WHT

ANGLE BRACKET FOR TENSILE LOADS

DESIGN REGISTERED

CE ETA-23/0813

NEW VERSION
The classic Rothoblaas hold-down in an optimised version. Reducing the number of fasteners and modifying steel thickness has led to more efficient fastening without sacrificing performance.

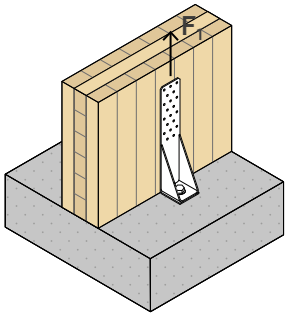
COMPLETE RANGE
Available in 5 sizes to meet all static or seismic performance requirements, for CLT, LVL or timber frame walls.

FREEDOM OF FASTENING
They can be fastened with LBA nails, LBS screws or LBS HARDWOOD in different lengths. Capacity design is made possible by the wide choice of fastenings and partial nailing.

TIMBER FRAME
The new NARROW PATTERN nailing allow installation on frame walls with reduced studs widths (60 mm).

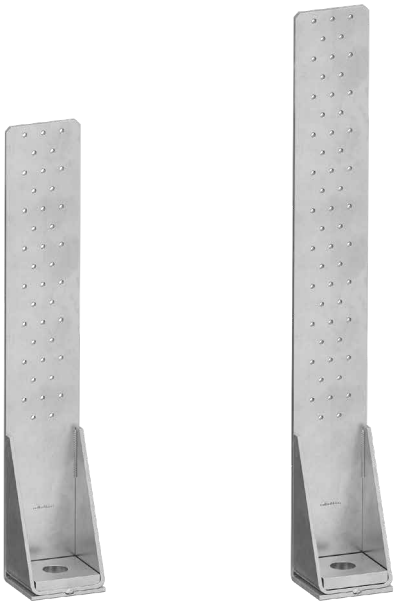
SERVICE CLASS	SC1 SC2
MATERIAL	
S355 Fe/Zn12c	**WHT**: S355 + Fe/Zn12c carbon steel
S275 Fe/Zn12c	**WHT WASHER**: S275 + Fe/Zn12c carbon steel

EXTERNAL LOADS



USA, Canada and more design values available online.

IMPROVED NEW! PERFORMANCES



FIELDS OF USE

Tensile joints for timber walls.
Suitable for walls subject to high stress.
Timber-to-timber, timber-to-concrete and timber-to-steel configurations.

Can be applied to:
- solid timber and glulam
- timber frame
- CLT and LVL panels

HYBRID STRUCTURES

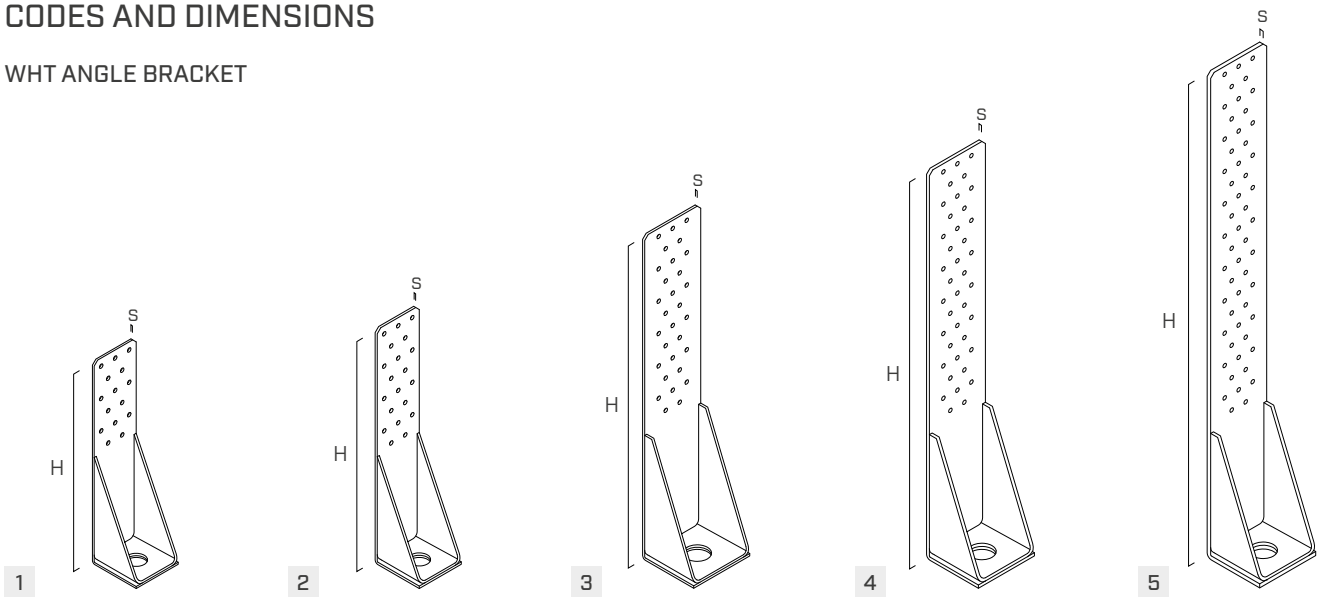
Ideal for tensile connections between timber floors and bracing core in hybrid timber-to-concrete buildings.

RAISED INSTALLATION

The certification with a gap between angle bracket and support allows special requirements such as reinforced concrete kerbs to be supported.

CODES AND DIMENSIONS

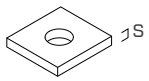
WHT ANGLE BRACKET



	CODE	H [mm]	s [mm]	n_V Ø5 [pcs]	hole [mm]	*H [in]*	*s [in]*	*n_V Ø.20 [pcs]*	*hole [in]*	pcs
1	**WHT15**	250	2,5	15	Ø23	*10*	*0.10*	*15*	*Ø0.91*	20
2	**WHT20**	290	3	20	Ø23	*11 7/16*	*0.12*	*20*	*Ø0.91*	20
3	**WHT30**	400	3	30	Ø29	*15 3/4*	*0.12*	*30*	*Ø1.14*	10
4	**WHT40**	480	4	40	Ø29	*19*	*0.16*	*40*	*Ø1.14*	10
5	**WHT55**	600	5	55	Ø29	*23 5/8*	*0.20*	*55*	*Ø1.14*	1

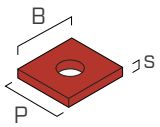
WHTW WASHER

	CODE	hole [mm]	Ø [mm]	s [mm]	*hole [in]*	*s [in]*	WHT15	WHT20	WHT30	WHT40	WHT55	pcs
1	**WHTW6016**	Ø18	M16	6	*Ø0.71*	*0.24*	●	●	-	-	-	1
2	**WHTW6020**	Ø22	M20	6	*Ø0.87*	*0.24*	●	●	-	-	-	1
3	**WHTW8020**	Ø22	M20	10	*Ø0.87*	*0.39*	-	-	●	●	-	1
4	**WHTW8024**	Ø26	M24	10	*Ø1.02*	*0.39*	-	-	●	●	-	1
5	**WHTW8024L**	Ø26	M24	12	*Ø1.02*	*0.47*	-	-	-	-	●	1



ACOUSTIC PROFILE | XYLOFON WASHER

CODE		hole [mm]	P [mm]	B [mm]	s [mm]	*hole [in]*	*P [in]*	*B [in]*	*s [in]*	pcs
XYLW806060	WHT15 WHT20	Ø23	60	60	6	*Ø0.91*	*2 3/8*	*2 3/8*	*0.24*	10
XYLW808080	WHT30 WHT40 WHT55	Ø27	80	80	6	*Ø1.06*	*3 1/8*	*3 1/8*	*0.24*	10

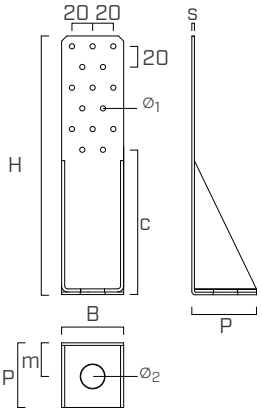


FASTENERS

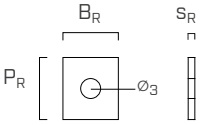
type	description		d [mm]	support	page
LBA	high bond nail		4		570
LBS	round head screw		5		571
LBS HARDWOOD	round head screw on hardwoods		5		572
VIN-FIX	vinyl ester chemical anchor		M16-M20-M24		545
HYB-FIX	hybrid chemical anchor		M16-M20-M24		552
EPO-FIX	epoxy chemical anchor		M16-M20-M24		557
KOS	hexagonal head bolt		M16-M20-M24		168

GEOMETRY

WHT			WHT15	WHT20	WHT30	WHT40	WHT55
Height	**H**	[mm]	250	290	400	480	600
Base	**B**	[mm]	60	60	80	80	80
Depth	**P**	[mm]	62,5	63	73	74	75
Vertical flange thickness	**s**	[mm]	2,5	3	3	4	5
Hole position in timber	**c**	[mm]	140	140	170	170	170
Hole position in concrete	**m**	[mm]	32,5	33	38	39	40
Flange holes	**Ø$_1$**	[mm]	5	5	5	5	5
Base hole	**Ø$_2$**	[mm]	23	23	29	29	29



WHTW WASHER			WHTW6016	WHTW6020	WHTW8020	WHTW8024	WHTW8024L
Base	**B$_R$**	[mm]	50	50	70	70	70
Depth	**P$_R$**	[mm]	56	56	66	66	66
Thickness	**s$_R$**	[mm]	6	6	10	10	12
Washer hole	**Ø$_3$**	[mm]	18	22	22	26	26

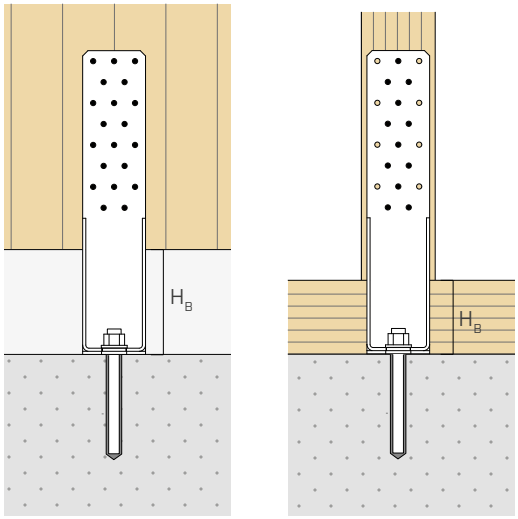


INSTALLATION

MAXIMUM HEIGHT OF THE INTERMEDIATE H$_B$ LAYER

CODE	H$_{B\,max}$ [mm]			
	CLT		C/GL	
	nails	screws	nails	screws
	LBA Ø4	LBS Ø5	LBA Ø4	LBS Ø5
WHT15	100	110	80	65
WHT20	100	110	80	65
WHT30	130	140	110	95
WHT40	130	140	110	95
WHT55	130	140	110	95

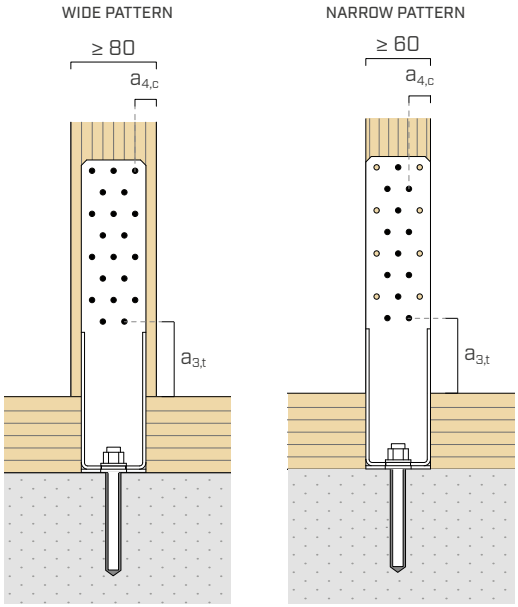
The height of the H$_B$ intermediate layer (levelling grout, sill or timber platform beam) is determined by taking into account the regulatory requirements for fastenings on timber, shown in the minimum distance table.



MINIMUM DISTANCES

TIMBER minimum distances			nails LBA Ø4	screws LBS 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 1995:2014 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 1995:2014 (Annex K) for nails and ETA-11/0030 for screws

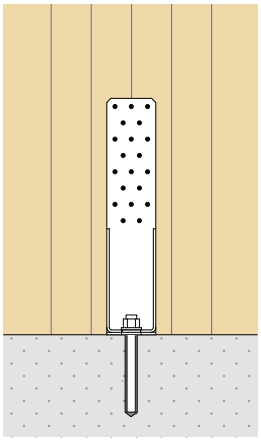


INSTALLATION

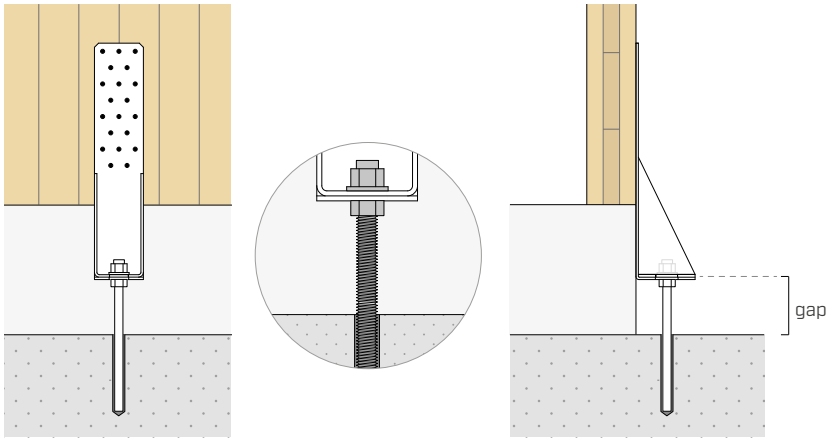
INSTALLATION WITH GAP

Installation of the angle bracket raised above the bearing surface is possible. This makes it possible, for example, to install the angle bracket even with an intermediate layer H_B (bedding grout, base plate or concrete kerb) greater than $H_{B\ max}$ or to manage site tolerances such as the anchor hole being located away from the wall or studs.
In case of installation with gap, it is recommended to install a lock nut below the horizontal flange, to prevent that excessive tightening of the nut may stress the connection.

without GAP

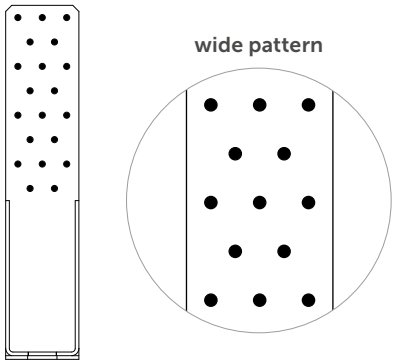


with GAP

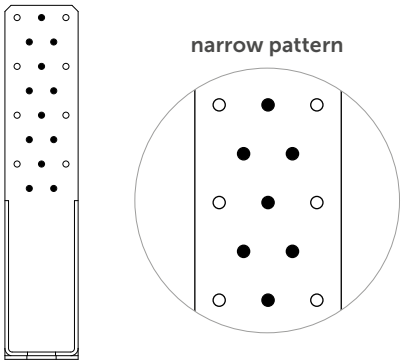


FASTENING PATTERNS

It is possible to install the angle bracket in two specific patterns:
- **wide pattern**: installation of connectors on all columns of the vertical flange;
- **narrow pattern**: installation with narrow nailing, leaving the outermost columns free.



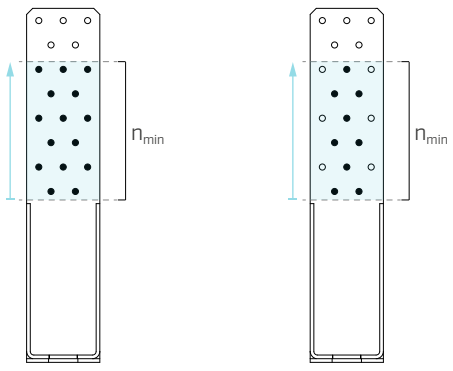
WHT20: total fastening in wide pattern configuration



WHT20: total fastening in narrow pattern configuration

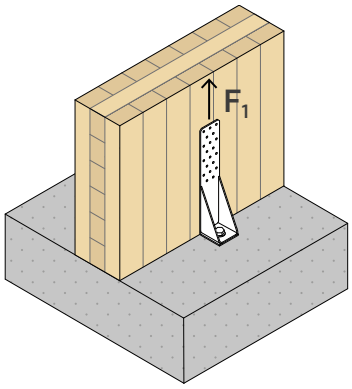
Full or partial fastening patterns can both be adopted. In the case of installation with partial fastening, the number of connectors can be varied, guaranteeing the minimum quantity $\mathbf{n_{min}}$ shown in the table below. The connectors must be installed starting from the bottom holes.

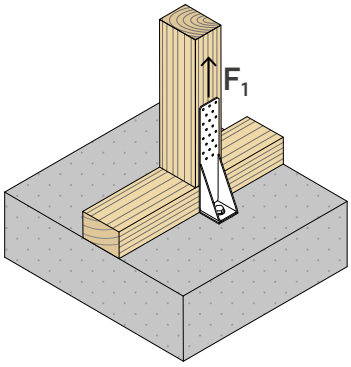
CODE	n_{min} [pcs.]	
	wide pattern	narrow pattern
WHT15	10	6
WHT20	15	9
WHT30	20	12
WHT40	25	15
WHT55	30	18

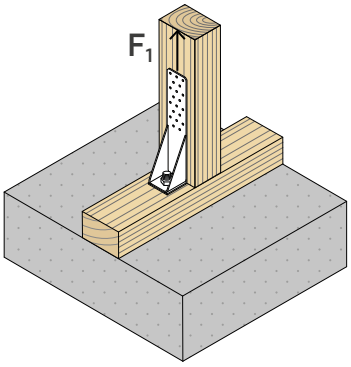


WHT20: partial fastening in wide pattern and narrow pattern respectively, with installation of the minimum number of connectors n_{min}.

STRUCTURAL VALUES | TIMBER-TO-CONCRETE | F_1







STRENGTH ON TIMBER SIDE | WIDE PATTERN | total fastening

	TIMBER				STEEL				
	fastening holes Ø5				no washer	washer		no washer	washer
CODE	type	Ø x L [mm]	n_V [pcs]	$R_{1,k\ timber}$ [kN]	$R_{1,k\ steel}$ [kN]	$R_{1,k\ steel}$ [kN]	γ_{steel}	$K_{1,ser}$ [N/mm]	$K_{1,ser}$ [N/mm]
WHT15	LBA	Ø4 x 60	15	36,8	**30,0**	**40,0**	γ_{M0}	5000	5880
	LBS	Ø5 x 70		35,6					
	LBSH	Ø5 x 50		35,3					
WHT20	LBA	Ø4 x 60	20	48,1	**40,0**	**50,0**	γ_{M0}	6667	7980
	LBS	Ø5 x 70		48,3					
	LBSH	Ø5 x 50		47,9					
WHT30	LBA	Ø4 x 60	30	76,4	-	**70,0**	γ_{M0}	-	11667
	LBS	Ø5 x 70		73,7					
	LBSH	Ø5 x 50		73,1					
WHT40	LBA	Ø4 x 60	40	101,9	-	**90,0**	γ_{M0}	-	15000
	LBS	Ø5 x 70		96,5					
	LBSH	Ø5 x 50		95,8					
WHT55	LBA	Ø4 x 60	55	141,5	-	**120,0**	γ_{M0}	-	20000
	LBS	Ø5 x 70		132,1					
	LBSH	Ø5 x 50		131,0					

STRENGTH ON TIMBER SIDE | NARROW PATTERN | total fastening

	TIMBER				STEEL			
	fastening holes Ø5				no washer	washer		
CODE	type	Ø x L [mm]	n_V [pcs]	$R_{1,k\ timber}$ [kN]	$R_{1,k\ steel}$ [kN]	$R_{1,k\ steel}$ [kN]	γ_{steel}	$K_{1,ser}$ [N/mm]
WHT15	LBA	Ø4 x 60	9	22,6	**30,0**	-	γ_{M0}	3360
	LBS	Ø5 x 70		20,3				
	LBSH	Ø5 x 50		20,2				
WHT20	LBA	Ø4 x 60	12	28,3	**40,0**	-	γ_{M0}	4620
	LBS	Ø5 x 70		27,9				
	LBSH	Ø5 x 50		27,7				
WHT30	LBA	Ø4 x 60	18	45,3	-	**70,0**	γ_{M0}	7140
	LBS	Ø5 x 70		43.2				
	LBSH	Ø5 x 50		42,8				
WHT40	LBA	Ø4 x 60	24	59,4	-	**90,0**	γ_{M0}	9240
	LBS	Ø5 x 70		55,9				
	LBSH	Ø5 x 50		55,4				
WHT55	LBA	Ø4 x 60	33	84,9	-	**120,0**	γ_{M0}	13020
	LBS	Ø5 x 70		78,7				
	LBSH	Ø5 x 50		78,1				

STRUCTURAL VALUES | TIMBER-TO-CONCRETE | F_1

STRENGTH ON TIMBER SIDE | PARTIAL FASTENING

For partial fastening patterns, the values of $R_{1,k\ timber}$ are obtained by multiplying the characteristic strength of the individual connector $R_{v,k}$ by the relative $\mathbf{n_{eq}}$ shown in the table below, where n represents the total number of nails expected to be installed.

CODE	wide pattern n_{eq}		narrow pattern n_{eq}	
	LBA	LBS / LBSH	LBA	LBS / LBSH
WHT15	n-2	n-1	n-1	n-1
WHT20	n-3	n-1	n-2	n-1
WHT30	n-3	n-1	n-2	n-1
WHT40	n-4	n-2	n-3	n-2
WHT55	n-5	n-3	n-3	n-2

For of R_{vk} values of the connectors, refer to the catalogue "TIMBER SCREWS AND DECK FASTENING" at www.rothoblaas.com.

USE OF ALTERNATIVE FASTENINGS

It is possible to use nails or screws of a shorter length than those proposed.
In this case, the bearing capacity values $R_{1,k\ timber}$ must be multiplied by a reductive factor k_F:

connector length	k_F		
[mm]	LBA Ø4	LBS Ø5	LBSH Ø5
40	0,74	0,79	0,83
50	0,91	0,89	**1,00**
60	**1,00**	0,94	1,08
70	-	**1,00**	1,14
75	1,13	-	-
100	1,30	-	-

CONCRETE STRENGTH

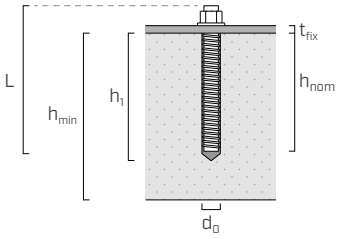
Strength values of some of the possible fastening solutions. For additional solutions, different from those indicated in the table, it is possible to use the My Project software available at www.rothoblaas.com.

CODE	configuration on concrete	fastening holes Ø14		$R_{1,d\ concrete}$	
		type	Ø x L [mm]	no gap [kN]	gap [kN]
WHT15 WHT20 no washer	**uncracked**	VIN-FIX 5.8	M16 x 195	**34,0**	**37,1**
			M16 x 245	**44,7**	**48,8**
			M20 x 245	**55,9**	**61,0**
	cracked	HYB-FIX 5.8	M16 x 195	**45,1**	**49,2**
		HYB-FIX 8.8	M16 x 245	**59,3**	**64,6**
	seismic	EPO-FIX 8.8	M20 x 245	**40,3**	**44,0**
			M20 x 330	**56,7**	**61,8**
WHT15 WHT20	**uncracked**	VIN-FIX 5.8	M16 x 245	**42,6**	**46,5**
			M20 x 245	**53,2**	**58,0**
	cracked	HYB-FIX 8.8	M16 x 195	**43,7**	**47,6**
			M16 x 245	**47,6**	**51,9**
	seismic	EPO-FIX 8.8	M20 x 245	**38,3**	**41,8**
			M20 x 330	**55,7**	**60,7**
WHT30 WHT40	**uncracked**	VIN-FIX 5.8	M20 x 245	**53,2**	**58,0**
		VIN-FIX 5.8	M20 x 330	**73,3**	**79,9**
		HYB-FIX 8.8	M20 x 245	**91,5**	**99,7**
	cracked	HYB-FIX 5.8	M20 x 245	**64,0**	**69,8**
		VIN-FIX 5.8	M24 x 330	**89,6**	**97,7**
		EPO-FIX 5.8	M24 x 330	**107,3**	**117,0**
	seismic	EPO-FIX 8.8	M24 x 330	**64,6**	**70,4**
			M24 x 495	**103,4**	**112,7**
WHT55	**uncracked**	HYB-FIX 8.8	M24 x 330	**153,2**	**167,0**
	cracked	EPO-FIX 5.8	M24 x 330	**107,3**	**117,0**
		HYB-FIX 8.8	M24 x 495	**143,4**	**156,3**
	seismic	EPO-FIX 8.8	M24 x 330	**64,6**	**70,4**
			M24 x 495	**103,3**	**112,6**

ANCHORS INSTALLATION PARAMETERS

type of rod Ø x L [mm]		WHT type	type of washer	t_{fix} [mm]	$h_{nom}=h_{ef}$ [mm]	h_1 [mm]	d_0 [mm]	h_{min} [mm]
M16	195	WHT15 / WHT20	WHTW6016	11	160	165	18	200
	245	WHT15 / WHT20	WHTW6016	11	200	205	18	250
M20	245	WHT15 / WHT20	WHTW6020	11	200	205	22	250
	330			11	290	295	22	350
	245	WHT30	WHTW8020	16	200	205	22	250
	330			16	280	285	22	350
	245	WHT40	WHTW8020	16	195	200	22	250
	330			16	275	280	22	350
M24	330	WHT30	WHTW8024	16	280	285	26	350
	330	WHT40 / WHT55	WHTW8024	18	275	280	26	350
	330	WHT55	WHTW8024	21	275	280	26	350
	495	WHT55	WHTW8024L	21	440	445	26	350

Precut INA threaded rod, with nut and washer: see page 562.
MGS threaded rod class 8.8 to be cut to size: see page 174.



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

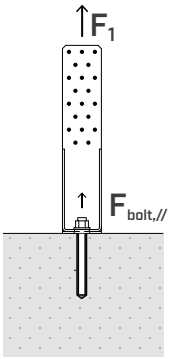
ANCHORS VERIFICATION FOR STRESS LOADING F_1

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 WHT 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 WITH GAP	INSTALLATION WITHOUT GAP
CODE	**$k_{t//}$**	**$k_{t//}$**
WHT15	1,00	1,09
WHT20	1,00	1,09
WHT30	1,00	1,09
WHT40	1,00	1,09
WHT55	1,00	1,09

GENERAL PRINCIPLES

- Characteristic values comply with the EN 1995:2014 standard in accordance with ETA-23/0813.
- Design values can be obtained from values in the table as follows:

TOTAL FASTENING

$$R_d = min \left\{ \frac{k_F \cdot R_{k,\,timber} \cdot k_{mod}}{\gamma_M} ; \frac{R_{k,\,steel}}{\gamma_{M0}} ; \frac{R_{d,\,concrete}}{k_{t//}} \right\}$$

PARTIAL FASTENING

$$R_d = min \left\{ \frac{n_{eq} \cdot R_{v,k} \cdot k_{mod}}{\gamma_M} ; \frac{R_{k,\,steel}}{\gamma_{M0}} ; \frac{R_{d,\,concrete}}{k_{t//}} \right\}$$

The coefficients k_{mod}, γ_M and γ_{M0} should be taken according to the current regulations used for the calculation.

- The value of $K_{1,ser}$ for fastenings other than those proposed can be calculated as follows:

$$K_{1,ser} = min \left\{ \frac{n_{eq} \cdot R_{v,k}}{6} ; \frac{R_{k,\,steel}}{6} \right\}$$

- The calculation process used a timber characteristic density of ρ_k = 350 kg/m^3 and a C25/30 concrete strength class with a thin reinforcing layer, where there is no spacing and edge-distance and minimum thickness indicated in the installation parameters tables of the anchors used. The strength values are valid for the calculation hypothesis defined in the table; for boundary conditions different from the ones in the table (e.g. minimum distances from the edge or different concrete thickness), the concrete-side anchors can be verified using MyProject calculation software according to the design requirements.
- Concrete design strength values are supplied for uncracked ($R_{1,d\ uncracked}$), cracked ($R_{1,d\ cracked}$) concrete and in case of seismic verification ($R_{1,d\ seismic}$) for use of chemical anchor with threaded rod in steel class 5.8 and 8.8.
- Seismic design in performance category C2, without ductility requirements on anchors (option a2) and elastic design according to EN 1992:2018.
- Dimensioning and verification of timber and concrete elements must be carried out separately.
- For applications on CLT (Cross Laminated Timber) it is recommended to use nails/screws of adequate length to ensure that the fixing depth involves a sufficient timber thickness to prevent fragile failure for group effects.

INTELLECTUAL PROPERTY

- WHT hold-downs are protected by the following Registered Community Designs: RCD 015032190-0019 | RCD 015032190-0020 | RCD 015032190-0021 | RCD 015032190-0022 | RCD 015032190-0023.