

Trovare IPE 240 S235

$$H_{Ed} = 60 \text{ kNm} \quad V_{Ed} = 70 \text{ kN}$$

Al:	H18	8.8	filette- estremità
Amin:	H16	5.6	

$$a_{di} = 15 \text{ mm}$$

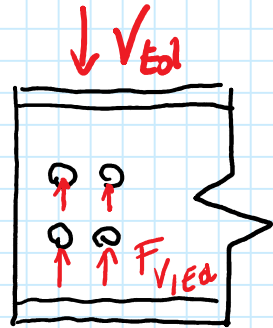
$$a_{emina} = 10 \text{ mm}$$

$$l_{di} = 120 \text{ mm}$$

$$l_{emina} = 120 \text{ mm}$$

$$t_p = 10 \text{ mm}$$

# Verifica a taglio dei bulloni



sigla	M12	M14	M16	M18
A (mm <sup>2</sup> )	113	154	201	254
A <sub>res</sub> (mm <sup>2</sup> )	84.3	115	157	192
A <sub>res</sub> / A	0.75	0.75	0.78	0.75

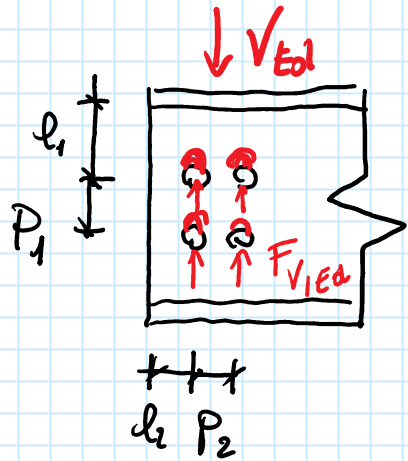
$$F_{V,Ed} = \frac{V_{Ed}}{4} = \frac{70}{4} = 17,5 \text{ kN}$$

$$F_{V,Rd} = 0,6 A \frac{f_{ub}}{\gamma_{M2}} = 0,6 \times 201 \times \frac{500}{1,25} \times \frac{1}{10^3} = 48,2 \text{ kN}$$

$$F_{V,Ed} = 17,5 \text{ kN} < F_{V,Rd} = 48,2 \text{ kN}$$

OK!

# Verifica e rifollamento dell'anima delle travi



$$F_{V,Ed} = 14,5 \text{ kN}$$

$$\frac{d_2}{d_0} = \frac{30}{14} = 1,96 > 1,5$$

$$\frac{P_2}{d_0} = \frac{60}{14} = 3,52 > 3,0$$

$$\Rightarrow K = 2,5$$

$$\alpha = \frac{d_1}{3d_0} > 1 \Rightarrow \alpha = 1$$

$$\alpha = \frac{P_1}{3d_0} - 0,25 = \frac{60}{3 \times 14} - 0,25 = \underline{0,9264}$$

$$F_{b,Rd} = 2,5 \times 0,9264 \times 16 \times 6,2 \times \frac{360}{1,25} \times \frac{1}{10^3} = 66,2 \text{ kN}$$

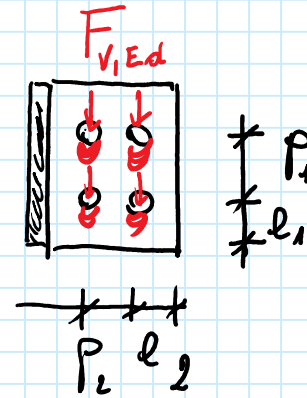
$$F_{V,Rd} = 14,5 \text{ kN} \leq F_{b,Rd} = 66,2 \text{ kN}$$

OK!

# Verifica e rifollamento delle piastre

$$\overline{F}_{V,Ed} = 17,5 \text{ KN}$$

$$\overline{F}_{b,Rd} = K \alpha d t \frac{f_u}{\gamma_{H2}}$$



$$\left. \begin{aligned} \frac{d_2}{d_o} &= \frac{30}{17} = 1,76 > 1,5 \\ \frac{P_2}{d_o} &= \frac{60}{17} = 3,52 > 3,0 \end{aligned} \right| \Rightarrow K = 2,5$$

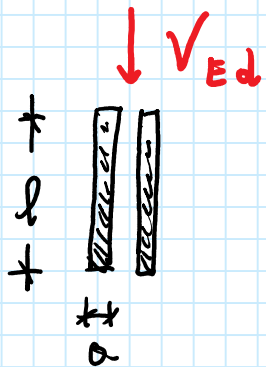
$$\alpha = \frac{d_1}{3d_o} = \frac{30}{3 \times 17} = \underline{0,5882}$$

$$\alpha = \frac{P_1}{3d_o} - 0,25 = \frac{60}{3 \times 17} - 0,25 = 0,9264$$

$$F_{b,rd} = 2,5 \times 0,5882 \times 16 \times 10 \times \frac{360}{1,25} \times \frac{1}{10^3} = 67,7 \text{ kN}$$

$$F_{v,Ed} = 17,5 \text{ kN} \leq F_{b,rd} = 67,7 \text{ kN} \quad \text{OK!}$$

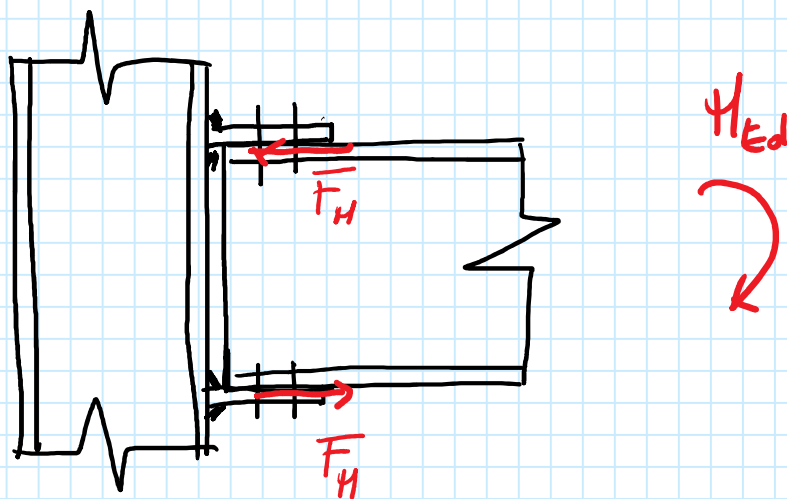
Verifica del cordone



$$t = \frac{V_{Ed}}{2al} = \frac{170 \times 10^3}{2 \times 10 \times 120} = 29,2 \text{ MPa}$$

$$f_{v,w,d} = \frac{f_u}{\sqrt{3} \beta_w \gamma_{M2}} = \frac{360}{\sqrt{3} \times 0,8 \times 1,25} = 207,8 \text{ MPa}$$

$$t = 29,2 \text{ MPa} \leq f_{v,w,d} = 207,8 \text{ MPa} \quad \text{OK!}$$



$$F_H = \frac{H_{Ed}}{h} = \frac{60}{0,24} = 250 \text{ kN}$$

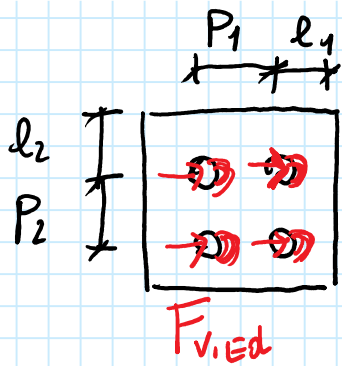
$$F_{V,Ed} = \frac{250}{4} = 62,5 \text{ kN}$$

$$F_{V,Rd} = 0,6 A \frac{f_{ub}}{\gamma_{M2}} = 0,6 \times 254 \times \frac{800}{1,25} \times \frac{1}{10^3} = 97,5 \text{ kN}$$

$$F_{V,Ed} = 62,5 \text{ kN} \leq F_{V,Rd} = 97,5 \text{ kN}$$

OK!

sigla	M12	M14	M16	M18
A (mm <sup>2</sup> )	113	154	201	254
A <sub>res</sub> (mm <sup>2</sup> )	84.3	115	157	192
A <sub>res</sub> / A	0.75	0.75	0.78	0.75



$$F_{v,Ed} = 62,5 \text{ kN}$$

$$\left. \begin{aligned} \frac{l_2}{d_o} &= \frac{30}{19} = 1,57 > 1,5 \\ \frac{P_2}{d_o} &= \frac{60}{19} = 3,15 > 3,0 \end{aligned} \right| \Rightarrow \kappa = 2,5$$

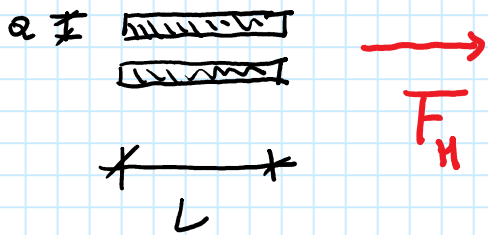
$$\alpha = \frac{l_1}{3d_o} = \frac{50}{3 \times 19} = \underline{0,8771}$$

$$\alpha = \frac{P_1}{3d_o} - 0,25 = \frac{80}{3 \times 19} - 0,25 = \cancel{1,15}^{1,0}$$

$$F_{b,Rd} = 2,5 \times 0,8771 \times 18 \times 9,8 \times \frac{360}{1,25} \times \frac{1}{10^3} = 111,4 \text{ kN}$$

$$F_{v,Ed} = 62,5 \text{ kN} \leq F_{b,Rd} = 111,4 \text{ kN} \quad \text{OK!}$$

# Verifica dei ordini d'angolo



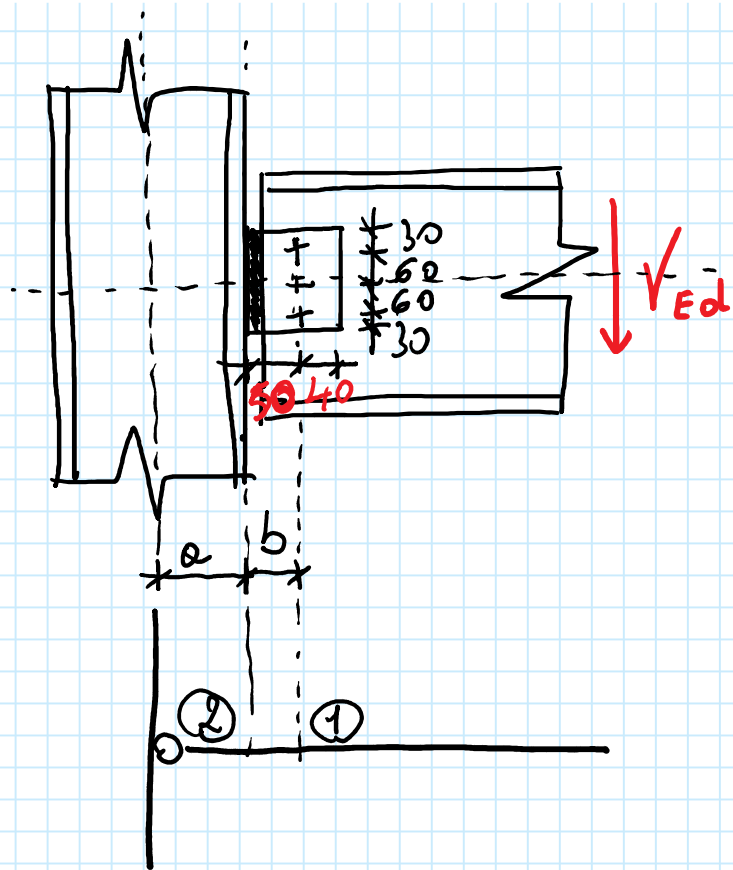
$$\tau = \frac{F_H}{2 a L} = \frac{250}{2 \times 15 \times 120} \times 10^3 = 69,4 \text{ MPa}$$

$$f_{v,w,d} = 207,8 \text{ MPa}$$

$$\tau = 69,4 \text{ MPa} \leq f_{v,w,d} = 207,8 \text{ MPa}$$

OK!





Colonne HEB 160

Trave IPE 240 S235

$$V_{Ed} = 70 \text{ kN}$$

3 M18 8.8 filetti all'estremità

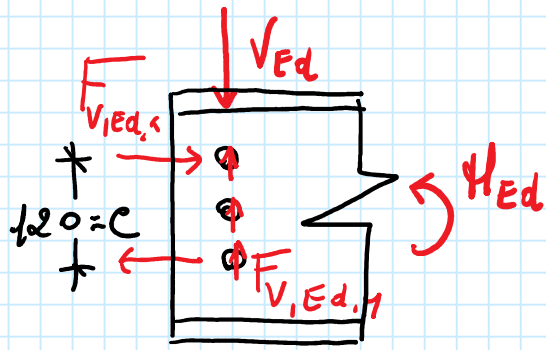
$$a = 10 \text{ mm}$$

$$b = 180 \text{ mm}$$

$$t_f = 10 \text{ mm}$$

$$V_{Ed} \uparrow \text{---} V_{Ed} \downarrow \quad M_{Ed} = V_{Ed} (a + b)$$

# Verifica dei bulloni



$$V_{Ed} = 70.0 \text{ kN}$$

$$H_{Ed} = 70.0 \times \left( \frac{0.16}{2} + 0.05 \right) = 9.1 \text{ kNm}$$

$$F_{V,Ed,y} = \frac{V_{Ed}}{3} = \frac{70.0}{3} = 23.3 \text{ kN}$$

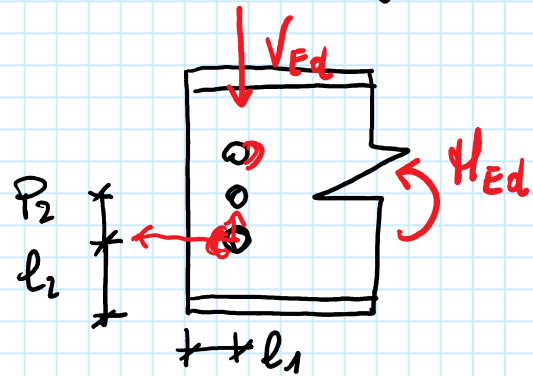
$$F_{V,Ed,x} = \frac{H_{Ed}}{e} = \frac{9.1}{0.12} = 75.8 \text{ kN}$$

$$F_{V,Ed} = \sqrt{F_{V,Ed,x}^2 + F_{V,Ed,y}^2} = \sqrt{75.8^2 + 23.3^2} = 79.3 \text{ kN}$$

$$F_{V,Rd} = 0.6 A \frac{f_{ub}}{\gamma_{M2}} = 94.5 \text{ kN}$$

OK!

# Verifica e rifollemento dell'anima delle trave



$$F_{V,Ed} = 79,3 \text{ kN}$$

$$\frac{l_2}{d_o} = \frac{60}{19} = 3,16 > 1,5 \quad \left| \Rightarrow \quad K = 2,5 \right.$$

$$\frac{P_2}{d_o} = \frac{60}{19} = 3,16 > 3,0$$

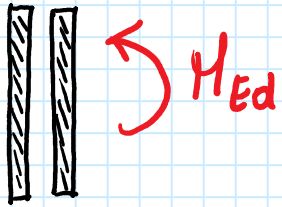
$$\alpha = \frac{l_1}{3d_o} = \frac{40}{3 \times 19} = 0,7017$$

$$F_{b,Rd} = 2,5 \times 0,7017 \times 18 \times 6,2 \times \frac{360}{1,25} \times \frac{1}{10^3} = 56,4 \text{ kN}$$

$$F_{V,Ed} = 79,3 \text{ kN} \leq F_{b,Rd} = 56,4 \text{ kN} \quad \text{NO}$$

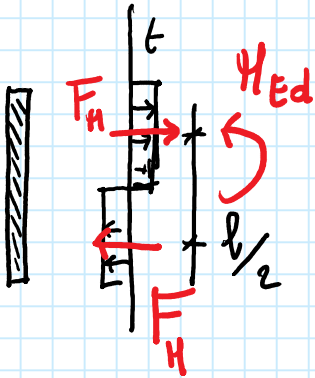
# Verifica dei cordoni d'angolo

$\downarrow V_{Ed}$



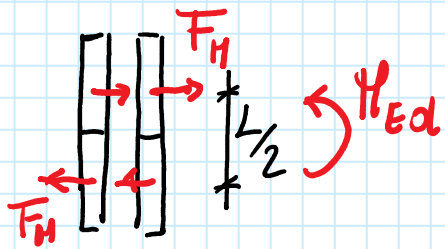
$$V_{Ed} = 70 \text{ kN}$$

$$M_{Ed} = V_{Ed} a = 70,0 \times \frac{0,16}{2} = 5,6 \text{ kN}$$



Il momento è supportato attraverso il  
compo di trazioni  $T$  indicato in figura.

Il diagramma delle  $T$  è costante e tratti  
perché si assume il cordone plastificato.



$$F_H = \frac{M_{Ed}}{2 \times l/2} = \frac{M_{Ed}}{l} = \frac{5.6}{0.18} = 31.1 \text{ kN}$$



$$F_V = \frac{V_{Ed}}{4} = \frac{70}{4} = 17.5 \text{ kN}$$

$$F_{w,Ed} = \sqrt{F_H^2 + F_V^2} = \sqrt{31.1^2 + 17.5^2} = 35.7 \text{ kN}$$

$$t = \frac{F_{w,Ed}}{a \cdot l/2} = \frac{35.7}{10 \times \frac{180}{2}} \times 10^3 = 39.6 \text{ MPa}$$

$$f_{v,w,d} = 207.8 \text{ MPa}$$

$$t = 39.6 \text{ MPa} \leq f_{v,w,d} = 207.8 \text{ MPa}$$

OK!