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Authorized and notified according to Article 29 of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011

European Technical Assessment ETA-21/0357 of 2024/03/01

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S	
Trade name of the construction product:	Fastening element Hilti HCW, HCW L
Product family to which the above construction product belongs:	Three-dimensional nailing plate (concealed beam hangers)
Manufacturer:	Hilti AG Feldkircherstrasse 100 9494 Schaan Fürstentum Liechtenstein
Manufacturing plant:	Hilti Werke
This European Technical Assessment contains:	23 pages including 3 annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	EAD 130186-00-0603 for Three-dimensional nailing plates
This version replaces:	The ETA with the same number issued on 2022-04-25

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

Hilti HCW and HCW L are two-piece connectors to be used in timber to timber connections as well as connections between a timber and a steel member or timber and concrete member.

Hilti HCW and HCW L has a nominal diameter of 40 mm, is installed in pre-drilled holes of timber members (see Annex A). The dowel type fastener has one end with M12 to slide into the connector. The dowel type fastener is fixed from the clamping device, so the connections are immediately load bearing.

Fastener type can be:

a) Threaded rod M12 (minimum 4.6 strength) for steel connections or timber connection with bolt
b) Concrete fastener with ETA and M12 connection (steel strength $f_{u,k} \geq 500$ N/mm^2)
c) Timber screw acc. EN 14592 or ETA with M12 connection (steel strength $f_{u,k} \geq 400$ N/mm^2)

Geometry and Material

The connectors are made from carbon steel, according to EN 10277 and are galvanized. Dimensions are shown in Annex A and typical installations are shown in Annex B.

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

The connectors are intended for use in making end-grain to side-grain connections, end-grain to end-grain and side-grain to side-grain connections in load bearing timber structures, as a connection between a wood based joist and a solid timber (softwood or hardwood) or wood based header, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 and 4 of Regulation (EU) 305/2011 shall be fulfilled.

They are also intended for use in making an end-grain or side-grain connection between a timber joist and a steel member or concrete member.

The connectors can be installed as connections between wood based members such as:

- Structural solid timber of soft- or hardwood according to EN 338 / EN 14081,
- Glulam made of soft- or hardwood, classified according to EN 1194 / EN 14080, or with ETA or national approval
- LVL according to EN 14374 or ETA/
- Parallam PSL,
- Intrallam LSL,
- Duo- and Triobalken,
- Cross laminated timber and similar structural glued products according EN16351 or ETA.
- Engineered wood products and solid wood panels according to EN13986 or ETA, the provisions of the ETA of the engineered wood product apply
- Engineered wood products according to ETA if the ETA of the product includes provisions for the use of self-tapping screws, the provisions of the ETA of the engineered wood product apply.

However, the calculation methods are only allowed for a characteristic wood density of up to 590 kg/m^3 for softwood and for hardwood. Even though the wood based material may have a larger density, this must not be used in the formulas for the load-carrying capacities of the fasteners.

Where an interlayer made of wood-based panel is placed between the Hilti HCW and HCW L and the dowel type fastener, the influence of the interlayer on the load-carrying-capacity of the type of fasteners has to be taken into account.

Annex C states the formulas for the characteristic load-carrying capacities of the connections. The design of the connections shall be in accordance with Eurocode 5 or/and Eurocode 8 a similar national Timber Code.

It is assumed that the forces acting on the connection are the following: F_{ax}, and F_v. The force F_{ax} acts longitudinal to the connector (axial), F_v can act with an eccentricity with regard to the centre of gravity of Hilti HCW and HCW L and the timber member.

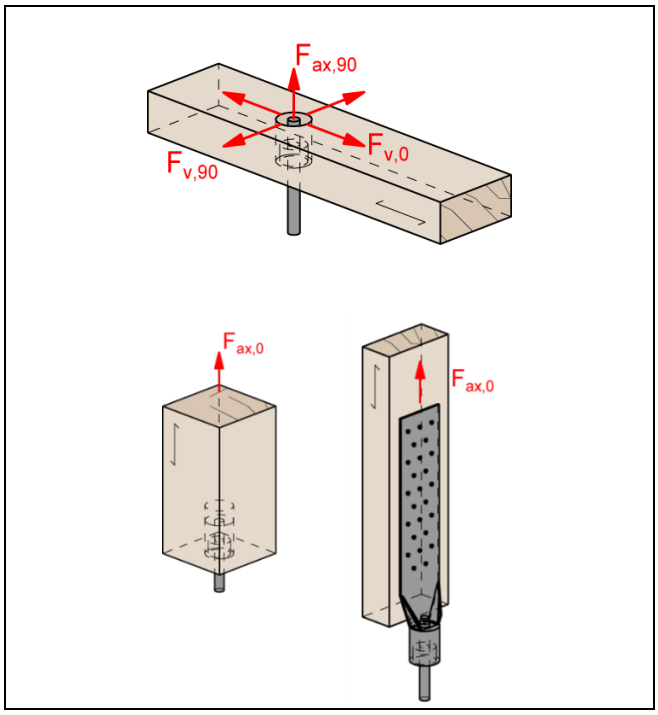

Figure 1: acting forces

It is assumed that the header beam is prevented from rotating. Similarly, it is assumed that the steel member to which the connector is bolted does not rotate. If the header beam only has installed a connector on one side the eccentricity moment $M_v = F_d \times b_H/2$ shall be considered where b_H is the header width. The same applies when the header has connections on both sides, but with vertical forces which differ more than 20%.

The connectors are intended for use in connections subject to static or quasi static loading and seismic.

The zinc-coated connectors are for use in timber structures subject to dry, internal conditions defined by the service classes 1 and 2 of EN 1995-1-1, (Eurocode 5). The fasteners (screws and bolts) and threaded rods to be used shall be made from suitable material. It shall be used a M12 with minimum strength class of 4.6.

The scope of the brackets regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the screws of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

Characteristic		Assessment of characteristic
3.1	**Mechanical resistance and stability*) (BWR1)**	
	Joint Strength - Characteristic load-carrying capacity	See Annex C
	Joint Stiffness	See Annex C
	Joint ductility	See Annex C
	Resistance to seismic actions	See Annex C
	Resistance to corrosion and deterioration	See section 3.5
3.2	**Safety in case of fire (BWR2)**	
	Reaction to fire	The connectors are made from steel classified as Euroclass A1 in accordance with EN13501-1 and Commission Delegated Regulation 2016/364
	Resistance to fire	No performance assessed
3.3	**General aspects related to the performance of the product**	
		The connectors have been assessed as having satisfactory durability and serviceability when used in timber structures using the timber species described in Eurocode 5 and subject to the conditions defined by service class 1 and 2
	Identification	See Annex A

*) See additional information in section 3.4 – 3.6.

3.4 Aspects related to the performance of the product

The characteristic load-carrying capacities are based on the characteristic values of the connectors.

According to EN 1990 (Eurocode – Basis of Design) the design value of load-carrying capacity can be determined by reducing the characteristic values of the load-carrying capacity with different partial factors.

Therefore, to obtain design values according to the Eurocodes or appropriate national codes of practice, the capacities have to be multiplied with different partial factors for the material properties and – for the connectors mounted in timber – also the coefficient k_{mod} that takes into account the load duration class.

Thus, the characteristic or design values of the load–carrying capacity are determined as minimum of (see also Annex C):

- timber failure $F_{v,Rk}$ and $F_{ax,Rk}$ (obtaining the embedment strength in the timber member of Hilti HCW and HCW L subjected to shear or the withdrawal, respectively as well as for
- steel failure $F_{t,Rd}$ of Hilti HCW and HCW L as well as for
- failure $F_{ax,Rk,DT}$ of the Dowel Type fastener subjected to shear or the withdrawal capacity.

The design value of the load–carrying capacity is the smaller value of load–carrying capacities.

$$F_{ax,Rd} = min \begin{cases} \dfrac{k_{mod} \cdot F_{ax,Rk}}{\gamma_M} \\ \dfrac{F_{t,Rk}}{\gamma_{M,2}} \\ \dfrac{k_{mod} \cdot F_{ax,Rk,DT}}{\gamma_M} \\ \dfrac{F_{t,Rk,DT}}{\gamma_{M,2}} \end{cases}$$

Therefore, for timber failure the load duration class and the service class are included. The different partial factors γ_M for steel or timber or concrete, respectively, are also correctly taken into account.

Further, the connectors can be fastened to a steel member by M12 bolts in holes with a diameter up to 2 mm larger than the bolt, and to a concrete member by concrete fasteners.

The design models allow the use of fasteners described in Annex A.

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3.5 Corrosion protection in service class 1 and 2.

The connectors have a zinc coating thickness of 5 microns (5 µm). Nailing plates < 3 mm thickness has 8 microns for service class 2.

3.6 General aspects related to the intended use of the product

A connector joint is deemed fit for its intended use provided: Position holes guarantee exact position for prefabricated wall and ceiling elements. Concrete foundation needs exact position of the concrete fasteners.

Header – support conditions
The header beam shall be restrained against rotation.

If the header carries joists only on one side the eccentricity moment from the joists $M_{ec} = R_{joist} \times b_H/2$ shall be considered at the strength verification of the header.
R_{joist} Reaction force from the joists
b_H Width of header

For a header with joists from both sides but with vertical forces which differ more than 20% a similar consideration applies.

Timber to timber connections
The connector joint is designed in accordance with Eurocode 5 or an appropriate national code.

The Hilti HCW and HCW L shall be in close contact with the timber to timber over the whole face. There shall be no intermediate layers in between, except static calculations are made for the interlayer.

Timber to steel and timber to concrete
The above mentioned rules for timber to timber connections are applicable also for the connection between the joist and the steel-header or concrete-header.

- The connector joint is designed in accordance with Eurocodes 2, 3, 5 or 9 or an appropriate national code.
- The Hilti HCW and HCW L shall be in close contact with the steel or concrete over the whole face. There shall be no intermediate layers in between, except static calculations are made for the interlayer.
- The hole in the steel member shall have a diameter not bigger than 12 mm plus 2 mm.
- Concrete fasteners shall be in accordance with an ETA.

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

4.1 AVCP system

According to the decision 97/808/EC of the European Commission1, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 2+.

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking.

Issued in Copenhagen on 2024-03-01 by

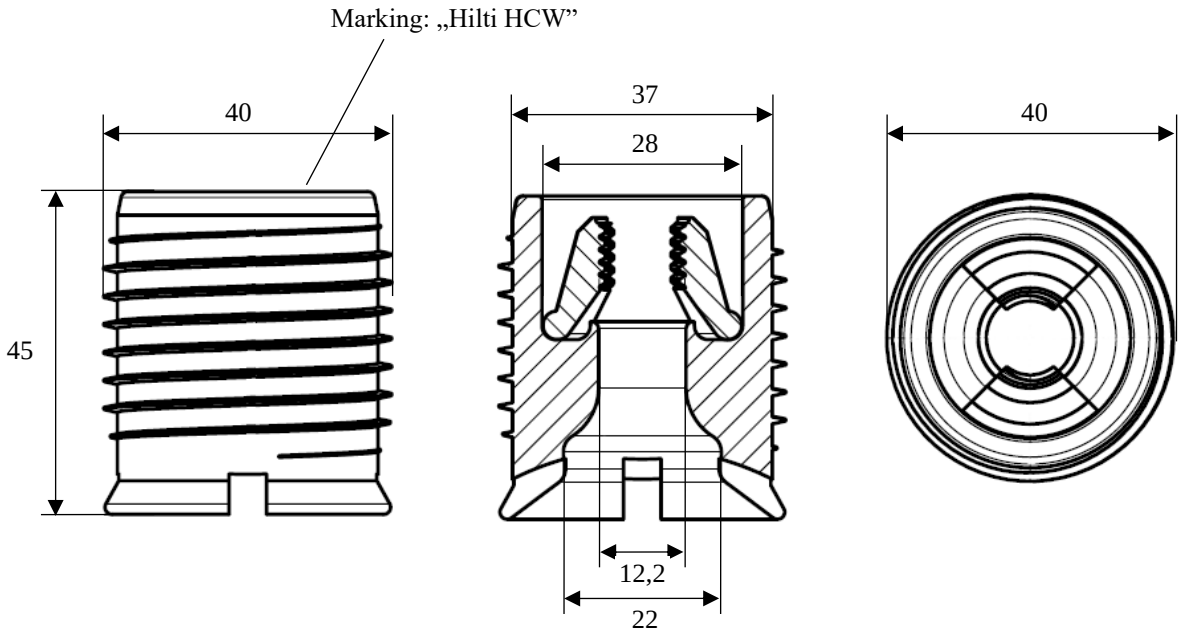
Thomas Bruun
Managing Director, ETA-Danmark

Annex A

Product description

Hilti HCW

Outer diameter:	40 mm
Diameter of the body	37 mm
Length:	45 mm
Material	Sleeve: 11SMnPb30+C according EN 10277; clamping device: 11SMnPb30, 16MnCrS5+C according EN 10277; Electroplated zinc coated ≥ 5 µm (equivalent material may be used and documented in the production inspection documentation)

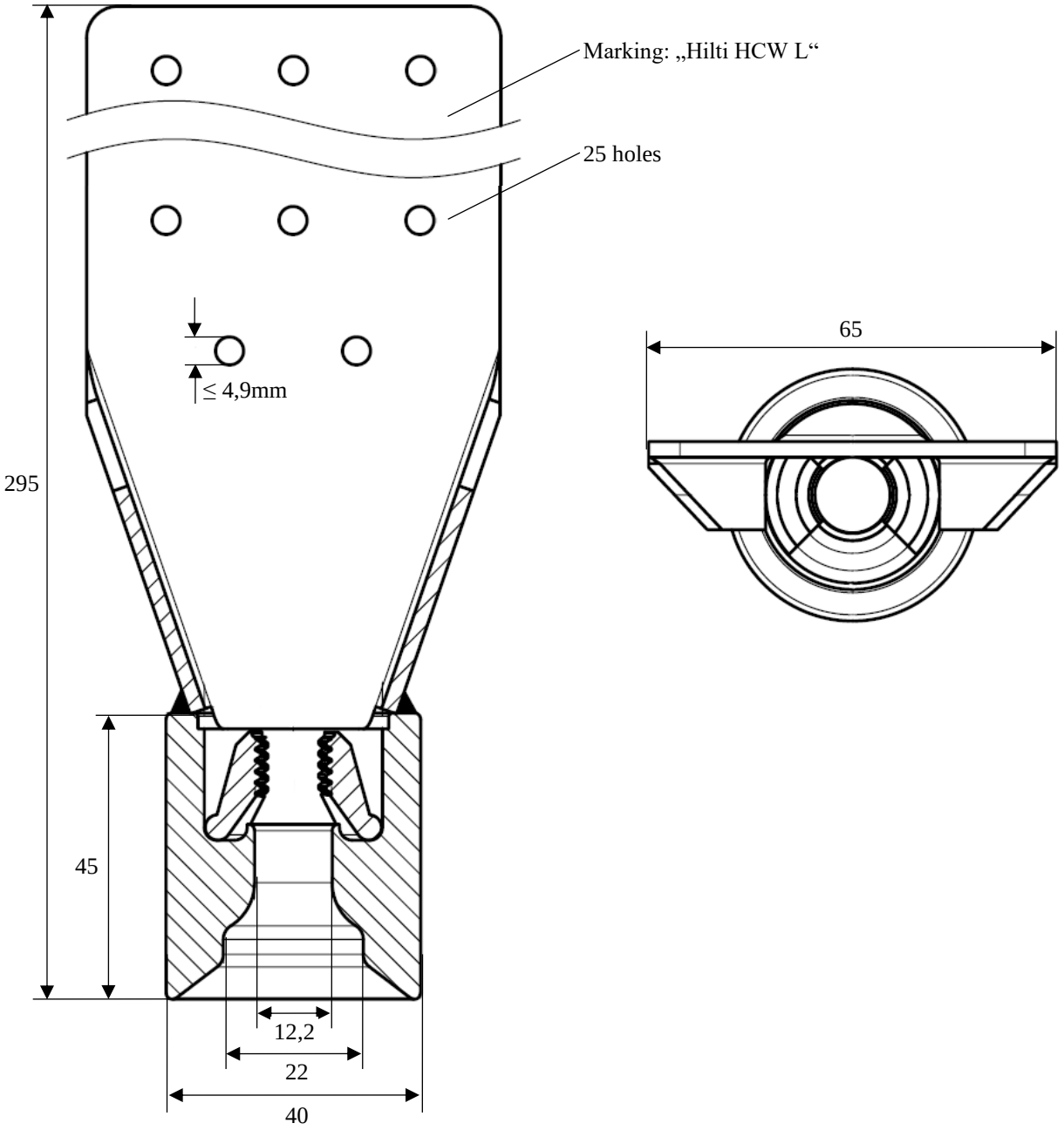


Annex A

Product description

Hilti HCW L

Outer diameter, sleeve:	40 mm	Width, plate	65 mm
Length, sleeve:	45 mm	Thickness, plate	2,5 mm
Length	295 mm	Hole diameter, plate	≤ 4,9 mm
Material	Sleeve and nailing plate: S355J2 according EN 10277 clamping device: 16MnCrS5+C according EN 10277 Electroplated zinc coated ≥ 5 µm (equivalent material may be used and documented in the production inspection documentation)		



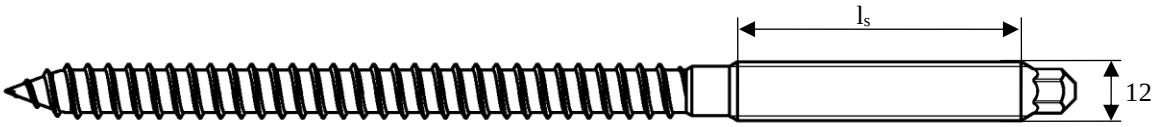
Annex A

Product description

Fastener type:

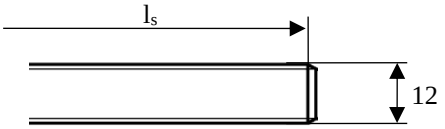
- upper side to push into Hilti HCW and HCW L: thread M12 (min. l_s = 40 mm), steel strength $f_{u,k} \geq 400$ N/mm^2 or material 4.6 or better.
- lower side: timber thread acc. ETA or EN14592 / steel connection acc. EC3 / concrete fastener acc. ETA

timber – timber connection timber thread acc. ETA or EN 14592

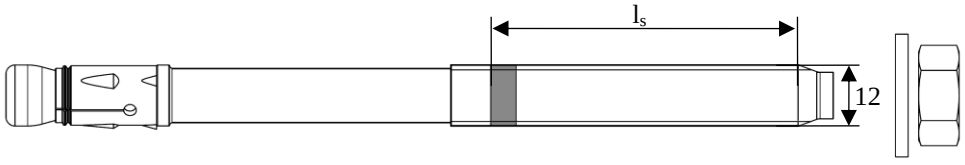


e.g. Hilti HSW M12 …
timber
thread acc. EN 14592

timber – steel connection Steel connection according EC3



timber – concrete connection Concrete fastener according to ETA

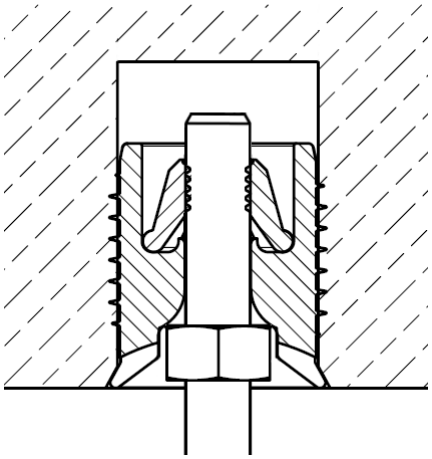


e.g. Hilti HST3 (ETA-98/0001)
or Hilti HAS-U with Hilti HIT-…

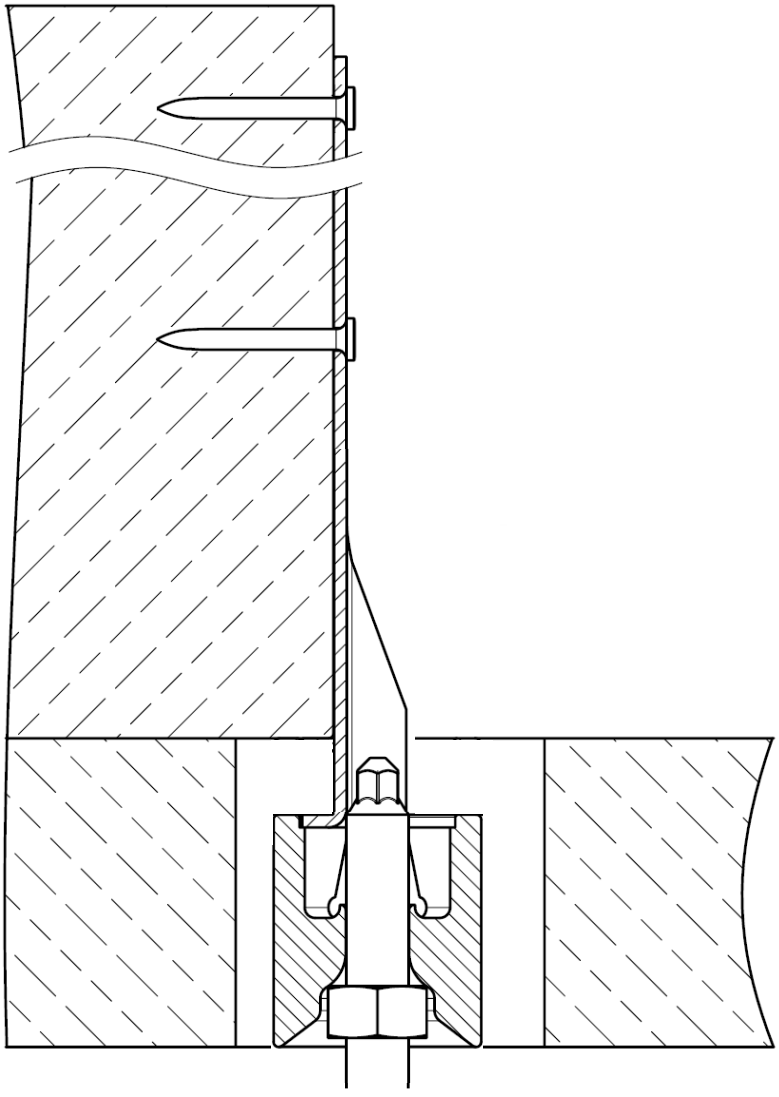
Annex A

Product description

Hilti HCW
with installed type fastener



Hilti HCW L
with installed type fastener



Annex B

Intended Use

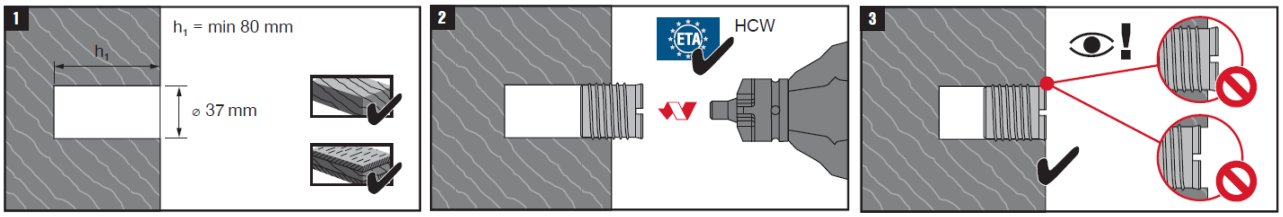
Installation parameters

		HCW
Pre-drilling diameter (softwood and hardwood)	d_0	37 mm
Minimum drilling depth	h_1	80 mm
End- (a_3) and edge- (a_4) distances	$e_{...}$	See Annex C, table C.1 and table C.2

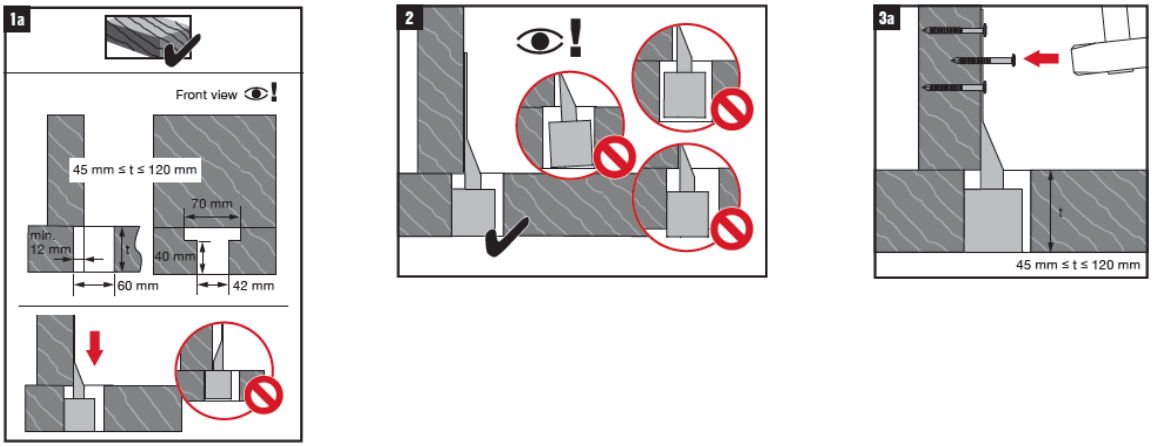
	HCW L
Nail / screw diameter	d = 4 mm and a length of l= 50 mm[1)]; (nails and screws according to EN14592 or ETA)
[1)] For other types and lengths of nails, calculations according to EN 1995-1-1 shall be done.	

Installation instruction Hilti HCW and HCW L

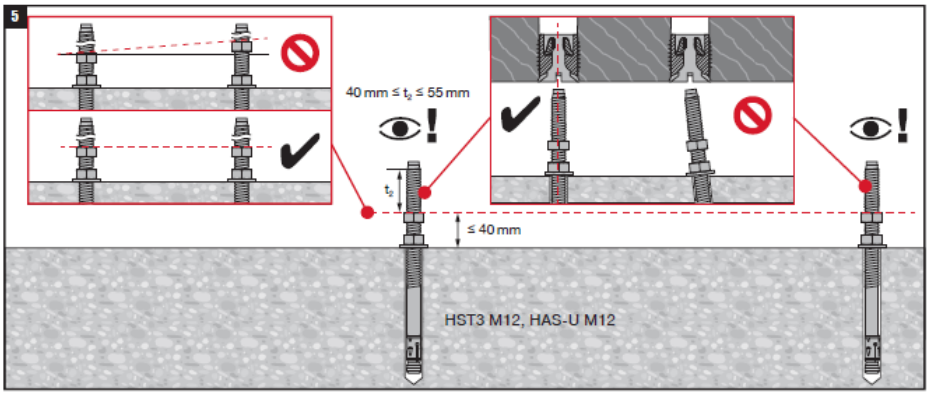
Setting HCW



Setting HCW L



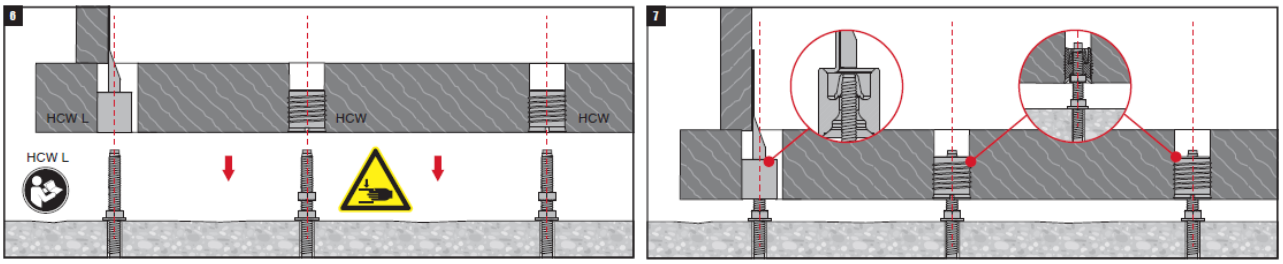
Levelling fastener



Annex B

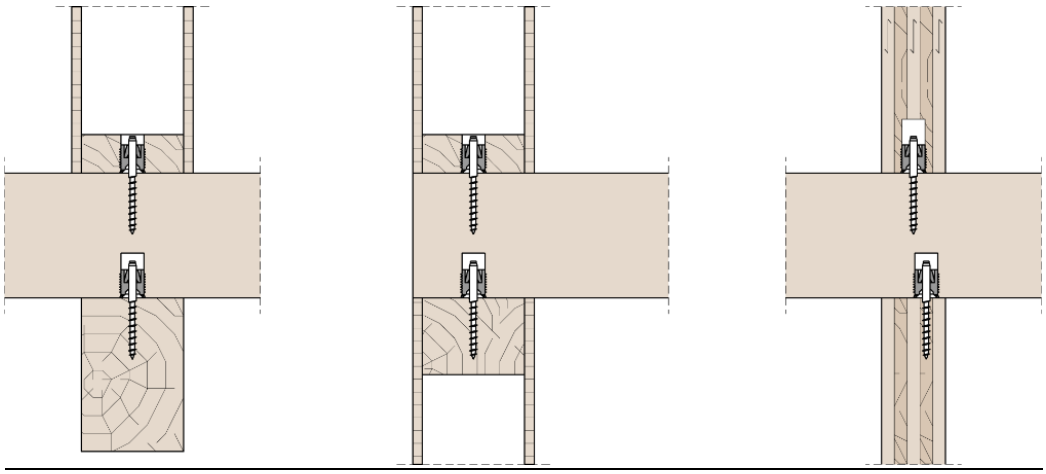
Intended Use

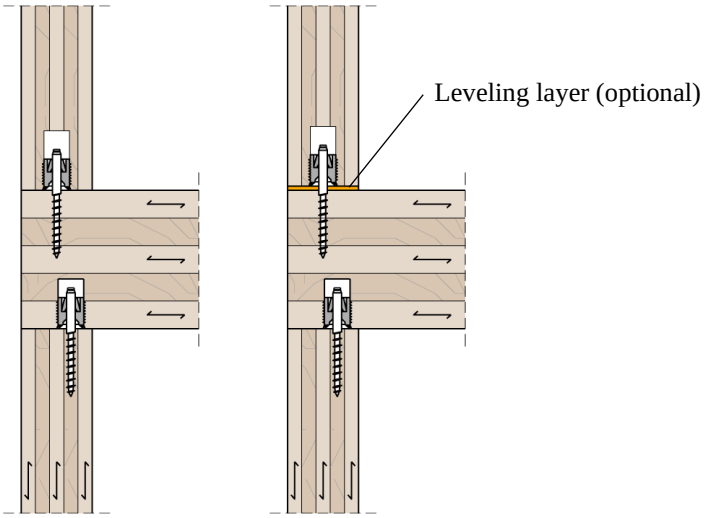
Connection of HCW and HCW L to the fastener



timber to timber joint
Timber cross sections are only examples (minimum dimension see Annex C)
Timber dimensions according static calculation

Wall

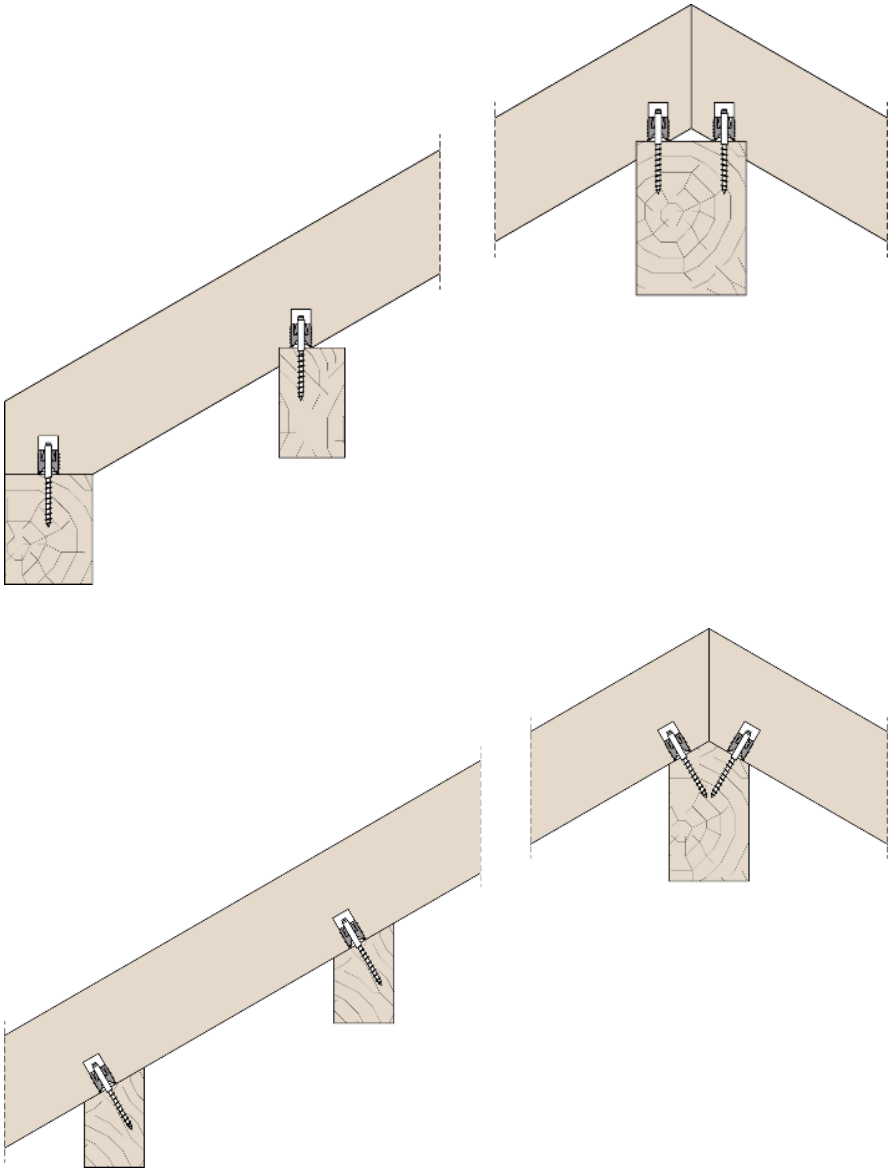




Annex B

Intended Use

Roof

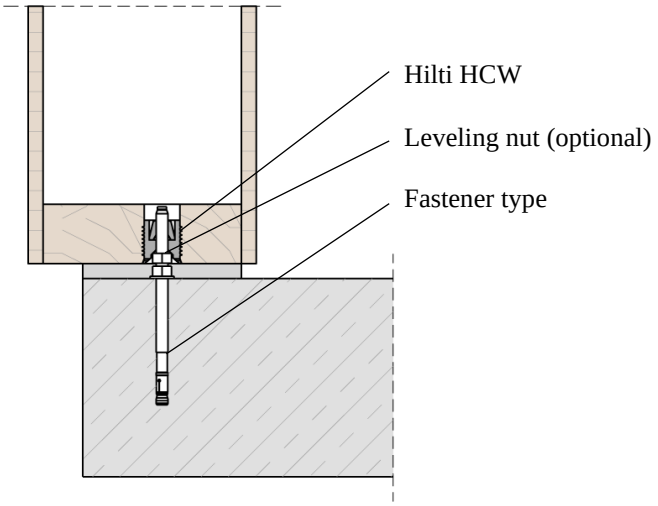


Annex B

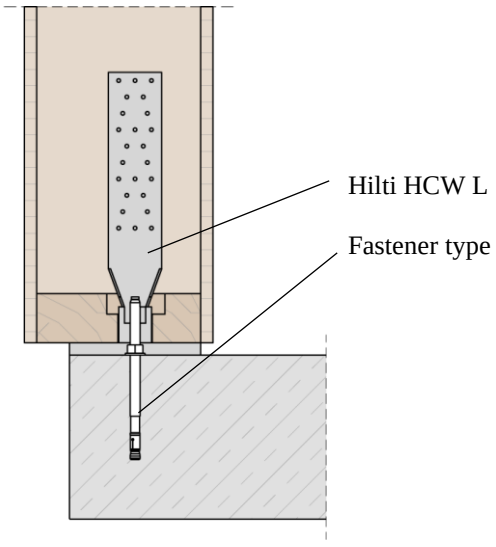
Intended Use

timber to concrete joint
Timber cross sections are only examples (minimum dimension see Annex C)
Timber dimensions according static calculation

Wall – Hilti HCW



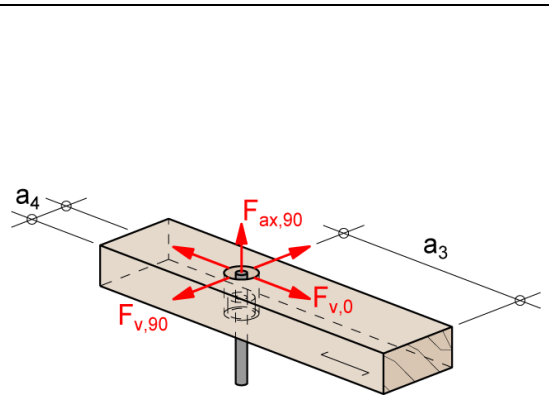
Wall – Hilti HCW L

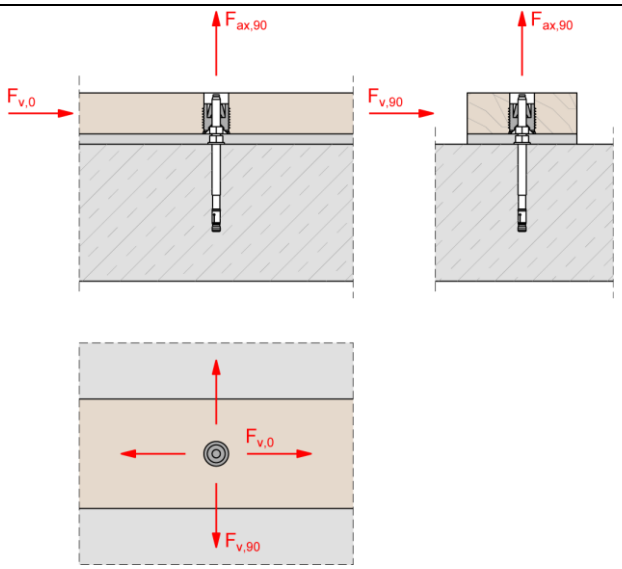


Annex C

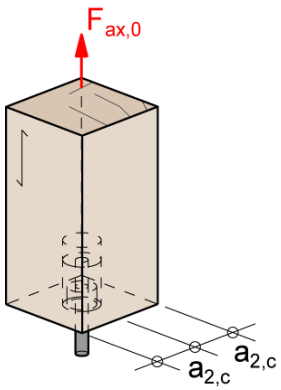
Performances

General information to load directions:

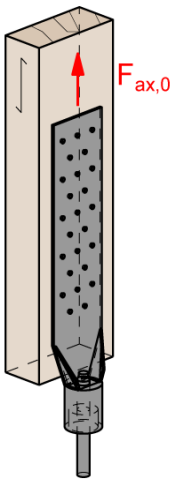




Cross section ≥ 80 x 45 mm², End- and edge-distances, see Table C.1



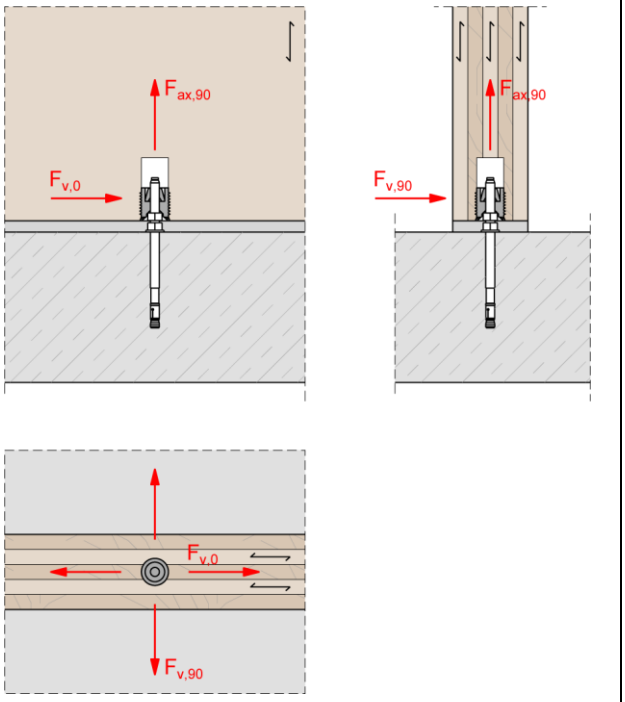
Cross section of column ≥ 100 x 100 mm²
Side distance ≥ 50 mm

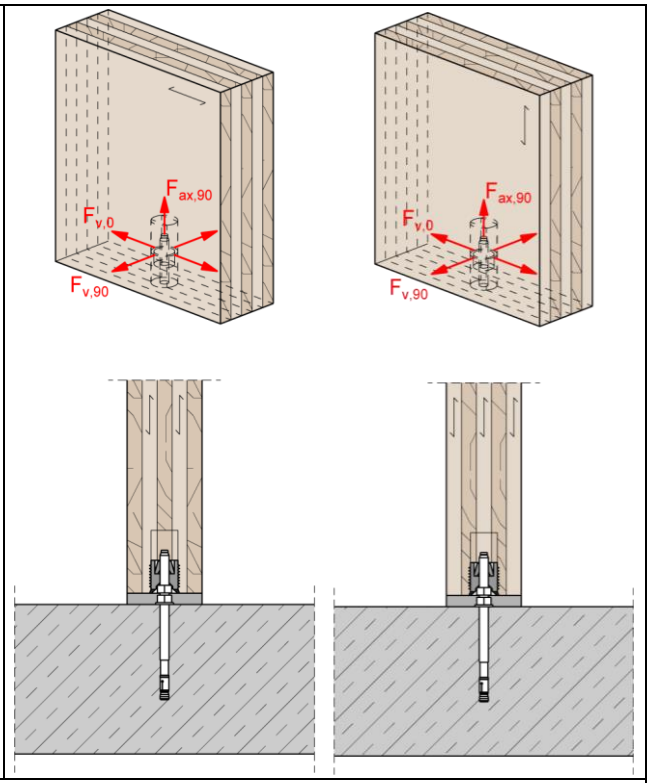


Cross section ≥ 80 x45 mm

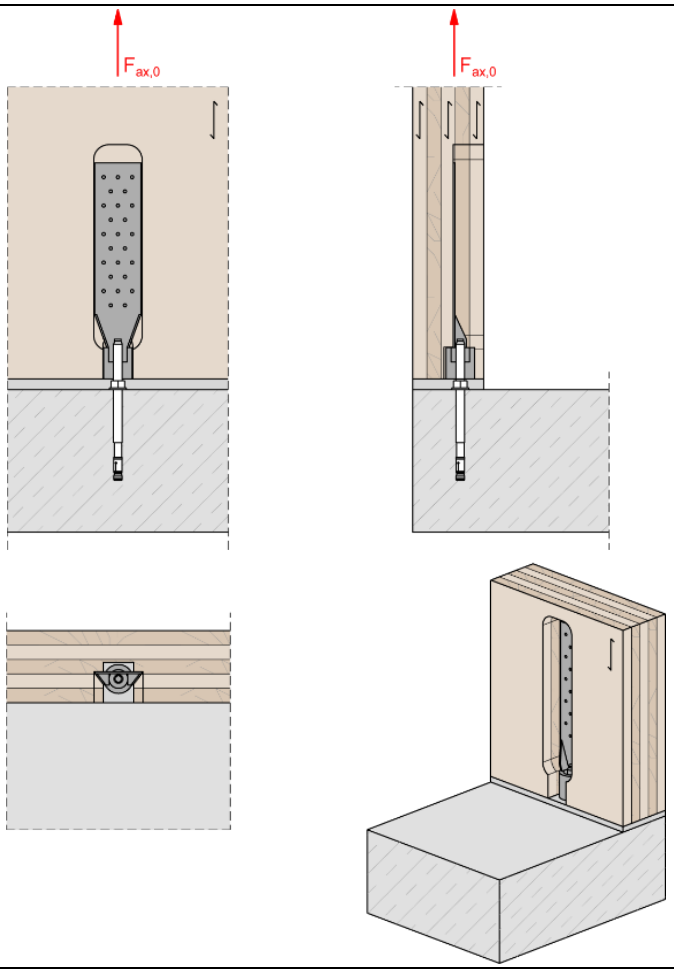
Annex C

Performances





Load direction in CLT applications for HCW



Load direction in CLT applications for HCW L

Annex C

Performances

Table C.1: Load carrying capacities and slip-modules for C24 and engineered wood products (ρ_k = 350 kg/m³), e.g. CLT, GL 24 h/c

Parameter	Type	Fastener type		Timber		Characteristic Load carrying capacities [kN]	
		Nails/ Screws	Rod	Edge distance (a_4) [mm]	Min cross-section [mm²]		
Tension Strength	HCW/ HCW L	-	M12, 4.6 M12, 8.8	-		$F_{t,Rk}$	30,0 42,0
Axial Strength	HCW L	15 nails 25 nails[2)]	M12, 8.8	-		$F_{ax,0,Rk}$	39,0 45,0
Withdrawal capacity parallel to the grain direction	HCW	-	M12, ≥ 4.6	≥ 50	100 x 100	$F_{ax,0,Rk}$	11,8
Withdrawal capacity perpendicular to the grain	HCW	-	M12, ≥ 4.6	≥ 40[1)]	45 x 80	$F_{ax,90,Rk}$	12,3
				≥ 50[1)]	45 x 100		12,9
Shear strength parallel to the grain direction	HCW	-	M12, ≥ 4.6	≥ 40[1)]	45 x 80	$F_{v,0,Rk}$	24,4
				≥ 50[1)]	45 x 100		28,2
Shear strength perpendicular to the grain direction	HCW	-	M12, ≥ 4.6	≥ 40[1)]	45 x 80	$F_{v,90,Rk}$	6,8
				≥ 50[1)]	45 x 100		7,3 11,8[3)]
				≥ 70[1)]	45 x 140		11,8
				≥ 80[1)]	45 x 140		14,8

Notes: [1)] End- distance (a_3) is ≥ 200 mm.
[2)] For other types, lengths or number of nails, calculations according to EN 1995-1-1 shall be done.
[3)] Shear capacity with tension perpendicular to grain, reinforced with 2 fully threaded screws with a diameter of d = 8 mm.

Table C.2: HCW load carrying capacities with reduced end- and side distances for C24 and engineered wood products (ρ_k = 350kg/m³), e.g. CLT, GL 24h/c:

Parameter	Type	Type of fastener		Timber C24	Characteristic Load carrying capacities [kN]	
		Nails/ Screws	Threaded rod	Distances (a_3) and (a_4) [mm]		
Withdrawal capacity perpendicular to the grain	HCW	-	M12, ≥ 4.6	$a_3 \geq 50$ mm $a_4 \geq 50$ mm	$F_{ax,90,Rk}$	11,6
				$a_3 \geq 58$ mm $a_4 \geq 40$ mm	$F_{ax,90,Rk}$	6,6

Annex C

Performances

Table C.3: Slip modulus in the Serviceability Service State (SLS) with standard end- and side distances for C24 and engineered wood products (ρ_k = 350kg/m³), e.g. CLT, GL 24h/c:

Parameter	Type	Type of fastener		Timber C24		Slip modulus (K_{ser}) [kN/mm]	
		Nails/ Screws	Threaded rod	Edge distance a_4 [mm]	Min cross-section [mm²]		
Withdrawal capacity parallel to the grain direction	HCW	-	M12, ≥ 4.6	≥ 50	100 x 100	$K_{ax,0,ser}$	15,0
Withdrawal capacity perpendicular to the grain	HCW	-	M12, ≥ 4.6	≥ 40	45 x 80	$K_{ax,90,ser}$	4,5
				≥ 50	45 x 100		7,9
Shear strength parallel to the grain direction	HCW	-	M12, ≥ 4.6	≥ 40	45 x 80	$K_{v,0,ser}$	5,2
				≥ 50	45 x 100		5,5
Shear strength perpendicular to the grain direction	HCW	-	M12, ≥ 4.6	≥ 40	45 x 80	$K_{v,90,ser}$	3,5
				≥ 50	45 x 100		4,0
				≥ 70	45 x 140		4,0
				≥ 80	45x 140		4,0

Annex C

Performances

C.1 Capacities of timber-to-timber connector joints

C.1.1 Axial forces (withdrawal)

$$F_{ax,Rd} = min\begin{cases} \dfrac{k_{mod} \cdot F_{ax,Rk}}{\gamma_M} \\ \dfrac{F_{t,Rk}}{\gamma_{M,2}} \\ \dfrac{k_{mod} \cdot F_{ax,Rk,DT}}{\gamma_M} \\ \dfrac{F_{t,Rk,DT}}{\gamma_{M,2}} \end{cases}$$

$F_{ax,Rk}$ … see table C.1, characteristic withdrawal capacity
$F_{t,Rk}$ … see table C.1, steel failure of Hilti HCW and HCW L
$F_{ax,Rk,DT}$, $F_{t,Rk,DT}$… withdrawal and steel capacity of dowel type connector (see DoP acc. EN 14592 / ETA)
k_{mod} and γ_M … see EN 1995-1-1
$\gamma_{M,2}$ … see EN 1993-1-1

$F_{ax,0,Rk}$ in table C.1 for Hilti HCW applies only for short-term (e.g. wind) and instantaneous load duration classes. For all other longer load-duration classes according to EN 1995-1-1:

- For angles $0° \leq \alpha \leq 45°$ between screw-axis and direction of wood grain, $F_{ax,k,\alpha}$ is obtained with:

$$f_{ax,k,a} = k_{ax} \cdot f_{ax,k,90°} \quad with: k_{ax} = 0{,}3 + \frac{0{,}7 \cdot \alpha}{45°}$$

- For angles $45° \leq \alpha \leq 90°$ between screw-axis and direction of wood grain, $F_{ax,k,\alpha}$ remains constant.

α … angle between grain direction and screw axis; $\alpha = 0°$ end grain, $\alpha = 90°$ side grain

$F_{ax,Rk}$ for timber member with lower or higher strength class as C24: EN 1995-1-1, 8.7 has to be applied.

$$F_{Rk,\rho a} = \left(\frac{\rho_k}{\rho_a = 350}\right)^{0,8} \cdot F_{Rk}$$

ρ_a … associated characteristic density in kg/m³ for the strength class differing of C24

Annex C

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C.1.2 Shear forces

$$F_{v,Rd} = min \begin{cases} \dfrac{k_{mod} \cdot F_{v,Rk}}{\gamma_M} \\ \dfrac{k_{mod} \cdot F_{v,Rk;DT}}{\gamma_M} \end{cases}$$

$F_{v,Rk}$ … see table C.1
$F_{v,Rk,DT}$ … shear capacity of the dowel type connector has to be calculated according EN1995-1-1
k_{mod} and γ_M … see EN1995-1-1

Effective number of Hilti HCW: $n_{ef} = n$ for $a_1 \geq 400$ mm in longitudinal direction of grain.

C.2 Capacities of connector joints with bolts (steel connection)

For Hilti HCW and HCW L connected to a steel member using bolts, the calculation of the load-carrying capacity of the connection is based on:

- K_{ser} and F_{Rk} in table C.1 and table C.2 has to be applied

$$F_{v,Rd} = \frac{k_{mod} \cdot F_{v,Rk}}{\gamma_M}$$

$F_{v,Rk}$ … see table C.1

For Hilti HCW and HCW L connected to a timber member using bolts or interconnection nuts the calculation of the load-carrying capacity of the connection is:

- K_{ser} and F_{Rk} in table C.1 and table C.2 has to be applied
- The bolts or interconnection nuts shall always be arranged as the screws they are replacing; characteristic values for the bolts or interconnection nuts have to be calculated according EN 1995-1-1 or acc. ETA of the product
- Sufficient diameter of washers are required for bolts
- The static behavior is the same as for a timber to timber connection with screws. The bolt capacities replace the respective screw capacities in equations C.1.

C.2.1 Combined forces

For combined shear and tension forces, the following verifications shall be applied:

- Between HCW and timber member described in section C.4, and
- Between connector and base material steel, the provisions according to EN 1993-1-1 apply.

Annex C

Performances

C.3 Capacities of connector joints with concrete (fastener connection)

C.3.1 Axial forces:

$$F_{ax,Rd} = min \begin{cases} \dfrac{k_{mod} \cdot F_{ax,Rk}}{\gamma_M} \\ \dfrac{F_{t,Rk}}{\gamma_{M,2}} \\ \min N_{Rd} \end{cases}$$

$F_{ax,Rk}$	… see table C.1, characteristic withdrawal capacity
k_{mod} and γ_M	… see EN1995-1-1
$F_{t,Rk}$	… see table C.1, steel failure of Hilti HCW and HCW L
$\gamma_{M,2}$	… see EN1993-1-1
min N_{Rd}	… decisive tensile capacity of concrete fastener (calculated according EN 1992-4)

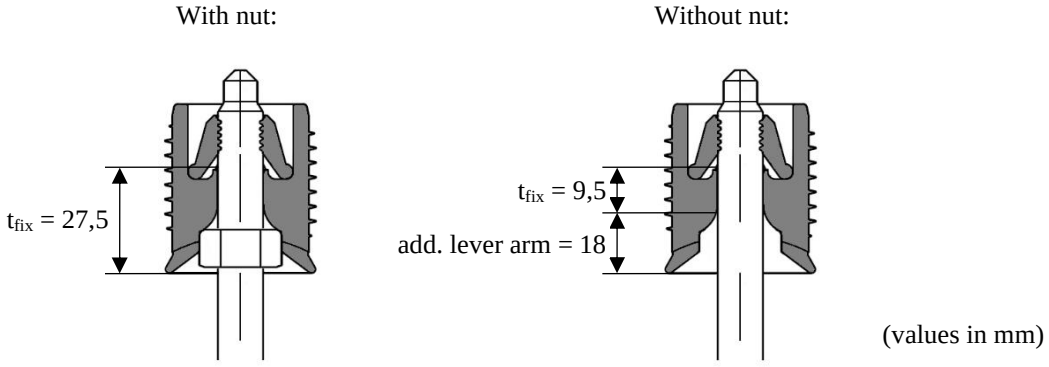
C.3.2 Shear forces:

$$F_{v,Rd} = min \begin{cases} \dfrac{k_{mod} \cdot F_{v,Rk}}{\gamma_M} \\ \min V_{Rd} \end{cases}$$

$F_{v,Rk}$	… see table C.1
k_{mod} and γ_M	… see EN1995-1-1
min V_{Rd}	… decisive shear capacity of concrete fastener (calculated according EN 1992-4)

Minimum edge distance and minimum spacing of the concrete fasteners must be regarded.

For shear loads acting on the concrete fastener following values shall be used as t_{fix}:



(values in mm)

C.3.3 Combined forces

For combined shear and tension forces, the following verifications shall be applied:

- Between HCW and timber member described in section C.4, and
- Between connector and base material concrete, the provisions according to EN 1992-4 apply.

Annex C

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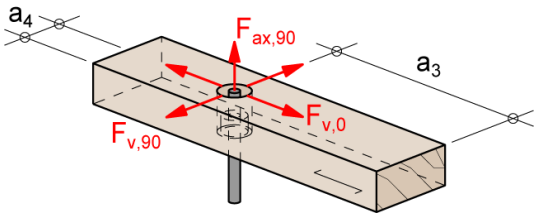
C.4 Combined forces (from HCW to the timber member)

In case of combined shear and tension forces transferred from HCW to the timber member, the following verification shall be fulfilled:



$$\left(\frac{F_{ax,90,Ed}}{F_{ax,90,Rd}}\right)^2 + \left(\frac{F_{v,0,Ed}}{F_{v,0,Rd}}\right)^2 + \left(\frac{F_{v,90,Ed}}{F_{v,90,Rd}}\right)^2 \leq 1$$

where:

$$F_{ax,90,Rd} = \frac{k_{mod} \cdot F_{ax,90,Rk}}{\gamma_M}$$

$F_{ax,90,Rk}$ … see table C.1, characteristic withdrawal capacity
k_{mod} and γ_M … see EN1995-1-1

$$F_{v,0,Rd} = \frac{k_{mod} \cdot F_{v,0,Rk}}{\gamma_M}$$

$F_{v,0,Rk}$ … see table C.1
k_{mod} and γ_M … see EN1995-1-1

$$F_{v,90,Rd} = \frac{k_{mod} \cdot F_{v,90,Rk}}{\gamma_M}$$

$F_{v,90,Rk}$ … see table C.1
k_{mod} and γ_M … see EN1995-1-1

C.5 Seismic behavior and Classes of Ductility of the Connectors

C.5.1 Ductility classes

Depending on their ductile behavior and energy dissipation capacity under seismic actions, timber buildings shall be assigned to a ductility class (DC) as given in EN 1998. To use the HCW and HCW L Connector for an earthquake design a classification given Table C.4.1 should be assumed.

Table C.4.1: Ductility classes

HCW type	Fasteners Type	Threaded rod	Load direction	Static ductility	Design Concept and Ductility Classes according to EN 1998-1
HCW L	Fully nailed (25 nails)	M12 ≤ 8.8	$F_{ax,0}$	2	DCL
	Partially nailed (15 nails)			4	DCM
HCW	-	M12 ≤ 8.8	$F_{ax,90}$	2	DCL
			$F_{v,0}$	4	DCM
Note: The design concepts in accordance to EN 1998 must be considered. Geographical limitations on the use of ductility classes M may be found in the relevant National Annex.					