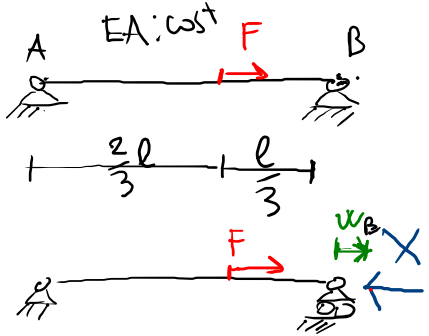
METODO DELLE FORZE PER LA RISOLV. DELLE STR IPERSTATICHE

2/12/22



STR IPERST. (1 V. IPER)

← INCOGNITA IPERST.

STR. PRINCIPALE (SP)

(STR. ISOSTATICA)

(σ, meglio, STAT. DETERM.)

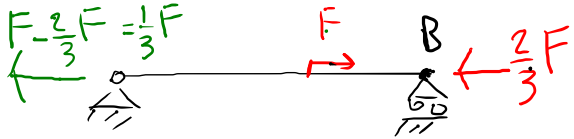
$W_B = 0$ EQ. DI CONGRUENZA ⇒ X ⇒ X DIVENTA UNA FORZA NOTA PER LA S.P.

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

$$+\frac{F\,\frac{2}{3}\ell}{EA} - \frac{X\,\ell}{EA} = 0$$

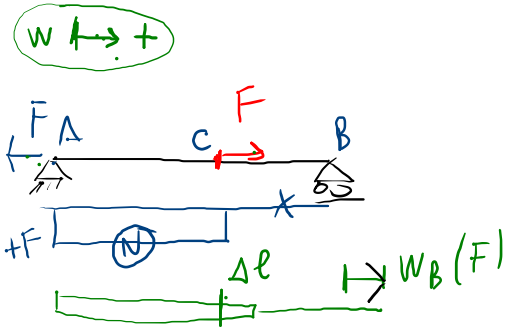
Segno !! VERSO CONF.

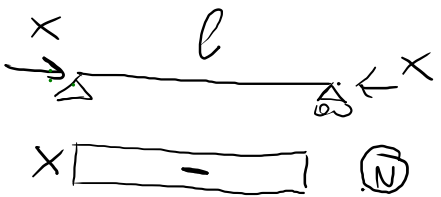
$$X = \frac{2}{3}F$$

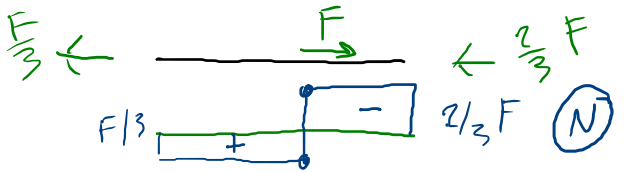


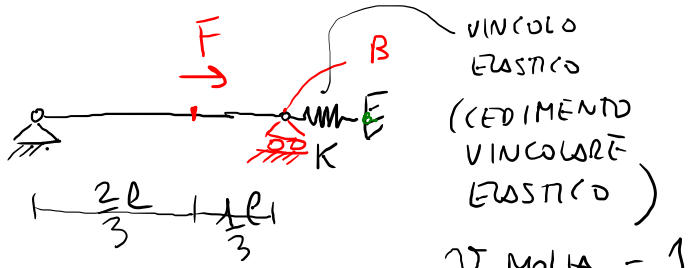
SP CON X RISOLTA. DIVENTA UN' ISOSTATICA "NORMALE"

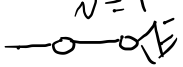
→ È EQUIVALENTE ALLA STR. IPERST. INIZIALE











$$\frac{X\ell}{EA} + \frac{X}{K} = \frac{2}{3}\frac{F\ell}{EA}$$

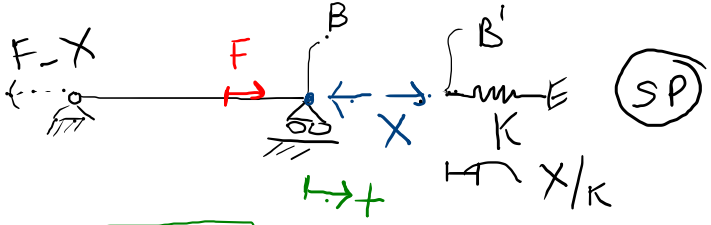
$$X\left(\frac{\ell}{EA} + \frac{1}{K}\right) = \frac{2}{3}F\frac{\ell}{EA}$$

$$X = \frac{2}{3}F\frac{\ell/EA}{\frac{\ell}{EA} + \frac{1}{K}}$$

$\frac{\ell}{EA} \sim \frac{1}{K}$

$\Rightarrow$ CEDEVOLEZZA

$= \frac{1}{\text{RIGIDEZZA}}$



$W_B = W_{B'}$ EQ. DI CONGR.

$W_B(F, X) = W_{B'}(X)$

$$\frac{F\frac{2}{3}\ell}{EA} - \frac{X\ell}{EA} = +\frac{X}{K} \quad (*)$$

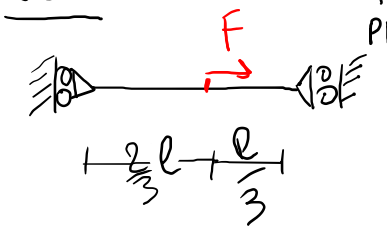
$K \to \infty$; $\frac{1}{K} \to 0$; $X \to \frac{2}{3}F$ LIMITE SUP DI X.

$K = 0$ (*) : $K[\ \ ] = X$

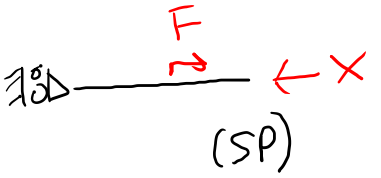
$0 = X$

OSS.

STR LABILE
PR STAT. INDET.

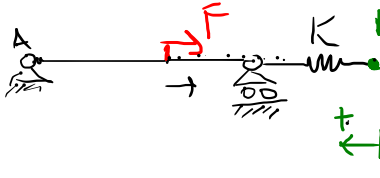


$\rightsquigarrow$

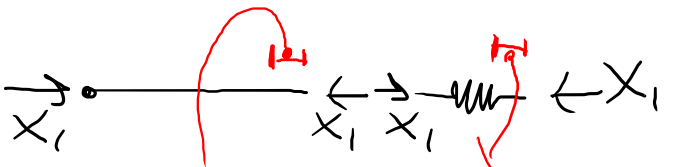


(SP)

STR LABILE
PR. STAT. DETERMINATO



(SP)
ALTERNATIVA



$\boxed{W_D = 0}$

$$W_D(F) + W_D(X_1) = 0$$

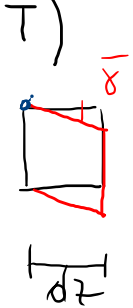
$$-\frac{F\frac{2}{3}l}{EA} + \frac{X_1 l}{EA} + \frac{X_1}{K} = 0 \rightsquigarrow X_1 = X \text{ di prima}$$

$\boxed{EA}$ STESSO DI PRIMA

LINEA ELASTICA (EFFETTI DI M, T)

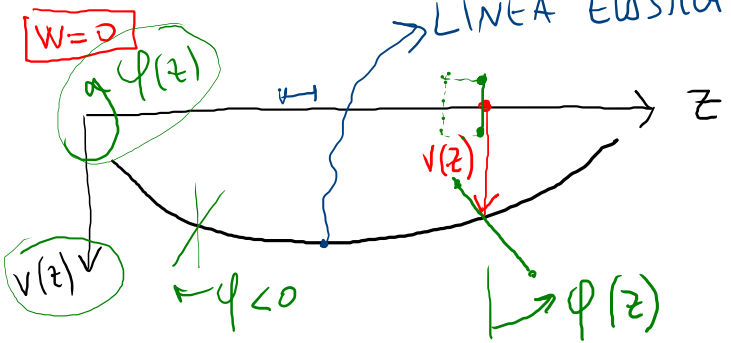
$$\frac{d\varphi}{dz} = \chi = \frac{M}{EJ}$$

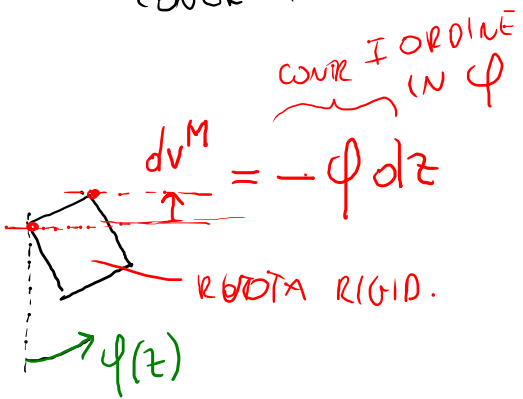
CONGRUENZA INTERNA



$$\frac{dv^T}{dz} = \gamma = \frac{k_v T}{GA}$$

CONGR. INTERNA





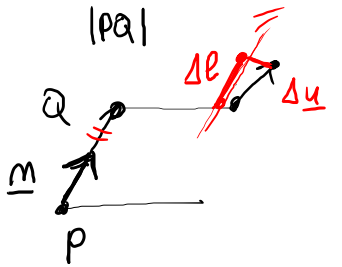
$$\frac{d\varphi}{dz} = \frac{M}{EJ} \qquad \frac{dv}{dz} = \frac{k_v T}{GA} - \varphi$$

$\Leftarrow$

$$dv = dv^T + dv^M = \frac{k_v T}{GA}\,dz - \varphi\,dz$$

$\varphi(z)$, $v(z)$ PICCOLE!

$$\frac{\Delta\ell}{|PQ|} = \varepsilon_M = \underset{\sim}{\varepsilon}\,\underline{m}\cdot\underline{m}$$



$$\Delta\ell = \Delta\underline{u}\cdot\underline{m} \qquad PQ = |PQ|\,\underline{m}$$

$$= \underset{\sim}{\varepsilon}\,PQ\cdot\underline{m}$$

$$\Delta\ell = \underset{\sim}{\varepsilon}\,\underline{m}\cdot\underline{m}\;|PQ|$$

$$\varepsilon_M = \frac{\Delta\ell}{|PQ|} = \underset{\sim}{\varepsilon}\,\underline{m}\cdot\underline{m}$$

$$\varepsilon_{11} = \underset{\sim}{\varepsilon}\,\underline{e}_1\cdot\underline{e}_1$$

EQ LINEA ELASTICA (ALLA TIMOSHENKO) [TEORIA DELLA TIMOSHENKO]

$$\begin{cases} \dfrac{d\varphi(z)}{dz} = \dfrac{M(z)}{EJ(z)} \\ \dfrac{dv(z)}{dz} = \dfrac{k\,T(z)}{GA(z)} - \varphi(z) \end{cases} \Rightarrow + 2 \text{ CONDIZ. AI LIMITI}$$

(*) EFFETTO DEL TAGLIO SULLA DEFORMAZIONE

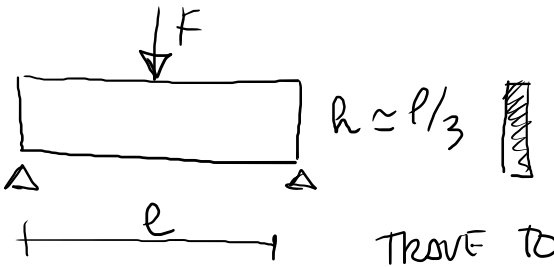
TRAVI SNELLE (ALLA EULERO-BERNOULLI-NAVIER)

$$\begin{cases} \dfrac{d\varphi}{dz} = \dfrac{M}{EJ} \\ \dfrac{dv}{dz} = -\varphi \end{cases} \Rightarrow \boxed{\dfrac{d^2v}{dz^2} = -\dfrac{M}{EJ}}$$

EQ. DELLA LINEA ELASTICA DEL II ORDINE

↳ 2 CONDIZ. AI LIMITI

TRAVE DI

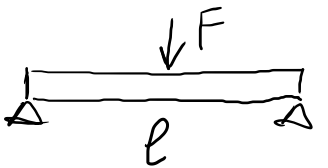


TRAVE TOZZA

(*) È IMPORTANTE

$\dfrac{l}{h} < 6 \div 8$

$\dfrac{l}{h} >$

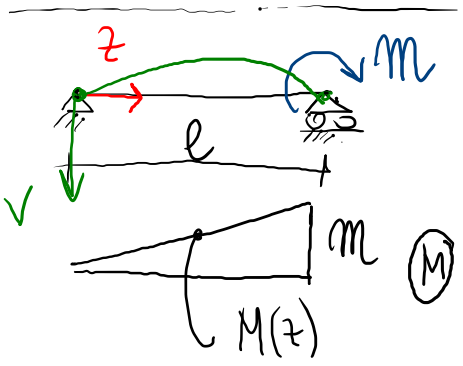


Il $h \ll l$

TRAVE SNELLA

(*) È TRASCURABILE

$$\begin{cases} v''(z) = -\dfrac{M(z)}{EJ} \\ v(0) = 0 \\ v'(0) = 0 \end{cases} \rightsquigarrow v(z) \Rightarrow \varphi(z) = -v'(z)$$



$(v(z) < 0)$

$$\begin{cases} v''(z) = -\dfrac{M(z)}{EJ} \\ v(0) = 0 \\ v(\ell) = 0 \end{cases}$$