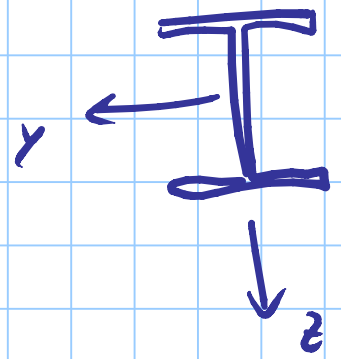
FLESSIONE COMPOSTA M + N

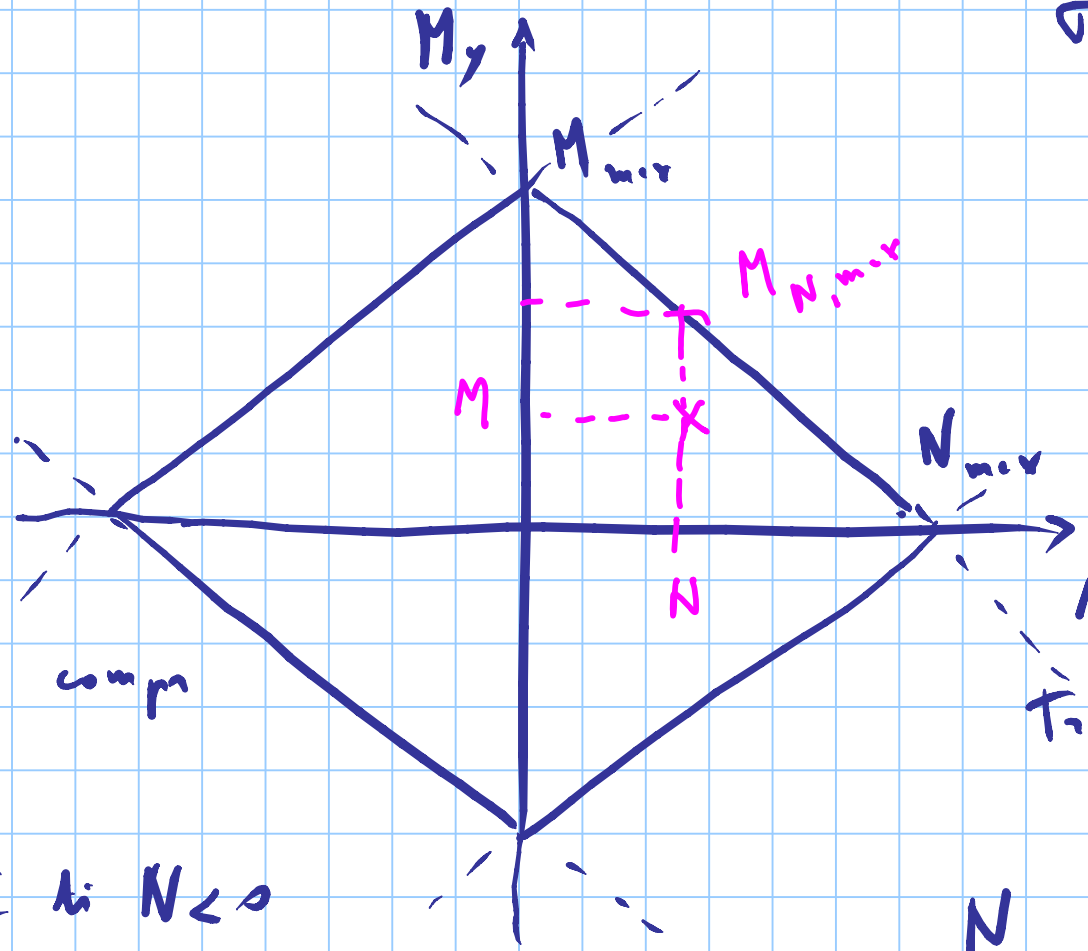
Titolo nota 26/11/2013

materiale elastico lineare



$$\sigma = \frac{N}{A} + \frac{M_y}{I_y} \cdot z$$

$$\sigma_{max} = \frac{N}{A} + \frac{M_y}{W_y}$$

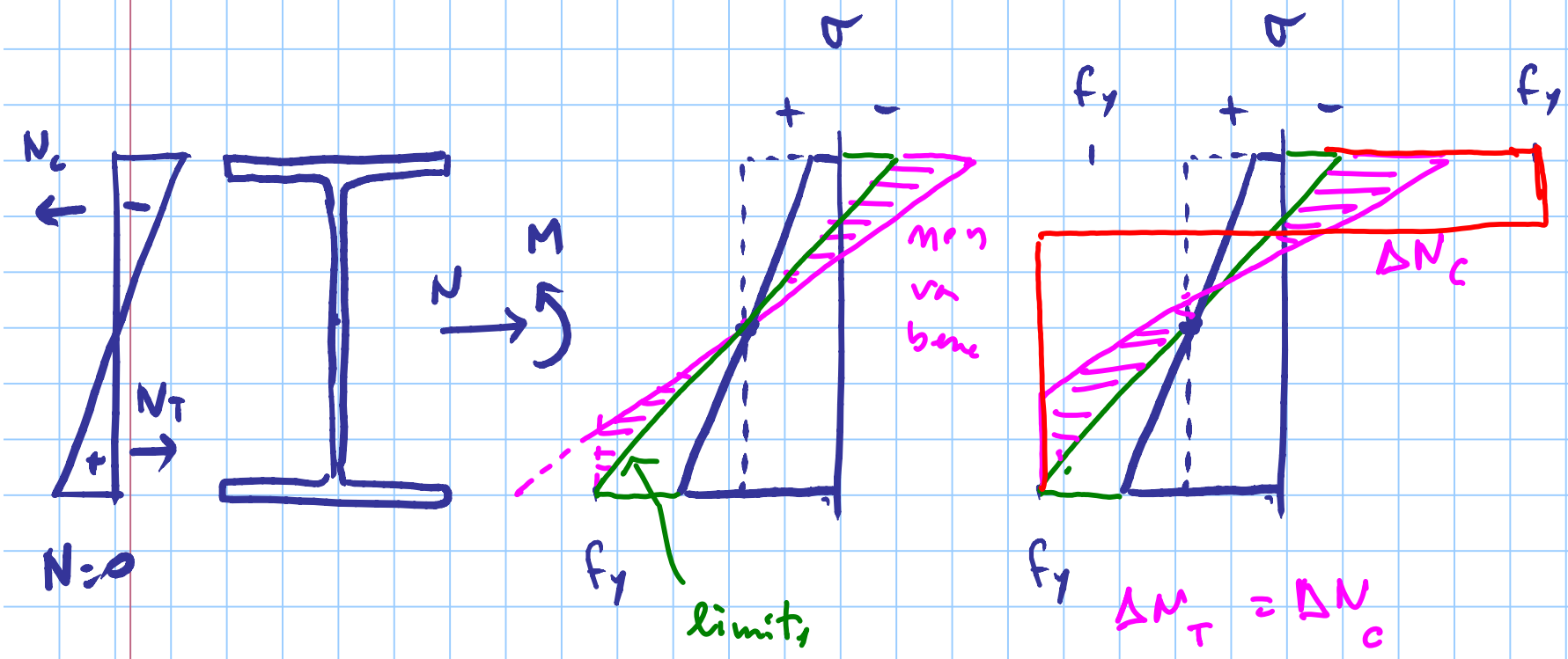


$\sigma_{max} = \overline{\sigma_s}$

T.A.

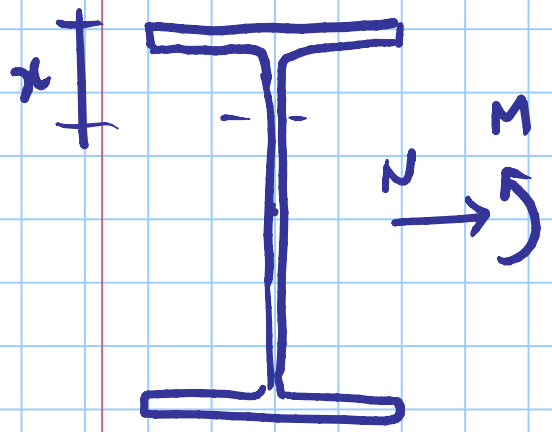
le parte di $N < 0$ (compr.) deve essere modificata per instabilità

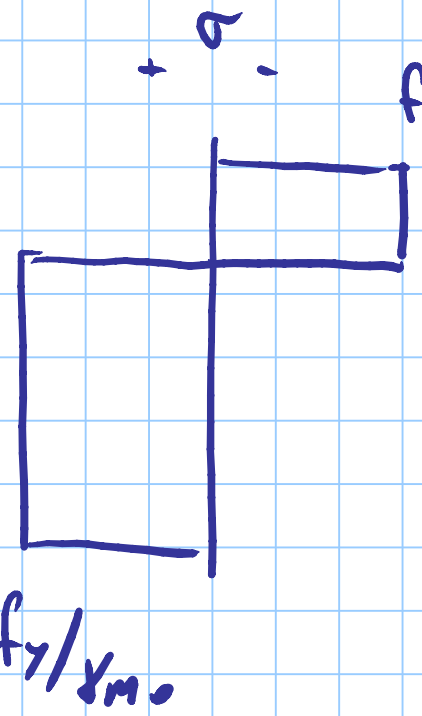
$$\frac{N}{A} + \frac{M_y}{W_y} = \overline{\sigma_s}$$



N_{fine}

facio variare M





$$N_{Ed} = N = \int \sigma \, dA =$$

$$= \int_{tens} \sigma \, dA + \int_{comp} \sigma \, dA =$$

$$= \frac{f_y}{\gamma_{M0}} \left(A_{tens} - A_{comp} \right)$$

N_{Ed} , M_{Ed}

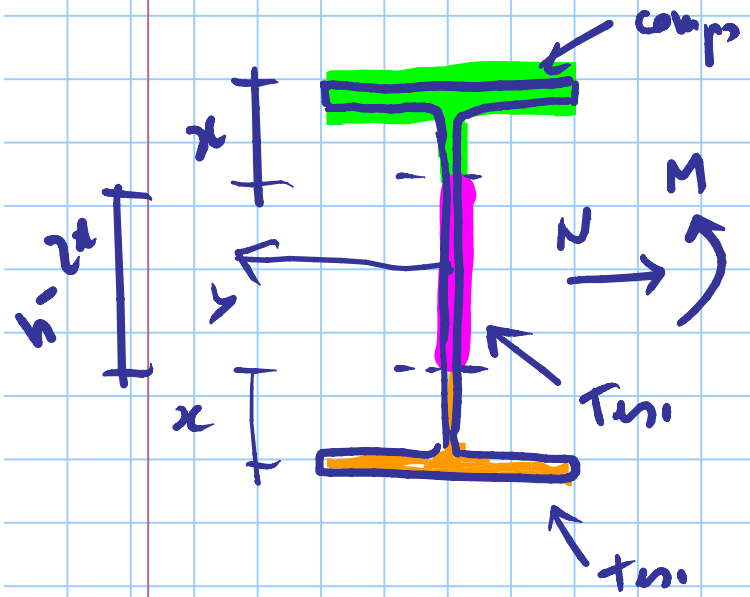
$$N_{Ed} = \frac{f_y}{\gamma_{M0}} \left(A_{tens} - A_{comp} \right)$$

$$M_{N,Rd} = f(N_{Ed})$$

$$M_{Ed} \leq M_{N,Rd}(N = N_{Ed})$$

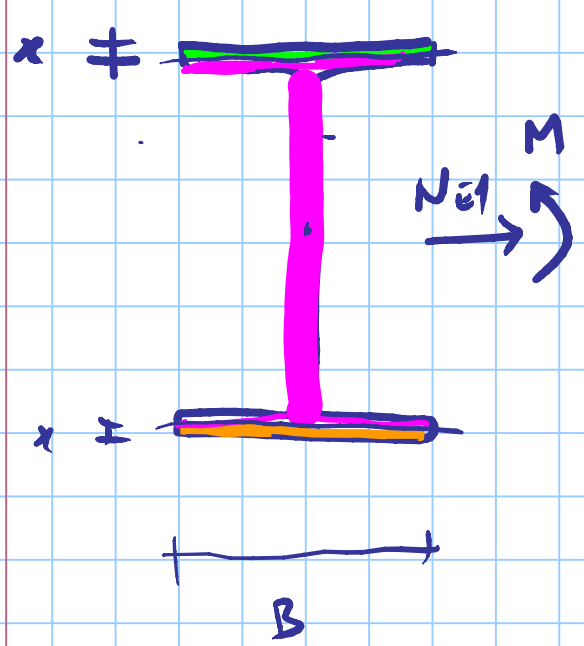
$$N_{Ed} = \frac{f_y}{\gamma_{M0}} \left(A_{tens} - A_{comp} \right)$$

$$A_{tens} - A_{comp} = \frac{N_{Ed}}{f_y / \gamma_{M0}}$$



se l'asse neutro taglia l'anima

$$N_{Ed} = (h - 2x)\, t_w \frac{f_y}{\gamma_{M0}}$$



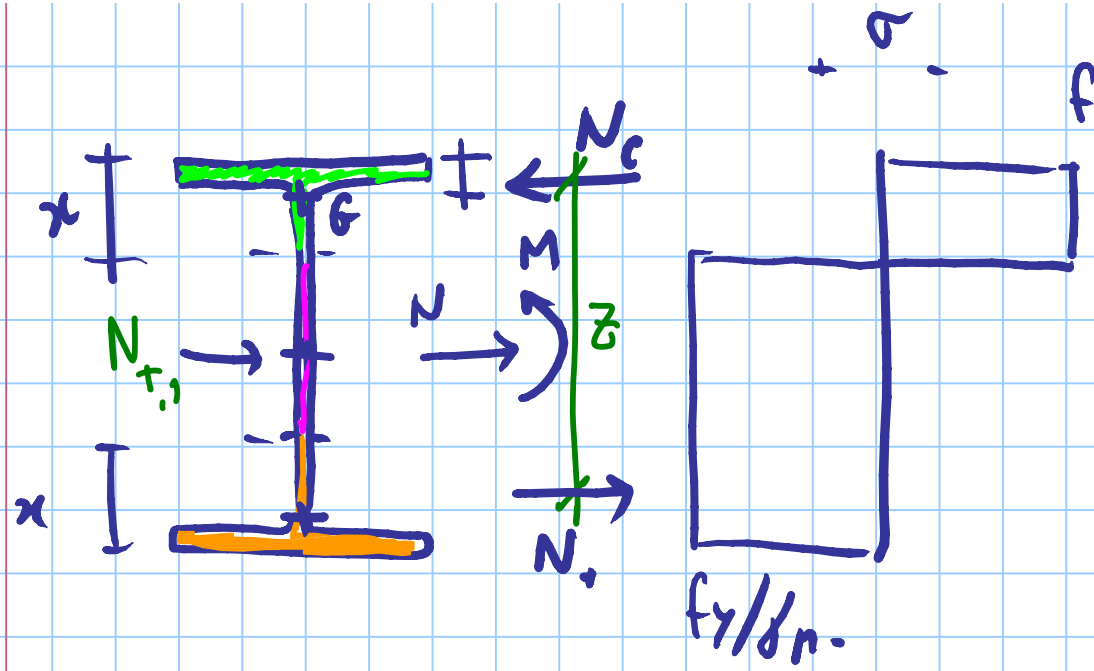
se l'asse neutro taglia l'ala

$$N_{Ed} = (A - 2Bx)\frac{f_y}{\gamma_{M0}}$$

se l'anima membra tutta l'anima $\qquad t_f \le x \le h - t_f$

$$N_{Ed} = (h - 2x)\, t_w \frac{f_y}{\gamma_{M0}}$$

$$\frac{N_{Ed}}{t_w f_y / \gamma_{M0}} = h - 2x \qquad x = \frac{1}{2}\left[h - \frac{N_{Ed}}{t_w f_y / \gamma_{M0}} \right]$$



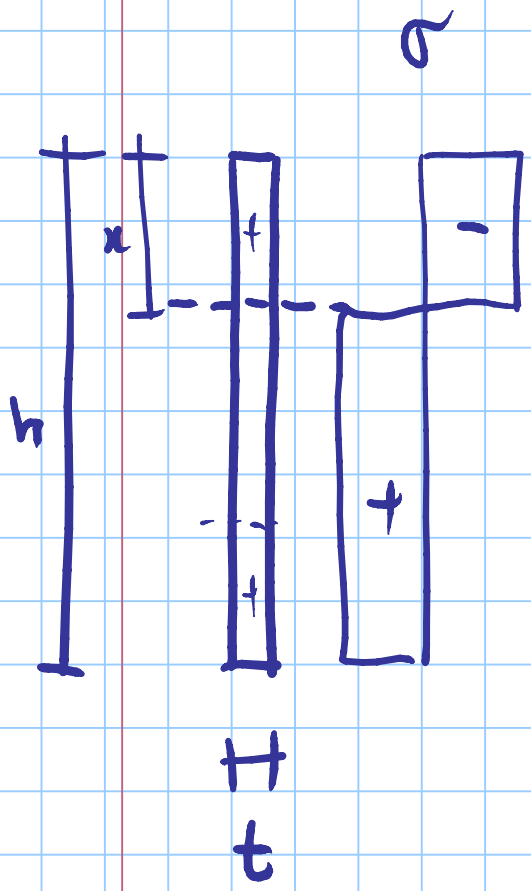
$$N_c = \int_{comp.} \sigma \, dA = N_T$$

$$M_{N,Rd} = N_c \cdot z$$

dopo aver trovato la posizione dell'asse neutro

$$M_{N,Rd} = \int \sigma z \, dA$$

$N_{Ed} \rightarrow x \rightarrow M_{N,Rd}$



$x \rightarrow N_{El}, M_{N,Rd}$

$$N_{El} = (h \cdot 2x)\, t \, \frac{f_y}{\gamma_{M0}}$$

$$M_{N,Rd} = t x \, \frac{f_y}{\gamma_{M0}} (h - x)$$

$$\frac{N_{Ed}}{t\, f_y/\gamma_{M0}} = h - 2x$$

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

$$x = \frac{1}{2}\left[h - \frac{N_{Ed}}{t\, f_y/\gamma_{M0}}\right] =$$

$$= \frac{h}{2}\left[1 - \frac{N_{Ed}}{t\, h\, f_y/\gamma_{M0}}\right] =$$

$$= \frac{h}{2}\left(1 - \frac{N_{Ed}}{N_{Rd}}\right)$$

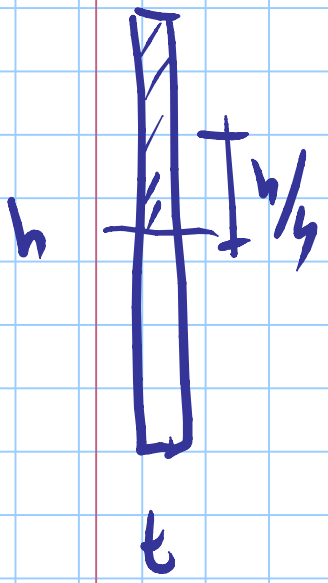
$$M_{N,Rd} = t\,x\,\frac{f_y}{\gamma_{M0}}\,(h-x)$$

$$M_{N,Rd} = t\,\frac{h}{2}\left(1-\frac{N_{Ed}}{N_{Rd}}\right)\frac{f_y}{\gamma_{M0}}\left[h-\underbrace{\frac{h}{2}\left(1-\frac{N_{Ed}}{N_{Rd}}\right)}_{\frac{h}{2}\left(1+\frac{N_{Ed}}{N_{Rd}}\right)}\right] =$$

$$= t\,\frac{h^2}{4}\,\frac{f_y}{\gamma_{M0}}\left[1-\left(\frac{N_{Ed}}{N_{Rd}}\right)^2\right]$$

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

$$W_{pl} = 2 S_{1/2} = \frac{t h^2}{4}$$

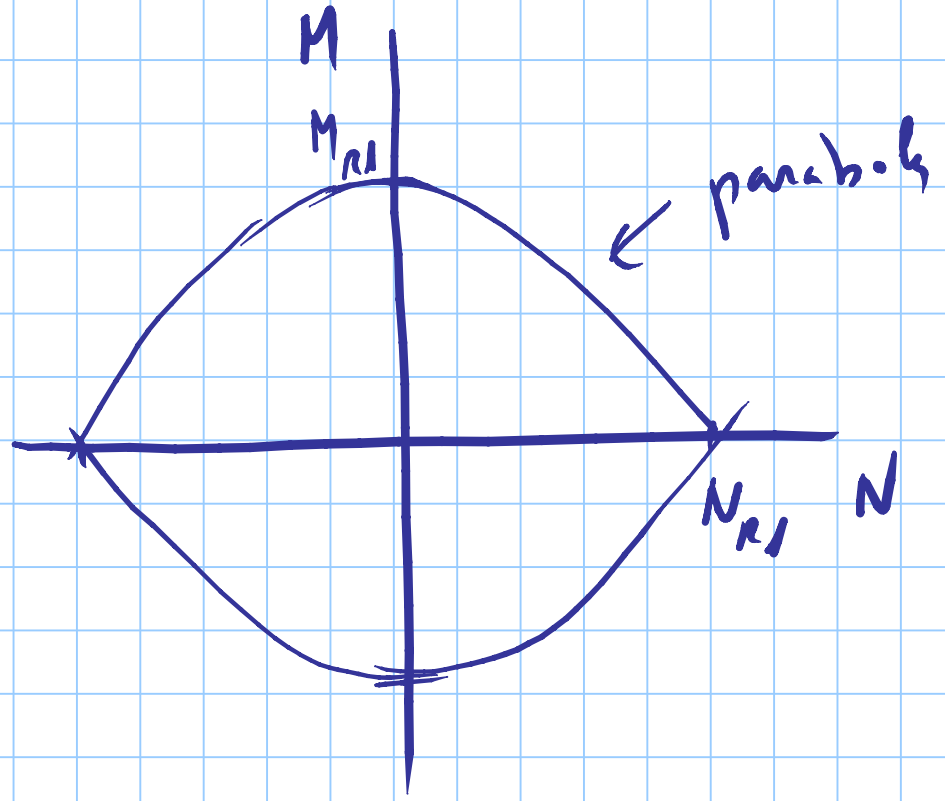


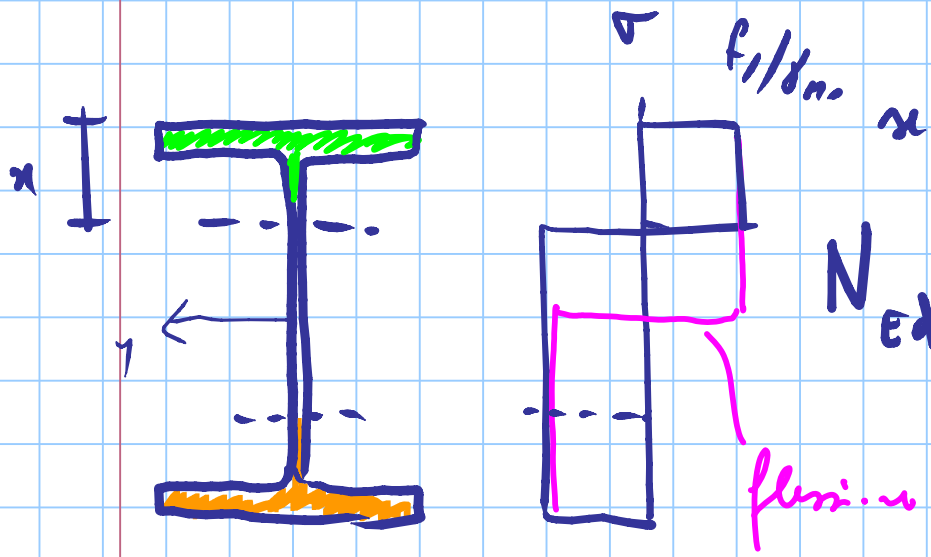
$$S_{1/2} = t \frac{h}{2} \cdot \frac{h}{4} = \frac{t h^2}{8}$$

$$M_{Rd} = \frac{t h^2}{4} \frac{f_y}{\gamma_{M0}}$$

$$M_{N,Rd} = M_{Rd}\left[1 - \left(\frac{N_{Ed}}{N_{Rd}}\right)^2\right]$$

$$\frac{M_{N,Rd}}{M_{Rd}} = 1 - \left(\frac{N_{Ed}}{N_{Rd}}\right)^2$$





se l'asse neutro taglia l'anima

$$N_{Ed} = (h-2x)\, t_w \frac{f_y}{\gamma_{M0}}$$

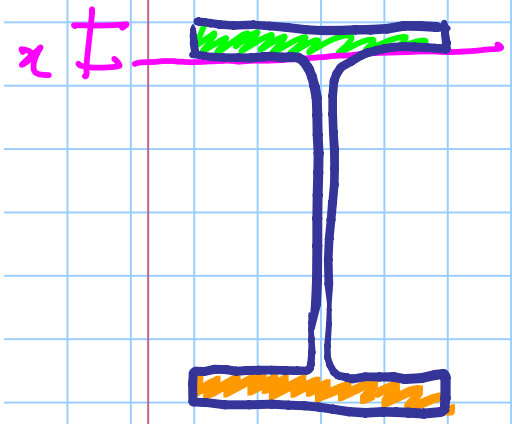
$$h-2x = \frac{N_{Ed}}{t_w f_y/\gamma_{M0}}$$

$$M_{N,Rd} = M_{Rd} - \frac{t_w (h-2x)^2}{4} \frac{f_y}{\gamma_{M0}}$$

$$M_{N,Rd} = M_{Rd} - \frac{N_{Ed}^2}{4\, t_w f_y/\gamma_{M0}}$$

$$t_f \le x \le h - t_f$$

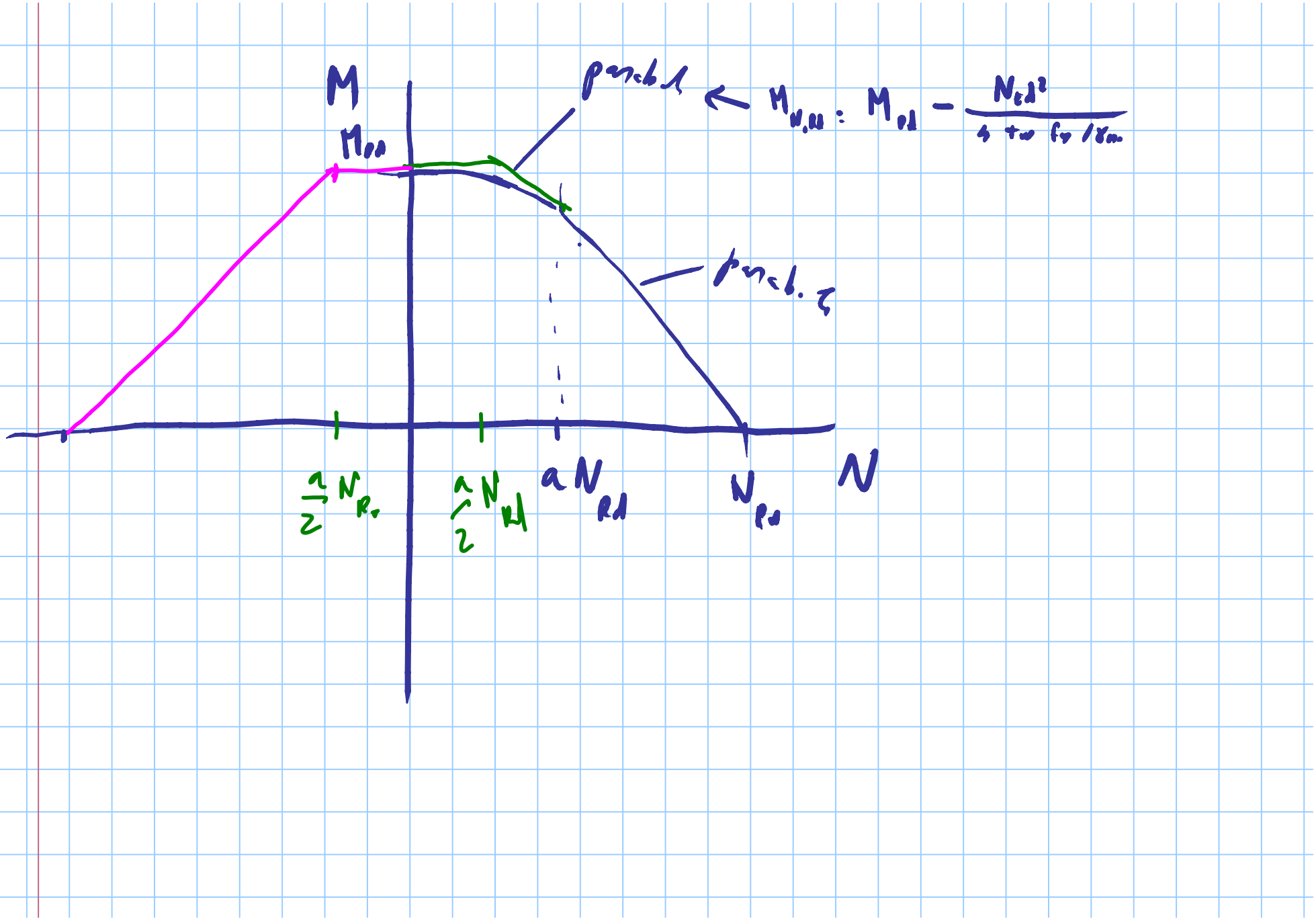
$x = t_f$



$$N_{Ed} = N_{Rd} - 2\,B\,t_f\,\frac{f_y}{\gamma_{M0}} =$$

$$= (A - 2\,B\,t_f)\,\frac{f_y}{\gamma_{M0}}$$

$$\frac{N_{Ed}}{N_{Rd}} = \frac{A - 2\,B\,t_f}{A} = a \qquad \Rightarrow N_{Ed} = a\,N_{Rd}$$


M
M_{Rd}
$\frac{a}{2} N_{Rd}$
$\frac{a}{2} N_{Rd}$
$a N_{Rd}$
N_{Rd}
N