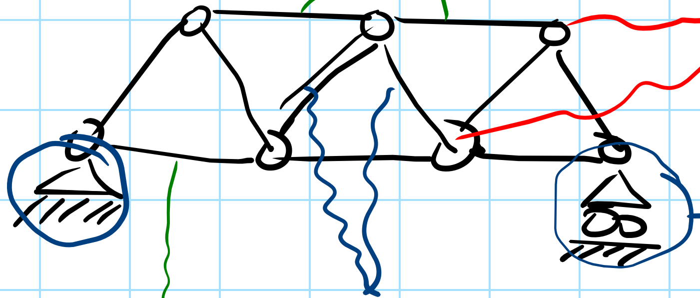
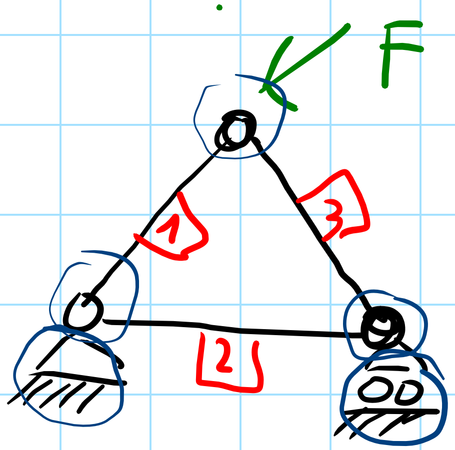
STRUTTURE RETICOLARI

22/5/25



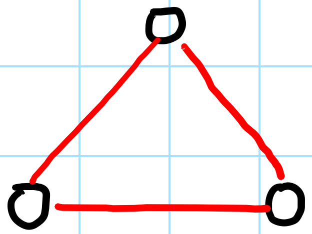


RETICOLARE ISOSTATICA

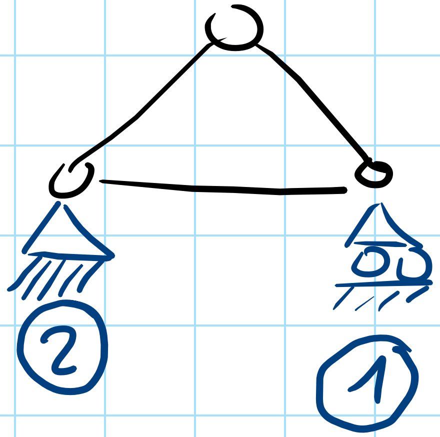
CERCHIAMO DI VERIFICARE L'ISOSTATICITÀ CON UN METODO DIVERSO DA QUELLO TRADIZIONALE

CONDIZ. NECESSARIA PER L'ISOSTATICITÀ:

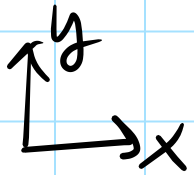
$$2 n_{NODI} = n_{ASTE} + n_{est}$$



3 NODI + 3 ASTE: CORPO RIGIDO (3 G.D.L.)



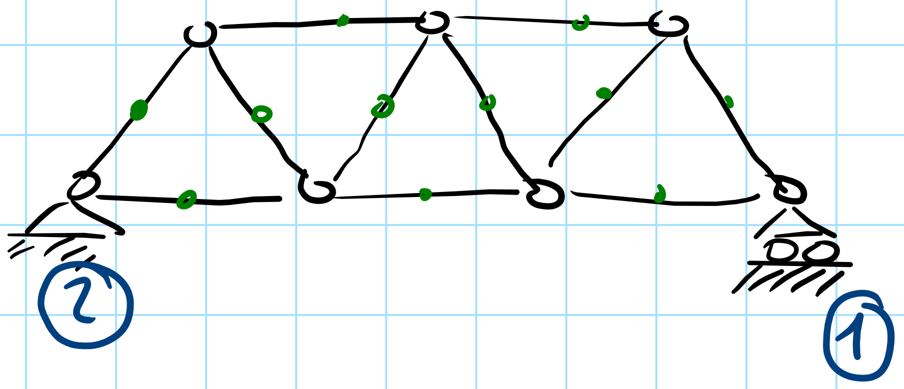
STR A TERRA ISOSTATICA



1) OGNI NODO HA 2 G.D.L. NEL PIANO

2) OGNI ASTA INTERNA TOGLIE 1 G.D.L.

3) BLOCCO A TERRA I G.D.L. RESIDUI

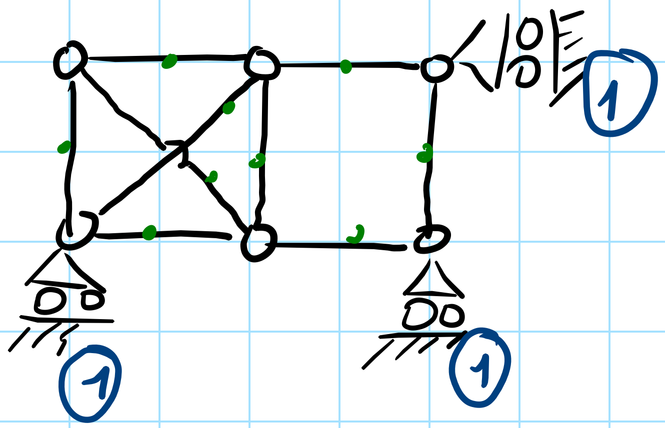


$$2m_N = 14$$

$$\left.\begin{aligned} m_A &= 11 \\ m_e &= 3 \end{aligned}\right\} 14$$

C. NECESSARIA SODDISFATTA : È ISOSTATICA?

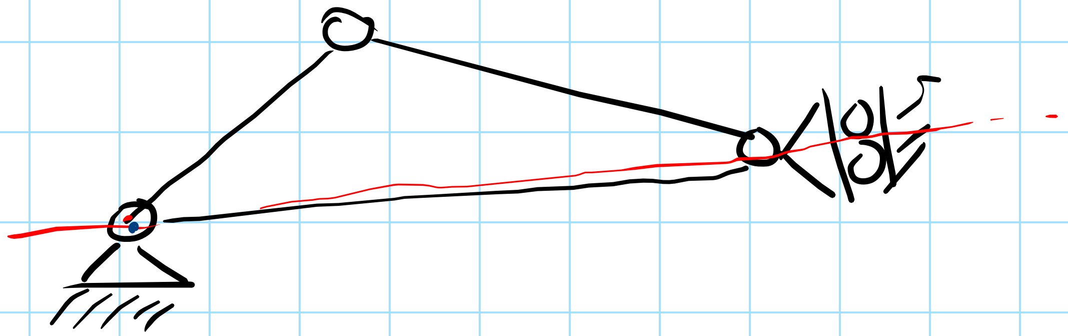
ESEMPI DI STRUTTURE NON ISOSTATICHE (LABILI)



$$2m_N = 12$$

$$\left.\begin{aligned} m_A &= 9 \\ m_e &= 3 \end{aligned}\right\} 12$$

STR LABILE PERCHÈ LA SECONDA MAGLIA È INTERNAM. LABILE

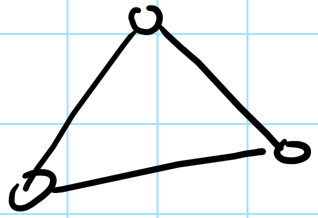


$$2m_N = 6$$

$$\left.\begin{aligned} m_A &= 3 \\ m_e &= 3 \end{aligned}\right\} 6$$

LABILE PERCHÈ ESTERNAM. LABILE

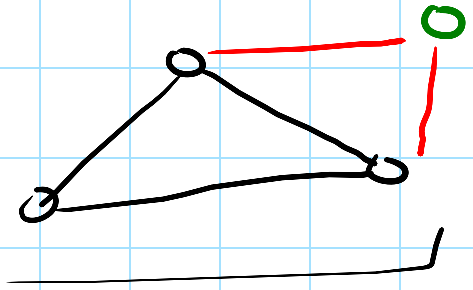
COSTRUZIONE DI UN TRALICCIO "ISOSTATICO" ATTRAVERSO LA GENERAZIONE TRIANGOLARE



TRIANGOLO "ISOSTATICO":

CORPO RIGIDO NEL PIANO

(3 GDL)

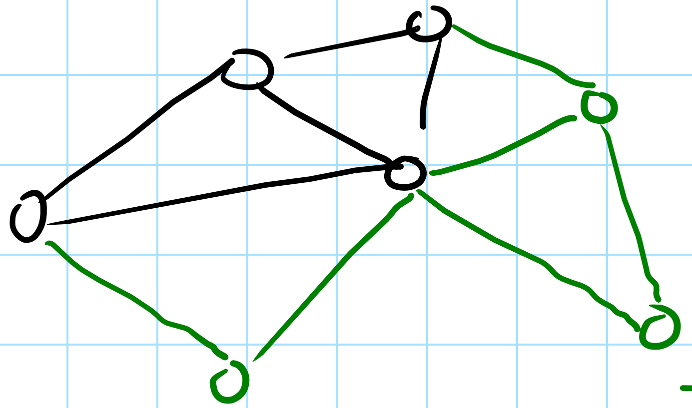


3 GDL

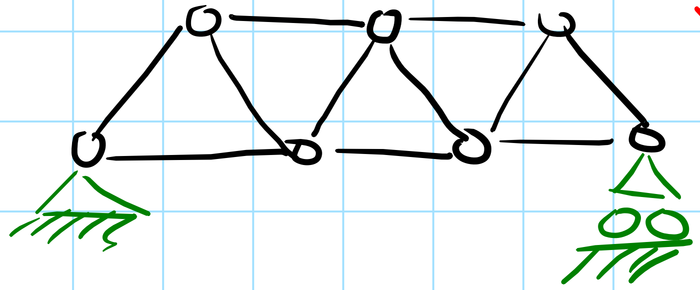
AGGIUNGO OGNI VOLTA

UN NODO (+2 GDL)

e 2 ASTE (−2 GDL)

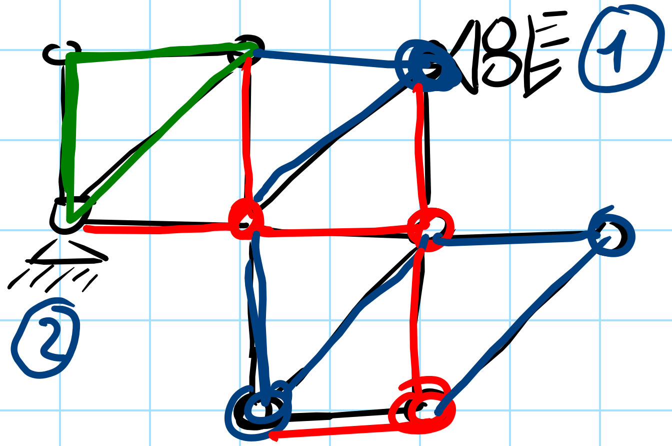


3 GDL



TRALICCIO "ISOSTATICO"

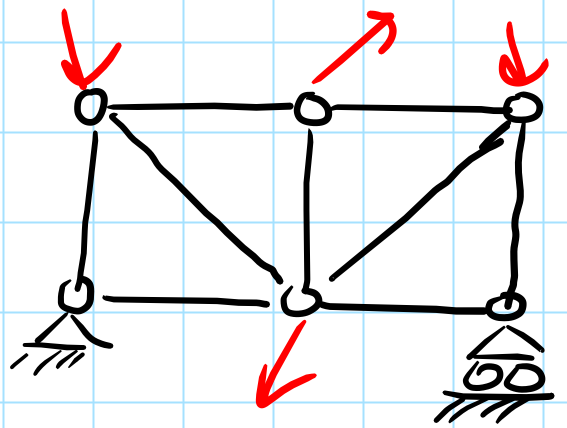
$m_e = 3$



$m_e = 3$

VERIFICARE SODDISFACIM. FORMULA DI MAXWELL

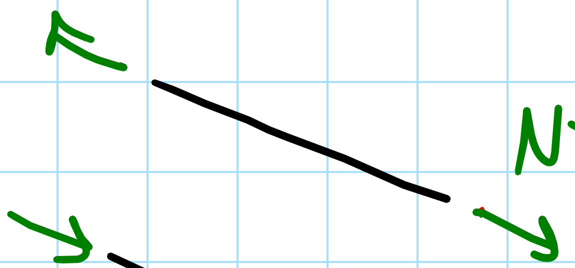
IPOTESI DEL CALCOLO DEGLI "SFORZI" INTERNI NELLE ASTE



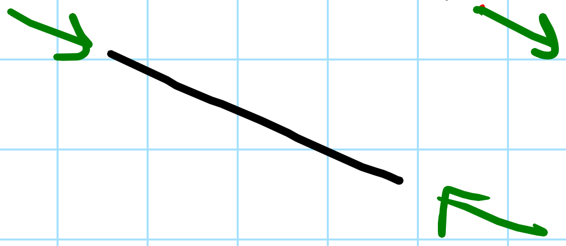
- NODI INCERNIERATI
- ASTE RETTILINEE
- FORZE APPLICATE AI NODI

L'UNICA C.D.S. PRESENTE NELLE ASTE È LA FORZA NORMALE N

(TAGLIO e MOMENTE FLETTENTE SONO NULLI)



$N > 0$ TIRANTE (ASTA TESA)

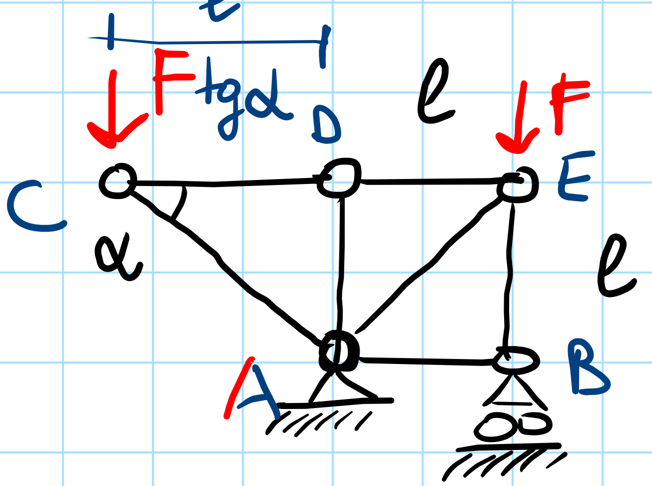


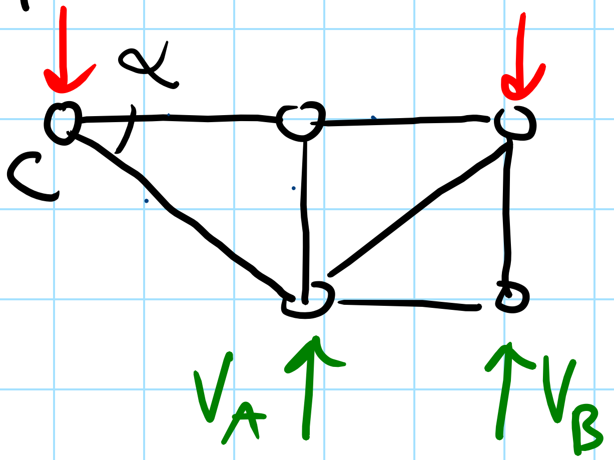
$N < 0$ PUNTONE (ASTA COMPRESSA)

PER IL CALCOLO DEGLI SFORZI INTERNI SI USANO DUE METODI:

- METODO DEI NODI (EQUILIBRIO DELLE CERNIERE INTERNE)
- " DELLE SEZIONI (O DI RITTER)

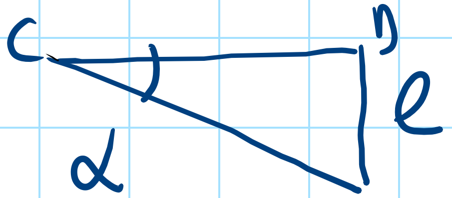
ES: METODO DEI NODI





S.C. LIBERO

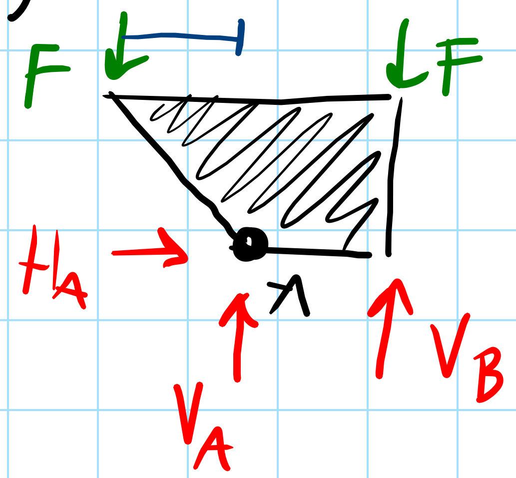
EQUILIBRIO



$$\frac{\ell}{CD} = tg\,\alpha$$

1) STUDIO UN NODO CHE HA 2 ASTE "INCOGNITE"

0) EQUILIBRIO ESTERNO



$$\overset{+}{\rightarrow}: +H_A = 0$$

$$+\uparrow: +V_A + V_B - 2F = 0$$

$$\overset{+}{\circlearrowleft} A: +F\frac{\cancel{\ell}}{tg\,\alpha} - F\cancel{\ell} + V_B\cancel{\ell} = 0$$

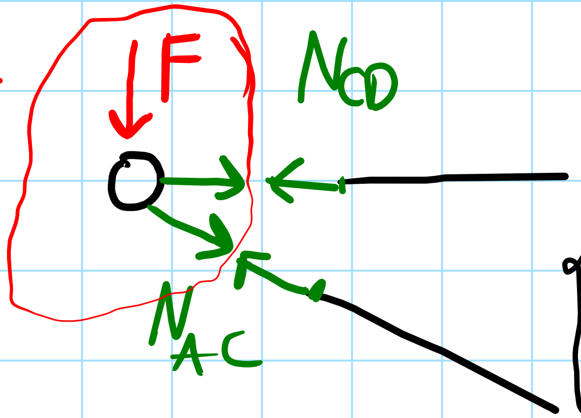
$$\boxed{H_A = 0}$$

$$\boxed{V_B = +F - \frac{F}{tg\,\alpha} = F\left(1 - \frac{1}{tg\,\alpha}\right)} \; ; \; \boxed{V_A = 2F - V_B = 2F - F\left(1 - \frac{1}{tg\,\alpha}\right) = F + \frac{F}{tg\,\alpha}}$$

NODO C

N_{CD}? N_{AC}?

EQUIL.



$$\begin{cases} \overset{+}{\rightarrow}: N_{CD} + N_{AC}\cos\alpha = 0 \\ +\uparrow: -F - N_{AC}\sin\alpha = 0 \end{cases}$$

nelle 2 INCOGNITE!

1) NODO C $\left(\alpha = 45^\circ,\ \alpha = \pi/4\right)$

$$\begin{cases} \xrightarrow{+} : \ N_{CD} + N_{AC}\dfrac{1}{\sqrt{2}} = 0 \\ +\uparrow : \ -F - N_{AC}\dfrac{1}{\sqrt{2}} = 0 \end{cases}$$

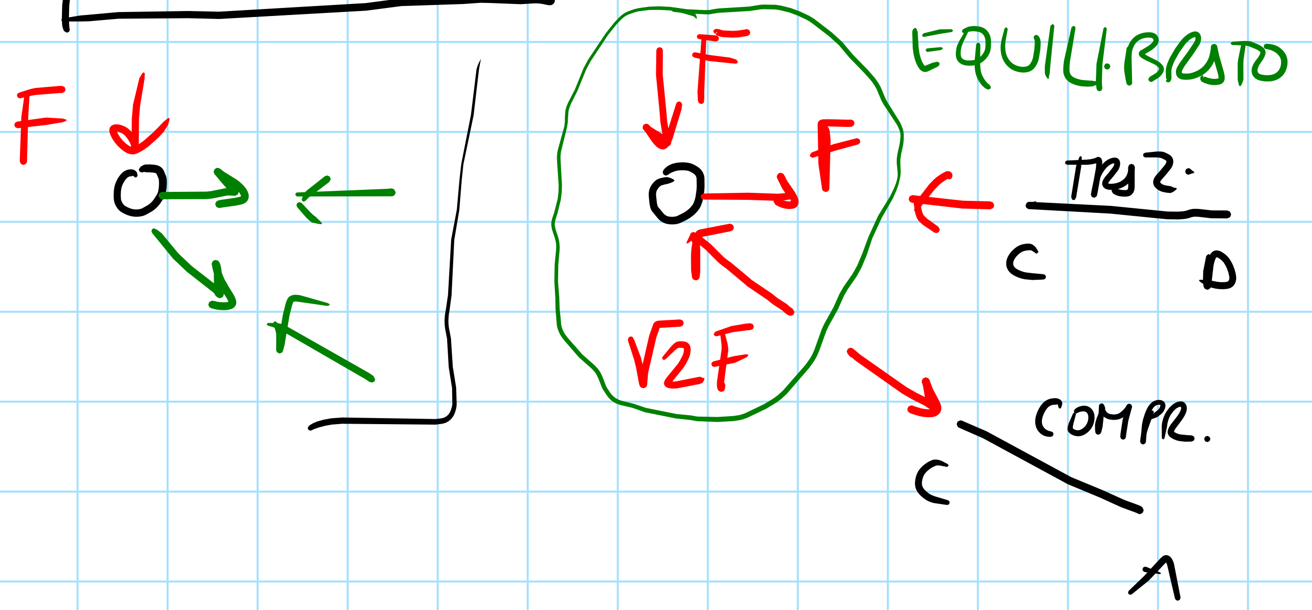
$N_{CD} = -\ N_{AC}\dfrac{1}{\sqrt{2}} = +F$

$\Rightarrow N_{AC} = -\sqrt{2}F$

$$\boxed{\begin{aligned} N_{AC} &= -\sqrt{2}F \\ N_{CD} &= +F \end{aligned}}$$

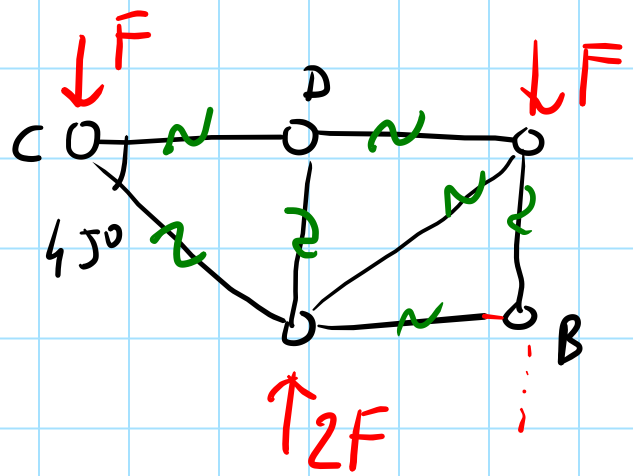
VERSO OPPOSTO

VERSO CONFERMATO

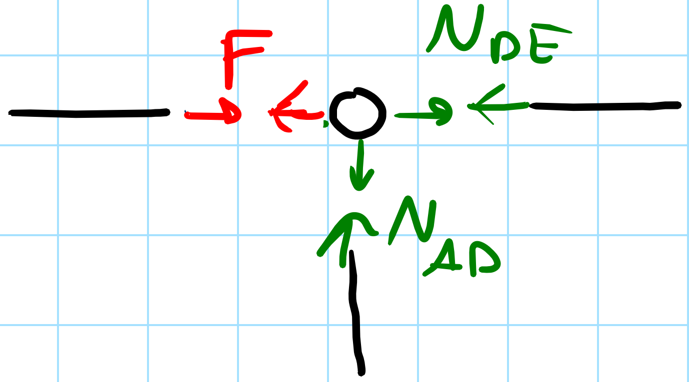


ASTA AC : PUNTONE $(N_{AC} = -\sqrt{2}F)$

CD : TIRANTE $(N_{CD} = +F)$



2) NODO D

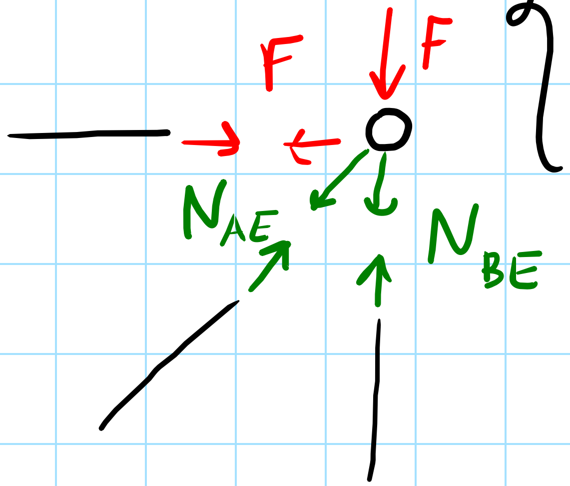


EQUIL. NODO

$$\begin{cases} \xrightarrow{+} : \ -F + N_{DE} = 0 \\ +\uparrow : \ -N_{AD} = 0 \end{cases}$$

$$\begin{cases} N_{AD} = 0 \\ N_{DE} = +F \ \text{(TIRANTE)} \end{cases}$$

3) NODO E



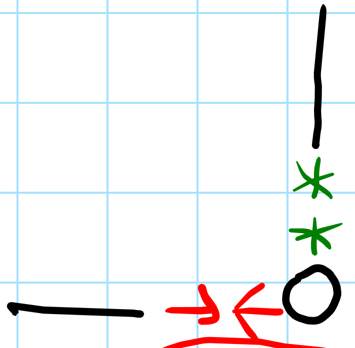
$$\begin{cases} \xrightarrow{+}: \; -F - N_{AE}\dfrac{1}{\sqrt{2}} = 0 \\ +\uparrow: \; -F - N_{BE} - N_{AE}\dfrac{1}{\sqrt{2}} = 0 \end{cases}$$

$$\boxed{N_{AE} = -F\sqrt{2}} \qquad \text{AE: PUNTONE}$$

$$\Downarrow$$

$$; \quad -\cancel{F} - N_{BE} + \cancel{F} = 0 \quad ; \quad \boxed{N_{BE} = 0}$$

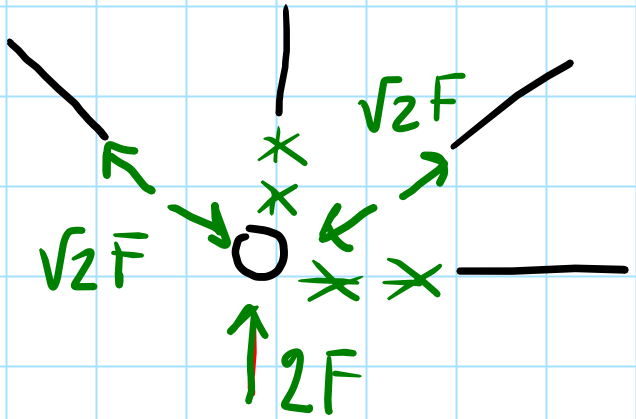
4) NODO B

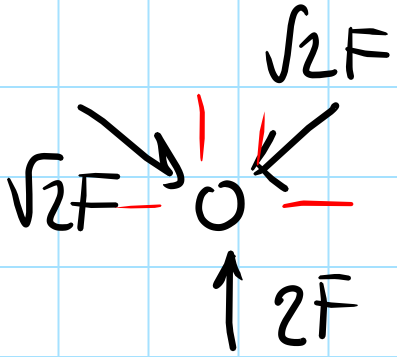


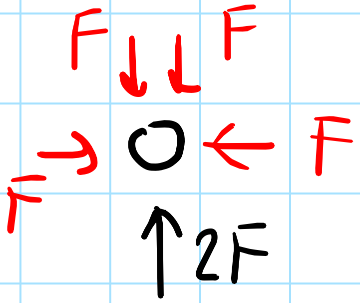
$N_{AB} = 0$

AB: SCARICA

5) VERIFICA EQUIL. NODO (A)





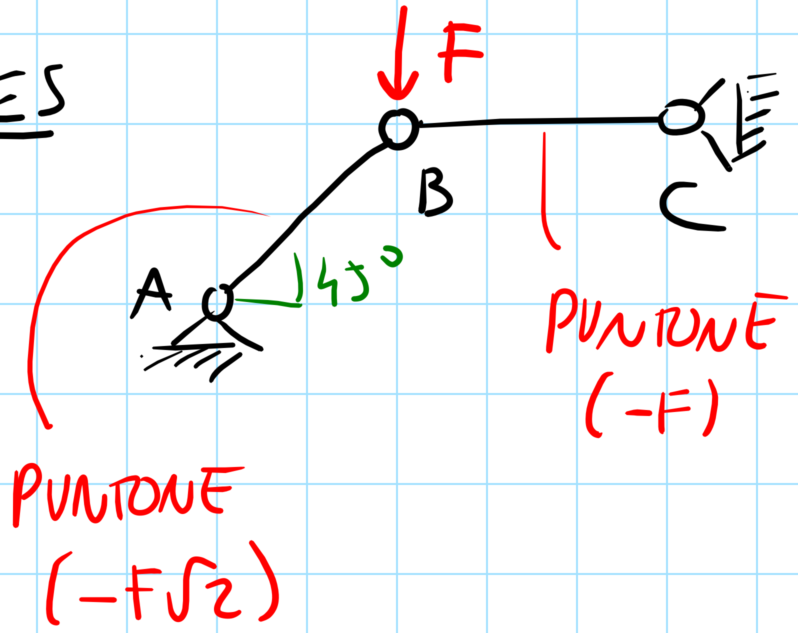


NODO EQUILIBRATO

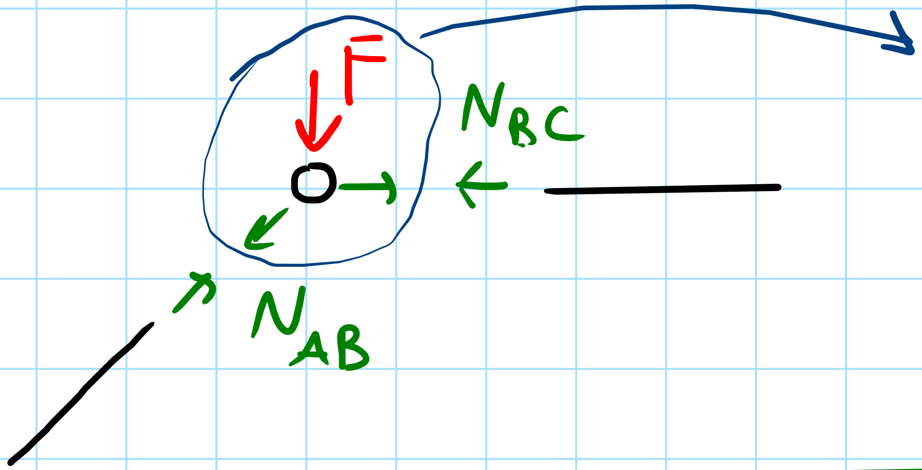
ASTA	AB	AC	AD	AE	BE	CD	DE
N	∅	$-\sqrt{2}F$	∅	$-\sqrt{2}F$	∅	$+F$	$+F$

(−): PUNTONE ; (+) TIRANTE

LES



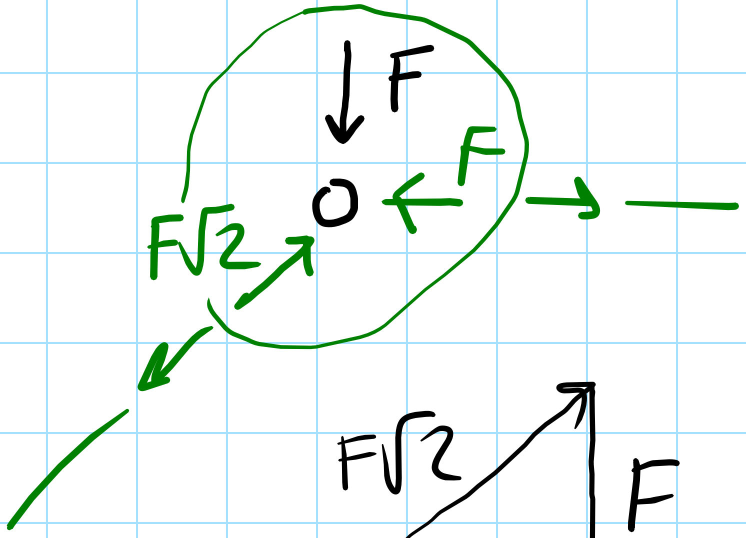
SI RISOLVE CON L'EQUIL. DEL NODO B:

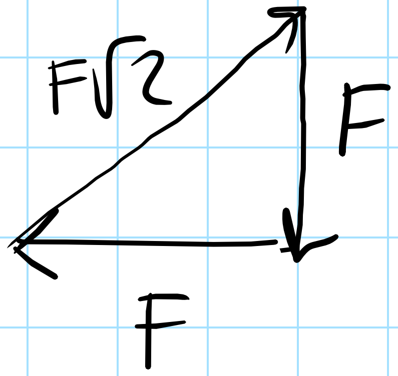


$$\begin{cases} \overset{+}{\rightarrow} : +N_{BC} - N_{AB}\dfrac{1}{\sqrt{2}} = 0 \\ +\uparrow : -F - N_{AB}\dfrac{1}{\sqrt{2}} = 0 \end{cases}$$

$$\boxed{N_{AB} = -F\sqrt{2}}$$

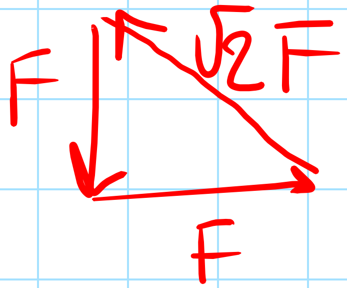
$$N_{BC} + F\cancel{\sqrt{2}}\frac{1}{\cancel{\sqrt{2}}} = 0 \; ; \quad \boxed{N_{BC} = -F}$$



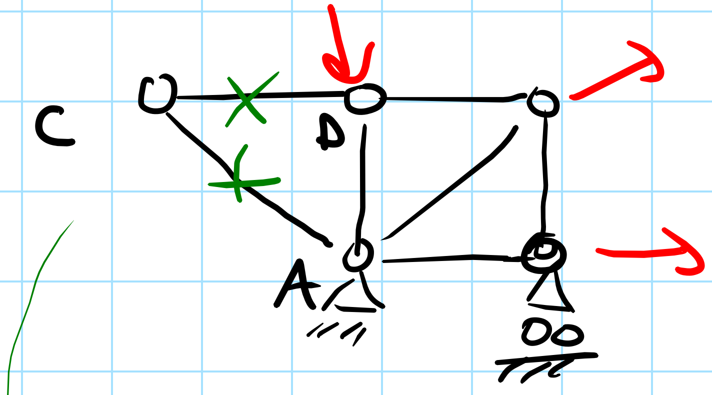


TRIANGOLO DELLE FORZE CHIUSO

es precedente (NODO C)



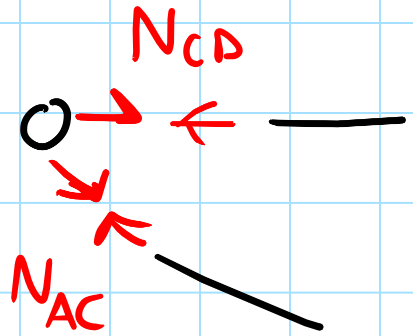
CRITERI PER IL RICONOSCIMENTO DI ASTE SCARICHE



NODO C SCARICO DOVE
CONVERGONO 2 ASTE
NON ALLINEATE

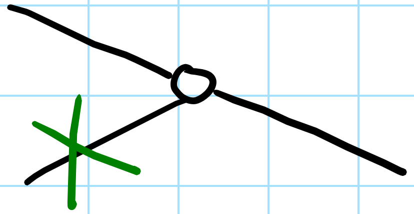
$\Downarrow$

LE 2 ASTE SONO SCARICHE



EQUILIBRIO

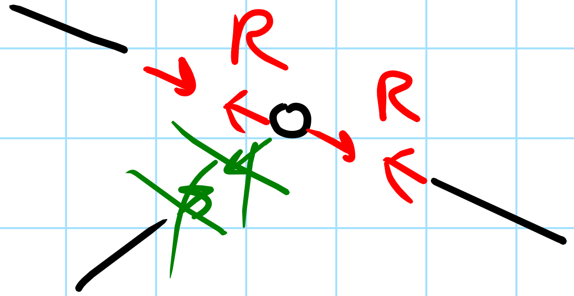
$$\left.\begin{matrix} N_{CD} \\ N_{AC} \end{matrix}\right\} = 0 \, !$$

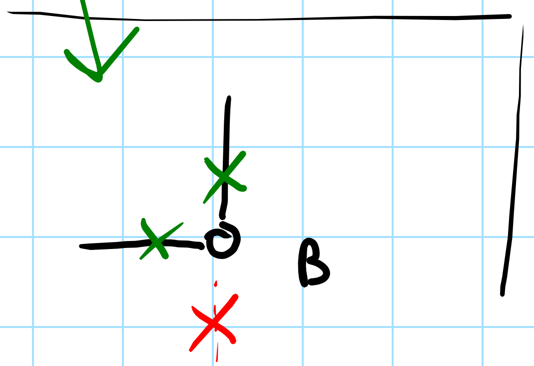


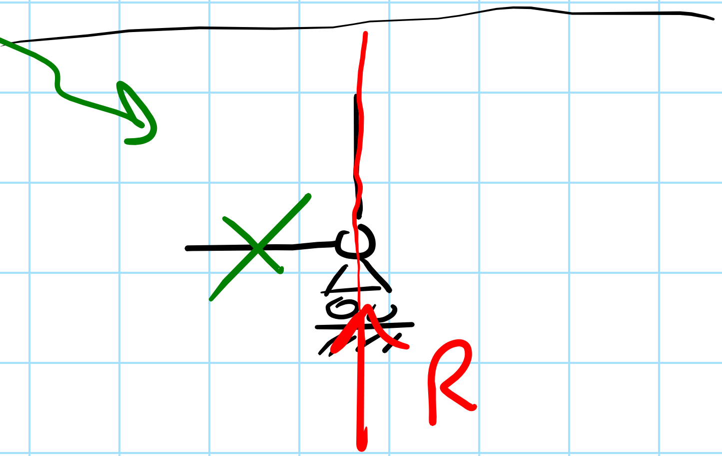
NODO SCARICO DOVE
CONVERGONO 2 ASTE ALLINEATE
E UNA 3ª NON ALLINEATA

$\Downarrow$

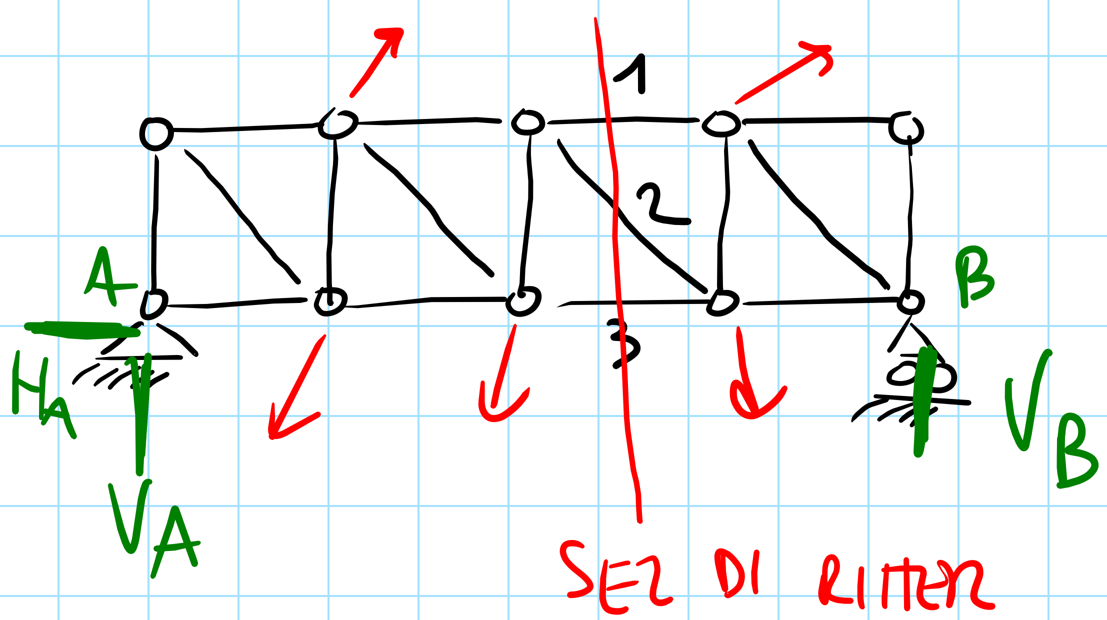
L'ASTA OBLIQUA È SCARICA

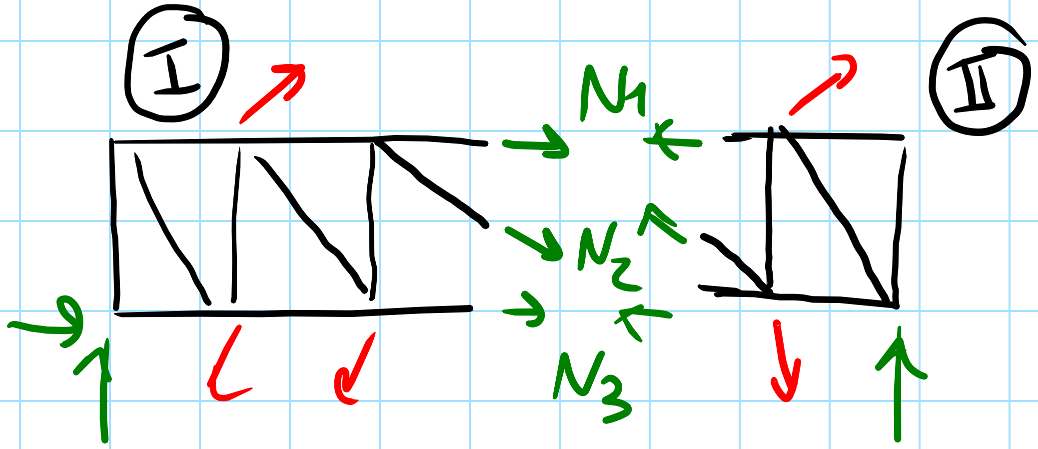






METODO DELLE SEZIONI (CALCOLARE, PRIMA, LE REAZ. ESTERNE)



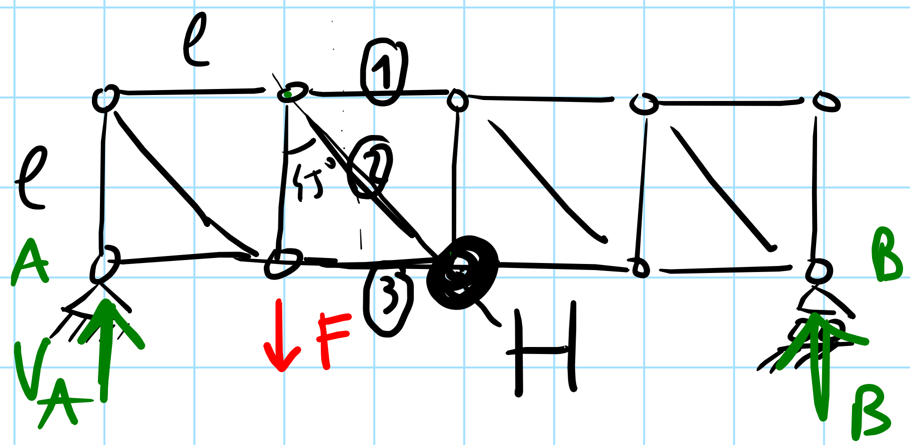


PER CALCOLARE N_1, N_2, N_3

STUDIO L'EQUILIBRIO o DI I

o DI II (3 EQUAZ. IN 3 INCOGNITE)

LES

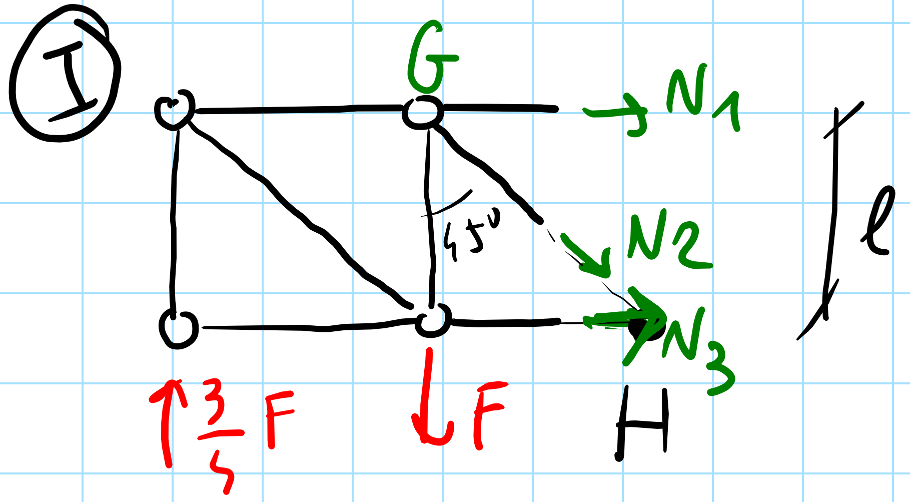


N_1
N_2 ?
N_3

0) CALCOLO REAZ ESTERNE

$V_A = \frac{3}{4} F$; $V_B = \frac{1}{4} F$ $(H_A = 0)$

1) STUDIO SEZ. DI RITTER



CERCO DI SCRIVERE OGNI VOLTA UNA SOLA EQUAZ. PER L'INCOGNITA CHE VOGLIO CALCOLARE:

N_1! I $\curvearrowleft^{+}$ H : $-\frac{3}{4} F 2\cancel{l} + F\cancel{l} - N_1 \cancel{l} = 0$

$N_1 = F - \frac{3}{2} F = -\frac{F}{2}$ (ASTA 1 : PUNTONE)

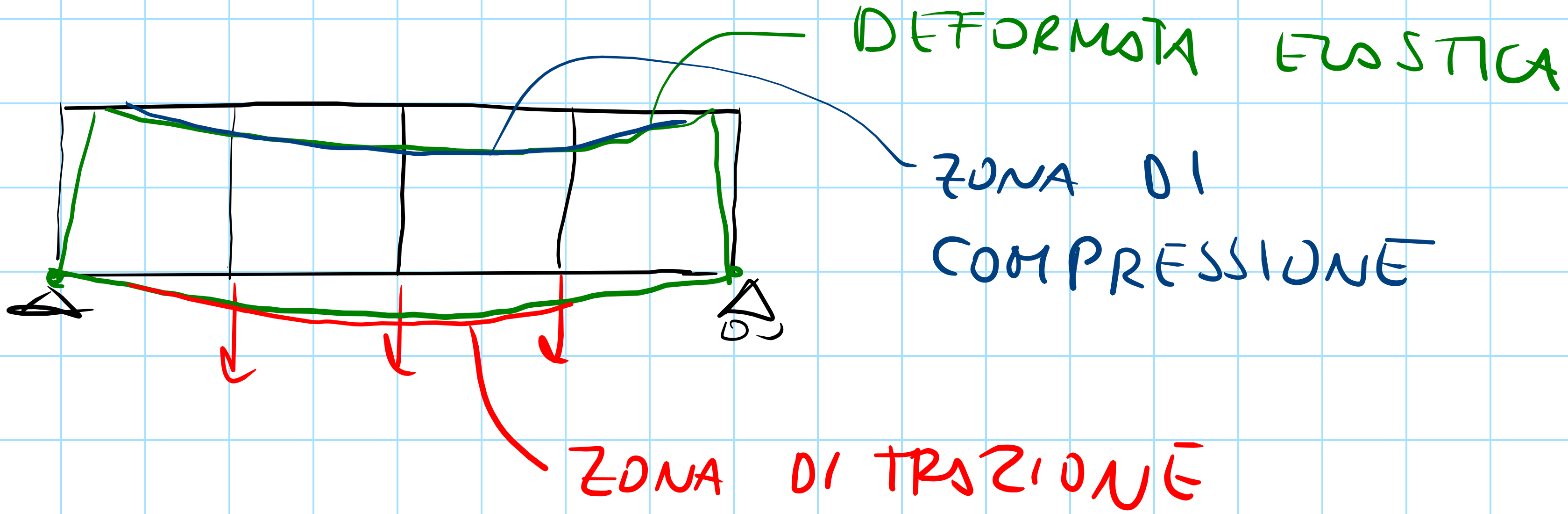
N_3! I $\curvearrowleft^{+}$ G : $-\frac{3}{4} F l + N_3 l = 0$

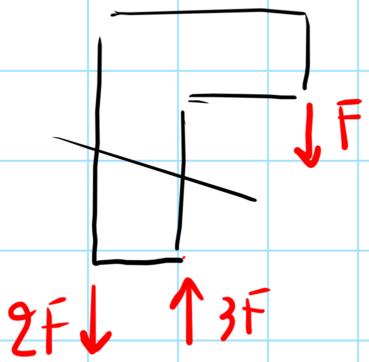
$N_3 = +\frac{3}{4} F$ (ASTA 3 : TIRANTE)

N_2! $\uparrow +$ I : $+\frac{3}{4} F - F - N_2 \frac{1}{\sqrt{2}} = 0$

$-\frac{F}{4} = N_2 \frac{1}{\sqrt{2}}$; $N_2 = -\frac{\sqrt{2}}{4} F$

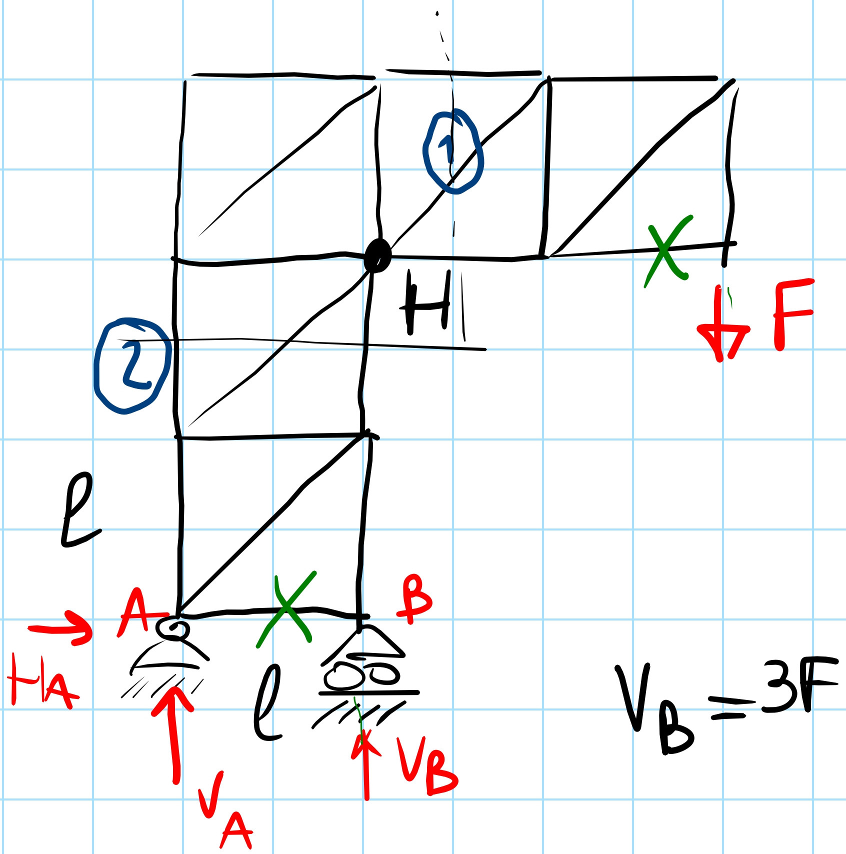
(ASTA 2 PUNTONE)





ES

VERIF L'ISOSTATICITÀ (CERNIERE IN TUTTI I NODI)



0) CALCOLO REAZ VINCOLARI

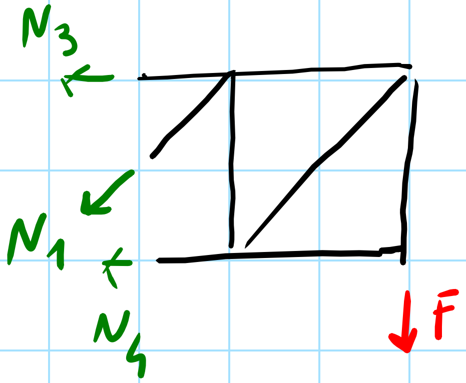
$$\overset{+}{\rightarrow}: \boxed{+H_A = 0}$$

$$+\uparrow: \; V_A + V_B - F = 0$$

$$\overset{+}{\curvearrowleft}A: \; +V_B \cancel{\ell} - F \cdot 3\cancel{\ell} = 0$$

$V_B = 3F$; $V_A = F - 3F = -2F$

N_1 ?

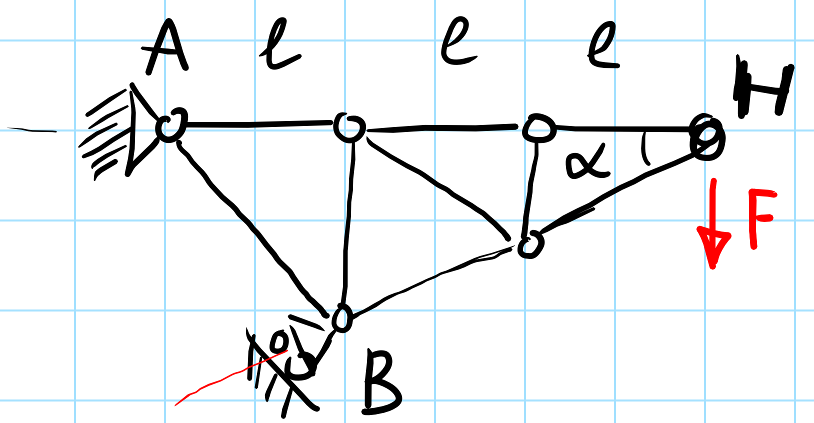


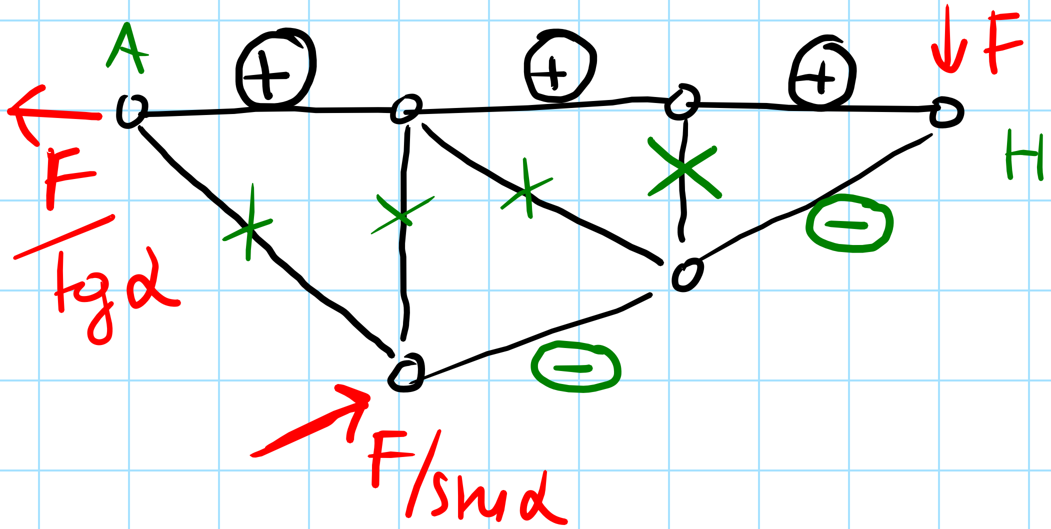
$$+\uparrow: \; -N_1 \frac{1}{\sqrt{2}} - F = 0 \; ; \quad N_1 = -F\sqrt{2}$$

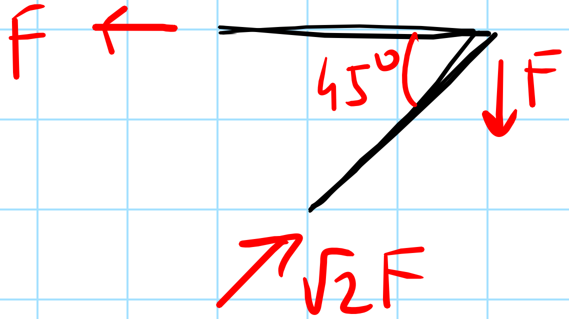
1 :

PUNTONE

ES

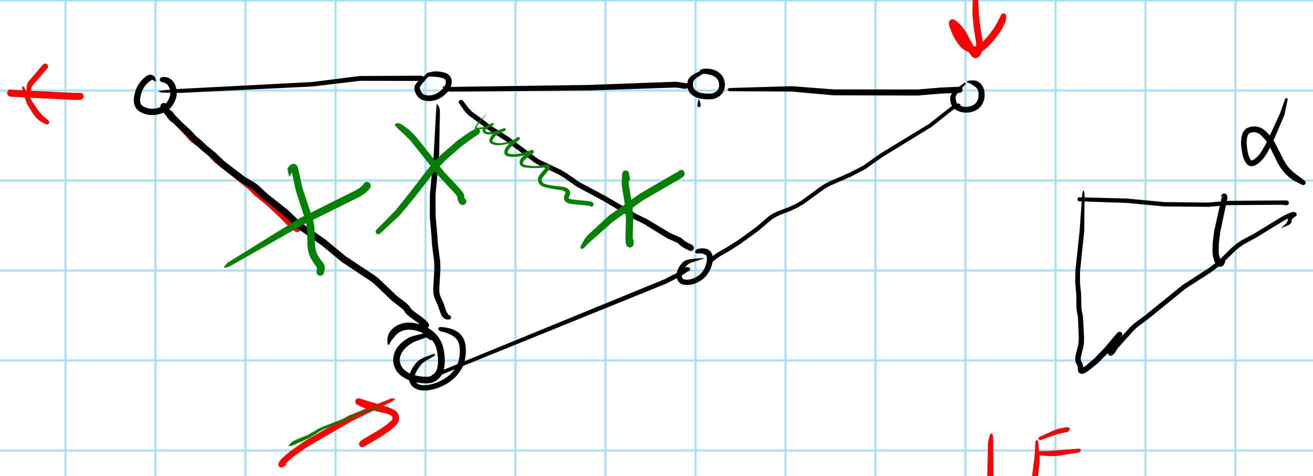




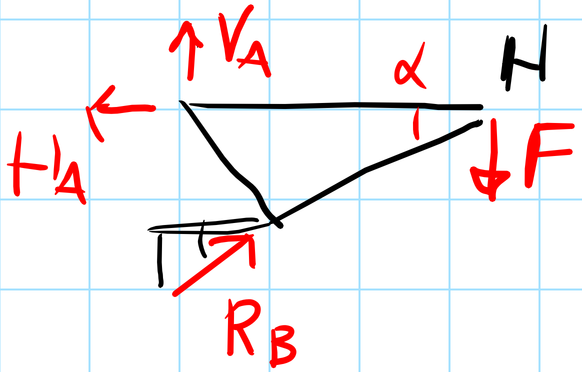


$2m_N = 12$

$\left.\begin{array}{l} m_A = 9 \\ m_e = 3 \end{array}\right\} 12$



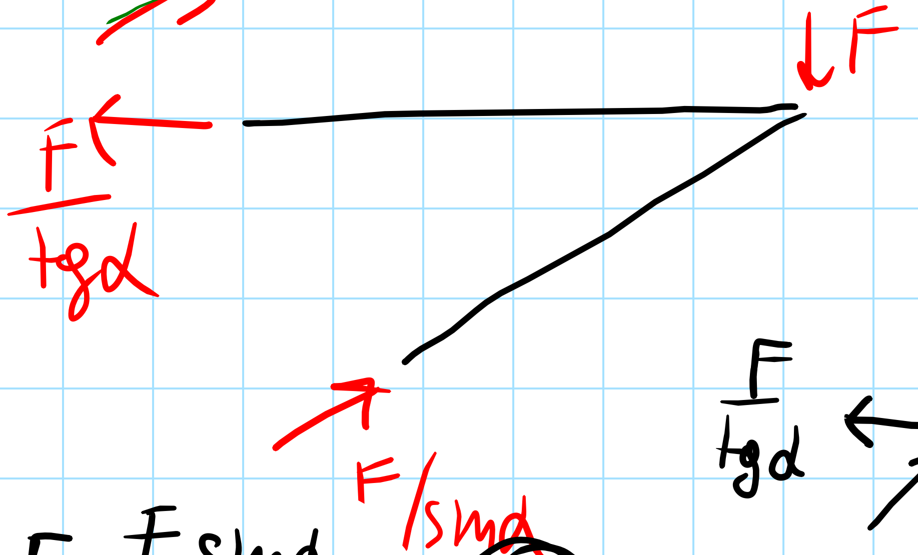
0) CALCOLO REAZ. VINCOLARI

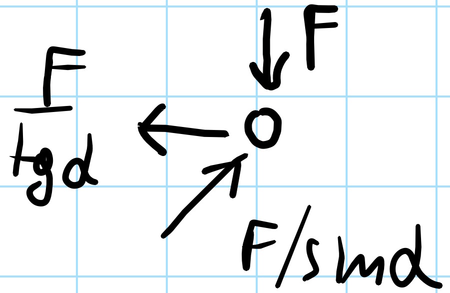


$+\uparrow: V_A - F + R_B \sin\alpha = 0$

$\xrightarrow{+}: -H_A + R_B \cos\alpha = 0$

$\circlearrowleft H^{+}: -V_A \cdot 3l = 0$





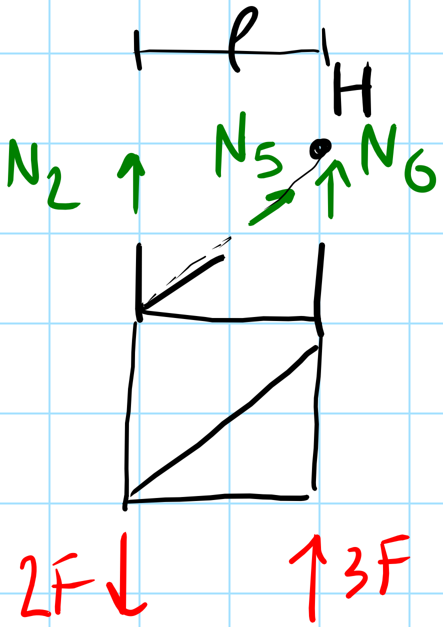
$+\uparrow: -F + \frac{F}{\sin\alpha}\sin\alpha = 0$ OK

$V_A = 0$

$R_B = F/\sin\alpha$; $\quad H_A = R_B \cos\alpha = \frac{F}{\sin\alpha}\cos\alpha = \frac{F}{tg\alpha}$

$\xrightarrow{+}: -F/tg\alpha + \frac{F}{\sin\alpha}\cos\alpha \overset{?}{=} 0$ OK

VERIF NODO H OK



N_2? $\overset{+}{\curvearrowleft} H$: $2F\ell - N_2\ell = 0$; $N_2 = {}^{+}2F$

(2) : TIRANTE