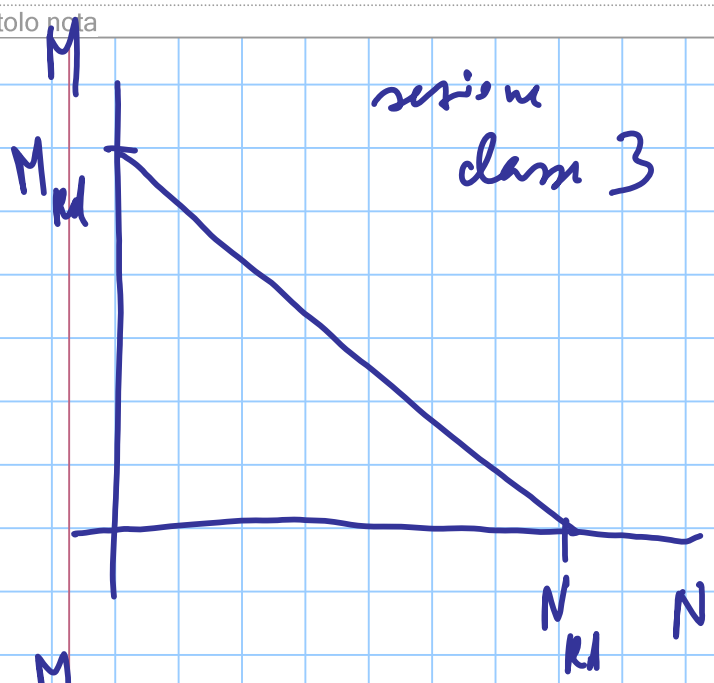
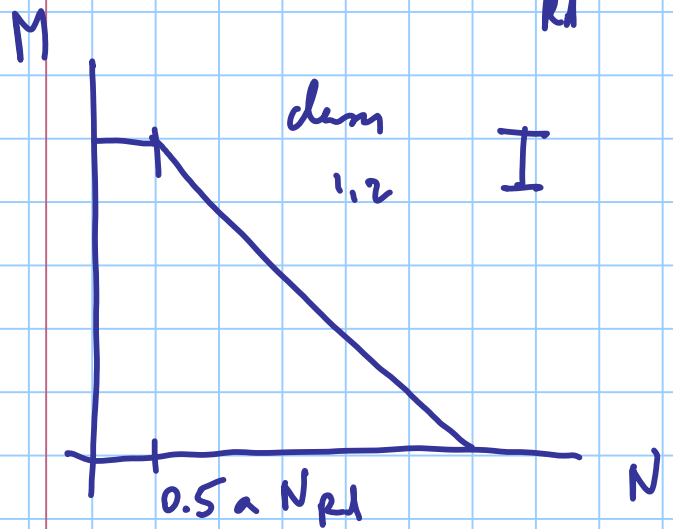
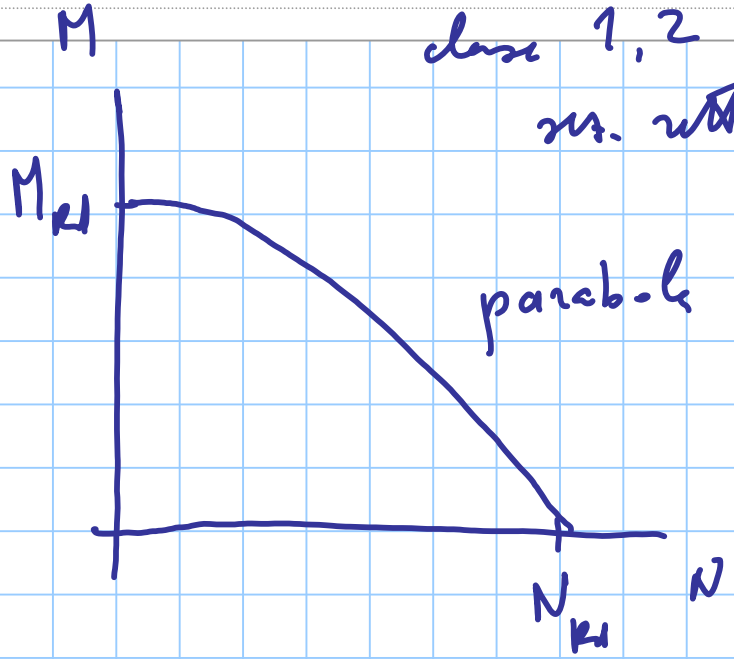
Titolo nota 02/12/2014

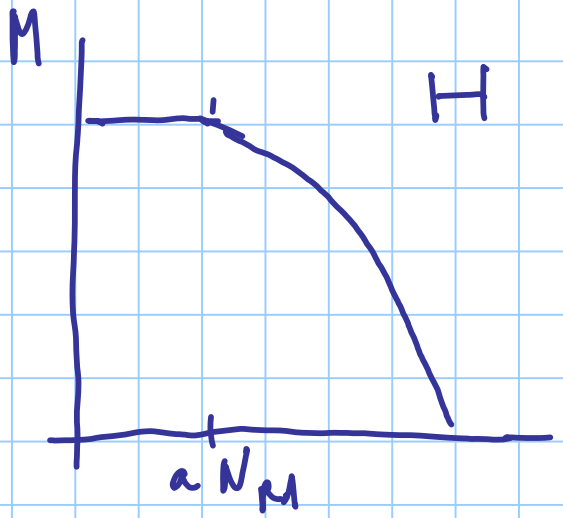


sezione classe 3





classe 1, 2
sez. rettangolare
parab-ta



verifica M_{Ed} , N_{Ed}

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

confronto $M_{Ed} \leq M_{N,Rd}$

PROGETTO

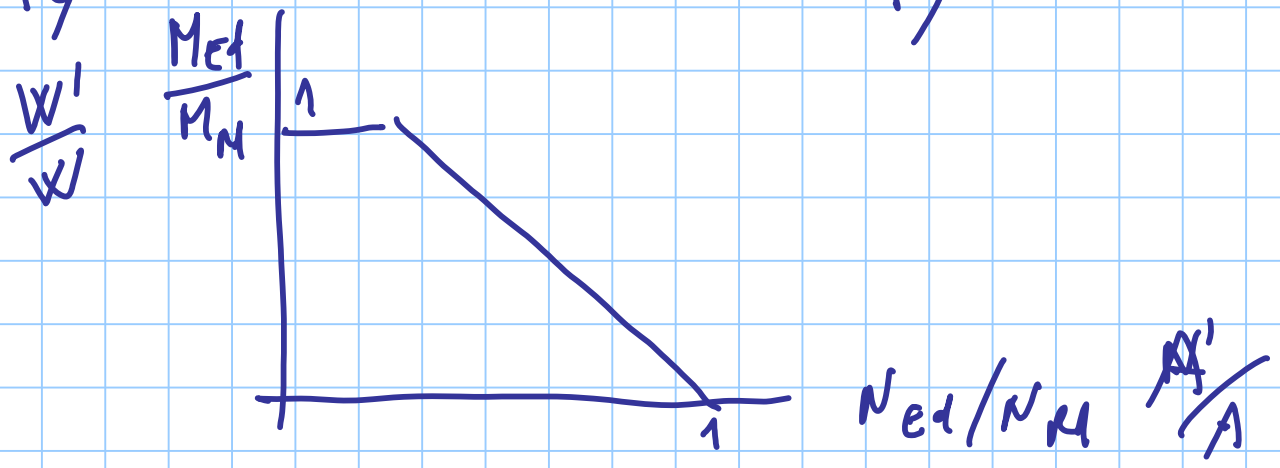
M_{Ed} N_{Ed}

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

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

$$W'_{pl} = \frac{M_{Ed}\,\gamma_{M0}}{f_y}$$

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



Ex. $M_{Ed} = 100\ kN_m$ $N_{Ed} = 500\ kN$

S275 $f_y = 275\ MPa$

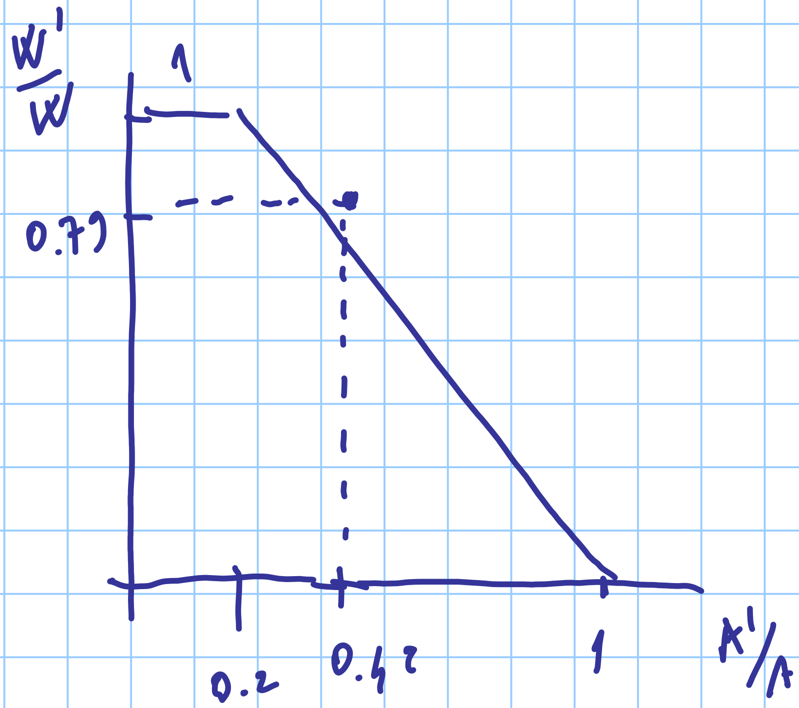
$$W'_{pl} = \frac{100 \times 10^6 \times 1.05}{275} = 381.8 \times 10^3\ mm^3$$

$$A' = \frac{500 \times 10^3 \times 1.05}{275} = 19.09 \times 10^2\ mm^2$$

IPE 270 $W_{pl} = 484.0 \times 10^3\ mm^3$ $A = 45.9 \times 10^2\ mm^2$

$a \simeq 0.4$ IPE

$0.5\,a \simeq 0.2$



$$\frac{A'}{A} = \frac{19.09}{45.9} = 0.42$$

$$\frac{W'}{W} = \frac{381.8}{484.0} = 0.79$$

meglio un IPE 300

TENSO FLESSIONE DEVIATA

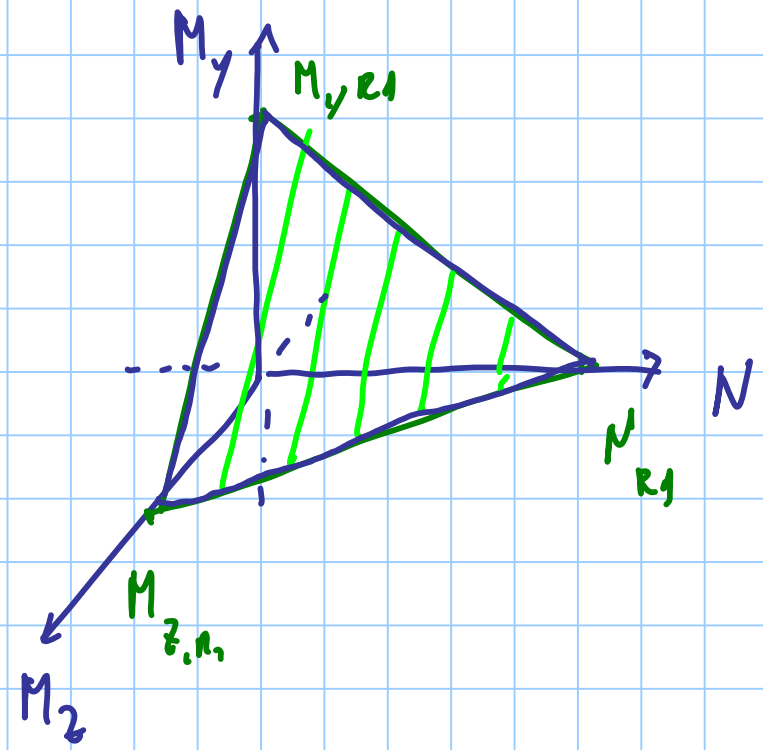
N_{Ed} $M_{y,Ed}$ $M_{z,Ed}$

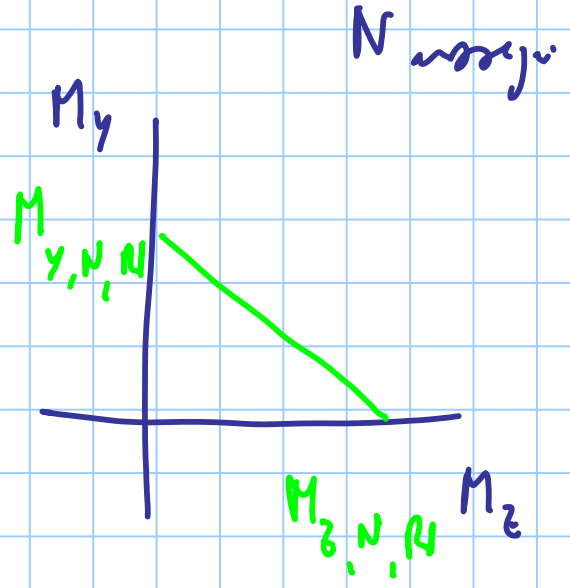
classe 3 comport. elastico lineare fino a $\frac{f_y}{\gamma_{M0}}$

$$\sigma = \frac{N}{A} + \frac{M_y}{I_y} z - \frac{M_z}{I_z} y$$

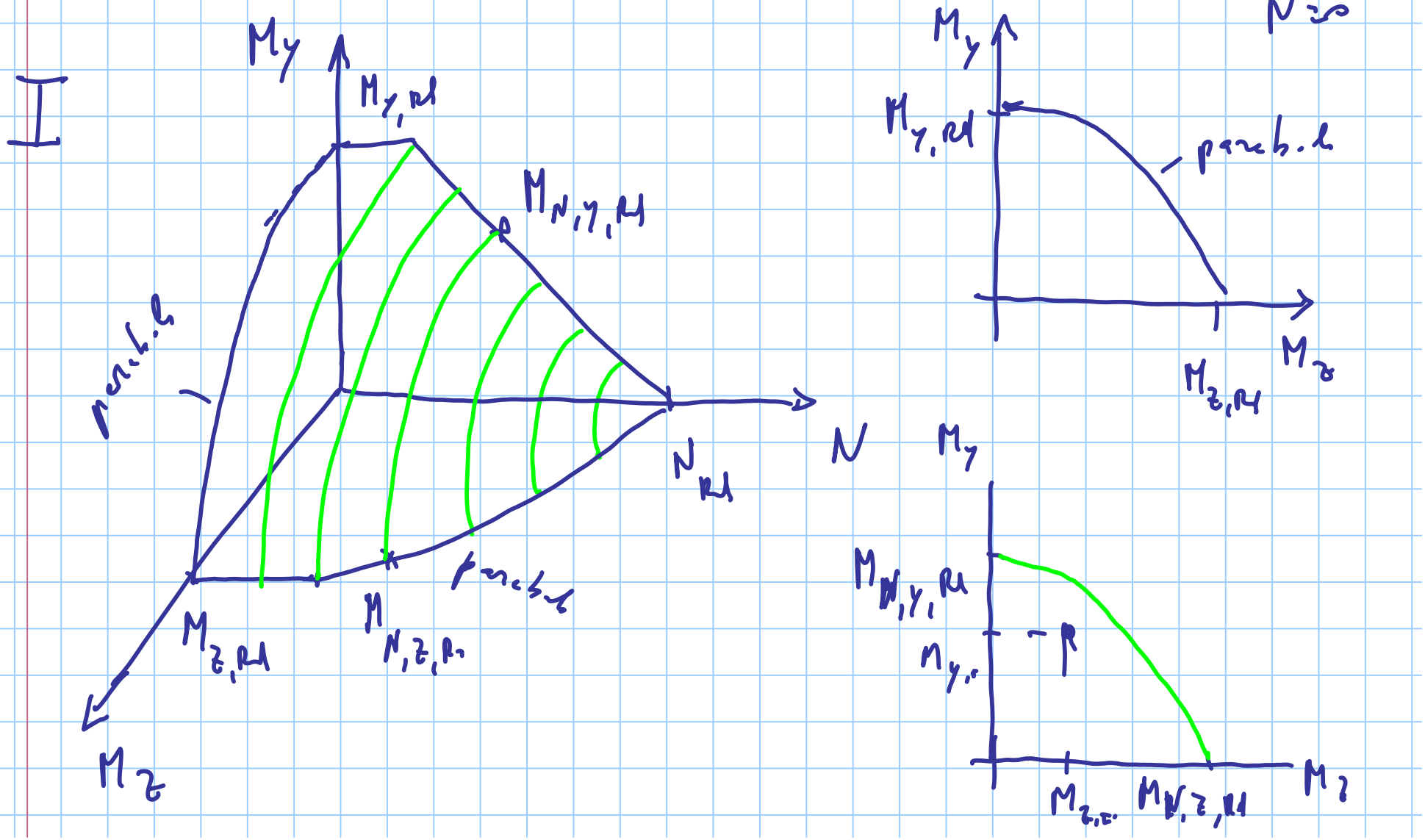
$$\sigma_{max} = \frac{|N|}{A} + \frac{|M_y|}{W_y} + \frac{|M_z|}{W_z} \leq \frac{f_y}{\gamma_{M0}}$$

$$\left|\frac{N_{Ed}}{N_{Rd}}\right| + \left|\frac{M_{y,Ed}}{M_{y,Rd}}\right| + \left|\frac{M_{z,Ed}}{M_{z,Rd}}\right| \leq 1$$





classe 1.2 piena plastificazione



$$\left(\frac{M_{y,Ed}}{M_{N,y,Rd}}\right)^2 + \left(\frac{M_{z,Ed}}{M_{N,z,Rd}}\right)^{5n \geq 1} \leq 1 \qquad n = \frac{N_{Ed}}{N_{Rd}}$$

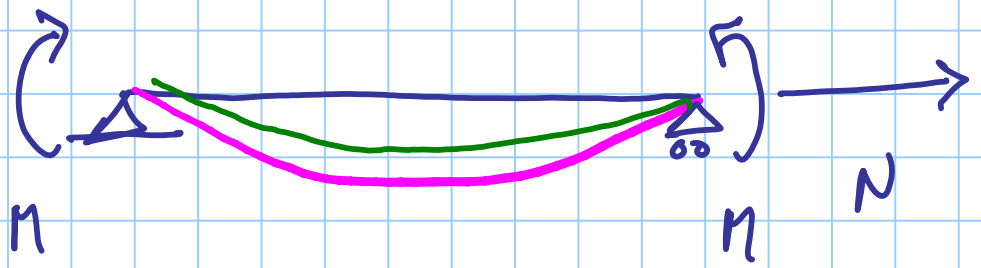
VERIFICA sezione maggiore $W_{pl,y}$ $W_{pl,z}$ A

calcolo N_{Rd} $M_{y,Rd}$ $M_{z,Rd}$

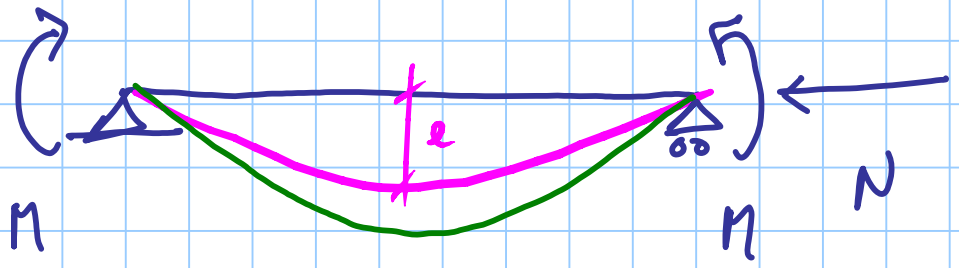
per tens.flessione retta calcolo $M_{N,y,Rd}$ $M_{N,z,Rd}$

applico la formula di sopra

PRESSOFLESSIONE

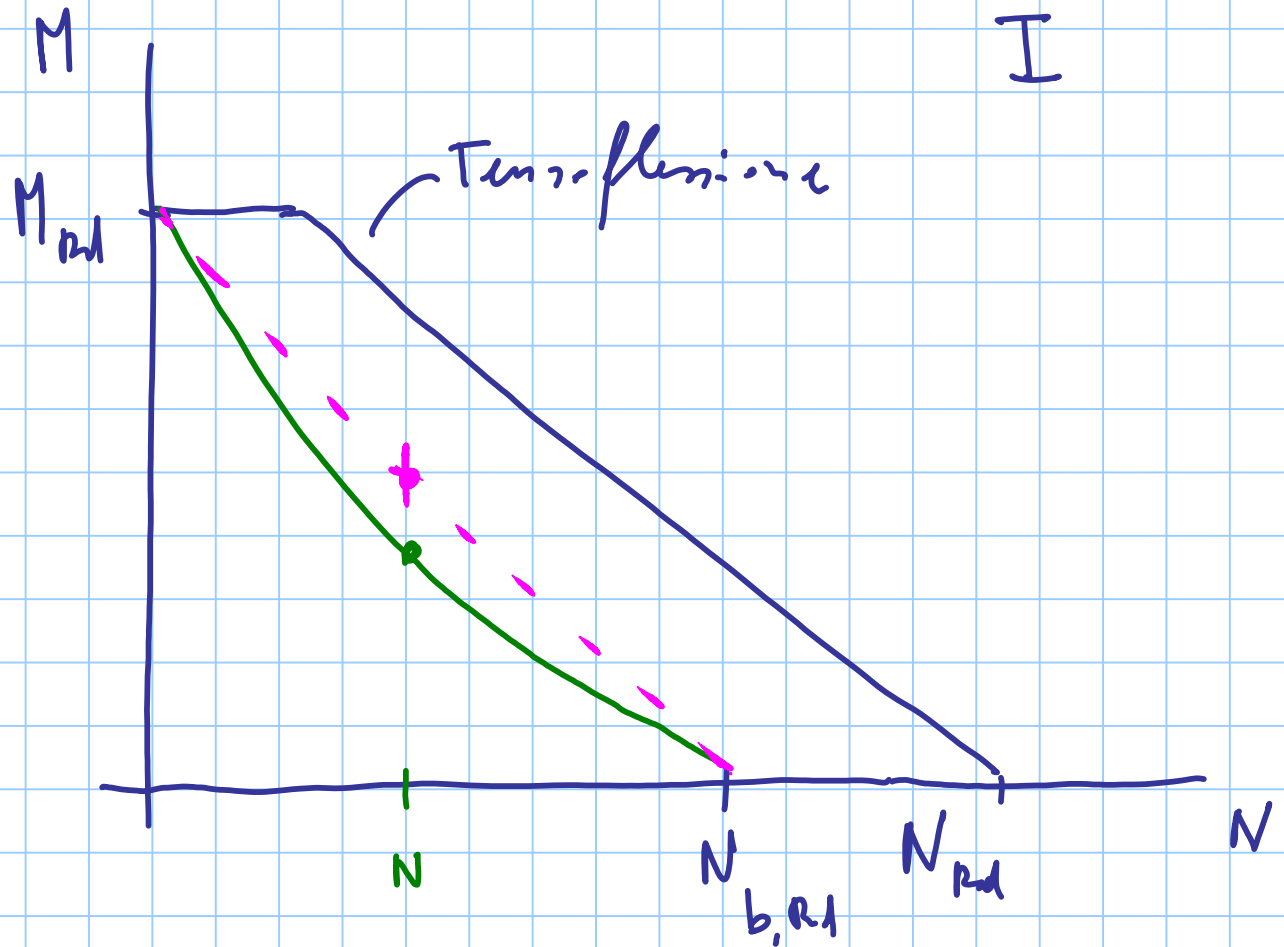


tens-flessione



pres-flessione

per effetto di N è come se $e \frac{1}{1 - N/N_u}$


M
I
M_{Rd}
Tensoflessione
N
$N_{b,Rd}$
N_{Rd}
N

comportamento nel piano

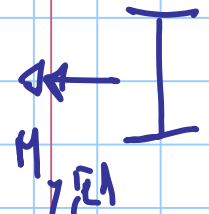
l'effetto di M è amplificato da N $\rightarrow$ $M \dfrac{1}{1 - N/N_{cr}}$

$$\frac{N}{A} + \frac{M}{W} \frac{1}{1 - N/N_{cr}} \leq \frac{f_y}{\gamma_{M0}}$$

NTC 08

metodo A

$$\frac{N_{Ed}}{N_{b,Rd}} + \frac{M_{Ed}}{M_{Rd}\,(1 - N/N_{cr})} \leq 1$$



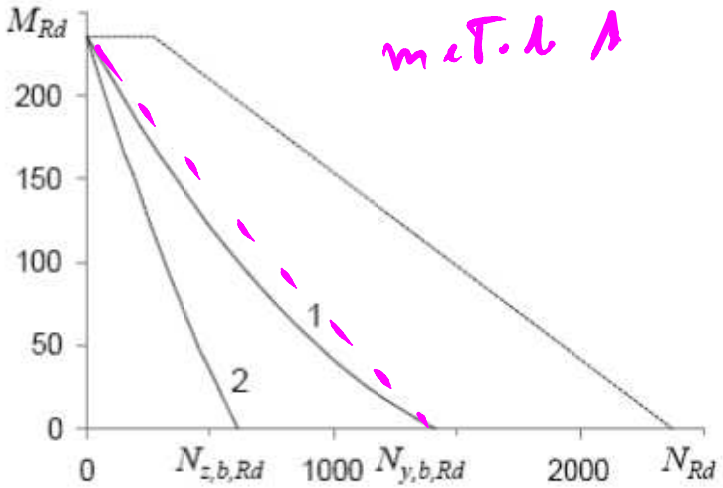
$$\frac{N_{Ed}}{N_{y,b,Rd}} + K_{yy}\,\frac{M_{y,Ed}}{M_{y,Rd}} \leq 1$$

metodo B

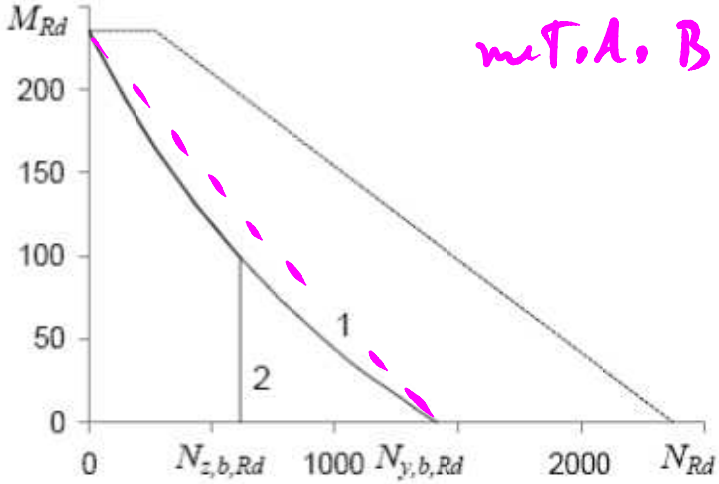
NTC 08

EC 3

$$\frac{1}{1 - N/N_{cr}} \longleftrightarrow K_{yy} = 1 + \min\left(\bar{\lambda}_y - 0.2\,;\,0.8\right)\frac{N_{Ed}}{N_{b,y,Rd}}$$



metodo A



metodo B

Fig. 22. Curve di normativa, metodo B

1 instabilità nel piano in cui giace M (xy)

2 possibile instabilità fuori piano

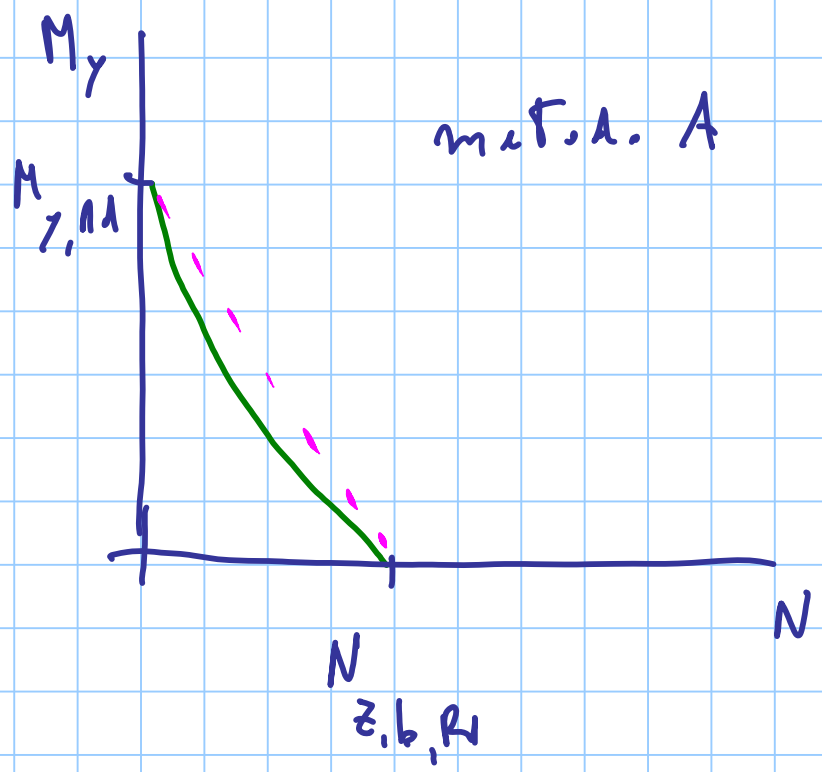
se è possibile instabilità fuori piano

metodo A

$$\frac{N_{Ed}}{N_{b,Rd}} + \frac{M_{y,Ed}}{M_{y,Rd}\left(1 - N/N_{cr,y}\right)} + \frac{M_{z,Ed}}{M_{z,Rd}\left(1 - N/N_{cr,z}\right)} \leq 1$$

$$\Downarrow$$

$$M/N\left(N_{y,b,Rd};\ N_{z,b,Rd}\right)$$ di solito $N_{z,b,Rd}$

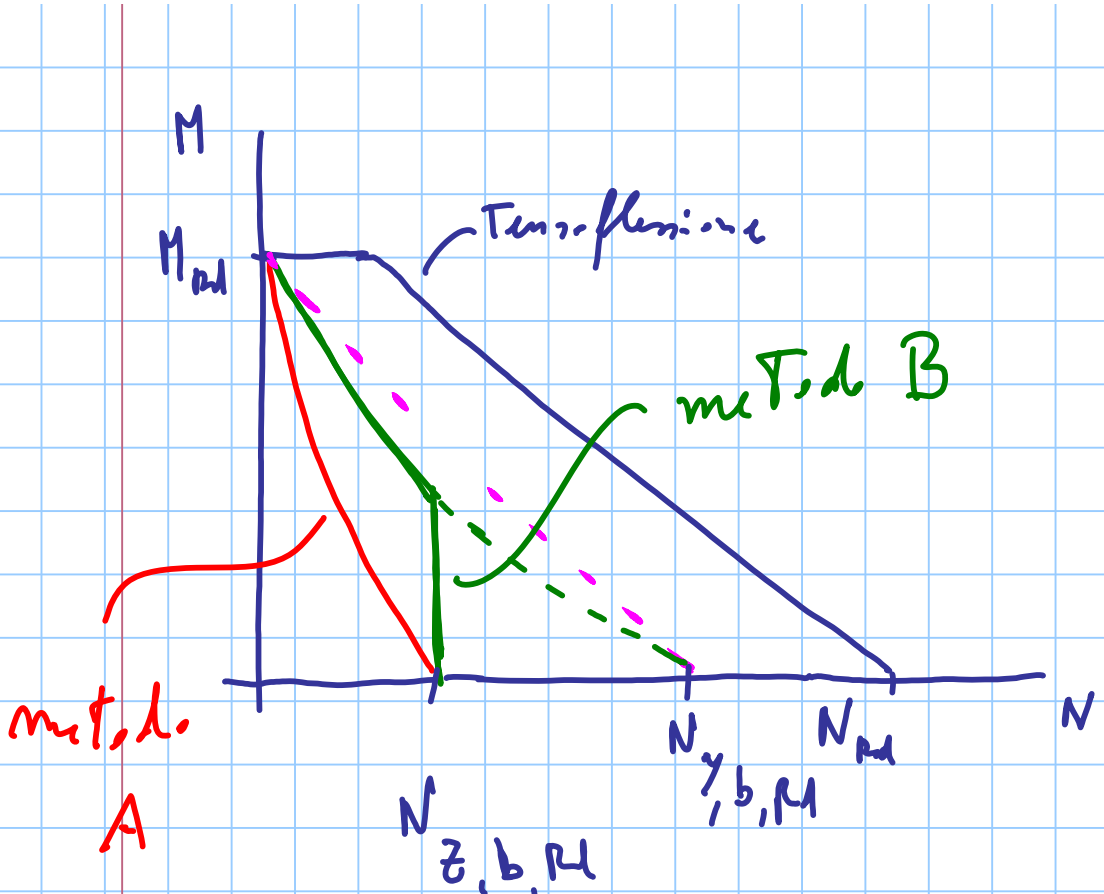


m.t.d. A

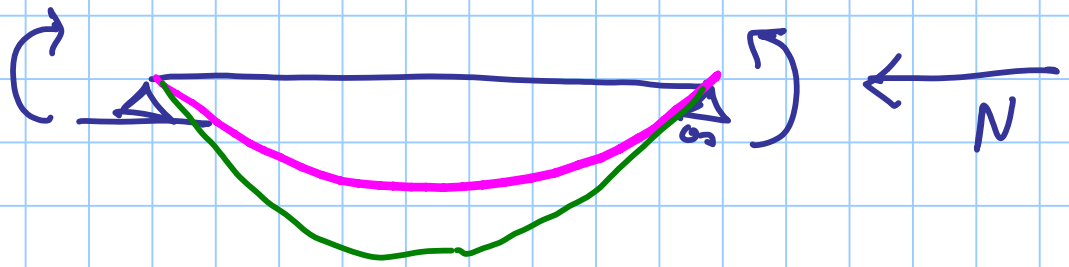
met. 1 B

$$\begin{cases} \dfrac{N_{Ed}}{N_{y,b,Rd}} + K_{yy}\dfrac{M_{y,Ed}}{M_{y,Rd}} + K_{yz}\dfrac{M_{z,Ed}}{M_{z,Rd}} \le 1 \\ \dfrac{N_{Ed}}{N_{z,b,Rd}} + K_{zy}\dfrac{M_{y,Ed}}{M_{y,Rd}} + K_{zz}\dfrac{M_{z,Ed}}{M_{z,Rd}} \le 1 \end{cases}$$

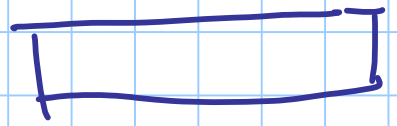
$K_{zy} = 0$ se $M_{z,Ed} = 0$


M
M_{Rd}
Tens. flessione
mcT, d B
mcT, d.
A
$N_{z,b,Rd}$
$N_{y,b,Rd}$
N_{Rd}
N

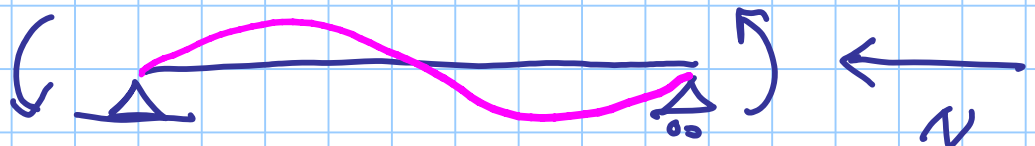
MOMENTO VARIABILE



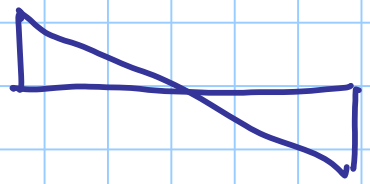
N



M = cost



N



quando M non è costante si considera

un momento "equivalente" $\leq M$

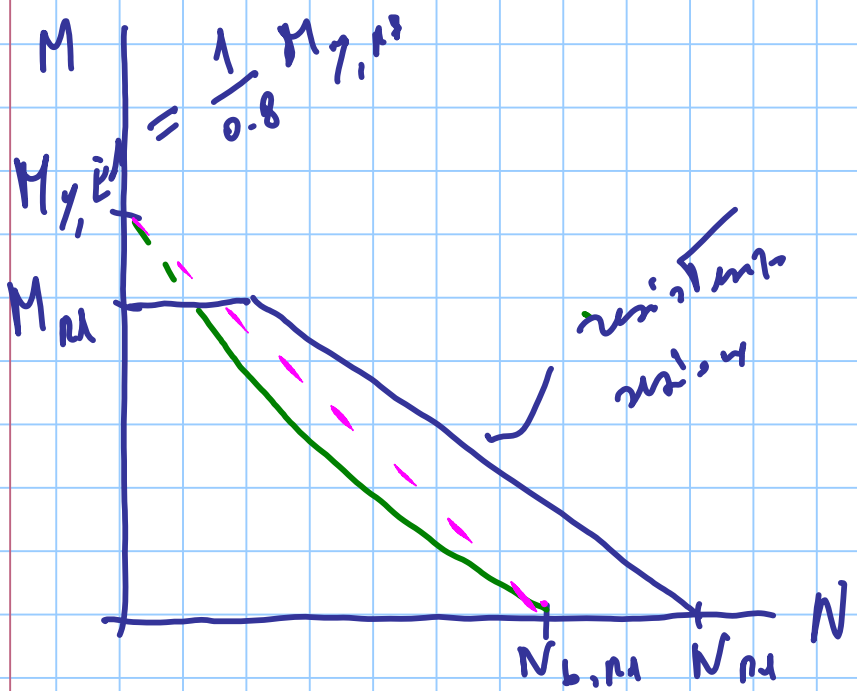
met. A $\quad M_{eq} \leq M_{max}$

met. B $\quad \alpha_m M_{max} \quad \alpha_m \leq 1$

in EC3 $\quad C_m M_{max} \quad C_m$ è il ritorno di α_m

metodo A

$$\frac{N_{Ed}}{N_{b,Rd}} + \frac{M_{y,Ed,eq}}{M_{y,Rd}\left(1 - N/N_{cr,T}\right)} \leq 1$$



per $N = 0$

$$M_{y,Ed,eq} \leq M_{y,Rd}$$

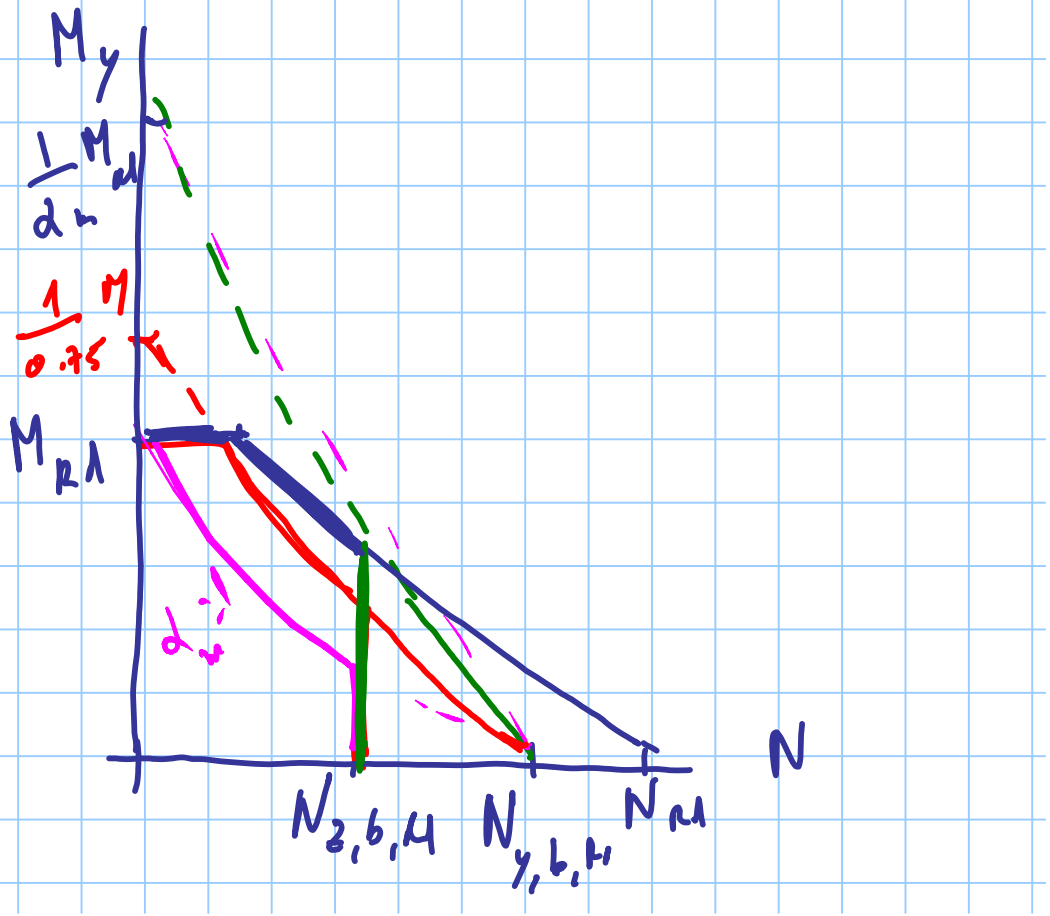
es. $M_{y,Ed,eq} = 0.8\, M_{y,Ed}$

metodo B

$$\begin{cases} \dfrac{N_{Ed}}{N_{y,b,Rd}} + K_y \dfrac{\alpha_m M_{y,Ed}}{M_{y,Rd}} \le 1 \\ \dfrac{N_{Ed}}{N_{z,b,Rd}} \le 1 \end{cases}$$

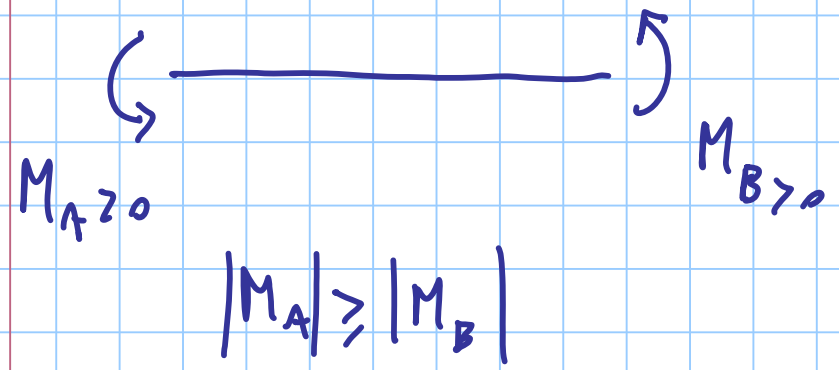
$\alpha_m = 0.5$

$\alpha_m = 0.75$



valori di M_{eq} e di α_m

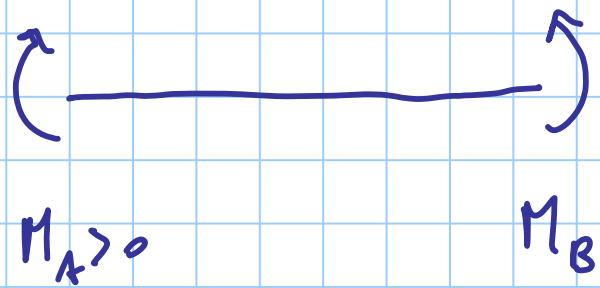
mom. rel. A



$|M_A| \geq |M_B|$

$M_{eq} = 0.6\,M_A - 0.4\,M_B \geq 0.4\,M_A$

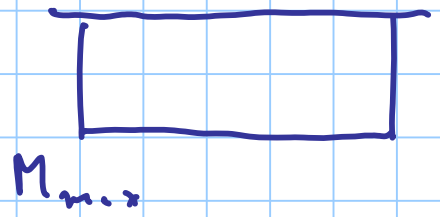
mom. rel. B



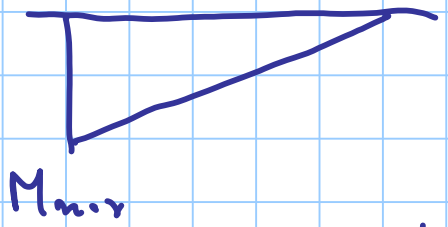
$\alpha_m = 0.6 + 0.4\,\psi \geq 0.4$

$\psi = \dfrac{M_B}{M_A}$

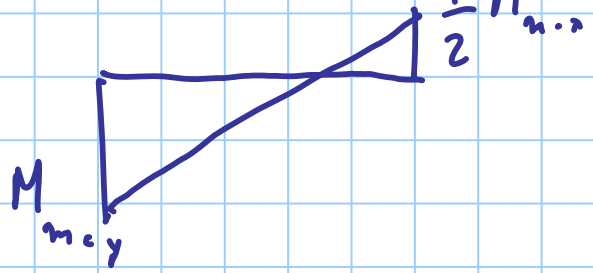
Diagramma M



$M_{eq} = M_{max}$ $\quad \alpha_m = 1$



$M_{eq} = 0.6\, M_{max}$ $\quad \alpha_m = 0.6$

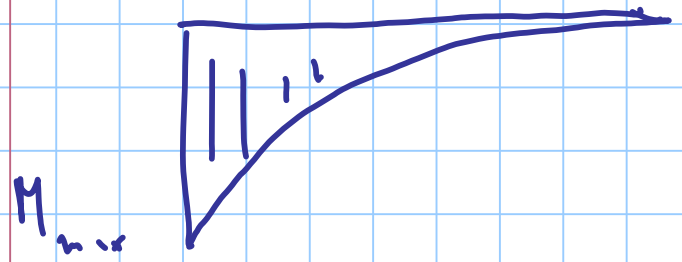


$M_{eq} = 0.4\, M_{max}$ $\quad \alpha_m = 0.4$

se M varia in maniera non lineare

$M_m \simeq \frac{2}{3} M_{max} \Rightarrow M_{eq} \simeq 0.87 M_{max}$

met. A $\quad M_{eq} = 1.3 M_m \geq 0.75 M_{max}$



$M_m \simeq \frac{1}{3} M_{max} \Rightarrow M_{eq} \simeq \cancel{0.43}\ 0.75\ M_{max}$