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 perforated plate Simpson NP20/620/1240, thickness t=2.0 mm, steel plate S250GD
dimensions: b = 1240.0 mm, h=620.0 mm, steel plate external, on both sides
The weakening of the cross-section due to the holes is taken into account by increasing the rated stresses
increase factor due to the imperfections = 1.3333
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	-620.0	-110.0	4	620.0	-110.0
2	-620.0	510.0	5	-620.0	-110.0
3	620.0	510.0			

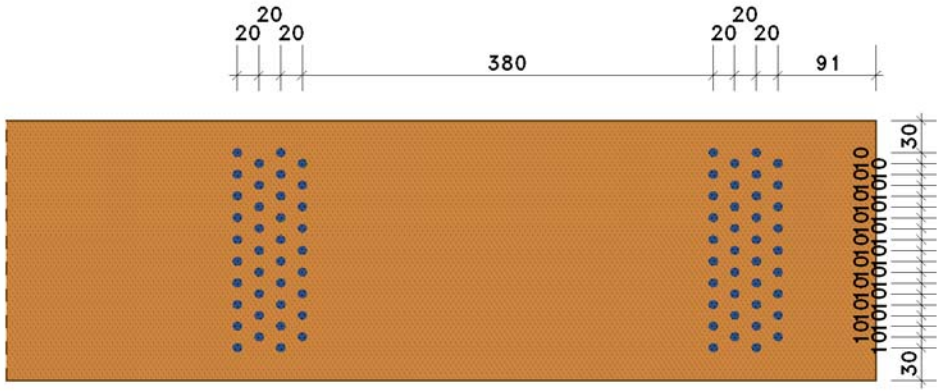
1.3. connected beams

Nr.	bar	material	b mm	t mm	α °
1	strap both sides w. kink	glue lam. timber EC GL24h	240	180	0
2	strut	solconiftimbr C24	160	180	90
3	diagonal left	solconiftimbr C24	160	180	45
4	diagonal right	solconiftimbr C24	160	180	45

1.4. fastener

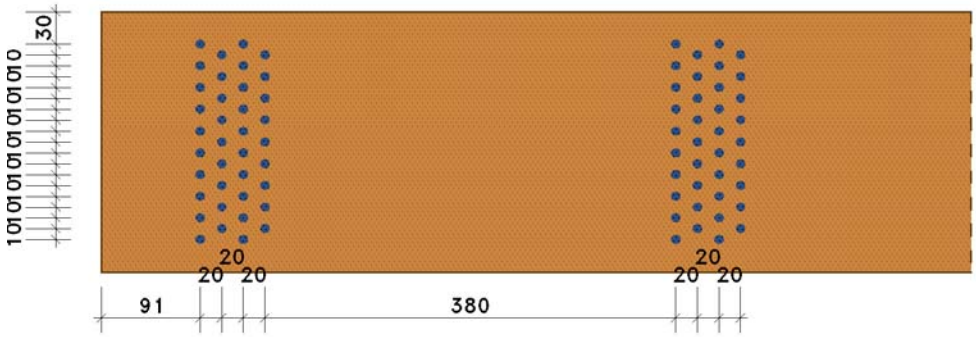
1.4.1. strap left

Simpson CSA, 5.0 x 50.0 mm, double-sided, d_k = 8.3 mm, l_{ef} = 44.0 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, ETA-04/0013
76 fastener, a_1 = 120 mm, a_2 = 96 mm on both sides
centroid of the fasteners from nodal point S at x_s = -341 mm, y_s = 0 mm
polar moment of inertia I_p = 3944379 mm⁴
fastener strap left scale 1:70



1.4.2. strap right

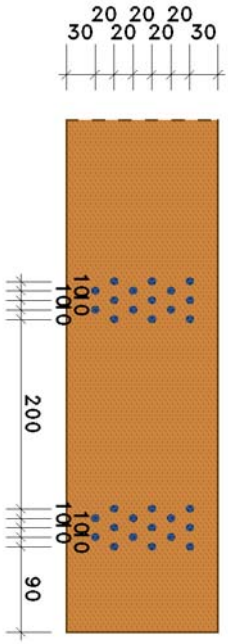
Simpson CSA, 5.0 x 50.0 mm, double-sided, d_k = 8.3 mm, l_{ef} = 44.0 mm, not predrilled
load-bearing capacity is reduced acc. to DIN EN 1995-1-1, 8.3.1.1(8)
$F_{v,Rk}$ increased acc. to DIN EN 1995-1-1, 8.2.3(4)
$F_{v,Rd}$ is calculated with the exact verification acc. to DIN EN 1995-1-1, 8.2.3, ETA-04/0013
76 fastener, a_1 = 120 mm, a_2 = 96 mm on both sides
centroid of the fasteners from nodal point S at x_s = 339 mm, y_s = 0 mm
polar moment of inertia I_p = 3944379 mm⁴
fastener strap right scale 1:70



1.4.3. strut

Simpson CSA, 5.0 x 50.0 mm, double-sided, d_k = 8.3 mm, l_{ef} = 44.0 mm, 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, ETA-04/0013
30 fastener, a_1 = 130 mm, a_2 = 96 mm on both sides
centroid of the fasteners from nodal point S at x_s = 2 mm, y_s = 350 mm
polar moment of inertia I_p = 472880 mm⁴

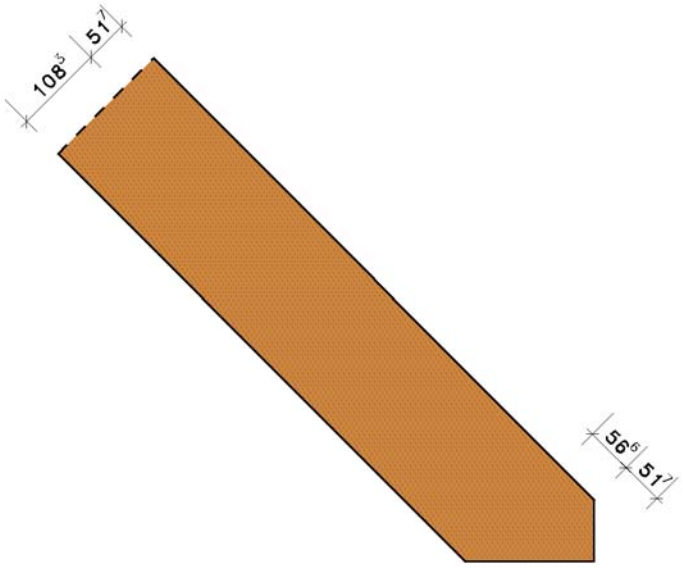
fastener strut scale 1:80



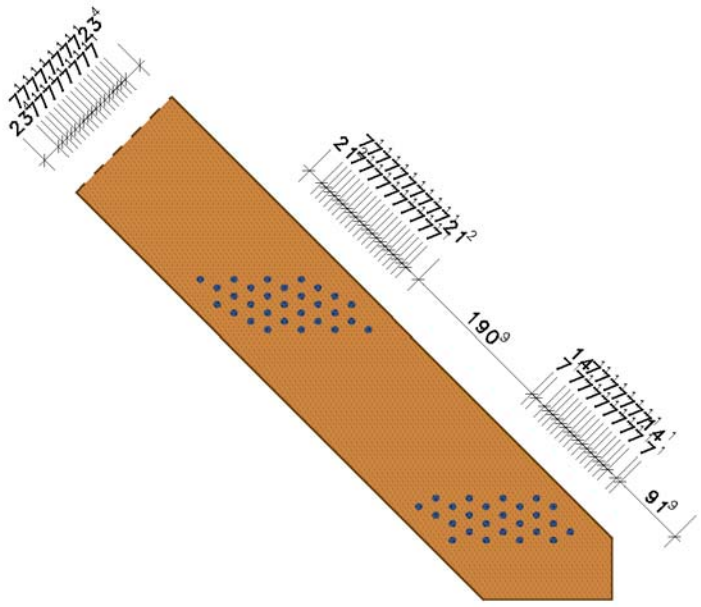
1.4.4. diagonal left

Simpson CSA, 5.0 x 50.0 mm, double-sided, d_k = 8.3 mm, l_{ef} = 44.0 mm, 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, ETA-04/0013
54 fastener, a_1 = 60 mm, a_2 = 60 mm on both sides
centroid of the fasteners from nodal point S at x_s = -353 mm, y_s = 352 mm
polar moment of inertia I_p = 1886859 mm⁴

view diagonal left scale 1:90



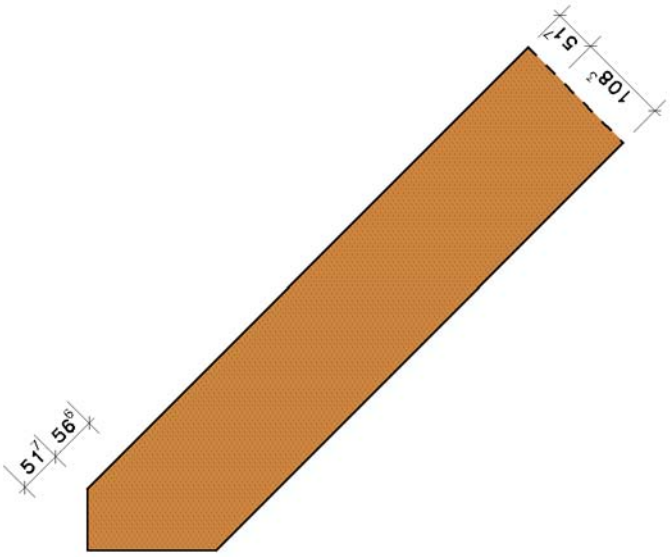
fastener diagonal left scale 1:90



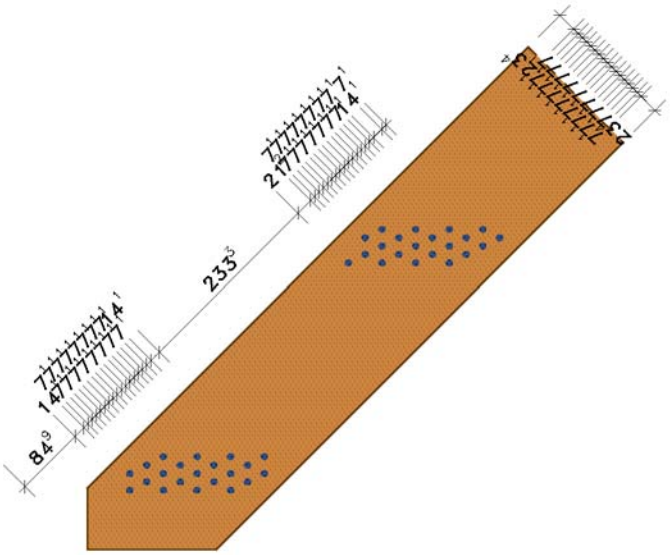
1.4.5. diagonal right

Simpson CSA, 5.0 x 50.0 mm, double-sided, d_k = 8.3 mm, l_{ef} = 44.0 mm, 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, ETA-04/0013
42 fastener, a_1 = 60 mm, a_2 = 60 mm on both sides
centroid of the fasteners from nodal point S at x_s = 344 mm, y_s = 345 mm
polar moment of inertia I_p = 1638076 mm^4

view diagonal right scale 1:90

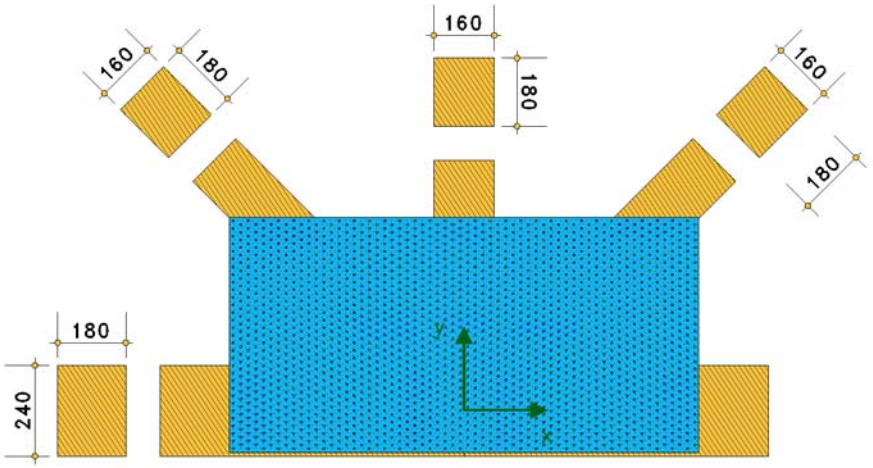


fastener diagonal right scale 1:90



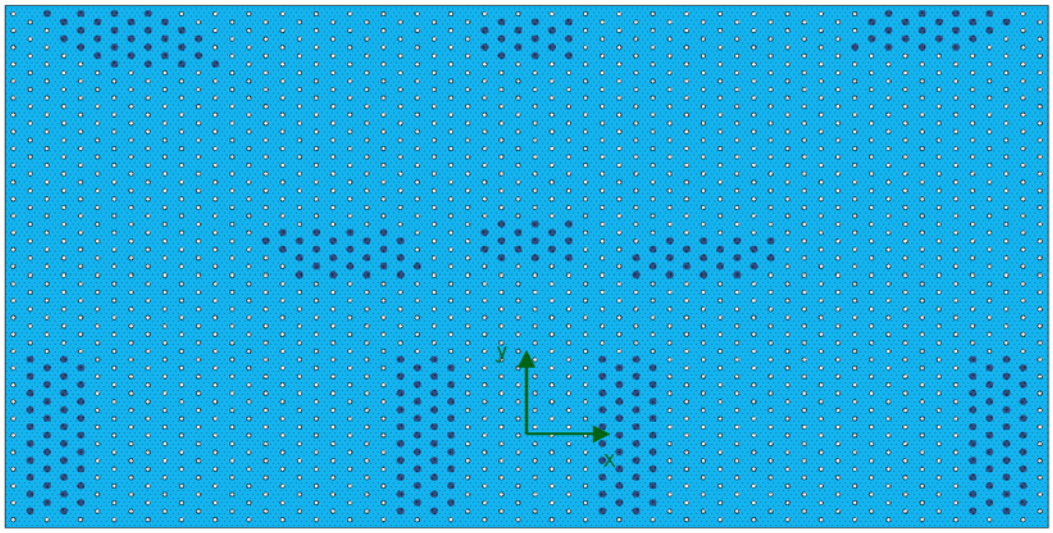
1.5. nodal point

view scale 1:200

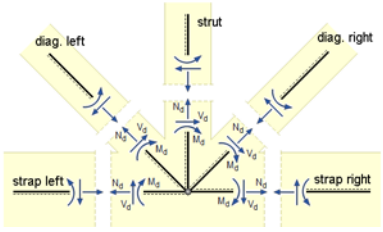


1.6. node plate

view scale 1:90



1.7. load combinations (design internal forces)



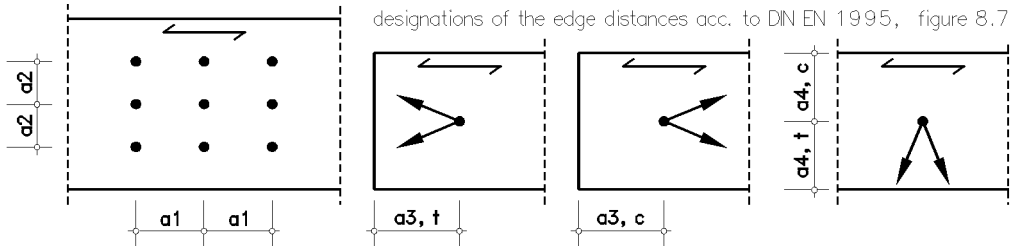
1.7.1. sum M straps, KLED: short-term

Nr	beam	N_d kN	M_d kNm	V_d kN	k_{mod} -	γ -
1	strap left	100.00	2.00	10.00	0.900	1.30
2	strap right	100.00	2.00	10.00	0.900	1.30
3	strut	0.00	4.00	0.00	0.900	1.30
4	diag. left	5.00	-4.00	5.00	0.900	1.30
5	diag. right	-5.00	-4.00	5.00	0.900	1.30
6	ΣH, ΣM, ΣV	-0.00	0.00	0.00	---	---

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	14.4	14.4	7.2	7.2	7.2	7.2
outtimbmbr	28.0	14.0	60.0	28.0	40.0	20.0



2.1.1. sum M straps

N_d = 100.000 kN, V_d = 10.000 kN, $M_{v,d}$ = 2.000 + -0.341 x 10.000 + 0.000 x 100.000 = -1.405 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} °	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
1	-0.09	0.03	0.09	0.03	0.09	1.35	0.22	1.37	9.3	3.1113	0.43	0.44
2	-0.09	0.02	0.09	0.02	0.09	1.34	0.22	1.36	9.3	3.1113	0.43	0.44
3	-0.09	0.02	0.09	0.02	0.09	1.33	0.22	1.35	9.4	3.1113	0.43	0.43
4	-0.09	0.01	0.09	0.01	0.09	1.33	0.22	1.34	9.4	3.1113	0.43	0.43
5	-0.09	0.00	0.09	0.00	0.09	1.32	0.22	1.34	9.5	3.1113	0.42	0.43
6	-0.09	-0.00	0.09	-0.00	0.09	1.31	0.22	1.33	9.5	3.1113	0.42	0.43
7	-0.09	-0.01	0.09	-0.01	0.09	1.31	0.22	1.32	9.6	3.1113	0.42	0.43
8	-0.09	-0.02	0.09	-0.02	0.09	1.30	0.22	1.32	9.6	3.1113	0.42	0.42
9	-0.09	-0.02	0.09	-0.02	0.09	1.29	0.22	1.31	9.7	3.1113	0.41	0.42
10	-0.09	-0.03	0.09	-0.03	0.09	1.28	0.22	1.30	9.7	3.1113	0.41	0.42
11	-0.09	0.03	0.08	0.03	0.08	1.34	0.21	1.36	9.0	3.1113	0.43	0.44
12	-0.08	0.02	0.08	0.02	0.08	1.34	0.21	1.35	9.1	3.1113	0.43	0.44
13	-0.08	0.01	0.08	0.01	0.08	1.33	0.21	1.35	9.1	3.1113	0.43	0.43
14	-0.08	0.01	0.08	0.01	0.08	1.32	0.21	1.34	9.2	3.1113	0.43	0.43
15	-0.08	-0.00	0.08	-0.00	0.08	1.32	0.21	1.33	9.2	3.1113	0.42	0.43
16	-0.08	-0.01	0.08	-0.01	0.08	1.31	0.21	1.33	9.3	3.1113	0.42	0.43
17	-0.08	-0.01	0.08	-0.01	0.08	1.30	0.21	1.32	9.3	3.1113	0.42	0.42
18	-0.08	-0.02	0.08	-0.02	0.08	1.29	0.21	1.31	9.4	3.1113	0.42	0.42
19	-0.09	-0.03	0.08	-0.03	0.08	1.29	0.21	1.30	9.4	3.1113	0.41	0.42
20	-0.08	0.03	0.07	0.03	0.07	1.35	0.21	1.36	8.7	3.1113	0.43	0.44
21	-0.08	0.02	0.07	0.02	0.07	1.34	0.21	1.36	8.7	3.1113	0.43	0.44
22	-0.08	0.02	0.07	0.02	0.07	1.33	0.21	1.35	8.8	3.1113	0.43	0.43
23	-0.08	0.01	0.07	0.01	0.07	1.33	0.21	1.34	8.8	3.1113	0.43	0.43
24	-0.07	0.00	0.07	0.00	0.07	1.32	0.21	1.34	8.9	3.1113	0.42	0.43
25	-0.07	-0.00	0.07	-0.00	0.07	1.31	0.21	1.33	8.9	3.1113	0.42	0.43
26	-0.08	-0.01	0.07	-0.01	0.07	1.31	0.21	1.32	9.0	3.1113	0.42	0.42
27	-0.08	-0.02	0.07	-0.02	0.07	1.30	0.21	1.31	9.0	3.1113	0.42	0.42
28	-0.08	-0.02	0.07	-0.02	0.07	1.29	0.21	1.31	9.1	3.1113	0.41	0.42
29	-0.08	-0.03	0.07	-0.03	0.07	1.28	0.21	1.30	9.1	3.1113	0.41	0.42
30	-0.07	0.03	0.07	0.03	0.07	1.34	0.20	1.36	8.4	3.1113	0.43	0.44
31	-0.07	0.02	0.07	0.02	0.07	1.34	0.20	1.35	8.5	3.1113	0.43	0.43
32	-0.07	0.01	0.07	0.01	0.07	1.33	0.20	1.34	8.5	3.1113	0.43	0.43
33	-0.07	0.01	0.07	0.01	0.07	1.32	0.20	1.34	8.6	3.1113	0.43	0.43
34	-0.07	-0.00	0.07	-0.00	0.07	1.32	0.20	1.33	8.6	3.1113	0.42	0.43
35	-0.07	-0.01	0.07	-0.01	0.07	1.31	0.20	1.32	8.6	3.1113	0.42	0.43
36	-0.07	-0.01	0.07	-0.01	0.07	1.30	0.20	1.32	8.7	3.1113	0.42	0.42
37	-0.07	-0.02	0.07	-0.02	0.07	1.29	0.20	1.31	8.7	3.1113	0.42	0.42
38	-0.07	-0.03	0.07	-0.03	0.07	1.29	0.20	1.30	8.8	3.1113	0.41	0.42
39	-0.08	0.03	-0.07	0.03	-0.07	1.35	0.06	1.35	2.7	3.1113	0.43	0.43
40	-0.07	0.02	-0.07	0.02	-0.07	1.34	0.06	1.34	2.7	3.1113	0.43	0.43
41	-0.07	0.02	-0.07	0.02	-0.07	1.33	0.06	1.34	2.7	3.1113	0.43	0.43
42	-0.07	0.01	-0.07	0.01	-0.07	1.33	0.06	1.33	2.7	3.1113	0.43	0.43
43	-0.07	0.00	-0.07	0.00	-0.07	1.32	0.06	1.32	2.8	3.1113	0.42	0.42
44	-0.07	-0.00	-0.07	-0.00	-0.07	1.31	0.06	1.31	2.8	3.1113	0.42	0.42
45	-0.07	-0.01	-0.07	-0.01	-0.07	1.31	0.06	1.31	2.8	3.1113	0.42	0.42
46	-0.07	-0.02	-0.07	-0.02	-0.07	1.30	0.06	1.30	2.8	3.1113	0.42	0.42
47	-0.07	-0.02	-0.07	-0.02	-0.07	1.29	0.06	1.29	2.8	3.1113	0.41	0.42
48	-0.08	-0.03	-0.07	-0.03	-0.07	1.28	0.06	1.29	2.8	3.1113	0.41	0.41
49	-0.08	0.03	-0.08	0.03	-0.08	1.34	0.06	1.35	2.4	3.1113	0.43	0.43
50	-0.08	0.02	-0.08	0.02	-0.08	1.34	0.06	1.34	2.4	3.1113	0.43	0.43

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} °	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
51	-0.08	0.01	-0.08	0.01	-0.08	1.33	0.06	1.33	2.4	3.1113	0.43	0.43
52	-0.08	0.01	-0.08	0.01	-0.08	1.32	0.06	1.32	2.4	3.1113	0.43	0.43
53	-0.08	-0.00	-0.08	0.00	-0.08	1.32	0.06	1.32	2.5	3.1113	0.42	0.42
54	-0.08	-0.01	-0.08	-0.01	-0.08	1.31	0.06	1.31	2.5	3.1113	0.42	0.42
55	-0.08	-0.01	-0.08	-0.01	-0.08	1.30	0.06	1.30	2.5	3.1113	0.42	0.42
56	-0.08	-0.02	-0.08	-0.02	-0.08	1.29	0.06	1.30	2.5	3.1113	0.42	0.42
57	-0.08	-0.03	-0.08	-0.03	-0.08	1.29	0.06	1.29	2.5	3.1113	0.41	0.41
58	-0.09	0.03	-0.08	0.03	-0.08	1.35	0.05	1.35	2.1	3.1113	0.43	0.43
59	-0.09	0.02	-0.08	0.02	-0.08	1.34	0.05	1.34	2.1	3.1113	0.43	0.43
60	-0.08	0.02	-0.08	0.02	-0.08	1.33	0.05	1.33	2.1	3.1113	0.43	0.43
61	-0.08	0.01	-0.08	0.01	-0.08	1.33	0.05	1.33	2.1	3.1113	0.43	0.43
62	-0.08	0.00	-0.08	0.00	-0.08	1.32	0.05	1.32	2.1	3.1113	0.42	0.42
63	-0.08	-0.00	-0.08	-0.00	-0.08	1.31	0.05	1.31	2.2	3.1113	0.42	0.42
64	-0.08	-0.01	-0.08	-0.01	-0.08	1.31	0.05	1.31	2.2	3.1113	0.42	0.42
65	-0.08	-0.02	-0.08	-0.02	-0.08	1.30	0.05	1.30	2.2	3.1113	0.42	0.42
66	-0.09	-0.02	-0.08	-0.02	-0.08	1.29	0.05	1.29	2.2	3.1113	0.41	0.42
67	-0.09	-0.03	-0.08	-0.03	-0.08	1.28	0.05	1.28	2.2	3.1113	0.41	0.41
68	-0.09	0.03	-0.09	0.03	-0.09	1.34	0.04	1.34	1.8	3.1113	0.43	0.43
69	-0.09	0.02	-0.09	0.02	-0.09	1.34	0.04	1.34	1.8	3.1113	0.43	0.43
70	-0.09	0.01	-0.09	0.01	-0.09	1.33	0.04	1.33	1.8	3.1113	0.43	0.43
71	-0.09	0.01	-0.09	0.01	-0.09	1.32	0.04	1.32	1.8	3.1113	0.43	0.43
72	-0.09	-0.00	-0.09	0.00	-0.09	1.32	0.04	1.32	1.8	3.1113	0.42	0.42
73	-0.09	-0.01	-0.09	-0.01	-0.09	1.31	0.04	1.31	1.9	3.1113	0.42	0.42
74	-0.09	-0.01	-0.09	-0.01	-0.09	1.30	0.04	1.30	1.9	3.1113	0.42	0.42
75	-0.09	-0.02	-0.09	-0.02	-0.09	1.29	0.04	1.30	1.9	3.1113	0.42	0.42
76	-0.09	-0.03	-0.09	-0.03	-0.09	1.29	0.04	1.29	1.9	3.1113	0.41	0.41

maximum utilization of fasteners $U_{max} = 0.44 \leq 1$ => **verification fulfilled**

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

$L_{net,t} = 180$ mm, $t_1 = 45$ mm $\Rightarrow A_{net,t} = 8100$ mm^2, $M_{y,k} = 5000.0$ Nmm, $f_{h,k} = 19.48$ N/mm^2
$L_{net,v} = 182$ mm, $t_{ef} = 45$ mm $\Rightarrow A_{net,v} = 8190$ mm^2 (failure mechanism c,f,j/l,k,m)
$L_{net,v} = 182$ mm $\Rightarrow A_{net,v} = 8190$ mm^2 $\Rightarrow F_{bs,Rk} = 233.28$ kN

load	N_d kN	$F_{bs,Rd}$ kN	U_{bs} -
1	50.000	161.502	0.31

maximum utilization block shear failure $U_{max} = 0.31 \leq 1$ => **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	14.4	14.4	7.2	7.2	7.2	7.2
outtimbmbr	28.0	14.0	60.0	28.0	40.0	20.0

2.2.1. sum M straps

$N_d = 100.000$ kN, $V_d = 10.000$ kN, $M_{v,d} = 2.000 + -0.339 \times 10.000 + -0.000 \times 100.000 = -1.395$ 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} °	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
1	-0.09	0.03	0.09	-0.03	-0.09	1.28	0.04	1.28	1.9	3.1113	0.41	0.41
2	-0.09	0.02	0.09	-0.02	-0.09	1.29	0.04	1.29	1.9	3.1113	0.41	0.42
3	-0.09	0.02	0.09	-0.02	-0.09	1.30	0.04	1.30	1.9	3.1113	0.42	0.42
4	-0.09	0.01	0.09	-0.01	-0.09	1.31	0.04	1.31	1.9	3.1113	0.42	0.42
5	-0.09	0.00	0.09	-0.00	-0.09	1.31	0.04	1.31	1.9	3.1113	0.42	0.42
6	-0.09	-0.00	0.09	0.00	-0.09	1.32	0.04	1.32	1.9	3.1113	0.42	0.42
7	-0.09	-0.01	0.09	0.01	-0.09	1.33	0.04	1.33	1.9	3.1113	0.43	0.43
8	-0.09	-0.02	0.09	0.02	-0.09	1.33	0.04	1.33	1.9	3.1113	0.43	0.43
9	-0.09	-0.02	0.09	0.02	-0.09	1.34	0.04	1.34	1.9	3.1113	0.43	0.43
10	-0.09	-0.03	0.09	0.03	-0.09	1.35	0.04	1.35	1.8	3.1113	0.43	0.43
11	-0.09	0.03	0.08	-0.03	-0.08	1.29	0.05	1.29	2.2	3.1113	0.41	0.41
12	-0.08	0.02	0.08	-0.02	-0.08	1.29	0.05	1.30	2.2	3.1113	0.42	0.42
13	-0.08	0.01	0.08	-0.01	-0.08	1.30	0.05	1.30	2.2	3.1113	0.42	0.42
14	-0.08	0.01	0.08	-0.01	-0.08	1.31	0.05	1.31	2.2	3.1113	0.42	0.42
15	-0.08	-0.00	0.08	0.00	-0.08	1.32	0.05	1.32	2.2	3.1113	0.42	0.42
16	-0.08	-0.01	0.08	0.01	-0.08	1.32	0.05	1.32	2.2	3.1113	0.43	0.43
17	-0.08	-0.01	0.08	0.01	-0.08	1.33	0.05	1.33	2.2	3.1113	0.43	0.43
18	-0.08	-0.02	0.08	0.02	-0.08	1.34	0.05	1.34	2.2	3.1113	0.43	0.43
19	-0.09	-0.03	0.08	0.03	-0.08	1.34	0.05	1.35	2.1	3.1113	0.43	0.43
20	-0.08	0.03	0.07	-0.03	-0.07	1.28	0.06	1.29	2.6	3.1113	0.41	0.41
21	-0.08	0.02	0.07	-0.02	-0.07	1.29	0.06	1.29	2.6	3.1113	0.41	0.42
22	-0.08	0.02	0.07	-0.02	-0.07	1.30	0.06	1.30	2.5	3.1113	0.42	0.42

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} °	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
23	-0.07	0.01	0.07	-0.01	-0.07	1.31	0.06	1.31	2.5	3.1113	0.42	0.42
24	-0.07	0.00	0.07	-0.00	-0.07	1.31	0.06	1.31	2.5	3.1113	0.42	0.42
25	-0.07	-0.00	0.07	0.00	-0.07	1.32	0.06	1.32	2.5	3.1113	0.42	0.42
26	-0.07	-0.01	0.07	0.01	-0.07	1.33	0.06	1.33	2.5	3.1113	0.43	0.43
27	-0.08	-0.02	0.07	0.02	-0.07	1.33	0.06	1.33	2.5	3.1113	0.43	0.43
28	-0.08	-0.02	0.07	0.02	-0.07	1.34	0.06	1.34	2.5	3.1113	0.43	0.43
29	-0.08	-0.03	0.07	0.03	-0.07	1.35	0.06	1.35	2.4	3.1113	0.43	0.43
30	-0.07	0.03	0.07	-0.03	-0.07	1.29	0.06	1.29	2.9	3.1113	0.41	0.41
31	-0.07	0.02	0.07	-0.02	-0.07	1.29	0.06	1.30	2.9	3.1113	0.42	0.42
32	-0.07	0.01	0.07	-0.01	-0.07	1.30	0.06	1.30	2.8	3.1113	0.42	0.42
33	-0.07	0.01	0.07	-0.01	-0.07	1.31	0.06	1.31	2.8	3.1113	0.42	0.42
34	-0.07	-0.00	0.07	0.00	-0.07	1.32	0.06	1.32	2.8	3.1113	0.42	0.42
35	-0.07	-0.01	0.07	0.01	-0.07	1.32	0.06	1.32	2.8	3.1113	0.43	0.43
36	-0.07	-0.01	0.07	0.01	-0.07	1.33	0.06	1.33	2.8	3.1113	0.43	0.43
37	-0.07	-0.02	0.07	0.02	-0.07	1.34	0.06	1.34	2.8	3.1113	0.43	0.43
38	-0.07	-0.03	0.07	0.03	-0.07	1.34	0.06	1.35	2.8	3.1113	0.43	0.43
39	-0.07	0.03	-0.07	-0.03	0.07	1.28	0.20	1.30	8.8	3.1113	0.41	0.42
40	-0.07	0.02	-0.07	-0.02	0.07	1.29	0.20	1.31	8.8	3.1113	0.41	0.42
41	-0.07	0.02	-0.07	-0.02	0.07	1.30	0.20	1.31	8.7	3.1113	0.42	0.42
42	-0.07	0.01	-0.07	-0.01	0.07	1.31	0.20	1.32	8.7	3.1113	0.42	0.42
43	-0.07	0.00	-0.07	-0.00	0.07	1.31	0.20	1.33	8.6	3.1113	0.42	0.43
44	-0.07	-0.00	-0.07	0.00	0.07	1.32	0.20	1.33	8.6	3.1113	0.42	0.43
45	-0.07	-0.01	-0.07	0.01	0.07	1.33	0.20	1.34	8.5	3.1113	0.43	0.43
46	-0.07	-0.02	-0.07	0.02	0.07	1.33	0.20	1.35	8.5	3.1113	0.43	0.43
47	-0.07	-0.02	-0.07	0.02	0.07	1.34	0.20	1.36	8.4	3.1113	0.43	0.44
48	-0.07	-0.03	-0.07	0.03	0.07	1.35	0.20	1.36	8.4	3.1113	0.43	0.44
49	-0.08	0.03	-0.07	-0.03	0.07	1.29	0.21	1.30	9.1	3.1113	0.41	0.42
50	-0.08	0.02	-0.07	-0.02	0.07	1.29	0.21	1.31	9.0	3.1113	0.42	0.42
51	-0.08	0.01	-0.07	-0.01	0.07	1.30	0.21	1.32	9.0	3.1113	0.42	0.42
52	-0.07	0.01	-0.07	-0.01	0.07	1.31	0.21	1.32	8.9	3.1113	0.42	0.43
53	-0.07	-0.00	-0.07	-0.00	0.07	1.32	0.21	1.33	8.9	3.1113	0.42	0.43
54	-0.07	-0.01	-0.07	0.01	0.07	1.32	0.21	1.34	8.9	3.1113	0.43	0.43
55	-0.08	-0.01	-0.07	0.01	0.07	1.33	0.21	1.35	8.8	3.1113	0.43	0.43
56	-0.08	-0.02	-0.07	0.02	0.07	1.34	0.21	1.35	8.8	3.1113	0.43	0.43
57	-0.08	-0.03	-0.07	0.03	0.07	1.34	0.21	1.36	8.7	3.1113	0.43	0.44
58	-0.09	0.03	-0.08	-0.03	0.08	1.28	0.21	1.30	9.4	3.1113	0.41	0.42
59	-0.09	0.02	-0.08	-0.02	0.08	1.29	0.21	1.31	9.4	3.1113	0.41	0.42
60	-0.08	0.02	-0.08	-0.02	0.08	1.30	0.21	1.32	9.3	3.1113	0.42	0.42
61	-0.08	0.01	-0.08	-0.01	0.08	1.31	0.21	1.32	9.3	3.1113	0.42	0.43
62	-0.08	0.00	-0.08	-0.00	0.08	1.31	0.21	1.33	9.2	3.1113	0.42	0.43
63	-0.08	-0.00	-0.08	0.00	0.08	1.32	0.21	1.34	9.2	3.1113	0.42	0.43
64	-0.08	-0.01	-0.08	0.01	0.08	1.33	0.21	1.34	9.1	3.1113	0.43	0.43
65	-0.08	-0.02	-0.08	0.02	0.08	1.33	0.21	1.35	9.1	3.1113	0.43	0.43
66	-0.09	-0.02	-0.08	0.02	0.08	1.34	0.21	1.36	9.0	3.1113	0.43	0.44
67	-0.09	-0.03	-0.08	0.03	0.08	1.35	0.21	1.36	9.0	3.1113	0.43	0.44
68	-0.09	0.03	-0.09	-0.03	0.09	1.29	0.22	1.31	9.7	3.1113	0.41	0.42
69	-0.09	0.02	-0.09	-0.02	0.09	1.29	0.22	1.31	9.7	3.1113	0.42	0.42
70	-0.09	0.01	-0.09	-0.01	0.09	1.30	0.22	1.32	9.6	3.1113	0.42	0.42
71	-0.09	0.01	-0.09	-0.01	0.09	1.31	0.22	1.33	9.5	3.1113	0.42	0.43
72	-0.09	-0.00	-0.09	-0.00	0.09	1.32	0.22	1.33	9.5	3.1113	0.42	0.43
73	-0.09	-0.01	-0.09	0.01	0.09	1.32	0.22	1.34	9.4	3.1113	0.43	0.43
74	-0.09	-0.01	-0.09	0.01	0.09	1.33	0.22	1.35	9.4	3.1113	0.43	0.43
75	-0.09	-0.02	-0.09	0.02	0.09	1.34	0.22	1.36	9.4	3.1113	0.43	0.44
76	-0.09	-0.03	-0.09	0.03	0.09	1.34	0.22	1.36	9.3	3.1113	0.43	0.44

maximum utilization of fasteners $U_{max} = 0.44 \leq 1$ => **verification fulfilled**

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

$L_{net,t} = 180$ mm, $t_1 = 45$ mm $\Rightarrow A_{net,t} = 8100$ mm², $M_{y,k} = 5000.0$ Nmm, $f_{h,k} = 19.48$ N/mm²
$L_{net,v} = 182$ mm, $t_{ef} = 45$ mm $\Rightarrow A_{net,v} = 8190$ mm² (failure mechanism c,f,j/l,k,m)
$L_{net,v} = 182$ mm $\Rightarrow A_{net,v} = 8190$ mm² $\Rightarrow F_{bs,Rk} = 233.28$ kN

load	N_d kN	$F_{bs,Rd}$ kN	U_{bs} -
1	50.000	161.502	0.31

maximum utilization block shear failure $U_{max} = 0.31 \leq 1$ => **verification fulfilled**

2.3. fastener strut

member	a_1 mm	a_2 mm	a_{3t} mm	a_{4t} mm	a_{3c} mm	a_{4c} mm
stplt	14.4	14.4	7.2	7.2	7.2	7.2
outtimbmbr	14.0	11.2	48.0	20.0	28.0	12.0

2.3.1. sum M straps

N_d = 0.000 kN, V_d = 0.000 kN, $M_{v,d}$ = 4.000 + -0.350 x 0.000 + 0.002 x 0.000 = 4.000 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} °	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
1	1.18	-1.10	-0.44	-0.44	1.10	-0.44	1.10	1.18	111.8	2.6292	0.17	0.45
2	1.03	-0.93	-0.44	-0.44	0.93	-0.44	0.93	1.03	115.3	2.6292	0.17	0.39
3	1.03	0.93	-0.44	-0.44	-0.93	-0.44	-0.93	1.03	-115.3	2.6292	0.17	0.39
4	1.18	1.10	-0.44	-0.44	-1.10	-0.44	-1.10	1.18	-111.8	2.6292	0.17	0.45
5	1.21	-1.18	-0.27	-0.27	1.18	-0.27	1.18	1.21	102.9	2.6292	0.12	0.46
6	1.05	-1.02	-0.27	-0.27	1.02	-0.27	1.02	1.05	104.9	2.6292	0.12	0.40
7	0.89	-0.85	-0.27	-0.27	0.85	-0.27	0.85	0.89	107.7	2.6292	0.12	0.34
8	0.89	0.85	-0.27	-0.27	-0.85	-0.27	-0.85	0.89	-107.7	2.6292	0.12	0.34
9	1.05	1.02	-0.27	-0.27	-1.02	-0.27	-1.02	1.05	-104.9	2.6292	0.12	0.40
10	1.21	1.18	-0.27	-0.27	-1.18	-0.27	-1.18	1.21	-102.9	2.6292	0.12	0.46
11	1.10	-1.10	-0.10	-0.10	1.10	-0.10	1.10	1.10	95.3	2.6292	0.04	0.42
12	0.94	-0.93	-0.10	-0.10	0.93	-0.10	0.93	0.94	96.2	2.6292	0.04	0.36
13	0.94	0.93	-0.10	-0.10	-0.93	-0.10	-0.93	0.94	-96.2	2.6292	0.04	0.36
14	1.10	1.10	-0.10	-0.10	-1.10	-0.10	-1.10	1.10	-95.3	2.6292	0.04	0.42
15	1.19	-1.18	0.07	0.07	1.18	0.07	1.18	1.19	86.7	2.6292	0.03	0.45
16	1.02	-1.02	0.07	0.07	1.02	0.07	1.02	1.02	86.2	2.6292	0.03	0.39
17	0.85	-0.85	0.07	0.07	0.85	0.07	0.85	0.85	85.4	2.6292	0.03	0.32
18	0.85	0.85	0.07	0.07	-0.85	0.07	-0.85	0.85	-85.4	2.6292	0.03	0.32
19	1.02	1.02	0.07	0.07	-1.02	0.07	-1.02	1.02	-86.2	2.6292	0.03	0.39
20	1.19	1.18	0.07	0.07	-1.18	0.07	-1.18	1.19	-86.7	2.6292	0.03	0.45
21	1.12	-1.10	0.24	0.24	1.10	0.24	1.10	1.12	77.8	2.6292	0.09	0.43
22	0.96	-0.93	0.24	0.24	0.93	0.24	0.93	0.96	75.7	2.6292	0.09	0.37
23	0.96	0.93	0.24	0.24	-0.93	0.24	-0.93	0.96	-75.7	2.6292	0.09	0.37
24	1.12	1.10	0.24	0.24	-1.10	0.24	-1.10	1.12	-77.8	2.6292	0.09	0.43
25	1.25	-1.18	0.41	0.41	1.18	0.41	1.18	1.25	71.1	2.6292	0.19	0.48
26	1.09	-1.02	0.41	0.41	1.02	0.41	1.02	1.09	68.2	2.6292	0.19	0.42
27	0.94	-0.85	0.41	0.41	0.85	0.41	0.85	0.94	64.4	2.6292	0.19	0.36
28	0.94	0.85	0.41	0.41	-0.85	0.41	-0.85	0.94	-64.4	2.6292	0.19	0.36
29	1.09	1.02	0.41	0.41	-1.02	0.41	-1.02	1.09	-68.2	2.6292	0.19	0.42
30	1.25	1.18	0.41	0.41	-1.18	0.41	-1.18	1.25	-71.1	2.6292	0.19	0.48

maximum utilization of fasteners U_{max} = 0.48 ≤ 1 => **verification fulfilled**

2.4. fastener diagonal left

member	a_1 mm	a_2 mm	a_{3t} mm	a_{4t} mm	a_{3c} mm	a_{4c} mm
stplt	14.4	14.4	7.2	7.2	7.2	7.2
outtimbmbr	14.0	11.2	48.0	20.0	28.0	12.0

2.4.1. sum M straps

N_d = 5.000 kN, V_d = 5.000 kN, $M_{v,d}$ = -4.000 + -0.499 x 5.000 + -0.001 x 5.000 = -6.496 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} °	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
1	-0.90	-0.51	0.75	0.17	0.89	0.26	0.98	1.01	75.1	2.6292	0.10	0.39
2	-0.79	-0.41	0.68	0.19	0.77	0.29	0.86	0.91	71.6	2.6292	0.11	0.34
3	-0.83	-0.47	0.68	0.14	0.82	0.24	0.91	0.94	75.4	2.6292	0.09	0.36
4	-0.71	-0.37	0.61	0.17	0.69	0.26	0.79	0.83	71.6	2.6292	0.10	0.31
5	-0.75	-0.44	0.61	0.12	0.74	0.21	0.83	0.86	75.7	2.6292	0.08	0.33
6	-0.79	-0.51	0.61	0.07	0.79	0.16	0.88	0.90	79.5	2.6292	0.06	0.34
7	-0.64	-0.34	0.54	0.14	0.62	0.24	0.71	0.75	71.6	2.6292	0.09	0.29
8	-0.68	-0.41	0.54	0.10	0.67	0.19	0.76	0.78	76.1	2.6292	0.07	0.30
9	-0.72	-0.47	0.54	0.05	0.72	0.14	0.81	0.82	80.2	2.6292	0.05	0.31
10	-0.56	-0.30	0.47	0.12	0.55	0.21	0.64	0.67	71.6	2.6292	0.08	0.26
11	-0.60	-0.37	0.47	0.07	0.60	0.16	0.69	0.71	76.6	2.6292	0.06	0.27
12	-0.65	-0.44	0.47	0.02	0.64	0.12	0.74	0.75	81.1	2.6292	0.04	0.28
13	-0.69	-0.51	0.47	-0.03	0.69	0.07	0.79	0.79	85.2	2.6292	0.03	0.30
14	-0.53	-0.34	0.40	0.05	0.52	0.14	0.62	0.63	77.2	2.6292	0.05	0.24
15	-0.57	-0.41	0.40	-0.00	0.57	0.09	0.66	0.67	82.2	2.6292	0.03	0.25
16	-0.62	-0.47	0.40	-0.05	0.62	0.04	0.71	0.71	86.6	2.6292	0.02	0.27
17	-0.45	-0.30	0.33	0.02	0.45	0.12	0.54	0.55	78.0	2.6292	0.04	0.21
18	-0.50	-0.37	0.33	-0.03	0.50	0.07	0.59	0.59	83.6	2.6292	0.03	0.23
19	-0.55	-0.44	0.33	-0.07	0.55	0.02	0.64	0.64	88.4	2.6292	0.01	0.24

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} °	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
20	-0.61	-0.51	0.33	-0.12	0.60	-0.03	0.69	0.69	92.6	2.6292	0.01	0.26
21	-0.43	-0.34	0.27	-0.05	0.43	0.04	0.52	0.52	85.4	2.6292	0.02	0.20
22	-0.48	-0.41	0.27	-0.10	0.47	-0.01	0.57	0.57	90.7	2.6292	0.00	0.22
23	-0.54	-0.47	0.27	-0.15	0.52	-0.06	0.62	0.62	95.1	2.6292	0.02	0.24
24	-0.36	-0.30	0.20	-0.07	0.35	0.02	0.45	0.45	87.7	2.6292	0.01	0.17
25	-0.42	-0.37	0.20	-0.12	0.40	-0.03	0.49	0.49	93.6	2.6292	0.01	0.19
26	-0.48	-0.44	0.20	-0.17	0.45	-0.08	0.54	0.55	98.3	2.6292	0.03	0.21
27	-0.36	-0.34	0.13	-0.15	0.33	-0.06	0.42	0.42	97.5	2.6292	0.02	0.16
28	-0.43	-0.41	0.13	-0.20	0.38	-0.10	0.47	0.48	102.5	2.6292	0.04	0.18
29	-0.31	-0.30	0.06	-0.17	0.26	-0.08	0.35	0.36	102.9	2.6292	0.03	0.14
30	-0.45	0.42	-0.15	0.19	-0.40	0.29	-0.31	0.42	-47.3	2.6292	0.11	0.16
31	-0.50	0.46	-0.22	0.17	-0.48	0.26	-0.38	0.46	-55.7	2.6292	0.10	0.18
32	-0.44	0.39	-0.22	0.12	-0.43	0.21	-0.33	0.40	-57.5	2.6292	0.08	0.15
33	-0.63	0.56	-0.29	0.19	-0.60	0.29	-0.50	0.58	-60.5	2.6292	0.11	0.22
34	-0.57	0.49	-0.29	0.14	-0.55	0.24	-0.46	0.51	-62.5	2.6292	0.09	0.20
35	-0.51	0.42	-0.29	0.10	-0.50	0.19	-0.41	0.45	-65.2	2.6292	0.07	0.17
36	-0.63	0.52	-0.35	0.12	-0.62	0.21	-0.53	0.57	-68.1	2.6292	0.08	0.22
37	-0.58	0.46	-0.35	0.07	-0.57	0.16	-0.48	0.51	-71.2	2.6292	0.06	0.19
38	-0.52	0.39	-0.35	0.02	-0.52	0.12	-0.43	0.45	-75.1	2.6292	0.04	0.17
39	-0.70	0.56	-0.42	0.10	-0.69	0.19	-0.60	0.63	-72.6	2.6292	0.07	0.24
40	-0.65	0.49	-0.42	0.05	-0.65	0.14	-0.55	0.57	-75.8	2.6292	0.05	0.22
41	-0.60	0.42	-0.42	-0.00	-0.60	0.09	-0.50	0.51	-79.8	2.6292	0.03	0.19
42	-0.72	0.52	-0.49	0.02	-0.72	0.12	-0.63	0.64	-79.6	2.6292	0.04	0.24
43	-0.67	0.46	-0.49	-0.03	-0.67	0.07	-0.58	0.58	-83.4	2.6292	0.03	0.22
44	-0.63	0.39	-0.49	-0.07	-0.62	0.02	-0.53	0.53	-88.1	2.6292	0.01	0.20
45	-0.79	0.56	-0.56	-0.00	-0.79	0.09	-0.70	0.70	-82.6	2.6292	0.03	0.27
46	-0.74	0.49	-0.56	-0.05	-0.74	0.04	-0.65	0.65	-86.3	2.6292	0.02	0.25
47	-0.70	0.42	-0.56	-0.10	-0.69	-0.01	-0.60	0.60	-90.6	2.6292	0.00	0.23
48	-0.82	0.52	-0.63	-0.07	-0.82	0.02	-0.72	0.72	-88.6	2.6292	0.01	0.28
49	-0.78	0.46	-0.63	-0.12	-0.77	-0.03	-0.67	0.68	-92.6	2.6292	0.01	0.26
50	-0.74	0.39	-0.63	-0.17	-0.72	-0.08	-0.63	0.63	-97.2	2.6292	0.03	0.24
51	-0.89	0.56	-0.70	-0.10	-0.89	-0.01	-0.80	0.80	-90.5	2.6292	0.00	0.30
52	-0.85	0.49	-0.70	-0.15	-0.84	-0.06	-0.75	0.75	-94.2	2.6292	0.02	0.29
53	-0.82	0.42	-0.70	-0.20	-0.79	-0.10	-0.70	0.71	-98.5	2.6292	0.04	0.27
54	-0.93	0.52	-0.77	-0.17	-0.91	-0.08	-0.82	0.82	-95.5	2.6292	0.03	0.31

maximum utilization of fasteners $U_{max} = 0.39 \leq 1$ => **verification fulfilled**

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

$L_{net,t} = 113$ mm, $t_1 = 45$ mm $\Rightarrow A_{net,t} = 5091$ mm², $M_{y,k} = 5000.0$ Nmm, $f_{h,k} = 27.27$ N/mm²
$L_{net,v} = 1173$ mm, $t_{ef} = 45$ mm $\Rightarrow A_{net,v} = 52805$ mm² (failure mechanism c,f,j/l,k,m)
$L_{net,v} = 1173$ mm $\Rightarrow A_{net,v} = 52805$ mm² $\Rightarrow F_{bs,Rk} = 147.85$ kN

load	N_d kN	$F_{bs,Rd}$ kN	U_{bs} -
1	2.500	102.360	0.02

maximum utilization block shear failure $U_{max} = 0.02 \leq 1$ => **verification fulfilled**

2.5. fastener diagonal right

member	a_1 mm	a_2 mm	a_{3t} mm	a_{4t} mm	a_{3c} mm	a_{4c} mm
stplt	14.4	14.4	7.2	7.2	7.2	7.2
outtimbmbr	14.0	11.2	48.0	20.0	28.0	12.0

2.5.1. sum M straps

$N_d = -5.000$ kN, $V_d = 5.000$ kN, $M_{v,d} = -4.000 + -0.488 \times 5.000 + -0.001 \times -5.000 = -6.434$ 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} °	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
1	-1.04	0.61	0.84	0.16	-1.03	0.04	-0.91	0.91	-87.2	2.6292	0.02	0.35
2	-1.00	0.53	0.84	0.22	-0.97	0.10	-0.85	0.86	-83.3	2.6292	0.04	0.33
3	-0.95	0.57	0.76	0.14	-0.94	0.02	-0.82	0.82	-88.8	2.6292	0.01	0.31
4	-0.91	0.49	0.76	0.19	-0.89	0.07	-0.77	0.77	-84.6	2.6292	0.03	0.29
5	-0.92	0.61	0.68	0.05	-0.92	-0.07	-0.80	0.80	-94.7	2.6292	0.03	0.30
6	-0.87	0.53	0.68	0.11	-0.86	-0.01	-0.74	0.74	-90.8	2.6292	0.00	0.28
7	-0.82	0.45	0.68	0.16	-0.80	0.04	-0.69	0.69	-86.2	2.6292	0.02	0.26
8	-0.83	0.57	0.61	0.03	-0.83	-0.09	-0.71	0.72	-97.5	2.6292	0.04	0.27
9	-0.78	0.49	0.61	0.08	-0.78	-0.04	-0.66	0.66	-93.3	2.6292	0.01	0.25
10	-0.81	0.61	0.53	-0.06	-0.80	-0.18	-0.69	0.71	-104.5	2.6292	0.07	0.27
11	-0.75	0.53	0.53	-0.00	-0.75	-0.12	-0.63	0.64	-100.9	2.6292	0.05	0.24
12	-0.70	0.45	0.53	0.05	-0.69	-0.07	-0.57	0.58	-96.6	2.6292	0.03	0.22
13	-0.73	0.57	0.45	-0.09	-0.72	-0.21	-0.60	0.64	-108.8	2.6292	0.08	0.24

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} °	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
14	-0.67	0.49	0.45	-0.03	-0.67	-0.15	-0.55	0.57	-105.3	2.6292	0.06	0.22
15	-0.71	0.61	0.37	-0.17	-0.69	-0.29	-0.57	0.64	-116.7	2.6292	0.11	0.24
16	-0.65	0.53	0.37	-0.11	-0.64	-0.23	-0.52	0.57	-114.2	2.6292	0.09	0.22
17	-0.58	0.45	0.37	-0.06	-0.58	-0.18	-0.46	0.50	-111.0	2.6292	0.07	0.19
18	-0.64	0.57	0.29	-0.20	-0.61	-0.32	-0.49	0.58	-122.8	2.6292	0.12	0.22
19	-0.57	0.49	0.29	-0.14	-0.55	-0.26	-0.44	0.51	-120.9	2.6292	0.10	0.19
20	-0.57	0.53	0.21	-0.22	-0.53	-0.34	-0.41	0.53	-130.2	2.6292	0.13	0.20
21	-0.50	0.45	0.21	-0.17	-0.47	-0.29	-0.35	0.45	-129.3	2.6292	0.11	0.17
22	-0.49	-0.45	-0.18	0.19	0.45	0.07	0.56	0.57	82.7	2.6292	0.03	0.22
23	-0.55	-0.49	-0.26	0.16	0.53	0.04	0.65	0.65	86.0	2.6292	0.02	0.25
24	-0.62	-0.57	-0.26	0.22	0.58	0.10	0.70	0.71	81.9	2.6292	0.04	0.27
25	-0.56	-0.45	-0.34	0.08	0.56	-0.04	0.68	0.68	93.2	2.6292	0.01	0.26
26	-0.63	-0.53	-0.34	0.14	0.61	0.02	0.73	0.73	88.7	2.6292	0.01	0.28
27	-0.69	-0.61	-0.34	0.19	0.67	0.07	0.79	0.79	84.7	2.6292	0.03	0.30
28	-0.64	-0.49	-0.42	0.05	0.64	-0.07	0.76	0.76	95.0	2.6292	0.03	0.29
29	-0.70	-0.57	-0.42	0.11	0.70	-0.01	0.81	0.81	90.7	2.6292	0.00	0.31
30	-0.67	-0.45	-0.49	-0.03	0.67	-0.15	0.79	0.80	100.8	2.6292	0.06	0.30
31	-0.72	-0.53	-0.49	0.03	0.72	-0.09	0.84	0.85	96.4	2.6292	0.04	0.32
32	-0.78	-0.61	-0.49	0.08	0.78	-0.04	0.90	0.90	92.4	2.6292	0.01	0.34
33	-0.75	-0.49	-0.57	-0.06	0.75	-0.18	0.87	0.89	101.5	2.6292	0.07	0.34
34	-0.81	-0.57	-0.57	-0.00	0.81	-0.12	0.93	0.93	97.5	2.6292	0.05	0.36
35	-0.79	-0.45	-0.65	-0.14	0.78	-0.26	0.90	0.94	106.2	2.6292	0.10	0.36
36	-0.84	-0.53	-0.65	-0.09	0.83	-0.21	0.95	0.98	102.1	2.6292	0.08	0.37
37	-0.89	-0.61	-0.65	-0.03	0.89	-0.15	1.01	1.02	98.4	2.6292	0.06	0.39
38	-0.88	-0.49	-0.73	-0.17	0.86	-0.29	0.98	1.02	106.4	2.6292	0.11	0.39
39	-0.92	-0.57	-0.73	-0.11	0.92	-0.23	1.04	1.06	102.7	2.6292	0.09	0.40
40	-0.97	-0.53	-0.81	-0.20	0.95	-0.32	1.06	1.11	106.5	2.6292	0.12	0.42
41	-1.01	-0.61	-0.81	-0.14	1.00	-0.26	1.12	1.15	103.1	2.6292	0.10	0.44
42	-1.05	-0.57	-0.89	-0.22	1.03	-0.34	1.15	1.20	106.7	2.6292	0.13	0.46

maximum utilization of fasteners $U_{max} = 0.46 \leq 1$ => **verification fulfilled**

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

$L_{net,t} = 113$ mm, $t_1 = 45$ mm $\Rightarrow A_{net,t} = 5091$ mm², $M_{y,k} = 5000.0$ Nmm, $f_{h,k} = 27.27$ N/mm²
$L_{net,v} = 1160$ mm, $t_{ef} = 45$ mm $\Rightarrow A_{net,v} = 52206$ mm² (failure mechanism c,f,j/l,k,m)
$L_{net,v} = 1160$ mm $\Rightarrow A_{net,v} = 52206$ mm² $\Rightarrow F_{bs,Rk} = 146.18$ kN

load	N_d kN	$F_{bs,Rd}$ kN	U_{bs} -
1	-2.500	101.198	0.00

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

2.6. results beams

2.6.1. strap left with $A_n = 43200$ mm², $W_n = 1728000$ mm³, $I_n = 207360000$ mm⁴, $k_h = 1.096$

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	19.94	13.29	16.62	2.42	100.000	-1.405	2.31	-0.81	-0.81	10.000	0.61	0.12	0.25

beam maximum utilization $U_{max} = 0.25 \leq 1$ => **verification fulfilled**

2.6.2. strap right with $A_n = 43200$ mm², $W_n = 1728000$ mm³, $I_n = 207360000$ mm⁴, $k_h = 1.096$

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	19.94	13.29	16.62	2.42	100.000	-1.395	2.31	-0.81	-0.81	10.000	0.61	0.12	0.25

beam maximum utilization $U_{max} = 0.25 \leq 1$ => **verification fulfilled**

2.6.3. strut with $A_n = 26100$ mm², $W_n = 728175$ mm³, $I_n = 58253969$ 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	16.62	10.04	14.54	2.77	0.000	4.000	0.00	5.49	5.49	3.790	0.44	0.33	0.16

beam maximum utilization $U_{max} = 0.33 \leq 1$ => **verification fulfilled**

2.6.4. diagonal left with $A_n = 27000$ mm², $W_n = 739133$ mm³, $I_n = 59130600$ 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	16.62	10.04	14.54	2.77	5.000	-6.496	0.19	-8.79	-8.79	14.185	1.58	0.51	0.57

beam maximum utilization $U_{max} = 0.57 \leq 1$ => **verification fulfilled**

2.6.5. diagonal right with A_n = 27000 mm², W_n = 745133 mm³, I_n = 59610600 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	16.62	10.04	14.54	2.77	-5.000	-6.434	-0.19	-8.64	-8.64	13.577	1.51	0.52	0.54

beam maximum utilization U_{max} = 0.54 ≤ 1 => **verification fulfilled**

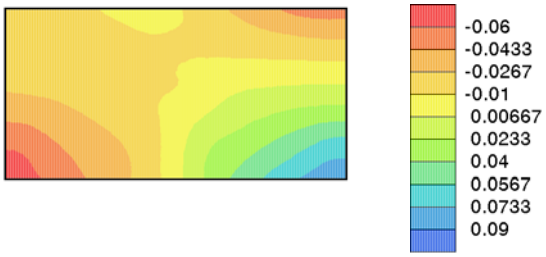
2.7. results node plate

with $\sigma_{v,R,k}$ = 250.00 N/mm², $\tau_{R,k}$ = 144.34 N/mm², $\gamma_{S/V}$ = 1.00, γ_A = 1.00

2.7.1. sum M straps

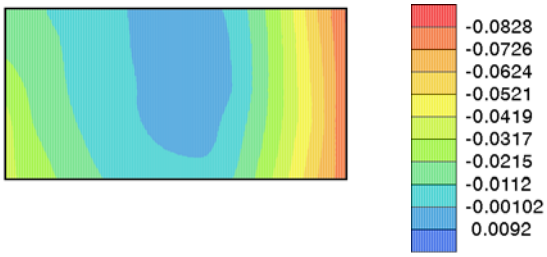
deformations u_x [mm]

min u_x = -0.0661 mm, max u_x = 0.0842 mm



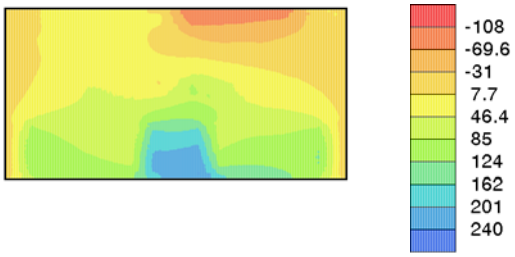
deformations u_y [mm]

min u_y = -0.0841 mm, max u_y = 0.0076 mm



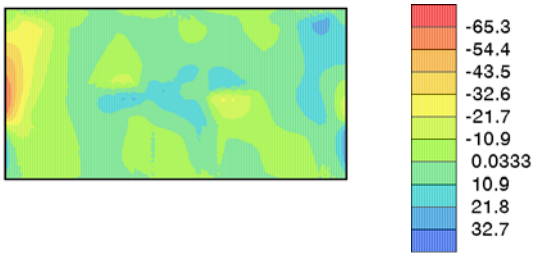
normal forces n_{xx} [kN/m]

min n_{xx} = -108.26 kN/m, max n_{xx} = 240.07 kN/m



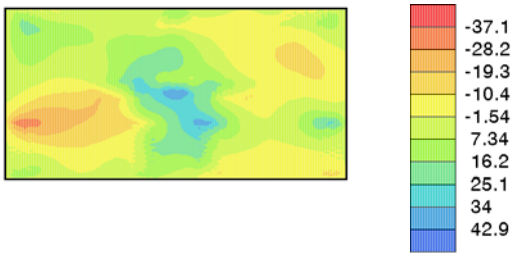
normal forces n_{yy} [kN/m]

min n_{yy} = -65.30 kN/m, max n_{yy} = 32.68 kN/m



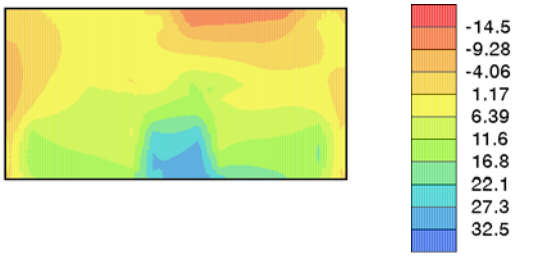
normal forces n_{xy} [kN/m]

min n_{xy} = -37.11 kN/m, max n_{xy} = 42.47 kN/m



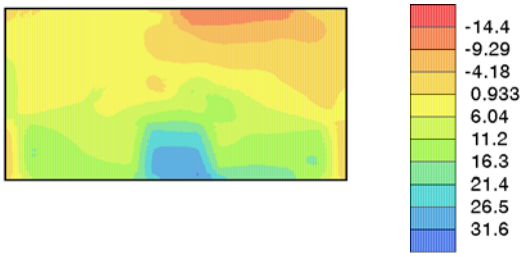
main normal stresses σ_1 [N/mm²]

min σ_1 = -14.45 N/mm², max σ_1 = 32.15 N/mm²



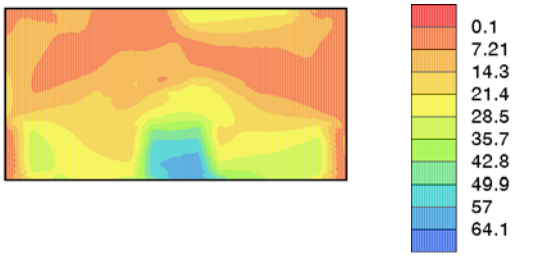
main shear stresses τ_1 [N/mm²]

min τ_1 = -14.43 N/mm², max τ_1 = 31.97 N/mm²



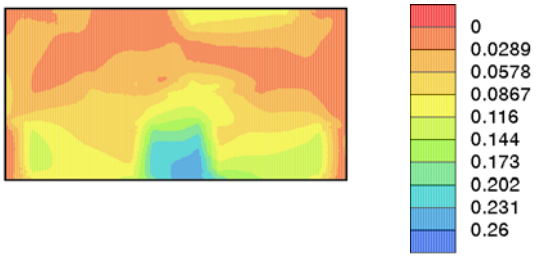
equivalent stresses σ_v [N/mm²]

min σ_v = 0.07 N/mm², max σ_v = 63.98 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
4	620.0	110.0	0.084	-0.079	1.27	1.03	-1.44	0.31	0.03	0.73	0.003
171	10.0	-210.0	-0.009	0.007	59.96	11.59	36.94	9.54	6.45	22.51	0.090
306	-620.0	-186.1	-0.029	-0.031	-0.36	-65.30	-0.24	-8.75	8.66	17.36	0.070
393	80.8	-510.0	-0.016	0.004	-108.26	-0.02	0.63	-14.44	-14.43	28.87	0.115
394	95.3	-510.0	-0.017	0.004	-108.15	-0.19	0.25	-14.45	-14.40	28.82	0.116
472	620.0	-30.7	0.059	-0.082	0.29	32.68	0.11	4.40	-4.32	8.68	0.035
739	-546.0	-97.6	-0.042	-0.025	49.87	-17.00	-37.11	4.38	8.92	23.48	0.094
1029	82.7	90.2	0.019	-0.005	240.07	0.33	1.89	32.05	31.97	63.98	0.256
1035	81.9	70.6	0.019	-0.003	238.47	2.62	8.48	32.15	31.45	63.37	0.257
1570	5.9	-202.3	-0.008	0.007	57.62	11.85	42.47	9.26	6.10	24.13	0.097

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**

2.8. bearing forces strap left

$p_1 = 120$ mm, $e_1 = 18$ mm, $e_2 = 18$ mm, $p_2 = 96.00$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk} = 20.63$ kN
$e_1 = 18$ mm, $e_2 = 18$ mm, $p_2 = 96$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk,Rand} = 20.63$ kN

2.8.1. 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	16.50	0.04	27	0.66	16.50	0.04	53	0.66	16.50	0.04
2	0.68	16.50	0.04	28	0.65	16.50	0.04	54	0.65	16.50	0.04
3	0.68	16.50	0.04	29	0.65	16.50	0.04	55	0.65	16.50	0.04
4	0.67	16.50	0.04	30	0.68	16.50	0.04	56	0.65	16.50	0.04
5	0.67	16.50	0.04	31	0.68	16.50	0.04	57	0.64	16.50	0.04
6	0.67	16.50	0.04	32	0.67	16.50	0.04	58	0.67	16.50	0.04
7	0.66	16.50	0.04	33	0.67	16.50	0.04	59	0.67	16.50	0.04
8	0.66	16.50	0.04	34	0.67	16.50	0.04	60	0.67	16.50	0.04
9	0.65	16.50	0.04	35	0.66	16.50	0.04	61	0.66	16.50	0.04
10	0.65	16.50	0.04	36	0.66	16.50	0.04	62	0.66	16.50	0.04
11	0.68	16.50	0.04	37	0.65	16.50	0.04	63	0.66	16.50	0.04
12	0.68	16.50	0.04	38	0.65	16.50	0.04	64	0.65	16.50	0.04
13	0.67	16.50	0.04	39	0.67	16.50	0.04	65	0.65	16.50	0.04
14	0.67	16.50	0.04	40	0.67	16.50	0.04	66	0.65	16.50	0.04
15	0.67	16.50	0.04	41	0.67	16.50	0.04	67	0.64	16.50	0.04
16	0.66	16.50	0.04	42	0.66	16.50	0.04	68	0.67	16.50	0.04
17	0.66	16.50	0.04	43	0.66	16.50	0.04	69	0.67	16.50	0.04
18	0.66	16.50	0.04	44	0.66	16.50	0.04	70	0.67	16.50	0.04
19	0.65	16.50	0.04	45	0.65	16.50	0.04	71	0.66	16.50	0.04
20	0.68	16.50	0.04	46	0.65	16.50	0.04	72	0.66	16.50	0.04
21	0.68	16.50	0.04	47	0.65	16.50	0.04	73	0.65	16.50	0.04
22	0.67	16.50	0.04	48	0.64	16.50	0.04	74	0.65	16.50	0.04
23	0.67	16.50	0.04	49	0.67	16.50	0.04	75	0.65	16.50	0.04
24	0.67	16.50	0.04	50	0.67	16.50	0.04	76	0.64	16.50	0.04
25	0.66	16.50	0.04	51	0.67	16.50	0.04				
26	0.66	16.50	0.04	52	0.66	16.50	0.04				

maximum utilization of the bearing forces $U_{max} = 0.04 \leq 1$ => **verification fulfilled**

2.9. bearing forces strap right

$p_1 = 120$ mm, $e_1 = 18$ mm, $e_2 = 18$ mm, $p_2 = 96.00$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk} = 20.63$ kN
$e_1 = 18$ mm, $e_2 = 18$ mm, $p_2 = 96$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk,Rand} = 20.63$ kN

2.9.1. 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	0.64	16.50	0.04	17	0.67	16.50	0.04	33	0.66	16.50	0.04
2	0.65	16.50	0.04	18	0.67	16.50	0.04	34	0.66	16.50	0.04
3	0.65	16.50	0.04	19	0.67	16.50	0.04	35	0.66	16.50	0.04
4	0.65	16.50	0.04	20	0.64	16.50	0.04	36	0.67	16.50	0.04
5	0.66	16.50	0.04	21	0.65	16.50	0.04	37	0.67	16.50	0.04
6	0.66	16.50	0.04	22	0.65	16.50	0.04	38	0.67	16.50	0.04
7	0.66	16.50	0.04	23	0.65	16.50	0.04	39	0.65	16.50	0.04
8	0.67	16.50	0.04	24	0.66	16.50	0.04	40	0.65	16.50	0.04
9	0.67	16.50	0.04	25	0.66	16.50	0.04	41	0.66	16.50	0.04
10	0.67	16.50	0.04	26	0.66	16.50	0.04	42	0.66	16.50	0.04
11	0.64	16.50	0.04	27	0.67	16.50	0.04	43	0.66	16.50	0.04
12	0.65	16.50	0.04	28	0.67	16.50	0.04	44	0.67	16.50	0.04
13	0.65	16.50	0.04	29	0.67	16.50	0.04	45	0.67	16.50	0.04
14	0.65	16.50	0.04	30	0.64	16.50	0.04	46	0.67	16.50	0.04
15	0.66	16.50	0.04	31	0.65	16.50	0.04	47	0.68	16.50	0.04
16	0.66	16.50	0.04	32	0.65	16.50	0.04	48	0.68	16.50	0.04

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 -
49	0.65	16.50	0.04	59	0.65	16.50	0.04	69	0.66	16.50	0.04
50	0.66	16.50	0.04	60	0.66	16.50	0.04	70	0.66	16.50	0.04
51	0.66	16.50	0.04	61	0.66	16.50	0.04	71	0.66	16.50	0.04
52	0.66	16.50	0.04	62	0.66	16.50	0.04	72	0.67	16.50	0.04
53	0.67	16.50	0.04	63	0.67	16.50	0.04	73	0.67	16.50	0.04
54	0.67	16.50	0.04	64	0.67	16.50	0.04	74	0.67	16.50	0.04
55	0.67	16.50	0.04	65	0.68	16.50	0.04	75	0.68	16.50	0.04
56	0.68	16.50	0.04	66	0.68	16.50	0.04	76	0.68	16.50	0.04
57	0.68	16.50	0.04	67	0.68	16.50	0.04				
58	0.65	16.50	0.04	68	0.65	16.50	0.04				

maximum utilization of the bearing forces $U_{max} = 0.04 \leq 1$ => **verification fulfilled**

2.10. bearing forces strut

$p_1 = 130$ mm, $e_1 = 18$ mm, $e_2 = 18$ mm, $p_2 = 96.00$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk} = 20.63$ kN
$e_1 = 18$ mm, $e_2 = 18$ mm, $p_2 = 96$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk,Rand} = 20.63$ kN

2.10.1. 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	0.59	16.50	0.04	11	0.55	16.50	0.03	21	0.56	16.50	0.03
2	0.51	16.50	0.03	12	0.47	16.50	0.03	22	0.48	16.50	0.03
3	0.51	16.50	0.03	13	0.47	16.50	0.03	23	0.48	16.50	0.03
4	0.59	16.50	0.04	14	0.55	16.50	0.03	24	0.56	16.50	0.03
5	0.61	16.50	0.04	15	0.59	16.50	0.04	25	0.63	16.50	0.04
6	0.53	16.50	0.03	16	0.51	16.50	0.03	26	0.55	16.50	0.03
7	0.44	16.50	0.03	17	0.42	16.50	0.03	27	0.47	16.50	0.03
8	0.44	16.50	0.03	18	0.42	16.50	0.03	28	0.47	16.50	0.03
9	0.53	16.50	0.03	19	0.51	16.50	0.03	29	0.55	16.50	0.03
10	0.61	16.50	0.04	20	0.59	16.50	0.04	30	0.63	16.50	0.04

maximum utilization of the bearing forces $U_{max} = 0.04 \leq 1$ => **verification fulfilled**

2.11. bearing forces diagonal left

$p_1 = 60$ mm, $e_1 = 8$ mm, $e_2 = 8$ mm, $p_2 = 60.00$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk} = 20.63$ kN
$e_1 = 8$ mm, $e_2 = 8$ mm, $p_2 = 60$ mm, $\alpha_b = 0.44$, $k_1 = 2.03$ => $F_{b,Rk,Rand} = 7.46$ kN

2.11.1. 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	0.51	5.96	0.09	19	0.32	16.50	0.02	37	0.25	16.50	0.02
2	0.45	16.50	0.03	20	0.34	5.96	0.06	38	0.22	16.50	0.01
3	0.47	16.50	0.03	21	0.26	16.50	0.02	39	0.32	16.50	0.02
4	0.41	16.50	0.03	22	0.28	16.50	0.02	40	0.29	16.50	0.02
5	0.43	16.50	0.03	23	0.31	16.50	0.02	41	0.26	16.50	0.02
6	0.45	5.96	0.08	24	0.22	16.50	0.01	42	0.32	16.50	0.02
7	0.38	16.50	0.02	25	0.25	16.50	0.01	43	0.29	16.50	0.02
8	0.39	16.50	0.02	26	0.27	16.50	0.02	44	0.26	16.50	0.02
9	0.41	16.50	0.02	27	0.21	16.50	0.01	45	0.35	16.50	0.02
10	0.34	16.50	0.02	28	0.24	16.50	0.01	46	0.33	16.50	0.02
11	0.35	16.50	0.02	29	0.18	16.50	0.01	47	0.30	16.50	0.02
12	0.37	16.50	0.02	30	0.21	16.50	0.01	48	0.36	16.50	0.02
13	0.39	5.96	0.07	31	0.23	16.50	0.01	49	0.34	16.50	0.02
14	0.32	16.50	0.02	32	0.20	16.50	0.01	50	0.32	16.50	0.02
15	0.34	16.50	0.02	33	0.29	16.50	0.02	51	0.40	16.50	0.02
16	0.36	16.50	0.02	34	0.26	16.50	0.02	52	0.37	16.50	0.02
17	0.28	16.50	0.02	35	0.22	16.50	0.01	53	0.35	16.50	0.02
18	0.30	16.50	0.02	36	0.28	16.50	0.02	54	0.41	16.50	0.02

maximum utilization of the bearing forces $U_{max} = 0.09 \leq 1$ => **verification fulfilled**

2.12. bearing forces diagonal right

$p_1 = 60$ mm, $e_1 = 8$ mm, $e_2 = 8$ mm, $p_2 = 60.00$ mm, $\alpha_b = 1.00$, $k_1 = 2.50$ => $F_{b,Rk} = 20.63$ kN
$e_1 = 8$ mm, $e_2 = 8$ mm, $p_2 = 60$ mm, $\alpha_b = 0.44$, $k_1 = 2.03$ => $F_{b,Rk,Rand} = 7.46$ kN

2.12.1. 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	0.45	16.50	0.03	6	0.37	16.50	0.02	11	0.32	16.50	0.02
2	0.43	16.50	0.03	7	0.34	16.50	0.02	12	0.29	16.50	0.02
3	0.41	16.50	0.02	8	0.36	16.50	0.02	13	0.32	16.50	0.02
4	0.39	16.50	0.02	9	0.33	16.50	0.02	14	0.28	16.50	0.02
5	0.40	16.50	0.02	10	0.35	16.50	0.02	15	0.32	16.50	0.02

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 -
16	0.28	16.50	0.02	25	0.34	16.50	0.02	34	0.47	16.50	0.03
17	0.25	16.50	0.02	26	0.37	16.50	0.02	35	0.47	16.50	0.03
18	0.29	16.50	0.02	27	0.40	5.96	0.07	36	0.49	16.50	0.03
19	0.25	16.50	0.02	28	0.38	16.50	0.02	37	0.51	5.96	0.09
20	0.27	16.50	0.02	29	0.41	16.50	0.02	38	0.51	16.50	0.03
21	0.23	16.50	0.01	30	0.40	16.50	0.02	39	0.53	16.50	0.03
22	0.28	16.50	0.02	31	0.42	16.50	0.03	40	0.56	16.50	0.03
23	0.32	16.50	0.02	32	0.45	5.96	0.08	41	0.58	5.96	0.10
24	0.36	16.50	0.02	33	0.44	16.50	0.03	42	0.60	16.50	0.04

maximum utilization of the bearing forces $U_{max} = 0.10 \leq 1$ => **verification fulfilled**

3. summary

total utilization of all verifications $u_{max,Ges} = 0.569 \leq 1 \Rightarrow$ ok.