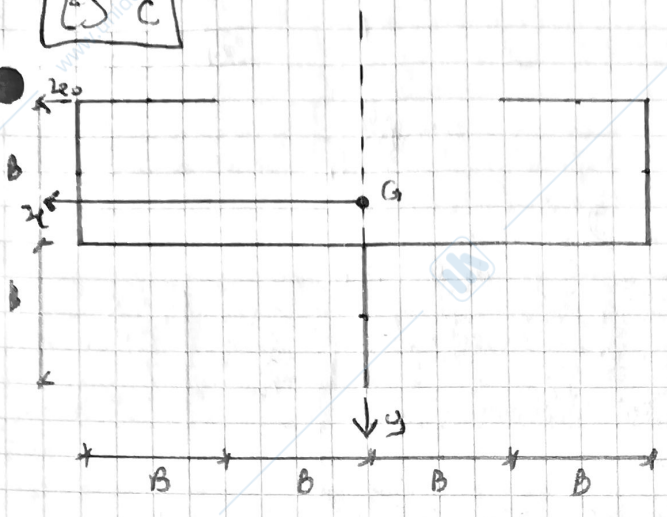






SdC TOTALE 15/09/20

ES C



$$\begin{cases} N_c = \frac{3}{176} q l = 852\ N \\ T_c = \frac{73}{176} q l = 20\,739\ N \\ M_c = 0 \end{cases}$$

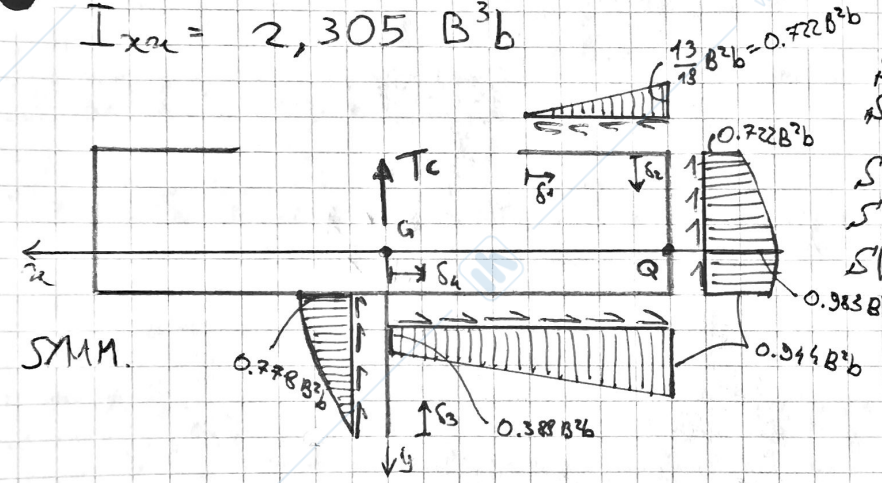
$B = 100\ mm$ $\quad b = 1\ mm$ $\quad l = 1000\ mm$ $\quad q = 50\ N/mm$ $\quad \sigma_{am} = 200\ N/mm^2$

$Area = 9Bb$

$$y_G = \frac{2Bb \cdot 0.5B + 4B^2b + Bb \cdot 1.5B}{9Bb} = \frac{13}{18}B \qquad y_G = 0.722B$$

$$I_{xx} = 3\frac{B^3b}{12} + 2Bb\left(\frac{13}{18}B\right)^2 + 2Bb\left(\frac{4}{18}B\right)^2 + 4Bb\left(\frac{5}{18}B\right)^2 + Bb\left(\frac{14}{18}B\right)^2$$

$$I_{xx} = 2{,}305\ B^3b$$



$$S(\delta_1) = \delta_1 b \frac{13}{18}B$$
$$S(\delta_1 = B) = \frac{13}{18}B^2b = 0{,}722B^2b$$

$$S(\delta_2) = \frac{13}{18}B^2b + \delta_2 b\left(\frac{13}{18}B - \frac{\delta_2}{2}\right)$$
$$S(\delta_2 = \tfrac{13}{18}B) = 0{,}983B^2b$$
$$S(\delta_2 = B) = 0{,}944B^2b$$

$$S(\delta_3) = \delta_3 b\left(\frac{23}{18}B - \frac{\delta_3}{2}\right)$$
$$S(\delta_3 = B) = 0.778B^2b$$

$$S(\delta_4) = 0.778B^2b + \delta_4 b\left(\frac{5}{18}B\right)$$
$$S(\delta_4 = 2B) = 0.944B^2b$$

$$\tau^{(Q)} = \frac{T_c S^{(Q)}}{I_{xx} b} = \frac{20739 \cdot 0{,}983B^2b}{2{,}305\ B^4b^2}$$

$$\tau^{(Q)} = 88{,}4\ MPa$$

$$\sigma_{z(N)}^{(Q)} = \frac{N_c}{Area} = \frac{852}{9 \cdot 100} = 0{,}95\ MPa$$

$$\sigma_{id}^{(Q)} = \sqrt{\sigma_z^{(Q)2} + 3 \cdot \tau^{(Q)2}} = \sqrt{0{,}95^2 + 3 \cdot 88{,}4^2} = 153{,}1\ MPa$$

$< \sigma_{am}$ VERIFICATO

Verifica in (Q)