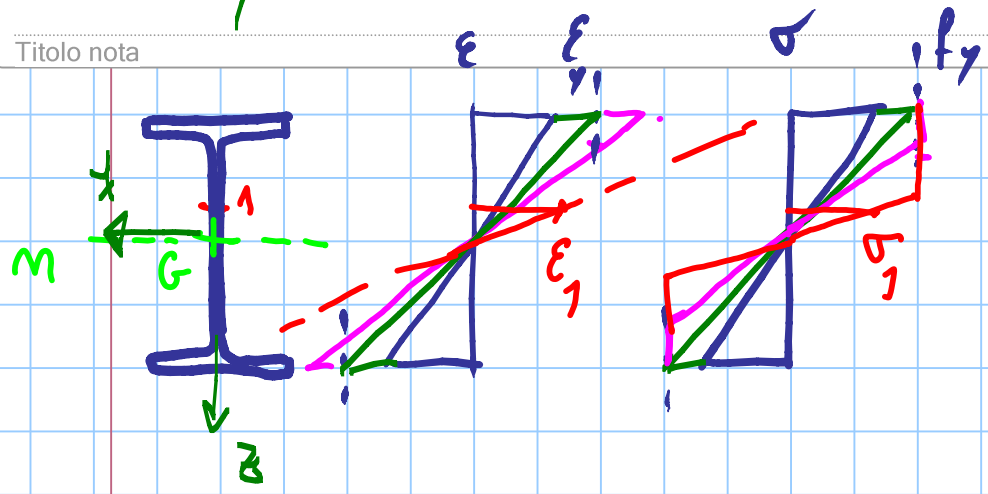
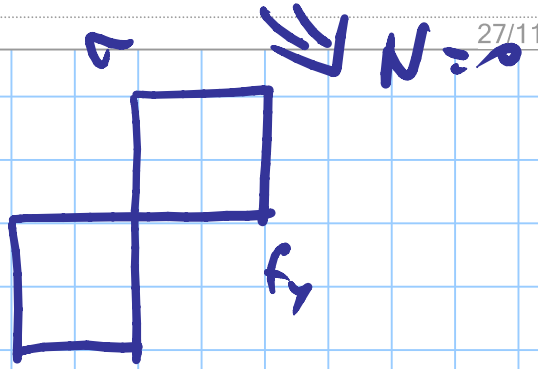
M_y FLESSIONE SEMPLICE RETTA

Titolo nota 27/11/2012

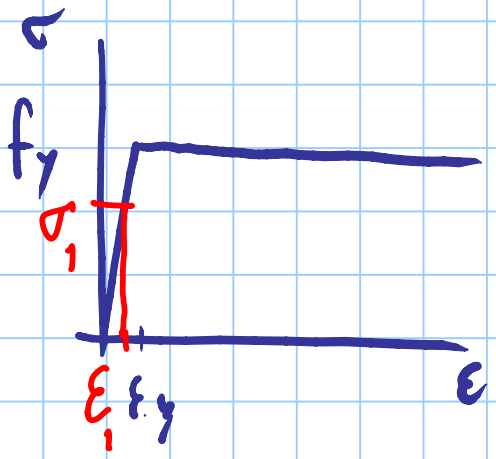


al limite $\varepsilon \to \infty$

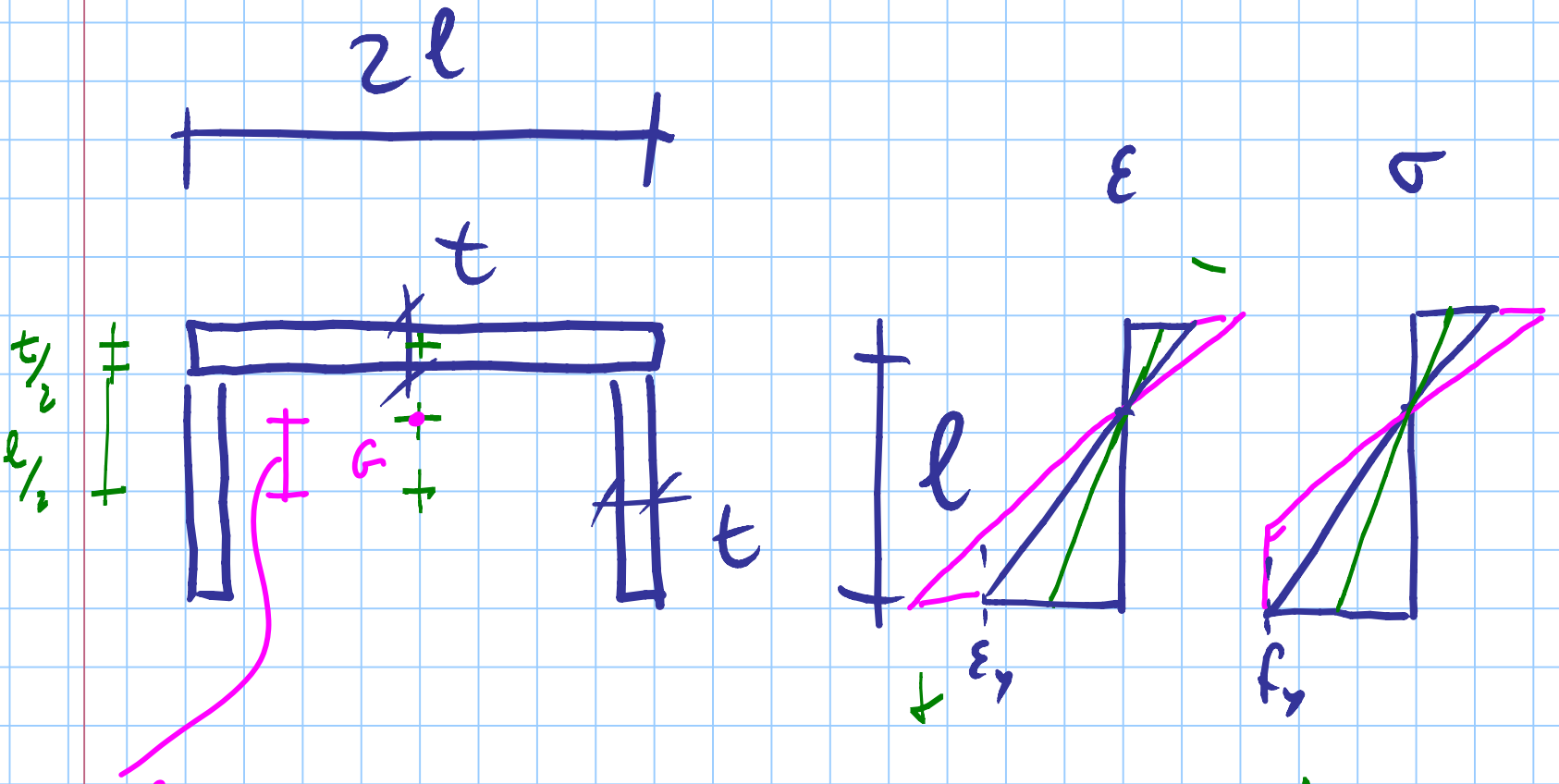


Hp.: mantenimento sezioni piane

legge ε lineare



$$N = 0 \qquad \int_{A_{mi}} \sigma \, dA = 0$$

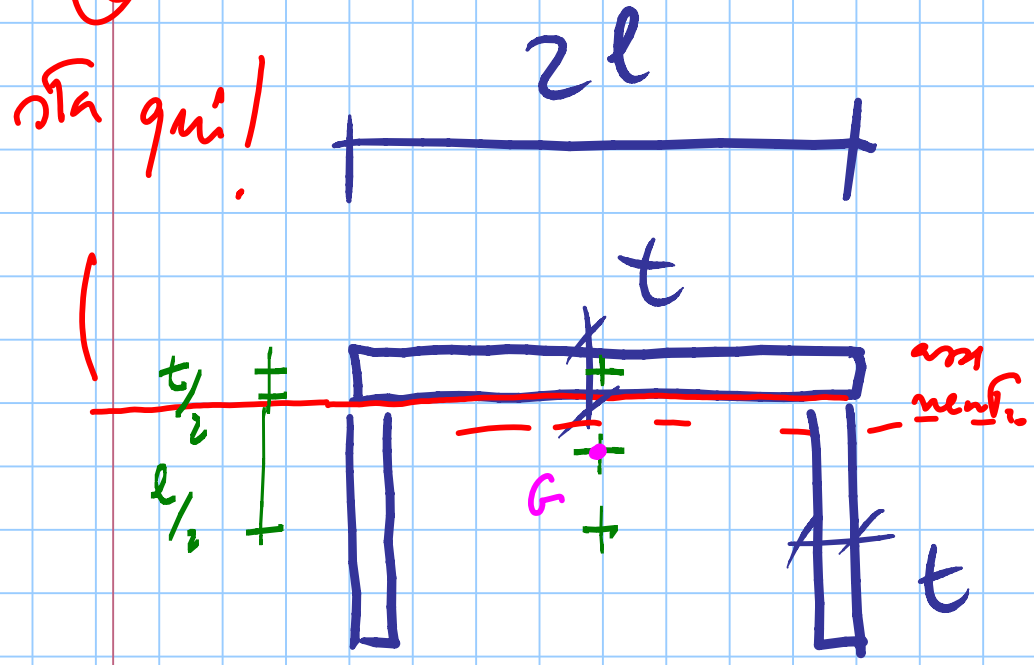


l'asse neutro rimane invariato?

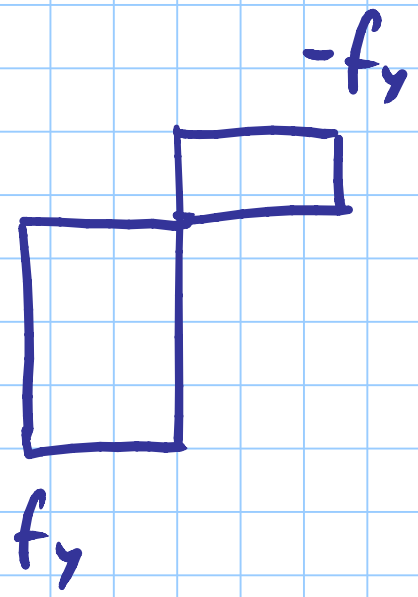
No, si sposta verso l'alto

$N = 0 \Rightarrow \int_{TESA} \sigma \, dA + \int_{compr} \sigma \, dA = 0$

② sta qui!



① dove sta l'asse neutro?



$$N = 0$$

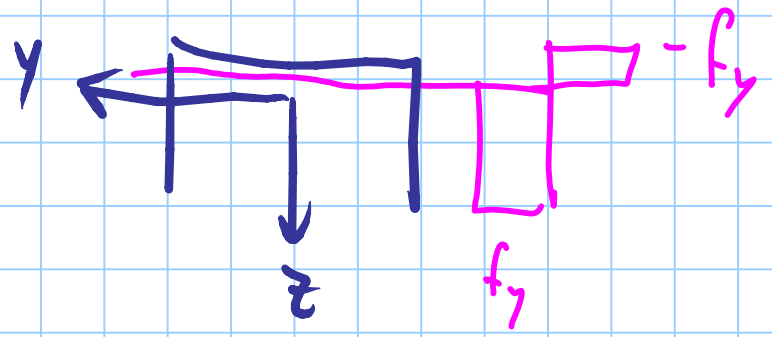
$$\int_{TESA} \sigma \, dA + \int_{compr.} \sigma \, dA = 0$$

$$f_y \int_{TESA} dA - f_y \int_{COMPA} dA = 0$$

$$\Downarrow$$

$$f_y A_{TESA} - f_y A_{COMPA} = 0$$

$$\Rightarrow A_{TESA} = A_{COMPA}$$



quanto vale M_{Rd} ?

$$M = \int \sigma z \, dA$$

$$M_{RD} = \int_{TESA} \sigma z \, dA + \int_{compr} \sigma z \, dA =$$

$$= f_y \int_{TESA} z \, dA - f_y \int_{compr} z \, dA =$$

$$= f_y \, S_{y,Tesa} - f_y \, S_{y,comp} = \underbrace{2 \, S_{y,Tesa}}_{W_{pl}} f_y$$

modulo di resistenza plastico

$$\int_{TUTTO} z \, dA = 0 \qquad S_{y,TESA} + S_{y,compr} = 0 \qquad -S_{y,compr} = S_{y,TESA}$$

$$\sigma = \frac{M}{I} z$$

$$\sigma_{max} = \frac{M}{I} z_{min} = \frac{M}{W} \leq \bar{\sigma}_s$$

$$\Downarrow$$

$$W = \frac{I}{z_{min}}$$

$$M_{max} = W_{el} \bar{\sigma}_s$$

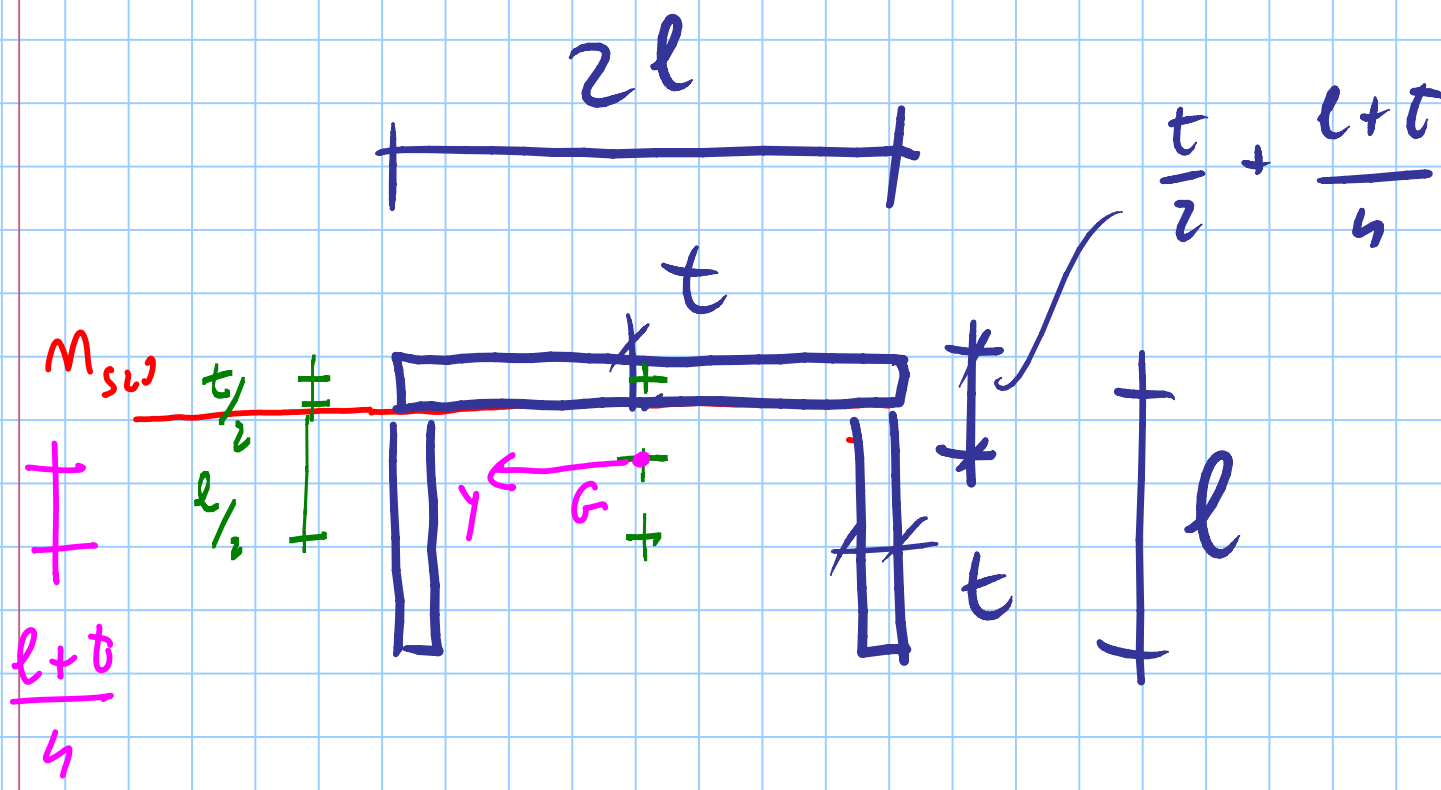
↳ modulo di resistenza elastico

RIEPILOGO

T.A. $\sigma_{max} = \frac{M}{W_{el}} \leq \bar{\sigma}_s$

$M_{max} = W_{el}\ \bar{\sigma}_s$

S.L.U. $M_{Rd} = W_{pl} \frac{f_y}{\gamma_{M0}}$



T.A.

$$I_y = 2\,\frac{t\ell^3}{12} + 2t\ell\left(\frac{\ell+t}{4}\right)^2 + \frac{2\ell t^3}{12} + 2t\ell\left(\frac{\ell+t}{4}\right)^2$$

$$z_{min} = \frac{t}{2} + \frac{\ell+t}{4} \qquad W_el = \frac{I_y}{z_{min}}$$

SLU

distanza dell'asse baricentrico

$$S_{y\,\text{TESTA}} = 2 \cdot t \cdot \frac{l + t}{4}$$

IPE 180

$W_{el} = 146.3 \times 10^3 \ mm^3$

$W_{pl} = 166.4 \times 10^3 \ mm^3$

$g_k = 0.55$ $\quad q_k = 2.55 \ kN/m$

$g_1 = 0.71$ $\quad q_1 = 3.83 \ kN/m$

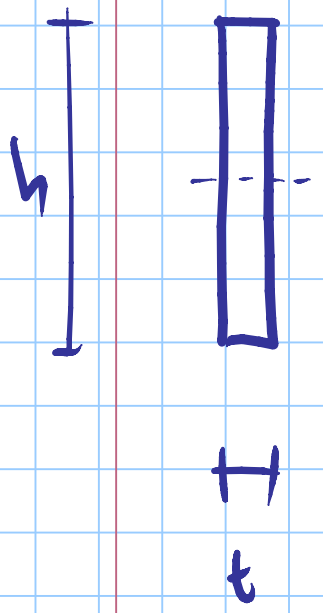
T.A. $\quad M = \frac{q l^2}{8} = \frac{3.10 \times 6.00^2}{8} = 13.95 \ kNm$

$\sigma = \frac{M}{W_{el}} = \frac{13.95 \times 10^6}{146.3 \times 10^3} = 95.4 \ MPa \leq \bar{\sigma}_s = 190 \ MPa$

S.L.U. $M_{Ed} = \frac{4.54 \times 6.00^2}{8} = 20.43$ kNm

$M_{Rd} = W_{pl} \frac{f_y}{\gamma_{M0}} = \frac{166.4 \times 10^3}{10^6} \times \frac{275}{1.05} = 43.6$ kNm

	▽		
	19	1	W
T.A.	19	3.10	146.3
		1.38 ↑	1.46 ↑	1.14 ↑
SLU	$\frac{275}{1.05} = 261.9$	4.54	166.4

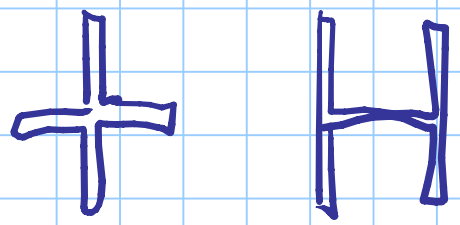


$$W_{el} = \frac{t h^3/12}{h/2} = \frac{t h^2}{6}$$

$$W_{pl} = 2 \; t \, h/2 \; \frac{h}{4} = \frac{t h^2}{4}$$

$$\frac{W_{pl}}{W_{el}} = 1.5$$

FATTORE DI FORMA



$$M_{Ed} \leq M_{Rd} = W_{pl} \frac{f_y}{\gamma_{M0}}$$

PROGETTO $$W_{pl} \geq \frac{M_{Ed} \cdot \gamma_{M0}}{f_y}$$

dai valori caratt., SLE $\Rightarrow$ I $\left(I \geq 870.4\ cm^4 \right)$

dai valori di calcol., SLU $\Rightarrow$ $W_{pl} = \frac{20.43 \times 10^6 \times 1.05}{275} =$

$$= 78.0 \times 10^3\ mm^3$$

FORI

NELL'ANIMA — NON DANNO PROBLEMI PER M

NELL'ALA — stesse considerazioni che per aste tese

$$N_{pl,Rd} = A \frac{f_y}{\gamma_{M0}}$$

$$N_{u,Rd} = 0.9\, A_{net} \frac{f_u}{\gamma_{M2}}$$

$$\frac{A_{net}}{A} \geq \frac{f_y/\gamma_{M0}}{0.9\, f_u/\gamma_{M2}}$$

applicare all'area dell'ala

FLESSIONE DEVIATA

$$\frac{M_{y,Ed}}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} \leq 1$$