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).

CANADIAN DESIGN VALUES
USA, EU and more design values available online.

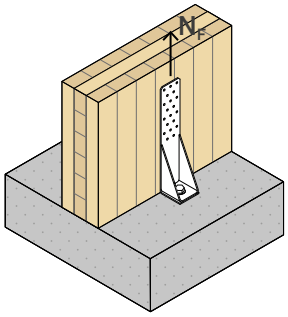
SERVICE CONDITIONS	
	DRY

MATERIAL

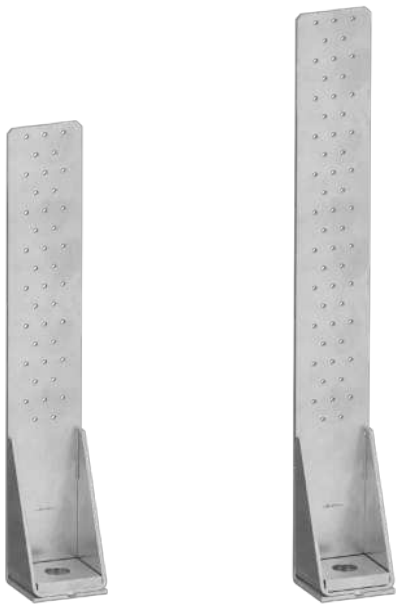
S355 Fe/Zn12c — **WHT**: S355 + Fe/Zn12c carbon steel

S275 Fe/Zn12c — **WHT WASHER**: S275 + Fe/Zn12c carbon steel

EXTERNAL LOADS



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

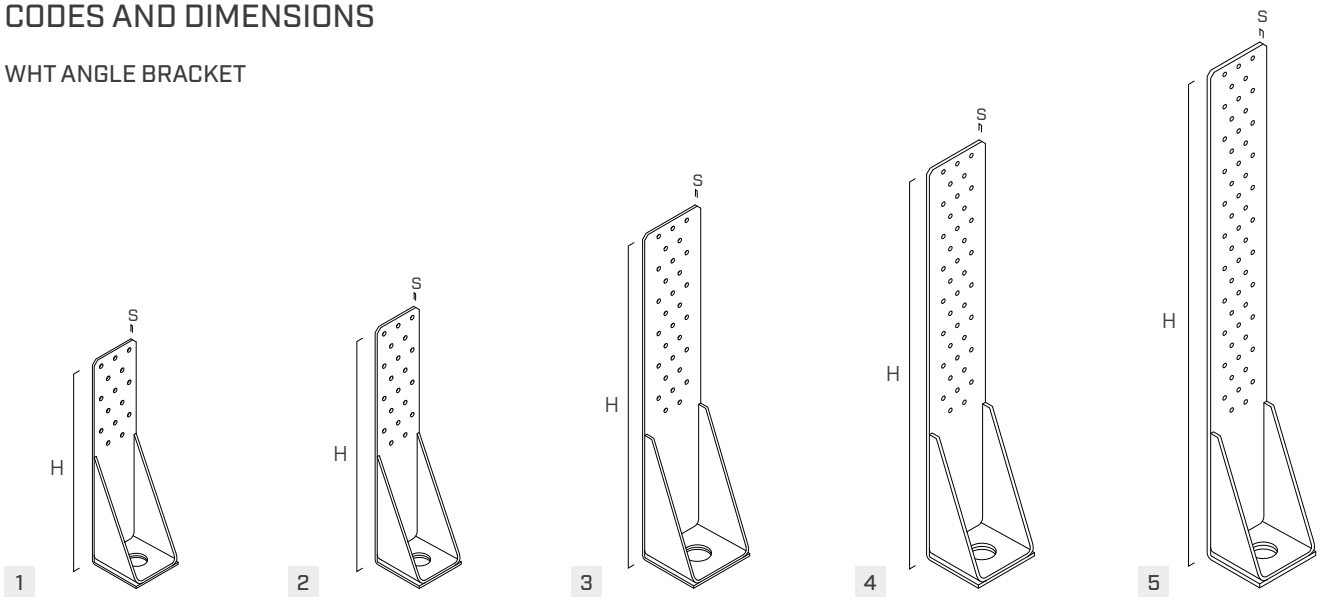
Ideal for tensile connections between timber floors and bracing core in hybrid timber-to-concrete buildings.

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

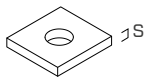
WHT ANGLE BRACKET



	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

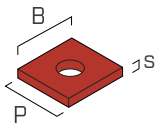
WHTW WASHER

	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

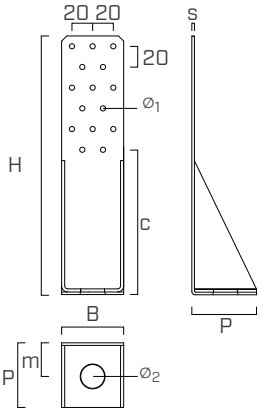


FASTENERS

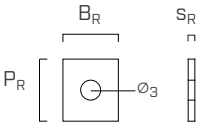
type	description		d [mm]	support
LBA	high bond nail		4	
LBS	round head screw		5	
LBS HARDWOOD	round head screw on hardwoods		5	
VIN-FIX	vinyl ester chemical anchor		M16-M20-M24	
HYB-FIX	hybrid chemical anchor		M16-M20-M24	
EPO-FIX	epoxy chemical anchor		M16-M20-M24	
KOS	hexagonal head bolt		M16-M20-M24	

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

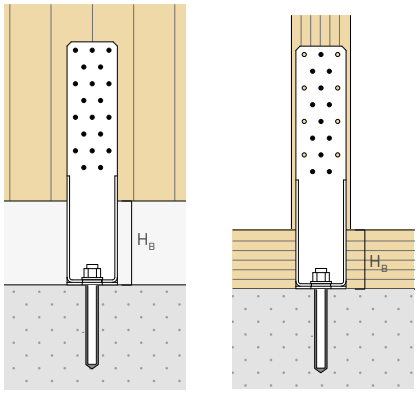


INSTALLATION

MAXIMUM HEIGHT OF THE INTERMEDIATE H$_B$ LAYER

CODE	H$_{B\,max}$ [mm]				
	nails LBA Ø4		screws LBS Ø5		
	spruce-pine-fir and northern species	douglas fir-larch, hem-fir, and western red cedar	not pre-drilled G ≤ 0.44	not pre-drilled 0.44 < G ≤ 0.5	pre-drilled any G
WHT15	92	80	65	30	80
WHT20	92	80	65	30	80
WHT30	122	110	95	60	110
WHT40	122	110	95	60	110
WHT55	122	110	95	60	110

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.



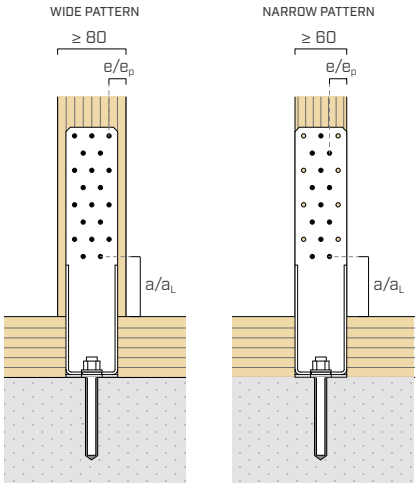
MINIMUM DISTANCES | LBA

TIMBER minimum distances			nails LBA Ø4	
			spruce-pine-fir and northern species	douglas fir-larch, hem-fir and western red cedar
timber	**e**	[mm]	≥ 16	≥ 20
	a	[mm]	≥ 48	≥ 60

TIMBER minimum distances			screws LBS Ø5		
			not pre-drilled G ≤ 0.44	not pre-drilled 0.44< G ≤ 0.5	pre-drilled any G
timber	**e$_p$**	[mm]	≥ 25	≥ 35	≥ 15
	a$_L$	[mm]	≥ 75‡	≥ 110	≥ 60†

G = mean relative density
† For Douglas Fir-Larch and Western Red Cedar, this minimum spacing shall be increased by 50%.
‡ For Western Red Cedar, this minimum spacing shall be increased by 50%.

Timber: minimum distances for Cross laminated timber according to section 12.9 placemen t of nails and spikes for LBA nails and section 12.12 placement of self tapping screws for LBS screws in CSA O86 2024.



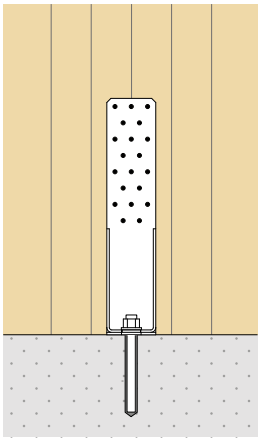
e edge distance perpendicular to grain
e$_p$ unloaded edge distance
a end distance parallel to grain
a$_L$ loaded end distance

INSTALLATION

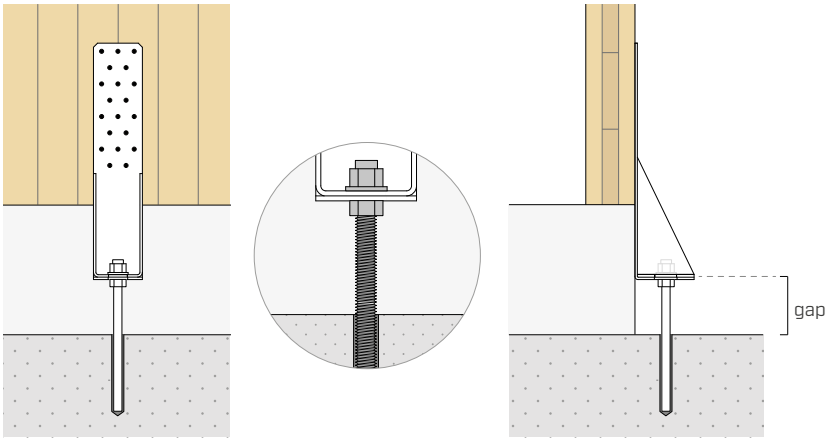
INSTALLATION WITH GAP

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



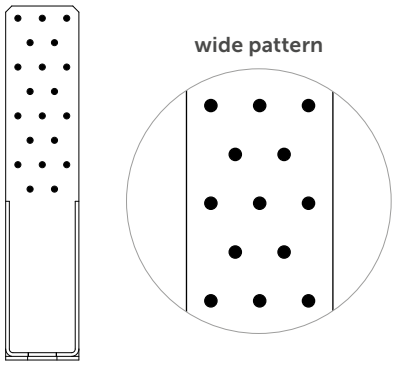
with gap[1]



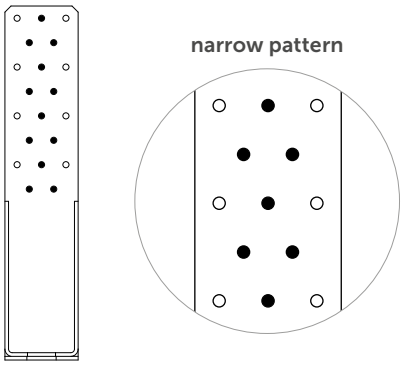
[1] The gap height does not affect the resistance N_r of the angle bracket.

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.



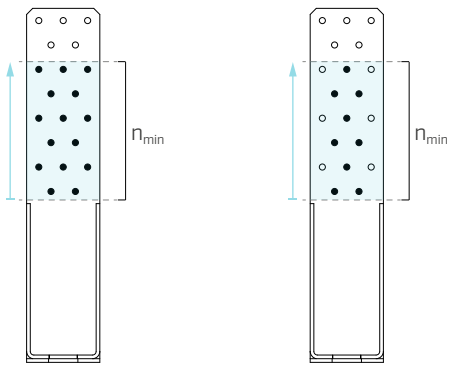
WHT20: total fastening in wide pattern configuration



WHT20: total fastening in narrow pattern configuration

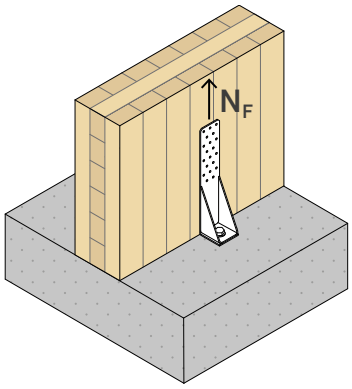
Full or partial fastening patterns can both be adopted. In the case of installation with partial fastening, the number of connectors can be varied, guaranteeing the minimum quantity $\mathbf{n_{min}}$ shown in the table below. The connectors must be installed starting from the bottom holes.

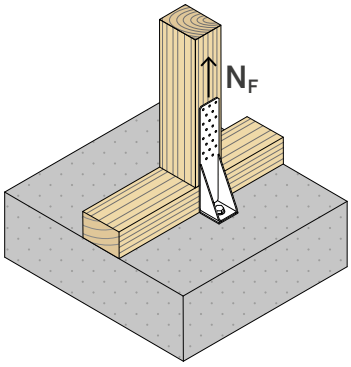
CODE	n_{min} [pcs.]	
	wide pattern	narrow pattern
WHT15	10	6
WHT20	15	9
WHT30	20	12
WHT40	25	15
WHT55	30	18

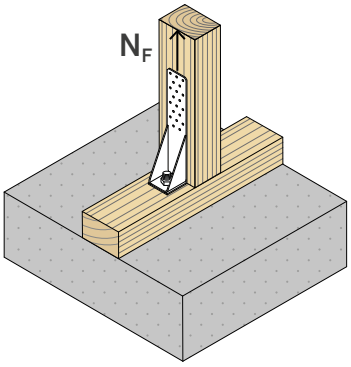


WHT20: partial fastening in wide pattern and narrow pattern respectively, with installation of the minimum number of connectors n_{min}.

STRUCTURAL VALUES | TIMBER-TO-CONCRETE | F_1 to N_F







STRENGTH ON TIMBER SIDE | WIDE PATTERN | total fastening

CODE	fastening holes Ø5 type	Ø x L	n_V	TIMBER N_r (1)(2) Factored lateral resistance (K_D=1.15) G = 0.35	G = 0.42	G = 0.49	G = 0.55	STEEL no washer R_{steel}	washer R_{steel}	no washer K_{ser} (3)	washer K_{ser} (3)
		[mm]	[pcs]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[N/mm]	[N/mm]
WHT15	LBA	Ø4 x 60	15	17,7	19,4	20,9	22,1	30	40	5000	5880
	LBS	Ø5 x 70		22,0	24,7	27,2	29,3				
	LBSH	Ø5 x 50		20,8	23,8	26,8	29,1				
WHT20	LBA	Ø4 x 60	20	23,5	25,8	27,9	29,5	40	50	6667	7980
	LBS	Ø5 x 70		29,3	32,9	36,3	39,1				
	LBSH	Ø5 x 50		27,6	31,6	35,6	38,8				
WHT30	LBA	Ø4 x 60	30	35,3	38,7	41,8	44,2	-	70	-	11667
	LBS	Ø5 x 70		44,0	49,4	54,4	58,6				
	LBSH	Ø5 x 50		41,4	47,5	53,3	58,2				
WHT40	LBA	Ø4 x 60	40	46,7	51,7	55,7	59,0	-	90	-	15000
	LBS	Ø5 x 70		58,7	65,8	72,6	78,1				
	LBSH	Ø5 x 50		54,9	62,9	70,6	77,1				
WHT55	LBA	Ø4 x 60	55	63,6	71,0	76,6	81,1	-	120	-	20000
	LBS	Ø5 x 70		80,7	90,5	99,8	107,4				
	LBSH	Ø5 x 50		74,9	85,8	96,4	105,2				

STRENGTH ON TIMBER SIDE | NARROW PATTERN | total fastening

CODE	fastening holes Ø5 type	Ø x L	n_V	TIMBER N_r (1)(2) Factored lateral resistance Nr (K_D=1.15) G = 0.35	G = 0.42	G = 0.49	G = 0.55	STEEL no washer R_{steel}	washer R_{steel}	K_{ser} (3)
		[mm]	[pcs]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[N/mm]
WHT15	LBA	Ø4 x 60	9	10,6	11,6	12,5	13,3	30	-	3360
	LBS	Ø5 x 70		13,2	14,8	16,3	17,6			
	LBSH	Ø5 x 50		12,5	14,3	16,1	17,5			
WHT20	LBA	Ø4 x 60	12	14,1	15,5	16,7	17,7	40	-	4620
	LBS	Ø5 x 70		17,6	19,7	21,8	23,4			
	LBSH	Ø5 x 50		16,6	19,0	21,3	23,3			
WHT30	LBA	Ø4 x 60	18	21,2	23,2	25,1	26,5	-	70	7140
	LBS	Ø5 x 70		26,4	29,6	32,7	35,2			
	LBSH	Ø5 x 50		24,8	28,5	32,0	34,9			
WHT40	LBA	Ø4 x 60	24	28,0	31,0	33,4	33,4	-	90	9240
	LBS	Ø5 x 70		35,2	39,5	43,6	46,9			
	LBSH	Ø5 x 50		32,9	37,7	42,4	46,2			
WHT55	LBA	Ø4 x 60	33	38,1	42,6	46,0	48,7	-	120	13020
	LBS	Ø5 x 70		48,4	54,3	59,9	64,5			
	LBSH	Ø5 x 50		45,0	51,5	57,8	63,1			

STRUCTURAL VALUES | TIMBER-TO-CONCRETE | F_1 to N_F

USE OF ALTERNATIVE FASTENINGS

It is possible to use screws of shorter or longer lengths than those proposed.In this case, the design values Nr for timber part must be multiplied by a reductive factor k_F:

connector length	k_F	
[mm]	LBA Ø5	LBS Ø5
40	0,72	0,85
50	0,85	1
60	0,92	1,08
70	1	1,16

CONCRETE STRENGTH

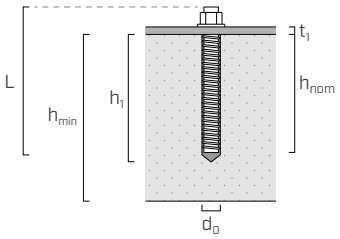
Strength values of some of the possible fastening solutions. For additional solutions, different from those indicated in the table, it is possible to use the My Project software available at www.rothoblaas.com.
The values shown in the table have been determined taking into account the contribution of the coefficient $k_{t//}$ in the calculations.

CODE	configuration on concrete	fastening holes Ø14		concrete resistance $R_{concrete}$ (4)	
		type	Ø x L [mm]	no gap [kN]	gap [kN]
WHT15 WHT20 no washer	uncracked	VIN-FIX 5.8	M16 x 195	26,9	29,4
			M16 x 245	33,7	36,7
			M20 x 245	41,1	44,9
	cracked	HYB-FIX 5.8	M16 x 195	29,7	32,4
		HYB-FIX 8.8	M16 x 245	37,1	40,5
	seismic	EPO-FIX 8.8	M20 x 245	25,8	28,1
			M20 x 330	37,4	40,8
WHT15 WHT20	uncracked	VIN-FIX 5.8	M16 x 245	33,7	36,7
			M20 x 245	41,1	44,9
	cracked	HYB-FIX 8.8	M16 x 195	29,7	32,4
			M16 x 245	37,1	40,5
	seismic	EPO-FIX 8.8	M20 x 245	25,8	28,1
			M20 x 330	37,4	40,8
WHT30 WHT40	uncracked	VIN-FIX 5.8	M20 x 245	41,1	44,9
		VIN-FIX 5.8	M20 x 330	57,6	62,8
		HYB-FIX 8.8	M20 x 245	66,1	72,1
	cracked	HYB-FIX 5.8	M20 x 245	42,9	46,7
		VIN-FIX 5.8	M24 x 330	37,6	40,9
		EPO-FIX 5.8	M24 x 330	71,1	77,5
	seismic	EPO-FIX 8.8	M24 x 330	42,7	46,5
			M24 x 495	67,1	73,1
WHT55	uncracked	HYB-FIX 8.8	M24 x 330	114,8	125,1
	cracked	EPO-FIX 5.8	M24 x 330	69,9	76,1
		HYB-FIX 8.8	M24 x 495	111,5	121,5
	seismic	EPO-FIX 8.8	M24 x 330	41,9	45,7
			M24 x 495	67,1	73,1

ANCHORS INSTALLATION PARAMETERS

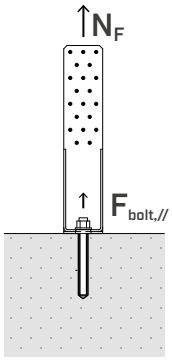
type of rod Ø x L [mm]		WHT type	type of washer	t_1 [mm]	$h_{nom}=h_{ef}$ [mm]	h_1 [mm]	d_0 [mm]	h_{min} [mm]
M16	195	WHT15 / WHT20	WHTW6016	11	160	165	18	200
	245	WHT15 / WHT20	WHTW6016	11	200	205	18	250
M20	245	WHT15 / WHT20	WHTW6020	11	200	205	22	250
	330			11	290	295	22	350
	245	WHT30	WHTW8020	16	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	28	350
	330	WHT40 / WHT55	WHTW8024	18	275	280	28	350
	330	WHT55	WHTW8024	21	275	280	28	350
	495	WHT55	WHTW8024L	21	440	445	28	350

Precut INA threaded rod, with nut and washer. MGS threaded rod class 8.8 to be cut to size: for more information, see the "**PLATES AND CONNECTORS FOR TIMBER**" catalogue, available in the "Catalogues" section of the website www.rothoblaas.com



t_1	thickness of plate
h_{nom}	nominal eembedment depth
h_{ef}	effective anchor embedment depth
h_1	minimum hole depth
d_0	hole diameter in the concrete support
h_{min}	concrete minimum thickness

ANCHORS VERIFICATION FOR STRESS LOADING N_F



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:

$$F_{bolt} = k_{t//} \cdot N_r$$

$k_{t//}$ coefficient of eccentricity
N_r 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: $R_{concrete} \geq F_{bolt}$.

	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

- Design values can be obtained from values in the table as follows:

  WIDE AND NARROW PATTERN

$$R_d = min \begin{cases} N_r \\ R_{steel} \\ R_{concrete} \end{cases}$$

- The lateral resistance of LBS & LBSH screws and LBA nails is determined according to CSA O86:2024, section 12.12 (self-tapping screws) and section 12.9 (nails and spikes), respectively.
- The specified bending yield strength for LBA with a 4 mm diameter is f_{yb} = 645 MPa, for LBS with a 5 mm diameter is f_{yb} = 1075 MPa, and for LBSH with a 5 mm diameter is f_{yb} = 1122 MPa.
- G is the mean relative density according to Table A.12 in CSA O86:2024. Typical wood species considered include Northern species (G = 0.35), Spruce-Pine-Fir (G = 0.42), Douglas Fir (G = 0.49), and Southern Pine (G = 0.55).
- 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.
- The gap height does not affect the angle bracket resistance N_r.
- Dimensioning and verification of timber and concrete elements must be carried out separately. Verify that there are no brittle failures before reaching the connection strength.
- The calculation of the concrete anchors is performed following CSA A23.3:2024, Annex D.
- The characteristic bond stress of adhesive anchors in cracked and uncracked concrete is taken from European Technical Assessment test reports.
- The bond strength of EPO-FIX for seismic design is calculated by multiplying τ_{cr} by 0.8, according to Section D.6.5.2 in CSA A23.3:2024.
- The calculation process uses C25/30 concrete without considering edge effects.
- Fastening elements to concrete using anchors not listed in the table must be verified according to the load applied to the anchors.
- The strength values are valid for the calculation hypotheses defined in the table; for boundary conditions different from the ones in the table (e.g. minimum distances from the edge), the anchors-to-concrete must be recalculated according to the design requirements.
- The product ETAs for the anchors used in the concrete-side strength calculation are indicated below:
  - VIN-FIX chemical anchor according to ETA-20/0363;
  - HYB-FIX chemical anchor according to ETA-20/1285;
  - EPO-FIX chemical anchor according to ETA-23/0419;

NOTES

(1) Values for factored lateral resistance for self-taping screws are determined following the guidelines in Section 12.12 in CSA-O86 2020. Short term load duration factor (K_D = 1.15), dry service condition factor (K_{SF} = 1.0), and treatment factor (K_T = 1.0) are assumed.

(2) Adjustment factor for connections (J_x) is assumed to be equal to 0.9 for CLT connections.

(3) The slip modulus of the shear connection, K_{ser}, is measured through testing on European wood species with a density of 350 kg/m^3.

(4) The characteristic bond stress of adhesive anchors in cracked and uncracked concrete is based on ETA certifications for VIN-FIX, HYB-FIX, and EPO-FIX chemical anchors.