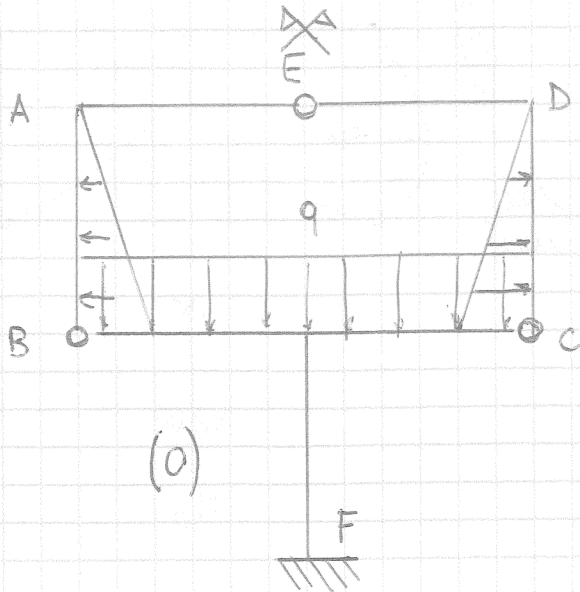
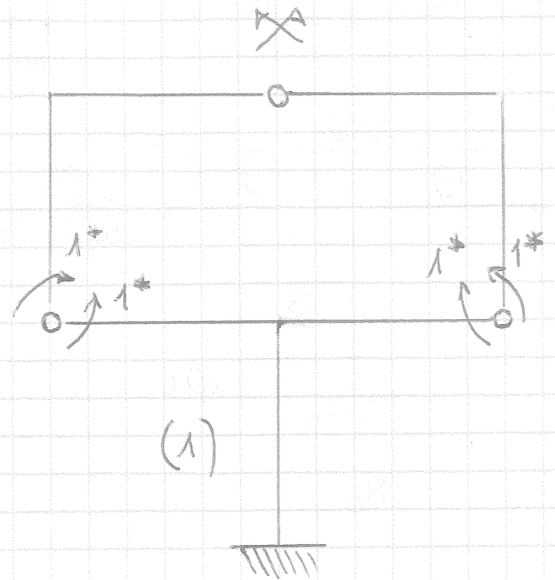
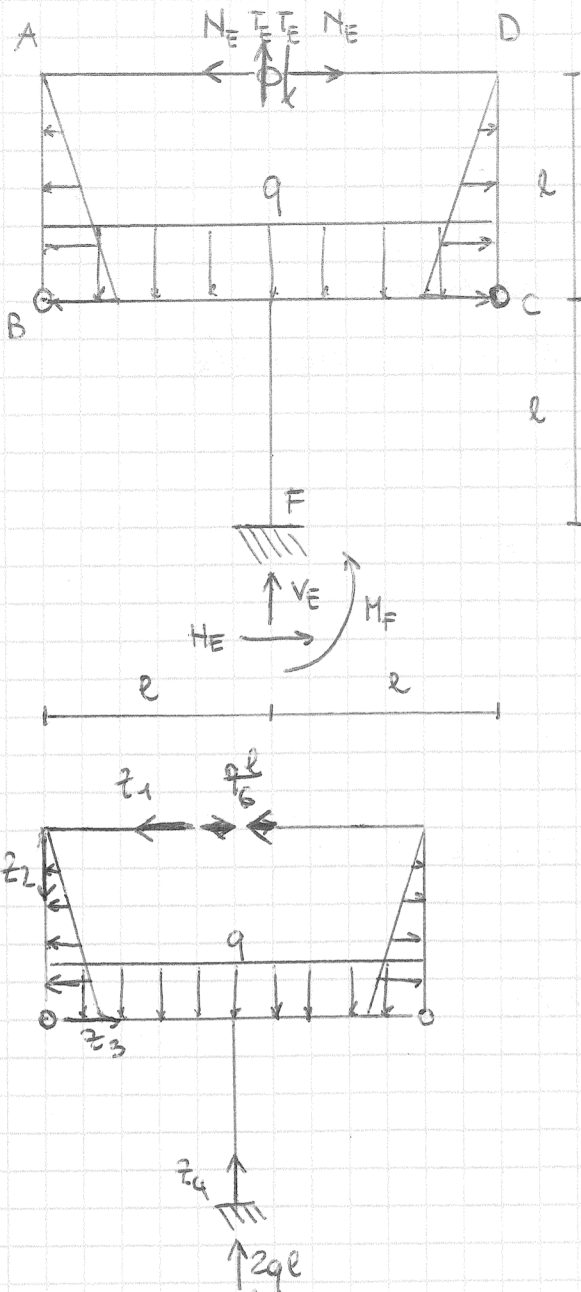


13/01/2017

FILA A

+ X_1 

SISTEMA (0)



$$\rightarrow) H_F = 0$$

$$F) M_F = 0$$

$$\uparrow) V_F = 2ql$$

$$T_E = 0 \text{ per simmetria}$$

$$B) N_E \cdot l + \frac{ql^2}{6} = 0 \quad N_E = -\frac{ql}{6}$$

$$N(z_1) = \frac{ql}{6} = 500 \text{ N}$$

$$N(z_2) = 0$$

$$N(z_3) = -\frac{ql}{6} + \frac{ql}{2} = 1000 \text{ N}$$

$$N(z_4) = -2ql = -6000 \text{ N}$$

$$T(z_1) = 0$$

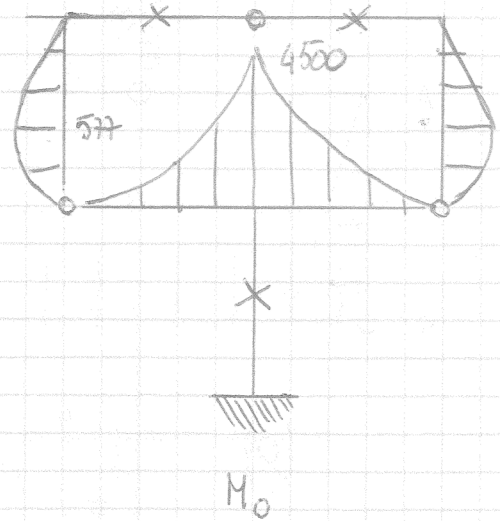
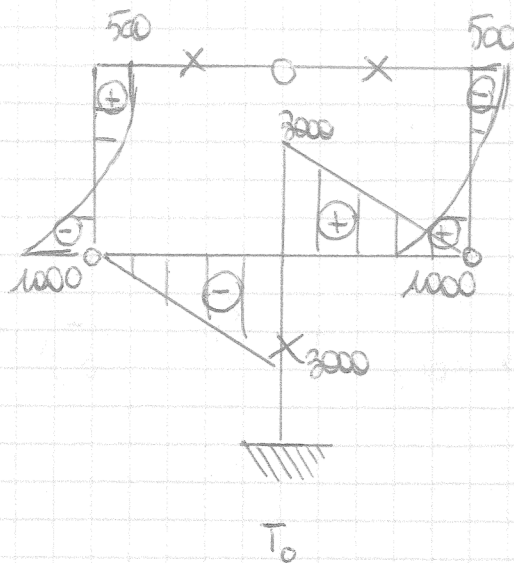
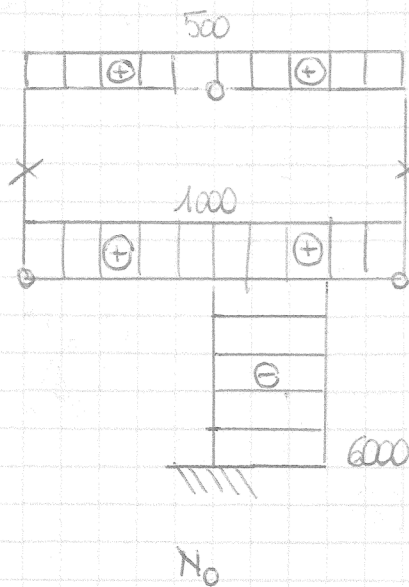
$$T(z_2) = \frac{ql}{6} - \frac{qz^2}{2l}$$

$$T(z_3) = -qx$$

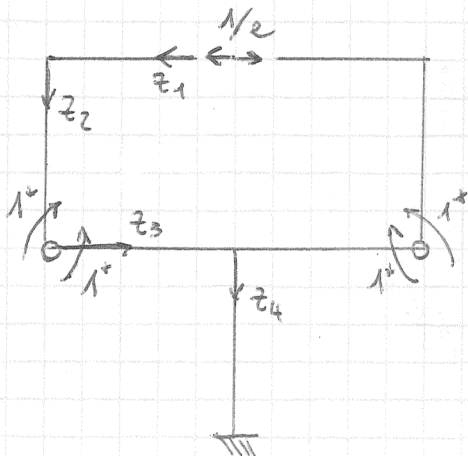
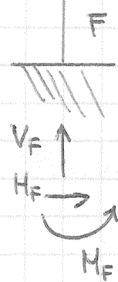
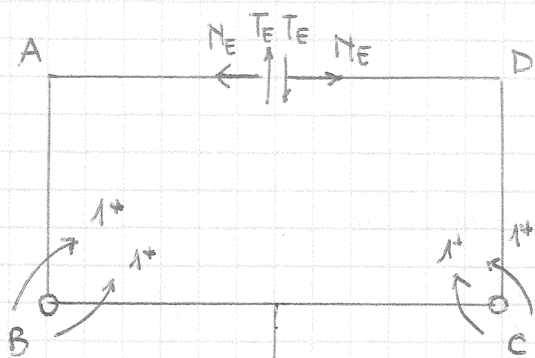
$$M(z_1) = 0 = M(z_4)$$

$$M(z_2) = \frac{qlz}{6} - \frac{qz^3}{6l}$$

$$M(z_3) = -\frac{qz^2}{2}$$



SISTEMA (1)



$$\rightarrow H_F = 0$$

$$\uparrow V_F = 0$$

$$\curvearrowright M_F = 0$$

$$T_F = 0 \text{ per simmetria}$$

$$B) N_F \cdot e - 1^+ = 0 \quad N_F = 1/e$$

$$N(z_1) = -1/e$$

$$N(z_2) = N(z_4) = 0$$

$$N(z_3) = 1/e$$

$$T(z_1) = 0$$

$$T(z_2) = -1/e$$

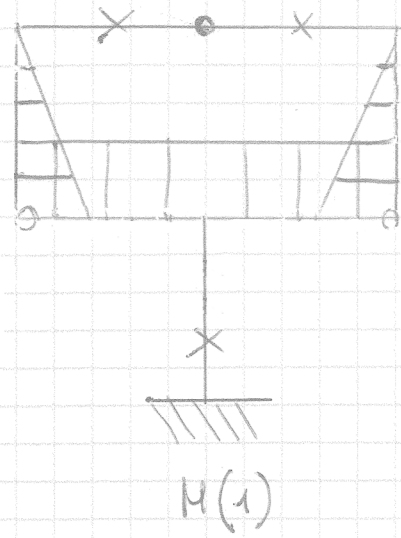
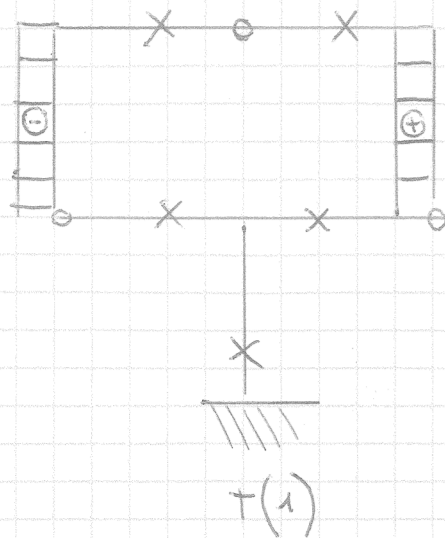
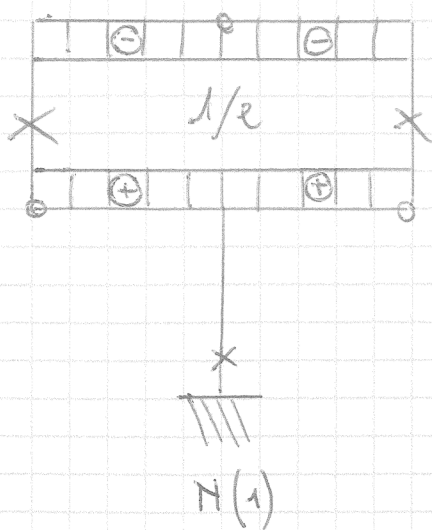
$$T(z_3) = T(z_4) = 0$$

$$M(z_1) = 0$$

$$M(z_2) = -x/e$$

$$M(z_3) = -1$$

$$M(z_4) = 0$$



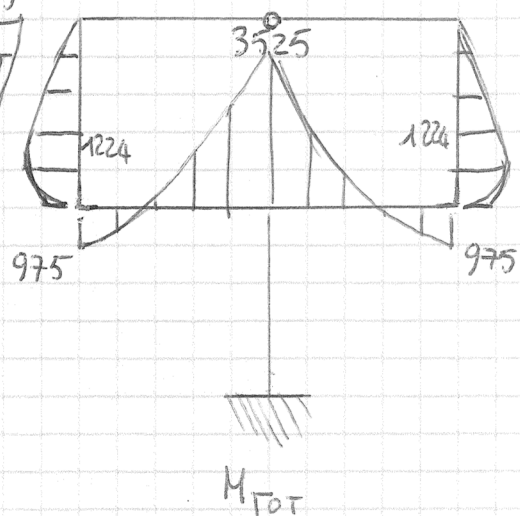
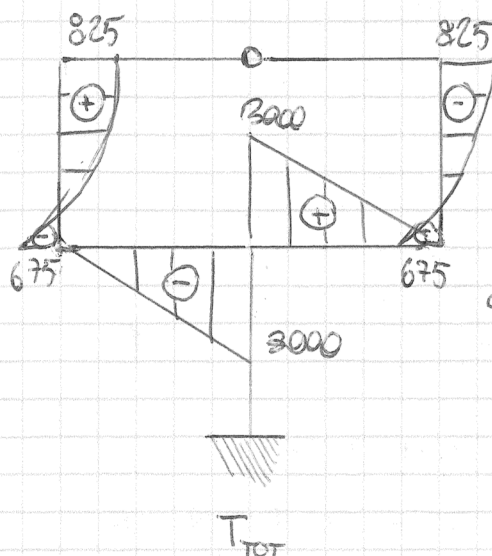
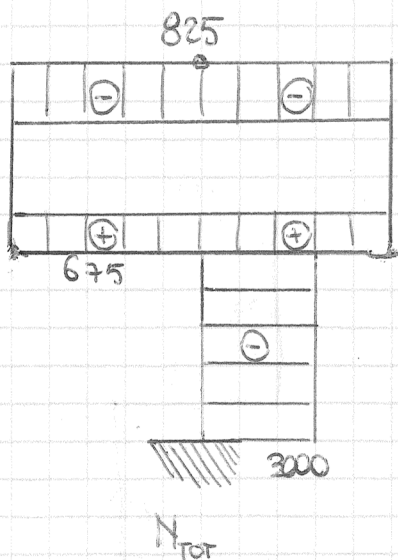
$$M_{10} = \frac{1}{EJ} \left\{ 2 \int_0^l \left(\frac{qlz}{16} - \frac{qz^3}{6l} \right) \left(-\frac{z}{l} \right) dz + 2 \int_0^l \left(-\frac{qz^2}{2} \right) (-1) dz \right\}$$

$$= \frac{13}{45} \frac{ql^3}{EJ}$$

$$M_{20} = \frac{1}{EJ} \left\{ 2 \int_0^l \left(-\frac{z}{l} \right)^2 dz + 2 \int_0^l (-1)^2 dz \right\} =$$

$$= \frac{8}{3} \frac{l}{EJ}$$

$$X = -\frac{M_{10}}{M_{11}} = -\frac{13}{15} \frac{ql^3}{45 EJ} \frac{3}{8} \frac{EJ}{l} = -975 \text{ Nm}$$



2) Combinazione

$$M = -3525 \text{ Nm}$$

$$N = 675 \text{ N}$$

$$W_{\min} = \frac{M}{\sigma_{\text{am}}} = \frac{3525 \cdot 1000}{390} = 9038,5 \text{ mm}^3 \rightarrow 9,04 \text{ cm}^3$$

Adatto IPE 80 $W_y = 20,03 \text{ cm}^3$ $I_y = 80,14 \text{ cm}^4$ $A = 7,64 \text{ cm}^2$

VERIFICA

$$\sigma = \frac{N}{A} + \frac{M}{W} = \frac{675}{7,64 \cdot 100} + \frac{3525 \cdot 1000}{20,03 \cdot 1000} = 176 < 390 \text{ MPa} \quad \text{OK!}$$

3) $\chi^T = \frac{\alpha \Delta t}{h}$

$h = \text{altezza IPE 80} = 80 \text{ mm}$

$\Delta t = 40^\circ \text{C}$

$\alpha = 1,2 \cdot 10^{-5} \text{ } ^\circ \text{C}^{-1}$

$$M_{11}^T = 2 \int_0^l M_{AE}^{(1)} \cdot \chi^T dz = 2 \int_0^l (0) \cdot \left(-\frac{\alpha \Delta t}{h}\right) dz = 0$$

$$M_{11}^N = \frac{2}{EA} \int_0^l N_{AE}^{(1)2} dz = \frac{2}{EA} \int_0^l \left(-\frac{1}{2}\right)^2 dz = \frac{2}{EA \cdot l}$$

$$M_{10}^T = 2 \int_0^l M_{AE}^{(0)} \cdot \chi^T dz = 2 \int_0^l (0) \cdot \left(-\frac{\alpha \Delta t}{h}\right) dz = 0$$

$$M_{10}^N = \frac{2}{EA} \int_0^l N_{AE}^{(0)} \cdot N_{AE}^{(1)} dz = \frac{2}{EA} \int_0^l \left(\frac{ql}{6}\right) \left(-\frac{1}{2}\right) dz = -\frac{ql}{3EA}$$

$$M_{10}^{\text{TOT}} = M_{10} + M_{10}^T + M_{10}^N$$

$$M_{11}^{\text{TOT}} = M_{11} + M_{11}^T + M_{11}^N$$

$$X = \frac{-M_{10}^{\text{TOT}}}{M_{11}^{\text{TOT}}} = 974,77$$

