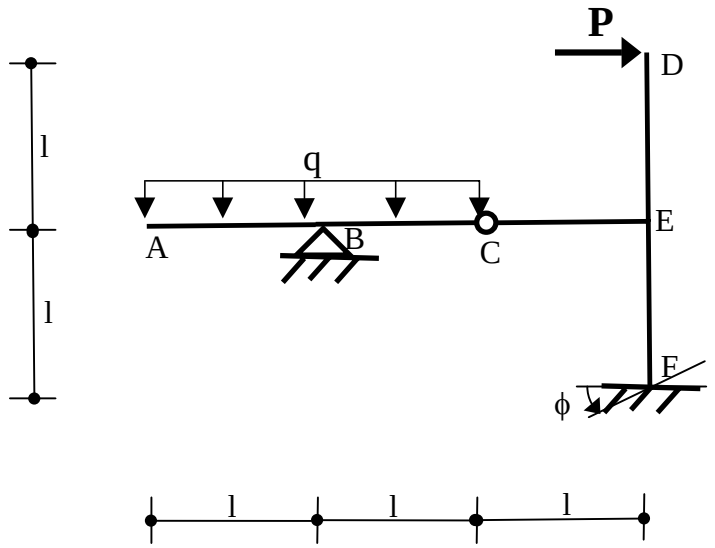
**CORSO DI LAUREA IN INGEGNERIA MECCANICA**
**UNIVERSITÀ DEGLI STUDI DI FERRARA**
**PROVA SCRITTA DI STATICA**
**FERRARA, 07/12/2007**

C

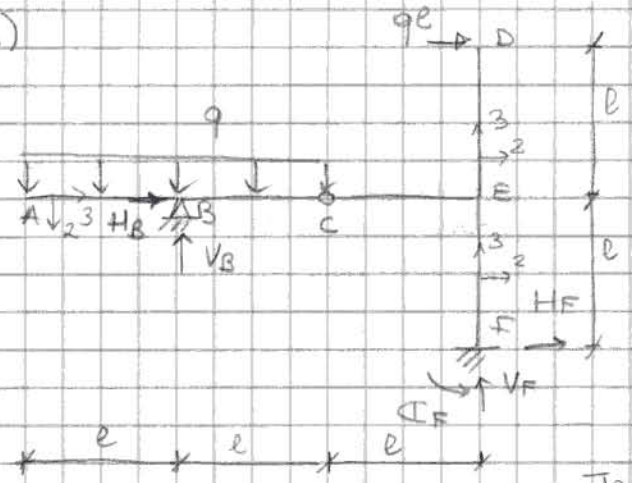



l = 1 m, q = 1 t/m, P=ql, $\sigma_{AMM}$ = 2400 kg/cm$^2$
E = 2.1 $10^6$ kg/cm$^2$, $\phi$= 0.1°

La travatura iperstatica di figura è realizzata con profilati IPE.

1. Utilizzando il metodo delle forze risolvere la travatura in presenza dei carichi q e P e disegnare i diagrammi delle caratteristiche della sollecitazione (N, T, M). Trascurare le deformazioni assiali.
2. Progettare la travatura.
3. Calcolare la rotazione del nodo B.
4. Risolvere nuovamente la travatura considerando anche il cedimento $\delta$ del vincolo in B e disegnare i diagrammi delle caratteristiche della sollecitazione (N, T, M).

C1)




Eqne ausiliaria:

$(C\curvearrowleft)_{ABC}$ $V_B \ell = 2q\ell^2$

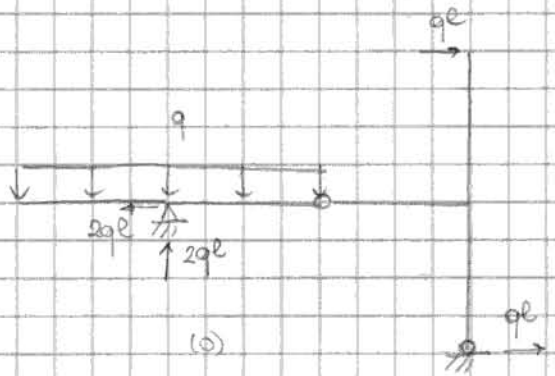
Eq.ni cardinali della Statica:

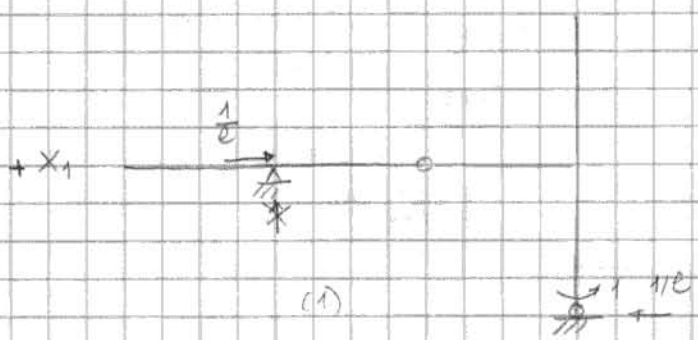
$(\uparrow)$ $V_F + V_B = 2q\ell \rightarrow V_F = 0$

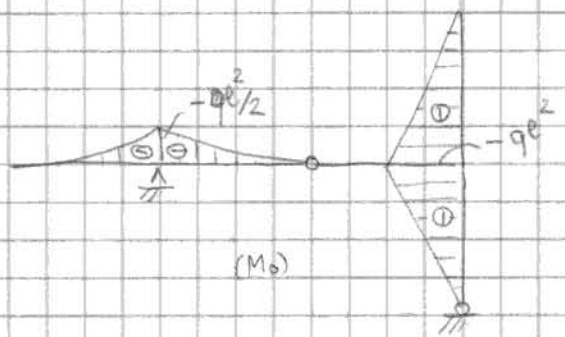
$(\rightarrow)$ $H_B + H_F = -q\ell$

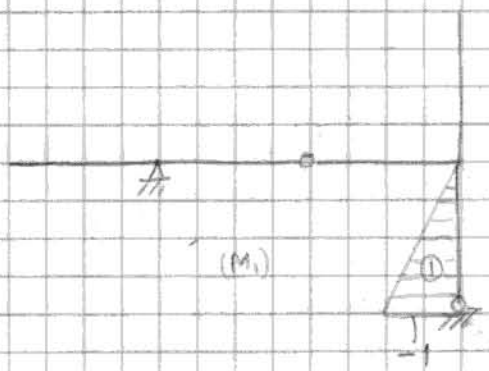
$(C\curvearrowleft)$ $V_F \ell + C_F + H_F \ell - q\ell^2 + 2q\ell^2 - V_B \ell = 0$ } 3 eq.ni, 2 eqni

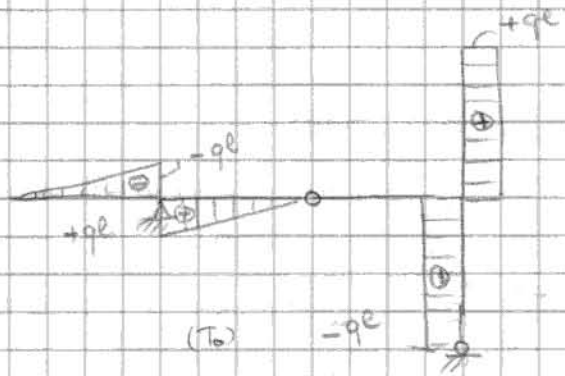
Trattasi una volta iperstatica. Incognita iperstatica $X_1 = C_F$.

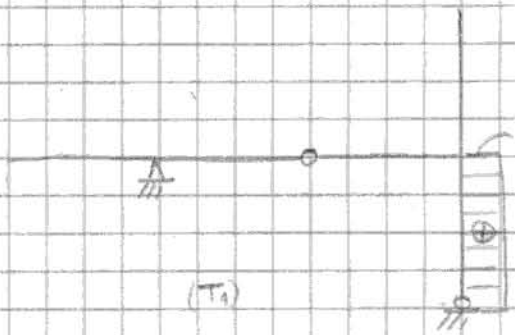


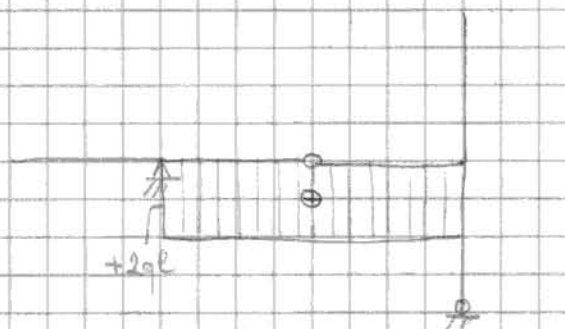



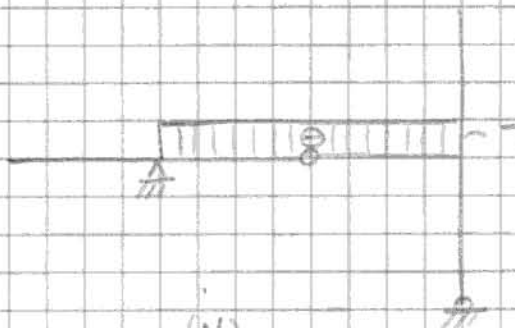



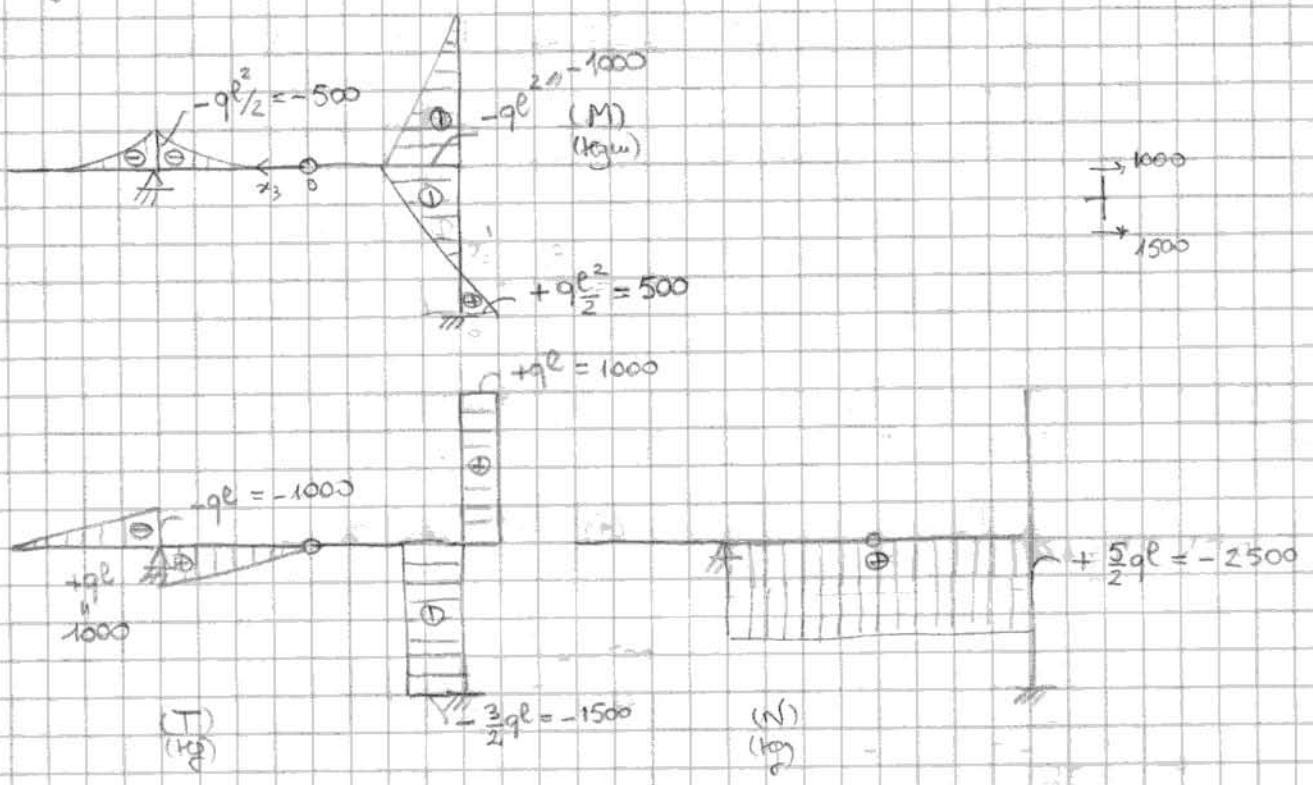



$$E_0 I_1 \eta_{10} = \frac{1}{6}\ell\left(-q\ell^2\right)(-1) = \frac{q\ell^3}{6}$$

$$E_0 I_1 \eta_{11} = \frac{1}{3}\ell(-1)^2 = \frac{\ell}{3}$$

Eq.ne di Müller - Breslau: $X_1 = -\frac{\eta_{10}}{\eta_{11}} = -\frac{q\ell^3}{6}\frac{3}{\ell} = -\frac{q\ell^2}{2} = -500$ kgm

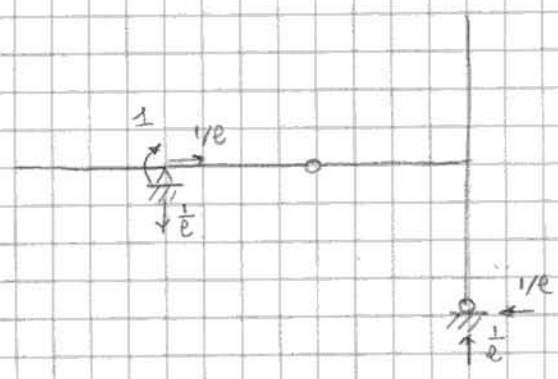
Diagrammi di (N, T, M):




C.2) Progetto:

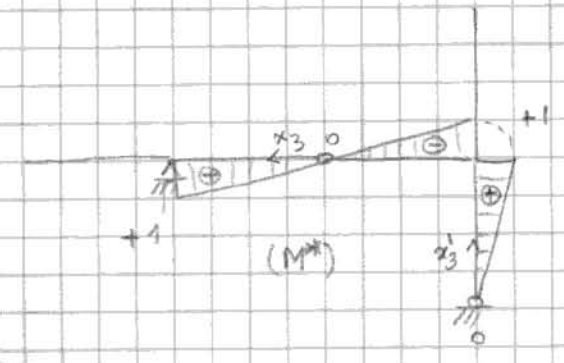
$$W_1 \geq \frac{1000 \cdot 100}{240} = 42 \text{ cm}^3 \Rightarrow \text{IPE 120} \quad \begin{cases} I_1 = 318 \text{ cm}^4 \\ A = 13,2 \text{ cm}^2 \end{cases}$$

C.3) Rotazione in B.




$$1 \cdot \varphi_B = \frac{1}{EI_1}\left[\int_0^\ell \left(\frac{x_3}{\ell}\right)\left(-q\frac{x_3^2}{2}\right)dx_3 + \int_0^\ell \left(\frac{x_3'}{\ell}\right)\left(+q\frac{\ell^2}{2} - 3q\frac{\ell}{2}x_3'\right)dx_3'\right]$$

$$= \frac{1}{EI_1}\left[-\frac{q}{2\ell}\frac{\ell^4}{4} + q\frac{\ell}{2}\frac{\ell^2}{2} - \frac{3q}{2}\frac{\ell^3}{3}\right] = -\frac{3}{8}\frac{q\ell^3}{EI_1} = -0,32°$$



C.4) Cedimento w F

(Def. assiale: $\frac{M_{II}^N}{M_{II}^M} = \frac{2\ell}{\ell^2} \frac{1}{EA} \frac{3EJ}{\ell} = \frac{6J}{A\ell^2} = 1,4\%$ $M_{II}^N$ è trascurabile)

$M_{1,0} + M_{11} X_1 = M_1$

$M_1 = 1 \cdot \bar{\Phi}$

$$X_1 = -\frac{M_{10}}{M_{11}} + \frac{M_1}{M_{11}} = -\frac{q\ell^2}{2} + \frac{3EJ_1\bar{\Phi}}{\ell} = -500 + \left[\frac{3 \cdot 2{,}1 \cdot 10^6 \cdot 318 \cdot 0{,}1 \cdot \pi/180}{100}\right]\frac{1}{100} \text{ kgm}$$

$$= -500 + 350 = -150 \text{ kgm}$$

Diagrammi di (N, T, M):