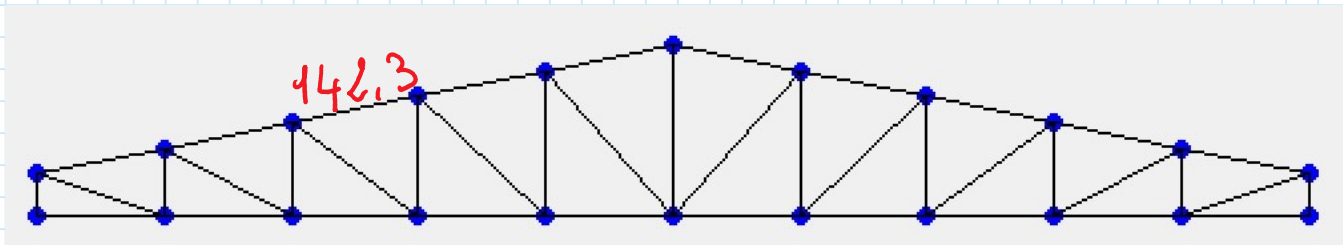
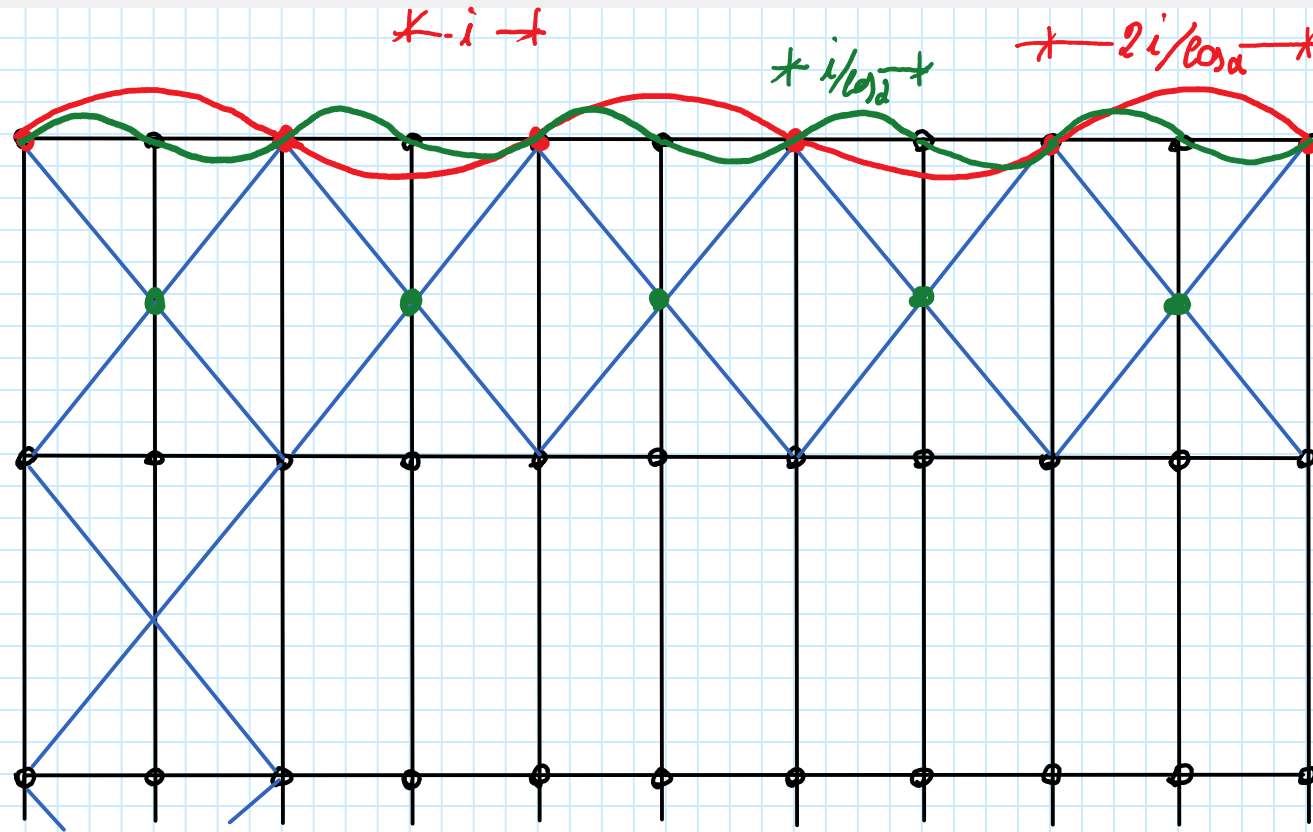
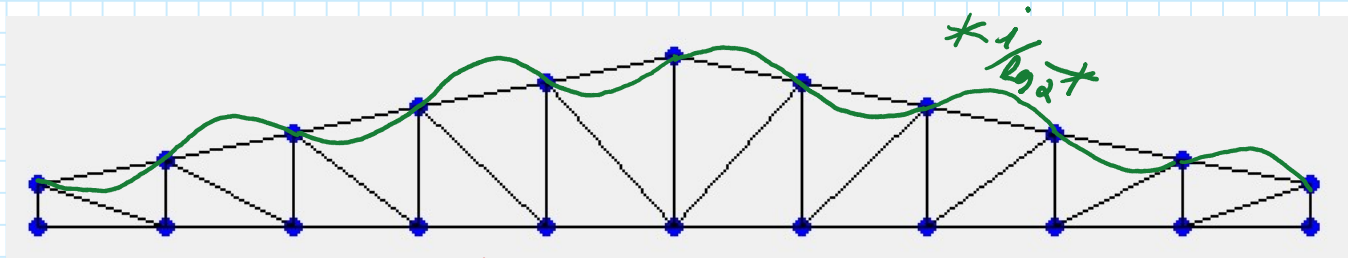


Progetto del corrente superiore

Sforzo normale del corrente superiore					
Asta	1° comb.	2° comb.	3° comb.	Max traz.	Max Comp.
11	-106.70	-77.57	74.42	74.42	-106.70
12	-137.95	-95.03	97.43	97.43	-137.95
13	-142.26	-90.98	101.67	101.67	-142.26
14	-133.89	-76.81	97.10	97.10	-133.89
15	-118.55	-57.07	87.66	87.66	-118.55
16	-118.55	-57.63	87.66	87.66	-118.55
17	-133.89	-53.32	97.10	97.10	-133.89
18	-142.26	-47.74	101.67	101.67	-142.26
19	-137.95	-39.84	97.43	97.43	-137.95
20	-106.70	-27.02	74.42	74.42	-106.70
Massimo N trazione				101.67 kN	
Massimo N compressione				-142.26 kN	





$$N_{Ed} = -148,3 \text{ kN}$$

$$N_{Ed} \leq N_{b,Rd} = \chi A \frac{f_y}{\gamma_{M1}}$$

$$|N_{Ed}| \leq \chi A \frac{f_y}{\gamma_{M1}} \Rightarrow A = \frac{\gamma_{M1} |N_{Ed}|}{\chi f_y}$$

$$\chi \leq 1 \quad \chi = 0,5 \quad \uparrow$$

$$A = \frac{1,05 \times 148,3}{0,5 \times 235} \times 10 = 12,72 \text{ cm}^2$$

$$U_{PN} \quad 2 \text{ UPN } 50 \times 38 \Rightarrow A = 14,2 \text{ cm}^2$$

2 UPN 50x38

$$|N_{Ed}| = 142,3 \text{ kN} < N_{b,Rd} = 193,4 \text{ kN}$$

Calcolare $N_{b,Rd}$

OK!

$$l_0 = \frac{i}{\cos \alpha} = \frac{150}{\cos 11,3} = 153 \text{ cm}$$

Profilo =	2 UPN 50 x 38	Acciaio =	S235	$f_{yk} =$	235 MPa		
Doppio profilo	SI	GammaM1=	1.05	$f_{uk} =$	360 MPa		
Distanza =	1 cm			$E_s =$	210000 MPa		
Area =	14.2 cm ²						
$\rho_y =$	1.92 cm	$I_{oy} =$	153.0 cm	$\lambda_y =$	79.7		
$\rho_z =$	2.19 cm	$I_{oz} =$	153.0 cm	$\lambda_z =$	70.0	$\lambda_{z\text{eq}} =$	83.3
$\rho_{\min SP} =$	1.13 cm	$I_{o SP} =$	51.0 cm	$\lambda_{\min SP} =$	45.1		
Curva =	c	$\alpha_y =$	0.49	$N_{cr,y} =$	464.3 kN	$\lambda_{sy} =$	0.85
Curva =	c	$\alpha_z =$	0.49	$N_{cr,z} =$	425.1 kN	$\lambda_{sz} =$	0.89
$\phi_y =$	1.0194	$\chi_y =$	0.6315	$N_{b,Rd,y} =$	201.25	kN	
$\phi_z =$	1.0620	$\chi_z =$	0.6077	$N_{b,Rd,z} =$	193.66	kN	
		$\chi_{\min} =$	0.6077	$N_{b,Rd} =$	193.66	kN	

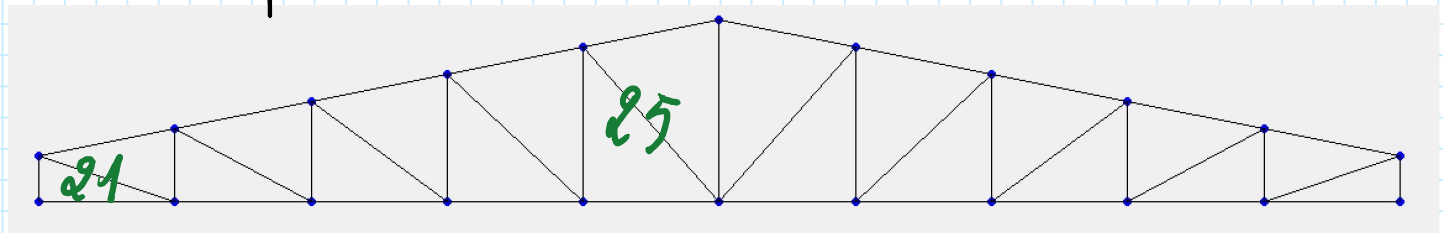
Progetto dei diagonali

Sforzo normale dei diagonali					
Asta	1° comb.	2° comb.	3° comb.	Max traz.	Max Comp.
21	110.28	80.06	-75.80	110.28	-75.80
22	34.73	19.15	-23.14	34.73	-23.14
23	5.24	-5.20	-2.51	5.24	-5.20
24	-11.22	-19.31	9.07	9.07	-19.31
25	-22.74	-29.58	17.21	17.21	-29.58
26	-22.74	7.70	17.21	17.21	-22.74
27	-11.22	8.68	9.07	9.07	-11.22
28	5.24	10.68	-2.51	10.68	-2.51
29	34.73	15.23	-23.14	34.73	-23.14
30	110.28	28.40	-75.80	110.28	-75.80
Massimo N trazione				110.28 kN	
Massimo N compressione					-75.8 kN

① Progetto e trazione $N_{Ed} = 110,3 \text{ kN}$ (asta 21)

② Verifico asta 21 e compressione $N_{Ed} = -75,8 \text{ kN}$ max compressione

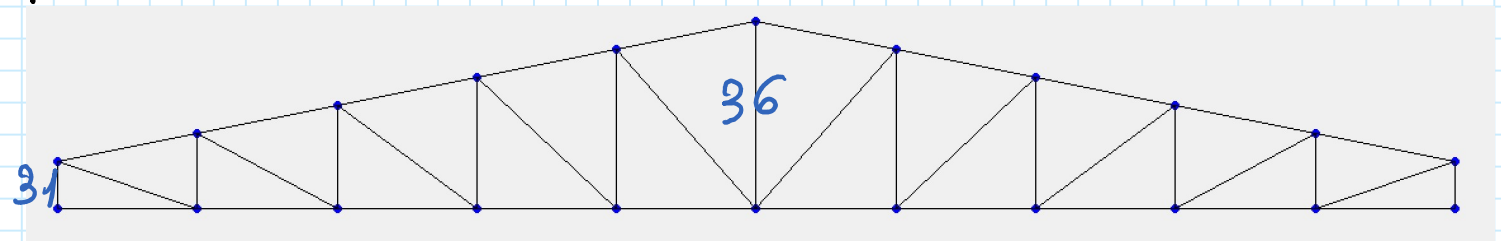
③ Verifico asta 25 e compressione $N_{Ed} = -29,6 \text{ kN}$ max snella



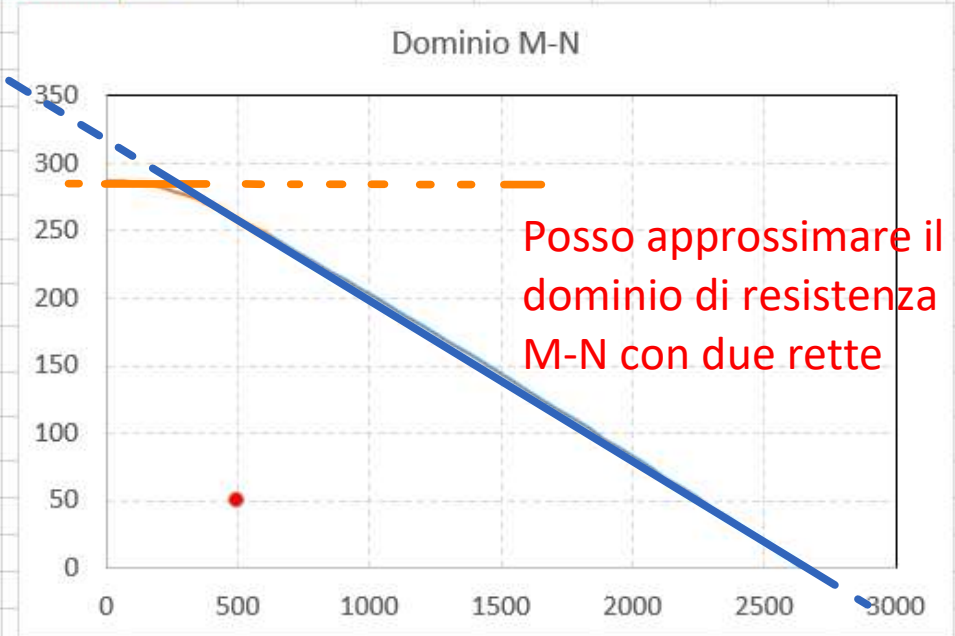
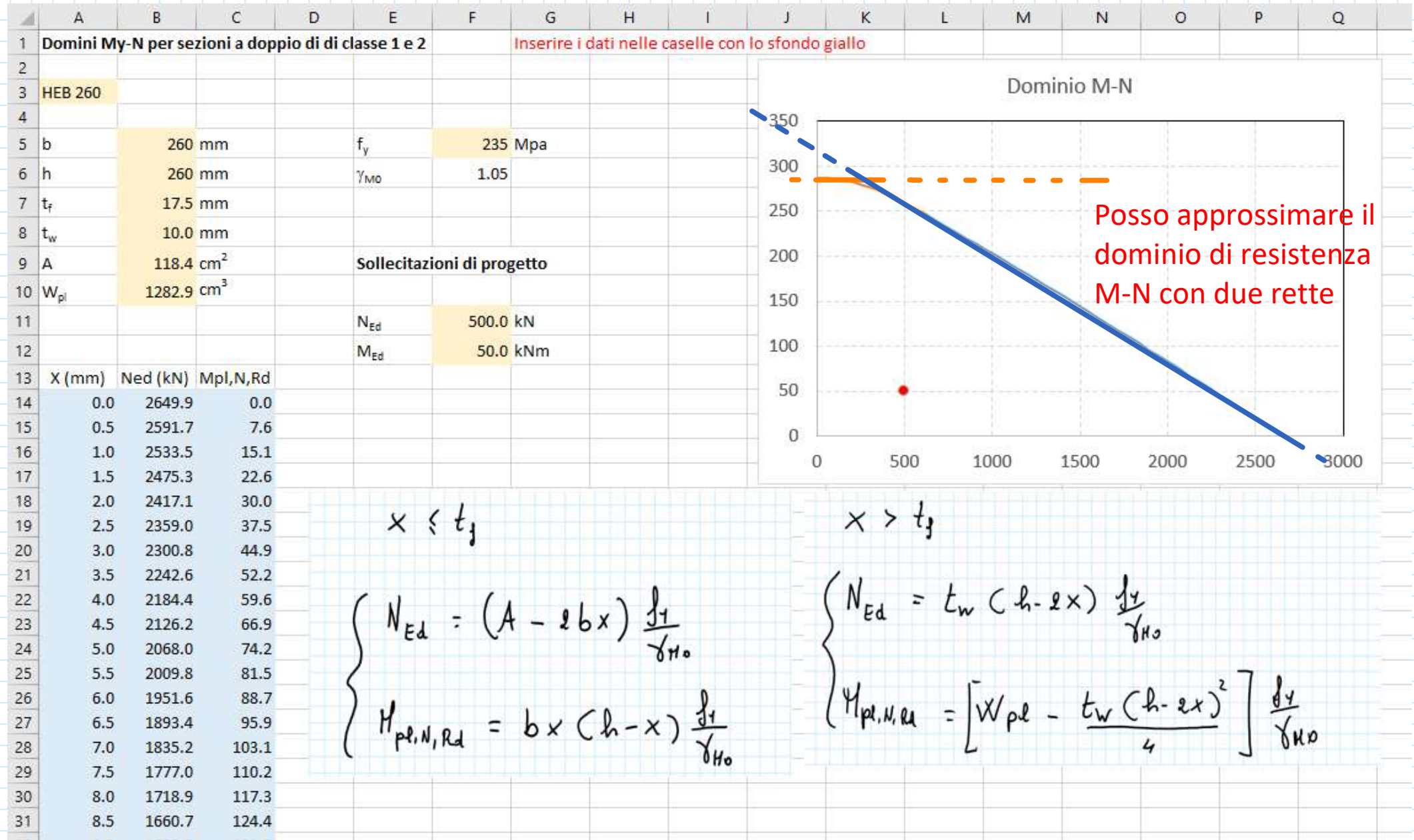
Progetto dei montanti

Sforzo normale dei montanti					
Asta	1° comb.	2° comb.	3° comb.	Max traz.	Max Comp.
31	-62.00	-46.97	42.85	42.85	-62.00
32	-34.87	-25.32	23.97	23.97	-34.87
33	-16.35	-9.01	10.89	10.89	-16.35
34	-3.10	3.07	1.49	3.07	-3.10
35	7.66	13.17	-6.19	13.17	-6.19
36	34.10	16.41	-25.81	34.10	-25.81
37	7.66	-5.92	-6.19	7.66	-6.19
38	-3.10	-6.32	1.49	1.49	-6.32
39	-16.35	-7.17	10.89	10.89	-16.35
40	-34.88	-8.98	23.97	23.97	-34.88
41	-62.00	-13.93	42.85	42.85	-62.00
Massimo N trazione				42.85 kN	
Massimo N compressione				-62 kN	

- ① Progetto a compressione asta 31 $N_{Ed} = -62,0 \text{ kN}$ max compressione
- ② Verifica a compressione asta 36 $N_{Ed} = -25,8 \text{ kN}$ max snella



Domini per sezioni di classe 1 e 2 della NTC18 (in forme analitiche)

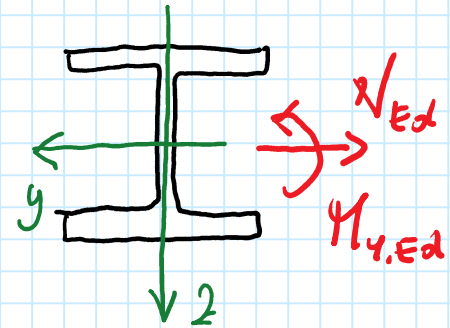


Domini per azioni di classe 1 e 2 dell'NTC18 (in forme analitiche)

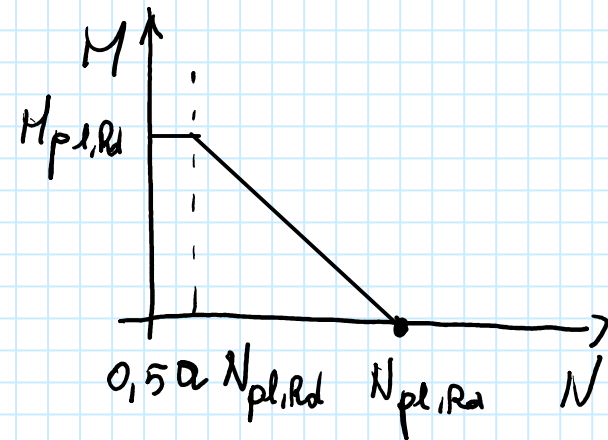
Sezione a doppio T con N e M_y

$$M_{pl,N,Rd} = M_{pl,Rd} \quad m \leq 0,5 \text{ e}$$

$$M_{pl,N,Rd} = M_{pl,Rd} \frac{1-m}{1-0,5\alpha} \quad m > 0,5 \text{ e}$$



$$m = \frac{N_{Ed}}{N_{pl,Rd}}$$
$$\alpha = \frac{A - 2bt_f}{A}$$



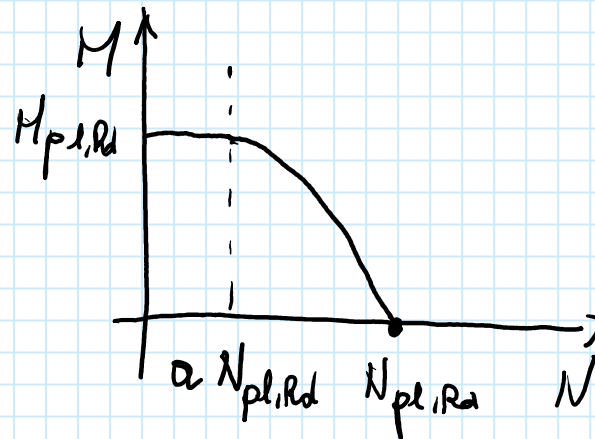
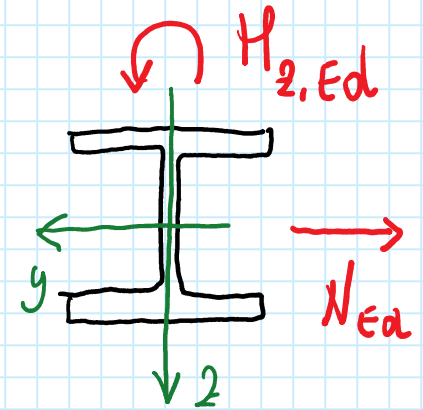
Sezione e doppio T con N e M_z

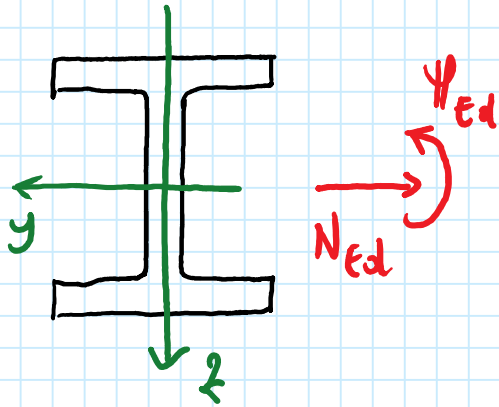
$$M_{pl,N,Rd} = M_{pl,Rd} \quad m \leq \alpha$$

$$M_{pl,N,Rd} = M_{pl,Rd} \left[1 - \left(\frac{m - \alpha}{1 - \alpha} \right)^2 \right] \quad m > \alpha$$

$$m = \frac{N_{Ed}}{N_{pl,Rd}}$$

$$\alpha = \frac{A - 2bt_f}{A}$$





HEB 260

S 235

Classe 1 e 2

$$N_{Ed} = 500 \text{ kN}$$

$$M_{Ed} = 50 \text{ kNm}$$

$$M_{N,Rd} = M_{pl,N,Rd} = M_{pl,Rd} \quad m \leq 0,5 \quad (1)$$

$$M_{N,Rd} = M_{pl,N,Rd} = M_{pl,Rd} \frac{1 - m}{1 - 0,5} \quad m > 0,5 \quad (2)$$

$$m = \frac{N_{Ed}}{N_{pl,Rd}} = \frac{500}{2649,9} = 0,1887$$

$$N_{pl,Rd} = A \frac{f_y}{\gamma_{M0}} = 2649,9 \text{ kN}$$

$$\alpha = \frac{A - 2bt_f}{A} = \frac{118,4 - 2 \times 26 \times 1,75}{118,4} = 0,2314$$

$$m = 0,1887 < 0,5 \quad \alpha = 0,5 \times 0,2314 = 0,1157 \quad \text{NO} \Rightarrow \text{use } h_e (2)$$

$$M_{pl,N,Rd} = M_{pl,Rd} \frac{1 - m}{1 - 0,5\alpha} = 287,2 \times \frac{1 - 0,1887}{1 - 0,5 \times 0,2314} = 263,5 \text{ kNm}$$

$$M_{pl,Rd} = W_{pl} \frac{f_y}{\gamma_{M0}} = 1283 \times \frac{235}{1,05} \times \frac{1}{10^3} = 287,2 \text{ kNm}$$

$$M_{Ed} = 50,0 \text{ kNm} \leq M_{pl,N,Rd} = 263,5 \text{ kNm} \quad \text{OK}$$

Verifica con domini (emolitee)

Classe 3: si può fare come segue (vedi lezioni del 20/11/2025)

$$\frac{|M_{Ed}|}{M_{el,Rd}} + \frac{|N_{Ed}|}{N_{pl,Rd}} \leq 1$$

... e per sezioni di classe 1 e 2?

Anche per sezioni di classe 1 e 2 le verifiche analitiche
può essere eseguite usando un approccio formalmente
uguale

Sezione a doppio T con N_{Ed} ed $M_{y,Ed}$

$$M_{pl,N,Rd} = M_{pl,Rd} \quad m \leq 0,5 \quad (1)$$

$$M_{pl,N,Rd} = M_{pl,Rd} \frac{1 - m}{1 - 0,5 \alpha} \quad m > 0,5 \quad (2)$$

$$m = \frac{N_{Ed}}{N_{pl,Rd}} \quad \alpha = \frac{A - 2 b t_f}{A}$$

$$(1) \quad M_{Ed} \leq M_{pl,N,Rd} = M_{pl,Rd}$$

$$M_{Ed} \leq M_{pl,Rd}$$

$$\boxed{\frac{M_{Ed}}{M_{pl,Rd}} \leq 1}$$

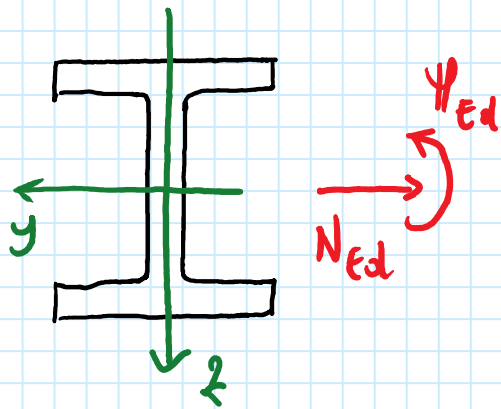
$$\textcircled{2} \quad M_{Ed} \leq M_{pl, N, Rd} = M_{pl, Rd} \frac{1 - m}{1 - 0,5 \alpha}$$

$$M_{Ed} \leq M_{pl, Rd} \frac{1 - m}{1 - 0,5 \alpha}$$

$$\frac{M_{Ed}}{M_{pl, Rd}} \leq \frac{1 - m}{1 - 0,5 \alpha}$$

$$\frac{M_{Ed}}{M_{pl, Rd}} (1 - 0,5 \alpha) \leq 1 - \frac{N_{Ed}}{N_{pl, Rd}}$$

$$\boxed{\frac{|N_{Ed}|}{N_{pl, Rd}} + (1 - 0,5 \alpha) \frac{|M_{Ed}|}{M_{pl, Rd}} \leq 1}$$



HEB 260

S 235

Classe 1 e 2

$$N_{Ed} = 500 \text{ kN}$$

$$M_{Ed} = 50 \text{ kNm}$$

$$m = 0,1887 < 0,5 \text{ e } 0,5 \times 0,2314 = 0,1157$$

NO \Rightarrow uso de (2)

$$\frac{|N_{Ed}|}{N_{pl,Rd}} + (1 - 0,5 \alpha) \frac{|M_{Ed}|}{M_{pl,Rd}} \leq 1$$

$$\frac{500}{2649,9} + (1 - 0,5 \times 0,2314) \frac{50}{287,2} = 0,3426 < 1 \quad \text{OK!}$$

$$\underbrace{\quad}_{0,1887}$$

$$\underbrace{\quad}_{0,1539}$$

Tenso-flessione (o presso-flessione delle sezioni) e He

Classe 1 e 2

Classe 3

1. $M_{Ed} \leq M_{pl,N,Rd}$

$M_{Ed} \leq M_{el,N,Rd}$ Verifica diretta

2. dominio per punti:

dominio elastico

dominio elastico

3. X

$$\sigma_{max} \leq \frac{f_y}{\gamma_{H0}}$$