HTKR

CE
ETA-22/0089

REINFORCED TENSILE ANGLE BRACKET

- The most classic of the tensile angle brackets: ideal for tensile fastening of CLT or frame walls
- Hole size and disposition designed for an optimal application in any situation
- Reinforced base, to be fastened by screw (on timber) or anchor (on concrete)

S250 Zn ELECTRO PLATED

CODE	B [mm]	P [mm]	H [mm]	s [mm]			pcs
HTKR9530	65	85	95	3	●	●	25

Number of holes:

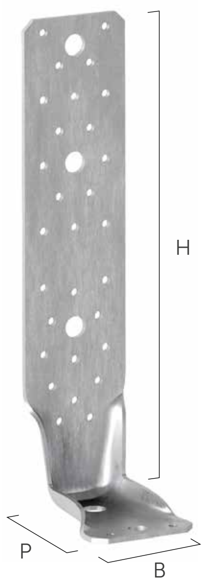
n_H Ø5	n_H Ø11	n_H Ø14	n_V Ø5	n_V Ø13,5
2	1	1	8	-

S235 Zn ELECTRO PLATED

CODE	B [mm]	P [mm]	H [mm]	s [mm]			pcs
HTKR13535	65	85	135	3,5	●	●	25

Number of holes:

n_H Ø5	n_H Ø11	n_H Ø14	n_V Ø5	n_V Ø13,5
2	1	1	13	1



S235 Zn ELECTRO PLATED

CODE	B [mm]	P [mm]	H [mm]	s [mm]			pcs
HTKR28535	65	85	287	3,5	●	●	25

Number of holes:

n_H Ø5	n_H Ø11	n_H Ø14	n_V Ø5	n_V Ø13,5
2	1	1	29	3

ADDITIONAL PRODUCTS - FASTENING

type	description		d [mm]	support
LBA-HT	Anker nail		4	
SBL	round-head screw and flat underhead		5	
VGS	full thread screw		11-13	
SHT	turned washer		11	
HUS	turned washer		13	
HBSPLATE	pan head screw		10-12	
AB1	mechanical anchor		12	
SKR-CE	screw anchor		M12	
V-NEX	chemical anchor		M12	
HYB-FIX	chemical anchor		M12	

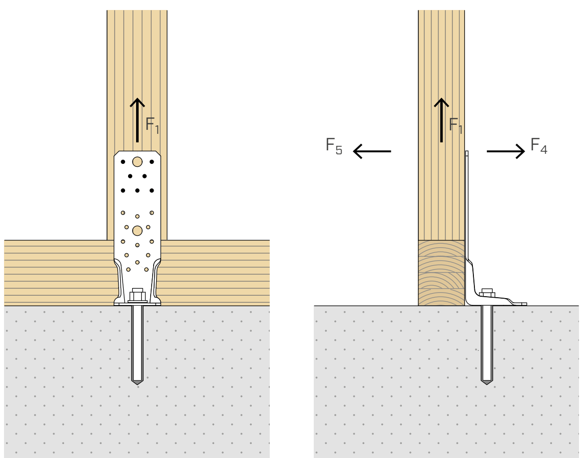
MATERIAL AND DURABILITY

WKR9530: S250 + Z275 steel.
WKR13535 | WKR21535 | WKR28535 | WKR53035:
S235 bright zinc plated carbon steel.
To be used in service classes 1 and 2 (EN 1995-1-1)

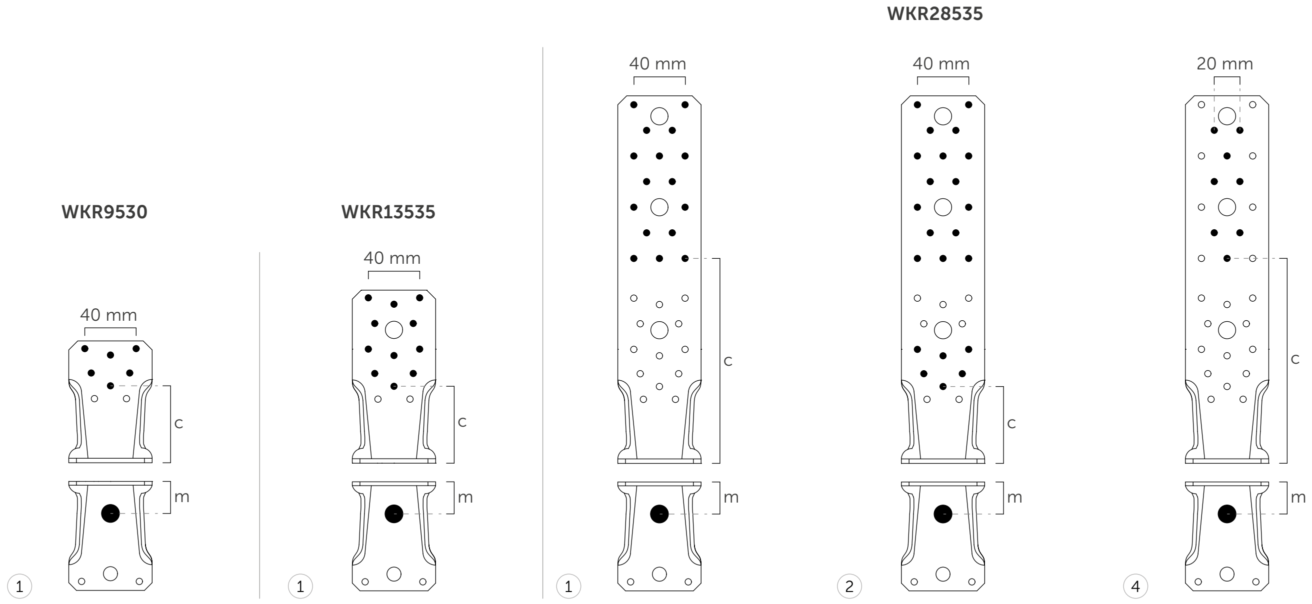
FIELD OF USE

- Timber-to-timber joints
- Timber to concrete joints
- Timber-to-steel joints

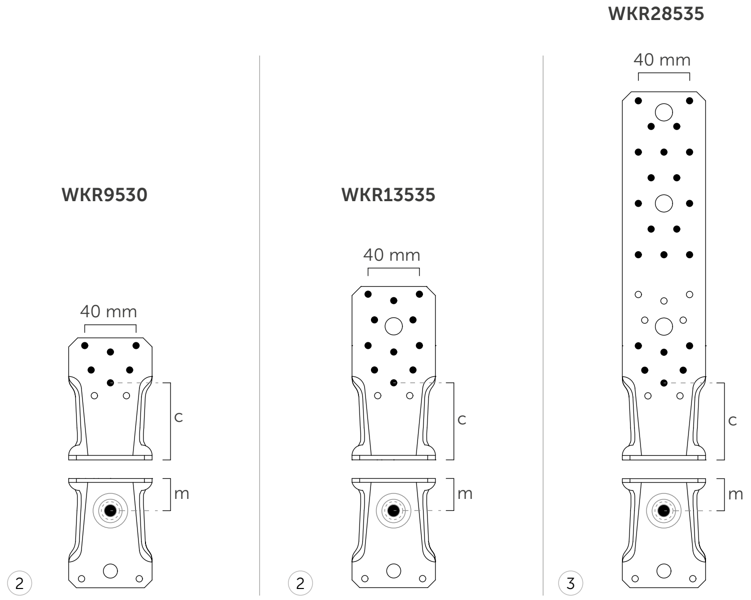
EXTERNAL LOADS



TIMBER-TO-CONCRETE FASTENING DIAGRAMS

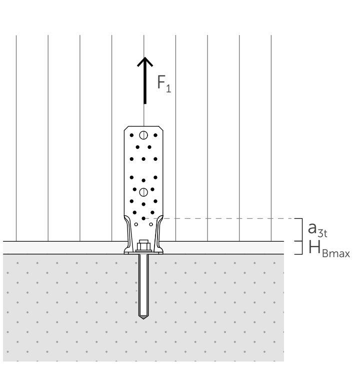


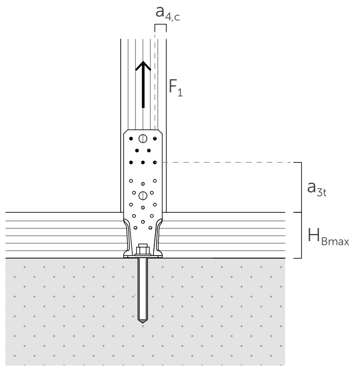
TIMBER-TO-TIMBER FASTENING DIAGRAMS



CODE	configuration	holes fastening Ø5 n_v pcs	c [mm]	m [mm]	support	
WKR9530	pattern 1	6	60	25	●	-
	pattern 2	6	60		-	●
WKR13535	pattern 1	11	60	25	●	-
	pattern 2	11	60		-	●
WKR28535	pattern 1	16	160	25	●	-
	pattern 2	22	60		●	-
	pattern 3	22	60		-	●
	pattern 4	8	160		●	-

INSTALLATION





MAXIMUM HEIGHT OF THE INTERMEDIATE H_B LAYER

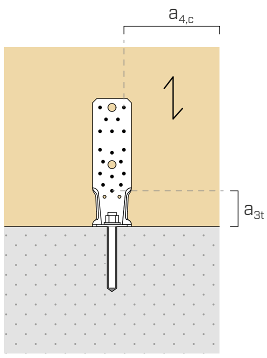
CODE	configuration	$H_{B\,max}$ [mm]			
		CLT		C/GL	
		nails	screws	nails	screws
		LBA-HT Ø4	SBL Ø5	LBA-HT Ø4	SBL Ø5
WKR9530	**pattern** 1 - 2	20	30	-	-
WKR13535	**pattern** 1 - 2	20	30	-	-
WKR28535	**pattern** 1 - 4	120	130	100	85
	pattern 2 - 3	20	30	-	-

The height of the H_B intermediate layer (levelling mortar, sill or timber platform beam) is determined by taking into account the regulatory requirements for fastenings on timber, shown in the minimum distance table.

MINIMUM DISTANCES

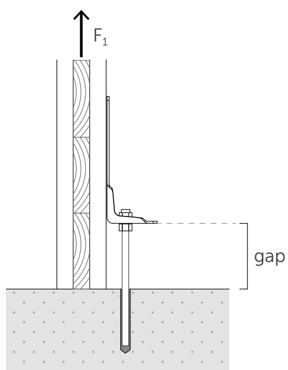
TIMBER minimum distances			nails	screws
			LBA-HT Ø4	SBL Ø5
C/GL	$a_{4,c}$	[mm]	≥ 20	≥ 25
	$a_{3,t}$	[mm]	≥ 60	≥ 75
CLT	$a_{4,c}$	[mm]	≥ 12	≥ 12,5
	$a_{3,t}$	[mm]	≥ 40	≥ 30

- C/GL: minimum distances for solid timber or glulam consistent with EN 1995-1-1 according to ETA considering a timber density $\rho_k \leq 420$ kg/m^3.
- CLT: minimum distances for Cross Laminated Timber according to ÖNORM EN 1995-1-1 (Annex K) for nails and ETA 11/0030 for screws.

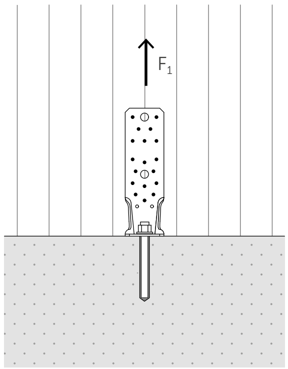


INSTALLATION WITH GAP

In the presence of F_1 tensile forces, installation of the angle bracket raised above the bearing surface is possible. This allows, for example, to install the angle bracket even in the presence of an intermediate H_B layer (bedding mortar, root beam or concrete curb) greater than $H_{B\,max}$. It is recommended to install a lock nut below the horizontal flange, to prevent that excessive tightening of the nut may stress the connection.



STRUCTURAL VALUES | TENSILE JOINT F_1 | TIMBER-TO-CONCRETE



TIMBER STRENGTH

CODE	configuration	holes fastening Ø5 type	Ø x L [mm]	n_v [pcs]	$R_{1,k\ timber}$ (1) [kN]	$K_{1,ser}$ [kN/mm]
WKR9530	pattern 1	LBA nails	Ø4,0 x 60	6	15,0	$R_{1,k\ timber}/4$
		SBL screws	Ø5,0 x 50		13,3	
WKR13535	pattern 1	LBA nails	Ø4,0 x 60	11	28,3	
		SBL screws	Ø5,0 x 50		24,6	
WKR28535	pattern 1	LBA nails	Ø4,0 x 60	16	37,3	
		SBL screws	Ø5,0 x 50		36,0	
	pattern 2	LBA nails	Ø4,0 x 60	22	57.6	
		SBL screws	Ø5,0 x 50		49,3	
	pattern 4	LBA nails	Ø4,0 x 60	8	21,3	
		SBL screws	Ø5,0 x 50		18,0	

NOTES:

(1) Installation with nails and screws of shorter length than proposed in the table is possible. In this case, the bearing capacity values $R_{1,k\ timber}$ must be multiplied by the following reductive factor k_F:

- for nails

$$k_F = \min\left\{\frac{F_{v,short,Rk}}{2,66\ kN}\ ;\ \frac{F_{ax,short,Rk}}{1,28\ kN}\right\}$$

- for screws

$$k_F = \min\left\{\frac{F_{v,short,Rk}}{2,25\ kN}\ ;\ \frac{F_{ax,short,Rk}}{2,63\ kN}\right\}$$

$F_{v,short,Rk}$ = *characteristic shear strength of the nail or screw*
$F_{ax,short,Rk}$ = *characteristic withdrawal strength of the nail or screw*

- For installation in the presence of an H_B intermediate layer (levelling mortar, sill or platform) with nails on CLT and $a_{3,t}$ < 60mm, the $R_{1,k\ timber}$ values in the table must be multiplied by a 0,93 coefficient.
- If there are design requirements such as the presence of an intermediate H_B layer (levelling mortar, sill or platform) greater than $H_{B\ max}$, the installation of the angle bracket raised above the bearing surface (gap installation) is allowed.

STRENGTH ON STEEL SIDE

CODE	configuration	$R_{1,k,bolt,head}$ (*)		
		no gap	gap	γ_{steel}
		[kN]	[kN]	
WKR9530	pattern (1)	26	8,3	γ_{M2}
WKR13535	pattern (1)	26	19	
WKR28535	pattern (1)-(4)	26	-	
	pattern (2)		19	

(*) The values in the table refer to a punching shear failure of the connector in the horizontal flange.

CONCRETE STRENGTH

CODE	configuration on concrete	holes fastening Ø14		$R_{1,d\ concrete}$					
				no gap				gap	
		type	Ø x L	pattern 1	pattern 2	pattern 3	pattern 4	pattern 1	pattern 2
			[mm]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
WKR9530 WKR13535	• uncracked	V-NEX 5.8(1)	M12 x 195	26,6	-	-	-	28,0	-
		SKR-CE	12 x 90	10,5	-	-	-	-	-
		AB1(2)	M12 x 100	17,4	-	-	-	-	-
	• cracked	V-NEX 5.8	M12 x 195	19,5	-	-	-	20,5	-
		HYB-FIX 5.8(3)	M12 x 195	26,7	-	-	-	28,0	-
		AB1	M12 x 100	10,2	-	-	-	-	-
	• seismic	HYB-FIX 8.8	M12 x 195	14,6	-	-	-	15,4	-
			M12 x 245	18,1	-	-	-	19,0	-
WKR28535	• uncracked	V-NEX 5.8	M12 x 195	19,3	25,4	-	19,3	-	28,0
		SKR-CE	12 x 90	7,6	10,1	-	7,6	-	-
		AB1	M12 x 100	12,6	16,6	-	12,6	-	-
	• cracked	V-NEX 5.8	M12 x 195	14,1	18,6	-	14,1	-	20,5
		HYB-FIX 5.8	M12 x 195	19,3	25,5	-	19,3	-	28,0
		AB1	M12 x 100	7,4	9,7	-	7,4	-	-
	• seismic	HYB-FIX 8.8	M12 x 195	10,6	14,0	-	10,6	-	15,4
			M12 x 245	13,1	17,3	-	13,1	-	19,0

NOTES:

(1) V-NEX chemical anchor according to ETA 20/0363.

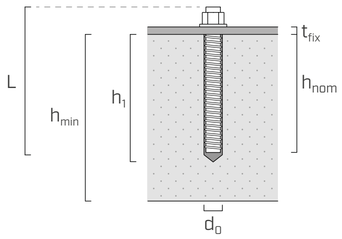
(2) Mechanical anchor AB1 according to ETA 17/0481.

(3) HYB-FIX chemical anchor according to ETA 20/1285. The gap installation must be carried out with only chemical anchors and pre-cut INA threaded rod or MGS to be cut to size.

ANCHORS INSTALLATION PARAMETERS[1]

anchor type		h_{ef}	h_{nom}	h_1	d_0	h_{min}
type	Ø x L [mm]	[mm]	[mm]	[mm]	[mm]	[mm]
V-NEX 5.8	M12 x 195	170	170	175	14	200
HYB-FIX 5.8	M12 x 195	170	170	175	14	200
HYB-FIX 8.8	M12 x 195	170	170	175		200
	M12 x 245	210	210	215		250
SKR-CE	12 x 90	64	87	110	10	200
AB1	M12 x 100	70	80	85	14	200

Pre-cut INA class 5.8 / 8.8 threaded rod, including nut and washer.
For more information, see the data sheet available at www.rothoblaas.com.
Concrete-side strength values were calculated assuming a t_{fix} thickness of 3 mm for all angle brackets.



t_{fix} fastened plate thickness
h_{nom} nominal anchoring depth
h_{ef} effective anchoring depth
h_1 minimum hole depth
d_0 hole diameter in the concrete support
h_{min} concrete minimum thickness

DIMENSIONING OF ALTERNATIVE ANCHORS

Fastening elements to the concrete through anchors not listed in the table, shall be verified according to the load acting on the anchors, which can be evaluated through the $k_{t//}$ coefficients. The axial load acting on the anchor can be obtained as follows:

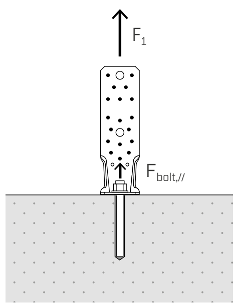
$$F_{bolt//,d} = k_{t//} \cdot F_{1,d}$$

$k_{t//}$ coefficient of eccentricity
$F_{1,d}$ axial load on the WKR angle bracket

The anchor check is satisfied if the design tensile strength, obtained considering the boundary effects, is greater than the design external load: $R_{bolt//,d} \geq F_{bolt//,d}$.

INSTALLATION WITHOUT GAP

CODE	configuration	$k_{t//}$
WKR9530	**pattern** ① - ②	1,05
WKR13535	**pattern** ① - ②	1,05
WKR28535	**pattern** ② - ③	1,10
	pattern ① - ④	1,45



INSTALLATION WITH GAP

CODE	configuration	$k_{t//}$
WKR9530	**pattern** ①	1,00
WKR13535	**pattern** ①	
WKR28535	**pattern** ②	

NOTES:
[1] Valid for the strength values shown in the table.

CALCULATION EXAMPLES: DETERMINING RESISTANCE R_{1d}

TIMBER-TO-CONCRETE | INSTALLATION WITH GAP

PROJECT DATA
Service class = 1
Load duration = instantaneous

CONNECTOR
WKR13535
Configuration = Pattern 1 with gap
Fixing on timber = LBA-HT nails 4 x 60 mm

ANCHOR CHOICE
Uncracked concrete
V-NEX anchor M12 x 195 (5.8 steel class)

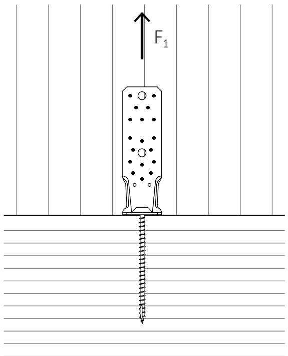
$$R_{1,d} = min \begin{cases} \dfrac{R_{1,k\ timber} \cdot k_{mod}}{\gamma_M} & = 23{,}95\ [kN] \\ \dfrac{R_{1,k,bolt,head}}{\gamma_{M2}} & = 15{,}2\ [kN] \\ R_{1,d\ concrete} & = 28{,}0\ [kN] \end{cases}$$

EN 1995:2014

k_{mod} = 1,1
γ_M = 1,3
γ_{M2} = 1,25
$R_{1,k\ timber}$ = 28,3 kN
$R_{1,k,bolt,head}$ = 19,0 kN
$R_{1,d\ concrete}$ = 28,0 kN

$R_{1,d}$ = 15,2 kN

STRUCTURAL VALUES | TENSILE JOINT F_1 |TIMBER-TO-TIMBER



TIMBER STRENGTH

CODE	configuration	holes fastening Ø5 type	Ø x L [mm]	n_v [pcs]	$R_{1,k\ timber}$ (1) [kN]	$K_{1,ser}$ [kN/mm]
WKR9530	**pattern** 2	LBA nails	Ø4,0 x 60	6	15,0	$R_{1,k\ timber}/4$
		SBL screws	Ø5,0 x 50		13,3	
WKR13535	**pattern** 2	LBA nails	Ø4,0 x 60	11	28,3	
		SBL screws	Ø5,0 x 50		24,6	
WKR28535	**pattern** 3	LBA nails	Ø4,0 x 60	22	57.6	
		SBL screws	Ø5,0 x 50		49,3	

NOTES:

(1) Installation with nails and screws of shorter length than proposed in the table is possible. In this case, the bearing capacity values $R_{1,k\ timber}$ must be multiplied by the following reductive factor k_F:

- for nails

$$k_F = min \left\{ \frac{F_{v,short,Rk}}{2{,}66\ kN} ; \frac{F_{ax,short,Rk}}{1{,}28\ kN} \right\}$$

- for screws

$$k_F = min \left\{ \frac{F_{v,short,Rk}}{2{,}25\ kN} ; \frac{F_{ax,short,Rk}}{2{,}63\ kN} \right\}$$

$F_{v,short,Rk}$ = characteristic shear strength of the nail or screw
$F_{ax,short,Rk}$ = characteristic withdrawal strength of the nail or screw

STRENGTH ON STEEL SIDE

connector	WKR	$R_{1,k\ screw,head}$ (*) [kN]	γ_{steel}
VGS Ø11 + SHT10	WKR9530 / WKR13535 / WKR285135	$R_{tens,k}$	γ_{M2}
VGS Ø13 + HUS12			
HBS PLATE Ø10	WKR9530	20,0	
	WKR13535 / WKR285135	21,0	
HBS PLATE Ø12	WKR9530	27,0	
	WKR13535 / WKR285135	29,0	

(*) The values in the table refer to a punching shear failure of the connector in the horizontal flange.

STRENGTH ON ANCHOR SYSTEM SIDE

Strength values of some of the possible fastening solutions.

CODE	configuration	$k_{t//}$	holes fastening Ø14 type(1)	holes fastening Ø14 $R_{1,k,screw,ax}$ [kN]
WKR9530	**pattern** ②	1,05	HBSP Ø10 x 180	18,9
			HBSP Ø10 x 140	13,9
			HBSP Ø12 x 200	24,2
WKR13535	**pattern** ②	1,05	HBSP Ø12 x 140	16,7
			VGS Ø11 x 200 + SHT10	26,4
			VGS Ø11 x 150 + SHT10	19,5
WKR28535	**pattern** ③	1,10	VGS Ø13 x 200 + HUS12	31,2
			VGS Ø13 x 150 + HUS12	23,0

CALCULATION EXAMPLES: DETERMINING RESISTANCE R_{1d}

TIMBER-TO-TIMBER

PROJECT DATA
Service class = 1
Load duration = instantaneous

CONNECTOR
WKR9530
Configuration = Pattern 2
Fixing on timber = LBA-HT nails 4 x 60 mm

SCREW SELECTION
HBS PLATE = 10 x 140 mm
Pre-drilling hole = no

$$R_{1,d} = \min \begin{cases} \dfrac{R_{1,k\ timber} \cdot k_{mod}}{\gamma_M} = 12,7\ [kN] \\ \dfrac{R_{1,k,screw,head}}{\gamma_{M2}} = 16,0\ [kN] \\ \dfrac{R_{1,k,screw,ax}}{k_{t//}} \cdot \dfrac{k_{mod}}{\gamma_M} = 11,2\ [kN] \end{cases}$$

EN 1995:2014

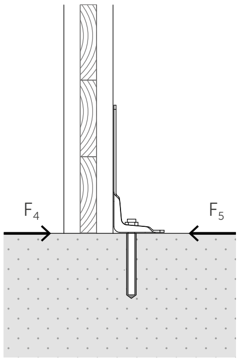
k_{mod} = 1,1
γ_M = 1,3
γ_{M2} = 1,25
$k_{t//}$ = 1,05
$R_{1,k,\ timber}$ = 15,0 kN
$R_{1,k,screw,head}$ = 20,0 kN
$R_{1,k,\ screw,ax}$ = 13,9 kN

$R_{1,d}$ = 11,2 kN

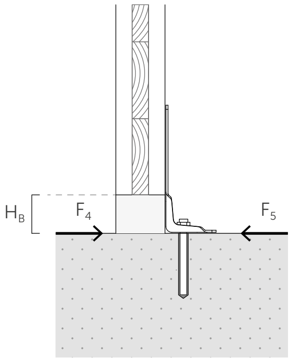
NOTES:

(1) If there are design requirements such as F_1 stresses of different amounts, or depending on the thickness of the floor slab, it is possible to use Ø11 and Ø13 VGS screws with SHT10 and HUS12 washers and Ø10 and Ø12 HBS PLATE screws of different lengths than those proposed in the table.

STRUCTURAL VALUES | SHEAR JOINT F_4-F_5 | TIMBER-TO-CONCRETE



$H_B = 0$



$0 < H_B \leq H_{Bmax}$

CODE	configuration	holes fastening Ø5 type	Ø x L [mm]	n_v [pcs]	$H_B = 0$: $R_{4,k\ timber}$(1) [kN]	$H_B = 0$: $R_{5,k\ timber}$(1) [kN]	$0 < H_B \leq H_{Bmax}$: $R_{4,k\ timber}$(1) [kN]	$0 < H_B \leq H_{Bmax}$: $R_{5,k\ timber}$(1) [kN]	l_{BL} [mm]
WKR9530	pattern 1	LBA nails	Ø4,0 x 60	6	14,7	2,6	11,3	2,6	70,0
		SBL screws	Ø5,0 x 50		14,1	3,4	10,7	3,4	
WKR13535	pattern 1	LBA nails	Ø4,0 x 60	11	18,3	2,6	14,9	2,6	70,0
		SBL screws	Ø5,0 x 50		17,2	3,6	13,8	3,6	
WKR28535	pattern 1	LBA nails	Ø4,0 x 60	16	21,7	1,0	13,0	0,9	160,0
		SBL screws	Ø5,0 x 50		20,0	1,0	11,3	0,9	
	pattern 2	LBA nails	Ø4,0 x 60	22	25,6	2,6	22,3	2,6	70,0
		SBL screws	Ø5,0 x 50		23,4	3,6	20,0	3,6	

NOTES:

(1) Installation with nails and screws of shorter length than proposed in the table is possible. In this case, the bearing capacity values $R_{4,k\ timber}$ and $R_{5,k\ timber}$ must be multiplied by the following reductive factor k_F:

- for nails

$$k_F = min \left\{ \frac{F_{v,short,Rk}}{2,66\ kN} ; \frac{F_{ax,short,Rk}}{1,28\ kN} \right\}$$

- for screws

$$k_F = min \left\{ \frac{F_{v,short,Rk}}{2,25\ kN} ; \frac{F_{ax,short,Rk}}{2,63\ kN} \right\}$$

$F_{v,short,Rk}$ = characteristic shear strength of the nail or screw
$F_{ax,short,Rk}$ = characteristic withdrawal strength of the nail or screw

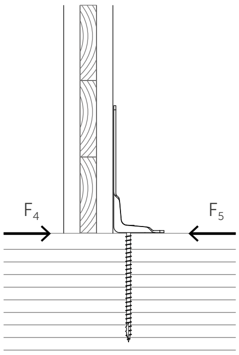
- In the case of $F_{5,Ed}$ stress, it is required to verify for the simultaneous shear action on the $F_{v,Ed}$ anchor and the additional extraction component $F_{ax,Ed}$:

$$F_{ax,Ed} = \frac{F_{5,Ed} \cdot l_{BL}}{25\ mm}$$

l_{BL} = distance between the last row of at least two connectors and the bearing surface

- The $R_{4,k\ timber}$ resistance is limited by the lateral $R_{v,k}$ resistance of the base connector.
- Refer to ETA-22/0089 for $K_{4,ser}$ stiffness values in timber-to-concrete configuration.

STRUCTURAL VALUES | SHEAR JOINT F_4-F_5 | TIMBER-TO-TIMBER



CODE	configuration	holes fastening Ø5					
		type	Ø x L	n_v	$R_{4,k\ timber}$ (1)	$R_{5,k\ timber}$ (1)	l_{BL}
			[mm]	[pcs]	[kN]	[kN]	[mm]
WKR9530	pattern (2)	LBA nails	Ø4,0 x 60	6	14,7	2,6	70,0
		SBL screws	Ø5,0 x 50		14,1	3,4	
WKR13535	pattern (2)	LBA nails	Ø4,0 x 60	11	18,3	2,6	
		SBL screws	Ø5,0 x 50		17,2	3,6	

NOTES:

(1) Installation with nails and screws of shorter length than proposed in the table is possible. In this case, the bearing capacity values $R_{4,k\ timber}$ and $R_{5,k\ timber}$ must be multiplied by the following reductive factor k_F:

- for nails

$$k_F = min \left\{ \frac{F_{v,short,Rk}}{2{,}66\ kN} ; \frac{F_{ax,short,Rk}}{1{,}28\ kN} \right\}$$

- for screws

$$k_F = min \left\{ \frac{F_{v,short,Rk}}{2{,}25\ kN} ; \frac{F_{ax,short,Rk}}{2{,}63\ kN} \right\}$$

$F_{v,short,Rk}$ = characteristic shear strength of the nail or screw
$F_{ax,short,Rk}$ = characteristic withdrawal strength of the nail or screw

- In the case of $F_{5,Ed}$ stress, it is required to verify for the simultaneous shear action on the $F_{v,Ed}$ anchor and the additional extraction component $F_{ax,Ed}$:

$$F_{ax,Ed} = \frac{F_{5,Ed} \cdot l_{BL}}{25\ mm}$$

l_{BL} = distance between the last row of at least two connectors and the bearing surface

- The $R_{4,k\ timber}$ resistance is limited by the lateral $R_{v,k}$ resistance of the base connector.
- Refer to ETA-22/0089 for $K_{4,ser}$ stiffness values in timber-to-timber configuration.

GENERAL PRINCIPLES:

- Characteristic values are consistent with EN 1995-1-1 and in accordance with ETA-22/0089. The design values of the anchors for concrete are calculated in accordance with the respective European Technical Assessments. The connection design strength values are obtained from the values on the table as follows:

  - timber-to-concrete installation

$$R_d = min \begin{cases} \dfrac{R_{k,\,timber} \cdot k_{mod}}{\gamma_M} \\ \dfrac{R_{k\ bolt,\ head}}{\gamma_{M2}} \\ R_{d,\ concrete} \end{cases}$$

  - timber-to- timber installation

$$R_d = min \begin{cases} \dfrac{R_{k,\,timber} \cdot k_{mod}}{\gamma_M} \\ \dfrac{R_{k,screw,ax}}{k_{t//}} \cdot \dfrac{k_{mod}}{\gamma_M} \\ \dfrac{R_{k,screw,head}}{\gamma_{M2}} \end{cases}$$

- Dimensioning and verification of timber and concrete elements must be carried out separately. Verify that there are no brittle fractures before reaching the connection strength.
- Structural elements in timber, to which the connection devices are fastened, must be prevented from rotating.
- For the calculation process a timber characteristic density ρ_k = 350 kg/m^3 has been considered. For higher ρ_k values, the strength on timber side can be converted by the k_{dens} value:

$$k_{dens} = \left(\frac{\rho_k}{350}\right)^{0,5} \quad for\ 350\ kg/m^3 \ \leq \rho_k \leq \ 420\ kg/m^3$$

$$k_{dens} = \left(\frac{\rho_k}{350}\right)^{0,5} \quad for\ LVL\ with\ \ \rho_k \leq \ 500\ kg/m^3$$

- In the calculation phase, a strength class of C25/30 concrete with thin reinforcement was considered, in the absence of spacing and distances from the edge and minimum thickness indicated in the tables listing the installation parameters of the anchors used.
- The anchors seismic design was carried out in performance category C2, without ductility requirements on anchors (option a2) elastic design according to EN 1992-4, with α_{sus}= 0,6. For chemical anchors it is assumed that the annular space between the anchor and the plate hole is filled (α_{gap}=1).