POSITION 124: PANEL 2

1. Input parameters

verifications acc. to DIN EN 1995, Germany

1.1. floor diaphragm

panel width b = 7.500 m with ⊥ h_{eff} = 3.750 m, panel height h = 8.750 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 **100/220**, inner **100/220 mm**, oriented in x-direction
edge beams **100/220 mm**, inner beams **100/220 mm**

1.3. sheathing top

plywood F25/10 with ρ_k = 400 kg/m³, NKL 1, b/h/t = 1250/2500/28.00 mm in y-direction
input parameters for the verification of sheathing in bending stress
dead load: 0.112 kN/m²
permanent area load g: 2.000 kN/m²
transient area load q: 2.500 kN/m² (load class: housing, office rooms)
W = 130.667 mm³/m, $f_{v,k}$ = 8.00 N/mm², $f_{m,k}$ = 14.00 N/mm²

1.4. sheathing bottom

gypsum board GKBi with ρ_k = 800 kg/m³, NKL 1, b/h/t = 1000/2000/12.50 mm in x-direction
input parameters for the verification of sheathing in bending stress
dead load: 0.112 kN/m²
permanent area load g: 2.000 kN/m²
transient area load q: 2.500 kN/m² (load class: housing, office rooms)
W = 130.667 mm³/m, $f_{v,k}$ = 8.00 N/mm², $f_{m,k}$ = 14.00 N/mm²

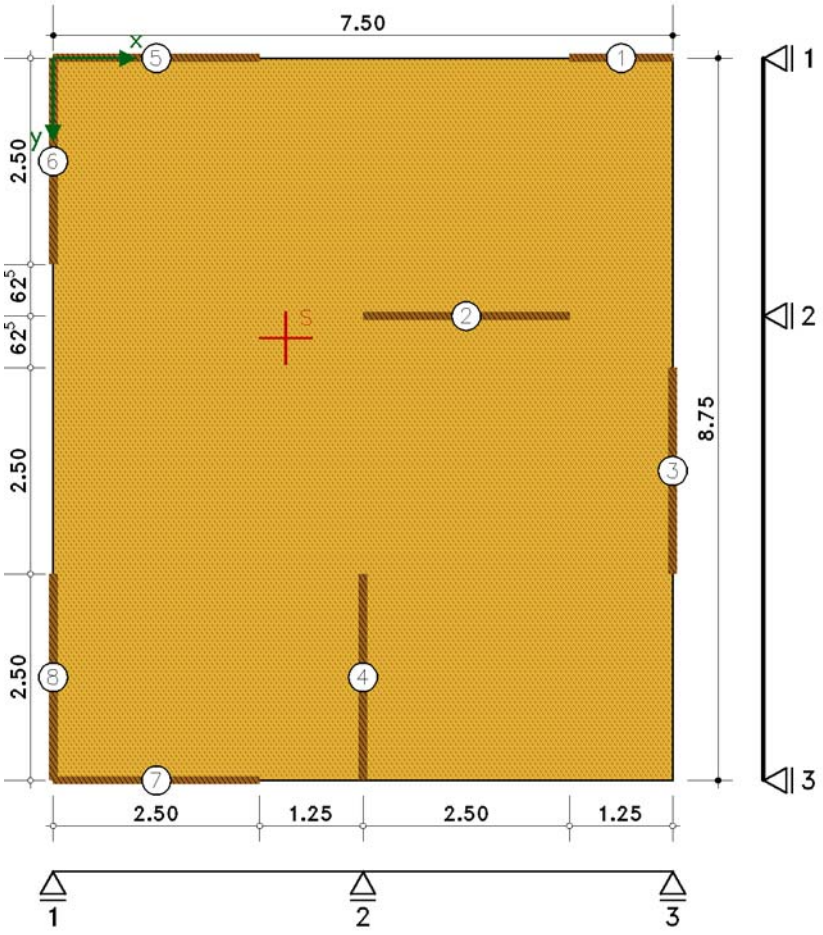
1.5. Fasteners top

staple, 1.53 x 35 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, 2-row

1.6. Fasteners bottom

staple, 1.53 x 35 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 1:0.917



1.7. 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

1.8. walls

Nr	x_a	x_e	y_a	y_e	l
-	m	m	m	m	m
1	6.250	7.500	0.000	0.000	1.250
2	3.750	6.250	3.125	3.125	2.500
3	7.500	7.500	3.750	6.250	2.500
4	3.750	3.750	6.250	8.750	2.500
5	0.000	2.500	0.000	0.000	2.500
6	0.000	0.000	0.000	2.500	2.500
7	0.000	2.500	8.750	8.750	2.500
8	0.000	0.000	8.750	6.250	2.500

1.9. spans in x-direction

axis	l	walls
	m	
1	3.750	6+8
2	3.750	4
3	0.000	3

1.10. spans in y-direction

axis	l m	walls
1	3.125	5+1
2	5.625	2
3	0.000	7

1.11. 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 = 2.813 m, y_s = 3.393 m, I_p = 211.77 m^5, $e_{x,s}$ = -0.938 m, $e_{y,s}$ = -0.982 m (wall eccentricity)

2.1.1. Load combination 1: wind x

wind in x-direction, application of load double-sided
w_X = 4.70 kN/m, $e_{y,w}$ = 0.565 m ⇒ $w_{l,x}$ = 2.88 kN/m, $w_{r,x}$ = 6.52 kN/m, ΔMx = 63.63 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
1	1.250	0.000	-3.393	5.875	-1.274	4.601
2	2.500	3.125	-0.268	11.750	-0.201	11.549
5	2.500	0.000	-3.393	11.750	-2.548	9.202
7	2.500	8.750	5.357	11.750	4.024	15.774

axis	span	A_x kN	M_x kNm	$V_{l,x}$ kNm	$V_{r,x}$ kNm	$M_{max,x}$ kNm	y_{max} m
1x	-	13.802	0.000	---	---	---	---
-	1x	---	---	13.802	2.773	---	---
2x	-	11.549	26.958	---	---	---	---
-	2x	---	---	14.322	-15.774	49.242	2.983
3x	-	15.774	29.047	---	---	---	---

2.1.2. Load combination 2: wind y

wind in x-direction, application of load double-sided
w_X = 3.60 kN/m, $e_{y,w}$ = 0.656 m ⇒ $w_{l,x}$ = 1.98 kN/m, $w_{r,x}$ = 5.22 kN/m, ΔMx = 51.60 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
1	1.250	0.000	-3.393	4.500	-1.033	3.467
2	2.500	3.125	-0.268	9.000	-0.163	8.837
5	2.500	0.000	-3.393	9.000	-2.067	6.933
7	2.500	8.750	5.357	9.000	3.263	12.263

axis	span	A_x kN	M_x kNm	$V_{l,x}$ kNm	$V_{r,x}$ kNm	$M_{max,x}$ kNm	y_{max} m
1x	-	10.400	0.000	---	---	---	---
-	1x	---	---	10.400	2.403	---	---
2x	-	8.837	20.946	---	---	---	---
-	2x	---	---	11.240	-12.263	38.885	3.038
3x	-	12.263	23.557	---	---	---	---

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	49.242	3.750	13.131	0.597	1.000	1.000	0.037
2	38.885	3.750	10.369	0.471	1.000	1.000	0.029

2.3. Verification of diaphragm loading

sheathing
γ = 1.30, f_{vk1} = 8.0 N/mm², f_{ck1} = 9.0 N/mm², f_{vk2} = 1 N/mm², f_{ck2} = 5 N/mm², k_{v1} = 0.66, k_{v2} = 0.50

2.3.1. Load combination 1: wind x

with h_{eff} = 3.750 m, $_{max}V_d$ = 15.774 kN ⇒ s_{v0d} = 4.21 N/mm

sheathing 1

k_{mod} = 1.00, $F_{v,Rd}$ = 475 N, f_{v0d} = 6.15 N/mm², f_{v90d} = 4.75 N/mm²

f_{v0d} = 3.13 N/mm (fastener) ⇒ decisive

f_{v0d} = 56.86 N/mm (plate shear strength)

f_{v0d} = 89.16 N/mm (shear force buckling)

sheathing 2

k_{mod} = 0.95, $F_{v,Rd}$ = 234 N, f_{v0d} = 0.73 N/mm², f_{v90d} = 2.34 N/mm²

f_{v0d} = 1.55 N/mm (fastener) ⇒ decisive

f_{v0d} = 3.01 N/mm (plate shear strength)

f_{v0d} = 2.11 N/mm (shear force buckling)

⇒ total load carrying capacity: f_{v0d} = 0.00 N/mm², f_{v90d} = 2.11 N/mm²

⇒ utilization: U_0 = 0.98 ⇒ **U = 0.98 verification successful**

2.3.2. Load combination 2: wind y

with h_{eff} = 3.750 m, $_{max}V_d$ = 12.263 kN ⇒ s_{v0d} = 3.27 N/mm

sheathing 1

k_{mod} = 1.00, $F_{v,Rd}$ = 475 N, f_{v0d} = 6.15 N/mm², f_{v90d} = 4.75 N/mm²

f_{v0d} = 3.13 N/mm (fastener) ⇒ decisive

f_{v0d} = 56.86 N/mm (plate shear strength)

f_{v0d} = 89.16 N/mm (shear force buckling)

sheathing 2

k_{mod} = 0.95, $F_{v,Rd}$ = 234 N, f_{v0d} = 0.73 N/mm², f_{v90d} = 2.34 N/mm²

f_{v0d} = 1.55 N/mm (fastener) ⇒ decisive

f_{v0d} = 3.01 N/mm (plate shear strength)

f_{v0d} = 2.11 N/mm (shear force buckling)

⇒ total load carrying capacity: f_{v0d} = 0.00 N/mm², f_{v90d} = 2.11 N/mm²

⇒ utilization: U_0 = 0.76 ⇒ **U = 0.76 verification successful**

2.4. verification der Biege- und shear stress der sheathing

duration of load medium-term ⇒ k_{mod} = 0.800, $f_{v,d}$ = 4.92 N/mm², $f_{m,d}$ = 8.62 N/mm²

V_d = 2.063 kN/m, τ_d = 0.11 N/mm², u_σ = 0.022 ⇒ **verification successful**

M_d = 0.322 kNm/m, σ_d = 2.47 N/mm², u_σ = 0.286 ⇒ **verification successful**

3. Summary

maximum utilization of all verifications U_{max} = 0.98 ≤ 1 ⇒ **all verifications successful**