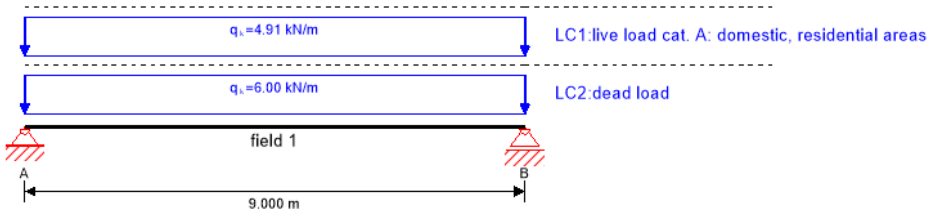
Vedlegg 16

Dimensjonering av dekke i Calculatis

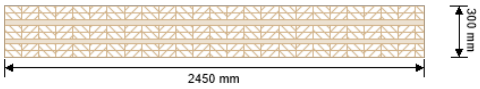
system



global utilization ratio 66 %

ULS	29 %	ULS fire	0 %	SLS	66 %	SLS vibration	0 %	support	-1 %

section: CLT 300 L8s - 2



layer	thickness	orientation	material
1	40.0 mm	0°	C24 spruce
2	40.0 mm	0°	C24 spruce
3	30.0 mm	90°	C24 spruce
4	40.0 mm	0°	C24 spruce
5	40.0 mm	0°	C24 spruce
6	30.0 mm	90°	C24 spruce
7	40.0 mm	0°	C24 spruce
8	40.0 mm	0°	C24 spruce
t_{CLT}	**300.0 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	dead load	G	permanet	0.6	1	1.35	1	1	1
LC1	live load cat. A: domestic, residential areas	Q	medium term	0.8	0	1.5	0.7	0.5	0.3

LC2:dead load

continous load

field	load at start
	[kN/m]
1	6.00

LC1:live load cat. A: domestic, residential areas

continous load

field	load at start
	[kN/m]
1	4.91

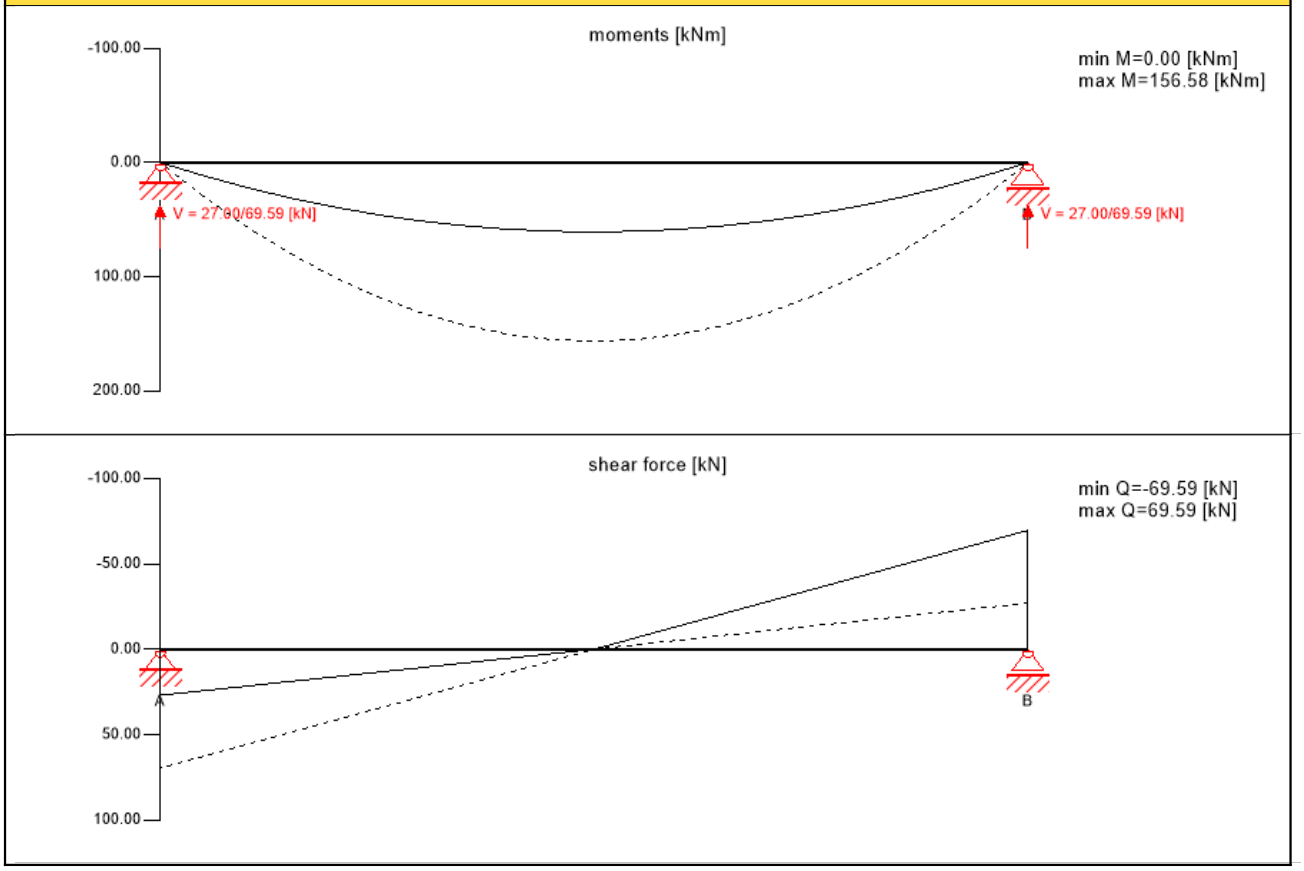
ULS combinations

	combination rule
LCO1	1.35/1.00 * LC2
LCO2	1.35/1.00 * LC2 + 1.50/0.00 * LC1

SLS characteristic combination	
	combination rule
LCO3	1.00/1.00 * LC2
LCO4	1.00/1.00 * LC2 + 1.00/0.00 * LC1

SLS quasi-permanent combination	
	combination rule
LCO5	1.00/1.00 * LC2
LCO6	1.00/1.00 * LC2 + 1.00/0.00 * 0.30 * LC1

Ultimate limit state (ULS) - design results



ULS flexural design

field	dist.	$f_{m,k}$	γ_m	k_{mod}	$k_{sys,y}$	$f_{m,y,d}$	$M_{y,d}$	$\sigma_{m,y,d}$	ratio	
	[m]	[N/mm²]	[-]	[-]	[-]	[N/mm²]	[kNm]	[N/mm²]		
1	4.5	24.00	1.30	0.80	1.10	16.25	156.58	-4.64	29 %	LCO2

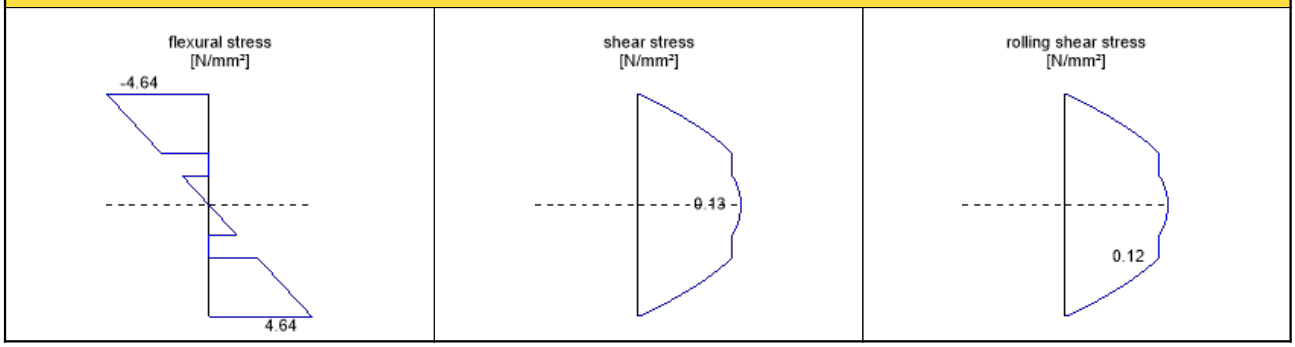
ULS shear analysis

field	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]		
1	9.0	4.00	1.30	0.80	2.46	-69.59	0.13	5 %	LCO2

ULS rolling shear

field	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]		
1	9.0	1.15	1.30	0.80	0.71	-69.59	0.12	17 %	LCO2

stress diagram



flexural stress analysis

$M_{y,d}$ =	156.58	kNm		$f_{m,k}$ =	24.00	N/mm²	
$N_{t,d}$ =	0.00	kN		γ_m =	1.30	-	
				k_{mod} =	0.80	-	
				$k_{sys,y}$ =	1.10	-	
				k_{hm} =	1.00	-	
				k_l =	1.00	-	
$\sigma_{t,d}$ =	0.00	N/mm²		$f_{t,d}$ =	8.62	N/mm²	
$\sigma_{m,y,d}$ =	-4.64	N/mm²	<	$f_{m,y,d}$ =	16.25	N/mm²	✓

utilization ratio 29 %

shear stress analysis

V_d =	- 69.59	kN		$f_{v,k}$ =	4.00	N/mm²	
				γ_m =	1.30		
				k_{mod} =	0.80		
$\tau_{v,d}$ =	0.13	N/mm²	<	$f_{v,d}$ =	2.46	N/mm²	✓

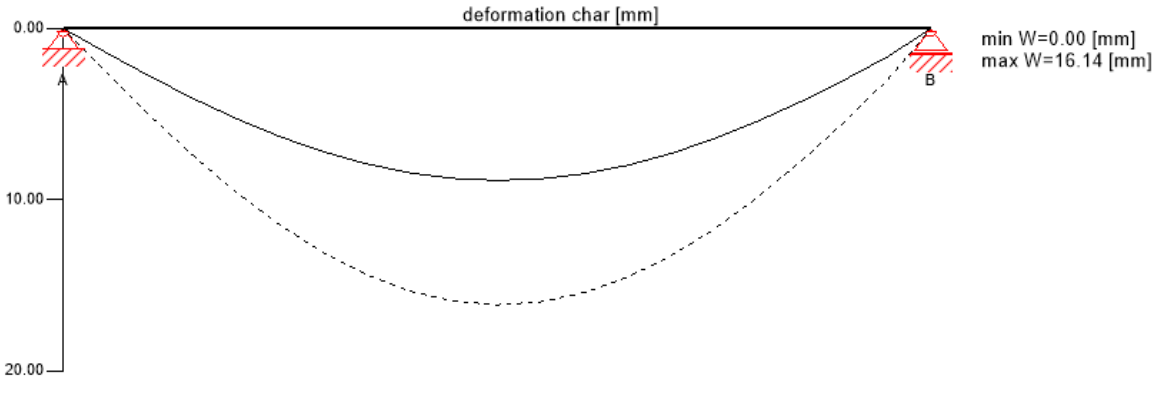
utilization ratio 5 %

rolling shear analysis

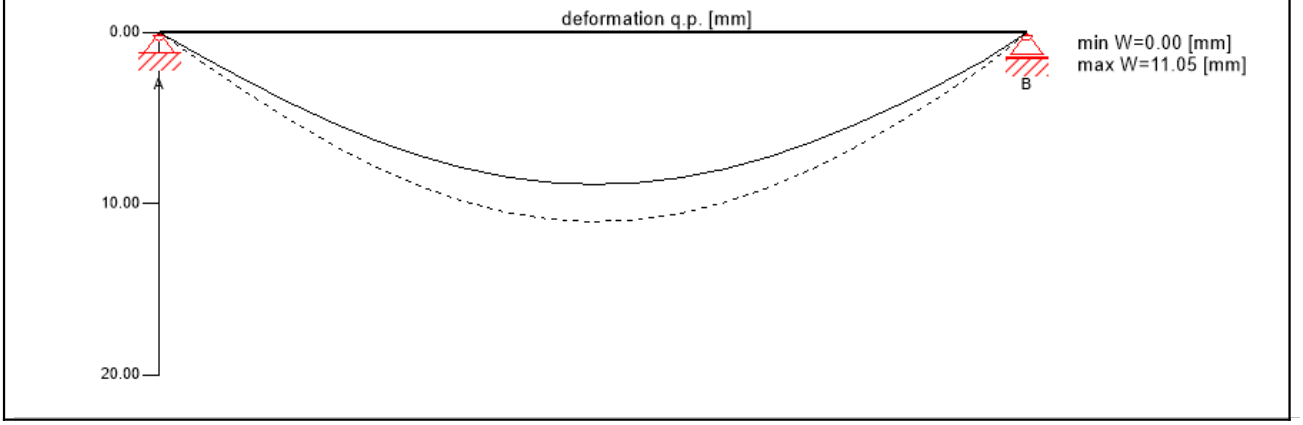
V_d =	-69.59	kN		$f_{r,k}$ =	1.15	N/mm²	
				γ_m =	1.30	-	
				k_{mod} =	0.80	-	
$\tau_{r,d}$ =	0.12	N/mm²	<	$f_{r,d}$ =	0.71	N/mm²	✓

utilization ratio 17 %

Service limit state design (SLS) - design results



Service limit state design (SLS) - design results



w_{inst} = w[char]

field	limit	w_{limit}	$w_{calc.}$	ratio
	[-]	[mm]	[mm]	
1	1/300	30.0	16.1	54 %

w_{fin} = w[char] + w[q.p.]*kdef

field	limit	w_{limit}	$w_{calc.}$	ratio
	[-]	[mm]	[mm]	
1	1/200	45.0	25.0	56 %

$w_{net,fin}$ = w[q.p.] + w[q.p.]*kdef

field	limit	w_{limit}	$w_{calc.}$	ratio
	[-]	[mm]	[mm]	
1	1/300	30.0	19.9	66 %

support reaction

load case category	k_{mod}	A_V	B_V
		[kN]	
dead load	0.6	27.00	27.00
		27.00	27.00
live load cat. A: domestic, residential areas	0.8	22.09	22.09
		0.00	0.00

reference documents for this analysis

English title	description
EN 338	EN 338 - Structural timber — Strength classes
ETA-14/0349	European Technical Assessment ETA-14/0349 of 02.10.2014
Expertise Rolling shear - no edge gluing, H.J. Blass	Expertise on Rolling shear for CLT
EN 1995-1-2	EN 1995-1-2 - Eurocode 5 — Design of timber structures — Part 1-2: General — Structural fire design
EN 14080	EN 14080 - Timber Structures - Glued laminated timber and glued solid timber - Requirements
DIN EN 1995-1-1	EN 1995-1-1 - Eurocode 5: Design of timber structures - Part 1-1: General - Common rules and rules for buildings
DIN EN 1995-1-1 NA	EN 1995-1-1 - National Annex – Nationally determined parameters – Eurocode 5: Design of timber structures – Part 1-1: General — Common rulesand rules for buildings
Technical expertise 122/2011/02: analysis of load bearing capacity and separation performance of CLT elements	Verification of the load bearing capacity and the insulation criterion of CLT structures with Stora Enso CLT
Technical expertise 2434/2012 - BB: failure time tf of gypsum fire boards (GKF) according to ON B 3410	Expertise on failure time tf of gypsum wall fire boards according to ON B3410 and gypsum wall boards type DF according to EN 520
EN 1990	EN 1990 - Eurocode — Basis of structural design
Fire safety in timber buildings - technical guildeline for Europe	Fire safety in timber buildings - technical guildeline for Europe; publishes by SP Technical Research Institute of Sweden
National specifications concerning ÖNORM EN 1995-1-2, national comments and national supplements, chapter 12	ÖNORM EN 1995-1-2 - National specifications concerning ÖNORM EN 1995-1-2, national comments and national supplements, chapter 12

reference documents for this analysis	
English title	description
DIN EN 1995-1-2_NA	DIN EN 1995-1-2 - Germany - National Annex - Eurocode 5: Design of timber structures — Part 1-2: General — Structural fire design — National specifications concerning DIN EN 1995-1-2, national comments and national supplements
Expertise Rolling shear, H.J. Blass	Expertise on rolling shear strength and rolling shear modulus of CLT panels
ÖNORM EN 1995-1-1_NA, chapter 7.3	ÖNORM EN 1995-1-1 - Austria - National Annex – Nationally determined parameters – Eurocode 5: Design of timber structures – Part 1-1: General-Common rules and rules for buildings; chapter 7.3

Disclaimer