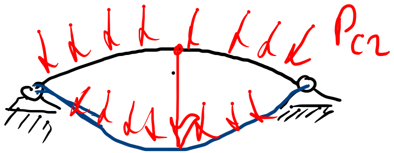
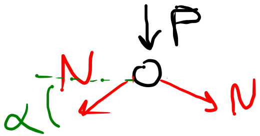
PROBLEMA DI SNAP-THROUGH ('A SCATTO') MADS 17/11/23

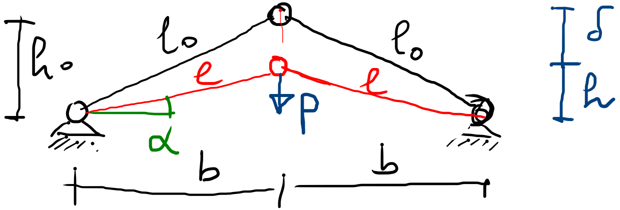


$P(\delta)$: STUDIO L'EQUIL. NELLA CONFIG. DEFORMATA



$$\downarrow + : \quad P + 2N \overbrace{\sin\alpha}^{h/l} = 0$$

$$\boxed{P = -2N\,\frac{h}{l}}$$



$h_0 = \delta + h$

$h = h_0 - \delta$

$l_0^2 = b^2 + h_0^2$

$$N = EA\,\varepsilon = EA\,\frac{\Delta l}{l_0} = EA\,\frac{l - l_0}{l_0}$$

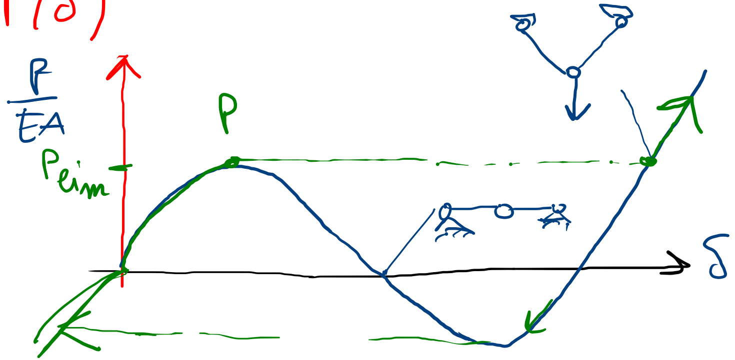
$$l = \sqrt{b^2 + h^2} = \sqrt{b^2 + (h_0 - \delta)^2} = \sqrt{b^2 + h_0^2 + \delta^2 - 2h_0\delta}$$

$$= \sqrt{l_0^2 + \delta^2 - 2h_0\delta}$$

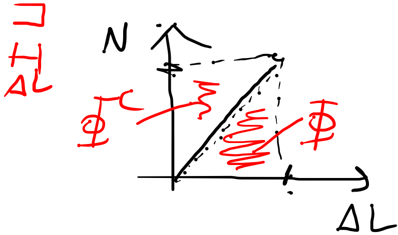
$$N = EA\left[\sqrt{1 + \frac{\delta^2 - 2h_0\delta}{l_0^2}} - 1\right]$$

$$\boxed{P = -2EA\left[\sqrt{\qquad} - 1\right]\frac{h_0 - \delta}{\sqrt{(h_0 - \delta)^2 + b^2}}}$$

$P(\delta)$



TEOREMI ENERGETICI



EN. ELASTICI IN TRAVI INFLESSE

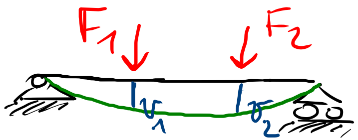
$$\Phi = \frac{1}{2}\int_s M\kappa\, ds + \frac{1}{2}\int_s N\varepsilon\, ds = \boxed{\frac{1}{2}\int_s \frac{M^2}{EI} + \frac{N^2}{EA}\, ds} = \Phi^c$$

$$\kappa = \frac{M}{EI} \quad ; \quad \varepsilon = \frac{N}{EA}$$

Posso calcolare Φ sapendo solo N e Δl?

$$\Phi = \frac{1}{2} N \Delta l$$

TEOREMA DI CLAPEYRON



IPOTESI:
- CARICAMENTO QUASI STATICO
- MAT. ELASTICO LINEARE
- VINCOLI PERFETTI

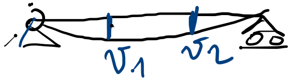
$$\boxed{\Phi = \frac{1}{2}\left(F_1 v_1 + F_2 v_2\right)}$$

TESI DEL TEOREMA

DIM. (TRAMITE PLV)

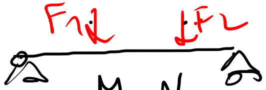
$$L_{ve} = F_1 v_1 + F_2 v_2 \quad ; \quad L_{vi} = \int_s M\kappa + N\varepsilon\, ds = \int_s \frac{M^2}{EI} + \frac{N^2}{EA}\, ds$$

SIST. CINEM. AMM.



κ, ε

SIST. STAT. AMM.



M, N

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

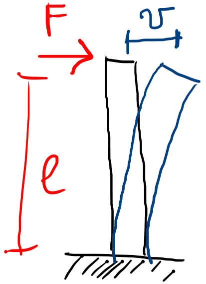
$$\boxed{\frac{1}{2}\left(F_1 v_1 + F_2 v_2\right)} = \frac{1}{2}\int \frac{M^2}{EI} + \frac{N^2}{EA}\, ds = \boxed{\Phi}$$

QUALCHE APPLICAZ.

Per CLAPEYRON

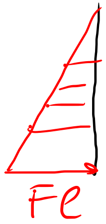
$$\frac{1}{2} F v = \frac{1}{2} \int \frac{M^2}{EI}\, ds$$

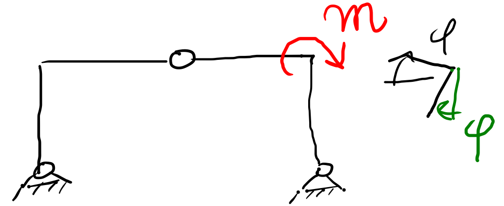
INCOGNITA



E?

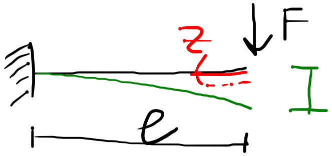
NOTI: F, v, M, I



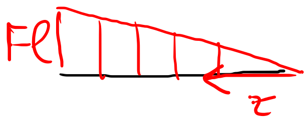


INCOGNITA

$$\frac{1}{2} m \varphi = \frac{1}{2} \int \frac{M^2}{EI}\, ds$$



$$\underbrace{\frac{F l^3}{3EI}}_{1/K_{eq}} = v$$



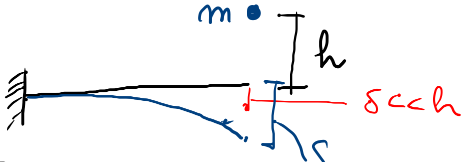
$$M(z) = -Fz$$

NOTI: F, E, I... calcolo v con TH. DI CLAPEYRON

$$\cancel{\frac{1}{2}} F v = \cancel{\frac{1}{2}} \frac{1}{EI} \int_0^l F^2 z^2\, dz$$

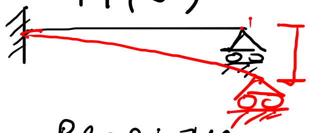
$$= \frac{1}{EI} F^2 \frac{l^3}{3}$$

$$\cancel{F} v = \frac{F^{\cancel{2}} l^3}{3EI}$$



δ_{max}?

$E_{pot} = mgh$

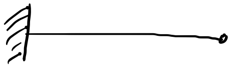


PROBLEMA IPERSTATICO.

$\delta_{max} \sim \Phi = E_{pot}$

$$\frac{1}{2}\int_s \frac{M^2}{EI} = mgh \Rightarrow \delta_{max}$$

$M(\delta_{max})$



$$\doteq \quad K_{eq} = \frac{3EI}{\ell^3}$$