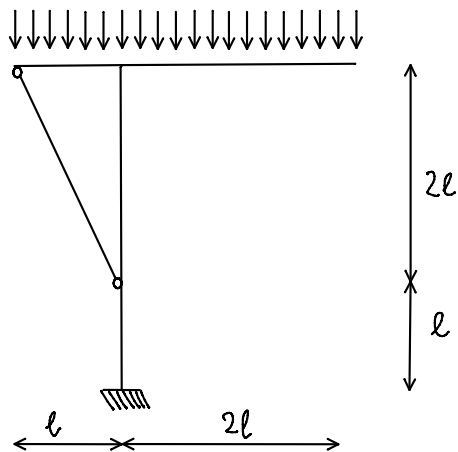
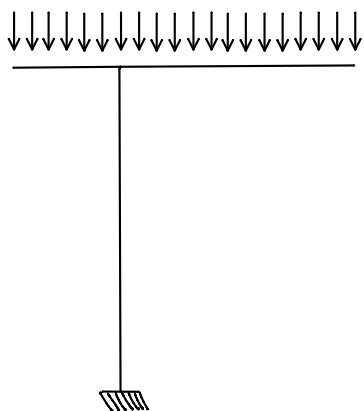


Soluzione compito del 11-11-2020

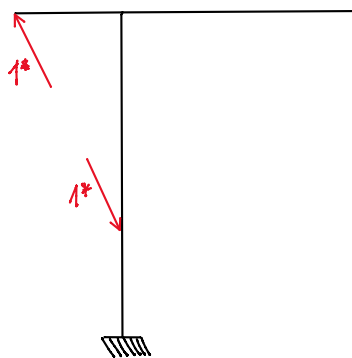
lunedì 9 novembre 2020 09:00



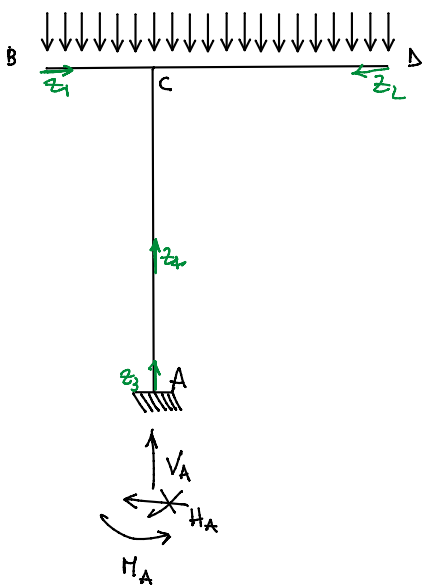
$q = 4000 \text{ kN/m}$
 $l = 3 \text{ m}$
 1 volta iperstatica



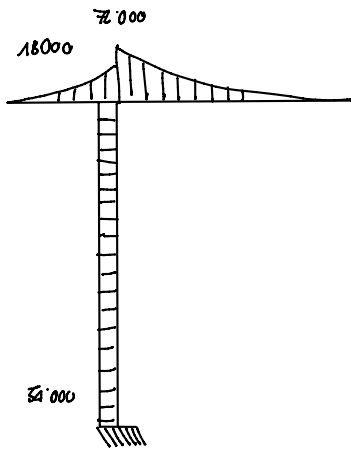
$+x_1$



SISTEMA 0



$H_A = 0$
 $V_A = q \cdot 3l$
 $M_A = \frac{3}{2} q l^2$

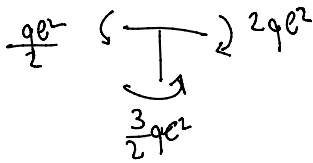


$M [Nm]$

$$M_0(z_1) = -q \frac{z_1^2}{2}$$

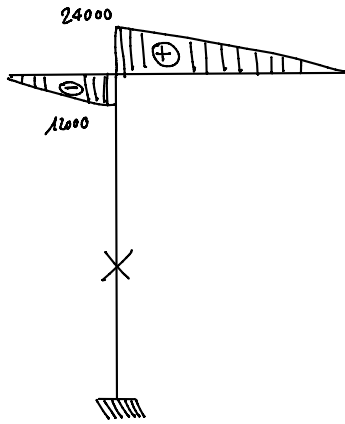
$$M_0(z_2) = -q \frac{z_2^2}{2}$$

$$M_0(z_3) = -\frac{3}{2} q l^2 \quad \text{(N.B.) } M(z_3) = M(z_4)$$



$$T(z_3) = T(z_4)$$

$$N(z_3) = N(z_4)$$

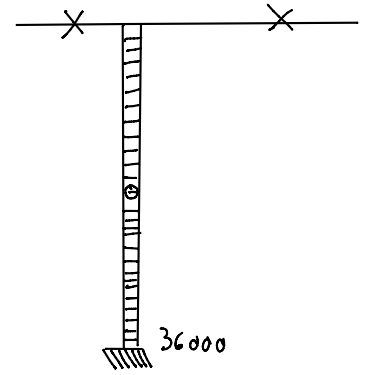


$T [N]$

$$T_0(z_1) = -qz$$

$$T_0(z_2) = +qz$$

$$T_0(z_3) = 0$$



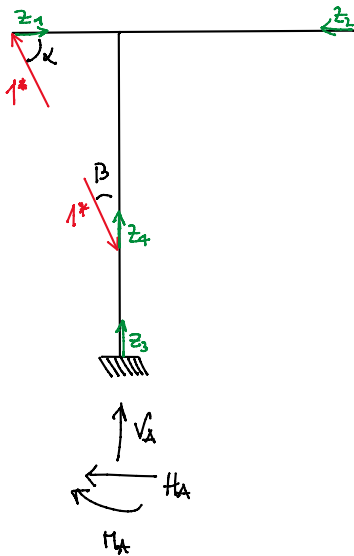
$N [N]$

$$N_0(z_1) = 0$$

$$N_0(z_2) = 0$$

$$N_0(z_3) = -3ql$$

SISTEMA 1



$$\beta = \tan^{-1}(1/2) = 26.56^\circ$$

$$\alpha = 63.45^\circ$$

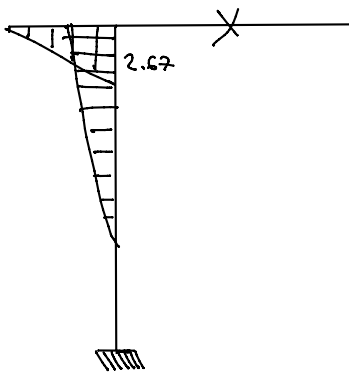
$$1_x = 0.45$$

$$1_y = 0.89$$

$$\uparrow \rangle \quad V_A = 0$$

$$\rightarrow \rangle \quad H_A = 0$$

$$A \rangle \quad M_A = 0$$



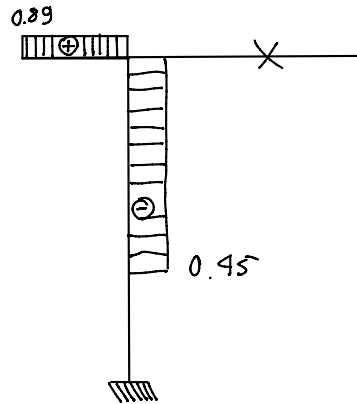
$M [N/m]$

$$M(z_1) = 1 \cdot \sin \alpha \cdot z$$

$$M(z_2) = 0$$

$$M(z_3) = 0$$

$$M(z_4) = -1 \cdot \sin \beta \cdot z$$



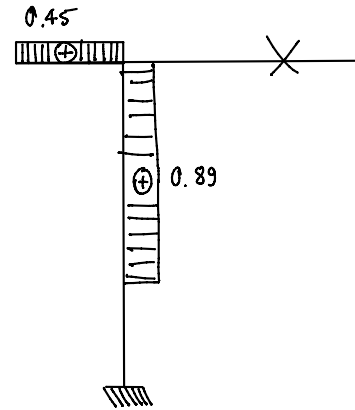
$T [N]$

$$T(z_1) = 1 \cdot \sin \alpha$$

$$T(z_2) = 0$$

$$T(z_3) = 0$$

$$T(z_4) = -1 \cdot \sin \beta$$



$N [N]$

$$N(z_1) = 1 \cdot \cos \alpha$$

$$N(z_2) = 0$$

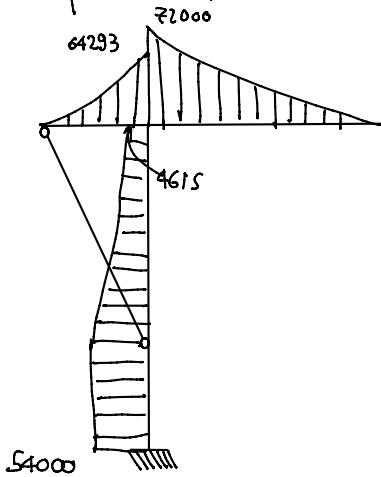
$$N(z_3) = 0$$

$$N(z_4) = +1 \cdot \cos \beta$$

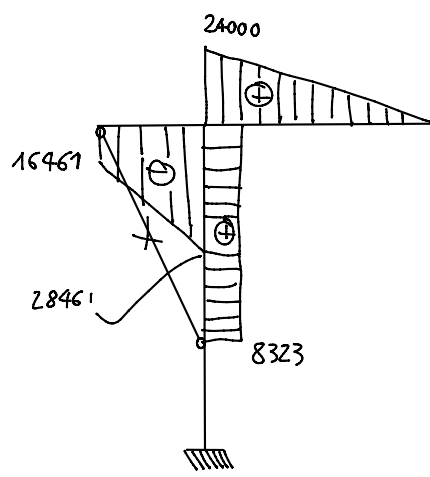
$$\eta_{10} = \frac{1}{ES} \left[\int_0^l (1 \cdot \sin \alpha \cdot z) \cdot \left(-q \frac{z^2}{2}\right) dz + \int_0^{2l} (-1 \cdot \sin \beta \cdot z) \cdot \left(-\frac{3}{2} q l^2\right) dz \right] = \frac{401355}{ES}$$

$$\eta_{11} = \frac{1}{ES} \left[\int_0^l (1 \cdot \sin \alpha \cdot z)^2 dz + \int_0^{2l} (-1 \cdot \sin \beta \cdot z)^2 dz \right] = \frac{21.70}{ES}$$

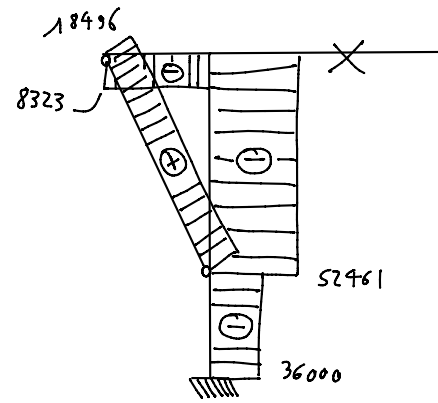
$$\eta_{11} X_1 = -\eta_{10} \rightarrow X_1 = -18496 \text{ N}$$



$M [N/m]$



$T [N]$



$N [N]$

2) $M = 72000 \text{ Nm}$ $\sigma_{\text{adm}} = 190 \text{ MPa}$

$$W_{\text{min}} = \frac{M_{\text{max}}}{\sigma_{\text{adm}}} = \frac{72000 \cdot 1000}{190} = 378 \text{ cm}^3$$

ADOTTO IPE 270 $W = 429 \text{ cm}^3$ $A = 45.9 \text{ cm}^2$ $J = 5790 \text{ cm}^4$

$$\sigma_{\text{max}} = \frac{M}{W} = 168 < 190 \text{ MPa} \quad \checkmark$$

3) $\eta_{ij}^{\text{TOT}} = \eta_{ij}^M + \eta_{ij}^N$ $\eta_{ij}^N = \int \frac{N_i N_j}{EA} dz$

$$\eta_{11}^{\text{TOT}} = \eta_{11}^M + \frac{1}{EA} \left[\int_0^L (1^* \cos \alpha)^2 dz + \int_0^{2L} (1^* \cos \beta)^2 dz \right] + \frac{\sqrt{5}L}{EA}$$

$$\eta_{10}^{\text{TOT}} = \eta_{10}^M + \frac{1}{EA} \left[\int_0^{2L} (-3qL) \cdot (1^* \cos \beta) dz \right]$$

$$\eta_{11}^{\text{TOT}} X_1 = -\eta_{10}^{\text{TOT}} \quad X_1 = -18256 \text{ N}$$

