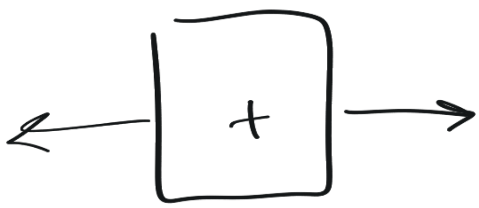
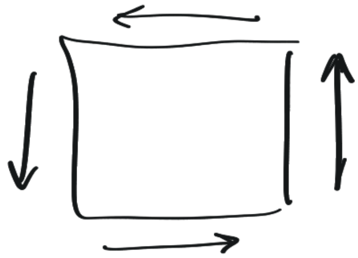
Azioni Interne, come le forze esterne e reazioni vincoli si distribuiscono sulla struttura.

N



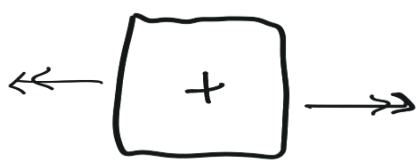
T

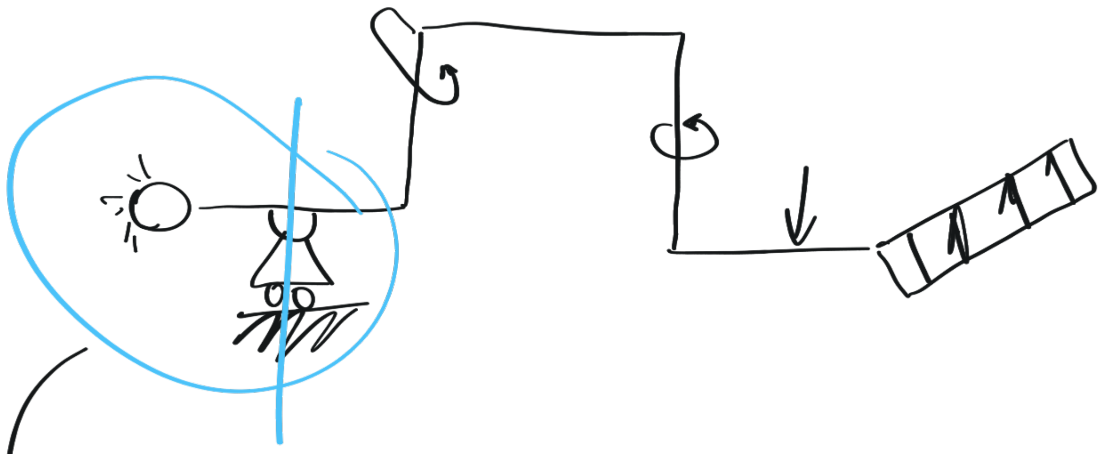


M_f

Fibbre Tese sono sotto

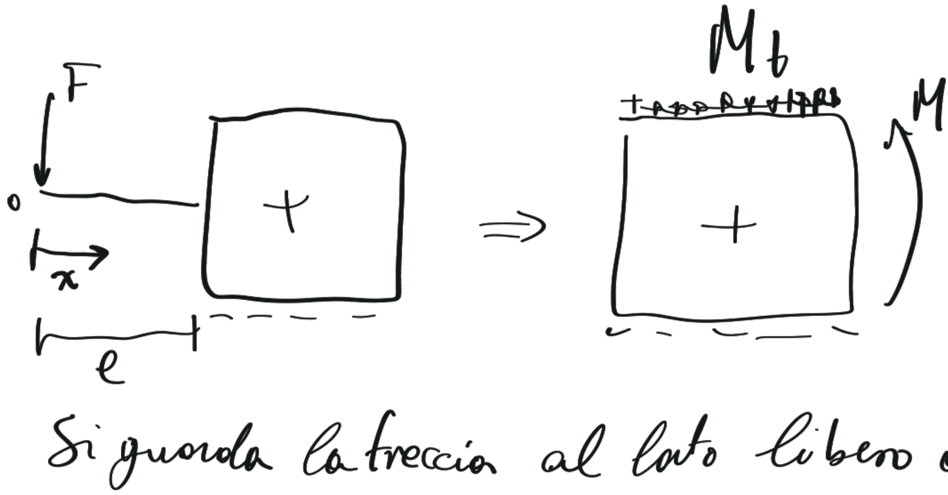
M_T (solo 3D)





Spezziamo dove sono applicate le forze e le reazioni vincolari

→ e.g.

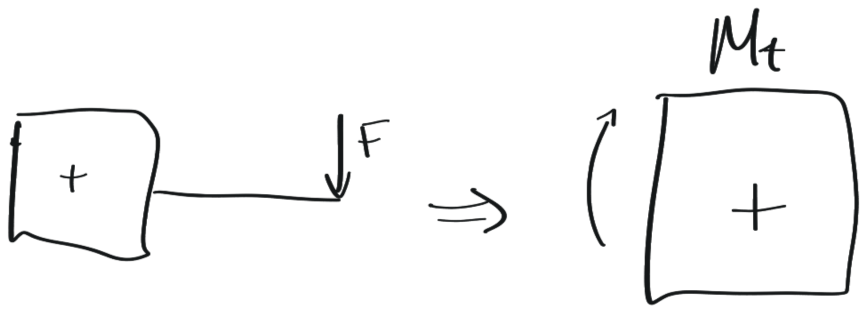


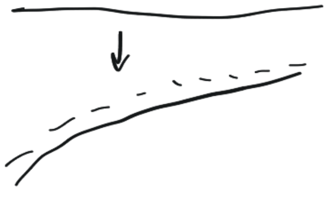
$$\sum M = 0 = M + Fx$$

con $0 \le x \le L$

$\Rightarrow M = -Fx$

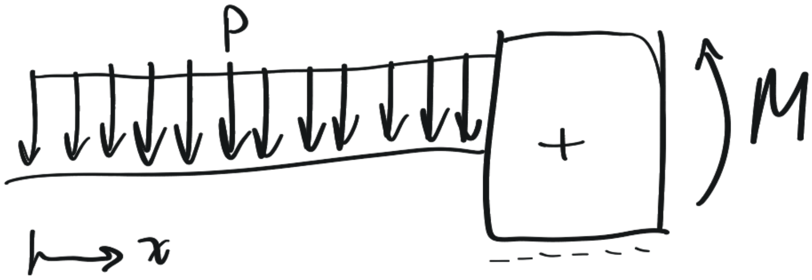
Si guarda la freccia al lato libero della asta





M_t si disegna al lato delle fibre tese → sempre

Carichi Distribuiti

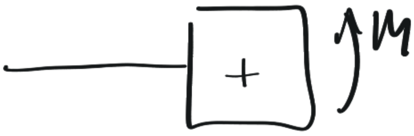


$\neq$

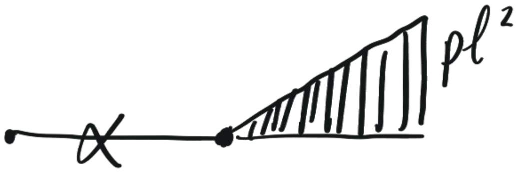
non è uguale per le azioni interne

Studiamo di nuovo

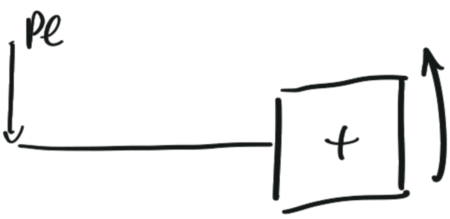
$0 \leq x < l/2$



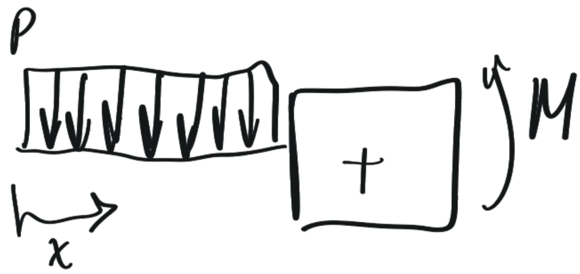
$M = 0$



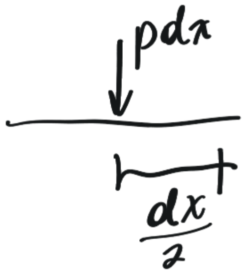
$l/2 \leq x < l$



$M = Plx$



Bisogna usare gli equilibri interni per studiarlo



$$\sum M = 0 = M + p x \frac{x}{2}$$

$$M = -\frac{p x^2}{2}$$

o

Usando il metodo della vela, vento da sopra piega la vela in basso, quindi

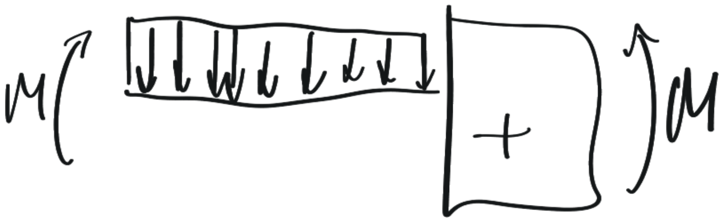
è come si distribuisce il carico

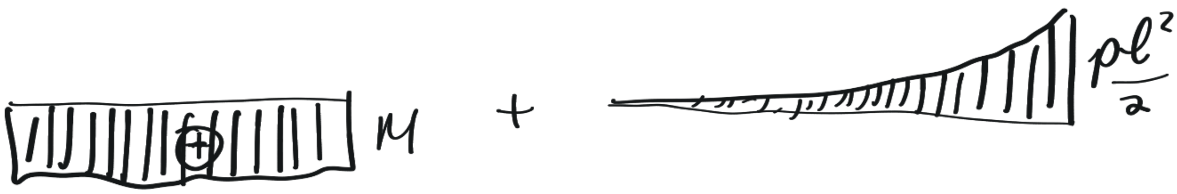
<u>Momenti</u>

$\Sigma M = 0 = M_f - M \Rightarrow M_f = M$

Sovrapposizione

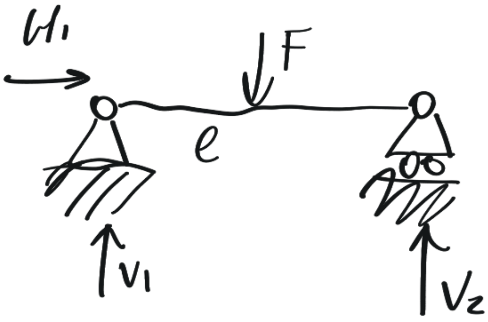
I grafici dei momenti si sommano per ascisse che sono sullo stesso punto





per trovare 0 $M - p\frac{x^2}{2}$

Esempio

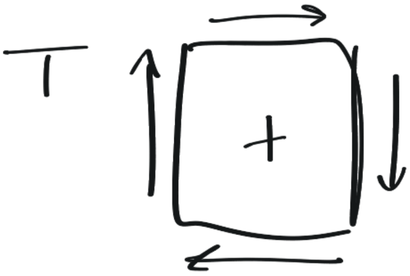


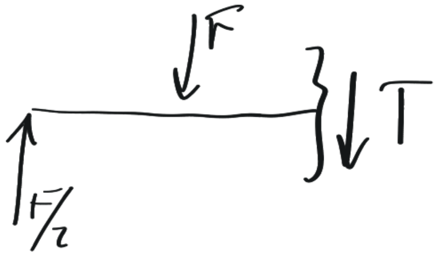
$$\sum F_x = 0 = H_1$$

$$\sum M^1 = 0 = V_2 \cdot l - F l/2 \Rightarrow V_2 = \frac{F}{2}$$

$$\sum F_y = 0 = \frac{F}{2} - F + \boxed{V_1 = \frac{F}{2}}$$

Trovare tagli

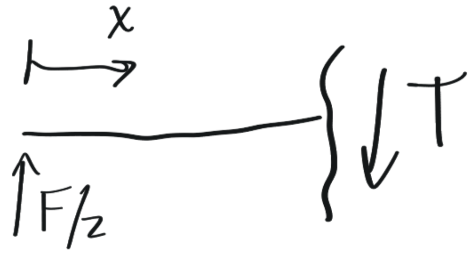




$$\sum F_y = 0 = F/2 - F - T$$

$$T = \frac{-F}{2}$$

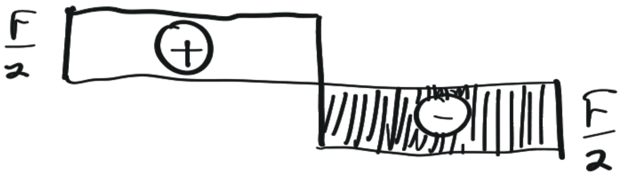
per $l/2 \le x \le l$

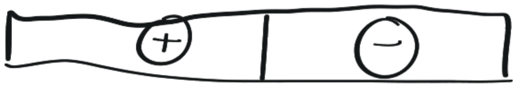


$$\sum F_y = 0 = \frac{F}{2} - T$$

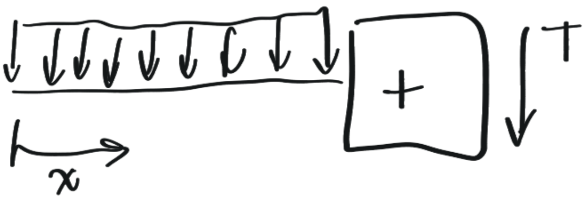
$$T = F/2$$

per $0 \le x \le l/2$





Non importa il lato perché mettiamo il segno quindi sappiamo già che c'è una differenza.

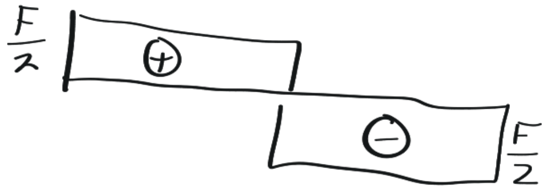


$\sum F_y = 0 = -T - px \Rightarrow T = -px$

$x = 0 \rightarrow T = 0$

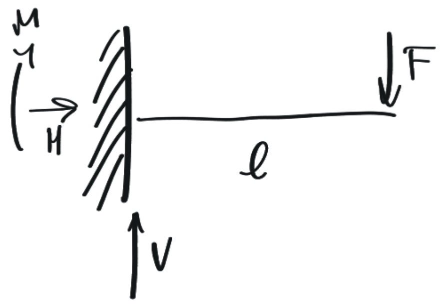
$x = l \rightarrow T = -pl$

Nei tagli avremo sempre una discontinuità, che avrà lo stesso valore della forza concentrata al punto



$-\frac{F}{2} - \frac{F}{2} = F$

Esercizio 1



Passi:

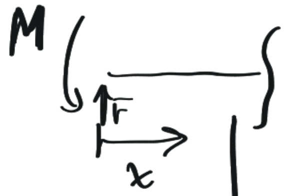
1) Reazioni vincolari
2) Azioni interne

$\sum M = 0 = -M - Fl \Rightarrow M = -Fl$

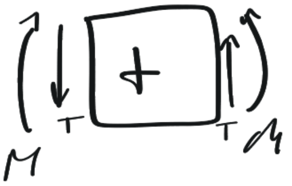
$\sum F_x = 0 = H$

$\sum F_y = 0 = V - F \Rightarrow V = F$

Azioni Interne



← Disegno più grande



$$\sum F_y = 0 = F + T \Rightarrow T = -F$$

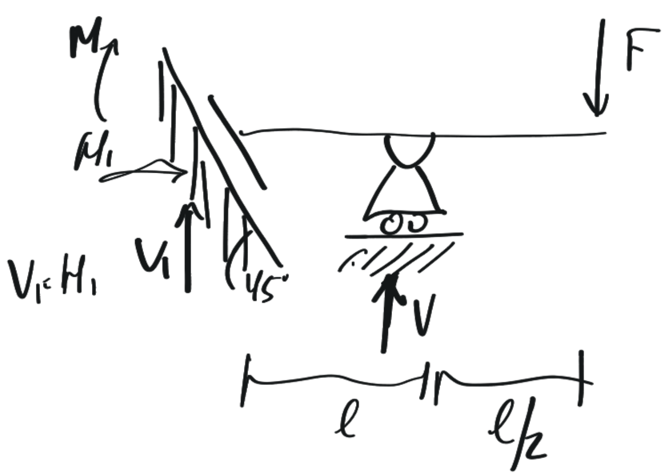
$$\sum M = 0 = M_f + Fl - Fx \Rightarrow M_f = F(x-l)$$

T (Diagramma

M_f

se $M_f = 0$ è detto estremo libero

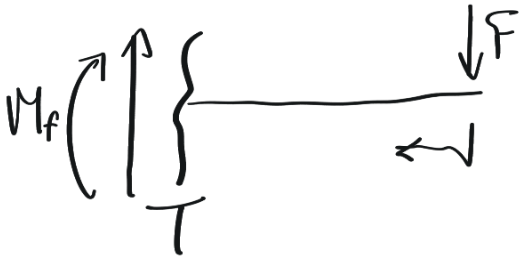
Esercizio 2

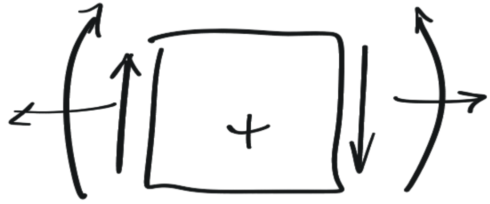


$$\sum F_y = 0 = V - F + \cancel{V_1} \Rightarrow V = F$$

$$\sum F_x = 0 = H_1 = V_1 = 0$$

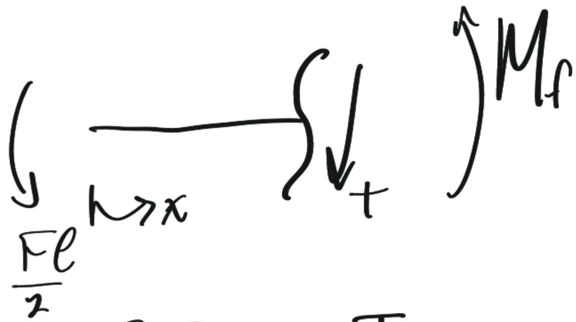
$$\sum M = 0 = -M - \frac{Vl}{2} \Rightarrow M = -\frac{Vl}{2} = -\frac{Fl}{2}$$





$$\sum F_y = 0 = T - F \Rightarrow T = F$$

$$\sum M = 0 = -M_g - Fx \Rightarrow M_f = -Fx$$



$$\sum F_y = 0 = T$$

Va senso perchè il taglio è portato solo fino al carrello.

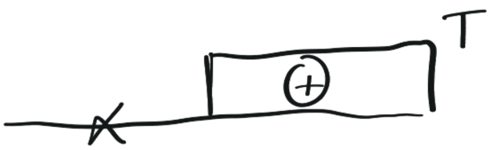
Alla destra è sotto effetto del taglio

$$\sum M_f = 0 = \frac{Fl}{2} + M_G$$

$$M_f = -\frac{Fl}{2}$$

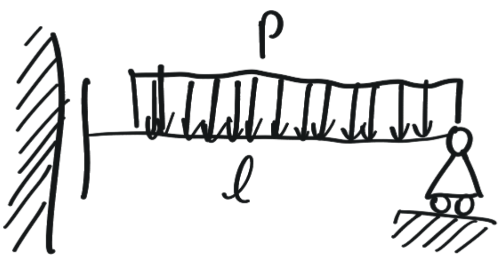
Se ci fosse un taglio sul pattino ci sarebbe uno spostamento verticale

I Diagrammi



M_f

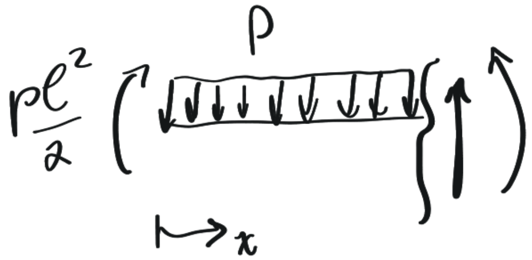
Esercizio 4

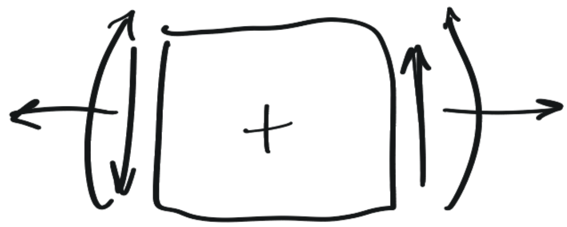


$$\sum F_x = 0 = H$$

$$\sum F_y = -pl + V = 0 \Rightarrow V = pl$$

$$\sum M = 0 = -M + \underbrace{p\frac{l^2}{2}}_{pl \cdot l/2} \Rightarrow M = p\frac{l^2}{2}$$



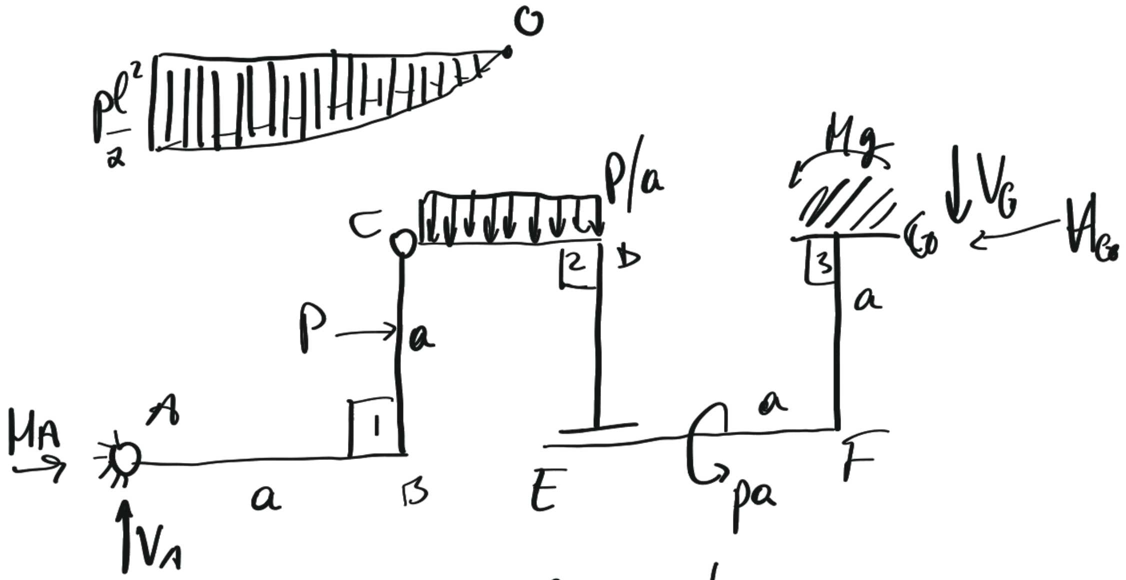


$$\sum M_f = 0 = -p\frac{l^2}{2} + p\frac{x^2}{2} + M_f \Rightarrow M_f = \frac{p}{2}(l^2 - x^2)$$

quando $x = l$ $M = 0$
ha senso perchè il carrello non blocca la rotazione, non c'è blocco sulla rotazione.

T

M_f



1) Reazioni vincolari a terra

2) Reazioni vincolari interne

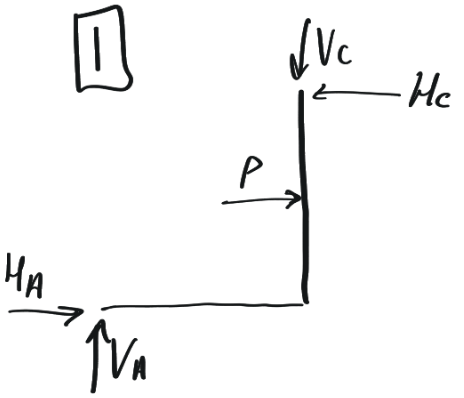
3) Azioni vincolari interne

$$\sum F_{i,x} = 0 = H_A + P + H_G \Rightarrow \overset{H_G =}{0} = -P + P$$

$$\sum F_y = 0 = V_A + V_G - P$$

$$\sum M^G = 0 = H_A \cdot a - V_A \cdot 3a + P\frac{a}{2} + \frac{3}{2}P \cdot a + P \cdot a + M_G = \frac{7}{2}Pa$$

$\boxed{1}$

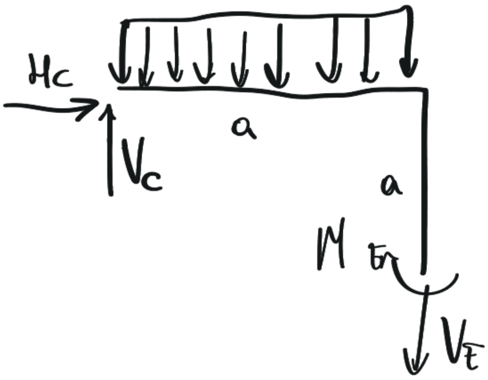


$$\sum F_y = 0 = V_A - V_C \Rightarrow V_C = V_A = P/2$$

$$\sum F_x = H_A + P - H_C = 0 \Leftarrow H_A = -P$$

$$\sum M_C = P \cdot \frac{a}{2} + H_A \cdot a - V_A \cdot a$$

2



$$\sum F_x = 0 = H_c$$

$$\sum F_y = 0 = V_c - V_E - P \Rightarrow V_E = V_c - P = -\frac{P}{2} - P = \frac{3P}{2}$$

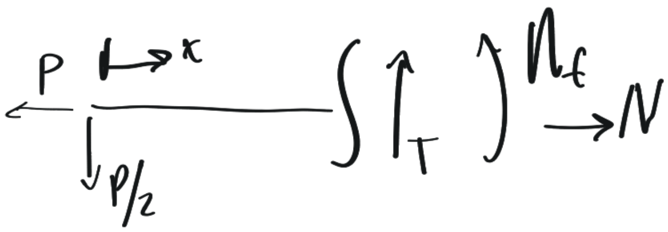
$$\sum M_c = 0 = \frac{-Pa}{2} - M_E - V_E \cdot a$$

$$\Rightarrow \quad M_E = \frac{-Pa}{2} + \frac{3}{2}a \Rightarrow M_E = Pa$$

3) Azioni Interne

Partiamo da cerniera a terra

$0 \le x \le a$ su AB



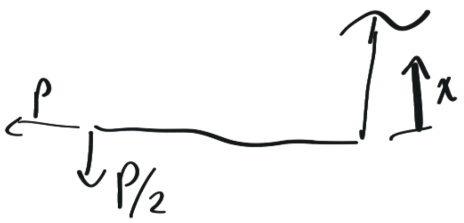
$$\sum F_x : 0 = N - P \Rightarrow N = P$$

$$\sum F_y = 0 = T - \frac{P}{2} \Rightarrow F = \frac{P}{2}$$

$$\sum M_f = \frac{P}{2} \cdot x + M_f = 0 \Rightarrow M_f = -\frac{P}{2} \cdot x$$

Fino al punto B invariati

$0 \le x \le a/2$

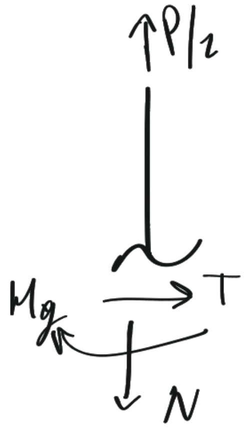


$$\sum F_x = 0 = -P - T \Rightarrow T = P$$

$$\sum F_y = 0 = -\frac{P}{2} + N \Rightarrow N = \frac{P}{2}$$

$$\sum M_G = 0 = -Px + \frac{P}{2} \cdot a + M_f$$

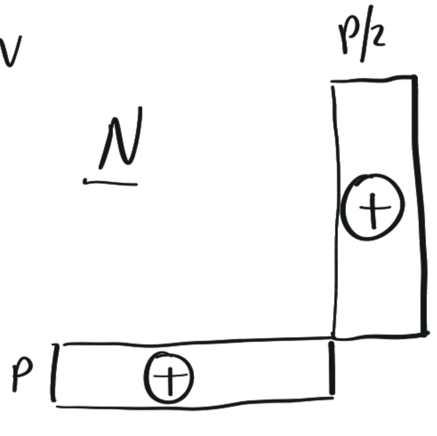
$$\Rightarrow M_f = Px - \frac{Pa}{2} = P(x - a/2)$$

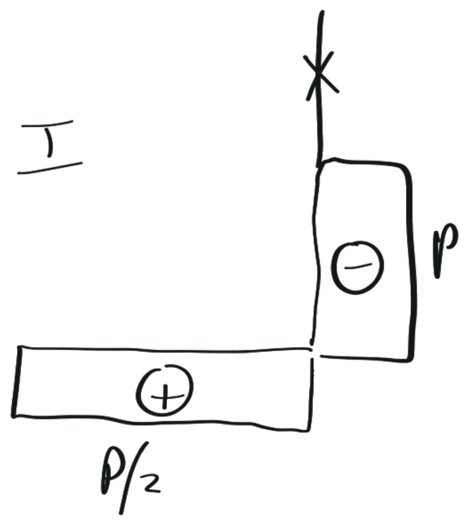


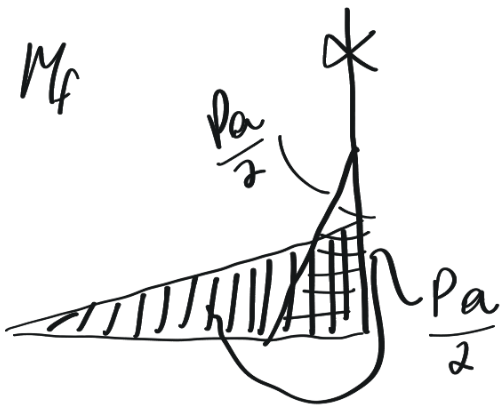
$T = 0$

$M_f = 0$

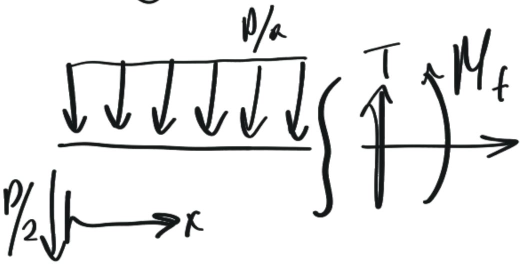
$N = P/2$







$0 \le x \le a$



$$\sum F_x = 0 = N$$

$$\sum F_y = 0 = -\frac{P}{2} - \frac{P}{a}x + T \Rightarrow T = \frac{P}{2} + \frac{P}{a}x$$

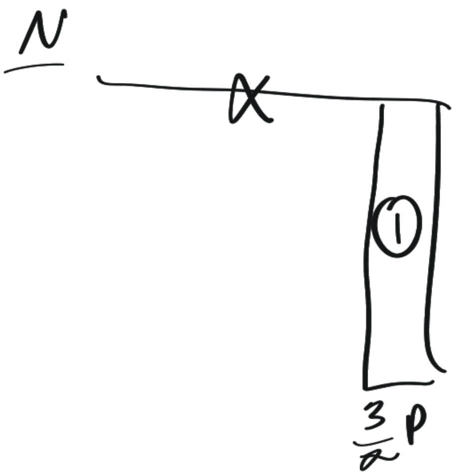
$$\sum M = 0 = M_f + \frac{P}{2}x + \frac{P}{a}\frac{x^2}{2} \Rightarrow M_f = -\frac{P}{2}x - \frac{P}{a}\frac{x^2}{2}$$

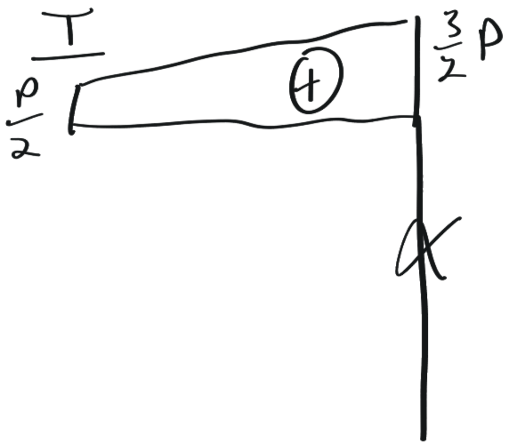
$$// \; -\frac{P}{2}a - \frac{Pa}{2}$$

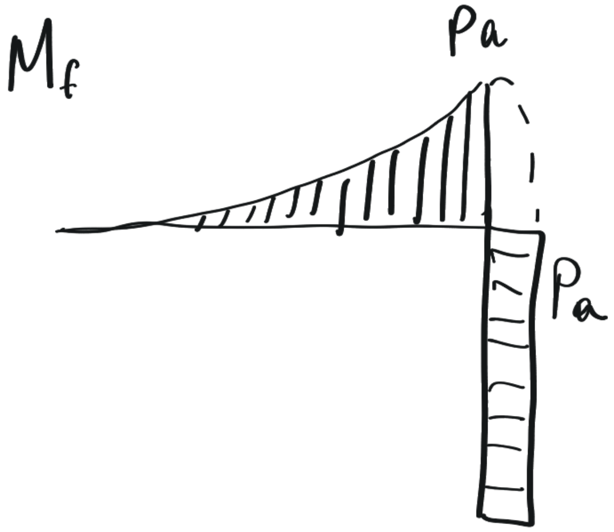
$$\sum F_x = 0 = T$$

$$\sum F_y = N + \frac{3}{2}P \Rightarrow N = -\frac{3}{2}P$$

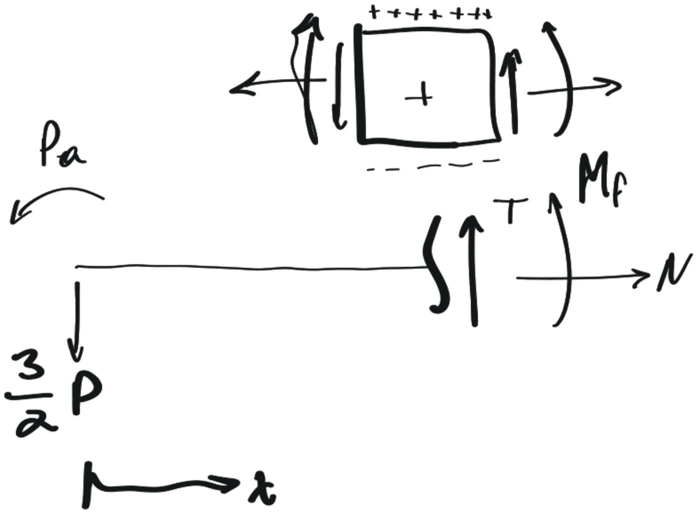
$$\sum M_f = M_f - Pa = 0 \Rightarrow M_f = Pa$$







$\boxed{3}$



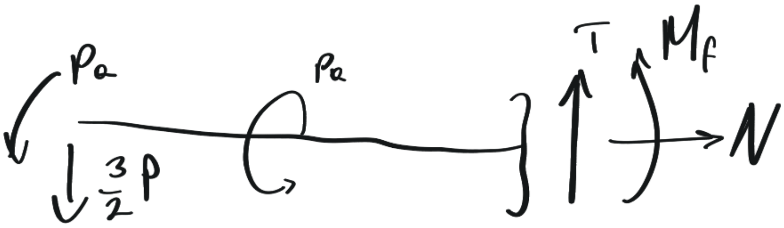
$$\Sigma F_x = 0 = N$$

$$\Sigma F_y = 0 = T - \frac{3}{2}P$$

$$\Rightarrow T = \frac{3}{2}P$$

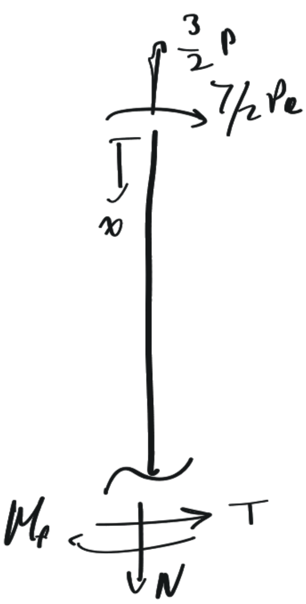
$$\Sigma M = 0 = M_f + \frac{3}{2}Px + Pa$$

$$M_f = -\frac{3}{2}Px - Pa$$



$$\Sigma M_y = 0 = M_f + \frac{3}{2}Px + Pa + Pa$$

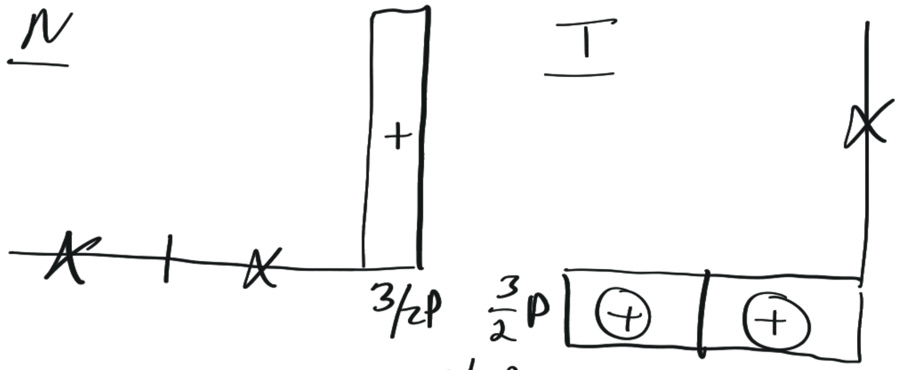
$$M_f = -\frac{3}{2}Px - 2Pa$$

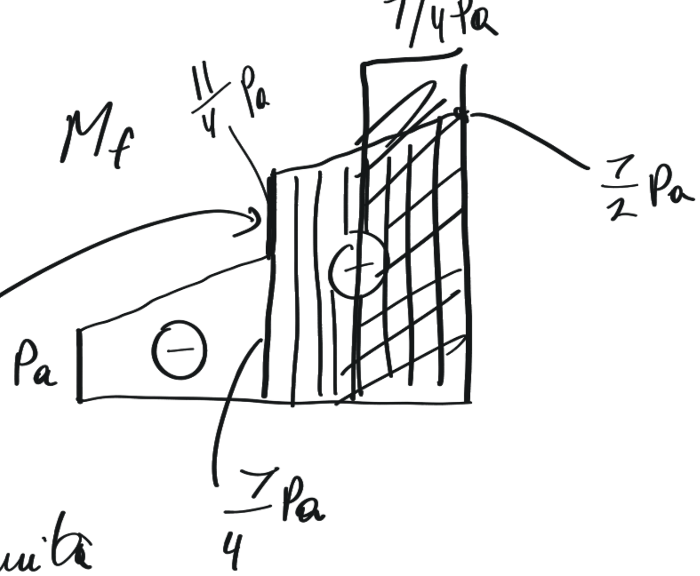


$$N = \frac{3}{2}P$$

$$T = 0$$

$$\Sigma M_f = 0 = -\frac{7}{2}Pa - M_f \Rightarrow M_f = -\frac{7}{2}Pa$$





Discontinuità del carico concentrato