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-22/0772**
**of 03.04.2023**

General part

| | |
|---|---|
| **Technical Assessment Body issuing the European Technical Assessment** | Österreichisches Institut für Bautechnik (OIB)<br>Austrian Institute of Construction Engineering |
| **Trade name of the construction product** | Hilti screws S-WCF, S-WXF, S-WCP, S-WWP and S-WDF |
| **Product family to which the construction product belongs** | Screws for use in timber constructions |
| **Manufacturer** | Hilti AG<br>Feldkircherstrasse 100<br>FL 9494 Schaan<br>Principality of Liechtenstein |
| **Manufacturing plant** | Hilti AG, Plant 0320 |
| **This European Technical Assessment contains** | 51 pages including 9 Annexes, which form an integral part of this assessment. |
| **This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of** | European Assessment Document (EAD) 130118-01-0603 “Screws and threaded rods for use in timber constructions”. |

**Remarks**

Translations of the European Technical Assessment in other languages shall fully correspond to the original issued document and should be identified as such.

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Specific parts

## 1 Technical description of the product

This European Technical Assessment (ETA) applies to the screws for use in timber constructions "Hilti screws S-WCF, S-WXF, S-WCP, S-WWP and S-WDF" hereinafter referred to as Hilti screws. Hilti screws are self-tapping screws divided into a drill tip, optionally a compressor and/or cutting groove, thread, optionally a friction part, shank, and head of the screw. The screws are made from special carbon steel and hardened. They are anti-friction coated and are electrogalvanized and passivated (yellow or blue), provided with a zinc-nickel coating or hot-dip galvanised. The washers are made from carbon steel. Possible outer thread diameters as well as overall lengths for the Hilti screws are given in Table 1.

A bending angle of 45° is reached for all screws.

The screws and washers correspond to the specifications given from Annex 1 to Annex 5. The material characteristics, dimensions and tolerances of the product not indicated in these Annexes, are given in the technical file[1] of the European Technical Assessment.

**Table 1**: Possible outer thread diameter and overall length of screws

| Type of Hilti screws | Outer thread diameter | | Overall length | |
|---|---|---|---|---|
| | min. | max. | min. | max. |
| | mm | mm | mm | mm |
| S-WCF-H-8xL Z<br>S-WCF-H-10xL Z<br>S-WCF-H-12xL Z | 8 | 12 | 50<br>50<br>60 | 1 000 |
| S-WXF-H/S-8xL Z *<br>S-WXF-H-10xL Z<br>S-WXF-H-12xL Z | 8 | 12 | 50<br>50<br>60 | 1 000 |
| S-WCP-S-4xL Z<br>S-WCP-S-5xL Z<br>S-WCP-S-6xL Z<br>S-WCP-S-8xL Z<br>S-WCP-S-10xL Z<br>S-WCP-S-12xL Z | 4 | 12 | 30<br>30<br>50<br>50<br>60<br>80 | 600 |
| S-WWP-S-6xL Z<br>S-WWP-S-8xL Z<br>S-WWP-S-10xL Z<br>S-WWP-S-12xL Z | 6 | 12 | 50<br>50<br>60<br>80 | 600 |
| S-WDF-S-12xL Z | 12 | 12 | 60 | 1 000 |

* H/S … with / without half tip

[1] The technical file of the European Technical Assessment is deposited at Österreichisches Institut für Bautechnik.

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

### 2.1 Intended use

The screws are used for connections in load bearing timber structures between wood-based members or between those members and steel members:

- Solid timber of softwood of strength class C14 or better and solid timber of hardwood of strength class D18 or better according to EN 338[2] and EN 14081-1,
- Glued laminated timber and glued solid timber of softwood of strength class GL20 or better according to EN 14080 or glued laminated timber of hardwood according to European Technical Assessments (ETA) or national provisions that apply on the installation site,
- Laminated veneer lumber LVL according to EN 14374,
- Cross laminated timber according to European Technical Assessments or national provisions that apply on the installation site.
- Cement-bonded particle boards according EN 634-1 and EN 13986 or ETA or national provisions that apply on the installation site.

The screws may be used for connecting the following wood-based panels to the timber members mentioned above:

- Laminated veneer lumber LVL according to EN 14374 or ETA,
- Solid wood panels according to EN 13353 and EN 13986 or ETA,
- Plywood according to EN 636 and EN 13986 or ETA,
- Oriented strand boards, OSB, according to EN 300 and EN 13986 or ETA,
- Particleboards according to EN 312 and EN 13986 or ETA,
- Fibreboards according to EN 622-2, EN 622-3 and EN 13986 or ETA,
- Cement-bonded particle boards according EN 634-1 and EN 13986 or ETA or national provisions that apply on the installation site,
- Engineered wood products according to ETA, provided that the ETA for the product provides provisions for the use of self-tapping screws and these provisions are applied.

Compression and tension reinforcement perpendicular to the grain with fully threaded screws as well as shear reinforcement with fully threaded screws with a diameter $d \geq 8$ mm is allowed.

In addition, screws with 6 mm $\leq d \leq$ 12 mm may be used for fixing of thermal insulation on rafters and walls.

For engineered wood products according to a European Technical Assessment (ETA) including provisions for the use of self-tapping screws, the provisions of the ETA of the engineered wood product apply.

The product shall be subjected to static and quasi static actions only.

The product is intended to be used in service classes 1, 2 and 3 according to EN 1995-1-1. The scope of the screws regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions.

Hot-dip galvanised screws with a minimum thickness of the zinc coating of 55 µm may be used in conditions defined by service class 3.

[2] Reference documents are listed in Annex 9.

## 2.2 General assumptions

The screws for use in timber constructions are 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 design and execution of the works.

<u>Design</u>

The European Technical Assessment only applies to the manufacture and use of the screws for use in timber constructions. Verification of stability of the works including application of loads on the products is not subject to the European Technical Assessment.

The following conditions shall be observed:

- Design of Hilti screws is carried under the responsibility of an engineer experienced in such products.
- Design of the works shall account for the protection of Hilti screws to maintain service classes 1, 2 and 3 according to EN 1995-1-1 or national provisions that apply on the installation site.
- Hilti screws are installed correctly.

Design of the screws for use in timber constructions may be according to EN 1995-1-1, taking into account of Annex 5 to Annex 8 of the European Technical Assessment. Hereby, the outer thread diameter d is used as nominal diameter d or rather effective diameter $d_{ef}$ and $l_{ef}$ is the threaded part in the timber member including point.

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

<u>Packaging, transport, storage, maintenance, replacement and repair</u>

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.

<u>Installation</u>

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

The screws are either driven into the wood-based member of softwood without pre-drilling or in predrilled holes with a diameter not exceeding the inner thread diameter or rather into the wood-based member of hardwood in predrilled holes with a diameter minimally exceeding the inner thread diameter.

The screw holes in steel members shall be pre-drilled with an adequate diameter greater than the outer thread diameter.

The minimum penetration length of screws in the load-bearing wood-based members shall be 4 d.

Screws made of carbon steel with an outer thread diameter 5 mm ≤ d ≤ 12 mm may be driven into laminated veneer lumber LVL of beech or related products of hardwood with predrilling.

At least four screws shall be used in a connection with screws (4 mm ≤ d ≤ 12 mm) inserted in the timber member with an angle between screw axis and grain direction of less than 15°. The penetration length of the threaded part of the partly or fully threaded screw shall be at least 20 d.

The use of only one screw in load-bearing connections is possible for screws (4 mm ≤ d ≤ 12 mm) loaded in axial direction and angles between grain direction and screw axis $\alpha \geq 15°$ provided that a minimum penetration length of the threaded part of the screw of 20 d can be ensured. Hereby, the load-bearing capacity of the screw must be reduced by 50%. This reduction is not necessary for screws used as reinforcement perpendicular to the grain of wood-based members.

To ensure a proper installation for screws with lengths of more than 800 mm a guiding hole of 5 d is recommended.

For mounting of steel plates and wood-based panels the screw head must be placed on top of these members.

The structural members which are connected with Hilti screws shall

- be in accordance with Clause 2.1;
- ensure minimum spacing and edge distances in accordance with EN 1995-1-1 and Annex 5.

### 2.3 Assumed working life

The provisions made in the European Technical Assessment (ETA) are based on an assumed intended working life of Hilti screws of 50 years, when installed in the works, provided that the screws are 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[3].

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 a means for choosing the appropriate products in relation to the expected economically reasonable working life of the works.

[3] The real working life of a product incorporated in a specific works depends on the environmental conditions to which that 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 Essential characteristics of the product

**Table 2: Essential characteristics of the product and product performance**

| № | Essential characteristic | Product performance |
|---|---|---|
| | Basic requirement for construction works 1: Mechanical resistance and stability [1)] | |
| 1 | Dimensions | Annex 1 to Annex 4 |
| 2 | Characteristic yield moment | Annex 5 |
| 3 | Bending angle | Clause 1 |
| 4 | Characteristic withdrawal parameter | Annex 5 |
| 5 | Characteristic head pull-trough parameter | Annex 5 |
| 6 | Characteristic tensile strength | Annex 5 |
| 7 | Characteristic yield strength | Annex 5 |
| 8 | Characteristic torsional strength | Annex 5 |
| 9 | Insertion moment | Annex 5 |
| 10 | Spacing, end and edge distances of the screws and minimum thickness of the wood based material | Annex 5 |
| 11 | Slip modulus for mainly axially loaded screws | Annex 5 |
| 12 | Durability against corrosion | 3.1.1 |
| | Basic requirement for construction works 2: Safety in case of fire | |
| 13 | Reaction to fire | 3.1.2 |
| | Basic requirement for construction works 4: Safety and accessibility in use | |
| 14 | Same as BWR 1 | |
| [1)] These characteristics also relate to basic requirement 4 for construction works. | | |

3.1.1 Durability against corrosion

The product is intended to be used in service classes 1, 2 and 3 according to EN 1995-1-1.

The screws and washers made from carbon steel are electrogalvanized and yellow or blue passivated, coated with a zinc-nickel coating or hot-dip galvanised. The minimum thickness of the zinc coating of the screws is 5 µm and the minimum thickness of the zinc-nickel coating is 4 µm. The minimum thickness of the zinc coating of hot-dip galvanised screws is 55 µm.

Durability of Hilti screws is in accordance with EN 1995-1-1 or national provisions that apply on the installation site.

3.1.2 Reaction to fire

Hilti screws are made from steel classified as Euroclass A1 in accordance with Commission Decision 96/603/EC, as amended by Commission Decision 2000/605/EC.

### 3.2 Assessment methods

#### 3.2.1 General

The assessment of the essential characteristics in Clause 3.1 of the screws for use in timber constructions for the intended use, and in relation to the requirements for mechanical resistance and stability, for safety in case of fire and for safety and accessibility in use in the sense of the basic requirements for construction works № 1, 2 and 4 of Regulation (EU) № 305/2011 has been made in accordance with the European Assessment Document EAD 130118-01-0603, “Screws and threaded rods for use in timber constructions”.

#### 3.2.2 Identification

The European Technical Assessment for the screws for use in timber constructions is issued on the basis of 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 the system of assessment and verification of constancy of performance to be applied to “Hilti screws S-WCF, S-WXF, S-WCP, S-WWP and S-WDF” is System 3. System 3 is detailed in Commission Delegated Regulation (EU) № 568/2014 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 on the basis of testing (based on sampling carried out by the manufacturer), calculation, tabulated values or descriptive documentation of the construction product.

### 4.2 AVCP for 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 procedures and specifications adopted by the manufacturer shall be documented in a systematic manner. The factory production control shall ensure the constancy of performances of Hilti screws 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 manufacturer before acceptance. Check of incoming materials shall include control of inspection documents presented by the manufacturer of the raw materials.

The frequencies of controls conducted during manufacturing and on the finalised product are defined by taking account of the manufacturing process of the product and are laid down in the control plan.

The results of factory production control are recorded and evaluated. The records include at least the following data:

– 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

The records shall be kept at least for ten years time after the construction product has been placed on the market. On request they shall be presented to Österreichisches Institut für Bautechnik.

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 issue a declaration of performance.

Issued in Vienna on 03.04.2023
by Österreichisches Institut für Bautechnik

The original document is signed by:

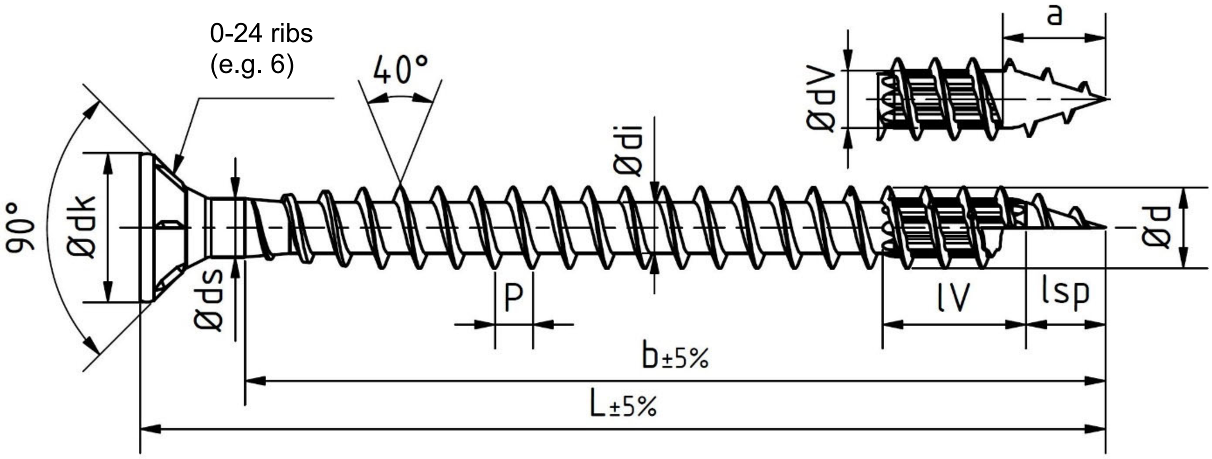
Rainer Mikulits

Managing Director

OIB Member of EOTA



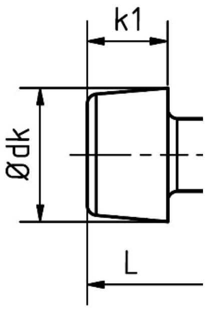
Full threaded screws, countersunk head, half tip: S-WCF-H (alternative with full tip: S-WCF-S)
(all dimensions in mm)




| Dim | Ødk | | Øds ±5% | Ød | | Ødi ±5% | P ±10% | lsp | | a | | ØdV ±10% | L | b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8,0 | 15,0 | ±1,2 | 5,9 | 8,0 | ±0,4 | 5,1 | 3,8 | 8,2 | ±2,1 | 11,0 | ±2.5 | 6,0 | 50-400 | L-10 |
| | | | | | | | | | | | | | >400 | L-23 |
| 10,0 | 18,5 | ±1,5 | 7,1 | 10,0 | ±0,6 | 6,3 | 4,6 | 10,1 | ±2,3 | 13,0 | ±3.0 | 7,1 | 50-300 | L-12 |
| | | | | | | | | | | | | | >300 | L-24 |
| 12,0 | 21,0 | ±2,0 | 8,2 | 12,0 | ±0,7 | 7,0 | 6,0 | 11,2 | ±2,6 | 15,0 | ±3.0 | 7,9 | 60-300 | L-20 |
| | | | | | | | | | | | | | >300 | L-25 |

Compressor lV = 2P to 4P, number of flanks: 4-8

Full threaded screws with cylinder head: S-WXF-S (with full tip), S -WXF-H (with half tip)




| Dim | Ødk | | k1 | |
|---|---|---|---|---|
| 8,0 | 10,2 | ±0,51 | 7,5 | ±1,0 |
| 10,0 | 13,4 | ±0,67 | 8,0 | ±1,0 |
| 12,0 | 14,2 | ±0,71 | 10,0 | ±1,5 |

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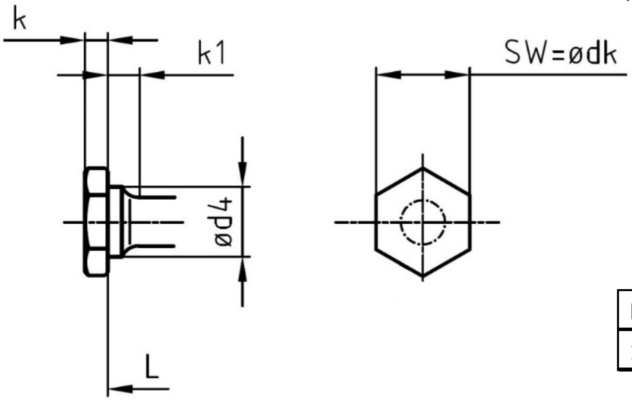
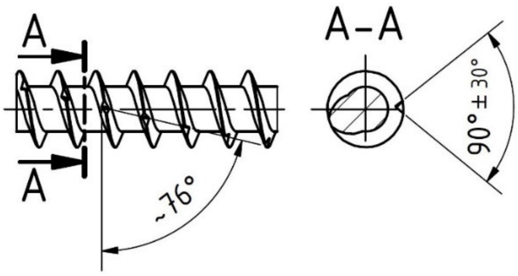
Full threaded screws with dual head: S -WDF-S (with full tip), alternative S -WDF-H (with half tip)

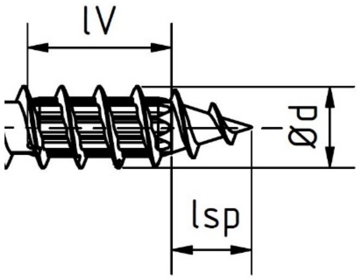



| Dim | SW=Ødk | | k | | k1 | | Ød4 | |
|---|---|---|---|---|---|---|---|---|
| 12,0 | 17,0 | -0,85 | 5,5 | ±1,3 | 10,0 | ±2,0 | 12,0 | ±1,2 |

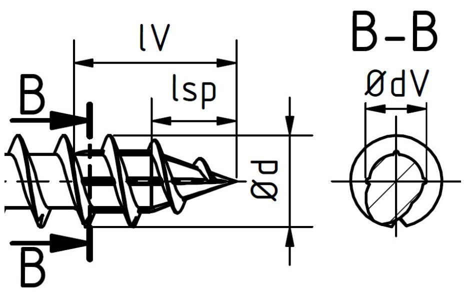
Cutting groove




Alternative tip type: full tip with compressor (S-WCF-S with countersunk head, S-WXF-S with cylinder head, S-WDF-S with dual head), all dimensions see Table on page 9

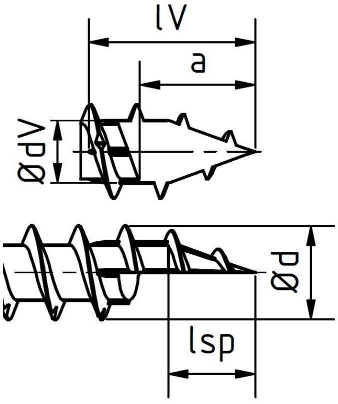



Alternative tip type: full tip with alternative compressor (S-WCF-S with countersunk head, S-WXF-S with cylinder head, S-WDF-S with dual head), all dimensions see Table on page 9




| **Hilti screws** | Annex 1 |
|---|---|
| S-WCF-S, S-WCF-H<br>S-WXF-S, S-WXF-H<br>S-WDF-S, S-WDF-H | of European Technical Assessment<br>ETA-22/0772 of 03.04.2023 |

Alternativ tip type: half tip with alternative compressor (S-WCF-H with countersunk head, S-WXF-H with cylinder head, S-WDF-H with dual head), all dimensions see table on page 9




| Hilti screws | Annex 1 of European Technical Assessment ETA-22/0772 of 03.04.2023 |
|---|---|
| S-WCF-S, S-WCF-H<br>S-WXF-S, S-WXF-H<br>S-WDF-S, S-WDF-H | |

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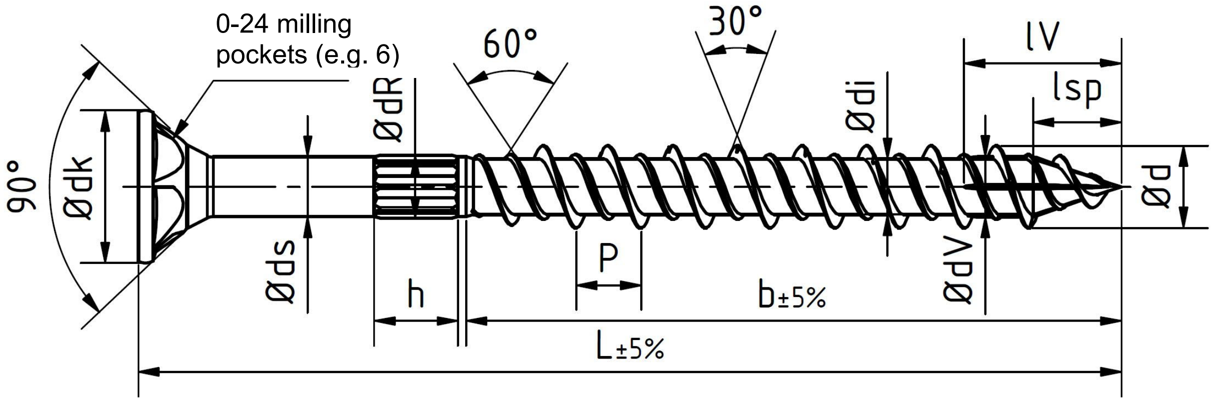
Partly threaded screws, countersunk head: S-WCP-S (with full tip)
(all dimensions in mm)



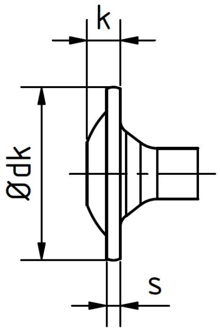

| Dim | Ødk | | Øds ±5% | Ød | | Ødi | | P ±10% | ØdR ±10% | h | | lsp | | ØdV ±10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4,0 | 8,0 | ±0,7 | 2,8 | 4,0 | ±0,20 | 2,45 | ±0,15 | 3,4 | 3,1 | 6,2 | ±1,0 | 4,6 | ±1,5 | 2,9 |
| 5,0 | 10,0 | ±0,8 | 3,6 | 5,0 | ±0,25 | 3,25 | ±0,16 | 4,2 | 3,9 | 8,2 | ±1,0 | 6,0 | ±1,7 | 3,7 |
| 6,0 | 12,0 | ±0,9 | 4,3 | 6,0 | ±0,30 | 4,00 | ±0,20 | 5,0 | 4,7 | 10,2 | ±1,0 | 7,3 | ±1,9 | 4,4 |
| 8,0 | 15,0 | ±1,2 | 5,9 | 8,0 | ±0,40 | 5,35 | ±0,28 | 6,7 | 6,2 | 10,2 | ±1,0 | 8,2 | ±2,1 | 6,0 |
| 10,0 | 18,5 | ±1,5 | 7,1 | 10,0 | ±0,60 | 6,80 | ±0,34 | 7,9 | 7,7 | 10,2 | ±1,0 | 10,1 | ±2,3 | 7,1 |

Compressor lV = 2P to 4P, number of flanks: 4-8

| Screw length L and thread length b | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dim. 4,0 | | Dim. 5,0 | | Dim. 6,0 | | Dim. 8,0 | | Dim. 10,0 | |
| L | b | L | b | L | b | L | b | L | b |
| 30-35 | 20 | 30-35 | 20 | 50 | 30 | 50 | 30 | 60-70 | 40 |
| 40-45 | 25 | 40 | 25 | 60-70 | 40 | 60-70 | 40 | 80 | 50 |
| 50 | 30 | 50 | 30 | 80-90 | 50 | 80-90 | 50 | 100 | 60 |
| 60-70 | 35 | 60-70 | 40 | 100-110 | 60 | 100 | 60 | 120-160 | 80 |
| | | 80-90 | 50 | 120-300 | 70 | 120-160 | 80 | 180-600 | 100 |
| | | 100-120 | 60 | | | 180-600 | 100 | | |

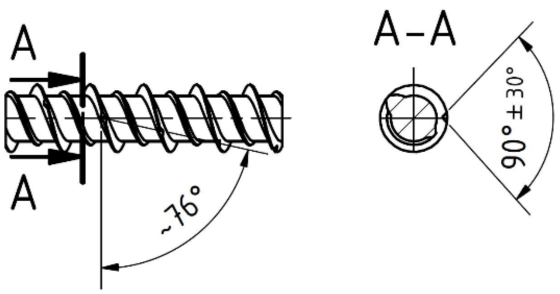
| Hilti screws | Annex 2 |
|---|---|
| S-WCP-S<br>S-WWP-S | of European Technical Assessment<br>ETA-22/0772 of 03.04.2023 |

Partly threaded screws with washer head: S-WWP-S (with full tip)



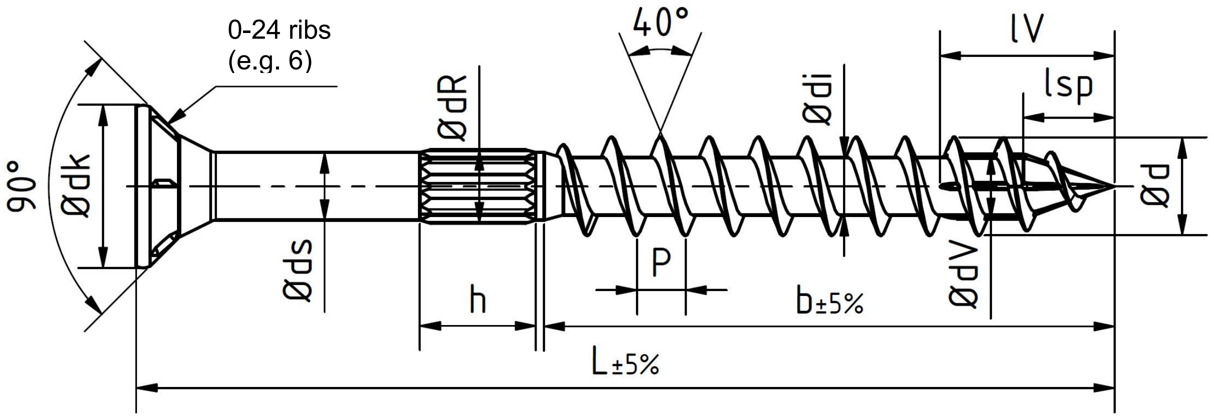

| Dim | Ødk | | k | | s | |
|---|---|---|---|---|---|---|
| 6,0 | 14,0 | ±0,8 | 3,0 | ±1,0 | 1,5 | ±0,8 |
| 8,0 | 20,0 | ±1,5 | 3,5 | ±1,0 | 2,0 | ±0,9 |
| 10,0 | 25,0 | ±2,0 | 4,5 | ±1,2 | 2,0 | ±0,9 |

Cutting groove




| Hilti screws | Annex 2 |
|---|---|
| S-WCP-S<br>S-WWP-S | of European Technical Assessment<br>ETA-22/0772 of 03.04.2023 |

Partly threaded screws, countersunk head: S-WCP-S with d = 12mm (with full tip)
(all dimensions in mm)

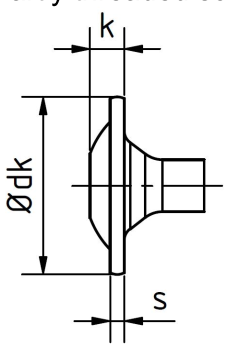



| Dim | Ødk | | Øds ±5% | Ød | | Ødi ±5% | P ±10% | ØdR ±10% | h | | lsp | | ØdV ±10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12,0 | 21,0 | ±2,0 | 8,2 | 12,0 | ±0,7 | 7,0 | 6,0 | 9,0 | 14,2 | ±1,0 | 11,2 | ±2,6 | 7,9 |

Compressor lV = 2P to 4P, number of flanks: 4-8

| Screw length L and thread length b | |
|---|---|
| Dim. 12.0 | |
| L | b |
| 80 | 50 |
| 100 | 60 |
| 120-160 | 80 |
| 180-280 | 100 |
| 300-600 | 120 |

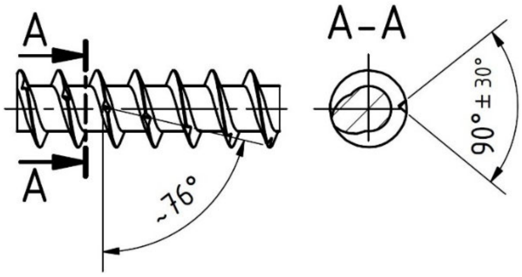
Partly threaded screws with washer head: S-WWP-S (with full tip)




| Dim | Ødk | | k | | s | |
|---|---|---|---|---|---|---|
| 12,0 | 27,0 | ±2,0 | 4,7 | ±1,2 | 2,5 | ±0,9 |

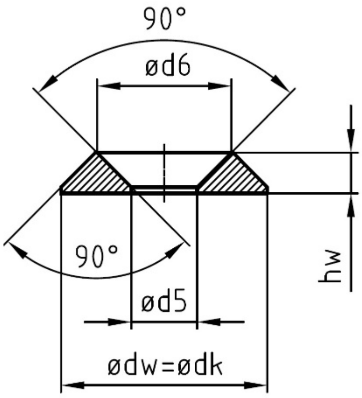
| **Hilti screws** | Annex 3 |
|---|---|
| S-WCP-S with d = 12 mm<br>S-WWP-S with d = 12 mm | of European Technical Assessment<br>ETA-22/0772 of 03.04.2023 |

Cutting groove



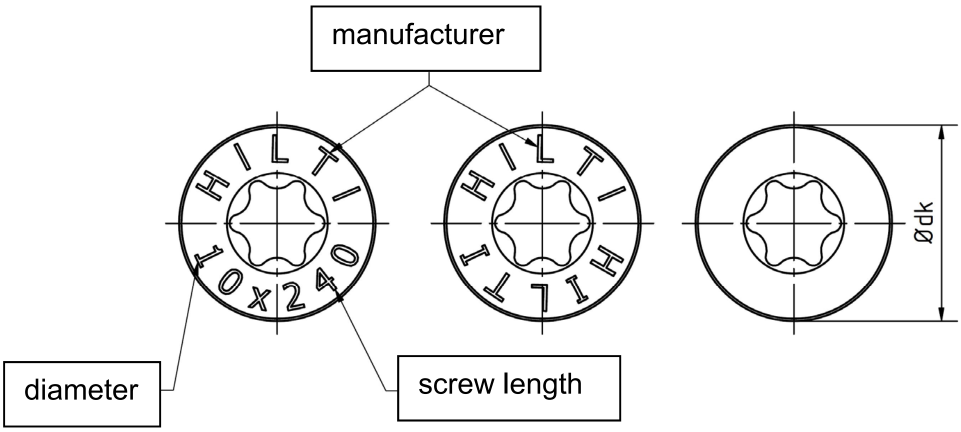

| Hilti screws | Annex 3 |
|---|---|
| S-WCP-S with d = 12 mm<br>S-WWP-S with d = 12 mm | of European Technical Assessment<br>ETA-22/0772 of 03.04.2023 |

Washer (for screws with 90° head, only)




| Dim | Ødw=Ødk | Ød5 | Ød6 | hw |
|---|---|---|---|---|
| 6,0 | 22,0 ±2.0 | 8,5 ±2.0 | 13,5 ±1.5 | 4,5 ±1.0 |
| 8,0 | 28,0 ±2.0 | 10,0 ±2.0 | 17,5 ±2.0 | 5,5 ±1.0 |
| 10,0 | 35,0 ±3.0 | 12,0 ±2.0 | 22,5 ±2.2 | 6,5 ±1.5 |
| 12,0 | 42,0 ±3.0 | 14,0 ±2.0 | 25,0 ±2.5 | 7,5 ±1.5 |

Head mark (example)




T-Drive size

| Dim | T |
|---|---|
| 4,0 | T10 / T15 / T20 |
| 5,0 | T20 / T25 / T30 |
| 6,0 | T20 / T25 / T30 |
| 8,0 | T30 / T40 |
| 10,0 | T40 / T50 |
| 12,0 | T40 / T50 / T55 |

| **Hilti screws** | Annex 4 |
|---|---|
| Drive types, washer and head mark | of European Technical Assessment<br>ETA-22/0772 of 03.04.2023 |

## A.5 Load bearing capacity of Hilti screws

The characteristic load bearing capacities in Tables A5.1 to A5.2 are given for timber of strength class C24 according to EN 338 ($\rho_{k,ref}$ = 350 kg/m³) unless specified otherwise in the following.

If relevant, the design block shear failure resistance of a timber member has to be proven.

**Table A5.1: Characteristic load bearing capacities of Hilti screws S-WCF, S-WXF and S-WDF; screw diameter 8 to 12 mm**

| Product characteristic | | | Screw diameter | | |
|---|---|---|---|---|---|
| | | | 8 | 10 | 12 |
| Max. length | $l_{max}$ | mm | 1000 | 1000 | 1000 |
| Characteristic tensile strength | $f_{tens,k}$ | kN | 24.1 | 40.0 | 46.7<br>45.0 [1)] |
| Characteristic yield moment | $M_{y,k}$ | Nm | 20.3 | 36.7 | 48.5 |
| Characteristic withdrawal parameter angle screw-axis to grain: 90° ($\rho_{k,ref}$ = 350 kg/m³) | $f_{ax,k,90°}$ | N/mm² | 13.1 | 12.5 | 11.2 |
| Characteristic yield strength | $f_{y,k}$ | N/mm² | 950 (carbon steel) | | |
| Characteristic torsional strength | $f_{tor,k}$ | Nm | 25.8 | 55.0 | 73.0 |
| Ratio characteristic torsional strength to mean insertion moment $\rho_{k,ref}$ = 450 kg/m³ | $f_{tor,k}$ / $R_{tor,m}$ | - | ≥ 1.5 | ≥ 1.5 | ≥ 1.5 |
| Slip modulus | $K_{ser}$ | N/mm | see A.5.1.7 | | |

1) S-WDF-S-12xL Z

**Table A5.2: Characteristic load bearing capacities of Hilti screws S-WCP and S-WWP; screw diameter 4 to 12 mm**

| Product characteristic | | | Screw diameter | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 4 | 5 | 6 | 8 | 10 | 12 |
| Max. length | $l_{max}$ | mm | 70 | 120 | 300 | 600 [1)] | 600 [1)] | 600 [1)] |
| Characteristic tensile strength | $f_{tens,k}$ | kN | 5.0 | 8.8 | 13.1 | 23.3 | 35.0 | 42.0 |
| Characteristic yield moment | $M_{y,k}$ | Nm | 3.1 | 5.9 | 10.7 | 22.6 | 33.6 | 46.9 |
| Characteristic withdrawal parameter angle screw-axis to grain: 90° ($\rho_{k,ref}$ = 350 kg/m³) | $f_{ax,k,90°}$ | N/mm² | 14.3 | 13.6 | 13.0 | 10.9 | 11.0 | 11.2 |
| Characteristic yield strength | $f_{y,k}$ | N/mm² | 900 (carbon steel) | | | | | |
| Characteristic torsional strength | $f_{tor,k}$ | Nm | 3.5 | 6.6 | 10.9 | 28.0 | 52.5 | 59.6 |
| Ratio characteristic torsional strength to mean insertion moment $\rho_{k,ref}$ = 450 kg/m³ | $f_{tor,k}$ / $R_{tor,m}$ | - | ≥ 1.5 | | | | | |

1) For screws with l > 500 mm a friction part is mandatory.

### A.5.1 Axially loaded screws

#### A.5.1.1 General

For verification of the load bearing capacity of axially loaded Hilti screws the failure mechanisms according to EN 1995-1-1 as well as the minimum thicknesses, spacings and distances according to A.5.1.2 must be taken into account.

Alternative to EN 1995-1-1 the effective number of inclined Hilti screws with an angle between screw axis and grain direction 30° ≤ α ≤ 60° may be taken as

$$n_{ef} = max\{n^{0.9}; 0.9 \cdot n\}$$

In the following cases the effective number of screws $n_{ef}$ = n:

- screws used as compression reinforcement inclined or perpendicular to the grain
- inclined screws used for flexible jointing of beams or columns
- screws used for fastening of thermal insulation material on top of rafters
- screws applied for single row connections with $a_1 \geq 25$ d

For verification of the load bearing capacity according to EN 1995-1-1 and EN 1993 1-1 in the tensile as well as in the compressive area reductions in the cross sectional area of wooden members or steel members caused by screws shall be taken into account. Screws with an outer thread diameter d ≥ 10 mm shall be taken into account by the inner thread diameter in wooden members whereas in steel members the drilling diameter shall be taken into account.

In case of double-shear connections between wood-based members or between those members and steel members where wood-based or metal flaps are arranged symmetrically to the axis of the central timber member with inclined self-tapping screws, tension in transverse direction must be verified if the overlapping of the crossed screws in the middle of the axis is lower than 4 d.

#### A.5.1.2 Spacing, end and edge distances of the screws and minimum thicknesses

For Hilti screws with d ≤ 8 mm or provided with a half tip which are loaded only axially, the minimum spacing, end and edge distances according to Table A5.3 apply for a minimum timber thickness of t = 12 d in non-predrilled holes. Table A5.3 is not valid for cross laminated timber.

**Table A5.3: Minimum spacing, end and edge distances of only axially loaded Hilti screws (except CLT)**

| Designation | | Variant 1 | Variant 2 |
|---|---|---|---|
| Boundary condition | $a_1 \cdot a_2$ | ≥ 25 $d^2$ | ≥ 21 $d^2$ |
| Spacing in a plane parallel to the grain | $a_1$ | 5 $d$ | 7 $d$ |
| Spacing perpendicular to a plane parallel to the grain | $a_2$ | 2.5 $d$ | 3 $d$ |
| Spacing between the crossing screws for a crossed screw couple perpendicular to a plane parallel to the grain | $a_{cross}$ | 1.5 $d$ | |
| End distance of the centre of gravity of the threaded part in the timber member | $a_{1,c}$ | 5 $d$ | |
| Edge distance of the centre of gravity of the threaded part in the timber member | $a_{2,c}$ | 4 $d$ | |

Provided that a minimum thickness of the cross laminated timber of 10 d as well as a minimum penetration length of the screws of 4 d in the wide face or 10 d in the narrow face are met, the minimum spacings, end and edge distances given in Table A5.4 apply.

**Table A5.4: Minimum spacings, end and edge distances of Hilti screws in cross laminated timber (axially and/or laterally loaded)**

| | $a_1$ | $a_{3,t}$ | $a_{3,c}$ | $a_2$ | $a_{4,t}$ | $a_{4,c}$ |
|---|---|---|---|---|---|---|
| Wide face (see Figure A5.1) | 4 $d$ | 6 $d$ | 6 $d$ | 2.5 $d$ | 6 $d$ | 2.5 $d$ |
| Narrow face (see Figure A5.1) | 10 $d$ | 12 $d$ | 7 $d$ | 3 $d$ | 5 $d$ | 3 $d$ |

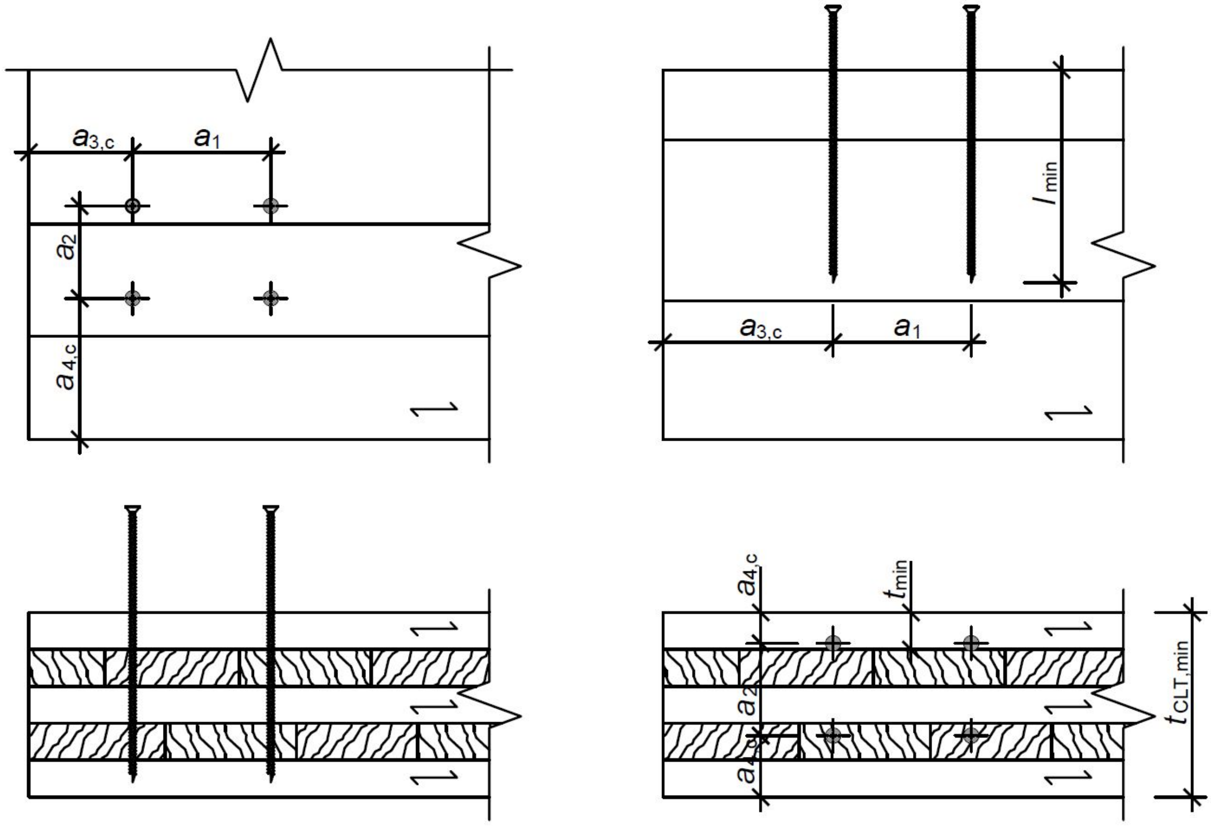
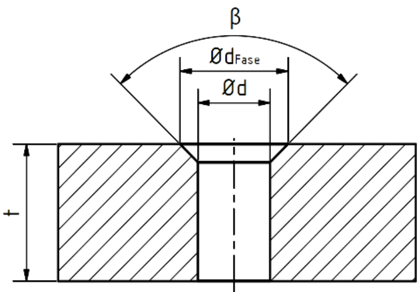



**Figure A5.1: Definition of minimum spacings, end and edge distances in the wide face (left) and narrow face (right) of cross laminated timber**

| **Hilti screws** | Annex 5 |
|---|---|
| Characteristic data of the screws | of European Technical Assessment ETA-22/0772 of 03.04.2023 |

For connections between timber and a metal member of steel or aluminium sufficient contact of the screw head must be ensured. This is fulfilled for countersunk heads with countersunk washer as well as heads with a flat bottom side (e.g. pan head, washer head,…) for 90° drillings. Alternatively, countersunk head screws may be used in 90° countersunk drillings where the diameter of the chamfer is 1.5 times the diameter of the drilling, see Figure A5.2. The diameter d of the drilling must be greater than the diameter of the screw.



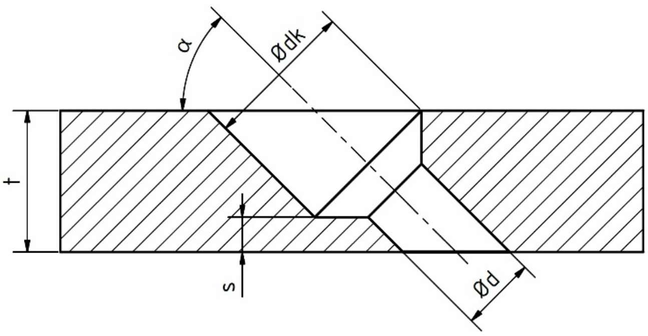

$d_{Fase} = d \cdot 1.5$ in mm

$d$ = diameter of the drilling in mm

$d_{Fase}$ = diameter of the chamfer in mm

**Figure A5.2: Drilling of Hilti screws with countersunk head in metal members**

For countersunk head screws used in countersunk drillings of metal members under an angle 30° ≤ α < 90° the drilling must be greater than the head diameter $d_k$ and the outer thread diameter d of the screw. Hereby, the minimum thickness s of the steel member underneath the screw head according to Figure A5.3 is required.




| | |
|---|---|
| α > 45° | s ≥ 3mm |
| 30° ≤ α ≤ 45° | s ≥ 2 mm |

**Figure A5.3: Inclined drilling of Hilti screws with countersunk head in metal members**

Alternatively, screws with inclined washers can be used for inclined metal-wood connections.

| **Hilti screws** | Annex 5 |
|---|---|
| Characteristic data of the screws | of European Technical Assessment<br>ETA-22/0772 of 03.04.2023 |

### A.5.1.3 Characteristic withdrawal parameter

The characteristic withdrawal parameter for Hilti screws for angles $0° \leq \alpha \leq 90°$ between screw-axis and direction of wood-fibre may be calculated as

$$f_{ax,calc,k} = f_{ax,k,90°} \cdot k_{ax} \cdot k_{sys} \cdot \left(\frac{\rho_k}{\rho_{k,ref}}\right)^{k_\rho}$$

$$k_{ax} = \begin{cases} 1.0 & \text{for } 30° \leq \alpha \leq 90° \\ 0.3 \cdot k_{gap} + \frac{\alpha}{30°}(1 - 0.3 \cdot k_{gap}) & \text{for } 0° \leq \alpha \leq 30° \end{cases}$$

$$k_{gap} = \begin{cases} 0.9 & \text{for narrow face in CLT} \\ 1.0 & \text{other} \end{cases}$$

$$k_{sys} = \begin{cases} 1.0 & \text{for solid timber} \\ \text{see Table A5.5} & \text{for layered timber} \end{cases}$$

$$k_\rho = \begin{cases} 1.10 & \text{for softwood and } 15° \leq \alpha \leq 90° \\ 1.25 - 0.05\,d & \text{for softwood and } 0° \leq \alpha \leq 15° \\ 1.40 & \text{for ring porous hardwood and } 0° \leq \alpha \leq 90° \\ 1.70 & \text{for diffuse porous hardwood and } 0° \leq \alpha \leq 90° \end{cases}$$

Examples for ring porous hardwoods: chestnut, ash, oak
Examples for diffuse porous hardwoods: poplar, birch, beech

$f_{ax,k,90°}$ characteristic withdrawal parameter according to Tables A5.1 to A5.2 in N/mm²

$\rho_{k,ref}$ reference characteristic density of timber raw material in kg/m³ in which the screw is driven (350 kg/m³ (C24) for Tables A5.1 to A5.2)

$\rho_k$ characteristic density of timber in kg/m³

$\alpha$ angle between screw axis and grain direction

$k_{sys}$ system factor according to Table A5.5

n number of screwed layers

**Table A5.5: System factor $k_{sys}$ depending on the number of layers n for screw insertion in GLT or CLT**

| n | 1 | 2 | 3 | 4 | 5 | ≥ 6 |
|---|---|---|---|---|---|---|
| $k_{sys}$ | 1.00 | 1.06 | 1.10 | 1.12 | 1.13 | 1.15 |

The characteristic withdrawal capacity of Hilti screws in the narrow face of cross laminated timber may be alternatively determined independent of the angle between screw axis and grain direction as

$$F_{ax,Rk} = 20 \cdot d^{0,8} \cdot l_{ef}^{0,9}$$

unless otherwise specified in the technical specification of the cross laminated timber.

#### A.5.1.4 Characteristic head pull-through capacity for timber

The characteristic head pull-through capacities for timber with a char. density $\rho_{k,ref}$ = 350 kg/m³ and for a timber thickness ≥ 20 mm is given in Table A5.6 and A5.7.

For softwood with a deviating density the characteristic head pull-through parameter shall be corrected by the factor

$$k_{dens} = \left(\frac{\rho_k}{350}\right)^{0.8}$$

Where

$\rho_k$ Characteristic density of timber in kg/m³

For the characteristic withdrawal parameter the correction according to A.5.1.3 applies.

**Table A5.6: Characteristic head pull-through capacities of Hilti screws in structural timber for 90° heads; head diameter 8 to 21 mm**

| **Group 1** | | | Head diameter $d_k$ (90° heads) [1)] | | | | | |
|---|---|---|---|---|---|---|---|---|
| Product characteristic | | | 8 | 10 | 12 | 15 | 18.5 | 21 |
| Characteristic head pull-through parameter ($\rho_{k,ref}$ = 350 kg/m³) | $f_{head,k}$ | N/mm² | 17.1 | 14.6 | 14.6 | 12.4 | 12.2 | 10.3 |

[1)] Linear interpolation is possible for head diameters in between the stated values

**Table A5.7: Characteristic head pull-through capacities of Hilti screws in structural timber for washers and 180° heads; (head) diameter 14 to 27 mm**

| **Group 2** | | | Head diameter $d_k$ (180° heads) [1)] | | | |
|---|---|---|---|---|---|---|
| Product characteristic | | | 14 | 20 | 25 | 27 |
| Characteristic head pull-through parameter ($\rho_{k,ref}$ = 350 kg/m³) | $f_{head,k}$ | N/mm² | 16.7 | 17.6 | 15.2 | 14.5 |

[1)] Linear interpolation is possible for head diameters in between the stated values

### A.5.1.5 Characteristic head pull-through capacity for wood based panels

The characteristic value of the head pull-through parameter for a characteristic density of 380 kg/m³ of the timber and for the following wood based panels

- Plywood according to EN 636 and EN 13986,
- Oriented strand boards, OSB, according to EN 300 and EN 13986,
- Solid wood panels according to EN 13353 and EN 13986,
- Particleboard according to EN 312 and EN 13986,
- Fibreboards according to EN 622-2, EN 622-3 and EN 13986,
- Cement-bonded particle boards according to EN 634-1 and EN 13986

is given in Table A5.8.

**Table A5.8: Characteristic value of the head pull-through parameter in dependence of the thickness of the wood-based panels $t_{WBP}$**

| $t_{WBP}$ | ≤ 12 mm | 12 mm < $t_{WBP}$ ≤ 20 mm | > 20 mm |
|---|---|---|---|
| $f_{head,k}$ | 8 N/mm²* | 8 N/mm² | 10 N/mm² |
| * limited to 400 N complying with the minimum thicknesses of the wood based panels of 1.2 d, with d as outer thread diameter | | | |

For plywood with a minimum of 7 layers and a minimum thickness of 18 mm, the characteristic value of the head pull-through parameter for a characteristic density of 490 kg/m³ is ($d_k$ ≥ 18.8 mm)

$f_{head,k}$ = 16 N/mm²

In addition the minimum thicknesses of Table A5.9 apply.

**Table A5.9 Minimum thicknesses of wood based panels**

| Wood based panel | Minimum thickness in mm |
|---|---|
| Plywood | 6 |
| Oriented strand board, OSB | 8 |
| Solid wood panels | 12 |
| Particleboard | 8 |
| Fibreboards | 6 |
| Cement-bonded particle boards | 8 |

### A.5.1.6 Compressive loading for fully threaded screws

The design load carrying capacity for Hilti screws with a full thread for an angle 30° ≤ $\alpha$ ≤ 90° between screw-axis and direction of wood-fibre for axial compressive loading is given as

$$F_{ax,Rd} = \min\left(f_{ax,calc,k} \cdot d \cdot l_{ef} \cdot \frac{k_{mod}}{\gamma_M}; \kappa_c \cdot \frac{N_{pl,k}}{\gamma_{M1}}\right)$$

with

$f_{ax,calc,k}$ char. withdrawal capacity of the threaded part of the screw according to Clause A.5.1.3 in N/mm²

$d$ outer thread diameter of the screw in mm

$l_{ef}$ penetration length of the threaded part of the screw in the timber member in mm

$k_{mod}$ modification factor for duration of load and moisture content according to EN 1995-1-1

$\gamma_M$ partial safety factor for connections according to EN 1995-1-1

$\gamma_{M1}$ partial safety factor according to EN 1993-1-1

$$\kappa_c = \begin{cases} 1.0 & \text{for } \overline{\lambda_k} \leq 0.2 \\ \dfrac{1.0}{k + \sqrt{k^2 - \overline{\lambda_k}^2}} & \text{for } \overline{\lambda_k} > 0.2 \end{cases}$$

$$k = 0.5\left[1 + 0.49 \cdot \left(\overline{\lambda_k} - 0.2\right) + \overline{\lambda_k}^2\right]$$

The related slenderness ratio

$$\overline{\lambda_k} = \sqrt{\frac{N_{pl,k}}{N_{ki,k}}}$$

with

$N_{pl,k}$ characteristic value of the plastic normal force load bearing capacity of the net cross-section, related to the inner thread diameter $d_i$ (or shank diameter $d_s$ if relevant) of the screws in N

$$N_{pl,k} = \frac{\pi \cdot d_i^2}{4} \cdot f_{y,k}$$

$f_{y,k}$ characteristic yield strength of Hilti screws in N/mm² according to Table A5.1 to A5.2

$N_{ki,k}$ characteristic ideal elastic buckling load in N

$$N_{ki,k} = \sqrt{c_h \cdot E_s \cdot I_s}$$

$c_h$ elastic foundation of the Hilti screws in the wooden member in N/mm²

$$c_h = (0.19 + 0.012 \cdot d) \cdot \rho_k \cdot \left(\frac{90 + \alpha}{180}\right)$$

$E_s$ modulus of elasticity of Hilti screws in N/mm², $E_s$ = 210 000 N/mm²

$I_s$ area moment of inertia of Hilti screws in mm⁴

$\rho_k$ characteristic density of the wood-based member in kg/m³

$$I_s = \frac{\pi \cdot d_i^4}{64}$$

### A.5.1.7 Slip modulus for mainly axially loaded screws

The axial slip modulus $K_{ser,ax}$ of the threaded part per cutting surface for the serviceability limit state shall be taken for screws independent of angle $\alpha$ to the grain as

$$K_{ser,ax} = k_{HA} \cdot d \cdot l_{ef}$$

with

$d$ outer thread diameter of the screw in mm

$l_{ef}$ penetration length of the threaded part of the screw in the timber member in mm

$k_{HA}$ coefficient depending on the type of wood of the wood-based member according to Table A5.10

**Table A5.10: Coefficient $k_{HA}$ depending on the type of wood of the wood-based member**

| Type of wood | Reference density $\rho_m$ in kg/m³ | Coefficient $k_{HA}$ |
|---|---|---|
| softwood | 420 | 25 |
| chestnut | 530 | 48 |
| ash | 660 | 62 |
| poplar | 485 | 34 |
| birch | 635 | 54 |
| beech | 740 | 78 |
| LVL beech* | 840 | 53 |
| * according to EN 14374 or European Technical Assessment | | |

The coefficients listed in Table A5.10 apply to Hilti screws installed with or without pre-drilling, provided that the pre-drilling diameter does not exceed 75% of the outer thread diameter.

### A.5.2 Laterally loaded screws (perpendicular to the screw axis)

#### A.5.2.1 General

For verification of the load bearing capacity of laterally loaded Hilti screws the failure mechanisms according to EN 1995-1-1 as well as the minimum thicknesses, spacings and distances according to A.5.2.2 must be taken into account.

NOTES:

1) Hereby, the outer thread diameter d is used as effective diameter of the screw in accordance with EN 1995-1-1.

2) For connections between timber and a steel member where the special head shape of the Hilti screws enables a precise fit into the drilling of the steel member the equations for thick steel may be used in case of steel thicknesses $t \geq 1.5$ mm. The height of the flange must be greater than the thickness of the steel member.

3) In the case of a connection with a group of screws loaded perpendicular to the screw axis the effective number of screws is to be taken as for nails according to EN 1995-1-1 if the connection area of the timber is not reinforced according to Clause A.7.2.3.

#### A.5.2.2 Spacing, end and edge distances of the screws and minimum thicknesses

For Hilti screws which are loaded laterally or latterally and axial, the minimum spacing, end and edge distances according to Table A5.11 apply.

**Table A5.11: Minimum spacing, end and edge distances of only laterally loaded Hilti screws**

| Type | Spacing/distances |
|---|---|
| Predrilled wooden members or Hilti screws with half tip (H) in non-predrilled holes of softwood members | Analogous to pre-drilled nails according to EN 1995-1-1 |
| Non-predrilled wooden members with Hilti screws with full tip (S) | Analogous to non-predrilled nails according to EN 1995-1-1 |

NOTES:

1) For screws with outer thread diameter $d \geq 8$ mm in non-predrilled holes in wood-based members with thickness $t < 5$ d, the minimum distances for loaded and unloaded ends shall be 15 d.

2) Minimum distances from the unloaded edge perpendicular to the grain may be reduced to 3 d also for timber thickness $t < 5$ d, if the spacing parallel to the grain and the end distance is at least 25 d.

3) Minimum spacings, end and edge distances of laterally loaded Hilti screws in wide face and narrow face of cross laminated timber are given in Table A5.4.

The minimum thickness for structural members shall be in accordance with Table A5.12.

**Table A5.12: Minimum thickness for structural members for laterally loaded Hilti screws d ≤ 12 mm**

| Screw diameter | | < 8 | 8 | 10 | 12 |
|---|---|---|---|---|---|
| Minimum thickness t for structural members | mm | 24 | 30 | 40 | 80 |

### A.5.2.3 Characteristic embedment strength

EN 1995-1-1 applies for the embedment strength of Hilti screws in wooden members unless specified otherwise below.

The characteristic embedment strength of Hilti screws installed in wooden members of solid wood, glued laminated timber, glued solid timber, solid wood panels or laminated veneer lumber (made of softwood) may be determined as follows:

$f_{h,k} = k_\alpha \cdot k_\beta \cdot k_\varepsilon \cdot f_{h,k,ref}$ in N/mm²

with

$f_{h,k,ref}$ as reference characteristic embedment strength, for non-predrilled members

$f_{h,k,ref} = 0.082 \cdot \rho_k \cdot d^{-0.3}$ in N/mm²

and for pre-drilled members

$f_{h,k,ref} = 0.082 \cdot \rho_k \cdot (1 - 0.01 \cdot d)$ in N/mm²

and

$$k_\alpha = \frac{1}{2.5 \cdot \cos^2\alpha + \sin^2\alpha}$$

α angle between screw axis and grain direction

$$k_\beta = \begin{cases} \dfrac{1.0}{1.5 \cdot \cos^2\beta + \sin^2\beta} & \text{screws inserted in LVL made of softwood} \\ 1.0 & \text{others} \end{cases}$$

β angle between screw axis and the wide face of LVL

$$k_\varepsilon = k_{90} \cdot \cos^2\varepsilon + \sin^2\varepsilon$$

ε angle between load and grain direction

$$k_{90} = \begin{cases} 1.10 & \text{in the member of the head side} \\ 1.20 & \text{in the member of the point side} \end{cases}$$

$\rho_k$ characteristic density of the wooden member in kg/m³

d outer thread diameter of the screw in mm

The Equations above may be applied for Hilti screws within single softwood layers in cross laminated timber, if the single layer is considered as a separate softwood member and the minimum spacing, end and edge distances are observed for the single layer. Hereby, $\rho_k$ is the characteristic density of the cover layer.

The characteristic embedment strength of Hilti screws in the narrow face of cross laminated timber may be determined independent of the angle between screw axis and grain direction as

$$f_{h,k} = 20 \cdot d^{-0.5}$$

unless otherwise specified in the technical specification of the cross laminated timber.

**A.5.2.4 Slip modulus for screws loaded perpendicular to the screw axis**

The slip modulus $K_{ser,v}$ per shear joint for the serviceability limit state shall be taken for screws independent of angle $\alpha$ to the grain as

$$K_{ser,V} = k_V \cdot d^{1.7} \text{ in N/mm}^2$$

with

$k_V$ coefficient depending on the direction of load on the type of the connection and the predrilling according to Table A5.13

**Table A5.13: Coefficient $k_V$ depending on the direction of load on the type of the connection and the predrilling**

| Direction of load | Non-predrilled | | Pre-drilled | |
|---|---|---|---|---|
| | Wood-wood | Metal-wood | Wood-wood | Metal-wood |
| Parallel to the direction of the grain $K_{ser,v,0}$ | 32 | 64 | $1.6 \cdot \rho_k^{0.5}$ | $3.2 \cdot \rho_k^{0.5}$ |
| Perpendicular to the direction of the grain $K_{ser,v,90}$ | 16 | 32 | $0.8 \cdot \rho_k^{0.5}$ | $1.6 \cdot \rho_k^{0.5}$ |

Linear interpolation is possible for arbitrary angles between load direction and angle of the grain.

For the connection of two wooden members with different characteristic densities $\rho_k$ for the determination of $k_V$ may be determined by

$$\rho_k = \sqrt{\rho_{k,1} \cdot \rho_{k,2}}$$

with

$\rho_{k,1}$ characteristic density of wooden member 1 in kg/m³

$\rho_{k,2}$ characteristic density of wooden member 2 in kg/m³

### A.5.3 Combined loading (perpendicular to and in direction of the screw axis)

Verification of Hilti screws under combined loading (perpendicular to and in direction of the screw axis) is performed by

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

with

$F_{ax,Ed}$ design value of the load in a connection in in axial direction of the screws

$F_{ax,Rd}$ design value of the load-bearing capacity of the screw connection in axial direction

$F_{V,Ed}$ design value of the load in a connection in in lateral direction of the screws

$F_{V,Rd}$ design value of the load-bearing capacity of the screw connection in lateral direction

## A.6 Hilti screws in selected steel-wood and wood-wood connections

### A.6.1 Steel-wood connections

Design for equally tightened screws (torque controlled) in a steel member under an angle 30° ≤ α ≤ 60° (see Figure A7.1) may follow:

$$F_{\alpha,Rd} = F_{ax,Rd} \cdot (\cos\alpha + \mu \cdot \sin\alpha)$$

with

$$F_{ax,Rd} = n_{ef} \cdot min \begin{cases} f_{ax,calc,k} \cdot d \cdot l_{ef} \cdot \dfrac{k_{mod}}{\gamma_M} \\ \dfrac{f_{tens,k}}{\gamma_{M2}} \end{cases}$$

where:

| | |
|---|---|
| $F_{\alpha,Rd}$ | load bearing capacity of inclined screws in N |
| $n_{ef}$ | effective number of screws according to A.5.1.1 |
| $k_{mod}$ | modification factor for duration of load and moisture content according to EN 1995-1-1 |
| $\gamma_M$ | partial safety factor for connections according to EN 1995-1-1 |
| $\gamma_{M2}$ | partial safety factor according to EN 1993-1-1 |
| α | angle between screw axis and grain direction |
| μ | friction coefficient between steel member and timber surface, $\mu = 0.3$ |

NOTES:

1) The real thread length of the screw is to be considered.

2) Occurring tensile stresses perpendicular to grain have to be verified for $h_{ef}$ : h < 0.7. A related reinforcement with fully threaded Hilti screws is shown in Figure A6.1.

3) For arrangement of the Hilti screws perpendicular to the grain verification shall follow Clause A.5.2.

4) For combined loading (more than one loading component to be transferred by the screwed joint) the regulations according to A5.3 shall be considered.

Figure A6.1 shows an example of metal-to-timber connection with inclined Hilti Screws located in the end-grain or in side-grain.

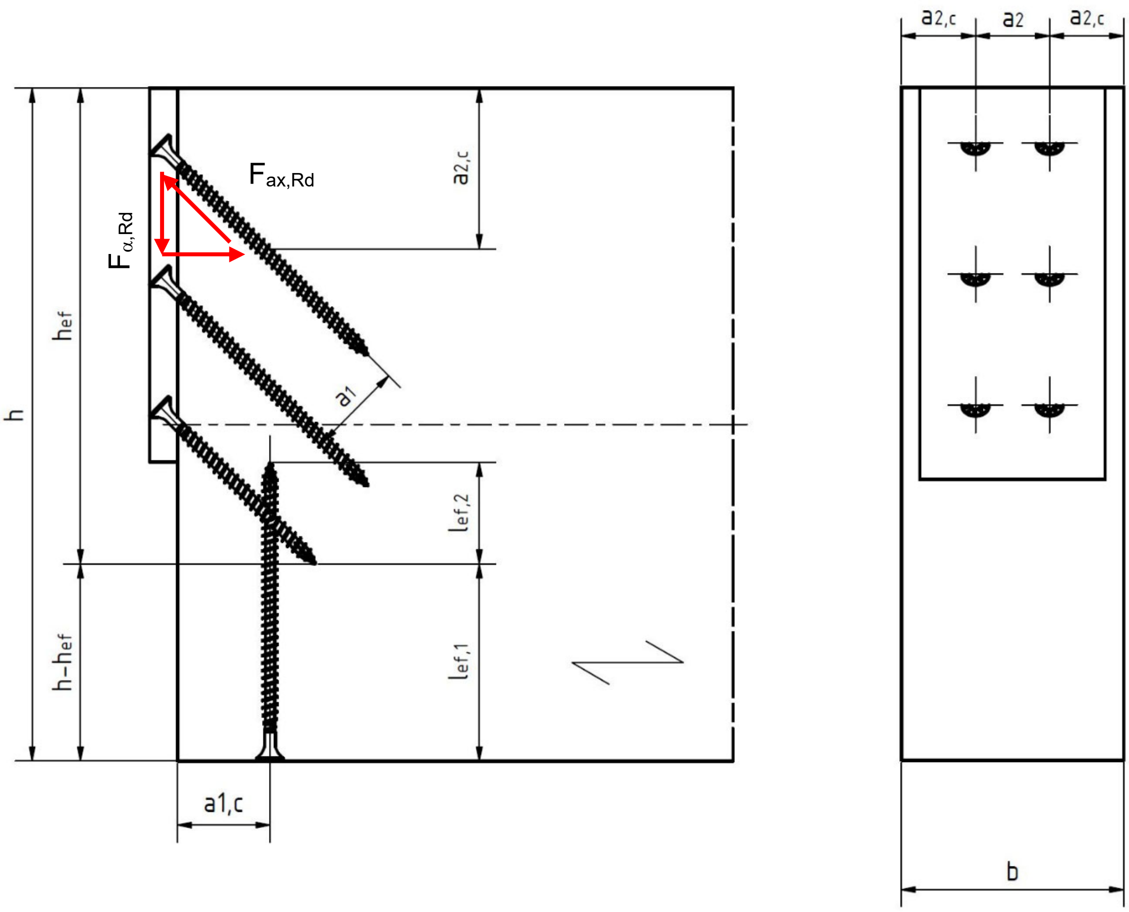



**Figure A6.1: Example of metal-to-timber connection with inclined Hilti Screws located in the end-grain or in side-grain**

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| Bending beams under flexible jointing | of European Technical Assessment ETA-22/0772 of 03.04.2023 |

The screws may be used in connections between timber and a steel member, e.g. wind bracing or tensile splice in solid timber, glued laminated timber and glued solid timber of softwood. The screws are driven into the timber member under an angle between the screw axis and the grain direction of α ≤ 90°.

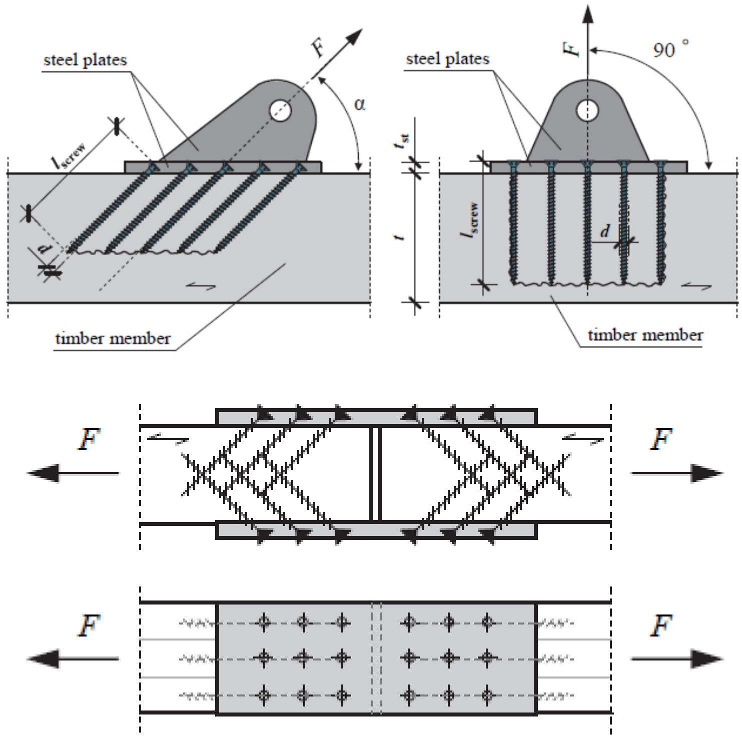


**Figure A6.2: Example of metal-to-timber connection with inclined Hilti screws and Hilti screws arranged perpendicular to the grain**

| **Hilti screws** | Annex 6 |
|---|---|
| Bending beams under flexible jointing | of European Technical Assessment<br>ETA-22/0772 of 03.04.2023 |

## A7 Hilti screws for reinforcement of timber members for timber members loaded perpendicular to the grain and shear

### A.7.1 Reinforcement of timber members loaded in compression perpendicular to the grain (reinforcement of supports)

The screws are driven into the timber member perpendicular to the contact surface under an angle between the screw axis and the grain direction of 45° to 90°. The screw heads must be flush with the timber surface.

Reinforcing screws for wood-based panels are not covered by this European Technical Assessment.

The design resistance of a reinforced contact area is:

$$R_{90,d} = min\begin{cases} k_{c,90} \cdot B_1 \cdot l_{ef,1} \cdot f_{c,90,d} + n \cdot \min\left(F_{ax,Rd}; \frac{N_{pl,k}}{\gamma_{M1}}\right) \\ B_2 \cdot l_{ef,2} \cdot f_{c,90,d} \end{cases} \text{ in N}$$

In addition to Clause A.5.1.6 the following parameters apply

| | |
|---|---|
| $k_{c,90}$ | parameter considering the type of loading, the risk of splitting and the degree of the compression deformation according to EN 1995-1-1, 6.1.5 |
| $B_1$ | bearing width in mm (minimum of steel plate and wooden member) |
| l | contact length in mm |
| $B_2$ | Width of the wooden member in the plane of the screw tip in mm |
| $l_{ef,1}$ | effective contact length according to EN 1995-1-1, 6.1.5, in mm |
| $f_{c,d,90}$ | design compressive strength perpendicular to the grain in N/mm² |
| n | number of reinforcing screws $n = n_0 \cdot n_{90}$ |
| $n_0$ | number of reinforcing screws arranged in a row parallel to the grain |
| $n_{90}$ | number of reinforcing screws arranged in a row perpendicular to the grain |
| $l_{ef,2}$ | effective contact length in the plane of the screw tips in mm |

$l_{ef,2} = l_{ef} + (n_0 - 1) \cdot a_1 + min(l_{ef}; a_{1,c})$ end supports

$l_{ef,2} = 2 \cdot l_{ef} + (n_0 - 1) \cdot a_1$ intermediate supports

| | |
|---|---|
| $l_{ef}$ | penetration length of the threaded part of the screw in the timber member in mm |
| $a_{1,c}$ | given spacing to end distance of the centre of gravity of the threaded part in the timber member in mm |
| $a_1$ | given spacing of Hilti screws in a plane parallel to the grain and screw axis |
| $\gamma_{M1}$ | partial safety factor according to EN 1993-1-1 |

If the reinforcement screws are screwed into the wooden member from both sides and the following recommendations are observed, the second line in the Equation for calculation of the design resistance may be omitted.

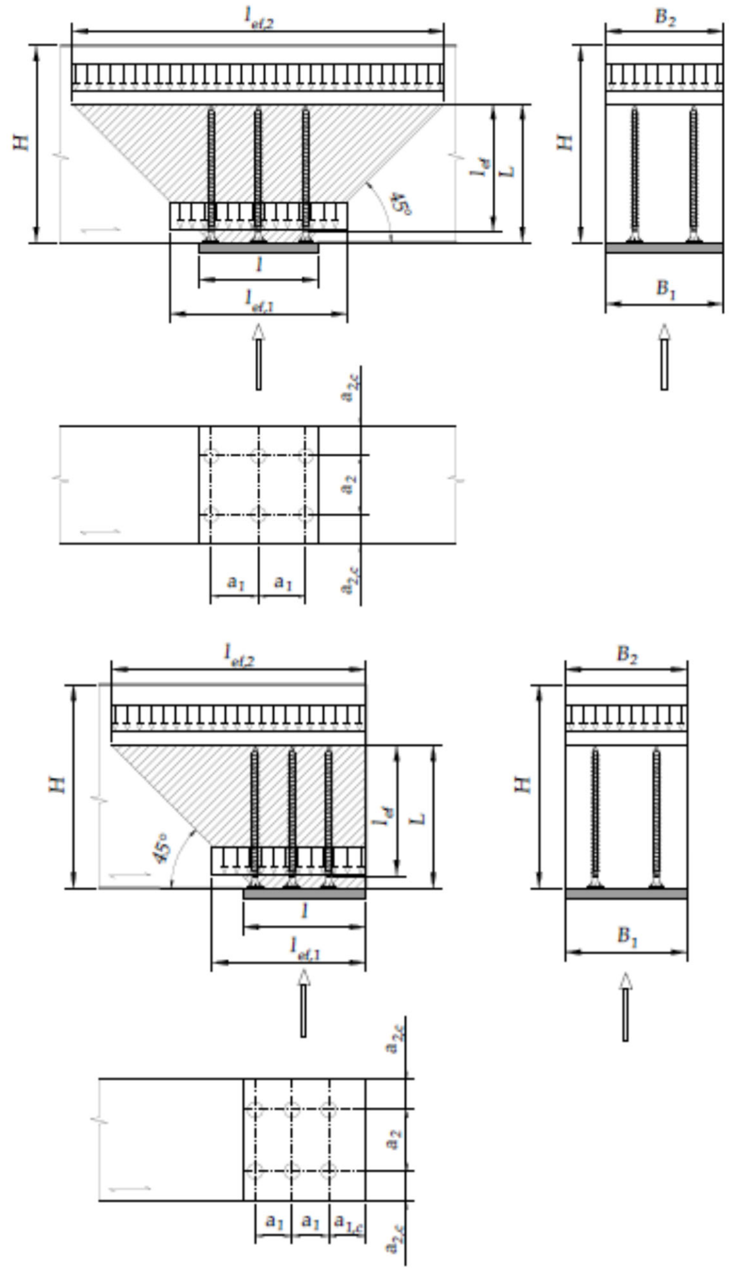


**Figure A7.1: Reinforcement of timber members loaded in compression perpendicular to the grain: end support (bottom) intermediate support (top)**

For both sided reinforcement of timber members loaded in compression perpendicular to the grain for load transfer (see Figure A7.2) the contact surfaces on the bottom and top side of the wooden member must be arranged symmetrically. Arrangement of the reinforcing screws must be symmetrically and alternating. The minimum spacings according to A.5.1.2 must be observed. The overlap $l_{lap}$ of the reinforcement screw threads should be at least 10 d.

| **Hilti screws** | Annex 7 |
| --- | --- |
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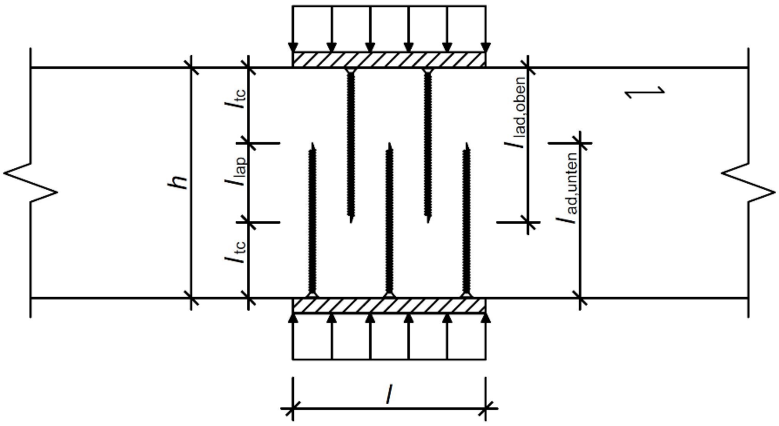


**Figure A7.2: Reinforcement of timber members loaded in compression perpendicular to the grain for load transfer**

### A.7.2 Reinforcement of timber members loaded in tension perpendicular to the grain

Fully threaded screws may be used as tensile reinforcement perpendicular to the grain of the timber members. The screws are driven into the timber member under an angle between the screw axis and the grain direction of 90°. A minimum of two screws shall be used for tensile reinforcement perpendicular to the grain. Only one screw may be used when the minimum penetration depth of the screws below and above the potential crack is 20 · d where d is the outer thread diameter of the screw.

#### A.7.2.1 Tension reinforcement for transverse connections and notches

Tension reinforcement of transverse connections and notches in wooden members may be designed as follows:

$$1.3 \cdot V_d \cdot \left[3 \cdot \left(1 - \frac{h_{ef}}{h}\right)^2 - 2 \cdot \left(1 - \frac{h_{ef}}{h}\right)^3\right] \leq F_{ax,Rd}$$ for notches

$$F_{90,Ed} \cdot \left[1 - 3 \cdot \left(\frac{a}{h}\right)^2 + 2 \cdot \left(\frac{a}{h}\right)^3\right] \leq F_{ax,Rd}$$ for transverse connections

where

$$F_{ax,Rd} = n_{90} \cdot min \begin{cases} f_{ax,k} \cdot d \cdot l_{ef} \cdot \frac{k_{mod}}{\gamma_M} \\ \frac{f_{tens,k}}{\gamma_{M2}} \end{cases}$$ for reinforcement acc. to Figure A7.3 and A7.4

| | |
|---|---|
| $V_d$ | design value of the lateral force in N |
| $F_{90,Ed}$ | design value of the force acting in the connection perpendicular to the grain of the timber members in N |
| $h_{ef}$ | effective height/thickness of the timber member above the notch in mm |
| h | height/thickness of the timber member in mm |

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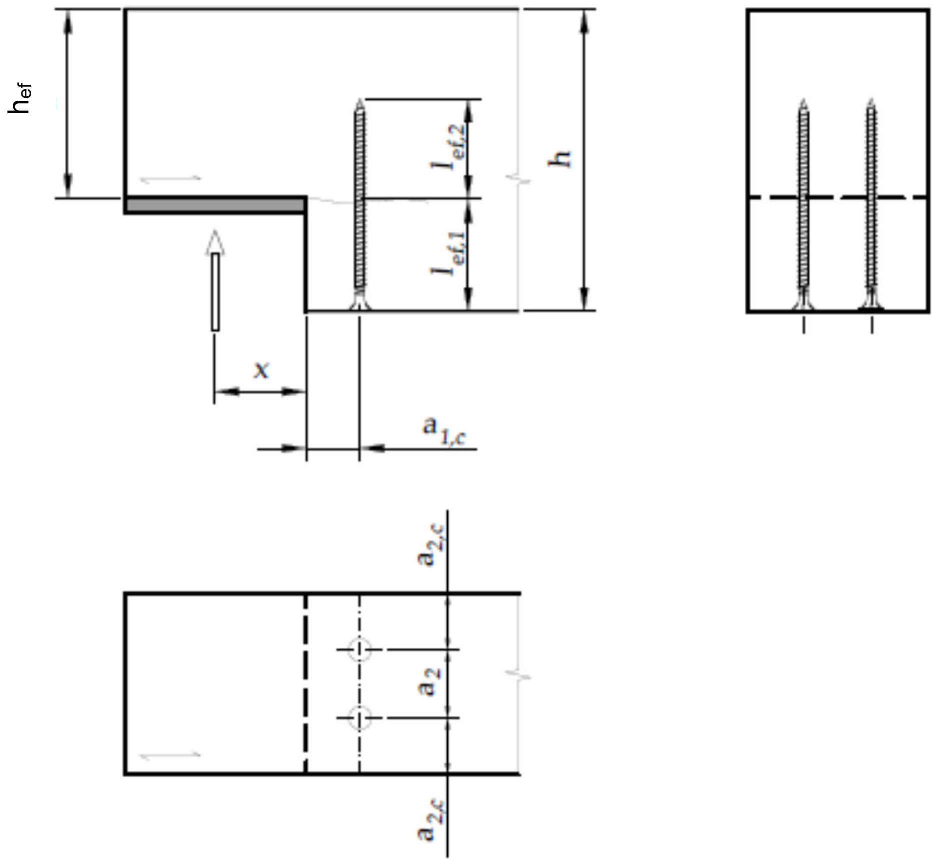
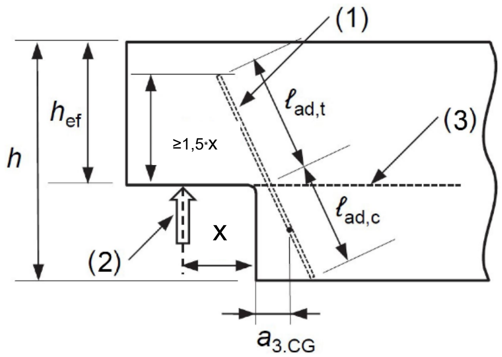
| Reinforcement with Hilti screws | of European Technical Assessment ETA-22/0772 of 03.04.2023 |

| | |
|---|---|
| a | distance of the furthermost fastener of the transverse connection from the loaded edge of the wooden member in mm (Figure A7.4) |
| $l_{ef}$ | smaller value of the penetration depth below or above the plane of the potential crack in mm |
| $k_{mod}$ | modification factor for duration of load and moisture content according to EN 1995 1-1 |
| $\gamma_M$ | partial safety factor for connections according to EN 1995-1-1, Table 2.3 |
| $\gamma_{M2}$ | partial safety factor according to EN 1993-1-1 |
| $n_{90}$ | number of reinforcing screws arranged in a row perpendicular to the grain (NOTE: Outside of the transverse connection or in the case of notches in general, only one screw may be taken into account in longitudinal direction of the beam) |




| Hilti screws | Annex 7 |
|---|---|
| Reinforcement with Hilti screws | of European Technical Assessment ETA-22/0772 of 03.04.2023 |




(1) inclined fully threaded screw
(2) application of load at the support
(3) plane of the potential crack

**Figure A7.3: Reinforcement of notches with screws arranged under an angle of 90° or inclined screws**

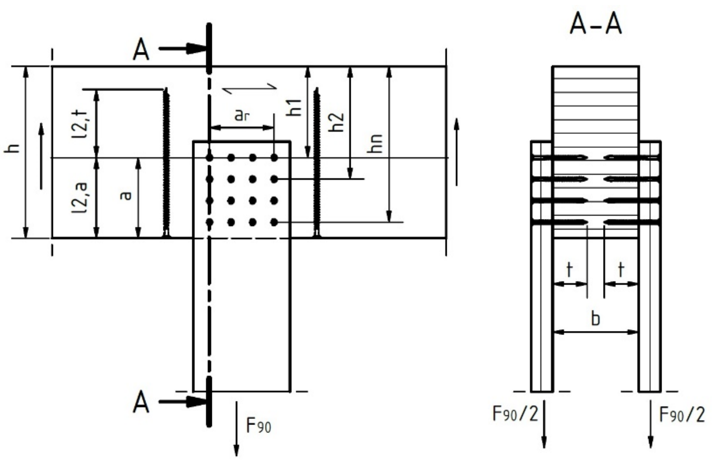



**Figure A7.4: Reinforcement of transverse connections with Hilti screws**

### A.7.2.2 Openings

Openings in wooden members may be designed as follows:

$$F_{t,V,d} + F_{t,M,d} \leq F_{ax,Rd}$$

where

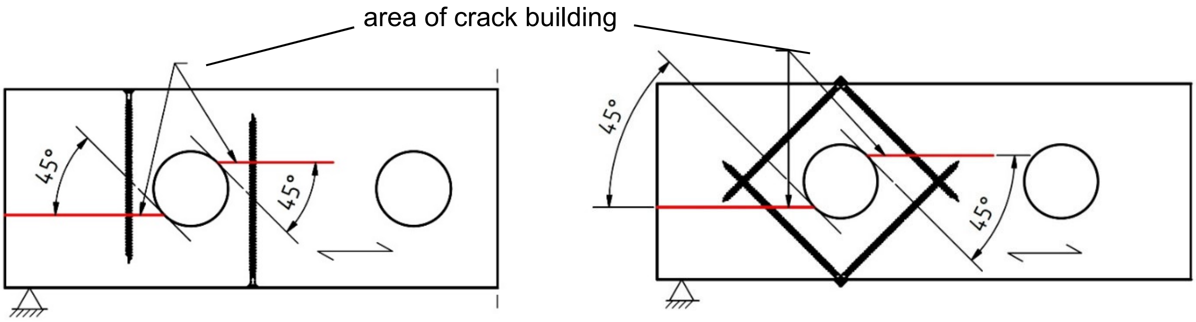
$$F_{t,V,d} = \frac{V_d \cdot h_d}{4 \cdot h} \cdot \left(3 - \frac{h_d^2}{h^2}\right)$$

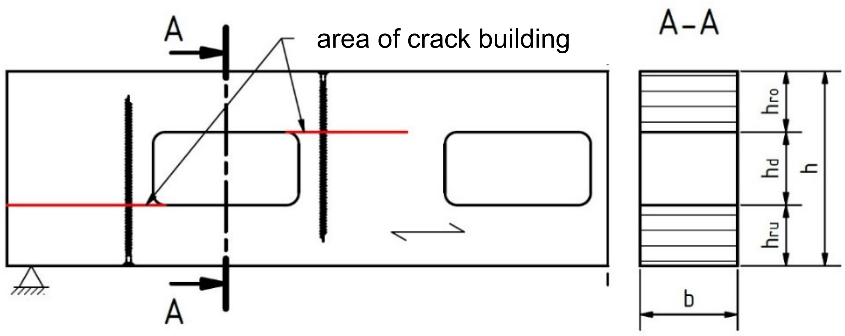
$$F_{t,M,d} = 0.008 \cdot \frac{M_d}{h_r}$$

$$F_{ax,Rd} = n_{90} \cdot min \begin{cases} f_{ax,k} \cdot d \cdot l_{ef} \cdot \frac{k_{mod}}{\gamma_M} \\ \frac{f_{tens,k}}{\gamma_{M2}} \end{cases}$$ for reinforcement acc. to Figure A7.5

with

| | |
|---|---|
| $F_{t,V,d}$ | design value of tension force perpendicular to the grain due to lateral force $V_d$ in N |
| $F_{t,M,d}$ | design value of tension force perpendicular to the grain due to bending moment $M_d$ in N |
| $h_d$ | height of the opening for rectangular openings or 70 % of opening diameter for circular openings in mm |
| $h_r$ | min ($h_{ro}$ ; $h_{ru}$) for rectangular openings or min ($h_{ro}$ + 0.15 $h_d$ ; $h_{ru}$ + 0.15 $h_d$) for circular openings in mm |
| $l_{ef}$ | smaller value of the penetration depth below or above the plane of the potential crack in mm |
| $k_{mod}$ | modification factor for duration of load and moisture content according to EN 1995 1-1 |
| $\gamma_M$ | partial safety factor for connections according to EN 1995-1-1, Table 2.3 |
| $\gamma_{M2}$ | partial safety factor according to EN 1993-1-1 |
| $n_{90}$ | number of reinforcing screws arranged in a row perpendicular to the grain |




| Hilti screws | Annex 7 |
|---|---|
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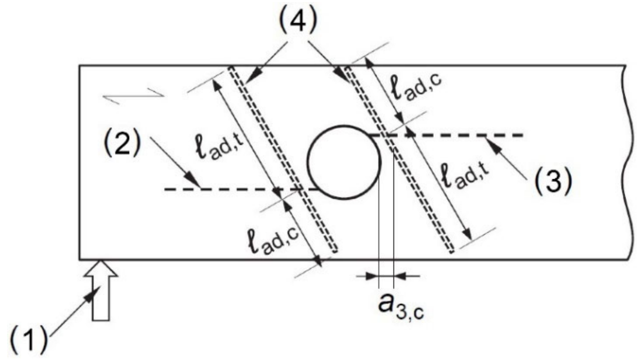



(1) application of load at the support
(2) (3) plane of the potential crack
(4) inclined fully threaded screw

**Figure A7.5: Reinforcement of openings with Hilti screws**

### A.7.2.3 Connections with dowel-type fasteners stressed with shear loads

In connections with dowel-type fasteners stressed with shear loads (connection loaded in direction of the grain) the number of effective screws $n_{ef}$ may be taken as $n_{ef}$ = n for side and middle wood of each connection reinforced according to Figure A7.6 and

$$\frac{0.3 \cdot F_{v,0,Ed}}{F_{ax,Rd}} \leq 1$$

where

$F_{v,0,Ed}$ Design value of the stress per fastener parallel to the grain in N
Side wood: stress per fastener and shear plane
Middle wood: Summed up stress per fastener and both shear planes

$$F_{ax,Rd} = n_{90} \cdot min \begin{cases} f_{ax,k} \cdot d \cdot l_{ef} \cdot \dfrac{k_{mod}}{\gamma_M} \\ \dfrac{f_{tens,k}}{\gamma_{M2}} \end{cases}$$

with

| | |
|---|---|
| $l_{ef}$ | smaller value of the penetration depth of the thread of the screw and the tip in mm |
| $k_{mod}$ | modification factor for duration of load and moisture content according to EN 1995 1-1 |
| $\gamma_M$ | partial safety factor for connections according to EN 1995-1-1 |
| $\gamma_{M2}$ | partial safety factor according to EN 1993-1-1 |
| $n_{90}$ | number of reinforcing screws arranged in a row perpendicular to the grain per side or middle wood |

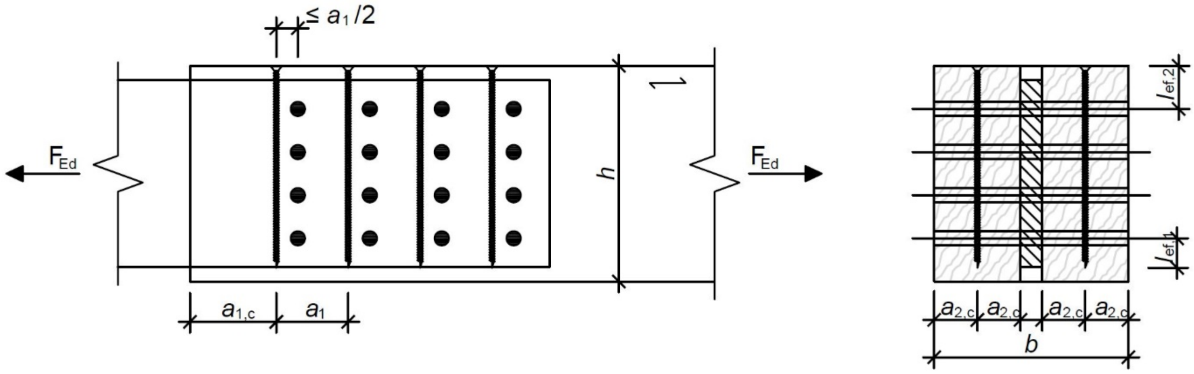



**Figure A7.6: Reinforcement of connections stressed with shear loads**

| **Hilti screws** | Annex 7 |
| --- | --- |
| Reinforcement with Hilti screws | of European Technical Assessment ETA-22/0772 of 03.04.2023 |

### A.7.2.4 Shear reinforcement

Fully threaded screws may be used as shear reinforcement of solid timber, glued laminated timber and glued solid timber of softwood. The provisions are valid for straight beams with constant rectangular cross-section. The screws are driven into the timber member under an angle between the screw axis and the grain direction of 45°.

A minimum of four screws shall be used for shear reinforcement in a line parallel to the grain whereas the spacing between the screws shall not exceed the depth h of the timber member. If the screws are arranged in one line parallel to the grain, it shall be done centrically in relation to the beam width.

The effect of the reinforcement is limited to the shaded part of the timber member. Outside this area sufficient shear strength of the cross section must be verified.

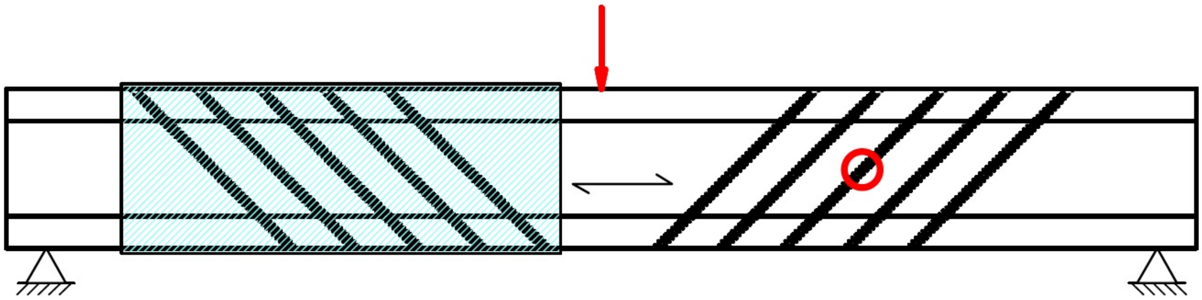


**Figure A7.7: Shear reinforcement with Hilti screws**

Shear reinforcement may be designed according to

$$\tau_d \leq \frac{f_{v,d} \cdot \kappa_\tau}{\eta_H}$$

where

$\tau_d$ design value of shear stress in N/mm²

$f_{v,d}$ design value of shear strength in N/mm²

$$\kappa_\tau = 1 - 0.46 \cdot \sigma_{90,d} - 0.052 \cdot \sigma_{90,d}^2$$

$\sigma_{90,d}$ design value of stress perpendicular to the grain in N/mm²

$$\sigma_{90,d} = \frac{F_{ax,d}}{\sqrt{2} \cdot b \cdot a_1}$$

b with of the timber member in mm

$a_1$ spacing of screws parallel to the grain in mm

$$F_{ax,d} = \frac{\sqrt{2} \cdot (1 - \eta_H) \cdot V_d \cdot a_1}{h}$$

$V_d$ design shear force in N

h height of the timber member in mm

$$\eta_H = \frac{G \cdot b}{G \cdot b + \frac{1}{2 \cdot \sqrt{2} \cdot \left( \frac{6}{\pi \cdot d \cdot h \cdot k_{ax}} + \frac{a_1}{EA_S} \right)}}$$

G mean value of shear modulus of the timber member in N/mm²

d outer thread diameter of the screw in mm

$k_{ax}$ connection stiffness between screw and timber member in N/mm³,
$k_{ax}$ = 12.5 N/mm³ for a fully threaded screw with d = 8 mm

$EA_s$ axial stiffness of one screw in N

$$EA_s = \frac{E \cdot \pi \cdot d_i^2}{4}$$

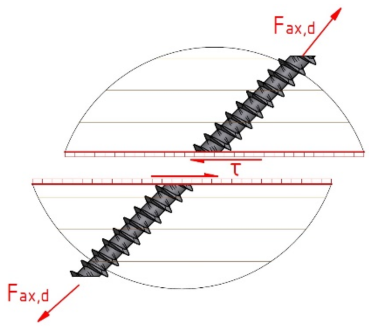
$d_i$ inner thread diameter of the screw in mm

The axial capacity of the screw shall fulfil

$$\frac{F_{ax,d}}{F_{ax,Rd}} \leq 1$$

where

$$F_{ax,Rd} = n_{90} \cdot min \begin{cases} f_{ax,k} \cdot d \cdot l_{ef} \cdot \frac{k_{mod}}{\gamma_M} \\ \frac{f_{tens,k}}{\gamma_{M2}} \end{cases}$$




with

$l_{ef}$ 50 % of the penetration depth of the thread in mm

$k_{mod}$ modification factor for duration of load and moisture content according to EN 1995 1-1

$\gamma_M$ partial safety factor for connections according to EN 1995-1-1

$\gamma_{M2}$ partial safety factor according to EN 1993-1-1

$n_{90}$ number of reinforcing screws arranged in a row perpendicular to the grain

| **Hilti screws** | Annex 7 |
|---|---|
| Reinforcement with Hilti screws | of European Technical Assessment ETA-22/0772 of 03.04.2023 |

### A.8.1 Fastening of thermal insulation material (on top of rafters and facades)

Hilti screws with an outer thread diameter of at least 6 mm and lengths between 120 mm and 600 mm may be used for fixing of thermal insulation material on rafters or on wood-based members in vertical facades. Screws with partial thread and cylinder head are excluded from fixing wood-based panels on rafters with thermal insulation material as interlayer.

The angle between grain direction and screw axis shall be 30° ≤ α ≤ 90°.

The thickness of the **thermal insulation material** is max. 400 mm. The thermal insulation material shall be applicable as insulation on top of rafters according to national provisions that apply at the installation site.

The **battens** are made from solid timber strength class C24 according to EN 338 and EN 14081-1. The minimum thickness and width of the battens is:

**Table A8.1 Minimum thickness and width of the battens**

| Screw diameter d in mm | $b_{min}$ | $t_{min}$ |
|---|---|---|
| | mm | mm |
| ≤ 8 | 50 | 30 |
| 10 | 60 | 40 |
| 12 | 80 | 50 |

Instead of battens the following **wood-based panels** may be used to cover the thermal insulation material if they are suitable for that use:

− Plywood according to EN 636 and EN 13986,

− Oriented Strand Board, OSB according to EN 300 and EN 13986,

− Particleboard according to EN 312 and EN 13986

− Fibreboards according to EN 622-2, EN 622-3 and EN 13986.

The minimum thickness of the wood-based panels shall be 22 mm.

The word batten in the following includes the meaning of the above mentioned wood-based panels.

The **substructure** is made from solid timber strength class C24 according to EN 338 and EN 14081-1, cross laminated timber according to European Technical Assessments or laminated veneer lumber according to EN 14374. The minimum width is $b_{min}$ = 60 mm, for screws with an outer thread diameter of 12 mm the minimum width $b_{min}$ = 80 mm.

The spacing between screws $e_s$ shall be not more than 1.75 m.

Friction forces shall not be considered for the design of the characteristic axial capacity of the screws.

The anchorage of wind suction forces as well as the bending stresses of the battens or the boards, respectively, shall be considered for design. Screws perpendicular to the grain of the rafter (angle $\alpha$ = 90 °) may be arranged if necessary.

Design may follow EN 1995-1-1 if nothing different is specified below.

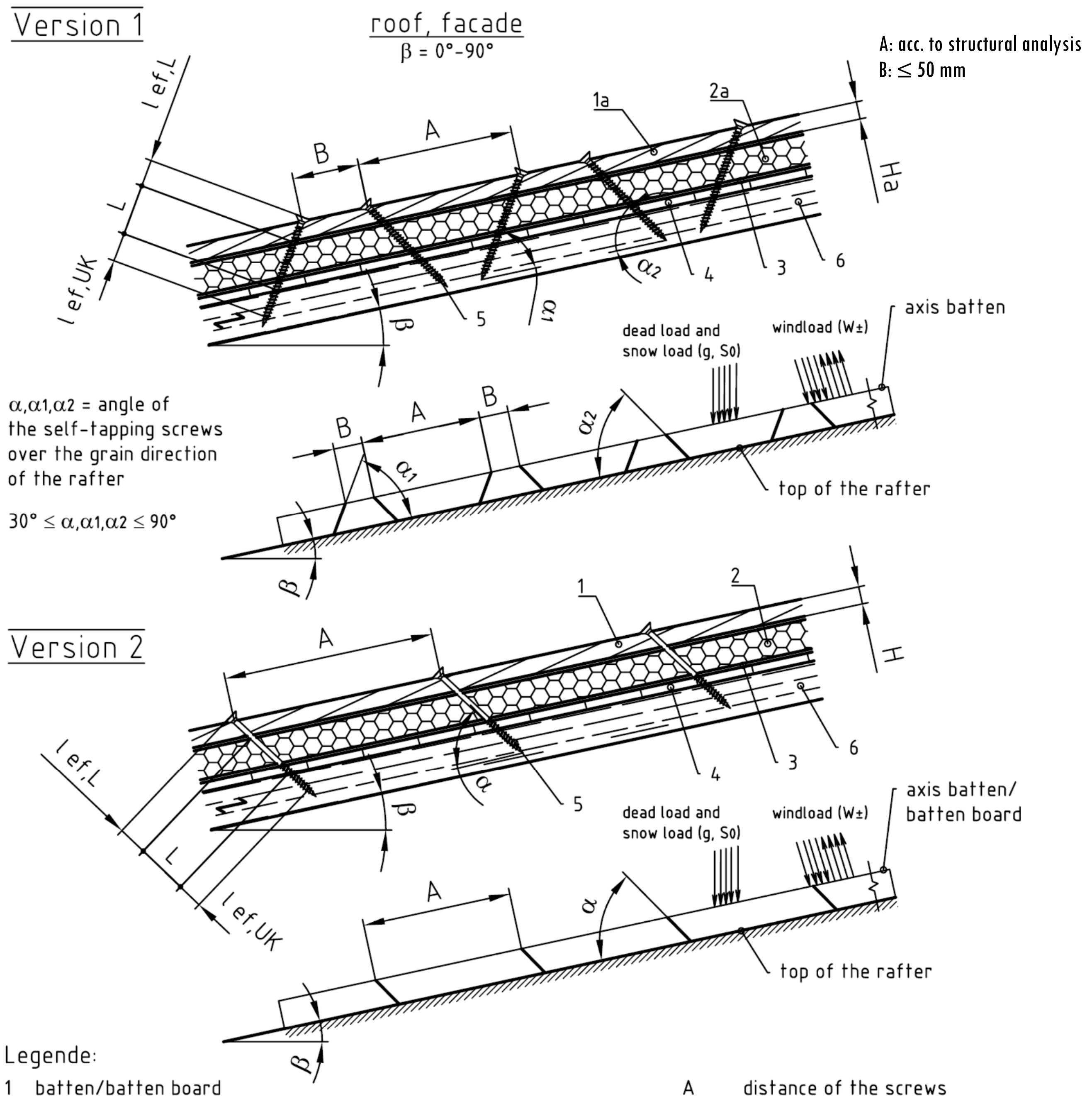
The **two** following **systems** are possible for 0° ≤ β ≤ 90°:

- System 1: Alternately inclined screws (only screws with full thread, double thread)

  A according to structural analysis, B ≤ 50 mm
- System 2: Parallel inclined screws (all screws, in case of compression resistant insulation material ≥ 0.05 N/mm²)

  A according to structural analysis

Member of EOTA




Legende:

1 batten/batten board
1a batten
2 heat isulation (till 300mm), pressure resistant (min. 0,05) N/mm²
2a heat isulation (till 400mm), not pressure resistant
3 vapour barrier
4 roof boards
5 self-tapping screws
6 rafter

A distance of the screws
H thickness batten/batten board
Ha thickness batten
l ef,L penetration lenght in the batten/batten board
l ef,UK penetration lenght in the rafter

| Hilti screws | Annex 8 |
|---|---|
| Fastening of thermal insulation material | of European Technical Assessment ETA-22/0772 of 03.04.2023 |

### A.8.2 Alternately inclined screws (only screws with full thread)

The screws are predominantly loaded in withdrawal or compression, respectively. Only systems with battens are allowed.

**Design**

For design of thermal insulation systems in terms of number and spacing of the screws the following characteristic values of tensile or compressive load bearing capacity may be taken into account:

$$R_{ax,k} = \min\begin{cases} f_{ax,k,\alpha} \cdot d \cdot l_{ef,L} \\ f_{ax,k,\alpha} \cdot d \cdot l_{ef,UK} \end{cases} \quad \text{in N}$$

where:

| | | |
|---|---|---|
| $f_{ax,k,\alpha}$ | = | characteristic value of the axial withdrawal parameter of the threaded part of the screw in the batten, $f_{ax,k,\alpha}$ does not apply for wood-based panels |
| $\alpha$ | = | angle between screw axis and grain direction of batten or substructure |
| $d$ | = | outer thread diameter of the screw in mm |
| $l_{ef,L}$ | = | penetration length of the threaded part of the screw in the batten in mm; the screw head length *k* may be taken into account for tension load (not for compressive loading) |
| $l_{ef,UK}$ | = | penetration length of the threaded part of the screw in the substructure in mm; ≥ 60 mm |

For compressive loading the design compressive load bearing capacity shall not exceed the buckling capacity of the screws $\chi \cdot N_{pl,d}$ according to Table A8.2.

**Table A8.2 Buckling capacity of the screws**

| Free screw length l between batten and rafter (mm) | $\kappa_c$ * $N_{pl,k}$ (kN) for Hilti screws | | |
|---|---|---|---|
| | Outer thread diameter d | | |
| | 8 | 10 | 12 |
| | Inner thread diameter $d_i$ | | |
| | 5.2 | 6.2 | 6.9 |
| ≤35 | 11.681 | 19.024 | 25.125 |
| 60 | 7.576 | 13.516 | 18.834 |
| 80 | 5.416 | 10.070 | 14.470 |
| 100 | 4.008 | 7.621 | 11.154 |
| 120 | 3.068 | 5.912 | 8.747 |
| 140 | 2.418 | 4.699 | 7.000 |
| 160 | 1.952 | 3.815 | 5.710 |
| 180 | 1.608 | 3.156 | 4.739 |
| 200 | 1.347 | 2.652 | 3.992 |
| 220 | 1.144 | 2.259 | 3.407 |
| 240 | 0.984 | 1.947 | 2.941 |
| 260 | 0.855 | 1.695 | 2.563 |
| 280 | 0.750 | 1.489 | 2.254 |
| 300 | 0.663 | 1.318 | 1.997 |
| 320 | 0.591 | 1.175 | 1.781 |
| 340 | 0.529 | 1.054 | 1.599 |
| 360 | 0.477 | 0.950 | 1.443 |
| 380 | 0.432 | 0.862 | 1.309 |
| 400 | 0.393 | 0.785 | 1.193 |

### A.8.3 Parallel inclined screws

The screws are predominantly loaded in tension whereas corresponding thermal insulation material is loaded in compression. The minimum compression stress of the thermal insulation material at 10 % deformation, measured according to EN 826, shall be $\sigma_{(10\%)} \geq 0.05$ N/mm². Hereby systems with battens or wood-based panels may be used.

**Design**

For design of thermal insulation systems in terms of number and spacing of the screws the following characteristic withdrawal parameter may be taken into account:

$$R_{ax,k} = \min \begin{cases} f_{ax,k,\alpha} \cdot d \cdot l_{ef,UK} \cdot k_1 \cdot k_2 \\ \max \begin{cases} f_{head,k} \cdot d_k^2 \\ f_{ax,k,\alpha} \cdot l_{ef,L} \cdot d \end{cases} \end{cases} \quad \text{in N}$$

where:

$f_{ax,k,\alpha}$ = characteristic value of the axial withdrawal parameter of the threaded part of the screw in the batten, $f_{ax,k,\alpha}$ does not apply for wood-based panels

$f_{head,k}$ = characteristic head pull-through parameter according to Tables A5.6 and A5.7

$$k_1 = \min \begin{cases} 1 \\ \dfrac{220}{d_{Dä.}} \end{cases}$$

$$k_2 = \min \begin{cases} 1 \\ \dfrac{\sigma_{10\%}}{0.12} \end{cases}$$

$d_{Dä.}$ = thickness of thermal insulation material in mm

$\sigma_{10\%}$ = compressive stress of thermal insulation material at 10 % strain in N/mm²

European Assessment Document EAD 130118-01-0603 "Screws and threaded rods for use in timber constructions"

EN 300 (07.2006), Oriented Strand Boards (OSB) – Definitions, classification and specifications

EN 312 (09.2010), Particleboards – Specifications

EN 338 (04.2016), Structural timber – Strength classes

EN 622-2 (04.2004) +AC (12.2005), Fibreboards – Specifications – Part 2: Requirements for hardboards

EN 622-3 (04.2004), Fibreboards – Specifications – Part 3: Requirements for medium boards

EN 634-1 (03.1995), Cement-bonded particleboards – Specifications – Part 1: General requirements

EN 636:2012+A1 (03.2015), Plywood – Specifications

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EN 14080 (06.2013), Timber structures – Glued laminated timber and glued solid timber – Requirements

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EN 14374 (11.2004), Timber structures – Structural laminated veneer lumber – Requirements

| **Hilti screws** | Annex 9 |
|---|---|
| Reference documents | of European Technical Assessment<br>ETA-22/0772 of 03.04.2023 |