IGNIS – Fire Design Consulting GmbH
Luise-Ullrich-Straße 14, München

office@ignis-consulting.eu

Technical expert opinion

Contract no.: *Auftrag-Nr.:*	2025-103, Version 1 *(English translation)*
Customer *Auftraggeber*	Hilti Aktiengesellschaft Feldkircherstrasse 100 9494 Schaan, Liechtenstein
Subject *Auftragsgegenstand*	Assessment of element joints using the Hilti HTC-P2P Connector following the appendix A3 of the Model Timber Construction Guideline 2024 (MHolzBauRL) in Germany
Date of contract *Auftragsdatum*	11.03.2025
Period of service *Leistungszeitraum*	February 2025 – April 2025
Number of pages *Anzahl der Seiten*	This technical expert opinion contains 24 pages, including the cover page and appendix
Person in charge *Bearbeitung*	Dr.-Ing. Michael Rauch Reviewed and approved by: Prof. Dr. Andrea Frangi (ETH Zürich), Dr. Michael Klippel

Munich/ Zurich, 31.03.2025

IGNIS – Fire Design Consulting GmbH
Luise-Ullrich-Straße 14, München

office@ignis-consulting.eu

Table of content

1 Purpose and scope

By letter dated 19.02.2025, Hilti Aktiengesellschaft (hereinafter referred to as Hilti) commissioned IGNIS – Fire·Design·Consulting Deutschland GmbH to prepare a technical statement evaluating element joints between cross-laminated timber (CLT) floor elements using the Hilti HTC-P2P connector for a fire resistance time of up to 90 minutes.

The subject of the following evaluation is based on the application of section A3, "Element and component connections without further verification," of the Model Guideline on Fire Protection Requirements for Components and External Wall Claddings in Timber Construction, version dated September 24, 2024 (In German: Muster-Richtlinie über brandschutztechnische Anforderungen an Bauteile und Außenwandbekleidungen in Holzbauweise, MHolzBauRL 2024) [4], for element joints of CLT floor elements connected by the Hilti HTC-P2P connector. This evaluation assesses the application requirements specified in the MHolzBauRL regarding the transmission of fire and smoke through the element joint under a one-sided standard temperature-time curve (EN/ISO) fire exposure. The technical statement relates exclusively to the design of the element joints using the Hilti HTC-P2P connector.

Furthermore, floor constructions are specified for which the verification of fire resistance under one-sided EN/ISO fire exposure from the top side of the floor can be considered as provided.

In addition to the joint itself, the fire resistance-dependent charring depth is a decisive parameter for evaluating the fire resistance of the CLT floor in the joint area. The respective applicability verifications, such as the manufacturer's general building inspectorate approvals (*In German: Allgemeine Bauartgenehmigung, aBG*), contain the fundamentals for determining the charring depth for CLT floors. Alternatively, generally recognized models can be used to determine the charring depth according to FprEN 1995-1-2:2024-08 [2]. In countries where FprEN 1995-1-2:2014-08 is not an adopted technical building regulation (e.g. Germany), national or federal state-dependent regulations must be observed.

This assessment serves as a basis for the fire protection evaluation of the connection within the application for a general building inspectorate or other national approval (e.g. aBG at the German Institute for Building Technology, In German: Deutsches Institut für Bautechnik, DIBt)

This technical statement does not constitute an applicability verification within the international building laws (e.g. German laws).

2 Basis of assessment (references)

The basis of assessment in this technical statement comprises the following documents:

[1] DIN EN 1995-1-2:2010-12: Eurocode 5: Eurocode 5: Design of timber structures – Part 1-2: General rules – Structural fire design, German Version EN 1995-1-2:2004 + AC:2009.

[2] FprEN 1995-1-2:2024-08: Eurocode 5 – Design of timber structures – Part 1-2: Structural fire design, Entwurfsversion.

[3] MHolzbauRL (2020) Model Guideline on fire protection requirements for components and external wall claddings in timber construction (M-HolzBauRL) in the version of October 2020.

[4] MHolzbauRL (2024) Model Guideline on fire protection requirements for components and external wall claddings in timber construction (M-HolzBauRL) in the version of 04. September 2024.

[5] DIN EN 1995-1-1:2010-12 Eurocode 5: Design and construction of timber structures - Part 1-1: General - Common rules and rules for buildings.

[6] ETA-24/1199, European Technical Assessment, Timber Connector HTC-P2P, Austrian Institute for Construction Engineering (OIB), February 11, 2025, Vienna.

[7] HTC-P2P Timber Panel Connector, Product Technical Datasheet CLT Panel to Panel Connector, Update: Feb. 24, Hilti.

[8] DIN EN 13162:2015-04: Thermal insulation products for buildings – Factory made mineral wool (MW) products – Specification.

[9] DIN EN 13986:2015-06: Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking.; German Version of EN 13986:2004+A1:2015.

[10] DIN EN 636:2015-05: Plywood - Requirements.; German Version of EN 636:2012+A1:2015.

[11] DIN EN 1995-1-1:2010-12: Eurocode 5: Design and construction of timber structures – Part 1-1: General – Common rules and rules for buildings; German Version of EN 1995-1-1:2004 + AC:2006 + A1:2008.

[12] DIN EN 1995-1-1/NA:2013-08: National Annex – Nationally determined parameters – Eurocode 5: Design and construction of timber structures – Part 1-1: General – Common rules and rules for buildings.

[13] E DIN 4102-4/A1:2023-04, Fire behaviour of building materials and building components – Part 4: Compilation and application of classified building materials, components and special components; Amendment A1, Berlin, 2023.

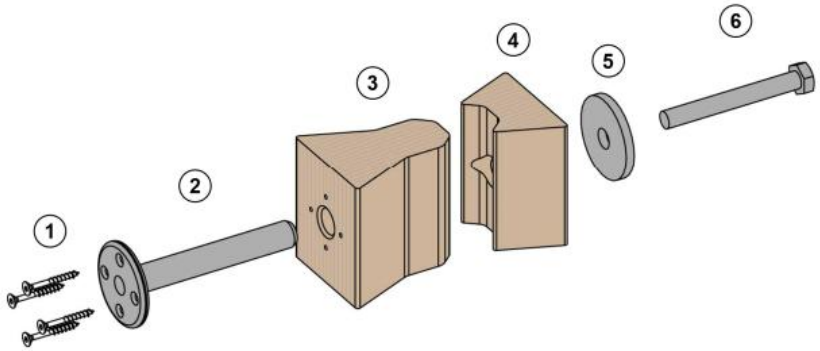
[14] DIN 4102-17. Fire behaviour of building materials and building components – Part 17: Melting point of building materials – Requirements and testing. Berlin: Deutsches Institut für Normung e.V.

3 Basics

3.1 Description of Hilti HTC-P2P connector

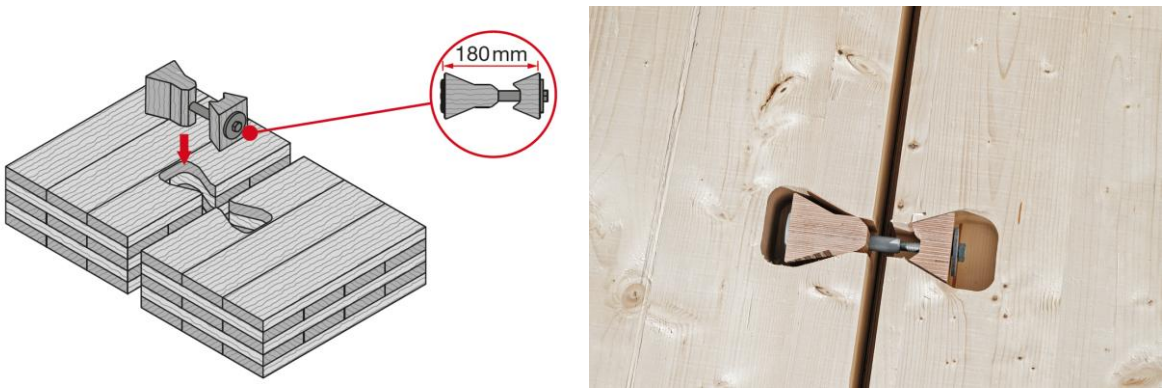
The Hilti HTC-P2P connector, according to ETA-24/1199 [6] dated 11.02.2025, is a connector used to create a force-transmitting connection between cross-laminated timber (CLT) plane elements. The Hilti "Panel-to-Panel connector" HTC-P2P is inserted laterally into a pre-fabricated recess in the cross-laminated timber element. The two-part, dovetail-shaped Hilti HTC-P2P connector consists of the base connector made of beech plywood (cf. ETA-24/1199), which is connected by a threaded screw. The individual components are shown in Table 1.

Table 1 Single components of the Hilti "Panel-to-Panel connector" HTC-P2P according to ETA-24/1199 [6]



1	Wood screw	According to EN 14592, 3.5 x 35 mm with a countersunk head made of carbon steel [6]
2	Internal thread sleeve	Made of carbon steel, tensile strength ≥ 300 N/mm², yield strength ≥ 180 N/mm² [6]
3 / 4	Timber connector	Two-part dovetail connector consisting of a plug connector (3) and the corresponding sleeve (4) made of beech plywood according to EN 13986 [9] in conjunction with EN 636 [10] [6]
5	Washer	Oversized, made of carbon steel, thickness 6 mm, according to DIN 1052 [6]
6	Screw	Made of carbon steel, tensile strength ≥ 800 N/mm², yield strength ≥ 640 N/mm², size: M12x100, according to DIN 933 [6]
Note: The exact details and dimensions are to be taken from ETA-24/1199 [6].		

For the connection of cross-laminated timber (CLT) elements using a butt joint, a half-lap joint, a profiled joint, or a slot-key joint (refer to Figure 3-3), the connector is inserted into an oversized routed recess in the CLT elements. The screw is then tightened (single-sided) with an impact screwdriver and a special adapter (according to the Instruction for use) pulling the two CLT elements together without gaps. The connector is approximately 180 mm long, approximately 90 mm high, and is made of beech plywood. Figures 3-1 and 3-2 illustrate the HTC-P2P connector and its installation. The associated precise dimensions of the recess and the connector are specified in ETA-24/1199 [6].



(a) (b)

Figure 3-1: Hilti HTC-P2P Connector (a) Schematic drawing and (b) picture of the installed connector before tightening, Source: Hilti

(a) (b)

Figure 3-2: Hilti HTC-P2P Connector: (a) during and (b) after tightening, Source: Hilti

The various joint configurations, installation scenarios and spacing of the connectors are illustrated in Figure 3-2 and Table 3-2.

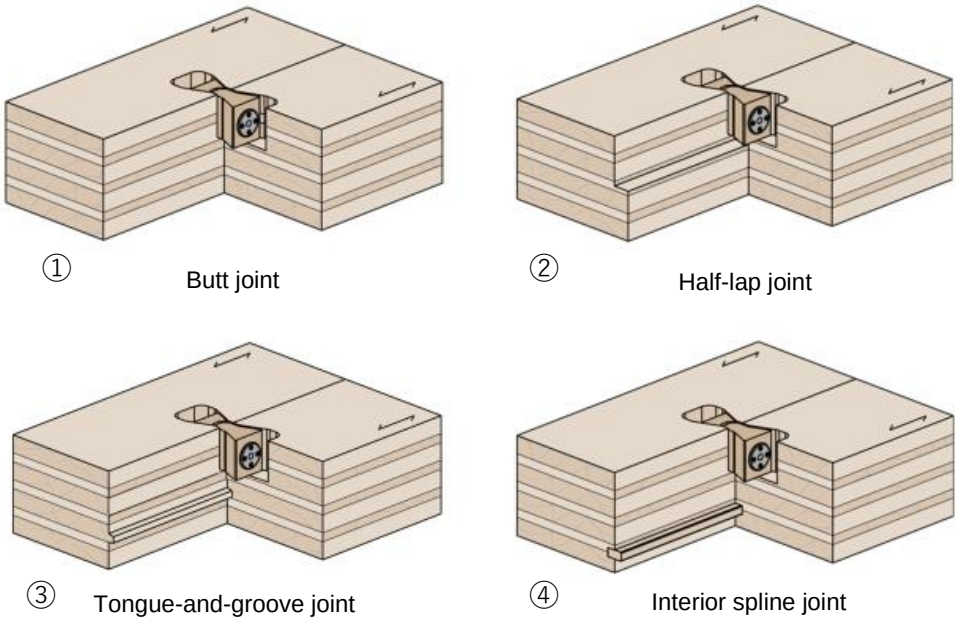
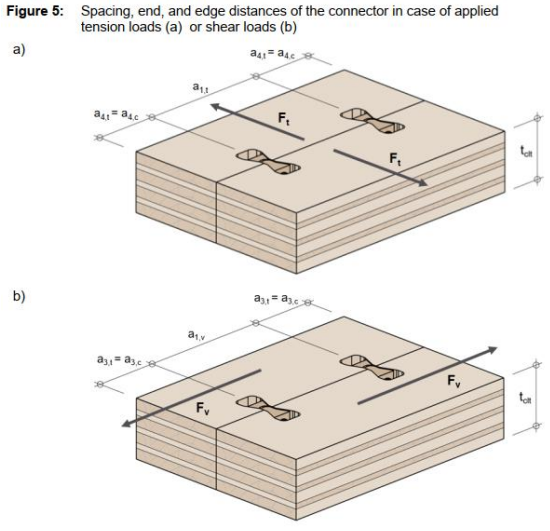


Figure 3-3: Joint configurations of CLT elements: ① Butt joint, ② half-lap joint, ③ tongue-and-groove joint, ④ Interior spline joint, Source: Hilti

Table 3-1: Distances of the Hilti HTC-P2P Connector according to ETA-24/1199 [6]



Distances according to ETA-24/1199 [6]		
For tension loads		
Minimum side cover distance	$a_{4,t} = a_{4,c}$ [mm]	250
Minimum* distance of connectors	$a_{1,t}$ [mm]	500
For shear loads		
Minimum side cover distance	$a_{3,t} = a_{3,c}$ [mm]	300
Minimum* distance of connectors	$a_{1,v}$ [mm]	300

3.2 Basic principles for joint configuration according to MHolzBauRL 2024

In Germany, the Model Guideline on Fire Protection Requirements for Components and External Wall Claddings in Timber Construction (MHolzBauRL) 2024 [4] was developed by a panel of experts and adopted by the Conference of Building Ministers in September 2024, replacing the currently valid MHolzBauRL 2020 [3]. However, at the current time, this is not yet a technically introduced building regulation. Introducing the MHolzBauRL 2024 nationwide is presumed to be in 2026, when the Administrative Regulation on Technical Building Regulations should be amended. In individual federal states, e.g., Bavaria or North Rhine-Westphalia, applying the guideline is currently possible through a ministerial decree in conjunction with a deviation in the fire protection verification.

Regarding the present technical statement of the Hilti connector, the following essential protection goals or verification options from section A3 of the MHolzBauRL 2024 [4] can be mentioned (taken from [4]):

(1) Connections and joints of space-enclosing components between elements (element joints) and adjacent components (component joints) must be executed tightly to ensure the compartmentation function.

(2) The tightness of connections and joints to prevent the transmission of fire and smoke can be achieved by execution according to Table A3.1 (cf. Figure 3-4 in this technical assessment). Corresponding measures must be planned and executed generally on both sides of a component, providing compartmentation or separately for each fire transmission path.

Since the MHolzBauRL 2024, as an officially adopted document, enables verification of the joints between the cross-laminated timber components, applying this verification document for joints connected with the Hilti HTC-P2P connector is recommended.

For the fire resistance design of the floor, the following elements of verification shall be considered:

1) The fire resistance design of the floor consists of the verification of the cross-laminated timber elements (in the surface and without the element joint) in conjunction with the verification of the element joint (in the element plane) and the verification of the component joint (e.g. between the floor and wall element).
2) Verifying the fire resistance for the load-bearing capacity and the fire compartmentation of the components must be provided independently of the MHolzBauRL. Within the MHolzBauRL 2024, corresponding verification methods are outlined. According to MHolzBauRL 2024, sections A 1.2 and A 1.3 [4], the verification of the fire resistance time of floor elements made of cross-laminated timber may be based on a declaration of performance in conjunction with a manufacturer-specific European Technical Assessment (ETA). In this context, the indication of the fire resistance time must be available as a classification for the specific construction of the building product. Alternatively, the verification can be based on introduced technical building regulations or manufacturer-specific applicability verifications, e.g., general building authority approvals for cross-laminated timber.
3) *"Element and component joints, especially the installed fire protection cladding, must not open due to deformations caused by the fire exposure and thereby lose their protection capability."* [4]. This can be assumed to be fulfilled if the spacing of screws or comparable mechanical fasteners in the joint area does not exceed 500 mm [4].
   Principles for the element and component joints of solid wood elements (such as cross-laminated timber elements) have been included in the consolidated version of the MHolzBauRL 2024 [4], section A3. Thus, according to MHolzBauRL 2024 [4], sufficient fire resistance and tightness of the joint can be assumed for element and component joints. Figure 3-4 provides an overview of the execution principles.

Row	Type	Measure / execution in the contact area	Location and measure for external sealing and details regarding the lateral arrangement (fire-exposed side or fire-unexposed side)
Execution with a joint of width s in the contact area, 0 < s ≤ 30 mm (see principle sketch A3. 1)			
1	tightly jointed, s ≤ 0.5 mm	no measure required	No measure necessary
2	s ≤ 2 mm	no measure required	Only non-fire-exposed side: a), b), c), d) or e)
3	s ≤ 5 mm	Sealing strips made of at least normally combustible material with a density ρ ≥ 50 kg/m³ in uncompressed state[1)] or insulating material according to DIN EN 13162-5:2015-04 with a density ρ ≥ 15 kg/m³ in uncompressed state[1)]	Only non-fire-exposed side: a), b) or c)
4	s ≤ 15 mm	Sealing strips / acoustic isolation, at least normally combustible with ρ ≥ 200 kg/m³ or fire protection sealant or intumescent building material	Only fire-exposed side: a), b) or c)
5	s ≤ 30 mm	Sealing strips made of mineral wool insulation materials with a melting point ≥ 1000°C according to DIN 4102-17 and ρ ≥ 30 kg/m³ in uncompressed state[1)]	No additional measure required
Measures for external sealing in the area of joints and corners: a) Filling with spackle; b) Fire protection sealant[2]; c) Complete covering with the fire protection boarding of the planar components or by means of floor constructions; d) Permanently elastic joint sealant[2] or compressed sealing strip[2] or e) Airtight sealing.			
[1] In the installed state, the insulating material shall be compressed to at least half its original thickness. [2] Corresponding measures may also be arranged within the contact joint, provided that these are at least 20 mm inside of the respective calculated residual wood cross-section. Deviating from this, this retention dimension may be reduced to 0 for fire protection sealants / materials / tapes. [3] Unless otherwise specified, the fire resistance refers to each possible fire exposure direction.			

Figure 3-4: Overview of the execution principles for component joints and element joints according to MHolzBauRL 2024 [4]

4 Design of compartmentation of floor element joints using the Hilti HTC-P2P connector

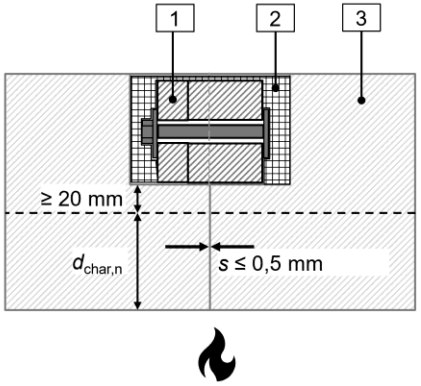
4.1 Fire exposure of floor from the underside

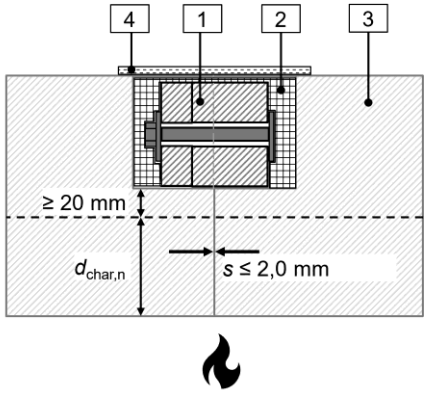
To verify compartmentation EI, an engineering approach based on the charring model is recommended. For this purpose, the charring depth is first to be determined based on calculation methods corresponding to the respective applicability verifications, such as the manufacturers' general building authority approvals (e.g. aBG's in Germany). Alternatively, generally recognized models can be used for determining the charring depth according to FprEN 1995-1-2:2024-08 [2]. Since FprEN 1995-1-2:2014-08 is currently not an introduced technical building regulation, the national and/or federal state-dependent regulations must be observed (e.g. in Germany) when applying it.

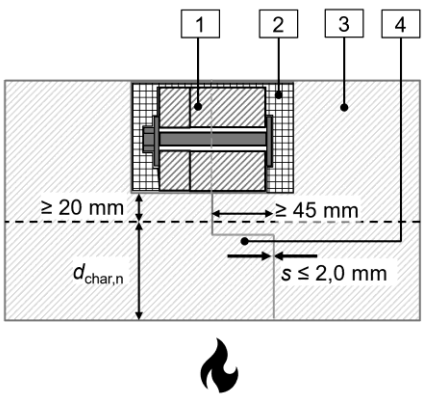
At element joints, a minimum distance of the charring boundary (300 °C isotherm) to the underside of the connector of 20 mm is recommended according to the approach of E DIN 4102-4/A1 [13] and the MHolzBauRL 2024 [4]. This ensures a sufficient residual wood thickness up to the connector so that no consideration of thermal softening in the structural design is required for the verification of the connector according to ETA-24/1199 [6]. This applies exclusively to the connector, not to verifying the load-bearing resistance of the cross-laminated timber elements. This sufficient residual cross-section, together with a tightness measure, ensures the fire compartmentation of the element joint.

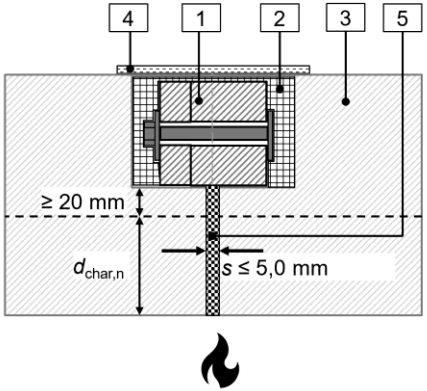
The different options of element joints of CLT floor elements with the Hilti HTC-P2P connector and the corresponding verification system for a fire resistance time of up to 90 minutes are shown in Table 4-1.

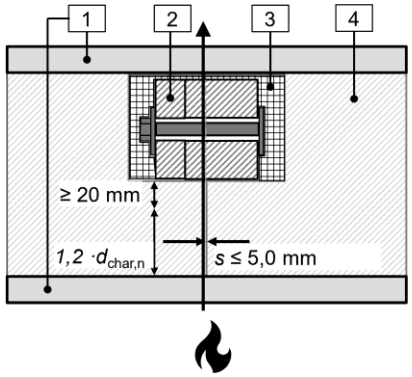
Table 4-1: Options of element joints and technical assessment according to MHolzBauRL 2024 [4] for fire exposure from the underside of a CLT floor element

No.	Figure and description	Description and assessment
A	 1. Hilti HTC-P2P connector 2. Mineral insulation materials (with a melting point >1000 ° C according to DIN 4102-17:2017-12) or products that seal the remaining cross-section in case of fire exposure (according to MVV TB A 2.1.3.3.1) 3. CLT element according to the applicability verification $d_{char,n}$: notional charring depth according to FprEN1995-1-2:2024-08 or applicability verification for the CLT element *Figure 4-1: Element joint configuration of cross-laminated timber with «Hilti HTC-P2P-Connector», butt jointed with s ≤ 0,5 mm*	**Cross-laminated timber, butt jointed, s ≤ 0,5 mm, connected with Hilti HTC-P2P connector** • Element joint configuration, „tightly" jointed with s ⩽ 0,5 mm. • Voids around the connector shall be filled with horizontally compressed mineral wool, melting point ≥ 1000°C according to DIN 4102-17 [14]. ➔ **According to MHolzBauRL 2024, Table A3.1, row 1, a tight joint can be assumed.**

No.	Figure and description	Description and assessment
B	 1. Hilti HTC-P2P connector 2. Mineral insulation materials (with a melting point >1000 ° C according to DIN 4102-17:2017-12) or products that seal the remaining cross-section in case of fire exposure (according to MVV TB A 2.1.3.3.1) 3. CLT element according to the applicability verification 4. Air-tight sealing covered with a cladding according to „MHolzBauRL“ or a floor construction according to „MHolzBauRL“ $d_{char,n}$: notional charring depth according to FprEN1995-1-2:2024-08 or applicability verification for the CLT element *Figure 4-2: Element joint configuration of cross-laminated timber with «Hilti HTC-P2P-Connector», butt jointed with s ≤ 2,0 mm*	**Cross-laminated timber, butt jointed, s ≤ 2,0 mm, connected with Hilti HTC-P2P connector** • Element joint configuration, jointed with s ⩽ 2,0 mm. • Voids around the connector shall be filled with horizontally compressed mineral wool, melting point ≥ 1000°C according to DIN 4102-17 [14]. • Fire unexposed measure according to MHolzBauRL 2024 [4]: ▪ Covering with fire protection boarding or floor construction according to MHolzBauRL or ▪ Air/gas tight sealing. ➔ **According to MHolzBauRL 2024, Table A3.1, row 1, a tight joint can be assumed.**

No.	Figure and description	Description and assessment
C	 1. Hilti HTC-P2P connector 2. Mineral insulation materials (with a melting point >1000 ° C according to DIN 4102-17:2017-12) or products that seal the remaining cross-section in case of fire exposure (according to MVV TB A 2.1.3.3.1) 3. CLT element according to the applicability verification 4. Half-lap joint filled with a compressed sealing strip $d_{char,n}$: notional charring depth according to FprEN1995-1-2:2024-08 or applicability verification for the CLT element *Figure 4-3: Element joint configuration of cross-laminated timber with «Hilti HTC-P2P-Connector», half-lap jointed with s ≤ 2,0 mm*	**Cross-laminated timber, half-lap jointed, s ≤ 2,0 mm, connected with Hilti HTC-P2P connector** • Element joint configuration, half-lap joint according to MHolzBauRL, jointed with s ⩽ 2,0 mm. • Voids around the connector shall be filled with horizontally compressed mineral wool, melting point ≥ 1000 °C according to DIN 4102-17 [14]. • Measure in half-lap joint according to MHolzBauRL 2024 [4]: ▪ Inserted compressed sealing tape within the half-lap joint in the thermally non-critical zone. ➔ **According to MHolzBauRL 2024, principle sketch A3.5, a tight joint can be assumed.**

No.	Figure and description	Description and assessment
D	 1. Hilti HTC-P2P connector 2. Mineral insulation materials (with a melting point >1000 ° C according to DIN 4102-17:2017-12) or products that seal the remaining cross-section in case of fire exposure (according to MVV TB A 2.1.3.3.1) 3. CLT element according to the applicability verification 4. Air-tight sealing covered with a cladding according to „MHolzBauRL“ or a floor construction according to „MHolzBauRL“ 5. Sealing strip or insulation material according to „MHolzBauRL“ (Table A3.1) $d_{char,n}$: notional charring depth according to FprEN1995-1-2:2024-08 or applicability verification for the CLT element *Figure 4-4: Element joint configuration of cross-laminated timber with «Hilti HTC-P2P-Connector», butt jointed with s ≤ 5,0 mm*	**Cross-laminated timber, butt jointed, s ≤ 5,0 mm with measure in the contact area, connected with Hilti HTC-P2P connector** • Element joint configuration, jointed with s ⩽ 5,0 mm. • Voids around the connector shall be filled with horizontally compressed mineral wool, melting point ≥ 1000°C according to DIN 4102-17 [14]. • Measure in the contact area according to MHolzBauRL 2024 [4] • Fire unexposed measure according to MHolzBauRL 2024 [4]: ▪ Covering with fire protection boarding or floor construction according to MHolzBauRL or ▪ Air/gas tight sealing. ➔ **According to MHolzBauRL 2024, Table A3.1, row 3, a tight joint can be assumed.**

No.	Figure and description	Description and assessment
E	 1. Fire protection cladding according to Section 4.2 / 4.3 or floor construction according to „MHolzBauRL 2024“ 2. Hilti HTC-P2P connector 3. Mineral insulation materials (with a melting point >1000 ° C according to DIN 4102-17:2017-12) or products that seal the remaining cross-section in case of fire exposure (according to MVV TB A 2.1.3.3.1) 4. CLT element according to the applicability verification $d_{char,n}$: Increased notional charring depth $d_{char,n}$ by 20% to consider increased charring in the joint area according to FprEN 1995-1-2:2024-08. The protective effects of fire cladding on the fire-exposed side can be considered in this case. *Figure 4-5: Element joint configuration of cross-laminated timber with «Hilti HTC-P2P-Connector» and fire protection boarding, butt jointed with s ≤ 5,0 mm*	**Cross-laminated timber, butt jointed, s ≤ 5,0 mm, connected with Hilti HTC-P2P connector and fire protection boarding on both sides** • Element joint configuration, jointed with s ⩽ 5,0 mm. • Voids around the connector shall be filled with horizontally compressed mineral wool, melting point ≥ 1000°C according to DIN 4102-17 [14]. • Fire protection boarding according to Section 4.2 and. 4.3 or floor construction, according to MHolzBauRL 2024 [4]. **No exact execution according to MHolzBauRL, requirements and verification proposal by IGNIS:** • The thickness of the residual cross-section of the CLT panel in the joint area shall be at least 20 mm. **→ To ensure a sufficient residual cross-section thickness for the load transfer, the thermally in-**

No.	Figure and description	Description and assessment
		fluenced part of the timber cross-section (considered in the load bearing design R) is not located in the area of the connector. • Increase of the charring depth $d_{char,n}$ by 20% to account for increased charring in the joint area, in accordance with FprEN 1995-1-2:2024-08 [2]. The contribution of the fire-exposed fire protection boarding can be taken into account. **→ This approach accounts for increased charring in joints with joint widths > 2 mm and joint widths ≤ 5 mm when calculating the charring boundary up to 20 mm in front of the connector.** **In accordance with MHolzBauRL 2024, Table A3.1, row 2 (fire unexposed covering of the joint by boarding or a floor construction according to MHolzBauRL), an air/gas tight joint can be assumed.**

4.2 Fire exposure of floor from above

For the design of the load-bearing capacity (R) and compartmentation (EI) to be considered fulfilled, charring of the cross-laminated timber floor element under fire exposure from the top side of the component within the required fire resistance time of up to 90 minutes must be excluded, and the load transfer via the Hilti HTC-P2P connector must be ensured. This requirement can be met with floor constructions according to Table A2.1 of the MHolzBauRL 2024 [4] or based on existing test results of floor constructions specific to the project. Furthermore, it can be stated that for fire exposure from the top side of the floor when floor constructions according to Table A2.1 of the MHolzBauRL 2024 [4] are used (cf. Table 4-2), in addition to the requirement for fire resistance (load-bearing capacity and fire compartmentation), the requirement for the top-side fire protection boarding can also be considered fulfilled.

In the area of connection joints between the floor construction and a wall element, a non-combustible perimeter insulation strip, according to MHolzBauRL 2024 [4], made of mineral wool (melting point ≥ 1000°C and density ≥ 30 kg/m³) shall be installed to prevent premature burn-through in the joint area.

Table 4-2: Overview of minimum layup configurations of floor constructions according to MHolzBauRL 2024 [4] (Table A2.1)

Floor elements	**Minimum thickness of floating screed or floor construction [mm]**		
	Non-combustible mineral wool insulation or expanded perlite, [a]	**Gypsum plasterboard / gypsum fibre board** [b] (floating screed)	**Screed** [c] **or non-combustible prefabricated screed boards** [c] **or mastic asphalt** (floor construction)
	d_2	d_1	d_1
t_{ch} = 60 min for components highly fire-retardant (*In German: hochfeuerhemmend*) or alternatively highly fire-resistant	20	-	30
	20	2 x 12.5	-
	-	-	60
t_{ch} = 90 min for components alternatively fire-resistant (feuerbeständig)	30	-	45
	20	25	-
	20		55
	20	2 x 15	-
	-	-	80

[a] Non-combustible mineral wool according to DIN EN 13162:2015-04 with ρ ≥ 30 kg/m³, expanded perlite according to DIN EN 13169:2015-04 with ρ ≥ 130 kg/m³

[b] Boarding according to Section 3.4 of this guideline

[c] Screed according to DIN EN 13813:2003-01 and DIN 18560-1:2021-02

4.3 Requirements for fulfilling a positive connection

Within the MHolzBauRL 2024 [4], a positive connection of the joint is considered fulfilled if, in the connection area, the cross-laminated timber (CLT) elements are connected with screws or comparably effective fasteners at a continuous spacing of maximal 500 mm.

Within ETA-24/1199 [6], a minimum spacing of 500 mm is specified for the Hilti HTC-P2P connector. As no maximum spacing of the connectors is prescribed, the authors of this technical assessment recommend four verification options for a positive connection:

1) The stiffness of the element joint under fire conditions with the Hilti HTC-P2P connector, considering the planned spacings, is executed with comparable stiffness to a connection with screws (maximum spacing 500 mm) according to MHolzBauRL 2024 [4]. The verification shall be provided within the structural design.

2) The horizontal spacing of the Hilti HTC-P2P connectors is executed at 500 mm. According to ETA-24/1199 [6], a minimum spacing of 500 mm is specified, thus excluding smaller spacings.

3) In addition to the connector, screws are installed at a spacing of 500 mm to ensure a positive connection, according to MHolzBauRL 2024 [4].

4) The tightness of the connection is verified via a loaded fire resistance test with a maximum connector spacing, loaded to 100%.

The specified positive connection refers to the structural boundary conditions to ensure the tightness of the joint. **For all 4 options, the transfer of loads of the Hilti HTC-P2P connector must be ensured for the required fire resistance time**. This is ensured, for example, by the connector being protected on the underside by a sufficient timber cover according to Section 4.1 and on the top side by a floor construction according to Section 4.2. A separate structural analysis for the transfer of loads shall be performed.

5 Limitations and Notes

This technical assessment exclusively covers the fire protection assessment of the listed five connection variants A to E (cf. Table 4-1) for element joints of cross-laminated timber (CLT) floor elements connected with the Hilti HTC-P2P connector for a fire resistance time of up to

90 minutes. In addition to an assessment from the underside of the component, an assessment from the top side of the floor is carried out, considering various floor constructions according to MHolzBauRL 2024 [4].

The basis of this assessment for the execution variants designed by Hilti is the existing ETA-24/1199 [6] and the future MHolzBauRL 2024 [4] in conjunction with FprEN 1995-1-2:2024-08 [2], based on which the fire compartmentation and the air tightness of the joints are evaluated. Verification of the CLT components and the load-bearing capacity of the joints under fire conditions is not the subject of this assessment. The fire compartmentation of the investigated element joints is only considered fulfilled if the load-bearing capacity of the components and the transfer of loads via the Hilti HTC-P2P connector are maintained for the required fire resistance time.

This document assesses only the element joints of the floor elements connected with the Hilti HTC-P2P connector. For adjacent components to these floor elements, applying the principles of the MHolzBauRL 2024 [4] is recommended.

6 Summary

This document assesses the joint configuration between cross-laminated timber (CLT) floor elements connected with the Hilti HTC-P2P connector for a fire resistance time of up to 90 minutes. For this purpose, five connection variants A to E, corresponding to Table 4-1 and based on the principles of the Model Guideline on Fire Protection Requirements for Components and External Wall Claddings in Timber Construction (MHolzBauRL 2024) [4], were assessed for fire exposure from the underside and the top side of the component (not simultaneously).

The component's assessment of the element joints from the underside is based on the joint configuration corresponding to Table A3.1 of the MHolzBauRL [4], cf. Figure 3-4. For an assessment from the top side of the component, reference is made to the floor constructions corresponding to Table 4-2, for which the fire resistance of the components can be considered fulfilled.

For the assessment of the joint itself, in addition to the measures of the MHolzBauRL [4] to ensure sufficient tightness of the joint, the charring depth is a decisive parameter for evaluating the fire resistance of the CLT floor in the joint area. The principles for determining the charring depth for CLT floor panels are contained in the respective applicability verifications, such as

the manufacturers' general building authority approvals (e.g. aBGs) (e.g. for CLT). Alternatively, generally recognized models can be used for determining the charring depth according to FprEN 1995-1-2:2024-08 [2]. Since FprEN 1995-1-2:2014-08 is not an introduced technical building regulation, the federal state-dependent regulations must be observed e.g. in Germany when applying it.

The present assessment serves as a basis for the fire protection evaluation of the joints, e.g. within the application for a general building authority approval (e.g. aBG) e.g. at the German Institute for Building Technology (DIBt).

This technical statement does not constitute an applicability verification within the international building laws (e.g. German laws).

München, 31.03.2025
Dr.-Ing. Michael Rauch (Author)

Zürich, 31.03.2025
Prof. Dr. Andrea Frangi (Checker)
(ETH Zürich)

Zürich, 31.03.2025
Dr.-Ing. Michael Klippel (Approver)

7 APPENDIX

7.1 Cover of ETA-24/1199 [6]

Austrian Institute of Construction Engineering
Schenkenstrasse 4 | T +43 1 533 65 50
1010 Vienna | Austria | F +43 1 533 64 23
www.oib.or.at | mail@oib.or.at

Designated according to Article 29 of Regulation (EU) No 305/2011

Member of EOTA
www.eota.eu

European Technical Assessment **ETA-24/1199 of 11.02.2025**

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
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	17 pages including 9 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 Regulation (EU) No 305/2011, on the basis of	European Assessment Document (EAD) 130336-01-0603 “Point connectors – dovetails made of plywood for cross laminated timber”

7.2 Cover of Product Technical Datasheet CLT Panel to Panel Connector [7]

HILTI

HTC-P2P Timber Panel Connector

Product Technical Datasheet
CLT Panel to Panel Connector
Update: Feb 24