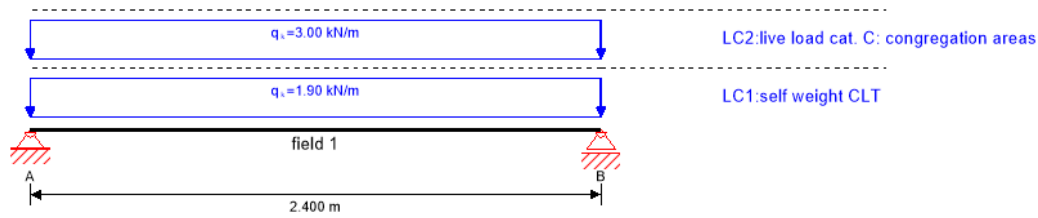


## system



## global utilization ratio

12 %

ULS	12 %	ULS fire	0 %	SLS	5 %	SLS vibration	0 %	support	-1 %
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## section: CLT 140 L5s

	layer	thickness	orientation	material
	1	50.0 mm	0°	C20/25
	2	40.0 mm	0°	C24 spruce
	3	20.0 mm	90°	C24 spruce
	4	20.0 mm	0°	C24 spruce
	5	20.0 mm	90°	C24 spruce
	6	40.0 mm	0°	C24 spruce
	t <sub>CLT</sub>	190.0 mm		

## material values

material	f <sub>m,k</sub>	f <sub>t,0,k</sub>	f <sub>t,90,k</sub>	f <sub>c,0,k</sub>	f <sub>c,90,k</sub>	f <sub>v,k</sub>	f <sub>r,k min</sub>	E <sub>0,mean</sub>	G <sub>mean</sub>	G <sub>r,mean</sub>
	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]
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 <sub>inf</sub>	γ <sub>sup</sub>	Ψ <sub>0</sub>	Ψ <sub>1</sub>	Ψ <sub>2</sub>
LC1	self weight CLT	G	permanet	0.6	1	1.35	1	1	1
LC2	live load cat. C: congregation areas	Q	short term	0.9	0	1.5	0.7	0.7	0.6

## LC1:self weight CLT

continous load	
field	load at start
	[kN/m]
1	1.90

## LC2:live load cat. C: congregation areas

continous load	
field	load at start
	[kN/m]
1	3.00

## ULS combinations

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

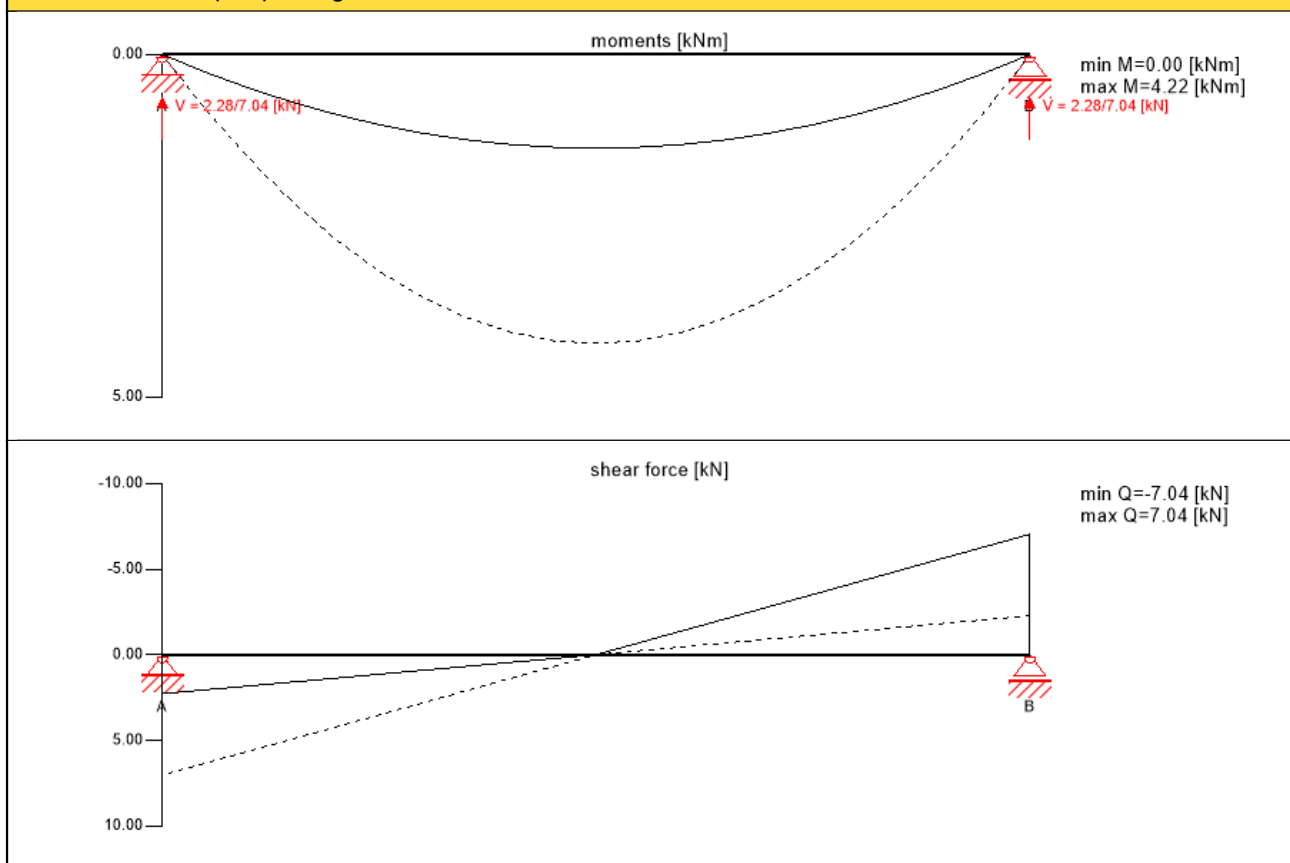
### SLS characteristic combination

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

### SLS quasi-permanent combination

	combination rule
LCO5	1.00/1.00 * LC1
LCO6	1.00/1.00 * LC1 + 1.00/0.00 * 0.60 * LC2

### Ultimate limit state (ULS) - design results



### ULS flexural design

field	dist.	$f_k$	$\gamma_m$	$k_{mod}$	$k_{sys,y}$	$f_{y,d}$	$M_{y,d}$	$\sigma_{m,y,d}$	ratio	
	[m]	[N/mm <sup>2</sup> ]	[-]	[-]	[-]	[N/mm <sup>2</sup> ]	[kNm]	[N/mm <sup>2</sup> ]		
1	1.2	20.00	1.50	1.00	1.00	13.33	4.22	-1.63	12 %	LCO2

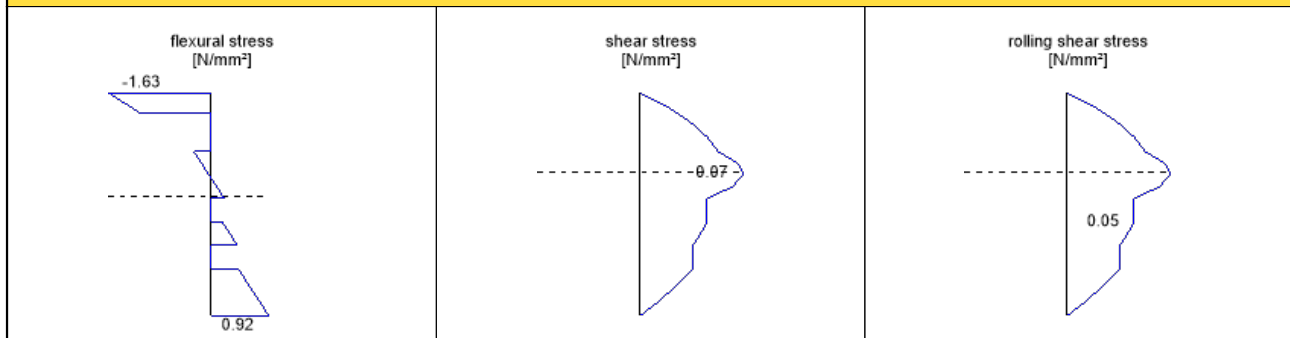
### ULS shear analysis

field	dist.	$f_{v,k}$	$\gamma_m$	$k_{mod}$	$k_{cr}$	$f_{v,d}$	$V_d$	$\tau_{v,d}$	ratio	
	[m]	[N/mm <sup>2</sup> ]	[-]	[-]	[-]	[N/mm <sup>2</sup> ]	[kN]	[N/mm <sup>2</sup> ]		
1	0.0	4.00	1.25	0.90	1.00	2.88	7.04	0.07	2 %	LCO2

### ULS rolling shear

field	dist.	$f_{r,k}$	$\gamma_m$	$k_{mod}$	$f_{r,d}$	$V_d$	$\tau_{r,d}$	ratio	
	[m]	[N/mm <sup>2</sup> ]	[-]	[-]	[N/mm <sup>2</sup> ]	[kN]	[N/mm <sup>2</sup> ]		
1	0.0	1.25	1.25	0.90	0.90	7.04	0.05	5 %	LCO2

### stress diagram



### flexural stress analysis

$M_d = 4.22 \text{ kNm}$	$f_{m,k} = 20.00 \text{ N/mm}^2$
	$\gamma_m = 1.50$
	$k_{mod} = 1.00$
	$k_{sys} = 1.00$
$\sigma_{m,d} = -1.63 \text{ N/mm}^2$	$f_{m,d} = 13.33 \text{ N/mm}^2$
<	✓

### utilization ratio

12 %

### shear stress analysis

$V_d = 7.04 \text{ kN}$	$f_{v,k} = 4.00 \text{ N/mm}^2$
	$\gamma_m = 1.25$
	$k_{mod} = 0.90$
	$k_{cr} = 1.000$
$\tau_{v,d} = 0.07 \text{ N/mm}^2$	$f_{v,d} = 2.88 \text{ N/mm}^2$
<	✓

### utilization ratio

2 %

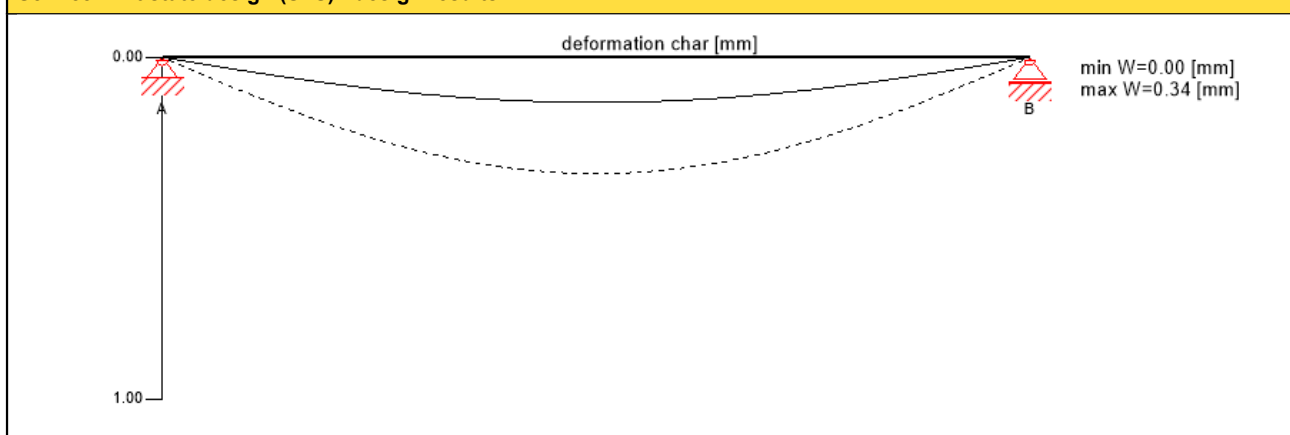
### rolling shear analysis

$V_d = 7.04 \text{ kN}$	$f_{r,k} = 1.25 \text{ N/mm}^2$
	$\gamma_m = 1.25$
	$k_{mod} = 0.90$
$\tau_{r,d} = 0.05 \text{ N/mm}^2$	$f_{r,d} = 0.90 \text{ N/mm}^2$
<	✓

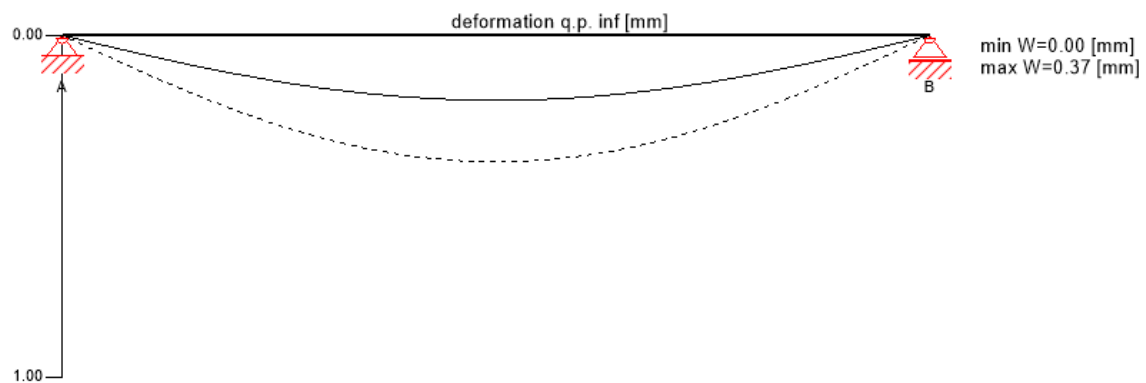
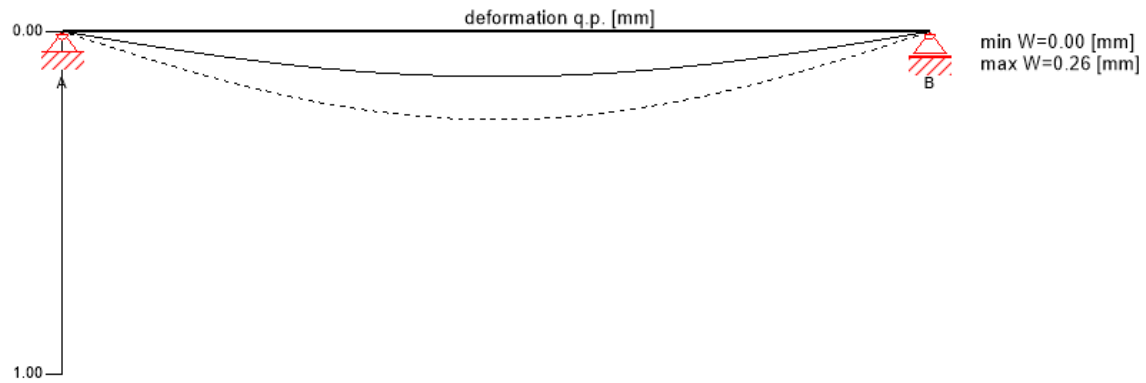
### utilization ratio

5 %

### 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	8.0	0.3	4 %

#### $w_{fin} = w[char] + w[q.p.\infty]$

field	limit	$w_{limit}$	$w_{calc.}$	ratio
	[-]	[mm]	[mm]	
1	1/150	16.0	0.5	3 %

#### $w_{net,fin} = w[q.p.] + w[q.p.\infty]$

field	limit	$w_{limit}$	$w_{calc.}$	ratio
	[-]	[mm]	[mm]	
1	1/250	9.6	0.5	5 %

#### support reaction

load case category	$k_{mod}$	$A_v$	$B_v$
		[kN]	
self weight CLT	0.6	2.28	2.28
		2.28	2.28
live load cat. C: congregation areas	0.9	3.60	3.60
		0.00	0.00

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