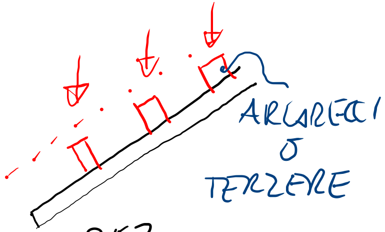
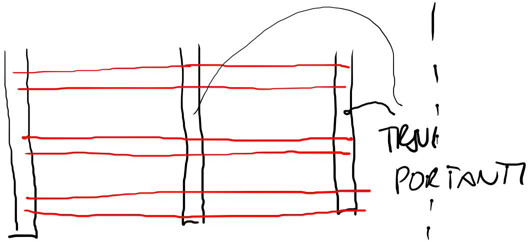
FLESSIONE DEVIATA (COMBINAZ. DI 2 FLESSIONI RETTE)

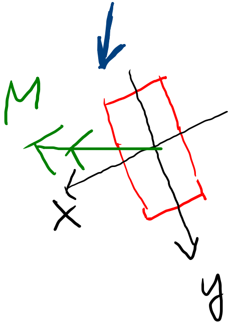
24/11/22



SEZ
(FALDA DI UN TETTO)



PIANTA

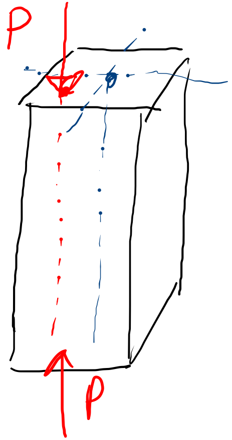


M: MOMENTO FLETTENTE SULLE TRAVI INCLINATE

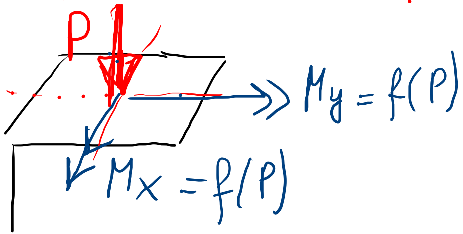
M è "obliquo" rispetto ad x, y

NO FLESSIONE RETTA

⇒ FLESSIONE DEVIATA



CARICO "ECCENTRICO"
NO NEL BARICENTRO.

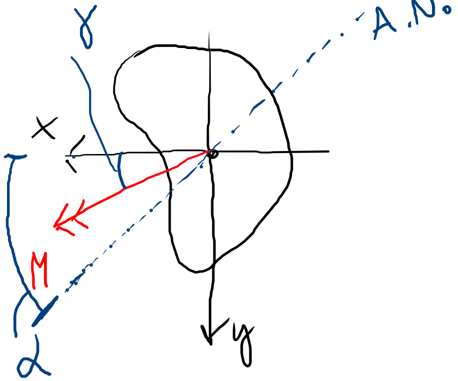


FORZA NORMALE + 2 FLESS. RETTE

$$\boxed{\sigma_{zz} = \frac{M_x}{J_x}\, y - \frac{M_y}{J_y}\, x}$$

dove M_x e M_y sono le componenti di M lungo x e y

A.N. ⇒ $\sigma_{zz} = 0$, è sempre una retta baricentrica.



$M_x = M\cos\gamma$

$M_y = M\sin\gamma$

$$\boxed{\sigma_{zz} = \frac{M\cos\gamma}{J_x} y - \frac{M\sin\gamma}{J_y} x}$$

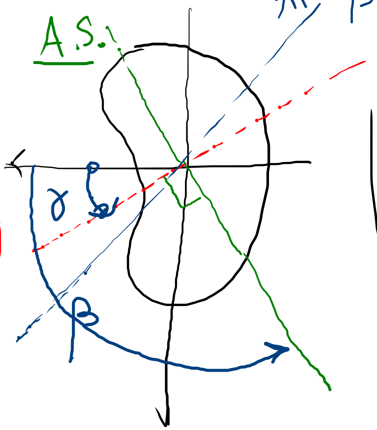
$\underline{\sigma_{zz} = 0}$ A.N.

A.S.: ASSE DI SOLLECITAZ. $\perp M$

$$\frac{\cos\gamma}{J_x} y - \frac{\sin\gamma}{J_y} x = 0 \;;\quad y = \frac{\sin\gamma}{J_y}\frac{J_x}{\cos\gamma} x = \boxed{\underbrace{tg\gamma \frac{J_x}{J_y}}_{tg\alpha} x}$$

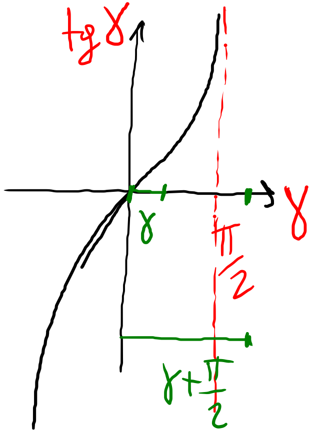
• OSS: SE $\underline{J_x = J_y} \Rightarrow \alpha = \gamma$: FLESSIONE RETTA

.. $J_x \neq J_y$



AN: $\beta = \gamma + \frac{\pi}{2}$; $\boxed{tg\beta = tg\left(\gamma + \frac{\pi}{2}\right) = -\frac{1}{tg\gamma}}$

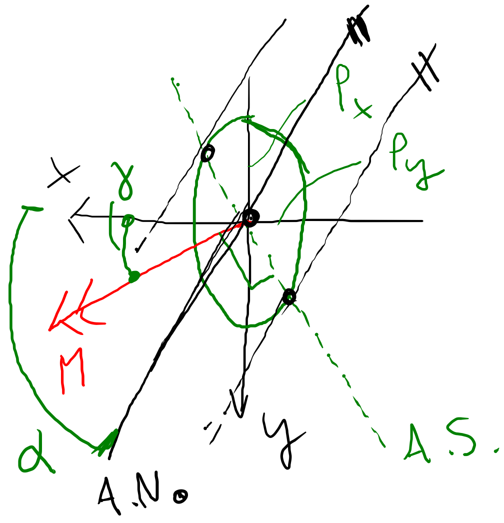
$$\boxed{tg\gamma = -\frac{1}{tg\beta}}$$



$$y = -\underbrace{\frac{1}{tg\beta}\frac{J_x}{J_y}}_{tg\alpha} x$$

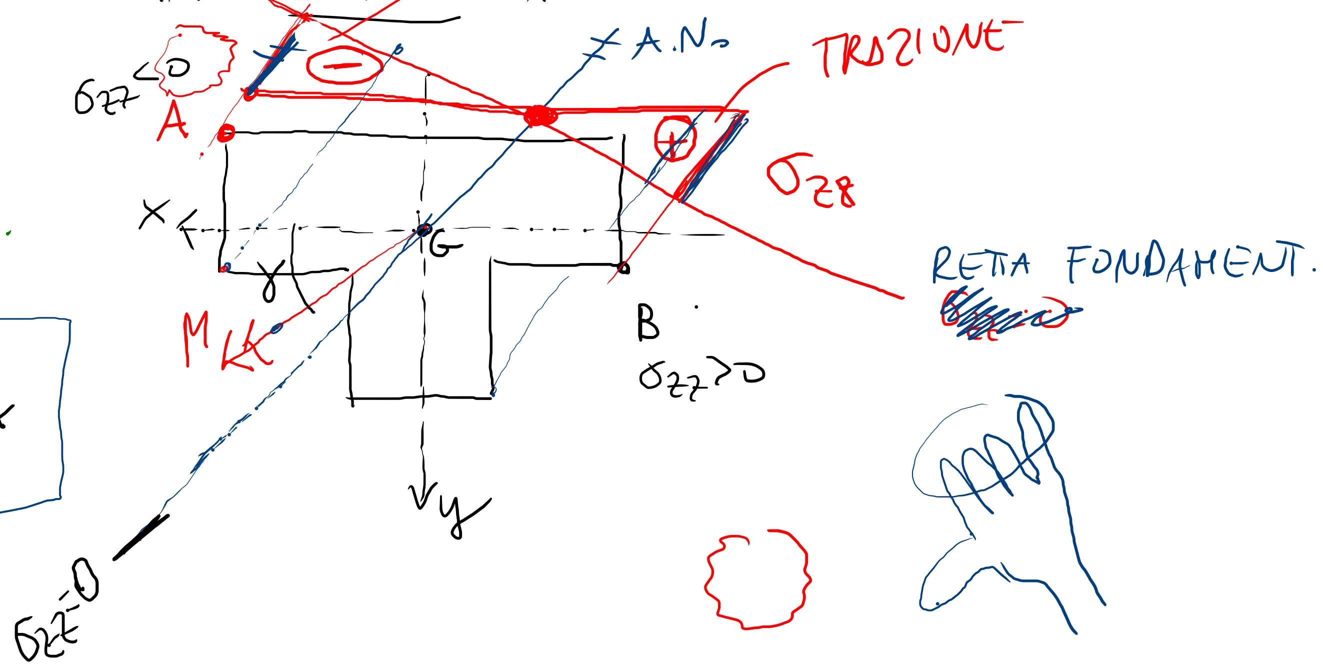
$$\boxed{tg\alpha\, tg\beta = -J_x/J_y}$$

A. NEUTRO E A. SOLLECITAZIONE SONO CONIUGATI.



$$\rho_x = \sqrt{\frac{J_x}{A}} \; ; \; \rho_y = \sqrt{\frac{J_y}{A}}$$

A.N. è CONIUGATO AD A.S.



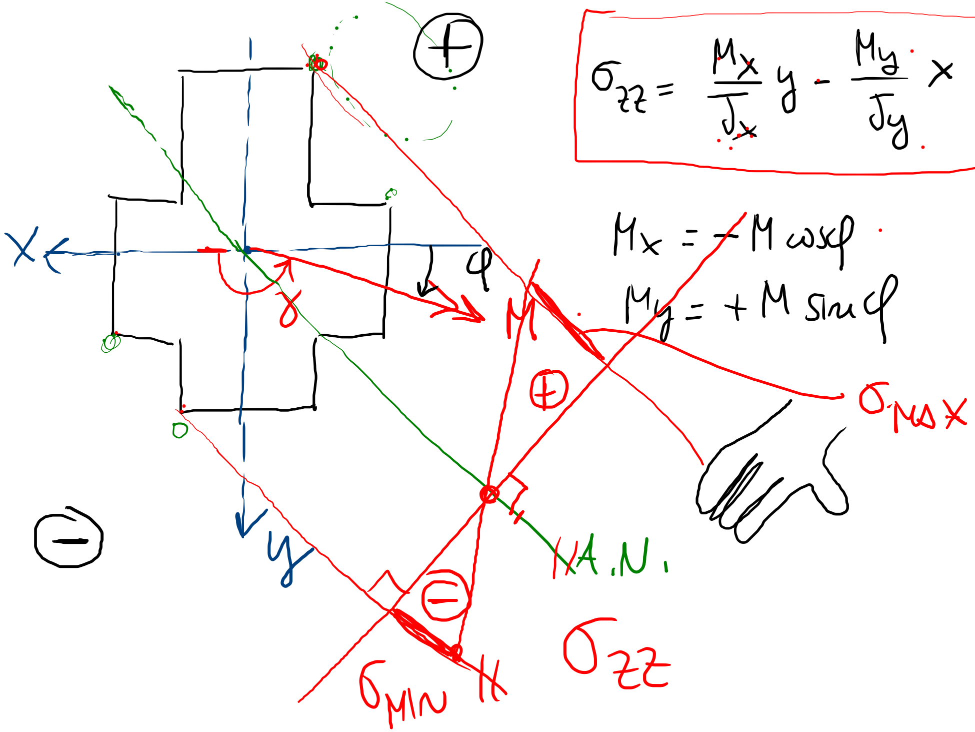
$$\boxed{\sigma_{zz} = \frac{M\cos\gamma}{J_x}\,y - \frac{M\sin\gamma}{J_y}\,x}$$

A: $x_A > 0$; $y_A < 0$

$\Rightarrow \sigma_{zz}(A) < 0$

B: $x_B < 0$; $y_B > 0$; $\sigma_{zz}(B) > 0$

$$\boxed{\sigma_{zz} = \frac{M_x}{J_x} y - \frac{M_y}{J_y} x} = -\frac{M\cos\varphi}{J_x} y - \frac{M\sin\varphi}{J_y} x$$



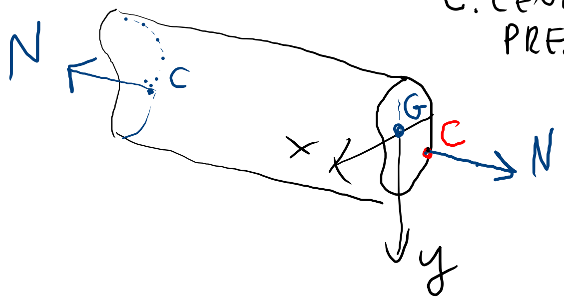
$M_x = -M\cos\varphi$

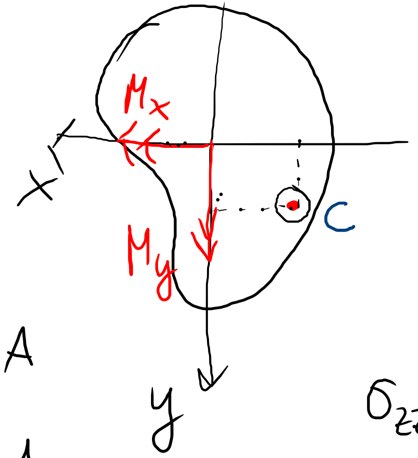
$M_y = +M\sin\varphi$

$\sigma_{zz} = 0$: A.N. $\quad \frac{\cancel{M}\cos\varphi}{J_x} y + \frac{\cancel{M}\sin\varphi}{J_y} x = 0$

TENSOFLESSIONE (FORZA NORMALE ECCENTRICA)

C: CENTRO DI PRESSIONE





$$\left.\begin{array}{l} N>0 \\ x_c<0 \\ y_c>0 \end{array}\right\}$$

$$M_x = N y_c > 0$$

$$M_y = -N x_c > 0$$

$$\sigma_{zz} = \frac{N}{A} + \frac{N y_c}{J_x} y + \frac{N x_c}{J_y} x$$

$$\sigma_{zz} = \underbrace{\frac{N}{A}}_{\text{FORZA NORM.}} + \underbrace{\frac{M_x}{J_x} y - \frac{M_y}{J_y} x}_{\text{FLESSIONE DEVIATA}}$$

$$J_x = \rho_x^2 A$$

$$J_y = \rho_y^2 A$$

$$\sigma_{zz} = \frac{N}{A} + \frac{N y_c y}{\rho_x^2 A} + \frac{N x_c x}{\rho_y^2 A}$$

$$\sigma_{zz} = \frac{N}{A}\Big[1 + \underbrace{\frac{y_c y}{\rho_x^2} + \frac{x_c x}{\rho_y^2}}_{=0}\Big] \quad ; \ \sigma_{zz} = 0 \ \text{A.N.}$$

A.N. $\sigma_{zz} = 0$

$$\sigma_{zz}(G) = \frac{N}{A}$$

$(x=0, y=0)$

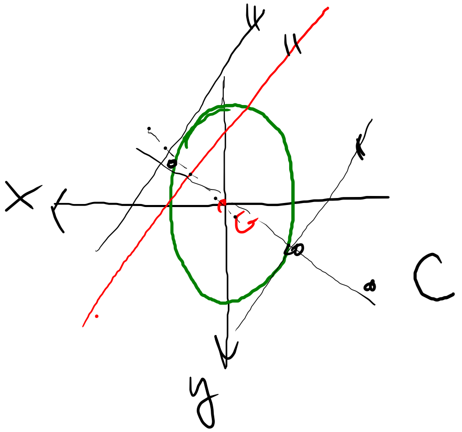
A.N.: $1 + \frac{y_c}{\rho_x^2} y + \frac{x_c}{\rho_y^2} x = 0$

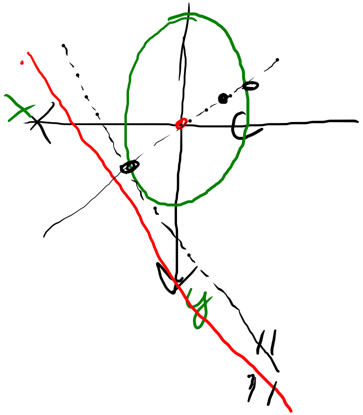
RETTA NON BARICENTRICA

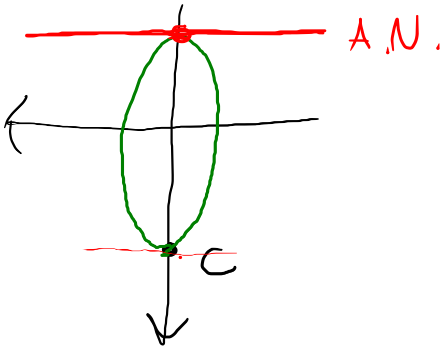
STUDIO ALCUNE PROPR. DELL'ASSE NEUTRO

$$1+\frac{\tilde{y}_c}{\rho_x^2}\,y+\frac{\tilde{x}_c}{\rho_y^2}\,x=0 \qquad (*)$$

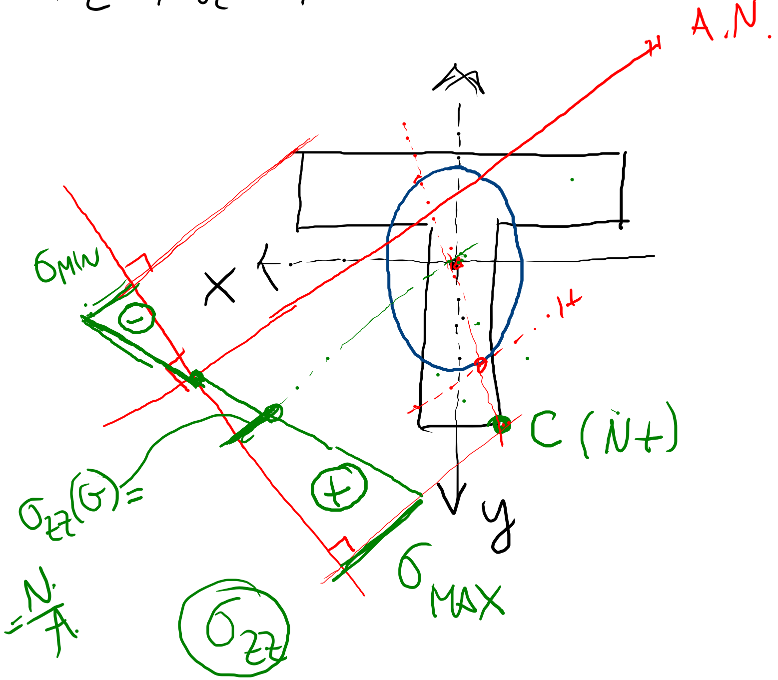
- QUESTA EQ. È L'EQ. DELL'ANTIPOLARITÀ D'INERZIA.
- C È L'ANTIPOLO DELLA RETTA DI EQ. (*)



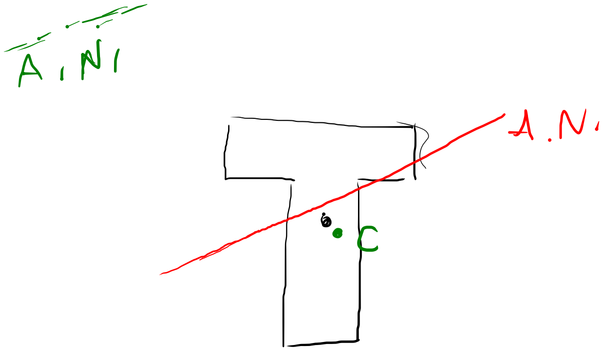




$x_C < 0;\ y_C > 0;\ N > 0$



NEL BARIC. $\sigma_{zz} > 0$ perché $N > 0$



$C \to \infty$

IL PROBLEMA → FLESSIONE DEVIATA

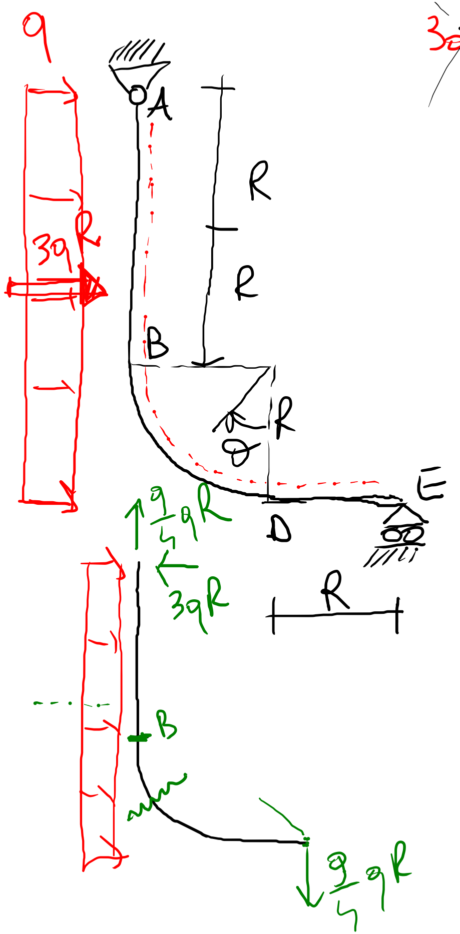
$C \to G$

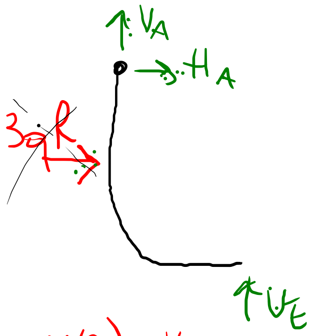
IL PROBLEMA → FORZA NORMALE

C

∞

ES. STR. ISOSTATICA

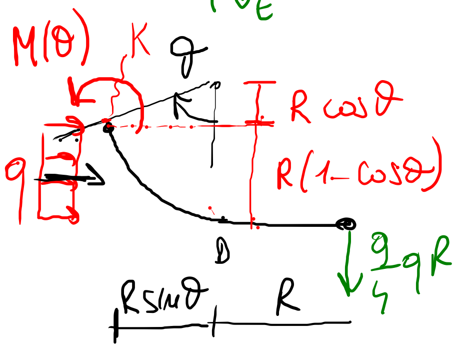




$\xrightarrow{+}$: $+3qR + H_A = 0$ $\qquad H_A = -3qR$

$+\uparrow$: $V_A + V_E = 0$ $\qquad V_A = \frac{9}{4}qR$

$\circlearrowleft_A^+$: $+3qR \cdot \frac{3}{2}R + V_E\, 2R = 0$; $V_E = -\frac{9}{4}qR$

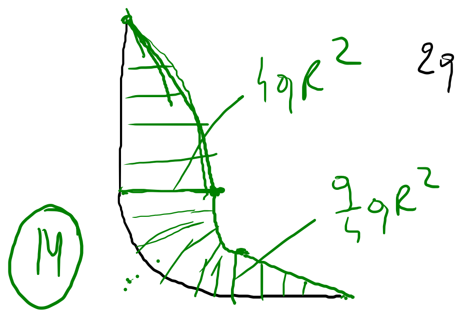


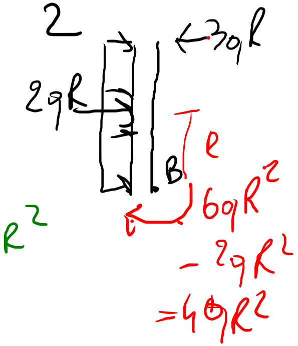
$\circlearrowleft_K^+$: $M(\theta) + \frac{qR^2(1-\cos\theta)^2}{2} - \frac{9}{4}qR \cdot R(1+\sin\theta) = 0$

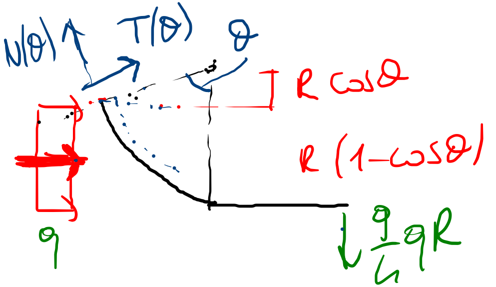
$$\boxed{M(\theta) = \frac{9}{4}qR^2(1+\sin\theta) - \frac{qR^2(1-\cos\theta)^2}{2}}$$

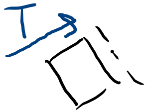
$M(0) = +\frac{9}{4}qR^2$

$M\left(\frac{\pi}{2}\right) = \frac{9}{4}qR^2 \cdot 2 - \frac{qR^2}{2} = 4qR^2$



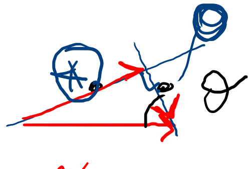


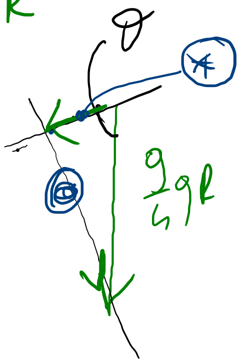


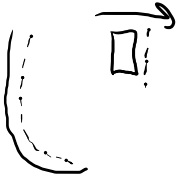


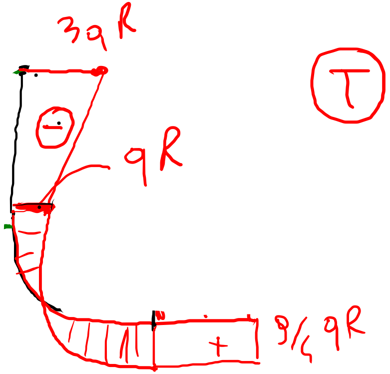
$$+\nearrow:\ T(\theta) + qR(1-\cos\theta)\sin\theta - \frac{9}{4}qR\cos\theta = 0$$

$$\boxed{T(\theta) = \frac{9}{4}qR\cos\theta - qR(1-\cos\theta)\sin\theta}$$









$$T(0) = \frac{9}{4}qR$$

$$T\left(\frac{\pi}{2}\right) = -qR$$

OK

$$+\uparrow:\ N(\theta) - qR(1-\cos\theta)\cos\theta - \frac{9}{4}qR\sin\theta = 0$$

$$\boxed{N(\theta) = qR(1-\cos\theta)\cos\theta + \frac{9}{4}qR\sin\theta}$$

$$N(0) = 0\ ;\ N\left(\frac{\pi}{2}\right) = +\frac{9}{4}qR$$