general wooden joint nach EC 3 - NA-Deutschland

1. input data

1.1. general statements

service class 1, origin of the coordinate system at the intersection of the beams

1.2. node plate

external steel plate S235 (St37), thickness t=10.0 mm, shape: contour
contour plate external, on both sides
The steel plate must be structurally secured against buckling
fastener with a diameter < 8.0mm are discretised as a point and not as a hole
The missing areas are taken into account by reducing the cross-section thickness.
coordinates of the steel plate

Nr	x_k mm	y_k mm	Nr	x_k mm	y_k mm
1	-700.0	-100.0	4	700.0	100.0
2	-700.0	100.0	5	700.0	-100.0
3	1.0	100.0	6	-700.0	-100.0

1.3. connected beams

Nr.	bar	material	b mm	t mm	α °
1	strap both sides w. kink	solconiftimbr C24	200	120	0

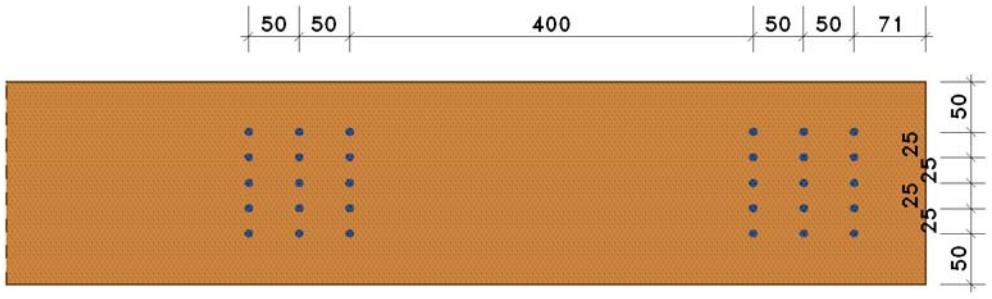
1.4. fastener

1.4.1. strap left

nail, 4.6 x 90.0 mm, double-sided, d_k = 8.0 mm, not predrilled
load-bearing capacity is reduced acc. to DIN EN 1995-1-1, 8.3.1.1(8)
$F_{v,Rk}$ increased acc. to DIN EN 1995-1-1, 8.2.3(4)
$F_{v,Rd}$ is calculated with the exact verification acc. to DIN EN 1995-1-1, 8.2.3
30 fastener, a_1 = 50 mm, a_2 = 25 mm on both sides
centroid of the fasteners from nodal point S at x_s = -370 mm, y_s = 0 mm
polar moment of inertia I_p = 1962500 mm^4
fastener caused holes are taken into account by increasing the rated stresses in the hole area
area hole range = 14018.56 mm^2, area holes = 249.29 mm^2 ⇒ increase factor = 1.0181
coordinates of the fasteners (origin in the nodal point, x to the right, y to the top)

Nr	x_k mm	y_k mm	Nr	x_k mm	y_k mm	Nr	x_k mm	y_k mm	Nr	x_k mm	y_k mm
1	-70.0	50.0	9	-120.0	-25.0	17	-570.0	25.0	25	-620.0	-50.0
2	-70.0	25.0	10	-120.0	-50.0	18	-570.0	0.0	26	-670.0	50.0
3	-70.0	0.0	11	-170.0	50.0	19	-570.0	-25.0	27	-670.0	25.0
4	-70.0	-25.0	12	-170.0	25.0	20	-570.0	-50.0	28	-670.0	0.0
5	-70.0	-50.0	13	-170.0	0.0	21	-620.0	50.0	29	-670.0	-25.0
6	-120.0	50.0	14	-170.0	-25.0	22	-620.0	25.0	30	-670.0	-50.0
7	-120.0	25.0	15	-170.0	-50.0	23	-620.0	0.0			
8	-120.0	0.0	16	-570.0	50.0	24	-620.0	-25.0			

fastener strap left scale 1:75

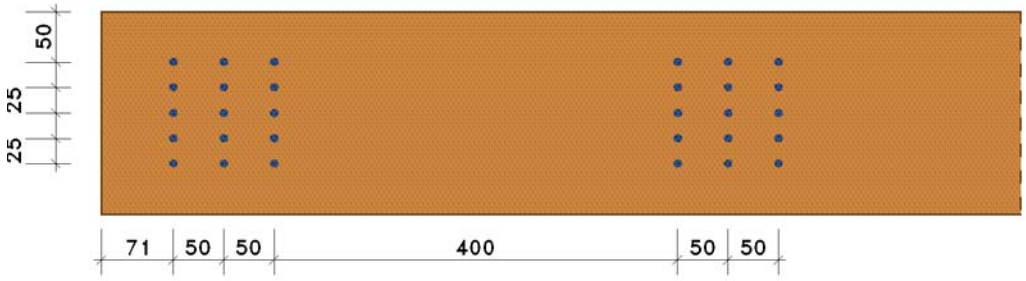


1.4.2. strap right

nail, 4.6 x 90.0 mm, double-sided, d_k = 8.0 mm, not predrilled
load-bearing capacity is reduced acc. to DIN EN 1995-1-1, 8.3.1.1(8)
$F_{v,Rk}$ increased acc. to DIN EN 1995-1-1, 8.2.3(4)
$F_{v,Rd}$ is calculated with the exact verification acc. to DIN EN 1995-1-1, 8.2.3
30 fastener, a_1 = 50 mm, a_2 = 25 mm on both sides
centroid of the fasteners from nodal point S at x_s = 370 mm, y_s = 0 mm
polar moment of inertia I_p = 1962500 mm⁴
fastener caused holes are taken into account by increasing the rated stresses in the hole area
area hole range = 14018.56 mm², area holes = 249.29 mm² ⇒ increase factor = 1.0181
coordinates of the fasteners (origin in the nodal point, x to the right, y to the top)

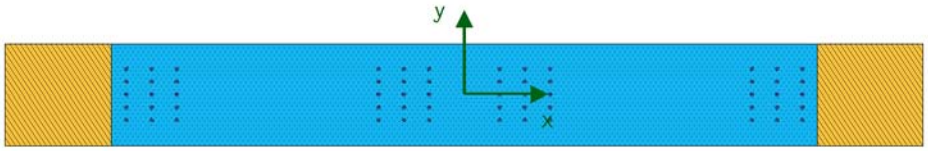
Nr	x_k mm	y_k mm	Nr	x_k mm	y_k mm	Nr	x_k mm	y_k mm	Nr	x_k mm	y_k mm
1	70.0	50.0	9	120.0	-25.0	17	570.0	25.0	25	620.0	-50.0
2	70.0	25.0	10	120.0	-50.0	18	570.0	0.0	26	670.0	50.0
3	70.0	0.0	11	170.0	50.0	19	570.0	-25.0	27	670.0	25.0
4	70.0	-25.0	12	170.0	25.0	20	570.0	-50.0	28	670.0	0.0
5	70.0	-50.0	13	170.0	0.0	21	620.0	50.0	29	670.0	-25.0
6	120.0	50.0	14	170.0	-25.0	22	620.0	25.0	30	670.0	-50.0
7	120.0	25.0	15	170.0	-50.0	23	620.0	0.0			
8	120.0	0.0	16	570.0	50.0	24	620.0	-25.0			

fastener strap right scale 1:75



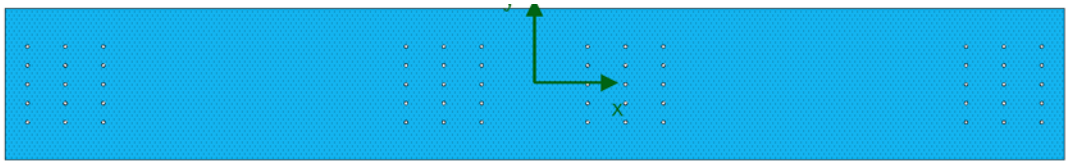
1.5. nodal point

view scale 1:150

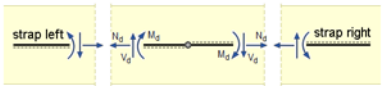


1.6. node plate

view scale 1:100



1.7. load combinations (design internal forces)



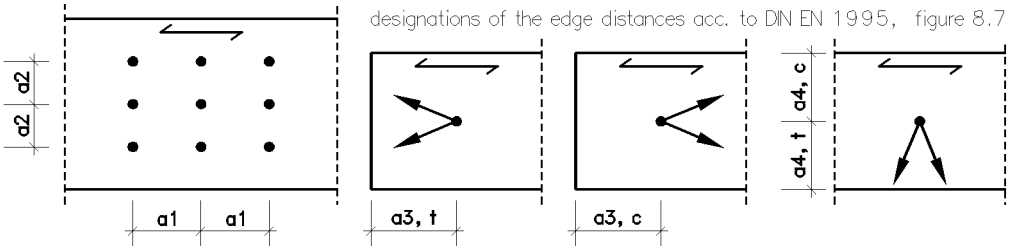
1.7.1. sum M straps, KLED: medium-term

Nr	bar	N_d kN	M_d kNm	V_d kN	k_{mod} -	γ -
1	strap left	0.000	7.965	5.500	0.800	1.30
2	strap right	0.000	-7.965	5.500	0.800	1.30
3	ΣH, ΣM, ΣV	-0.000	0.000	0.000	---	---

2. results of all load case combinations

2.1. fastener strap left

member	a_1 mm	a_2 mm	a_{3t} mm	a_{4t} mm	a_{3c} mm	a_{4c} mm
stplt	13.4	13.4	6.7	6.7	6.7	6.7
outtimbmbr	32.2	16.1	69.0	32.2	46.0	23.0



2.1.1. sum M straps

N_d = 0.000 kN, V_d = 5.500 kN, $M_{v,d}$ = 7.965 + -0.370 x 5.500 + 0.000 x 0.000 = 5.930 KNm

Nr	F_{Mi} kN	F_{Mxi} kN	F_{Myi} kN	F_{MNi} kN	F_{MVi} kN	F_{totHi} kN	F_{totVi} kN	F_{toti} kN	α_{toti} °	$f_{h,\alpha,k}$ N/mm²	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
1	0.919	0.151	0.906	0.151	0.906	0.151	1.090	1.100	82.1	18.16	2.8011	0.07	0.39
2	0.910	0.076	0.906	0.076	0.906	0.076	1.090	1.092	86.0	18.16	2.8011	0.03	0.39
3	0.906	0.000	0.906	-0.000	0.906	-0.000	1.090	1.090	90.0	18.16	2.8011	0.00	0.39
4	0.910	-0.076	0.906	-0.076	0.906	-0.076	1.090	1.092	94.0	18.16	2.8011	0.03	0.39
5	0.919	-0.151	0.906	-0.151	0.906	-0.151	1.090	1.100	97.9	18.16	2.8011	0.07	0.39
6	0.770	0.151	0.755	0.151	0.755	0.151	0.939	0.951	80.9	18.16	2.8011	0.07	0.34
7	0.759	0.076	0.755	0.076	0.755	0.076	0.939	0.942	85.4	18.16	2.8011	0.03	0.34
8	0.755	0.000	0.755	-0.000	0.755	-0.000	0.939	0.939	90.0	18.16	2.8011	0.00	0.34
9	0.759	-0.076	0.755	-0.076	0.755	-0.076	0.939	0.942	94.6	18.16	2.8011	0.03	0.34
10	0.770	-0.151	0.755	-0.151	0.755	-0.151	0.939	0.951	99.1	18.16	2.8011	0.07	0.34
11	0.623	0.151	0.604	0.151	0.604	0.151	0.788	0.802	79.1	18.16	2.8011	0.07	0.29
12	0.609	0.076	0.604	0.076	0.604	0.076	0.788	0.791	84.5	18.16	2.8011	0.03	0.28
13	0.604	0.000	0.604	-0.000	0.604	-0.000	0.788	0.788	90.0	18.16	2.8011	0.00	0.28
14	0.609	-0.076	0.604	-0.076	0.604	-0.076	0.788	0.791	95.5	18.16	2.8011	0.03	0.28
15	0.623	-0.151	0.604	-0.151	0.604	-0.151	0.788	0.802	100.9	18.16	2.8011	0.07	0.29
16	0.623	0.151	-0.604	0.151	-0.604	0.151	-0.421	0.447	-70.3	18.16	2.8011	0.07	0.16
17	0.609	0.076	-0.604	0.076	-0.604	0.076	-0.421	0.428	-79.8	18.16	2.8011	0.03	0.15
18	0.604	0.000	-0.604	0.000	-0.604	0.000	-0.421	0.421	-90.0	18.16	2.8011	0.00	0.15
19	0.609	-0.076	-0.604	-0.076	-0.604	-0.076	-0.421	0.428	-100.2	18.16	2.8011	0.03	0.15
20	0.623	-0.151	-0.604	-0.151	-0.604	-0.151	-0.421	0.447	-109.7	18.16	2.8011	0.07	0.16
21	0.770	0.151	-0.755	0.151	-0.755	0.151	-0.572	0.592	-75.2	18.16	2.8011	0.07	0.21
22	0.759	0.076	-0.755	0.076	-0.755	0.076	-0.572	0.577	-82.5	18.16	2.8011	0.03	0.21
23	0.755	0.000	-0.755	0.000	-0.755	0.000	-0.572	0.572	-90.0	18.16	2.8011	0.00	0.20
24	0.759	-0.076	-0.755	-0.076	-0.755	-0.076	-0.572	0.577	-97.5	18.16	2.8011	0.03	0.21
25	0.770	-0.151	-0.755	-0.151	-0.755	-0.151	-0.572	0.592	-104.8	18.16	2.8011	0.07	0.21
26	0.919	0.151	-0.906	0.151	-0.906	0.151	-0.723	0.739	-78.2	18.16	2.8011	0.07	0.26
27	0.910	0.076	-0.906	0.076	-0.906	0.076	-0.723	0.727	-84.0	18.16	2.8011	0.03	0.26
28	0.906	0.000	-0.906	0.000	-0.906	0.000	-0.723	0.723	-90.0	18.16	2.8011	0.00	0.26
29	0.910	-0.076	-0.906	-0.076	-0.906	-0.076	-0.723	0.727	-96.0	18.16	2.8011	0.03	0.26
30	0.919	-0.151	-0.906	-0.151	-0.906	-0.151	-0.723	0.739	-101.8	18.16	2.8011	0.07	0.26

maximum utilization of fasteners U_{max} = 0.39 ≤ 1 => **verification fulfilled**

2.1.2. verification block shear failure acc. to DIN EN 1995-1-1, annex A, strap left

$L_{net,t}$ = 100 mm, t_1 = 60 mm ⇒ $A_{net,t}$ = 6000 mm², $M_{y,k}$ = 9515.7 Nmm, $f_{h,k}$ = 18.16 N/mm²
$L_{net,v}$ = 142 mm, t_{ef} = 60 mm ⇒ $A_{net,v}$ = 8520 mm² (Versagensmechanismus c,f,j/l,k,m)
$L_{net,v}$ = 142 mm ⇒ $A_{net,v}$ = 8520 mm² ⇒ $F_{bs,Rk}$ = 130.50 kN

load	N_d kN	$F_{bs,Rd}$ kN	U_{bs} -
1	0.000	80.308	0.00

maximum utilization block shear failure U_{max} = 0.00 ≤ 1 => **verification fulfilled**

2.2. fastener strap right

member	a_1 mm	a_2 mm	a_{3t} mm	a_{4t} mm	a_{3c} mm	a_{4c} mm
stplt	13.4	13.4	6.7	6.7	6.7	6.7
outtimbmbr	32.2	16.1	69.0	32.2	46.0	23.0

2.2.1. sum M straps

N_d = 0.000 kN, V_d = 5.500 kN, $M_{v,d}$ = -7.965 + -0.370 x 5.500 + -0.000 x 0.000 = -10.000 KNm

Nr	F_{Mi} kN	F_{Mxi} kN	F_{Myi} kN	F_{MNi} kN	F_{MVi} kN	F_{totHi} kN	F_{totVi} kN	F_{toti} kN	α_{toti} °	$f_{h,\alpha,k}$ N/mm²	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
1	-1.550	-0.255	1.529	0.255	-1.529	0.255	-1.345	1.369	-79.3	18.16	2.8011	0.11	0.49
2	-1.534	-0.127	1.529	0.127	-1.529	0.127	-1.345	1.351	-84.6	18.16	2.8011	0.06	0.48
3	-1.529	-0.000	1.529	0.000	-1.529	0.000	-1.345	1.345	-90.0	18.16	2.8011	0.00	0.48
4	-1.534	0.127	1.529	-0.127	-1.529	-0.127	-1.345	1.351	-95.4	18.16	2.8011	0.06	0.48
5	-1.550	0.255	1.529	-0.255	-1.529	-0.255	-1.345	1.369	-100.7	18.16	2.8011	0.11	0.49
6	-1.299	-0.255	1.274	0.255	-1.274	0.255	-1.091	1.120	-76.9	18.16	2.8011	0.11	0.40
7	-1.280	-0.127	1.274	0.127	-1.274	0.127	-1.091	1.098	-83.3	18.16	2.8011	0.06	0.39
8	-1.274	-0.000	1.274	0.000	-1.274	0.000	-1.091	1.091	-90.0	18.16	2.8011	0.00	0.39
9	-1.280	0.127	1.274	-0.127	-1.274	-0.127	-1.091	1.098	-96.7	18.16	2.8011	0.06	0.39
10	-1.299	0.255	1.274	-0.255	-1.274	-0.255	-1.091	1.120	-103.1	18.16	2.8011	0.11	0.40
11	-1.050	-0.255	1.019	0.255	-1.019	0.255	-0.836	0.874	-73.0	18.16	2.8011	0.11	0.31
12	-1.027	-0.127	1.019	0.127	-1.019	0.127	-0.836	0.845	-81.3	18.16	2.8011	0.06	0.30
13	-1.019	-0.000	1.019	0.000	-1.019	0.000	-0.836	0.836	-90.0	18.16	2.8011	0.00	0.30
14	-1.027	0.127	1.019	-0.127	-1.019	-0.127	-0.836	0.845	-98.7	18.16	2.8011	0.06	0.30
15	-1.050	0.255	1.019	-0.255	-1.019	-0.255	-0.836	0.874	-107.0	18.16	2.8011	0.11	0.31
16	-1.050	-0.255	-1.019	0.255	1.019	0.255	1.202	1.229	78.0	18.16	2.8011	0.11	0.44
17	-1.027	-0.127	-1.019	0.127	1.019	0.127	1.202	1.209	84.0	18.16	2.8011	0.06	0.43
18	-1.019	-0.000	-1.019	-0.000	1.019	-0.000	1.202	1.202	90.0	18.16	2.8011	0.00	0.43
19	-1.027	0.127	-1.019	-0.127	1.019	-0.127	1.202	1.209	96.0	18.16	2.8011	0.06	0.43
20	-1.050	0.255	-1.019	-0.255	1.019	-0.255	1.202	1.229	102.0	18.16	2.8011	0.11	0.44
21	-1.299	-0.255	-1.274	0.255	1.274	0.255	1.457	1.479	80.1	18.16	2.8011	0.11	0.53
22	-1.280	-0.127	-1.274	0.127	1.274	0.127	1.457	1.463	85.0	18.16	2.8011	0.06	0.52
23	-1.274	-0.000	-1.274	-0.000	1.274	-0.000	1.457	1.457	90.0	18.16	2.8011	0.00	0.52
24	-1.280	0.127	-1.274	-0.127	1.274	-0.127	1.457	1.463	95.0	18.16	2.8011	0.06	0.52
25	-1.299	0.255	-1.274	-0.255	1.274	-0.255	1.457	1.479	99.9	18.16	2.8011	0.11	0.53
26	-1.550	-0.255	-1.529	0.255	1.529	0.255	1.712	1.731	81.5	18.16	2.8011	0.11	0.62
27	-1.534	-0.127	-1.529	0.127	1.529	0.127	1.712	1.717	85.7	18.16	2.8011	0.06	0.61
28	-1.529	-0.000	-1.529	-0.000	1.529	-0.000	1.712	1.712	90.0	18.16	2.8011	0.00	0.61
29	-1.534	0.127	-1.529	-0.127	1.529	-0.127	1.712	1.717	94.3	18.16	2.8011	0.06	0.61
30	-1.550	0.255	-1.529	-0.255	1.529	-0.255	1.712	1.731	98.5	18.16	2.8011	0.11	0.62

maximum utilization of fasteners U_{max} = 0.62 ≤ 1 => **verification fulfilled**

2.2.2. verification block shear failure acc. to DIN EN 1995-1-1, annex A, strap right

$L_{net,t}$ = 100 mm, t_1 = 60 mm ⇒ $A_{net,t}$ = 6000 mm², $M_{y,k}$ = 9515.7 Nmm, $f_{h,k}$ = 18.16 N/mm²
$L_{net,v}$ = 142 mm, t_{ef} = 60 mm ⇒ $A_{net,v}$ = 8520 mm² (Versagensmechanismus c,f,j/l,k,m)
$L_{net,v}$ = 142 mm ⇒ $A_{net,v}$ = 8520 mm² ⇒ $F_{bs,Rk}$ = 130.50 kN

load	N_d kN	$F_{bs,Rd}$ kN	U_{bs} -
1	0.000	80.308	0.00

maximum utilization block shear failure U_{max} = 0.00 ≤ 1 => **verification fulfilled**

2.3. results beams

2.3.1. strap left with A_n = 24000 mm², W_n = 800000 mm³, I_n = 80000000 mm⁴, k_h = 1.000

load	$f_{m,d}$ N/mm²	$f_{t,d}$ N/mm²	$f_{c,d}$ N/mm²	$f_{v,d}$ N/mm²	N_d kN	M_d kNm	$\sigma_{0,d}$ N/mm²	$\sigma_{mo,d}$ N/mm²	$\sigma_{mu,d}$ N/mm²	V_d kN	τ_d N/mm²	U_σ -	U_τ -
1	14.77	8.92	12.92	2.46	0.000	5.930	0.00	7.41	7.41	14.081	1.76	0.50	0.72

beam maximum utilization U_{max} = 0.72 ≤ 1 => **verification fulfilled**

2.3.2. strap right with A_n = 24000 mm², W_n = 800000 mm³, I_n = 80000000 mm⁴, k_h = 1.000

load	$f_{m,d}$ N/mm²	$f_{t,d}$ N/mm²	$f_{c,d}$ N/mm²	$f_{v,d}$ N/mm²	N_d kN	M_d kNm	$\sigma_{0,d}$ N/mm²	$\sigma_{mo,d}$ N/mm²	$\sigma_{mu,d}$ N/mm²	V_d kN	τ_d N/mm²	U_σ -	U_τ -
1	14.77	8.92	12.92	2.46	0.000	-10.000	0.00	-12.50	-12.50	21.858	2.73	0.85	1.11

beam maximum utilization U_{max} = 1.11 > 1 => **verification not fulfilled** !!

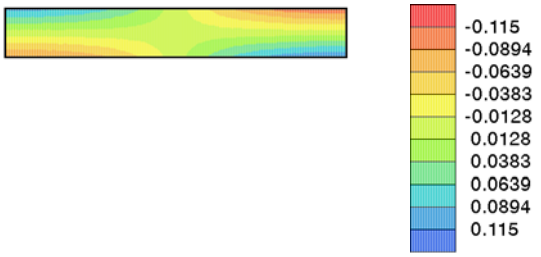
2.4. results node plate

with $\sigma_{v,R,k}$ = 235.00 N/mm², $\tau_{R,k}$ = 135.68 N/mm², $\gamma_{S/V}$ = 1.00, γ_A = 1.00

2.4.1. sum M straps

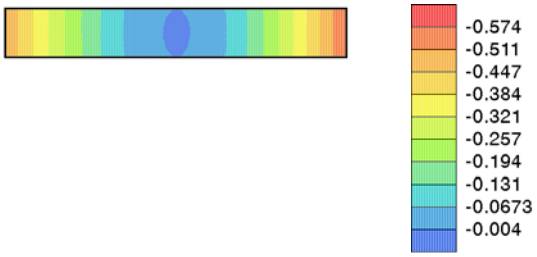
deformations u_x [mm]

min u_x = -0.1133 mm, max u_x = 0.1133 mm



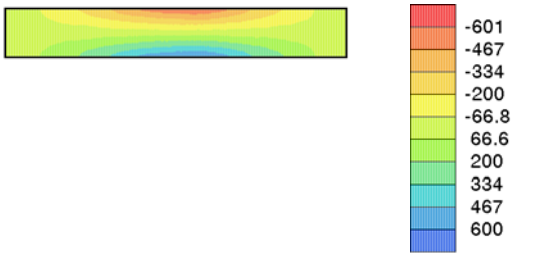
deformations u_y [mm]

min u_y = -0.5736 mm, max u_y = 0.0000 mm



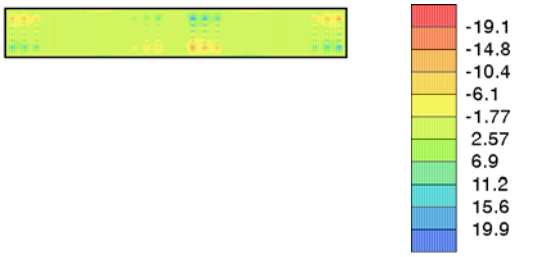
normal forces n_{xx} [kN/m]

min n_{xx} = -600.59 kN/m, max n_{xx} = 600.68 kN/m



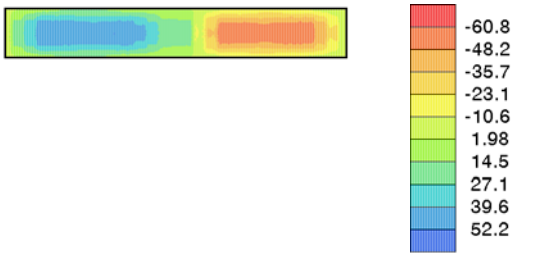
normal forces n_{yy} [kN/m]

min n_{yy} = -19.07 kN/m, max n_{yy} = 19.51 kN/m



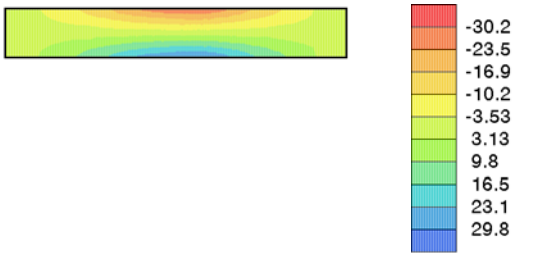
normal forces n_{xy} [kN/m]

min n_{xy} = -60.75 kN/m, max n_{xy} = 52.21 kN/m



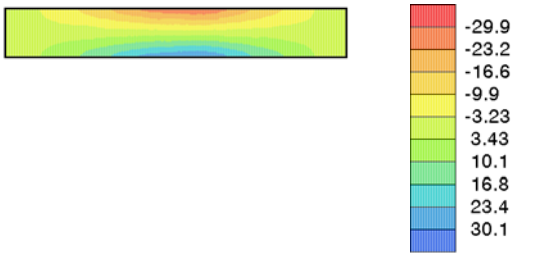
main normal stresses σ_1 [N/mm²]

min σ_1 = -30.18 N/mm², max σ_1 = 30.20 N/mm²



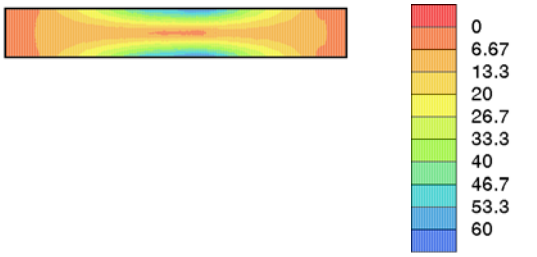
main shear stresses τ_1 [N/mm²]

min τ_1 = -29.88 N/mm², max τ_1 = 29.87 N/mm²



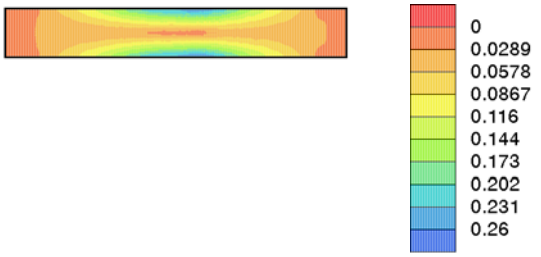
equivalent stresses σ_v [N/mm²]

min σ_v = 0.02 N/mm², max σ_v = 59.91 N/mm²



utilization of the node plate U_p

min U_p = 0.000, max U_p = 0.257



utilization of the node plate

Kno	x mm	y mm	u_x mm	u_y mm	n_{xx} kN/m	n_{yy} kN/m	n_{xy} kN/m	σ_1 N/mm²	τ_1 N/mm²	σ_v N/mm²	U_p
5	700.0	100.0	0.113	-0.574	-0.41	-0.35	0.53	-0.04	-0.00	0.10	---
66	0.0	-0.0	-0.000	0.000	-0.02	-0.11	19.72	-0.01	0.00	3.42	0.015
132	76.8	-100.0	-0.023	-0.012	-600.59	-2.98	0.08	-30.18	-29.88	59.91	0.257
225	84.0	100.0	0.025	-0.014	600.68	3.25	-0.51	30.20	29.87	59.91	0.257
454	74.1	-57.6	-0.013	-0.009	-352.26	19.51	-3.95	-16.94	-18.93	36.90	0.157
482	74.1	57.4	0.013	-0.009	351.09	-19.07	-4.47	16.90	18.84	36.76	0.156
2600	291.3	-3.5	-0.003	-0.131	-13.39	-1.15	-60.75	-0.73	-0.61	10.60	0.045
2642	-251.1	2.9	-0.002	-0.090	11.17	-0.67	52.21	0.53	0.59	9.12	0.039

x,y: node coordinates; u_x,u_y: deformations; n_{xx},n_{yy},n_{xy}: normal forces; σ,τ: stresses
U_p: total utilization of the node plate

maximum utilization of the node plate $U_{max} = 0.26 \leq 1$ => **verification fulfilled**

2.5. bearing forces strap left

$p_1 = 50$ mm, $e_1 = 30$ mm, $e_2 = 50$ mm, $p_2 = 25.00$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk} = 41.40$ kN
$e_1 = 30$ mm, $e_2 = 50$ mm, $p_2 = 25$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk,Rand} = 41.40$ kN

2.5.1. sum M straps

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	0.55	33.12	0.02	11	0.40	33.12	0.01	21	0.30	33.12	0.01
2	0.55	33.12	0.02	12	0.40	33.12	0.01	22	0.29	33.12	0.01
3	0.54	33.12	0.02	13	0.39	33.12	0.01	23	0.29	33.12	0.01
4	0.55	33.12	0.02	14	0.40	33.12	0.01	24	0.29	33.12	0.01
5	0.55	33.12	0.02	15	0.40	33.12	0.01	25	0.30	33.12	0.01
6	0.48	33.12	0.01	16	0.22	33.12	0.01	26	0.37	33.12	0.01
7	0.47	33.12	0.01	17	0.21	33.12	0.01	27	0.36	33.12	0.01
8	0.47	33.12	0.01	18	0.21	33.12	0.01	28	0.36	33.12	0.01
9	0.47	33.12	0.01	19	0.21	33.12	0.01	29	0.36	33.12	0.01
10	0.48	33.12	0.01	20	0.22	33.12	0.01	30	0.37	33.12	0.01

maximum utilization of the bearing forces $U_{max} = 0.02 \leq 1$ => **verification fulfilled**

2.6. bearing forces strap right

$p_1 = 50$ mm, $e_1 = 30$ mm, $e_2 = 50$ mm, $p_2 = 25.00$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk} = 41.40$ kN
$e_1 = 30$ mm, $e_2 = 50$ mm, $p_2 = 25$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk,Rand} = 41.40$ kN

2.6.1. sum M straps

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	0.68	33.12	0.02	11	0.44	33.12	0.01	21	0.74	33.12	0.02
2	0.68	33.12	0.02	12	0.42	33.12	0.01	22	0.73	33.12	0.02
3	0.67	33.12	0.02	13	0.42	33.12	0.01	23	0.73	33.12	0.02
4	0.68	33.12	0.02	14	0.42	33.12	0.01	24	0.73	33.12	0.02
5	0.68	33.12	0.02	15	0.44	33.12	0.01	25	0.74	33.12	0.02
6	0.56	33.12	0.02	16	0.61	33.12	0.02	26	0.87	33.12	0.03
7	0.55	33.12	0.02	17	0.60	33.12	0.02	27	0.86	33.12	0.03
8	0.55	33.12	0.02	18	0.60	33.12	0.02	28	0.86	33.12	0.03
9	0.55	33.12	0.02	19	0.60	33.12	0.02	29	0.86	33.12	0.03
10	0.56	33.12	0.02	20	0.61	33.12	0.02	30	0.87	33.12	0.03

maximum utilization of the bearing forces $U_{max} = 0.03 \leq 1$ => **verification fulfilled**

3. summary

total utilization of all verifications $U_{max,Ges} = 1.110 > 1 \Rightarrow$ not ok. !!