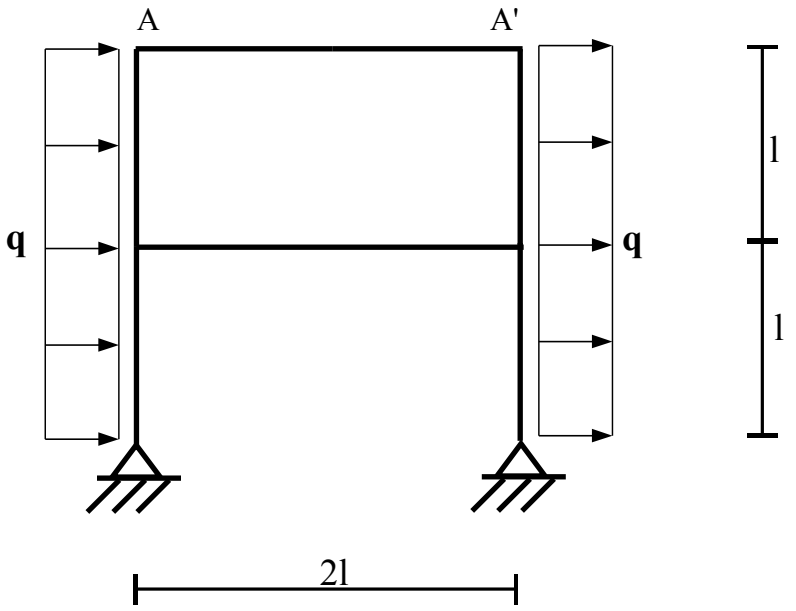
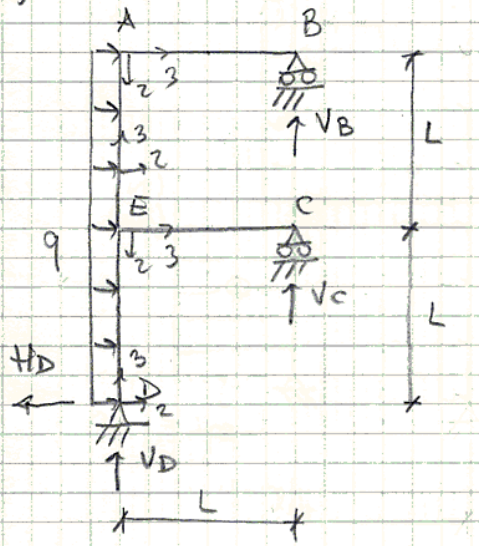
CORSO DI LAUREA IN INGEGNERIA MECCANICA
UNIVERSITÀ DEGLI STUDI DI FERRARA
PROVA SCRITTA DI STATICA
FERRARA, 17/06/2014



l = 2 m, q = 10 kN/m,
E = 210 GPa, σ_{AMM}= 240 MPa

1. Utilizzando il metodo delle forze risolvere la travatura in presenza del carico q e disegnare i diagrammi delle caratteristiche della sollecitazione (N, T, M).
2. Progettare la travatura con profilati IPE.
3. Calcolare lo spostamento orizzontale del piano superiore AA' (ipotizzare trascurabili le deformazioni assiali).

1)



La struttura è iperstatica e caricata in modo antisimmetrico. È possibile ricondursi allo studio di metà struttura.

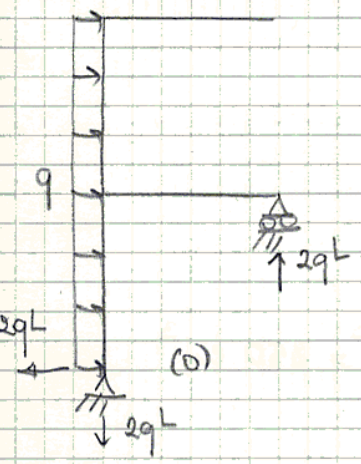
Eq. ni cardinali della Statica:

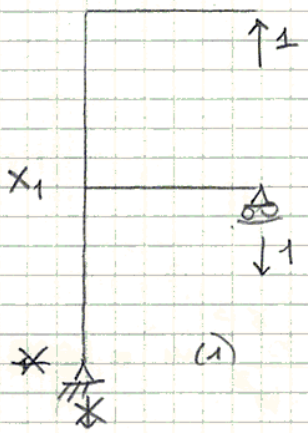
$(\leftarrow)\quad H_D = 2qL$

$(\uparrow)\quad V_D + V_C + V_B = 0$

$(D\circlearrowleft)\quad V_C L + V_B L - 2qL^2 = 0$

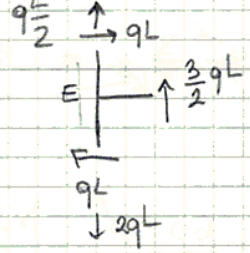
La trave è una volta staticamente indeterminata. $X_1 = V_B$.

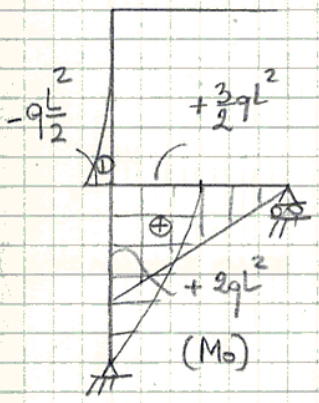


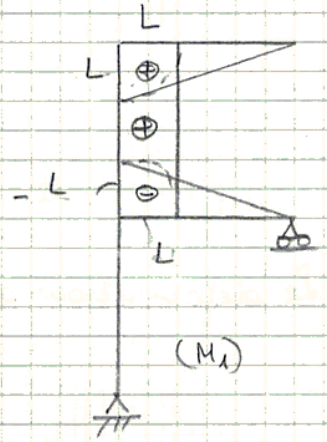


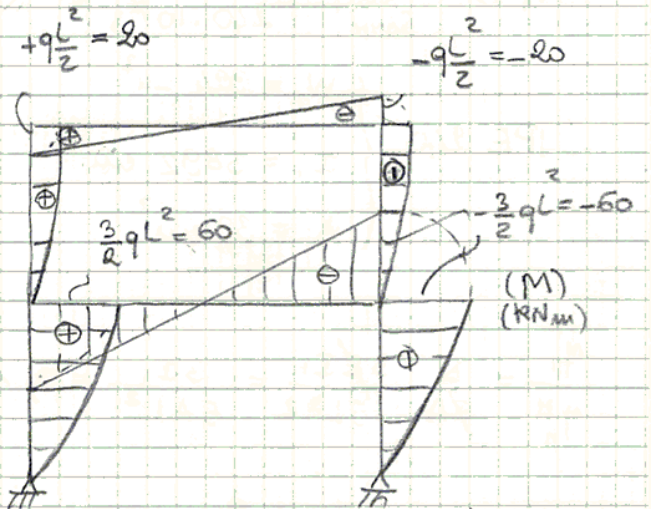
Calcoli

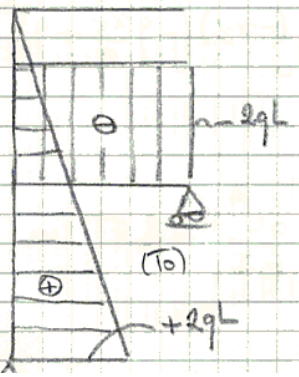
- $2 - \frac{1}{2} = \frac{3}{2}$

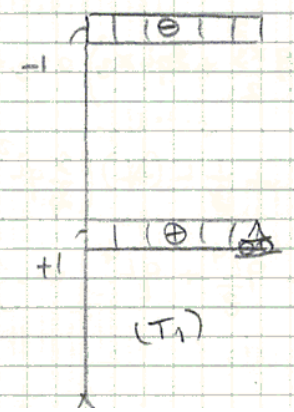


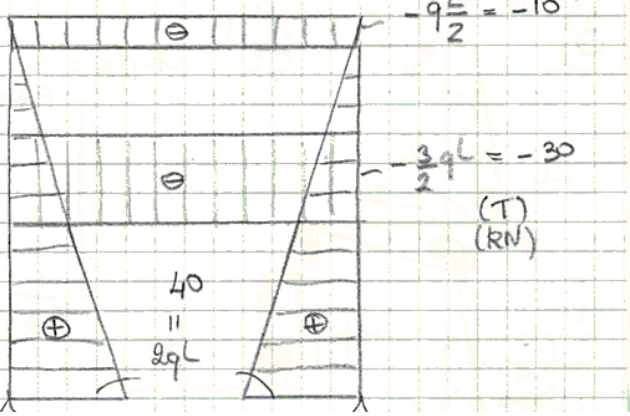


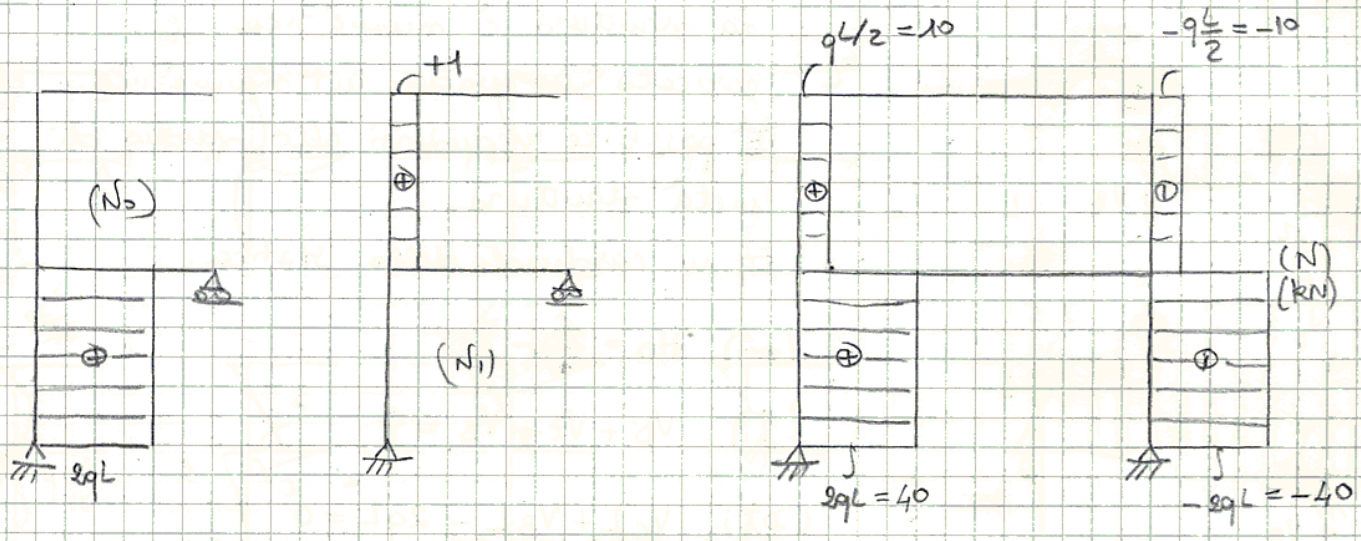












$$EI_1 \gamma_{10} = \frac{1}{3} L\, L\left(-q\frac{L^2}{2}\right) + \frac{1}{3} L\,(2qL^2)(-L)$$

$$= -qL^4\left(\frac{1}{6} + \frac{2}{3}\right) = -\frac{5}{6} qL^4$$

$$EI_1 \gamma_{11} = 2\,\frac{1}{3} L\,(L^2) + L(L^2) = \frac{5}{3} L^3$$

$$X_1 = -\frac{\gamma_{10}}{\gamma_{11}} = \frac{5}{6} qL^4 \frac{3}{5L^3} = \frac{qL}{2}$$

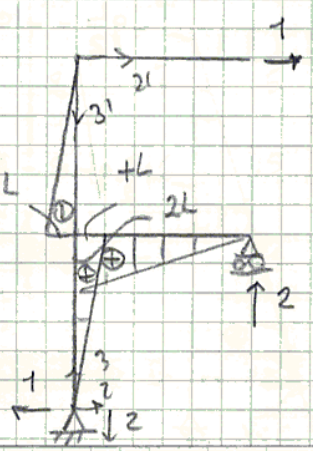
2)

$$W_1 \geq \frac{3/2\, qL^2}{\sigma_{AMM}} = \frac{60 \cdot 10^3}{240 \cdot 10^8} \frac{N\,m^3}{N} = \frac{60 \cdot 10^8}{240 \cdot 10^8}\, cm^3 = \frac{6000}{24}\, cm^3 = 250\, cm^3$$

IPE 240 $\begin{cases} W_1 = 324\ cm^3 \\ I_1 = 3892\ cm^4 \\ A = 39\ cm^2 \end{cases}$

$$\frac{M_{11}^N}{M_h^M} = \frac{\Delta}{\varepsilon} \frac{3EI_1}{5L^2} = \frac{3I_1}{5AL^2} = 0,14\ \%$$ (La deformazione assiale può trascurarsi)

3)



$$1 \cdot \delta_A = \frac{1}{EI_1}\left[\int_0^L (x_3)\left(-q\frac{x_3^2}{2} + 2qLx_3\right) dx_3 + \int_0^L (-x_3')\left(-q\frac{x_3'^2}{2} + q\frac{L^2}{2}\right) dx_3' + \frac{1}{3} L\,(2L)\left(\frac{2}{3} qL^2\right)\right]$$

$$= \frac{1}{EI_1}\left[\frac{13}{24} qL^4 - q\frac{L^4}{8} + qL^4\right] = \frac{17}{12}\frac{qL^4}{EI_1} = 2,77\ cm$$