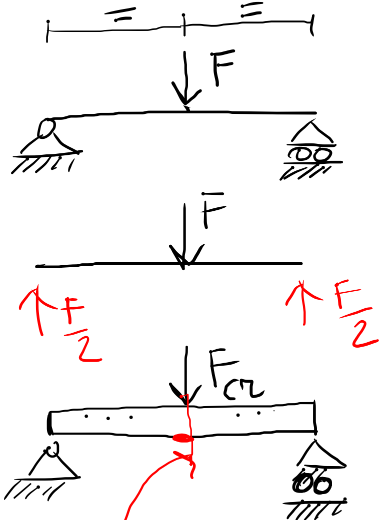
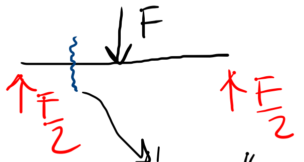
CARATTERISTICHE DELLA SOLLECITAZIONE "INTERNA" DELLE TRAVI (AZIONI INTERNE) (CDS)

13/04/2023

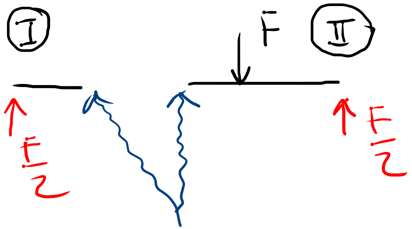


S.C.L.
REAZ. VINCOLARI
NOTE

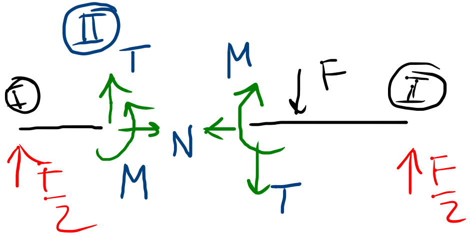
SEZ. CRITICA (PROGETTO)
CRISI DELLA STRUTTURA



"TAGLIO" DELLA TRAVE

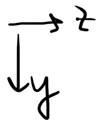


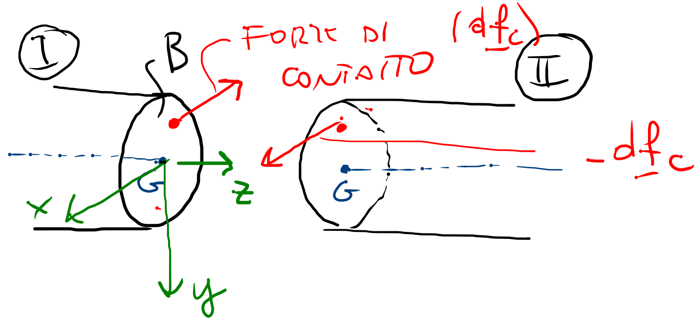
SCAMBIO DI FORZE E MOMENTI CHE MANTENGONO IN EQUILIBRIO SIA I SIA



SFORZO ASSIALE
SFORZO

CDS NELLE STRUTTURE PIANE
- N: FORZA NORMALE
- T: FORZA TAGLIANTE o TAGLIO
- M: MOMENTO FLETTENTE





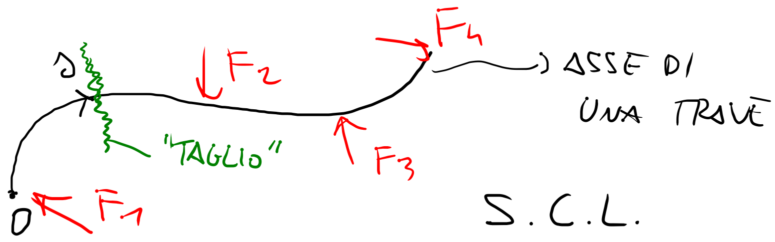
N: RISULTANTE IN DIREZ. z DELLE FORZE DI CONTATTO PRESENTI SULLA SEZ. B

T: RISULT. IN DIREZ. y .....

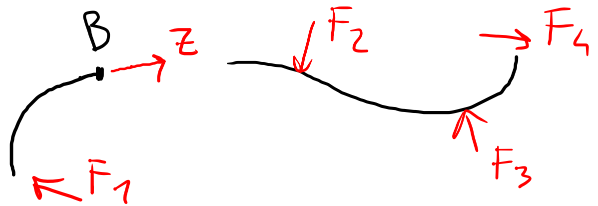
....

M: RISULT. DEI MOMENTI SULLA SEZ. B DELLE FORZE DI CONTATTO RISPETTO AL PUNTO G.

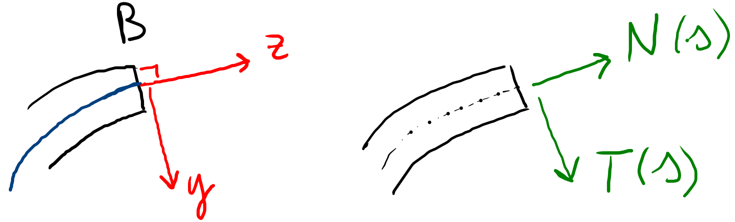
INTRODUCO FORMALMENTE LE CDS



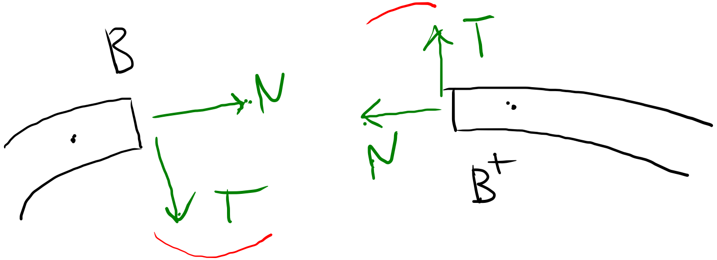
S.C.L. EQUILIBRATO

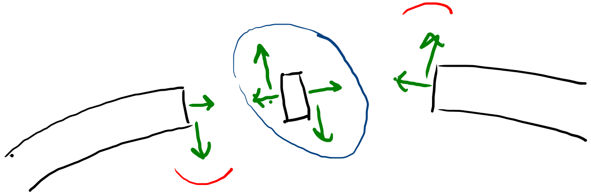


z: ASSE TANGENTE ALL'ASSE DELLA TRAVE



N, T: INCOGNITE DEL PROBLEMA E SONO FUNZ. DI s



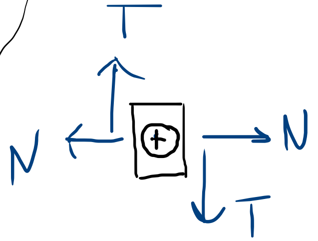


CONVENZIONE SUI SEGNI

$N(s) > 0$: QUANDO INDUCE TRAZIONE NELLA SEZIONE

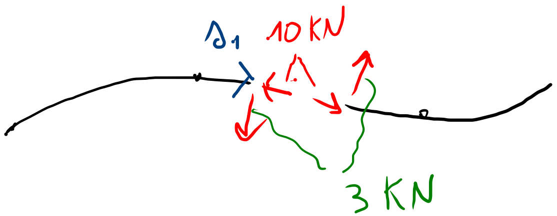
$N(s) < 0$: COMPRESSIONE

$T(s) > 0$: QUANDO FA RUOTARE IN SENSO ORARIO LA PARTE DI TRAVE A CUI È APPLICATO



CONCIO ELEMENTARE

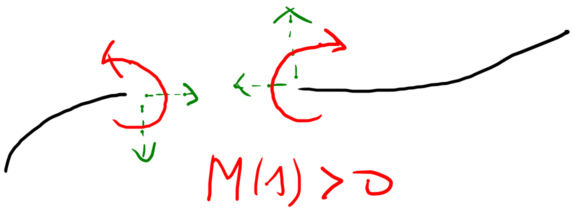
RACCOGLIE LE CONVENZIONE DEI SEGNI DELLE CDS



$N(s_1) = -10\ KN$

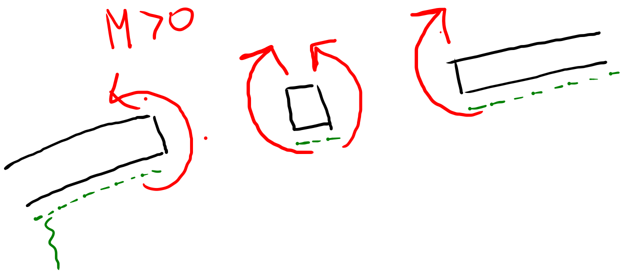
$T(s_1) = +3\ KN$

per quanto riguarda il Momento flettente $M(s)$

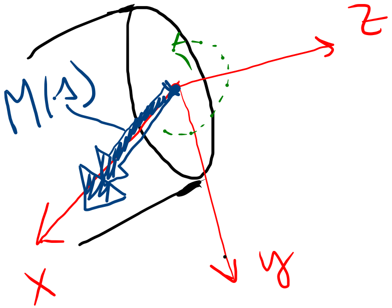


NEL PIANO $M(s)$ LO CONSIDERO POSITIVO QUANDO LA FRECCIA RICURVA "SCAPPA" DAL LATO DELLA SEZ. CON

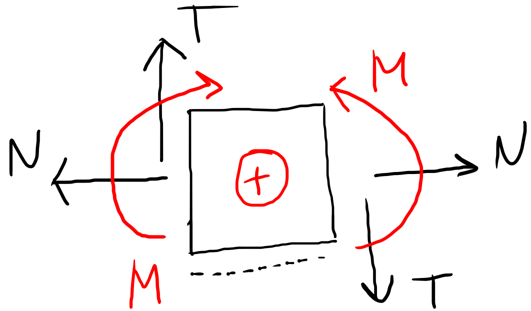
$y > 0$.



INDIVIDUA IL LEMBO DI TRAVE CON $y>0$

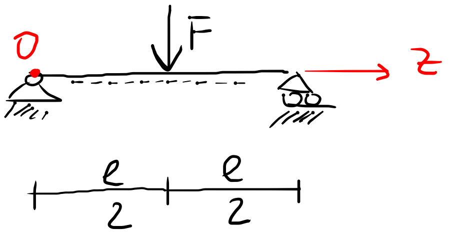


$M(s)$ È UN MOMENTO IL CUI VETTORE È ALLINEATO CON L'ASSE x ; $M(s) > 0$ SE IL VETTORE È CONCORDE a x.

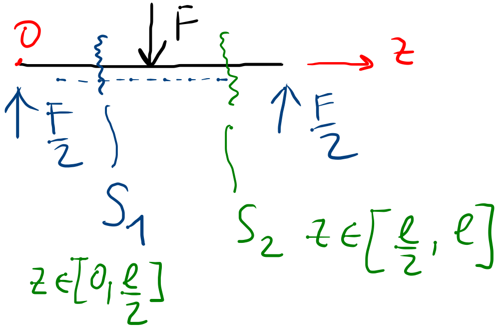


CONCIO ELEMENTARE

ES. CALCOLARE LE CDS $(N(s), T(s), M(s))$ DELLA TRAVE ASSEGNATA

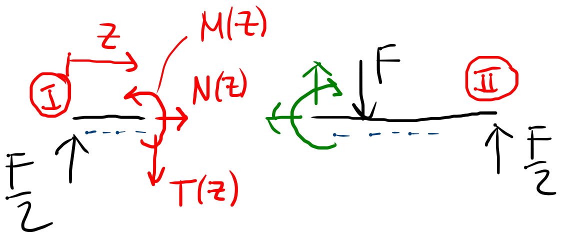


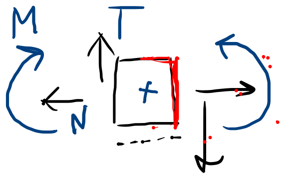
$N(z)$
$T(z)$
$M(z)$



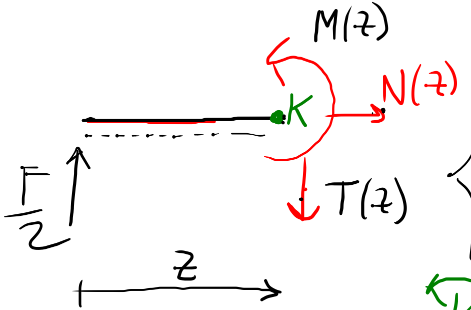
STUDIO la sez. S_1

$z \in [0, \frac{l}{2}]$





CALCOLO LE FUNZIONI $N(z), T(z), M(z)$ IMPONENDO L'EQUILIBRIO DELLA PARTE (I)

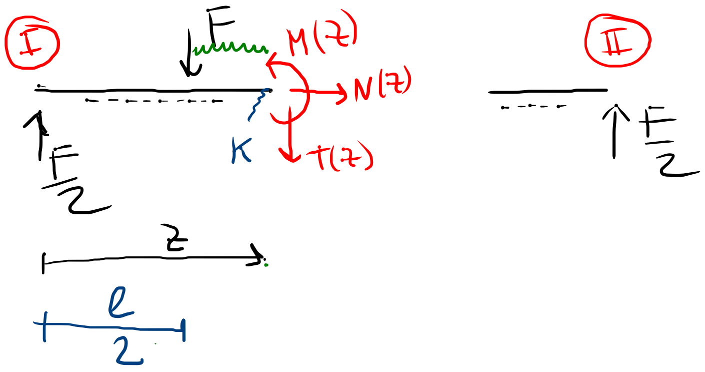


$$\begin{cases} \xrightarrow{+} : \quad \boxed{+N(z) = 0} \\ +\uparrow : \quad +\frac{F}{2} - T(z) = 0 \; ; \quad \boxed{T(z) = +\frac{F}{2}} \\ \circlearrowleft^{+}_{K} : \quad -\frac{F}{2} z + M(z) = 0 \\ \qquad \boxed{M(z) = +\frac{F}{2} z} \end{cases}$$

ES PER CASA!

VERIFICARE CHE LA PARTE (II) È IN EQUILIBRIO

STUDIO LE SEZIONI TIPO S_2, $z \in [\frac{l}{2}, l]$



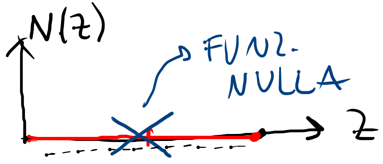
$$\begin{cases} \xrightarrow{+} : \boxed{+N(z) = 0} \\ +\uparrow : +\frac{F}{2} - F - T(z) = 0 \; ; \; \boxed{T(z) = -\frac{F}{2}} \\ \overset{+}{\circlearrowleft} K : -\frac{F}{2} z + F\left(z - \frac{l}{2}\right) + M(z) = 0 \end{cases}$$

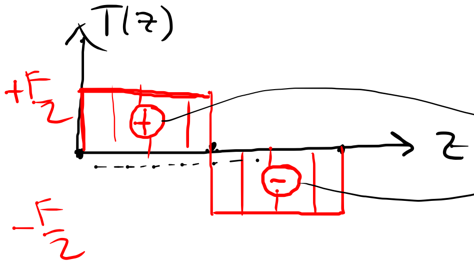
Impongo l'equil. di I

$$\boxed{M(z)} = \frac{F}{2} z + F\left(\frac{l}{2} - z\right) = \frac{F}{2} z - Fz + \frac{Fl}{2}$$

$$= -\frac{F}{2} z + \frac{Fl}{2} = \boxed{\frac{F}{2}(l - z)}$$

I grafici delle funzioni $N(s)$, $T(s)$, $M(s)$ si chiamano normalmente DIAGRAMMI DELLE CDS.





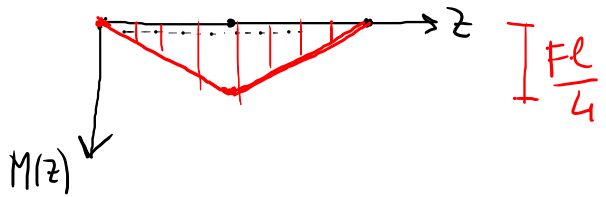
OBBLIGATORIO INDICARE I SEGNI NEI DIAGR. N e T

T è definito su $]0, \frac{l}{2}[\cup]\frac{l}{2}, l[$

DIAGRAMMA DEL MOMENTO FLETTENTE $M(z)$

$z \in [0, \frac{\ell}{2}]$: $M(z) = +\frac{F}{2} z$ $\qquad M(\frac{\ell}{2}) = +\frac{F\ell}{4}$

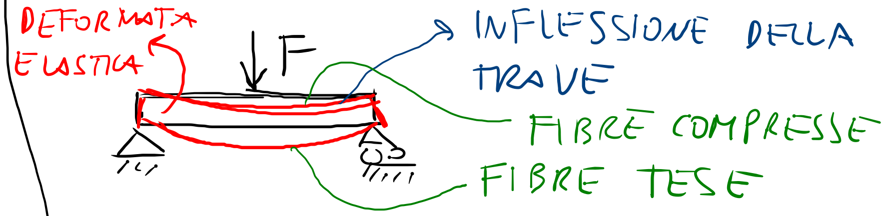
$z \in [\frac{\ell}{2}, \ell]$: $M(z) = \frac{F}{2}(\ell - z)$; $M(\frac{\ell}{2}) = +\frac{F\ell}{4}$; $M(\ell) = 0$



Nel DIAGR. M NON È OBBLIGATORIO METTERE IL SEGNO (È SCONSIGLIATO)

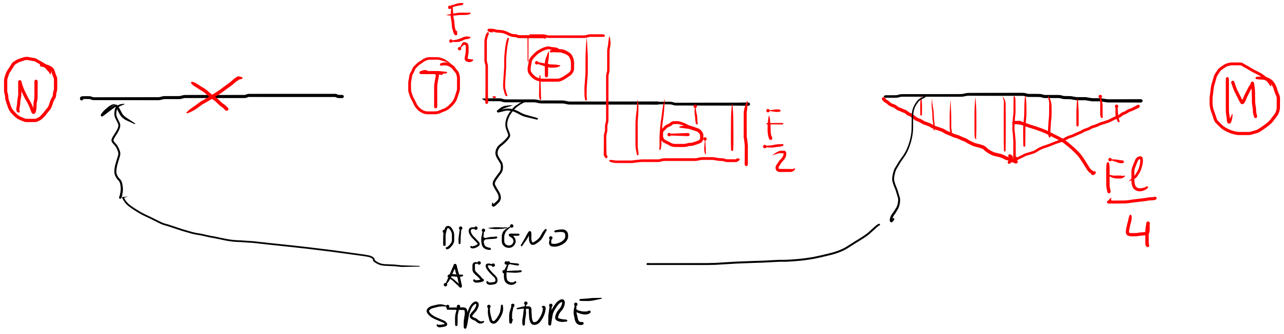
Il DIAGR. M RISULTA DISEGNATO SEMPRE DALLA STESSA PARTE PER ENTRAMBE LE SCELTE DELLA ⌐ TRATTEGGIATA

→ LA PARTE NELLA QUALE È DISEGNATO MI DÀ DELLE INDICAZ. SUL COMPORTAMENTO FISICO DELLA TRAVE

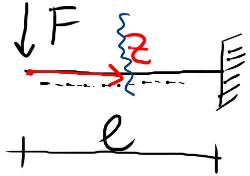


IL DIAGR. M VIENE DISEGNATO DALLA PARTE DELLE FIBRE TESE

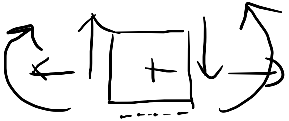
DIAGR. CDS FINALI

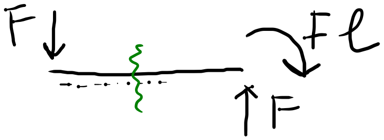


ES



DISEGNARE I DIAGR. QUOTATI DELLE CDS (M,T,N)





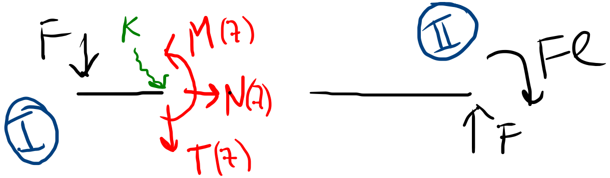
S.C.L. EQUILIBR.

Calcolo N,T,M imponendo l'equil di (I):

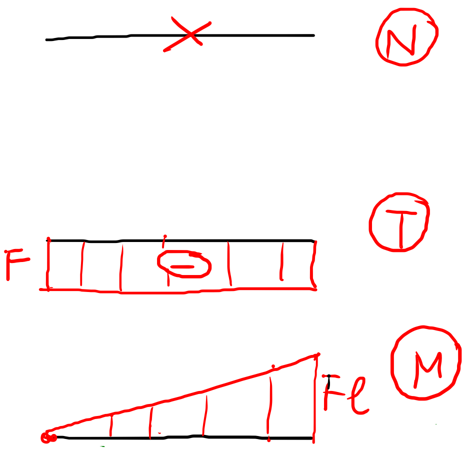
$\xrightarrow{+}$: $\boxed{N(z)=0}$

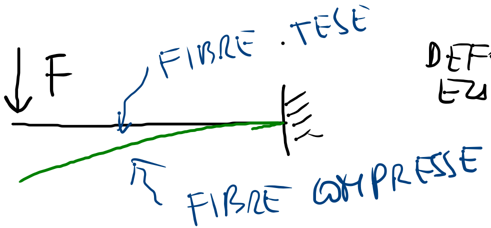
$+\uparrow$: $-F-T(z)=0$; $\boxed{T(z)=-F}$

$+_K\circlearrowleft$: $+Fz+M(z)=0$; $\boxed{M(z)=-Fz}$



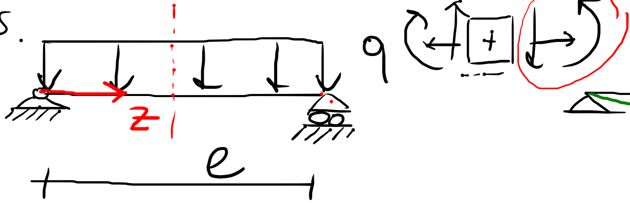
CON UN UNICO TAGLIO DESCRIVO TUTTO IL DOMINIO $z\in[0,\ell]$

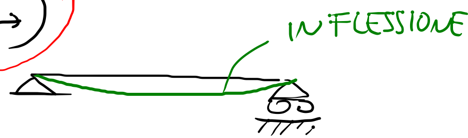




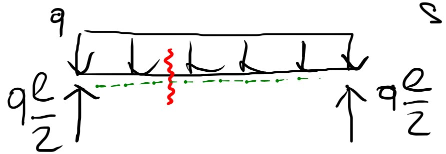
DEFORMATA ELASTICA

ES.

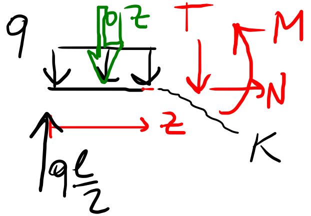


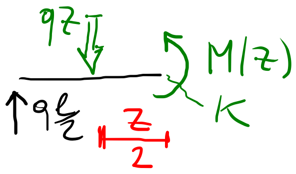


S.C.L-EQUIL.



con un unico "TAGLIO" posso descrivere tutte le CDS nel dominio $z \in [0, l]$





$\xrightarrow{+}$ .... $N(z)=0$

$+\uparrow$: $+q\frac{l}{2} - qz - T(z) = 0$; $T(z) = \underbrace{q\frac{l}{2} - qz}_{\text{LINEARE}}$

$T(0) = +q\frac{l}{2}$

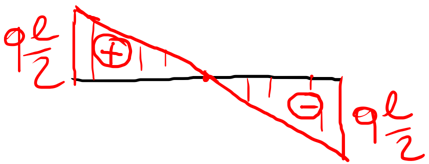
$T(l) = -q\frac{l}{2}$

$K\circlearrowleft$: $-q\frac{l}{2}z + qz\cdot\frac{z}{2} + M(z) = 0$

$M(z) = q\frac{l}{2}z - q\frac{z^2}{2}$ PARABOLA

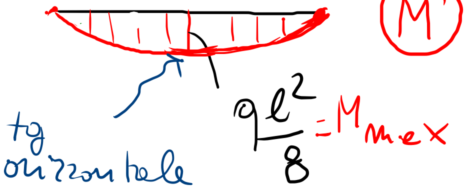
(ANTISYM)

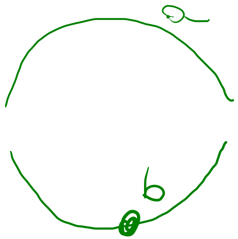
T

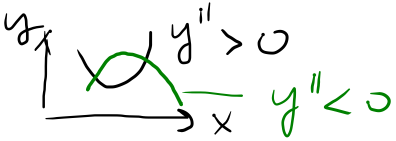


(SYM)

M







$$M(z) = q\frac{\ell}{2}z - q\frac{z^2}{2}$$

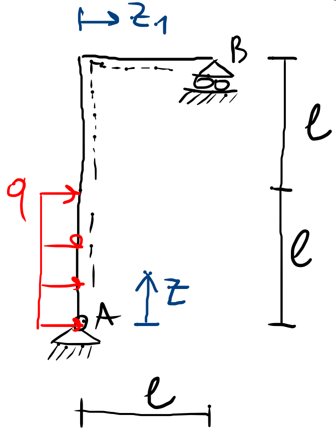
$$M(0) = 0$$

$$M(\ell) = 0$$

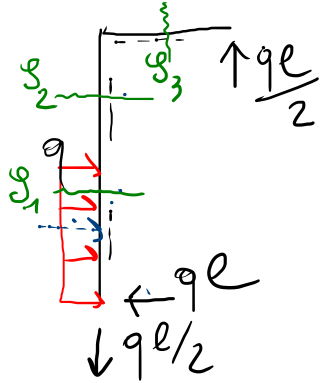
$$M\left(\frac{\ell}{2}\right) = q\frac{\ell^2}{4} - q\left(\frac{\ell}{2}\right)^2\frac{1}{2} = q\frac{\ell^2}{8} > 0$$

ES. $\boxed{\text{CDS?}}$

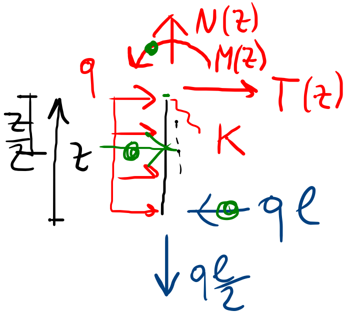
ISOST.

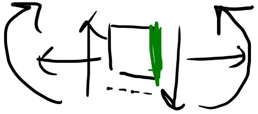


S.C.L. EQUIL.



S_1 $\quad z \in [0, \ell]$





$+\circlearrowleft \frac{\pi}{2}$

$\overset{+}{\rightarrow}: \; +qz - q\ell + T(z) = 0$

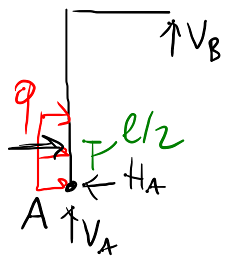
$+\uparrow: \; -q\frac{\ell}{2} + N(z) = 0$

$\overset{+}{\circlearrowleft} K: \; -q\ell z + qz \cdot \frac{z}{2} + M(z) = 0$

$$\left[\begin{aligned} &T(z) = q\ell - qz \;; \quad N(z) = +q\frac{\ell}{2} \\ &M(z) = q\ell z - q\frac{z^2}{2} \end{aligned}\right]$$

$M(0) = 0 \;; \quad M(\ell) = q\ell^2 - q\frac{\ell^2}{2} = q\frac{\ell^2}{2}$

CALCOLO REAZ. VINCOLARI

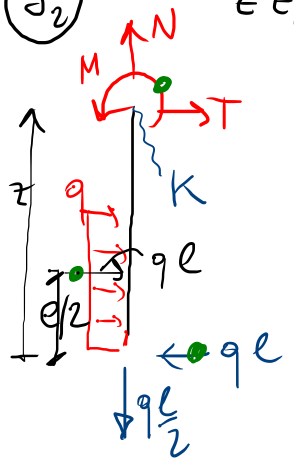


$$\left\{\begin{aligned} &\overset{+}{\rightarrow}: \; +q\ell - H_A = 0 \\ &+\uparrow: \; V_A + V_B = 0 \\ &+\circlearrowleft A: \; -q\ell \cdot \frac{\ell}{2} + V_B \ell = 0 \end{aligned}\right.$$

$H_A = +q\ell \;; \quad V_A = -q\frac{\ell}{2}$

$V_B = +q\frac{\ell}{2}$

(S_2) $\quad z \in [\ell, 2\ell]$



$\xrightarrow{+} : -\cancel{q\ell} + \cancel{q\ell} + T(z) = 0 \qquad T(z) = 0$

$+\uparrow : -q\frac{\ell}{2} + N(z) = 0 \qquad N(z) = +q\ell/2$

$\overset{+}{\curvearrowleft} K) : -q\ell z + q\ell\left(z - \frac{\ell}{2}\right) + M(z) = 0 \qquad M(z) = +q\frac{\ell^2}{2}$