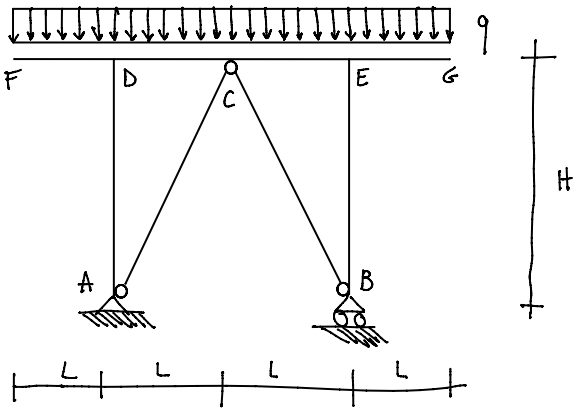
Soluzione compito del 24-02-2021 ver 2

martedì 16 febbraio 2021 15:58



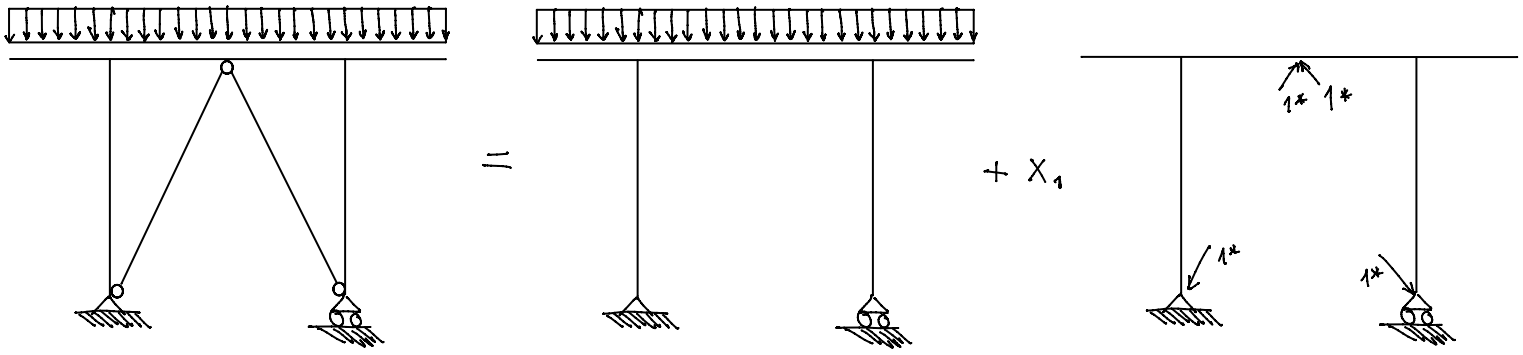
$q = 2000\ N/m$

$L = 2\ m$

$H = 4\ m$

$E = 210'000\ MPa$

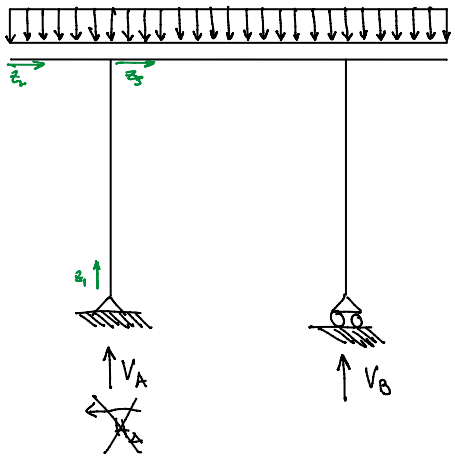
$\sigma_{amm} = 190\ MPa$



Sistema 0 Sistema 1

1) Si trovi la deformabilità assiale

Sistema 0



$\rightarrow) \ H_A = 0$

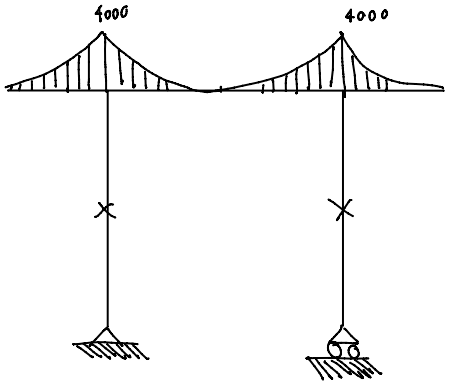
$\uparrow) \ V_A + V_B = 4ql$ $\qquad V_A = 2ql = 8000\ N$

$\hat{A}) \ V_B 2l - 4ql \cdot l = 0$ $\qquad V_B = 2ql = 8000\ N$

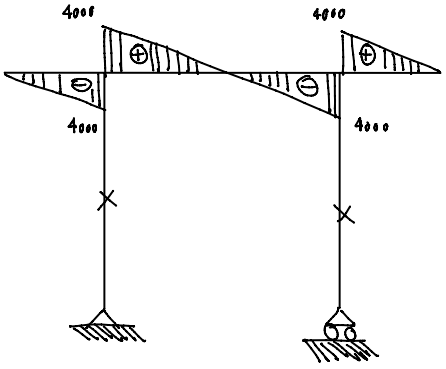
z_1: $M(z_1) = 0$ $\qquad T(z_1) = 0$ $\qquad N(z_1) = -2ql$

z_2: $M(z_2) = -q\frac{z_2^2}{2}$ $\qquad T(z_2) = -qz$ $\qquad N(z_2) = 0$

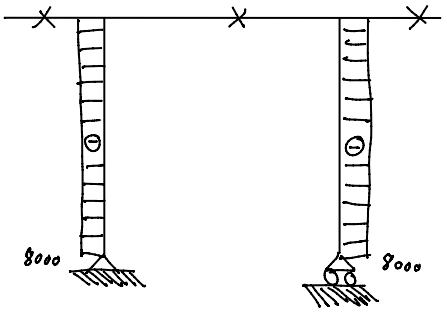
z_3: $M(z_3) = -q\frac{z^2}{2} + ql\,z - q\frac{z^2}{2}$ $\qquad T(z_3) = ql - qz$ $\qquad N(z_3) = 0$



M[N·m]

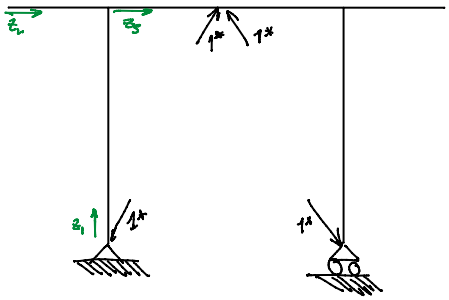


T[N]

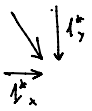


N[N]

Sistema 1



$\tan\alpha = \frac{4}{2} = 2 \longrightarrow \alpha = 63.43^\circ$

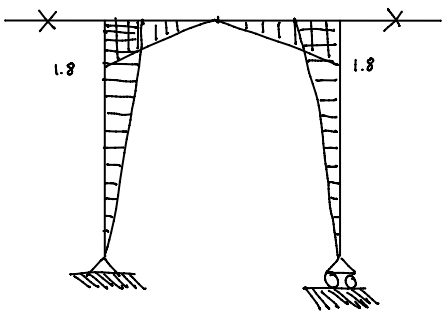


$1^*_x = 1\cos\alpha = 0.45$
$1^*_y = 1\sin\alpha = 0.89$

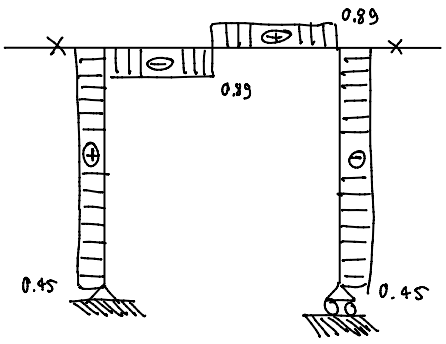
z_1: $M(z_1) = 1\cos\alpha\, z$ $\quad T(z_1) = +1\cos\alpha$ $\quad N(z_1) = 1\sin\alpha$

z_2: $M(z_2) = 0$ $\quad T(z_2) = 0$ $\quad N(z_2) = 0$

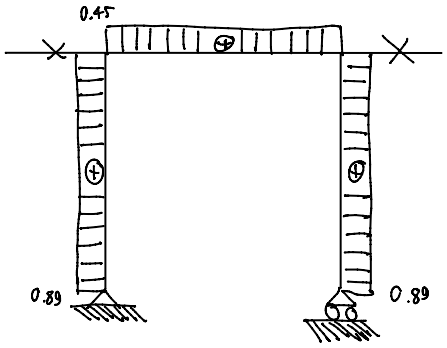
z_3: $M(z_3) = 1\cos\alpha\, H - 1^*\sin\alpha\, z$ $\quad T(z_3) = -1^*\sin\alpha$ $\quad N(z_3) = -1\cos\alpha$



M[N·m]



T[N]

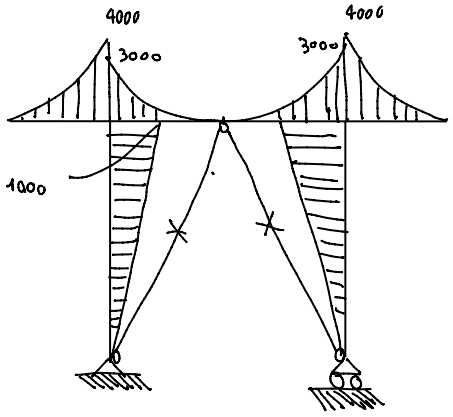


N[N]

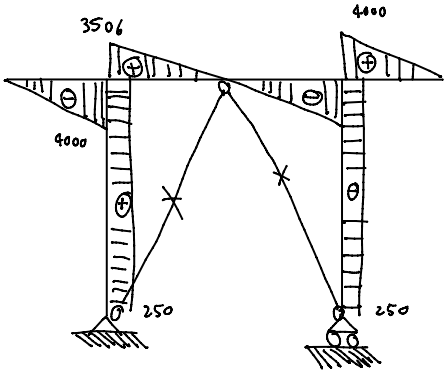
$$\eta_{10} = \frac{2}{EJ}\int_0^L \left(-q\frac{z^2}{2} + qlz - q\frac{l^2}{2}\right)(1\cos\alpha\, H - 1\sin\alpha\, z)\,dz = -\frac{21680}{3EJ}$$

$$\eta_{11} = \frac{1}{EJ}\left[2\int_0^H (1\cos\alpha\, z)^2\,dz + 2\int_0^L (1\cos\alpha H - 1\sin\alpha\, z)^2\,dz\right] = \frac{24391}{1875\,EJ}$$

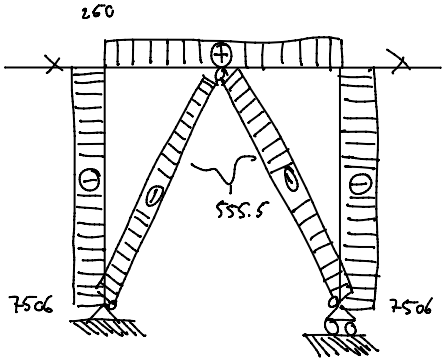
$$X_1 = -\frac{\eta_{10}}{\eta_{11}} = 555.53\ N$$



M[N·m]



T[N]



N[N]

2) Progetto del profilo

$\frac{M_{max}}{W} < \sigma_{amm} \longrightarrow W_{min} = \frac{M}{\sigma_{am}} = 21.05\ cm^3$

Adotto IPE 100

$W_x = 34.2\ cm^3 \qquad A = 10.3\ cm^2 \qquad J_x = 171\ cm^4$

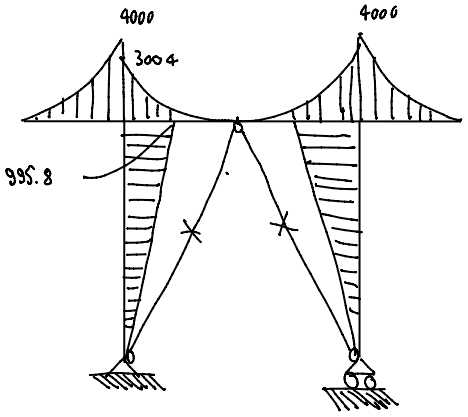
$\sigma_{m,max} = \frac{N}{A} \pm \frac{M}{W_x} = \frac{4000}{34.2} = \pm 116 < 190$ ✓ rinfusto

3) Considerando la deformabilità assiale delle bielle $\phi = 20\ mm$

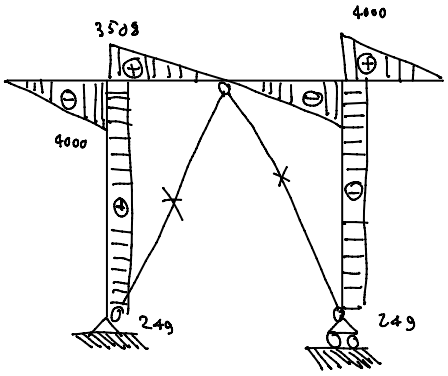
Area $A = 3.14\ cm^2$

$\eta_{11}^N = \frac{1}{EA_{BIELLA}} \int_0^{\sqrt{L^2+H^2}} 1\ dz = \frac{L^2+H^2}{2EA_{BIELLA}} = \frac{10}{EA_{bielle}}$

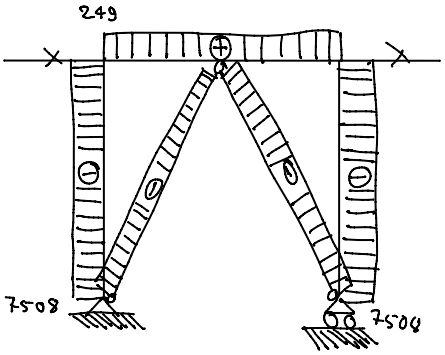
$X_1 = -\frac{\eta_{10}}{(\eta_{11} + \eta_{11}^N)} = 553.2\ N$



M[N·m]



T[N]



N[N]