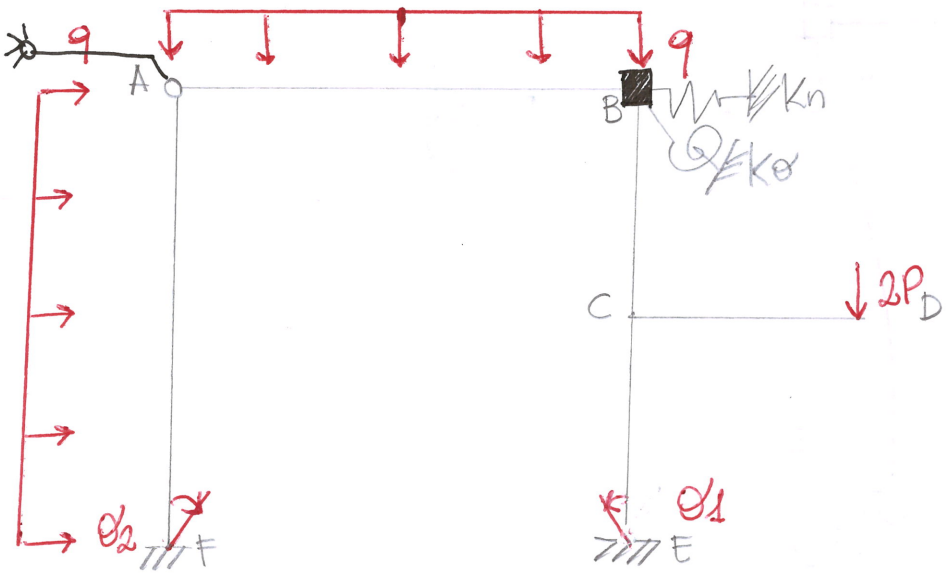
TELAIO 9 SETTEMBRE 2019



$$\vartheta_1 = \frac{7}{80}\frac{ql^3}{EJ} \quad ; \quad \vartheta_2 = \frac{5}{8}\frac{ql^3}{EJ}$$

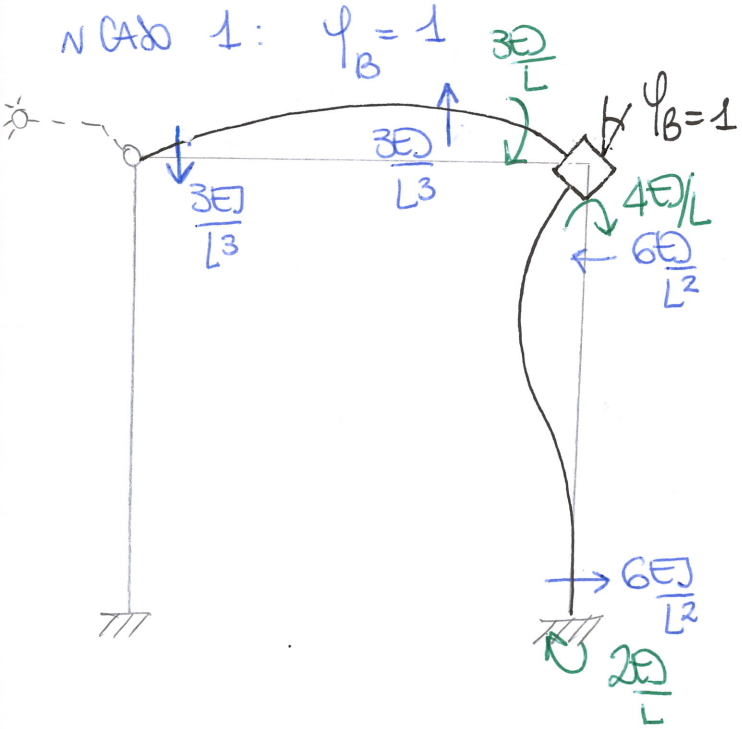
$$K_\eta = \frac{33}{8}\frac{EJ}{L^3} \quad ; \quad K_\vartheta = 3\frac{EJ}{L}$$

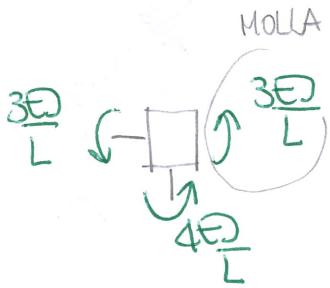
TELAIO A NODI SPOSTABILI → BIELLA FITTIZIA IN A

SISTEMA RISOLVENTE:

$$\begin{cases} m_{BB}\cdot\varphi_B + m_{BA}\cdot\eta_A + m_{B0} = 0 \\ h_{AB}\cdot\varphi_B + h_{AA}\cdot\eta_A + h_{A0} = 0 \end{cases}$$

CASO 1: $\varphi_B = 1$

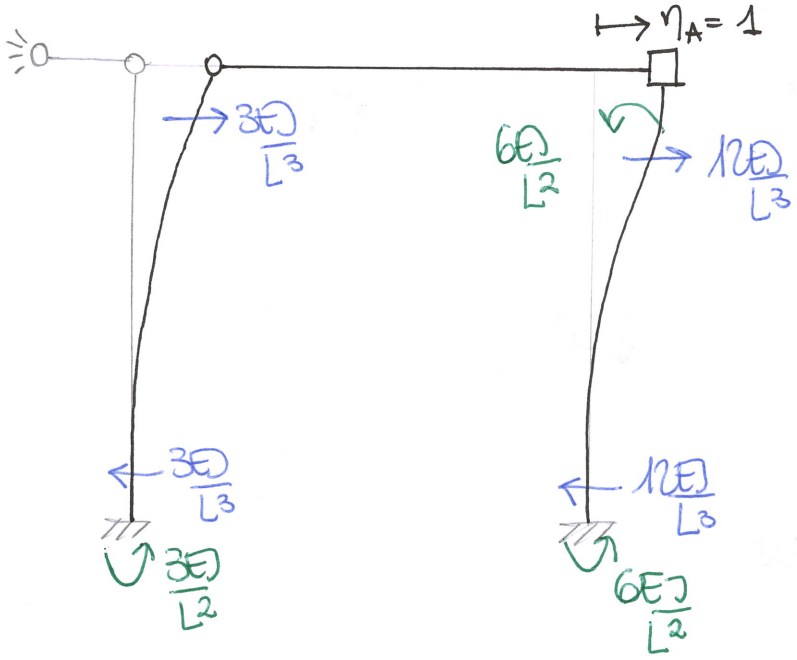




$$m_{BB} = 10\frac{EJ}{L}$$

$$h_{AB} = -\frac{6EJ}{L^2}$$

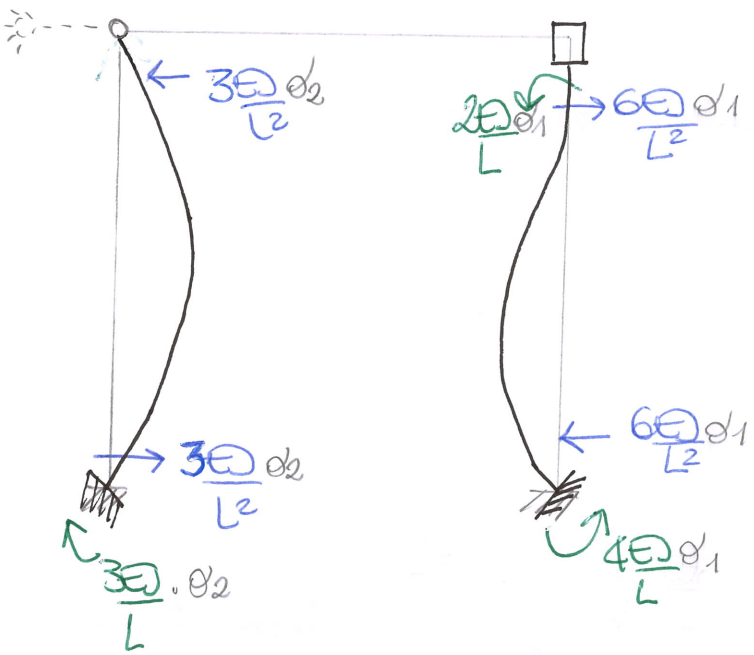
CAZ 2 $\eta_A = 1$

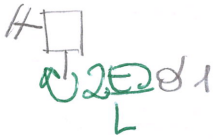


$$m_{BA} = -\frac{6EJ}{L^2}$$

$$h_{AA} = \left(15 + \frac{33}{8}\right)\frac{EJ}{L^3} = \frac{153}{8}\frac{EJ}{L^3}$$

CAZ 3: $\vartheta_1 \neq 0$; $\vartheta_2 \neq 0$

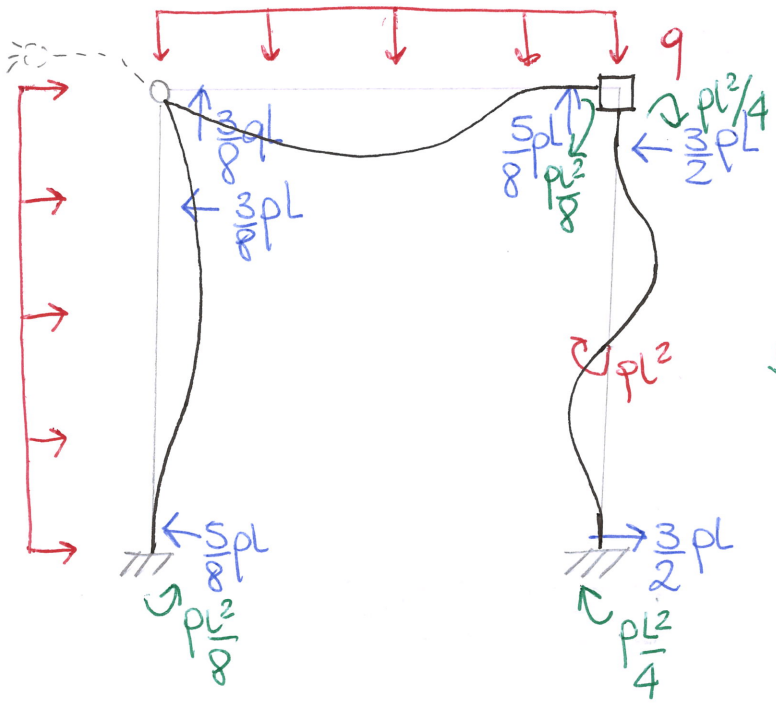


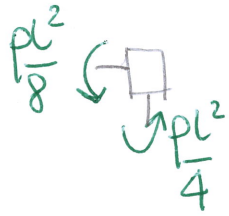


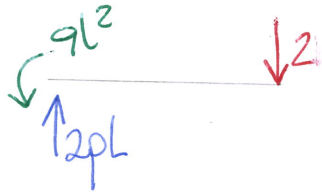
$$m_{BO,1} = -\frac{2EJ}{L}\cdot\frac{7}{80}\frac{pL^3}{EJ} = -\frac{7}{40}qL^2$$

$$h_{AO,1} = \frac{6EJ}{L^2}\cdot\frac{7}{80}\frac{pL^3}{EJ} - \frac{3EJ}{L^2}\cdot\frac{5}{8}\frac{qL^3}{EJ} = \frac{21}{40}qL - \frac{15}{8}pL = -\frac{54}{40}pL = -\frac{27}{20}pL$$

CASO 4: $q \neq 0$







$m_{BO,2} = \frac{3}{8} pL^2$

$h_{AO,2} = -\frac{15}{8} qL$

SISTEMA RISOLVENTE:

$$\begin{cases} 10 \frac{EJ}{L} \cdot \varphi_B - 6 \frac{EJ}{L^2} \eta_A \underbrace{- \frac{7}{40} pL^2 + \frac{3}{8} pL^2}_{\frac{1}{5} pL^2} = 0 \quad (1) \\ -6 \frac{EJ}{L^2} \cdot \varphi_B + \frac{153}{8} \frac{EJ}{L^3} \cdot \eta_A \underbrace{- \frac{27}{20} pL - \frac{15}{8} pL}_{-\frac{129}{40} pL} = 0 \quad (2) \end{cases}$$

moltiplico (1) per $\frac{6}{10L}$

$$\left(10 \cdot \frac{6}{10L} \frac{EJ}{L}\right) \varphi_B + \left(-6 \cdot \frac{6}{10L} \frac{EJ}{L^2}\right) \eta_A + \left(\frac{1}{5} qL^2 \cdot \frac{6}{10L}\right) = 0$$

$$6 \frac{EJ}{L^2} \varphi_B - \frac{36}{10} \frac{EJ}{L^3} \eta_A + \frac{6}{50} qL = 0$$

(1) + (2)

$$(6-6) \frac{EJ}{L^2} \varphi_B + \left(-\frac{36}{10} + \frac{153}{8}\right) \frac{EJ}{L^3} \eta_A + \left(\frac{6}{50} - \frac{129}{40}\right) pL = 0$$

$$\frac{1242}{80} \frac{EJ}{L^3} \eta_A = \frac{621}{200} qL \longrightarrow \boxed{\eta_A = \frac{1}{5} \frac{qL^4}{EJ}}$$

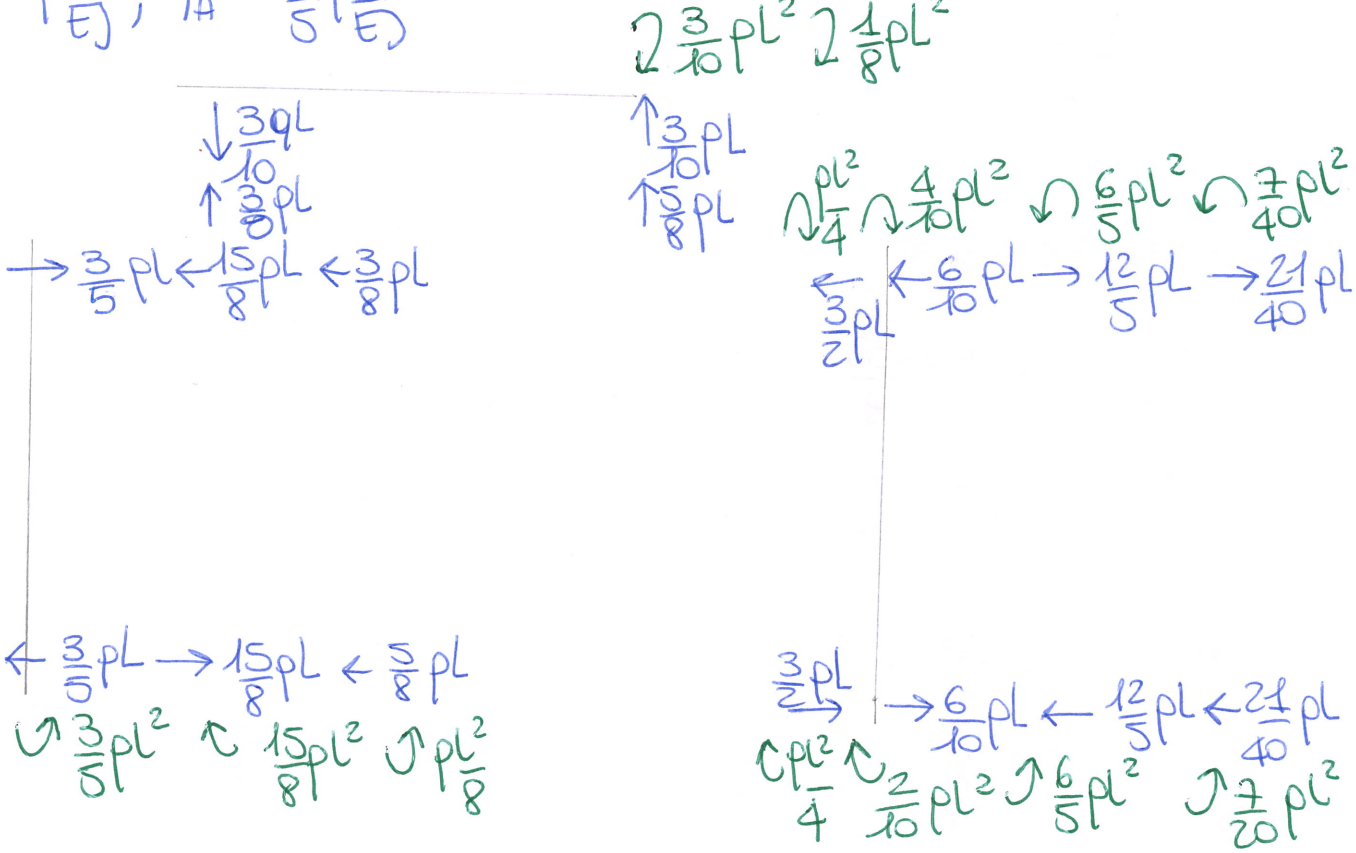
sostituisco η_A in (1)

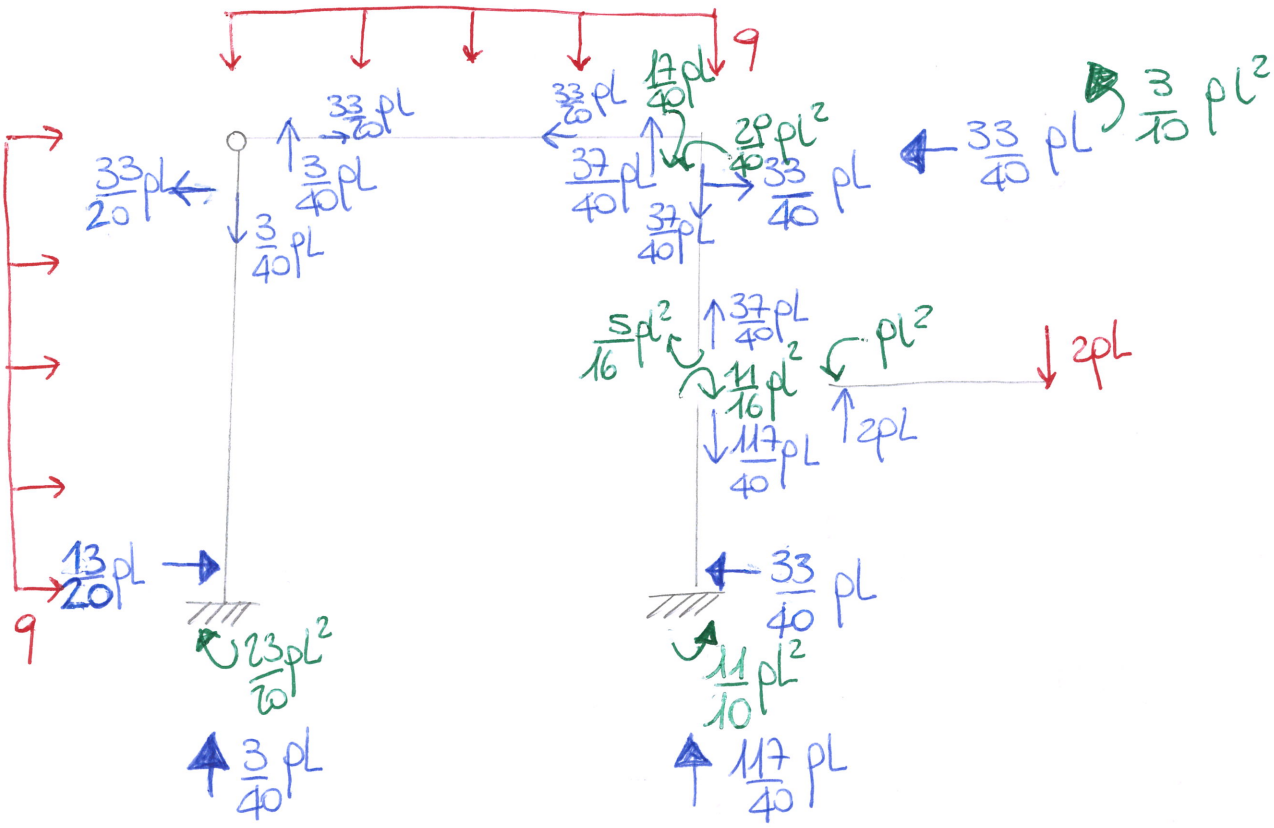
$$10\frac{EJ}{L}\varphi_B - 6\frac{EJ}{L^2}\cdot\frac{1}{5}\rho L^4\frac{1}{EJ} + \frac{1}{5}\rho L^2 = 0$$

$$10\frac{EJ}{L}\varphi_B = -\frac{1}{5}\rho L^2 + \frac{6}{5}\rho L^2$$

$$\boxed{\varphi_B = \frac{1}{10}\rho\frac{L^3}{EJ}}$$

$$\varphi_B = \frac{1}{10}\rho\frac{L^3}{EJ};\ \eta_A = \frac{1}{5}\rho\frac{L^4}{EJ}$$





Eq $\uparrow +=0$

$$\frac{3}{40}pL - qL + \frac{117}{40}qL - 2pL = 0 \quad \checkmark$$

Eq $\underset{+}{\rightarrow}=0$

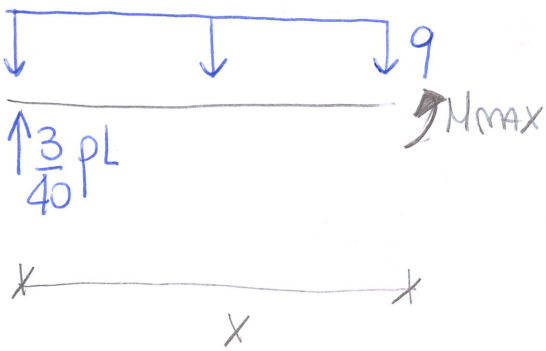
$$+\frac{13}{20}qL + qL - \frac{33}{40}qL - \frac{33}{40}qL = 0 \quad \checkmark$$

Ep $+\circlearrowleft_F=0$

$$q\cdot L\cdot\frac{L}{2} + pL\cdot\frac{L}{2} - \frac{33}{40}pL\cdot L - \frac{3}{10}pL^2 + 2pL\cdot\frac{3}{2}L - \frac{11}{10}pL^2 - \frac{117}{40}pL\cdot L + \frac{23}{20}pL^2 = 0$$

$$= +\frac{pL^2}{2} + \frac{pL^2}{2} - \frac{33}{40}pL^2 - \frac{3}{10}pL^2 + 3pL^2 - \frac{11}{10}pL^2 - \frac{117}{40}pL^2 + \frac{23}{20}pL^2 = 0 \quad \checkmark$$

Mmax



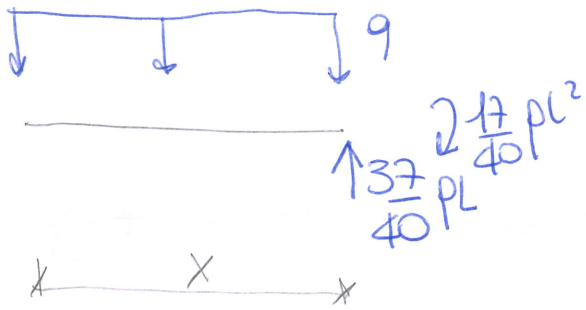
$$Mmax = \frac{3}{40}pL \cdot x - q \cdot x \cdot \frac{x}{2} = \frac{3}{40}pLx - q\frac{x^2}{2}$$

$$\frac{dMx}{dx} = 0 \rightarrow \frac{3}{40}qL - qx = 0 \qquad x = \frac{3}{40}L$$

$$Mmax\left(L = \frac{3}{40}\right) = \frac{3}{40}q \cdot \frac{3}{40}L^2 - q \cdot \left(\frac{3}{40}L\right)^2 \cdot \frac{1}{2} =$$

$$= \frac{9}{1600}qL^2 - \frac{9}{3200}qL^2 = \frac{18-9}{3200}pL^2 = \frac{9}{3200}pL^2$$

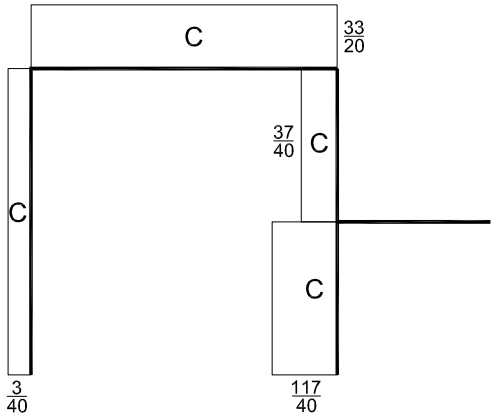
Flesso X1



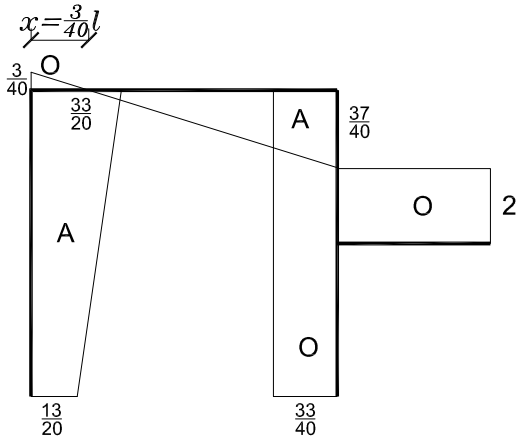
M=0

$$-\frac{37}{40}qLx + \frac{17}{40}pL^2 + q\frac{x^2}{2} = 0 \longrightarrow x = 0{,}85L$$

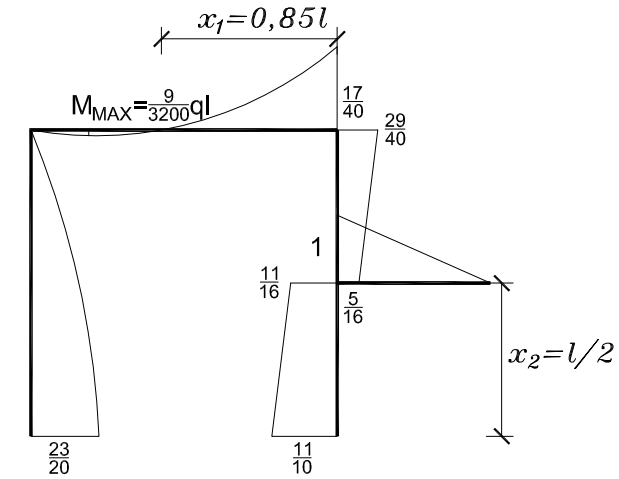
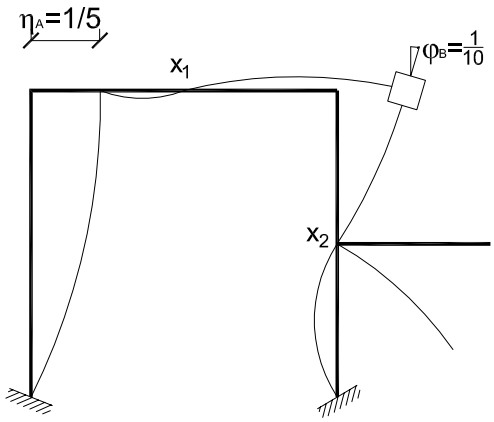
Forza assiale N [ql]



Forza di taglio V [ql]



Momento flettente M[ql²]



Deformata qualitativa