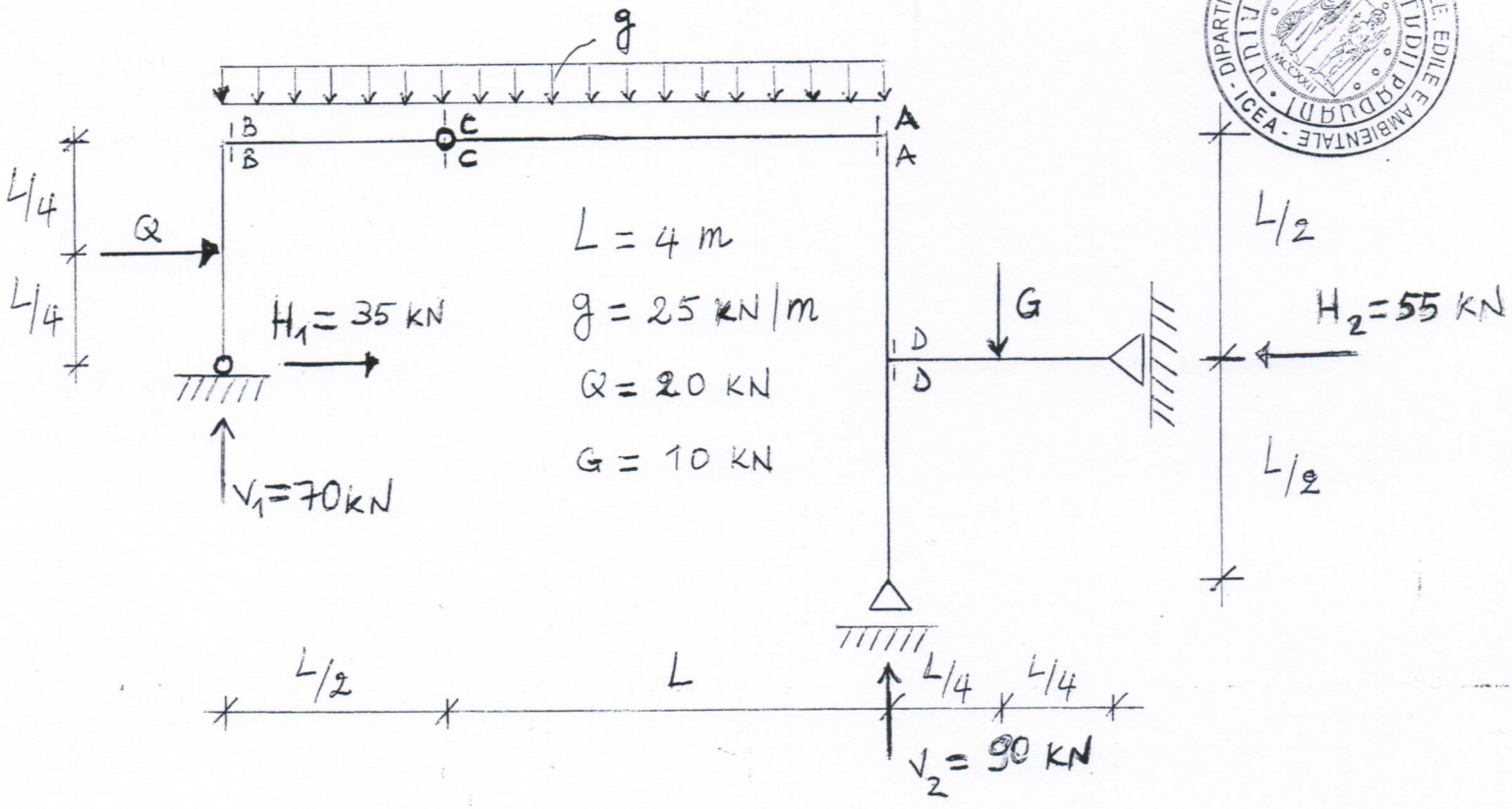
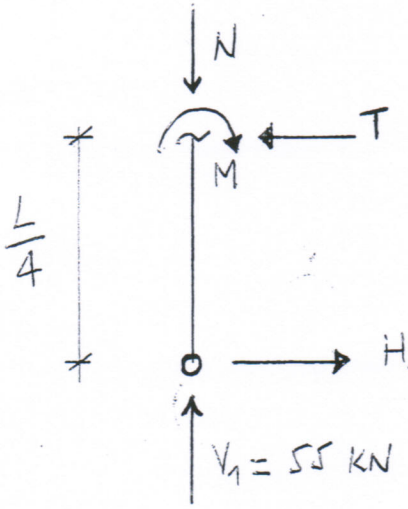
TEMA A 13/02/2018

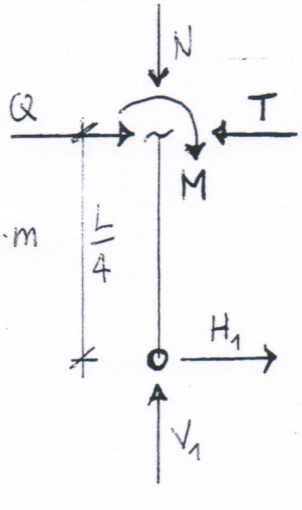


$$\begin{cases} V_1 + V_2 - g\cdot\frac{3}{2}L = 0 \\ H_1 - H_2 = -Q \\ -Q\cdot\frac{L}{4} - g\cdot\left(\frac{L}{2}\right)\cdot\frac{L}{4} + V_1\left(\frac{L}{2}\right) - H_1\left(\frac{L}{2}\right) = 0 \\ V_1\left(\frac{3}{2}L\right) - g\cdot\left(\frac{3}{2}L\right)\left(\frac{3}{4}L\right) + G\cdot\frac{L}{4} + Q\cdot\frac{L}{4} = 0 \end{cases}$$

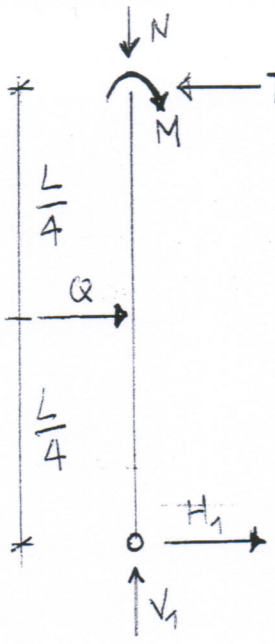
$$\begin{cases} V_2 = G + \frac{3}{2}\cdot g\cdot L - V_1 = 90\ kN \\ H_2 = H_1 + Q \\ H_1 = V_1 - \frac{Q}{2} - \frac{g}{4}\cdot L = 35\ kN \\ V_1 = \frac{3}{4}gL - \frac{G}{6} - \frac{Q}{6} = 70\ kN \end{cases}$$



$$\begin{cases} N = 70\ kN \\ T = 35\ kN \\ M = H_1\cdot\frac{L}{4} = 35\ kN\cdot m \end{cases}$$



$$\begin{cases} N = 70\ kN \\ T = Q + H_1 = 55\ kN \\ M = 35\ kN\cdot m \end{cases}$$

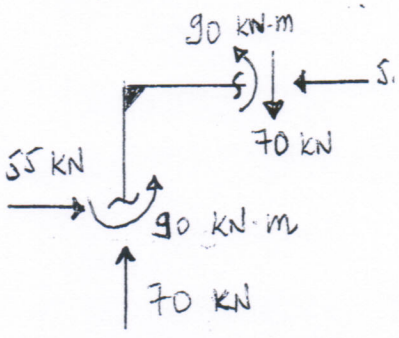


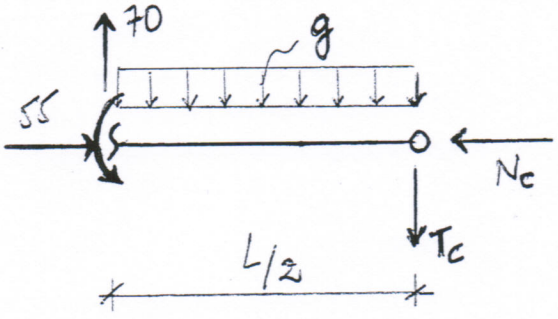
$N = 70$ kN

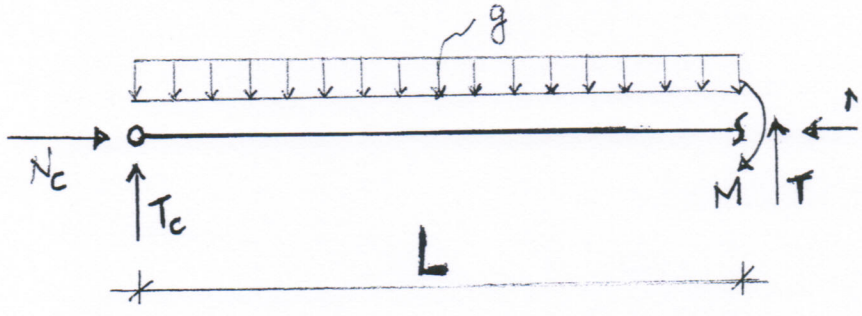
$T = 55$ kN

$M = Q \cdot \frac{L}{4} + H_1 \cdot \frac{L}{2} = 90$ kN·m

Equilibrio al nodo







$T_c = +70 - g \cdot \frac{L}{2} = 20$ kN ↑□↓

$N_c = 55$ kN →□←

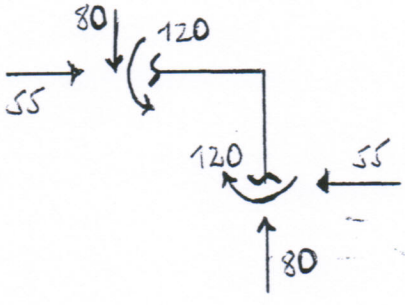
$M_c = 0$

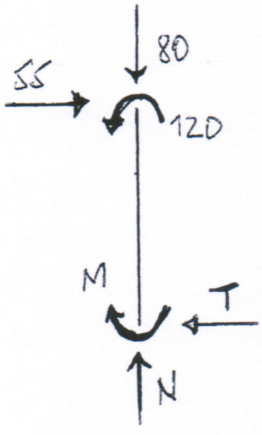
$N = 55$ kN →□←

$T = -T_c + g \cdot L = 80$ kN ↓□↑

$M = g \cdot \frac{L^2}{2} - T_c \cdot L = 120$ kN·m

Equilibrio al nodo

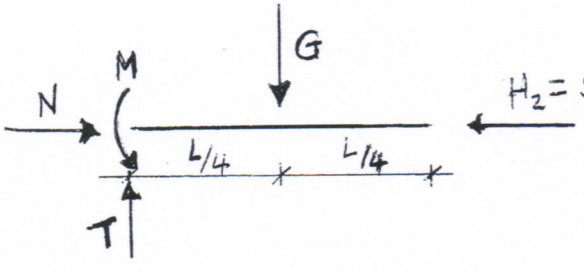




$N = 80$ kN

$T = 55$ kN

$M = +120 - 55 \cdot \frac{L}{2} = 10$ kN

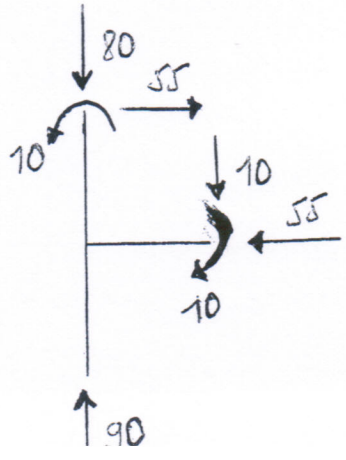


$H_2 = 55$ kN

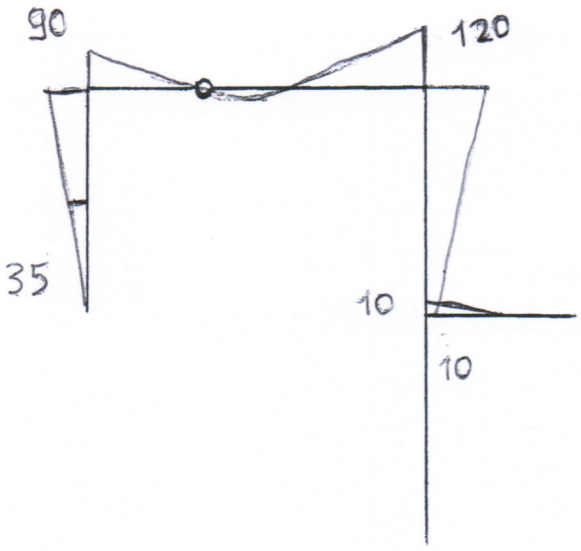
$N = 55$ kN

$T = 10$ kN

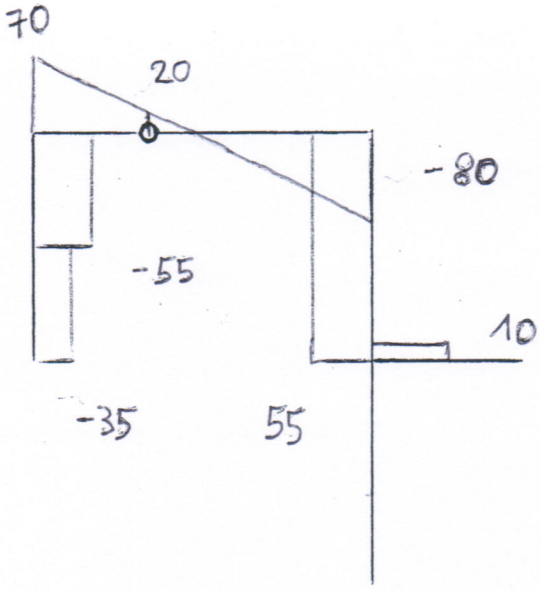
$M = G \cdot \frac{L}{4} = 10$ kN·m



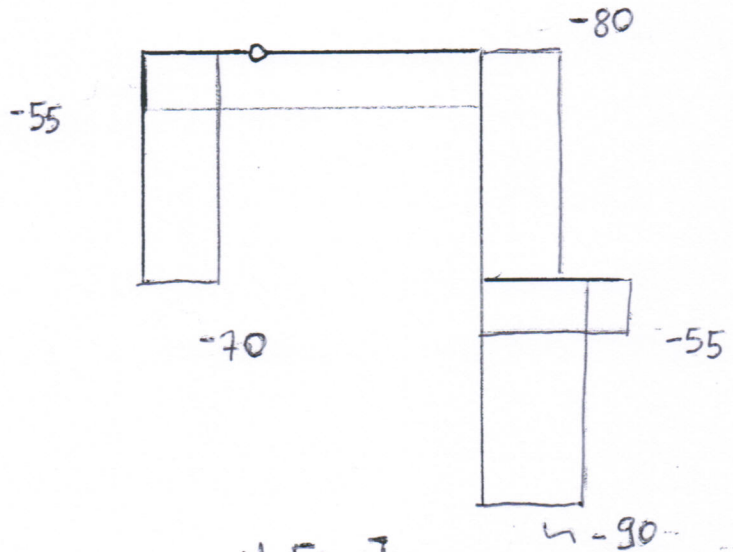
(i)



M [kN m]



T [kN]



N [kN]

(ii) ACCIAIO

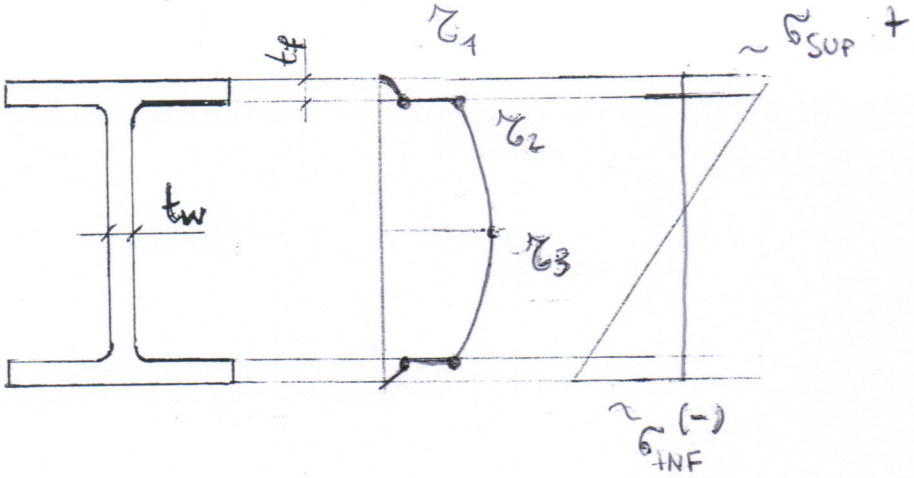
1) SEZ. A-A

$$W_{MIN.} = \frac{M_{ED} \cdot \gamma_{M0}}{f_{YK}} = \frac{120 \cdot 1{,}05}{235} = 536{,}17 \ cm^3$$

IPE 330 $W_{el} = 713 \ cm^3$

$$M_{RD} = \frac{f_{YK} \cdot W_{el}}{\gamma_{M0}} = 159{,}65 \ KN \cdot m$$

$$\begin{cases} A_v = A - 2 \cdot b \cdot t_f + (t_w + 2r) \cdot t_f = 3080 \ mm^2 \\ V_{RD} = A_v \cdot \frac{f_{YK}}{\sqrt{3}} \cdot \frac{1}{\gamma_{M0}} = 398 \ KN \end{cases}$$



$M_{Ed} = 120\ kN \cdot m \qquad V_{Ed} = 80\ kN$

$M_{RD} = 159,65\ kN \cdot m > M_{Ed}$

$V_{RD} = 398\ kN > V_{Ed}$

2) (iii)

SEZ. B-B

$M = 90\ kN \cdot m \qquad N = -55\ kN \qquad T = 70\ kN$

$$\sigma_{sup} = \frac{|M|}{W} + \frac{N}{A} = +117,38\ MPa$$

$$\sigma_{inf} = -\frac{|M|}{W} + \frac{N}{A} = -134,95\ MPa$$

$$\tau_1 = \frac{T \cdot S_1}{J \cdot B} = 1,089\ MPa$$

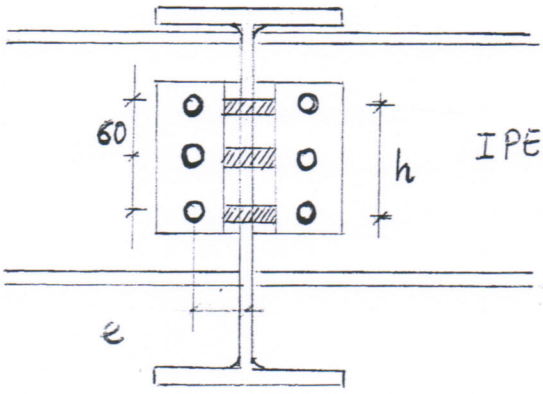
$$\tau_2 = \frac{T \cdot S_1}{J \cdot t_w} = 23,23\ MPa$$

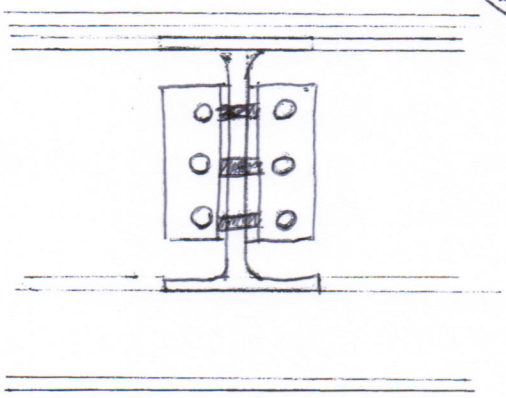
$$\tau_3 = \frac{T \cdot S_{1/2}}{J \cdot t_w} = 30,242\ MPa$$

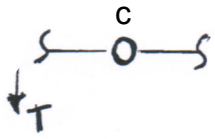
$$S_1 = (b \cdot t_f) \cdot \left(\frac{h}{2} - \frac{t_f}{2}\right)$$

$$S_{1/2} = S_1 + t_w \cdot \left(\frac{h}{2} - t_f\right) \cdot \frac{1}{2} \cdot \left(\frac{h}{2} - t_f\right)$$

BULLONATURA (iv)







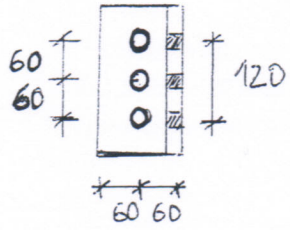
BULLONI M16 classe 8.8

$d_0 = 17$ mm $\quad f_{ub} = 800$ MPa

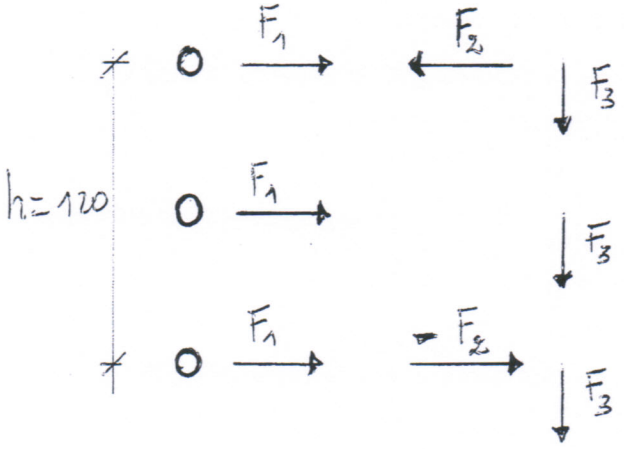
$T = 20$ kN

$N = -55$ kN

$e = 65.1$ mm



Bulloni anima - trave secondaria



$$F_1 = \frac{N}{3 \cdot 2} = \frac{55}{3 \cdot 2} = 9,16 \text{ kN}$$

$$F_2 = \frac{M}{h \cdot 2} = \frac{T \cdot e}{h \cdot 2} = \frac{20 \cdot 0,0651}{0,12 \cdot 2} = 5.4 \text{ kN}$$

$$F_3 = \frac{T}{3 \cdot 2} = \frac{20}{3 \cdot 2} = 3,33 \text{ kN}$$

$$F_{v,Ed} = R = \sqrt{(F_1 + F_2)^2 + F_3^2} = 14.93 \text{ kN} < F_{v,RD}$$

$$F_{v,RD} = \frac{0,6 \cdot f_{tb} \cdot A_{res}}{\gamma_{M2}} = \frac{0,6 \cdot 800 \cdot 157}{1,25} = 60,3 \text{ kN}$$

Bullonatura anime - trave principale

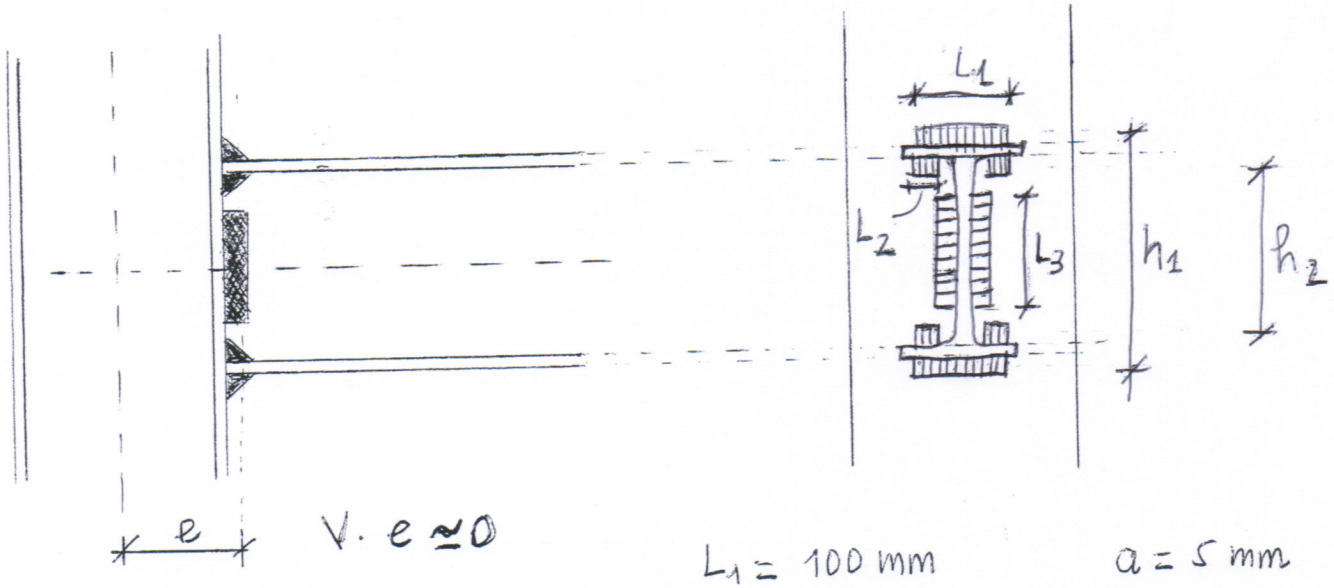
1) Trascuro momento dovuto ad ecc. taglio perché l'ecc. è trascurabile $\left(\frac{t_w}{2}\right)$

2) sforzo normale di compressione genera tensioni di contatto sulla piastra, quindi i bulloni sono soggetti a una sola componente di taglio verticale

$$F_{V,Ed} = \frac{T}{6} = \frac{20}{6} = 3,33 < F_{V,RD} = 60,3\ kN$$

(V) SEZ. D-D

$N = -55\ kN$ $M = 10\ kNm$ $T = 10\ kN$



$V \cdot e \simeq 0$

$e = \frac{330}{2} = 165\ mm$

$L_1 = 100\ mm$ $a = 5\ mm$

$L_2 = 50\ mm$ $h_1 = 335\ mm$

$L_3 = 150\ mm$ $h_2 = 302\ mm$

Saldatura ali

$$\sigma_\perp = \frac{(M + T \cdot e)}{W} + \frac{N}{A} = \frac{(M + T \cdot e)}{L_1 \cdot a \cdot h_1 + 2 \cdot L_2 \cdot a \cdot h_2} + \frac{N}{A}$$

$$A = 2 \cdot (L_1 \cdot a) + 4 \cdot (L_2 \cdot a) + 2 \cdot (L_3 \cdot a) = 3500\ mm^2$$

$\sigma_\perp = 47,11\ MPa$

SALDATURA ANIMA

$$\tau_{II} = \frac{T}{2 \cdot a \cdot L_3} = 6{,}67 \text{ MPa}$$

$$\sigma_{\perp} = \frac{N}{A} = \frac{N}{(2 \cdot L_1 \cdot a + 4 \cdot L_2 \cdot a + 2 \cdot L_3 \cdot a)} = 15{,}71 \text{ MPa}$$

VERIFICA ALI

$$\sqrt{\sigma_{\perp}^2 + \underbrace{\tau_{\perp}^2}_{0} + \underbrace{\tau_{II}^2}_{0}} \leq 0{,}85 \cdot f_{yk}$$

$$|\sigma_{\perp}| + \underbrace{|\tau_{\perp}|}_{0} \leq f_{yk}$$

ALI

$47{,}11 \leq 199$ ok

$\sigma_{\perp} \leq 0{,}85 \cdot f_{yk}$

$\sigma_{\perp} < f_{yk}$

VERIFICA ANIMA

$$\sqrt{\underbrace{\sigma_{\perp}^2 + \tau_{II}^2}} < 0{,}85 \cdot f_{yk}$$

$17{,}069 \leq 199$

$\sigma_{\perp} \leq f_{yk}$

$15{,}71 \leq 235$