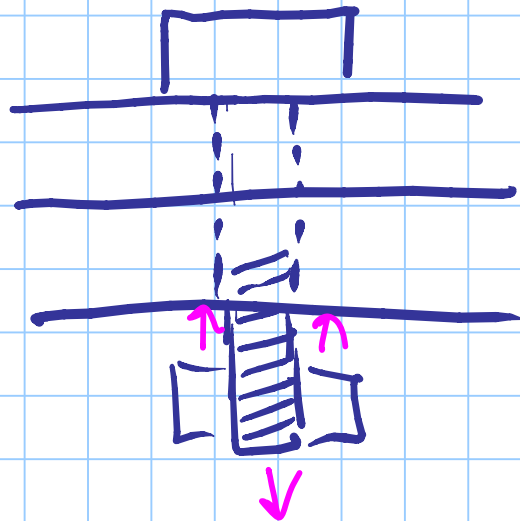
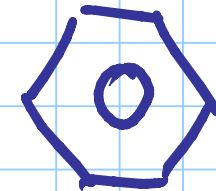
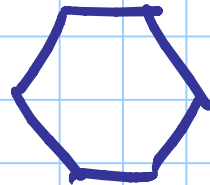
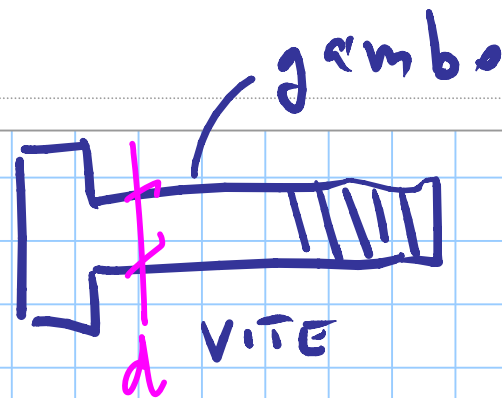


BULLONI

Titolo nota

08/01/2014

SERRAFRIO



serrando nasce

- compressione nei pezzi
- trazione nel gamba

$$F_{p,cd} = 0.7 A_{rs} \frac{f_{ub}}{\gamma_{M7}}$$

forza di precarico

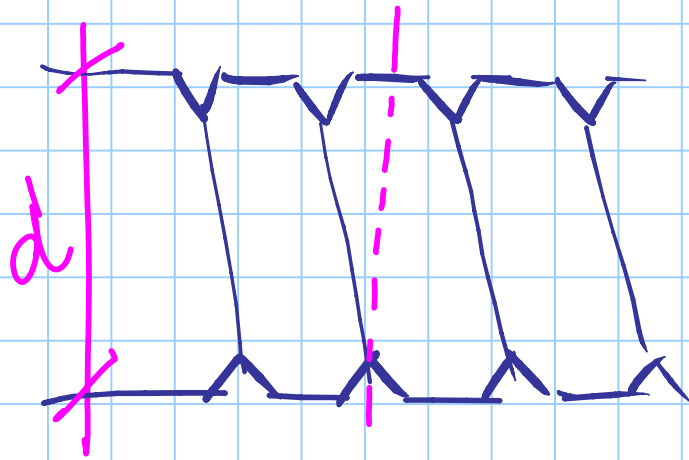
↓ 1.1

diametro d

10 mm → M10

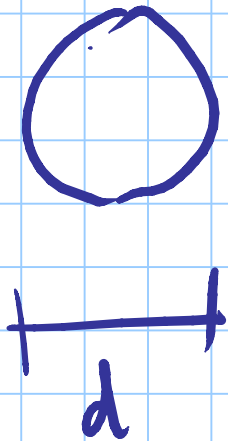
M10, M12, M14, ...

M20, M22, M24, M27, M30



A_{res} area
resistente

$$A_{res} \approx 0.75 A$$



$$A = \frac{\pi d^2}{4}$$

area nominal

diametro d	12	14	16	18	20	22	24	27	30
passo p	1.75	2.00	2.00	2.50	2.50	2.50	3.00	3.00	3.50
A	113	154	201	254	314	380	452	573	707
A_{res}	84.3	115	157	192	245	303	353	459	581
A_{res} / A	0.75	0.75	0.78	0.75	0.78	0.80	0.78	0.80	0.82

M14

$$A = 154 \text{ mm}^2$$

$$A_{res} = 115 \text{ mm}^2$$

ACCIAIO per bulloni

CLASSE del bullone

ALTA RESISTENZA

4.6

5.6

6.8

8.8

10.9

↑
tensione
ultima

↑
 $f_{yb} = f_{ub} \times 0.6 =$

$f_{ub} = 400 \text{ MPa} \quad \approx 240 \text{ MPa}$

↑

$f_{ub} = 1000 \text{ MPa}$

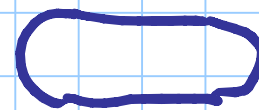
diametro del for. d_o

$$d_o \simeq d + 1 \text{ mm} \quad (\text{irr. } 1.5, 2, 3 \text{ mm})$$

diametro bullone	12	14	16	18	20	22	24	27	30
Norma italiana	1	1	1	1	1	1.5	1.5	1.5	1.5
Eurocodice 3	1	1	2	2	2	2	2	3	3

fori calibrati:
 $d_o = d + 0.2 \text{ mm}$

fori assoluti:



megh:

$1.5 d_o$

$1.2 d_o$

e_2

$3.0 d_o$

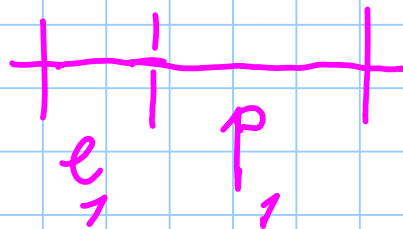
$2.4 d_o$

$\frac{p_2}{2}$



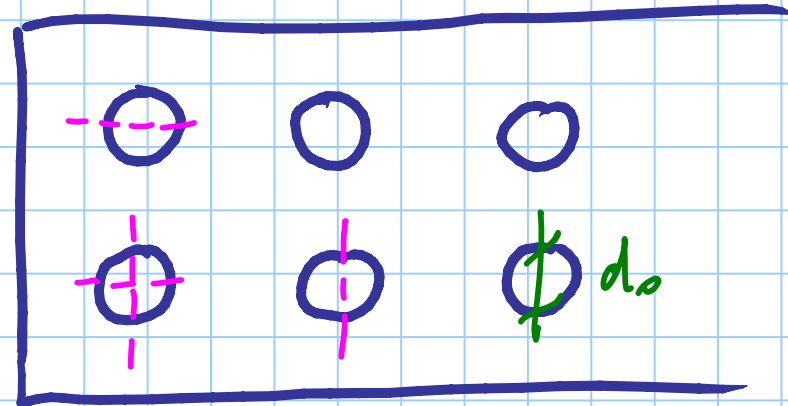
$k=2.5$

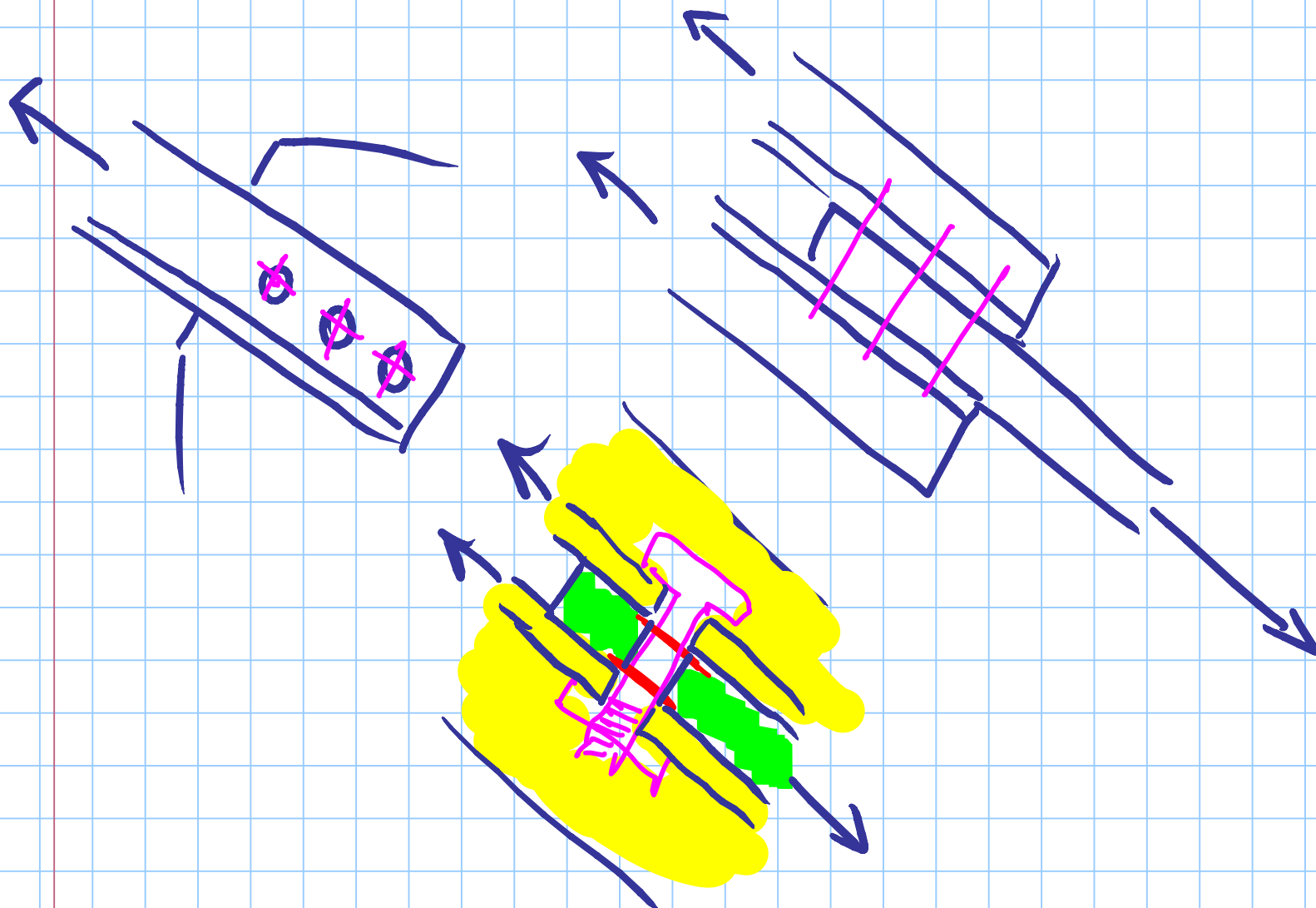
$K=166$



$1.2 d_o$

$2.2 d_o$



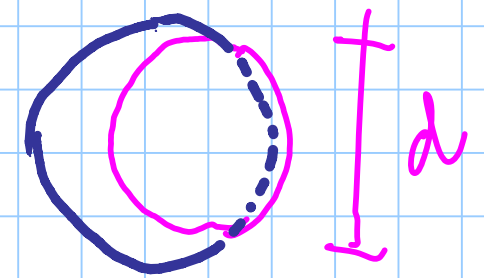
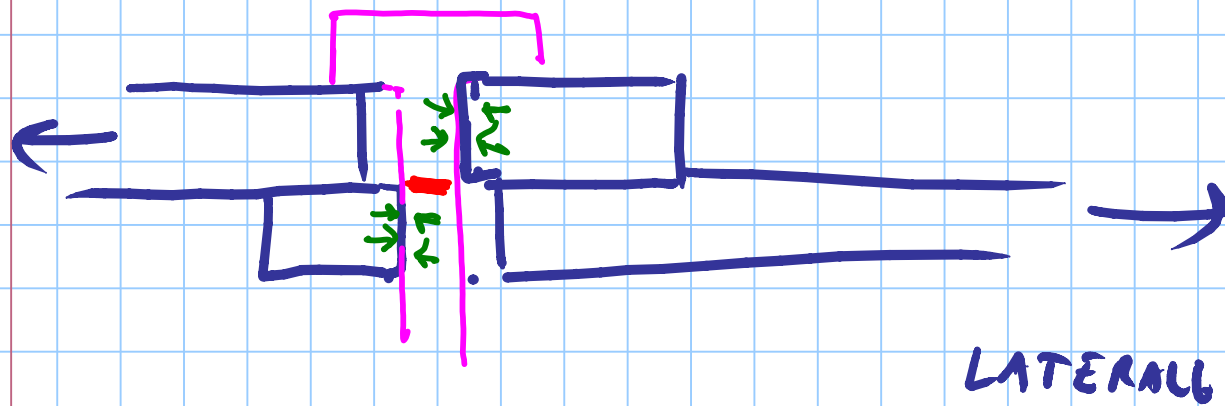


Resistenza a taglio di una sezione

$$F_{v,Rd} = 0.6 A \frac{f_{ub}}{\gamma_{M2}}$$

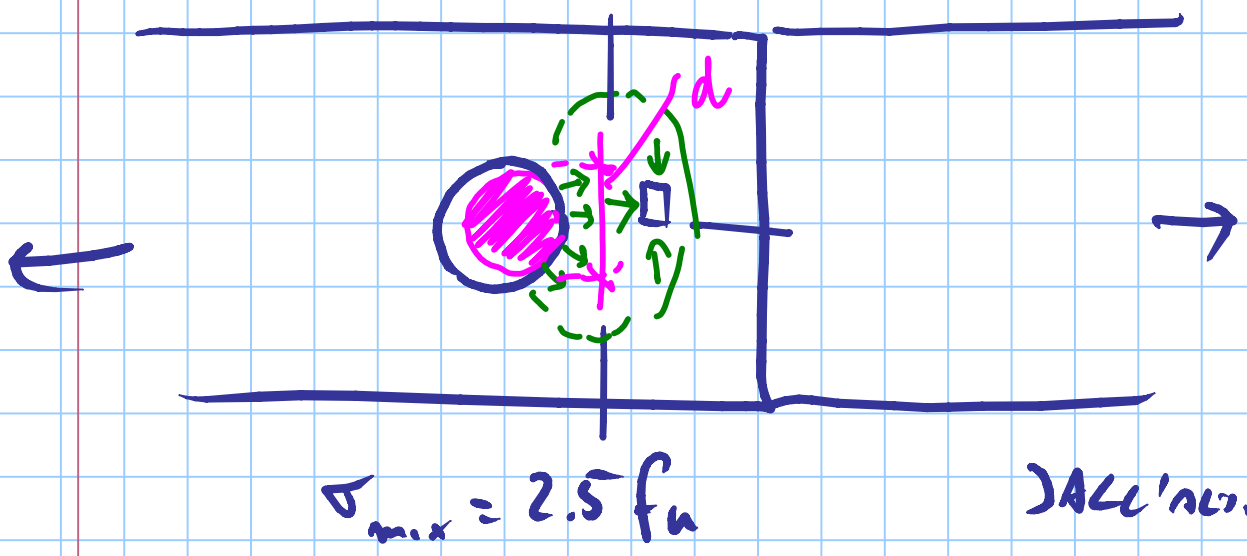
$\begin{array}{l} \rightarrow A \\ \rightarrow A_{res} \end{array}$

$$F_{v,Rd} = 0.5 A_{res} \frac{f_{ub}}{\gamma_{M2}} \quad \text{classe 6.8 e 10.9}$$

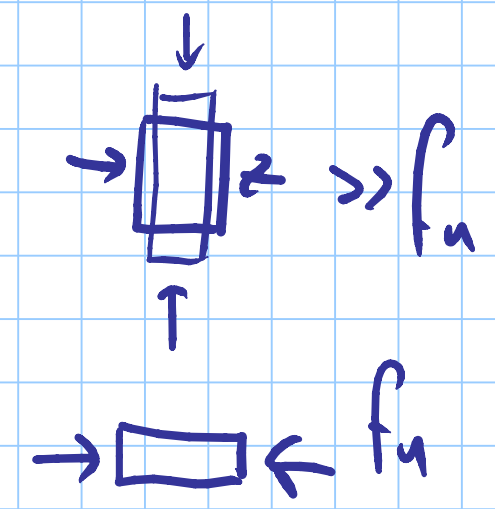


LATERALI

RIFOLLAMENTO $\sigma > \sigma_{max}$



DALL'ALTRA



resistenza a RIFOLLAMENTO

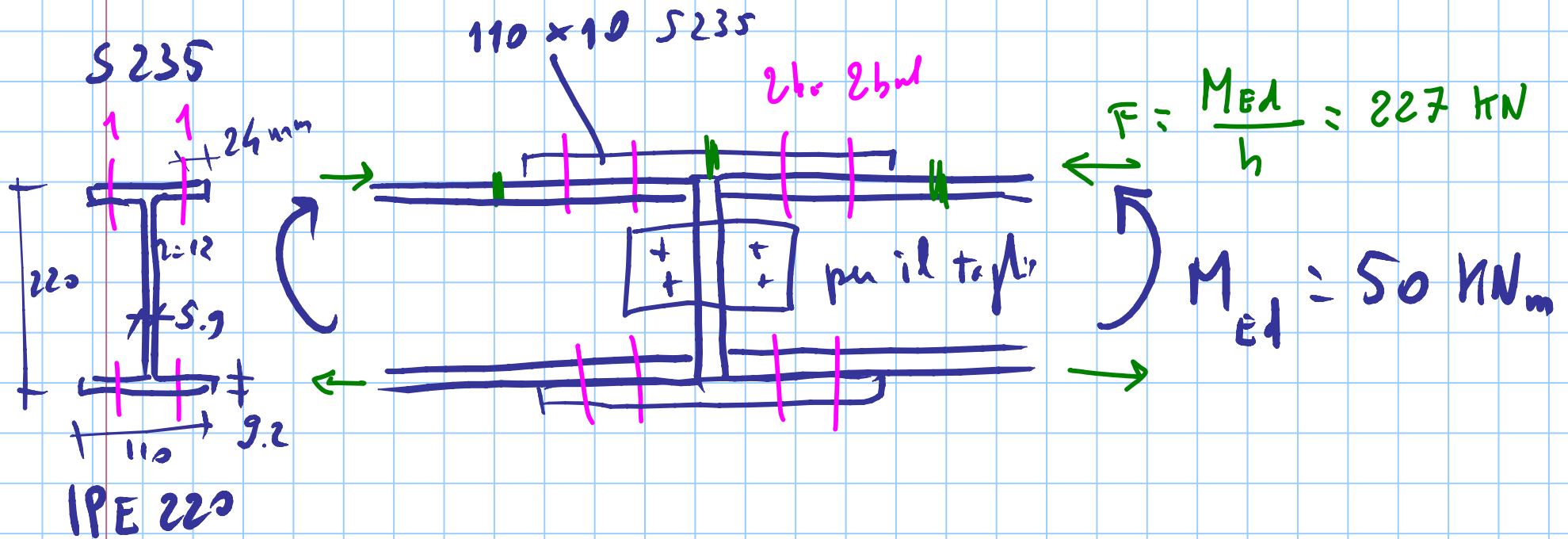
$$F_{b,Rd} = \underbrace{K \alpha}_{\leq 2.5} d t \frac{f_u}{\gamma_{M2}}$$

$$K = \min \left(2.5 ; \underbrace{2.8 \frac{e_2}{d_o} - 1.7}_{\substack{\text{se } e_2 \geq 1.5 d_o \\ \geq 2.5}} ; \underbrace{1.4 \frac{p_2}{d_o} - 1.7}_{\substack{\text{se } p_2 \geq 3 d_o \\ \geq 2.5}} \right)$$

$$d = \min \left(1 ; \underbrace{\frac{e_1}{3d_0}}_{\substack{\approx e_1 \geq 3d \\ \geq 1}} ; \underbrace{\frac{p_1}{3d_0} - 0.25}_{\substack{\approx p_1 \geq 3.75d \\ \geq 1}} ; \frac{f_{ub}}{f_u} \right)$$

$$\approx e_1 \geq 3d \\ \geq 1$$

$$\approx p_1 \geq 3.75d \\ \geq 1$$



$$W_{pl,y} = 285.4 \times 10^3 \text{ mm}^3$$

$$M_{ed} = W_{pl,y} \frac{f_y}{\gamma_m} = \frac{285.4}{10^3} \times \frac{235}{1.25} \times 10^{-6} = 63.9 \text{ kNm}$$

prov. con M16 tutti filetti $A_{us} = 157 \text{ mm}^2$

vediamo se bastano 4 bulloni.

n. viti per bullone 1

$$F_{v,u} = 0.6 A_{us} \frac{f_{ub}}{\gamma_{m2}} \times n_s \times n_b \geq F_{Ed}$$

$$f_{ub} \geq \frac{F_{Ed} \gamma_{m2}}{0.6 A_{us} n_s n_b} = \frac{227 \times 10^3 \times 1.25}{0.6 \times 157 \times 4} = 753 \text{ MPa}$$

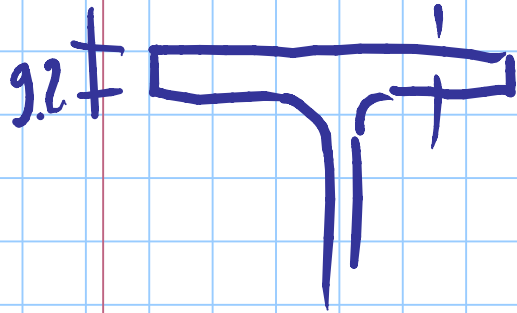
OK con classe 8.8

rip. elemento

$$d = 16 \text{ mm}$$

$$d_o = 17 \text{ mm}$$

$$2t = l_2$$



$$K = \frac{2.8 l_2}{d_o} - 1.7 = 2.25$$

$$F_{b,Rd} = K \alpha d t \frac{f_u}{\gamma_{M2}} \times n_s \times n_b \geq F_{Ed}$$

$$\alpha \geq \frac{F_{Ed} \gamma_{M2}}{K d t f_u n_s n_b} = \frac{227 \times 10^3 \times 1.25}{2.25 \times 16 \times 9.2 \times 360 \times 4} = 0.595$$

$$\frac{e_1}{3d_0} \geq 0.595 \quad \rightarrow \quad e_1 \geq 1.8 d_0 = 30.3 \text{ mm}$$

$$\frac{p_1}{3d_0} - 0.25 \geq 0.595 \quad \rightarrow \quad p_1 \geq 2.54 d_0 = 43 \text{ mm}$$

