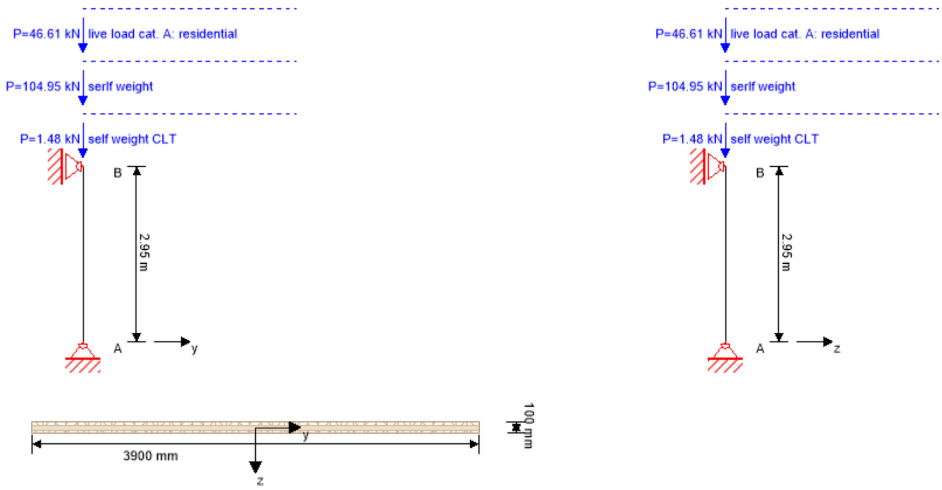
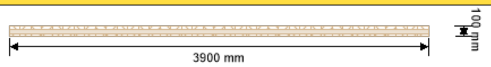
system



global utilization ratio — 21 %

ULS	21 %	ULS fire	-1 %

section: CLT 100 C3s



layer	thickness	orientation	material
1	30.0 mm	90°	C24 spruce
2	40.0 mm	0°	C24 spruce
3	30.0 mm	90°	C24 spruce
t_{CLT}	**100.0 mm**		

material values

material	$f_{m,k}$	$f_{t,0,k}$	$f_{t,90,k}$	$f_{c,0,k}$	$f_{c,90,k}$	$f_{v,k}$	$f_{r,k\ min}$	$E_{0,mean}$	G_{mean}	$G_{r,mean}$
	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]
C24 spruce	24.00	14.00	0.12	21.00	2.50	4.00	1.25	12,500.00	690.00	50.00

load

load case groups

	load case category	Typ	duration	Kmod	γ_{inf}	γ_{sup}	Ψ_0	Ψ_1	Ψ_2
LC2	self weight CLT	G	permanet	0.6	1	1.35	1	1	1
LC3	serlf weight	G	permanet	0.6	1	1.35	1	1	1
LC1	live load cat. A: residential	Q	medium term	0.8	0	1.5	0.7	0.5	0.3

LC2:self weight CLT

vertical load

P_k	ex. y	ex. z
[kN]	[m]	[m]
1.475	0.00	0.00

LC3:serlf weight

vertical load		
P_k	ex. y	ex. z
[kN]	[m]	[m]
104.95	0.03	0.05

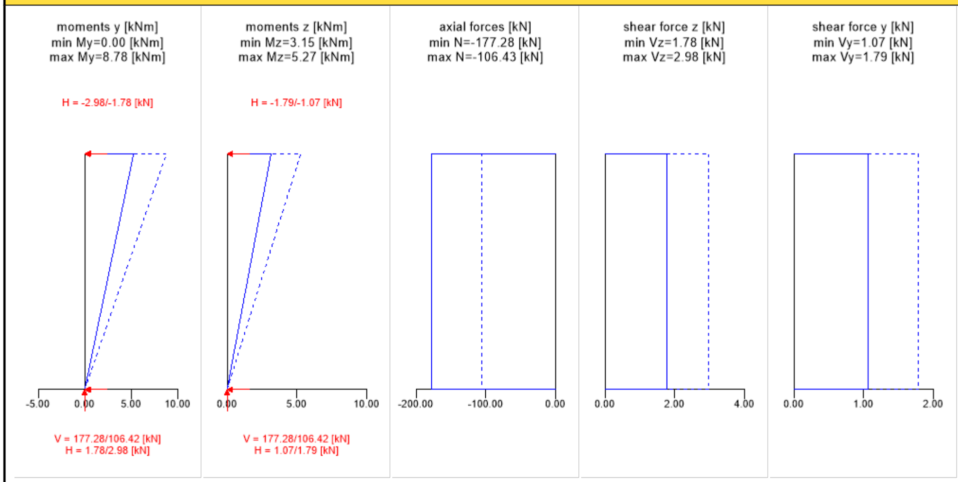
LC1:live load cat. A: residential

vertical load		
P_k	ex. y	ex. z
[kN]	[m]	[m]
46.61	0.03	0.05

ULS combinations

	combination rule
LCO1	1.12/1.00 * LC2 + 1.12/1.00 * LC3
LCO2	1.12/1.00 * LC2 + 1.12/1.00 * LC3 + 1.25/0.00 * LC1

Ultimate limit state (ULS) - design results



ULS flexural design

dist.	γ_m	k_{mod}	$k_{sys,y}$	$f_{m,k}$	$f_{m,y,d}$	$f_{t,d}$	$f_{c,d}$
[m]	[-]	[-]	[-]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]
2.95	1.25	0.80	1.10	24.00	16.90	8.96	13.44
$M_{y,d}$	$N_{c,d}$	$N_{t,d}$	$\sigma_{m,y,d}$	$\sigma_{c,d}$	$\sigma_{t,d}$	ratio	
[kNm]	[kN]	[kN]	[N/mm²]	[N/mm²]	[N/mm²]		
8.78	-177.28	0.00	1.44	0.76	0.00	9 %	LCO2

ULS shear analysis

dist.	$f_{v,k}$	γ_m	k_{mod}	$f_{v,d}$	V_d	$\tau_{v,d}$	ratio	
[m]	[N/mm²]	[-]	[-]	[N/mm²]	[kN]	[N/mm²]		
0.0	4.00	1.25	0.80	2.56	2.98	0.01	0 %	LCO2

ULS rolling shear

dist.	$f_{r,k}$	γ_m	k_{mod}	$f_{r,d}$	V_d	$\tau_{r,d}$	ratio	
[m]	[N/mm²]	[-]	[-]	[N/mm²]	[kN]	[N/mm²]		
0.0	1.05	1.25	0.80	0.67	2.98	0.01	2 %	LCO2

ULS shear design in plane of CLT - gross section

dist.	$f_{v,IP,Gross,k}$	γ_m	k_{mod}	$f_{v,IP,Gross,d}$	V_d	$\tau_{IP,Gross,d}$	ratio	
[m]	[N/mm²]	[-]	[-]	[N/mm²]	[kNm]	[N/mm²]		
0.0	3.50	1.25	0.80	2.24	1.79	0.01	0 %	LCO2

ULS shear design in plane of CLT - net section

dist.	$f_{v,IP,Net,k}$	γ_m	k_{mod}	$f_{v,IP,Net,d}$	$V_{Net,d}$	$\tau_{v,IP,Net,d}$	ratio	
[m]	[N/mm²]	[-]	[-]	[N/mm²]	[kNm]	[N/mm²]		
0.0	8.00	1.25	0.80	5.12	1.79	0.02	0 %	LCO2

ULS shear design in plane of CLT - gross section kombiniert

dist.	γ_m	k_{mod}	V_d	$\tau_{v,d}$	ratio	
[m]	[-]	[-]	[kN]	[N/mm²]		
2.95	1.25	0.80	2.98	0.01	0 %	LCO2

ULS shear design in plane of CLT - net section kombiniert

dist.	γ_m	k_{mod}	V_d	$\tau_{v,d}$	ratio	
[m]	[-]	[-]	[kN]	[N/mm²]		
2.95	1.25	0.80	2.98	0.01	0 %	LCO2

ULS torsional shear design in plane of CLT - in face glued surfaces

$f_{v,T,Node,k}$	γ_m	k_{mod}	$f_{v,T,Node,d}$	$V_{\delta,d}$	δM_t	n	a	I_p	ratio	
[N/mm²]	[-]	[-]	[N/mm²]	[kNm]	[kNm]	[-]	[m]	[mm⁴]		
2.50	1.25	0.80	1.60	1.79	0.27	52	0.150	84375010.00	0 %	LCO2

ULS buckling design

dist.	γ_m	k_{mod}	$k_{sys,y}$	$k_{sys,z}$	$f_{m,k}$	$f_{m,y,d}$	$f_{m,z,d}$	$f_{t,d}$	$f_{c,d}$
[m]	[-]	[-]	[-]	[-]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]
2.95	1.25	0.80	1.10	1.00	24.00	16.90	15.36	0.00	13.44

$l_{k,y}$	$l_{k,z}$	λ_y	λ_z	$\lambda_{rel,y}$	$\lambda_{rel,z}$	β_c	k_y	k_z	$k_{c,y}$	$k_{c,z}$
[m]	[m]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
2.950	2.950	82	3	1.30	0.04	0.2	1.45	0.48	0.48	1.00

$M_{y,d}$	$N_{c,d}$	$N_{t,d}$	$\sigma_{m,y,d}$	$\sigma_{m,z,d}$	$\sigma_{c,d}$	$\sigma_{t,d}$	ratio	
[kNm]	[kN]	[kN]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]		
8.78	-177.28	0.00	1.44	0.03	0.76	0.00	21 %	LCO2

ULS lateral torsional buckling design

dist.	γ_m	k_{mod}	$k_{sys,y}$	$f_{m,k}$	$f_{m,y,d}$	$f_{t,d}$	$f_{c,d}$
[m]	[-]	[-]	[-]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]
2.95	1.25	0.80	1.10	24.00	16.90	0.00	13.44

l_{ef}	l_k	λ_y	$\lambda_{rel,y}$	$\lambda_{rel,m}$	β_c	k_y	$k_{c,y}$	$\sigma_{m,crit}$	k_{crit}
[m]	[m]	[-]	[-]	[-]	[-]	[-]	[-]	[N/mm²]	[-]
2.950	2.950	82	1.30	1.67	0.2	1.45	0.48	8.57	0.36

$M_{y,d}$	$N_{c,d}$	$N_{t,d}$	$\sigma_{m,y,d}$	$\sigma_{c,d}$	$\sigma_{t,d}$	ratio	
[kNm]	[kN]	[kN]	[N/mm²]	[N/mm²]	[N/mm²]		
8.78	-177.28	0.00	1.44	0.76	0.00	12 %	LCO2

flexural stress analysis

$M_{y,d}$ =	8.78	kNm		$f_{m,k}$ =	24.00	N/mm²	
$N_{c,d}$ =	-177.28	kN		γ_m =	1.25	-	
				k_{mod} =	0.80	-	
				$k_{sys,y}$ =	1.10	-	
				k_{hm} =	1.00	-	
				k_l =	1.00	-	
$\sigma_{c,d}$ =	0.76	N/mm²		$f_{c,d}$ =	13.44	N/mm²	
$\sigma_{m,y,d}$ =	1.44	N/mm²	<	$f_{m,y,d}$ =	16.90	N/mm²	✓

utilization ratio 9 %

shear stress analysis

V_d =	2.98	kN		$f_{v,k}$ =	4.00	N/mm²	
				γ_m =	1.25	-	
				k_{mod} =	0.80	-	
$\tau_{v,d}$ =	0.01	N/mm²	<	$f_{v,d}$ =	2.56	N/mm²	✓
utilization ratio						0 %	

rolling shear analysis

V_d =	2.98	kN		$f_{r,k}$ =	1.05	N/mm²	
				γ_m =	1.25	-	
				k_{mod} =	0.80	-	
$\tau_{r,d}$ =	0.01	N/mm²	<	$f_{r,d}$ =	0.67	N/mm²	✓
utilization ratio						2 %	

shear analysis gross section

V_d =	1.79	kNm		$f_{v,IP,Gross,k}$ =	3.50	N/mm²	
				γ_m =	1.25	-	
				k_{mod} =	0.80	-	
$\tau_{IP,Gross,d}$ =	0.01	N/mm²	<	$f_{v,IP,Gross,d}$ =	2.24	N/mm²	✓
utilization ratio						0 %	

shear analysis net section

$V_{Net,d}$ =	1.79	kNm		$f_{v,IP,Net,k}$ =	8.00	N/mm²	
				γ_m =	1.25	-	
				k_{mod} =	0.80	-	
$\tau_{v,IP,Net,d}$ =	0.02	N/mm²	<	$f_{v,IP,Net,d}$ =	5.12	N/mm²	✓
utilization ratio						0 %	

shear analysis gross section combined

V_d =	2.98	kN		$f_{v,k}$ =	4.00	N/mm²	
$V_{Gross,d}$ =	1.79	kNm		$f_{v,IP,Gross,k}$ =	3.50	N/mm²	
				γ_m =	1.25	-	
				k_{mod} =	0.80	-	
$\tau_{v,d}$ =	0.01	N/mm²		$f_{v,d}$ =	2.56	N/mm²	
$\tau_{IP,Gross,d}$ =	0.01	N/mm²	<	$f_{v,IP,Gross,d}$ =	2.24	N/mm²	✓
utilization ratio						0 %	

shear analysis net section combined

V_d =	2.98	kN		$f_{v,k}$ =	4.00	N/mm²	
$V_{Net,d}$ =	1.79	kNm		$f_{v,IP,Net,k}$ =	8.00	N/mm²	
				γ_m =	1.25	-	
				k_{mod} =	0.80	-	
$\tau_{v,d}$ =	0.01	N/mm²		$f_{v,d}$ =	2.56	N/mm²	
$\tau_{IP,Net,d}$ =	0.02	N/mm²	<	$f_{v,IP,Net,d}$ =	5.12	N/mm²	✓
utilization ratio						0 %	

torsional shear design in plane of CLT - in face glued surfaces

$V_{\delta,d}$ =	1.79	kNm		$f_{v,T,Node,k}$ =	2.50	N/mm²	
				γ_m =	1.25	-	
				k_{mod} =	0.80	-	
$\tau_{T,Node,d}$ =	0.00	N/mm²	<	$f_{v,T,Node,d}$ =	1.60	N/mm²	✓
utilization ratio						0 %	

buckling analysis

$M_{y,d}$ =	8.78	kNm		$f_{m,k}$ =	24.00	N/mm²	
$N_{c,d}$ =	-177.28	kN		γ_m =	1.25	-	
				k_{mod} =	0.80	-	
				$k_{sys,y}$ =	1.10	-	
$\sigma_{c,d}$ =	0.76	N/mm²		$f_{c,d}$ =	13.44	N/mm²	
$\sigma_{m,y,d}$ =	1.44	N/mm²		$f_{m,y,d}$ =	16.90	N/mm²	
$\sigma_{m,z,d}$ =	0.03	N/mm²	<	$f_{m,z,d}$ =	15.36	N/mm²	✓
utilization ratio						21 %	

lateral torsional buckling analysis

$M_{y,d}$ =	8.78	kNm		$f_{m,k}$ =	24.00	N/mm²	
$N_{c,d}$ =	-177.28	kN		γ_m =	1.25	-	
				k_{mod} =	0.80	-	
				$k_{sys,y}$ =	1.10	-	
				k_{hm} =	1.00	-	
				k_l =	1.00	-	
$\sigma_{c,d}$ =	0.76	N/mm²		$f_{c,d}$ =	13.44	N/mm²	
$\sigma_{m,y,d}$ =	1.44	N/mm²	<	$f_{m,y,d}$ =	16.90	N/mm²	✓

utilization ratio 12 %

support reaction

load case category	k_{mod}	A_y	A_z	B_x	B_y	B_z
		[kN]	[kN]	[kN]	[kN]	[kN]
self weight CLT	0.6	0.00	0.00	1.48	0.00	0.00
		0.00	0.00	1.48	0.00	0.00
serlf weight	0.6	-1.07	-1.78	104.95	1.07	1.78
		-1.07	-1.78	104.95	1.07	1.78
live load cat. A: residential	0.8	0.00	0.00	0.00	0.47	0.79
		-0.47	-0.79	46.61	0.00	0.00