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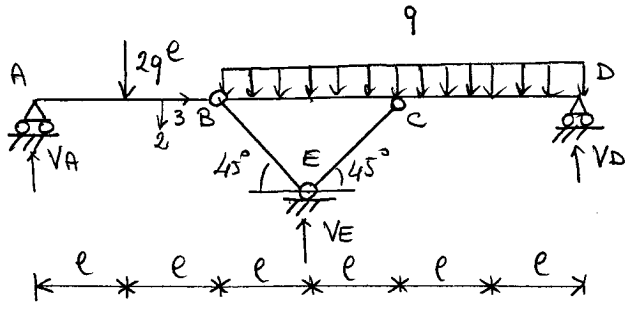
Soluzione Es. 1.

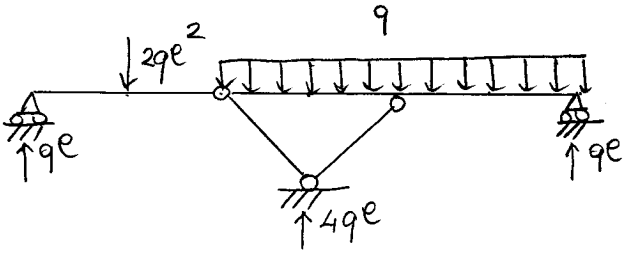


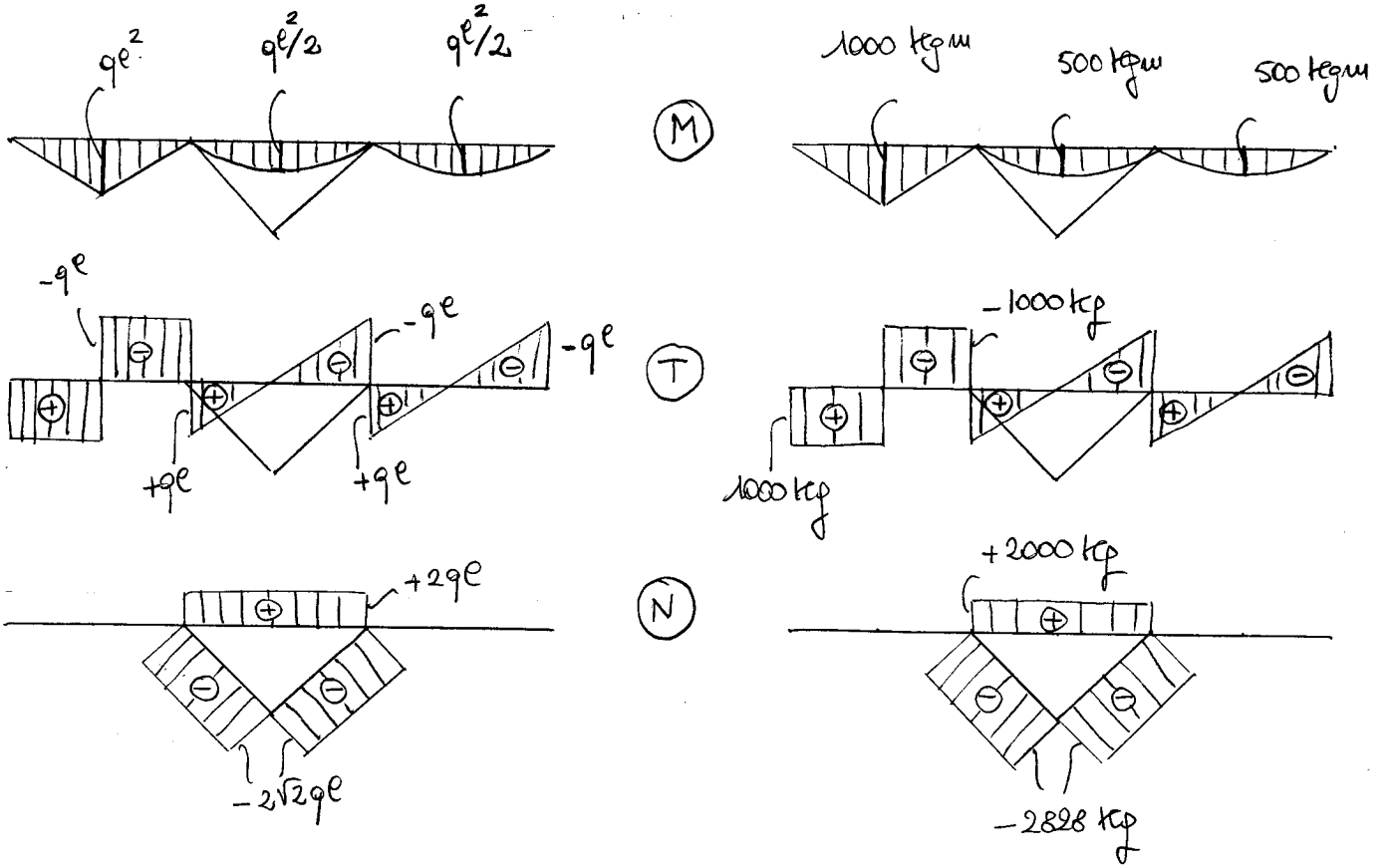
$B\circlearrowleft \quad -V_A 2\ell + 2q\ell^2 = 0 \longrightarrow \boxed{V_A = q\ell}$

$E\circlearrowleft \quad V_D 3\ell - 4q\ell^2 + 2q\ell 2\ell - q\ell 3\ell = 0$

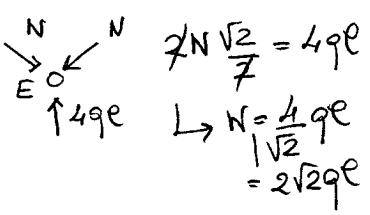
$\hookrightarrow 3V_D = 3q\ell \longrightarrow \boxed{V_D = q\ell}$

$\boxed{V_E} = 4q\ell + 2q\ell - q\ell - q\ell = \boxed{4q\ell}$



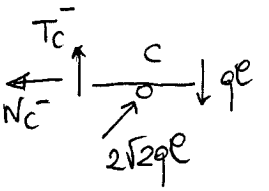


Calcoli



$\nearrow N \frac{\sqrt{2}}{2} = 4q\ell$

$\hookrightarrow N = \frac{4}{\sqrt{2}} q\ell = 2\sqrt{2} q\ell$



$T_C^- = -2\sqrt{2} q\ell \frac{\sqrt{2}}{2} + q\ell = -q\ell$

$N_C^- = 2\sqrt{2}\, q\ell \frac{\sqrt{2}}{2} = 2q\ell$

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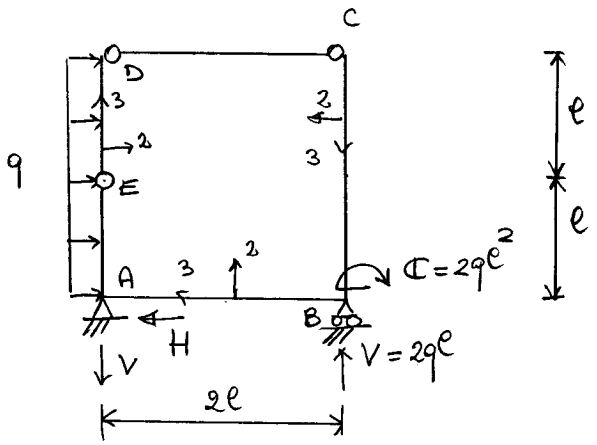
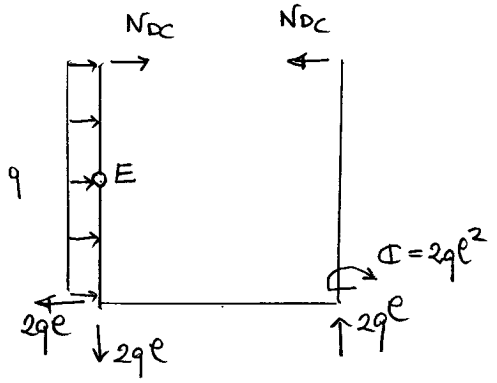
Soluzione Es. 2



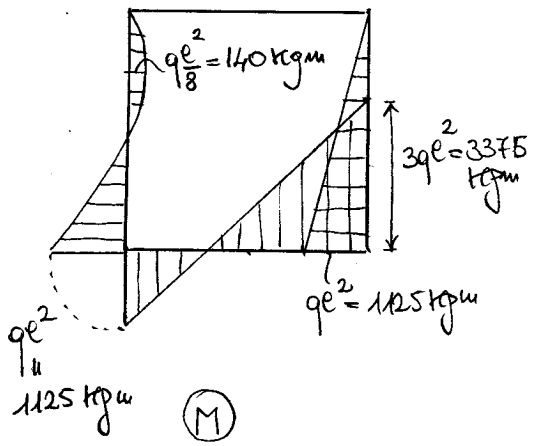
$$H = 2q\ell$$

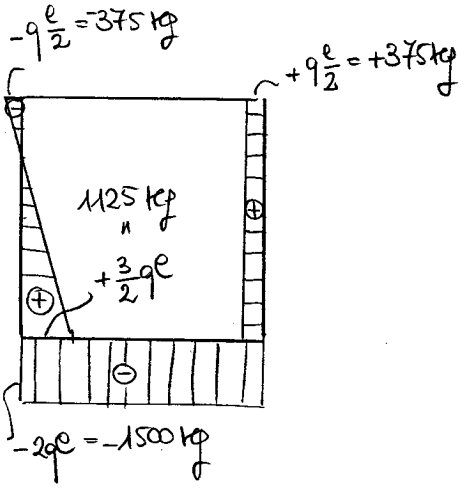
$$A\circlearrowleft \quad V\cdot 2\ell - 2q\ell^2 - 2q\ell^2 = 0 \longrightarrow V = 2q\ell$$

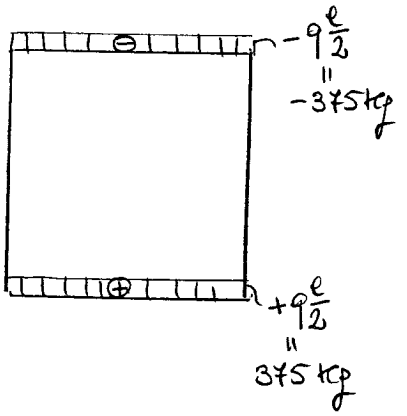


$$E\circlearrowleft \quad -N_{DC}\cdot\ell - q\ell^2/2 = 0 \longrightarrow N_{DC} = -q\ell$$

Diagrammi quotati







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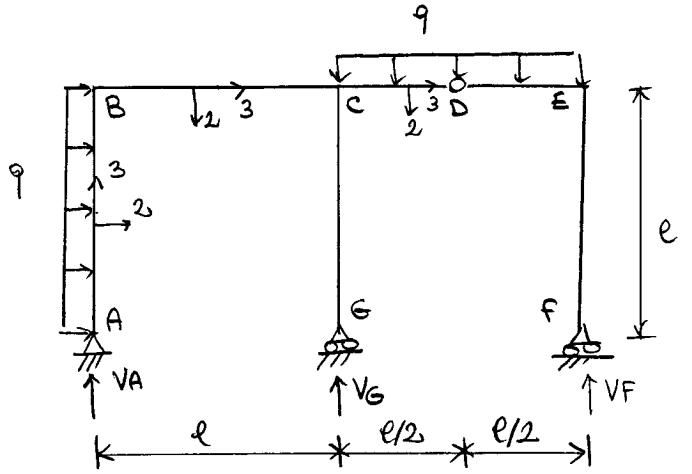
Soluzione Es. 3

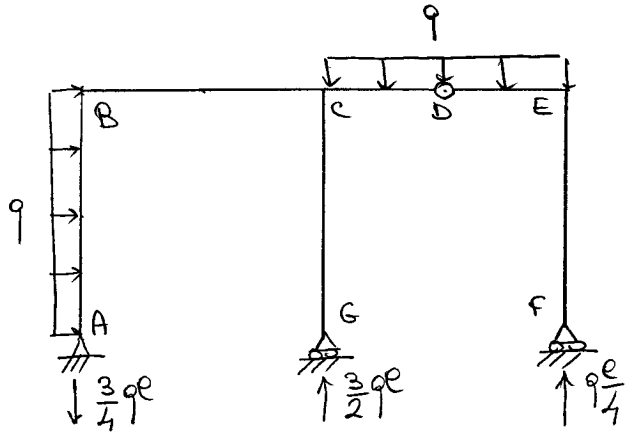


D ↺ $V_F \frac{e}{2} - q\frac{e}{2}\frac{e}{4} = 0 \rightarrow \boxed{V_F = q\,e/4}$

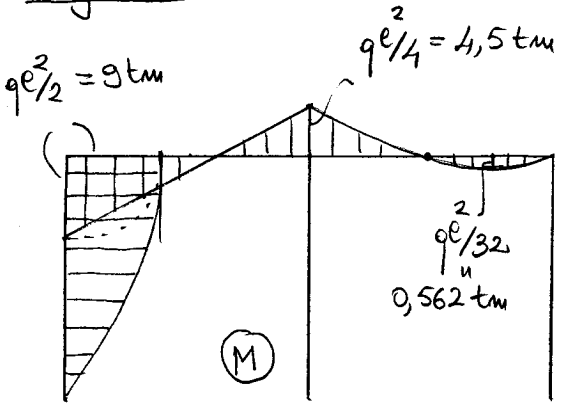
G ↺ $q\frac{e^2}{4} - q\frac{e^2}{2} - q\frac{e^2}{2} - V_A e = 0$

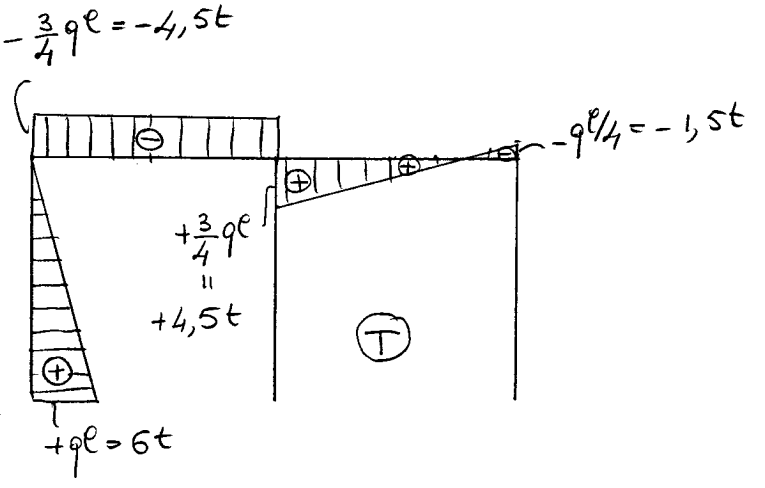
$\rightarrow \boxed{V_A = -\frac{3}{4}qe}$

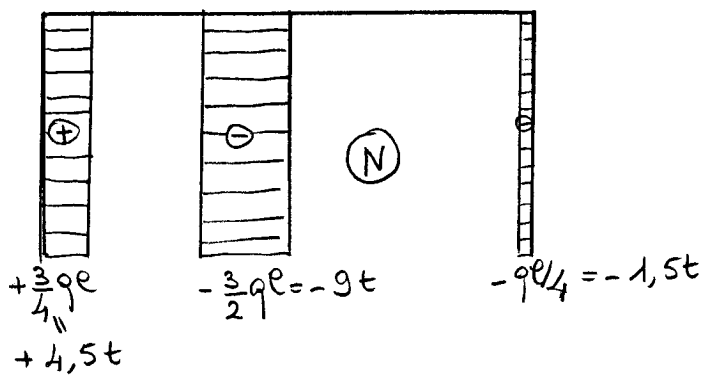
$\boxed{V_G} = qe - q\frac{e}{4} + \frac{3}{4}qe = \boxed{\frac{3}{2}qe}$



Diagrammi:







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Soluzione Es. 4

$$\underset{\sim}{H} = \begin{bmatrix} \frac{\alpha}{d} X_2^2 & \frac{\alpha}{d^2} 2X_1X_2 & 0 \\ \frac{\alpha}{d} X_2 & \frac{\alpha}{d} X_1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$\underset{\sim}{E} = \begin{bmatrix} \frac{\alpha}{d} X_2^2 & \frac{1}{2}\left(\frac{\alpha}{d} X_2 + \frac{\alpha}{d^2} 2X_1X_2\right) & 0 \\ \frac{1}{2}\left(\frac{\alpha}{d} X_2 + \frac{\alpha}{d^2} 2X_1X_2\right) & \frac{\alpha}{d} X_1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

a) $\dfrac{dV_{finale} - dV_{iniziale}}{dV_{iniziale}} = I \cdot E = \frac{\alpha}{d^2} X_2^2 + \frac{\alpha}{d} X_1$. NB: $dV_{iniziale} = dX_1 dX_2 dX_3$

$$\hookrightarrow V_{finale} - V_{iniziale} = \int_0^d \int_0^d \int_0^d \left(\frac{\alpha}{d^2} X_2^2 + \frac{\alpha}{d} X_1\right) dX_1 dX_2 dX_3 = \frac{5}{6} \alpha d^3$$

$$\hookrightarrow V_{finale} = V_{iniziale} + \frac{5}{6} \alpha d^3 = d^3\left(1 + \frac{5}{6}\alpha\right) = 1004\ cm^3$$

b) $$E_{P=(1,-1,+1)} = \begin{bmatrix} 0{,}5 & -3 \\ -3 & 5 \end{bmatrix} \cdot 10^{-4}$$

$$\hookrightarrow \begin{Bmatrix} \varepsilon_\xi \\ \varepsilon_\eta \end{Bmatrix} = \left[\frac{5{,}5}{2} \pm \sqrt{\frac{(4{,}5)^2}{4} + 9}\right] \cdot 10^{-4} = \begin{cases} 6{,}5 \cdot 10^{-4} \\ -1 \cdot 10^{-4} \end{cases}$$

$$\alpha = \frac{1}{2} \operatorname{arctg}\left(\frac{-2 \cdot (-3)}{0{,}5 - 5}\right) = -0{,}463 = 26{,}56°$$