

A1.0

$$N_x = 92.2 \text{ kN}$$

$$V_z = 368.6 \text{ kN}$$

$$N_{st} = 516.7 \text{ kN (vzlj. s silo iz zavrsta.)}$$

- spoj na nosilec:

$$F_{v, \max, d}^{k=63.3} = 39.23 \text{ kN (gl. priloga)}$$

$$F_{ed} = 29.04 \text{ kN} < 39.23 \text{ kN} \checkmark$$

- spoj na stebra:

$$F_{v, 11} = \frac{516.7}{3 \times 4} = 43.06 \text{ kN} < F_{v, \max, d}^{k=50} = 52.91 \text{ kN} \checkmark$$

- kontrola pločevin =

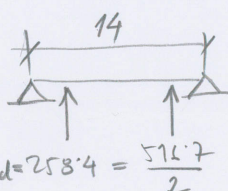
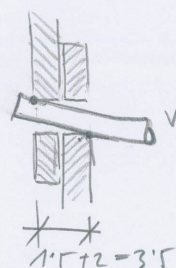
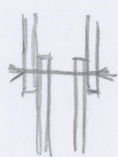
$$e \approx 30 \text{ cm} \rightarrow M = 368.6 \times 30 = 11058 \text{ kNcm}$$

$$F_H = \frac{11058}{40} = 276.5 \text{ kN}$$

$$f_{H, ed} = \frac{276.5}{2 \times 28} \approx 5 \text{ kN/cm}^2 < 35.5 \text{ kN/cm}^2 \checkmark$$

$$f_{V, ed} = \frac{368.6}{2 \times 1.5 \times 36} = 3.4 \text{ kN/cm}^2 < 20.5 \text{ kN/cm}^2 \checkmark$$

- sornik = ($\phi 60, S355$)



$$M = 258.4 \times 3.5 = 904.4 \text{ kN}$$

$$W_{pl} = \frac{d^3}{6} = \frac{60^3}{6} = 36 \text{ cm}^3$$

$$f_{ed}^H = \frac{904.4}{36} = 25.1 \text{ kN/cm}^2 < 35.5 \frac{\text{kN}}{\text{cm}^2} \checkmark$$

$$V_{pl, ed} = \frac{\pi 60^2}{4} \times \frac{355}{13 \times 10} = 579.5 \text{ kN}$$

$$V_{ed} < \frac{1}{2} V_{pl, ed} = 289.7 \text{ kN}$$

→ interakcija ni!

- bočni pritisk sornika =

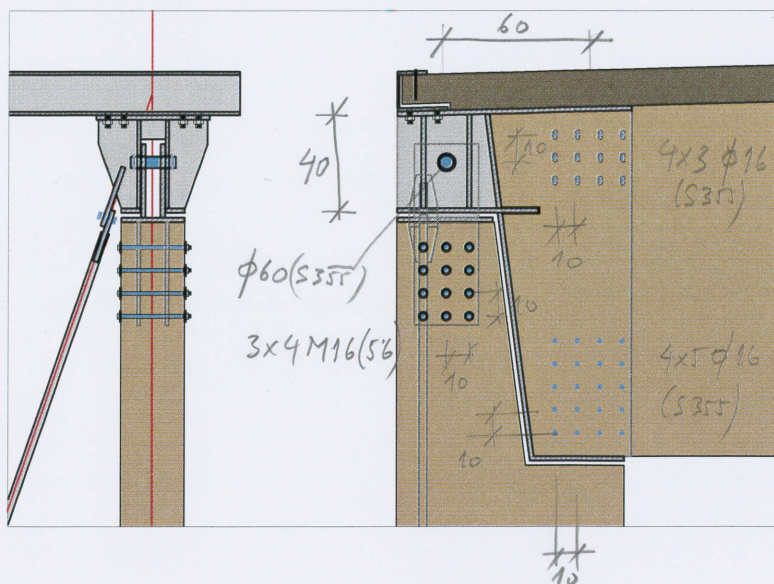
$$t_{min} = 15 \text{ mm}$$

$$F_{b, ed} = 2.5 \times 0.53 \times 49 / 1.25 \times 1.5 \times 60 = 467.5 \text{ kN} > 258.4 \text{ kN} \checkmark$$

$$\alpha = \min \left\{ \frac{100}{3 \times 63} = 0.53; \frac{49}{49} = 1.0; 1.0 \right\} = 0.53$$

$$\text{raznaka do roba pl. manjša na } e_1 = 80 \text{ mm} > 1.2 d_0 = 75.6 \text{ mm} \rightarrow \alpha = \frac{80}{3 \times 63} = 0.42$$

$$F_{b, ed} = 2.5 \times 0.42 \times 49 / 1.25 \times 1.5 \times 60 = 370.4 \text{ kN} > 258.4 \text{ kN}$$



VIJAČENA/MOZNIČENA ŠTIRISTRIŽNA ZVEZA LES-JEKLO-LES-JEKLO-LES (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL28c
Jeklo veznega sr.	S355
Razred trajanja obt.	Kratkotr.
Razred uporabe	1

$f_{m,k}$	28 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	510 MPa
γ_M	1.25
k_{mod}	0.90

$$\alpha = 64.8^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

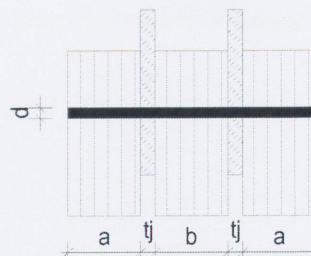
$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 26.174 \text{ MPa}$$

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 17.654 \text{ MPa}$$

$$M_{y,Rk} = 0.3 f_{uk} d^{2.6} = 206730 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

a	70 mm
b	110 mm
t_j	15 mm
d	16 mm



$$k_{90} = 1.590$$

A Zveza les (a) - jeklo - les(b) / strižna ravnina preko (a) ... $t_1=a$

$$F_{v,Rk} = \min \left\{ \begin{array}{ll} f_{h,1,k} t_1 d & \text{(f)} \quad 19772.3 \text{ N} \\ f_{h,1,k} t_1 d \left[\sqrt{2 + \frac{4M_{y,Rk}}{f_{h,1,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & \text{(g)} \quad (8.11) \quad 12094.0 \text{ N} \\ 2.3 \sqrt{M_{y,Rk} f_{h,1,k} d} + \frac{F_{ax,Rk}}{4} & \text{(h)} \quad 17575.6 \text{ N} \end{array} \right.$$

B Zveza les (a) - jeklo - les(b) / strižna ravnina preko (b) ... $t_1=b$

$$F_{v,Rk} = \min \left\{ \begin{array}{ll} f_{h,1,k} t_1 d & \text{(f)} \quad 31070.8 \text{ N} \\ f_{h,1,k} t_1 d \left[\sqrt{2 + \frac{4M_{y,Rk}}{f_{h,1,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & \text{(g)} \quad (8.11) \quad 15451.9 \text{ N} \\ 2.3 \sqrt{M_{y,Rk} f_{h,1,k} d} + \frac{F_{ax,Rk}}{4} & \text{(h)} \quad 17575.6 \text{ N} \end{array} \right.$$

C Zveza jeklo - les(b) - jeklo ... $t_2=b$

OPOMBA: Upoštevana je interpolacija med tanko in debelo priključno pločevino!

Tanka priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{ll} 0.5 f_{h,2,k} t_2 d & \text{(j)} \quad 15535.4 \text{ N} \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,2,k} d} + \frac{F_{ax,Rk}}{4} & \text{(k)} \quad (8.12) \quad 12427.8 \text{ N} \end{array} \right.$$

Debela priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{ll} 0.5 f_{h,2,k} t_2 d & \text{(l)} \quad 15535.4 \text{ N} \\ 2.3 \sqrt{M_{y,Rk} f_{h,2,k} d} + \frac{F_{ax,Rk}}{4} & \text{(m)} \quad (8.13) \quad 17575.6 \text{ N} \end{array} \right.$$

$$F_{v,Rk} = 2 \times F_{v,Rk,min}^A + 2 \times \min(F_{v,Rk,min}^B, F_{v,Rk,min}^C) = 54481.9 \text{ N}$$

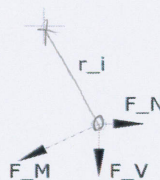
Računska strižna nosilnost zveze

$$F_{v,Rd} = 39.23 \text{ kN}$$

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N	92.2	kN
V	368.6	kN
M	221.16	kNm

št vij. za prevzem V	25
št vij. za prevzem N	40



F_v_max	29.04	kN
alfa	64.75	°

CENTER ROTACIJE		F_M	15.31
t_x	t_y	r_max	sum_r2
0.000	0.675	0.725	10.475

h	v	V?	H?	h_t	v_t	r_i	r_i^2	F_V,i	F_N,i	F_th,i	F_tv,i	F_v,i	alfa
-0.20	0.10	1	1	-0.200	-0.575	0.609	0.371	14.74	2.31	16.76	19.77	25.92	49.7
-0.10	0.10	1	1	-0.100	-0.575	0.584	0.341	14.74	2.31	17.39	12.12	21.19	34.9
0.00	0.10	1	1	0.000	-0.575	0.575	0.331	14.74	2.31	17.61	14.74	22.97	39.9
0.10	0.10	1	1	0.100	-0.575	0.584	0.341	14.74	2.31	17.39	17.37	24.57	45.0
0.20	0.10	1	1	0.200	-0.575	0.609	0.371	14.74	2.31	16.76	19.77	25.92	49.7
-0.20	0.20	1	1	-0.200	-0.475	0.515	0.266	14.74	2.31	16.41	8.80	18.62	28.2
-0.10	0.20	1	1	-0.100	-0.475	0.485	0.236	14.74	2.31	17.28	11.59	20.81	33.8
0.00	0.20	1	1	0.000	-0.475	0.475	0.226	14.74	2.31	17.61	14.74	22.97	39.9
0.10	0.20	1	1	0.100	-0.475	0.485	0.236	14.74	2.31	17.28	17.90	24.88	46.0
0.20	0.20	1	1	0.200	-0.475	0.515	0.266	14.74	2.31	16.41	20.68	26.40	51.6
-0.20	0.30	1	1	-0.200	-0.375	0.425	0.181	14.74	2.31	15.81	7.54	17.52	25.5
-0.10	0.30	1	1	-0.100	-0.375	0.388	0.151	14.74	2.31	17.10	10.80	20.22	32.3
0.00	0.30	1	1	0.000	-0.375	0.375	0.141	14.74	2.31	17.61	14.74	22.97	39.9
0.10	0.30	1	1	0.100	-0.375	0.388	0.151	14.74	2.31	17.10	18.69	25.33	47.5
0.20	0.30	1	1	0.200	-0.375	0.425	0.181	14.74	2.31	15.81	21.95	27.05	54.2
-0.20	0.40	1	1	-0.200	-0.275	0.340	0.116	14.74	2.31	14.68	5.74	15.77	21.4
-0.10	0.40	1	1	-0.100	-0.275	0.293	0.086	14.74	2.31	16.69	9.51	19.21	29.7
0.00	0.40	1	1	0.000	-0.275	0.275	0.076	14.74	2.31	17.61	14.74	22.97	39.9
0.10	0.40	1	1	0.100	-0.275	0.293	0.086	14.74	2.31	16.69	19.98	26.03	50.1
0.20	0.40	1	1	0.200	-0.275	0.340	0.116	14.74	2.31	14.68	23.75	27.92	58.3
-0.20	0.50	1	1	-0.200	-0.175	0.266	0.071	14.74	2.31	12.38	3.22	12.80	14.6
-0.10	0.50	1	1	-0.100	-0.175	0.202	0.041	14.74	2.31	15.60	7.15	17.16	24.6
0.00	0.50	1	1	0.000	-0.175	0.175	0.031	14.74	2.31	17.61	14.74	22.97	39.9
0.10	0.50	1	1	0.100	-0.175	0.202	0.041	14.74	2.31	15.60	22.34	27.24	55.1
0.20	0.50	1	1	0.200	-0.175	0.266	0.071	14.74	2.31	12.38	26.26	29.04	64.8
0.00	1.20	0	1	0.000	0.525	0.525	0.276	0.00	2.31	17.61	0.00	17.61	0.0
0.00	1.20	0	1	0.000	0.525	0.525	0.276	0.00	2.31	17.61	0.00	17.61	0.0
0.00	1.20	0	1	0.000	0.525	0.525	0.276	0.00	2.31	17.61	0.00	17.61	0.0
0.00	1.20	0	1	0.000	0.525	0.525	0.276	0.00	2.31	17.61	0.00	17.61	0.0
0.00	1.20	0	1	0.000	0.525	0.525	0.276	0.00	2.31	17.61	0.00	17.61	0.0
0.00	1.30	0	1	0.000	0.625	0.625	0.391	0.00	2.31	17.61	0.00	17.61	0.0
0.00	1.30	0	1	0.000	0.625	0.625	0.391	0.00	2.31	17.61	0.00	17.61	0.0
0.00	1.30	0	1	0.000	0.625	0.625	0.391	0.00	2.31	17.61	0.00	17.61	0.0
0.00	1.30	0	1	0.000	0.625	0.625	0.391	0.00	2.31	17.61	0.00	17.61	0.0
0.00	1.30	0	1	0.000	0.625	0.625	0.391	0.00	2.31	17.61	0.00	17.61	0.0
0.00	1.40	0	1	0.000	0.725	0.725	0.526	0.00	2.31	17.61	0.00	17.61	0.0
0.00	1.40	0	1	0.000	0.725	0.725	0.526	0.00	2.31	17.61	0.00	17.61	0.0
0.00	1.40	0	1	0.000	0.725	0.725	0.526	0.00	2.31	17.61	0.00	17.61	0.0
0.00	1.40	0	1	0.000	0.725	0.725	0.526	0.00	2.31	17.61	0.00	17.61	0.0
0.00	1.40	0	1	0.000	0.725	0.725	0.526	0.00	2.31	17.61	0.00	17.61	0.0

VIJAČENA/MOZNIČENA ŠTIRISTRIŽNA ZVEZA LES-JEKLO-LES-JEKLO-LES (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL28c
Jeklo veznega sr.	S355
Razred trajanja obt.	Kratkotr.
Razred uporabe	1

$$\begin{aligned}
 f_{m,k} &= 28 \text{ MPa} \\
 \rho_k &= 380 \text{ kg/m}^3 \\
 f_{u,k} &= 510 \text{ MPa} \\
 \gamma_M &= 1.25 \\
 k_{mod} &= 0.90
 \end{aligned}$$

$$\alpha = 0.0^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

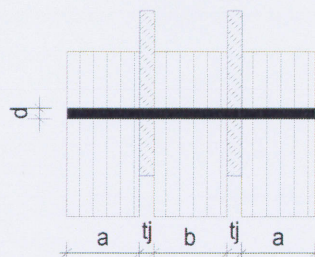
$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 26.174 \text{ MPa}$$

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 26.174 \text{ MPa}$$

$$M_{y,Rk} = 0.3 f_{uk} d^{2.6} = 206730 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

a	70 mm
b	110 mm
t _j	15 mm
d	16 mm



$$k_{90} = 1.590$$

A Zveza les (a) - jeklo - les(b) / strižna ravnina preko (a) ... t₁=a

$$\begin{aligned}
 F_{v,Rk} &= \min \left\{ \begin{aligned} & f_{h,1,k} t_1 d & (f) & 29315.3 \text{ N} \\ & f_{h,1,k} t_1 d \left[\sqrt{2 + \frac{4M_{y,Rk}}{f_{h,1,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (g) & 16127.9 \text{ N} \\ & 2.3 \sqrt{M_{y,Rk} f_{h,1,k} d} + \frac{F_{ax,Rk}}{4} & (h) & 21400.7 \text{ N} \end{aligned} \right. & (8.11)
 \end{aligned}$$

B Zveza les (a) - jeklo - les(b) / strižna ravnina preko (b) ... t₁=b

$$\begin{aligned}
 F_{v,Rk} &= \min \left\{ \begin{aligned} & f_{h,1,k} t_1 d & (f) & 46066.9 \text{ N} \\ & f_{h,1,k} t_1 d \left[\sqrt{2 + \frac{4M_{y,Rk}}{f_{h,1,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (g) & 21687.3 \text{ N} \\ & 2.3 \sqrt{M_{y,Rk} f_{h,1,k} d} + \frac{F_{ax,Rk}}{4} & (h) & 21400.7 \text{ N} \end{aligned} \right. & (8.11)
 \end{aligned}$$

C Zveza jeklo - les(b) - jeklo ... t₂=b

OPOMBA: Upoštevana je interpolacija med tanko in debelo priključno pločevino!

Tanka priključna pločevina

$$\begin{aligned}
 F_{v,Rk} &= \min \left\{ \begin{aligned} & 0.5 f_{h,2,k} t_2 d & (j) & 23033.5 \text{ N} \\ & 1.15 \sqrt{2 M_{y,Rk} f_{h,2,k} d} + \frac{F_{ax,Rk}}{4} & (k) & 15132.6 \text{ N} \end{aligned} \right. & (8.12)
 \end{aligned}$$

Debela priključna pločevina

$$\begin{aligned}
 F_{v,Rk} &= \min \left\{ \begin{aligned} & 0.5 f_{h,2,k} t_2 d & (l) & 23033.5 \text{ N} \\ & 2.3 \sqrt{M_{y,Rk} f_{h,2,k} d} + \frac{F_{ax,Rk}}{4} & (m) & 21400.7 \text{ N} \end{aligned} \right. & (8.13)
 \end{aligned}$$

$$F_{v,Rk} = 2 \times F_{v,Rk,min}^A + 2 \times \min(F_{v,Rk,min}^B, F_{v,Rk,min}^C) = 73490.1 \text{ N}$$

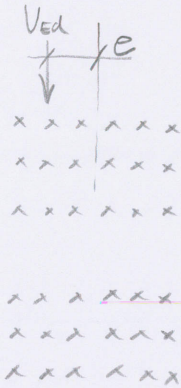
Računska strižna nosilnost zveze

$$F_{v,Rd} = 52.91 \text{ kN}$$

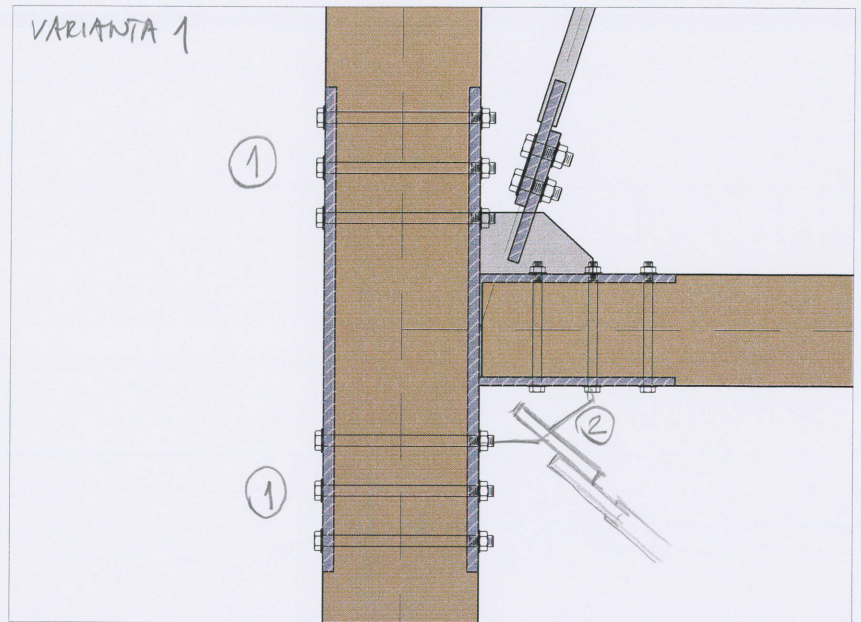
PRIKLJUČEK DIAG. OS A

$$V_{Ed} = 361.3 \cdot \cos 39^\circ = 280.8 \text{ kN}$$

$$H_{Ed} = 361.3 \cdot \sin 39^\circ = 227.4 \text{ kN}$$



VARIANTA 1



- $F_{y,rd} = 22.16 \text{ kN}$ (enostrižni priključek!)

redukcija zaradi razporeditve vijakov

$$F_{y,rd,eff} = 15.07 \text{ kN} \sim F_{Ed} = 15.42 \text{ kN} \quad \checkmark \quad (1)$$

(gl. priloge - upoštevana ekscentričnost e v vertikalni smeri!)

- $F_{y,rd} = 36.29 \text{ kN}$

$$F_{y,rd,eff} = 25.60 \text{ kN}$$

$$F_{Ed} = 25.3 \text{ kN} \sim 25.1 \text{ kN} \quad \checkmark \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} \text{ gl. priloge}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	S355
Razred trajanja obt.	Kratkotr.
Razred uporabe	1

$f_{m,k}$	=	24 MPa
ρ_k	=	380 kg/m ³
$f_{u,k}$	=	510 MPa
γ_M	=	1.25
k_{mod}	=	0.90

$\alpha = 16.0^\circ$... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 24.928 \text{ MPa}$$

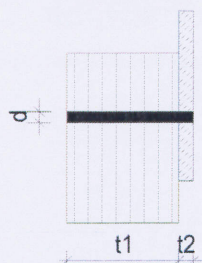
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 23.755 \text{ MPa}$$

$$k_{90} = 1.650$$

$$M_{y,Rk} = 0.3 f_{uk} d^{2.6} = 369292 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	280 mm
t_2	20 mm
d	20 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{l} 0.4 f_{h,k} t_1 d \quad (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} \quad (b) \end{array} \right. \quad (8.9) \quad \begin{array}{l} -/- \\ -/- \end{array}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{l} f_{h,k} t_1 d \quad (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} \quad (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} \quad (e) \end{array} \right. \quad (8.10) \quad \begin{array}{l} 133027.3 \text{ N} \\ 56957.8 \text{ N} \\ 30465.2 \text{ N} \end{array}$$

$$F_{v,Rk} = 30465.2 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 21.93 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	=	99 mm	... medsebojni razmak v smeri vlaken
a_2	=	80 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	=	140 mm	... obremenjeni konec
$a_{3,c}$	=	80 mm	... neobremenjeni konec
$a_{4,t}$	=	60 mm	... obremenjeni rob
$a_{4,c}$	=	60 mm	... neobremenjeni rob
a_l	=	90 mm	
m	=	12	... število vrst vijakov
n	=	3	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \begin{array}{l} n \\ n^{0.9} \sqrt{\frac{a_1}{13d}} \end{array} \right. = 2.062$$

Računska strižna nosilnost spoja

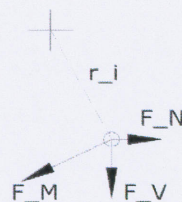
$$F_{v,Rd,tot} = 542.68 \text{ kN}$$

$$F_{v,Rd,eff} = 15.07 \text{ kN}$$

RAZPORED SIL V VIJAKIH

N 0 kN
V 360 kN
M 59.4 kNm

CENTER ROTACIJE		F_M 6.44	
t_x	t_y	r_max	sum_r2
0.225	0.380	0.442	4.073



št vij. za prevzem V 36
št vij. za prevzem N 36

F_v_max	15.42	kN
alfa	73.89	°

h	v	V?	H?	h_t	v_t	r_i	r_i^2	F_V,i	F_N,i	F_th,i	F_tv,i	F_v,i	alfa
0.00	0.00	1	1	-0.225	-0.380	0.442	0.195	10.00	0.00	5.54	6.72	8.71	50.5
0.09	0.00	1	1	-0.135	-0.380	0.403	0.163	10.00	0.00	6.07	7.84	9.92	52.3
0.18	0.00	1	1	-0.045	-0.380	0.383	0.146	10.00	0.00	6.40	9.24	11.24	55.3
0.27	0.00	1	1	0.045	-0.380	0.383	0.146	10.00	0.00	6.40	10.76	12.52	59.3
0.36	0.00	1	1	0.135	-0.380	0.403	0.163	10.00	0.00	6.07	12.16	13.59	63.5
0.45	0.00	1	1	0.225	-0.380	0.442	0.195	10.00	0.00	5.54	13.28	14.39	67.3
0.00	0.09	1	1	-0.225	-0.290	0.367	0.135	10.00	0.00	5.09	6.05	7.91	49.9
0.09	0.09	1	1	-0.135	-0.290	0.320	0.102	10.00	0.00	5.84	7.28	9.33	51.3
0.18	0.09	1	1	-0.045	-0.290	0.293	0.086	10.00	0.00	6.37	9.01	11.03	54.8
0.27	0.09	1	1	0.045	-0.290	0.293	0.086	10.00	0.00	6.37	10.99	12.70	59.9
0.36	0.09	1	1	0.135	-0.290	0.320	0.102	10.00	0.00	5.84	12.72	13.99	65.3
0.45	0.09	1	1	0.225	-0.290	0.367	0.135	10.00	0.00	5.09	13.95	14.85	70.0
0.00	0.18	1	1	-0.225	-0.200	0.301	0.091	10.00	0.00	4.28	5.19	6.72	50.5
0.09	0.18	1	1	-0.135	-0.200	0.241	0.058	10.00	0.00	5.34	6.40	8.33	50.1
0.18	0.18	1	1	-0.045	-0.200	0.205	0.042	10.00	0.00	6.28	8.59	10.64	53.8
0.27	0.18	1	1	0.045	-0.200	0.205	0.042	10.00	0.00	6.28	11.41	13.03	61.2
0.36	0.18	1	1	0.135	-0.200	0.241	0.058	10.00	0.00	5.34	13.60	14.61	68.6
0.45	0.18	1	1	0.225	-0.200	0.301	0.091	10.00	0.00	4.28	14.81	15.42	73.9
0.00	0.58	1	1	-0.225	0.200	0.301	0.091	10.00	0.00	4.28	5.19	6.72	50.5
0.09	0.58	1	1	-0.135	0.200	0.241	0.058	10.00	0.00	5.34	6.40	8.33	50.1
0.18	0.58	1	1	-0.045	0.200	0.205	0.042	10.00	0.00	6.28	8.59	10.64	53.8
0.27	0.58	1	1	0.045	0.200	0.205	0.042	10.00	0.00	6.28	11.41	13.03	61.2
0.36	0.58	1	1	0.135	0.200	0.241	0.058	10.00	0.00	5.34	13.60	14.61	68.6
0.45	0.58	1	1	0.225	0.200	0.301	0.091	10.00	0.00	4.28	14.81	15.42	73.9
0.00	0.67	1	1	-0.225	0.290	0.367	0.135	10.00	0.00	5.09	6.05	7.91	49.9
0.09	0.67	1	1	-0.135	0.290	0.320	0.102	10.00	0.00	5.84	7.28	9.33	51.3
0.18	0.67	1	1	-0.045	0.290	0.293	0.086	10.00	0.00	6.37	9.01	11.03	54.8
0.27	0.67	1	1	0.045	0.290	0.293	0.086	10.00	0.00	6.37	10.99	12.70	59.9
0.36	0.67	1	1	0.135	0.290	0.320	0.102	10.00	0.00	5.84	12.72	13.99	65.3
0.45	0.67	1	1	0.225	0.290	0.367	0.135	10.00	0.00	5.09	13.95	14.85	70.0
0.00	0.76	1	1	-0.225	0.380	0.442	0.195	10.00	0.00	5.54	6.72	8.71	50.5
0.09	0.76	1	1	-0.135	0.380	0.403	0.163	10.00	0.00	6.07	7.84	9.92	52.3
0.18	0.76	1	1	-0.045	0.380	0.383	0.146	10.00	0.00	6.40	9.24	11.24	55.3
0.27	0.76	1	1	0.045	0.380	0.383	0.146	10.00	0.00	6.40	10.76	12.52	59.3
0.36	0.76	1	1	0.135	0.380	0.403	0.163	10.00	0.00	6.07	12.16	13.59	63.5
0.45	0.76	1	1	0.225	0.380	0.442	0.195	10.00	0.00	5.54	13.28	14.39	67.3

VIJAČENA/MOZNIČENA DVOSTRIŽNA ZVEZA JEKLO-LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	S355
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	510 MPa
γ_M	1.25
k_{mod}	1.10

$\alpha = 15.0^\circ$... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 26.174 \text{ MPa}$$

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 25.179 \text{ MPa}$$

$$k_{90} = 1.590$$

$$M_{y,Rk} = 0.3 f_{uk} d^{2.6} = 206730 \text{ Nmm}$$

Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.5 f_{h,2,k} t_2 d & (j) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,2,k}} d + \frac{F_{ax,Rk}}{4} & (k) \end{cases} \quad (8.12)$$

40286.8 N

14842.1 N

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.5 f_{h,2,k} t_2 d & (l) \\ 2.3 \sqrt{M_{y,Rk} f_{h,2,k}} d + \frac{F_{ax,Rk}}{4} & (m) \end{cases} \quad (8.13)$$

40286.8 N

20989.9 N

OPOMBA: Upoštevana je interpolacija med tanko in debelo priključno pločevino!

$$F_{v,Rk} = 2 \times F_{v,Rk,min} = 40442.9 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 35.59 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	79 mm	... medsebojni razmak v smeri vlaken
a_2	64 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	112 mm	... obremenjeni konec
$a_{3,c}$	64 mm	... neobremenjeni konec
$a_{4,t}$	48 mm	... obremenjeni rob
$a_{4,c}$	48 mm	... neobremenjeni rob
a_l	80 mm	
m	4	... število vrst vijakov
n	3	... število vijakov v vrsti (vzporedno z vlakni)

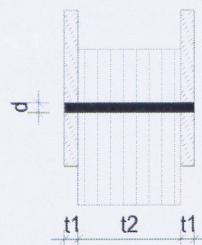
$$n_{ef} = \min \left\{ n, n^{0.94} \sqrt{\frac{a_1}{13d}} \right\} = 2.117$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 301.34 \text{ kN}$$

GEOMETRIJSKI PODATKI

t_1	15 mm
t_2	200 mm
d	16 mm

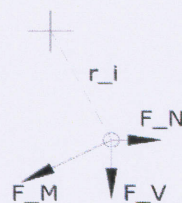


$$F_{v,Rd,eff} = 25.11 \text{ kN}$$

RAZPORED SIL V VIJAKIH

N 0 kN
V 227 kN
M 31.78 kNm

CENTER ROTACIJE		F_M 13.57	
t_x	t_y	r_max	sum_r2
0.090	0.250	0.266	0.622



št vij. za prevzem V 18
št vij. za prevzem N 18

F_v_max	25.35	kN
alfa	74.93	°

h	v	V?	H?	h_t	v_t	r_i	r_i^2	F_V,i	F_N,i	F_th,i	F_tv,i	F_v,i	alfa
0.00	0.00	1	1	-0.090	-0.250	0.266	0.071	12.61	0.00	12.77	8.01	15.08	32.1
0.09	0.00	1	1	0.000	-0.250	0.250	0.063	12.61	0.00	13.57	12.61	18.53	42.9
0.18	0.00	1	1	0.090	-0.250	0.266	0.071	12.61	0.00	12.77	17.21	21.43	53.4
0.00	0.10	1	1	-0.090	-0.150	0.175	0.031	12.61	0.00	11.64	5.63	12.93	25.8
0.09	0.10	1	1	0.000	-0.150	0.150	0.023	12.61	0.00	13.57	12.61	18.53	42.9
0.18	0.10	1	1	0.090	-0.150	0.175	0.031	12.61	0.00	11.64	19.59	22.79	59.3
0.00	0.20	1	1	-0.090	-0.050	0.103	0.011	12.61	0.00	6.59	0.75	6.63	6.5
0.09	0.20	1	1	0.000	-0.050	0.050	0.003	12.61	0.00	13.57	12.61	18.53	42.9
0.18	0.20	1	1	0.090	-0.050	0.103	0.011	12.61	0.00	6.59	24.47	25.35	74.9
0.00	0.30	1	1	-0.090	0.050	0.103	0.011	12.61	0.00	6.59	0.75	6.63	6.5
0.09	0.30	1	1	0.000	0.050	0.050	0.003	12.61	0.00	13.57	12.61	18.53	42.9
0.18	0.30	1	1	0.090	0.050	0.103	0.011	12.61	0.00	6.59	24.47	25.35	74.9
0.00	0.40	1	1	-0.090	0.150	0.175	0.031	12.61	0.00	11.64	5.63	12.93	25.8
0.09	0.40	1	1	0.000	0.150	0.150	0.023	12.61	0.00	13.57	12.61	18.53	42.9
0.18	0.40	1	1	0.090	0.150	0.175	0.031	12.61	0.00	11.64	19.59	22.79	59.3
0.00	0.50	1	1	-0.090	0.250	0.266	0.071	12.61	0.00	12.77	8.01	15.08	32.1
0.09	0.50	1	1	0.000	0.250	0.250	0.063	12.61	0.00	13.57	12.61	18.53	42.9
0.18	0.50	1	1	0.090	0.250	0.266	0.071	12.61	0.00	12.77	17.21	21.43	53.4

$$V_{ed} = 280.8 \text{ kN}$$

$$H_{ed} = 227.4 \text{ kN}$$

• kontaktne nap.:

$$A_c = 24 \times 25 = 600 \text{ cm}^2$$

$$f_{c,ed} = \frac{280.8}{600} = 0.468 \text{ kN/cm}^2$$

$$f_{c90,d} = \frac{1.1 \times 24}{1.25} = 2.11 \text{ kN/cm}^2 > 0.468 \text{ kN/cm}^2 \checkmark$$

• strig v horizontalni ravnini

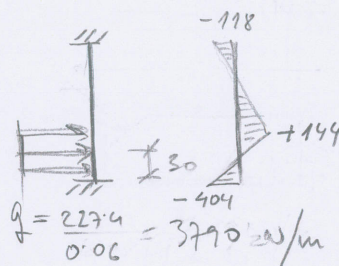
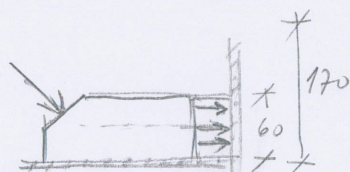
$$F_{y,ed} = 36.29 \text{ kN}$$

$$F_{y,ed,eff} = 25.60 \text{ kN}$$

$$F_{ed} = 25.3 \text{ kN} \sim 25.1 \text{ kN}$$

} gl. priloge za VAR 1

• prihode na stropu:

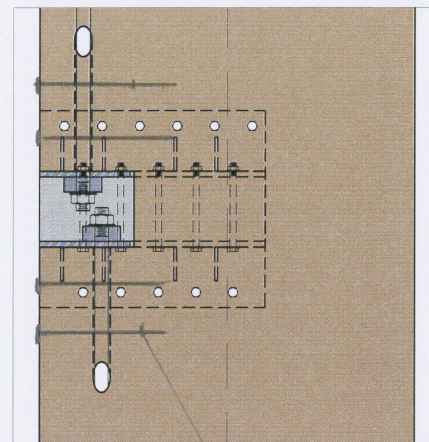
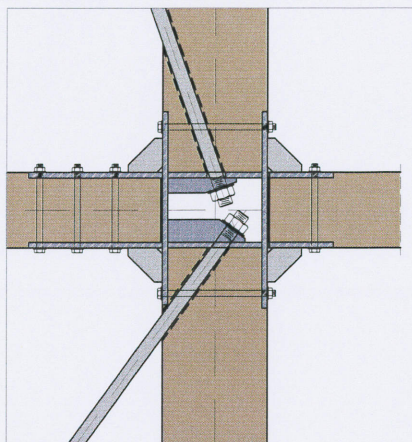


$$M_{ed} = 404 \text{ kNm}$$

$$W_{pl} = \frac{24 \times 1.5^2}{4} = 13.5 \text{ cm}^3$$

$$f_{bd} = \frac{404}{13.5} = 29.9 \text{ kN/cm}^2 < 35.5 \text{ kN/cm}^2$$

• Kloba se lahko udanejo - plošča se porci na t20



Vij. PROTI RAZCEPU VLAKEN

VNOS SIL IZ ZAVETROVANJE

$$H_{ed} = 361.3 \text{ kN} = N_{ed} (\phi 36, 5315)$$

• nijaki diagonalne =

$$F_{y,ed}(h_{30,8}) = 215.4 \text{ kN}$$

$$2F_{y,ed} = 430.8 \text{ kN} > 361.3 \text{ kN} \checkmark$$

① IZBEREM 2H30,8

$$CLT \text{ SS} \rightarrow 3L+2T$$

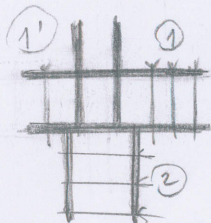
$$\alpha = \arctan \frac{3}{5} \approx 31^\circ$$

zajamen upliva L, T ulazben

• vnos sile u des =

$$H_{ed} = 361.3 \times \cos 39^\circ = 280.8 \text{ kN}$$

$$V_{ed} = 361.3 \times \sin 39^\circ = 227.4 \text{ kN}$$



$$\textcircled{1} F_{y,ed,tot}^H = 269.43 \text{ kN} (3 \times 6)$$

$$\textcircled{1'} F_{y,ed,tot}^H = 101.23 \text{ kN} (1 \times 6)$$

$$F_{y,ed,tot}^H = 370.66 \text{ kN} > 280.8 \text{ kN} \checkmark$$

4 vijake istosm zapretnu
ome sile u vnosi u stebu

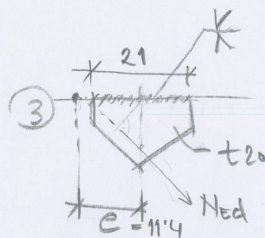
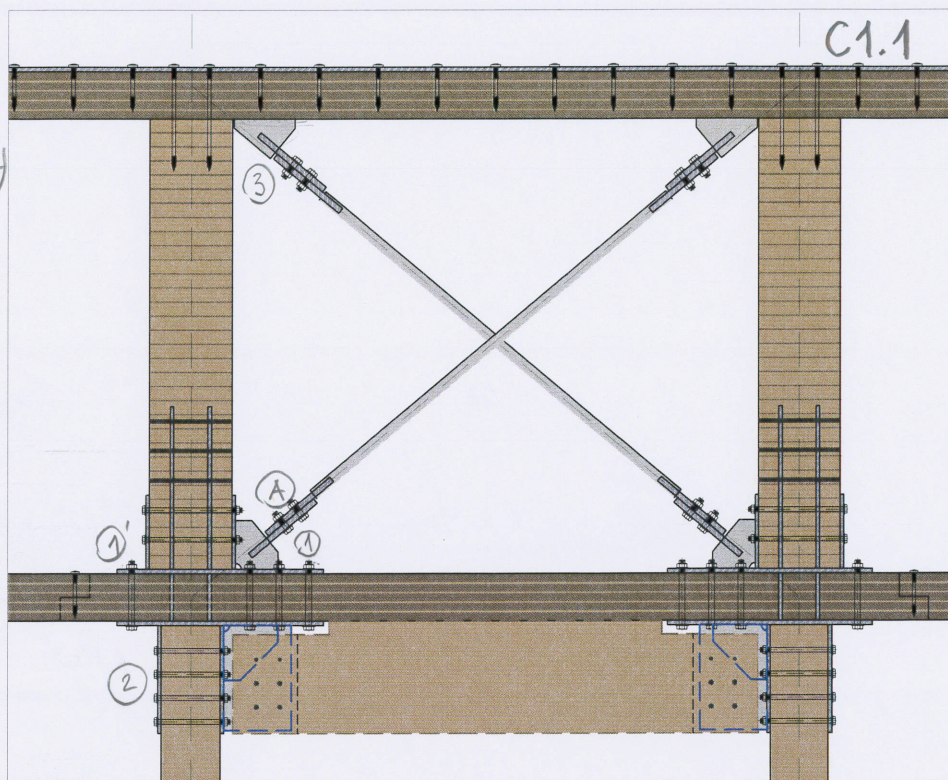
$$F_{y,ed,tot}^V = 370.66 - 4 \times 18.22 = 297.78 \text{ kN} > 280.8 \text{ kN} \checkmark$$

$$\text{prenos ome sile: } 4F_{t,ed} = 4 \times 90.4 = 361.6 \text{ kN} > 227.4 \text{ kN} \checkmark$$

① IZBEREM VIJAKE 3x6 + 1x6 M16,8.8

$$\textcircled{2} F_{y,ed,tot}^V = 298.52 \text{ kN} > 227.4 \text{ kN} \checkmark$$

IZBEREM VIJAKE 6x4 M16,5.6



$$W_{pl} = \frac{21^2 \times 1.5}{4} = 165.4 \text{ cm}^3$$

$$M = e \cdot V_{ed} = 11.4 \times 227.4$$

$$M = 2592.4 \text{ kN cm}$$

$$\sigma_{\perp} = \frac{2592.4}{165.4} + \frac{227.4}{21 \times 1.5} = 22.9 \text{ kN/cm}^2 < 35.5 \text{ kN/cm}^2$$

$$\sigma_{\parallel} = \frac{280.8}{21 \times 1.5} = 8.9 \text{ kN/cm}^2$$

$$V_{ed} = 280.8 < 0.5 V_{p,ed} = 0.5 \times 21.15 \times \frac{35.5}{\sqrt{3}} = 322.8 \text{ kN} \checkmark$$

interakcija M-V ni!

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	S355
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	510 MPa
γ_M	1.25
k_{mod}	1.10

$$\alpha = 31.0^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 26.174 \text{ MPa}$$

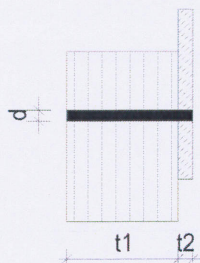
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 22.632 \text{ MPa}$$

$$k_{90} = 1.590$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} = 206730 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	160 mm
t_2	15 mm
d	16 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{l} 0.4 f_{h,k} t_1 d \quad (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} \quad (b) \end{array} \right. \quad (8.9)$$

$$23175.5 \text{ N}$$

$$14071.5 \text{ N}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{l} f_{h,k} t_1 d \quad (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} \quad (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} \quad (e) \end{array} \right. \quad (8.10)$$

$$57938.7 \text{ N}$$

$$25806.3 \text{ N}$$

$$19900.0 \text{ N}$$

OPOMBA: Potrebna je interpolacija med tenko in debelo priključno pločevino

$$F_{v,Rk} = 19171.5 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 16.87 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	78 mm	... medsebojni razmak v smeri vlaken
a_2	64 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	112 mm	... obremenjeni konec
$a_{3,c}$	50 mm	... neobremenjeni konec
$a_{4,t}$	48 mm	... obremenjeni rob
$a_{4,c}$	48 mm	... neobremenjeni rob
a_l	200 mm	
m	6	... število vrst vijakov
n	3	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \begin{array}{l} n \\ n^{0.9} \sqrt{\frac{a_1}{13d}} \end{array} \right. = 2.662$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 269.43 \text{ kN}$$

$$F_{v,Rd,eff} = 14.97 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	S355
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	510 MPa
γ_M	1.25
k_{mod}	1.10

$$\alpha = 31.0^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 26.174 \text{ MPa}$$

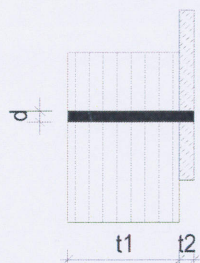
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 22.632 \text{ MPa}$$

$$k_{90} = 1.590$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} = 206730 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	160 mm
t_2	15 mm
d	16 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{l} 0.4 f_{h,k} t_1 d \quad (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} \quad (b) \end{array} \right. \quad (8.9)$$

Debela priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{l} f_{h,k} t_1 d \quad (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} \quad (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} \quad (e) \end{array} \right. \quad (8.10)$$

OPOMBA: Potrebna je interpolacija med tenko in debelo priključno pločevino

$$F_{v,Rk} = 19171.5 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 16.87 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	78 mm	... medsebojni razmak v smeri vlaken
a_2	64 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	112 mm	... obremenjeni konec
$a_{3,c}$	50 mm	... neobremenjeni konec
$a_{4,t}$	48 mm	... obremenjeni rob
$a_{4,c}$	48 mm	... neobremenjeni rob
a_l	200 mm	
m	6	... število vrst vijakov
n	1	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \begin{array}{l} n \\ n^{0.9} \sqrt{\frac{a_1}{13d}} \end{array} \right. = 1.000$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 101.23 \text{ kN}$$

$$F_{v,Rd,eff} = 16.87 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	S355
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	=	24 MPa
ρ_k	=	380 kg/m ³
$f_{u,k}$	=	510 MPa
γ_M	=	1.25
k_{mod}	=	1.10

$$\alpha = 0.0^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 26.174 \text{ MPa}$$

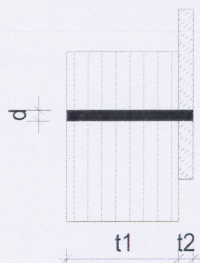
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 26.174 \text{ MPa}$$

$$k_{90} = 1.590$$

$$M_{y,Rk} = 0.3 f_{uk} d^{2.6} = 206730 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	200 mm
t_2	15 mm
d	16 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (b) \end{cases} \quad (8.9)$$

$$33503.2 \text{ N}$$

$$15132.6 \text{ N}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (e) \end{cases} \quad (8.10)$$

$$83758.1 \text{ N}$$

$$36146.6 \text{ N}$$

$$21400.7 \text{ N}$$

OPOMBA: Potrebna je interpolacija med tenko in debelo priključno pločevino

$$F_{v,Rk} = 20617.2 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 18.14 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	=	80 mm	... medsebojni razmak v smeri vlaken
a_2	=	64 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	=	112 mm	... obremenjeni konec
$a_{3,c}$	=	64 mm	... neobremenjeni konec
$a_{4,t}$	=	48 mm	... obremenjeni rob
$a_{4,c}$	=	48 mm	... neobremenjeni rob
a_l	=	80 mm	
m	=	6	... število vrst vijakov
n	=	4	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ n, n^{0.9} \sqrt{\frac{a_1}{13d}} \right\} = 2.742$$

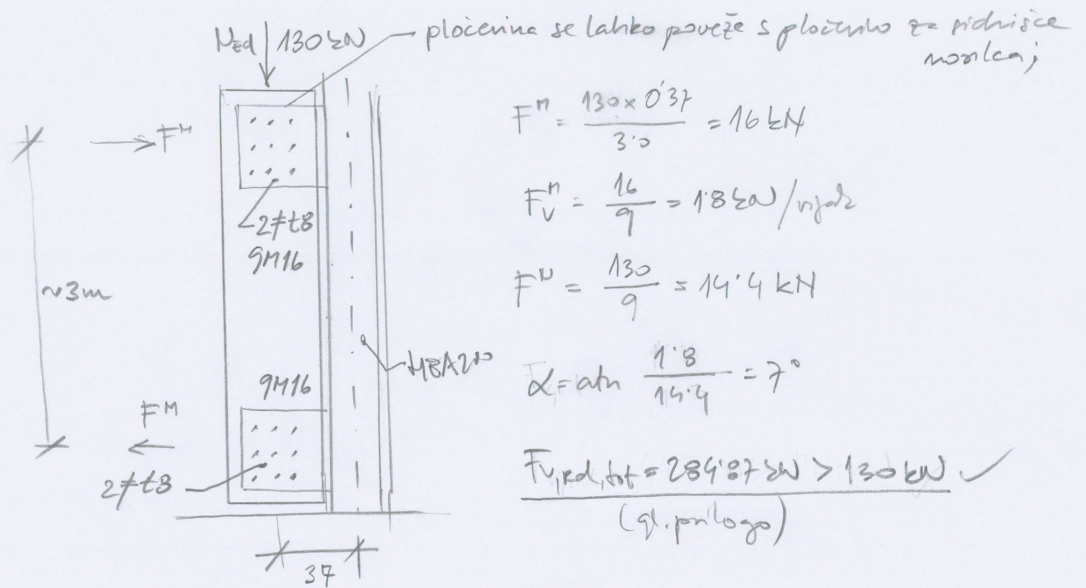
Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 298.52 \text{ kN}$$

$$F_{v,Rd,eff} = 12.44 \text{ kN}$$

PRIKLJUČEK STREBA V OŠI G/13 NA FASADNI NOSTILEC (DET G2)

1



$$F_H = \frac{130 \times 0.37}{3.0} = 16 \text{ kN}$$

$$F_V = \frac{16}{9} = 1.8 \text{ kN/m}^2$$

$$F_V = \frac{130}{9} = 14.4 \text{ kN}$$

$$\alpha = \arctan \frac{1.8}{14.4} = 7^\circ$$

$$F_{y,rd,tot} = 284.87 \text{ kN} > 130 \text{ kN} \quad \checkmark$$

(gl. priloga)

* kontrola pločnine *

$$e \approx 37 \text{ cm}$$

$$M_{ed} = 130 \times 37 = 4810 \text{ kNm}$$

$$W_{pl} = \frac{30^2 \times 0.8}{4} \times 2 = 360 \text{ cm}^3$$

$$f_{pl} = \frac{4810}{360} = 13.36 \text{ kN/cm}^2 < 35.52 \text{ kN/cm}^2 \quad \checkmark$$

VIAČENA/MOZNIČENA ŠTIRISTRIŽNA ZVEZA LES-JEKLO-LES-JEKLO-LES (SIST EN 1995-1-1: 2005)
MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	S355
Razred trajanja obt.	Kratkotr.
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	510 MPa
γ_M	1.25
k_{mod}	0.90

$$\alpha = 7.0^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

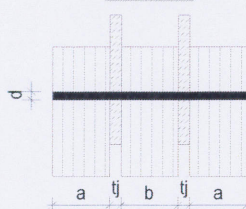
$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 26.174 \text{ MPa}$$

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 25.947 \text{ MPa}$$

$$M_{y,Rk} = 0.3 f_{uk} d^{2.6} = 206730 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

a	55 mm
b	74 mm
t _j	8 mm
d	16 mm



$$k_{90} = 1.590$$

A Zveza les (a) - jeklo - les(b) / strižna ravnina preko (a) ... t₁=a

$$F_{v,Rk} = \min \left\{ \begin{array}{l} f_{h,1,k} t_1 d \quad (f) \quad 22833.4 \text{ N} \\ f_{h,1,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,1,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} \quad (g) \quad 14396.0 \text{ N} \\ 2.3 \sqrt{M_{y,Rk} f_{h,1,k}} d + \frac{F_{ax,Rk}}{4} \quad (h) \quad 21307.5 \text{ N} \end{array} \right. \quad (8.11)$$

B Zveza les (a) - jeklo - les(b) / strižna ravnina preko (b) ... t₁=b

$$F_{v,Rk} = \min \left\{ \begin{array}{l} f_{h,1,k} t_1 d \quad (f) \quad 30721.3 \text{ N} \\ f_{h,1,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,1,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} \quad (g) \quad 16511.0 \text{ N} \\ 2.3 \sqrt{M_{y,Rk} f_{h,1,k}} d + \frac{F_{ax,Rk}}{4} \quad (h) \quad 21307.5 \text{ N} \end{array} \right. \quad (8.11)$$

C Zveza jeklo - les(b) - jeklo ... t₂=b

Tanka priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{l} 0.5 f_{h,2,k} t_2 d \quad (j) \quad 15360.6 \text{ N} \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,2,k}} d + \frac{F_{ax,Rk}}{4} \quad (k) \quad 15066.7 \text{ N} \end{array} \right. \quad (8.12)$$

Debela priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{l} 0.5 f_{h,2,k} t_2 d \quad (l) \quad -/- \\ 2.3 \sqrt{M_{y,Rk} f_{h,2,k}} d + \frac{F_{ax,Rk}}{4} \quad (m) \quad -/- \end{array} \right. \quad (8.13)$$

$$F_{v,Rk} = 2 \times F_{v,Rk,min}^A + 2 \times \min(F_{v,Rk,min}^B, F_{v,Rk,min}^C) = 58925.4 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 42.43 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

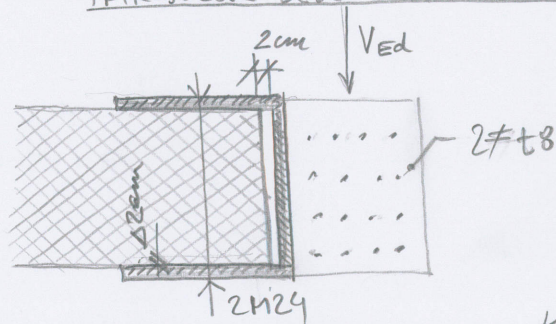
a_1	80 mm	... medsebojni razmak v smeri vlaken
a_2	64 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	112 mm	... obremenjeni konec
$a_{3,c}$	64 mm	... neobremenjeni konec
$a_{4,t}$	48 mm	... obremenjeni rob
$a_{4,c}$	48 mm	... neobremenjeni rob
a_l	100 mm	
m	3	... število vrst vijakov
n	3	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \begin{array}{l} n \\ n^{0.9} \sqrt{\frac{a_1}{13d}} \end{array} \right. = 2.238$$

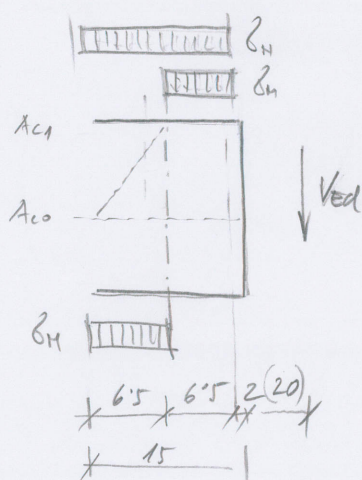
Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 284.87 \text{ kN}$$

PRIKLJUČEK LESENEGA PREDTAINEGA NOSILCA NA AB JEDRO



$$V_{Ed} = -154.3 / +124.5 \text{ kN}$$



KONTAKTNE NAPETOSTI V BETONU

$$c_v = 6.5 + 2 + 20 = 28.5 \text{ cm}$$

$$M_{Ed} = 154.3 \times 28.5 = 4397.6 \text{ kNm}$$

$$A_{co} = (6.5 + 1 \times 10) (30 + 2 \times 10) = 825 \text{ cm}^2$$

$$A_{ci} = 6.5 \times 30 = 195 \text{ cm}^2$$

$$F_M = \frac{M_{Ed}}{c_M} = \frac{4397.6}{6.5} = 676.6 \text{ kN}$$

$$F_{Edn} = A_{co} f_{cd} \sqrt{\frac{A_{ci}}{A_{co}}} = 825 \times 2.0 \sqrt{\frac{195}{825}} = 3393.8 \text{ kN}$$

$$f_{cd} = \frac{30}{1.5} = 20 \text{ MPa} = 2.020 \text{ kN/cm}^2$$

$$< 3 f_{cd} A_{co}$$

$$= 3 \times 2.0 \times 825$$

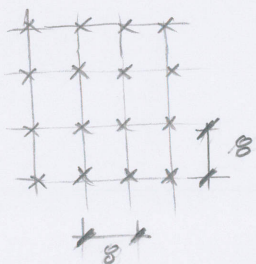
$$= 4950 \text{ kN} \checkmark$$

$$\rightarrow f_{rdn} = f_{cd} \sqrt{\frac{A_{ci}}{A_{co}}} = 4.11 \text{ kN/cm}^2$$

$$f_{Ed, M+V} = \frac{676.6}{825} + \frac{154.3}{(15+10)(30+2 \times 10)} = 0.94 \text{ kN/cm}^2$$

$$< 4.11 \text{ kN/cm}^2 \checkmark$$

KONTROLA LESENEGA ŠTIKA



$$M_{Ed} = 4397.6 \text{ kNm}$$

$$F_M = \frac{4397.6}{16} = 274.9 \text{ kN}$$

$$F_{v, M} = \frac{274.9}{8} = 34.36 \text{ kN}$$

$$F_{v, V} = \frac{154.3}{16} = 9.64 \text{ kN}$$

$$F_v = \sqrt{34.36^2 + 9.64^2} = 35.7 \text{ kN}$$

$$\alpha = \arctan \frac{9.64}{34.36} = 15.7^\circ \rightarrow F_{v, Ed} = 43.82 \text{ kN} > 35.7 \text{ kN} \checkmark$$

(priloga)

VIJAČENA/MOZNIČENA ŠTIRISTRIŽNA ZVEZA LES-JEKLO-LES-JEKLO-LES (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL28c
Jeklo veznega sr.	S355
Razred trajanja obt.	Kratkotr.
Razred uporabe	1

$f_{m,k}$	28 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	510 MPa
γ_M	1.25
k_{mod}	0.90

$$\alpha = 15.7^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

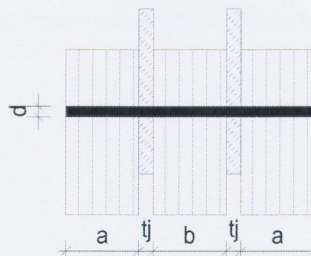
$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 26.174 \text{ MPa}$$

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 25.090 \text{ MPa}$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} = 206730 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

a	70 mm
b	110 mm
t_j	8 mm
d	16 mm



$$k_{90} = 1.590$$

A Zveza les (a) - jeklo - les(b) / strižna ravnina preko (a) ... $t_1=a$

$$F_{v,Rk} = \min \begin{cases} f_{h,1,k} t_1 d & (f) & 28101.3 \text{ N} \\ f_{h,1,k} t_1 d \left[\sqrt{2 + \frac{4M_{y,Rk}}{f_{h,1,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (g) & 15617.5 \text{ N} \\ 2.3 \sqrt{M_{y,Rk} f_{h,1,k} d} + \frac{F_{ax,Rk}}{4} & (h) & 20952.9 \text{ N} \end{cases} \quad (8.11)$$

B Zveza les (a) - jeklo - les(b) / strižna ravnina preko (b) ... $t_1=b$

$$F_{v,Rk} = \min \begin{cases} f_{h,1,k} t_1 d & (f) & 44159.2 \text{ N} \\ f_{h,1,k} t_1 d \left[\sqrt{2 + \frac{4M_{y,Rk}}{f_{h,1,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (g) & 20894.9 \text{ N} \\ 2.3 \sqrt{M_{y,Rk} f_{h,1,k} d} + \frac{F_{ax,Rk}}{4} & (h) & 20952.9 \text{ N} \end{cases} \quad (8.11)$$

C Zveza jeklo - les(b) - jeklo ... $t_2=b$

Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.5 f_{h,2,k} t_2 d & (j) & 22079.6 \text{ N} \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,2,k} d} + \frac{F_{ax,Rk}}{4} & (k) & 14815.9 \text{ N} \end{cases} \quad (8.12)$$

Debela priključna pločevina

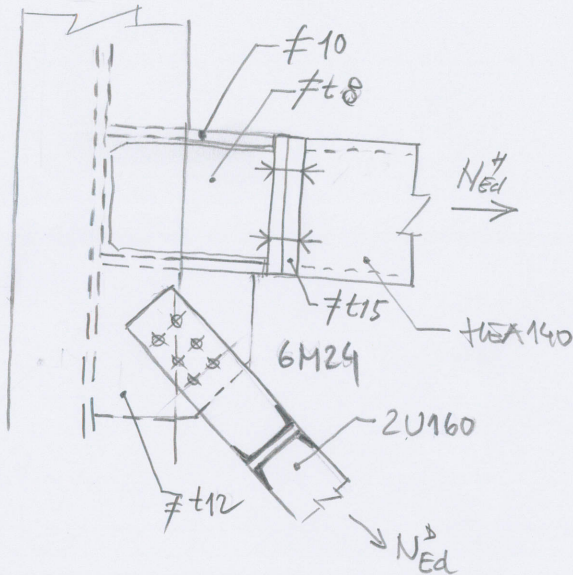
$$F_{v,Rk} = \min \begin{cases} 0.5 f_{h,2,k} t_2 d & (l) & -/ \\ 2.3 \sqrt{M_{y,Rk} f_{h,2,k} d} + \frac{F_{ax,Rk}}{4} & (m) & -/ \end{cases} \quad (8.13)$$

$$F_{v,Rk} = 2 \times F_{v,Rk,min}^A + 2 \times \min(F_{v,Rk,min}^B, F_{v,Rk,min}^C) = 60866.8 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 43.82 \text{ kN}$$

• PRIKLJUČEK ZAVETROVANJA



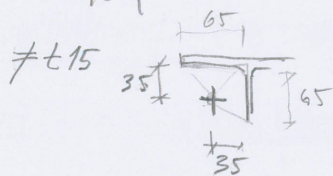
$$N_{Ed}^H = 231.3 \text{ kN}$$

$$N_{Ed}^D = 692.6 \text{ kN}$$

• priključek horizontala =

$$F_{t,rd}(M16, 8.8) = 90.4$$

$$n = \frac{231.3}{90.4} = 2.56 \rightarrow 4 \text{ kos}$$



$$W_{1,pl} = \frac{6.5 \times 1.5^2}{4} = 3.65 \text{ cm}^3$$

$$M_{1,pl} = 3.65 \text{ cm}^3 \times 35.5 \text{ kN/cm}^2 = 129.6 \text{ kNcm}$$

$$F_{1,pl} = \frac{129.6}{3.5} = 37 \text{ kN}$$

$$F_{tot} = 2 \times F_{1,pl} = 74.06 \text{ kN}$$

nosilnost škrta glede na ploščino

$$N_{Ed,pl} = 74.06 \times 4 = 296.2 \text{ kN} > 231.3 \text{ kN}$$

IZBEREM 4 M16(8.8), $\neq t15 \text{ mm}$ (čelna pl.)
 $\neq t8 \text{ mm}$ (rebra)

• priključek diagonale

$$F_{t,rd}(M20, 8.8) = 135.6 \text{ kN}$$

$$n = \frac{692.6}{135.6} = 5.1 \rightarrow 6 \text{ kos}$$

$$\frac{b}{\sqrt{12}} 40 = \frac{6.5}{\sqrt{12}} 40 = 750 \text{ mm}$$

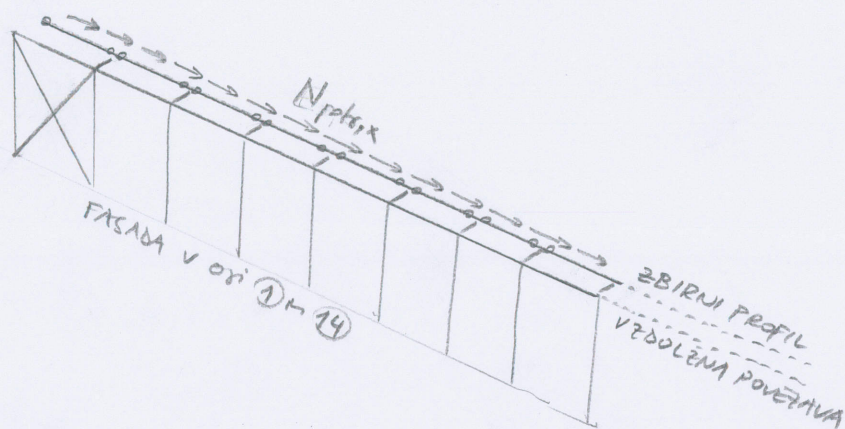
pozitaven profil 2M20/60 cm

IZBEREM 6 M20(8.8), $\neq t12$ (pričlj. pl.)

$$F_{b,rd}(e_1/d_0=2, p_1/d_0=2.5) = 59.5 \times 1.2 \times 24 = 171.6 \text{ kN} > 135.6 \text{ kN} \checkmark$$

$$F_{b,rd}(\text{dvoje U160, 2-stično}) = 68 \times 0.75 \times 2.0 \times 2 = 204.0 > 135.6 \text{ kN} \checkmark$$

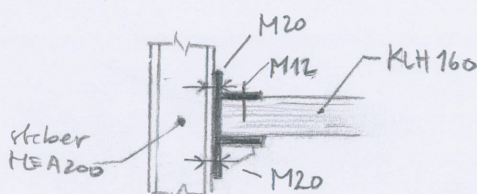
$$A_{net} = 24 \text{ cm}^2 + 2 \times 0.75 \times 2.7 = 20.0 \text{ cm}^2 \rightarrow F_{t,rd} = 20.0 \times 35.5 = 710 \text{ kN} (\times 2) \checkmark$$



Potr. reakcija (vsota projekcij sil v zavetrovanjih)

$$N_{ptr,x} = 1012 \text{ kN}$$

• ZBIRNI PROFIL:



$$N_{zb,1} = \frac{1012 \text{ kN}}{19 \text{ steb.}} = 53.3 \text{ kN} \rightarrow \text{izberem } 2 \text{ M20, } 8'8. \quad (F_{n,red} = 2 \times 120.6 = 241.2 \text{ kN})$$

$$A_{ptr} = \frac{1012 \text{ kN} \cdot \text{cm}^2}{35.5 \text{ kN}} = 28.5 \text{ cm}^2$$

• strizna močnost lesnega vijaka:

$$F_{ykd} = 9.64 \text{ kN (gl. priloge)}$$

$$N'_{ed} = 1012 \text{ kN} / 50.0 \text{ m} = 20.2 \text{ kN/m}$$

$$s = \frac{9.64}{20.2} = 0.47 \rightarrow 1 \text{ kos / } 30 \text{ cm}$$

$$1 \text{ profil} - 240 \text{ cm} \rightarrow \frac{240}{30} = 8 \text{ kos / profil}$$

$$n_{ef} = \min \left\{ \frac{n}{n^{0.9} \sqrt{\frac{a_1}{13d}}} \right\} = \min \left\{ 8; 8^{0.9} \sqrt{\frac{300}{13 \cdot 8}} \right\} = 8$$

$$F_{ykd,tot} = 9.64 \times 8 = 77.1 \text{ kN} > N_{ed} = 20.2 \text{ kN/m} \times 2.4 \text{ m} = 48.5 \text{ kN} \checkmark$$

IZBEREM LESNE VIJAKE M12, vezni del 120mm, raster 25cm

→ gl. prečnik za vnos hor. sil v robne profile!!

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL28h
Jeklo veznega sr.	S355
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	28 MPa
ρ_k	410 kg/m ³
$f_{u,k}$	510 MPa
γ_M	1.25
k_{mod}	1.10

$\alpha = 90.0^\circ$... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 29.586 \text{ MPa}$$

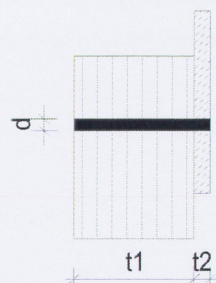
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 19.337 \text{ MPa}$$

$$k_{90} = 1.530$$

$$M_{y,Rk} = 0.3 f_{uk} d^{2.6} = 97850 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	120 mm
t_2	12 mm
d	12 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{ll} 0.4 f_{h,k} t_1 d & \text{(a)} \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k} d} + \frac{F_{ax,Rk}}{4} & \text{(b)} \end{array} \right. \quad (8.9) \quad \begin{array}{l} -/- \\ -/- \end{array}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{ll} f_{h,k} t_1 d & \text{(c)} \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & \text{(d)} \\ 2.3 \sqrt{M_{y,Rk} f_{h,k} d} + \frac{F_{ax,Rk}}{4} & \text{(e) } \boxed{A_1} \end{array} \right. \quad (8.10) \quad \begin{array}{l} 27845.3 \text{ N} \\ 12670.7 \text{ N} \\ 10959.6 \text{ N} \end{array}$$

$$F_{v,Rk} = 10959.6 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 9.64 \text{ kN}$$

• UZDOLŽNA POVEZAVA

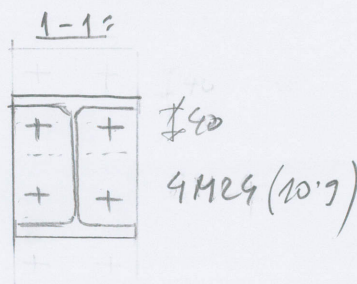
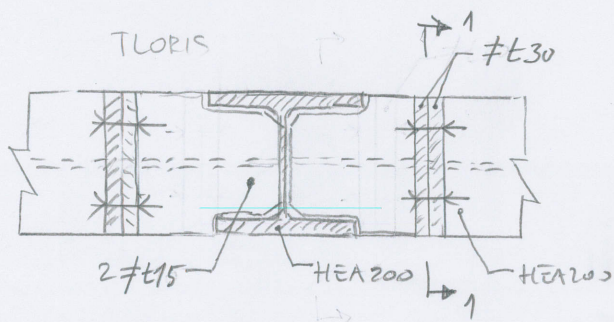
→ izberem HEA200

$$\lambda_1 = 76.4 \text{ (5555)}$$

$$\lambda = \frac{l_n}{i} = \frac{240}{4.98} = 48.2$$

$$\bar{\lambda} = \frac{48.2}{76.4} = 0.63 \rightarrow \chi^2 = 0.87$$

$$N_{ed} = 1350 \text{ kN} < 0.87 \times 53.8 \text{ cm}^2 \times 35.5 \text{ N/cm}^2 / 1.0 = 1661.6 \text{ kN} \checkmark$$



IZBEREM 4M24, 8.8

$$F_{t,ed} = 2542 \times 4 = 10168 \text{ N} > 1012 \text{ kN} \checkmark$$

• kontrola pločevine

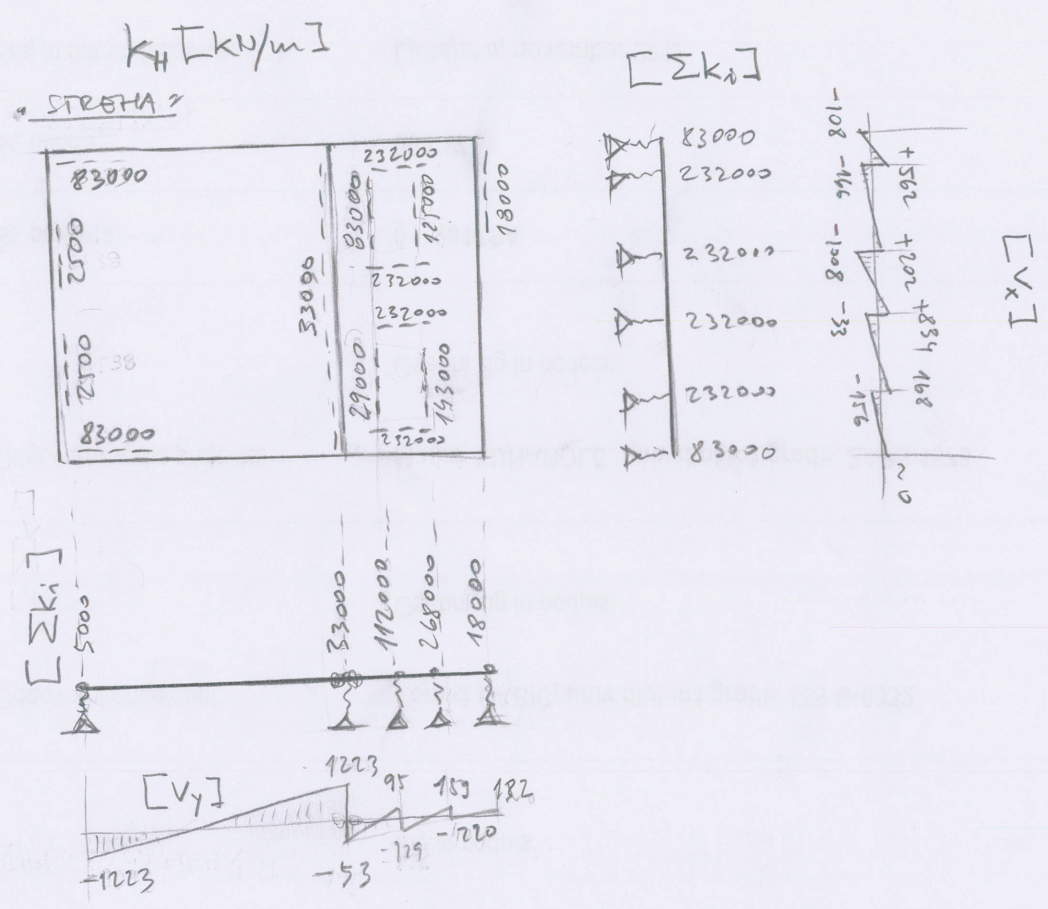
$$M = 2.56 \times 2542 = 6508 \text{ kNcm}$$

$$e = 4.0 - 0.8 \times 1.8 = 2.56$$

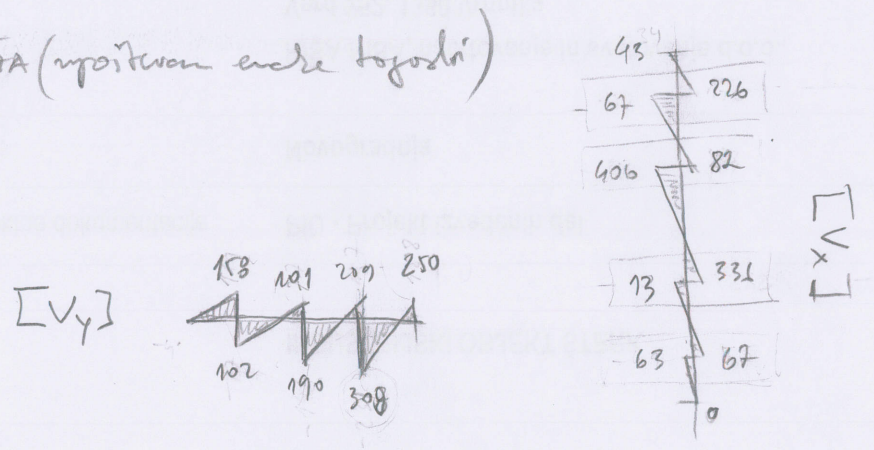
$$W_{pl} = \frac{3^2 \times 20 / 2}{4} = 22.5 \text{ cm}^3$$

$$f_{ed} = \frac{6508}{22.5} = 28.9 < 35.5 \text{ N/cm}^2 \checkmark$$

• TOČNOŠĆI VERTIKALNIH ELEMENTOV



• ETAŽA (npoštovan endre togoštri)



VNOS HOR. SIL V POBNE PROFILE MEDETAZE =

• MEDETAZA =

• OS G

$$F_{y,ed} = 250 \text{ kN} \rightarrow \text{sko preizanje le z relevantno ploščami} \rightarrow \frac{250}{6_{205}} = 417 \text{ kN}$$

$$\text{zveza J-L} \rightarrow F_{y,ed} = 63 \cdot 11 \text{ kN} > 417 \text{ kN} \checkmark$$

IZBEREM M12/300mm

npr. Fischer Power-Tact F+F-HT 12,0 x 140 ZP 25

• OS 1 in 14 =

$$F_{x,ed} = 108 \text{ kN}$$

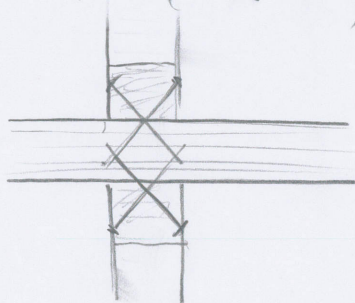
$$\text{zveza J-L} \rightarrow F_{y,ed} = 221 \cdot 43 \text{ kN} > 108 \text{ kN} \checkmark$$

IZBEREM M12/500mm

npr. Fischer Power-Tact FPF-HT 12,0 x 140 ZPP 25

• OS C =

$$F_{y,ed} = 158 \text{ kN} + 1275 \text{ kN} (12 \text{ zg. delov}) = 1275 \text{ kN}$$



nila je zveza poravnana - računam na m!
širina dolžine 27 m panelov

$$F_{y,ed}^1 = \frac{1275}{27} = 47,2 \text{ kN} < 72,84 \text{ kN}$$

IZBEREM zg in sp KRIŽNO POSTAVLJENE VIJAKE

M10, L350/250mm

$\alpha_x/\alpha_y = 45^\circ/45^\circ$

npr. Fischer Power-Full FPF-2T 10x300

$$\text{gl. tudi Dientankage hor. preizanje (Lut 3)} \quad F_{y,ed} = 68,3 \text{ kN} < 72,84 \text{ kN} \checkmark$$

tu je zagotovljen tudi vpliv točkastih koncentracij, zato $> 47,2 \text{ kN}$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	S355
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	490 MPa
γ_M	1.25
k_{mod}	1.10

$$\alpha = 31.0^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 27.421 \text{ MPa}$$

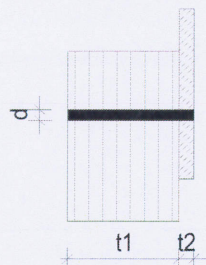
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 24.041 \text{ MPa}$$

$$k_{90} = 1.530$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 57559 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	120 mm
t_2	15 mm
d	12 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (b) \end{cases} \quad (8.9) \quad \begin{matrix} -/- \\ -/- \end{matrix}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (e) \end{cases} \quad (8.10) \quad \begin{matrix} 34618.9 \text{ N} \\ 15013.3 \text{ N} \\ 9372.4 \text{ N} \end{matrix}$$

$$F_{v,Rk} = 9372.4 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 8.25 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	58 mm	... medsebojni razmak v smeri vlaken
a_2	48 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	84 mm	... obremenjeni konec
$a_{3,c}$	38 mm	... neobremenjeni konec
$a_{4,t}$	36 mm	... obremenjeni rob
$a_{4,c}$	36 mm	... neobremenjeni rob
a_l	300 mm	
m	1	... število vrst vijakov
n	8	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ n, n^{0.9} \sqrt{\frac{a_1}{13d}} \right\} = 7.652$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 63.11 \text{ kN}$$

$$F_{v,Rd,eff} = 7.89 \text{ kN}$$

STRIŽNA NOSILNOST KRIŽNE ZVEZE "X" ZA LESNE VIJAKE (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les (1)	GL24h
Les (2)	GL24h
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

GEOMETRIJSKI PODATKI

l_{ef}	150 mm
t_2	160 mm
d	10 mm
n	4 št. vijakov
vijaki z navojem po celi dolžini	

	(1)	(2)
$f_{m,k}$	24	24 MPa
ρ_k	380	380 kg/m ³
$f_{u,k}$	360 MPa	
γ_M	1.25	
k_{mod}	1.10	
$f_{c,90,k(2)}$		2.7 MPa
	(1)	(2)
α	45.0	45.0 ° ... smer obtežbe glede na smer vlaken

$$f_{\alpha\alpha,k} = 0.52d^{-0.5} \times l_{ef}^{-0.1} \times \rho_k^{0.8} \quad \begin{matrix} (1) & (2) \\ =11.540 & =11.540 \text{ MPa} \end{matrix}$$

Izvlačna nosilnost za 1 vijak (navoj po celi dolžini vijaka)

$$F_{ax,\alpha,Rk} = \min \left\{ \frac{f_{\alpha\alpha,k} \times d \times l_{ef,1}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{1,k}}{350} \right)^{0.8}; \frac{f_{\alpha\alpha,k} \times d \times l_{ef,2}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{2,k}}{350} \right)^{0.8}; f_{tens,k} \right\} = 16.807 \text{ kN}$$

Tlačna nosilnost za 1 vijak (navoj po celi dolžini vijaka)

$$F_{ax,\alpha,Rk} = \min \left\{ \frac{f_{\alpha\alpha,k} \times d \times l_{ef,1}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{1,k}}{350} \right)^{0.8}; \frac{f_{\alpha\alpha,k} \times d \times l_{ef,2}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{2,k}}{350} \right)^{0.8}; F_{ki,Rk} \right\} = 16.807 \text{ kN}$$

Skupna strižna nosilnost za 2 ravlini vijakov postavljenih križno

skupaj vijakov 8

n_{ef}	=3.482
$F_{v,Rd,tot}$	=72.84 kN

• STREHA :

• OS A :

$$F_{y,red} = 1275 \text{ kN} \rightarrow \text{najstvarna višina dolžina } \frac{50 \text{ m}}{2} = 25 \text{ m, kar pomeni 2 zavezovalni}$$

$$F'_{y,red} = \frac{1275}{48 \text{ m}} = 26.7 \text{ kN/m} \rightarrow \text{računamo na } L_{max} = 5.5 \text{ m} \rightarrow 26.7 \times 5.5 = 146.85 \text{ kN}$$

$$F_{y,red} = 148.65 \text{ kN} > 146.85 \text{ kN} \checkmark$$

IZBEREM VIJAKE M12/200 mm

upr. Fischer Power-Fast FPF-HT 12,0 x 120 ZPP 25

• OS C :

$$F_{y,red} = 1400 \text{ kN} \rightarrow \text{vila upoštevam it projekciji 67 zavezovalni } 5 \times 280 \text{ kN}$$

$$\rightarrow \text{najstvarna višina dolžina } 765 \text{ cm} \times 5 \text{ zavezovalni}$$

$$F'_{y,red} = \frac{1400}{5} = 280 \text{ kN} \rightarrow F_{y,red} = 294.30 \text{ kN} > 280 \text{ kN} \checkmark$$

IZBEREM VIJAKE M12/120 mm

upr. Fischer Power-Fast FPF-HT 12,0 x 140 ZPP 25

• OS 1 in 14 :

$$F_{x,red} = 1012 \text{ kN} \rightarrow \text{gl. prečka se prenos na 14 v. z.}$$

$$L = 36 + 12 \text{ m} = 48 \text{ m}$$

višina stropa je nižja panela 240 cm

$$F'_{x,red} = \frac{1012 \times 2.4}{48} = 50.6 \text{ kN} \rightarrow F_{x,red} = 60.50 \text{ kN}$$

IZBEREM VIJAKE M12/250 mm

upr. Fischer Power-Fast FPF-HT 12,0 x 140 ZPP 25

• OS G :

$$F_{x,red} = 182 \text{ kN}$$

$$F_{x,red} = \frac{182}{48} \times 5.5 = 20.9 \text{ kN} < 100.28 \text{ kN}$$

IZBEREM VIJAKE M12/300 mm

upr. Fischer Power-Fast FPF-HT 12,0 x 140 ZPP 25

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	S355
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	490 MPa
γ_M	1.25
k_{mod}	1.10

$\alpha = 31.0^\circ$... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 27.421 \text{ MPa}$$

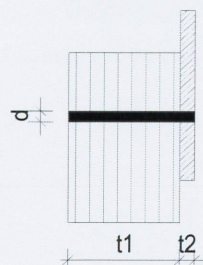
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 24.041 \text{ MPa}$$

$$k_{90} = 1.530$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz.} \quad M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 57559 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	120 mm
t_2	10 mm
d	12 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (b) \end{cases} \quad (8.9)$$

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (e) \end{cases} \quad (8.10)$$

OPOMBA: Potrebna je interpolacija med tenko in debelo priključno pločevino

$$F_{v,Rk} = 8457.4 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 7.44 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	58 mm	... medsebojni razmak v smeri vlaken
a_2	48 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	84 mm	... obremenjeni konec
$a_{3,c}$	38 mm	... neobremenjeni konec
$a_{4,t}$	36 mm	... obremenjeni rob
$a_{4,c}$	36 mm	... neobremenjeni rob
a_l	200 mm	
m	1	... število vrst vijakov
n	26	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ n, n^{0.9} \sqrt{\frac{a_1}{13d}} \right\} = 19.973$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 148.65 \text{ kN}$$

$$F_{v,Rd,eff} = 5.72 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	S355
Razred trajanja obt.	Trenutna
Razred uporabe	1

GEOMETRIJSKI PODATKI

t_1	120 mm
t_2	10 mm
d	12 mm

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	490 MPa
γ_M	1.25
k_{mod}	1.10

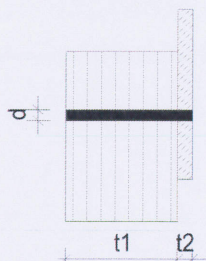
$$\alpha = 31.0^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 27.421 \text{ MPa}$$

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 24.041 \text{ MPa}$$

$$k_{90} = 1.530$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 57559 \text{ Nmm}$$



→ vpliv lamel L-T

Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (b) \end{cases} \quad (8.9)$$

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (e) \end{cases} \quad (8.10)$$

OPOMBA: Potrebna je interpolacija med tenko in debelo priključno pločevino

$$F_{v,Rk} = 8457.4 \text{ N}$$

Računska strižna nosilnost zveze

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$a_{3,t}$	84 mm	... obremenjeni konec
$a_{3,c}$	38 mm	... neobremenjeni konec
$a_{4,t}$	36 mm	... obremenjeni rob
$a_{4,c}$	36 mm	... neobremenjeni rob
a_l	120 mm	
m	1	... število vrst vijakov
n	64	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \frac{n}{n^{0.94} \sqrt{\frac{a_1}{13d}}} \right\} = 39.544$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 294.30 \text{ kN}$$

$$F_{v,Rd,eff} = 4.60 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

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Jeklo veznega sr.	S355
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$f_{u,k}$	490 MPa
γ_M	1.25
k_{mod}	1.10

$$\alpha = 31.0^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 27.421 \text{ MPa}$$

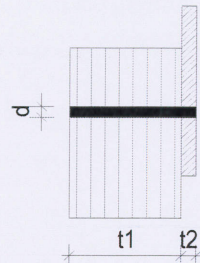
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 24.041 \text{ MPa}$$

$$k_{90} = 1.530$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 57559 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	120 mm
t_2	10 mm
d	12 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & \text{(a)} \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k} d} + \frac{F_{ax,Rk}}{4} & \text{(b)} \end{cases} \quad (8.9)$$

13847.6 N
6627.3 N

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & \text{(c)} \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & \text{(d)} \\ 2.3 \sqrt{M_{y,Rk} f_{h,k} d} + \frac{F_{ax,Rk}}{4} & \text{(e) } \langle A_1 \rangle \end{cases} \quad (8.10)$$

34618.9 N
15013.3 N
9372.4 N

OPOMBA: Potrebna je interpolacija med tenko in debelo priključno pločevino

$$F_{v,Rk} = 8457.4 \text{ N}$$

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$a_{3,t}$	84 mm	... obremenjeni konec
$a_{3,c}$	38 mm	... neobremenjeni konec
$a_{4,t}$	36 mm	... obremenjeni rob
$a_{4,c}$	36 mm	... neobremenjeni rob
a_l	250 mm	
m	1	... število vrst vijakov
n	9	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \begin{matrix} n \\ n^{0.9} \sqrt{\frac{a_1}{13d}} \end{matrix} \right\} = 8.129$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 60.50 \text{ kN}$$

$$F_{v,Rd,eff} = 6.72 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	S355
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γ_M	1.25
k_{mod}	1.10

$\alpha = 31.0^\circ$... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 27.421 \text{ MPa}$$

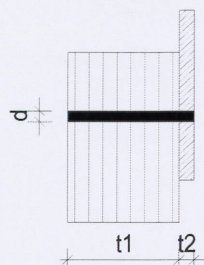
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 24.041 \text{ MPa}$$

$$k_{90} = 1.530$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz.} \quad M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 57559 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	120 mm
t_2	10 mm
d	12 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & \text{(a)} \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & \text{(b)} \end{cases} \quad (8.9)$$

13847.6 N
6627.3 N

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & \text{(c)} \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & \text{(d)} \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & \text{(e) (A1)} \end{cases} \quad (8.10)$$

34618.9 N
15013.3 N
9372.4 N

OPOMBA: Potrebna je interpolacija med tenko in debelo priključno pločevino

$$F_{v,Rk} = 8457.4 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 7.44 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	58 mm	... medsebojni razmak v smeri vlaken
a_2	48 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	84 mm	... obremenjeni konec
$a_{3,c}$	38 mm	... neobremenjeni konec
$a_{4,t}$	36 mm	... obremenjeni rob
$a_{4,c}$	36 mm	... neobremenjeni rob
a_l	300 mm	
m	1	... število vrst vijakov
n	15	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ n, n^{0.9} \sqrt{\frac{a_1}{13d}} \right\} = 13.474$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 100.28 \text{ kN}$$

$$F_{v,Rd,eff} = 6.69 \text{ kN}$$

VNOS HOR. SIL V JEDRA MEDETAZE IN POVEZOVANE PROFILE

Smer X =

$$\begin{aligned} H_{x,ed}^{os1} &= 226 + 67 = 293 \text{ kN} && \text{12BEREN 1xM24(8'8)/300mm} \\ H_{x,ed}^{os10} &= 406 + 82 = 488 \text{ kN} \rightarrow F_{y,ed} = 536'23 \text{ kN} && \text{12BEREN 2xM24(8'8)/400mm} \\ \rightarrow H_{x,ed}^{os2+} &= 331 + 13 = 344 \text{ kN} \rightarrow F_{y,ed} = 371'35 \text{ kN} && \text{12BEREN 1xM24(8'8)/300mm} \\ H_{x,ed}^{os2} &= 67 + 63 = 130 \text{ kN} \rightarrow F_{y,ed} = 294'79 \text{ kN} && \text{12BEREN 1xM24(8'8)/400mm} \end{aligned}$$

Smer Y =

J-AB

$$H_{y,ed}^{osD} = 101 + 190 = 291 \text{ kN}$$

$$H_{y,ed}^{osE} = 207 + 308 = 517 \text{ kN}$$

j₁ ... spodnje jidra

j₂ ... zgornje jidra

sko razporediti glede na razmerji togosti posamezne stene jidra

$$\frac{k_{j1}^D}{k_{j1}^D + k_{j2}^D} = \frac{29000}{112000} = 0'259$$

$$\frac{k_{j2}^D}{k_{j1}^D + k_{j2}^D} = 0'741$$

$$\frac{k_{j1}^E}{k_{j1}^E + k_{j2}^E} = \frac{143000}{268000} = 0'534$$

$$\frac{k_{j2}^E}{k_{j1}^E + k_{j2}^E} = 0'466$$

$$\begin{aligned} H_{y,ed}^{osD,j1} &= 0'259 \times 291 = 75'4 \text{ kN} \rightarrow F_{y,ed} = 143'77 \text{ kN} && \text{12BEREN 1xM24(8'8)/400} \\ \rightarrow H_{y,ed}^{osE,j1} &= 0'534 \times 517 = 276'1 \text{ kN} \rightarrow F_{y,ed} = 287'53 \text{ kN} && \text{12BEREN 2xM24(8'8)/400} \\ \rightarrow H_{y,ed}^{osD,j2} &= 0'741 \times 291 = 215'6 \text{ kN} \rightarrow F_{y,ed} = 287'53 \text{ kN} && \text{12BEREN 2xM24(8'8)/400} \\ H_{y,ed}^{osE,j2} &= 0'466 \times 517 = 240'9 \text{ kN} \rightarrow F_{y,ed} = 287'53 \text{ kN} && \text{12BEREN 2xM24(8'8)/400} \end{aligned}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	8.8
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	800 MPa
γ_M	1.25
k_{mod}	1.10

$\alpha = 31.0^\circ$... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 23.682 \text{ MPa}$$

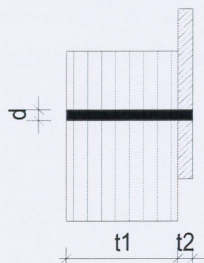
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 19.928 \text{ MPa}$$

$$k_{90} = 1.710$$

$$M_{y,Rk} = 0.3 f_{uk} d^{2.6} \quad \text{oz.} \quad M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 930594 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	160 mm
t_2	100 mm $\rightarrow AB$
d	24 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{l} 0.4 f_{h,k} t_1 d \quad (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} \quad (b) \end{array} \right. \quad (8.9) \quad \begin{array}{l} -/- \\ -/- \end{array}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{l} f_{h,k} t_1 d \quad (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} \quad (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} \quad (e) \end{array} \right. \quad (8.10) \quad \begin{array}{l} 76524.8 \text{ N} \\ 39632.1 \text{ N} \\ 48523.2 \text{ N} \end{array}$$

$$F_{v,Rk} = 39632.1 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 34.88 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	117 mm	... medsebojni razmak v smeri vlaken
a_2	96 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	168 mm	... obremenjeni konec
$a_{3,c}$	75 mm	... neobremenjeni konec
$a_{4,t}$	73 mm	... obremenjeni rob
$a_{4,c}$	72 mm	... neobremenjeni rob
a_l	400 mm	
m	2	... število vrst vijakov
n	9	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \begin{array}{l} n \\ n^{0.9} \sqrt{\frac{a_1}{13d}} \end{array} \right. = 7.688$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 536.23 \text{ kN}$$

$$F_{v,Rd,eff} = 29.79 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	8.8
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	800 MPa
γ_M	1.25
k_{mod}	1.10

$$\alpha = 31.0^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 23.682 \text{ MPa}$$

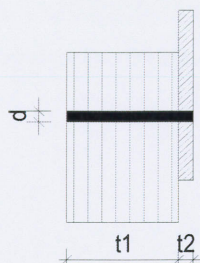
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 19.928 \text{ MPa}$$

$$k_{90} = 1.710$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 930594 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	160 mm
t_2	100 mm
d	24 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{l} 0.4 f_{h,k} t_1 d \quad (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k} d} + \frac{F_{ax,Rk}}{4} \quad (b) \end{array} \right. \quad (8.9) \quad \begin{array}{l} -/- \\ -/- \end{array}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{l} f_{h,k} t_1 d \quad (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} \quad (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k} d} + \frac{F_{ax,Rk}}{4} \quad (e) \end{array} \right. \quad (8.10) \quad \begin{array}{l} 76524.8 \text{ N} \\ 39632.1 \text{ N} \\ 48523.2 \text{ N} \end{array}$$

$$F_{v,Rk} = 39632.1 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 34.88 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	117 mm	... medsebojni razmak v smeri vlaken
a_2	96 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	168 mm	... obremenjeni konec
$a_{3,c}$	75 mm	... neobremenjeni konec
$a_{4,t}$	73 mm	... obremenjeni rob
$a_{4,c}$	72 mm	... neobremenjeni rob
a_l	300 mm	
m	1	... število vrst vijakov
n	14	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \begin{array}{l} n \\ n^{0.9} \sqrt{\frac{a_1}{13d}} \end{array} \right. = 10.648$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 371.35 \text{ kN}$$

$$F_{v,Rd,eff} = 26.53 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	8.8
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	800 MPa
γ_M	1.25
k_{mod}	1.10

$\alpha = 31.0^\circ$... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 23.682 \text{ MPa}$$

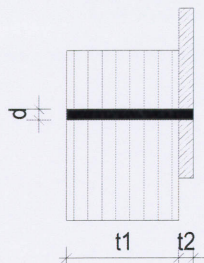
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 19.928 \text{ MPa}$$

$$k_{90} = 1.710$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 930594 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	160 mm
t_2	100 mm
d	24 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (b) \end{cases} \quad (8.9) \quad \begin{matrix} -/- \\ -/- \end{matrix}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (e) \end{cases} \quad (8.10) \quad \begin{matrix} 76524.8 \text{ N} \\ 39632.1 \text{ N} \\ 48523.2 \text{ N} \end{matrix}$$

$$F_{v,Rk} = 39632.1 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 34.88 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	117 mm	... medsebojni razmak v smeri vlaken
a_2	96 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	168 mm	... obremenjeni konec
$a_{3,c}$	75 mm	... neobremenjeni konec
$a_{4,t}$	73 mm	... obremenjeni rob
$a_{4,c}$	72 mm	... neobremenjeni rob
a_l	400 mm	
m	1	... število vrst vijakov
n	10	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ n, n^{0.9} \sqrt{\frac{a_1}{13d}} \right\} = 8.452$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 294.79 \text{ kN}$$

$$F_{v,Rd,eff} = 29.48 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	8.8
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	800 MPa
γ_M	1.25
k_{mod}	1.10

$\alpha = 31.0^\circ$... smer obtežbe glede na smer vlaken

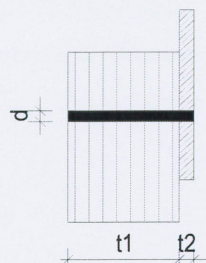
$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 23.682 \text{ MPa}$$

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 19.928 \text{ MPa}$$

$$k_{90} = 1.710$$

GEOMETRIJSKI PODATKI

t_1	160 mm
t_2	10 mm
d	24 mm



$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz.} \quad M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 930594 \text{ Nmm}$$

Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & (a) & 30609.9 \text{ N} \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (b) & 34311.1 \text{ N} \end{cases} \quad (8.9)$$

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & (c) & -/- \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (d) & -/- \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (e) \quad (A_1) & -/- \end{cases} \quad (8.10)$$

$$F_{v,Rk} = 30609.9 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 26.94 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	117 mm	... medsebojni razmak v smeri vlaken
a_2	96 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	168 mm	... obremenjeni konec
$a_{3,c}$	75 mm	... neobremenjeni konec
$a_{4,t}$	73 mm	... obremenjeni rob
$a_{4,c}$	72 mm	... neobremenjeni rob
a_l	400 mm	
m	1	... število vrst vijakov
n	6	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \frac{n}{n^{0.94} \sqrt{\frac{a_1}{13d}}} \right\} = 5.337$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 143.77 \text{ kN}$$

$$F_{v,Rd,eff} = 23.96 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	8.8
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	800 MPa
γ_M	1.25
k_{mod}	1.10

$$\alpha = 31.0^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 23.682 \text{ MPa}$$

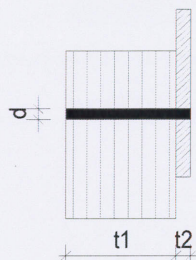
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 19.928 \text{ MPa}$$

$$k_{90} = 1.710$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz.} \quad M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 930594 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	160 mm
t_2	10 mm
d	24 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (b) \end{cases} \quad (8.9)$$

30609.9 N
34311.1 N

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (e) \end{cases} \quad (8.10)$$

-/-
-/-
-/-

$$F_{v,Rk} = 30609.9 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 26.94 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	117 mm	... medsebojni razmak v smeri vlaken
a_2	96 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	168 mm	... obremenjeni konec
$a_{3,c}$	75 mm	... neobremenjeni konec
$a_{4,t}$	73 mm	... obremenjeni rob
$a_{4,c}$	72 mm	... neobremenjeni rob
a_l	400 mm	
m	2	... število vrst vijakov
n	6	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \frac{n}{n^{0.9} \sqrt{\frac{a_1}{13d}}} \right\} = 5.337$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 287.53 \text{ kN}$$

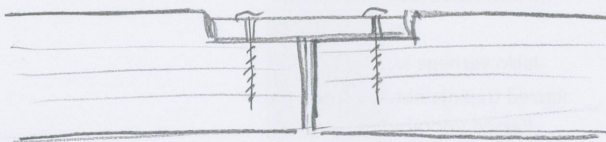
$$F_{v,Rd,eff} = 23.96 \text{ kN}$$

• JEKLENE POVEZAVE MED JEDRI MEDETAŽE

$$H_{y,ed} = 308 + 209 \text{ kN} = 488 \text{ kN}$$

uporabimo na obeh straneh črte ali 308 kN

$$F_{y,ed} = \frac{308 \text{ kN} \times 5.5 \text{ m}}{2.7 \text{ m (med jidri)}} = 62.74 \text{ kN}$$



$$F_{y,rd} = 94.78 \text{ kN} > 62.74 \text{ kN} \checkmark$$

IZBEREM 2M12/300mm

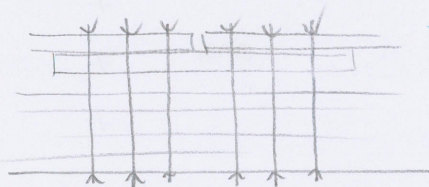
napr. Fischer Power Fast FPP-HT 12.0 x 140 28P25

• kontrola neto preseka p_L ($t_{eff} = 8 \text{ mm}$ - poglobljene lužnji)

$$A_{net} = (20 - 2 \times 1.3) \times 0.8 = 13.92 \text{ cm}^2$$

$$\sigma_{ed} = 13.92 \times 35.5 = 494.2 \text{ kN} > 488 \text{ kN} \checkmark$$

• sklepanje profila z zglato (oboje utopljeno v CLT)



$$F_{y,rd}(M16, 8.8) = 60.3 \text{ kN}$$

$$n = \frac{488}{60.3} = 8.09 \rightarrow 10 (2 \times 5)$$

IZBEREM 2x5M16, 8.8/60mm

• VNOS HOB. 8.12 V JEDRA V NIVOJU STREHE

• smer X =

$$F_{x,Ed}^{os11} = 562 + 166 = 728 \text{ kN}$$

→ v 3D modelu dobim $F_{x,Ed}^{os11} = 810 \text{ kN}$

$$F_{x,Ed}^{os10} = 1008 + 202 = 1210 \text{ kN}$$

→ v 3D modelu dobim $F_{x,Ed}^{os10} = 838 \text{ kN}$

$$F_{x,Ed}^{os2+} = 834 + 33 = 867 \text{ kN} \rightarrow$$

$$F_{x,Ed}^{os2+} = 683 \text{ kN}$$

$$F_{x,Ed}^{os2} = 168 + 156 = 324 \text{ kN} \rightarrow$$

$$F_{x,Ed}^{os2} = 725 \text{ kN}$$

bolj realna
razporeditev
hl

Upoštevan enotno

$$F_{x,Ed} = 838 \text{ kN}$$

$$F_{y,Ed} = 841.44 \text{ kN} > 838 \text{ kN} \checkmark$$

$$\text{Izberem M24, 8.8} \quad (2 \times 6 + 2 \times 12) \\ \text{raztek x/y} = 200/200$$

• smer Y =

file pretvarjam v 3D modela =

$$F_{y,Ed}^{D,12} = 996 \text{ kN}$$

$$\rightarrow F_{y,Ed} = 1006.67 \text{ kN} ; \text{Izberem M24, 8.8, } 3 \times 14, \text{ raztek x, y} = 200/200$$

$$F_{y,Ed}^{E,12} = 650 \text{ kN}$$

$$\rightarrow F_{y,Ed} = 671.11 \text{ kN} ; \text{Izberem M24, 8.8, } 2 \times 14, \text{ raztek x, y} = 200/200$$

$$F_{y,Ed}^{B,11} = 118 \text{ kN}$$

$$\rightarrow F_{y,Ed} = 292.09 \text{ kN} ; \text{Izberem M24, 8.8, } 1 \times 12, \text{ raztek y} = 200$$

$$F_{y,Ed}^{B,11} = 830 \text{ kN}$$

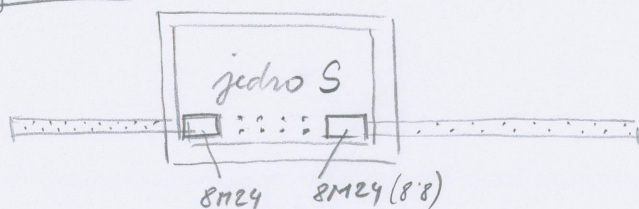
$$\rightarrow F_{y,Ed} = 876.26 \text{ kN} ; \text{Izberem M24, 8.8, } 3 \times 12, \text{ raztek x/y} = 200/200$$

file lahko pretvarjam v direktivni
slovarjen jellac porocilo

$$8M24(8.8) \rightarrow 8 \times 135.6 = 1084.8 \text{ kN} \checkmark$$

- VNOS SILE V HOB. POVEČAVI - SmaX - STREHA

• jedro S



$$F_{Ed} = 838 \text{ kN}$$

na celotni dolžini moramo vnesti sile: $F_{y,Ed} = 846.15 \text{ kN} \rightarrow 43 \times 2M12/200 \text{ mm}$

v območju jedra del niti že prenesen direktno na beton

\rightarrow npr. stena enak razen na prostalem območju

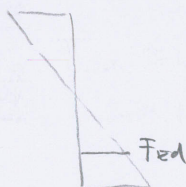
IZBEREN 2M12/200 mm, prečni zamik 150 mm

Fischer Power-Fast FPF-HT 12.0 x 140 zPP 25

• jedro J

$$F_{Ed} \approx 690 \text{ kN}$$

$$h = 9.80 \text{ m}$$



$$F_{y,Ed,eff} = 9.845 \text{ kN (gl. lnt 2a)}$$

$$F_{y,Ed} = n t \left(\frac{9.84}{20} \right) \times 9.84 \times 2 = 925 \text{ kN} \checkmark$$

IZBEREN 2M12/200 mm, prečni zamik 150 mm

Fischer Power-Fast FPF-HT 12.0 x 140 zPP 25

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	8.8
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	800 MPa
γ_M	1.25
k_{mod}	1.10

$\alpha = 31.0^\circ$... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 23.682 \text{ MPa}$$

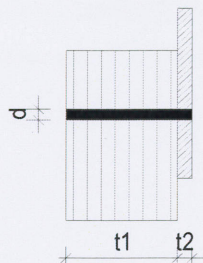
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 19.928 \text{ MPa}$$

$$k_{90} = 1.710$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 930594 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	160 mm
t_2	100 mm
d	24 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{l} 0.4 f_{h,k} t_1 d \quad (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} \quad (b) \end{array} \right. \quad (8.9) \quad \begin{array}{l} -/- \\ -/- \end{array}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{l} f_{h,k} t_1 d \quad (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} \quad (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} \quad (e) \end{array} \right. \quad (8.10) \quad \begin{array}{l} 76524.8 \text{ N} \\ 39632.1 \text{ N} \\ 48523.2 \text{ N} \end{array}$$

$$F_{v,Rk} = 39632.1 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 34.88 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	117 mm	... medsebojni razmak v smeri vlaken
a_2	96 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	168 mm	... obremenjeni konec
$a_{3,c}$	75 mm	... neobremenjeni konec
$a_{4,t}$	73 mm	... obremenjeni rob
$a_{4,c}$	72 mm	... neobremenjeni rob
a_l	200 mm	
m	2	... število vrst vijakov
n	18	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \begin{array}{l} n \\ n^{0.9} \sqrt{\frac{a_1}{13d}} \end{array} \right. = 12.063$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 841.44 \text{ kN}$$

$$F_{v,Rd,eff} = 23.37 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	8.8
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	800 MPa
γ_M	1.25
k_{mod}	1.10

$$\alpha = 31.0^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 27.421 \text{ MPa}$$

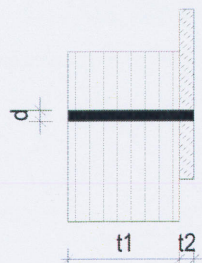
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 24.041 \text{ MPa}$$

$$k_{90} = 1.530$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 153491 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	120 mm
t_2	15 mm
d	12 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (b) \end{cases} \quad (8.9) \quad \begin{matrix} -/- \\ -/- \end{matrix}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (e) \end{cases} \quad (8.10) \quad \begin{matrix} 34618.9 \text{ N} \\ 16116.3 \text{ N} \\ 15305.1 \text{ N} \end{matrix}$$

$$F_{v,Rk} = 15305.1 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 13.47 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	58 mm	... medsebojni razmak v smeri vlaken
a_2	48 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	84 mm	... obremenjeni konec
$a_{3,c}$	38 mm	... neobremenjeni konec
$a_{4,t}$	36 mm	... obremenjeni rob
$a_{4,c}$	36 mm	... neobremenjeni rob
a_l	200 mm	
m	2	... število vrst vijakov
n	43	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ n, n^{0.9} \sqrt{\frac{a_1}{13d}} \right\} = 31.412$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 846.15 \text{ kN}$$

$$F_{v,Rd,eff} = 9.84 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	8.8
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	800 MPa
γ_M	1.25
k_{mod}	1.10

$\alpha = 31.0^\circ$... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 23.682 \text{ MPa}$$

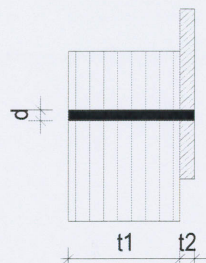
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 19.928 \text{ MPa}$$

$$k_{90} = 1.710$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 930594 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	160 mm
t_2	100 mm
d	24 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & \text{(a)} \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & \text{(b)} \end{cases} \quad (8.9) \quad \begin{matrix} -/- \\ -/- \end{matrix}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & \text{(c)} \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & \text{(d)} \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & \text{(e) (A1)} \end{cases} \quad (8.10) \quad \begin{matrix} 76524.8 \text{ N} \\ 39632.1 \text{ N} \\ 48523.2 \text{ N} \end{matrix}$$

$$F_{v,Rk} = 39632.1 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 34.88 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	117 mm	... medsebojni razmak v smeri vlaken
a_2	96 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	168 mm	... obremenjeni konec
$a_{3,c}$	75 mm	... neobremenjeni konec
$a_{4,t}$	73 mm	... obremenjeni rob
$a_{4,c}$	72 mm	... neobremenjeni rob
a_l	200 mm	
m	3	... število vrst vijakov
n	14	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ n, n^{0.9} \sqrt{\frac{a_1}{13d}} \right\} = 9.621$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 1,006.67 \text{ kN}$$

$$F_{v,Rd,eff} = 23.97 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	8.8
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	800 MPa
γ_M	1.25
k_{mod}	1.10

$\alpha = 31.0^\circ$... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 23.682 \text{ MPa}$$

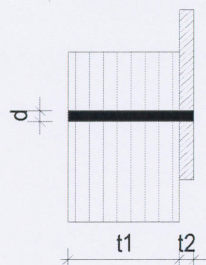
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 19.928 \text{ MPa}$$

$$k_{90} = 1.710$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 930594 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	160 mm
t_2	100 mm
d	24 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k} d} + \frac{F_{ax,Rk}}{4} & (b) \end{cases} \quad (8.9) \quad \begin{matrix} -/- \\ -/- \end{matrix}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k} d} + \frac{F_{ax,Rk}}{4} & (e) \end{cases} \quad (8.10) \quad \begin{matrix} 76524.8 \text{ N} \\ 39632.1 \text{ N} \\ 48523.2 \text{ N} \end{matrix}$$

$$F_{v,Rk} = 39632.1 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 34.88 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	117 mm	... medsebojni razmak v smeri vlaken
a_2	96 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	168 mm	... obremenjeni konec
$a_{3,c}$	75 mm	... neobremenjeni konec
$a_{4,t}$	73 mm	... obremenjeni rob
$a_{4,c}$	72 mm	... neobremenjeni rob
a_l	200 mm	
m	2	... število vrst vijakov
n	14	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ n, n^{0.9} \sqrt{\frac{a_1}{13d}} \right\} = 9.621$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 671.11 \text{ kN}$$

$$F_{v,Rd,eff} = 23.97 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	8.8
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	800 MPa
γ_M	1.25
k_{mod}	1.10

$\alpha = 31.0^\circ$... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 23.682 \text{ MPa}$$

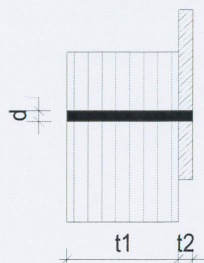
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 19.928 \text{ MPa}$$

$$k_{90} = 1.710$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 930594 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	160 mm
t_2	100 mm
d	24 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k} d} + \frac{F_{ax,Rk}}{4} & (b) \end{cases} \quad (8.9) \quad \begin{matrix} -/- \\ -/- \end{matrix}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k} d} + \frac{F_{ax,Rk}}{4} & (e) \end{cases} \quad (8.10) \quad \begin{matrix} 76524.8 \text{ N} \\ 39632.1 \text{ N} \\ 48523.2 \text{ N} \end{matrix}$$

$$F_{v,Rk} = 39632.1 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 34.88 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	117 mm	... medsebojni razmak v smeri vlaken
a_2	96 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	168 mm	... obremenjeni konec
$a_{3,c}$	75 mm	... neobremenjeni konec
$a_{4,t}$	73 mm	... obremenjeni rob
$a_{4,c}$	72 mm	... neobremenjeni rob
a_l	200 mm	
m	1	... število vrst vijakov
n	12	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \frac{n}{n^{0.9} \sqrt{\frac{a_1}{13d}}} \right\} = 8.375$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 292.09 \text{ kN}$$

$$F_{v,Rd,eff} = 24.34 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	8.8
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	800 MPa
γ_M	1.25
k_{mod}	1.10

$$\alpha = 31.0^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 23.682 \text{ MPa}$$

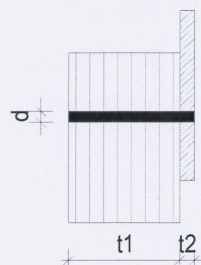
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 19.928 \text{ MPa}$$

$$k_{90} = 1.710$$

$$M_{y,Rk} = 0.3 f_{uk} d^{2.6} \quad \text{oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 930594 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	160 mm
t_2	100 mm
d	24 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (b) \end{cases} \quad (8.9) \quad \begin{matrix} -/- \\ -/- \end{matrix}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (e) \end{cases} \quad (8.10) \quad \begin{matrix} 76524.8 \text{ N} \\ 39632.1 \text{ N} \\ 48523.2 \text{ N} \end{matrix}$$

$$F_{v,Rk} = 39632.1 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 34.88 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	117 mm	... medsebojni razmak v smeri vlaken
a_2	96 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,e}$	168 mm	... obremenjeni konec
$a_{3,c}$	75 mm	... neobremenjeni konec
$a_{4,e}$	73 mm	... obremenjeni rob
$a_{4,c}$	72 mm	... neobremenjeni rob
a_l	200 mm	
m	3	... število vrst vijakov
n	12	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \frac{n}{n^{0.9} \sqrt{\frac{a_1}{13d}}} \right\} = 8.375$$

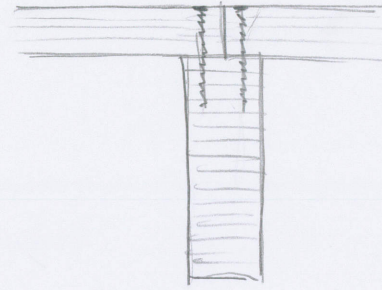
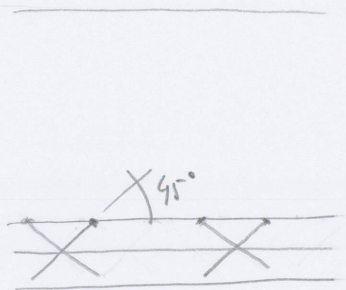
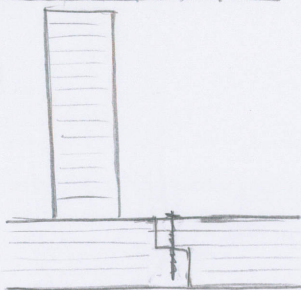
Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 876.26 \text{ kN}$$

$$F_{v,Rd,eff} = 24.34 \text{ kN}$$

• POVERAVALNED CLT - STREHA

• OS 2, 3, 4, 9, 10, 11, 12 =



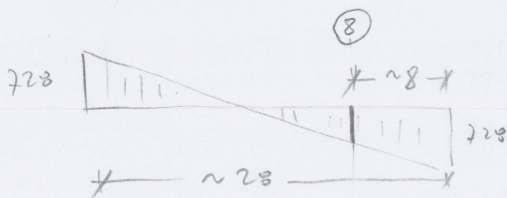
$$F_{ed} = 834 + 33 = 867 \text{ kN}$$

$$F_{v,ed} = 812.52 \text{ kN} > 867 \text{ kN} \checkmark$$

IZBEREN KRIZNO POSTAVLJENE VIJAKE 2 M8/250mm
npr. Fischer Power-Full FPF-2T 8x220; $\gamma = 45^\circ$

↑
⊗
2x v primenu
ko x panele shizeta
nad monitcem

• OS 5, 6, 7, 8, 13 =



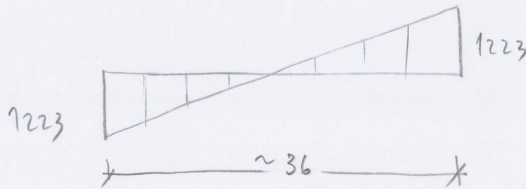
$$F_{ed} \approx \frac{728 \times 8}{28/2} = 416 \text{ kN}$$

$$F_{v,ed} = 470.66 \text{ kN} > 416 \text{ kN}$$

IZBEREN KRIZNO POSTAVLJENE VIJAKE 2 M8/500mm
npr. Fischer Power-Full FPF-2T 8x220; $\gamma = 45^\circ$

• OS A-C =

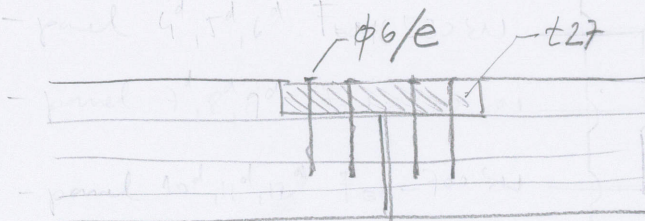
$$F_{ed} = 1223 \text{ kN}$$



File po ravni (stranske ravni so obdelane posebej - hidroizolacija profila) =

= za vsako ravno delovno ravno

e	75	100	125	150	200
F_{ed}	1180	860	700	540	380
F_{ed}	1294	1098	950	768	576



(raun mami' ← optionala dolžina)

File po ravni (stranske ravni so obdelane posebej - hidroizolacija profila) =

2 M8/500mm FPF-2T 8x220
2 M8/300mm FPF-2T 8x220

STRIŽNA NOSILNOST KRIŽNE ZVEZE "X" ZA LESNE VIJAKE (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les (1)	GL24h
Les (2)	GL24h
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

GEOMETRIJSKI PODATKI

l_{ef}	100 mm
t_2	100 mm
d	8 mm
n	160 št. vijakov
vijaki z navojem po celi dolžini	

	(1)	(2)
$f_{m,k}$	24	24 MPa
ρ_k	380	380 kg/m ³
$f_{u,k}$	360 MPa	
γ_M	1.25	
k_{mod}	1.10	
$f_{c,90,k(2)}$		2.7 MPa
	(1)	(2)
α	31.0	31.0 ° ... smer obtežbe glede na smer vlaken

$$f_{\alpha x,k} = 0.52 d^{-0.5} \times l_{ef}^{-0.1} \times \rho_k^{0.8} \quad (1) \quad (2)$$

$$= 13.436 \quad = 13.436 \text{ MPa}$$

Izvlačna nosilnost za 1 vijak (navoj po celi dolžini vijaka)

$$F_{ax,\alpha,Rk} = \min \left\{ \frac{f_{\alpha x,k} \times d \times l_{ef,1}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{1,k}}{350} \right)^{0.8}, \frac{f_{\alpha x,k} \times d \times l_{ef,2}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{2,k}}{350} \right)^{0.8}, f_{tens,k} \right\} = 2.000 \text{ kN}$$

Tlačna nosilnost za 1 vijak (navoj po celi dolžini vijaka)

$$F_{ax,\alpha,Rk} = \min \left\{ \frac{f_{\alpha x,k} \times d \times l_{ef,1}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{1,k}}{350} \right)^{0.8}, \frac{f_{\alpha x,k} \times d \times l_{ef,2}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{2,k}}{350} \right)^{0.8}, F_{kt,Rk} \right\} = 10.009 \text{ kN}$$

Skupna strižna nosilnost za 2 ravni vijakov postavljenih križno

skupaj vijakov 320

$$n_{ef} = 96.318$$

$$F_{v,Rd,tot} = 872.52 \text{ kN}$$

STRIŽNA NOSILNOST KRIŽNE ZVEZE "X" ZA LESNE VIJAKE (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les (1)	GL24h
Les (2)	GL24h
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

GEOMETRIJSKI PODATKI

l_{ef}	100 mm
t_2	100 mm
d	8 mm
n	96 št. vijakov
vijaki z navojem po celi dolžini	

	(1)	(2)
$f_{m,k}$	24	24 MPa
ρ_k	380	380 kg/m ³
$f_{u,k}$	360 MPa	
γ_M	1.25	
k_{mod}	1.10	
$f_{c,90,k(2)}$		2.7 MPa
	(1)	(2)
α	45.0	45.0 ° ... smer obtežbe glede na smer vlaken

$$f_{\alpha,k} = 0.52d^{-0.5} \times l_{ef}^{-0.1} \times \rho_k^{0.8} \quad \begin{matrix} (1) & (2) \\ =13.436 & =13.436 \text{ MPa} \end{matrix}$$

Izvlačna nosilnost za 1 vijak (navoj po celi dolžini vijaka)

$$F_{\alpha,\alpha,Rk} = \min \left\{ \frac{f_{\alpha,k} \times d \times l_{ef,1}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{1,k}}{350} \right)^{0.8}, \frac{f_{\alpha,k} \times d \times l_{ef,2}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{2,k}}{350} \right)^{0.8}, f_{tens,k} \right\} = 2.000 \text{ kN}$$

Tlačna nosilnost za 1 vijak (navoj po celi dolžini vijaka)

$$F_{\alpha,\alpha,Rk} = \min \left\{ \frac{f_{\alpha,k} \times d \times l_{ef,1}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{1,k}}{350} \right)^{0.8}, \frac{f_{\alpha,k} \times d \times l_{ef,2}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{2,k}}{350} \right)^{0.8}, F_{ki,Rk} \right\} = 10.437 \text{ kN}$$

Skupna strižna nosilnost za 2 ravlini vijakov postavljenih križno

skupaj vijakov 192

$$n_{ef} = 60.820$$

$$F_{v,Rd,tot} = 470.66 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-LES (SIST EN 1995-1-1: 2005)

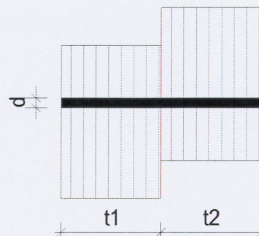
MATERIALNE KARAKTERISTIKE

Les (1)	GL24h
Les (2)	GL24h
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

GEOMETRIJSKI PODATKI

t_1	27 mm
t_2	73 mm
d	6 mm

	(1)	(2)
$f_{m,k}$	24	24 MPa
ρ_k	380	380 kg/m ³
$f_{u,k}$	360	MPa
γ_M	1.25	
k_{mod}	1.10	



α	(1)	(2)
	31.0	31.0

... smer obtežbe glede na smer vlaken

	(1)	(2)
$f_{h,0,k}$	$= 0.082(1 - 0.01d)\rho_k$	$= 29.290$

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 26.229 \quad = 26.229 \text{ MPa}$$

$$k_{90} = 1.440(1) = 1.440(2) \quad \beta = \frac{f_{h,2,k}}{f_{h,1,k}} = 1.000$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz.} \quad M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 9494 \text{ Nmm}$$

$$F_{v,Rk} = \min \left\{ \begin{array}{ll} f_{h,1,k}t_1d & \text{(a)} \\ f_{h,2,k}t_2d & \text{(b)} \\ \frac{f_{h,1,k}t_1d}{1+\beta} \left[\sqrt{\beta + 2\beta^2 \left[1 + \frac{t_2}{t_1} + \left(\frac{t_2}{t_1} \right)^2 \right] + \beta^3 \left(\frac{t_2}{t_1} \right)^2} - \beta \left(1 + \frac{t_2}{t_1} \right) \right] + \frac{F_{ax,Rk}}{4} & \text{(c)} \\ 1.05 \frac{f_{h,1,k}t_1d}{2+\beta} \left[\sqrt{2\beta(1+\beta) + \frac{4\beta(2+\beta)M_{y,Rk}}{f_{h,1,k}d t_1^2}} - \beta \right] + \frac{F_{ax,Rk}}{4} & \text{(d)} \quad (8.6) \\ 1.05 \frac{f_{h,1,k}t_2d}{1+2\beta} \left[\sqrt{2\beta^2(1+\beta) + \frac{4\beta(1+2\beta)M_{y,Rk}}{f_{h,1,k}d t_2^2}} - \beta \right] + \frac{F_{ax,Rk}}{4} & \text{(e)} \\ 1.15 \sqrt{\frac{2\beta}{1+\beta}} \sqrt{2M_{y,Rk} f_{h,1,k}d} + \frac{F_{ax,Rk}}{4} & \text{(f)} \end{array} \right.$$

$F_{v,Rk} = 1537.3 \text{ N}$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 1.35 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

	(1)	(2)	
a_1	29	29 mm	... medsebojni razmak v smeri vlaken
a_2	24	24 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,e}$	80	80 mm	... obremenjeni konec
$a_{3,c}$	20	20 mm	... neobremenjeni konec
$a_{4,e}$	18	18 mm	... obremenjeni rob
$a_{4,c}$	18	18 mm	... neobremenjeni rob
a_l	75	75 mm	
m	2		... število vrst vijakov
n	13		... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \begin{array}{ll} n & (1) \\ n^{0.94} \sqrt{\frac{a_1}{13d}} & (2) \end{array} \right. = 9.961 \quad = 9.961$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 26.95 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-LES (SIST EN 1995-1-1: 2005)

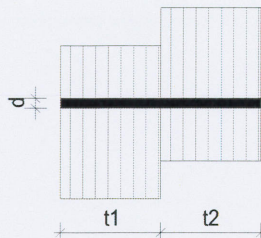
MATERIALNE KARAKTERISTIKE

Les (1)	GL24h
Les (2)	GL24h
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

GEOMETRIJSKI PODATKI

t_1	27 mm
t_2	73 mm
d	6 mm

	(1)	(2)
$f_{m,k}$	24	24 MPa
ρ_k	380	380 kg/m ³
$f_{u,k}$	360 MPa	
γ_M	1.25	
k_{mod}	1.10	



α	(1)	(2)
	31.0	31.0

... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 29.290 = 29.290 \text{ MPa}$$

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 26.229 = 26.229 \text{ MPa}$$

$$k_{90} = 1.440(1) = 1.440(2) \quad \beta = \frac{f_{h,2,k}}{f_{h,1,k}} = 1.000$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \text{ oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 9494 \text{ Nmm}$$

$$F_{v,Rk} = \min \left\{ \begin{array}{ll} f_{h,1,k}t_1d & \text{(a)} \\ f_{h,2,k}t_2d & \text{(b)} \\ \frac{f_{h,1,k}t_1d}{1+\beta} \left[\sqrt{\beta+2\beta^2 \left[1 + \frac{t_2}{t_1} + \left(\frac{t_2}{t_1} \right)^2 \right] + \beta^3 \left(\frac{t_2}{t_1} \right)^2} - \beta \left(1 + \frac{t_2}{t_1} \right) \right] + \frac{F_{ax,Rk}}{4} & \text{(c)} \\ 1.05 \frac{f_{h,1,k}t_1d}{2+\beta} \left[\sqrt{2\beta(1+\beta) + \frac{4\beta(2+\beta)M_{y,Rk}}{f_{h,1,k}d t_1^2}} - \beta \right] + \frac{F_{ax,Rk}}{4} & \text{(d)} \\ 1.05 \frac{f_{h,1,k}t_2d}{1+2\beta} \left[\sqrt{2\beta^2(1+\beta) + \frac{4\beta(1+2\beta)M_{y,Rk}}{f_{h,1,k}d t_2^2}} - \beta \right] + \frac{F_{ax,Rk}}{4} & \text{(e)} \\ 1.15 \sqrt{\frac{2\beta}{1+\beta}} \sqrt{2M_{y,Rk} f_{h,1,k}d} + \frac{F_{ax,Rk}}{4} & \text{(f)} \end{array} \right. \quad (8.6)$$

$F_{v,Rk} = 1537.3 \text{ N}$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 1.35 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

	(1)	(2)	
a_1	29	29 mm	... medsebojni razmak v smeri vlaken
a_2	24	24 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,e}$	80	80 mm	... obremenjeni konec
$a_{3,c}$	20	20 mm	... neobremenjeni konec
$a_{4,e}$	18	18 mm	... obremenjeni rob
$a_{4,c}$	18	18 mm	... neobremenjeni rob
a_l	100	100 mm	
m	2	... število vrst vijakov	
n	10	... število vijakov v vrsti (vzporedno z vlakni)	

$$n_{ef} = \min \left\{ \begin{array}{ll} n & (1) \\ n^{0.94} \sqrt{\frac{a_1}{13d}} & (2) \end{array} \right. = 8.452 = 8.452$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 22.87 \text{ kN}$$

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-LES (SIST EN 1995-1-1: 2005)

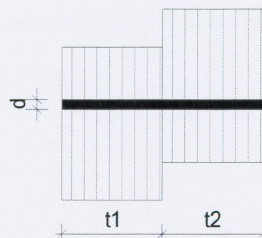
MATERIALNE KARAKTERISTIKE

Les (1)	GL24h
Les (2)	GL24h
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

GEOMETRIJSKI PODATKI

t_1	27 mm
t_2	73 mm
d	6 mm

	(1)	(2)
$f_{m,k}$	24	24 MPa
ρ_k	380	380 kg/m ³
$f_{u,k}$	360	MPa
γ_M	1.25	
k_{mod}	1.10	



	(1)	(2)
α	31.0	31.0 ° ... smer obtežbe glede na smer vlaken

	(1)	(2)
$f_{h,0,k}$	$= 0.082(1 - 0.01d)\rho_k$	$= 29.290 = 29.290$ MPa

$f_{h,\alpha,k}$	$= \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha}$	$= 26.229 = 26.229$ MPa
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k_{90}	$= 1.440(1) = 1.440(2)$	$\beta = \frac{f_{h,2,k}}{f_{h,1,k}} = 1.000$
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$M_{y,Rk}$	$= 0.3f_{uk}d^{2.6}$ oz. $M_{y,Rk} = 0.15 \times 600 \times d^{2.6}$	$= 9494$ Nmm
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$F_{v,Rk}$	$\min \left\{ \begin{array}{l} \frac{f_{h,1,k}t_1d}{1+\beta} \left[\sqrt{\beta+2\beta^2 \left[1+\frac{t_2}{t_1}+\left(\frac{t_2}{t_1}\right)^2} \right] + \beta^3 \left(\frac{t_2}{t_1}\right)^2} - \beta \left(1+\frac{t_2}{t_1} \right) \right] + \frac{F_{ax,Rk}}{4} \end{array} \right.$	(a)	4249.1 N
	$\frac{f_{h,2,k}t_2d}{1+\beta}$	(b)	11488.3 N
	$\frac{f_{h,1,k}t_1d}{1+\beta} \left[\sqrt{2\beta(1+\beta) + \frac{4\beta(2+\beta)M_{y,Rk}}{f_{h,1,k}d^2t_1^2}} - \beta \right] + \frac{F_{ax,Rk}}{4}$	(c)	3833.2 N
	$1.05 \frac{f_{h,1,k}t_1d}{2+\beta} \left[\sqrt{2\beta(1+\beta) + \frac{4\beta(2+\beta)M_{y,Rk}}{f_{h,1,k}d^2t_1^2}} - \beta \right] + \frac{F_{ax,Rk}}{4}$	(d) (8.6)	1835.9 N
	$1.05 \frac{f_{h,1,k}t_2d}{1+2\beta} \left[\sqrt{2\beta^2(1+\beta) + \frac{4\beta(1+2\beta)M_{y,Rk}}{f_{h,1,k}d^2t_2^2}} - \beta \right] + \frac{F_{ax,Rk}}{4}$	(e)	1537.3 N
	$1.15 \sqrt{\frac{2\beta}{1+\beta}} \sqrt{2M_{y,Rk}f_{h,1,k}d} + \frac{F_{ax,Rk}}{4}$	(f)	1987.9 N
$F_{v,Rk}$	$= 1537.3$ N		

Računska strižna nosilnost zveze

$F_{v,Rd}$	$= 1.35$ kN
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Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

	(1)	(2)	
a_1	29	29 mm	... medsebojni razmak v smeri vlaken
a_2	24	24 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	80	80 mm	... obremenjeni konec
$a_{3,c}$	20	20 mm	... neobremenjeni konec
$a_{4,t}$	18	18 mm	... obremenjeni rob
$a_{4,c}$	18	18 mm	... neobremenjeni rob
a_l	125	125 mm	
m	2	... število vrst vijakov	
n	8	... število vijakov v vrsti (vzporedno z vlakni)	

n_{ef}	$\min \left\{ \begin{array}{l} n \\ n^{0.9} \sqrt{\frac{a_1}{13d}} \end{array} \right.$	(1) (2)	$= 7.311 = 7.311$
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Računska strižna nosilnost spoja

$F_{v,Rd,tot}$	$= 19.78$ kN
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VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-LES (SIST EN 1995-1-1: 2005)

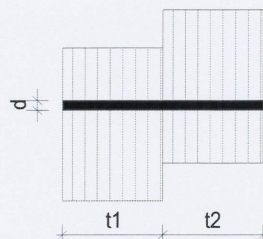
MATERIALNE KARAKTERISTIKE

Les (1)	GL24h
Les (2)	GL24h
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

GEOMETRIJSKI PODATKI

t_1	27 mm
t_2	73 mm
d	6 mm

	(1)	(2)
$f_{m,k}$	24	24 MPa
ρ_k	380	380 kg/m ³
$f_{u,k}$	360 MPa	
γ_M	1.25	
k_{mod}	1.10	



	(1)	(2)
α	31.0	31.0

... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k \quad (1) \quad (2)$$

$$= 29.290 \quad = 29.290 \text{ MPa}$$

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} \quad = 26.229 \quad = 26.229 \text{ MPa}$$

$$k_{90} = 1.440(1) = 1.440(2) \quad \beta = \frac{f_{h,2,k}}{f_{h,1,k}} = 1.000$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \quad \text{oz.} \quad M_{y,Rk} = 0.15 \times 600 \times d^{2.6} \quad = 9494 \text{ Nmm}$$

$$F_{v,Rk} = \min \left\{ \begin{array}{ll} \frac{f_{h,1,k}t_1d}{1+\beta} & (a) \quad 4249.1 \text{ N} \\ \frac{f_{h,2,k}t_2d}{1+\beta} & (b) \quad 11488.3 \text{ N} \\ \frac{f_{h,1,k}t_1d}{1+\beta} \left[\sqrt{\beta + 2\beta^2 \left[1 + \frac{t_2}{t_1} + \left(\frac{t_2}{t_1} \right)^2 \right] + \beta^3 \left(\frac{t_2}{t_1} \right)^2} - \beta \left(1 + \frac{t_2}{t_1} \right) \right] + \frac{F_{ax,Rk}}{4} & (c) \quad 3833.2 \text{ N} \\ 1.05 \frac{f_{h,1,k}t_1d}{2+\beta} \left[\sqrt{2\beta(1+\beta) + \frac{4\beta(2+\beta)M_{y,Rk}}{f_{h,1,k}d \frac{t_1^2}{t_2^2}} - \beta} \right] + \frac{F_{ax,Rk}}{4} & (d) \quad (8.6) \quad 1835.9 \text{ N} \\ 1.05 \frac{f_{h,1,k}t_2d}{1+2\beta} \left[\sqrt{2\beta^2(1+\beta) + \frac{4\beta(1+2\beta)M_{y,Rk}}{f_{h,1,k}d \frac{t_2^2}{t_1^2}} - \beta} \right] + \frac{F_{ax,Rk}}{4} & (e) \quad 1537.3 \text{ N} \\ 1.15 \sqrt{\frac{2\beta}{1+\beta}} \sqrt{2M_{y,Rk}f_{h,1,k}d} + \frac{F_{ax,Rk}}{4} & (f) \quad 1987.9 \text{ N} \end{array} \right.$$

$$F_{v,Rk} = 1537.3 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 1.35 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

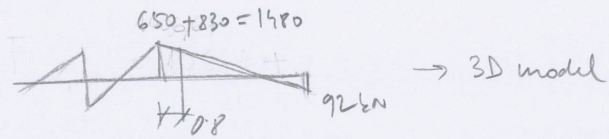
	(1)	(2)	
a_1	29	29 mm	... medsebojni razmak v smeri vlaken
a_2	24	24 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,e}$	80	80 mm	... obremenjeni konec
$a_{3,c}$	20	20 mm	... neobremenjeni konec
$a_{4,e}$	18	18 mm	... obremenjeni rob
$a_{4,c}$	18	18 mm	... neobremenjeni rob
a_l	150	150 mm	
m	2	... število vrst vijakov	
n	6	... število vijakov v vrsti (vzporedno z vlakni)	

$$n_{ef} = \min \left\{ \begin{array}{ll} n & (1) \\ n^{0.9} \sqrt{\frac{a_1}{13d}} & (2) \end{array} \right. \quad = 5.907 \quad = 5.907$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 15.98 \text{ kN}$$

• OS C - G =



$$F_{Ed, \text{max}}^{E+0.8} = 1300 \text{ kN}$$

→ 17 BEREIN 2M10/50 mm, upr Fischer FPF-2T 10'0x22.5

$$F_{Ed, \text{min}}^{E+3.4} = 600 \text{ kN}$$

→ 17 BEREIN 2M10/125 mm, upr — 11 —

$$F_{Ed}^D = 996 + 118 = 1114 \text{ kN} \rightarrow 17 BEREIN \times 2M10/75, \text{ upr} \text{ — 11 —}$$

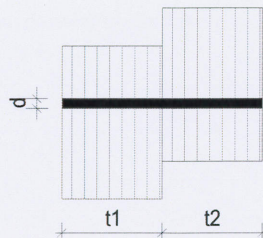
VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-LES (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les (1)	GL24h
Les (2)	GL24h
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

GEOMETRIJSKI PODATKI

t_1	27 mm
t_2	73 mm
d	6 mm



	(1)	(2)
$f_{m,k}$	24	24 MPa
ρ_k	380	380 kg/m ³
$f_{u,k}$	360	MPa
γ_M	1.25	
k_{mod}	1.10	

	(1)	(2)
α	31.0	31.0

... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 29.290 = 29.290 \text{ MPa}$$

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 26.229 = 26.229 \text{ MPa}$$

$$k_{90} = 1.440(1) = 1.440(2) \quad \beta = \frac{f_{h,2,k}}{f_{h,1,k}} = 1.000$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} \text{ oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 9494 \text{ Nmm}$$

$$F_{v,Rk} = \min \left\{ \begin{array}{ll} \frac{f_{h,1,k}t_1d}{1+\beta} & \text{(a)} \\ \frac{f_{h,2,k}t_2d}{1+\beta} & \text{(b)} \\ \frac{f_{h,1,k}t_1d}{1+\beta} \left[\sqrt{\beta + 2\beta^2 \left[1 + \frac{t_2}{t_1} + \left(\frac{t_2}{t_1} \right)^2 \right] + \beta^3 \left(\frac{t_2}{t_1} \right)^2} - \beta \left(1 + \frac{t_2}{t_1} \right) \right] + \frac{F_{ax,Rk}}{4} & \text{(c)} \\ 1.05 \frac{f_{h,1,k}t_1d}{2+\beta} \left[\sqrt{2\beta(1+\beta) + \frac{4\beta(2+\beta)M_{y,Rk}}{f_{h,1,k}d t_1^2} - \beta} \right] + \frac{F_{ax,Rk}}{4} & \text{(d)} \\ 1.05 \frac{f_{h,1,k}t_2d}{1+2\beta} \left[\sqrt{2\beta^2(1+\beta) + \frac{4\beta(1+2\beta)M_{y,Rk}}{f_{h,1,k}d t_2^2} - \beta} \right] + \frac{F_{ax,Rk}}{4} & \text{(e)} \\ 1.15 \sqrt{\frac{2\beta}{1+\beta}} \sqrt{2M_{y,Rk} f_{h,1,k} d} + \frac{F_{ax,Rk}}{4} & \text{(f)} \end{array} \right. \quad (8.6)$$

$F_{v,Rk} = 1537.3 \text{ N}$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 1.35 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

	(1)	(2)	
a_1	29	29 mm	... medsebojni razmak v smeri vlaken
a_2	24	24 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,e}$	80	80 mm	... obremenjeni konec
$a_{3,c}$	20	20 mm	... neobremenjeni konec
$a_{4,e}$	18	18 mm	... obremenjeni rob
$a_{4,c}$	18	18 mm	... neobremenjeni rob
a_l	50	50 mm	
m	2	... število vrst vijakov	
n	21	... število vijakov v vrsti (vzporedno z vlakni)	

$$n_{ef} = \min \left\{ \begin{array}{ll} n & (1) \\ n^{0.9} \sqrt{\frac{a_1}{13d}} & (2) \end{array} \right. = 13.858 = 13.858$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 37.50 \text{ kN}$$

• POVEŠTAVE MED CLT - MEDETAZA =

• OS 2(3) 4, 7, 10, 11, 12 ?

$F_{ed} = 406 \text{ kN} \rightarrow$ napašteran celo lot z streho!

2x Fischer Power-Full-ZT 8'0 x 220; $\gamma = 45^\circ$ KRIZ/300mm

• OS 5, 6 =

$F_{ed} < 406 \rightarrow$ celo lot pri strehi

2x Fischer Power-Full-ZT 8'0 x 220; $\gamma = 45^\circ$ KRIZ/300mm

• OS D, E \rightarrow gl. hidraze u jellene porostave

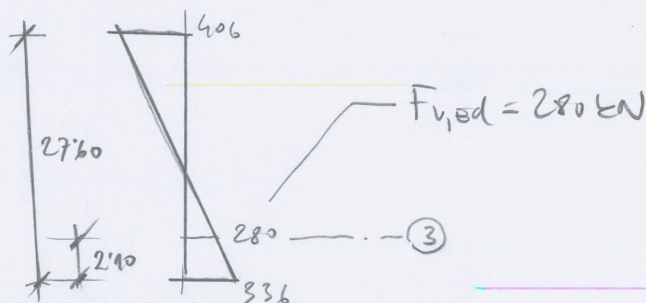
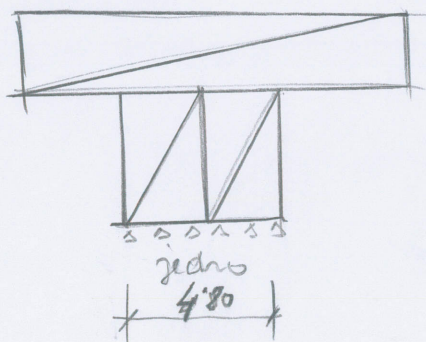
• OS C⁻, D⁺, F⁺

$F_{ed} < 308 \text{ kN} \rightarrow 2\phi 6/150 \text{ mm} \rightarrow$ gl. streho; $F_{ed} = 295.25 \text{ kN}$

2x Fischer Power-Fast FPF-SZ 60 x 100 2 $\phi 6/150 \text{ mm}$

• OS 3 =

filo moram porostri preko dvoch prednich panelov



$$F_{v,ed} = 295.25 \text{ kN} > 280 \text{ kN} \checkmark$$

1233222 KRIZ 2x

Fischer Power-Full FPF-ZT 8'0 x 220, $\gamma = 45^\circ$

STRIŽNA NOSILNOST KRIŽNE ZVEZE "X" ZA LESNE VIJAKE (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les (1)	GL24h
Les (2)	GL24h
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

GEOMETRIJSKI PODATKI

l_{ef}	100 mm
t_2	100 mm
d	8 mm
n	48 št. vijakov
vijaki z navojem po celi dolžini	

	(1)	(2)
$f_{m,k}$	24	24 MPa
ρ_k	380	380 kg/m ³
$f_{u,k}$	360 MPa	
γ_M	1.25	
k_{mod}	1.10	
$f_{c,90,k(2)}$		2.7 MPa
	(1)	(2)
α	31.0	31.0 ° ... smer obtežbe glede na smer vlaken

$$f_{\alpha,k} = 0.52d^{-0.5} \times l_{ef}^{-0.1} \times \rho_k^{0.8} \quad \begin{matrix} (1) & (2) \\ =13.436 & =13.436 \text{ MPa} \end{matrix}$$

Izvlačna nosilnost za 1 vijak (navoj po celi dolžini vijaka)

$$F_{ax,\alpha,Rk} = \min \left\{ \frac{f_{\alpha,k} \times d \times l_{ef,1}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{1,k}}{350} \right)^{0.8}; \frac{f_{\alpha,k} \times d \times l_{ef,2}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{2,k}}{350} \right)^{0.8}; f_{tens,k} \right\} = 2.000 \text{ kN}$$

Tlačna nosilnost za 1 vijak (navoj po celi dolžini vijaka)

$$F_{ax,\alpha,Rk} = \min \left\{ \frac{f_{\alpha,k} \times d \times l_{ef,1}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{1,k}}{350} \right)^{0.8}; \frac{f_{\alpha,k} \times d \times l_{ef,2}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{2,k}}{350} \right)^{0.8}; F_{ki,Rk} \right\} = 10.009 \text{ kN}$$

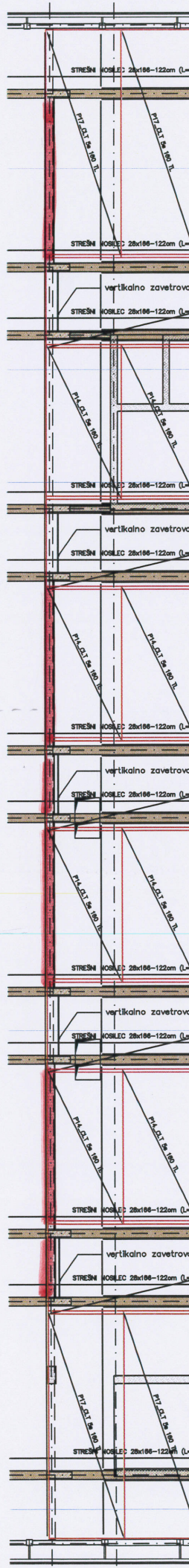
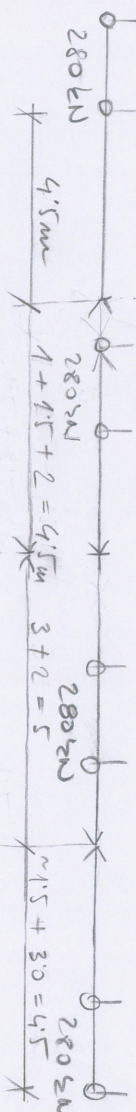
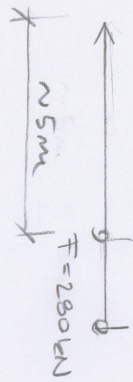
Skupna strižna nosilnost za 2 ravni vijakov postavljenih križno

skupaj vijakov 96

n_{ef}	=32.592
$F_{v,Rd,tot}$	=295.25 kN

SIDRANJE CLT V STENO

STREHA

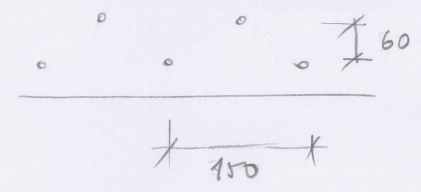


$$L_{\text{min}} = 4.5 \text{ m}$$

Struktura je sestavljena iz
glede na podane podatke
in L_{min}
evoluira zrak IL

$$F_{\text{red}} = 292.26 > V_{\text{Ed}} = 280.8 \text{ kN}$$

17BEREM 2M10/15cm CIK-CAK
upr. Fischer Power-Full
FPF - 2T 10,0x300



V STENASTI PANEL MORAMO
UMESTI SKUPNO SILA

$$N_{\text{tot}} = 1223 + 83 = 1246 \text{ kN}$$

preko zvez IL je že vneseno

$$212.99 \times 5 = 1065 \text{ kN (gl. 3)}$$

$$\Delta N = 1246 - 1065 = 181 \text{ kN}$$

$$4 \times 176.14 + 2 \times 48.78 = 722 \text{ kN}$$

$\rightarrow L = 1.2 \text{ m}$ ✓
 $\rightarrow \text{panel } L = 4.5 \text{ m}$

17BEREM 2M10/60

KLIFNO V DVEH RAVNINAH 45/450

upr. Fischer Power-Full
FPF - 2T 10,0x450

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	GL24h
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	380 kg/m ³
$f_{u,k}$	360 MPa
γ_M	1.25
k_{mod}	1.10

$$\alpha = 31.0^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 28.044 \text{ MPa}$$

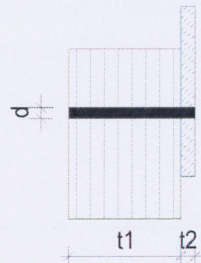
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 24.760 \text{ MPa}$$

$$k_{90} = 1.500$$

$$M_{y,Rk} = 0.3 f_{uk} d^{2.6} = 42996 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	140 mm
t_2	10 mm
d	10 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \begin{cases} 0.4 f_{h,k} t_1 d & (a) \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (b) \end{cases} \quad (8.9) \quad \begin{matrix} -/- \\ -/- \end{matrix}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & (c) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (d) \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (e) \end{cases} \quad (8.10) \quad \begin{matrix} 34664.0 \text{ N} \\ 14790.7 \text{ N} \\ 7504.4 \text{ N} \end{matrix}$$

$$F_{v,Rk} = 7504.4 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 6.60 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	49 mm	... medsebojni razmak v smeri vlaken
a_2	40 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	80 mm	... obremenjeni konec
$a_{3,c}$	32 mm	... neobremenjeni konec
$a_{4,t}$	30 mm	... obremenjeni rob
$a_{4,c}$	30 mm	... neobremenjeni rob
a_l	150 mm	
m	2	... število vrst vijakov
n	30	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ n, n^{0.9} \sqrt{\frac{a_1}{13d}} \right\} = 22.128$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 292.26 \text{ kN}$$

$$F_{v,Rd,eff} = 4.87 \text{ kN}$$

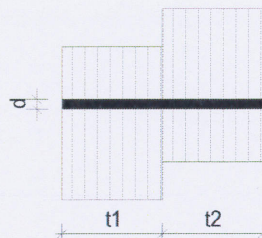
VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-LES (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les (1)	GL24h
Les (2)	GL24h
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

GEOMETRIJSKI PODATKI

t_1	120 mm
t_2	100 mm
d	10 mm



	(1)	(2)
$f_{m,k}$	24	24 MPa
ρ_k	380	380 kg/m ³
$f_{u,k}$	360	MPa
γ_M	1.25	
k_{mod}	1.10	

	(1)	(2)
α	31.0	0.0 ° ... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k \quad (1) \quad (2)$$

$$= 28.044 \quad = 28.044 \text{ MPa}$$

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} \quad = 24.760 \quad = 28.044 \text{ MPa}$$

$$k_{90} = 1.500(1) = 1.500(2) \quad \beta = \frac{f_{h,2,k}}{f_{h,1,k}} = 1.133$$

$$M_{y,Rk} = 0.3f_{uk}d^{2.6} = 42996 \text{ Nmm}$$

$$F_{v,Rk} = \min \left\{ \begin{array}{ll} f_{t1,k} t_1 d & (a) \\ f_{t2,k} t_2 d & (b) \\ \frac{f_{h,1,k} t_1 d}{1 + \beta} \left[\sqrt{\beta + 2\beta^2 \left[1 + \frac{t_2}{t_1} + \left(\frac{t_2}{t_1} \right)^2 \right] + \beta^3 \left(\frac{t_2}{t_1} \right)^2} - \beta \left(1 + \frac{t_2}{t_1} \right) \right] + \frac{F_{ax,Rk}}{4} & (c) \\ 1.05 \frac{f_{h,1,k} t_1 d}{2 + \beta} \left[\sqrt{2\beta(1 + \beta) + \frac{4\beta(2 + \beta)M_{y,Rk}}{f_{h,1,k} d t_1^2}} - \beta \right] + \frac{F_{ax,Rk}}{4} & (d) \\ 1.05 \frac{f_{h,1,k} t_2 d}{1 + 2\beta} \left[\sqrt{2\beta^2(1 + \beta) + \frac{4\beta(1 + 2\beta)M_{y,Rk}}{f_{h,1,k} d t_2^2}} - \beta \right] + \frac{F_{ax,Rk}}{4} & (e) \\ 1.15 \sqrt{\frac{2\beta}{1 + \beta}} \sqrt{2M_{y,Rk} f_{h,1,k} d} + \frac{F_{ax,Rk}}{4} & (f) \end{array} \right. \quad (8.6)$$

$$F_{v,Rk} = 5468.9 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 4.81 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

	(1)	(2)	
a_1	49	50 mm	... medsebojni razmak v smeri vlaken
a_2	40	40 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	80	80 mm	... obremenjeni konec
$a_{3,c}$	32	40 mm	... neobremenjeni konec
$a_{4,t}$	30	30 mm	... obremenjeni rob
$a_{4,c}$	30	30 mm	... neobremenjeni rob
a_l	150	150 mm	
m	2	... število vrst vijakov	
n	30	... število vijakov v vrsti (vzporedno z vlakni)	

$$n_{ef} = \min \left\{ \begin{array}{ll} n & (1) \\ n^{0.9} \sqrt{\frac{a_1}{13d}} & (2) \end{array} \right. = 22.128 \quad = 22.128$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 212.99 \text{ kN}$$

STRIŽNA NOSILNOST KRIŽNE ZVEZE "X" ZA LESNE VIJAKE (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les (1)	GL24h
Les (2)	GL24h
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

GEOMETRIJSKI PODATKI

l_{ef}	200 mm
t_2	200 mm
d	10 mm
n	7 št. vijakov
vijaki z navojem po celi dolžini	

	(1)	(2)
$f_{m,k}$	24	24 MPa
ρ_k	380	380 kg/m ³
$f_{u,k}$	360 MPa	
γ_M	1.25	
k_{mod}	1.10	
$f_{c,90,k(2)}$		2.7 MPa
α	(1)	(2)
	45.0	45.0 ° ... smer obtežbe glede na smer vlaken

$$f_{\alpha x,k} = 0.52 d^{-0.5} \times l_{ef}^{-0.1} \times \rho_k^{0.8} \quad (1) \quad (2)$$

$$= 11.213 \quad = 11.213 \text{ MPa}$$

Izvlačna nosilnost za 1 vijak (navoj po celi dolžini vijaka)

$$F_{ax,\alpha,Rk} = \min \left\{ \frac{f_{\alpha x,k} \times d \times l_{ef,1}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{1,k}}{350} \right)^{0.8}; \frac{f_{\alpha x,k} \times d \times l_{ef,2}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{2,k}}{350} \right)^{0.8}; f_{tens,k} \right\} = 21.774 \text{ kN}$$

Tlačna nosilnost za 1 vijak (navoj po celi dolžini vijaka)

$$F_{ax,\alpha,Rk} = \min \left\{ \frac{f_{\alpha x,k} \times d \times l_{ef,1}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{1,k}}{350} \right)^{0.8}; \frac{f_{\alpha x,k} \times d \times l_{ef,2}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{2,k}}{350} \right)^{0.8}; F_{ki,Rk} \right\} = 21.774 \text{ kN}$$

Skupna strižna nosilnost za 2 ravni vijakov postavljenih križno

skupaj vijakov 14

$$n_{ef} = 5.762$$

$$F_{v,Rd,tot} = 156.14 \text{ kN}$$

STRIŽNA NOSILNOST KRIŽNE ZVEZE "X" ZA LESNE VIJAKE (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les (1)	GL24h
Les (2)	GL24h
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

GEOMETRIJSKI PODATKI

l_{ef}	200 mm
t_2	200 mm
d	10 mm
n	2 št. vijakov
vijaki z navojem po celi dolžini	

	(1)	(2)
$f_{m,k}$	24	24 MPa
ρ_k	380	380 kg/m ³
$f_{u,k}$	360 MPa	
γ_M	1.25	
k_{mod}	1.10	
$f_{c,90,k(2)}$		2.7 MPa
α	(1) 45.0	(2) 45.0
° ... smer obtežbe glede na smer vlaken		

$$f_{\alpha x,k} = 0.52 d^{-0.5} \times l_{ef}^{-0.1} \times \rho_k^{0.8} \quad \begin{matrix} (1) & (2) \\ =11.213 & =11.213 \text{ MPa} \end{matrix}$$

Izvlačna nosilnost za 1 vijak (navoj po celi dolžini vijaka)

$$F_{ax,\alpha,Rk} = \min \left\{ \frac{f_{\alpha x,k} \times d \times l_{ef,1}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{1,k}}{350} \right)^{0.8}, \frac{f_{\alpha x,k} \times d \times l_{ef,2}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{2,k}}{350} \right)^{0.8}, f_{tens,k} \right\} = 21.774 \text{ kN}$$

Tlačna nosilnost za 1 vijak (navoj po celi dolžini vijaka)

$$F_{ax,\alpha,Rk} = \min \left\{ \frac{f_{\alpha x,k} \times d \times l_{ef,1}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{1,k}}{350} \right)^{0.8}, \frac{f_{\alpha x,k} \times d \times l_{ef,2}}{1.2 \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_{2,k}}{350} \right)^{0.8}, F_{ki,Rk} \right\} = 21.774 \text{ kN}$$

Skupna strižna nosilnost za 2 ravni vijakov postavljenih križno

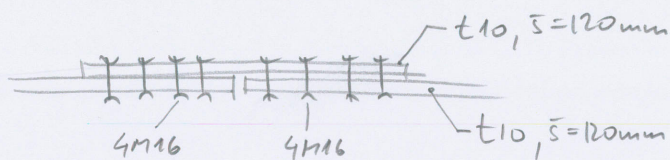
skupaj vijakov 4

$$n_{ef} = 1.800$$

$$F_{v,Rd,tot} = 48.78 \text{ kN}$$

$$F_{Ed} = 238,29 \text{ kN}$$

- spajanje profila preko zaplate



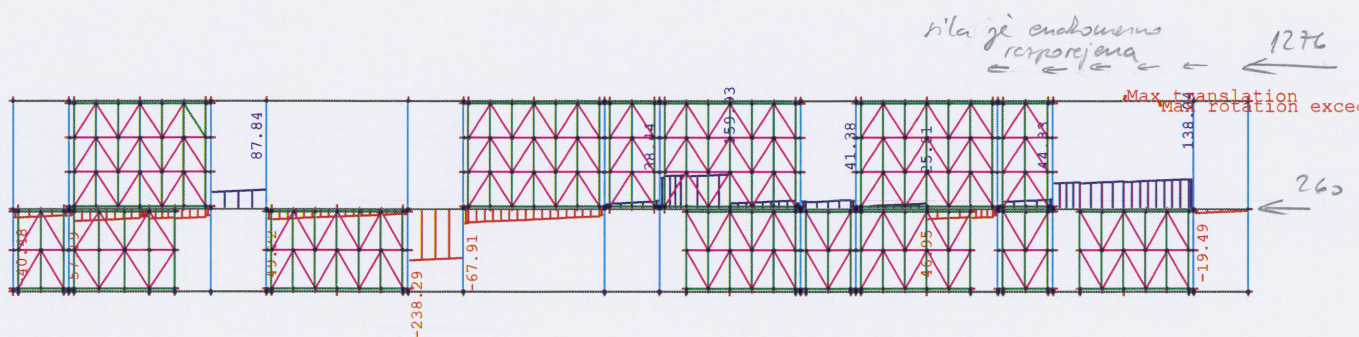
IZBEREN 4 M16, 8'8 na vsaki strani spoja

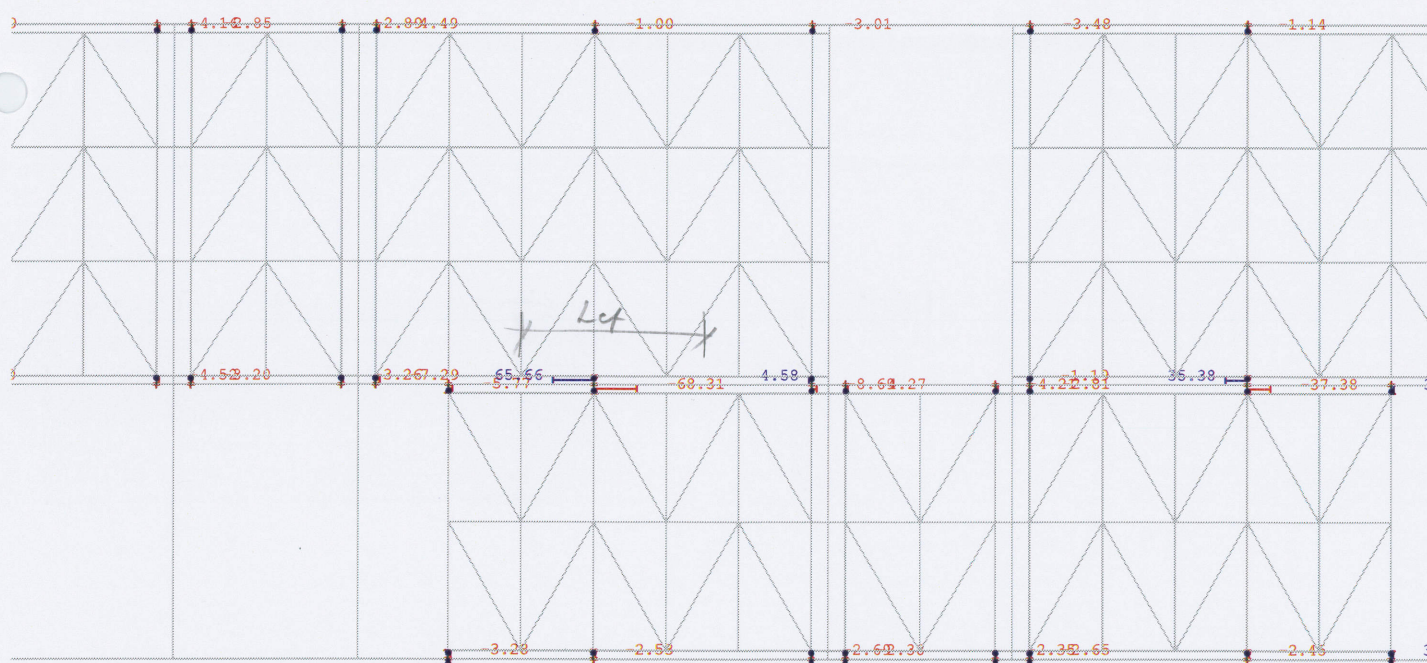
$$4 \times 603 = 2412 (+1.5\%) \text{ OK} \checkmark$$

- kontrola neto preseka

$$A_{net} = (12 - 2 \times 1.8) \times 10 = 840 \text{ cm}^2$$

$$F_{Ed}^N = 840 \times 35.5 = 298.2 \text{ kN} > 238.29 \text{ kN} \checkmark$$





$$F_{v,ed} = 68.3 \text{ kN}$$

$$\text{vplivna širina } L_{ef} \approx 2.6 \text{ m} \rightarrow F_{v,ed} = 68.68 \text{ kN} > 68.3 \text{ kN} \checkmark$$

IZBEREM VIJAKE $2 \times M12/400 \text{ mm}$, ZAMIK VEDOLŽNO/PREČNO $= 200/60 \text{ mm}$
npr. Fischer Power-Fast FPF-HT 12.0 x 140 ZPF25

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	C24
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

$f_{m,k}$	24 MPa
ρ_k	350 kg/m ³
$f_{u,k}$	360 MPa
γ_M	1.3
k_{mod}	1.10

$\alpha = 31.0^\circ$... smer obtežbe glede na smer vlaken

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 25.256 \text{ MPa}$$

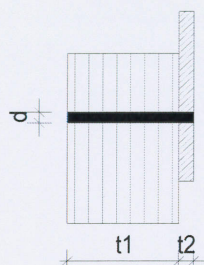
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 22.143 \text{ MPa}$$

$$k_{90} = 1.530$$

$$M_{y,Rk} = 0.3 f_{uk} d^{2.6} \quad \text{oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 57559 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	120 mm
t_2	10 mm
d	12 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{ll} 0.4 f_{h,k} t_1 d & \text{(a)} \\ 1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & \text{(b)} \end{array} \right. \quad (8.9)$$

$$12754.3 \text{ N}$$

$$6360.3 \text{ N}$$

Debela priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{array}{ll} f_{h,k} t_1 d & \text{(c)} \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & \text{(d)} \\ 2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & \text{(e) (A1)} \end{array} \right. \quad (8.10)$$

$$31885.8 \text{ N}$$

$$13880.8 \text{ N}$$

$$8994.8 \text{ N}$$

OPOMBA: Potrebna je interpolacija med tenko in debelo priključno pločevino

$$F_{v,Rk} = 8116.7 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 6.87 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	58 mm	... medsebojni razmak v smeri vlaken
a_2	48 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	84 mm	... obremenjeni konec
$a_{3,c}$	38 mm	... neobremenjeni konec
$a_{4,t}$	36 mm	... obremenjeni rob
$a_{4,c}$	36 mm	... neobremenjeni rob
a_l	400 mm	
m	2	... število vrst vijakov
n	5	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \begin{array}{l} n \\ n^{0.9} \sqrt{\frac{a_1}{13d}} \end{array} \right. = 5.000$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 68.68 \text{ kN}$$

$$F_{v,Rd,eff} = 6.87 \text{ kN}$$

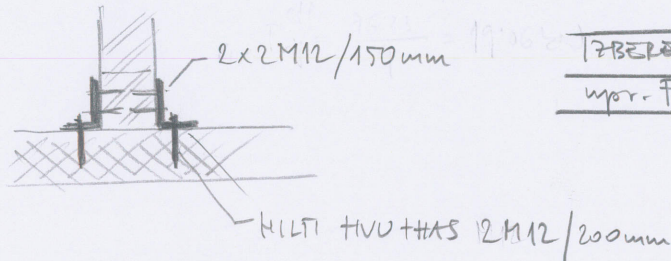
SIDRANJE V AB PLOŠČO

$$F_{ed} = 293.59 \text{ kN}$$

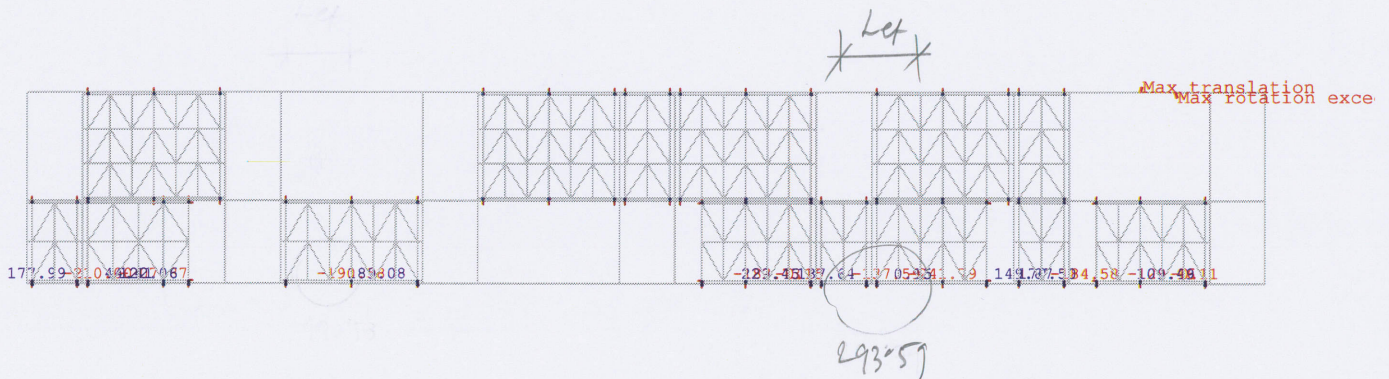
$$l_{ef} \approx 3.0 \text{ m}$$

$$F'_{ed} = \frac{293.59}{3.0} = 97.86 \text{ kN/m}$$

$$F_{ed}^{1.35} = \frac{293.59}{4} = 73.4 \text{ kN} < F_{ed} = 77.62 \text{ kN} \checkmark$$



IZBEREM 2x2M12/150mm
upr. Fischer Power-Fast FPF-H 12.0 x 14.0 FPF 25



HILTI

$$V_{k,d,c} = 4.2 \text{ kN} \times 1.22 \times 5.0 \times 1.0 = 25.62 \text{ kN}$$

$$V'_{k,d,c} = \frac{25.62}{0.20} = 128.1 \text{ kN/m} > 97.86 \text{ kN/m}$$

IZBEREM HILTI HVU+HAS 2M12/200mm

IZVLEKOV NA KRAJH PANELOV NI OŽ ŠO MAJHNI $N = 11 \text{ kN}$ ^{max}
GLEDE NA GLOBALNI MODEL, KI VKLJUČUJE VSE VPLIVE

VIJAČENA/MOZNIČENA ENOSTRIŽNA ZVEZA LES-JEKLO (SIST EN 1995-1-1: 2005)

MATERIALNE KARAKTERISTIKE

Les	C24
Jeklo veznega sr.	S235
Razred trajanja obt.	Trenutna
Razred uporabe	1

$$\begin{aligned} f_{m,k} &= 24 \text{ MPa} \\ \rho_k &= 350 \text{ kg/m}^3 \\ f_{u,k} &= 360 \text{ MPa} \\ \gamma_M &= 1.3 \\ k_{mod} &= 1.10 \end{aligned}$$

$$\alpha = 90.0^\circ \dots \text{smer obtežbe glede na smer vlaken}$$

$$f_{h,0,k} = 0.082(1 - 0.01d)\rho_k = 25.256 \text{ MPa}$$

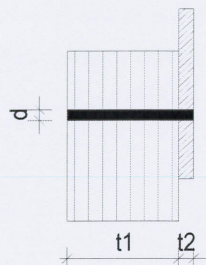
$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} = 16.507 \text{ MPa}$$

$$k_{90} = 1.530$$

$$M_{y,Rk} = 0.3 f_{uk} d^{2.6} \quad \text{oz. } M_{y,Rk} = 0.15 \times 600 \times d^{2.6} = 57559 \text{ Nmm}$$

GEOMETRIJSKI PODATKI

t_1	120 mm
t_2	8 mm
d	12 mm



Tanka priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{aligned} &0.4 f_{h,k} t_1 d & (a) & 9508.1 \text{ N} \\ &1.15 \sqrt{2 M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (b) & 5491.6 \text{ N} \end{aligned} \right. \quad (8.9)$$

Debela priključna pločevina

$$F_{v,Rk} = \min \left\{ \begin{aligned} &f_{h,k} t_1 d & (c) & 23770.4 \text{ N} \\ &f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,Rk}}{4} & (d) & 10517.6 \text{ N} \\ &2.3 \sqrt{M_{y,Rk} f_{h,k}} d + \frac{F_{ax,Rk}}{4} & (e) \quad (A_1) & 7766.3 \text{ N} \end{aligned} \right. \quad (8.10)$$

OPOMBA: Potrebna je interpolacija med tenko in debelo priključno pločevino

$$F_{v,Rk} = 6249.8 \text{ N}$$

Računska strižna nosilnost zveze

$$F_{v,Rd} = 5.29 \text{ kN}$$

Minimalni medsebojni razmaki in razdalje vijakov do roba elementa

a_1	48 mm	... medsebojni razmak v smeri vlaken
a_2	48 mm	... medsebojni razmak pravokotno na vlakna
$a_{3,t}$	84 mm	... obremenjeni konec
$a_{3,c}$	73 mm	... neobremenjeni konec
$a_{4,t}$	48 mm	... obremenjeni rob
$a_{4,c}$	36 mm	... neobremenjeni rob
a_l	150 mm	
m	1	... število vrst vijakov
n	20	... število vijakov v vrsti (vzporedno z vlakni)

$$n_{ef} = \min \left\{ \begin{aligned} &n \\ &n^{0.9} \sqrt{\frac{a_1}{13d}} \end{aligned} \right. = 14.678$$

Računska strižna nosilnost spoja

$$F_{v,Rd,tot} = 77.62 \text{ kN}$$

$$F_{v,Rd,eff} = 3.88 \text{ kN}$$

• SIDRANJE VERT. PROFILOV ZAVETROVANJA =

$$N_{ed} = 933'2 \text{ kN} + 527'7 \text{ kN} \times \cos 38^\circ = 1350'0 \text{ kN}$$

$$A_{potr} = \frac{1350'0}{35'5} = 38'0 \text{ cm}^2 \rightarrow \text{izberem } 2 \times \text{HEB100} (A_{dej} = 2 \times 26'0 = 52 \text{ cm}^2)$$

$$f_{bd} = 0'11 \text{ kN/cm}^2 \rightarrow A_{bd} = \frac{1350 \text{ kN}}{0'11 \text{ kN/cm}^2} = 12273 \text{ cm}^2$$

$$\sigma_{bd} = (2 \times 10 + 2 \times (10 - 0'60) + 2 \times 5'6) \times 2 = 100 \text{ cm}$$

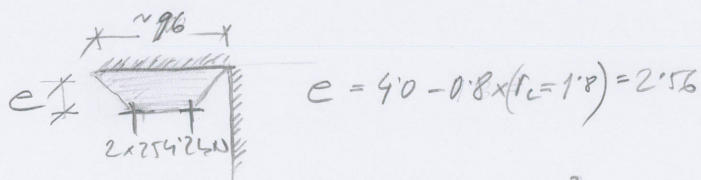
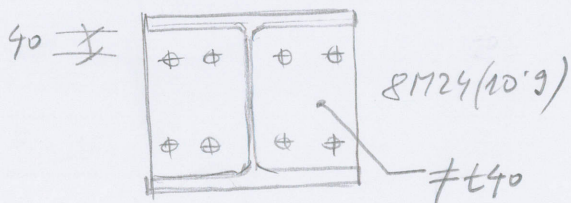
$$L_{bd} = \frac{12273 \text{ cm}^2}{100 \text{ cm}} = 122'7 \text{ cm}$$

izberem dolžino profila
 $L = 1'50 \text{ m}$

• čelni stik HEB200

$$N_{ed} = 1605'6 \text{ kN}$$

izberem 8M24(10'9) $\rightarrow \underline{F_{t,rd} = 8 \times 254'2 = 2033'6 \text{ kN} > 1605'6 \text{ kN} \checkmark}$



$$w_{potr} = \frac{F_e}{f_{yd}} = \frac{254'2 \times 2 \times 2'56}{35'5} = 36'7 \text{ cm}^3$$

$$t_{potr} = \sqrt{\frac{4w}{b}} = \sqrt{\frac{4 \times 36'7}{9'6}} = 3'9 \text{ cm}$$

izberem #t40mm