

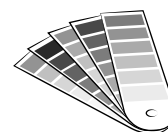
Angle bracket for tensile loads

Bright zinc plated carbon steel three-dimensional perforated plate



COMPLETE RANGE

4 sizes combined with 4 different washers determine 10 possible configurations, that can meet any static performance target



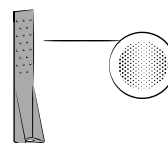
FIELD OF USE

Timber-to-concrete and timber-to-timber tension joints for panels and timber beams

- CLT (Cross Laminated Timber)
Framed structures
(platform frame)
- wood-based panels
- LVL (Laminated Veneer Lumber)
- solid wood
- glulam (Glued Laminated Timber)

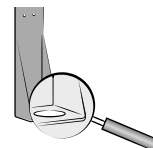
SPECIAL STEEL

S355 (Fe510) steel ensures high tensile strength



OVERSIZED HOLES

Holes with increased diameter permit to obtain higher strength values and facilitate the installation of the fastener



CERTIFIED SAFETY

Quality is proven by testing on the product and the related fasteners (nails, screws, threaded rods and resins)





STRENGTH

S355 steel, lateral reinforcing flanges, bigger holes and the increased number of nails on the flange ensure high strength values also in case of partial nailing

SEISMIC AND STIFFNESS

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

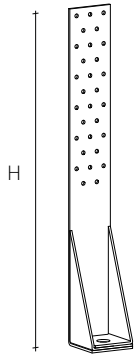
OPTIMIZED APPLICATIONS

The 4 versions can be combined with one or more washers to allow designers and carpenters to find the suitable application, on both solidwood (CLT - Cross Laminated Timber) and framed (platform frame) panels.



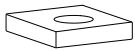
CODES AND DIMENSIONS

WHT



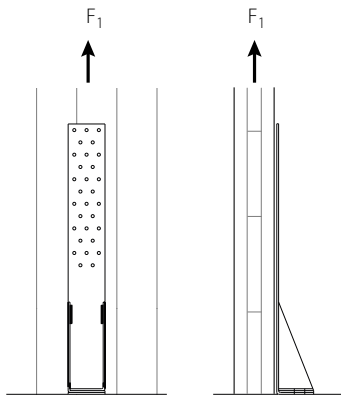
code	type	H [in]	hole [in]	n _v Ø5 [pcs]	s [in]	pcs/box
WHT340	WHT340	13.4	11/16	20	0.118	10
WHT440	WHT440	17.33	11/16	30	0.118	10
WHT540	WHT540	21.26	14/16	45	0.118	10
WHT620	WHT620	24.41	15/16	55	0.118	10

WHT WASHER



code	type	hole [in]	s [in]	WHT340	WHT440	WHT540	WHT620	pcs/box
ULS505610	WHTBS50	23/32	0.393	-	●	●	-	1
ULS505610L	WHTBS50L	14/16	0.393	-	-	●	-	1
ULS707720	WHTBS70	14/16	0.787	-	-	-	●	1
ULS707720L	WHTBS70L	15/16	0.787	-	-	-	●	1

EXTERNAL LOADS



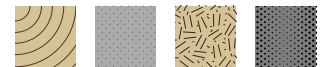
MATERIAL AND DURABILITY

WHT: S355 bright zinc plated Fe/Zn 12c carbon steel.

WHT WASHER: S235 bright zinc plated Fe/Zn 12c carbon steel. To be used in Service class 1 and 2 (EN 1995:2008).

FIELD OF USE

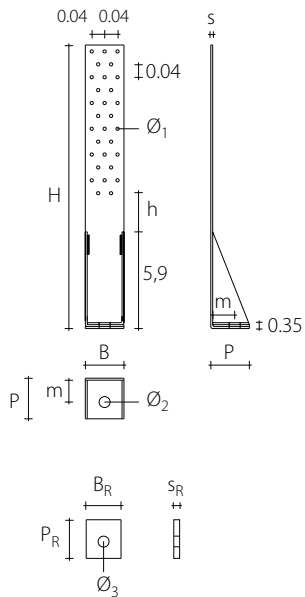
Timber to concrete joints
OSB to concrete joints
Timber to timber joints
OSB to timber joints
Steel to timber joints



ADDITIONAL PRODUCTS - FIXINGS

type	description		d [mm]	support
LBA	anker nail		4	
LBS	screw for plates		5	
VIN-FIX PRO	chemical anchor		M16 - M20 - M24	
EPO-FIX PLUS	chemical anchor		M16 - M20 - M24	
KOS	bolt		M16 - M20	

GEOMETRY

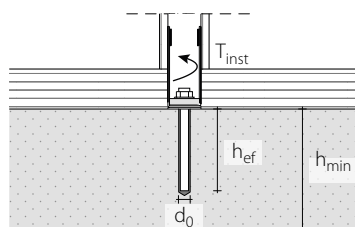
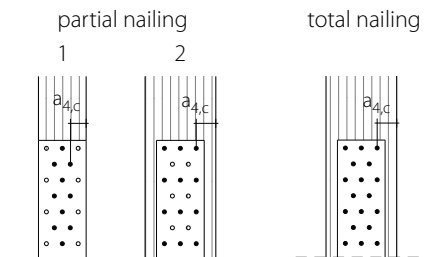


WHT ANGLE BRACKET			WHT340	WHT440	WHT540	WHT620
Height	H	[in]	13.386	17.323	21.260	24.409
Width	B	[in]	2.362	2.362	2.362	3.150
Depth	P	[in]	2.480	2.480	2.480	3.268
Thickness	s	[in]	0.118	0.118	0.118	0.118
Hole position in timber	h	[in]	1.575	2.362	1.575	1.575
Hole position in concrete	m	[in]	1.378	1.378	1.378	1.496
Flange holes	Ø1	[in]	0.197	0.197	0.197	0.197
Base hole	Ø2	[in]	0.669	0.669	0.866	1.024
WHT washer	type		-	WHTBS50	WHTBS50L WHTBS50	WHTBS70L WHTBS70

WHTBS WASHER		WHTBS50	WHTBS50L	WHTBS70	WHTBS70L
WHT Angle bracket	type	WHT440 / WHT540	WHT540	WHT620	WHT620
Width	B _R [in]	1.969	1.969	2.756	2.756
Depth	P _R [in]	2.205	2.205	3.031	3.031
Thickness	s _R [in]	0.394	0.394	0.787	0.787
Washer hole	Ø ₃ [in]	0.709	0.866	0.866	1.024

INSTALLATION

MINIMUM DISTANCES

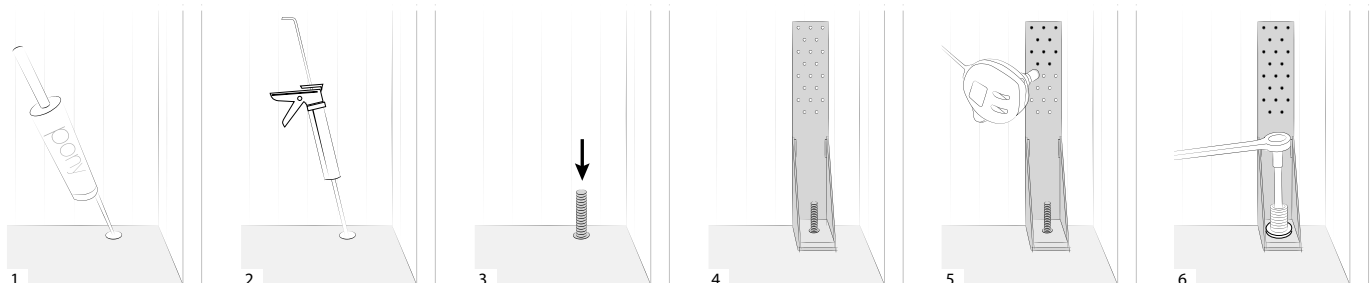


TIMBER				anker nail LBA Ø4	screw LBS Ø5
Lateral connector - Unloaded edge	a _{4,c}	[in]	≥ 5 d	≥ 0.787	≥ 0.984

		chemical anchor VIN-FIX PRO / EPO-FIX PLUS		
CONCRETE		M16	M20	M24
Minimum support thickness	h_{min} [in]	h _{ef} + 2 d ₀		
Hole diameter in concrete	d₀ [in]	0.708	0.945	1.102
Tightening torque	T_{inst} [in lbf]	708.06	1062.09	1416.12

h_{ef} = effective anchorage length on concrete

ASSEMBLING ON CONCRETE



1
Drilling of the
concrete support and
hole cleaning

2
Injection of the
chemical anchor
into the hole

3
Positioning of the
threaded rod

4
Installation of WHT
angle bracket (with
washer if prescribed)

5
Nailing of the
angle bracket

6
Positioning of the
nut by adequate
tightening

STATIC VALUES - TENSION JOINT - TIMBER-TO-CONCRETE

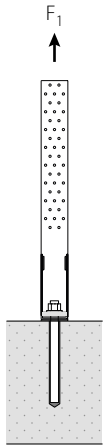
WHT340

CHARACTERISTIC VALUES								
configuration	type	Holes Ø 6/32 "		Z _{timber} [lbs]			Z _{Steel} [lbs]	
		Ø x L [in]	n _v [pcs]	G = 0.42	G = 0.49	G = 0.55	Washer	Z _{steel} [lbs]
- total nailing - anchor M16 - without washer	LBA Nails	5/32 "x 1 5/8 "	20	2550	2881	3149	-	9442
		5/32 "x 2 3/8 "	20	2550	2881	3149		
	LBS Screws	6/32 "x 1 5/8 "	20	1792	2025	2214		
		6/32 "x 2 "	20	1792	2025	2214		
- partial nailing - anchor M16 - without washer	LBA Nails	5/32 "x 1 5/8 "	14	1785	2017	2205	-	9442
		5/32 "x 2 3/8 "	14	1785	2017	2205		
	LBS Screws	6/32 "x 1 5/8 "	14	1255	1417	1550		
		6/32 "x 2 "	14	1255	1417	1550		

WHT440

CHARACTERISTIC VALUES								
configuration	type	Holes Ø 6/32 "		Z _{timber} [lbs]			Z _{Steel} [lbs]	
		Ø x L [in]	n _v [pcs]	G = 0.42	G = 0.49	G = 0.55	Washer	Z _{steel} [lbs]
- total fixing - washer WHTBSS0 - M16 anchor	LBA Nails	5/32 "x 1 5/8 "	30	3826	4321	4724	WHTBSS0	14253
		5/32 "x 2 3/8 "	30	3826	4321	4724		
	LBS Screws	6/32 "x 1 5/8 "	30	2688	3037	3321		
		6/32 "x 2 "	30	2688	3037	3321		
- partial fixing - washer WHTBSS0 - M16 anchor	LBA Nails	5/32 "x 1 5/8 "	20	2550	2881	3149	WHTBSS0	14253
		5/32 "x 2 3/8 "	20	2550	2881	3149		
	LBS Screws	6/32 "x 1 5/8 "	20	1792	2025	2214		
		6/32 "x 2 "	20	1792	2025	2214		
- partial fixing - without washer - M16 anchor	LBA Nails	5/32 "x 1 5/8 "	20	2550	2881	3149	-	9442
		5/32 "x 2 3/8 "	20	2550	2881	3149		
	LBS Screws	6/32 "x 1 5/8 "	20	1792	2025	2214		
		6/32 "x 2 "	20	1792	2025	2214		

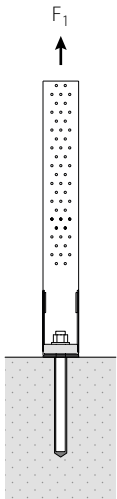
WHT540



CHARACTERISTIC VALUES								
configuration	Holes Ø 6/32"			Z _{timber} [lbs]			Z _{steel} [lbs]	
	type	Ø x L [in]	n _v [pcs]	G = 0.42	G = 0.49	G = 0.55	Washer	Z _{steel} [lbs]
- total nailing - anchor M20 - washer WHTBS50L	LBA Nails	5/32" x 1 5/8"	45	5738	6482	7086	WHTBS50L	14253
		5/32" x 2 3/8"	45	5738	6482	7086		
	LBS Screws	6/32" x 1 5/8"	45	4032	4556	4982		
		6/32" x 2"	45	4032	4556	4982		
- partial nailing - anchor M20 - washer WHTBS50L	LBA Nails	5/32" x 1 5/8"	27	3443	3889	4252	WHTBS50L	14253
		5/32" x 2 3/8"	27	3443	3889	4252		
	LBS Screws	6/32" x 1 5/8"	27	2419	2734	2989		
		6/32" x 2"	27	2419	2734	2989		
- total nailing - anchor M16 - washer WHTBS50	LBA Nails	5/32" x 1 5/8"	45	5738	6482	7086	WHTBS50	14253
		5/32" x 2 3/8"	45	5738	6482	7086		
	LBS Screws	6/32" x 1 5/8"	45	4032	4556	4982		
		6/32" x 2"	45	4032	4556	4982		
- partial nailing - anchor M16 - washer WHTBS50	LBA Nails	5/32" x 1 5/8"	27	3443	3889	4252	WHTBS50	14253
		5/32" x 2 3/8"	27	3443	3889	4252		
	LBS Screws	6/32" x 1 5/8"	27	2419	2734	2989		
		6/32" x 2"	27	2419	2734	2989		

(1) Length obtainable from MGS threaded rods (to be cut to measure)

WHT620

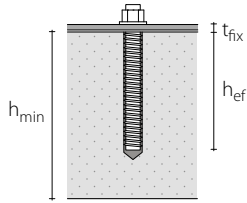


CHARACTERISTIC VALUES								
configuration	Holes Ø 6/32"			Z _{timber}			Z _{steel} [lbs]	
	type	Ø x L [in]	n _v [pcs]	G = 0.42	G = 0.49	G = 0.55	Washer	Z _{steel} [lbs]
- total nailing - anchor M24 - washer WHTBS70L	LBA Nails	5/32" x 1 5/8"	55	7013	7923	8661	WHTBS70L	19154
		5/32" x 2 3/8"	55	7013	7923	8661		
	LBS Screws	6/32" x 1 5/8"	55	4928	5568	6089		
		6/32" x 2"	55	4928	5568	6089		
- partial nailing - anchor M24 - washer WHTBS70L	LBA Nails	5/32" x 1 5/8"	33	4208	4754	5197	WHTBS70L	19154
		5/32" x 2 3/8"	33	4208	4754	5197		
	LBS Screws	6/32" x 1 5/8"	33	2957	3341	3653		
		6/32" x 2"	33	2957	3341	3653		
- total nailing - anchor M20 - washer WHTBS70	LBA Nails	5/32" x 1 5/8"	55	7013	7923	8661	WHTBS70	19154
		5/32" x 2 3/8"	55	7013	7923	8661		
	LBS Screws	6/32" x 1 5/8"	55	4928	5568	6089		
		6/32" x 2"	55	4928	5568	6089		
- partial nailing - anchor M20 - washer WHTBS70	LBA Nails	5/32" x 1 5/8"	33	4208	4754	5197	WHTBS70	19154
		5/32" x 2 3/8"	33	4208	4754	5197		
	LBS Screws	6/32" x 1 5/8"	33	2957	3341	3653		
		6/32" x 2"	33	2957	3341	3653		

(1) Length obtainable from MGS threaded bars (to be cut to measure)

STATIC VALUES - TENSION JOINT - TIMBER-TO-CONCRETE

CHEMICAL ANCHOR INSTALLATION PARAMETERS



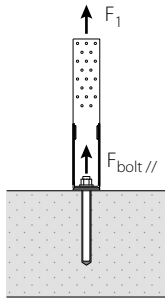
type of bar L [in]	code	steel class	type WHT	type of washer	t _{fix} [in]	h _{ef} [in]	h _{min} [in]
6.299	FE210116 ⁽²⁾	5.8	WHT340	-	0.354	5.079	9.449
M16	7.480	5.8	WHT340 / WHT440	-	0.354	6.260	9.449
			WHT440 / WHT540	WHTBS50	0.748	5.866	9.449
9.055	FE210121 ⁽²⁾	5.8	WHT440	WHTBS50	0.748	7.441	9.449
M20	9.449	5.8	WHT540	-	0.354	7.953	9.843
			WHT540	WHTBS50L	0.748	7.559	9.843
			WHT620	WHTBS70	1.142	7.165	9.843
M24	11.417	4.8 / 8.8	WHT540	WHTBS50L	0.748	9.449	11.811
			WHT620	-	0.354	8.976	11.811
			WHT620	WHTBS70L	1.142	8.189	11.811
12.992	MGS M24 ⁽³⁾	4.8 / 8.8	WHT620	WHTBS70L	1.142	10.551	12.992

⁽²⁾ Precut INA threaded rod, with nut and washer

⁽³⁾ When employing threaded rods that are cut on size, the use of MUT DIN934 nut and ULS DIN 125 washer is recommended

DIMENSIONING OF ALTERNATIVE ANCHORS

Fixing elements to the concrete ringbeam by means of anchors that are not listed in the table, shall be verified according to the load acting on the anchor, 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

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

- Values based on the "Technical Design Guide USA", download from www.rothoblaas.com
- Download the latest version of this document from www.rothoblaas.com

GENERAL PRINCIPLES

- For applications on CLT (Cross Laminated Timber) the use of nails/screws with length $L \geq 60$ mm is recommended. Shorter fasteners may lead to brittle failure due to "group effect" as the reduced penetration depth affects exclusively the outer layer.
- Dimensioning and verification of timber elements must be carried out separately.
- The strength values of the connection system are valid under the calculation hypotheses listed in the table; different boundary conditions (e.g., minimum edge distance) shall be verified.
- Thanks to validation via experimental testing, the strength values can be extended to the case where an OSB panel is placed between the WHT angle bracket and the timber support, providing that the minimum penetration depth and adequate OSB-to-framing fastening are guaranteed.
- The load carrying capacity of the nailed or screwed steel-to-timber connection was calculated according to NDS 2018.
- The load carrying capacity of the three-dimensional nailing plate was derived from calculation assisted by testing.
- The reference resistance values for connections shall be multiplied by all applicable adjustment factors (ref. NDS Table 11.3.1).
- The rope effect is not considered in the calculations.