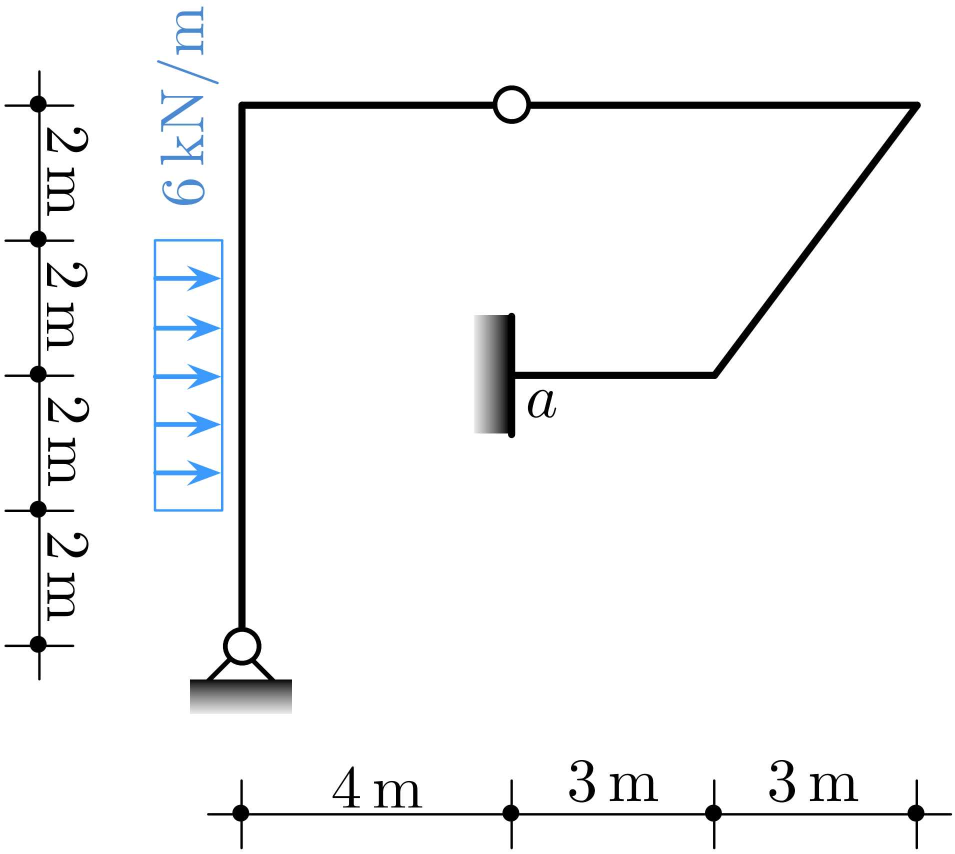
FONDAMENTI DI MECCANICA DELLE STRUTTURE

(docente: G. FORMICA)

PROVA DI VERIFICA – 19 gennaio 2017

STUDENTE: traccia **B**



Parte 2

Del sistema iperstatico rappresentato in figura, composto di elementi in acciaio caratterizzati da un momento ultimo $\boldsymbol{M}_{\mathrm{u}} = \mathbf{500\,kN\,m}$, si stimi il carico di collasso secondo i teoremi dell'analisi limite. Scelta come incognita X la **reazione a momento dell'incastro** in a e considerato il **carico distribuito come concentrato**, si consegnino

2.1. i risultati ottenuti all'interno dell'approccio statico:

- i diagrammi di (N_0, T_0, M_0) e (N_X, T_X, M_X) distribuiti sullo schema isostatico,
- il valore del fattore di amplificazione del carico λ_s e
- il relativo diagramma $M = M_0 + M_X$ *staticamente ammissibile* ($|M| \leq M_{\mathrm{u}}$);

2.2. i risultati ottenuti all'interno dell'approccio cinematico:

- il (grafico del) meccanismo di collasso *cinematicamente ammissibile*,
- il relativo valore del fattore di amplificazione del carico λ_p.

AGOSTINA INCUTTI
TRACCIA B

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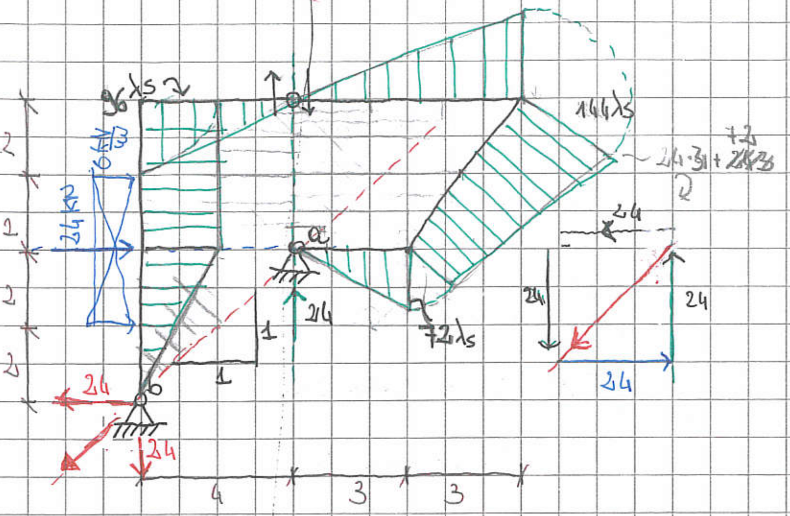
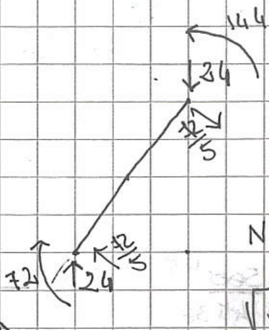


$R_{ob} = R_{vb}$
$R_{ob} = 24\ KN$
$R_{vb} = 24\ KN$
$R_{va} = R_{vb} = 24\ KN$

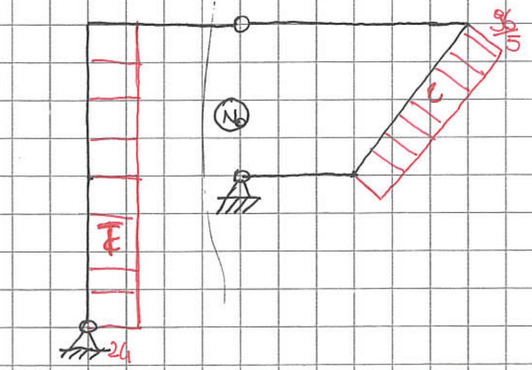


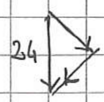
$T = \frac{144 - 72}{5} = \frac{72}{5}$

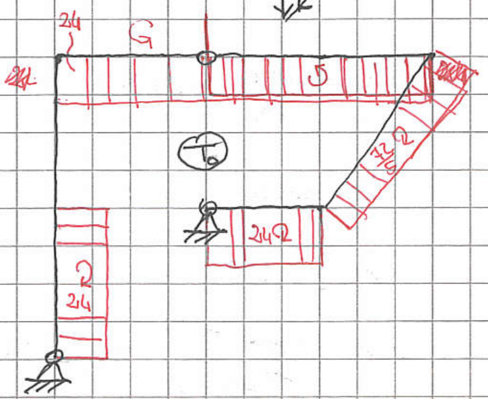
$N = \sqrt{24^2 - \frac{72}{5}^2} =$

$\sqrt{576 - \frac{5184}{25}} = \sqrt{\frac{9216}{25}}$

$N = \frac{96}{5}$





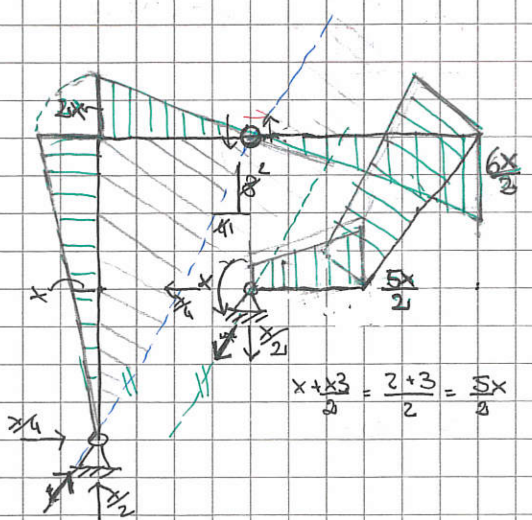


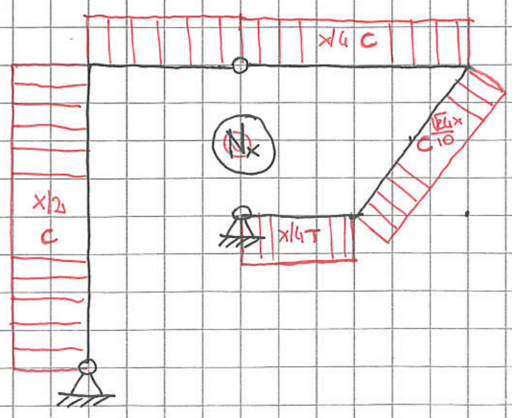
$\frac{R_o}{R_v} = \frac{1}{2} \rightarrow R_o = \frac{1}{2} R_v \rightarrow R_v = 2 R_o$

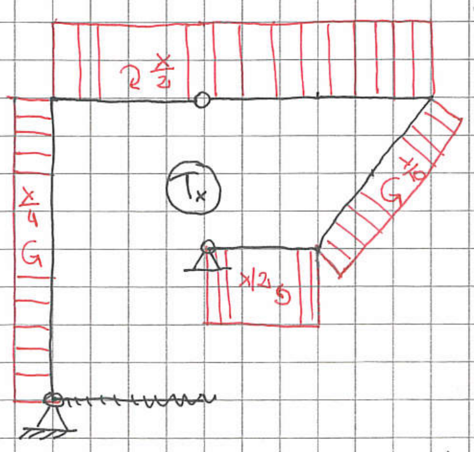
$x + R_o 4 - R_v 4 = 0$
$\hookrightarrow R_v 2$
$x - R_v 2 = 0 \rightarrow R_v = \frac{x}{2} \qquad R_o = \frac{x}{4}$

$x + \frac{x 3}{2} = \frac{2+3}{2} = \frac{5x}{2}$

$\frac{3x}{2} - x = \frac{3-2}{2} = \frac{x}{2}$

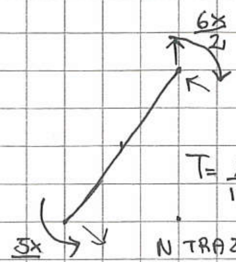






$T = \frac{x}{10}$

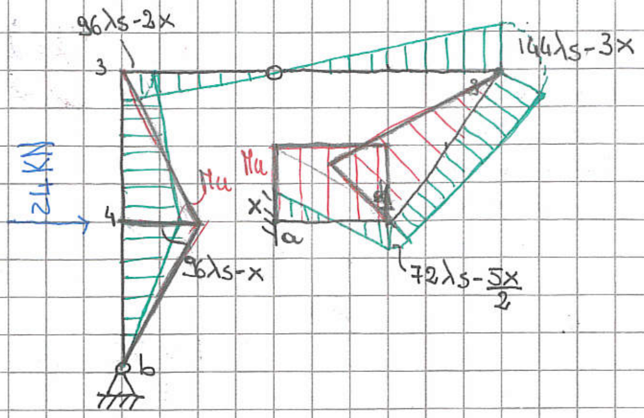
N TRAZIONE =



$\sqrt{\left(\frac{x}{4}\right)^2 + \left(\frac{x}{2}\right)^2 - \left(\frac{x}{10}\right)^2} \rightarrow$

N = 11/20 X

$M = \underline{M_0 + M_x}$



$M_u = 500$ kNm

$$\begin{cases} M(a): x \le M_u \\ M(1): 72\lambda s - \frac{5x}{2} \le M_u \\ M(2): 144\lambda s - 3x \le M_u \\ M(3): 96\lambda s - 2x \le M_u \\ M(4): 96\lambda s - x \le M_u \end{cases}$$

$x = 0 \longrightarrow \lambda s = \frac{\cancel{500}^{125}}{\cancel{144}\,36} \simeq 3.47$

$x = M_u$

$M(1): \quad 72\lambda s = \cancel{50}\ \frac{7}{2} M_u \qquad\qquad \lambda s = \frac{1750}{72} \simeq 24.3$

$M(2): \quad 144\lambda s = 4 \cdot 500 \qquad\qquad \lambda s = 13.8$

$M(3): \quad 96\lambda s = 3 \cdot 500 \qquad\qquad \lambda s = 15.625$

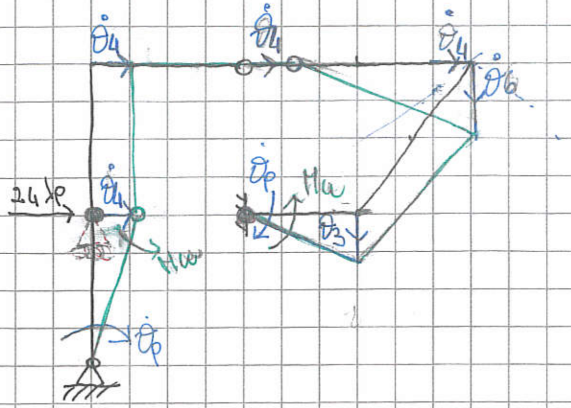
$M(4) = 96\lambda s = 1000 \qquad\qquad \lambda s = \frac{\cancel{500}\,\cancel{250}\,125}{\cancel{48}\,\cancel{24}\,12} \simeq 10.41 \qquad \boxed{\lambda s = \frac{125}{12}}$ più restrittivo

$\longrightarrow M(4) = 500$ kNm $(= M_u)$

$M(1): \cancel{72}^{6} \cdot \frac{125}{\cancel{12}} - 1250 \le 500 \qquad 750 - 1250 < 500 \qquad -500 < 500$

$M(2) = 144 \cdot \frac{125}{12} - 1500 \le 500 \qquad 1500 - 1500 < 500 \qquad 0 < 500$

$M(3) = 96 \cdot \frac{125}{12} - 1000 \le 500 \qquad 1000 - 1000 < 500 \qquad 0 < 500$



$$\lambda_p = \frac{2 M_u \cancel{\dot\theta_p}}{24 \cancel{\dot\theta_p} 4} = \frac{1000}{96} \approx 10.41$$

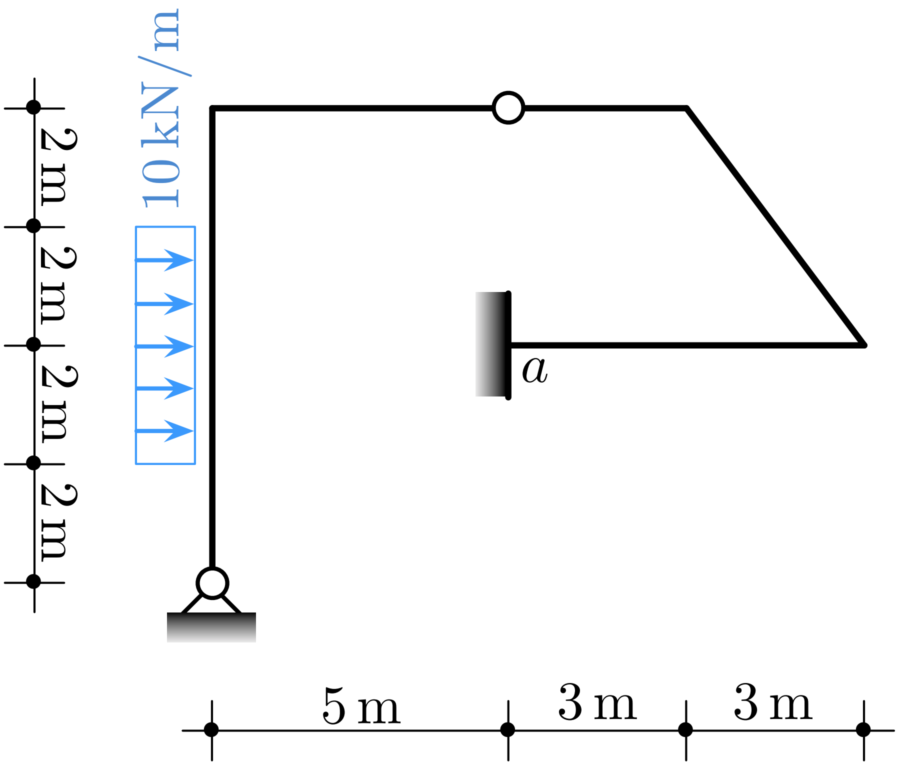
$\lambda_s = 10.41$, $\lambda_p = 10.41$ $\longrightarrow$ $\lambda_s = \lambda_p = \lambda_c = 10.41$

FONDAMENTI DI MECCANICA DELLE STRUTTURE

(docente: G. FORMICA)

PROVA DI VERIFICA – 19 gennaio 2017

STUDENTE: traccia **A**



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TRACCIA A

LINDA FLAVIANI
19 - 01 - 2017

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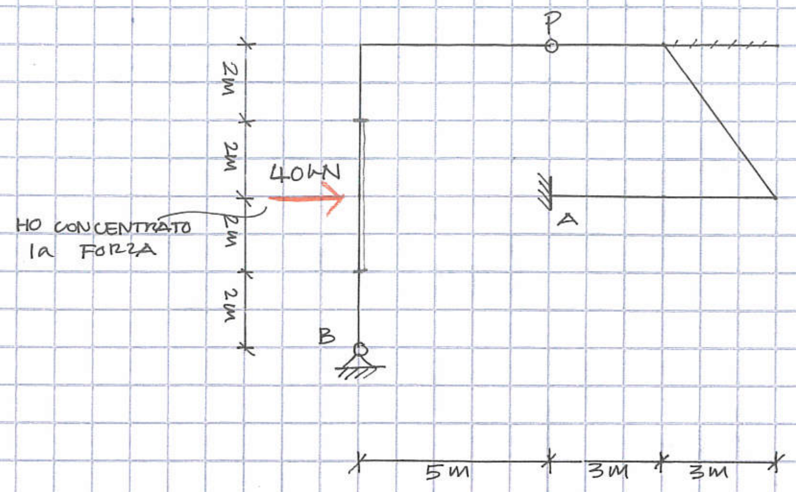
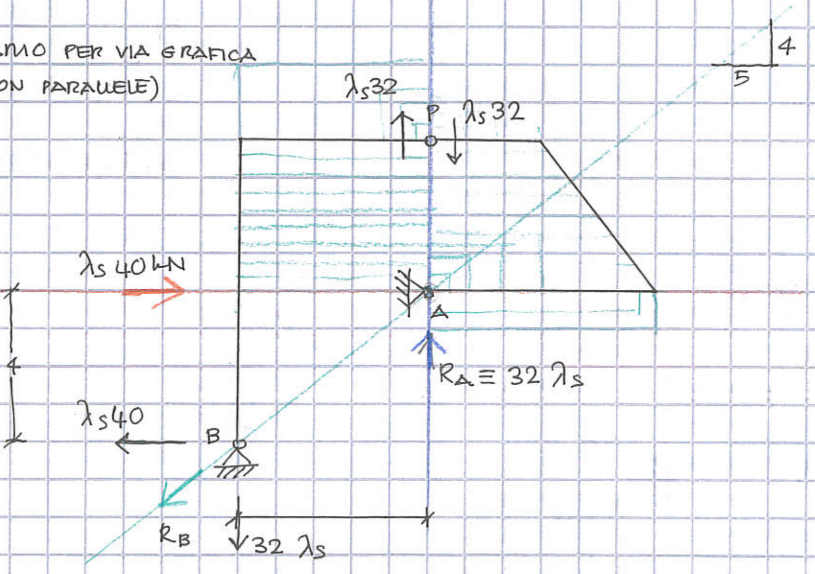


APPROCCIO STATICO

schema Ø (solo carico)

EQUILIBRIO PER VIA GRAFICA
(3F NON PARALLELE)



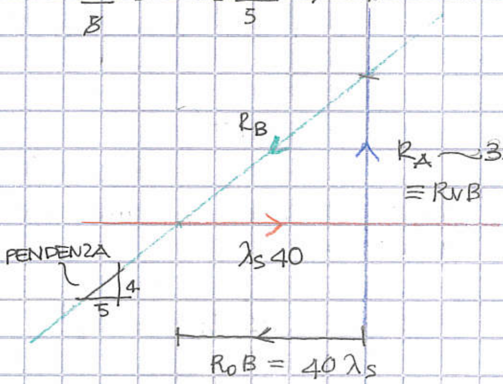
DATI:

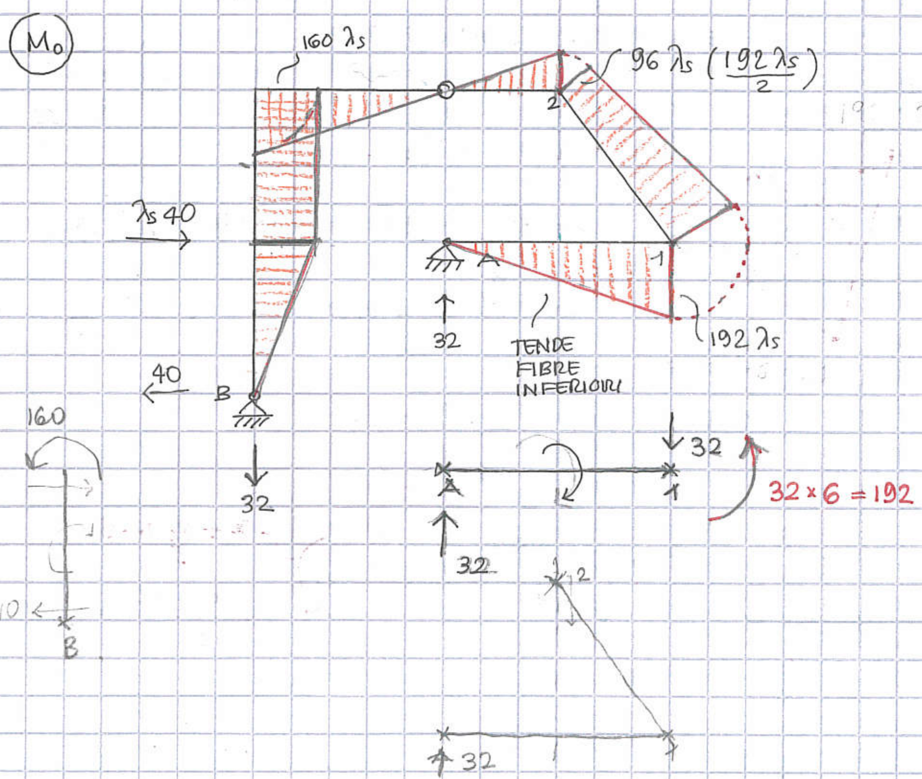
$R_A = R_V B$ | $R_o B = 5\bar{R}_B$

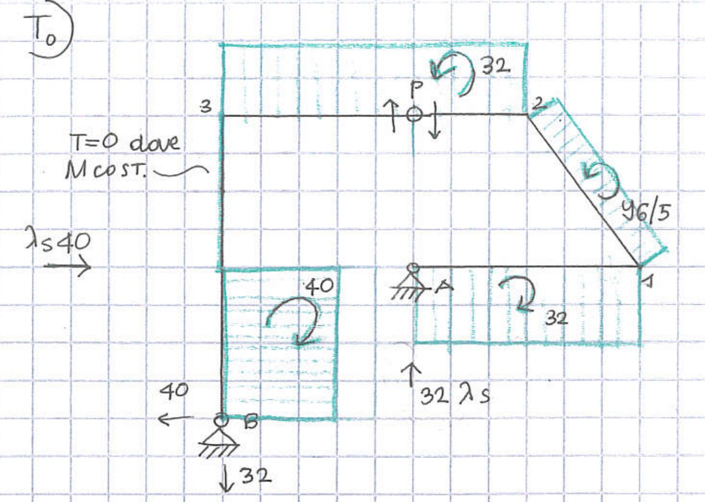
$R_o B = \lambda_s 40$ | $R_V B = 4\bar{R}_B$

$\Rightarrow R_A = 4\bar{R}_B$

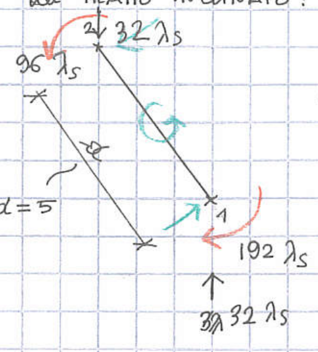
$\frac{\cancel{5}\bar{R}_B}{\cancel{5}} = \lambda_s \frac{40}{5} \Rightarrow \bar{R}_B = 8\lambda_s$







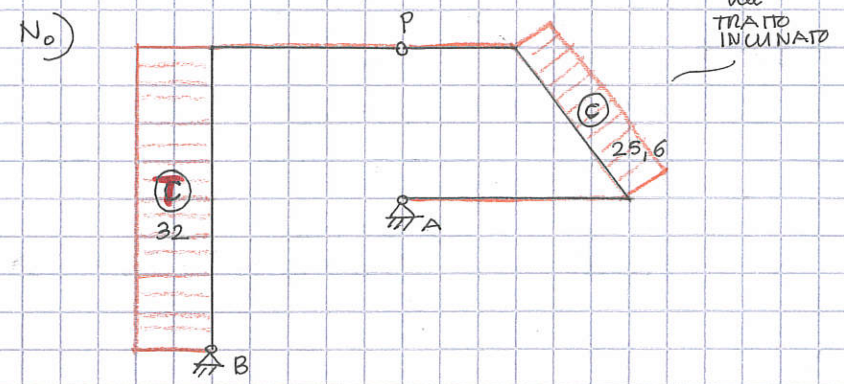
nel tratto inclinato:

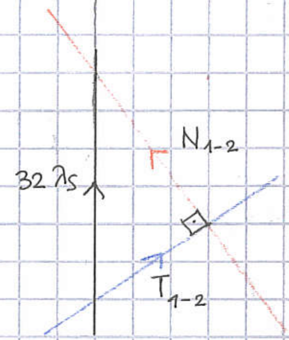


$$T_{12} = \frac{192\lambda_s - 96\lambda_s}{5} = \frac{96}{5} \sim 19.2$$

$$\frac{96}{5} \times 5 = 96$$

G





$$N_{1-2} = \sqrt{32^2 - \left(\frac{96}{5}\right)^2} = \sqrt{1024 - \frac{9216}{25}} = \sqrt{1024 - 368{,}64} = \sqrt{655{,}36} = 25{,}6$$

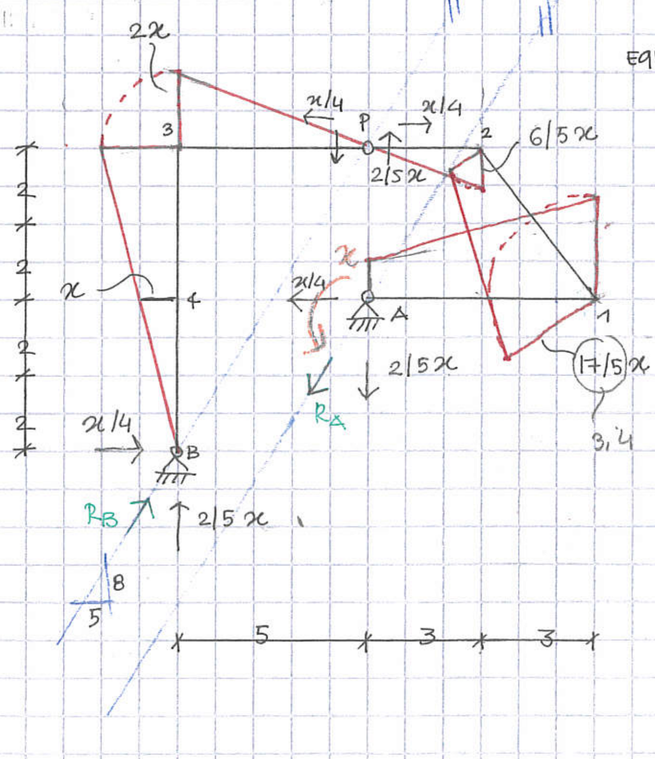
* PRIMA IPOTESI di λ_s dallo schema $\varnothing$
PER $x = 0$

$M(1) = 19\cancel{0}^2\,\lambda_s = M_0^{MAX}$ → lo porto ad $M_u = 500$ kN · m

quindi PONGO $192\lambda_s = 500 \Rightarrow \lambda_s = \frac{500}{192} \frac{250}{96} \frac{125}{48} \sim 2{,}6$

---

schema x (x INCOGNITA IPERSTATICA = REAZIONE A MOMENTO dell'INCASTRO in A)



EQUILIBRIO di 2F// + MOMENTO (x)

$$x = R_V \cdot 5 - R_o \cdot 4$$

G ↻ G

$R_V = 8\bar{R}$ $\quad 5\bar{R}$

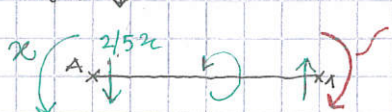
$x = R \cdot b$
$R = \frac{x}{b}$

$x = 8\bar{R} \cdot 5 - 5\bar{R} \cdot 4 = 40\bar{R} - 20\bar{R} = 20\bar{R} \Rightarrow \bar{R} = x/20$

$R_V = \cancel{8}^{4\,2} \cdot \frac{x}{\cancel{20}_{10\,5}} = 2/5x$; $R_o = \cancel{5} \cdot \frac{x}{\cancel{20}_4} = x/4$

$M(3) = \frac{x}{\cancel{4}} \cdot \cancel{8}^2 = 2x$

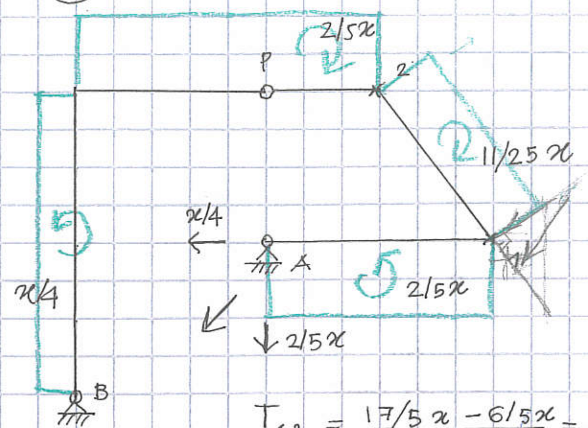
$M(1)$

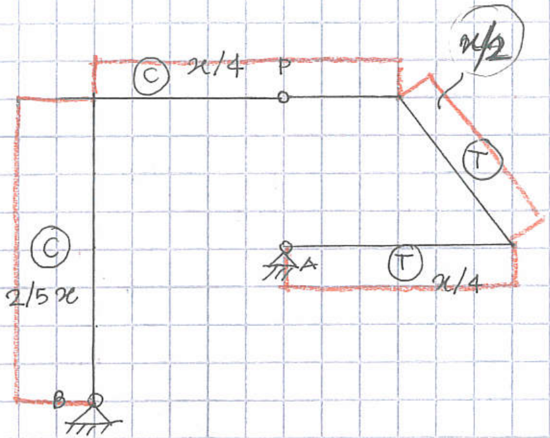


$x + \frac{2}{5}x \cdot 6$

$$\frac{5x + 12x}{5} = 17/5x \sim 3{,}4$$

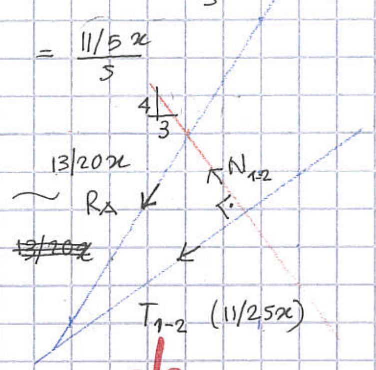
T_x e N_x





$$T_{1-2} = \frac{17/5\,x - 6/5\,x}{5} = \frac{11/5\,x}{5}$$

$$\frac{8+5}{20}x \left(\frac{13}{20}x\right)^2$$



$$R_A = \sqrt{\left(\frac{2}{5}x\right)^2 + \left(\frac{x}{4}\right)^2} = \sqrt{\frac{4}{25}x^2 + \frac{x^2}{16}}$$

$$\cancel{= \frac{2}{5}x + \frac{x}{4}}$$

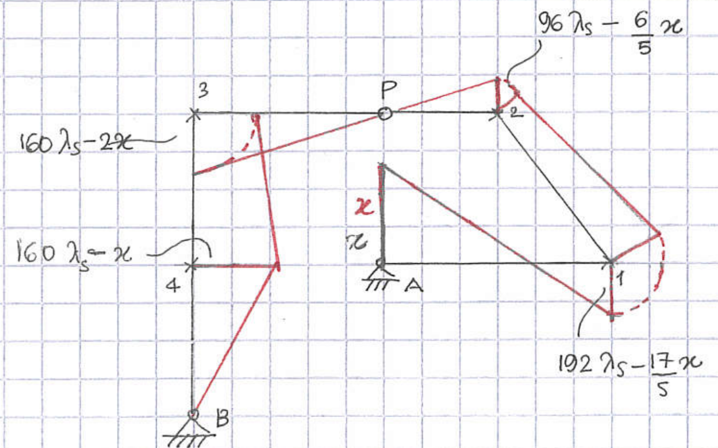
$$= \sqrt{\frac{64x^2 + 25x^2}{400}} = \boxed{\sqrt{\frac{89x^2}{400}}} = \frac{9,4}{20}$$

ok

$$\cancel{N_{1-2} = \sqrt{\left(\frac{13}{20}x\right)^2 - \left(\frac{11}{25}x\right)^2}} =$$

$$N_{1-2} = \sqrt{\left(\frac{13}{20}x\right)^2 - \left(\frac{11}{25}x\right)^2} = \sqrt{\left(\frac{325-220}{500}x\right)^2} = \sqrt{\frac{125}{500}x^2} = \sqrt{\frac{x^2}{4}} \rightarrow \frac{x}{2}$$

$$\boxed{M = M_0 + M_x}$$



• CONDIZIONI:

$M(A) = x$

$M(1) = 192\lambda_s - \frac{17}{5}x \leq M_u$

$M(2) = 96\lambda_s - \frac{6}{5}x \leq M_u$

$M(3) = 160\lambda_s - 2x \leq M_u$

$M(4) = 160\lambda_s - x \leq M_u$

Pongo $x = M_u = M(A)$

$M(1) \Rightarrow 192\lambda_s \leq \frac{22}{5}M_u \rightarrow \lambda_s = \frac{2200}{192} \sim 11,458$

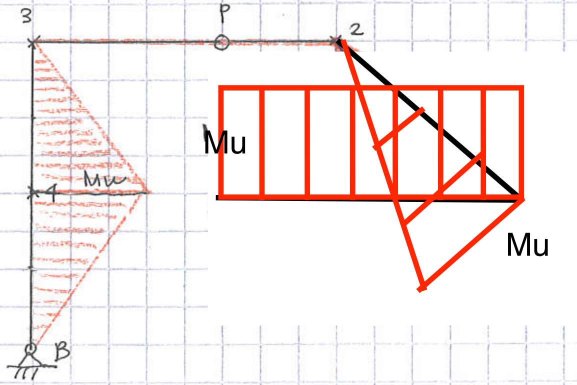
$M(2) \Rightarrow 96\lambda_s \leq \frac{11}{5}M_u \rightarrow \lambda_s = \frac{1100}{96} \sim 11,458$

$M(3) \Rightarrow 160\lambda_s \leq 3M_u \rightarrow \lambda_s = \frac{1500}{160} \sim 9,375$

MASSIMIZZO M(4) $M(4) \Rightarrow 160\lambda_s \leq 2M_u \rightarrow \boxed{\lambda_s = \frac{1000}{160} \sim 6,25}$

$\lambda_s = \frac{25}{4}$

—— GRAFICO FINALE ——



VERIFICO

$M(1)$ $192 \cdot \frac{25}{4} = \frac{17}{5}M_u \Rightarrow 1200 = \frac{17}{5} \cdot 500 =$ NO

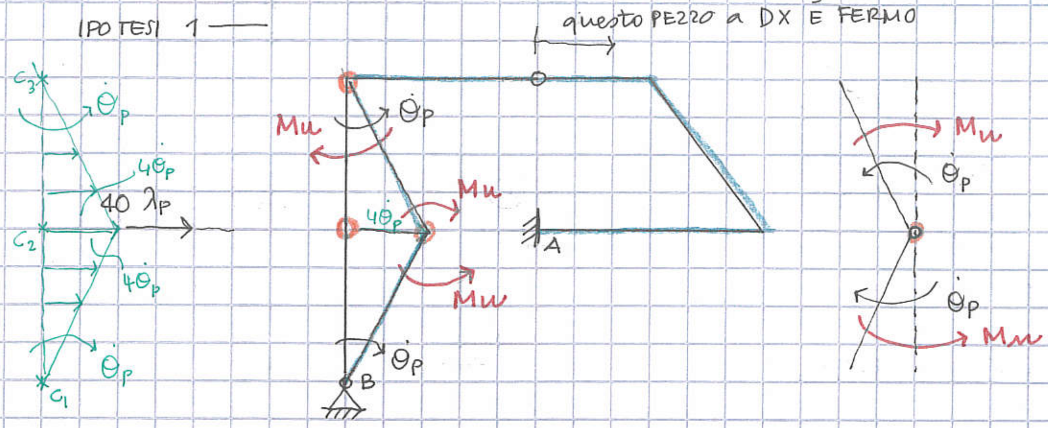
$= 1200 - 1700 = -500$

$M(2)$ $96 \cdot \frac{25}{4} - \frac{6}{5}500 \Rightarrow 600 - 600 = \emptyset$

$M(3)$ $160 \cdot \frac{25}{4} - 2 \cdot 500 \Rightarrow 1000 - 1000 = \emptyset$

APPROCCIO CINEMATICO

IPOTESI 1



$$P = \lambda_P\, 40\, \cancel{\dot{\theta}_P}\, u - Mu\,(\dot{\theta}_P + \dot{\theta}_P + \dot{\theta}_P) = 0 \quad \forall \cancel{\dot{\theta}_P} \Rightarrow \lambda_P = \frac{3\,Mu}{160} = \frac{3 \cdot 500}{160} = \frac{75}{8} \sim 9{,}37 > \lambda_s$$

✓