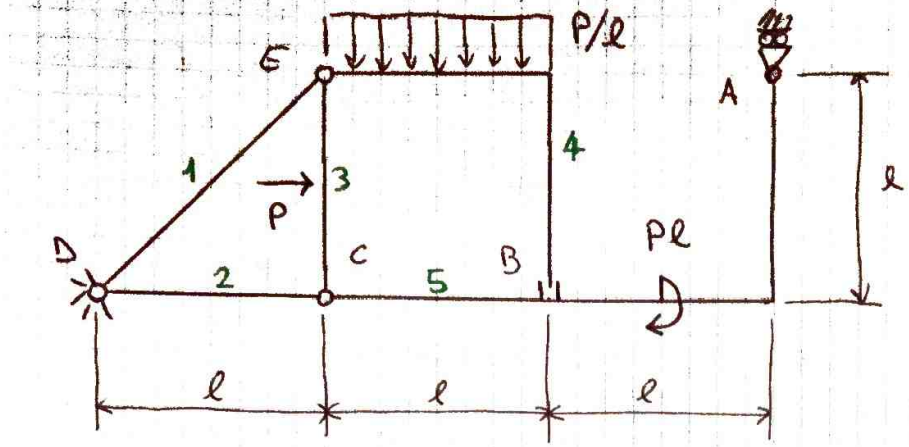
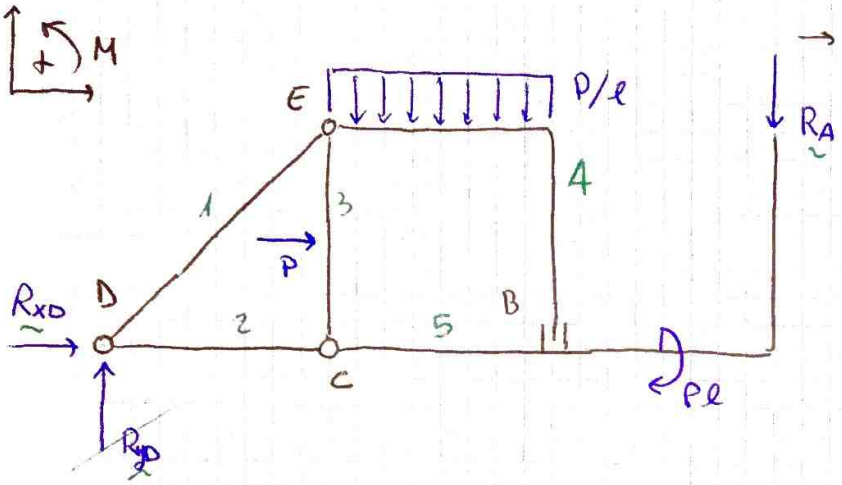


$G_{dℓ} = 3m = 15$

$\sum G_{dv} = 1_A + 2_B + 4_C + 4_D + 4_E = 15$

Aste 1-2-3 e Aste 3-4-5 formano 2 anelli chiusi internamente isostatici.

→ Struttura isostatica



$\sum M_D = 0$

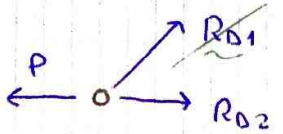
$-P\frac{\ell}{2} - \frac{3}{2}P\ell - P\ell - R_A 3\ell = 0 \qquad R_A 3 = -2P - P \rightarrow R_A = -P$

$\sum F_x = 0 \qquad R_{xD} + P = 0 \qquad R_{xD} = -P$

$\sum F_y = 0 \qquad R_{yD} - P - R_A = 0 \qquad R_{yD} = P - P = 0$

Analizziamo la struttura svincolata, partiamo dalla cerniera in D:

CERNIERA D



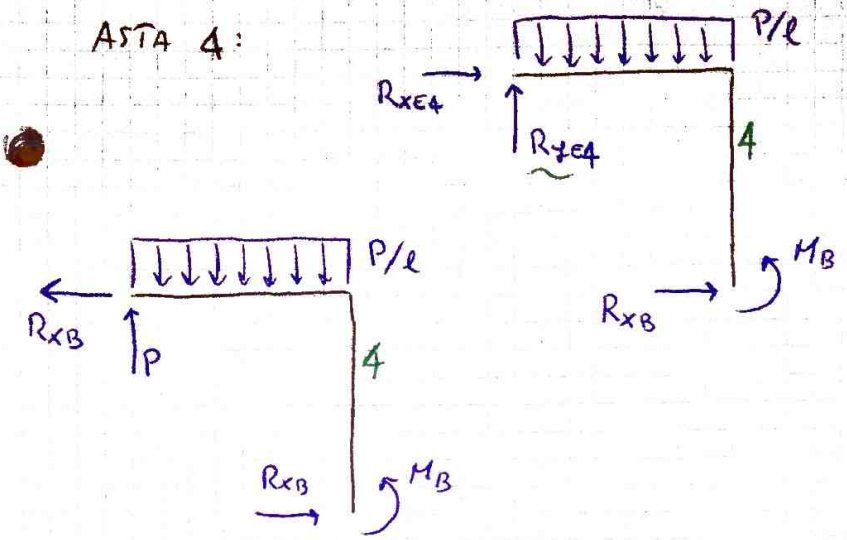
$\sum F_y = 0 \qquad R_{D1}\frac{\sqrt{2}}{2} = 0 \rightarrow R_{D1} = 0$

$\sum F_x = 0 \qquad R_{D2} - P = 0 \rightarrow R_{D2} = P$

ASTA DE: Scarica

ASTA DC:

ASTA 4:



$\Sigma F_y = 0$

$R_{yE4} - P = 0$

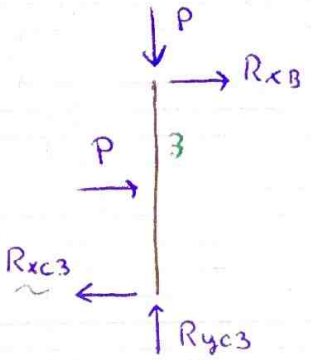
$R_{yE4} = P$

$\Sigma F_x = 0$

$R_{xE4} = -R_{xB}$

Cerniera in E → Non ha carichi localizzati, e collega solo 2 aste (Asta 1 scarica)

ASTA 3



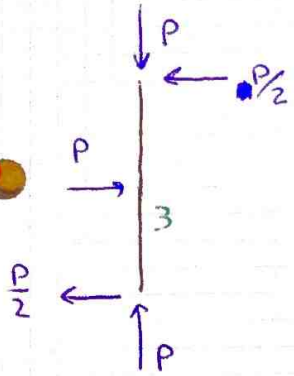
$\Sigma F_y = 0 \quad R_{yC3} - P = 0 \rightarrow R_{yC} = P$

$\Sigma M_B = 0 \quad P\frac{\ell}{2} - R_{xC3}\ell = 0$

$\rightarrow R_{xC3} = \frac{P}{2}$

$\Sigma F_x = 0 \quad R_{xB} + P - R_{xC3} = 0$

$R_{xB} = \frac{P}{2} - P = -\frac{P}{2}$

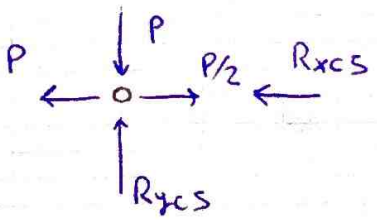


ASTA 4: Avendo R_{xB} calcolo M_B:

$\Sigma M_B = 0 \quad -P\frac{\ell}{2} + \left(-\frac{P}{2}\ell\right) + M_B = 0$

$\rightarrow M_B = P\ell$

CERNIERA C

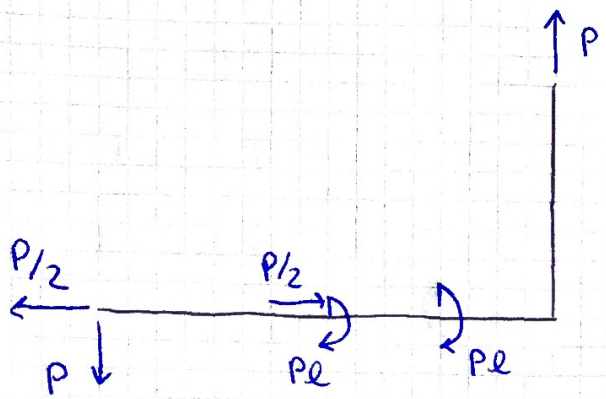


$\Sigma F_y = 0 \quad R_{yC5} = P$

$\Sigma F_x = 0 \quad -P + P/2 - R_{xC5} = 0$

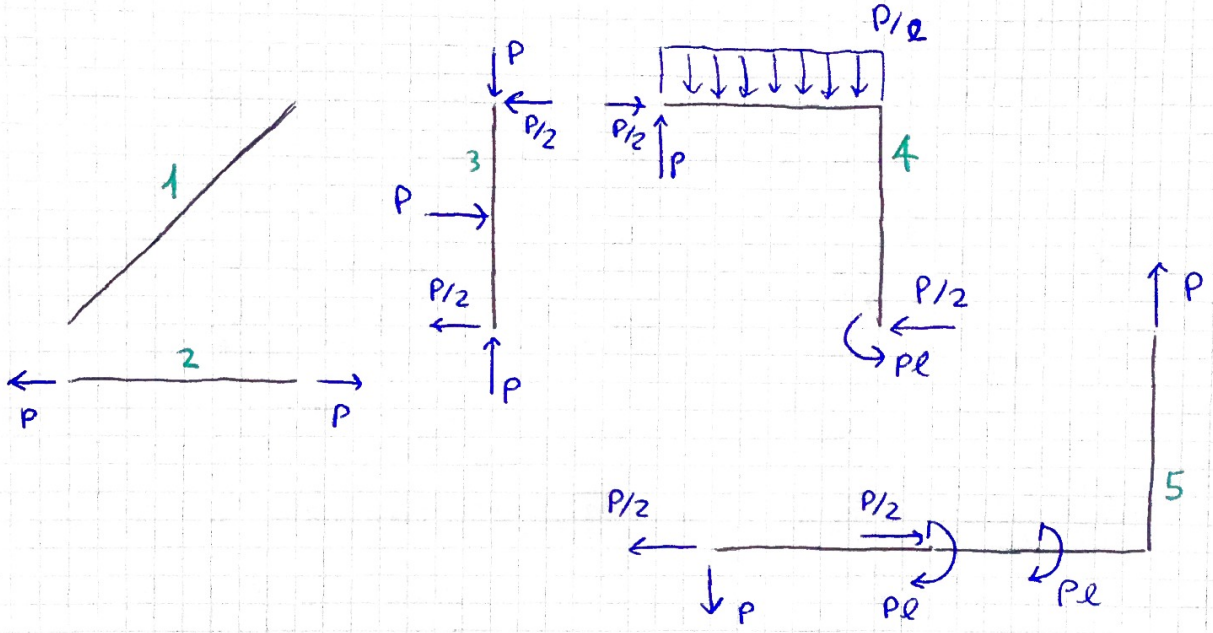
$R_{xC5} = -P/2$

ASTA 5

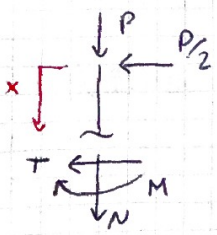


Non è stato il modo più furbo di procedere!
↳ Cercare un modo più veloce!

Struttura svincolata completa:



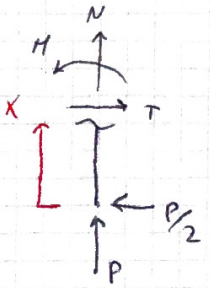
Asta 3:



$N = -P$

$-T - P/2 = 0 \quad T = -P/2$

$-M + P/2\,x = 0 \quad M = P/2\,x$



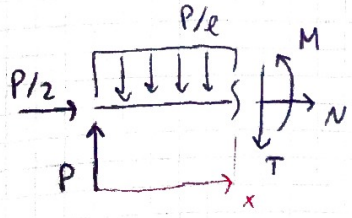
$N = -P$

$T = P/2$

$M - P/2\,x = 0$

$M = P/2\,x$

Asta 4:



$N = -P/2$

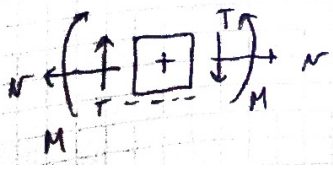
$-T + P - \frac{P}{\ell}x = 0 \quad T = P - \frac{P}{\ell}x$ $\quad x=0 \;\; T=P$ $\quad x=\ell \;\; T=0$

$M - Px + \frac{P}{\ell}x\frac{x}{2} = 0 \quad M = Px - \frac{1}{2}\frac{P}{\ell}x^2$

M: $x=0 \;\; M=0$

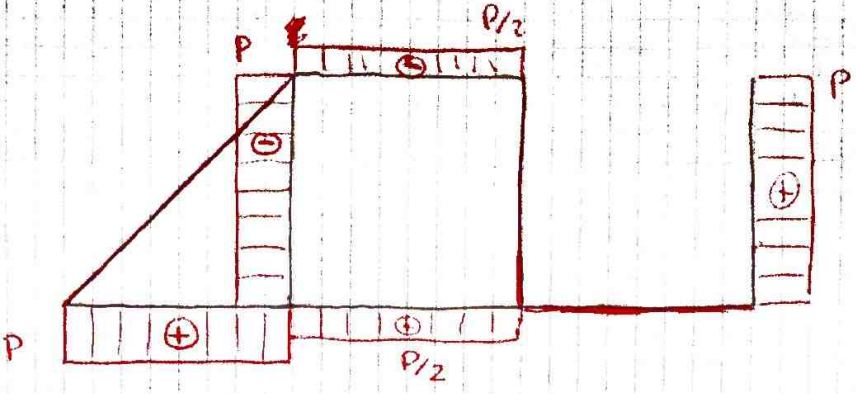
$x=\frac{\ell}{2} \;\; M = P\frac{\ell}{2} - \frac{1}{2}\frac{P}{\ell}\frac{\ell^2}{4} = \frac{3}{8}P\ell$

$x=\ell \;\; M = P\ell - \frac{P}{2\ell}\ell^2 = \frac{P\ell}{2}$

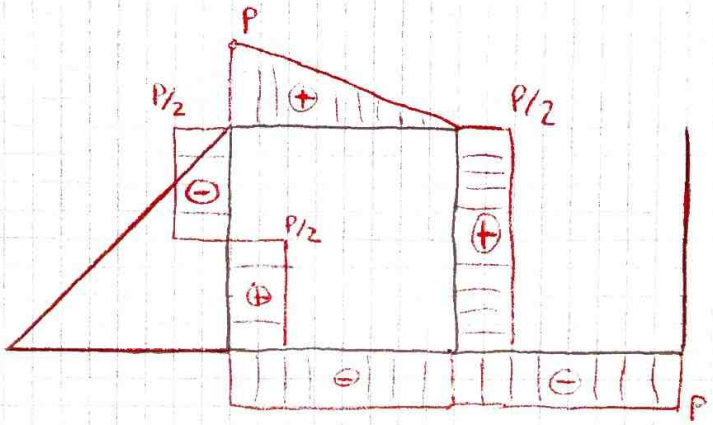


Azioni interne:

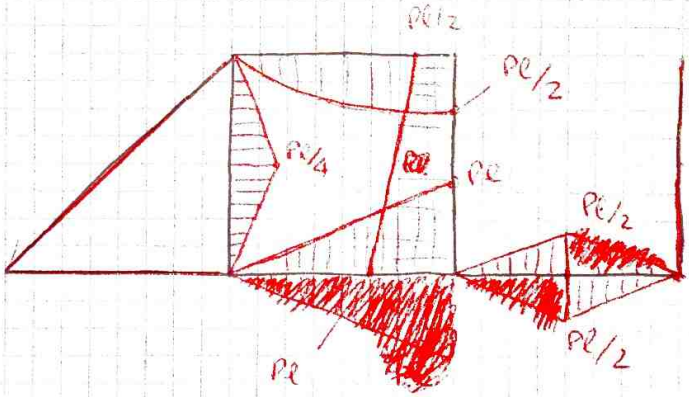
N



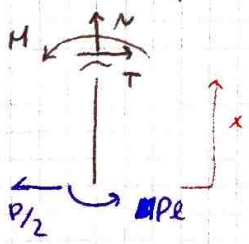
T



Mf



ASTA 4:



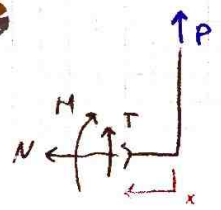
$N = 0$

$T = P/2$

$M + P\ell - \frac{P}{2}x = 0$

$M = \frac{P}{2}x - P\ell$ $\quad x=0 \;\; M=-P\ell$; $x=\ell \;\; M=-\frac{P\ell}{2}$

ASTA 5:



$T = -P$

$N = 0$

$-M + Px = 0 \quad M = +Px$

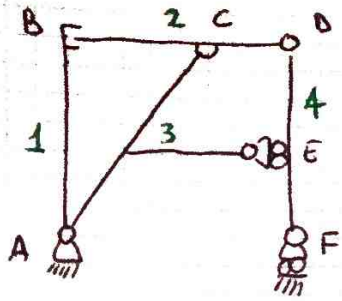
ASTA 5 (compressa ↻ Pℓ)

$-M - P\ell + Px = 0 \quad M = Px - P\ell$

$x = \frac{\ell}{2} \quad M = -P\ell/2$

$x = \ell \quad M = 0$

Tema d'esame → 17 luglio 2014

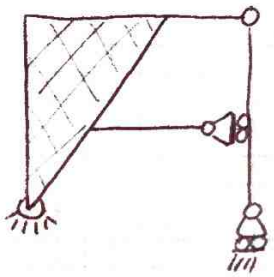


I)

$GdL = 3m = 12$

$\Sigma G_{dv} = 4_A + 2_B + 2_C + 2_D + 1_E + 1_F = 12$

Aste 1 - 2 - 3 formano un anello internamente isostatico

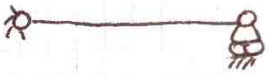


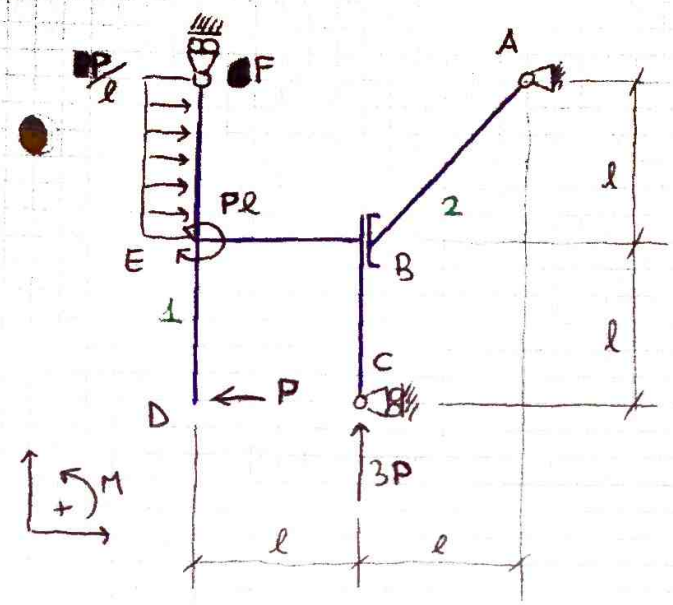
II)

Si può notare un secondo anello internamente isostatico

III)

Struttura isostatica





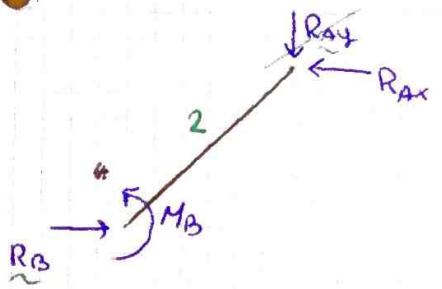
$GdL = 3m = 6$

$\Sigma GdV = 2_A + 2_B + 1_C + 1_F = 6$

Arco a tre cerniere (la 3ª si ottiene "combinando" i due carrelli a terra in una cerniera a terra) non allineate

→ Struttura isostatica

Partiamo ad analizzare l'asta 2 poiché si può intuitivamente notare subito che ricava una reazione vincolare a terra

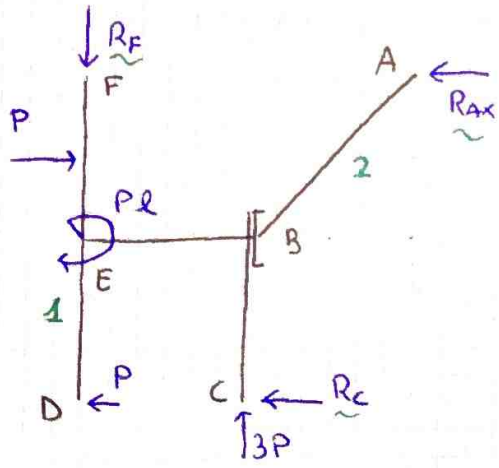


$\Sigma F_y = 0 \quad -R_{Ay} = 0 \quad R_{Ay} = 0$

$\Sigma F_x = 0 \quad R_B - R_{Ax} = 0 \quad R_B = R_{Ax}$

$\Sigma M_{0_B} = 0 \quad M_B + R_{Ax}\,\ell = 0 \quad M_B = -R_{Ax}\,\ell$

Struttura completa:



$\Sigma F_y = 0 \quad 3P - R_F = 0 \quad R_F = 3P$

$\Sigma M_D = 0 \quad -P\ell - P\frac{3}{2}\ell + 3P\ell + R_{Ax}2\ell = 0$

$P\frac{1}{2}\ell + R_{Ax}2\ell = 0 \quad R_{Ax} = -\frac{P}{4}$

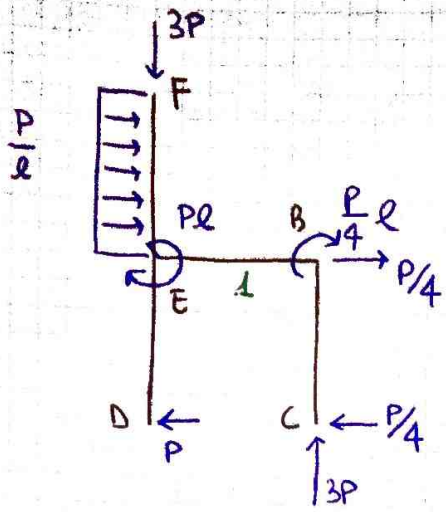
$\Sigma F_x = 0 \quad P - P - R_C - R_{Ax} = 0$

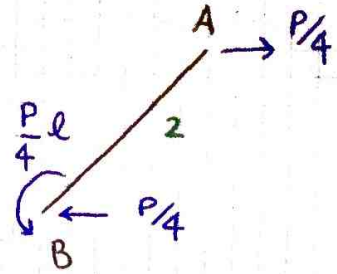
$R_C = -R_{Ax} = \frac{P}{4}$

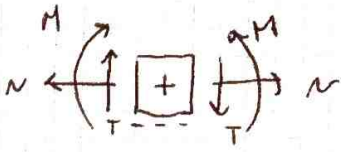
→ A questo punto ricaviamo le reazioni interne del pattino B

$R_B = R_{Ax} = -\frac{P}{4}$

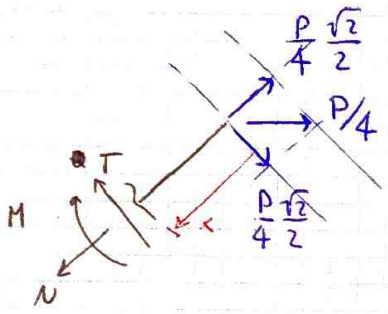
$M_B = -R_{Ax}\,\ell = \frac{P}{4}\ell$







ASTA $\overline{AB}$ (Asta 2)



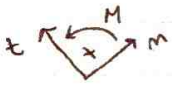
$-N + \frac{P}{4}\frac{\sqrt{2}}{2} = 0 \qquad N = \frac{P}{4}\frac{\sqrt{2}}{2} \qquad \Sigma F_n = 0$

$\Sigma F_t = 0 \qquad T - \frac{P}{4}\frac{\sqrt{2}}{2} = 0 \qquad T = \frac{P}{4}\frac{\sqrt{2}}{2}$

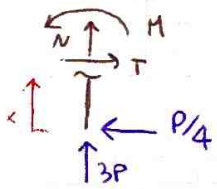
$\Sigma M_x = 0 \qquad -M - \frac{P}{4}\frac{\sqrt{2}}{2}x = 0$

$M = -\frac{P}{4}\frac{\sqrt{2}}{2}x \qquad x = 0 \quad M = 0$

$x = \frac{\ell}{\sqrt{2}/2} \qquad M = -\frac{P}{4}\frac{\sqrt{2}}{2}\frac{\ell}{\sqrt{2}/2} = -\frac{P}{4}\ell$



ASTA $\overline{BC}$

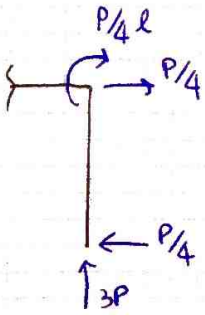


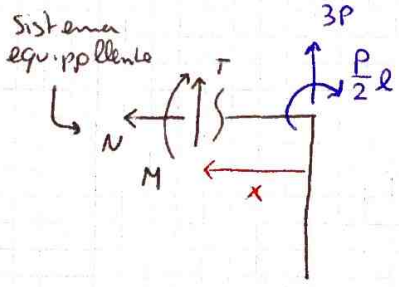
$N = -3P$

$T = P/4$

$M - P/4\,x = 0 \qquad M = \frac{P}{4}x$

ASTA $\overline{EB}$





$N = 0$

$T = -3P$

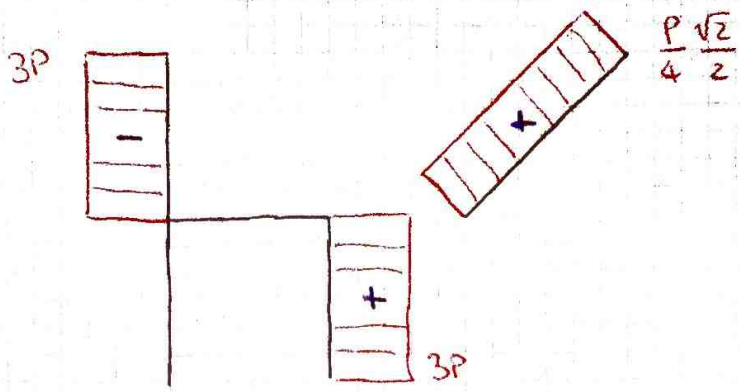
$-M - \frac{P}{2}\ell + 3Px = 0$

$M = 3Px - \frac{P}{2}\ell$

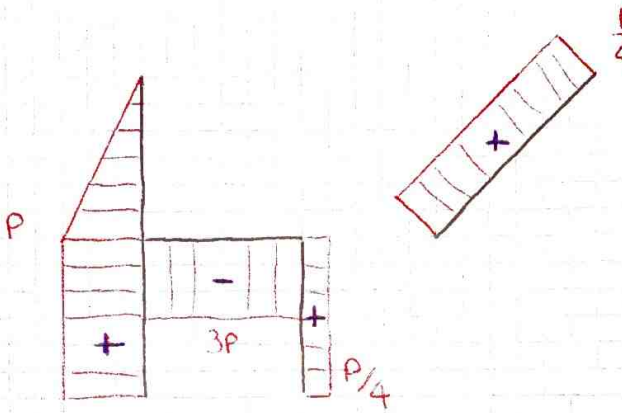
$x = 0 \qquad M = -\frac{P}{2}\ell$

$x = \ell \qquad M = \frac{5}{2}P\ell$

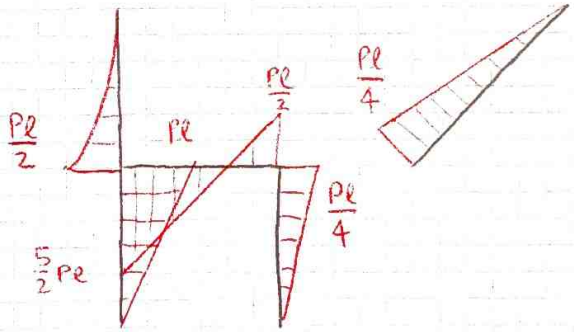
N



T



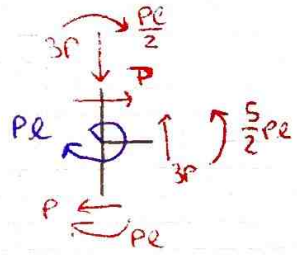
M_f



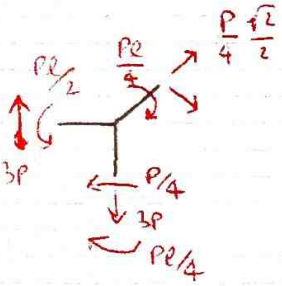
Verifica

Equilibrio ai nodi

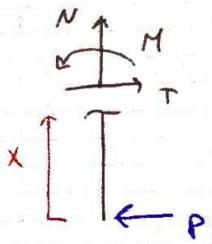
NODO E



NODO B



ASTA DE



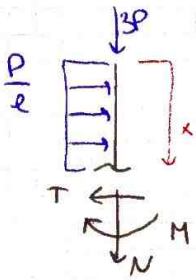
$N = 0$

$T = P$

$M - Px = 0$

$M = Px$

ASTA FE



$N = -3P$

$T = \frac{P}{l}x$

$-M - \frac{P}{l}x\frac{x}{2} = 0$ $\quad M = -\frac{P}{2l}x^2$

$x = 0 \quad M = 0$

$x = l \quad M = -\frac{P}{2}l$