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

internal sheet steel S235 (St37), thickness t=15.0 mm, shape: contour
contour plate
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	Nr	x_k mm	y_k mm	Nr	x_k mm	y_k mm
1	39.9	160.0	5	130.0	-80.0	9	-354.5	121.9	13	39.9	160.0
2	241.6	376.3	6	0.0	-80.0	10	-297.8	227.7			
3	358.6	267.2	7	-130.0	-80.0	11	-60.0	100.2			
4	130.0	22.1	8	-130.0	1.6	12	-60.0	160.0			

1.3. connected beams

Nr.	bar	material	b mm	t mm	α °
1	strap continuous	glue lam. timber DIN GL24h (B	160	160	0
2	strut	glue lam. timber DIN GL24h (B	120	120	90
3	diagonal left	glue lam. timber DIN GL24h (B	120	120	28
4	diagonal right	glue lam. timber DIN GL24h (B	160	160	47

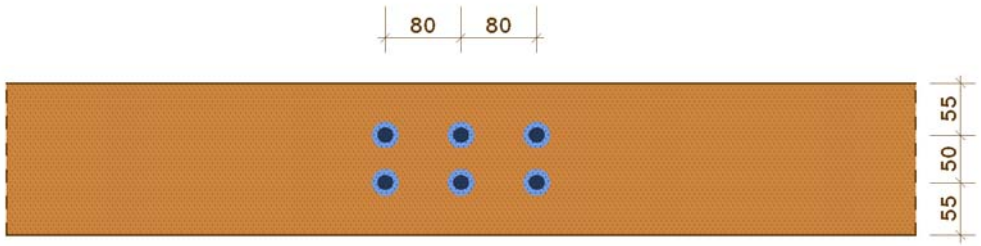
1.4. fastener

1.4.1. strap

dowel 16 mm, S235 (1052)
load-bearing capacity is reduced acc. to DIN EN 1995-1-1, 8.3.1.1(8)
$F_{v,Rd}$ calculated with the simplified verification acc. to NA.8.2.4
6 fastener, a_1 = 80 mm, a_2 = 50 mm
centroid of the fasteners from nodal point S at x_s = 0 mm, y_s = 0 mm
polar moment of inertia I_p = 29350 mm⁴
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
1	-80.0	25.0	4	0.0	-25.0
2	-80.0	-25.0	5	80.0	25.0
3	0.0	25.0	6	80.0	-25.0

fastener strap left scale 1:80

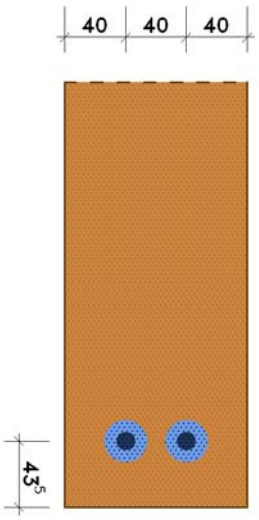


1.4.2. strut

dowel 12 mm, S235 (1052)
load-bearing capacity is reduced acc. to DIN EN 1995-1-1, 8.3.1.1(8)
$F_{v,Rd}$ calculated with the simplified verification acc. to NA.8.2.4
2 fastener, a_1 = 60 mm, a_2 = 40 mm
centroid of the fasteners from nodal point S at x_s = 0 mm, y_s = 124 mm
polar moment of inertia I_p = 800 mm⁴
coordinates of the fasteners (origin in the nodal point, x to the right, y to the top)

Nr	x_k mm	y_k mm
1	20.0	123.5
2	-20.0	123.5

fastener strut scale 1:50

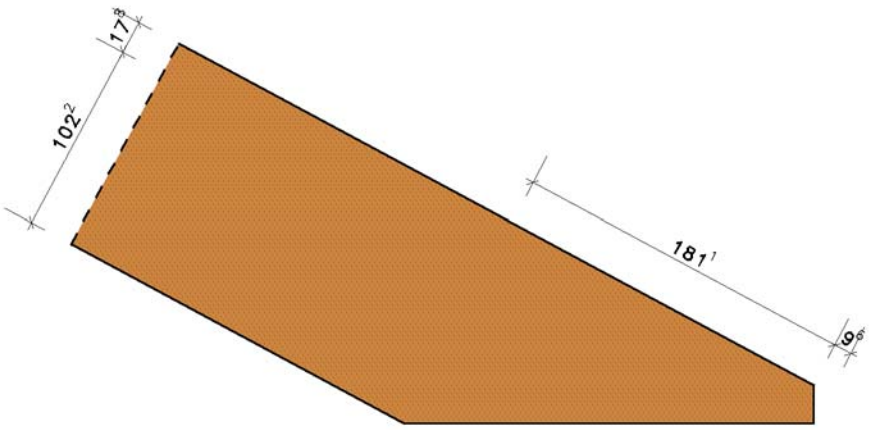


1.4.3. diagonal left

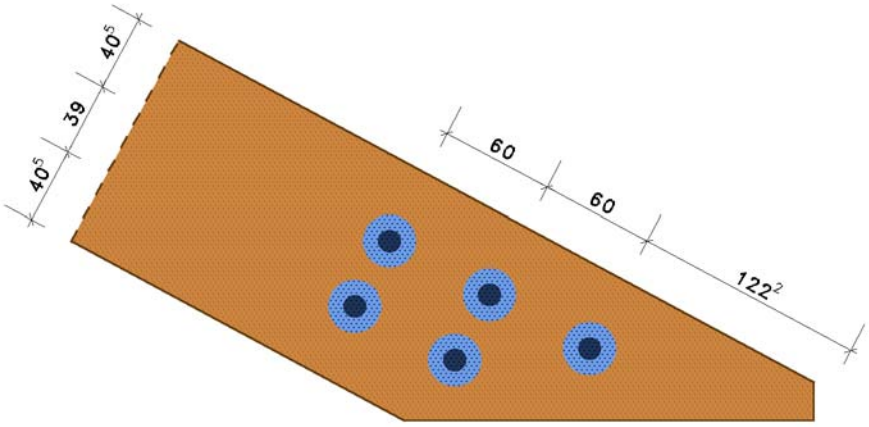
dowel 12 mm, S235 (1052)
load-bearing capacity is reduced acc. to DIN EN 1995-1-1, 8.3.1.1(8)
$F_{v,Rd}$ calculated with the simplified verification acc. to NA.8.2.4
5 fastener, a_1 = 60 mm, a_2 = 39 mm
centroid of the fasteners from nodal point S at x_s = -249 mm, y_s = 138 mm
polar moment of inertia I_p = 11905 mm⁴
coordinates of the fasteners (origin in the nodal point, x to the right, y to the top)

Nr	x_k mm	y_k mm
1	-178.4	117.7
2	-231.3	146.1
3	-249.7	111.7
4	-284.1	174.4
5	-302.6	140.1

view diagonal left scale 1:40



fastener diagonal left scale 1:40

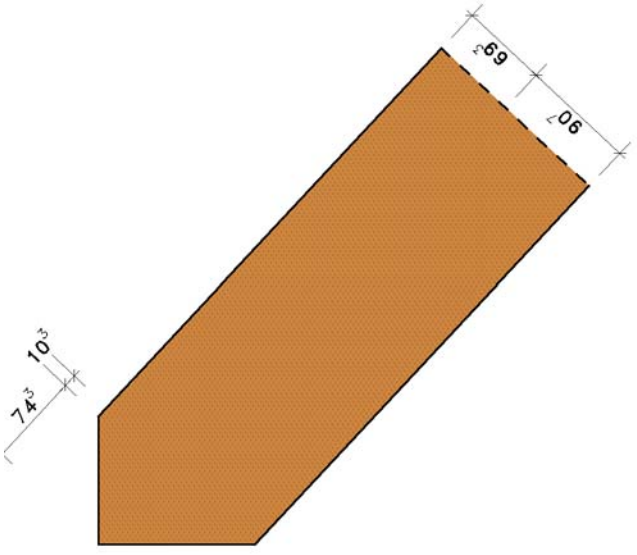


1.4.4. diagonal right

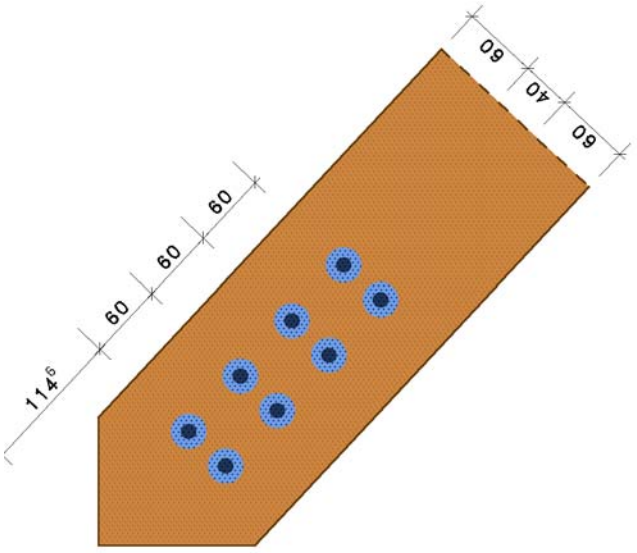
dowel 12 mm, S235 (1052)
load-bearing capacity is reduced acc. to DIN EN 1995-1-1, 8.3.1.1(8)
$F_{v,Rd}$ calculated with the simplified verification acc. to NA.8.2.4
8 fastener, a_1 = 60 mm, a_2 = 40 mm
centroid of the fasteners from nodal point S at x_s = 207 mm, y_s = 222 mm
polar moment of inertia I_p = 39200 mm⁴
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
1	160.6	142.8	5	242.5	230.6
2	131.4	170.1	6	213.2	257.9
3	201.5	186.7	7	283.4	274.5
4	172.3	214.0	8	254.1	301.7

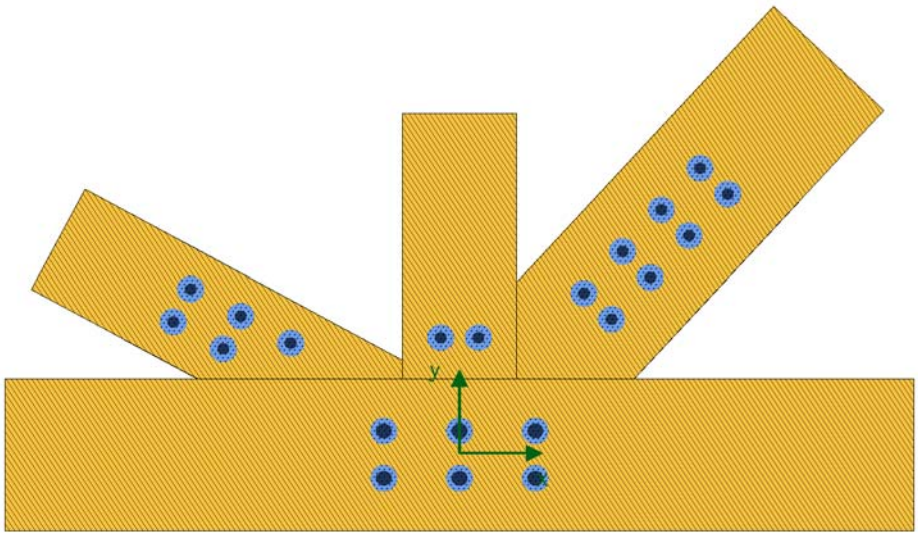
view diagonal right scale 1:60



fastener diagonal right scale 1:60

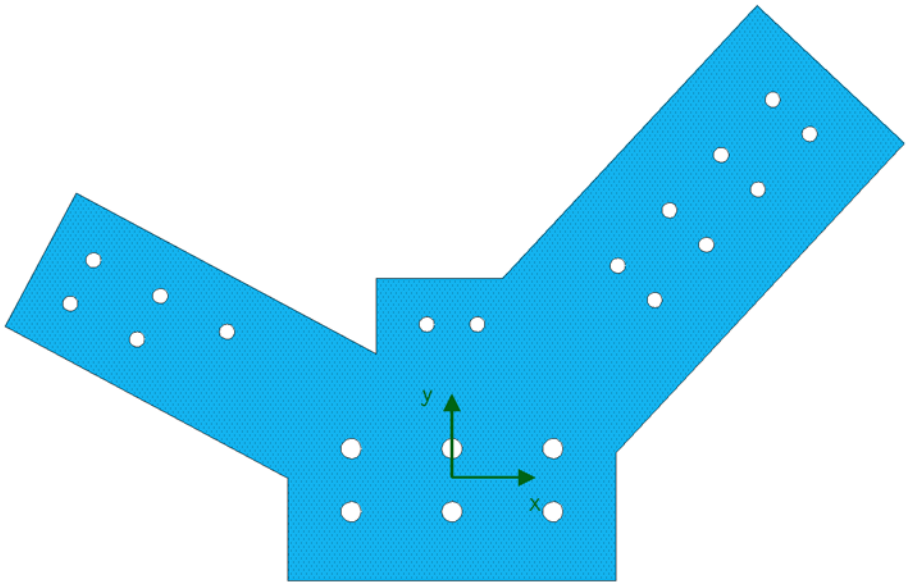


1.5. nodal point
view scale 1:80

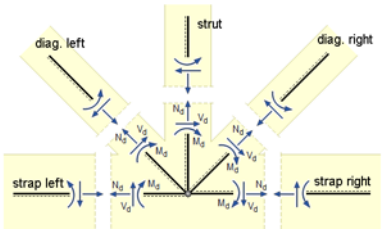


1.6. node plate

view scale 1:60



1.7. load combinations (design internal forces)



1.7.1. Lf1, KLED: free

Nr	beam	N_d kN	M_d kNm	V_d kN	k_{mod} -	γ -
1	strap left	68.61	0.00	0.00	0.600	1.30
2	strap right	46.13	0.00	0.00	0.600	1.30
3	strut	-5.28	0.00	0.00	0.600	1.30
4	diag. left	-13.18	0.00	0.00	0.600	1.30
5	diag. right	15.93	0.00	0.00	0.600	1.30
6	ΣH, ΣM, ΣV	-0.00	0.00	0.15	---	---

1.7.2. 1.35*Lf1, KLED: free

Nr	beam	N_d kN	M_d kNm	V_d kN	k_{mod} -	γ -
1	strap left	92.63	0.00	0.00	0.600	1.30
2	strap right	62.28	0.00	0.00	0.600	1.30
3	strut	-7.12	0.00	0.00	0.600	1.30
4	diag. left	-17.79	0.00	0.00	0.600	1.30
5	diag. right	21.51	0.00	0.00	0.600	1.30
6	ΣH, ΣM, ΣV	-0.00	0.00	0.20	---	---

1.7.3. 1.35*Lf1+1.5*Lf2, KLED: free

Nr	beam	N_d kN	M_d kNm	V_d kN	k_{mod} -	γ -
1	strap left	244.48	0.00	0.00	0.900	1.30
2	strap right	164.37	0.00	0.00	0.900	1.30
3	strut	-18.80	0.00	0.00	0.900	1.30
4	diag. left	-46.95	0.00	0.00	0.900	1.30
5	diag. right	56.77	0.00	0.00	0.900	1.30
6	ΣH, ΣM, ΣV	-0.00	0.00	0.53	---	---

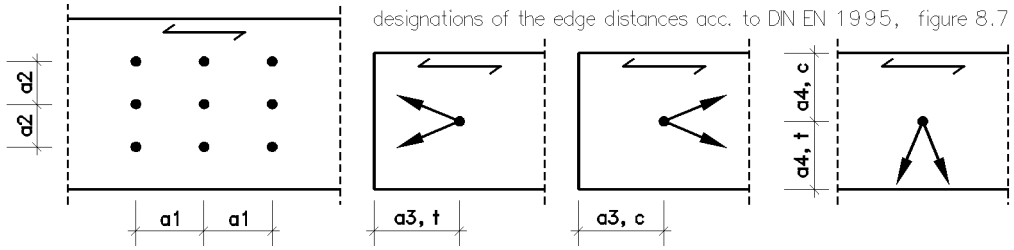
1.7.4. Lf1+1.5*Lf2, KLED: free

Nr	beam	N_d kN	M_d kNm	V_d kN	k_{mod} -	γ -
1	strap left	220.46	0.00	0.00	0.900	1.30
2	strap right	148.22	0.00	0.00	0.900	1.30
3	strut	-16.95	0.00	0.00	0.900	1.30
4	diag. left	-42.34	0.00	0.00	0.900	1.30
5	diag. right	51.19	0.00	0.00	0.900	1.30
6	ΣH, ΣM, ΣV	-0.00	0.00	0.47	---	---

2. results of all load case combinations

2.1. fastener strap

member	a_1 mm	a_2 mm	a_{3t} mm	a_{4t} mm	a_{3c} mm	a_{4c} mm
outtimbmembr	80.0	48.0	112.0	48.0	56.0	48.0
stplt	40.8	40.8	20.4	20.4	20.4	20.4



2.1.1. Lf1

N_d = 22.482 kN, V_d = -0.148 kN, $M_{v,d}$ = -0.000 + -0.000 x -0.148 + 0.000 x 22.482 = 0.000 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	0.00	0.00	-0.00	0.00	0.00	3.75	-0.02	3.75	-0.4	26.17	14.4007	0.37	0.26
2	0.00	-0.00	-0.00	0.00	-0.00	3.75	-0.02	3.75	-0.4	26.17	14.4007	0.37	0.26
3	0.00	0.00	0.00	0.00	0.00	3.75	-0.02	3.75	-0.4	26.17	14.4007	0.37	0.26
4	0.00	-0.00	0.00	-0.00	0.00	3.75	-0.02	3.75	-0.4	26.17	14.4007	0.37	0.26
5	0.00	0.00	0.00	0.00	0.00	3.75	-0.02	3.75	-0.4	26.17	14.4007	0.37	0.26
6	0.00	-0.00	0.00	-0.00	0.00	3.75	-0.02	3.75	-0.4	26.17	14.4007	0.37	0.26

maximum utilization of fasteners U_{max} = 0.37 ≤ 1 => **verification fulfilled**

2.1.2. 1.35*Lf1

N_d = 30.351 kN, V_d = -0.199 kN, $M_{v,d}$ = -0.000 + -0.000 x -0.199 + 0.000 x 30.351 = 0.000 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	0.00	0.00	-0.00	0.00	0.00	5.06	-0.03	5.06	-0.4	26.17	14.4007	0.50	0.35
2	0.00	-0.00	-0.00	0.00	-0.00	5.06	-0.03	5.06	-0.4	26.17	14.4007	0.50	0.35
3	0.00	0.00	0.00	0.00	0.00	5.06	-0.03	5.06	-0.4	26.17	14.4007	0.50	0.35
4	0.00	-0.00	0.00	-0.00	0.00	5.06	-0.03	5.06	-0.4	26.17	14.4007	0.50	0.35
5	0.00	0.00	0.00	0.00	0.00	5.06	-0.03	5.06	-0.4	26.17	14.4007	0.50	0.35
6	0.00	-0.00	0.00	-0.00	0.00	5.06	-0.03	5.06	-0.4	26.17	14.4007	0.50	0.35

maximum utilization of fasteners U_{max} = 0.50 ≤ 1 => **verification fulfilled**

2.1.3. 1.35*Lf1+1.5*Lf2

N_d = 80.106 kN, V_d = -0.526 kN, $M_{v,d}$ = -0.000 + -0.000 x -0.526 + 0.000 x 80.106 = 0.000 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	0.00	0.00	-0.00	0.00	0.00	13.35	-0.09	13.35	-0.4	26.17	21.6011	0.87	0.62
2	0.00	-0.00	-0.00	0.00	-0.00	13.35	-0.09	13.35	-0.4	26.17	21.6011	0.87	0.62
3	0.00	0.00	0.00	0.00	0.00	13.35	-0.09	13.35	-0.4	26.17	21.6011	0.87	0.62
4	0.00	-0.00	0.00	-0.00	0.00	13.35	-0.09	13.35	-0.4	26.17	21.6011	0.87	0.62
5	0.00	0.00	0.00	0.00	0.00	13.35	-0.09	13.35	-0.4	26.17	21.6011	0.87	0.62
6	0.00	-0.00	0.00	-0.00	0.00	13.35	-0.09	13.35	-0.4	26.17	21.6011	0.87	0.62

maximum utilization of fasteners U_{max} = 0.87 ≤ 1 => **verification fulfilled**

2.1.4. Lf1+1.5*Lf2

N_d = 72.237 kN, V_d = -0.474 kN, $M_{v,d}$ = -0.000 + -0.000 x -0.474 + 0.000 x 72.237 = 0.000 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	0.00	0.00	-0.00	0.00	0.00	12.04	-0.08	12.04	-0.4	26.17	21.6011	0.79	0.56
2	0.00	-0.00	-0.00	0.00	-0.00	12.04	-0.08	12.04	-0.4	26.17	21.6011	0.79	0.56
3	0.00	0.00	0.00	0.00	0.00	12.04	-0.08	12.04	-0.4	26.17	21.6011	0.79	0.56
4	0.00	-0.00	0.00	-0.00	0.00	12.04	-0.08	12.04	-0.4	26.17	21.6011	0.79	0.56
5	0.00	0.00	0.00	0.00	0.00	12.04	-0.08	12.04	-0.4	26.17	21.6011	0.79	0.56
6	0.00	-0.00	0.00	-0.00	0.00	12.04	-0.08	12.04	-0.4	26.17	21.6011	0.79	0.56

maximum utilization of fasteners U_{max} = 0.79 ≤ 1 => **verification fulfilled**

2.2. fastener strut

member	a_1 mm	a_2 mm	a_{3t} mm	a_{4t} mm	a_{3c} mm	a_{4c} mm
outtimbmembr	60.0	36.0	84.0	36.0	42.0	36.0
stplt	31.2	31.2	15.6	15.6	15.6	15.6

2.2.1. Lf1

N_d = -5.277 kN, V_d = 0.000 kN, $M_{v,d}$ = 0.000 + -0.124 x 0.000 + 0.000 x -5.277 = 0.000 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	0.00	0.00	0.00	0.00	0.00	-2.64	0.00	2.64	180.0	27.42	8.1937	0.32	0.32
2	0.00	0.00	-0.00	0.00	-0.00	-2.64	0.00	2.64	180.0	27.42	8.1937	0.32	0.32

maximum utilization of fasteners U_{max} = 0.32 ≤ 1 => **verification fulfilled**

2.2.2. 1.35*Lf1

N_d = -7.124 kN, V_d = 0.000 kN, $M_{v,d}$ = 0.000 + -0.124 x 0.000 + 0.000 x -7.124 = 0.000 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	0.00	0.00	0.00	0.00	0.00	-3.56	0.00	3.56	180.0	27.42	8.1937	0.43	0.43
2	0.00	0.00	-0.00	0.00	-0.00	-3.56	0.00	3.56	180.0	27.42	8.1937	0.43	0.43

maximum utilization of fasteners U_{max} = 0.43 ≤ 1 => **verification fulfilled**

2.2.3. 1.35*Lf1+1.5*Lf2

N_d = -18.802 kN, V_d = 0.000 kN, $M_{v,d}$ = 0.000 + -0.124 x 0.000 + 0.000 x -18.802 = 0.000 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	0.00	0.00	0.00	0.00	0.00	-9.40	0.00	9.40	180.0	27.42	12.2906	0.76	0.76
2	0.00	0.00	-0.00	0.00	-0.00	-9.40	0.00	9.40	180.0	27.42	12.2906	0.76	0.76

maximum utilization of fasteners U_{max} = 0.76 ≤ 1 => **verification fulfilled**

2.2.4. Lf1+1.5*Lf2

N_d = -16.955 kN, V_d = 0.000 kN, $M_{v,d}$ = 0.000 + -0.124 x 0.000 + 0.000 x -16.955 = 0.000 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	0.00	0.00	0.00	0.00	0.00	-8.48	0.00	8.48	180.0	27.42	12.2906	0.69	0.69
2	0.00	0.00	-0.00	0.00	-0.00	-8.48	0.00	8.48	180.0	27.42	12.2906	0.69	0.69

maximum utilization of fasteners U_{max} = 0.69 ≤ 1 => **verification fulfilled**

2.2.5. verification block shear failure acc. to DIN EN 1995-1-1, annex A, strut

$L_{net,t}$ = 40 mm, t_1 = 53 mm ⇒ $A_{net,t}$ = 2100 mm², $M_{y,k}$ = 69070.9 Nmm, $f_{h,k}$ = 27.42 N/mm²
$L_{net,v}$ = 87 mm, t_{ef} = 53 mm ⇒ $A_{net,v}$ = 4568 mm² (failure mechanism c,f,j/l,k,m)
$L_{net,v}$ = 87 mm ⇒ $A_{net,v}$ = 4568 mm² ⇒ $F_{bs,Rk}$ = 51.98 kN

load	N_d kN	$F_{bs,Rd}$ kN	U_{bs} -
1	-2.638	23.988	0.00
2	-3.562	23.988	0.00
3	-9.401	35.983	0.00
4	-8.477	35.983	0.00

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

2.3. fastener diagonal left

member	a_1 mm	a_2 mm	a_{3t} mm	a_{4t} mm	a_{3c} mm	a_{4c} mm
outtimbmembr	60.0	36.0	84.0	36.0	42.0	36.0
stplt	31.2	31.2	15.6	15.6	15.6	15.6

2.3.1. Lf1

N_d = -13.178 kN, V_d = 0.000 kN, $M_{v,d}$ = 0.000 + -0.285 x 0.000 + 0.004 x -13.178 = -0.051 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	-0.32	0.09	-0.31	-0.07	-0.31	-2.70	-0.31	2.72	-173.4	27.23	8.1374	0.46	0.33
2	-0.08	-0.03	-0.08	-0.07	-0.05	-2.70	-0.05	2.70	-178.9	27.42	8.1921	0.47	0.33
3	-0.11	0.11	0.00	0.10	-0.05	-2.53	-0.05	2.54	-178.8	27.41	8.1919	0.44	0.31
4	-0.22	-0.16	0.15	-0.07	0.21	-2.70	0.21	2.71	175.6	27.34	8.1684	0.46	0.33
5	-0.23	-0.01	0.23	0.10	0.21	-2.53	0.21	2.54	175.3	27.32	8.1650	0.43	0.31

maximum utilization of fasteners U_{max} = 0.47 ≤ 1 => **verification fulfilled**

2.3.2. 1.35*Lf1

N_d = -17.790 kN, V_d = 0.000 kN, $M_{v,d}$ = 0.000 + -0.285 x 0.000 + 0.004 x -17.790 = -0.069 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	-0.43	0.12	-0.41	-0.09	-0.42	-3.65	-0.42	3.67	-173.4	27.23	8.1374	0.62	0.45
2	-0.11	-0.05	-0.10	-0.09	-0.07	-3.65	-0.07	3.65	-178.9	27.42	8.1921	0.63	0.45
3	-0.15	0.15	0.00	0.14	-0.07	-3.42	-0.07	3.42	-178.8	27.41	8.1919	0.59	0.42
4	-0.29	-0.21	0.20	-0.09	0.28	-3.65	0.28	3.66	175.6	27.34	8.1684	0.62	0.45
5	-0.31	-0.01	0.31	0.14	0.28	-3.42	0.28	3.43	175.3	27.32	8.1650	0.58	0.42

maximum utilization of fasteners U_{max} = 0.63 ≤ 1 => **verification fulfilled**

2.3.3. 1.35*Lf1+1.5*Lf2

N_d = -46.954 kN, V_d = 0.000 kN, $M_{v,d}$ = 0.000 + -0.285 x 0.000 + 0.004 x -46.954 = -0.183 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	-1.13	0.31	-1.09	-0.24	-1.11	-9.63	-1.11	9.69	-173.4	27.23	12.2062	1.09	0.79
2	-0.30	-0.12	-0.28	-0.24	-0.18	-9.63	-0.18	9.63	-178.9	27.42	12.2882	1.11	0.78
3	-0.40	0.40	0.01	0.36	-0.18	-9.03	-0.18	9.03	-178.8	27.41	12.2879	1.04	0.74
4	-0.78	-0.56	0.54	-0.24	0.74	-9.63	0.74	9.66	175.6	27.34	12.2526	1.09	0.79
5	-0.82	-0.03	0.82	0.36	0.74	-9.03	0.74	9.06	175.3	27.32	12.2475	1.02	0.74

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

2.3.4. Lf1+1.5*Lf2

N_d = -42.342 kN, V_d = 0.000 kN, $M_{v,d}$ = 0.000 + -0.285 x 0.000 + 0.004 x -42.342 = -0.165 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	-1.02	0.28	-0.98	-0.22	-1.00	-8.68	-1.00	8.74	-173.4	27.23	12.2062	0.98	0.72
2	-0.27	-0.11	-0.25	-0.22	-0.17	-8.68	-0.17	8.69	-178.9	27.42	12.2882	1.00	0.71
3	-0.36	0.36	0.01	0.32	-0.17	-8.14	-0.17	8.15	-178.8	27.41	12.2879	0.93	0.66
4	-0.70	-0.51	0.48	-0.22	0.67	-8.68	0.67	8.71	175.6	27.34	12.2526	0.98	0.71
5	-0.74	-0.03	0.74	0.32	0.67	-8.14	0.67	8.17	175.3	27.32	12.2475	0.92	0.67

maximum utilization of fasteners U_{max} = 1.00 ≤ 1 => **verification fulfilled**

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

$L_{net,t}$ = 39 mm, t_1 = 53 mm ⇒ $A_{net,t}$ = 2048 mm², $M_{y,k}$ = 69070.9 Nmm, $f_{h,k}$ = 27.42 N/mm²
$L_{net,v}$ = 335 mm, t_{ef} = 53 mm ⇒ $A_{net,v}$ = 17610 mm² (failure mechanism c,f,j/l,k,m)
$L_{net,v}$ = 335 mm ⇒ $A_{net,v}$ = 17610 mm² ⇒ $F_{bs,Rk}$ = 50.68 kN

load	N_d kN	$F_{bs,Rd}$ kN	U_{bs} -
1	-6.589	23.389	0.00
2	-8.895	23.389	0.00
3	-23.477	35.083	0.00
4	-21.171	35.083	0.00

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

2.4. fastener diagonal right

member	a_1 mm	a_2 mm	a_{3t} mm	a_{4t} mm	a_{3c} mm	a_{4c} mm
outtimbmembr	60.0	36.0	84.0	36.0	42.0	36.0
stplt	31.2	31.2	15.6	15.6	15.6	15.6

2.4.1. Lf1

N_d = 15.932 kN, V_d = 0.000 kN, $M_{v,d}$ = 0.000 + -0.304 x 0.000 + -0.000 x 15.932 = -0.000 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	-0.00	0.00	0.00	-0.00	-0.00	1.99	-0.00	1.99	-0.0	27.42	10.4015	0.28	0.19
2	-0.00	0.00	0.00	0.00	-0.00	1.99	-0.00	1.99	-0.0	27.42	10.4015	0.28	0.19
3	-0.00	0.00	0.00	-0.00	-0.00	1.99	-0.00	1.99	-0.0	27.42	10.4015	0.28	0.19
4	-0.00	0.00	0.00	0.00	-0.00	1.99	-0.00	1.99	-0.0	27.42	10.4015	0.28	0.19
5	-0.00	-0.00	-0.00	-0.00	0.00	1.99	0.00	1.99	0.0	27.42	10.4015	0.28	0.19
6	-0.00	-0.00	-0.00	0.00	0.00	1.99	0.00	1.99	0.0	27.42	10.4015	0.28	0.19
7	-0.00	-0.00	-0.00	-0.00	0.00	1.99	0.00	1.99	0.0	27.42	10.4015	0.28	0.19
8	-0.00	-0.00	-0.00	0.00	0.00	1.99	0.00	1.99	0.0	27.42	10.4015	0.28	0.19

maximum utilization of fasteners U_{max} = 0.28 ≤ 1 => **verification fulfilled**

2.4.2. 1.35*Lf1

N_d = 21.508 kN, V_d = 0.000 kN, $M_{v,d}$ = 0.000 + -0.304 x 0.000 + -0.000 x 21.508 = -0.000 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	-0.00	0.00	0.00	-0.00	-0.00	2.69	-0.00	2.69	-0.0	27.42	10.4015	0.38	0.26
2	-0.00	0.00	0.00	0.00	-0.00	2.69	-0.00	2.69	-0.0	27.42	10.4015	0.38	0.26
3	-0.00	0.00	0.00	-0.00	-0.00	2.69	-0.00	2.69	-0.0	27.42	10.4015	0.38	0.26
4	-0.00	0.00	0.00	0.00	-0.00	2.69	-0.00	2.69	-0.0	27.42	10.4015	0.38	0.26
5	-0.00	-0.00	-0.00	-0.00	0.00	2.69	0.00	2.69	0.0	27.42	10.4015	0.38	0.26
6	-0.00	-0.00	-0.00	0.00	0.00	2.69	0.00	2.69	0.0	27.42	10.4015	0.38	0.26
7	-0.00	-0.00	-0.00	-0.00	0.00	2.69	0.00	2.69	0.0	27.42	10.4015	0.38	0.26
8	-0.00	-0.00	-0.00	0.00	0.00	2.69	0.00	2.69	0.0	27.42	10.4015	0.38	0.26

maximum utilization of fasteners U_{max} = 0.38 ≤ 1 => **verification fulfilled**

2.4.3. 1.35*Lf1+1.5*Lf2

N_d = 56.766 kN, V_d = 0.000 kN, $M_{v,d}$ = 0.000 + -0.304 x 0.000 + -0.000 x 56.766 = -0.000 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	-0.00	0.00	0.00	-0.00	-0.00	7.10	-0.00	7.10	-0.0	27.42	15.6023	0.66	0.45
2	-0.00	0.00	0.00	0.00	-0.00	7.10	-0.00	7.10	-0.0	27.42	15.6023	0.66	0.45
3	-0.00	0.00	0.00	-0.00	-0.00	7.10	-0.00	7.10	-0.0	27.42	15.6023	0.66	0.45
4	-0.00	0.00	0.00	0.00	-0.00	7.10	-0.00	7.10	-0.0	27.42	15.6023	0.66	0.45
5	-0.00	-0.00	-0.00	-0.00	0.00	7.10	0.00	7.10	0.0	27.42	15.6023	0.66	0.45
6	-0.00	-0.00	-0.00	0.00	0.00	7.10	0.00	7.10	0.0	27.42	15.6023	0.66	0.45
7	-0.00	-0.00	-0.00	-0.00	0.00	7.10	0.00	7.10	0.0	27.42	15.6023	0.66	0.45
8	-0.00	-0.00	-0.00	0.00	0.00	7.10	0.00	7.10	0.0	27.42	15.6023	0.66	0.45

maximum utilization of fasteners U_{max} = 0.66 ≤ 1 => **verification fulfilled**

2.4.4. Lf1+1.5*Lf2

N_d = 51.190 kN, V_d = 0.000 kN, $M_{v,d}$ = 0.000 + -0.304 x 0.000 + -0.000 x 51.190 = -0.000 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	-0.00	0.00	0.00	-0.00	-0.00	6.40	-0.00	6.40	-0.0	27.42	15.6023	0.60	0.41
2	-0.00	0.00	0.00	0.00	-0.00	6.40	-0.00	6.40	-0.0	27.42	15.6023	0.60	0.41
3	-0.00	0.00	0.00	-0.00	-0.00	6.40	-0.00	6.40	-0.0	27.42	15.6023	0.60	0.41
4	-0.00	0.00	0.00	0.00	-0.00	6.40	-0.00	6.40	-0.0	27.42	15.6023	0.60	0.41
5	-0.00	-0.00	-0.00	-0.00	0.00	6.40	0.00	6.40	0.0	27.42	15.6023	0.60	0.41
6	-0.00	-0.00	-0.00	0.00	0.00	6.40	0.00	6.40	0.0	27.42	15.6023	0.60	0.41
7	-0.00	-0.00	-0.00	-0.00	0.00	6.40	0.00	6.40	0.0	27.42	15.6023	0.60	0.41
8	-0.00	-0.00	-0.00	0.00	0.00	6.40	0.00	6.40	0.0	27.42	15.6023	0.60	0.41

maximum utilization of fasteners U_{max} = 0.60 ≤ 1 => **verification fulfilled**

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

$L_{net,t}$ = 40 mm, t_1 = 73 mm ⇒ $A_{net,t}$ = 2900 mm², $M_{y,k}$ = 69070.9 Nmm, $f_{h,k}$ = 27.42 N/mm²
$L_{net,v}$ = 569 mm, t_{ef} = 29 mm ⇒ $A_{net,v}$ = 27890 mm² (failure mechanism h)
$L_{net,v}$ = 569 mm ⇒ $A_{net,v}$ = 27890 mm² ⇒ $F_{bs,Rk}$ = 71.78 kN

load	N_d kN	$F_{bs,Rd}$ kN	U_{bs} -
1	7.966	33.127	0.24
2	10.754	33.127	0.32
3	28.383	49.690	0.57
4	25.595	49.690	0.52

maximum utilization block shear failure U_{max} = 0.57 ≤ 1 => **verification fulfilled**

2.5. results beams

2.5.1. strap left with A_n = 18560 mm², W_n = 581020 mm³, I_n = 46481587 mm⁴, k_h = 1.100

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	13.29	7.62	11.08	1.62	68.613	0.000	3.70	0.00	0.00	0.000	0.00	0.44	0.00
2	13.29	7.62	11.08	1.62	92.627	0.000	4.99	0.00	0.00	0.000	0.00	0.60	0.00
3	19.94	11.42	16.62	2.42	244.475	0.000	13.17	0.00	0.00	0.000	0.00	1.05	0.00
4	19.94	11.42	16.62	2.42	220.461	0.000	11.88	0.00	0.00	0.000	0.00	0.95	0.00

beam maximum utilization U_{max} = 1.05 > 1 => **verification not fulfilled** !!

2.5.2. strap right with A_n = 18560 mm², W_n = 581020 mm³, I_n = 46481587 mm⁴, k_h = 1.100

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	13.29	7.62	11.08	1.62	46.131	0.000	2.49	0.00	0.00	0.000	0.00	0.30	0.00
2	13.29	7.62	11.08	1.62	62.277	0.000	3.36	0.00	0.00	0.000	0.00	0.40	0.00
3	19.94	11.42	16.62	2.42	164.370	0.000	8.86	0.00	0.00	0.000	0.00	0.70	0.00
4	19.94	11.42	16.62	2.42	148.224	0.000	7.99	0.00	0.00	0.000	0.00	0.64	0.00

beam maximum utilization U_{max} = 0.70 ≤ 1 => **verification fulfilled**

2.5.3. strut with A_n = 10080 mm², W_n = 234609 mm³, I_n = 14076510 mm⁴, k_h = 1.100

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	11.08	7.62	11.08	1.62	-5.277	0.000	-0.52	0.00	0.00	0.000	0.00	0.00	0.00
2	11.08	7.62	11.08	1.62	-7.124	0.000	-0.71	0.00	0.00	0.000	0.00	0.00	0.00
3	16.62	11.42	16.62	2.42	-18.802	0.000	-1.87	0.00	0.00	0.000	0.00	0.01	0.00
4	16.62	11.42	16.62	2.42	-16.955	0.000	-1.68	0.00	0.00	0.000	0.00	0.01	0.00

beam maximum utilization U_{max} = 0.01 ≤ 1 => **verification fulfilled**

2.5.4. diagonal left with A_n = 10080 mm², W_n = 235438 mm³, I_n = 14126280 mm⁴, k_h = 1.100

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	11.08	7.62	11.08	1.62	-13.178	-0.051	-1.31	-0.22	-0.22	0.414	0.11	0.03	0.07
2	11.08	7.62	11.08	1.62	-17.790	-0.069	-1.76	-0.29	-0.29	0.559	0.15	0.05	0.09
3	16.62	11.42	16.62	2.42	-46.954	-0.183	-4.66	-0.78	-0.78	1.477	0.38	0.12	0.16
4	16.62	11.42	16.62	2.42	-42.342	-0.165	-4.20	-0.70	-0.70	1.332	0.35	0.10	0.14

beam maximum utilization U_{max} = 0.16 ≤ 1 => **verification fulfilled**

2.5.5. diagonal right with A_n = 19720 mm², W_n = 600654 mm³, I_n = 48052323 mm⁴, k_h = 1.100

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	11.08	7.62	11.08	1.62	15.932	-0.000	0.81	-0.00	-0.00	0.000	0.00	0.10	0.00
2	11.08	7.62	11.08	1.62	21.508	-0.000	1.09	-0.00	-0.00	0.000	0.00	0.13	0.00
3	16.62	11.42	16.62	2.42	56.766	-0.000	2.88	-0.00	-0.00	0.000	0.00	0.23	0.00
4	16.62	11.42	16.62	2.42	51.190	-0.000	2.60	-0.00	-0.00	0.000	0.00	0.21	0.00

beam maximum utilization U_{max} = 0.23 ≤ 1 => **verification fulfilled**

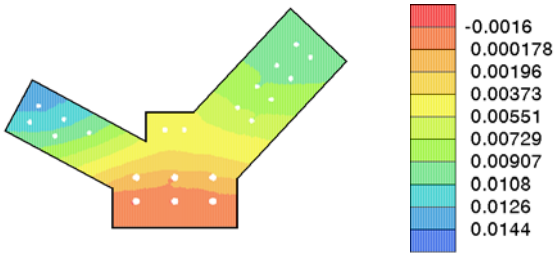
2.6. results node plate

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

2.6.1. Lf1

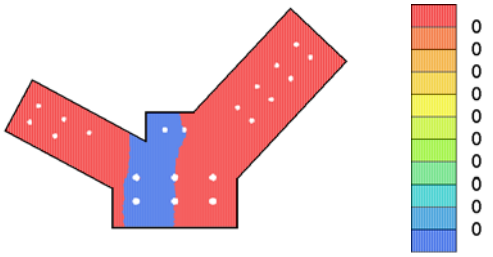
deformations u_x [mm]

min u_x = -0.0019 mm, max u_x = 0.0141 mm

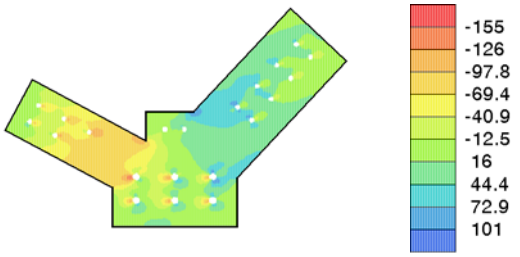


deformations u_y [mm]

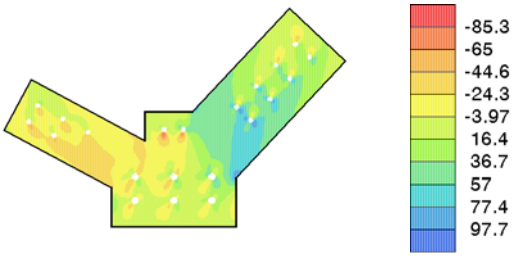
min u_y = -0.0067 mm, max u_y = 0.0011 mm



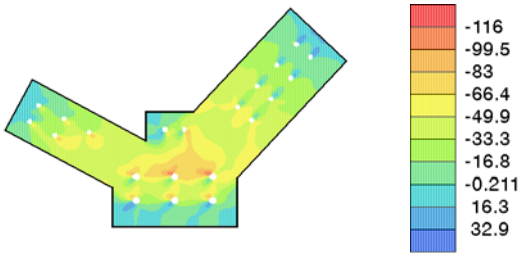
normal forces n_{xx} [kN/m]
min n_{xx} = -154.71 kN/m, max n_{xx} = 101.32 kN/m



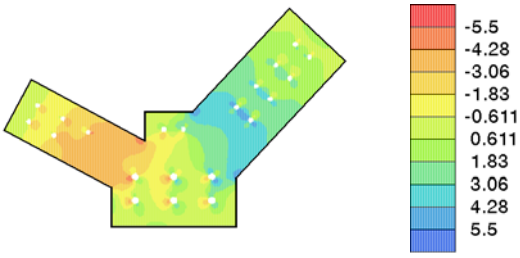
normal forces n_{yy} [kN/m]
min n_{yy} = -85.34 kN/m, max n_{yy} = 97.79 kN/m



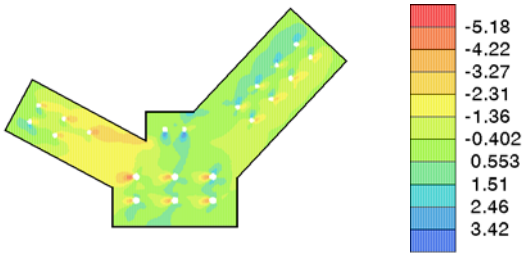
normal forces n_{xy} [kN/m]
min n_{xy} = -116.13 kN/m, max n_{xy} = 32.65 kN/m



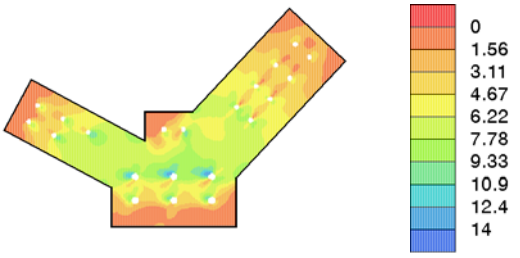
main normal stresses σ_1 [N/mm²]
min σ_1 = -5.48 N/mm², max σ_1 = 5.27 N/mm²



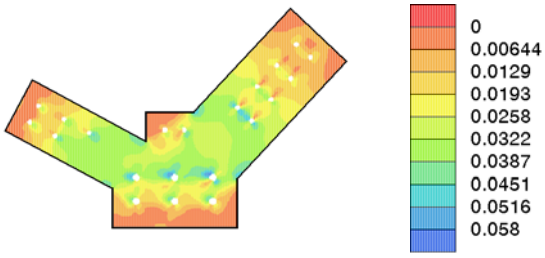
main shear stresses τ_1 [N/mm²]
min τ_1 = -5.18 N/mm², max τ_1 = 3.44 N/mm²



equivalent stresses σ_v [N/mm²]
min σ_v = 0.01 N/mm², max σ_v = 13.71 N/mm²



utilization of the node plate U_p
min U_p = 0.000, max U_p = 0.058



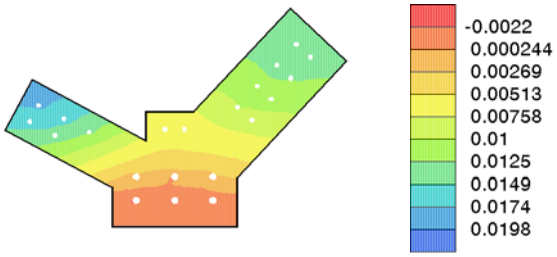
utilization of the node plate

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
1	39.9	-160.0	0.005	-0.001	101.32	50.13	-50.97	5.05	1.71	8.30	0.047
10	-297.8	-227.7	0.014	-0.004	-0.88	0.02	0.29	-0.03	-0.03	0.07	---
11	-60.0	-100.2	0.005	0.000	-90.86	-16.13	-18.94	-3.57	-2.49	6.01	0.031
98	43.2	-163.6	0.006	-0.001	97.44	60.50	-60.20	5.26	1.23	8.98	0.051
1124	-89.9	-23.2	0.001	0.000	-154.71	-5.03	-35.68	-5.32	-4.99	10.95	0.047
1125	-88.9	-20.2	0.001	0.001	-137.65	-26.71	-12.82	-5.48	-3.70	8.56	0.047
1221	72.6	-31.9	0.001	-0.001	30.78	49.23	-116.13	2.67	-0.62	13.71	0.058
1910	-91.7	-24.5	0.001	0.000	-151.54	3.92	-49.43	-4.92	-5.18	11.72	0.050
1912	-89.2	32.3	-0.002	0.000	-49.10	-27.69	32.65	-2.56	-0.71	4.72	0.025
2158	167.9	-138.0	0.006	-0.003	42.83	97.79	-57.88	4.69	-1.83	8.76	0.046
2444	19.0	-114.1	0.005	0.000	29.43	-73.64	-42.42	-1.47	3.44	7.85	0.033
2458	-20.9	-114.1	0.004	0.001	4.33	-85.34	-13.14	-2.70	2.99	6.03	0.026

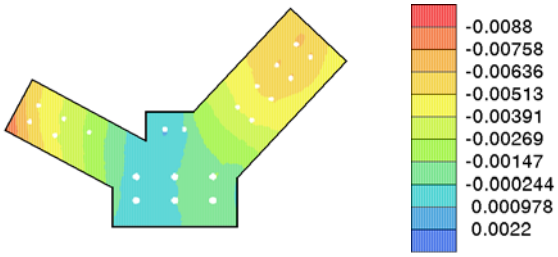
x,y: node coordinates; u_x,u_y: deformations; n_{xx},n_{yy},n_{xy}: normal forces; σ,τ: stresses
U_p: total utilization of the node plate

2.6.2. 1.35*Lf1

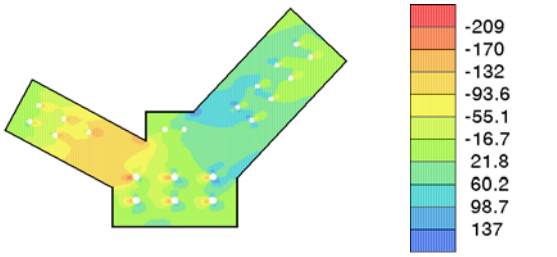
deformations u_x [mm]
min u_x = -0.0026 mm, max u_x = 0.0190 mm



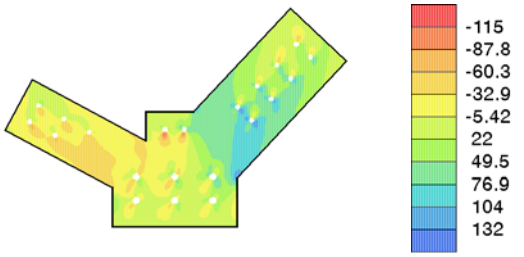
deformations u_y [mm]
min u_y = -0.0090 mm, max u_y = 0.0016 mm



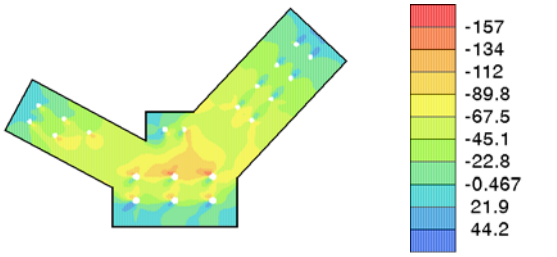
normal forces n_{xx} [kN/m]
min n_{xx} = -208.85 kN/m, max n_{xx} = 136.78 kN/m



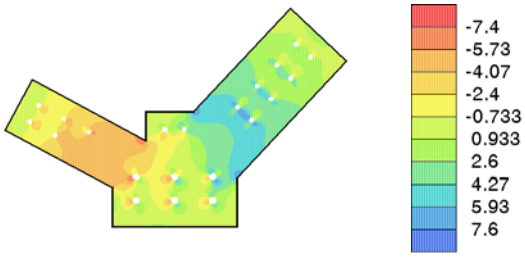
normal forces n_{yy} [kN/m]
min n_{yy} = -115.21 kN/m, max n_{yy} = 132.01 kN/m



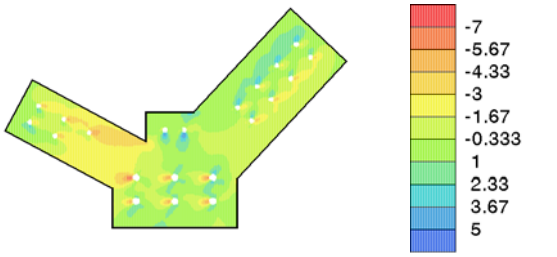
normal forces n_{xy} [kN/m]
min n_{xy} = -156.78 kN/m, max n_{xy} = 44.08 kN/m



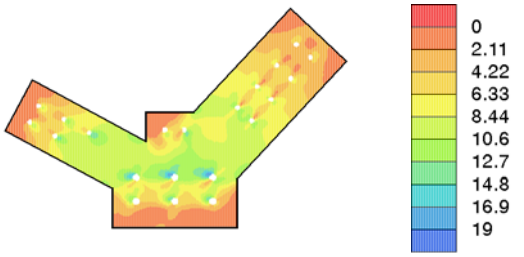
main normal stresses σ_1 [N/mm²]
min σ_1 = -7.40 N/mm², max σ_1 = 7.11 N/mm²



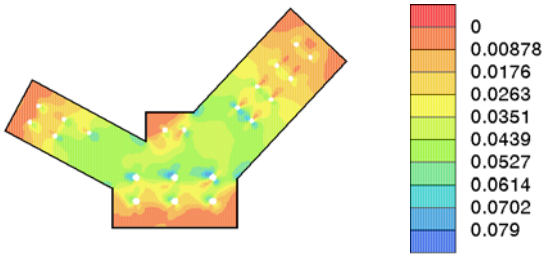
main shear stresses τ_1 [N/mm²]
min τ_1 = -7.00 N/mm², max τ_1 = 4.64 N/mm²



equivalent stresses σ_v [N/mm²]
min σ_v = 0.01 N/mm², max σ_v = 18.51 N/mm²



utilization of the node plate U_p
min U_p = 0.000, max U_p = 0.079



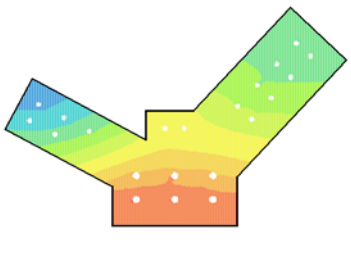
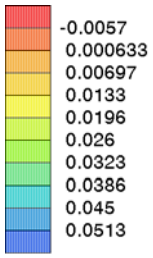
utilization of the node plate

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
1	39.9	-160.0	0.007	-0.002	136.78	67.68	-68.81	6.82	2.30	11.20	0.064
10	-297.8	-227.7	0.019	-0.006	-1.19	0.03	0.39	-0.04	-0.04	0.09	---
13	-88.0	-25.0	0.001	0.001	-194.93	4.14	-70.79	-6.36	-6.64	15.47	0.066
1124	-89.9	-23.2	0.001	0.001	-208.85	-6.79	-48.16	-7.19	-6.74	14.79	0.064
1125	-88.9	-20.2	0.001	0.001	-185.82	-36.05	-17.30	-7.40	-4.99	11.55	0.063
1221	72.6	-31.9	0.002	-0.001	41.55	66.46	-156.78	3.60	-0.83	18.51	0.079
1910	-91.7	-24.5	0.001	0.000	-204.58	5.29	-66.73	-6.64	-7.00	15.82	0.067
1912	-89.2	32.3	-0.002	0.001	-66.28	-37.38	44.08	-3.46	-0.96	6.37	0.034
2158	167.9	-138.0	0.009	-0.004	57.82	132.01	-78.14	6.33	-2.47	11.82	0.062
2444	19.0	-114.1	0.006	0.001	39.73	-99.41	-57.27	-1.99	4.64	10.59	0.045
2458	-20.9	-114.1	0.006	0.001	5.85	-115.21	-17.74	-3.65	4.04	8.14	0.035
3330	151.5	-148.4	0.009	-0.004	103.53	109.72	-81.54	7.11	-0.21	11.80	0.068

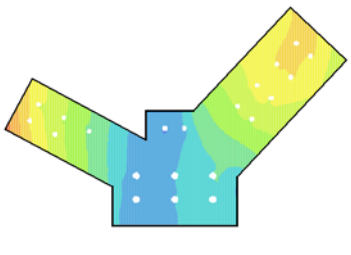
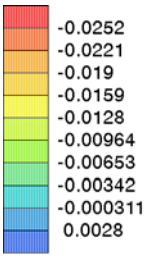
x,y: node coordinates; u_x,u_y: deformations; n_{xx},n_{yy},n_{xy}: normal forces; σ,τ: stresses
U_p: total utilization of the node plate

2.6.3. 1.35*Lf1+1.5*Lf2

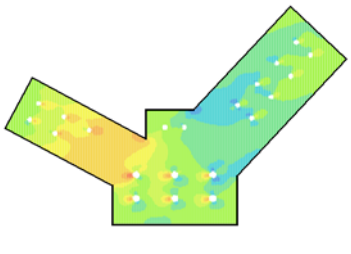
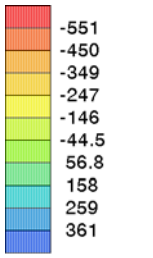
deformations u_x [mm]
min u_x = -0.0069 mm, max u_x = 0.0503 mm

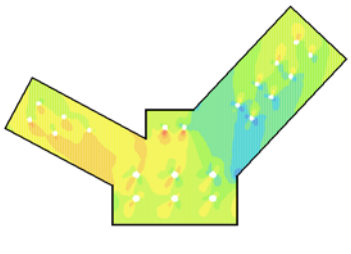
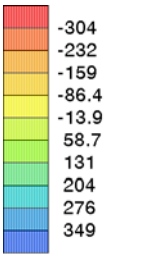
deformations u_y [mm]
min u_y = -0.0238 mm, max u_y = 0.0041 mm

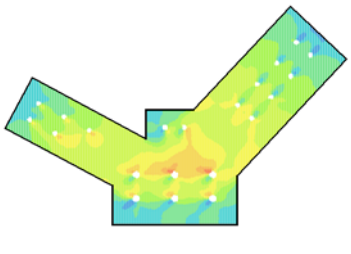
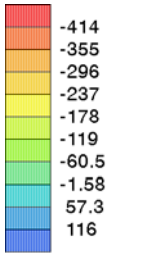
normal forces n_{xx} [kN/m]
min n_{xx} = -551.23 kN/m, max n_{xx} = 361.00 kN/m

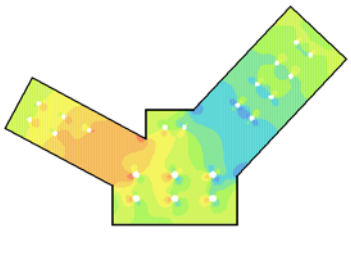
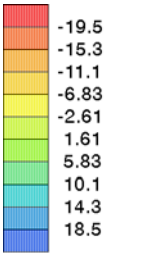
normal forces n_{yy} [kN/m]
min n_{yy} = -304.07 kN/m, max n_{yy} = 348.42 kN/m

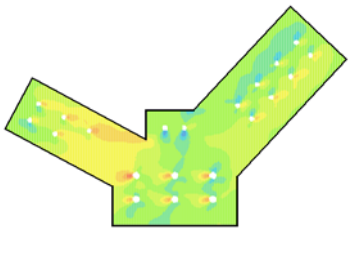
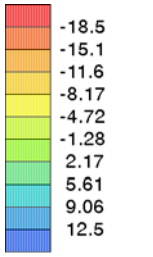
normal forces n_{xy} [kN/m]
min n_{xy} = -413.79 kN/m, max n_{xy} = 116.35 kN/m

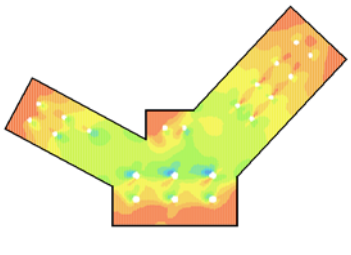
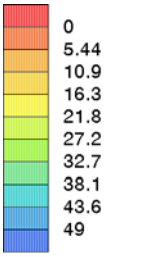
main normal stresses σ_1 [N/mm²]
min σ_1 = -19.52 N/mm², max σ_1 = 18.76 N/mm²

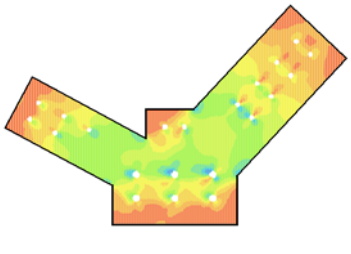
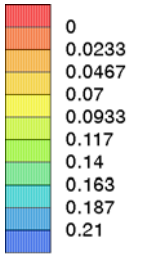
main shear stresses τ_1 [N/mm²]
min τ_1 = -18.46 N/mm², max τ_1 = 12.24 N/mm²

equivalent stresses σ_v [N/mm²]
min σ_v = 0.03 N/mm², max σ_v = 48.86 N/mm²

utilization of the node plate U_p
min U_p = 0.000, max U_p = 0.208

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
1	39.9	-160.0	0.019	-0.004	361.00	178.63	-181.60	17.99	6.08	29.57	0.169
10	-297.8	-227.7	0.050	-0.015	-3.13	0.07	1.04	-0.10	-0.11	0.24	0.001
42	-20.0	-117.5	0.016	0.004	19.74	-265.21	-71.39	-8.18	9.50	20.14	0.086
1124	-89.9	-23.2	0.003	0.001	-551.23	-17.91	-127.12	-18.97	-17.78	39.03	0.169
1125	-88.9	-20.2	0.002	0.002	-490.44	-95.16	-45.67	-19.52	-13.18	30.49	0.167
1221	72.6	-31.9	0.005	-0.002	109.65	175.41	-413.79	9.50	-2.19	48.86	0.208
1910	-91.7	-24.5	0.004	0.001	-539.95	13.97	-176.12	-17.53	-18.46	41.76	0.178

utilization of the node plate

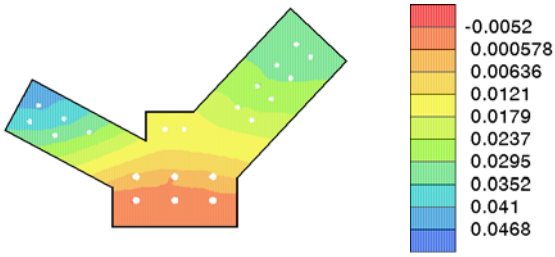
Kno	x mm	y mm	u_x mm	u_y mm	n_{xx} kN/m	n_{yy} kN/m	n_{xy} kN/m	σ_1 N/mm²	τ_1 N/mm²	σ_v N/mm²	U_p
1912	-89.2	32.3	-0.006	0.001	-174.93	-98.67	116.35	-9.12	-2.54	16.82	0.090
2158	167.9	-138.0	0.023	-0.011	152.60	348.42	-206.24	16.70	-6.53	31.21	0.163
2444	19.0	-114.1	0.016	0.001	104.86	-262.37	-151.16	-5.25	12.24	27.96	0.119
2458	-20.9	-114.1	0.016	0.003	15.43	-304.07	-46.83	-9.62	10.65	21.50	0.091
3330	151.5	-148.4	0.024	-0.010	273.25	289.60	-215.20	18.76	-0.54	31.15	0.180

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

2.6.4. Lf1+1.5*Lf2

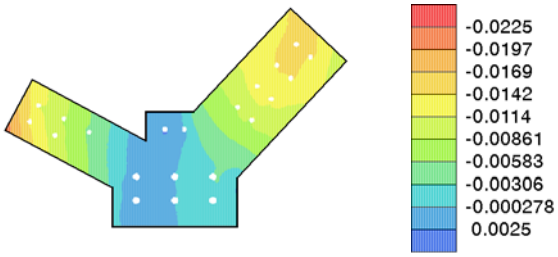
deformations u_x [mm]

min u_x = -0.0062 mm, max u_x = 0.0453 mm



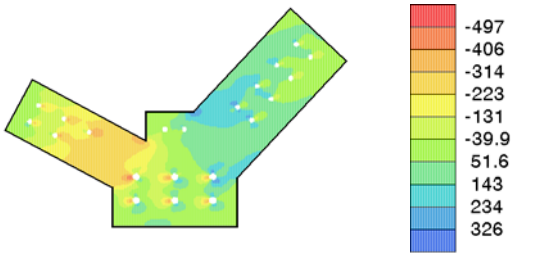
deformations u_y [mm]

min u_y = -0.0215 mm, max u_y = 0.0037 mm



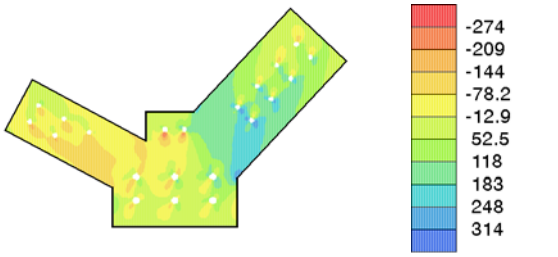
normal forces n_{xx} [kN/m]

min n_{xx} = -497.08 kN/m, max n_{xx} = 325.54 kN/m



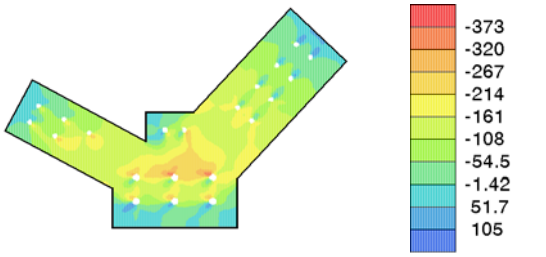
normal forces n_{yy} [kN/m]

min n_{yy} = -274.20 kN/m, max n_{yy} = 314.20 kN/m



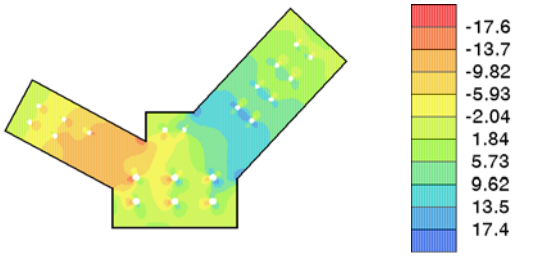
normal forces n_{xy} [kN/m]

min n_{xy} = -373.14 kN/m, max n_{xy} = 104.92 kN/m



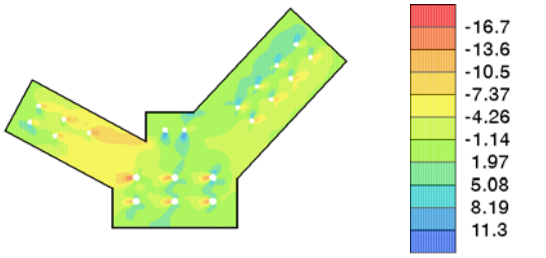
main normal stresses σ_1 [N/mm²]

min σ_1 = -17.60 N/mm², max σ_1 = 16.92 N/mm²



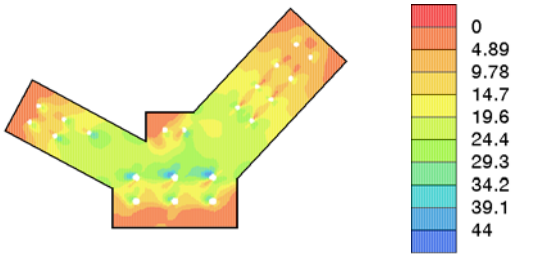
main shear stresses τ_1 [N/mm²]

min τ_1 = -16.65 N/mm², max τ_1 = 11.04 N/mm²



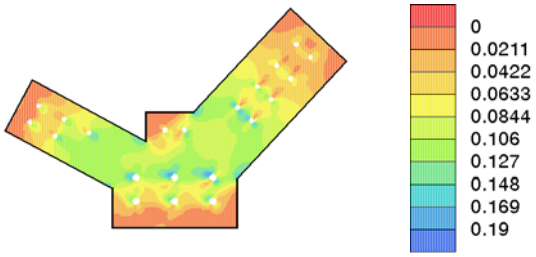
equivalent stresses σ_v [N/mm²]

min σ_v = 0.02 N/mm², max σ_v = 44.06 N/mm²



utilization of the node plate U_p

min U_p = 0.000, max U_p = 0.188



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
1	39.9	-160.0	0.017	-0.004	325.54	161.08	-163.76	16.22	5.48	26.66	0.152
10	-297.8	-227.7	0.045	-0.014	-2.83	0.06	0.94	-0.09	-0.10	0.22	---
42	-20.0	-117.5	0.014	0.004	17.80	-239.16	-64.38	-7.38	8.57	18.16	0.077
1124	-89.9	-23.2	0.002	0.001	-497.08	-16.15	-114.63	-17.11	-16.03	35.20	0.153
1125	-88.9	-20.2	0.002	0.002	-442.27	-85.81	-41.18	-17.60	-11.88	27.50	0.151
1221	72.6	-31.9	0.005	-0.002	98.88	158.18	-373.14	8.57	-1.98	44.06	0.188
1910	-91.7	-24.5	0.003	0.001	-486.91	12.59	-158.82	-15.81	-16.65	37.66	0.160
1912	-89.2	32.3	-0.005	0.001	-157.75	-88.98	104.92	-8.22	-2.29	15.17	0.081
2158	167.9	-138.0	0.021	-0.010	137.61	314.20	-185.98	15.06	-5.89	28.14	0.147
2444	19.0	-114.1	0.015	0.001	94.56	-236.60	-136.31	-4.73	11.04	25.21	0.107
2458	-20.9	-114.1	0.014	0.003	13.91	-274.20	-42.23	-8.68	9.60	19.38	0.082
3330	151.5	-148.4	0.022	-0.009	246.41	261.15	-194.06	16.92	-0.49	28.09	0.163

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 $U_{max} = 0.21 \leq 1$ => **verification fulfilled**

2.7. bearing forces strap

$p_1 = 80$ mm, $e_1 = 50$ mm, $e_2 = 53$ mm, $p_2 = 50.00$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk} = 216.00$ kN
$e_1 = 50$ mm, $e_2 = 53$ mm, $p_2 = 50$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk,Rand} = 216.00$ kN

2.7.1. Lf1

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	3.75	172.80	0.02	4	3.75	172.80	0.02
2	3.75	172.80	0.02	5	3.75	172.80	0.02
3	3.75	172.80	0.02	6	3.75	172.80	0.02

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

2.7.2. 1.35*Lf1

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	5.06	172.80	0.03	4	5.06	172.80	0.03
2	5.06	172.80	0.03	5	5.06	172.80	0.03
3	5.06	172.80	0.03	6	5.06	172.80	0.03

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

2.7.3. 1.35*Lf1+1.5*Lf2

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	13.35	172.80	0.08	4	13.35	172.80	0.08
2	13.35	172.80	0.08	5	13.35	172.80	0.08
3	13.35	172.80	0.08	6	13.35	172.80	0.08

maximum utilization of the bearing forces $U_{max} = 0.08 \leq 1$ => **verification fulfilled**

2.7.4. Lf1+1.5*Lf2

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	12.04	172.80	0.07	4	12.04	172.80	0.07
2	12.04	172.80	0.07	5	12.04	172.80	0.07
3	12.04	172.80	0.07	6	12.04	172.80	0.07

maximum utilization of the bearing forces $U_{max} = 0.07 \leq 1$ => **verification fulfilled**

2.8. bearing forces strut

$p_1 = 60$ mm, $e_1 = 37$ mm, $e_2 = 38$ mm, $p_2 = 40.00$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk} = 162.00$ kN
$e_1 = 37$ mm, $e_2 = 38$ mm, $p_2 = 40$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk,Rand} = 162.00$ kN

2.8.1. Lf1

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	2.64	129.60	0.02
2	2.64	129.60	0.02

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

2.8.2. 1.35*Lf1

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	3.56	129.60	0.03
2	3.56	129.60	0.03

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

2.8.3. 1.35*Lf1+1.5*Lf2

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	9.40	129.60	0.07
2	9.40	129.60	0.07

maximum utilization of the bearing forces U_{max} = 0.07 ≤ 1 => **verification fulfilled**

2.8.4. Lf1+1.5*Lf2

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	8.48	129.60	0.07
2	8.48	129.60	0.07

maximum utilization of the bearing forces U_{max} = 0.07 ≤ 1 => **verification fulfilled**

2.9. bearing forces diagonal left

p_1 = 60 mm, e_1 = 37 mm, e_2 = 39 mm, p_2 = 39.00 mm, α_b = 1.00, k_1 = 2.50 => $F_{b,Rk}$ = 162.00 kN
e_1 = 37 mm, e_2 = 39 mm, p_2 = 39 mm, α_b = 1.00, k_1 = 2.50 => $F_{b,Rk,Rand}$ = 162.00 kN

2.9.1. Lf1

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	2.72	129.60	0.02	4	2.71	129.60	0.02
2	2.70	129.60	0.02	5	2.54	129.60	0.02
3	2.54	129.60	0.02				

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

2.9.2. 1.35*Lf1

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	3.67	129.60	0.03	4	3.66	129.60	0.03
2	3.65	129.60	0.03	5	3.43	129.60	0.03
3	3.42	129.60	0.03				

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

2.9.3. 1.35*Lf1+1.5*Lf2

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	9.69	129.60	0.07	4	9.66	129.60	0.07
2	9.63	129.60	0.07	5	9.06	129.60	0.07
3	9.03	129.60	0.07				

maximum utilization of the bearing forces U_{max} = 0.07 ≤ 1 => **verification fulfilled**

2.9.4. Lf1+1.5*Lf2

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	8.74	129.60	0.07	4	8.71	129.60	0.07
2	8.69	129.60	0.07	5	8.17	129.60	0.06
3	8.15	129.60	0.06				

maximum utilization of the bearing forces U_{max} = 0.07 ≤ 1 => **verification fulfilled**

2.10. bearing forces diagonal right

p_1 = 60 mm, e_1 = 46 mm, e_2 = 58 mm, p_2 = 40.00 mm, α_b = 1.00, k_1 = 2.50 => $F_{b,Rk}$ = 162.00 kN
e_1 = 46 mm, e_2 = 58 mm, p_2 = 40 mm, α_b = 1.00, k_1 = 2.50 => $F_{b,Rk,Rand}$ = 162.00 kN

2.10.1. Lf1

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	1.99	129.60	0.02	5	1.99	129.60	0.02
2	1.99	129.60	0.02	6	1.99	129.60	0.02
3	1.99	129.60	0.02	7	1.99	129.60	0.02
4	1.99	129.60	0.02	8	1.99	129.60	0.02

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

2.10.2. 1.35*Lf1

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	2.69	129.60	0.02	5	2.69	129.60	0.02
2	2.69	129.60	0.02	6	2.69	129.60	0.02
3	2.69	129.60	0.02	7	2.69	129.60	0.02
4	2.69	129.60	0.02	8	2.69	129.60	0.02

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

2.10.3. 1.35*Lf1+1.5*Lf2

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	7.10	129.60	0.05	5	7.10	129.60	0.05
2	7.10	129.60	0.05	6	7.10	129.60	0.05
3	7.10	129.60	0.05	7	7.10	129.60	0.05
4	7.10	129.60	0.05	8	7.10	129.60	0.05

maximum utilization of the bearing forces U_{max} = 0.05 ≤ 1 => **verification fulfilled**

2.10.4. Lf1+1.5*Lf2

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	6.40	129.60	0.05	5	6.40	129.60	0.05
2	6.40	129.60	0.05	6	6.40	129.60	0.05
3	6.40	129.60	0.05	7	6.40	129.60	0.05
4	6.40	129.60	0.05	8	6.40	129.60	0.05

maximum utilization of the bearing forces U_{max} = 0.05 ≤ 1 => **verification fulfilled**

3. summary

total utilization of all verifications $u_{max,Ges}$ = 1.105 > 1 ⇒ not ok. !!