WHT

CE
ETA 11/0086

ANGLE BRACKET FOR TENSILE LOADS

COMPLETE RANGE
Available in 5 sizes to be combined with 5 washers to meet all static performance requirements.

SPECIAL STEEL
S355 steel ensures high tensile strength.

HOLE DIAMETER
The hole for "big size" rods is proportioned to the system dimensions.

CHARACTERISTICS

FOCUS	tensile joints
HEIGHT	from 340 to 740 mm
THICKNESS	3,0 mm
FASTENERS	LBA, LBS, VIN-FIX, HYB-FIX

MATERIAL

Bright zinc plated carbon steel, three dimensional perforated plate.

FIELDS OF USE

Timber-to-concrete and timber-to-timber tensile joints for panels and timber beams
- CLT, LVL
- solid timber and glulam
- framed structures (platform frame)
- timber based panels

CLT, TIMBER FRAME

High strength thanks to S355 steel, side reinforcement flanges and larger diameter hole at the base.

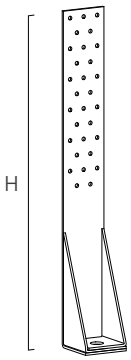
SEISMIC AND STIFFNESS

Within the SEISMIC-REV research project framework, the product and the related fastening elements were tested under static and cyclic loading, providing stiffness parameters (K_{ser}) and ductility levels.

CODES AND DIMENSIONS

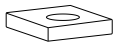
WHT ANGLE BRACKET

CODE	H [mm]	hole [mm]	n_v Ø5 [pcs]	s [mm]	pcs
WHT340	340	Ø18	20	3	10
WHT440	440	Ø18	30	3	10
WHT540	540	Ø22	45	3	10
WHT620	620	Ø26	55	3	10
WHT740	740	Ø29	75	3	1



WHTW WASHER

CODE	hole [mm]	s [mm]	WHT340	WHT440	WHT540	WHT620	WHT740	pcs
WHTW50	Ø18	10	●	●	●	-	-	1
WHTW50L	Ø22	10	-	-	●	-	-	1
WHTW70	Ø22	20	-	-	-	●	-	1
WHTW70L	Ø26	20	-	-	-	●	-	1
WHTW130	Ø29	40	-	-	-	-	●	1



XYLOFON WASHER RESILIENT PROFILE

CODE		hole [mm]	P [mm]	B [mm]	s [mm]	pcs
XYLW806060	WHT340 WHT440 WHT540	Ø23	60	60	6,0	10
XYLW808080	WHT620	Ø27	80	80	6,0	10
XYLW8080140	WHT740	Ø30	80	140	6,0	1

MATERIAL AND DURABILITY

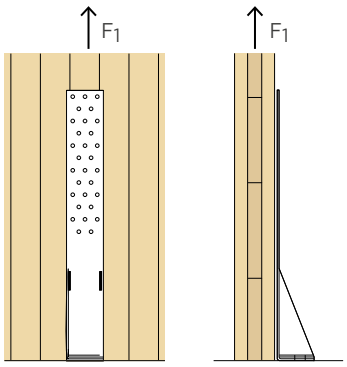
WHT: S355 bright zinc plated carbon steel.
WHTW WASHER: S235 bright zinc plated carbon steel.
To be used in service classes 1 and 2 (EN 1995-1-1).

XYLOFON WASHER: Monolithic polyurethane compound.

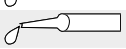
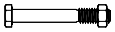
FIELD OF USE

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

EXTERNAL LOADS



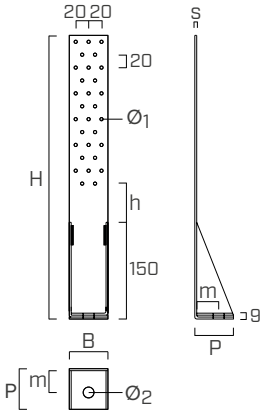
ADDITIONAL PRODUCTS - FASTENING

type	description		d [mm]	support
LBA	Anker nail		4	
LBS	screw for plates		5	
VIN-FIX(*)	chemical anchor		M16 - M20 - M24 - M27	
HYB-FIX	chemical anchor		M16 - M20 - M24 - M27	
KOS	bolt		M16 - M20	

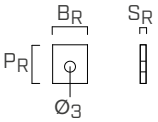
(*) For more information, see the data sheet available at www.rothoblaas.com

GEOMETRY

WHT			WHT340	WHT440	WHT540	WHT620	WHT740
Height	H	[mm]	340	440	540	620	740
Base	B	[mm]	60	60	60	80	140
Depth	P	[mm]	63	63	63	83	83
Thickness	s	[mm]	3	3	3	3	3
Hole position in timber	h	[mm]	40	60	40	40	-
Hole position in concrete	m	[mm]	35	35	35	38	38
Flange holes	$Ø_1$	[mm]	5,0	5,0	5,0	5,0	5,0
Base hole	$Ø_2$	[mm]	18,0	18,0	22,0	26,0	29,0



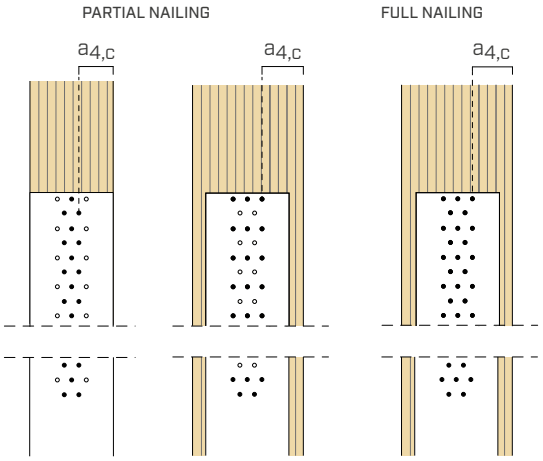
WHTW WASHER			WHTW50	WHTW50L	WHTW70	WHTW70L	WHTW130
Base	B_R	[mm]	50	50	70	70	130
Depth	P_R	[mm]	56	56	77	77	77
Thickness	s_R	[mm]	10	10	20	20	40
Washer hole	$Ø_3$	[mm]	18,0	22,0	22,0	26,0	29,0



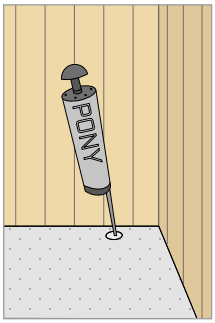
INSTALLATION

TIMBER minimum distances			nails LBA Ø4	screws LBS Ø5
C/GL	$a_{4,c}$	[mm]	≥ 20	≥ 25
CLT	$a_{4,c}$	[mm]	≥ 12	≥ 12,5

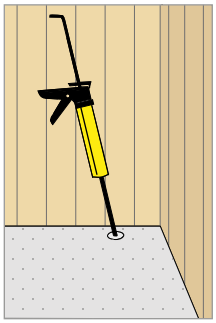
- C/GL: minimum distances for solid timber or glulam consistent with EN 1995-1-1 according to ETA considering a timber density $\rho_k \leq 420$ kg/m^3
- CLT: minimum distances for Cross Laminated Timber according to ÖNORM EN 1995-1-1 (Annex K) for nails and ETA 11/0030 for screws



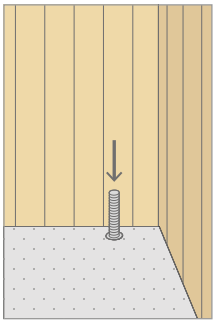
ASSEMBLY



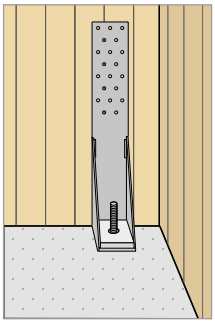
Drilling of the concrete support and hole cleaning



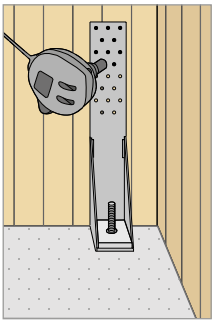
Injection of the chemical anchor into the hole



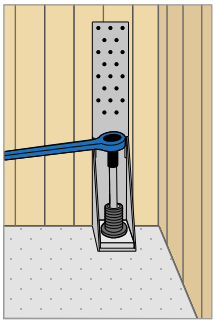
Positioning of the threaded rod



Installation of WHT angle bracket (with washer if prescribed)



Nailing of the angle bracket

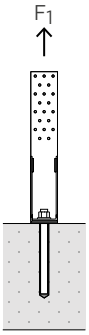


Positioning of the nut by adequate tightening

STRUCTURAL VALUES | TIMBER-TO-CONCRETE TENSILE JOINT

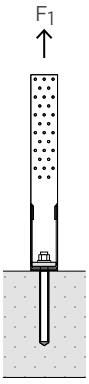
WHT340 - with or without WHTW50 washer

configuration	$R_{1,K}$ TIMBER				$R_{1,K}$ STEEL		$R_{1,d}$ CONCRETE					
	holes fastening Ø5			$R_{1,k\ timber}$	$R_{1,k\ steel}$		$R_{1,d\ uncracked}$		$R_{1,d\ cracked}$		$R_{1,d\ seismic}$	
	type	Ø x L	n_v				VIN-FIX 5.8 Ø x L		HYB-FIX 5.8 Ø x L		HYB-FIX 8.8 Ø x L	
		[mm]	[pcs]	[kN]	[kN]	γ_{steel}	[mm]	[kN]	[mm]	[kN]	[mm]	[kN]
• total fastening • washer WHTW50 • M16 anchor	LBA nails	Ø4,0 x 40	20	**31,4**	**63,4**	γ_{M2}	M16 x 195	**36,5**	M16 x 195	**48,3**	M16 x 245 M16 x 195	**24,3** **18,4**
		Ø4,0 x 60	20	**38,6**								
	screws LBS	Ø5,0 x 40	20	**31,4**								
		Ø5,0 x 50	20	**38,6**								
• partial fastening • washer WHTW50 • M16 anchor	LBA nails	Ø4,0 x 40	14	**22,0**	**63,4**	γ_{M2}	M16 x 195	**36,5**	M16 x 195	**48,3**	M16 x 245 M16 x 195	**24,3** **18,4**
		Ø4,0x 60	14	**27,0**								
	screws LBS	Ø5,0 x 40	14	**22,0**								
		Ø5,0 x 50	14	**27,0**								
• total fastening • without washer • M16 anchor	LBA nails	Ø4,0 x 40	20	**31,4**	**42,0**	γ_{M0}	M16 x 160	**30,7**	M16 x 160	**38,9**	M16 x 245 M16 x 195	**24,6** **19,6**
		Ø4,0 x 60	20	**38,6**								
	screws LBS	Ø5,0 x 40	20	**31,4**								
		Ø5,0 x 50	20	**38,6**								
• partial fastening • without washer • M16 anchor	LBA nails	Ø4,0 x 40	14	**22,0**	**42,0**	γ_{M0}	M16 x 160	**30,7**	M16 x 160	**38,9**	M16 x 245 M16 x 195	**24,6** **19,6**
		Ø4,0x 60	14	**27,0**								
	screws LBS	Ø5,0 x 40	14	**22,0**								
		Ø5,0 x 50	14	**27,0**								



WHT440 - with or without WHTW50 washer

configuration	$R_{1,K}$ TIMBER				$R_{1,K}$ STEEL		$R_{1,d}$ CONCRETE					
	holes fastening Ø5			$R_{1,k\ timber}$	$R_{1,k\ steel}$		$R_{1,d\ uncracked}$		$R_{1,d\ cracked}$		$R_{1,d\ seismic}$	
	type	Ø x L	n_v				VIN-FIX 5.8 Ø x L		HYB-FIX 5.8 Ø x L		HYB-FIX 8.8 Ø x L	
		[mm]	[pcs]	[kN]	[kN]	γ_{steel}	[mm]	[kN]	[mm]	[kN]	[mm]	[kN]
• total fastening • washer WHTW50 • M16 anchor	LBA nails	Ø4,0 x 40	30	**47,1**	**63,4**	γ_{M2}	M16 x 245	**46,4**	M16 x 245	**51,9**	M16 x 330 M16 x 245	**32,8** **24,3**
		Ø4,0 x 60	30	**57,9**								
	screws LBS	Ø5,0 x 40	30	**47,1**								
		Ø5,0 x 50	30	**57,9**								
• partial fastening • washer WHTW50 • M16 anchor	LBA nails	Ø4,0 x 40	20	**31,4**	**63,4**	γ_{M2}	M16 x 245 M16 x 195	**46,4** **36,5**	M16 x 245 M16 x 195	**51,9** **48,3**	M16 x 330 M16 x 245	**32,8** **24,3**
		Ø4,0 x 60	20	**38,6**								
	screws LBS	Ø5,0 x 40	20	**31,4**								
		Ø5,0 x 50	20	**38,6**								
• partial fastening • without washer • M16 anchor	LBA nails	Ø4,0 x 40	20	**31,4**	**42,0**	γ_{M0}	M16 x 160	**30,7**	M16 x 160	**38,9**	M16 x 330 M16 x 245	**34,0** **24,6**
		Ø4,0x 60	20	**38,6**								
	screws LBS	Ø5,0 x 40	20	**31,4**								
		Ø5,0 x 50	20	**38,6**								



NOTES FOR SEISMIC DESIGN

Particular attention has to be paid to the "capacity design" applied at different scale levels: the global structure and the connection system. Experimentally the ultimate strength of the LBA nail (and of the LBS screw) is notably larger than the characteristic strength evaluated according to EN 1995.

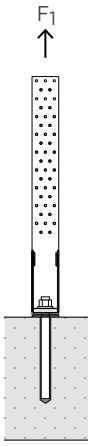
E.g. LBA nail Ø4 x 60 mm: $R_{v,k}$ =2,8 - 3,6 kN by experimental tests (variable according to the type of timber and plate thickness).

Experimental data derive from tests carried out within the Seismic-Rev research project and are reported in the scientific report: "Connection systems for timber buildings: experimental campaign to characterize stiffness, strength and ductility" (DICAM - Department of Civil, Environmental and Mechanical Engineering - UniTN).

STRUCTURAL VALUES | TIMBER-TO-CONCRETE TENSILE JOINT

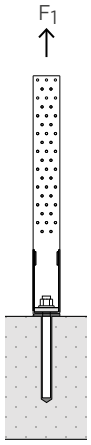
WHT540 - with WHTW50 washer (M16)

configuration	$R_{1,K}$ TIMBER				$R_{1,K}$ STEEL		$R_{1,d}$ CONCRETE					
	holes fastening Ø5			$R_{1,k\ timber}$	$R_{1,k\ steel}$		$R_{1,d\ uncracked}$		$R_{1,d\ cracked}$		$R_{1,d\ seismic}$	
	type	Ø x L	n_v				VIN-FIX 5.8 Ø x L		HYB-FIX 5.8 Ø x L		HYB-FIX 8.8 Ø x L	
		[mm]	[pcs]	[kN]	[kN]	γ_{steel}	[mm]	[kN]	[mm]	[kN]	[mm]	[kN]
• total fastening • washer WHTW50 • M16 anchor	LBA nails	Ø4,0 x 40	45	**70,7**	**63,4**	γ_{M2}	M16 x 245 M16 x 195	**46,4** **36,5**	M16 x 245 M16 x 195	**52,0** **48,3**	M16 x 330 M16 x 245	**32,8** **23,5**
		Ø4,0 x 60	45	**86,9**								
	screws LBS	Ø5,0 x 40	45	**70,7**								
		Ø5,0 x 50	45	**86,9**								
• partial fastening • washer WHTW50 • M16 anchor	LBA nails	Ø4,0 x 40	29	**45,5**	**63,4**	γ_{M2}	M16 x 245 M16 x 195	**46,4** **36,5**	M16 x 245 M16 x 195	**52,0** **48,3**	M16 x 330 M16 x 245	**32,8** **23,5**
		Ø4,0 x 60	29	**56,0**								
	screws LBS	Ø5,0 x 40	29	**45,5**								
		Ø5,0 x 50	29	**56,0**								



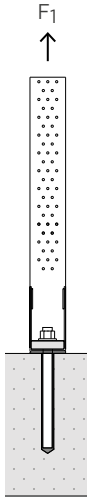
WHT540 - with washer WHTW50L (M20)

configuration	$R_{1,K}$ TIMBER				$R_{1,K}$ STEEL		$R_{1,d}$ CONCRETE					
	holes fastening Ø5			$R_{1,k\ timber}$	$R_{1,k\ steel}$		$R_{1,d\ uncracked}$		$R_{1,d\ cracked}$		$R_{1,d\ seismic}$	
	type	Ø x L	n_v				VIN-FIX 5.8 Ø x L		HYB-FIX 5.8 Ø x L		HYB-FIX 8.8 Ø x L	
		[mm]	[pcs]	[kN]	[kN]	γ_{steel}	[mm]	[kN]	[mm]	[kN]	[mm]	[kN]
• total fastening • washer WHTW50L • M20 anchor	LBA nails	Ø4,0 x 40	45	**70,7**	**63,4**	γ_{M2}	M20 x 330 M20 x 245	**81,2** **58,0**	M20 x 330 M20 x 245	**100,6** **71,9**	M20 x 495 M20 x 330	**55,3** **38,7**
		Ø4,0 x 60	45	**86,9**								
	screws LBS	Ø5,0 x 40	45	**70,7**								
		Ø5,0 x 50	45	**86,9**								
• partial fastening • washer WHTW50L • M20 anchor	LBA nails	Ø4,0 x 40	29	**45,5**	**63,4**	γ_{M2}	M20 x 330 M20 x 245	**81,2** **58,0**	M20 x 330 M20 x 245	**100,6** **71,9**	M20 x 495 M20 x 330	**55,3** **38,7**
		Ø4,0 x 60	29	**56,0**								
	screws LBS	Ø5,0 x 40	29	**45,5**								
		Ø5,0 x 50	29	**56,0**								



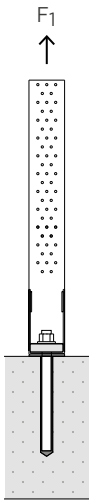
WHT620 - with WHTW70 washer (M20)

configuration	$R_{1,K}$ TIMBER				$R_{1,K}$ STEEL		$R_{1,d}$ CONCRETE					
	holes fastening Ø5			$R_{1,k\ timber}$	$R_{1,k\ steel}$		$R_{1,d\ uncracked}$		$R_{1,d\ cracked}$		$R_{1,d\ seismic}$	
	type	Ø x L	n_v				VIN-FIX 5.8 Ø x L		HYB-FIX 5.8 Ø x L		HYB-FIX 8.8 Ø x L	
		[mm]	[pcs]	[kN]	[kN]	γ_{steel}	[mm]	[kN]	[mm]	[kN]	[mm]	[kN]
• total fastening • washer WHTW70 • M20 anchor	LBA nails	Ø4,0 x 40	55	**86,4**	**85,2**	γ_{M2}	M20 x 330 M20 x 245	**78,4** **56,6**	M20 x 330 M20 x 245	**81,3** **69,8**	M20 x 495 M20 x 330	**55,3** **37,3**
		Ø4,0 x 60	55	**106,2**								
	screws LBS	Ø5,0 x 40	55	**86,4**								
		Ø5,0 x 50	55	**106,2**								
• partial fastening • washer WHTW70 • M20 anchor	LBA nails	Ø4,0 x 40	35	**55,0**	**85,2**	γ_{M2}	M20 x 330 M20 x 245	**78,4** **56,6**	M20 x 330 M20 x 245	**81,3** **69,8**	M20 x 495 M20 x 330	**55,3** **37,3**
		Ø4,0 x 60	35	**67,6**								
	screws LBS	Ø5,0 x 40	35	**55,0**								
		Ø5,0 x 50	35	**67,6**								



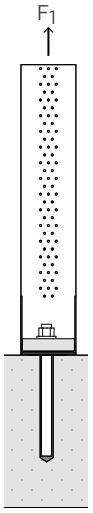
STRUCTURAL VALUES | TIMBER-TO-CONCRETE TENSILE JOINT

WHT620 - with WHTW70L washer (M24)



configuration	$R_{1,K}$ TIMBER				$R_{1,K}$ STEEL		$R_{1,d}$ CONCRETE					
	holes fastening Ø5			$R_{1,k\ timber}$	$R_{1,k\ steel}$		$R_{1,d\ uncracked}$		$R_{1,d\ cracked}$		$R_{1,d\ seismic}$	
	type	Ø x L	n_v				VIN-FIX 5.8 Ø x L		HYB-FIX 5.8 Ø x L		HYB-FIX 8.8 Ø x L	
		[mm]	[pcs]	[kN]	[kN]	γ_{steel}	[mm]	[kN]	[mm]	[kN]	[mm]	[kN]
• total fastening • washer WHTW70L • M24 anchor	LBA nails	Ø4,0 x 40	55	**86,4**	**85,2**	γ_{M2}	M24 x 330	**94,0**	M24 x 330	**95,9**	M24 x 495 M24 x 330	**46,2** **31,2**
		Ø4,0 x 60	55	**106,2**								
	screws LBS	Ø5,0 x 40	55	**86,4**								
		Ø5,0 x 50	55	**106,2**								
• partial fastening • washer WHTW70L • M24 anchor	LBA nails	Ø4,0 x 40	35	**55,0**	**85,2**	γ_{M2}	M24 x 330	**94,0**	M24 x 330	**95,9**	M24 x 495 M24 x 330	**46,2** **31,2**
		Ø4,0 x 60	35	**67,6**								
	screws LBS	Ø5,0 x 40	35	**55,0**								
		Ø5,0 x 50	35	**67,6**								

WHT740 - with WHTW130 washer (M27)



configuration	$R_{1,K}$ TIMBER				$R_{1,K}$ STEEL		$R_{1,d}$ CONCRETE			
	holes fastening Ø5			$R_{1,k\ timber}$	$R_{1,k\ steel}$		$R_{1,d\ uncracked}$		$R_{1,d\ cracked}$	
	type	Ø x L	n_v				HYB-FIX 5.8 Ø x L		HYB-FIX 5.8 Ø x L	
		[mm]	[pcs]	[kN]	[kN]	γ_{steel}	[mm]	[kN]	[mm]	[kN]
• total fastening • M27 anchor • washer WHTW130	LBA nails	Ø4,0 x 40	75	**117,8**	**158,6**	γ_{M2}	M27 x 495 M27 x 330	**153,3** **144,9**	M27 x 495 M27 x 330	**153,3** **100,9**
		Ø4,0 x 60	75	**144,8**						
	screws LBS	Ø5,0 x 40	75	**117,8**						
		Ø5,0 x 50	75	**144,8**						
• partial fastening • M27 anchor • washer WHTW130	LBA nails	Ø4,0 x 40	45	**70,7**	**158,6**	γ_{M2}	M27 x 330	**144,9**	M27 x 330	**100,9**
		Ø4,0 x 60	45	**86,9**						
	screws LBS	Ø5,0 x 40	45	**70,7**						
		Ø5,0 x 50	45	**86,9**						

GENERAL PRINCIPLES:

- Characteristic values are consistent with EN 1995-1-1 and in accordance with ETA-11/0086. The design values of the anchors for concrete are calculated in accordance with the respective European Technical Assessments.

  The connection design strength value is obtained from the values on the table as follows:

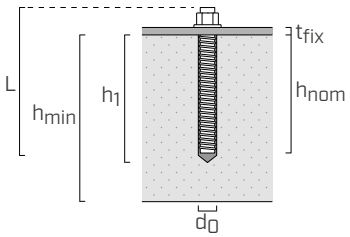
$$R_d = min \begin{cases} \dfrac{R_{k,\ timber} \cdot k_{mod}}{\gamma_M} \\ \dfrac{R_{k,\ steel}}{\gamma_{steel}} \\ R_{d,\ concrete} \end{cases}$$

  The coefficients k_{mod}, γ_M and γ_{steel} should be taken according to the current regulations used for the calculation.
- 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 edge-distance and minimum thickness indicated in the installation parameters tables.
- 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.
- Seismic design in performance category C2, without ductility requirements on anchors (option a2) elastic design according to EOTA TR045.
- 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.
- 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 can be verified using MyProject calculation software according to the design requirements.

CHEMICAL ANCHORS INSTALLATION PARAMETERS[1]

type of rod Ø x L [mm]		WHT type	type of washer	t_{fix}	$h_{nom} = h_{ef}$ [mm]	h_1 [mm]	d_0 [mm]	h_{min} [mm]
M16	160	WHT340 / WHT440	-	9	132	140	18	**200**
	195	WHT340 / WHT440	-	9	167	175		**210**
		WHT340 / WHT440 / WHT540	WHTW50	19	157	165		**200**
	245	WHT340 / WHT440	-	9	210	215		**250**
		WHT340 / WHT440	WHTW50	19	207	215		**250**
		WHT540	WHTW50	19	200	205		**250**
	330	WHT440	-	9	290	295		**340**
		WHT540	WHTW50	19	280	285		**340**
M20	245	WHT540	WHTW50L	19	200	205	22 (HYB-FIX) 24 (VIN-FIX)	**250**
		WHT620	WHTW70	29	195	200		**250**
	330	WHT540	WHTW50L	19	280	285		**340**
		WHT620	WHTW70	29	270	275		**340**
	495	WHT540	WHTW50L	19	400	405		**500**
		WHT620	WHTW70	29	400	405		**500**
M24	330	WHT620	WHTW70L	29	270	275	28	**340**
	495	WHT620	WHTW70L	29	400	405		**500**
M27	330	WHT740	WHTW130	49	250	255	30	**340**
	495	WHT740	WHTW130	49	405	410		**480**

INA precut INA threaded rod complete with nut and washer: see INA data sheet at www.rothoblaas.com



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

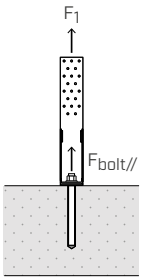
DIMENSIONING OF ALTERNATIVE ANCHORS

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	axial load on the WHT angle bracket

	$k_{t//}$
WHT340	1,00
WHT440	1,00
WHT540	1,00
WHT620	1,00
WHT740	1,00



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

NOTES:

(1) Valid for the strength values shown in the table.

CONNECTION STIFFNESS

EVALUTATION OF SLIP MODULUS K_{ser}

- $K_{1,ser}$ experimental average value for WHT joints on GL24h Glulam and on CLT

WHT type	configuration	fastening type Ø x L [mm]	n_v [pcs]	$K_{1,ser}$ [N/mm] GL24h	CLT
WHT340	• total fastening • without washer	LBA nails Ø4,0 x 60	20	-	**3440**
	• total fastening • with washer	LBA nails Ø4,0 x 60	20	**5705**	**7160**
	• partial fastening • with washer	LBA nails Ø4,0 x 60	12	-	**5260**
WHT440	• total fastening • with washer	LBA nails Ø4,0 x 60	30	**6609**	**10190**
	• partial fastening • with washer	LBA nails Ø4,0 x 60	20	-	**8060**
WHT540	• total fastening • with washer	LBA nails Ø4,0 x 60	45	-	**11470**
	• partial fastening • with washer	LBA nails Ø4,0 x 60	29	-	**9700**
WHT620	• total fastening • with washer	LBA nails Ø4,0 x 60	52/55	**13247**	**13540**
	• partial fastening • with washer	LBA nails Ø4,0 x 60	30/35	**9967**	**10310**

Seismic-REV experimental campaign on GL24h glulam (DICAM-University of Trento and CNR-IVALSA San Michele All'Adige, 2015).

- K_{ser} according to EN 1995-1-1 for timber-to-timber joint nails* GL24h/C24

Nails (without pre-drilling hole) $\frac{\rho_m^{1,5} \cdot d^{0,8}}{30}$ (EN 1995 § 7.1)

WHT type	fastening type Ø x L [mm]	n_v [pcs]	K_{ser} [N/mm]
WHT340	LBA nails Ø4,0 x 60	14	**12177**
		20	**17395**
WHT440	LBA nails Ø4,0 x 60	20	**17395**
		30	**26093**
WHT540	LBA nails Ø4,0 x 60	29	**25223**
		45	**39139**
WHT620	LBA nails Ø4,0 x 60	35	**30442**
		55	**47837**

* For steel-to-timber connections the reference standard indicates the possibility of doubling the value of K_{ser} listed in the table (7.1 (3)).

Experimental campaign on CLT panels (C24) (CNR-IBE San Michele All'Adige,2020).