

ASTE

$$\sigma_{cr} = \frac{\pi^2 E}{\underbrace{(l/i)^2}}$$

asta perfetta mat. ideale

reale

$\bar{\lambda}$

χ

$$N_{b,rd} = \chi A \frac{f_y}{\gamma_{m0}}$$

LASTRE

$$\sigma_{cr} = \frac{\kappa \pi^2 E}{12(1-\nu^2) \underbrace{(b/t)^2}}$$

$$\varepsilon = \sqrt{\frac{235}{f_y}}$$

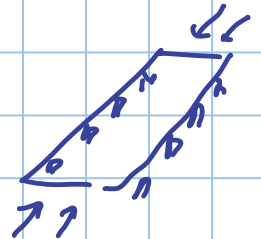
$$\bar{\lambda}_p = \frac{b/t}{28.4 \varepsilon \sqrt{\kappa}}$$

$$\frac{b_{eff}}{b} = \rho = \frac{1}{\bar{\lambda}_p}$$

in presenza
di imperf.

$$\kappa = 4$$

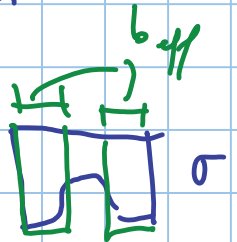
$$\kappa = 0.43$$



sol. in bord
vincolo

Von Karman

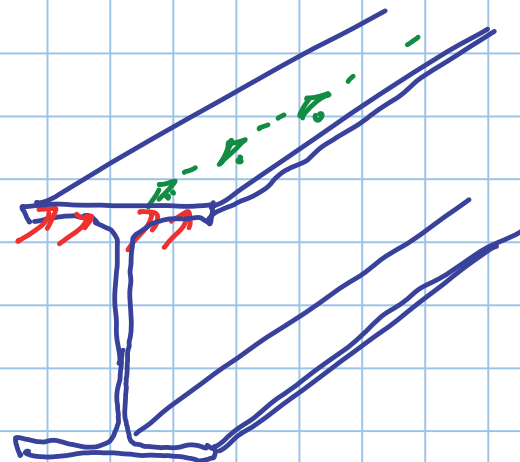
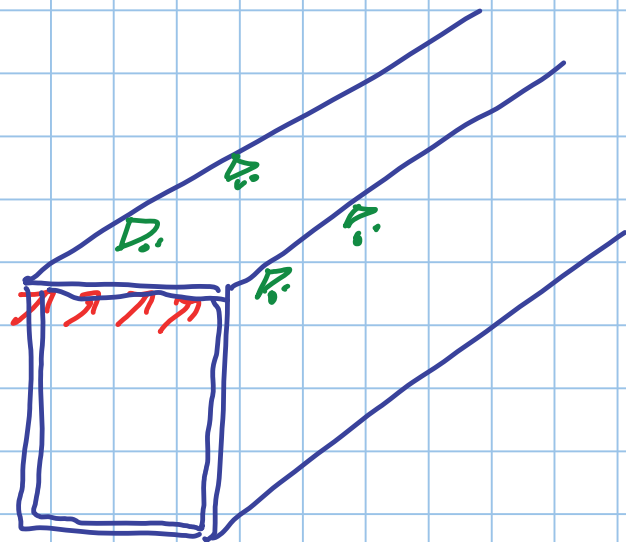
b_{eff}



$$\rho = 1 \quad \text{per} \quad \bar{\lambda}_p = 1$$

$$\rho = \frac{\bar{\lambda}_p - 0.22}{\bar{\lambda}_p^2}$$

$$\rho = 1 \quad \text{per} \quad \bar{\lambda}_p = 0.673$$

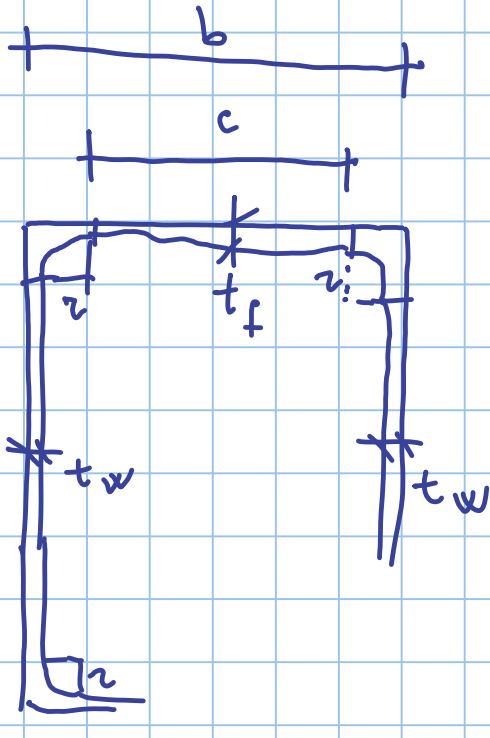


valori limite di $\frac{b}{t}$ oltre i quali occorre tener conto nel calcolo

dell'instabilità locale

profili di classe 4

↓
 b_{eff} A_{eff}



$$c = b - 2(t_w + r)$$

$$\frac{c}{t_f}$$

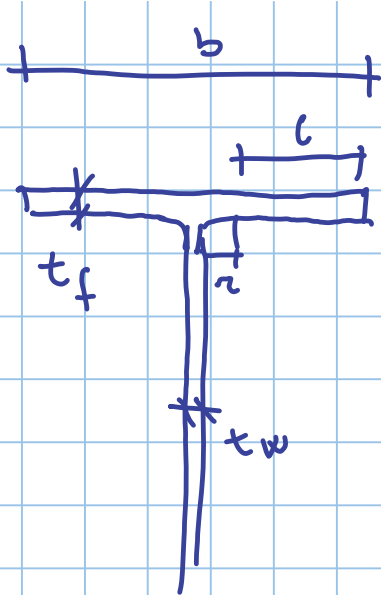
r = raggio interno

per elementi interni compressi

$$x \quad \frac{c}{t} > 42 \varepsilon \Rightarrow \text{classe 4}$$

$$c = h - 2(t_f + r)$$

$$\frac{c}{t_w}$$



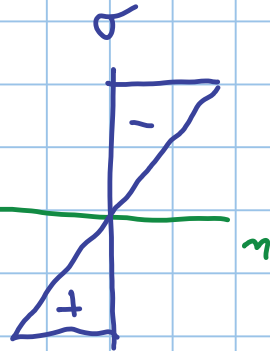
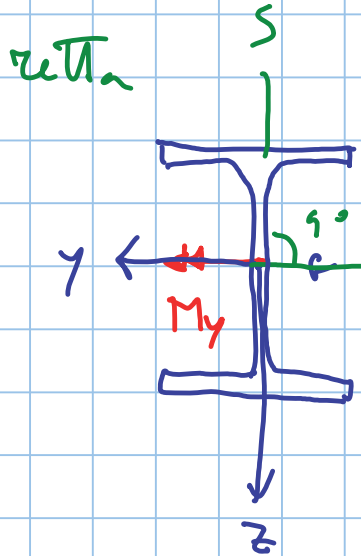
$$c = \frac{b - t_w - 2r}{2}$$

$$\frac{c}{t_f}$$

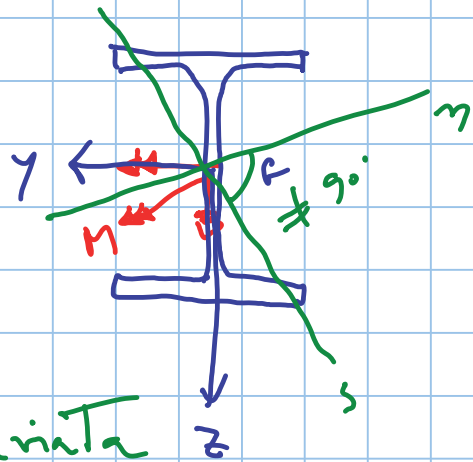
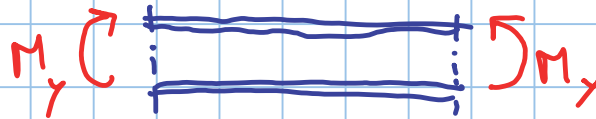
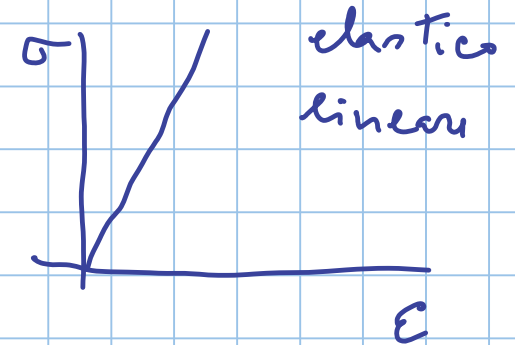
per elementi esterni: compressi

$$\text{se } \frac{c}{t} > 14 \varepsilon \Rightarrow \text{classe 4}$$

FLESSIONE SEMPLICE



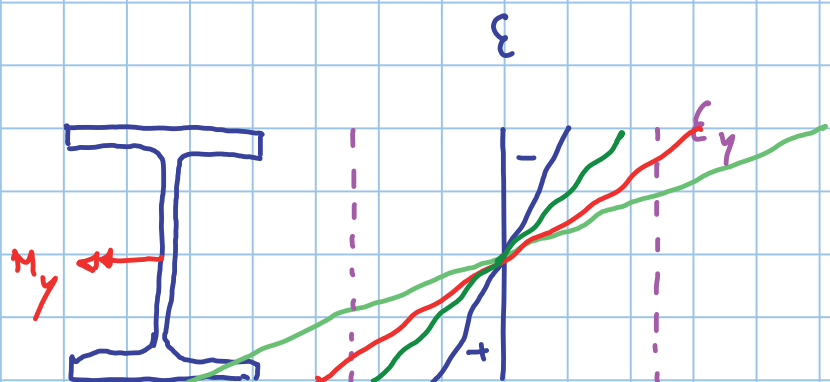
l'asse neutro
passa per il baricentro



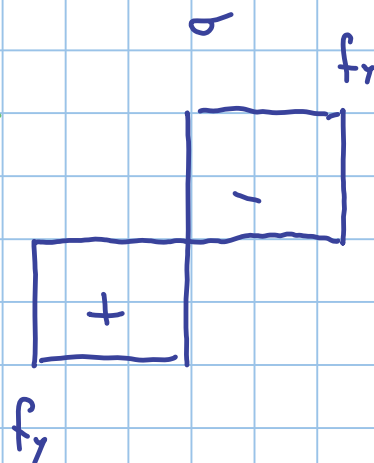
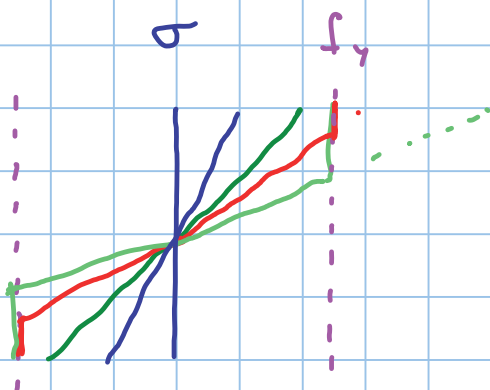
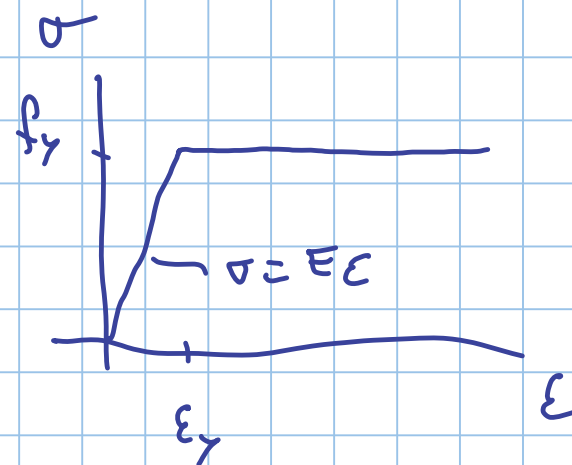
$$\sigma = \frac{M}{I_y} z$$

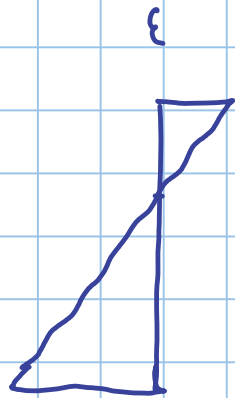
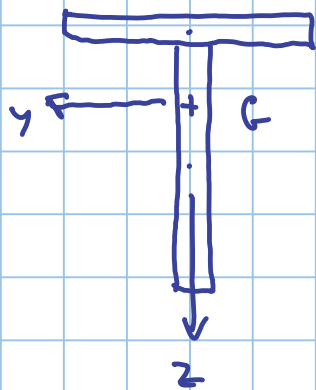
$$\sigma_{max} = \frac{M}{W_y} \leftarrow \text{modulo di resistenza}$$

$$M_{max} = W_{y,el} \sigma_{max}$$



$\propto \epsilon \rightarrow \infty$



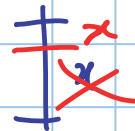
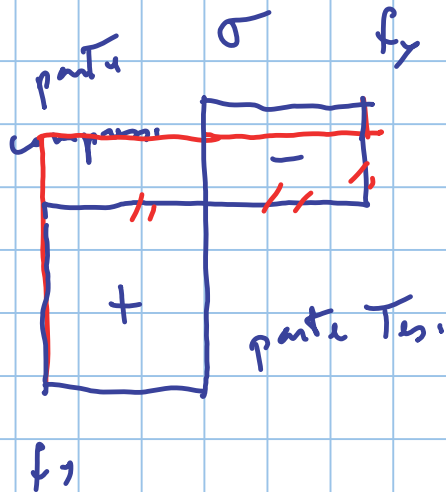
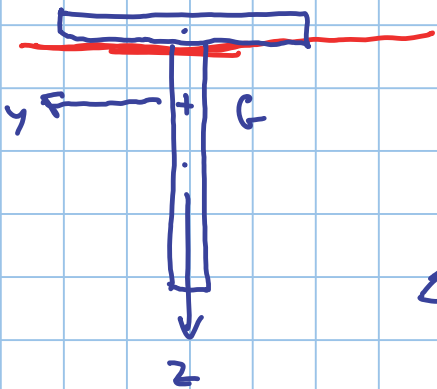


$$\epsilon \rightarrow \infty$$

$$N = \int \sigma dA =$$

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

$$= -f_y A_{\text{comp}} + f_y A_{\text{tens}}$$



$$N = 0$$

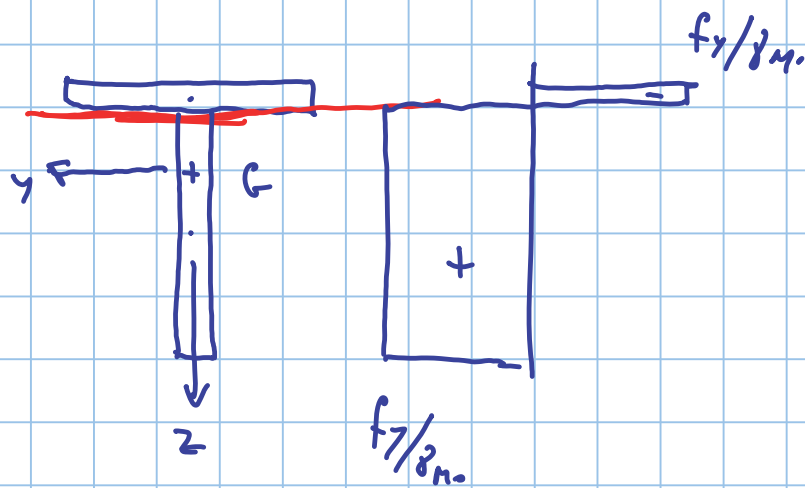


$$A_{\text{tens}} = A_{\text{comp}}$$

se abbiamo un unico materiale

SEMPRE

$$A_{\text{tens}} = A_{\text{comp}}$$



$$M_{y,KA} = \int \sigma z \, dA =$$

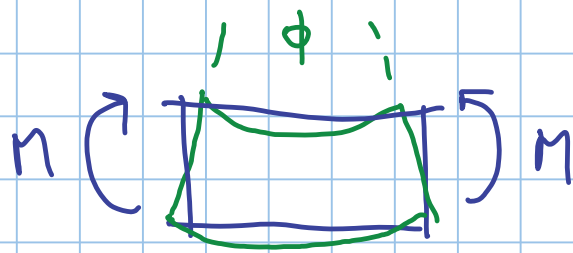
$$= \int_{A_{comp}} \sigma z \, dA + \int_{A_{tension}} \sigma z \, dA =$$

$$= - \int_{\bar{y}_n}^y \int_{A_{comp}} z \, dA + \int_{\bar{y}_n}^y \int_{A_{tension}} z \, dA =$$

$$\int_{A_{comp}} z \, dA + \int_{A_{tension}} z \, dA = \int_A z \, dA = 0$$

$$- \int_{A_{comp}} z \, dA = \int_{A_{tension}} z \, dA = S_{1/2 m.}$$

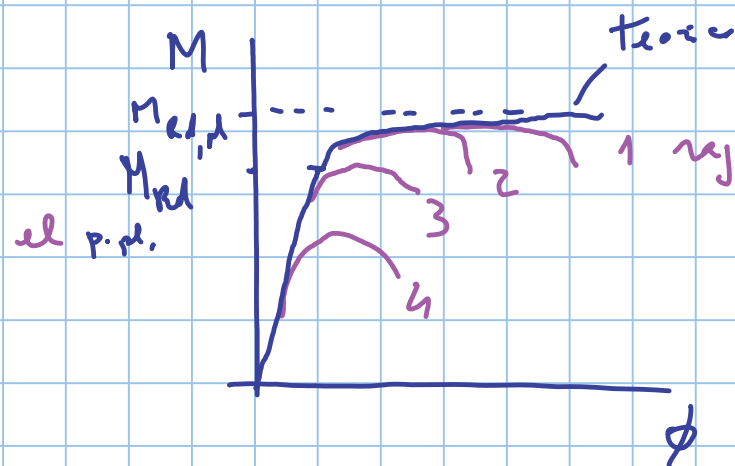
$$M_{y,KA} = \underbrace{2 S_{1/2 m.}}_{W_{y,pl}} \frac{f_y}{y_n.}$$



curvatura ϕ

oppure $\frac{1}{r}$

$$\frac{W_{pl}}{W_{el}} = \text{fattore di forma}$$



1 raggiunge $M_{el,pl}$ ed ha grandi deformazioni
grandi duttilità

2 M_{pl} ma minore duttilità

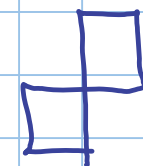
3 M_{pl}

4 $< M_{el}$; $M_{el,eff}$



diagramma
momento - curvatura

M_{Ri} di prima plasticizzazione



$M_{el,pl}$