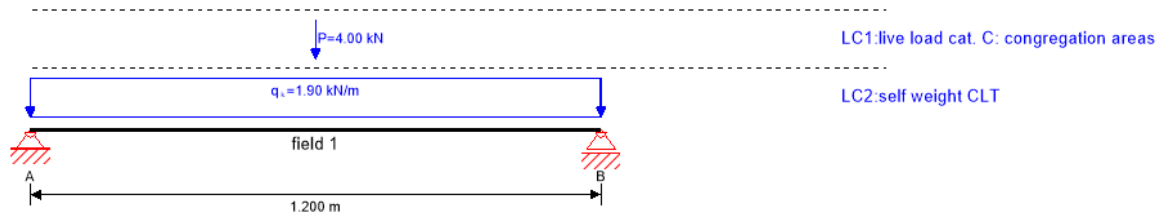


system



global utilization ratio

5 %

| | | | | | | | | | |
|-----|-----|----------|-----|-----|-----|---------------|-----|---------|------|
| ULS | 5 % | ULS fire | 0 % | SLS | 1 % | SLS vibration | 0 % | support | -1 % |
|-----|-----|----------|-----|-----|-----|---------------|-----|---------|------|

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_{CLT} | 190.0 mm | | |

material values

| material | $f_{m,k}$ | $f_{t,0,k}$ | $f_{t,90,k}$ | $f_{c,0,k}$ | $f_{c,90,k}$ | $f_{v,k}$ | $f_{r,k \text{ min}}$ | $E_{0,mean}$ | G_{mean} | $G_{r,mean}$ |
|------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|----------------------|----------------------|----------------------|
| | [N/mm ²] | [N/mm ²] | [N/mm ²] | [N/mm ²] | [N/mm ²] | [N/mm ²] | [N/mm ²] | [N/mm ²] | [N/mm ²] | [N/mm ²] |
| 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 |
| LC1 | live load cat. C: congregation areas | Q | short term | 0.9 | 0 | 1.5 | 0.7 | 0.7 | 0.6 |

LC2:self weight CLT

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

LC1:live load cat. C: congregation areas

| point load | | |
|------------|---------------------|---------------|
| field | distance from start | load at start |
| | [m] | [kN] |
| 1 | 0.600 | 4.00 |

ULS combinations

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

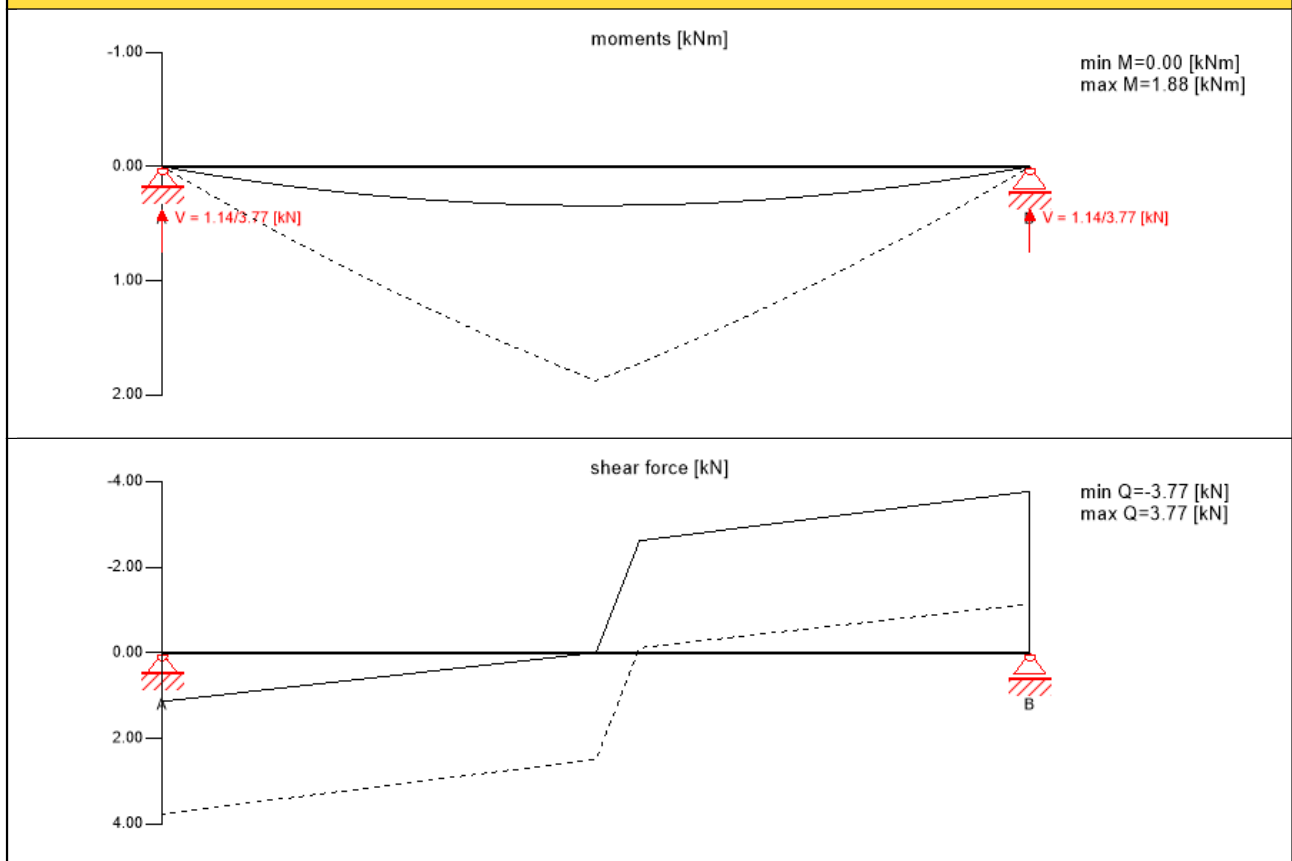
SLS characteristic combination

| | 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 * 0.60 * LC1 |

Ultimate limit state (ULS) - design results



ULS flexural design

| field | dist. | f_k | γ_m | k_{mod} | $k_{sys,y}$ | $f_{y,d}$ | $M_{y,d}$ | $\sigma_{m,y,d}$ | ratio | |
|-------|-------|----------------------|------------|-----------|-------------|----------------------|-----------|----------------------|-------|------|
| | [m] | [N/mm ²] | [-] | [-] | [-] | [N/mm ²] | [kNm] | [N/mm ²] | | |
| 1 | 0.6 | 20.00 | 1.50 | 1.00 | 1.00 | 13.33 | 1.88 | -0.72 | 5 % | LCO2 |

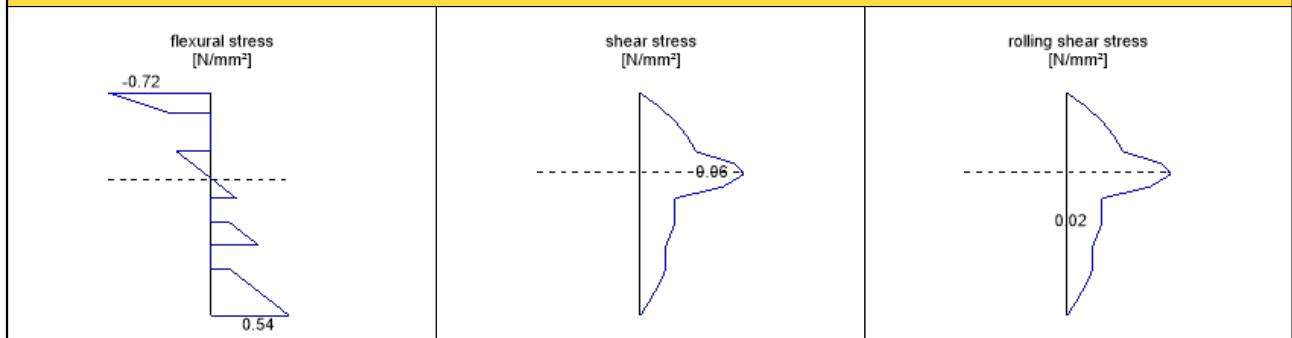
ULS shear analysis

| field | dist. | $f_{v,k}$ | γ_m | k_{mod} | k_{cr} | $f_{v,d}$ | V_d | $\tau_{v,d}$ | ratio | |
|-------|-------|----------------------|------------|-----------|----------|----------------------|-------|----------------------|-------|------|
| | [m] | [N/mm ²] | [-] | [-] | [-] | [N/mm ²] | [kN] | [N/mm ²] | | |
| 1 | 0.0 | 4.00 | 1.25 | 0.90 | 1.00 | 2.88 | 3.77 | 0.06 | 2 % | LCO2 |

ULS rolling shear

| field | dist. | $f_{r,k}$ | γ_m | k_{mod} | $f_{r,d}$ | V_d | $\tau_{r,d}$ | ratio | |
|-------|-------|----------------------|------------|-----------|----------------------|-------|----------------------|-------|------|
| | [m] | [N/mm ²] | [-] | [-] | [N/mm ²] | [kN] | [N/mm ²] | | |
| 1 | 0.0 | 1.25 | 1.25 | 0.90 | 0.90 | 3.77 | 0.02 | 2 % | LCO2 |

stress diagram



flexural stress analysis

| | |
|---------------------------------------|----------------------------------|
| $M_d = 1.88 \text{ kNm}$ | $f_{m,k} = 20.00 \text{ N/mm}^2$ |
| | $\gamma_m = 1.50$ |
| | $k_{mod} = 1.00$ |
| | $k_{sys} = 1.00$ |
| $\sigma_{m,d} = -0.72 \text{ N/mm}^2$ | $f_{m,d} = 13.33 \text{ N/mm}^2$ |
| < | ✓ |

utilization ratio

5 %

shear stress analysis

| | |
|------------------------------------|---------------------------------|
| $V_d = 3.77 \text{ kN}$ | $f_{v,k} = 4.00 \text{ N/mm}^2$ |
| | $\gamma_m = 1.25$ |
| | $k_{mod} = 0.90$ |
| | $k_{cr} = 1.000$ |
| $\tau_{v,d} = 0.06 \text{ N/mm}^2$ | $f_{v,d} = 2.88 \text{ N/mm}^2$ |
| < | ✓ |

utilization ratio

2 %

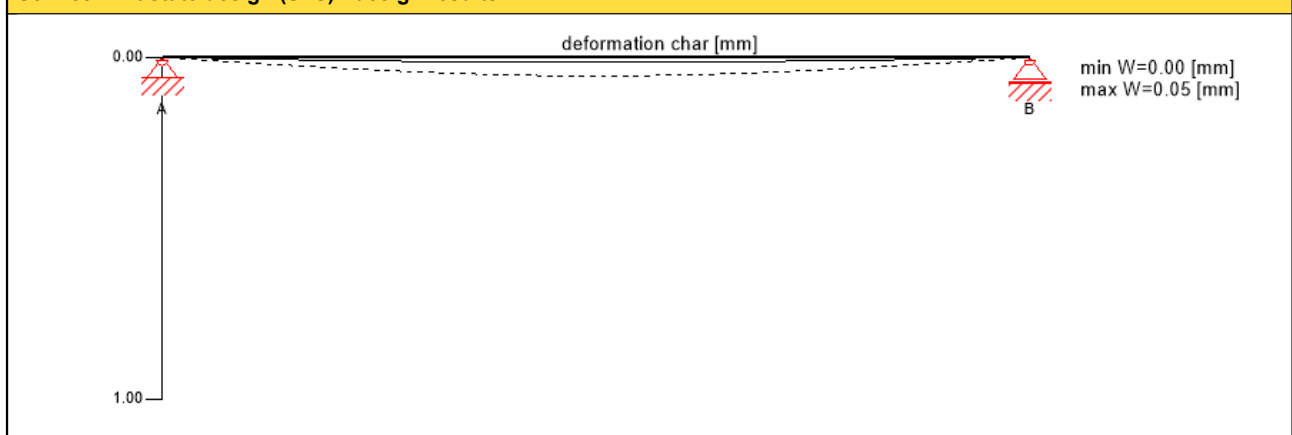
rolling shear analysis

| | |
|------------------------------------|---------------------------------|
| $V_d = 3.77 \text{ kN}$ | $f_{r,k} = 1.25 \text{ N/mm}^2$ |
| | $\gamma_m = 1.25$ |
| | $k_{mod} = 0.90$ |
| $\tau_{r,d} = 0.02 \text{ N/mm}^2$ | $f_{r,d} = 0.90 \text{ N/mm}^2$ |
| < | ✓ |

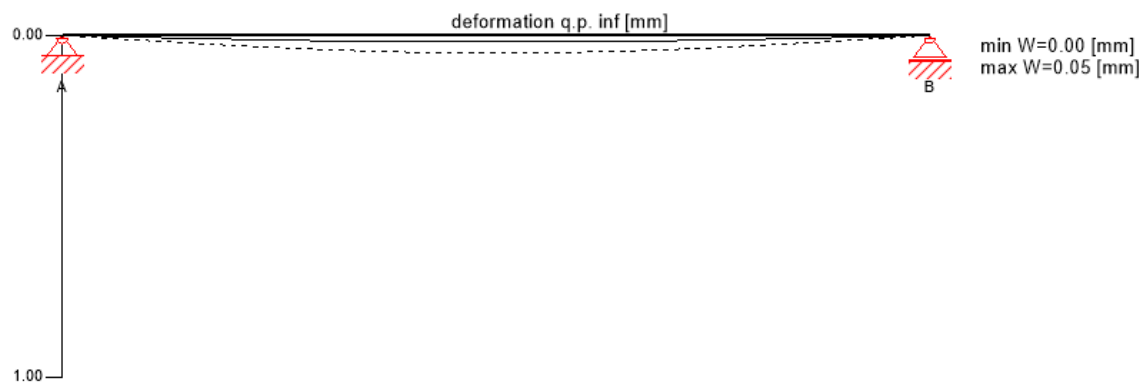
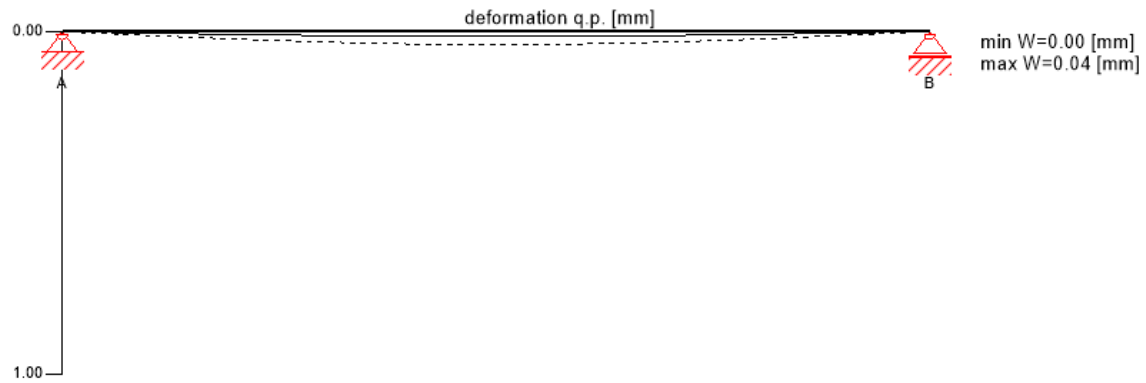
utilization ratio

2 %

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 | 4.0 | 0.1 | 1 % |

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

| field | limit | w_{limit} | $w_{calc.}$ | ratio |
|-------|-------|-------------|-------------|-------|
| | [-] | [mm] | [mm] | |
| 1 | 1/150 | 8.0 | 0.1 | 1 % |

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

| field | limit | w_{limit} | $w_{calc.}$ | ratio |
|-------|-------|-------------|-------------|-------|
| | [-] | [mm] | [mm] | |
| 1 | 1/250 | 4.8 | 0.1 | 1 % |

support reaction

| load case category | k_{mod} | A_v | B_v |
|--------------------------------------|-----------|-------|-------|
| | | [kN] | |
| self weight CLT | 0.6 | 1.14 | 1.14 |
| | | 1.14 | 1.14 |
| live load cat. C: congregation areas | 0.9 | 2.00 | 2.00 |
| | | 0.00 | 0.00 |

Disclaimer

The software was created to assist engineers in their daily business. The software is an engineering software that is dealing with a very complex matter of structural analysis and building physics analysis. Therefore, this software shall only be operated by skilled, experienced engineers, with a deep understanding of structural engineering and building physics related to timber structures. The user of the software is obliged to check all input values, no matter if they were given by the user or given by default by the software and all results for plausibility.

The use of the results of the software should not be relied upon as the basis for any decision or action. Any use of results of the software is only allowed, if the results have been

verified and approved regarding completeness and correctness by a project structural/building physics engineer. The user has the possibility to make print-outs from the software. Any modification of those are not allowed.

Stora Enso Wood Products GmbH does not assume any warranty regarding the software. The software has been developed with utmost diligence, nevertheless Stora Enso Wood Products GmbH, neither expressly nor implicitly, provides any warranty in terms of accuracy, validity, timeliness and completeness of information and data created by the software. Stora Enso Wood Products GmbH does also not assume any warranty for the general usability of the software, its suitability for a special purpose or for the compatibility of the software with the ones of third party producers or providers.

Stora Enso Wood Products GmbH is only liable for damages caused by gross negligence or intent through Stora Enso Wood Products GmbH; the liability for slight negligence is excluded. This does not apply to personal injury. Under the aforementioned conditions Stora Enso Wood Products GmbH is as well not liable for operational failures or the loss of programs and/or data of the user's data processing system.

Applicable Law: These terms of use shall be governed by the laws of Austria excluding however any conflict of laws rules and any laws regarding the Convention of the International Sale of Goods (CISG).