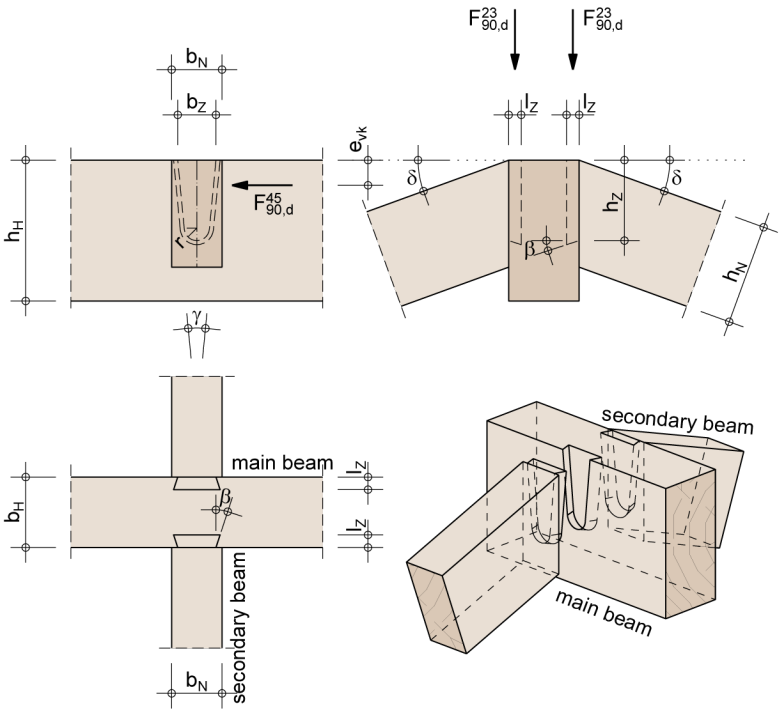
Verification Dovetail-Connection

according to building approval Z-9.1-649 (validity 18 June 2018 - 5 October 2022)

Connection & Geometry

double-sided connection

material:	laminated timber
solidity:	GL24c according to DIN EN 14080:2013-09
width secondary beam b_N:	120 mm
height secondary beam h_N:	240 mm
width main beam b_H:	160 mm
height main beam h_H:	320 mm
inclination δ:	30 °
milling angle β:	10 °
pin cone angle γ:	4 °
length pin l_Z:	28 mm
width pin b_Z:	110 mm
height pin h_Z:	218 mm
pin hole radius r:	47.7 mm
dimensional tolerances:	+/- 0.2 mm



Loads

Load $F_{23,90,d}$:	13.00 kN
Load $F_{45,90,d}$:	0.00 kN
e_{vk}:	0 mm
Service class:	NKL1 - heated interiors
KLED:	medium
modification factor k_{mod}:	0.8

Verification:	$0.98 \leq 1.00$	**Verification fulfilled**

Construction tip

Building approval Z-9.1-649 must be observed.

Stress resistance in insertion direction

k_n: 6.50

$$\alpha = \cos(\delta) * \frac{h_Z - r}{h_N} = \cos(30) * \frac{218 - 47.7}{240} = 0.61$$

$$k_v = min \begin{Bmatrix} 1 \\ \frac{k_n}{\sqrt{h_N} * \left(\sqrt{\alpha * (1-\alpha)} + 0.4 * \frac{l_Z}{h_N} * \sqrt{\frac{1}{\alpha} - \alpha^2}\right)} \end{Bmatrix}$$

$$= min \begin{Bmatrix} 1 \\ \frac{6.50}{\sqrt{240} * \left(\sqrt{0.61 * (1-0.61)} + 0.4 * \frac{28}{240} * \sqrt{\frac{1}{0.61} - 0.61^2}\right)} \end{Bmatrix}$$

$$= min \begin{Bmatrix} 1 \\ 0.78 \end{Bmatrix}$$

k_{ab}: 0.80

$f_{t,90,d}$: 0.308 N/mm² (with $f_{t,90,k}$ = 0.5 N/mm² according to approval)

$f_{v,d}$: 1.538 N/mm² (with $f_{v,k}$ = 2.5 N/mm² according to approval)

$$F_{90,Rd}^{23} = min \begin{Bmatrix} k_{ab} * \frac{h_Z}{h_Z - r} * \left(6.5 + \frac{18 * (h_H - h_Z + r)^2}{h_H^2}\right) * (t_{ef} * h_H)^{0.8} * f_{t,90,d} \\ \frac{k_v * b_N * (h_Z - r)}{1.5} * f_{v,d} \end{Bmatrix}$$

$$= min \begin{Bmatrix} 0.80 * \frac{218}{218 - 47.7} * \left(6.5 + \frac{18 * (320 - 218 + 47.7)^2}{320^2}\right) * (100 * 320)^{0.8} * 0.308 \\ \frac{0.78 * 120 * (218 - 47.7)}{1.5} * 1.538 \end{Bmatrix}$$

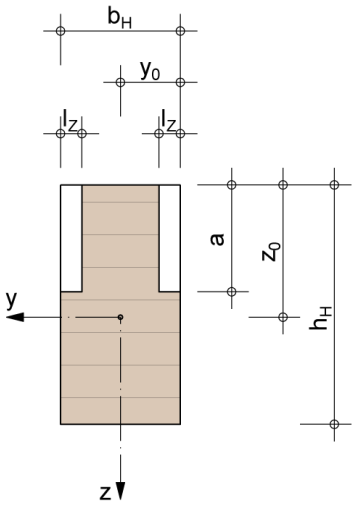
$$= min \begin{Bmatrix} 13.22 \\ 16.28 \end{Bmatrix}$$

stress resistance $F_{90,Rd}^{23}$: 13.22 kN

Verification in insertion direction:	$\frac{F_{90,d}^{23}}{F_{90,Rd}^{23}} = \frac{13.00}{13.22} =$	$0.98 \leq 1.00$

Cross-sectional weakening

width main beam b_H:	160 mm
height main beam h_H:	320 mm
height a:	222.9 mm
length pin l_Z:	28 mm
position of centre y_0:	80.0 mm
position of centre z_0:	175.6 mm
moment of interia I_y:	34631 cm^4



moment of inertia of the unattenuated main beam:

$$I_{y,H} = \frac{b_H * h_H^3}{12} = \frac{160 * 320^3}{12} * 10^{-4} = 43691 \text{ cm}^4$$

required cross-sectional height with the same moment of interia I_y related to the unattenuated cross-sectional of the main beam:

width beam b_H:	160 mm
height beam h_{erf}:	346 mm
height a:	222.9 mm
length pin l_Z:	28 mm
position of centre y_0:	80.0 mm
position of centre z_0:	190.9 mm
moment of interia I_y:	43955 cm^4