

direzione x

piano	Fd	ΣF	Nd	A
6	35.9	35.9	40.1	1.53
5	71.8	107.7	120.4	4.60
4	71.8	179.5	200.7	7.66
3	71.8	251.3	281.0	10.73
2	71.8	323.1	361.3	13.79
1	35.9	359.0	401.4	15.33
				$\times 10^2 \text{ mm}^2$

direzione y

piano	Fd	ΣF	Nd	A
6	73.3	73.3	84.2	3.21
5	146.6	219.9	252.5	9.64
4	146.6	366.5	420.9	16.07
3	146.6	513.1	589.2	22.50
2	146.6	659.7	757.6	28.93
1	73.3	733.0	841.7	32.14
				$\times 10^2 \text{ mm}^2$

A : Area necessaria per verifica SLO

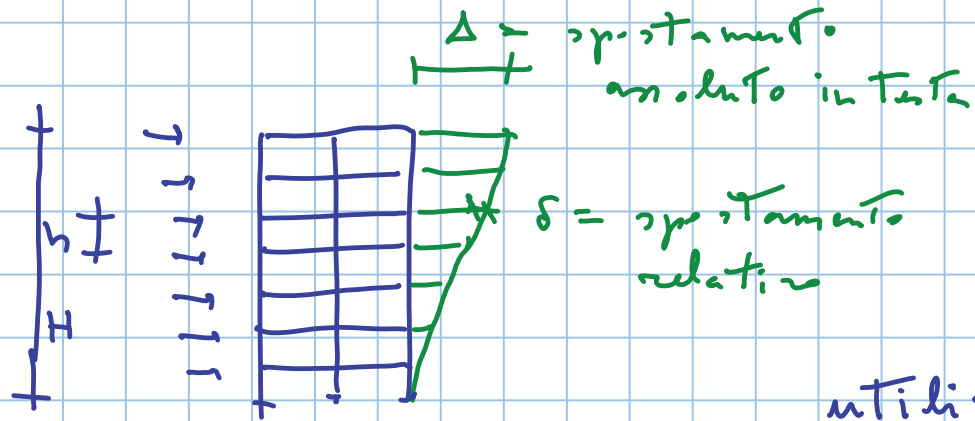
o $f_y = 275 \text{ MPa}$

SLE

→ p → Tanti

NTC

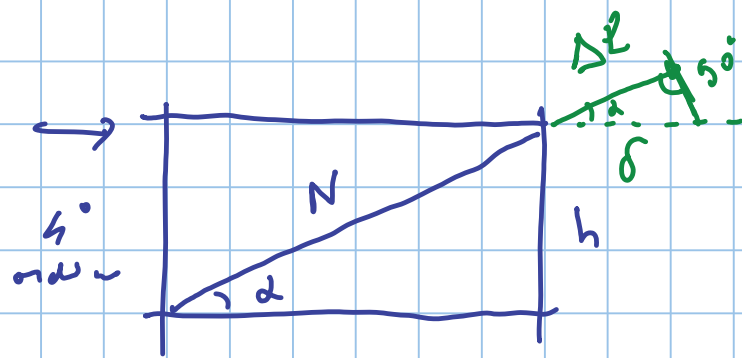
4.2.4.2



$$\frac{\delta}{h} \leq \frac{1}{300}$$

$$\frac{\Delta}{H} \leq \frac{1}{500}$$

utilizzare i valori caratteristici



$$\Delta l = \frac{N l}{E A} = \frac{N h}{E A \sin \alpha}$$

$$l = \frac{h}{\sin \alpha}$$

$$\delta = \frac{N h}{E A \sin \alpha \cos \alpha} \leq \frac{1}{300} h$$

$$N_{Ed} = 420.8 \text{ kN}$$

$$N_{Ek} = 280.5 \text{ kN}$$

$$\delta = \frac{\Delta l}{\cos \alpha}$$

$$\delta = \frac{N h}{E A \sin \alpha \cos \alpha} \leq \frac{1}{300}$$

$$A \geq \frac{300 N}{E \sin \alpha \cos \alpha}$$

280.5 kN

210000 MPa 0.492 0.871

$$A \geq \frac{300 \times 280.5 \times 10^3}{210000 \times 0.492 \times 0.871} \times 10^{-2} = 9.35 \times 10^2 \text{ mm}^2$$

con $\frac{1}{500}$ avrei $A \geq 15.58 \times 10^2 \text{ mm}^2$

				1/300	1/500
piano	Fk	Σ F	Nk	A	A
6	23.9	23.9	26.8	0.96	1.59
5	47.9	71.8	80.3	2.87	4.78
4	47.9	119.7	133.8	4.78	7.96
3	47.9	167.5	187.3	6.69	11.15
2	47.9	215.4	240.8	8.60	14.34
1	23.9	239.3	267.6	9.56	15.93

				1/300	1/500
piano	Fk	Σ F	Nk	A	A
6	48.9	48.9	56.1	1.87	3.12
5	97.7	146.6	168.3	5.62	9.36
4	97.7	244.3	280.6	9.36	15.61
3	97.7	342.1	392.8	13.11	21.85
2	97.7	439.8	505.0	16.85	28.09
1	48.9	488.7	561.2	18.73	31.21

diraz. x nel vnto.

diraz. y

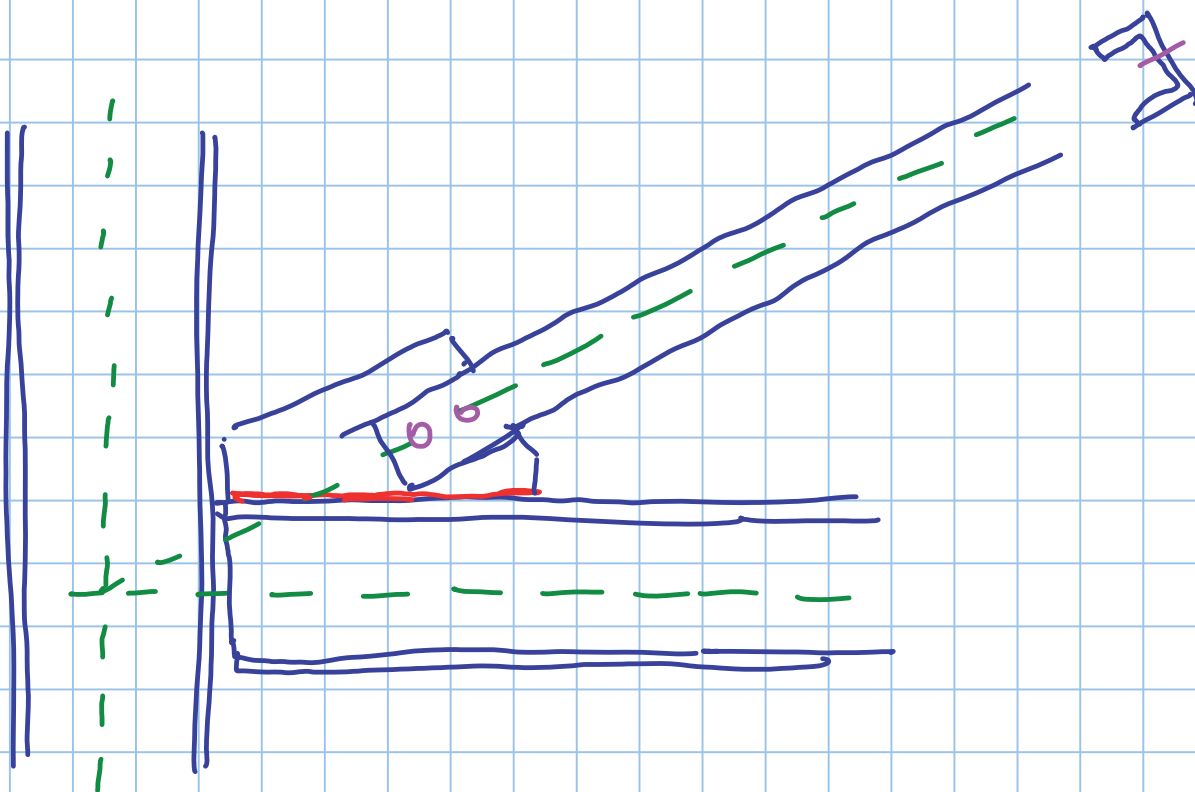
1/300 1/500

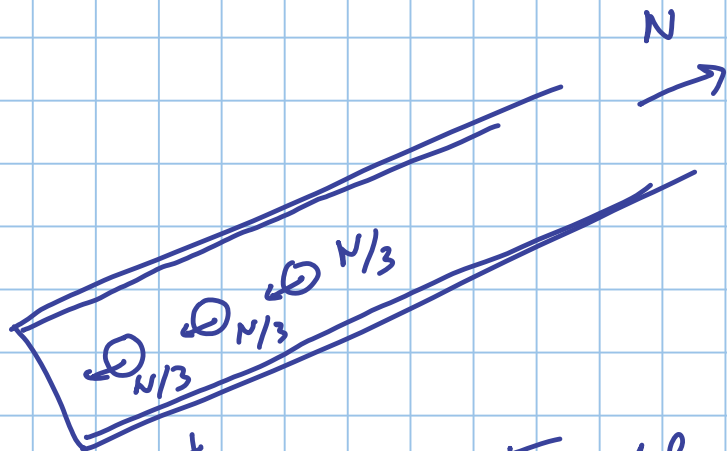
1/300 1/500

SLE

SLU

piano	Fk	ΣF	Nk	A	A					piano	Fk	ΣF	Nk	A	A				
6	23.9	23.9	26.8	0.96	1.59					6	48.9	48.9	56.1	1.87	3.12				
5	47.9	71.8	80.3	2.87	4.78					5	97.7	146.6	168.3	5.62	9.36				
4	47.9	119.7	133.8	4.78	7.96					4	97.7	244.3	280.6	9.36	15.61				
3	47.9	167.5	187.3	6.69	11.15					3	97.7	342.1	392.8	13.11	21.85				
2	47.9	215.4	240.8	8.60	14.34					2	97.7	439.8	505.0	16.85	28.09				
1	23.9	239.3	267.6	9.56	15.93					1	48.9	488.7	561.2	18.73	31.21				
piano	Fd	ΣF	Nd	A						piano	Fd	ΣF	Nd	A					
6	35.9	35.9	40.1	1.53						6	73.3	73.3	84.2	3.21					
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4	71.8	179.5	200.7	7.66						4	146.6	366.5	420.9	16.07					
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2	71.8	323.1	361.3	13.79						2	146.6	659.7	757.6	28.93					
1	35.9	359.0	401.4	15.33						1	73.3	733.0	841.7	32.14					
				x10^2 mm2										x10^2 mm2					





d_o = diametro del foro

d = diametro del bullone

$$h = 3500 \text{ mm}$$

$$\frac{1}{300} - \frac{2}{3500 \times 0.871} = 0.00268$$

$$= \frac{1}{374}$$

$$= \frac{1}{500} - \frac{1}{744}$$

$$d_o = d + 1 \text{ mm}$$

$$\delta = \frac{N h}{E A \sin \alpha \cos \alpha} + \frac{2 \text{ mm}}{\cos \alpha h} \leq \frac{1}{300} h$$

$$\frac{N}{E A \sin \alpha \cos \alpha} \leq \frac{1}{300} - \frac{2}{h \cos \alpha}$$

$$A \geq \frac{N}{E \sin \alpha \cos \alpha} \cdot \frac{1}{\frac{1}{300} - \frac{2}{h \cos \alpha}}$$

controlla $\frac{\Delta}{H}$

calcola a ogni piano $\delta_i = \frac{N_i h}{E A_i \sin \alpha \cos \alpha} + \frac{z}{\cos \alpha}$

somma i δ

$$\Delta = \sum_{i=1}^6 \delta_i$$

ricorda che per trattenere in presenza di forze

$$N_{pl,Rd} = A \frac{f_y}{\gamma_{m0}}$$

duffile e

$$N_{u,Rd} > N_{pl,Rd}$$

$$N_{u,Rd} = 0.9 A_{net} \frac{f_u}{\gamma_{m2}}$$

$$0.9 A_{net} \frac{f_u}{\gamma_{m2}} > A \frac{f_y}{\gamma_{m0}}$$

$$\frac{A_{net}}{A} > \frac{f_y / \gamma_{m0}}{0.9 f_u / \gamma_{m2}}$$

$$S275 \quad \frac{275 / 1.05}{0.9 \times 430 / 1.25} \geq 0.846$$

VERIFICA SEZIONI / ASTE

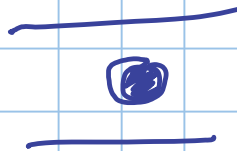
COMPRESSIONE

verifica sezione

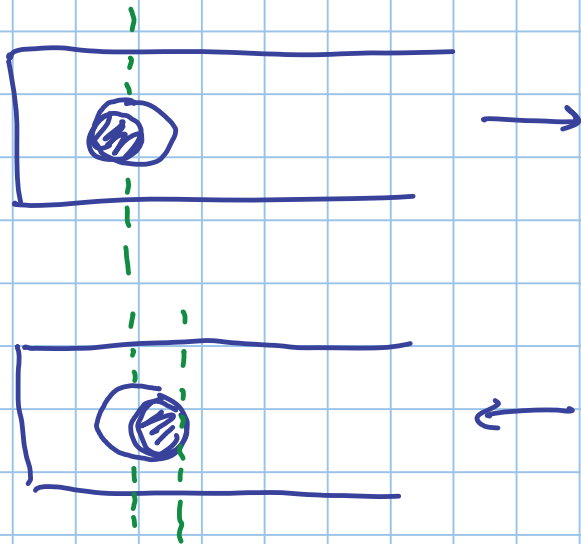
trazione = compressione

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

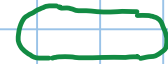
" sezione forata



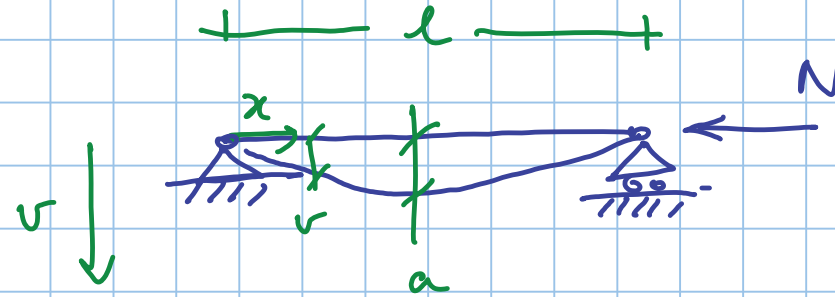
l'azione si trasmette
attraverso il bullone, dopo lo snervam.



attenzione ai fori isolati



ASTA COMPRESSA



$$M = N v$$

$$v'' = -\frac{M}{EI}$$

$$M = -EI v''$$

$$v = a \sin \pi \frac{x}{l}$$

$$-EI v'' = N v$$

$$N v + EI v'' = 0$$

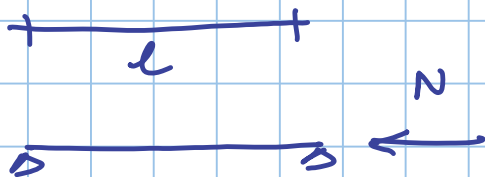
$$v' = a \frac{\pi}{l} \cos \pi \frac{x}{l}$$

$$N a \sin \pi \frac{x}{l} - EI a \frac{\pi^2}{l^2} \sin \pi \frac{x}{l} = 0$$

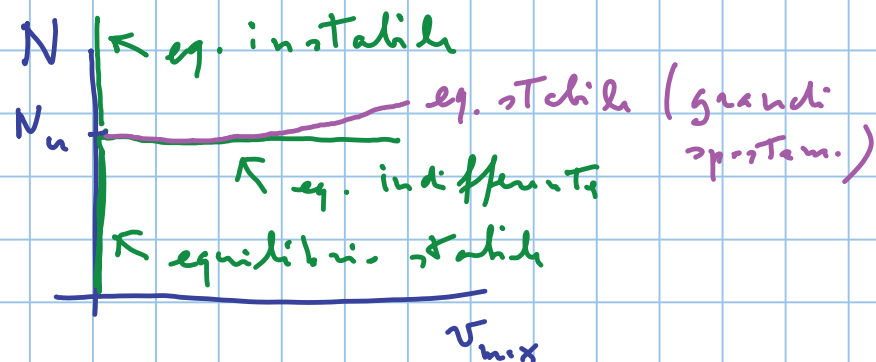
$$v'' = -a \frac{\pi^2}{l^2} \sin \pi \frac{x}{l}$$

$$\underbrace{a \sin \pi \frac{x}{l}}_{\neq 0} \left(N - EI \frac{\pi^2}{l^2} \right) = 0$$

$\rightarrow N = \frac{\pi^2 EI}{l^2}$

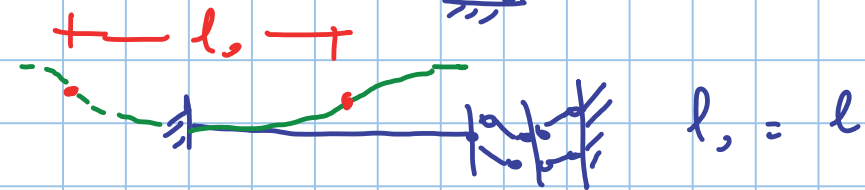
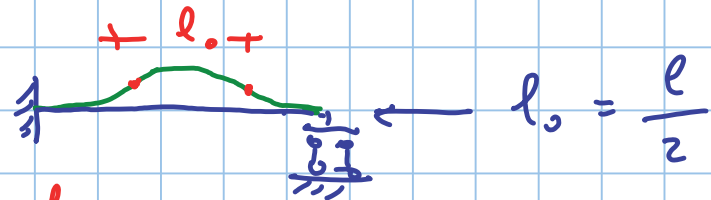
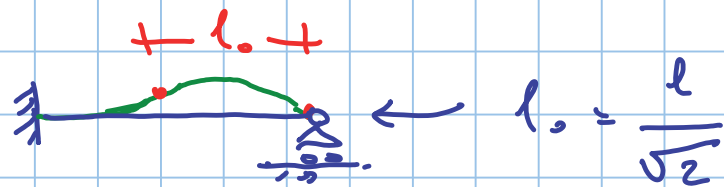
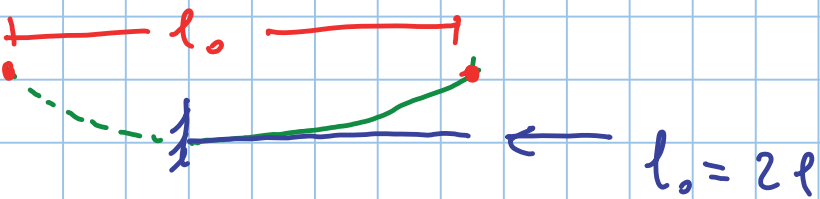


$$N_u = \frac{\pi^2 EI}{l^2}$$



instabilità Euleriana
o flessionale

altri schemi geometrici



l

l_0 = distanza tra punti di flessione

$$N_c = \frac{\pi^2 EI}{l_0^2}$$

l_0 = lunghezza libera di inflessione

non dimenticare le dimensioni relative

