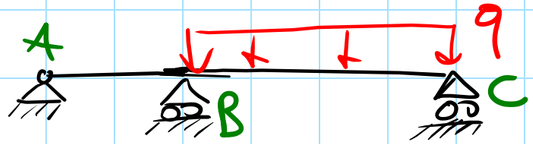
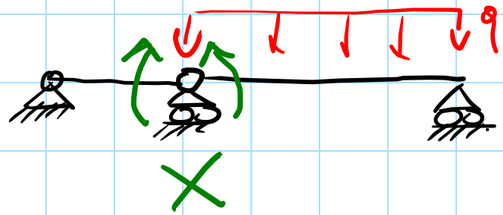
ES



EJ cost

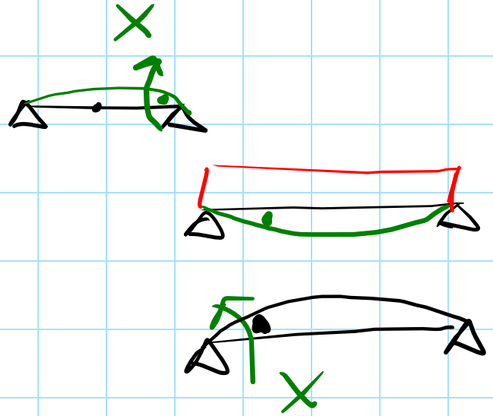
1 v. IPERST



S.P.

EQ. CONGRUENZA

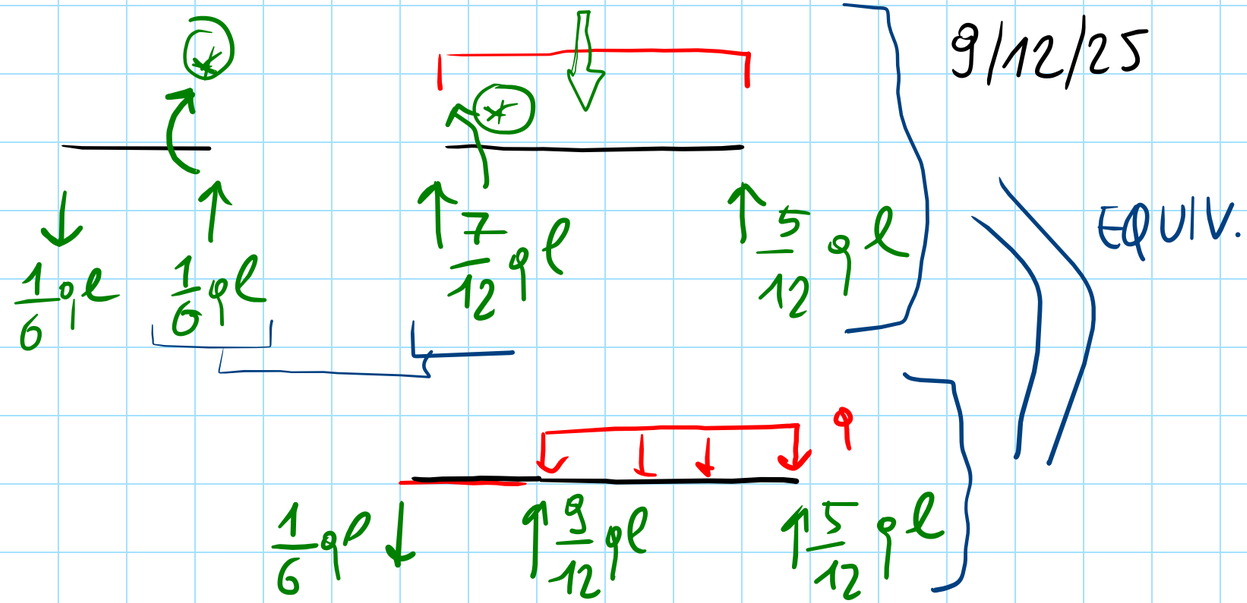
$\varphi_{BA} = \varphi_{BC}$ ↻ φ



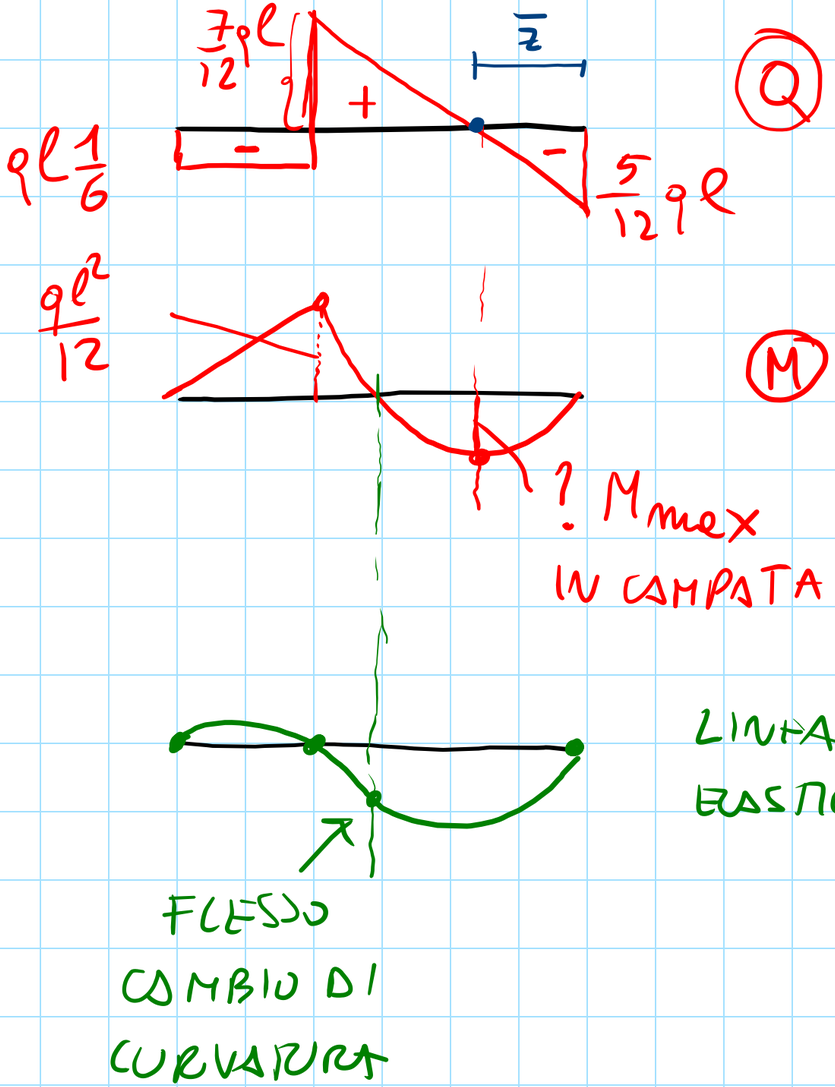
$$-\frac{X(l/2)}{3EJ} = -\frac{ql^3}{24EJ} + \frac{Xl}{3EJ}$$

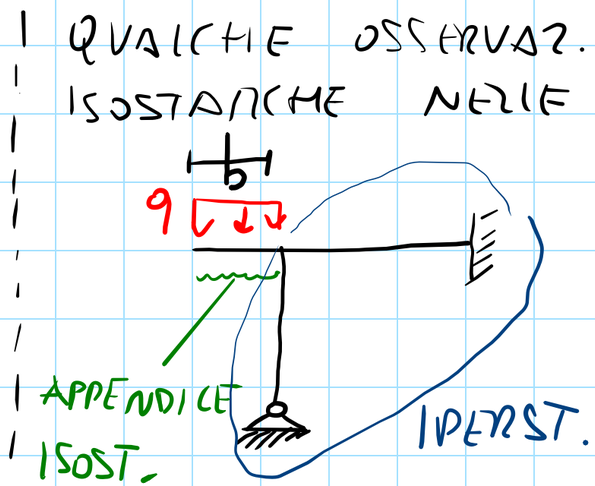
$$\frac{Xl}{6EJ} + \frac{Xl}{3EJ} = \frac{ql^2}{24EJ} \quad ; \quad X\,\frac{1+2}{6} = \frac{ql^2}{24} \quad ; \quad \boxed{X = \frac{ql^2}{12}}$$

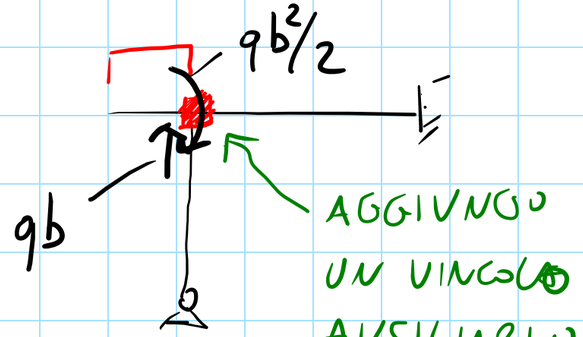
9/12/25

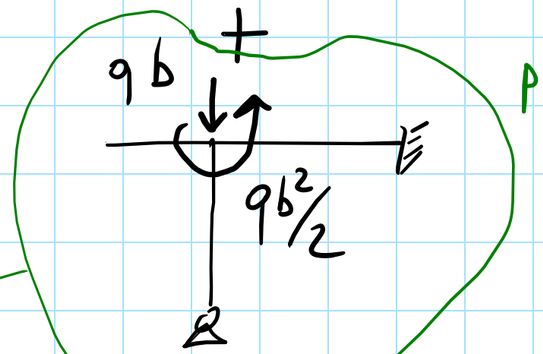


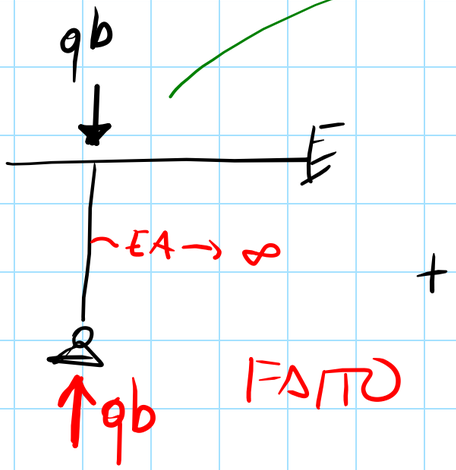
S.C.L. EQUIL



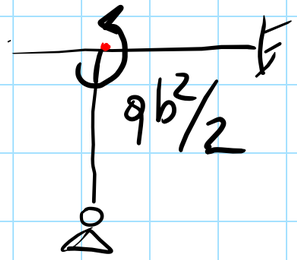






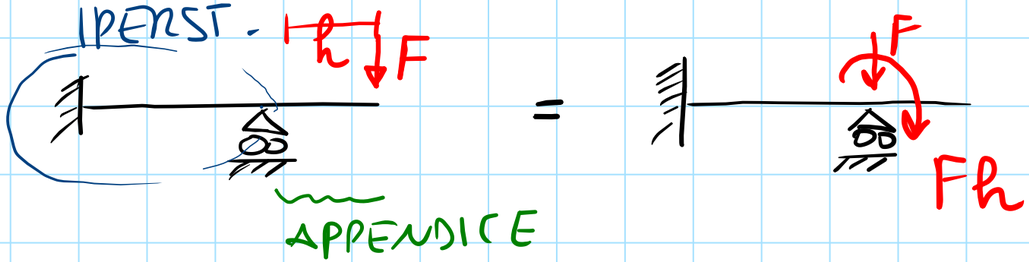


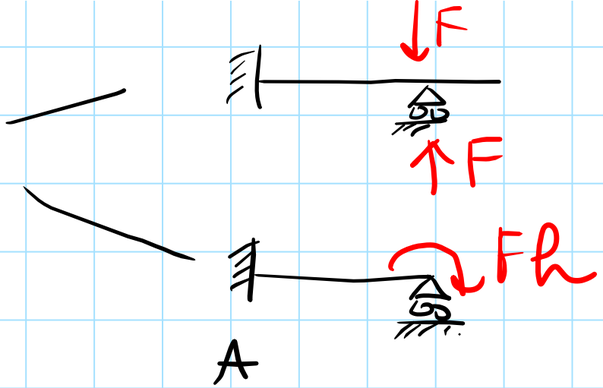
+



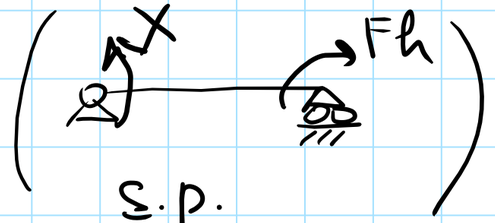
"VERO"
PROBLEMA
IPERSTATICO

MOMENTO ESTERNO
APPLICATO AL NODO

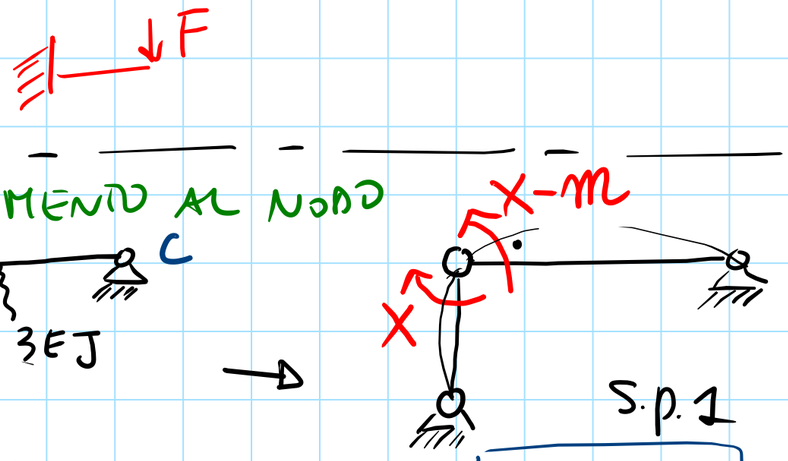




FTOOL



$\varphi_A = 0$



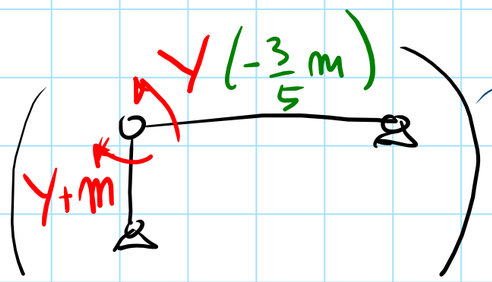
S.p. 1

$\boxed{\varphi_{BA} = \varphi_{BC}}$ ↻+

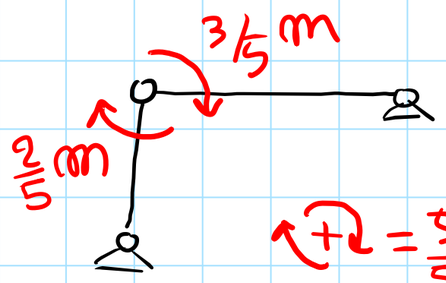
$$-\frac{X\ell}{3EJ} = +\frac{(X-m)\,2\ell}{3\cdot 3EJ}$$

$$-X = \frac{2}{3}(X-m) \rightsquigarrow \frac{5}{3}X = \frac{2}{3}m$$

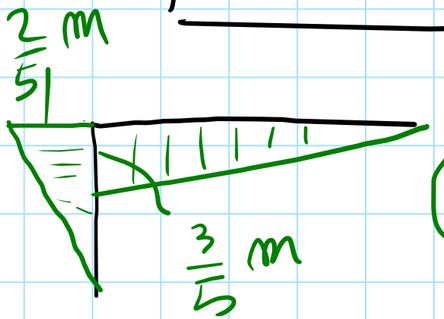
$$\boxed{X = +\frac{2}{5}m}$$



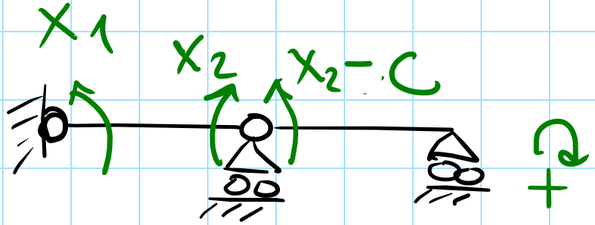
S.p. 2



$\curvearrowleft +2 = \frac{5}{5}m$ [= m ASSEGNATO]

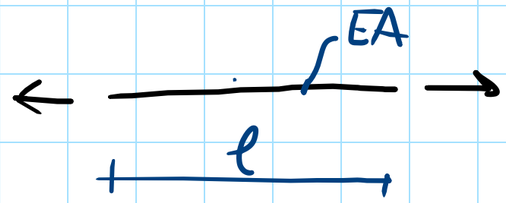


2 V. IPERST

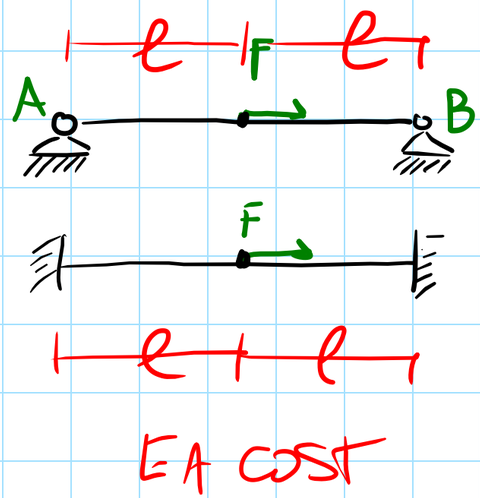


$$\left.\begin{aligned}\varphi_A &= 0\\ \varphi_{BA} &= \varphi_{BD}\end{aligned}\right\} X_1, X_2$$

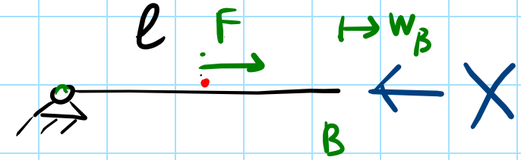
PROBL. A IPERST. ASSIALE



$$\Delta\ell = \frac{F\ell}{EA}$$



1 V. IPERST. ASSIALMENTE



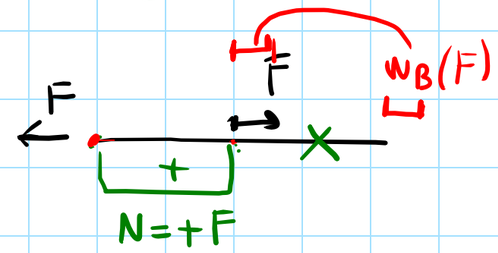
S.P.

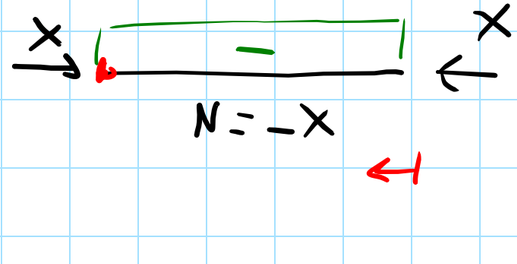
$w_B = 0$ +

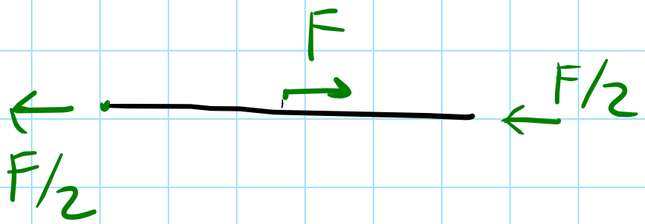
$$w_B(F) + w_B(X) = 0$$

$$+\frac{F\ell}{EA} - \frac{X\,2\ell}{EA} = 0$$

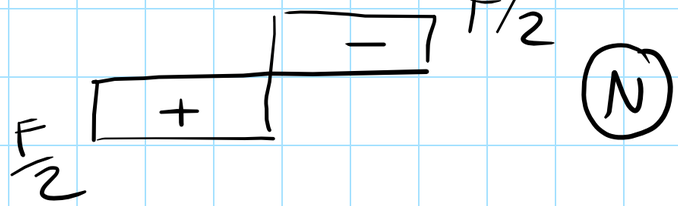
$$\boxed{X = \frac{F}{2}}$$







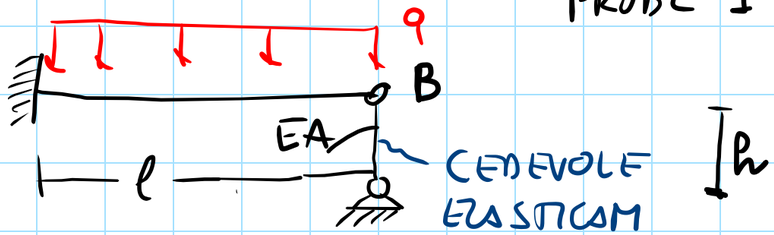
S.C.L. EQUIL.



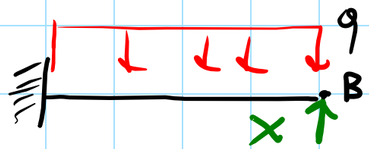
$J = 7Ae^2$

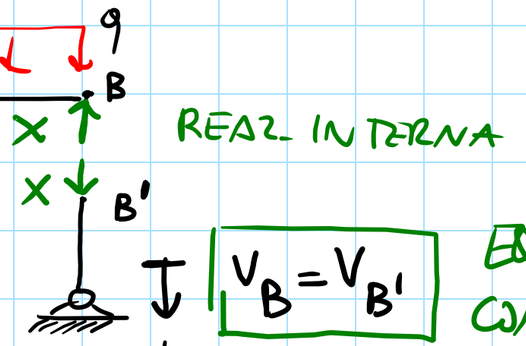
VINCOLI CEDEVOLI

PROBL 1 V. IPERST.



S.P.





$V_B = V_{B'}$ EQ. DI CONGRUENZA

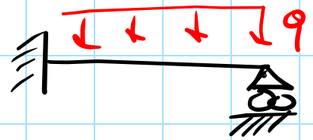
$$V_B = V_B(q) + V_B(X) = +\frac{q\ell^4}{8EJ} - \frac{X\ell^3}{3EJ}$$

$$V_{B'} = +\frac{Xh}{EA}$$

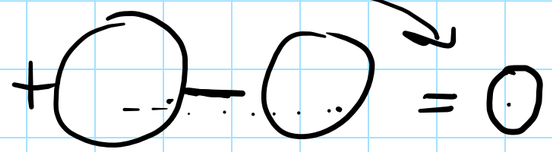
$$+\frac{q\ell^4}{8EJ} - \frac{X\ell^3}{3EJ} = \frac{Xh}{EA}$$

DOMANDE: COSA SUCCEDE QUANDO

$EA \to \infty$?

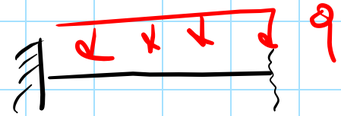


← CORRETTO 'RIGIDO'



COSA SUCCEDE QUANDO

$EA \to 0$?

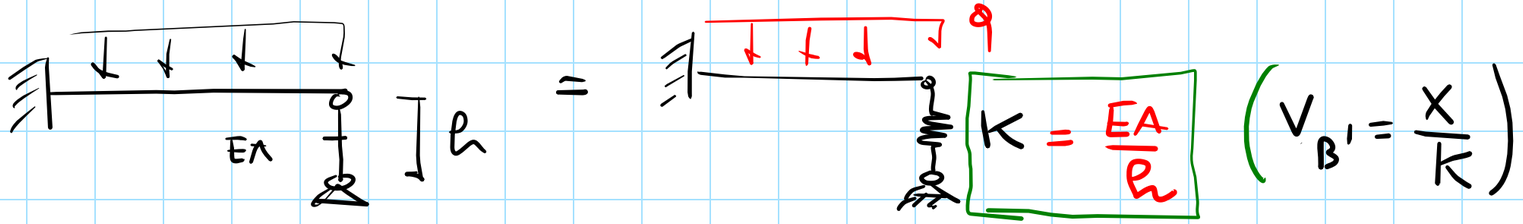


MENSOLA ISOSTATICA ($X = 0$)

$EA(+0-0) = Xh$

$EA \downarrow 0$

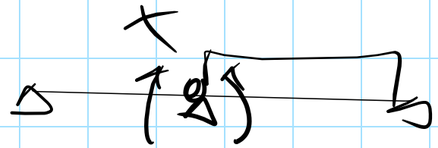
$0 = X$



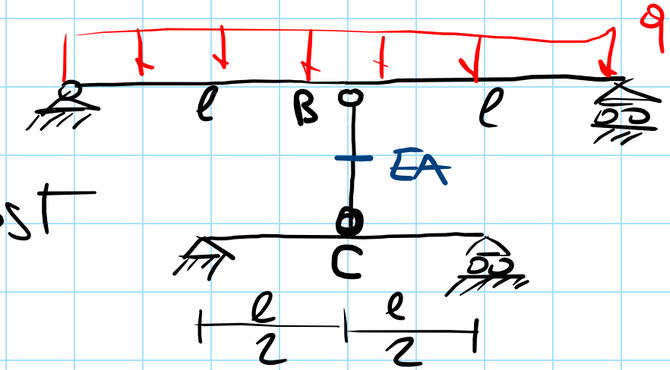
IN TUTTI I PROBL. UNA VOLTA IPERST, I COEFF. DELLA 'X' NELL'EQ. DI CONGRUENZA, SE PORTATI ALLO STESSO MEMBRO, HANNO TUTTI LO STESSO SEGNO. (PER MOTIVI DI ESISTENZA DELL'ENERGIA ELASTICA / STABILITÀ TERMODINAMICA)

$$\frac{q\ell^3}{24EJ} + \frac{X\ell}{3EJ} = + \frac{X\ell}{3EJ}$$

$$\boxed{q = 0}$$



ES



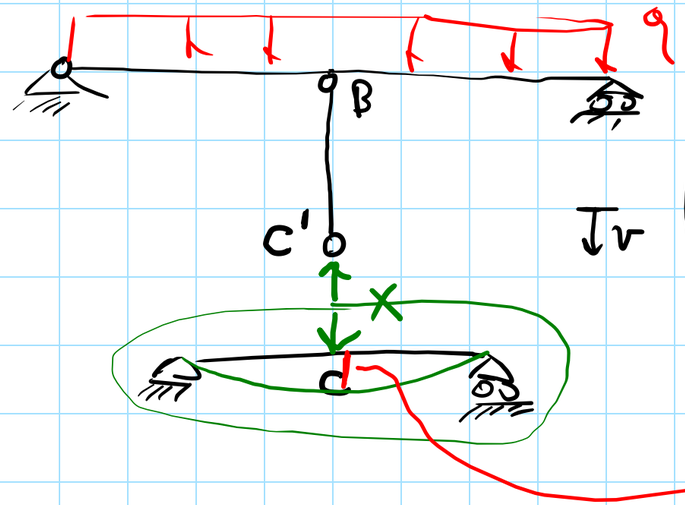
EJ cost

h

BIELLA CEDEVOLE ELASTICA.

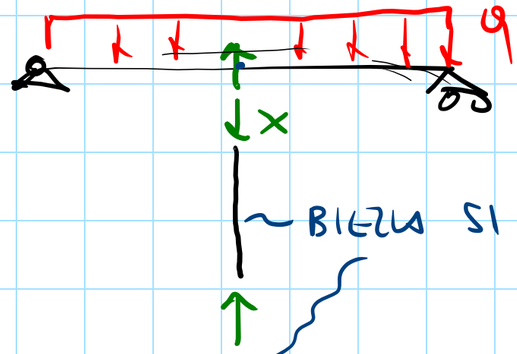
(1 V. IPERST. : SE TOLGO LA BIELLA INTERNA HO 2 TRAVI ISOSTATICHE)

S.P.



$\downarrow v$ $\boxed{v_{C'} = v_C}$

$+\frac{X\ell^3}{48EJ}$



$$v_{C'} = -\frac{Xh}{EA} - \frac{X(2\ell)^3}{48EJ} + \frac{5}{384}\frac{q(2\ell)^4}{EJ}$$

(1)

$$-\frac{Xh}{EA} - \frac{X(2\ell)^3}{48EJ} + \frac{5}{384}\frac{q(2\ell)^4}{EJ} = \frac{X\ell^3}{48EJ}$$

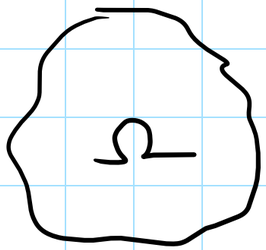
SE LA BIELLA NON FOSSE CEDEVOLE (RIGIDA) ALLORA (1) SPARIREBBE

UTILIZZO DEL T.L.V. PER IL CALCOLO DI SPOST. NELLE STR ISOSTATICHE

MECCANICA DEI SOLIDI

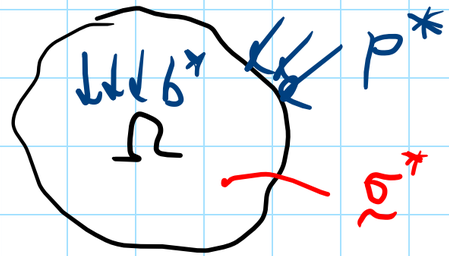
SIST. SPOST-DEFORMAZ. CINEMATIC. AMMISSIBILE

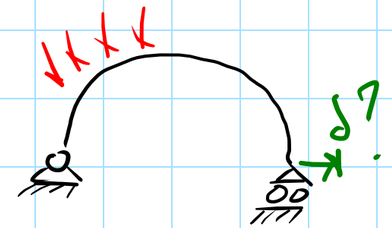
$\{\underline{u}, \underset{\sim}{\varepsilon}\}$

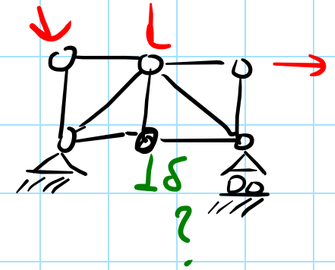


SIST. FORZE-TENSIONI STAT. AMMISSIBILE

$\{\underline{b}^*, \underline{p}^*, \underset{\sim}{\sigma}^*\}$







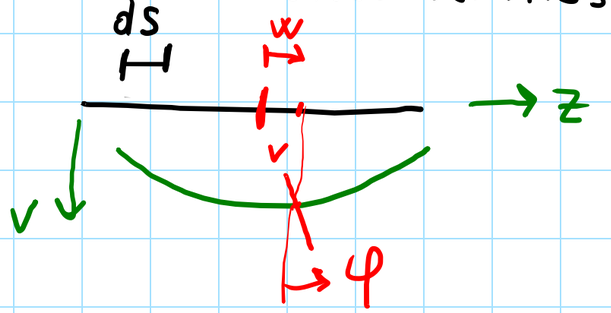
$$L_{ve} = L_{vi}$$

$$\int_\Omega \underline{b}^* \cdot \underline{u}\, d\Omega + \int_{\partial\Omega} \underline{p}^* \cdot \underline{u}\, d\Gamma = \int_\Omega \underset{\sim}{\sigma}^* \cdot \underset{\sim}{\varepsilon}\, d\Omega$$

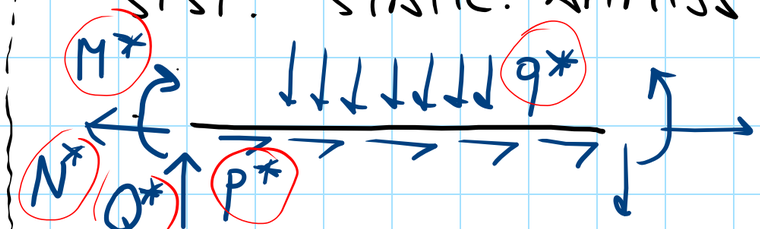
$\Longrightarrow$ POSSO RIFORMULARE QUESTA UGUAGLIANZA PER TRAVI SUPER / STR. RETIC. ?

TRAVI SNELLE

SIST. CINEMATIC. AMMISS.



SIST. STATIC. AMMISS.



STR. EQUILIBRATA

(CDS) $M^*(s)$, $N^*(s)$

$\bar{\varepsilon}$; DEFORMAZ. ASSIALE

k : CURVATURA DELLA TRAVE

$$\boxed{L_{ve} = L_{vi}}$$

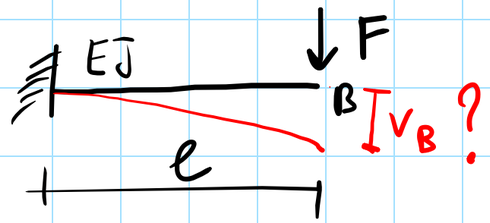
$$\int_{STR.} p^* w + q^* v \, ds + \begin{array}{l}\text{LAVORO VIRTUALE}\\ \text{DELLE FORZE E}\\ \text{DEI MOMENTI CONCENTRATI}\\ \text{PRESENTI SULLA STRUTTURA}\end{array}$$

LAVORO VIRT. INTERNO DI TRAVE SNELLA

$$= \int_{STR} N^*(s)\,\bar{\varepsilon}(s) + M^*(s)\,k(s)\,ds$$

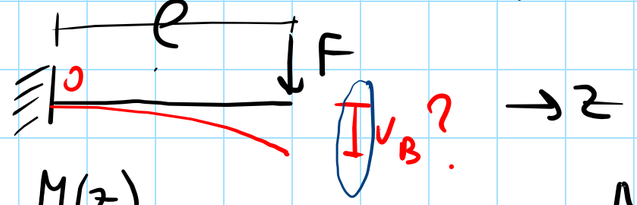
$$\sigma^*_{zz} = \frac{N^*}{A} + \frac{M^*_x}{J_x} y$$

LES



CALCOLO V_B CON IL T.L.V. (P.L.V.)

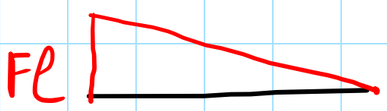
SIST. CINEM. AMM. (STR. REALE)



$M(z)$, K : CURVATURA $= \frac{M}{EJ}$

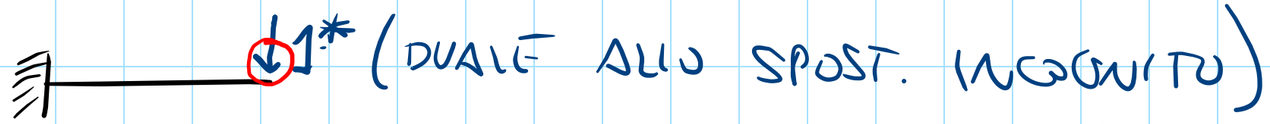
$L_{ve} = L_{vi}$

$$1^* \cdot V_B = \int_{STR} M^*(s)\, K(s)\, ds \Rightarrow V_B = \int_0^\ell M^*(z)\, \frac{M(z)}{EJ}\, dz$$



$M(z) = -F\ell + Fz$

SIST. STAT. AMMISS. (STR FITTIZIO)



(DUALE ALLO SPOST. INCOGNITO)

$M^*(z)$ $(N^* = 0)$

$M^*(z) = -\ell + z$ (1^)

$$\rightarrow V_B = \frac{F}{EJ}\int_0^\ell (-\ell + z)^2\, dz$$

$$V_B = \frac{F}{EJ}\int_0^\ell \left(\ell^2 - 2z\ell + z^2\right) dz$$

$$V_B = \frac{F}{EJ}\left[\ell^3 - \cancel{2}\ell\frac{\ell^2}{\cancel{2}} + \frac{\ell^3}{3}\right]$$

$$\boxed{V_B = \oplus \frac{F}{EJ}\,\frac{\ell^3}{3}}$$

SPOST CONCORDE ALLA FORZA UNITARIA

LES

SIST. CINEM. AMM.
(STR. RESLE)

SIST. STAT. AMM. (STR FITTIZIA)

$(N^* = 0)$

$M^* \neq 0$

$M^*(z) = -1$

$M(z)/EJ$

$L_{ve} = L_{vi}$

$$1^* \cdot \alpha_B = \int_{STR} M^* K \, dz \Rightarrow \alpha_B = \int_0^\ell M^*(z) \frac{M(z)}{EJ} dz \Rightarrow \alpha_B = \frac{F}{EJ} \int_0^\ell (-1)(-\ell + z) dz$$

$M(z) = -F\ell + Fz$

$M^*(z) = -1$

$$\alpha_B = \frac{F}{EJ} \int_0^\ell \ell - z \, dz \; ; \; \alpha_B = \frac{F}{EJ} \left[\ell^2 - \frac{\ell^2}{2} \right] ;$$

$$\boxed{\alpha_B = \frac{F\ell^2}{2EJ}}$$

OK (GIÀ VISTO CON LA LINEA ELASTICA)