POSITION 6: FERMACELL

1. Input parameters

1.1. ribs (vertical), flanges (horizontal)

service class 1
panel width/height = **125.0 / 220.0 cm**, sheet edges transmitting shear on all sides
ribs **6.0 / 10.0 cm** from solid coniferous timber, C24 (S10) with ρ_k = 350 kg/m³, a_r = 62.5 cm
flanges **6.0 / 10.0 cm** from solid coniferous timber, C24 (S10) with ρ_k = 350 kg/m³

1.2. sheathing on one side

Fermacell 12,5 mm with ρ_k = 1150 kg/m³, service class 1, t = 12.5 mm
nail, 2.8 x 42.5 mm, d_k = 6.1 mm, not predrilled
detailed verification acc. to DIN EN 1995, 8.2.2, distance a_v = 50 mm, 1-row
$F_{v,Rk}$ increased acc. to DIN EN 1995, 8.2.2(2)
vertical loads transmitted only by ribs

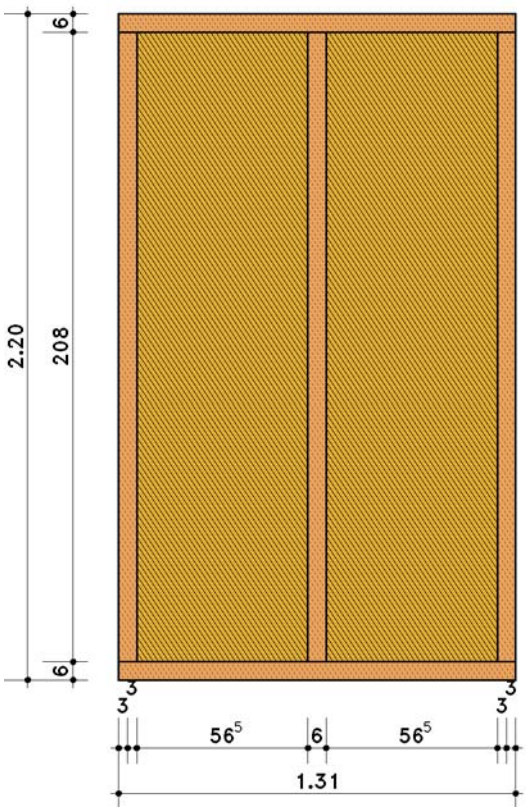
1.3. Combinations of internal forces for verifications at ultimate limit state

Nr	$F_{v,d}$ kN	E_{dl} kN/m	E_{dr} kN/m	$F_{1c,d}$ kN	$F_{2c,d}$ kN	$k_{mod,r}$ -	$k_{mod,bl}$ -	A
1	5.000	2.000	2.000	2.000	2.000	0.900	0.800	

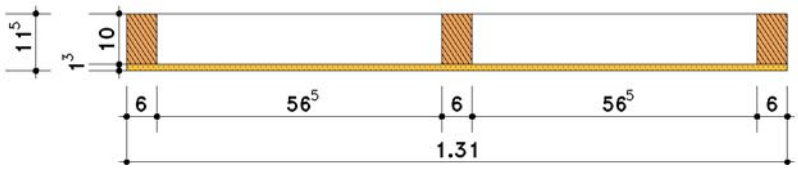
1.4. Combinations of internal forces for verifications at serviceability limit state

Nr	$F_{v,k}$ kN	E_{kl} kN/m	E_{kr} kN/m	$F_{1c,k}$ kN	$F_{2c,k}$ kN
1	5.000	0.000	0.000	1.000	1.000

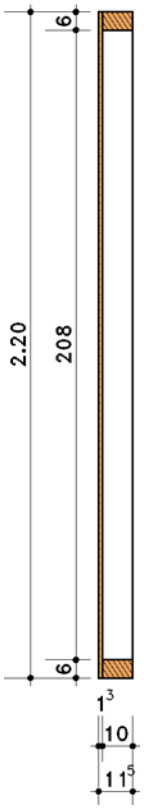
elevation scale 1:25



longitudinal section scale 1:15



transversal section scale 1:25



2. verifications acc. to DIN EN 1995, Germany

2.1. Fasteners sheathing 1

fastener ends in rib, penetration depth t = 30 mm
$f_{1k,\ Tab.\ 14}$ = 2.45 N/mm², f_{2k} = 17.50 N/mm², $F_{ax,Rk}$ = 139.65 N, ⇒ $\Delta F_{v,R}$ = **34.91 N**
f_{uk} = 600 N/mm², M_{yk} = 2617 Nmm, f_{hk} = 33.06 N/mm², β = 0.72
decisive is Eq. (Eq.(d)), γ_M = 1.30, **$F_{v,Rk}$ = 543.8 N + $\Delta F_{v,Rk}$ (34.9 N) = 578.7 N, $F_{v,Rd}$ = 377.7 N**
per shear plane

2.2. Verification of diaphragm loading

web
γ = 1.30, f_{vk} = 3.6 N/mm², f_{ck} = 8.5 N/mm², k_{v1} = 1.00, k_{v2} = 0.33

2.2.1. Load combination 1

wall panel in horizontal diaphragm loading
sheathing 1
$F_{v,Rd}$ = 378 N, f_{vd} = 2.22 N/mm², f_{cd} = 5.23 N/mm²
f_{v0d} = 6.09 N/mm (shear stress), f_{v90d} = 7.55 N/mm (shear stress)
⇒ utilization: U_{0d} = 0.66, U_{90} = -1.00 => **U = 0.66 verification successful**

2.3. Verification of compression of bottom edge beam

$A_{ef\ li}$ = 9000 mm², $A_{ef\ inside}$ = 12000 mm², $A_{ef\ re}$ = 9000 mm², x_1 = 1.00 DIN 1052, 8.7.5, k_{c90} = 1.25

2.3.1. Load combination 1

f_{v90d} = 7.55 N/mm², f_{c90d} = 2.08 N/mm², f_{rib} = 1.00
$\Sigma F_{c,d\ edge}$ = 11269 N, $\Sigma F_{c,d\ inside}$ = 3563 N, $\sigma_{c,d\ li}$ = 1.25 N/mm², $\sigma_{c,d\ inside}$ = 0.30 N/mm², $\sigma_{c,d\ re}$ = 1.25 N/mm²
⇒ utilization: **U = 0.48 verification successful**

2.4. Verification of compression flange

$E_{0,05}$ = 7333 N/mm², f_{c0k} = 21.0 N/mm², l = 1250 cm, i_r = 17.3 mm, A = 6000 mm²
flanges secured against buckling perpendicular to the wall surface

2.4.1. Load combination 1

f_{c0d} = 14.54 N/mm², $F_{c,d}$ = 5000 N, **$\sigma_{c0,d}$ = 0.83 N/mm²**
⇒ utilization: **U = 0.06 verification successful**

2.5. verification of vertical Borderribs

f_{c0k} = 21.0 N/mm², h = 220 cm, i_r = 28.9 mm, A = 6000 mm²
k = 1.440, k_c = 0.484, β_c = 0.200, $\lambda_{rel,c}$ = 1.2967, λ = 76.12

2.5.1. Load combination 1

f_{c0d} = 14.54 N/mm², $\Sigma F_{c,d}$ = 11269 N ⇒ **σ_c = 1.88 N/mm²**
⇒ utilization: **U = 0.27 verification successful**

2.6. Verification of vertical ribs (inside)

f_{c0k} = 21.0 N/mm², h = 220 cm, i_r = 28.9 mm, A = 6000 mm²
k = 1.440, k_c = 0.484, β_c = 0.200, $\lambda_{rel,c}$ = 1.2967, λ = 76.12

2.6.1. Load combination 1

f_{c0d} = 14.54 N/mm², $\Sigma F_{c,d}$ = 3563 N ⇒ **σ_c = 0.59 N/mm²**
⇒ utilization: **U = 0.08 verification successful**

2.7. Verification of deformation at ultimate limit state

k_{ser} = 818.3 N/mm, k_{c90} = 1.25, A_r = 5340.7 mm², l_1 = 565 mm, u_{zul} = 22.0 mm
G_{mean} = 1230.8 N/mm², $E_{0,mean}$ = 8461.5 N/mm², f_{c90} = 1.92 N/mm²

2.7.1. Load combination 1

σ_{c90} = 1.25 N/mm², u_k = 1.35 mm, u_G = 0.57 mm, u_E = 0.59 mm, u_v = 1.53 mm, K_d = 1236.44 N/mm
Σ u = 4.04 mm ⇒ utilization: **U = 0.18 verification successful**

2.8. Verification of deformation at serviceability limit state

k_{ser} = 1595.7 N/mm, k_{c90} = 1.25, A_r = 5340.7 mm², l_1 = 565 mm, u_{zul} = 14.7 mm
G_{mean} = 1600.0 N/mm², $E_{0,mean}$ = 11000.0 N/mm², f_{c90} = 2.50 N/mm²

2.8.1. Load combination 1

σ_{c90} = 0.98 N/mm², u_k = 0.69 mm, u_G = 0.44 mm, u_E = 0.46 mm, u_v = 0.92 mm, K_d = 1994.21 N/mm
Σ u = 2.51 mm ⇒ utilization: **U = 0.17 verification successful**

3. Summary

maximum utilization of all verifications U_{max} = 0.66 ≤ 1 ⇒ **all verifications successful**