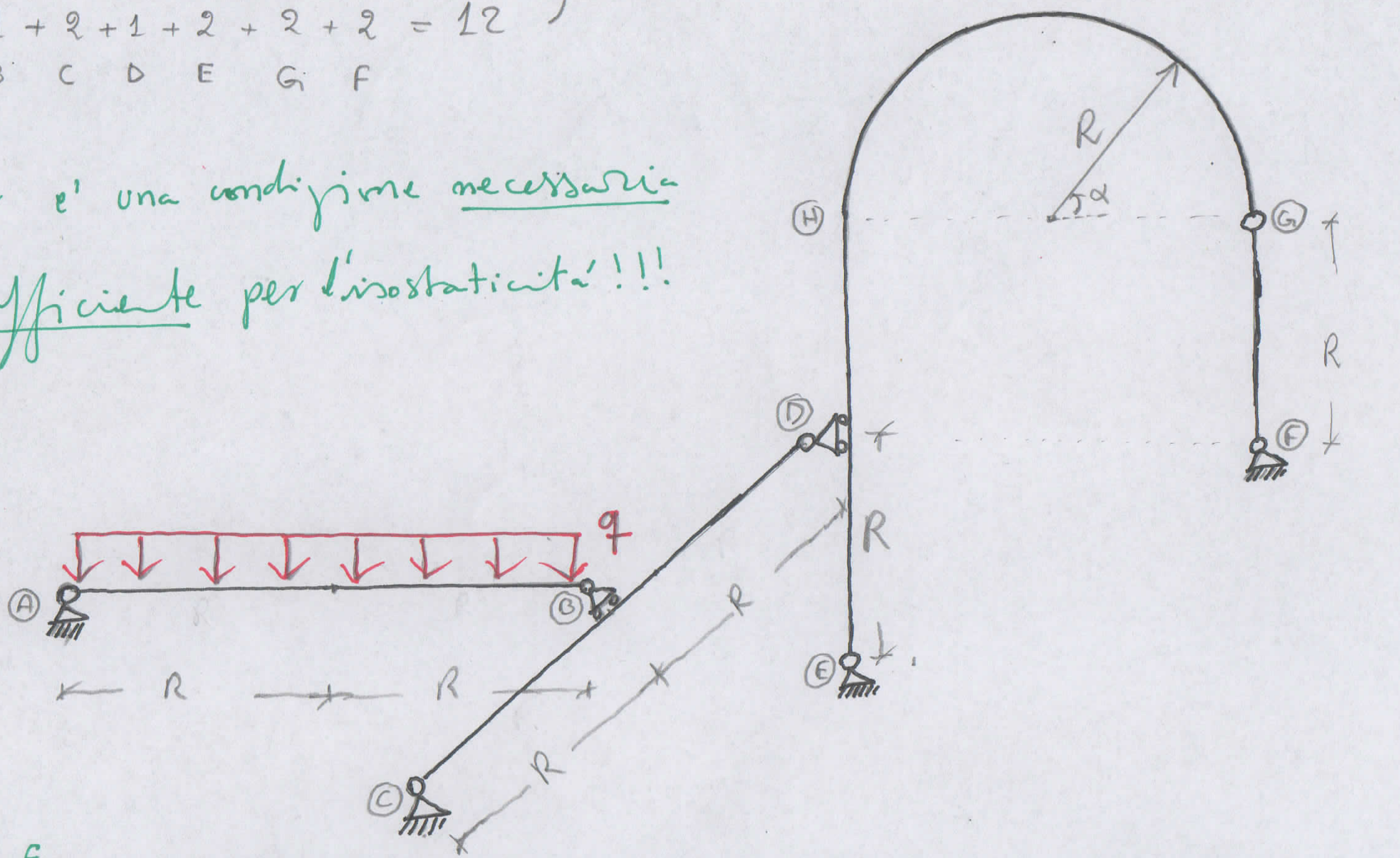
Es. isostatica (appello scritto 10.01.2014)

Summer Shahzad

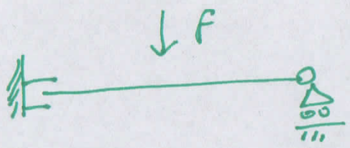
$$\left.\begin{array}{l} g.d.l = 3 \times 14 = 12 \\ g.d.v = \underset{A}{2} + \underset{B}{1} + \underset{C}{2} + \underset{D}{1} + \underset{E}{2} + \underset{G}{2} + \underset{F}{2} = 12 \end{array}\right\} \text{iso!}$$



NB! g.d.l = g.d.v e' una condizione necessaria

Ma non sufficiente per l'isostaticita'!!!

e.g.



$$\left.\begin{array}{l} g.d.l = 3 \\ g.d.v = 3 \end{array}\right\}$$ dovrebbe essere iso in realta' orizzontalmente labile e verticalmente 1^a volta iper!

i) Troppe incognite esterne da trovare ⇒ Esplodo la struttura in corrispondenza dei vincoli interni

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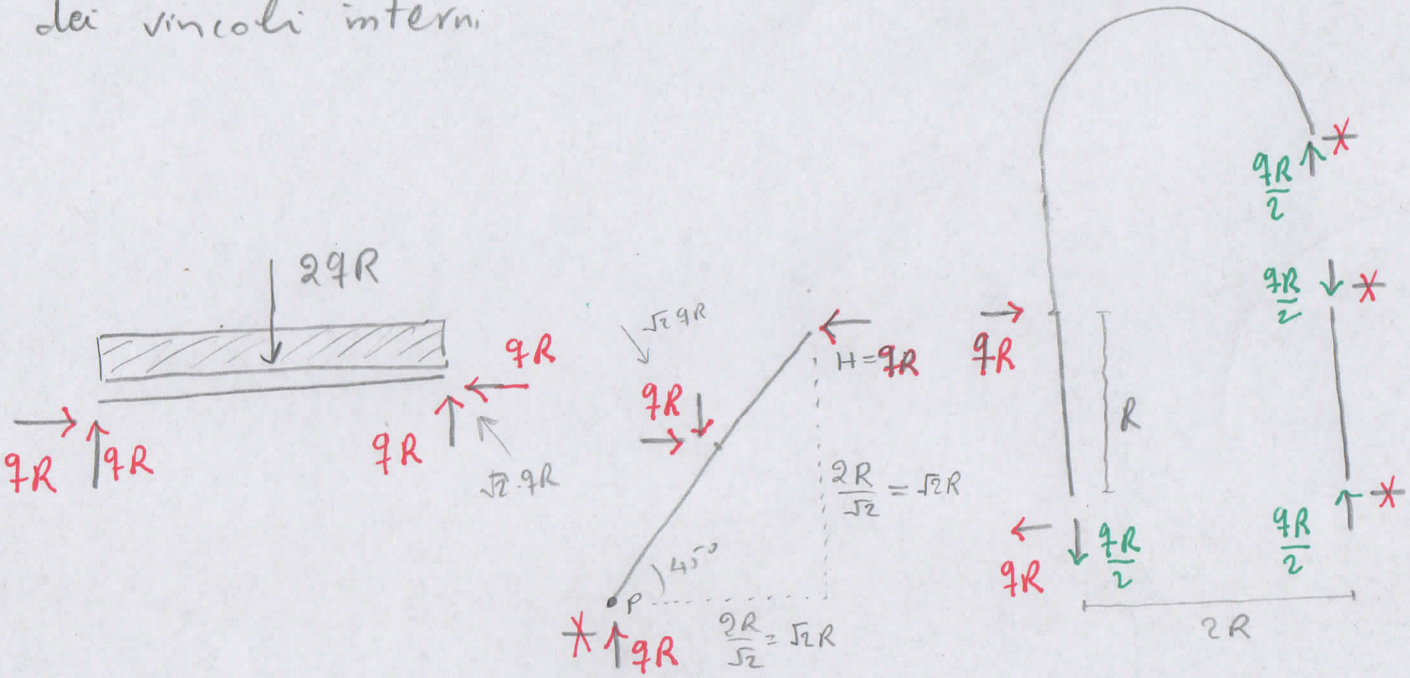
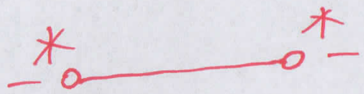


perché la biella non porta i tagli!



$P+\curvearrowleft$ $\quad H\cdot\cancel{\sqrt{2}R} - \cancel{\sqrt{2}}\,qR\cdot\cancel{R} = 0 \Rightarrow H = qR$

verifica:

$qR\cdot R = \frac{q\cdot R}{2}\cdot 2R$ ✓ ok!

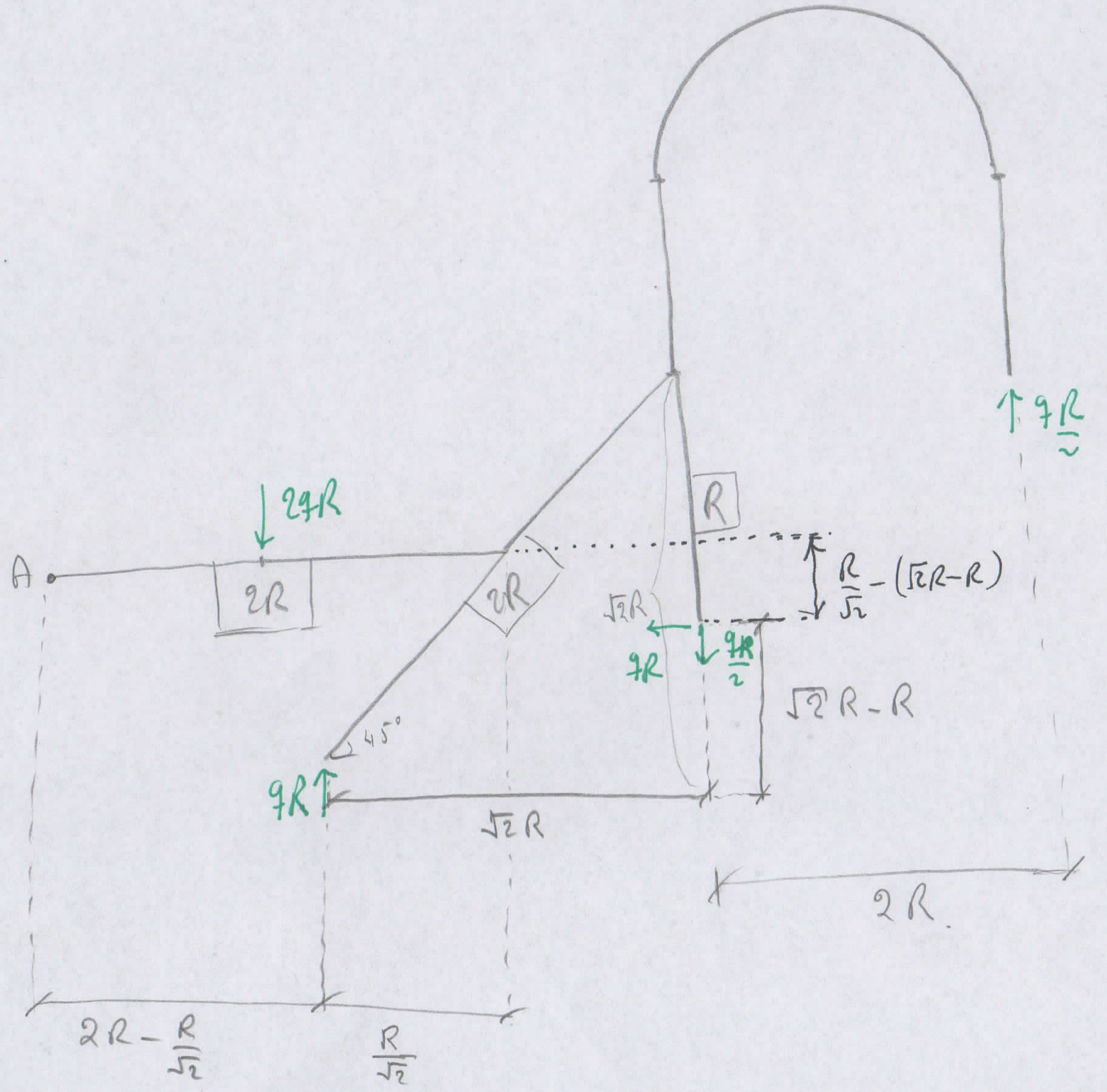
NB! Strutt. iso: ∃! soluzione equilibrante!

⇒ devo verificare l'equilibrio locale e globale!

③

verifica equilibrio globale!

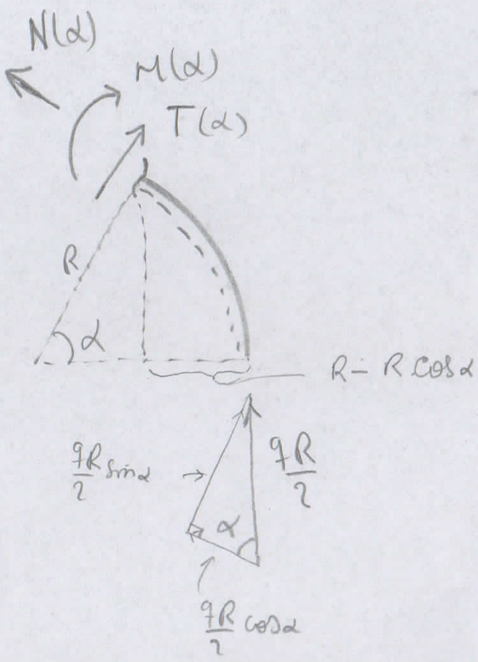
[illegible]



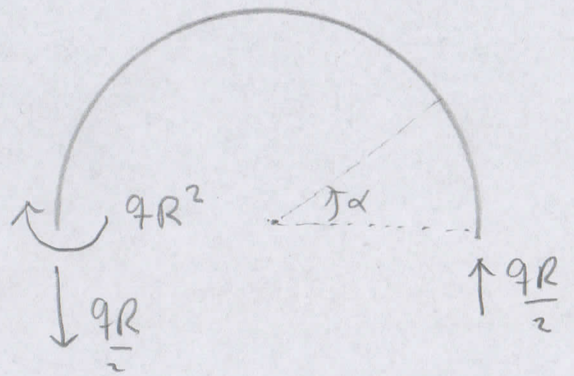
OK!

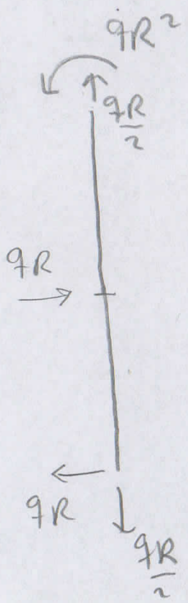
$$\overset{\curvearrowleft}{+A}\quad -2qR(R)+qR\left(2R-\frac{R}{\sqrt{2}}\right)-qR\left(\frac{R}{\sqrt{2}}-(\sqrt{2}R-R)\right)-\frac{qR}{2}\left(2R+\frac{R}{\sqrt{2}}\right)+\frac{qR}{2}\left(2R+\frac{R}{\sqrt{2}}+2R\right)=0$$

Sommer Stuttgart



$\boxed{0 \leq \alpha \leq \pi}$





$$N(\alpha) = -\frac{qR}{2}\cos\alpha \begin{cases} -\frac{qR}{2} & \text{se } \alpha = 0 \\ 0 & \text{se } \alpha = \pi/2 \\ \frac{qR}{2} & \text{se } \alpha = \pi \end{cases}$$

$$T(\alpha) = -\frac{qR}{2}\sin\alpha \begin{cases} 0 & \text{se } \alpha = 0 \\ -\frac{qR}{2} & \text{se } \alpha = \pi/2 \\ 0 & \end{cases}$$

$$M(\alpha) = \frac{qR}{2}\left(R - R\cos\alpha\right) \begin{cases} 0 & \text{se } \alpha = 0 \\ \frac{qR^2}{2}(1) & \text{se } \alpha = \pi/2 \\ qR^2 & \text{se } \alpha = \pi \end{cases}$$

Diagrammi:

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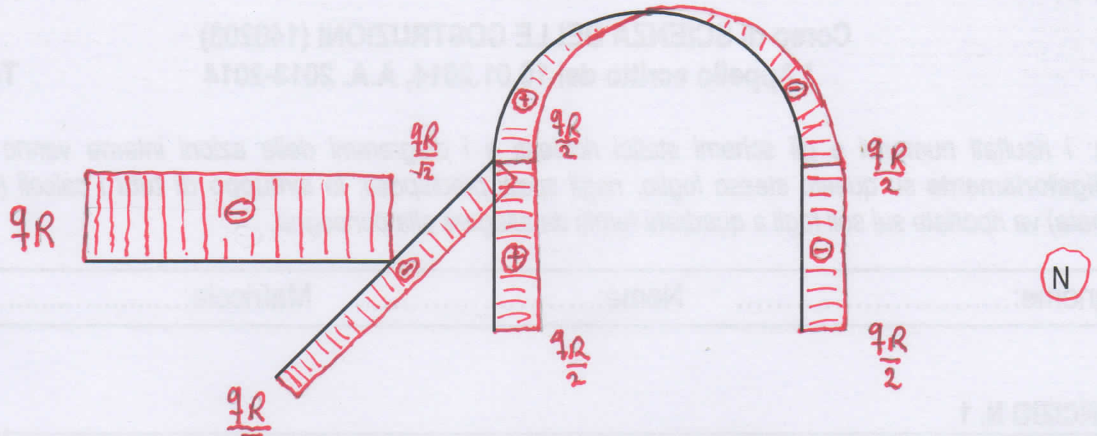
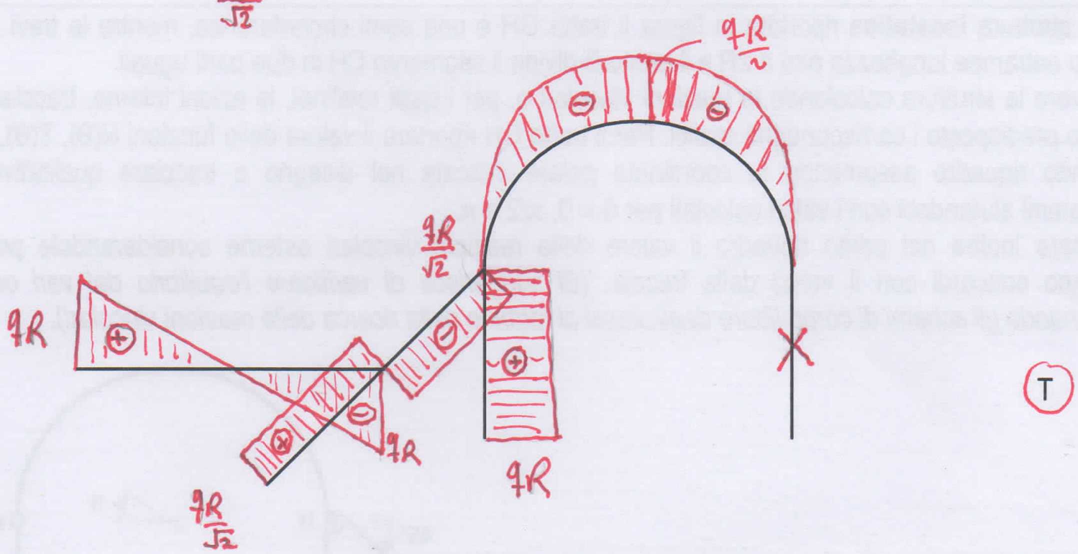
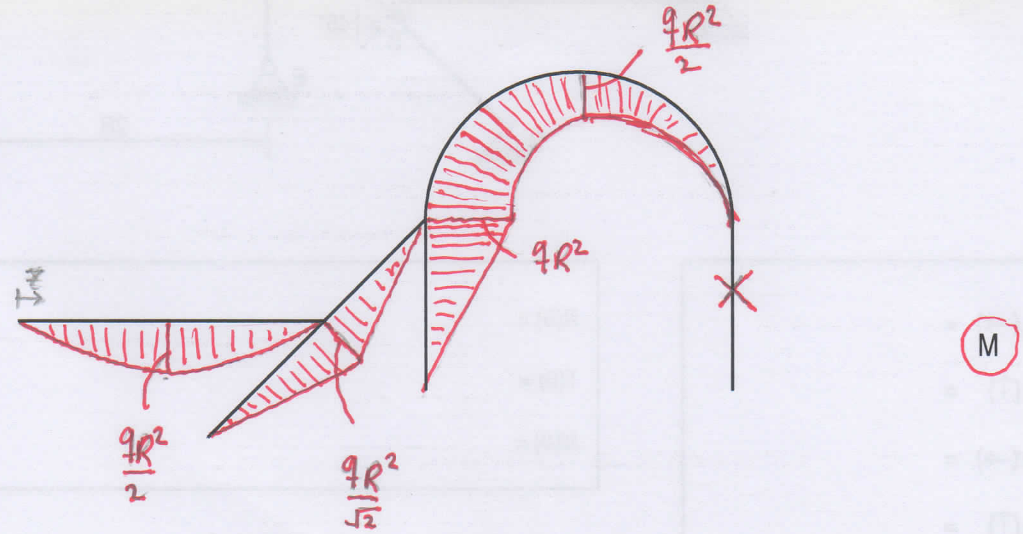
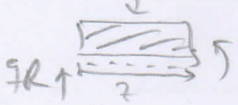




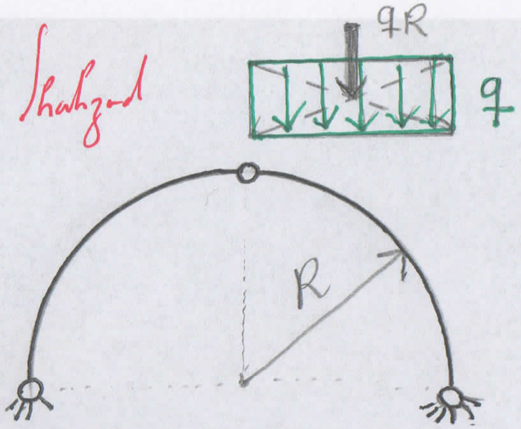




$$M(x) = qRz - \frac{qz^2}{2}$$

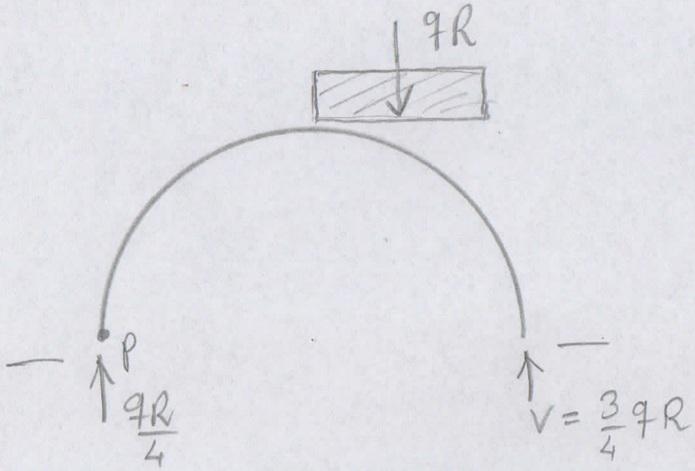
$$M(R) = qR^2 - \frac{qR^2}{2} = \frac{qR^2}{2}$$

Esercizio isostatica con aste curvilinee: Summer Shahzad



[Arco a tre cerniere]

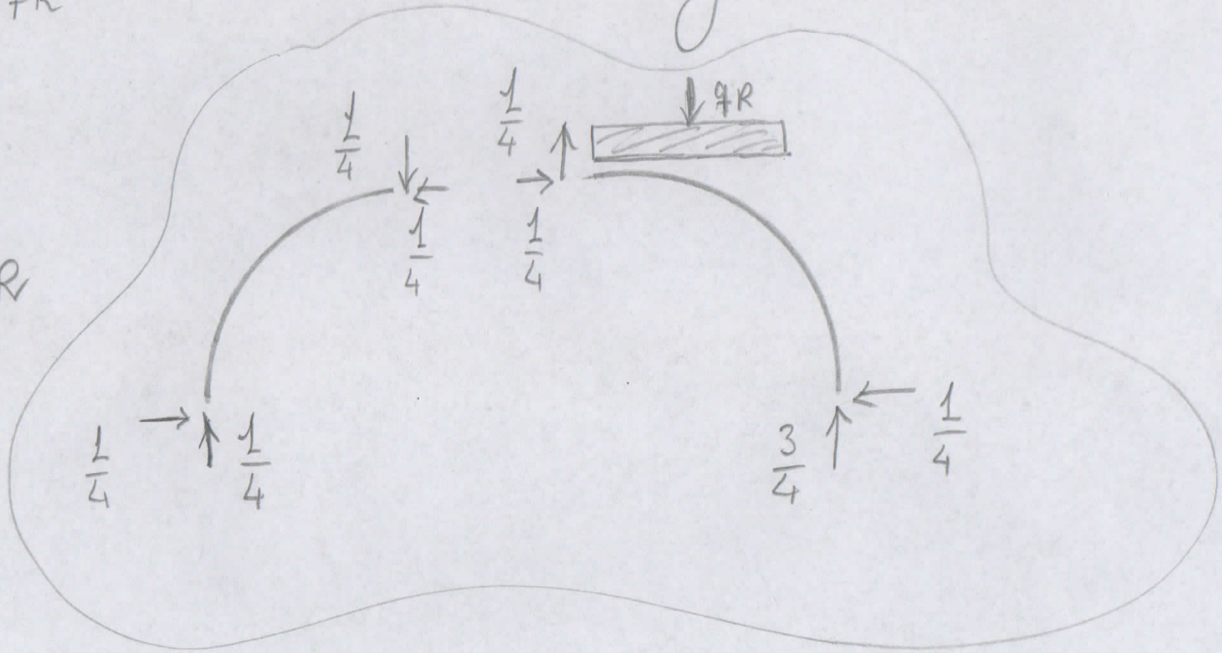
i) Diagramma del corpo libero



$$g.d.l = 2 \times 3 = 6$$
$$g.d.v = 2 + 2 + 2 = 6$$
iso!

P^{+}) $V \cdot 2R - qR \cdot \left(R + \frac{R}{2}\right) = 0$

$$V = \frac{1}{\cancel{2R}}\, qR\left(\frac{3}{2}R\right) = \frac{3}{4} qR$$



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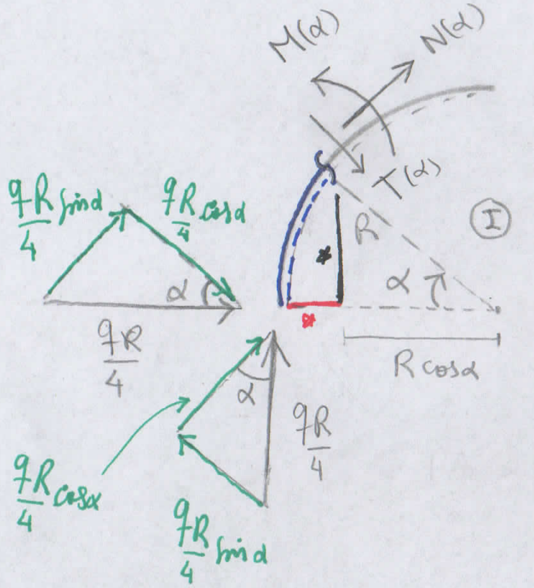
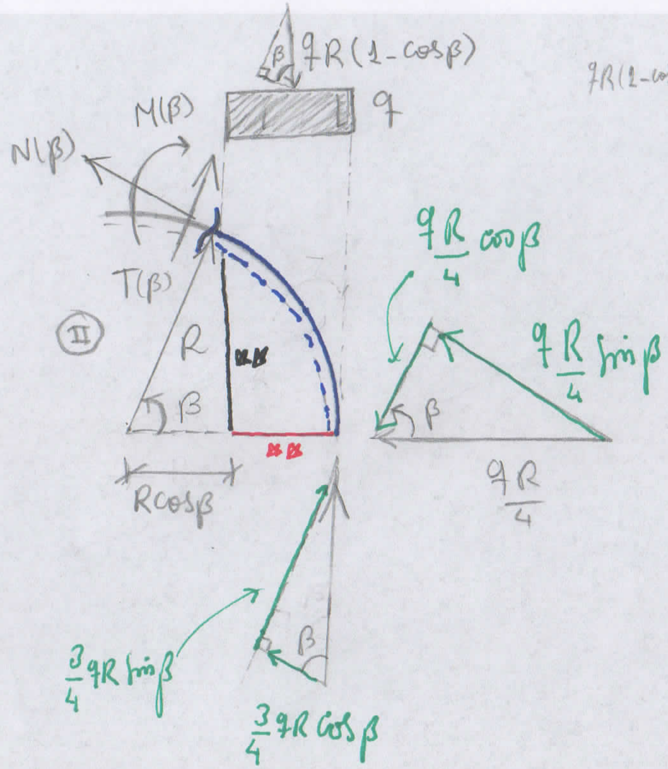
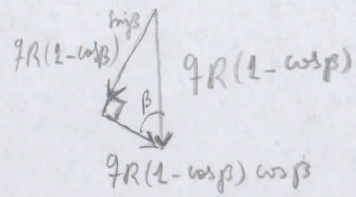
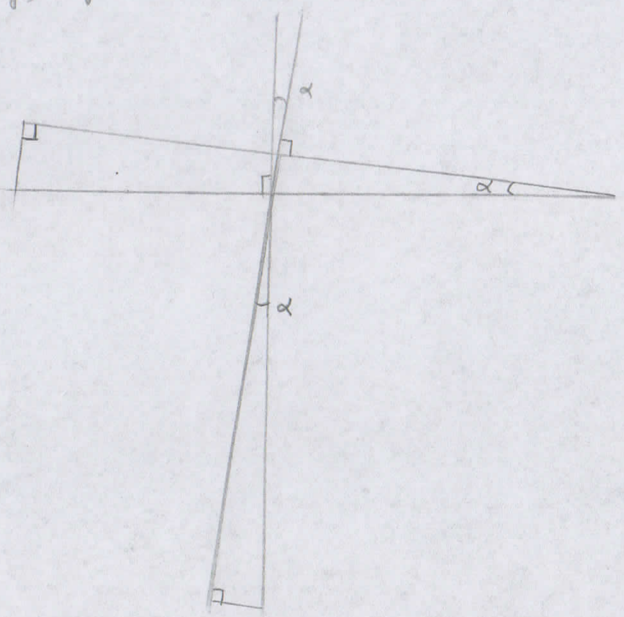
(2)



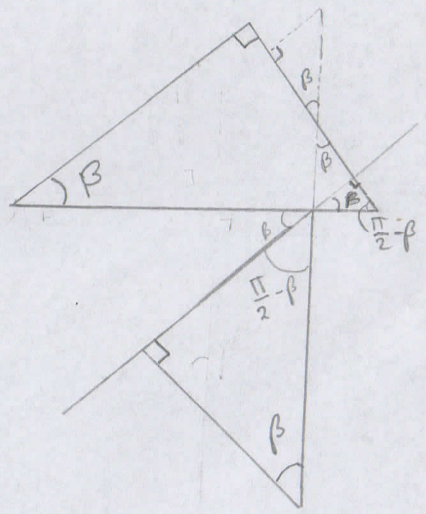






$$
\text{I}\begin{cases}
N(\alpha) = -\dfrac{qR}{4}(\cos\alpha + \sin\alpha) \\
T(\alpha) = \dfrac{qR}{4}(\sin\alpha - \cos\alpha) \\
M(\alpha) = \dfrac{qR}{4}\underline{(R - R\cos\alpha)} - \dfrac{qR}{4}\underline{(R.\sin\alpha)}
\end{cases}
$$

$$= \frac{qR^2}{4}(1 - \sin\alpha - \cos\alpha)$$



$\frac{\pi}{2} + \frac{\pi}{2} - \beta + \beta = \pi$

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$$
\begin{cases}
N(\beta) = -qR\left(\frac{3}{4}\cos\beta + \frac{1}{4}\sin\beta\right) + qR(1-\cos\beta)\cos\beta \\[2ex]
T(\beta) = \frac{qR}{4}\cos\beta - \frac{3}{4}qR\sin\beta + qR(1-\cos\beta)\sin\beta \\[2ex]
M(\beta) = \frac{3}{4}qR\underbrace{(R - R\cos\beta)}_{\star\star} - \frac{qR}{4}\underbrace{(R\sin\beta)}_{\star\star} - qR(1-\cos\beta)\underbrace{\frac{(R-R\cos\beta)}{2}}_{\star\star/2}
\end{cases}
$$

Tratto I

$$
N(\alpha) = qR\begin{cases} -1/4 & \text{se } \alpha = 0 \\ -\sqrt{2}/4 & \text{se } \alpha = \pi/4 \\ -1/4 & \text{se } \alpha = \pi/2 \end{cases}
$$

$$
T(\alpha) = qR\begin{cases} -1/4 & \text{se } \alpha = 0 \\ 0 & \text{se } \alpha = \pi/4 \\ +1/4 & \text{se } \alpha = \pi/2 \end{cases}
$$

$$
M(\alpha) = qR^2\begin{cases} 0 & \text{se } \alpha = 0 \\ -\frac{(\sqrt{2}-1)}{4} & \text{se } \alpha = \pi/4 \\ 0 & \text{se } \alpha = \pi/2 \end{cases}
$$

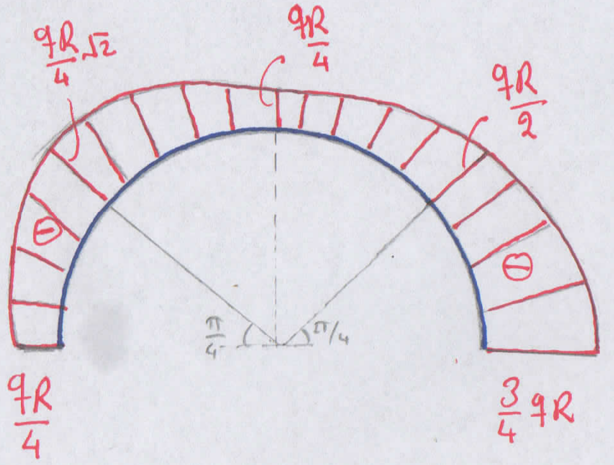
Tratto II

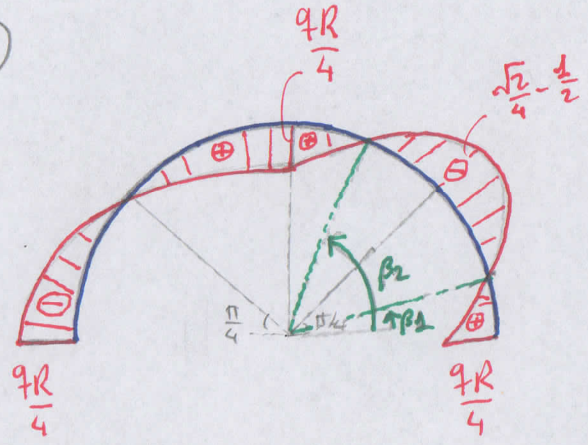
$$
N(\beta) = qR\begin{cases} -\frac{3}{4} & \text{se } \alpha = 0 \\ -\frac{1}{2} & \text{se } \alpha = \pi/4 \\ -1/4 & \text{se } \alpha = \pi/2 \end{cases}
$$

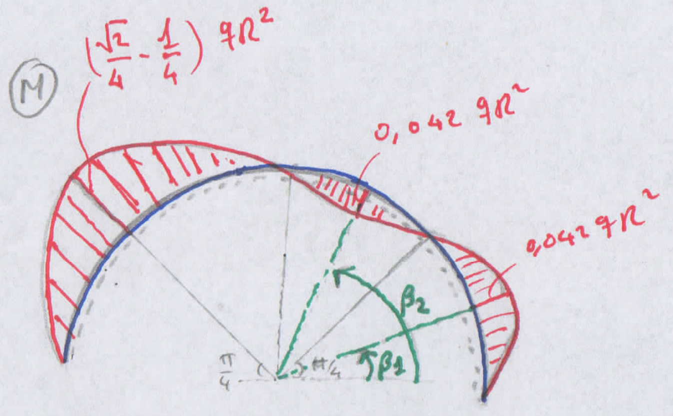
$$
T(\beta) = qR\begin{cases} 1/4 & \text{se } \alpha = 0 \\ \frac{\sqrt{2}}{4} - \frac{1}{2} & \text{se } \alpha = \pi/4 \\ 1/2 & \text{se } \alpha = \pi/2 \end{cases}
$$

$$
M(\beta) = qR^2\begin{cases} 0 & \text{se } \alpha = 0 \\ 0 & \text{se } \alpha = \pi/4 \\ 0 & \text{se } \alpha = \pi/2 \end{cases}
$$

Diagrammi







$\boxed{?}$ Dove taglio e' nullo il mom. e' max!

$$T(\beta) = 0 \implies \begin{cases} \beta_1 = -78{,}51^\circ \\ \beta_2 = 19{,}91^\circ \\ \beta_3 = 70{,}09^\circ \end{cases}$$

$\longleftarrow$ Non ha senso fisico! (β_1)

$$M(19{,}91^\circ) = -0{,}042\ qR^2$$

$$M(70{,}09^\circ) = +0{,}042\ qR^2$$