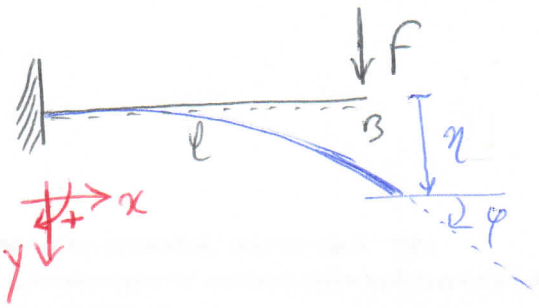
Linea elastica → iso / → iper

Summer Mahzad

Es - iso



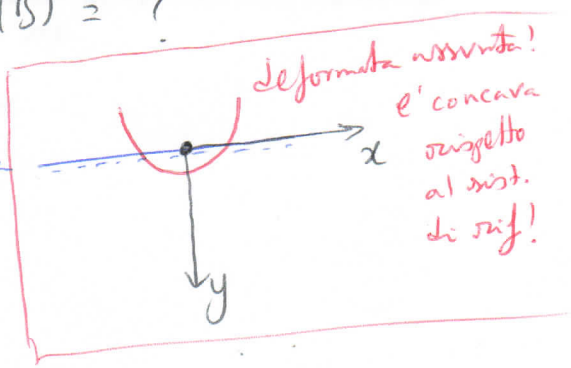
$M(x) = ?$ (banale)

$\varphi(B) = ?$

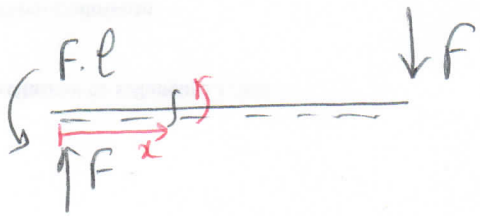
$\eta(B) = ?$

⊙ Eq. della linea elastica

$$y''(x) = -\frac{M(x)}{EI}$$



⊙



$$M(x) = F \cdot x - F \cdot \ell$$ ✓

$$y''(x) \cdot EI = -Fx + F\ell$$

$$y'(x)\,EI = -\frac{Fx^2}{2} + F\ell x + \cancel{C_1}^{\,0}$$

$$y(x) \cdot EI = -\frac{Fx^3}{6} + \frac{F \cdot \ell x^2}{2} + C_1 z + \cancel{C_2}^{\,0}$$

⊙ b.c

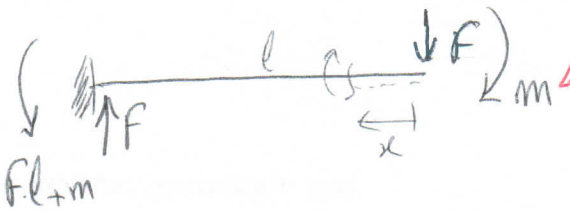
$y(x=0) = 0 \Rightarrow \boxed{C_1 = 0}$

$y'(x=0) = 0 \Rightarrow \boxed{C_2 = 0}$

$$\varphi(0) = y'(x=\ell) = \left[-\frac{F\ell^2}{2} + F\ell^2\right]\frac{1}{EI} = +\frac{F\ell^2}{2EI}$$ ✓

$$\eta(B) = y(x=\ell) = \left[-\frac{F\ell^3}{6} + \frac{F\ell^3}{2}\right]\frac{1}{EI} = +\frac{F\ell^3}{3EI}$$ ✓

① Verifica con il Th. castigliano:



NB! aggiungo e poi tolgo!
Barba trucco!!!

$$M(x) = -m - F\cdot x$$

$$\xi = \frac{1}{2EI}\int_0^l (-m-Fx)^2\,dx = \frac{1}{2EI}\int_0^l m^2 + F^2x^2 + 2mFx\,dx$$

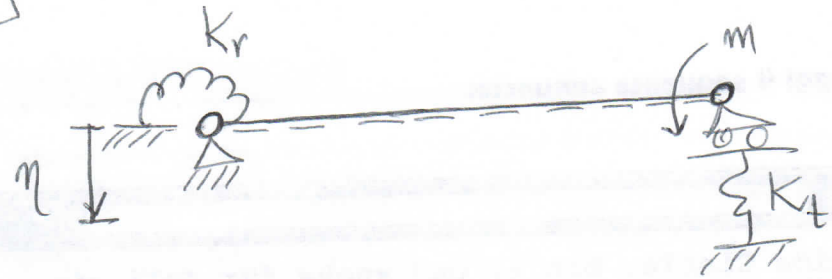
$$= \frac{1}{2EI}\left[\, m^2\cdot l + \frac{F^2 l^3}{3} + \frac{2mFl^2}{2}\right]$$

$$\left[\frac{\partial \xi}{\partial m}\right] = \varphi_B^* = \frac{1}{2EI}\left[2m\cdot l + 0 + Fl^2\right]$$

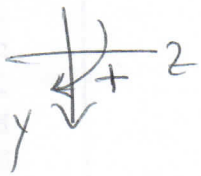
$$\lim_{m\to 0}\varphi_B^* = \boxed{\varphi_B = +\frac{F\cdot l^2}{2EI}}$$ ok!

$$\left[\frac{\partial \xi}{\partial F}\right]_{m=0} = \boxed{\eta_B = +\frac{F\cdot l^3}{3EI}}$$ ok!

Es - iper

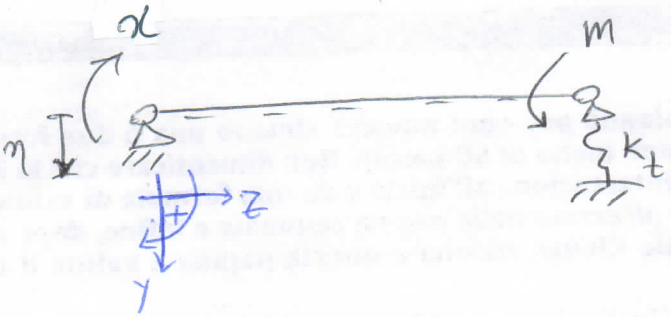


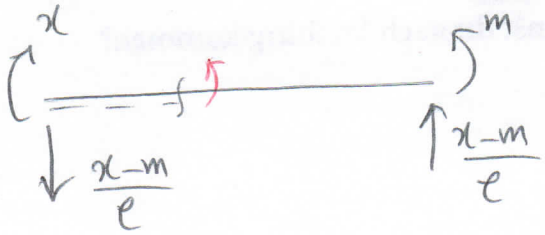
sist. di rif.



① 1ª volta iper.

② isostatica associata:





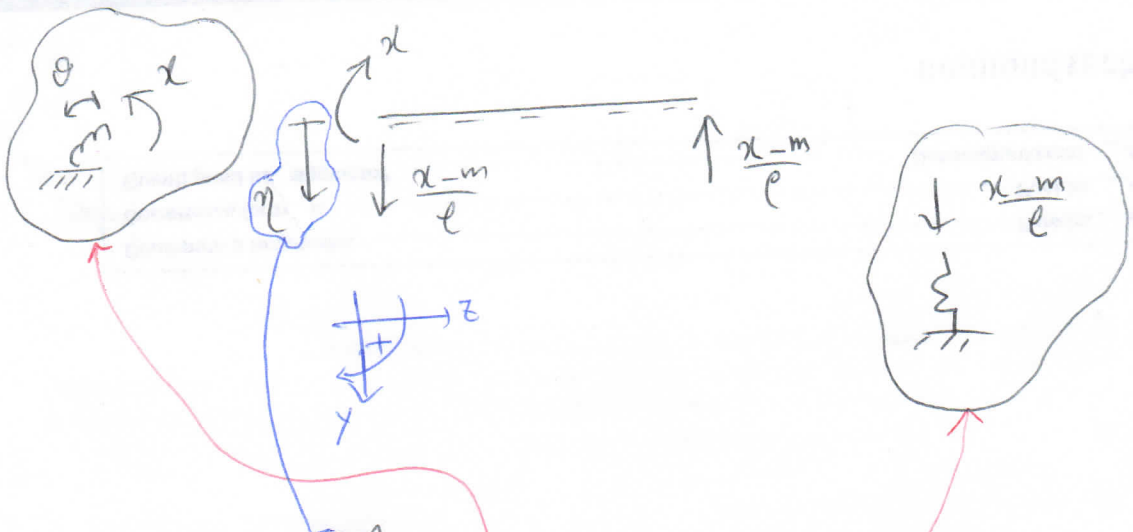
$$M(z) = x - \left(\frac{x-m}{\ell}\right)(z)$$

$$y''.EI = -x + \left(\frac{x-m}{\ell}\right)z$$

$$y'\,EI = -xz + \left(\frac{x-m}{\ell}\right)\frac{z^2}{2} + C_1$$

$$y\,EI = -\frac{xz^2}{2} + \left(\frac{x-m}{\ell}\right)\frac{z^3}{6} + C_1 z + C_2$$

C. C.



$$\begin{cases} y(z=0) = +\eta \\ y'(z=0) = -\dfrac{x}{K_r} \\ y(z=\ell) = +\dfrac{\left(\frac{x-m}{\ell}\right)}{K_t} \end{cases}$$

- soluzione:

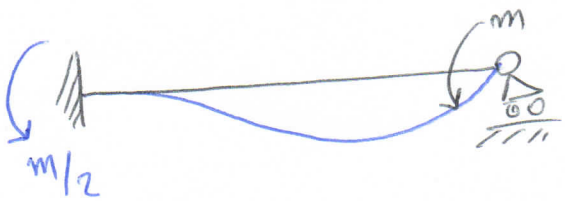
$$x = \frac{K_r\left(6mEJ - K_t m\cdot\ell^3 + 6K_t\cdot EJ\cdot\ell\cdot\eta\right)}{2\left(3K_r EJ + 3K_t\cdot EJ\cdot\ell^2 + K_r\cdot K_t\cdot\ell^3\right)}$$

- alcuni casi limite che conosco:

i) se $K_r \to 0 \Rightarrow \boxed{x=0}$ come mi aspetto!

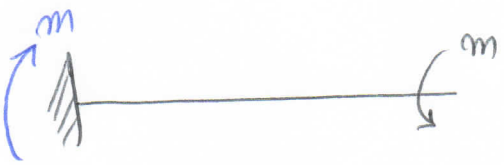
struttura isostatica di facile risoluzione!

ii) se $k_t \to \infty$ e $k_r \to \infty$ e $\eta = 0$



$$\boxed{\alpha = -\frac{m}{2}}$$ ok!

se $k_r \to \infty$ e $k_t \to 0$ e $\forall \eta$



$$\boxed{\alpha = m}$$ ok!

9. I tre grandi poeti italiani esponenti del Neoclassicismo sono .....

.....

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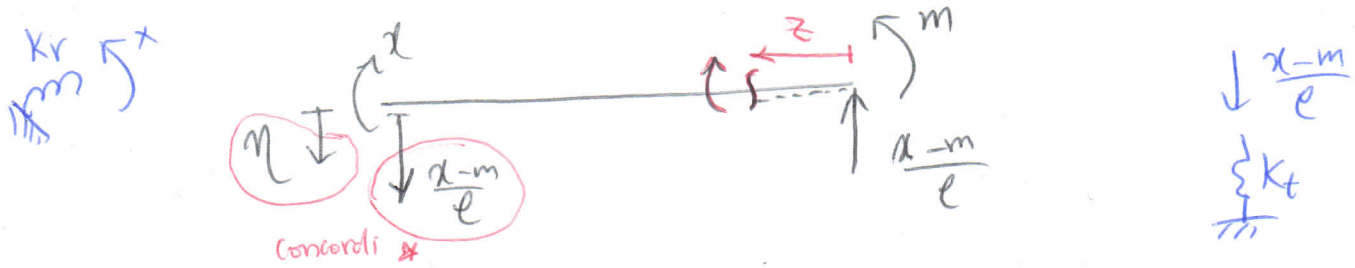
⊙ verifica con P.L.V.



$$M(z) = \left(\frac{x-m}{\ell}\right) z + m \qquad \left| \; M'(z) = \frac{z}{\ell}\right.$$

$$\mathcal{L}_{vi} = \mathcal{L}_{ve}$$

$$\frac{1}{EJ}\int_0^{\ell}\left[\left(\frac{x-m}{\ell}\right)z+m\right]\frac{z}{\ell}\,dz = \underbrace{-\left(\frac{x}{K_r}\right)}_{\vartheta}\underbrace{(1)}_{M'} + \underbrace{\left(\frac{1}{\ell}\right)}_{F'}\underbrace{(\eta)}_{\delta_{cedimento}} +$$

Sepre!

Sepre!

$$-\underbrace{\left(\frac{1}{\ell}\right)}_{F'}\underbrace{\left(\frac{(x-m)/\ell}{K_t}\right)}_{\delta_{molla}}$$

F': forza fittizia
M': Mom. fittizio
ϑ: rotazione molla!

⊙ una incognita e una eq.

$$\Rightarrow$$

$$\boxed{x = \frac{K_r\left(6m\,EJ - K_t\cdot m\ell^3 + 6K_t\,EJ\cdot\ell\cdot\eta\right)}{2\left(3K_r EJ + 3EJK_t\ell^2 + K_r K_t\cdot\ell^3\right)}}$$

c.v.d.