POSITION 109: PANEL 1

1. Input parameters

verifications acc. to DIN EN 1995, Germany

1.1. floor diaphragm

panel width b = 11.250 m with ⊥ h_{eff} = 3.750 m, panel height h = 3.750 m with ⊥ h_{eff} = 3.750m

1.2. ribs

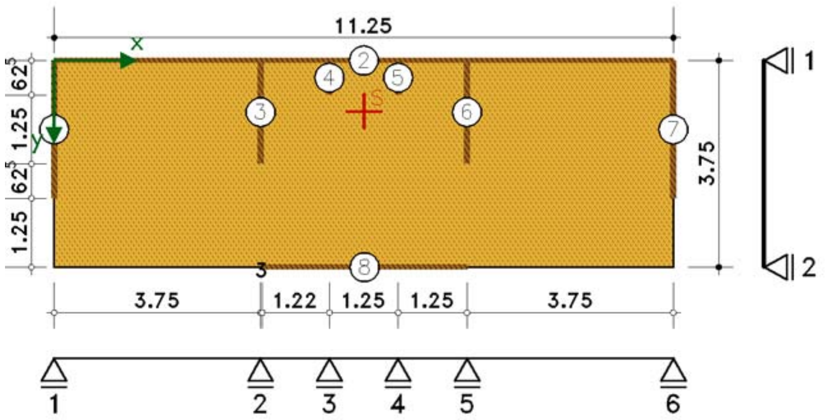
solid coniferous timber, C24 (S10), NKL 1, ρ_k = 350 kg/m³, a_r = 0.625 m
edge **100/200**, inner **100/200 mm**, oriented in x-direction
edge beams **100/200 mm**, inner beams **100/200 mm**

1.3. sheathing top

OSB 3 with ρ_k = 550 kg/m³, NKL 1, b/h/t = 1250/2500/20.00 mm in y-direction
input parameters for the verification of sheathing in bending stress
dead load: 0.110 kN/m²
permanent area load g: 0.300 kN/m²
transient area load q: 2.500 kN/m² (load class: housing, office rooms)
W = 66.667 mm³/m, $f_{v,k}$ = 6.80 N/mm², $f_{m,k}$ = 6.80 N/mm²

1.4. Fasteners top

staple, 1.53 x 40 mm, br = 5.5 mm , timber at fibre saturation point
detailed verification acc. to DIN EN 1995, 8.2.2, distance a_v = 100 mm, 1-row
elevation scale 1:1.375



1.5. sheet edges

free sheet edges successful acc. to DIN EN 1995-1-1/NA:2013-08, NCI zu 9.2.3.2 (NA.9), if the following conditions are satisfied:

- the sheets are staggered by a minimum beam spacing of a_r = 0.625 m
- the sheets are fixed also to all beams with nails in distance a_1

1.6. walls

Nr -	x_a m	x_e m	y_a m	y_e m	l m
1	0.000	0.000	0.000	2.500	2.500
2	0.000	11.250	0.000	0.000	11.250
3	3.750	3.750	0.000	1.875	1.875
4	5.000	5.000	0.000	0.625	0.625
5	6.250	6.250	0.000	0.625	0.625
6	7.500	7.500	0.000	1.875	1.875
7	11.250	11.250	0.000	2.500	2.500
8	3.780	7.500	3.750	3.750	3.720

1.7. spans in x-direction

axis	l m	walls
1	3.750	1
2	1.250	3
3	1.250	4
4	1.250	5
5	3.750	6
6	0.000	7

1.8. spans in y-direction

axis	l m	walls
1	3.750	2
2	0.000	8

1.9. deflection

the conditions acc. to DIN EN 1995-1-1/NA:2013-08, NCI zu 9.2.3.2 (NA.12) for the simplified method for verification of deflections are satisfied

2. results

2.1. wall forces

x_s = 5.625 m, y_s = 0.932 m, I_p = 211.19 m^5, $e_{x,s}$ = 0.000 m, $e_{y,s}$ = -0.943 m (wall eccentricity)

2.1.1. Load combination 1: wind x

wind in x-direction, application of load double-sided

w_x = 4.14 kN/m, $e_{y,w}$ = 0.280 m $\Rightarrow$ $w_{l,x}$ = 2.29 kN/m, $w_{r,x}$ = 6.00 kN/m, ΔM_x = 19.00 kNm

Nr	l_x m	y_i m	y_i-y_s m	$F_{x,wx}$ kN	$F_{x,\Delta Mx}$ kN	$F_{v,x,d}$ kN
2	11.250	0.000	-0.932	11.673	-0.943	10.730
8	3.720	3.750	2.818	3.860	0.943	4.803

axis	span	A_x kN	M_x kNm	$V_{l,x}$ kNm	$V_{r,x}$ kNm	$M_{max,x}$ kNm	y_{max} m
1x	-	6.606	0.000	---	---	---	---
-	1x	---	---	6.606	-8.926	7.321	2.013
2x	-	6.606	1.000	---	---	---	---

2.1.2. Load combination 2: wind y

wind in y-direction, application of load double-sided

w_y = 3.43 kN/m, $e_{x,w}$ = 0.840 m $\Rightarrow$ $w_{l,y}$ = 1.89 kN/m, $w_{r,y}$ = 4.97 kN/m, ΔM_y = 32.41 kNm

Nr	l_y m	x_i m	x_i-x_s m	$F_{y,wy}$ kN	$F_{y,\Delta My}$ kN	$F_{v,y,d}$ kN
1	2.500	0.000	5.625	9.647	2.158	11.805
3	1.875	3.750	1.875	7.235	0.540	7.775
4	0.625	5.000	0.625	2.412	0.060	2.472
5	0.625	6.250	-0.625	2.412	-0.060	2.352
6	1.875	7.500	-1.875	7.235	-0.540	6.696
7	2.500	11.250	-5.625	9.647	-2.158	7.489

axis	span	A_y kN	M_y kNm	$V_{l,y}$ kNm	$V_{r,y}$ kNm	$M_{max,y}$ kNm	x_{max} m
1y	-	11.805	0.000	---	---	---	---
-	1y	---	---	11.805	2.784	---	---
2y	-	7.775	28.556	---	---	---	---
-	2y	---	---	10.559	6.698	---	---
3y	-	2.472	39.386	---	---	---	---
-	3y	---	---	9.170	6.163	---	---
4y	-	2.352	49.014	---	---	---	---
-	4y	---	---	8.515	5.508	---	---
5y	-	6.696	57.823	---	---	---	---
-	5y	---	---	12.203	1.902	---	---
6y	-	7.489	85.471	---	---	---	---

2.2. verification of flanges

LK	$M_{max,d}$ kNm	h_{eff} m	$F_{c,d}$ kN	$\sigma_{c,d}$ N/mm²	k_c -	k_{mod} -	u -
1	7.321	3.750	1.952	0.098	1.000	1.100	0.005
2	85.471	5.625	15.195	0.760	1.000	1.100	0.043

2.3. Verification of diaphragm loading

sheathing

$\gamma = 1.30$, $f_{vk} = 6.8$ N/mm², $f_{ck} = 12.4$ N/mm², $k_{v1} = 0.66$, $k_{v2} = 0.33$

2.3.1. Load combination 1: wind x

with $h_{eff} = 3.750$ m, ${}_{max}V_d = 8.926$ kN ⇒ $s_{v0d} = 2.38$ N/mm

sheathing 1

$k_{mod} = 1.10$, $F_{v,Rd} = 553$ N, $f_{v0d} = 5.75$ N/mm², $f_{v90d} = 5.53$ N/mm²

$f_{v0d} =$ 3.65 N/mm (fastener) ⇒ decisive

$f_{v0d} = 25.06$ N/mm (plate shear strength)

$f_{v0d} = 28.07$ N/mm (shear force buckling)

⇒ utilization: $U_0 = 0.65$ ⇒ **U = 0.65 verification successful**

2.3.2. Load combination 2: wind y

with $h_{eff} = 3.750$ m, ${}_{max}V_d = 12.203$ kN ⇒ $s_{v0d} = 3.25$ N/mm, $s_{v90d} = 1.72$ N/mm (shear flow)

sheathing 1

$k_{mod} = 1.10$, $F_{v,Rd} = 553$ N, $f_{v0d} = 5.75$ N/mm², $f_{v90d} = 5.53$ N/mm²

$f_{v0d} =$ 3.65 N/mm (fastener) ⇒ decisive

$f_{v0d} = 25.06$ N/mm (plate shear strength)

$f_{v0d} = 28.07$ N/mm (shear force buckling)

$f_{v90d} =$ 5.53 N/mm (fastener) ⇒ decisive

$f_{v90d} = 69.25$ N/mm (plate shear strength)

$f_{v90d} = 44.32$ N/mm (shear force buckling)

⇒ utilization: $U_0 = 0.89$, $U_{90} = 0.31$, $U_{komb} = 0.94$ ⇒ **U = 0.94 verification successful**

2.4. verification der Biege- und shear stress der sheathing

duration of load medium-term ⇒ $k_{mod} = 0.700$, $f_{v,d} = 3.66$ N/mm², $f_{m,d} = 3.66$ N/mm²

$V_d = 1.345$ kN/m, $\tau_d = 0.10$ N/mm², $u_\sigma = 0.028$ ⇒ **verification successful**

$M_d = 0.210$ kNm/m, $\sigma_d = 3.15$ N/mm², $u_\sigma = 0.861$ ⇒ **verification successful**

3. Summary

maximum utilization of all verifications $U_{max} = 0.94 \leq 1$ ⇒ **all verifications successful**