

$$\rightarrow R_x = 0 \quad F_{(D)} - H_B + H_A = 0$$

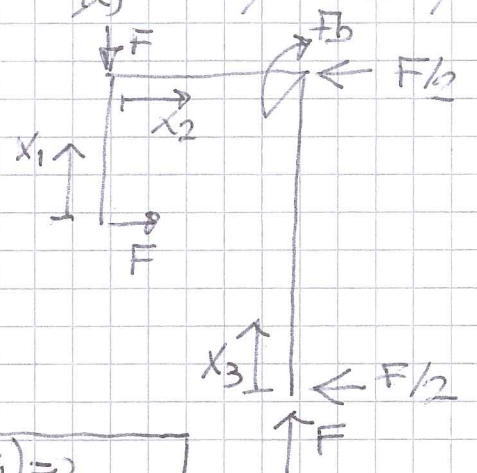
$$\uparrow R_y = 0 \quad -F_{(C)} + V_A = 0$$

$$\int M_z(x) = 0 \quad -F_{(C)}b + F_{(D)}b - F_b + H_B \cdot 2b = 0$$

$$V_A = F$$

$$H_B = F/2$$

$$H_A = -F/2$$



D → C (0 < x₁ < b)

$$\uparrow R_{//} = 0 \quad N(x_1) = 0 \quad \boxed{N(x_1) = 0}$$

$$\rightarrow R_{\perp} = 0 \quad F + T(x_1) = 0 \quad \boxed{T(x_1) = -F}$$

$$\int M_z(x) = 0 \quad Fx_1 + M(x_1) = 0 \quad \boxed{M(x_1) = -Fx_1}$$

$$\begin{cases} M(x_1=0) = 0 \\ M(x_1=b) = -Fb \end{cases}$$

C → B (0 < x₂ < b)

$$\rightarrow R_{//} = 0 \quad F + N(x_2) = 0 \quad \boxed{N(x_2) = -F}$$

$$\uparrow R_{\perp} = 0 \quad -F - T(x_2) = 0 \quad \boxed{T(x_2) = -F}$$

$$\int M_z(x) = 0 \quad +Fb + Fx_2 + M(x_2) = 0 \quad \boxed{M(x_2) = -F[b + x_2]}$$

$$\begin{cases} M(x_2=0) = -Fb \\ M(x_2=b) = -2Fb \end{cases}$$

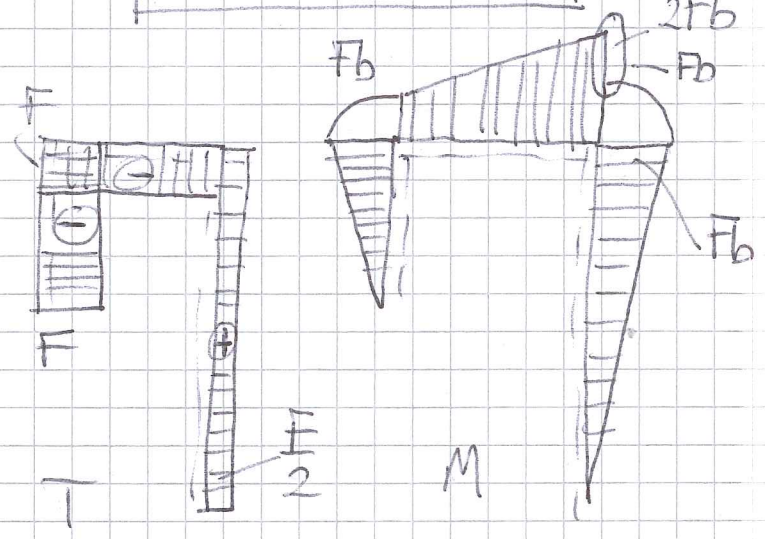
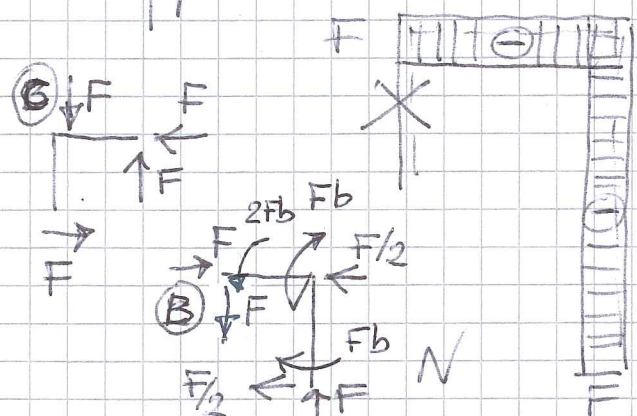
A → B (0 < x₃ < 2b)

$$\rightarrow R_{//} = 0 \quad F + N(x_3) = 0 \quad \boxed{N(x_3) = -F}$$

$$\rightarrow R_{\perp} = 0 \quad -F/2 + T(x_3) = 0 \quad \boxed{T(x_3) = +F/2}$$

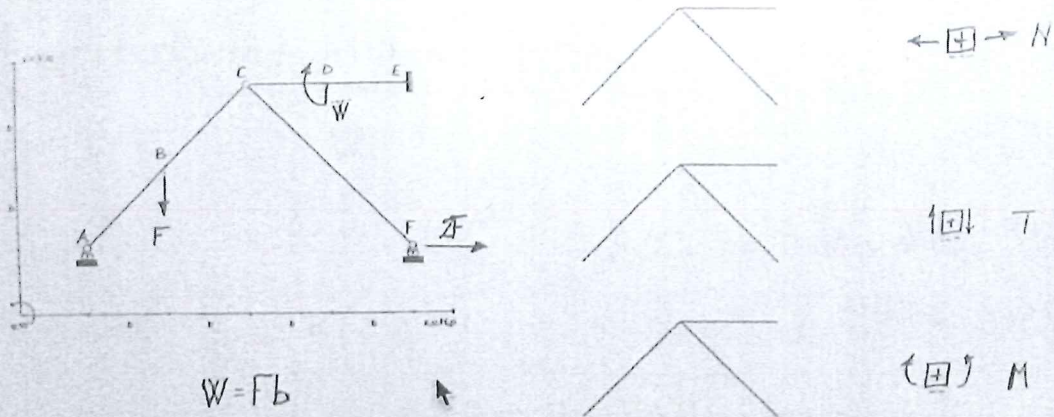
$$\int M_z(x) = 0 \quad -F/2 x_3 - M(x_3) = 0 \quad \boxed{M(x_3) = -F/2 x_3}$$

$$\begin{cases} M(x_3=0) = 0 \\ M(x_3=2b) = Fb \end{cases}$$



Esercizio n.1 (9 punti)

Risolvere la struttura presentata in Figura e riportare in grafico e per iscritto le azioni interne nei tratti indicati.

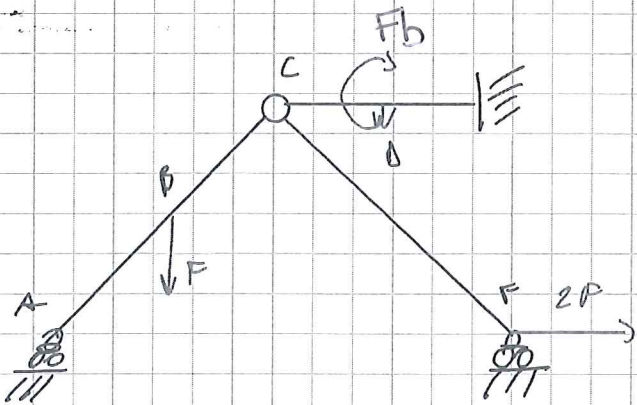


$W = Fb$

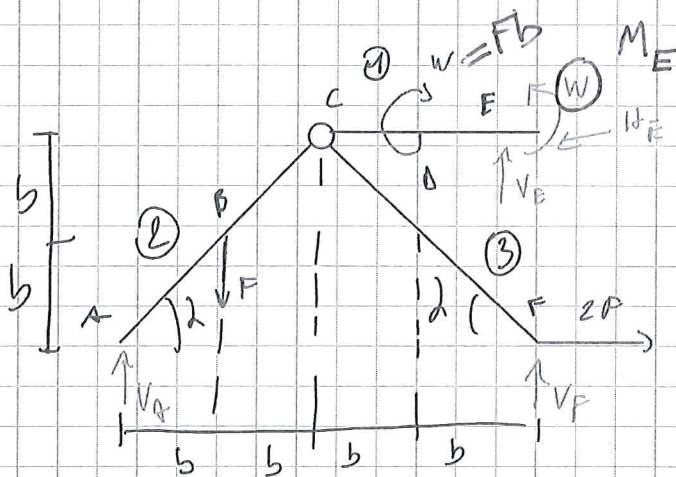
$\left[\oplus \right] \rightarrow N$

$\left[\ominus \right] \rightarrow T$

$\left[\oplus \right] \rightarrow M$



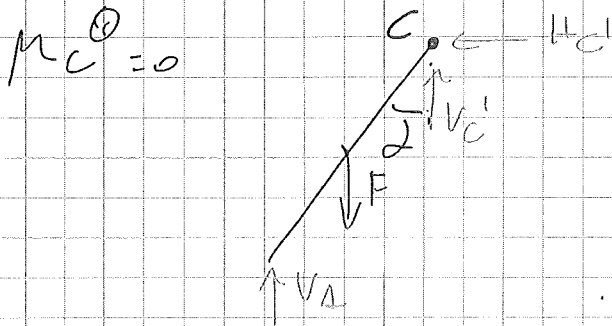
REAZIONI VINCOLARI



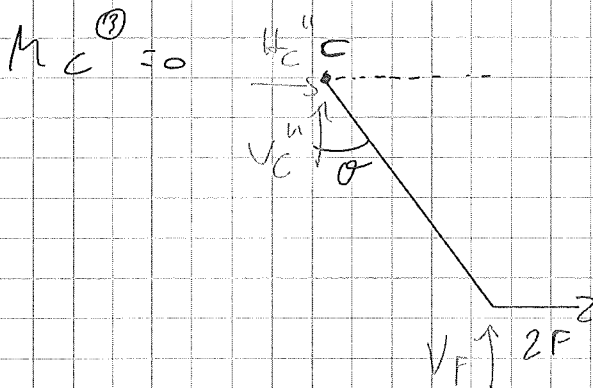
$$\textcircled{1} \cup \textcircled{2} \cup \textcircled{3} \begin{cases} \rightarrow R_x = 0 & -H_E + 2F = 0 \\ \uparrow R_y = 0 & V_A + V_F - F + V_E = 0 \\ \curvearrowright M_{Z(E)} = 0 & \left[W - Fb + 2b \cdot 2F - 4bV_A + 3bF = 0 \right] \\ & -V_A 4b + F \cdot 3b = Fb + 2F \cdot 2b + M_E = 0 \end{cases}$$

$$\begin{cases} H_E = 2F \\ V_A + V_F - F + V_E = 0 \\ W - Fb + 4bF - 4bV_A + 3bF = 0 \end{cases}$$

EQ. AUSILIARE:



$$M_C^{\oplus} = 0 \rightarrow +\cancel{1}F - 2bV_A = 0 \rightarrow V_A = \frac{F}{2}$$



$$M_C^{\ominus} = 0 \rightarrow +\cancel{2}b \cdot 2F + \cancel{2}b \cdot V_F = 0 \rightarrow V_F = -2F$$

$$\begin{cases} H_E = 2F \\ V_A + V_F - F + V_E = 0 \rightarrow \frac{F}{2} - 2F - F + V_E = 0 \rightarrow V_E = +\frac{5}{2}F \end{cases}$$

$$\left[4bF - 4bV_A + 3bF - W - Fb = 0 \Rightarrow \right] -\left[\frac{F}{2}\right] \cdot 4b + 3Fb - Fb + 4Fb + M_E = 0$$

$$4bF - 4b \cdot \frac{F}{2} + 3b \cdot F - W - Fb = 0 \rightarrow 4bF - 2bF + 3bF - Fb + W = 0$$

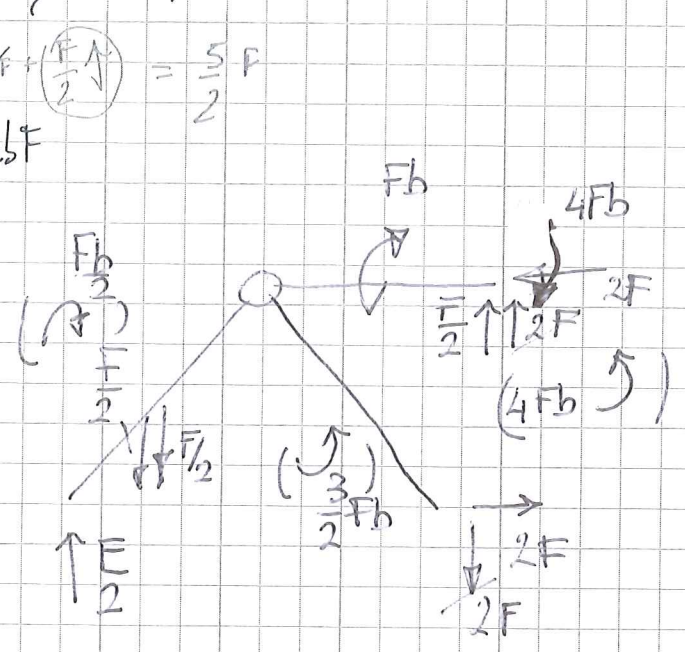
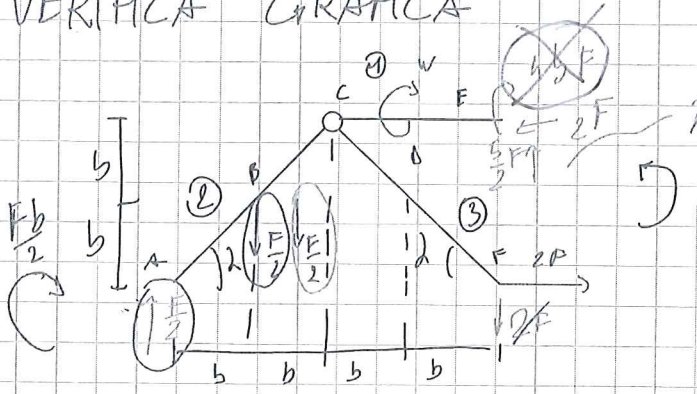
$$\rightarrow W + 4bF = 0 \rightarrow W = -4bF$$

$$-2Fb + 3Fb - Fb + 4Fb + M_E = 0$$

$$\underline{M_E = -4Fb}$$

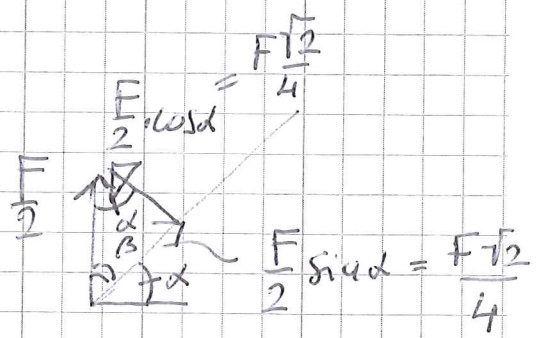
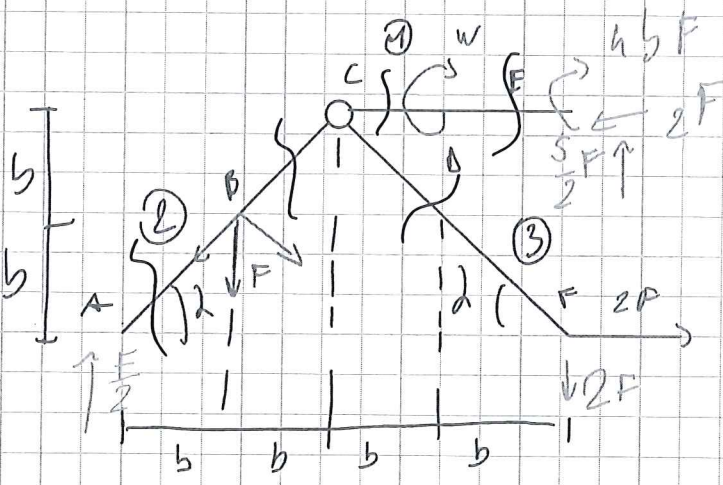
VERIFICA GRAFICA

oppo con $b=0!$



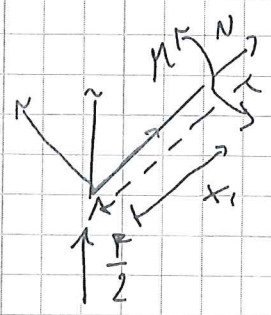
$R_y = 0 \rightarrow -F + \frac{F}{2} - 2F + \frac{5F}{2} = 0 \text{ OK}$
 $R_x = 2F - 2F = 0 \text{ OK}$
 $M_b = 0 \rightarrow -\frac{Fb}{2} + \frac{Fb}{2} - 4bF + 4bF = 0 \text{ OK}$

AZIONI INTERNE

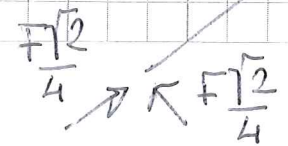


TRAMO A → B $0 < x_1 < \sqrt{2}b$

$\uparrow R_b = 0 \quad + \frac{\sqrt{2}F}{4} + N = 0 \rightarrow N = -\frac{\sqrt{2}F}{4} \checkmark$
 $\leftarrow R_l = 0 \quad \frac{\sqrt{2}F}{4} - T = 0 \rightarrow T = \frac{\sqrt{2}F}{4} \checkmark$
 $\curvearrowright M_z(x_1) = 0 \quad \frac{\sqrt{2}F}{4} x_1 + M(x_1) = 0 \rightarrow M(x_1) = -\frac{\sqrt{2}F}{4} x_1 \rightarrow x_1 = \sqrt{2}b$

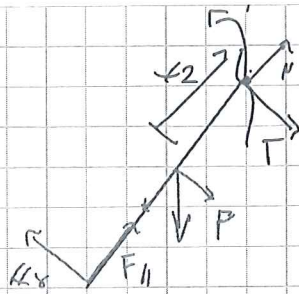


$x_1 = \sqrt{2}b$
 $M(\sqrt{2}b) = -\frac{Fb}{2}$

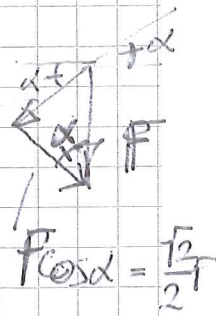


caso B → C $0 < x_2 < \sqrt{2}L$

$$\begin{cases} \rightarrow R_{||} = \frac{\sqrt{2}F}{4} + N - \frac{\sqrt{2}F}{2} = 0 \\ \uparrow R_{\perp} = \frac{\sqrt{2}F}{L} - T - \frac{\sqrt{2}F}{2} = 0 \\ \int M(x_2) = -\frac{\sqrt{2}F}{L}(\sqrt{2}b + x_2) + \frac{\sqrt{2}F}{2}x_2 + M(x_2) = 0 \end{cases}$$



$T \sin \alpha = \frac{\sqrt{2}}{2}F$



$$\begin{cases} N = \frac{\sqrt{2}F}{4} \\ T = -\frac{\sqrt{2}F}{L} \end{cases}$$

$$M(x) = -\frac{\sqrt{2}F}{L}(\sqrt{2}b) - \frac{\sqrt{2}F}{L}x_2 + \frac{\sqrt{2}F}{2}x_2 + M(x_2) = 0$$

$$-\frac{\sqrt{2}F}{L}(\sqrt{2}b) + \frac{\sqrt{2}F}{L}x_2 + M(x_2) = 0$$

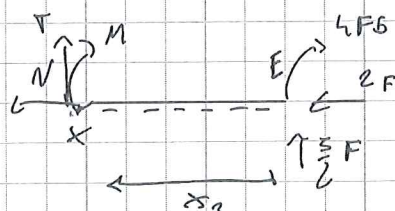
$$M(x_2) = \frac{\sqrt{2}F}{L}(\sqrt{2}b - x_2)$$

$$M(x_2=0) = \frac{\sqrt{2}}{4}F \cdot \sqrt{2}b = \frac{Fb}{2}$$

$$M(x_2=\sqrt{2}b) = 0$$

caso E → D

$$\begin{cases} \rightarrow R_{||} -N - 2F = 0 \rightarrow N = -2F \\ \uparrow R_{\perp} +T + \frac{5}{2}F = 0 \rightarrow T = -\frac{5}{2}F \\ \int M(x) -M(x_3) - 4Fb + \frac{5}{2}F(x_3) \rightarrow M(x_3) = -4Fb + \frac{5}{2}Fx_3 \end{cases}$$

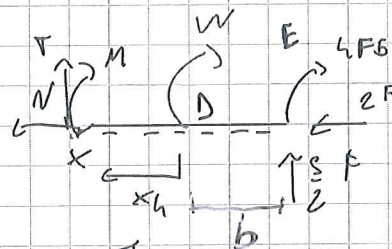


$$M(x_3=0) = -4Fb$$

$$M(x_3=b) = -\frac{3}{2}Fb$$

caso D → C

$$\begin{cases} \rightarrow R_{||} -N - 2F = 0 \rightarrow N = -2F \\ \uparrow R_{\perp} +T + \frac{5}{2}F = 0 \rightarrow T = -\frac{5}{2}F \\ \int M(x) -M(x_4) - 4Fb - Fb + \frac{5}{2}F(b + x_4) \end{cases}$$



$$M(x_4) = -5Fb + \frac{5}{2}Fb + \frac{5}{2}Fx_4 \rightarrow -\frac{5}{2}Fb + \frac{5}{2}Fx_4$$

$$M(x_4=0) = -\frac{5}{2}Fb$$

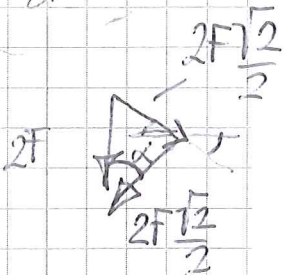
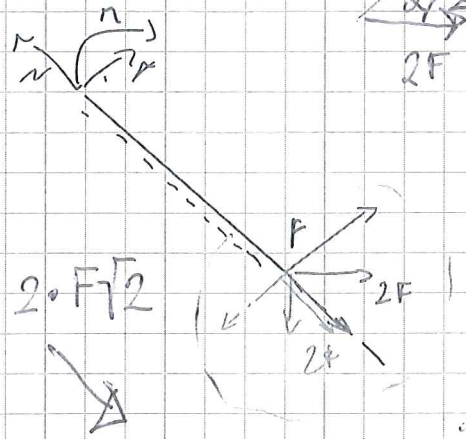
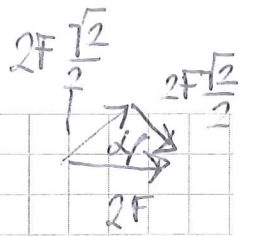
$$M(x_4=b) = 0$$

↑ Nastro $F \rightarrow C$

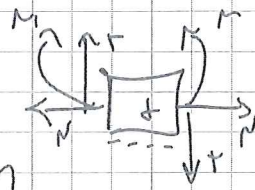
$$R_H = 0 \quad - \sqrt{2}F - \sqrt{2}LF + N = 0 = 2\sqrt{2}F$$

$$R_V = 0 \quad //$$

$$M_2(x_2) = 0 \quad //$$



DIAGRAMMI A COME INTERNE



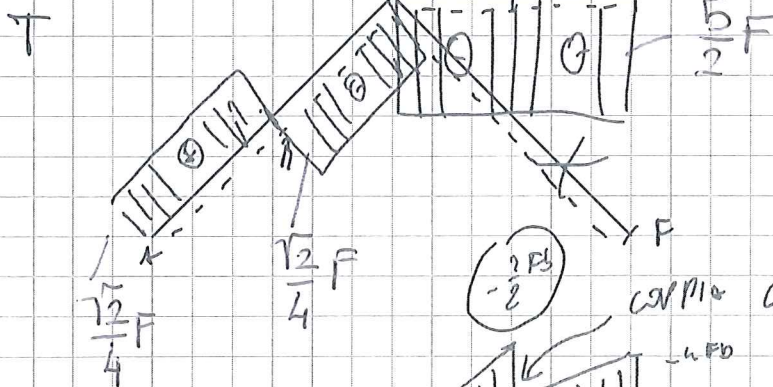
HO INVERTITO

RISPETTO ALLA SOLUZIONE.

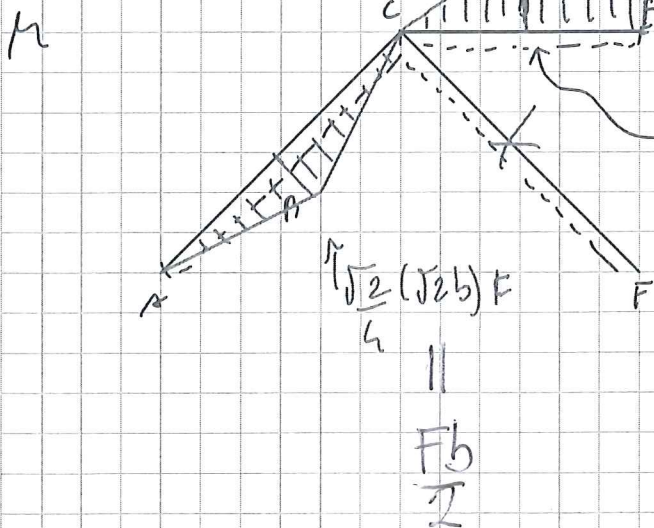
COME VANNO POSIZIONATE

LE FIANCHE DI RIF?

ARBITRARIAMENTE?



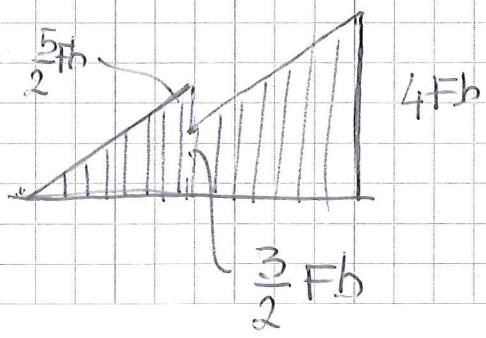
COPPIA CONCENTRATA



COPPIA $-Fb$

$$-\frac{2}{2}Fb - Fb = -\frac{5}{2}Fb$$

NON CAMBIA IL SEGNO

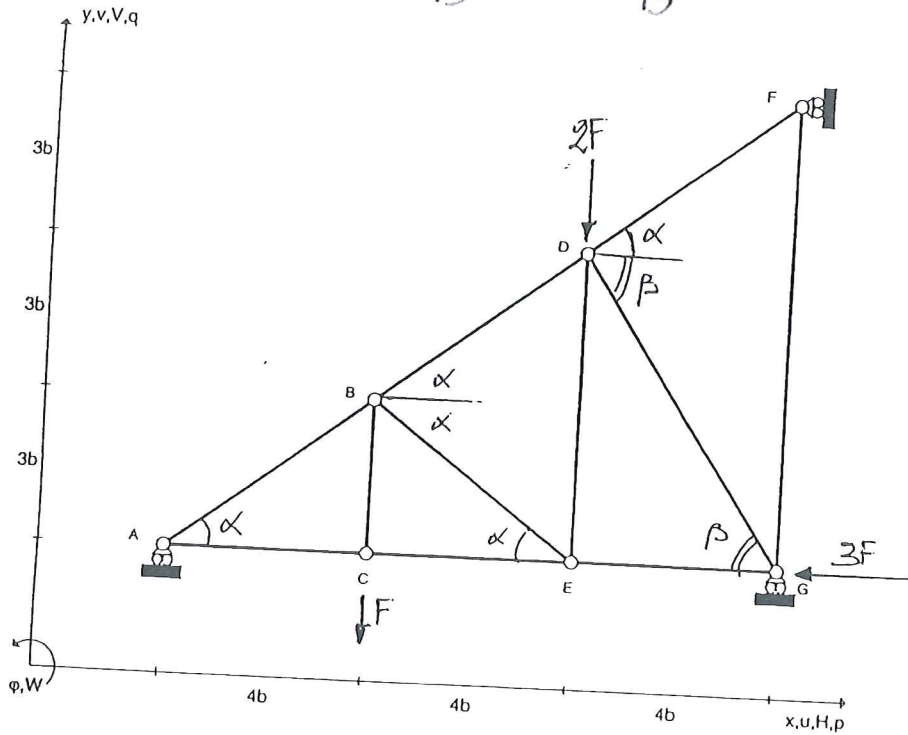


Esercizio n.2 (8 punti)

Risolvere la struttura reticolare indicata in Figura; calcolare i valori delle azioni assiali nelle singole aste e indicare, ingrossandole nel disegno, quali si comportano come puntoni.

Si ricorda che $\text{sen}\alpha=3/5$, $\text{cos}\alpha=4/5$, $\text{sen}\beta=6/\sqrt{52}$ e $\text{cos}\beta=4/\sqrt{52}$.

$$\frac{3\sqrt{13}}{13} \qquad \frac{2\sqrt{13}}{13}$$

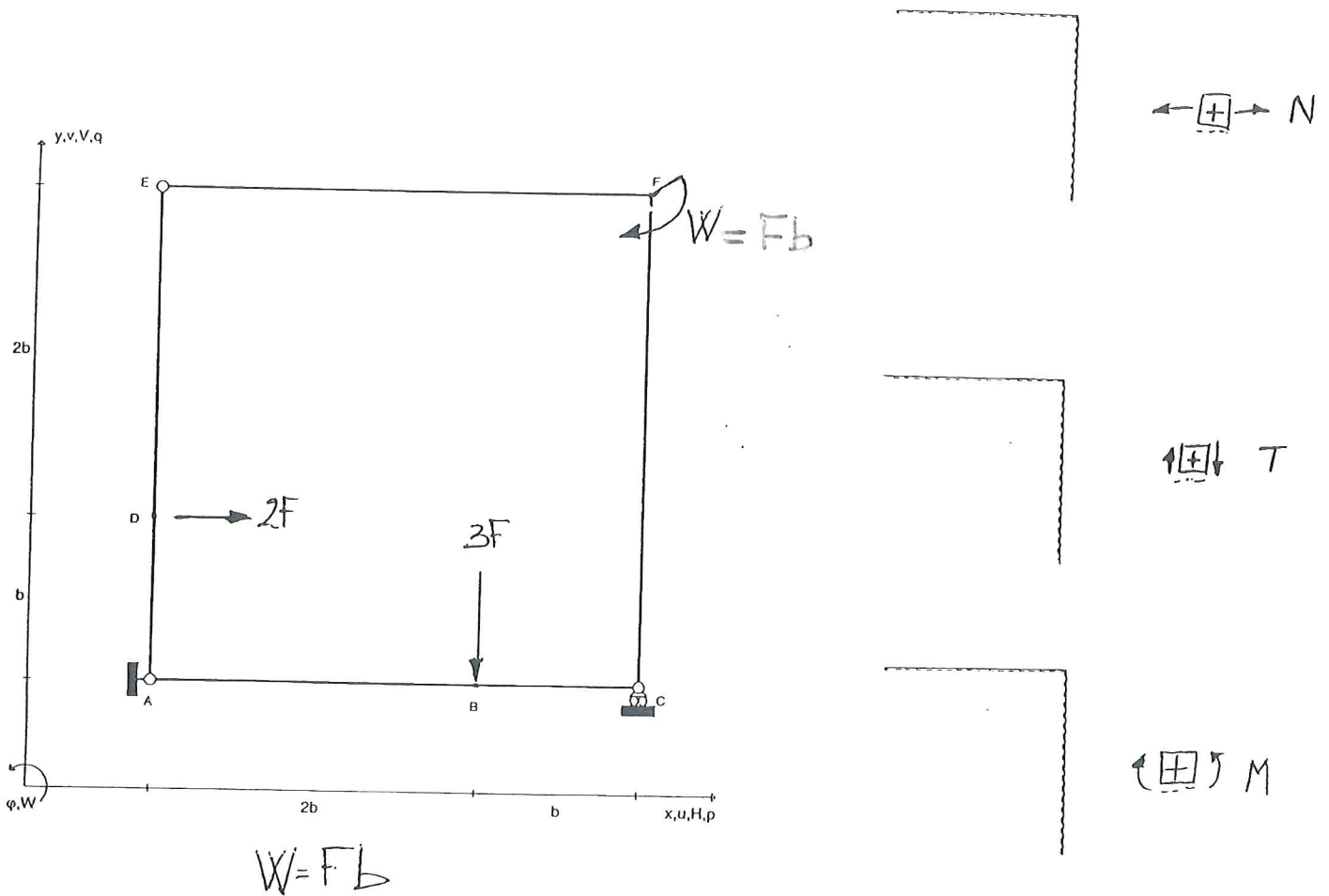


$V_A = \dots\dots\dots$; $V_G = \dots\dots\dots$; $H_F = \dots\dots\dots$;
 $N_{AB} = \dots\dots\dots$; $N_{AC} = \dots\dots\dots$; $N_{BC} = \dots\dots\dots$; $N_{CE} = \dots\dots\dots$;
 $N_{BE} = \dots\dots\dots$; $N_{BD} = \dots\dots\dots$; $N_{EG} = \dots\dots\dots$;
 $N_{DG} = \dots\dots\dots$; $N_{DF} = \dots\dots\dots$; $N_{FG} = \dots\dots\dots$

1/2

Esercizio n.3 (7 punti)

Risolvere la struttura riportata in Figura e tracciare i grafici delle azioni interne sul tratto EFC.



$W = Fb$

$V_A = \dots\dots\dots$	$H_A = \dots\dots\dots$	$V_C = \dots\dots\dots$
$N_{FC} = \dots\dots\dots$	$N_{EF} = \dots\dots\dots$	
$T_{FC} = \dots\dots\dots$	$T_{EF} = \dots\dots\dots$	
$M_{FC} = \dots\dots\dots$	$M_{EF} = \dots\dots\dots$	