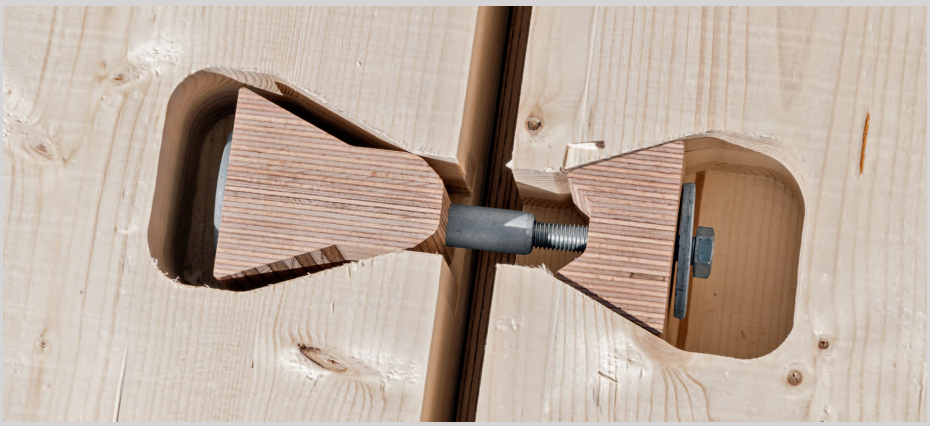
ETA - EUROPEAN TECHNICAL ASSESSMENT

HTC-P2P
Timber connector

ETA-26/0074 (02.03.2026)



English 2-25

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European Technical Assessment

ETA-26/0074 of 02.03.2026

General part

Technical Assessment Body issuing the European Technical Assessment	Österreichisches Institut für Bautechnik (OIB) Austrian Institute of Construction Engineering
Trade name of the construction product	Timber Connector HTC-P2P for static actions
Product family to which the construction product belongs	Point connectors – dovetails made of plywood for cross laminated timber
Manufacturer	Hilti Aktiengesellschaft Feldkircherstrasse 100 9494 Schaan LIECHTENSTEIN
Manufacturing plant	Hilti Plant 1
This European Technical Assessment contains	24 pages including 16 annexes which form an integral part of this assessment. Annex 1A contains confidential information and is not included in the European Technical Assessment when that assessment is publicly disseminated.
This European Technical Assessment is issued in accordance with Article 95(4) of Regulation (EU) 2024/3110, on the basis of	European Assessment Document (EAD) 130336-00-0603 “Point connectors – dovetails made of plywood for cross laminated timber”.

Specific parts

1 Technical description of the product

1.1 General

This European Technical Assessment (ETA) applies to the point connector for cross laminated timber "Timber Connector HTC-P2P for static actions" in the following referred to as "Timber Connector HTC-P2P". Timber Connector HTC-P2P is composed of plug and socket (two wedges) made of plywood additionally connected with a steel threaded system.

The geometry and dimensions of the Timber Connector HTC-P2P are given in Annexes 1 to 4.

Timber Connector HTC-P2P and the components for its manufacturing correspond to the specifications given in Annex 1 to 4 and 1A. The material characteristics, dimensions and tolerances of the Timber Connector HTC-P2P, not indicated in these Annexes, are given in the technical file[1] of the European Technical Assessment.

This ETA covers:

- Standard configurations of connectors (HTC-P2P) and
- Extended configurations of connectors (HTC-P2P LB; HTC-P2P LB DP).

The application of wood preservatives and flame retardants is not subject of this European Technical Assessment.

1.2. Components

1.2.1. Plug and socket of plywood

Plug and socket are made of plywood made of beech for load-bearing applications according to EN 13986[2] and EN 636[3]. The specification of the plywood is given in Annex 1, Table 1.

Wood species is European beech.

1.2.2. Steel threaded system

Geometry of the steel components according to DIN 1052 (washer M12), DIN 933 (hexagon head screw M12x100 for HTC-P2P or up to M12x500 for HTC-P2P LB, HTC-P2P LB DP) and AISI 1008 (sleeve M12). The specification of the steel threaded system is given in Annex 1, Table 1.

2 Specification of the intended use(s) in accordance with the applicable European Assessment Document (thereafter EAD)

2.1 Intended use

Timber Connector HTC-P2P is intended to be used as non-structural or structural connector for cross laminated timber to cover:

- For standard configurations of connectors: in-plane shear and/or tension loads;
- For extended configurations of connectors (HTC-P2P LB, HTC-P2P LB DP): tension loads;

For joint configurations see Annex 8 and 9. Extended configurations of connectors (HTC-P2P LB, HTC-P2P LB DP) can be used for connection of cross laminated timber that adjoin a perpendicularly oriented structure on both sides. Analysis of the structural integrity of such joints and interaction between the structures are not in the scope of the ETA and shall be done separately.

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[1] The technical file of the European Technical Assessment is deposited at Österreichisches Institut für Bautechnik and, in so far as is relevant to the tasks of the notified product certification body involved in the assessment and verification of constancy of performance procedure, is handed over to the notified product certification body.

[2] EN 13986:2004+A1:2015

[3] EN 636:2012+A1:2015

Timber Connector HTC-P2P is intended to be used as a shear connector for butt joints and able to cover tension loads.

Timber Connector HTC-P2P is not applicable to transfer bending moments or resist out-of-plane shear loads.

The point connectors are subjected to static and quasi static (all configurations) actions. The point connectors are intended to be used in service classes 1 and 2 according to EN 1995-1-1[4].

The following applies to the cross laminated timber to be connected:

- Minimum thickness is:
  - For HTC-P2P 60mm: 80 mm
  - For HTC-P2P 90mm: 120 mm
- Minimum 3 crosswise arranged layers.
- Minimum thickness of the layer (layers) being engaged in the load transfer (oriented in the load direction) by the fully embedded connector is:
  - For HTC-P2P 60 mm: 0 mm (for panels with a double top layer) or 20 mm (for panels with a single top layer)
  - For HTC-P2P 90 mm: 13 mm (for panels with a double top layer) or 20 mm (for panels with a single top layer)
- Minimum strength class of lamellas is C16, average strength class of lamellas is C24 according to EN 338[5].
- Close contact or glued edge surfaces of the lamellas within one layer.

2.2 General assumptions

The connector is manufactured in accordance with the provisions of the European Technical Assessment using the manufacturing process as identified in the inspection of the manufacturing plant by Österreichisches Institut für Bautechnik and laid down in the technical file.

The manufacturer shall ensure that the requirements in accordance with the Clauses 1, 2 and 3 as well as with the Annexes of the European Technical Assessment are made known to those who are concerned with planning and execution of the works.

Design

This European Technical Assessment only applies to the manufacture and use of the point connector. Verification of stability of the works including application of loads on the point connector is not subject to this European Technical Assessment.

The following conditions shall be observed:

– Design of the point connector is carried out under the responsibility of an engineer experienced in such products.
– Design of the works shall account for the protection of the point connector to maintain service classes 1 and 2 according to EN 1995-1-1.
– The point connector is installed correctly.

Design of Timber Connector HTC-P2P may be according to TR 085, EN 1995-1-1, EN 1995-1-2[6] and EN 1998-1[7], taking into account Annexes 12 to 16 of this European Technical Assessment.

Standards and regulations in force at the place of use shall be considered.

[4] EN 1995-1-1:2004 +AC:2006 +A1:2008 +A2:2014
[5] EN 338:2016
[6] EN 1995-1-2:2004 + AC:2006 + AC:2009
[7] EN 1998-1:2004 + AC:2009 + A1:2013

Packaging, transport, storage, maintenance, replacement and repair

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

Installation

It is assumed that the product will be installed according to the manufacturer's instructions. Actual manufacturer's instructions are shown in Annex 10 and 11 or in the package with the product.

Connector can be removed from the cutout (optional step as shown in the Annex 11). Connector can be re-installed only when not subjected to loading or in-service conditions after installation.

2.3 Assumed working life

The provisions made in the European Technical Assessment (ETA) are based on an assumed intended working life of the Timber Connector HTC-P2P of 50 years, when installed in the works, provided that the point connector is subject to appropriate installation, use and maintenance (see Clause 2.2). These provisions are based upon the current state of the art and the available knowledge and experience[8].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA nor by the Technical Assessment Body but are regarded only as means for choosing the appropriate products in relation to the expected economically reasonable working life of the works.

[8] The real working life of a product incorporated in specific works depends on the environmental conditions to which those works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product can also be shorter than the assumed working life.

3 Performance of the product and reference to the methods used for its assessment

3.1. Performance of the product

Table 1: Performance of the product in relation to the essential characteristics

Essential characteristic	Method of assessment	Performance
Basic Work Requirement 1: Mechanical resistance and stability		
Tension strength and stiffness	EAD 130336-00-0603, Clause 2.2.1	Annex 12, 13 and 14
Shear strength and stiffness	EAD 130336-00-0603, Clause 2.2.2	Annex 12, 15 and 16
Embedment depth	EAD 130336-00-0603, Clause 2.2.3	Annex 6 and 12
Spacing, end and edge distances of the connector	EAD 130336-00-0603, Clause 2.2.4	Annex 7 and 12
Dimensional stability	EAD 130336-00-0603, Clause 2.2.5	Annex 12
Basic Work Requirement 2: Safety in case of fire		
Reaction to fire	EAD 130336-00-0603, Clause 2.2.6	Annex 12
Basic Work Requirement 3: Hygiene, health and the environment		
Emission of formaldehyde	EAD 130336-00-0603, Clause 2.2.7	Annex 12
Aspects of durability		
Durability	EAD 130336-00-0603, Clause 2.2.8	Annex 12

3.2. Assessment methods

3.2.1. General

The assessment of the essential characteristics in Clause 3.1 of the Timber Connector HTC-P2P for the intended use, and in relation to the requirements for mechanical resistance and stability, for safety in case of fire and for hygiene, health and the environment in the sense of the basic requirements for construction works № 1, 2 and 3 of Regulation (EU) № 305/2011 has been made in accordance with the European Assessment Document EAD 130336-00-0603, Point connectors – dovetails made of plywood for cross laminated timber.

3.2.2. Identification

The European Technical Assessment for the Timber Connector HTC-P2P is issued based on agreed data that identify the assessed product. Changes to materials, to composition, to characteristics of the product, or to the production process could result in these deposited data being incorrect. Österreichisches Institut für Bautechnik should be notified before the changes are implemented, as an amendment of the European Technical Assessment is possibly necessary.

4. Assessment and verification of constancy of performance (thereinafter AVCP) system applied, with reference to its legal base

4.1. System of assessment and verification of constancy of performance

According to Commission Decision 97/176/EC[9] the system of assessment and verification of constancy of performance to be applied to "Timber Connector HTC-P2P" is System 3. System 3 is detailed in Commission Delegated Regulation (EU) № 568/2014[10] of 18 February 2014, Annex, 1.4, and provides for the following items.

(a) The manufacturer shall carry out factory production control.

(b) The notified laboratory shall assess the performance based on testing (based on sampling carried out by the manufacturer), calculation, tabulated values or descriptive documentation of the construction product.

4.2. Construction products for which a European Technical Assessment has been issued

Notified bodies undertaking tasks under System 3 shall consider the European Technical Assessment issued for the construction product in question as the assessment of the performance of that product. Notified bodies shall therefore not undertake the tasks referred to in point 4.1 (b).

5. Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

5.1. Tasks for the manufacturer

5.1.1. Factory production control

In the manufacturing plant the manufacturer shall establish and continuously maintain a factory production control. All data, procedures, and specifications adopted by the manufacturer are documented in a systematic manner in the form of instructions manual (user's guides) and process instructions. Purpose of factory production control is to ensure the constancy of performances of the product with regard to the essential characteristics.

The manufacturer shall only use raw materials supplied with the relevant inspection documents as laid down in the control plan. The incoming raw materials shall be subject to controls by the

[9] Official Journal of the European Communities OJ L 073, 14.3.1997, p.19

[10] Official Journal of the European Communities OJ L 157, 27.5.2014, p.76

manufacturer before acceptance. Check of incoming materials shall include control of inspection documents presented by the manufacturer of the raw materials.

The frequency of control and testing performed within factory production control as well as on the finished product, is in accordance with the determined manufacturing process and the prescribed test plan. The factory production control's results of testing are recorded and evaluated. The records are kept at least for ten years after the product has been placed on the market. On request the records are presented to Österreichisches Institut für Bautechnik. The records shall include at least:

- Designation of the product, basic materials and components
- Type of control or test
- Date of manufacture of the product and date of testing of the product or basic materials or components
- Results of controls and tests and, if appropriate, comparison with requirements
- Name and signature of person responsible for factory production control

If test results are unsatisfactory, the manufacturer immediately implements measures to eliminate the defects. Products or components that are not in conformity with the requirements are removed. After elimination of the defects, the respective test – if verification is required for technical reasons – is repeated immediately.

5.1.2. Declaration of performance

The manufacturer is responsible for preparing the declaration of performance. When all the criteria of the assessment and verification of constancy of performance are met, the manufacturer shall draw up a declaration of performance.

Issued in Vienna on 02.03.2026
by Österreichisches Institut für Bautechnik

The original document is signed by:

Thomas Rockenschaub

Managing Director

Product description – Standard configurations of the Connector

Figure 1: Main components of the HTC-P2P

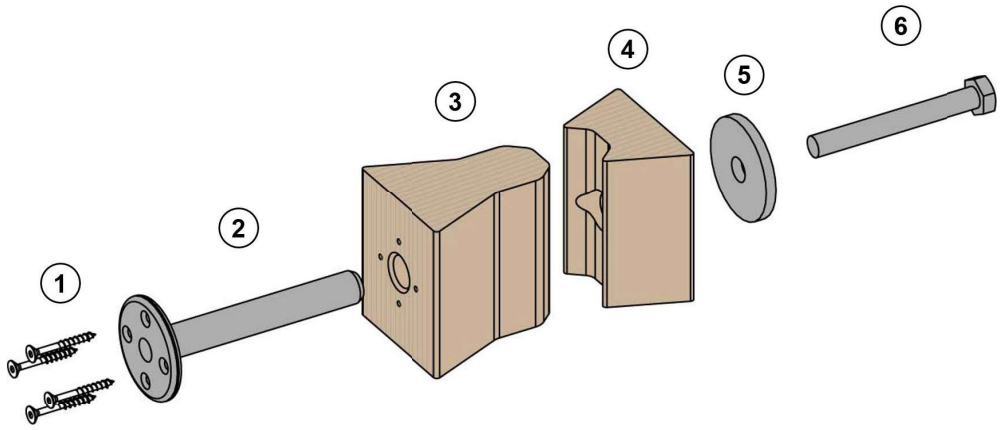


Table 1: Materials

Pos.	Item	Dimension / Specification
1	Timber screws	Carbon steel, Coating – galv. Zn (minimum thickness ≥ 5 µm), Size 3,5 x 30…40, Countersunk head, EN 14592
2	Internally threaded sleeve	Carbon steel AISI1008, (tensile strength ≥ 300 N/mm², yield strength ≥ 180 N/mm²); Coating – galv. Zn or HDG (minimum thickness ≥ 12 µm)
3, 4	Timber elements – Plug (3) and Socket (4)	Beech plywood; Planed, sanded, milled surface; Mechanical strength and stiffness – according to Annex 1A; Bonding quality - Class 3 acc. to EN 314-2; k_{mod}, k_{def} acc. EN 1995-1-1; Use class 3 acc. to EN 335 Nominal height: - 60 mm (for HTC-P2P 60mm) - 90 mm (for HTC-P2P 90mm)
5	Oversized flat washer	Carbon steel, Coating – galv. Zn or HDG (minimum thickness ≥ 5 µm), thickness 6 mm, DIN 1052
6	Screw	Carbon steel, strength class 8.8 (tensile strength ≥ 800 N/mm², yield strength ≥ 640 N/mm²), Coating – galv. Zn (minimum thickness ≥ 5 µm), Size M12x100, Hexagonal head, wrench size SW19, DIN 933

Figure 2: Main dimensions of the HTC-P2P

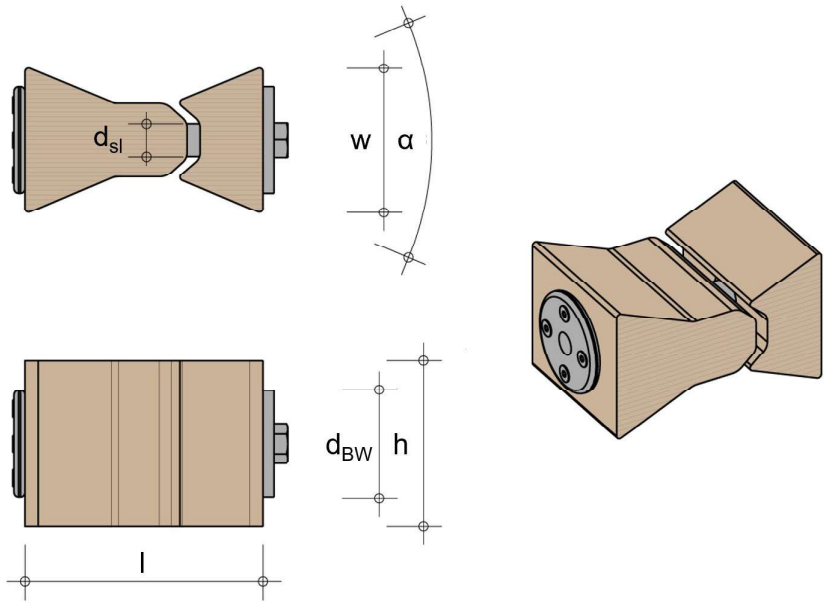


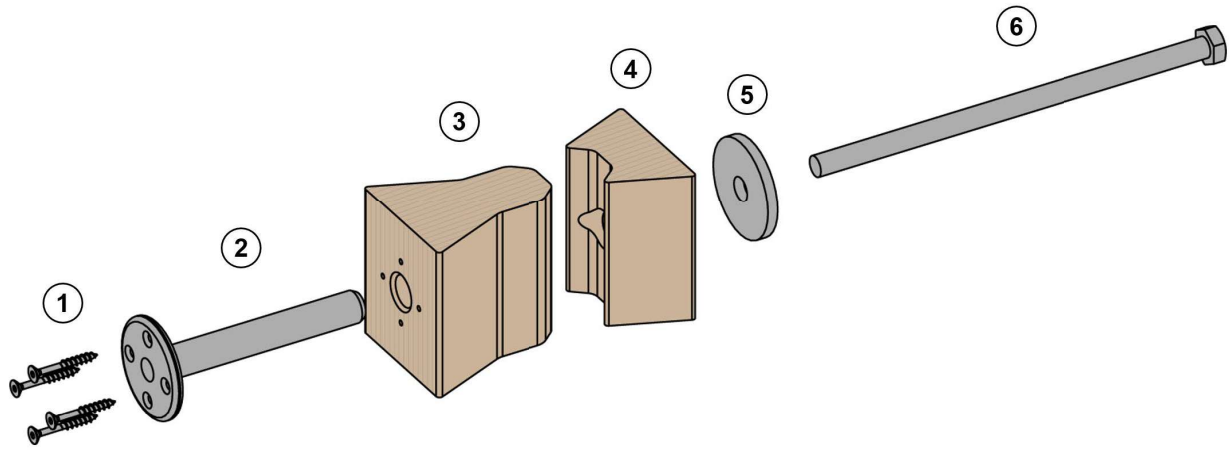
Table 2: Main dimensions of the Timber Connector HTC-P2P

Item	Symbol	Unit	Dimension / Specification	
			HTC-P2P 60 mm	HTC-P2P 90 mm
Assembled connector				
Height of the connector	h	[mm]	60,0 ±1	90,0 ±1
Length of the connector (not installed)	l	[mm]	120,0…210,0	
Width of the connector	w	[mm]	78,5 ±1	
Angle of inclination of wedges	α	[°]	45,0 ±1	
Internally threaded sleeve				
Outer diameter of the sleeve	d_{sl}	[mm]	≥ 18,0	
Nominal internal diameter	-	-	M12	
Oversized flat washer				
Outer diameter	d_{BW}	[mm]	≥ 58,0	

Product description – Extended configurations of the Connector

Figure 3: Main components of the HTC-P2P LB (a) and HTC-P2P LB DP (b).

a)



b)

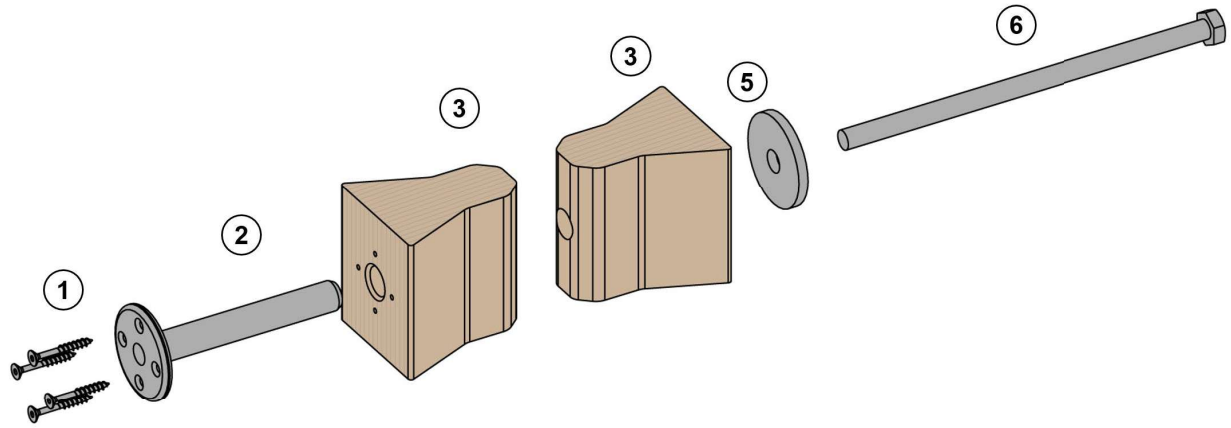
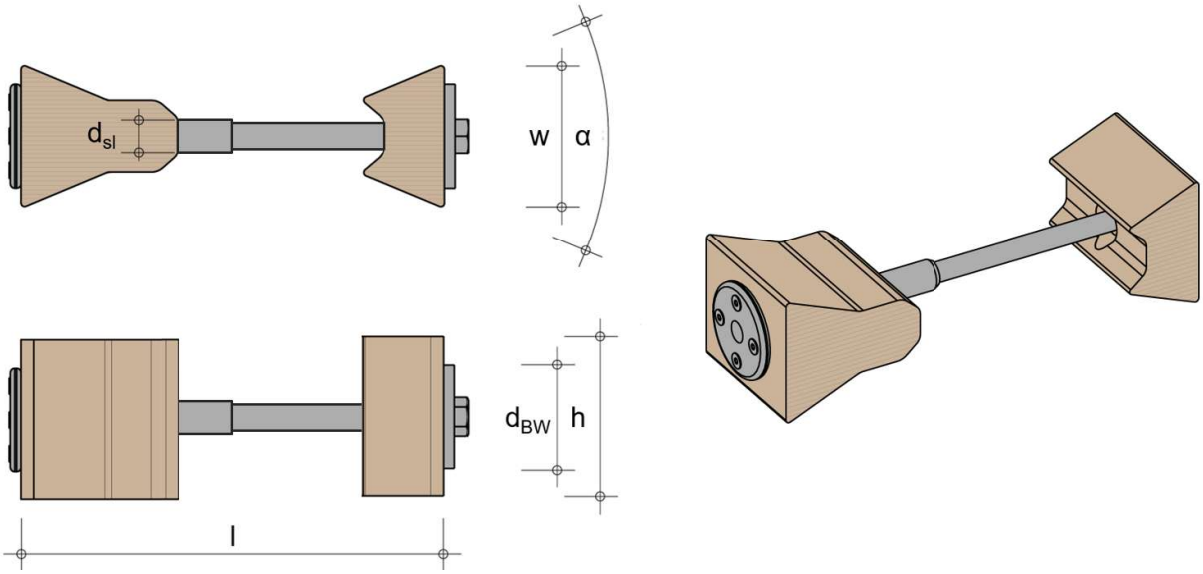


Table 3: Materials for the extended configurations of the connector (LB, LB DP)

Pos.	Item	Dimension / Specification
1	Timber screws	According to the Table 1
2	Internally threaded sleeve	
3, 4	Timber elements – Plug (3) and Socket (4); or Double Plug (3)	
5	Oversized flat washer	
6	Screw	Dimensions/Specification according to the Table 1, except: Size: M12x150 … M12x500

Figure 4: Main dimensions of the HTC-P2P LB (a) and HTC-P2P LB DP (b)

a)



b)

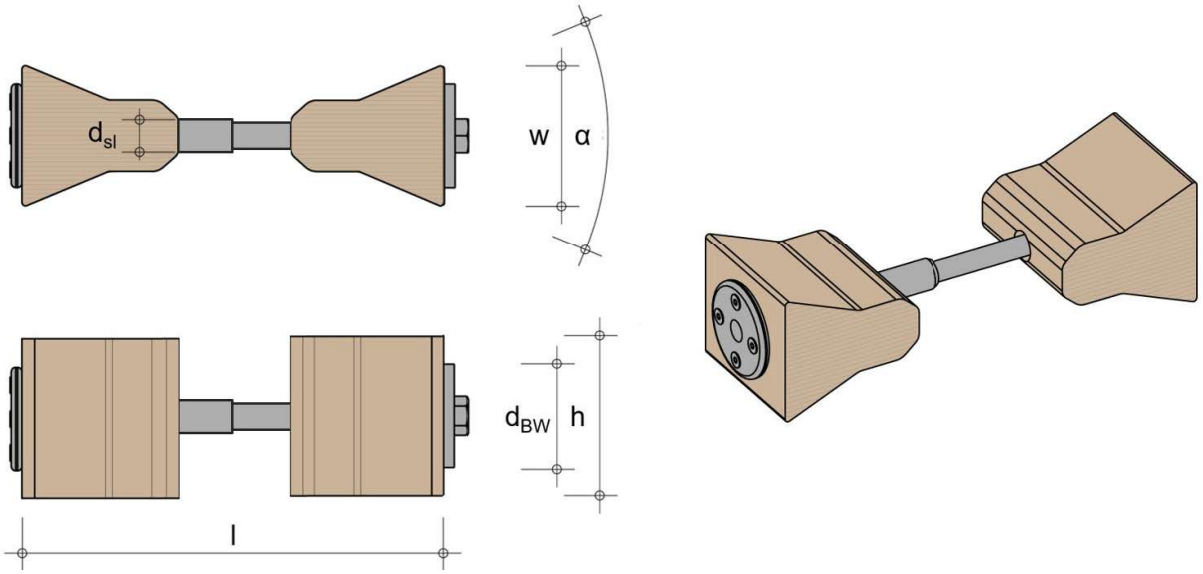


Table 4: Main dimensions of the extended configurations (LB, DP)

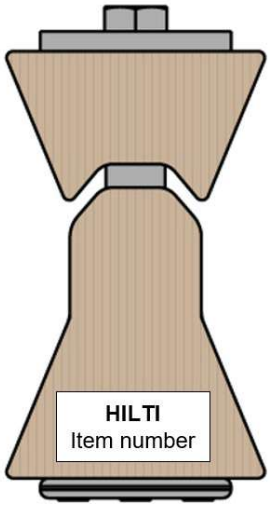
Item	Symbol	Unit	Dimension / Specification	
			HTC-P2P (LB) (DP) 60 mm	HTC-P2P (LB) (DP) 90 mm
Assembled connector – According to the Table 2, except				
Length of the connector (not installed)	l	[mm]	120,0 … 610	
Internally threaded sleeve – According to the Table 2				
Oversized flat washer – According to the Table 2				

Identification of the Connector:

e.g. HTC-P2P M12 (LB250) (DP) 90mm

HTC	- Identification mark of the manufacturer – Hilti Timber Connector
P2P	- Panel-to-Panel
M12	- Diameter of the bolt (e.g. M12)
LB	- Version with Long Bolt
250	- Length of a bolt (e.g. 250 – only for LB version)
DP	- Version with Double Plug
90mm	- Height of the connector (e.g. 90mm or 60mm)

Identification marks:



(example)

Connectors have stickers with the following information:

Hilti	- Name of the Manufacturer
Item number	- Unique item number for the specific configuration

Geometry of the Cutout

Figure 5: Cutout in the cross laminated timber (sketch)

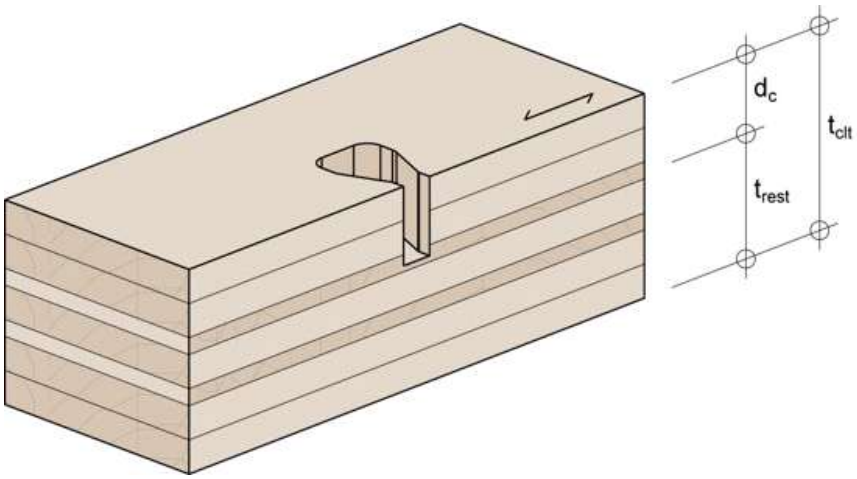
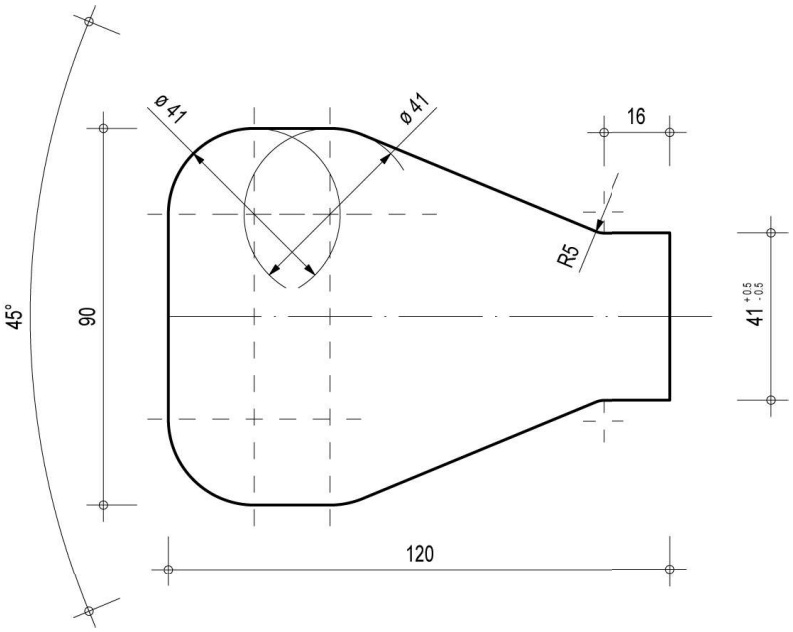


Figure 6: Main dimensions of the cutout



To install the Timber Connector HTC-P2P a cutout of predefined shape must be done inside the cross-laminated timber panel.

The geometry of cutout that accommodates the Timber Connector HTC-P2P is shown in Figure 6.

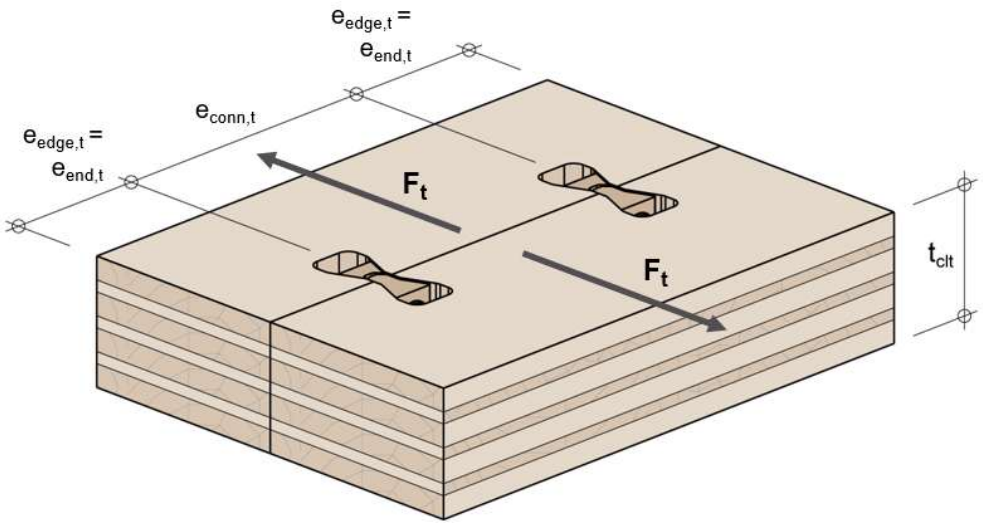
Recommended range of cutout depth is shown in the Table 5.

Cutout depth is selected in a way that the Connector is installed either sunk-in or flush with the surface of the timber element.

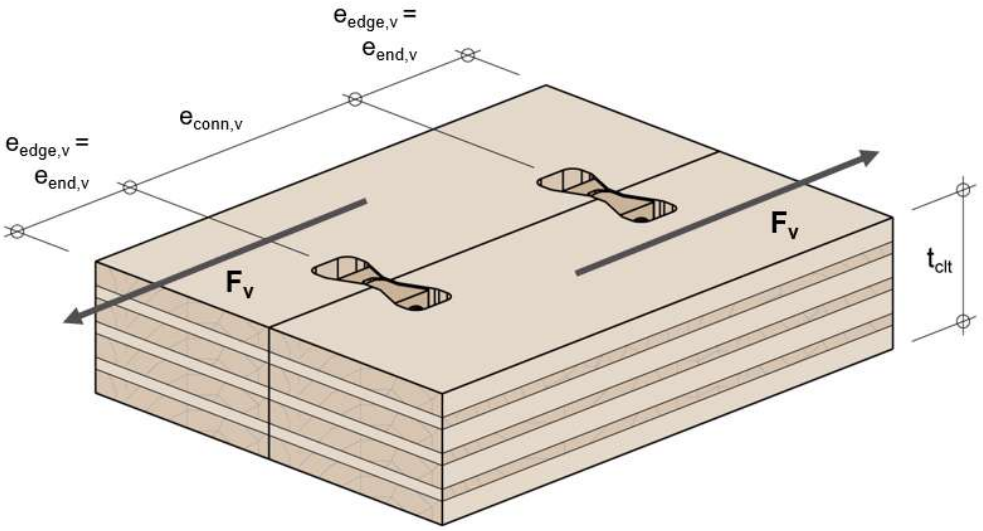
Minimum edge distances and spacings

Figure 7: Spacing, end, and edge distances of the connector in case of applied tension loads (a) or shear loads (b)

a)



b)

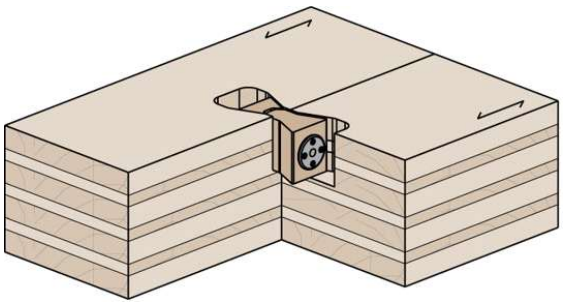


Note: Values of minimum edge and end distance and minimum spacing are shown in the Table 5.

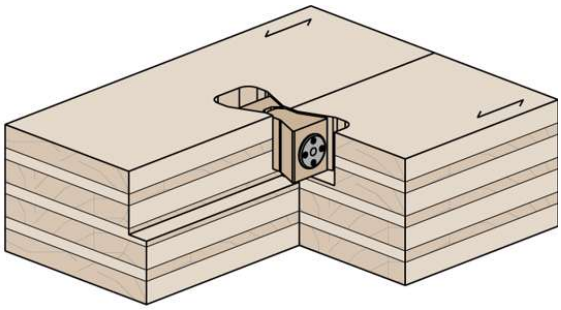
Product description Minimum edge distances and spacings	**Annex 7** of ETA-26/0074 of 02.03.2026

Installed condition – Standard configurations of the Connector

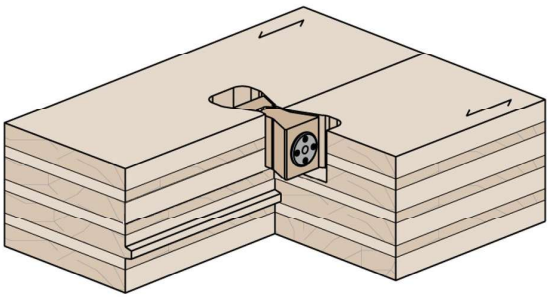
Figure 8: Typical joint configurations of the HTC-P2P



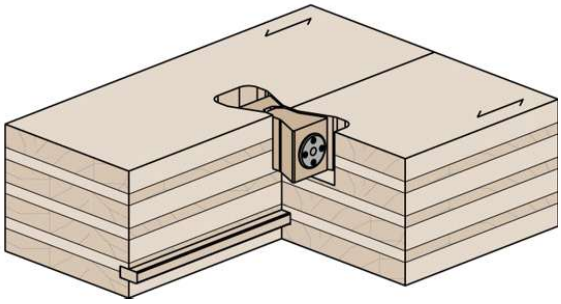
Flat joint



Overlap joint

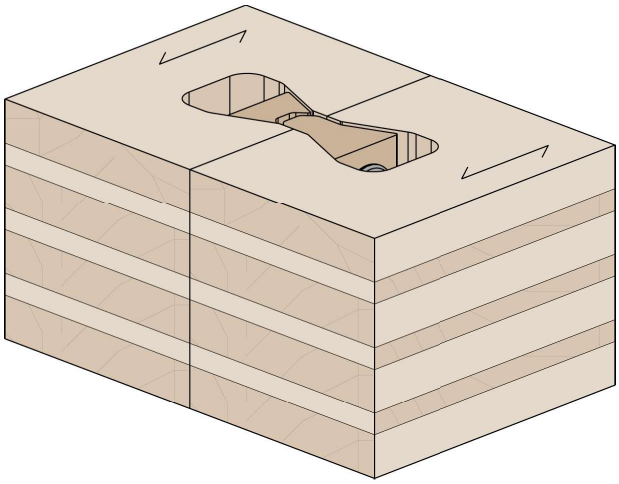


Profiled joint



Slot-key joint

Figure 9: Connector in assembled connection (sketch)



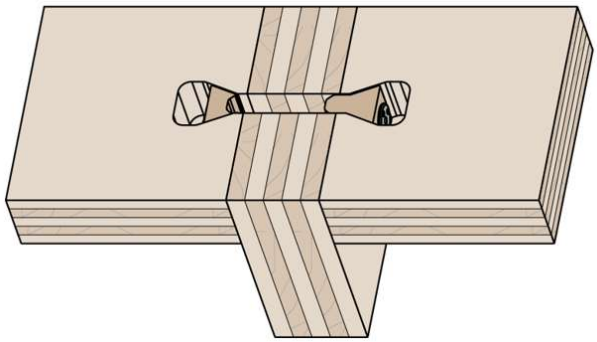
The HTC-P2P Connector shall be installed either sunk-in or flush with the surface of the timber element.

Protrusion of the connector above the surface of the panels is not allowed.

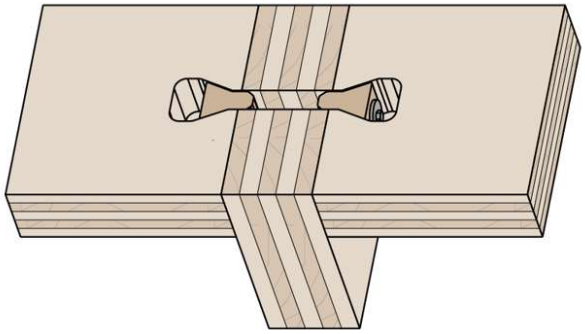
Installed condition – Extended configurations of the Connector

Figure 10: Typical joint configurations of the HTC-P2P LB (a) and HTC-P2P LB DP (b)

a)



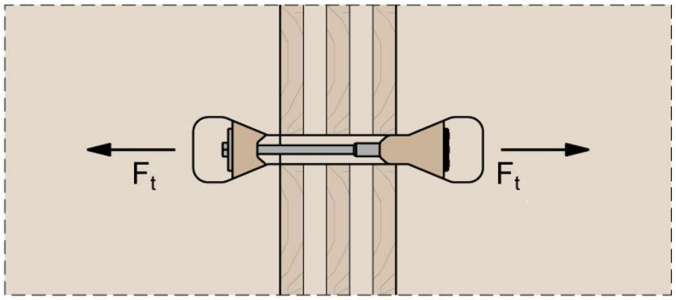
b)



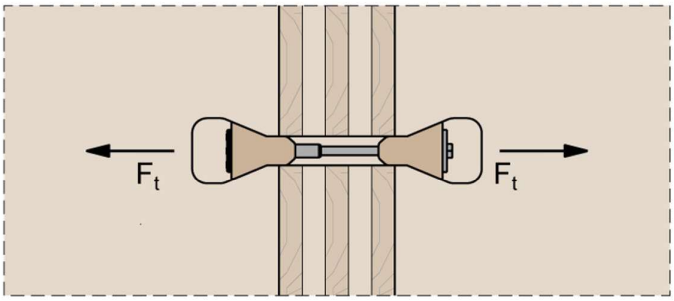
Flat joint (for tension loads only)

Figure 11: Connector HTC-P2P LB (a) and HTC-P2P LB DP (b) in assembled connection (sketch)

a)



b)



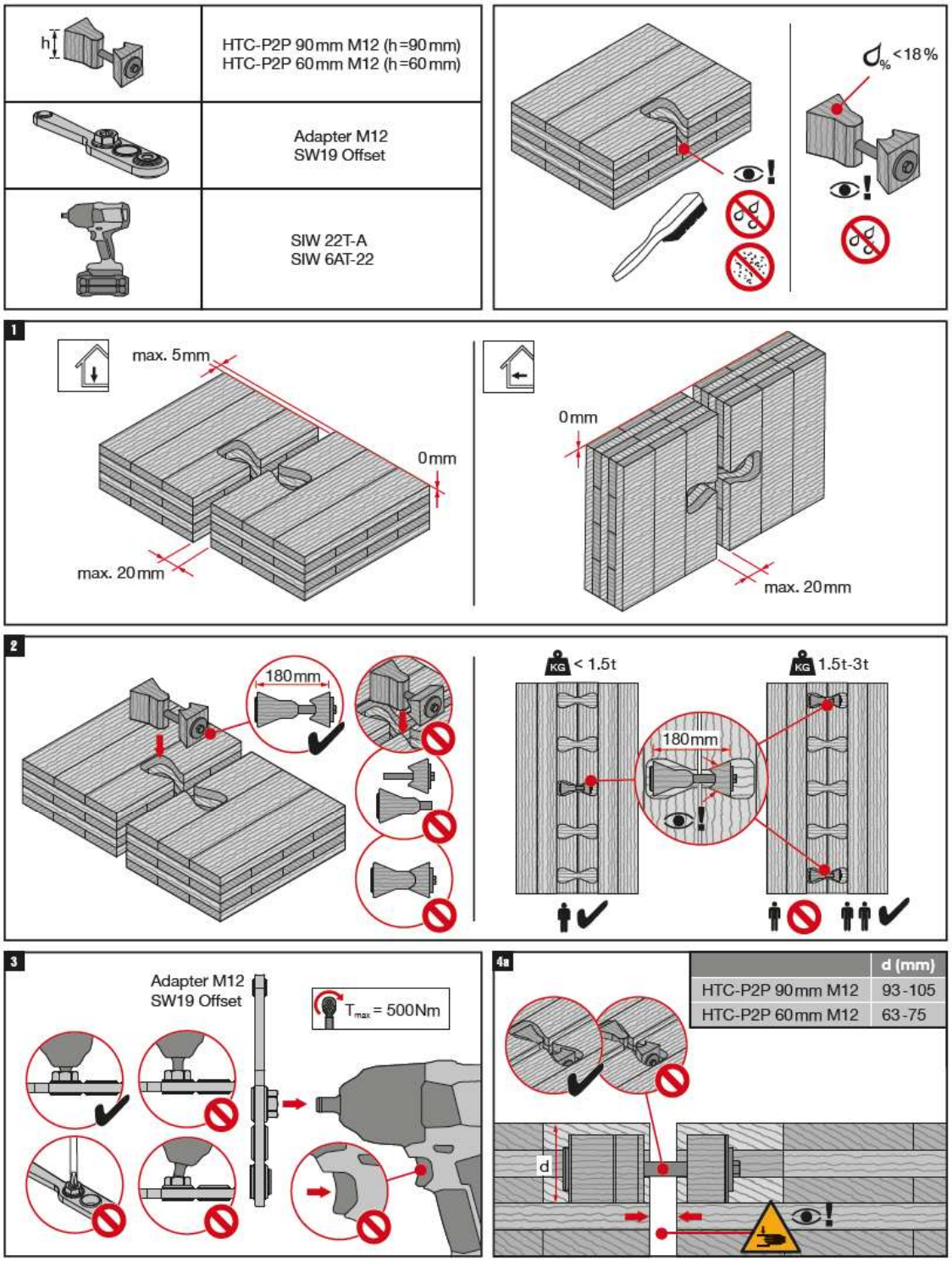
The HTC-P2P Connector shall be installed either sunk-in or flush with the surface of the timber element.

Protrusion of the connector above the surface of the panels is not allowed.

It is allowed to connect two CLT panels that adjoin a perpendicularly oriented structure on both sides (as shown on the sketch) to transfer only tension loads.

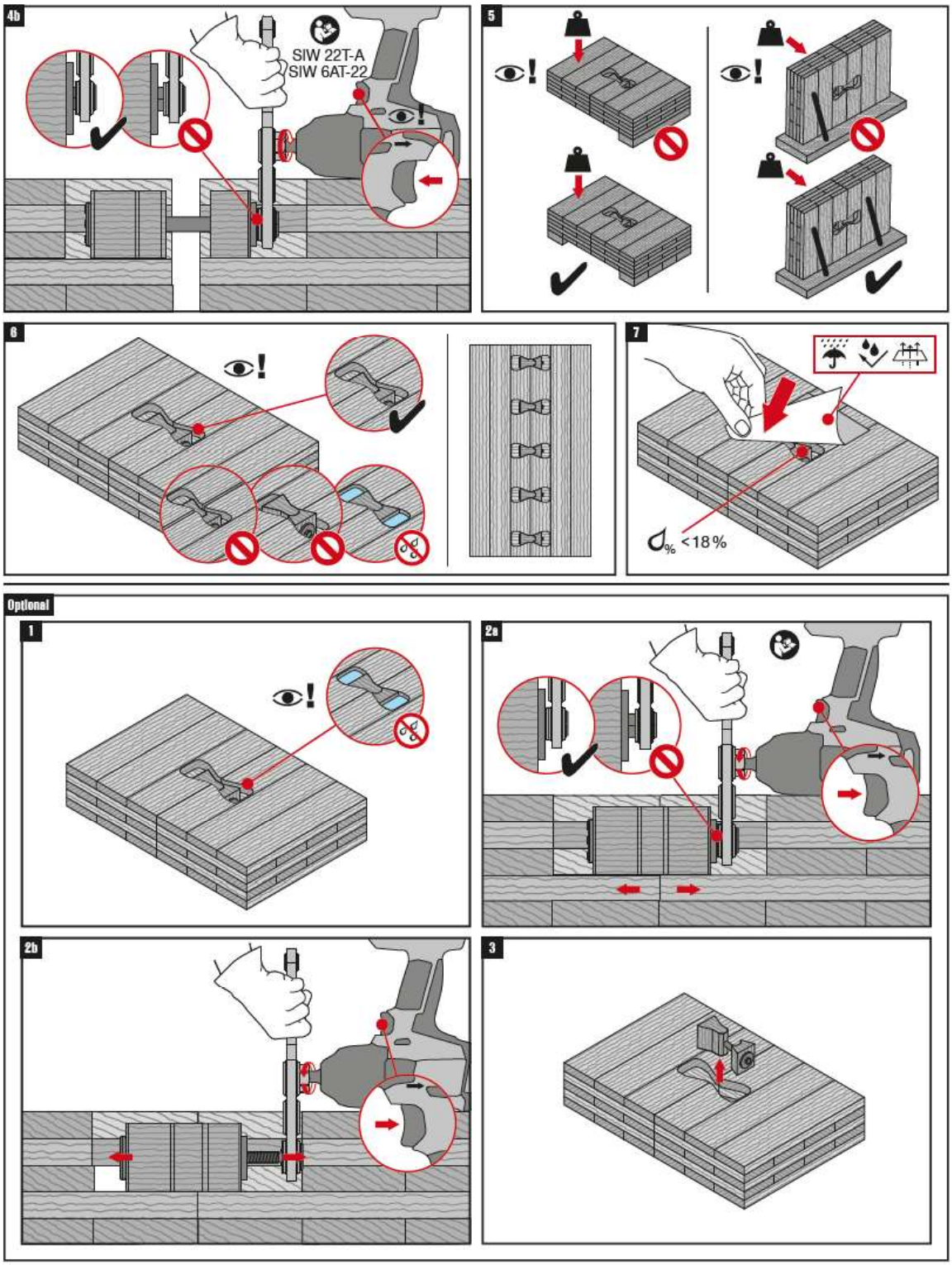
P2P Connector

2425994-2025.12.11



Product description Installation instructions	**Annex 10** of ETA-26/0074 of 02.03.2026

P2P Connector



Product description Installation instructions	**Annex 11** of ETA-26/0074 of 02.03.2026

Table 5: Product characteristics of Timber Connector HTC-P2P

BWR	Essential characteristic			Level / Class / Description	
				HTC-P2P 60mm	HTC-P2P 90mm
1	**Installation parameters**				
	In case of tension loads				
	Minimum edge distance, Minimum end distance	$e_{end,t}$ = $e_{edge,t}$	*[mm]*	250	
	Minimum spacing	$e_{conn,t}$	*[mm]*	500	
	In case of shear loads				
	Minimum edge distance, Minimum end distance	$e_{end,v}$ = $e_{edge,v}$	*[mm]*	300	
	Minimum spacing	$e_{conn,v}$	*[mm]*	300	
	In case of tension and shear loads				
	Cutout depth [1)]	d_c	*[mm]*	63…75	93…105
	Embedment depth of the connector	d_e	*[mm]*	60	90
	Minimum remaining cross-section depth	t_{rest}	*[mm]*	15	
	Minimum base material thickness	t_{clt}	*[mm]*	$d_c + t_{rest}$	
				≥ 80	≥ 120
	Mechanical resistance and stability				
	See Tables 6 and 7			-	
	Other mechanical actions				
	Dimensional stability				
	Moisture content of the connector in the moment of production		*[%]*	10 ± 2%	
	Moisture content during service shall not change to such an extent that adverse deformation will occur				
	Durability				
	Service classes			1 and 2	
2	**Reaction to fire**				
	Timber members (Beech plywood) End use condition: without an air gap behind the wood-based panel			Class D-s2-d0	
	Minimum characteristic density		*[kg/m³]*	400	
	Minimum thickness		*[mm]*	9	
	Steel members			Class A1	
3	**Hygiene, health and environment**				
	Emission of formaldehyde			Class E1	

Note:
[1)] Maximum cutout depth is limited by the length of the installation tool

Table 6: Product characteristics of Timber Connector HTC-P2P in case of tension loads for the Standard HTC-P2P and Extended configurations HTC-P2P LB and LB DP

BWR	Essential characteristic			Level / Class / Description for CLT panels with a	
				Single top layer	**Double top layer**
1	**Mechanical resistance and stability**				
	Characteristic resistance of the steel sleeve in tension	$R_{t,s,k}$	*[kN]*	50,0	
	Performance of the connector for the smallest, highest and intermediate effective ratios [1) 2)]				
	For the HTC-P2P 60mm (LB, LB DP)				
	Effective ratio in tension	$\beta_{II,t}$	*[-]*	0,33 … 0,66	0,00 … 1,00
	Char. tension strength	$R_{t,k}$	*[kN]*	$8,4 \times \beta_{II,t} + 18,3$	$9,9 \times \beta_{II,t} + 13,2$
	Stiffness (slip modulus)	$k_{ser,t}$	*[kN/mm]*	$-4,1 \times \beta_{II,t} + 8,7$	$0,3 \times \beta_{II,t} + 8,7$
	For HTC-P2P 90mm (LB, LB DP)				
	Effective ratio in tension	$\beta_{II,t}$	*[-]*	0,22 … 0,78	0,14 … 0,86
	Char. tension strength	$R_{t,k}$	*[kN]*	39,3	$16,5 \times \beta_{II,t} + 21,1$
	Stiffness (slip modulus)	$k_{ser,t}$	*[kN/mm]*	$-1,6 \times \beta_{II,t} + 10,9$	$-0,1 \times \beta_{II,t} + 7,2$

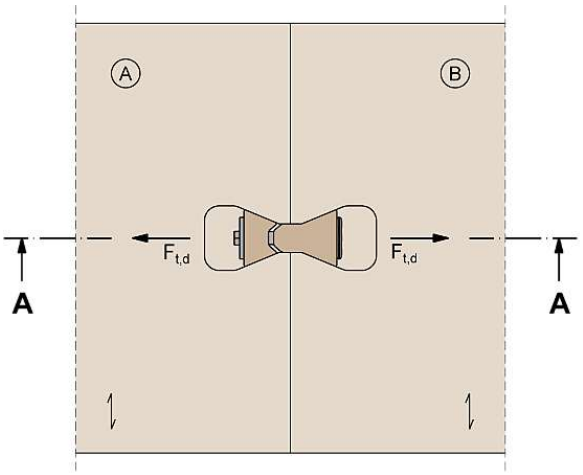
Notes:

[1)] Effective ratio is a ratio between the total thickness of layers, oriented parallel to the load direction (t_p) across embedment depth of the connector, and the embedment depth of the connector (d_e). Effective ratio shall be determined individually based on the used CLT, direction of the load, embedment depth of the connector and the depth of the cutout. Examples showing how the effective ratio is calculated is shown in Figure 12.

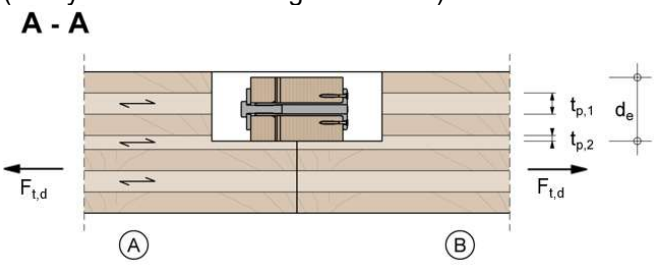
[2)] In case if formula is shown – calculation of essential characteristic for a specific ratio ($\beta_{II,t}$) is allowed. Shown formula is based on the linear interpolation of the essential characteristic between the highest and smallest ratio.

[3)] No performance assessed.

Figure 12: Example of the determination of the effective ratio in tension, $\beta_{II,t}$

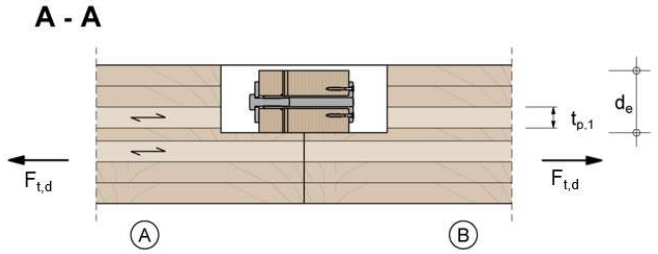


Panel with a **Single top layer** (example)
(all layers with alternating orientation)



Layers $t_{p,1}$ and $t_{p,2}$ are parallel to the applied load and crossed by the connector. Thickness of the layer $t_{p,2}$ is decreased since it's not fully crossed by the connector.
Effective ratio is: $\beta_{II,t} = (t_{p,1} + t_{p,2}) / d_e$

Panel with a **Double top layer** (example)
(external layers with the same orientation)



Only one layer $t_{p,1}$ is parallel to the applied load and crossed by the Connector.
Effective ratio is: $\beta_{II,t} = t_{p,1} / d_e$

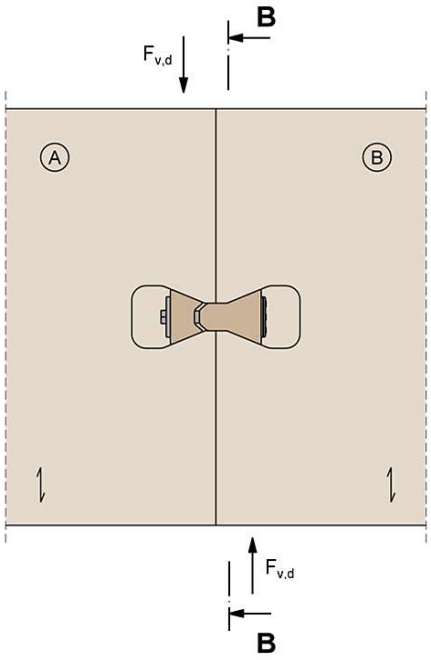
Performance Characteristic performance in case of static tension loads	**Annex 14** of ETA-26/0074 of 02.03.2026

Table 7: Product characteristics of Timber Connector HTC-P2P in case of shear loads for the Standard configurations HTC-P2P

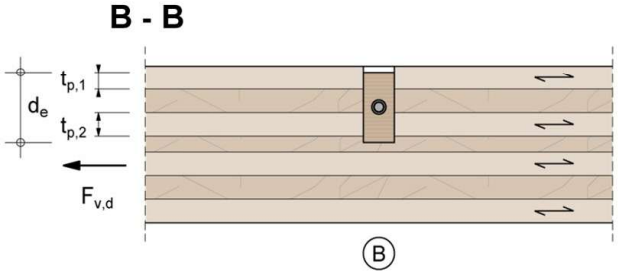
BWR	Essential characteristic			Level / Class / Description for CLT panels with a	
				Single top layer	**Double top layer**
1	**Mechanical resistance and stability**				
	Performance for the smallest, highest and intermediate effective ratios [1) 2)]				
	For the HTC-P2P 60mm (Standard)				
	Effective ratio in shear	$\beta_{II,v}$	*[-]*	0,33 … 0,66	0,00 … 1,00
	Char. shear strength	$R_{v,k}$	*[kN]*	$25,0 \times \beta_{II,v} + 13,5$	$17,7 \times \beta_{II,v} + 12,5$
	Stiffness (slip modulus)	$k_{ser,v}$	*[kN/mm]*	$3,2 \times \beta_{II,v} + 2,1$	$2,1 \times \beta_{II,v} + 2,1$
	For the HTC-P2P 90mm (Standard)				
	Effective ratio in shear	$\beta_{II,v}$	*[-]*	0,22 … 0,78	0,14 … 0,86
	Char. shear strength	$R_{v,k}$	*[kN]*	$30,7 \times \beta_{II,v} + 24,6$	$31,6 \times \beta_{II,v} + 21,0$
	Stiffness (slip modulus)	$k_{ser,v}$	*[kN/mm]*	$5,4 \times \beta_{II,v} + 5,4$	$9,6 \times \beta_{II,v} + 3,7$

Notes:
[1)] Effective ratio is a ratio between the total thickness of layers, oriented parallel to the load direction (t_p) across the embedment depth of the connector, and the embedment depth of the connector (d_e). Effective ratio shall be determined individually based on the used CLT, direction of the load, embedment depth of the connector and the depth of the cutout. Examples showing how the effective ratio is calculated is shown in Figure 13.
[2)] In case if formula is shown – calculation of essential characteristic for a specific ratio ($\beta_{II,t}$) is allowed. Shown formula is based on the linear interpolation of the essential characteristic between the highest and smallest ratio.
[3)] No performance assessed.

Figure 13: Example of the determination of the effective ratio in shear, $\beta_{II,v}$

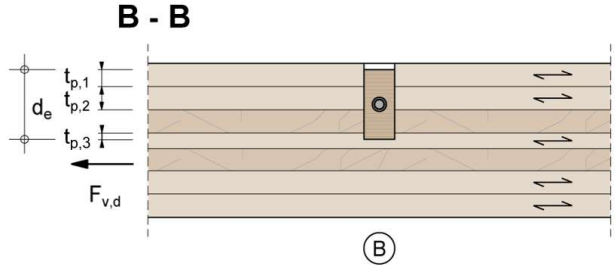


Panel with a **Single top layer**
(all layers with alternating orientation)



Layers $t_{p,1}$ and $t_{p,2}$ are parallel to the applied load and crossed by the connector. Thickness of the layer $t_{p,1}$ is decreased since it's not fully crossed by the connector.
Effective ratio is: $\beta_{II,v} = (t_{p,1} + t_{p,2}) / d_e$

Panel with a **Double top layer**
(external layers with the same orientation)



Layers $t_{p,1}$, $t_{p,2}$ and $t_{p,3}$ are parallel to the applied load and crossed by the connector. Thickness of layers $t_{p,1}$ and $t_{p,3}$ is decreased since it's not fully crossed by the connector.
Effective ratio is: $\beta_{II,v} = (t_{p,1} + t_{p,2} + t_{p,3}) / d_e$