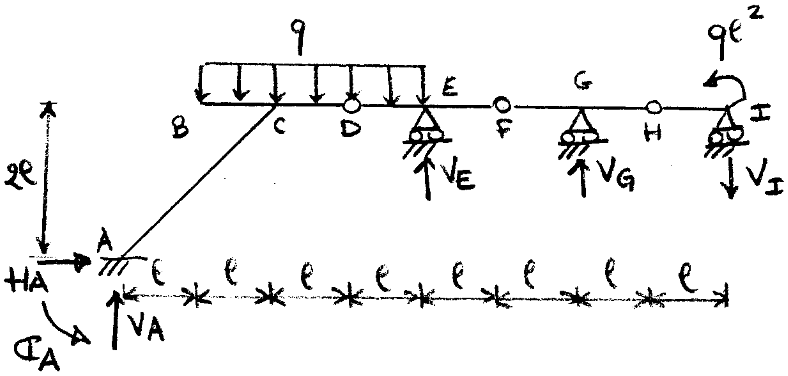
Risoluzione Es. 1

08/01/02



$H_A = 0$

$I)\; -V_I \cdot \ell + q\ell^2 = 0$

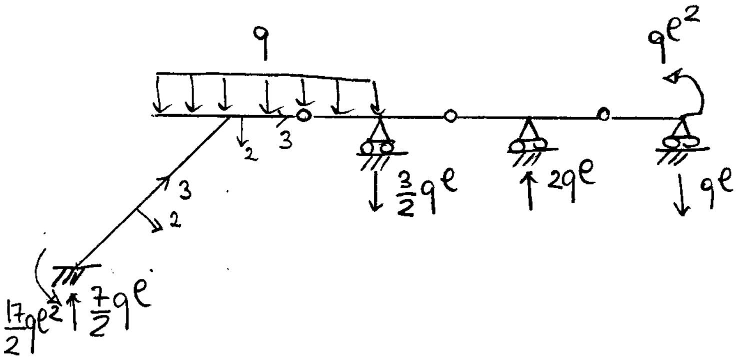
$\hookrightarrow V_I = q\ell = 6t$

$F)\; V_G \ell + q\ell^2 - V_I 3\ell = 0$

$\hookrightarrow V_G = 2q\ell = 12t$

$D)\; V_E \ell + 2q\ell \cdot 3\ell + q\ell^2 - q\ell 5\ell + q\frac{\ell^2}{2} = 0$

$\hookrightarrow V_E = q\ell(-6-1+5+\frac{1}{2}) = q\ell(-2+\frac{1}{2}) = -\frac{3}{2}q\ell = -9t$

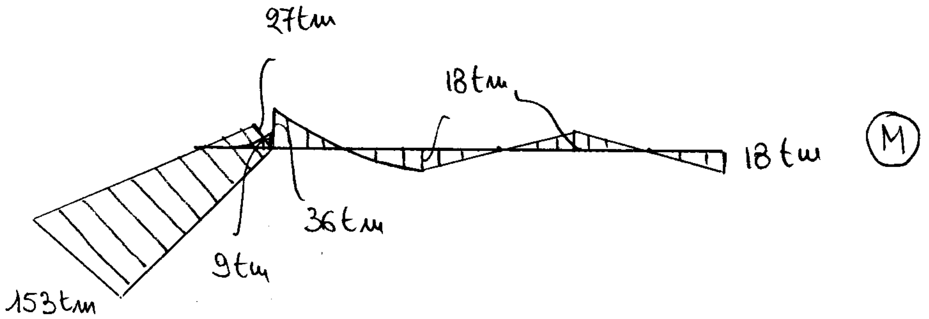


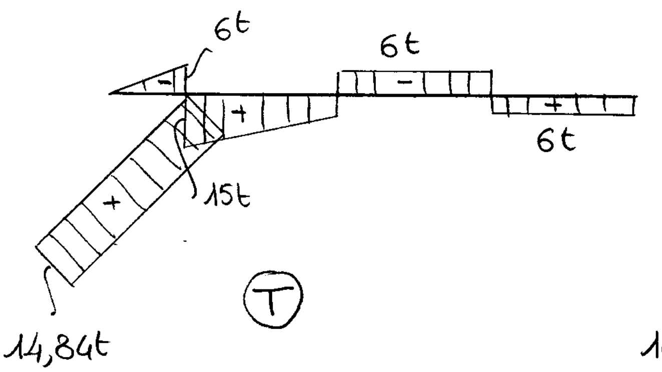
$V_A = 3q\ell + q\ell + \frac{3}{2}q\ell - 2q\ell = (2+\frac{3}{2})q\ell = \frac{7}{2}q\ell = 21\,t$

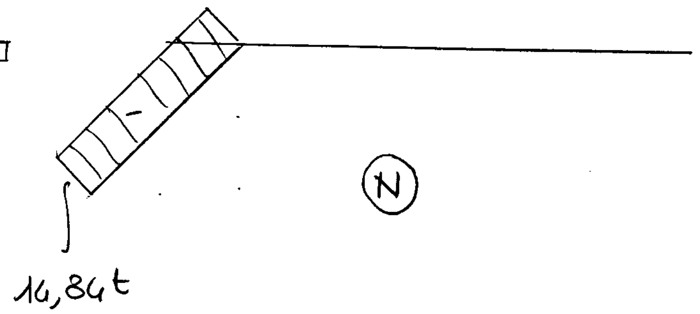
$D)\; C_A - V_A 3\ell + 2q\ell^2 = 0$

$\hookrightarrow C_A = 3\ell V_A - 2q\ell^2 = \frac{21}{2}q\ell^2 - 2q\ell^2 = \frac{17}{2}q\ell^2 = 153\,tm$

Diagrammi quotati:

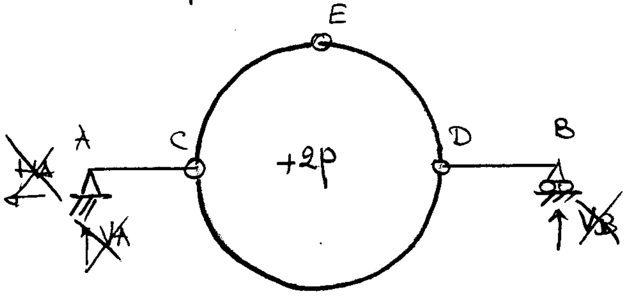




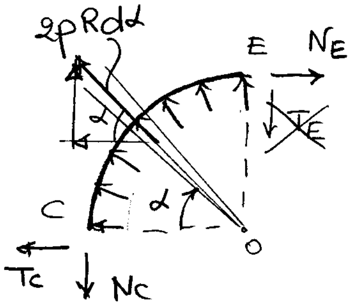


Risoluzione Es. 2 | 08/01/02

La struttura è isostatica per vincoli esterni e su di essa agisce un carico autoequilibrato. Pertanto le reazioni vincolari in A e B sono zero e i tratti AC e BD sono scarichi.



Calcolo delle azioni interne nei punti C e E della trave circolare:

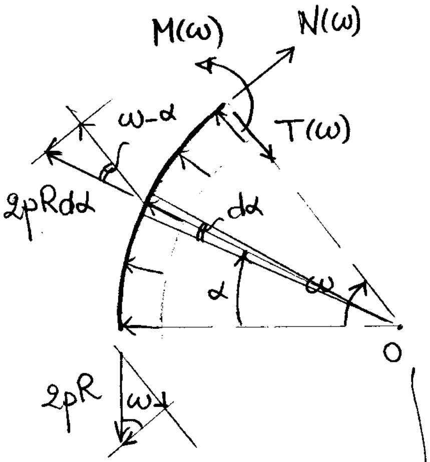


$T_E = 0$ per simmetria

$$\begin{cases} N_C - \int_0^{\pi/2} 2p \operatorname{sen}\alpha \, R\, d\alpha = 0 \\ T_C + \int_0^{\pi/2} 2p \cos\alpha \, R\, d\alpha = 0 \\ O\circlearrowleft \quad N_C \cdot \cancel{R} - N_E \cdot \cancel{R} = 0 \end{cases}$$

da cui: $N_C = N_E = 2pR$, $T_C = 0$.

Calcolo delle azioni interne nella trave circolare:



$0 \le \omega \le \frac{\pi}{2}$

$$\begin{cases} N(\omega) - 2pR\cos\omega - \int_0^{\omega} \operatorname{sen}(\omega-\alpha)\, 2pR\, d\alpha = 0 \\ T(\omega) + 2pR\operatorname{sen}\omega - \int_0^{\omega} \cos(\omega-\alpha)\, 2pR\, d\alpha = 0 \\ O\circlearrowleft \quad M(\omega) - N(\omega)R + 2pR^2 = 0 \end{cases}$$

$$\boxed{N(\omega)} = 2pR\cos\omega + 2pR\left[\cos(\omega-\alpha)\right]_0^{\omega} = 2pR\cancel{\cos\omega} + 2pR\left[1 - \cancel{\cos\omega}\right] = \boxed{2pR}$$

$$\boxed{T(\omega)} = -2pR\operatorname{sen}\omega + \left[-\operatorname{sen}(\omega-\alpha)\right]_0^{\omega} 2pR = -2pR\operatorname{sen}\omega + 2pR\operatorname{sen}\omega = \boxed{0}$$

$$\boxed{M(\omega)} = 2pR^2 - 2pR^2 = \boxed{0}$$

La linea d'asse è la funicolare del carico.

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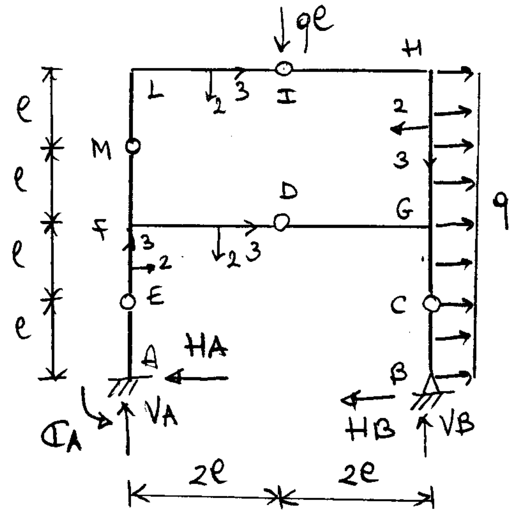
Risoluzione Es. 3



C↺ $-H_B \cdot l + q\frac{l^2}{2} = 0 \quad \rightarrow \quad H_B = q\frac{l}{2} = 250$ kg

$H_A = 4ql - H_B = \frac{7}{2}ql = 1750$ kg

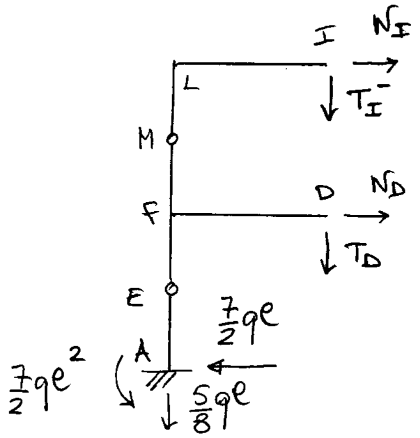
E↺ $C_A - H_A l = 0 \quad \rightarrow \quad C_A = \frac{7}{2}ql^2 = 1750$ kgm

A↺ $V_B 4l - 4ql \cdot 2l - ql \cdot 2l + C_A = 0$

↳ $4V_B = 8ql + 2ql - \frac{7}{2}ql = \frac{13}{2}ql$

↳ $V_B = \frac{13}{8}ql = 810$ kg

$V_A = ql - V_B = -\frac{5}{8}ql = 310$ kg



D↺ $N_D \cdot 2\cancel{l} + \frac{5}{8}ql \cdot 2\cancel{l} - \frac{7}{2}ql\,4\cancel{l} + \frac{7}{2}ql^{\cancel{2}} = 0$

↳ $2N_D = ql\left(\frac{21}{2} - \frac{5}{4}\right) = ql\,\frac{37}{4}$

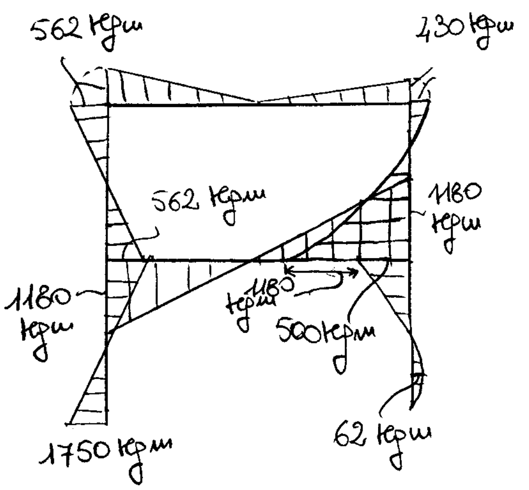
↳ $N_D = \frac{37}{8}ql = 2310$ kg

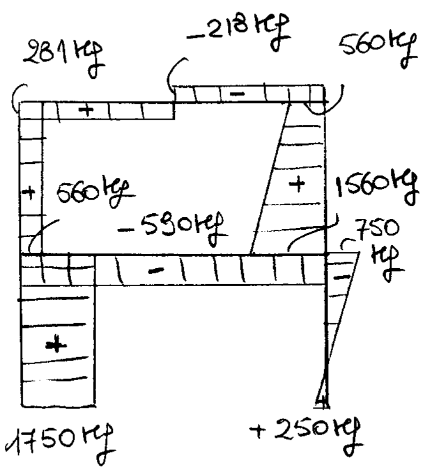
$N_I = \frac{7}{2}ql - N_D = -\frac{9}{8}ql = -560$ kg

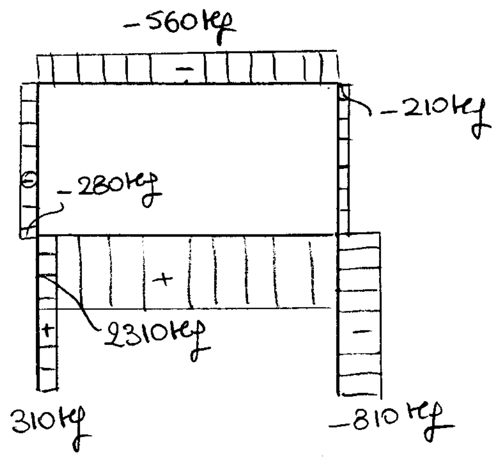
M↺ $-T_I^- \, 2\cancel{l} - N_I \cancel{l} = 0 \quad \rightarrow \quad T_I^- = -\frac{N_I}{2} = +\frac{9}{16}ql = 281$ kg

$T_D = -\frac{5}{8}ql - T_I^- = -\frac{19}{16}ql = -590$ kg

Diagrammi quotati







M   T   N

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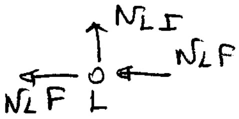
Risoluzione Es. 4

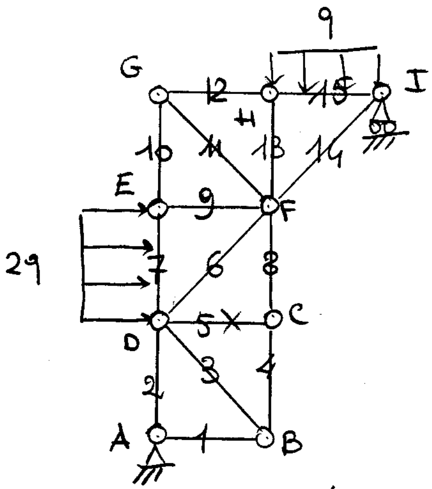
Le aste che convergono nel nodo L sono scariche. Infatti:



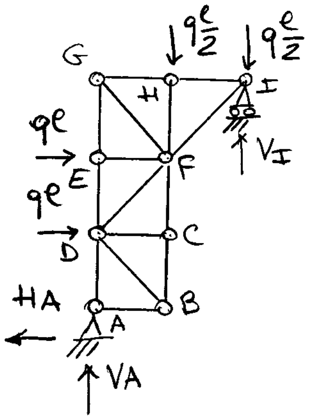
$2N_{LF}=0$

$N_{LI}=0$

Pertanto, utilizzando la proprietà di antisimmetria di cui godono le azioni interne in questa struttura, ci si può ricondurre a studiarne solo metà:



Calcolo dello stato primario di sollecitazione:



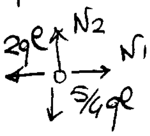
$H_A = 2q\ell = 4000$ kg

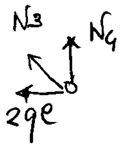
$A \circlearrowleft \; V_I \cdot 2\ell - q\frac{\ell}{2}\cdot 2\ell - q\frac{\ell^2}{2} - q\ell 2\ell - q\ell^2 = 0$

$\hookrightarrow \quad V_I = \frac{9}{4}q\ell = 4500$ kg

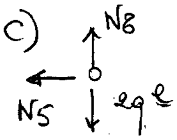
$V_A = q\ell - V_I = -\frac{5}{4}q\ell = -2500$ kg

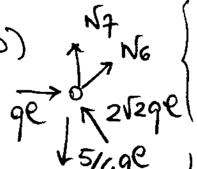
Equilibri ai nodi:

A) 

B) 

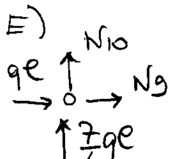
$$\begin{cases} N_3\frac{1}{\sqrt{2}} = -2q\ell \\ N_4 = -\frac{N_3}{\sqrt{2}} = 2q\ell \end{cases}$$

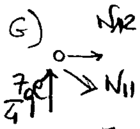
C) 

D) 

$$\begin{cases} \frac{N_6}{\sqrt{2}} + q\ell - 2\sqrt{2}q\ell\frac{1}{\sqrt{2}} = 0 \\ N_7 = \frac{5}{4}q\ell - 2\frac{\sqrt{2}}{\sqrt{2}}q\ell - \frac{N_6}{\sqrt{2}} \end{cases}$$

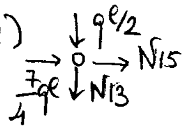
$$\hookrightarrow \begin{cases} N_6 = \sqrt{2}q\ell \\ N_7 = -\frac{7}{4}q\ell \end{cases}$$

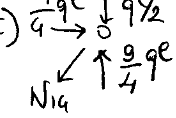
E) 

G) 

$N_{11}\frac{1}{\sqrt{2}} = \frac{7}{4}q\ell$

$N_{12} = -\frac{7}{4}q\ell$

H) 

I) 

$\frac{N_{14}}{\sqrt{2}} = \frac{7}{4}q\ell$

		(kg)			(kg)
1	$2q\ell$	4000	8	$2q\ell$	4000
2	$\frac{5}{4}q\ell$	2500	9	$-q\ell$	-2000
3	$-2\sqrt{2}q\ell$	-5656	10	$-\frac{7}{4}q\ell$	-3500
4	$+2q\ell$	4000	11	$\frac{7\sqrt{2}}{4}q\ell$	4949
5	0	0	12	$-\frac{7}{4}q\ell$	-3500
6	$\sqrt{2}q\ell$	2828	13	$-q\ell/2$	-1000
7	$-\frac{7}{4}q\ell$	-3500	14	$\frac{7\sqrt{2}}{4}q\ell$	4949
			15	$-\frac{7}{4}q\ell$	-3500

Stato secondario di sollecitazione: