TITAN PLATE C CONCRETE

PLATE FOR SHEAR LOADS

DESIGN REGISTERED | UKCA EN 14545 | CE EN 14545

VERSATILE
It can be used for continuous connection to the substructure of both CLT and light timber frame walls.

INNOVATIVE
Designed to be partially or completely fastened with nails or screws. Possibility of installation even in the presence of bedding grout.

CALCULATED AND CERTIFIED
Strength values are calculated according to CSA O86:24 and CSA A23.3:24, CE marking according to EN 14545. Available in 2 versions. TCP300 with increased thickness optimised for CLT.

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

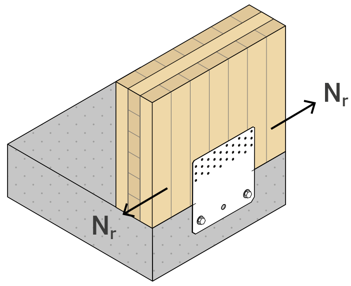
SERVICE CONDITION DRY

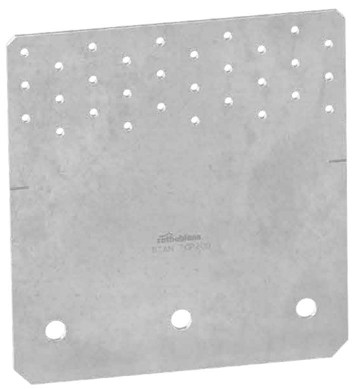
MATERIAL

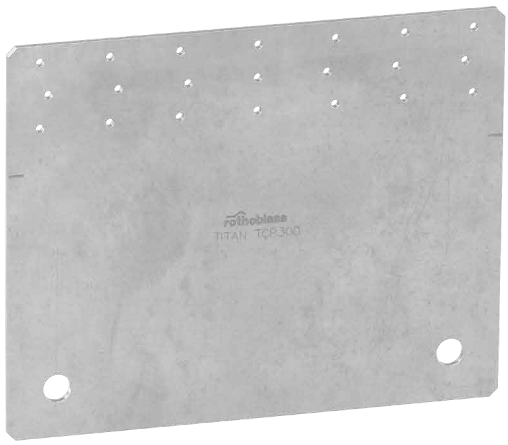
DX51D Z275 — **TCP200**: DX51D + Z275 carbon steel

S355 Fe/Zn12c — **TCP300**: S355 + Fe/Zn12c carbon steel

EXTERNAL LOADS







FIELDS OF USE

Shear joints for timber walls.
Timber-to-concrete or timber to-steel configurations.
Suitable for walls aligned to the concrete edge.

Can be applied to:

- solid timber and glulam
- timber frame
- CLT and LVL panels

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ADDED STOREYS

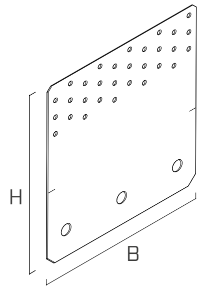
Ideal for making flat joints between concrete or masonry elements and CLT panels. Construction of continuous shear connections.

HYBRID STRUCTURES

Within hybrid timber-to-steel structures, it can be used for shear connections by simply aligning the edge of the timber with the edge of the steel element.

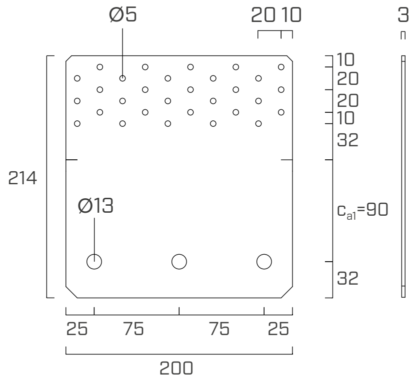
CODES AND DIMENSIONS

CODE	B [mm]	H [mm]	holes	s [mm]	B [in]	H [in]	holes	s [in]	n_V Ø5 / n_V Ø0.20 [pcs]		pcs
TCP200	200	214	Ø13	3	*8*	*8 7/16*	*Ø0.52*	*0.12*	30	●	10
TCP300	300	240	Ø17	4	*11 3/4*	*9 1/2*	*Ø0.67*	*0.16*	21	●	5

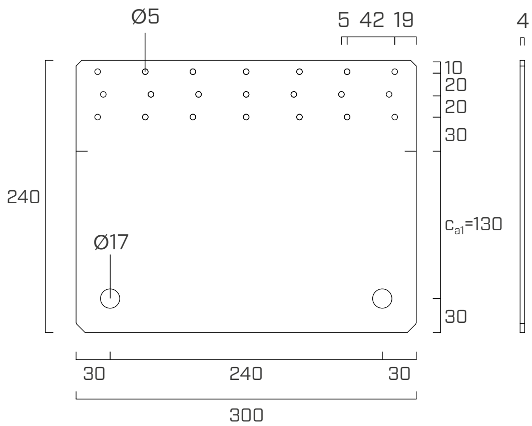


GEOMETRY

TCP200



TCP300



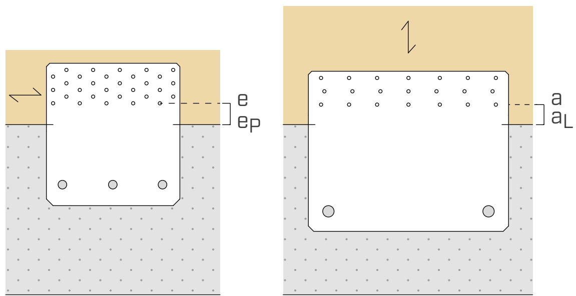
FASTENERS

type	description		d [mm]	support
LBA	high bond nail		4	
LBS	round head screw		5	
LBS EVO	C4 EVO round head screw		5	
AB1	CE1 expansion anchor		M12 - M16	
SKR	screw-in anchor		12 - 16	
VIN-FIX	vinyl ester chemical anchor		M12 - M16	
HYB-FIX	hybrid chemical anchor		M12 - M16	
EPO-FIX	epoxy chemical anchor		M12 - M16	

INSTALLATION

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		**pre-drilled**
			G ≤ 0.44	**0.44< G ≤ 0.5**	**any G**
timber	**e_P**	[mm]	≥ 25	≥ 35	≥ 15
	a_L	[mm]	≥ 75‡	≥ 110	≥ 60†



e edge distance perpendicular to grain
e_P unloaded edge distance
a end distance parallel to grain
a_L loaded end distance

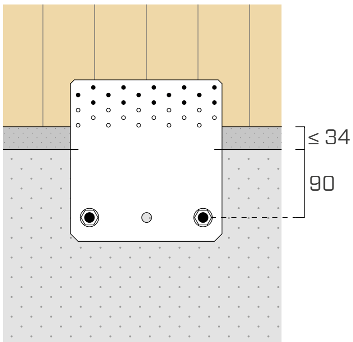
G = mean relative density of wood
†For Douglas Fir-Larch and Western Red Cedar, this minimum spacing shall be increased by 50%.
‡For Western Red Cedar, this minimum spacing shall be increased by 50%.
Timber minimum distances is according to SECTION 12.9 Placemen t of nails and spikes for LBA nails and SECTION 12.12 placement of self tapping screws for LBS screws in CSA O86; 2024

FASTENING PATTERNS

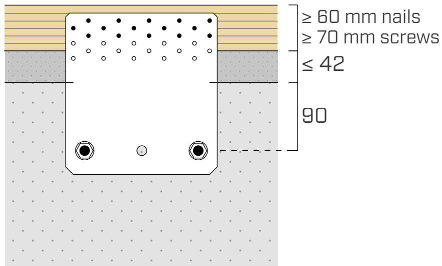
PARTIAL FASTENING

In the presence of design requirements such as varying stress values or the presence of a grout between the wall and the support surface, it is possible to use pre-calculated **partial nailing patterns** or to position the plates as required (e.g. lowered plates). Take care to respect the minimum distances indicated in the table and verify the strength of the anchor-to-concrete group taking into account the increase in distance from the edge (c_{a1}). Below there are some examples of possible limit configurations:

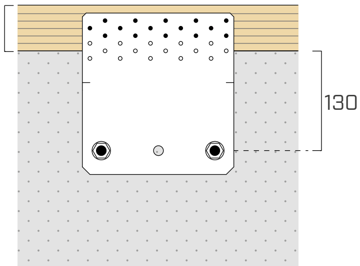
TCP200



partial 15 fasteners - CLT

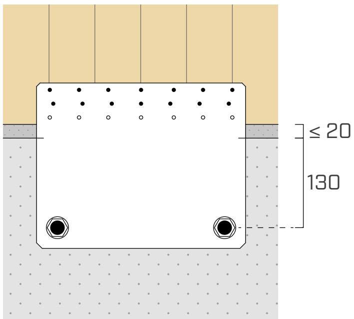


partial 15 fastenings - C/GL

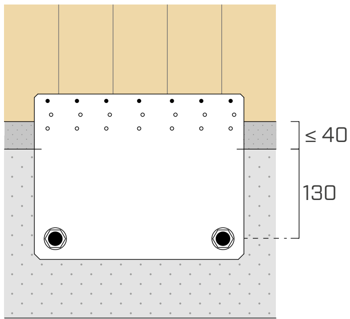


lowered plate - C/GL

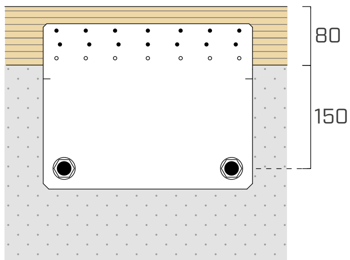
TCP300



partial 14 fastenings - CLT

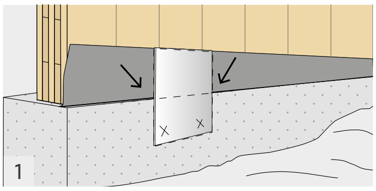


partial 7 fastenings - CLT

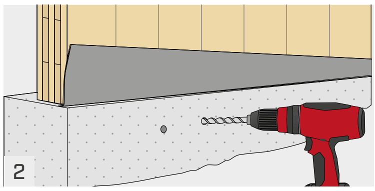


lowered plate - C/GL

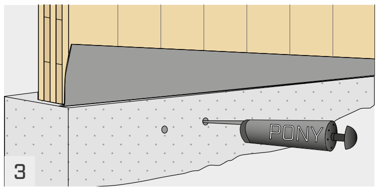
MOUNTING



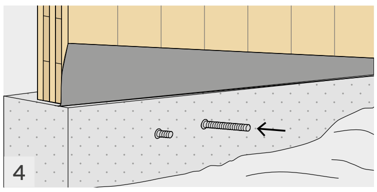
Positioning of the TITAN TCP with the dashed line at the timber-concrete interface and hole marking.



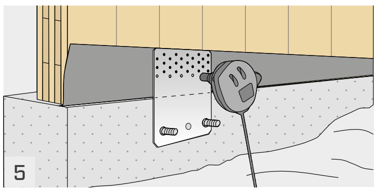
Removal of the TITAN TCP plate and drilling of the concrete support.



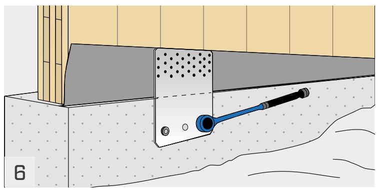
Accurate hole cleaning.



Injection of the anchor and insertion of the threaded rods into the holes.

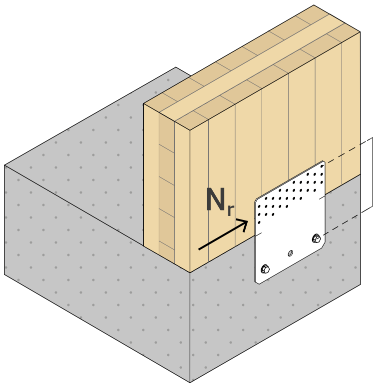


Installation of the TITAN TCP and nailing.

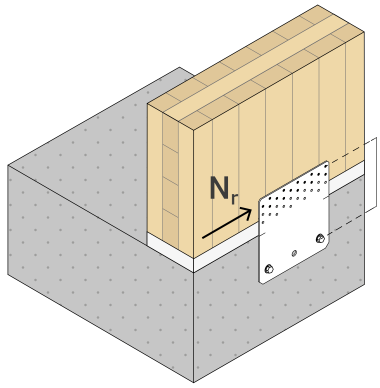


Positioning of nuts and washers by adequate tightening.

STRUCTURAL VALUES | **TCP200** | TIMBER-TO-CONCRETE | N_r



total fastening



partial fastening

TIMBER STRENGTH

	TIMBER			STEEL TO TIMBER				STEEL TO CLT			CONCRETE		
configuration on timber	**fastening holes Ø5**			**N_r [1] Factored lateral resistance (K_D=1.15)**				**N_r [1][2] Factored lateral resistance (K_D=1.15)**			**fastening holes Ø13**		
	type	**Ø x L**	**n_V**	**G=0.35**	**G=0.42**	**G=0.49**	**G=0.55**	**E G = 0.35**	**E1 and V2 G = 0.42**	**E2 and V1 G = 0.49**	**Ø**	**n_V**	**e_y [3]**
		[mm]	[pcs]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[mm]	[pcs]	[mm]
total fastening	LBA	Ø4 x 60	30	**37,2**	**40,7**	**43,8**	**46,4**	**35,3**	**38,6**	**41,6**	M12	2	147
	LBS	Ø5 x 60	30	**42,1**	**47,1**	**51,8**	**55,6**	**40,8**	**45,7**	**50,2**			
partial fastening	LBA	Ø4 x 60	15	**18,6**	**20,3**	**21,9**	**23,2**	**17,6**	**19,3**	**20,8**			162
	LBS	Ø5 x 60	15	**21,1**	**23,5**	**25,9**	**27,8**	**20,4**	**22,8**	**25,1**			

CONCRETE STRENGTH

Concrete strength values of some of the possible anchoring solutions, according to the configurations adopted for fastening on timber (e_y). It is assumed that the plate is positioned with the assembly notches at the timber-to-concrete interface (distance between anchor and concrete edge c_{a1} = 90 mm).

			total fastening (e_y = 147 mm)	partial fastening (e_y = 162 mm)
configuration on concrete	**fastening holes Ø13**		**N_r**	**N_r**
	type	**Ø x L**	**concrete resistance**	**concrete resistance**
		[mm]	[kN]	[kN]
uncracked	VIN-FIX 5.8	M12 x 140	**9,7**	**8,8**
		M12 x 195	**9,7**	**8,8**
	SKR	12 x 90	**8,5**	**7,7**
	AB1	M12 x 100	**9,1**	**8,2**
cracked	VIN-FIX 5.8	M12 x 140	**6,9**	**6,3**
		M12 x 195	**6,9**	**6,3**
	SKR	12 x 90	**6,0**	**5,5**
	AB1	M12 x 100	**6,5**	**5,9**
seismic	HYB-FIX 8.8	M12 x 140	**6,9**	**6,3**
		M12 x 195	**6,9**	**6,3**
	EPO-FIX 8.8	M12 x 140	**6,9**	**6,3**

NOTES

[1] Values for factored lateral resistance for self-taping screws are determined following the guidelines in Section 12.12 in CSA-O86 2024. 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] Eccentricity of calculation for verification of the anchor-to-concrete group.

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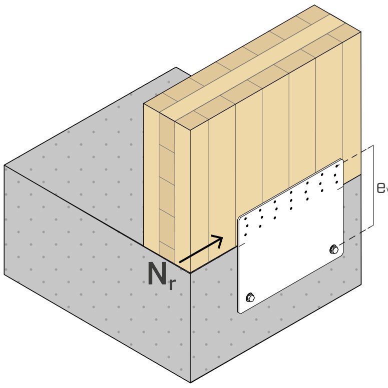
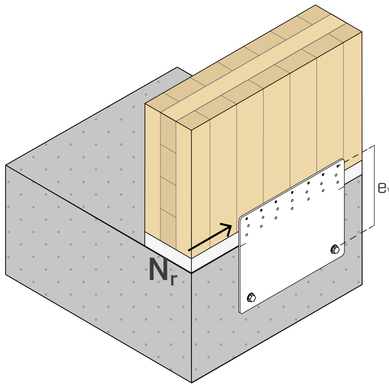
STRUCTURAL VALUES | **TCP300** | TIMBER-TO-CONCRETE | N_r



total fastening



partial fastening

TIMBER STRENGTH

	TIMBER			STEEL TO TIMBER				STEEL TO CLT			CONCRETE		
configuration on timber	**fastening holes Ø5**			**N_r [(1)] Factored lateral resistance (K_D=1.15)**				**N_r [(1)(2)] Factored lateral resistance (K_D=1.15)**			**fastening holes Ø13**		
	type	**Ø x L**	**n_V**	**G=0.35**	**G=0.42**	**G=0.49**	**G=0.55**	**E G = 0.35**	**E1 and V2 G = 0.42**	**E2 and V1 G = 0.49**	**Ø**	**n_V**	**e_y [(3)]**
		[mm]	[pcs]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[mm]	[pcs]	[mm]
total fastening	LBA	Ø4 x 60	21	**26,1**	**28,6**	**30,9**	**32,7**	**24,5**	**27,1**	**29,3**	M16	2	180
	LBS	Ø5 x 60	21	**29,5**	**33,0**	**36,3**	**39,0**	**28,6**	**32,0**	**35,2**			
partial fastening 14 fasteners	LBA	Ø4 x 60	14	**17,4**	**19,1**	**20,6**	**21,8**	**16,3**	**18,1**	**19,5**			190
	LBS	Ø5 x 60	14	**19,7**	**22,0**	**24,2**	**26,0**	**19,1**	**21,3**	**23,5**			
partial fastening 7 fasteners	LBA	Ø4 x 60	7	**8,7**	**9,5**	**10,3**	**10,9**	**8,2**	**9,0**	**9,8**			200
	LBS	Ø5 x 60	7	**9,8**	**11,0**	**12,1**	**13,0**	**9,5**	**10,7**	**11,7**			

CONCRETE STRENGTH

Concrete strength values of some of the possible anchoring solutions, according to the configurations adopted for fastening on timber (e_y). It is assumed that the plate is positioned with the assembly notches at the timber-to-concrete interface (distance between anchor and concrete edge c_{a1} = 130 mm).

			total fastening (e_y = 180 mm)	partial fastening (e_y = 190 mm)	partial fastening (e_y = 200 mm)
configuration on concrete	**fastening holes Ø17**		**N_r**	**N_r**	**N_r**
	type	**Ø x L**	**concrete resistance**	**concrete resistance**	**concrete resistance**
		[mm]	[kN]	[kN]	[kN]
uncracked	VIN-FIX 5.8	M16 x 195	**25,3**	**24,0**	**22,8**
	SKR	16 x 130	**23,3**	**22,1**	**21,0**
	AB1	M16 x 145	**23,3**	**22,1**	**21,0**
cracked	VIN-FIX 5.8	M16 x 195	**18,1**	**17,1**	**16,3**
	SKR	16 x 130	**16,6**	**15,8**	**15,0**
	AB1	M16 x 145	**16,6**	**15,8**	**15,0**
seismic	HYB-FIX 8.8	M16 x 195	**18,1**	**17,1**	**16,3**
		M16 x 245	**18,1**	**17,1**	**16,3**
	EPO-FIX 8.8	M16 x 195	**18,1**	**17,1**	**16,3**

NOTES

(1) Values for factored lateral resistance for self-taping screws are determined following the guidelines in Section 12.12 in CSA-O86 2024. 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.

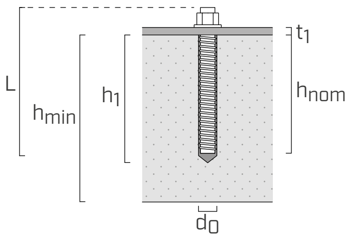
(2) Adjustment factor for connections (J_x) is assumed to be equal to 0,9 for CLT connections.

(3) Eccentricity of calculation for verification of the anchor-to-concrete group.

ANCHORS INSTALLATION PARAMETERS

installation	anchor type		t_1	h_{ef}	h_{nom}	h_1	d_0	h_{min}
	type	Ø x L [mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
TCP200	VIN-FIX 5.8 HYB-FIX 8.8 EPO-FIX 8.8	M12 x 140	3	112	112	120	14	150
	SKR	12 x 90	3	64	87	110	10	
	AB1	M12 x 100	3	70	80	85	12	
	VIN-FIX 5.8	M12 x 195	3	170	170	175	14	200
	HYB-FIX 8.8							
TCP300	VIN-FIX 5.8 HYB-FIX 8.8 EPO-FIX 8.8	M16 x 195	4	164	164	170	18	200
	SKR	16 x 130	4	85	126	150	14	
	AB1	M16 x 145	4	85	97	105	16	
	HYB-FIX 8.8	M16 x 245	4	210	210	215	18	250

Precut INA threaded rod, with nut and washer: see www.rothoblaas.com.
MGS threaded rod class 8.8 to be cut to size: see www.rothoblaas.com..



t_1	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 N_r

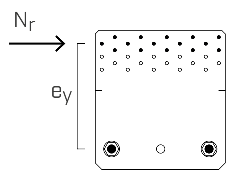
Fastening to concrete using anchors must be verified on the basis of the load acting on the anchors, which depend on the timber fastening configuration.

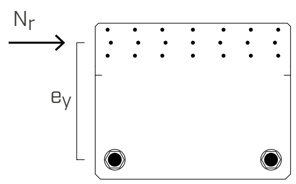
The position and number of nails/screws determine the ey eccentricity value, understood as the distance between the centre of gravity of the nailing and that of the anchors.

The anchor group must be verified for:

$V_r = N_r$

$M_r = N_r \cdot e_y$





GENERAL PRINCIPLES

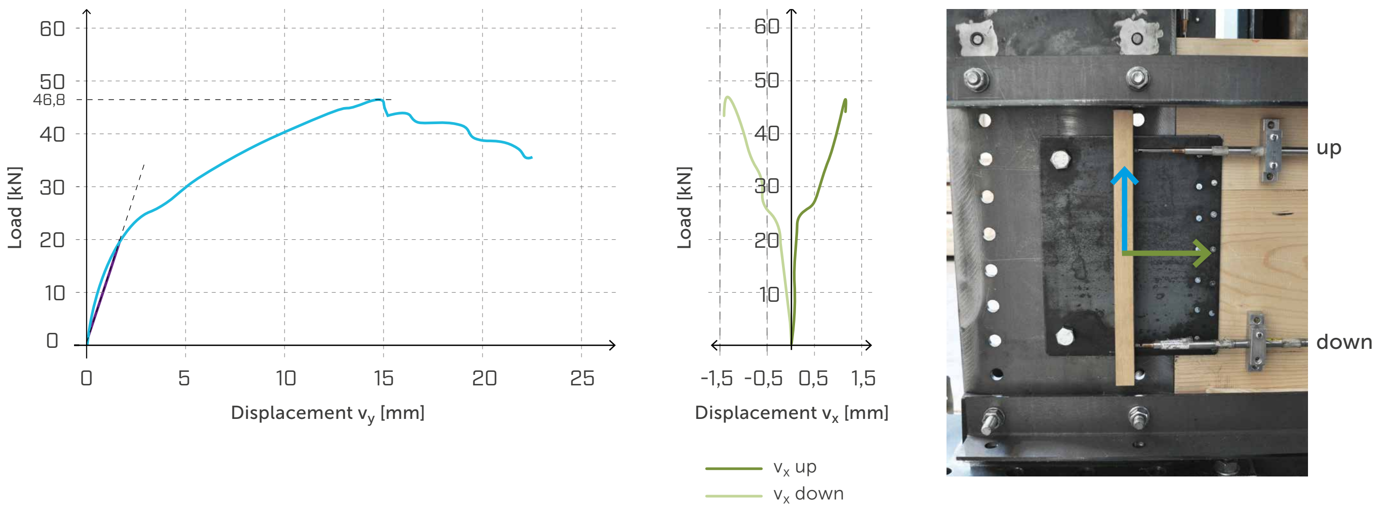
- The lateral resistance of LBS screws and LBA nails is determined according to CSA O86:2024, section 12.12 (self-tapping screws) and section 12.9 (nails and spikes), respectively.
- The specified bending yield strength value of LBS Ø5 is f_{yb} = 1047 MPa and for LBA Ø4 is f_{yb} = 645 MPa.
- G is the mean relative density according to Table A.12 in CSA O86:2024. Most common wood species are assumed such as Northern species (G = 0,35), Spruce-Pine-Fir (G = 0,42), Douglas Fir (G = 0,49), and Southern Pine (G =0,55).
- Dimensioning and verification of the timber elements must be carried out separately.
- The calculation of the concrete anchors is performed following CSA A23.3:2024, Annex D.
- The characteristic bond stress of adhesive anchors in uncracked concrete is taken from European Technical Assessment test reports.
- Seismic design is carried out for a heavy seismic zone without ductility requirements for the anchors.
- The bond strength of HYB-FIX and EPO-FIX for seismic design is calculated by multiplying τ_{uncr} by 0.8, according to Section D.6.5.2 in CSA A23.3:2024.
- The anchor calculation is based on C25/30 concrete.
- Edge distance and concrete thickness is not assumed critical for this calculation.
- 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;
  - SKR screw-in anchor according to ETA-24/0024;
  - AB1 mechanical anchor according to ETA-17/0481 (M12);
  - AB1 mechanical anchor according to ETA-99/0010 (M16).

INTELLECTUAL PROPERTY

- TITAN PLATE C plates are protected by the following Registered Community Designs:
  - RCD 002383265-0003;
  - RCD 008254353-0014.

EXPERIMENTAL INVESTIGATIONS | TCP300

In order to calibrate the numerical models used for the design and verification of the TCP300 plate, an experimental campaign was carried out in collaboration with the Institute for BioEconomy (IBE) - San Michele all'Adige.
The connection system nailed or screwed to CLT panels (European wood species) has been shear stressed through monotonic tests in displacement control, registering the load, displacement in the two main directions and collapse mode.
The results obtained were used to validate the analytical calculation model for the TCP300 plate, based on the hypothesis that the shear centre is placed at the centre of gravity of the fastenings on timber. Therefore that the anchors, usually the weak point of the system, are stressed not only by the shear actions but also by the local moment.
The study in different fastening configurations (Ø4 nails/Ø5 screws, full nailing, partial nailing with 14 connectors, partial nailing with 7 connectors) shows that the mechanical behaviour of the plate is strongly influenced by the **relative stiffness of the connectors** on timber compared to that of the anchors, in tests simulated by bolting on steel.
In all cases a shear failure mode of the timber fasteners has been observed, which does not result in evident plate rotation. Only in some cases (full nailing) the non-negligible rotation of the plate leads to an increase in stress on the timber fasteners resulting from a redistribution of the local moment with consequent stress relief on the anchors, which represent the limiting point of the overall strength of the system.



Load-to-displacement diagrams for TCP300 specimen with partial nailing (no. 14 LBA Ø4 x 60 mm nails).

Further investigations are necessary in order to define an analytical model that can be generalized to the different configurations of use of the plate that is able to provide the actual stiffness of the system and the redistribution of stresses as the boundary conditions (connectors and base materials) vary.