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

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European Technical Assessment

ETA-13/0796 of 16.02.2022

General part

Technical Assessment Body issuing the European Technical Assessment	Österreichisches Institut für Bautechnik (OIB) Austrian Institute of Construction Engineering
Trade name of the construction product	Simpson Strong-Tie® screws ESCRC/ESCRC-S, ESCR/ESCR-S, ESCRS, ESCRSW, ESCRHD/HRD, ESCRH/ESCRH-S, ESCRFTC/ ESCRFTC-S, ESCRFT/ESCRFT-S, ESCRFTZ/ ESCRFTZ-S, SSTA and ESCRT2R/ ESCRT2R-S
Product family to which the construction product belongs	Screws for use in timber constructions
Manufacturer	SIMPSON STRONG-TIE® GmbH Hubert-Vergölst-Straße 6-14 61231 Bad Nauheim Germany
Manufacturing plant	Simpson Strong-Tie® Manufacturing Facility
This European Technical Assessment contains	59 pages including 11 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”.
This European Technical Assessment replaces	European Technical Assessment ETA-13/0796 of 15.12.2017.

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[1] (ETA) applies to the screws for use in timber constructions "Simpson Strong-Tie® screws ESCRC, ESCR, ESCRS, ESCRSW, ESCRHD/HRD, ESCRH, ESCRFTC, ESCRFT, ESCRFTZ, SSTA and ESCRT2R" made from hardened carbon steel as well as "Simpson Strong-Tie® screws ESCRC-S, ESCR-S, ESCRH-S, ESCRFTC-S, ESCRFT-S, ESCRFTZ-S, ESCRT2R-S" made from stainless steel. Simpson Strong-Tie® 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 from special carbon steel 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 Simpson Strong-Tie® 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 6. The material characteristics, dimensions and tolerances of the product not indicated in these Annexes, are given in the technical file[2] of the European Technical Assessment.

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

Type of screws	Outer thread diameter		Overall length	
	min.	max.	min.	max.
	mm	mm	mm	mm
ESCR/ESCR-S	6	10	20	500
ESCRC/ESCRC-S	4	10	20	500
ESCRS	4	12	20	500
ESCRSW	6	12	20	500
ESCRFTC/ESCRFTC-S	8	16	20	1000
ESCRFT/ESCRFT-S ESCRFTZ/ESCRFTZ-S	8	12	20	1000
ESCRHD/HRD	8	12	20	500
ESCRT2R/ESCRT2R-S	8	8	120	600
ESCRH/ESCRH-S	6	12	20	500
SSTA	6	12	20	1000

[1] The ETA-13/0796 was firstly issued in 2013 as European technical approval with validity from 28.06.2013, amended and converted in 2017 to the European Technical Assessment ETA-13/0796 of 15.12.2017 and amended in 2022 to the European Technical Assessment ETA-13/0796 of 16.02.2022.

[2] 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[3] 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 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.

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,
- Solid wood panels according to EN 13353 and EN 13986,
- Plywood according to EN 636 and EN 13986,
- Oriented strand boards, OSB, according to EN 300 and EN 13986,
- Particleboards according to EN 312 and EN 13986,
- Fibreboards according to EN 622-2, EN 622-3 and EN 13986,
- Cement-bonded particle boards according EN 634-1 and EN 13986 or European Technical Assessments or national provisions that apply on the installation site.

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 $6 \text{ mm} \leq d \leq 12$ 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 as well as screws made of stainless steel may be used in conditions defined by service class 3. The field of application of the screws made of stainless steel shall be defined according to EN 1993-1-4 or national provisions that apply at the installation site.

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[3] Reference documents are listed in Annex 11.

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.

Design

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 Simpson Strong-Tie® screws is carried under the responsibility of an engineer experienced in such products.
- Design of the works shall account for the protection of Simpson Strong-Tie® screws to maintain service classes 1, 2 and 3 according to EN 1995-1-1 or national provisions that apply on the installation site.
- Simpson Strong-Tie® 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 7 to Annex 10 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.

Packaging, transport, storage, maintenance, replacement and repair

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

Installation

It is assumed that the product will be installed according to the manufacturer's instructions 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 ≤ 16 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 Simpson Strong-Tie® screws shall

- be in accordance with Clause 2.1;
- ensure minimum spacing and edge distances in accordance with EN 1995-1-1 and Annex 7.

2.3 Assumed working life

The provisions made in the European Technical Assessment (ETA) are based on an assumed intended working life of Simpson Strong-Tie® 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[4].

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.

[4] 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.

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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 6
2	Characteristic yield moment	Annex 7
3	Bending angle	Annex 7
4	Characteristic withdrawal parameter	Annex 7
5	Characteristic head pull-trough parameter	Annex 7
6	Characteristic tensile strength	Annex 7
7	Characteristic yield strength	Annex 7
8	Characteristic torsional strength	Annex 7
9	Insertion moment	Annex 7
10	Spacing, end and edge distances of the screws and minimum thickness of the wood based material	Annex 7
11	Slip modulus for mainly axially loaded screws	Annex 7
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.

Steel no. 1.4567 or 1.4578 or equivalent according to EN 10088-1 is used for screws made from stainless steel.

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

3.1.2 Reaction to fire

Simpson Strong-Tie® 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 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 “Simpson Strong-Tie® screws” 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 Simpson Strong-Tie® 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 16.02.2022
by Österreichisches Institut für Bautechnik

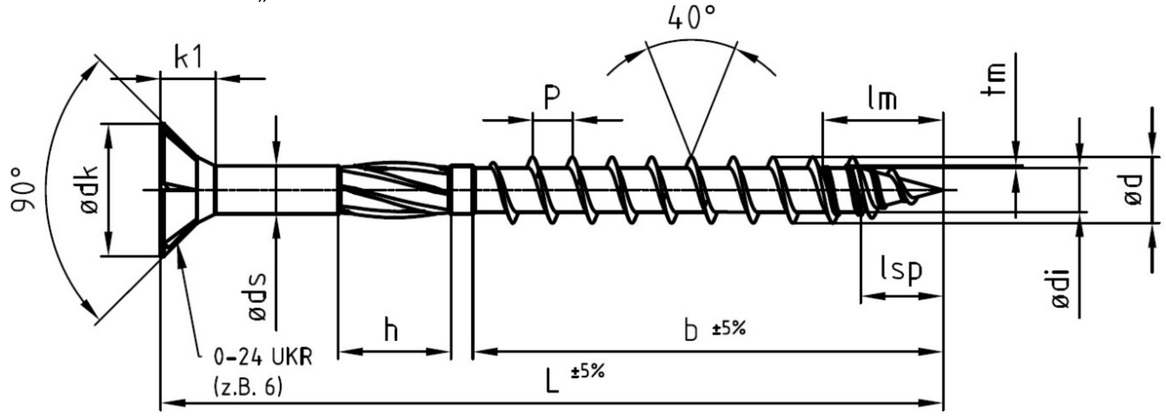
The original document is signed by:

Rainer Mikulits

Managing Director

Member of EOTA

Countersunk head „ESCRC/ESCRC-S“



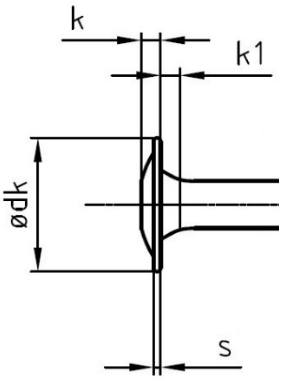
UKR … cutter ribs

Dim	Ødk	k1	Øds	Ød	Ødi	P	lsp	Ødn	ØdR	h	tm
4,0	8,0 ±0.70	3,0 ±0.30	2,8 ±0.14	4,0 ±0.20	2,50 ±0.15	2,2 ±0.22	4,6 ±1.5	3,7 ±0.37	3,2 ±0.3	6,2 ±1.0	0,20 ±0.05
4,5	9,0 ±0.70	3,5 ±0.35	3,2 ±0.16	4,5 ±0.22	2,70 ±0.15	2,4 ±0.24	5,0 ±1.6	4,1 ±0.41	3,6 ±0.3	8,2 ±1.0	0,30 ±0.05
5.0 x)	10,0 ±0.80	4,5 ±0.45	3,6 ±0.18	5,0 ±0.25	3,25 ±0.17	2,7 ±0.27	6,0 ±1.7	4,5 ±0.45	4,1 ±0.4	8,2 ±1.0	0,35 ±0.07
6.0 xx)	12,0 ±0.90	5,5 ±0.55	4,3 ±0.21	6,0 ±0.30	3,95 ±0.20	3,6 ±0.36	7,3 ±1.9	5,4 ±0.54	5,0 ±0.5	10,2 ±1.0	0,30 ±0.07
8,0	15,0 ±1.20	7,0 ±0.70	5,9 ±0.29	8,0 ±0.40	5,30 ±0.26	5,6 ±0.56	8,2 ±2.1	7,2 ±0.72	6,8 ±0.6	10,2 ±1.0	0,60 ±0.12
10,0	18,5 ±1.50	9,0 ±0.90	7,1 ±0.35	10,0 ±0.60	6,20 ±0.50	6,6 ±0.66	10,1 ±2.3	8,6 ±0.86	8,3 ±0.8	10,2 ±1.0	0,60 ±0.12

x) Dim 5 optional with pitch $P = 3.4^{\pm 0.34}$
xx) Dim 6 optional with pitch $P = 4.6^{\pm 0.46}$

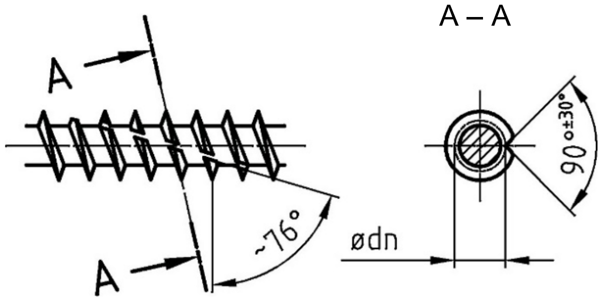
lm = lsp + 1.0 P

Washer head „ESCR/ESCR-S“

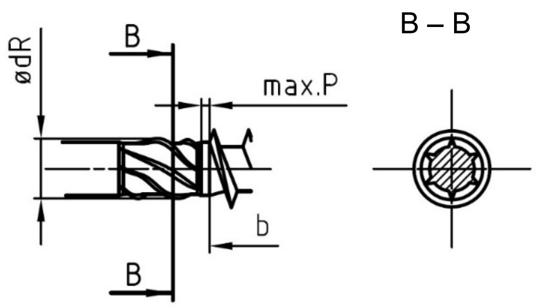


Dim	Ødk	k	k1	s
6,0	14,0 ±0.80	3,0 ±1.0	1,4 ±0.8	1,5 ±0.8
8,0	20,0 ±1.50	3,5 ±1.0	1,9 ±1.0	2,0 ±0.9
10,0	25,0 ±2.00	4,5 ±1.2	2,6 ±1.5	2,0 ±0.9

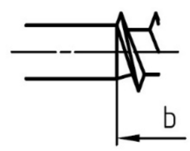
Detail: optional with cutting groove



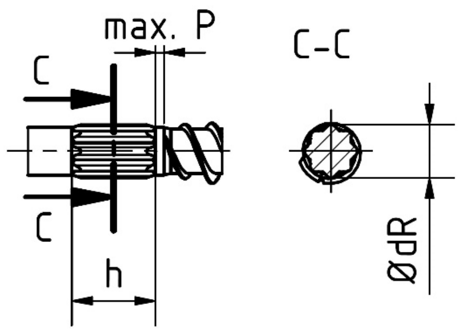
Detail: friction part



alternative without friction part



alternative friction part



Simpson Strong-Tie® screws SIMPSON Strong-Tie	Annex 1 of European Technical Assessment ETA-13/0796 of 16.02.2022
ESCRC/ESCRC-S and ESCR/ESCR-S	

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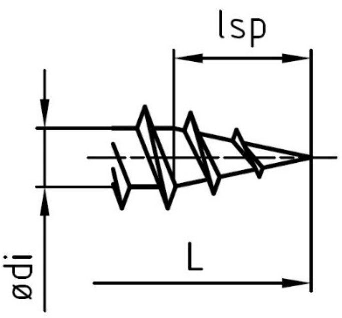
Alternative point type: regular point



length L and threaded part of the screw b											
Dim. 4.0		Dim. 4.5		Dim. 5.0		Dim. 6.0		Dim. 8.0		Dim. 10.0	
L	b	L	b	L	b	L	b	L	b	L	b
30	24	40	24	40	30	60	36	80	54	80	60
35	24	45	24	50	30	70	36	100	54	100	60
40	30	50	29	60	30	80	48	120	54	120	60
50	30	60	29	70	37	90	48	140	84	140	60
60	35	70	39	80	37	100	48	160	84	160-500	100
70	35	80	39	90-120	55	110-300	64	180-500	100		
80	35										

threaded part of the screw b = b_{min}
b_{max} (fully threaded screw) = L – k1

Simpson Strong-Tie® screws

SIMPSON Strong-Tie®

ESCRC/ESCRC-S and ESCR/ESCR-S

Annex 1

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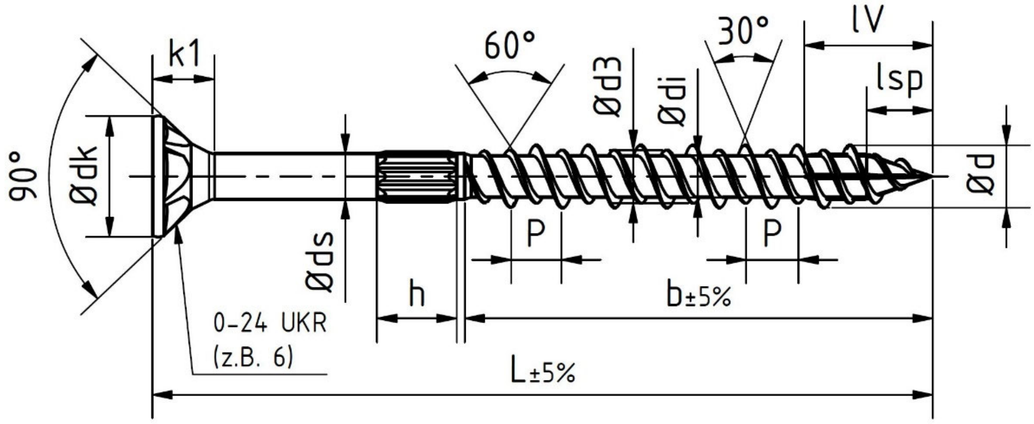
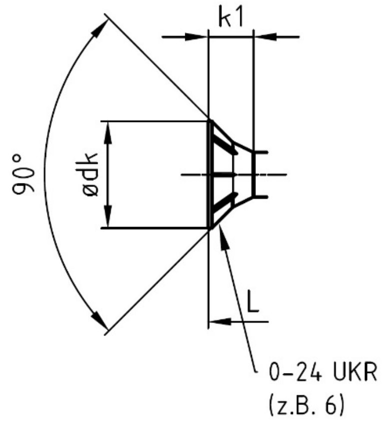
Countersunk head „ESCRS“



Countersunk head with UKR (cutter ribs)



Dim	Ødk		k1		Øds		Ød		Ødi		Ød3		P		lsp		Ødn		ØdR		h		ØdV		lV	
4,0	8,0	±0.70	3,0	±0.30	2,8	±0.14	4,0	±0.20	2,45	±0.15	3,3	±0.16	3,4	±0.34	4,6	±1.5	3,7	±0.37	3,1	±0.3	6,2	±1.0	2,9	±0.29	8,0	±1.0
4,5	9,0	±0.70	3,5	±0.35	3,2	±0.16	4,5	±0.22	2,75	±0.15	3,7	±0.18	3,8	±0.38	5,0	±1.6	4,1	±0.41	3,5	±0.3	8,2	±1.0	3,2	±0.32	9,0	±1.0
5,0	10,0	±0.80	4,5	±0.45	3,6	±0.18	5,0	±0.25	3,25	±0.16	4,1	±0.20	4,2	±0.42	6,0	±1.7	4,5	±0.45	3,9	±0.4	8,2	±1.0	3,7	±0.37	10,0	±1.0
6,0	12,0	±0.90	5,5	±0.55	4,3	±0.21	6,0	±0.30	4,00	±0.20	5,0	±0.25	5,0	±0.50	7,3	±1.9	5,4	±0.54	4,7	±0.5	10,2	±1.0	4,4	±0.44	13,0	±1.0
8,0	15,0	±1.20	7,0	±0.70	5,9	±0.29	8,0	±0.40	5,35	±0.27	6,8	±0.34	6,7	±0.67	8,2	±2.1	7,2	±0.72	6,2	±0.6	10,2	±1.0	5,8	±0.58	15,6	±1.0
10,0	18,5	±1.50	9,0	±0.90	7,1	±0.35	10,0	±0.60	6,80	±0.34	7,9	±0.40	7,9	±0.79	10,1	±2.3	8,6	±0.86	7,7	±0.8	10,2	±1.0	7,3	±0.73	17,6	±1.0

Simpson Strong-Tie® screws

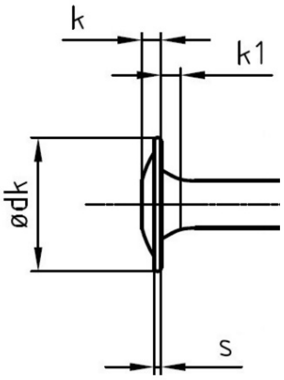
SIMPSON Strong-Tie®

ESCRS, ESCRSW, ESCRHD/HRD and ESCRH/ESCRH-S

Annex 2

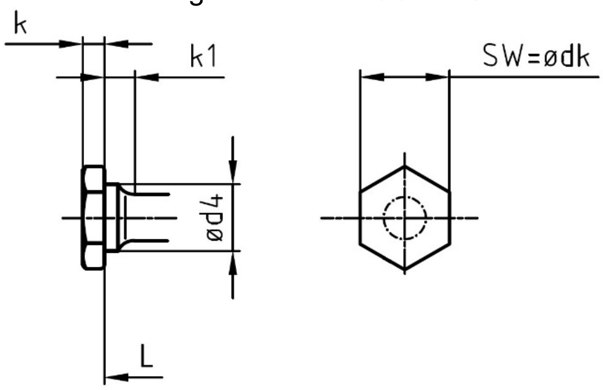
of European Technical Assessment
ETA-13/0796 of 16.02.2022

Washer head „ESCRSW“



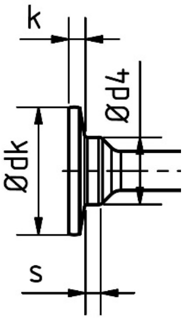
Dim	Ødk	k	k1	s
6,0	14,0 ±0.80	3,0 ±1.0	1,4 ±0.8	1,5 ±0.8
8,0	20,0 ±1.50	3,5 ±1.0	1,9 ±1.0	2,0 ±0.9
10,0	25,0 ±2.00	4,5 ±1.2	2,6 ±1.5	2,0 ±0.9

Kombi hexagonal head “ESCRHD/HRD”



Dim	SW=Ødk	k	k1	Ød4
6,0	9,0 -0,45	3,0 ±1.3	4,7 ±1.0	6,0 ±0.60
8,0	12,0 -0,60	4,5 ±1.3	6,3 ±1.0	8,0 ±0.80
10,0	15,0 -0,75	5,0 ±1.3	8,0 ±1.5	10,0 ±1.00

Washer head „ESCRH/ESCRH-S“

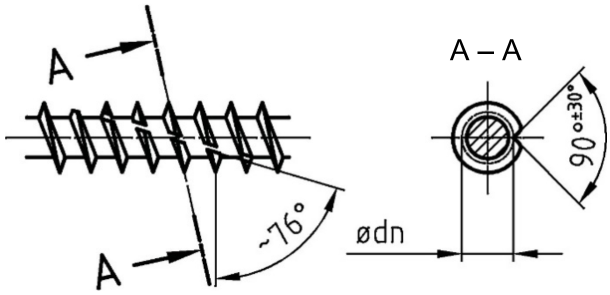


Dim	Ødk	k	s	Ød4
6,0	13,0 ±0.65	1,8 ±1.0	1,8 ±1.0	8,0 ±0.4
8,0	19,0 ±1.50	2,4 ±1.0	2,4 ±1.0	10,0 ±0.5
10,0	24,0 ±2.50	3,0 ±1.0	3,0 ±1.0	13,0 ±0.65

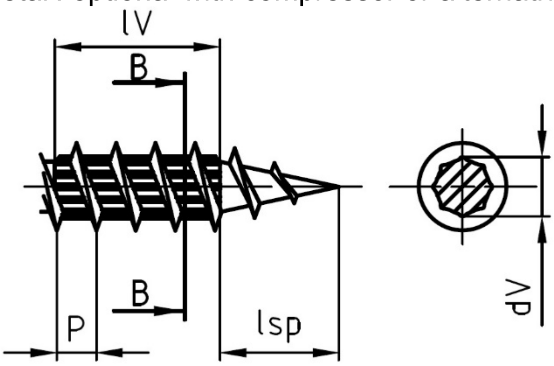
Simpson Strong-Tie® screws SIMPSON Strong-Tie®	Annex 2 of European Technical Assessment ETA-13/0796 of 16.02.2022
ESCRS, ESCRSW, ESCRHD/HRD and ESCRH/ESCRH-S	

Member of EOTA

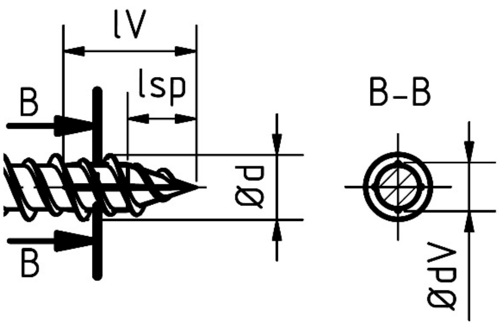
Detail: cutting groove (alternative without cutting groove)



Detail: optional with compressor or alternative compressor

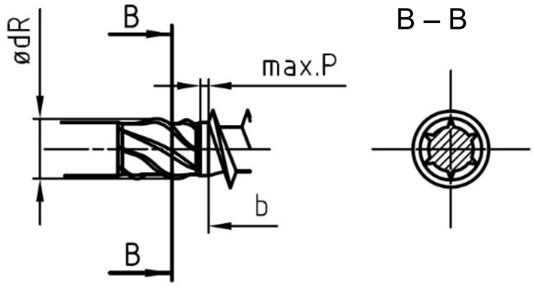


Number of flanks: 4 – 8 lV = 2P to 4P (1P for L ≤ 100)

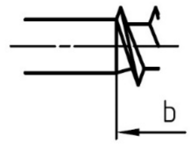


Simpson Strong-Tie® screws SIMPSON Strong-Tie®	Annex 2 of European Technical Assessment ETA-13/0796 of 16.02.2022
ESCRS, ESCRSW, ESCRHD/HRD and ESCRH/ESCRH-S	

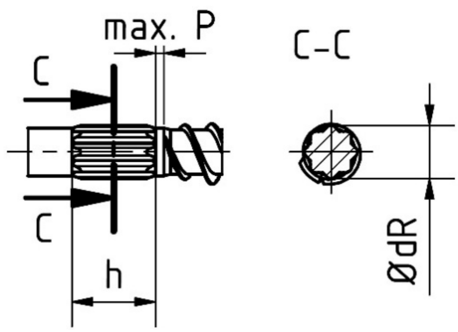
Detail: friction part



alternative without friction part



alternative friction part



length L and threaded part of the screw b											
Dim. 4.0		Dim. 4.5		Dim. 5.0		Dim. 6.0		Dim. 8.0		Dim. 10.0	
L	b	L	b	L	b	L	b	L	b	L	b
30-35	20	30-35	20	30-35	20	50	30	50	30	60-70	40
40-45	25	40-45	25	40	25	60-70	40	60-70	40	80	50
50	30	50-55	30	50	30	80-90	50	80-90	50	100	60
60-70	35	60-80	40	60-70	40	100-110	60	100	60	120-160	80
				80-90	50	120-300	70	120-160	80	180-500	100
				100-120	60			180-500	100		

threaded part of the screw b = b_{min}
b_{max} (fully threaded screw) = L – k1

Simpson Strong-Tie® screws

SIMPSON Strong-Tie®

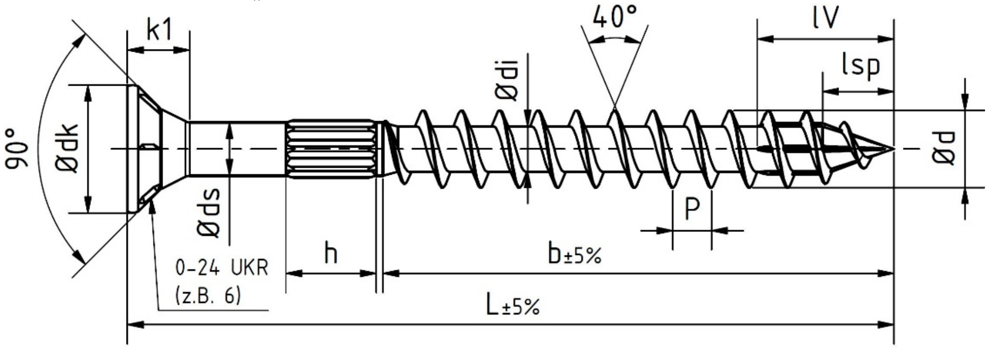
ESCRS, ESCRSW, ESCRHD/HRD and ESCRH/ESCRH-S

Annex 2

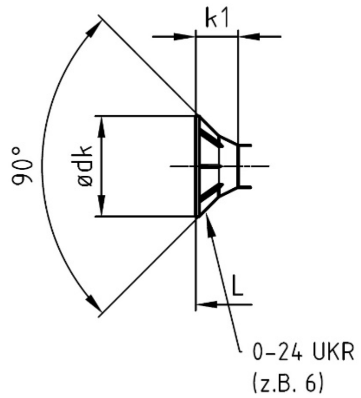
of European Technical Assessment ETA-13/0796 of 16.02.2022

OIB Member of EOTA

Countersunk head „ESCRS“

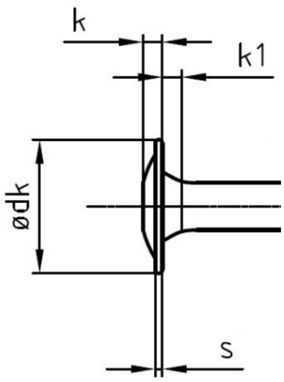


Countersunk head with UKR (cutter ribs)

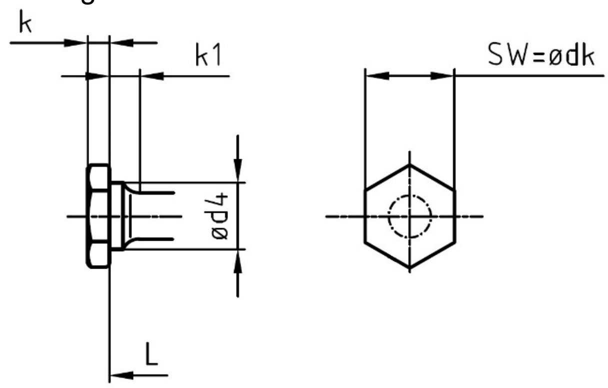


Dim	Ødk	k1	Øds	Ød	Ødi	P	lsp	Ødn	ØdR	h	ØdV	lV
12,0	21,0 ±2.00	10,0 ±1.00	8,2 ±0.41	12,0 ±0.70	7,00 ±0.35	6,0 ±0.60	11,2 ±2.6	9,6 ±0.96	9,0 ±0.9	14,2 ±1.0	8,3 ±0.83	20,0 ±1.0

Washer head „ESCRSW“



Kombi hexagonal head with thick shaft “ESCRHD/HRD”



Dim	Ødk	k	k1	s
12,0	27,0 ±2.00	4,7 ±1.2	3,0 ±1.6	2,5 ±0.9

Dim	SW=Ødk	k	k1	Ød4
12,0	17,0 -0,85	5,5 ±1.3	10,0 ±2.0	12,0 ±1.20

Simpson Strong-Tie® screws

SIMPSON Strong-Tie®

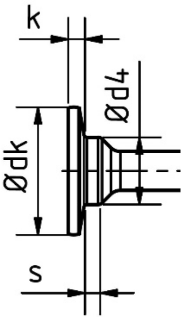
ESCRS, ESCRSW, ESCRHD/HRD and ESCRH/ESCRH-S with d = 12 mm

Annex 3

of European Technical Assessment ETA-13/0796 of 16.02.2022

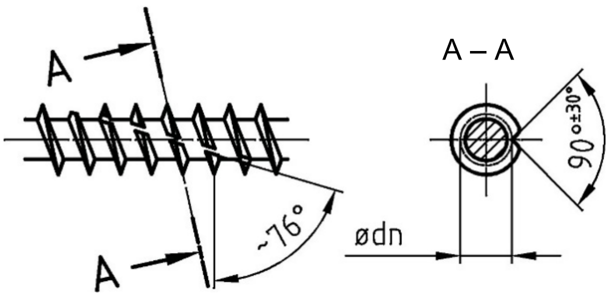
Member of EOTA

Washer head „ESCRH/ESCRH-S“

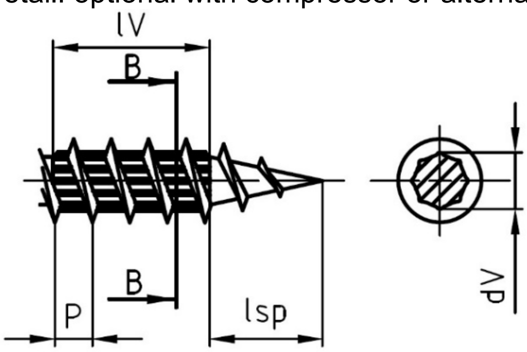


Dim	Ødk	k	s	Ød4
12,0	26,0 ±2.50	3,0 ±1.0	3,0 ±1.0	13,0 ±0.65

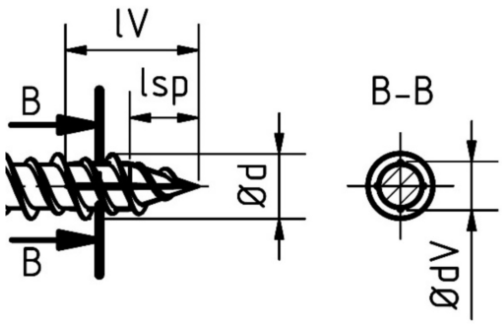
Detail: cutting groove (alternative without cutting groove)



Detail: optional with compressor or alternative compressor



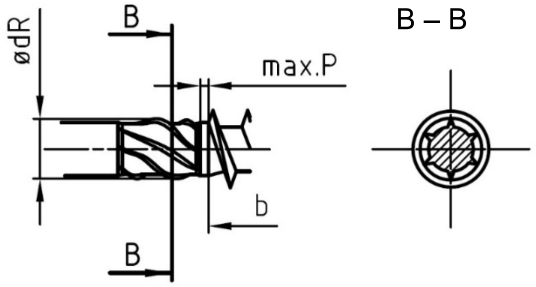
Number of flanks: 4 – 8 lV = 2P to 4P (1P for L ≤ 100)



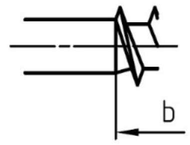
Simpson Strong-Tie® screws SIMPSON Strong-Tie®	Annex 3 of European Technical Assessment ETA-13/0796 of 16.02.2022
ESCRS, ESCRSW, ESCRHD/HRD and ESCRH/ESCRH-S with d = 12 mm	

Member of EOTA

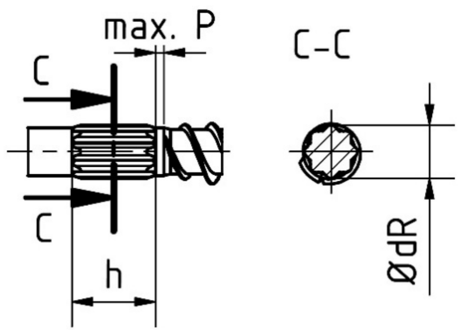
Detail: friction part



alternative without friction part



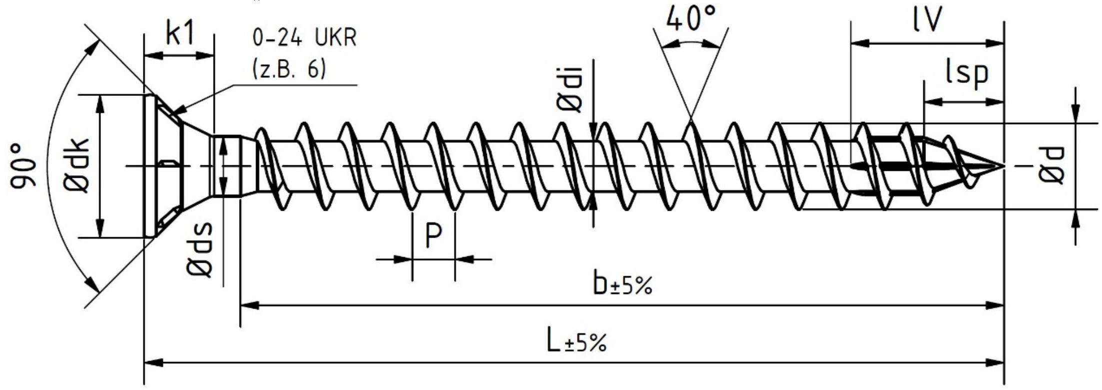
alternative friction part



length L and threaded part of the screw b	
Dim. 12.0	
L	b
80	50
100	60
120-160	80
180-280	100
300-500	120

Simpson Strong-Tie® screws SIMPSON Strong-Tie®	Annex 3 of European Technical Assessment ETA-13/0796 of 16.02.2022
ESCRS, ESCRSW, ESCRHD/HRD and ESCRH/ESCRH-S with d = 12 mm	

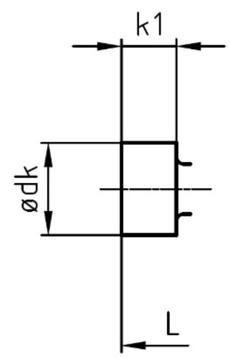
Countersunk head „ESCRFTC/ESCRFTC S“



UKR … cutter ribs

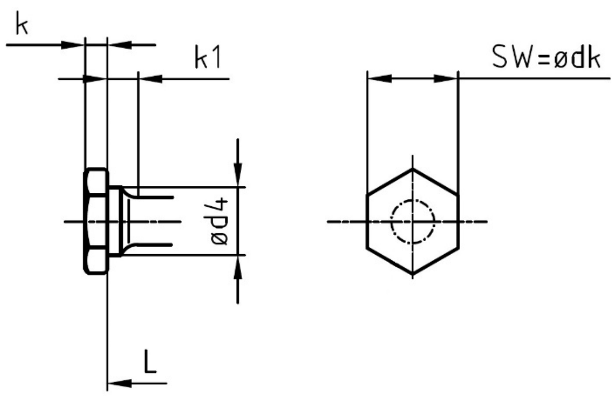
Dim	Ødk	k1	Øds	Ød	Ødi	P	lsp	Ødn	ØdV	a
6,0	12,0 ±0.90	5,5 ±0.55	4,3 ±0.21	6,0 ±0.35	3,80 ±0.19	2,6 ±0.26	7,3 ±1.9	5,3 ±0.53	4,4 ±0.44	8,5 ±2.0
8,0	15,0 ±1.20	7,0 ±0.70	5,9 ±0.29	8,0 ±0.40	5,10 ±0.26	4,0 ±0.40	8,2 ±2.1	7,3 ±0.73	5,8 ±0.58	11,0 ±2.5
10,0	18,5 ±1.50	9,0 ±0.90	7,1 ±0.35	10,0 ±0.60	6,30 ±0.32	4,6 ±0.46	10,1 ±2.3	8,7 ±0.87	7,3 ±0.73	13,0 ±3.0
12,0	21,0 ±2.00	10,0 ±1.00	8,2 ±0.41	12,0 ±0.70	7,00 ±0.35	6,0 ±0.60	11,2 ±2.6	9,6 ±0.96	8,3 ±0.83	15,0 ±3.0
16,0	26,0 ±2.50	11,0 ±1.10	11,5 ±0.58	15,5 ±0.80	10,70 ±0.53	8,0 ±0.80	15,0 ±3.5	13,0 ±1.30	11,8 ±1.20	16,0 ±3.0

Cylinder head „ESCRFT/ESCRFT S“
„ESCRFTZ/ESCRFTZ S“



Dim	Ødk	k1
6,0	8,2 ±0.40	4,7 ±0.8
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

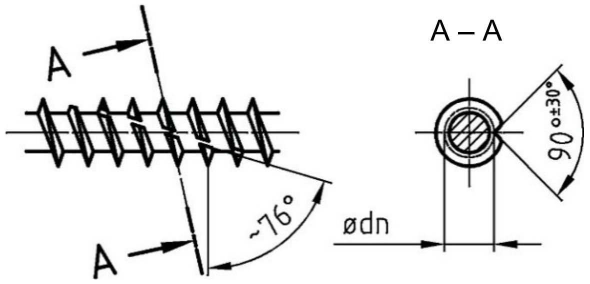
Kombi hexagonal head with thick shaft „SSTA“



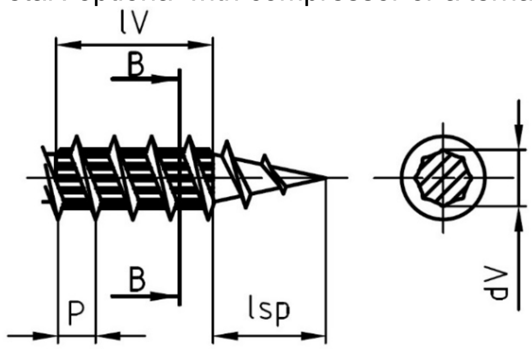
Dim	SW=Ødk	k	k1	Ød4
6,0	9,0 -0,45	3,0 ±1.3	4,7 ±1.0	6,0 ±0.60
8,0	12,0 -0,60	4,5 ±1.3	6,3 ±1.0	8,0 ±0.80
10,0	15,0 -0,75	5,0 ±1.3	8,0 ±1.5	10,0 ±1.00
12,0	17,0 -0,85	5,5 ±1.3	10,0 ±2.0	12,0 ±1.20
16,0	22,0 -1,10	8,0 ±1.3	12,0 ±2.4	16,0 ±1.60

Simpson Strong-Tie® screws	Annex 4 of European Technical Assessment ETA-13/0796 of 16.02.2022
ESCRFT/ESCRFT-S, ESCRFTZ/ESCRFTZ-S, ESCRFTC/ESCRFTC-S and SSTA	

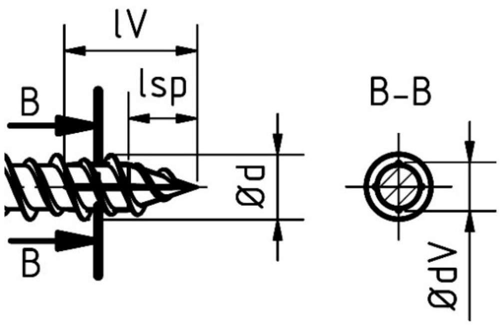
Detail: optional with cutting groove



Detail: optional with compressor or alternative compressor



Number of flanks: 4 – 8 lV = 2P to 4P (1P for L ≤ 100)

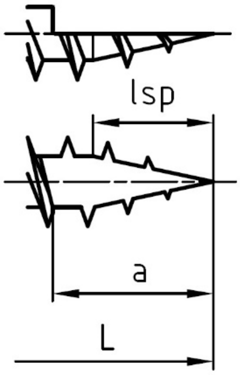


Simpson Strong-Tie® screws SIMPSON Strong-Tie	Annex 4 of European Technical Assessment ETA-13/0796 of 16.02.2022
ESCRFT/ESCRFT-S, ESCRFTZ/ESCRFTZ-S, ESCRFTC/ESCRFTC-S and SSTA	

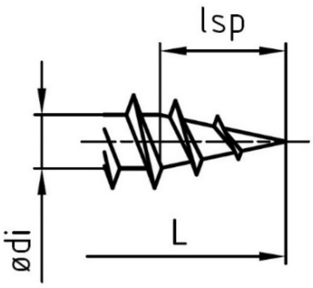
Member of EOTA

Alternative point types

Half cut



Regular point



Regular point for Dim. 6.0 only

length L and threaded part of the screw b									
Dim. 6.0		Dim. 8.0		Dim. 10.0		Dim. 12.0		Dim. 16.0	
L	b	L	b	L	b	L	b	L	b
80-220	L-7	50-400	L-10	50-300	L-12	60-300	L-20	200-300	L-20
		>400	L-23	>300	L-24	>300	L-25	>300	L-25

threaded part of the screw b:
$b_{max} = L - k1$

Simpson Strong-Tie® screws

SIMPSON Strong-Tie®

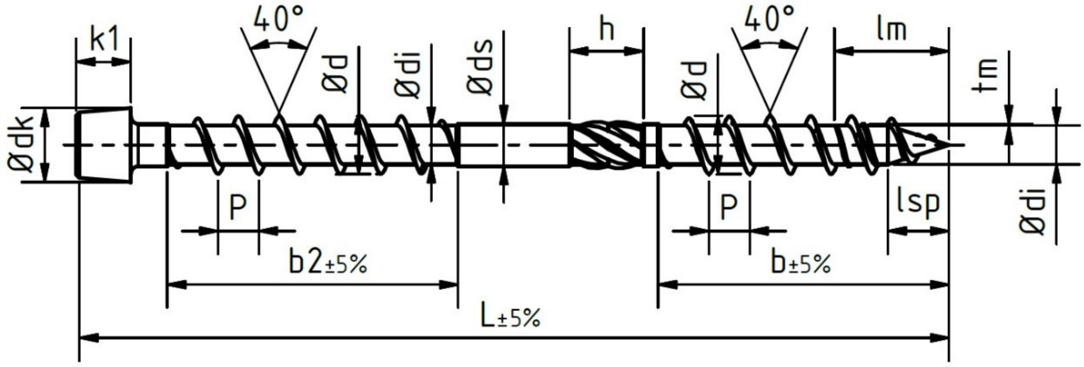
ESCRFT/ESCRFT-S, ESCRFTZ/ESCRFTZ-S, ESCRFTC/ESCRFTC-S and SSTA

Annex 4

of European Technical Assessment ETA-13/0796 of 16.02.2022

OIB Member of EOTA

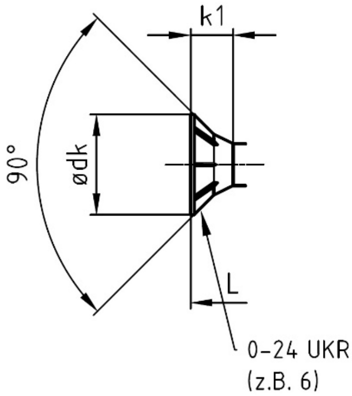
Cylinder head „ESCRT2R/ESCRT2R-S“



Dim	Ødk	k1	Øds	Ød	Ødi	P	lsp	Ødn	ØdR	h	tm
8,0	10,2 ±0.51	7,5 ±1.0	5,9 ±0.29	8,0 ±0.40	5,30 ±0.26	5,6 ±0.56	8,2 ±2.1	7,2 ±0.72	6,8 ±0.6	10,2 ±1.0	0,60 ±0.12

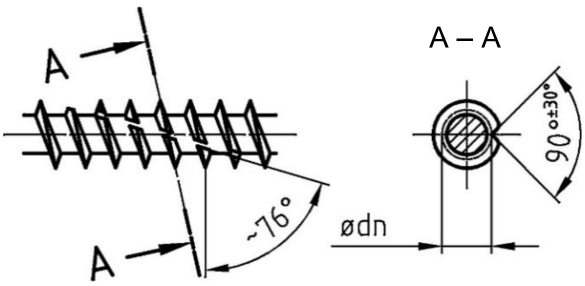
lm = lsp + 1.0 P

alternative Countersunk head with UKR (cutter ribs)



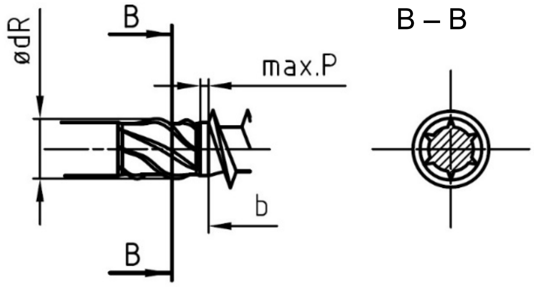
Dim	Ødk	k1
8,0	15,0 ±1.20	7,0 ±0.70

Detail: cutting groove (alternative without cutting groove)

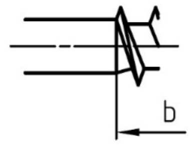


Simpson Strong-Tie® screws SIMPSON Strong-Tie ESCRT2R/ESCRT2R-S	Annex 5 of European Technical Assessment ETA-13/0796 of 16.02.2022

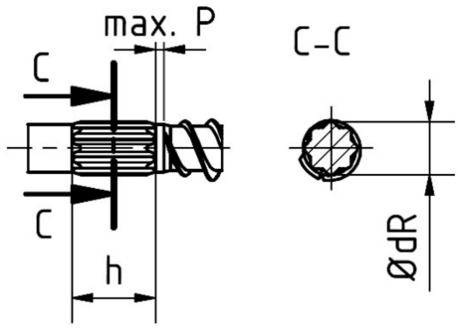
Detail: friction part



alternative without friction part



alternative friction part



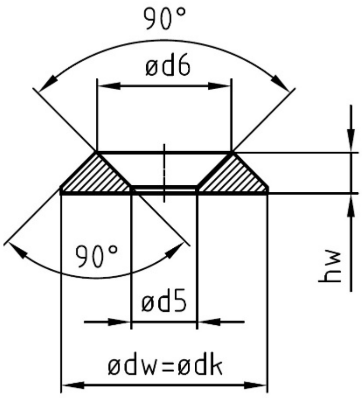
length L and threaded part of the screw b		
Dim. 8.0		
L	b	b2
120	40	40
200	60	60
220-240	80	80
260-600	100	80

threaded part of the screw b / b2 = b_{min}

Simpson Strong-Tie® screws SIMPSON Strong-Tie®	Annex 5 of European Technical Assessment ETA-13/0796 of 16.02.2022
ESCRT2R/ESCRT2R-S	

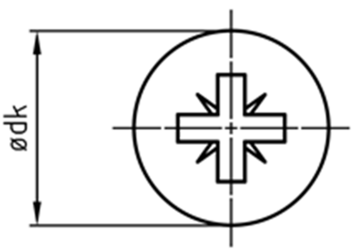
OIB
Member of EOTA

Washer (for screws with 90° head, only)

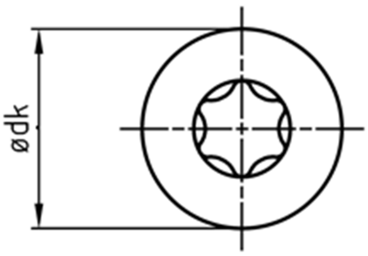


Dim	Ødw=Ødk	Ød6	Ød5	hw
6.0	22.0 ±2.0	14.5 ±1.5	8.5 ±1.0	4.5 ±1.0
8.0	28.0 ±2.0	19.0 ±1.9	10.0 ±2.0	6.0 ±1.0
10.0	35.0 ±3.0	22.5 ±2.2	12.0 ±2.0	7.0 ±1.0
12.0	42.0 ±3.0	25.0 ±2.5	14.0 ±2.0	7.5 ±1.0

KS-Drive



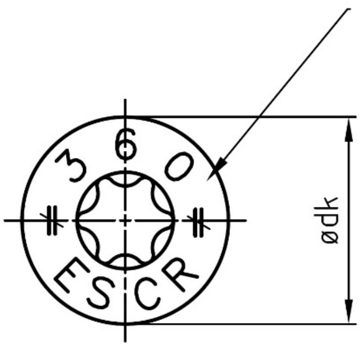
T-Drive



Dim	KS	T
4.0	KS 2	T10 / T15 / T20
4.5	KS 2	T15 / T20 / T25
5.0	KS 2	T20 / T25 / T30
6.0	KS 3	T20 / T25 / T30
7.0	KS 3	T25 / T30
8.0	KS 4	T30 / T40
10.0	KS 4	T40 / T50
12.0	KS 4	T40 / T50 / T55
16.0	KS 4	T50 / T55 / T60

head labelling optional

e.g.: supplier code, screw type and length



Simpson Strong-Tie® screws SIMPSON Strong-Tie®	Annex 6 of European Technical Assessment ETA-13/0796 of 16.02.2022
Drive types and head labeling	

The characteristic load bearing capacities in Tables A7.1 to A7.5 are given for timber of strength class C24 according to EN 338 (ρ_k = 350 kg/m³) unless specified otherwise in the following. 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

ρ_k Characteristic density of timber in kg/m³

For the characteristic withdrawal parameter the correction according to A.7.1.3 applies.

Table A7.1: Characteristic head pull-through capacities of Simpson Strong-Tie® screws in structural timber for 90° heads; head diameter 8 to 21 mm

Group 1			Head diameter (90° heads) [1)]							
Product characteristic			8	9	10	12	14	15	18.5	21
Characteristic head pull-through parameter (ρ_k = 350 kg/m³)	$f_{head,k}$	N/mm²	17.1	17.6	14.6	14.6	13.1	12.4	12.2	10.3

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

Table A7.2: Characteristic head pull-through capacities of Simpson Strong-Tie® screws in structural timber for washers and 180° heads; (head) diameter 13 to 42 mm

Group 2			Head diameter (180° heads) [1)]							
Product characteristic			13	14	20	22	25	27	33	42
Characteristic head pull-through parameter (ρ_k = 350 kg/m³)	$f_{head,k}$	N/mm²	-	16.7	17.6	20.4	15.2	14.5	10.0	6.5
	$f_{head,k}$ head “N”		19.7	-	23.5	14.6	-	-	-	-

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

Member of EOTA

Table A7.3: Characteristic load bearing capacities of Simpson Strong-Tie® screws ESCRFTC/ ESCRFTC S, ESCRFT/ESCRFT S, ESCRFTZ/ ESCRFTZ S and SSTA; screw diameter 6 to 16 mm

Product characteristic				Screw diameter [1]				
				6	8	10	12	16
Max. length	carbon steel	l_{max}	mm	220	1000	1000	1000	500
	stainless steel			-	300	510	-	-
Characteristic tensile strength	carbon steel	$f_{tens.k}$	kN	12.5	24.1	40.0	46.7 45.0 [3]	88.6
	stainless steel			-	13.8	18.6	-	-
Characteristic yield moment	carbon steel	$M_{y.k}$	Nm	10.0	20.3	36.7	48.5	112.9
	stainless steel			-	14.2	-	-	-
Characteristic withdrawal parameter angle screw-axis to grain: 90° (ρ_k = 350 kg/m³)		$f_{ax.k.90°}$	N/mm²	13.5	13.1	12.5	11.2	11.0
Characteristic yield strength		$f_{y.k}$	N/mm²	950 (carbon steel) 657 (stainless steel)				
Characteristic torsional strength	carbon steel	$f_{tor.k}$	Nm	10.5	25.8	55.0	73.0	194.7
	stainless steel			-	17.5	28.6	-	-
Ratio characteristic torsional strength to mean insertion moment	carbon steel ρ_k = 450 kg/m³ ρ_k = 480 kg/m³	$f_{tor.k}$ / $R_{tor.m}$	-	≥ 1.5 -	≥ 1.5 -	≥ 1.5 -	≥ 1.5 -	- ≥ 1.5
	stainless steel ρ_k = 480 kg/m³ ρ_k = 534 kg/m³ [2]			- -	≥ 1.5 -	≥ 1.5 ≥ 1.5 [2]	- -	- -
Slip modulus		K_{ser}	N/mm	see A.7.1.6				

[1] For intermediate screw diameters the conservative value of the next screw diameter may be used.
[2] Max. screw length is 440 mm.
[3] SSTA.

Simpson Strong-Tie® screws SIMPSON Strong-Tie® Characteristic data of the screws	Annex 7 of European Technical Assessment ETA-13/0796 of 16.02.2022

Table A7.4: Characteristic load bearing capacities of Simpson Strong-Tie® screws ESCRS, ESCRSW, ESCRHD/HRD and ESCRH/ESCRH-S; screw diameter 4 to 12 mm

Product characteristic				Screw diameter [1]						
				4	4.5	5	6	8	10	12
Max. length	carbon steel	l_{max}	mm	70	80	120	300	500	500	500
	stainless steel			-	-	-	-	440	450	-
Characteristic tensile strength	carbon steel	$f_{tens.k}$	kN	5.0	7.0	8.8	13.1	23.3	35.0	42.0
	stainless steel			-	-	-	-	13.6	21.3	-
Characteristic yield moment	carbon steel	$M_{y.k}$	Nm	3.1	4.2	5.9	10.7	22.6	33.6	46.9
	stainless steel			-	-	-	-	-	-	-
Characteristic withdrawal parameter angle screw-axis to grain: 90° (ρ_k = 350 kg/m³)		$f_{ax.k.90°}$	N/mm²	14.3	13.3	13.6	13.0	10.9	11.0	11.2 [2]
Characteristic yield strength		$f_{y.k}$	N/mm²	900 (carbon steel) 640 (stainless steel)						
Characteristic torsional strength	carbon steel	$f_{tor.k}$	Nm	3.5	4.9	6.6	10.9	28.0	52.5	59.6
	stainless steel			-	-	-	-	18.7	33.1	-
Ratio characteristic torsional strength to mean insertion moment	carbon steel ρ_k = 450 kg/m³	$f_{tor.k}$ / $R_{tor.m}$	-	≥ 1.5						
	stainless steel ρ_k = 480 kg/m³			-	-	-	-	≥ 1.5		-

[1] For intermediate screw diameters the conservative value of the next screw diameter may be used.
[2] Single thread and compressor.

Table A7.5: Characteristic load bearing capacities of Simpson Strong-Tie® screws ESCRC/ESCRC S, ESCR/ESCR S and ESCRT2R/ ESCRT2R S; screw diameter 4 to 10 mm

Product characteristic				Screw diameter [1)]					
				4	4.5	5	6	8	10
Max. length	carbon steel	l_{max}	mm	70	80	120	300	500	500
	stainless steel			-	-	-	-	240	-
Characteristic tensile strength	carbon steel	$f_{tens,k}$	kN	5.0	5.8	8.5	12.4	22.0	32.0
	stainless steel			-	-	-	-	16.0	-
Characteristic yield moment	carbon steel	$M_{y,k}$	Nm	3.2	4.9	6.5	10.1	22.6	33.0
	stainless steel			-	-	-	-	16.6	-
Characteristic withdrawal parameter angle screw-axis to grain: 90° (ρ_k = 350 kg/m³)		$f_{ax,k,90°}$	N/mm²	14.8	13.8	12.8	12.1	10.7	9.5
Characteristic yield strength		$f_{y,k}$	N/mm²	900 (carbon steel) 735 (stainless steel)					
Characteristic torsional strength	carbon steel	$f_{tor,k}$	Nm	3.0	4.2	6.2	9.5	24.8	44.8
	stainless steel			-	-	-	-	18.8	-
Ratio characteristic torsional strength to mean insertion moment	carbon steel ρ_k = 450 kg/m³	$f_{tor.k}$ / $R_{tor.m}$	-	≥ 1.5					
	stainless steel ρ_k = 480 kg/m³			-	-	-	-	≥ 1.5	-

[1)] For intermediate screw diameters the conservative value of the next screw diameter may be used.

Simpson Strong-Tie® screws SIMPSON Strong-Tie®	Annex 7 of European Technical Assessment ETA-13/0796 of 16.02.2022
Characteristic data of the screws	

A.7.1 Axially loaded screws

A.7.1.1 General

For verification of the load bearing capacity of axially loaded Simpson Strong-Tie® screws the failure mechanisms according to EN 1995-1-1 as well as the minimum thicknesses, spacings and distances according to A.7.1.2 must be taken into account.

Alternative to EN 1995-1-1 the effective number of inclined Simpson Strong-Tie® 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

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.7.1.2 Spacing, end and edge distances of the screws and minimum thicknesses

For Simpson Strong-Tie® screws with d ≤ 8 mm or provided with a half cut or drill point which are loaded only axially, the minimum spacing, end and edge distances according to Table 7.6 apply for a minimum timber thickness of t = 12 d in non-predrilled holes. Table 7.6 is not valid for cross laminated timber.

Table A7.6: Minimum spacing, end and edge distances of only axially loaded Simpson Strong-Tie® 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*)	5 *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 plane surface or 10 d in the edge surface are met, the minimum spacings, end and edge distances given in Table A7.7 apply.

Tabelle A7.7: Minimum spacings, end and edge distances of Simpson Strong-Tie® screws in cross laminated timber

	a_1	$a_{3,t}$	$a_{3,c}$	a_2	$a_{4,t}$	$a_{4,c}$
Plane surface (see Figure A7.1)	4 *d*	6 *d*	6 *d*	2.5 *d*	6 *d*	2.5 *d*
Edge surface (see Figure A7.1)	10 *d*	12 *d*	7 *d*	3 *d*	5 *d*	3 *d*

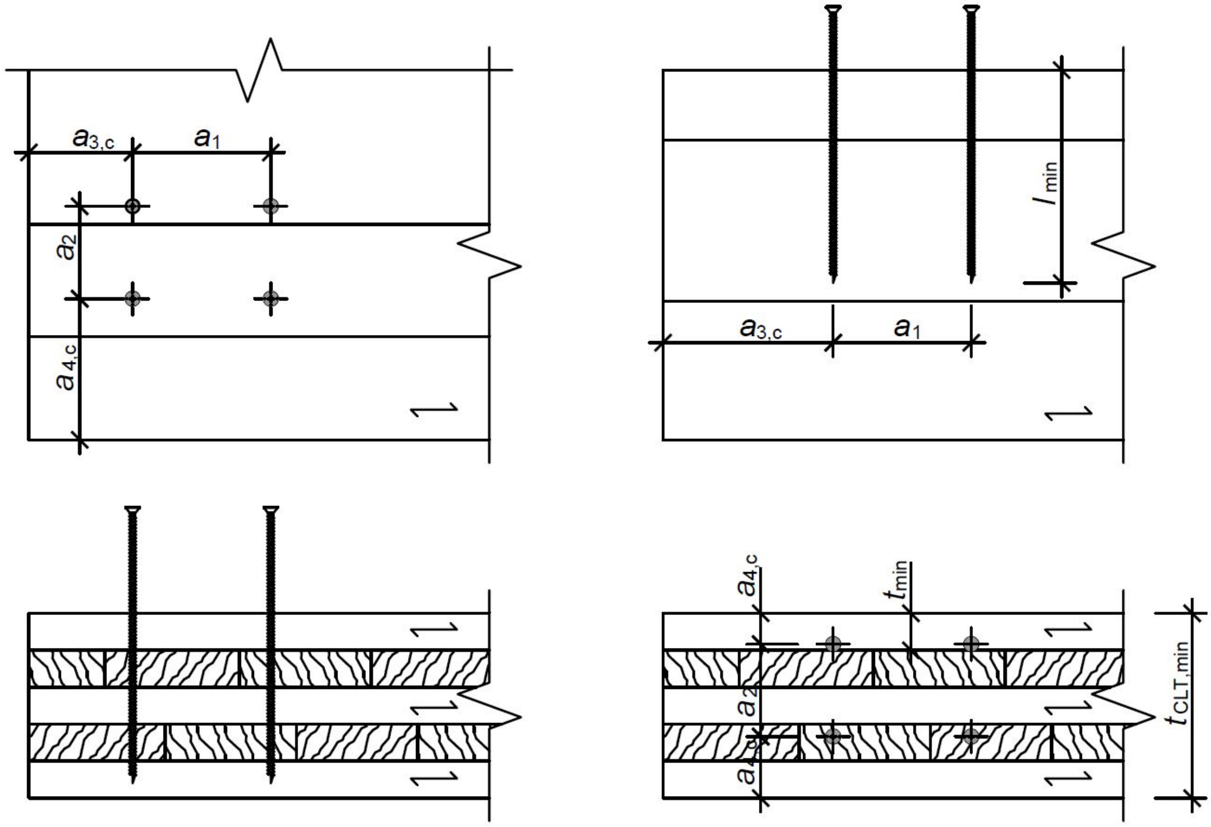
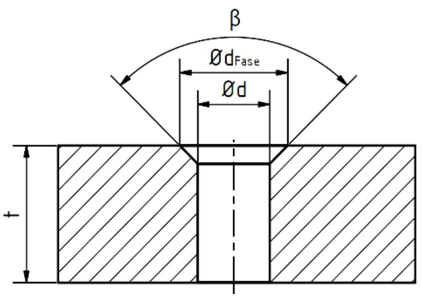


Figure A7.1: Definition of minimum spacings, end and edge distances in the plane surface (left) and edge surface (right) of cross laminated timber

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. 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 A.7.2. The diameter d of the drilling must be greater than the diameter of the screw.



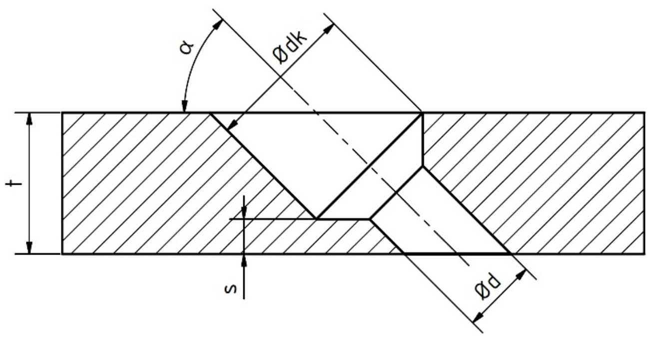
$d_{Fase} = d \cdot 1.5$ in mm

d = diameter of the drilling in mm

d_{Fase} = diameter of the chamfer in mm

Figure A7.2: Drilling of Simpson Strong-Tie® 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 A7.3 is required.



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

Figure A7.3: Inclined drilling of Simpson Strong-Tie® screws with countersunk head in metal members

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

Simpson Strong-Tie® screws SIMPSON Strong-Tie®	Annex 7 of European Technical Assessment ETA-13/0796 of 16.02.2022
Characteristic data of the screws	

A.7.1.3 Characteristic withdrawal parameter

The characteristic withdrawal parameter for Simpson Strong-Tie® screws for angles $0° \le \alpha \le 90°$ between screw-axis and direction of wood-fibre may be calculated as

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

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

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

$$k_{sys} = \begin{cases} 1.00 & \text{other} \\ 1.10 & \text{for edges in CLT; } n \ge 3 \text{ layers} \\ 1.13 & \text{for edges in GLT; } n \ge 5 \text{ layers} \end{cases}$$ see Figure A7.1

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

$f_{ax,k,90}$ characteristic withdrawal parameter according to Tables 7.3 to 7.5 in N/mm²

$\rho_{ref,k}$ reference characteristic density of timber in kg/m³

ρ_k characteristic density of timber in kg/m³

n number of layers screwed through

A.7.1.4 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 A.7.8.

Table A7.8: 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 A.7.9 apply.

Table A7.9 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.7.1.5 Compressive loading for fully threaded screws

The design load carrying capacity for Simpson Strong-Tie® screws with a full thread for an angle 30° ≤ α ≤ 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.7.1.3 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

γ_M partial safety factor for connections according to EN 1995-1-1

γ_{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 / shank diameter d_s 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 Simpson Strong-Tie® screws in N/mm² according to Table A7.3 to A7.5

$N_{ki,k}$ 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 Simpson Strong-Tie® 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 Simpson Strong-Tie® screws in N/mm², E_s = 210 000 N/mm²

I_s area moment of inertia of Simpson Strong-Tie® screws in mm⁴

ρ_k characteristic density of the wood-based member in kg/m³

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

A.7.1.6 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 α 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 A7.10

Table A7.10: Coefficient k_{HA} depending on the type of wood of the wood-based member

Type of wood	Reference density ρ_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 A7.10 apply to Simpson Strong-Tie® screws installed with or without pre-drilling, provided that the pre-drilling diameter does not exceed 75% of the outer thread diameter.

A.7.2 Laterally loaded screws (perpendicular to the screw axis)

A.7.2.1 General

For verification of the load bearing capacity of laterally loaded Simpson Strong-Tie® screws the failure mechanisms according to EN 1995-1-1 as well as the minimum thicknesses, spacings and distances according to A.7.2.2 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 Simpson Strong-Tie® 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 ≥ 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.9.2.3.

A.7.2.2 Spacing, end and edge distances of the screws and minimum thicknesses

For Simpson Strong-Tie® screws which are loaded only laterally, the minimum spacing, end and edge distances according to Table 7.11 apply.

Table A7.11: Minimum spacing, end and edge distances of only laterally loaded Simpson Strong-Tie® screws

Type	Spacing/distances
Predrilled wooden members Simpson Strong-Tie® screws with drill tip in non-predrilled holes of softwood members	Analogous to pre-drilled nails according to EN 1995-1-1
Non-predrilled wooden members with Simpson Strong-Tie® screws without drill tip	Analogous to non-predrilled nails according to EN 1995-1-1

NOTES:

1) For screws with outer thread diameter d ≥ 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 Simpson Strong-Tie® screws in plane surfaces and edge surfaces of cross laminated timber are given in Table A7.7.

The minimum thickness for structural members shall be in accordance with Table A7.12.

Table A7.12: Minimum thickness for structural members for laterally loaded Simpson Strong-Tie® screws d ≤ 12 mm

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

A.7.2.3 Characteristic embedment strength

EN 1995-1-1 applies for the embedment strength of Simpson Strong-Tie® screws in wooden members unless specified otherwise below.

The characteristic embedment strength of Simpson Strong-Tie® screws installed in non-predrilled wooden members of solid wood, glued laminated timber, glued solid timber or solid wood panels may be determined as follows for angles 0° ≤ α ≤ 90° between screw axis and grain direction:

$$f_{h,k} = \frac{0.082 \cdot \rho_k \cdot d^{-0.3}}{2.5\cos^2\alpha + \sin^2\alpha} \text{ in N/mm}^2$$

ρ_k characteristic density of the wooden member in kg/m³

d outer thread diameter of the screw in mm

The characteristic embedment strength of Simpson Strong-Tie® screws installed in predrilled wooden members of solid wood, glued laminated timber, glued solid timber or solid wood panels may be determined as follows for angles 0° ≤ α ≤ 90° between screw axis and grain direction:

$$f_{h,k} = \frac{0.082 \cdot \rho_k \cdot (1 - 0.01\,d)}{2.5\cos^2\alpha + \sin^2\alpha} \text{ in N/mm}^2$$

The Equations above may be applied for Simpson Strong-Tie® 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, ρ_k is the characteristic density of the cover layer.

The characteristic embedment strength of Simpson Strong-Tie® screws in the edge surface 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.7.2.4 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 α to the grain as

$K_{ser,V} = k_V \cdot d_{ef}^{1.7}$ in N/mm²

with

d_{ef} effective screw diameter in mm
for a minimum distance of 4 d between thread and shear joint $d_{ef} = d_s$
otherwise $d_{ef} = 1.1 \cdot d_i$

k_V coefficient depending on the direction of load on the type of the connection and the predrilling according to Table A7.13

Table A7.13: 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 $K_{ser,v,0}$	60	120	$3 \cdot \rho_k^{0.5}$	$6 \cdot \rho_k^{0.5}$
Perpendicular to the direction of the grain $K_{ser,v,90}$	30	60	$1.5 \cdot \rho_k^{0.5}$	$3 \cdot \rho_k^{0.5}$

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 ρ_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.7.3 Combined loading (perpendicular to and in direction of the screw axis)

Verification of Simpson Strong-Tie® 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

NOTE:

1) For Simpson Strong-Tie® screws loaded in axial as well as in lateral direction the part of the rope effects shall be neglected for the determination of $F_{V,Rd}$

A.8 Simpson Strong-Tie® screws in selected steel-wood and wood-wood connections

A.8.1 Steel-wood connections

Design for equally tightened screws (torque controlled) in a steel member under an angle 30° ≤ α ≤ 45° may follow:

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

with

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

where:

$F_{\alpha,Rd}$	load bearing capacity of inclined screws in N
n_{ef}	effective number of screws according to A.7.1.1
k_{mod}	modification factor for duration of load and moisture content according to EN 1995-1-1
γ_M	partial safety factor for connections according to EN 1995-1-1
γ_{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 Simpson Strong-Tie® screws is shown in Figure A8.1.
3) For arrangement of the Simpson Strong-Tie® screws perpendicular to the grain verification shall follow Clause A.7.2.
4) For combined loading (more than one loading component to be transferred by the screwed joint) the regulations according to A7.3 shall be considered.

Figure A8.1 shows an example of metal-to-timber connection with inclined Simpson Strong-Tie® screws located in the end-grain or in side-grain.

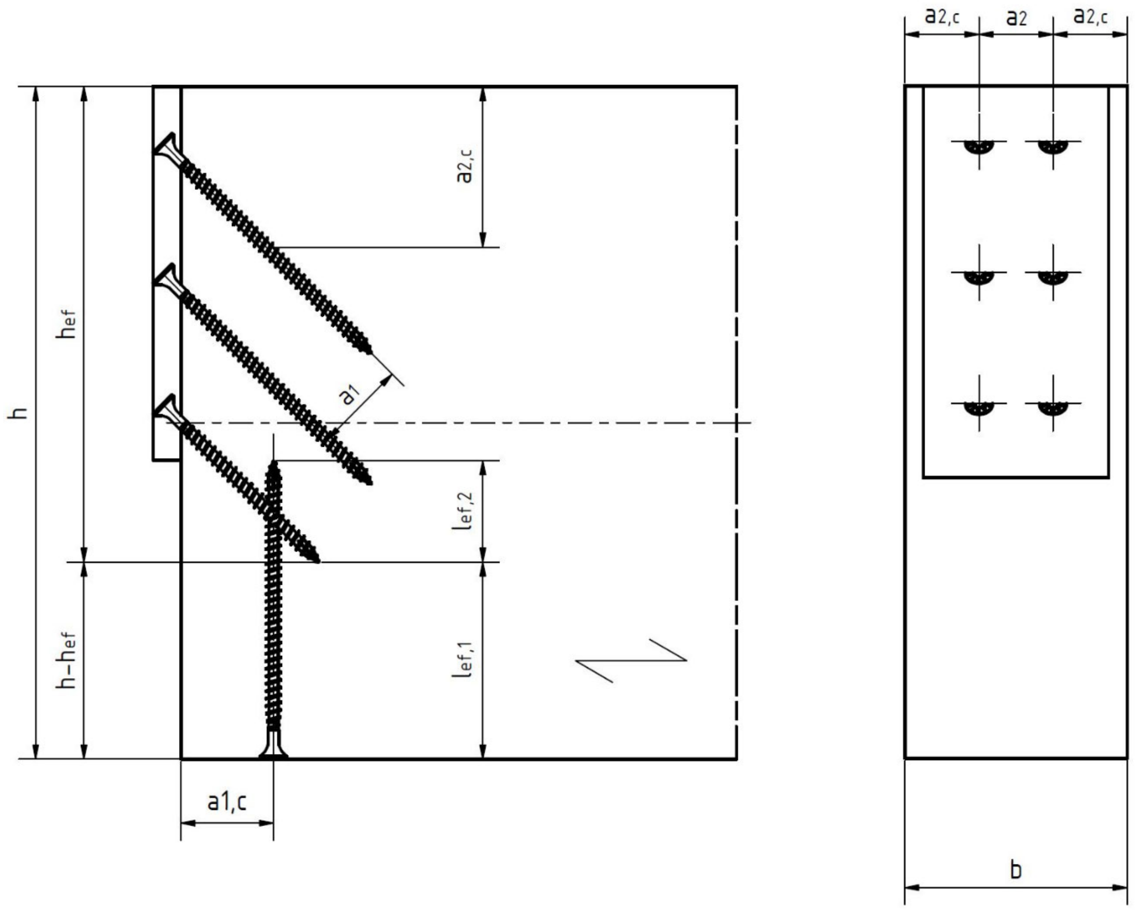


Figure A8.1: Example of metal-to-timber connection with inclined Simpson Strong-Tie® screws located in the end-grain or in side-grain

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 30° ≤ α ≤ 90°.

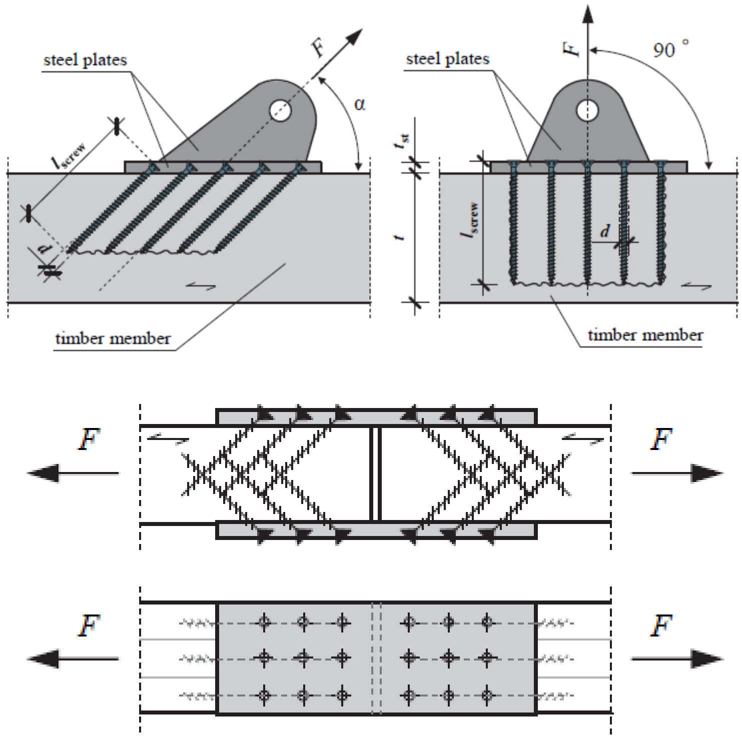


Figure A8.2: Example of metal-to-timber connection with inclined Simpson Strong-Tie® screws and Simpson Strong-Tie® screws arranged perpendicular to the grain

A.9 Simpson Strong-Tie® screws for reinforcement of timber members for timber members loaded perpendicular to the grain and shear

A.9.1 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.7.1.5 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
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
$a_{1,c}$	end distance of the centre of gravity of the threaded part in the timber member in mm
a_1	spacing of Simpson Strong-Tie® screws in a plane parallel to the grain and screw axis
γ_{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.

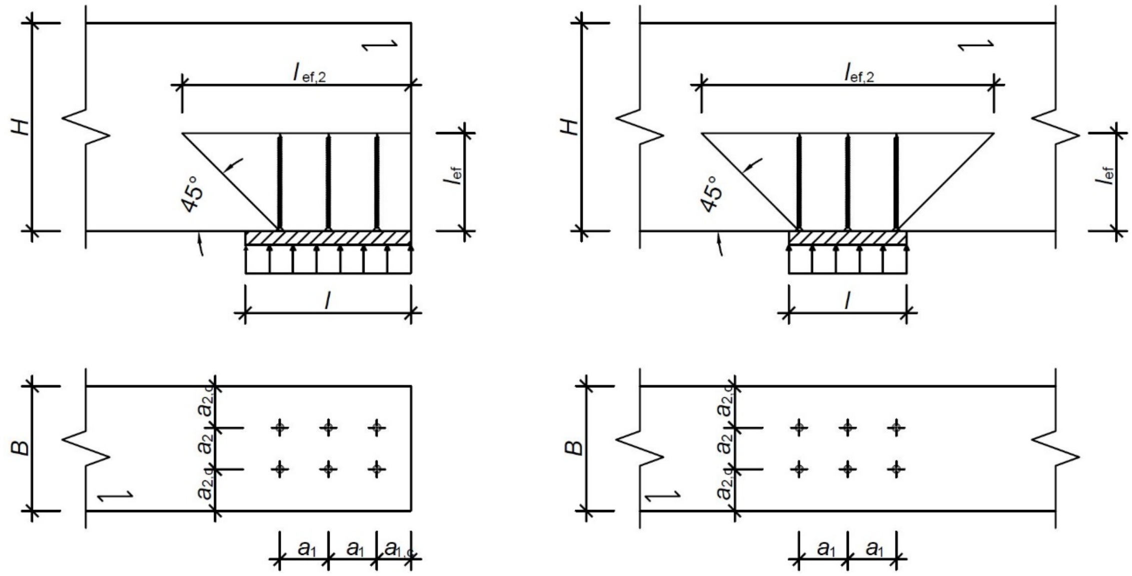


Figure A9.1: Reinforcement of timber members loaded in compression perpendicular to the grain: end support (left) intermediate support (right)

For both sided reinforcement of timber members loaded in compression perpendicular to the grain for load transfer (see Figure A9.2) 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 A7.1.2 must be observed. The overlap l_{lap} of the reinforcement screw threads should be at least 10 d.

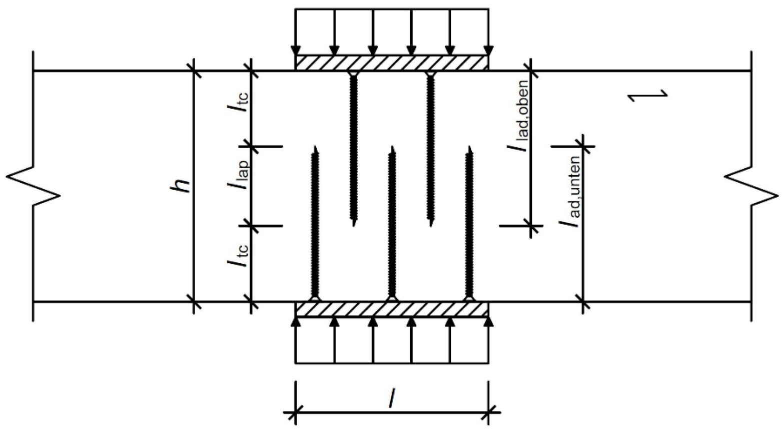


Figure A9.2: Reinforcement of timber members loaded in compression perpendicular to the grain for load transfer

A.9.2 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.9.2.1 Tension reinforcement for transverse connections and notches

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

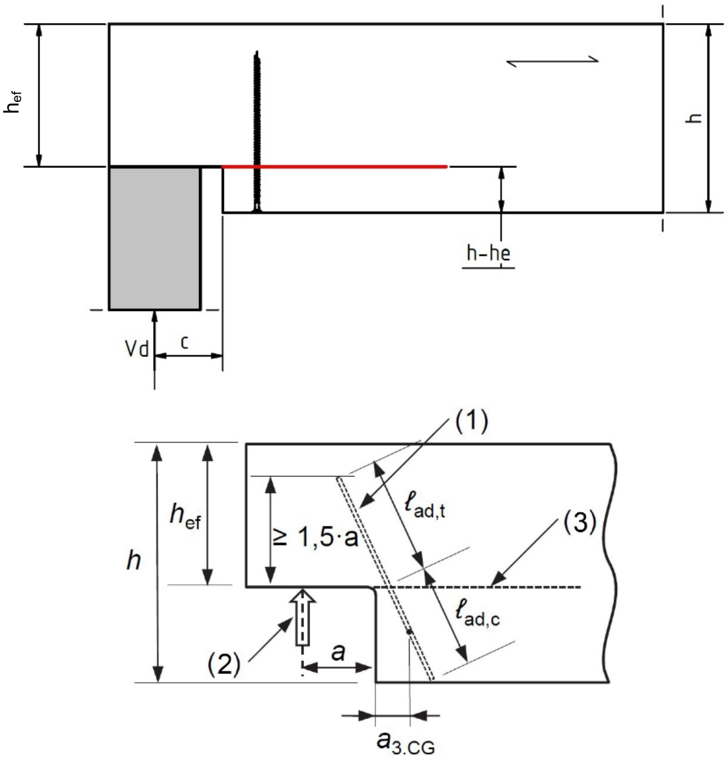
$$1.3 \cdot V_d \cdot \left[1 - 3 \cdot \left(\frac{h_{ef}}{h}\right)^2 + 2 \cdot \left(\frac{h_{ef}}{h}\right)^3\right] \leq F_{ax,Rd}$$ for notches

$$F_{90,Ed} \cdot \left[1 - 3 \cdot \left(\frac{a}{h}\right)^2 + 2 \cdot \left(\frac{a}{h}\right)^3\right] \leq F_{ax,Rd}$$ 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 A9.3 and A9.4

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
a	distance of the furthermost fastener of the transverse connection from the loaded edge of the wooden member 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
γ_M	partial safety factor for connections according to EN 1995-1-1, Table 2.3
γ_{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)



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

Figure A9.3: Reinforcement of notches with screws arranged under an angle of 90° or inclined screws

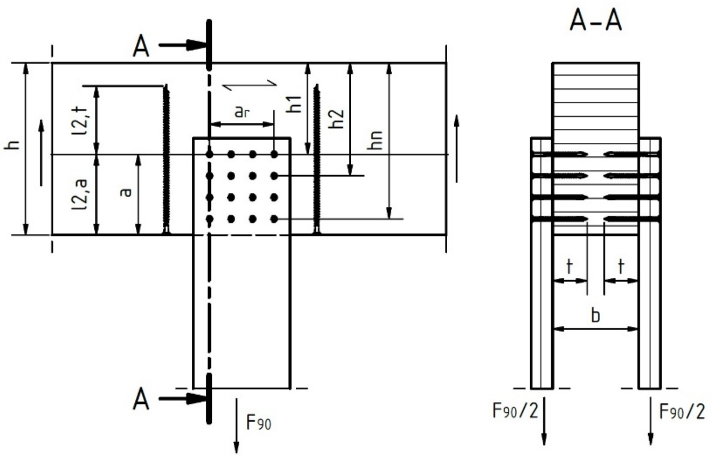


Figure A9.4: Reinforcement of transverse connections with Simpson Strong-Tie® screws

A.9.2.2 Openings

Openings in wooden members may be designed as follows:

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

where

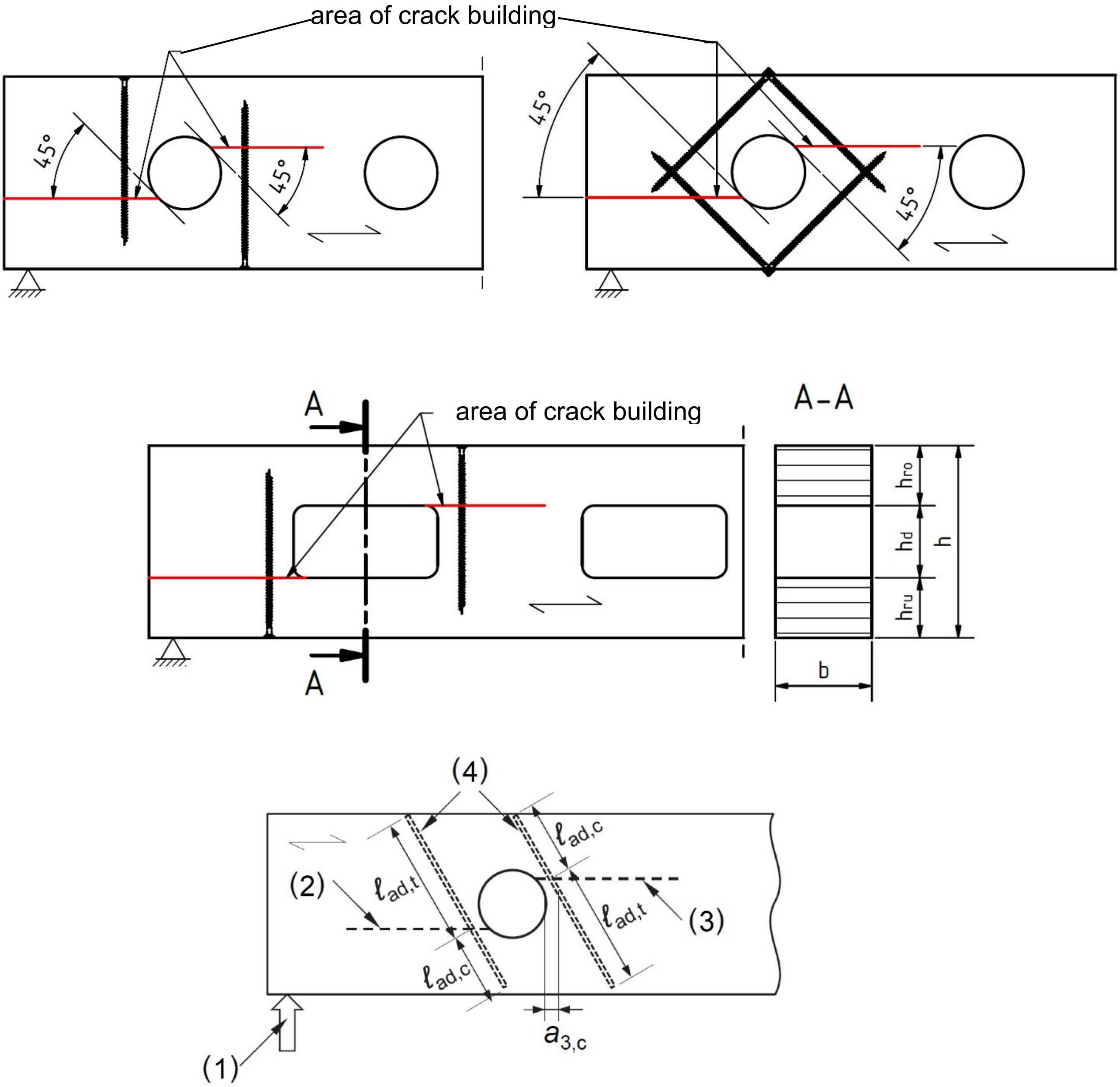
$$F_{t,V,d} = \frac{V_d \cdot h_d}{4 \cdot h} \cdot \left(3 - \frac{h_d^2}{h^2}\right)$$

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

$$F_{ax,Rd} = n_{90} \cdot min \begin{cases} f_{ax,k} \cdot d \cdot l_{ef} \cdot \frac{k_{mod}}{\gamma_M} \\ \frac{f_{tens,k}}{\gamma_{M2}} \end{cases}$$ for reinforcement acc. to Figure A9.5

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
γ_M	partial safety factor for connections according to EN 1995-1-1, Table 2.3
γ_{M2}	partial safety factor according to EN 1993-1-1
n_{90}	number of reinforcing screws arranged in a row perpendicular to the grain



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

Figure A9.5: Reinforcement of openings with Simpson Strong-Tie® screws

A.9.2.3 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 A9.6 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

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

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

γ_M partial safety factor for connections according to EN 1995-1-1

γ_{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

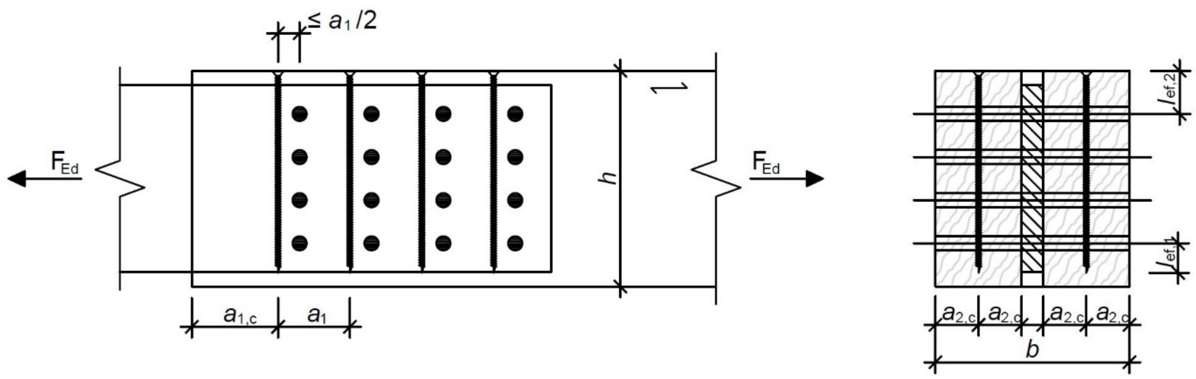


Figure A9.6: Reinforcement of connections stressed with shear loads

A.9.2.4 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.

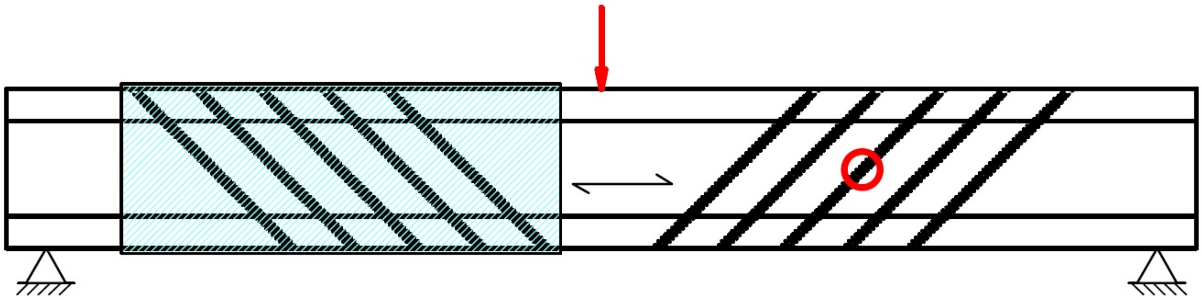


Figure A9.7: Shear reinforcement with Simpson Strong-Tie® screws

Shear reinforcement may be designed according to

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

where

τ_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 Simpson Strong-Tie® screw ESCRFTC with d = 8 mm

EA_s axial stiffness of one screw in N

$$EA_s = \frac{E \cdot \pi \cdot d_1^2}{4}$$

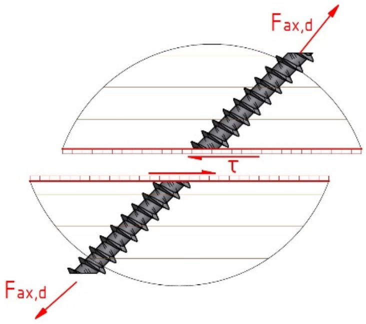
d_1 inner thread diameter of the screw in mm

The axial capacity of the screw shall fulfil

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

where

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



with

n number of screws parallel and in a row

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

γ_M partial safety factor for connections according to EN 1995-1-1

γ_{M2} partial safety factor according to EN 1993-1-1

Simpson Strong-Tie® screws	Annex 9
Reinforcement with Simpson Strong-Tie® screws	of European Technical Assessment ETA-13/0796 of 16.02.2022

A.10.1 Fastening of thermal insulation material (on top of rafters and facades)

Simpson Strong-Tie® 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 A10.1 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 α = 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 $0° \leq \beta \leq 90°$:

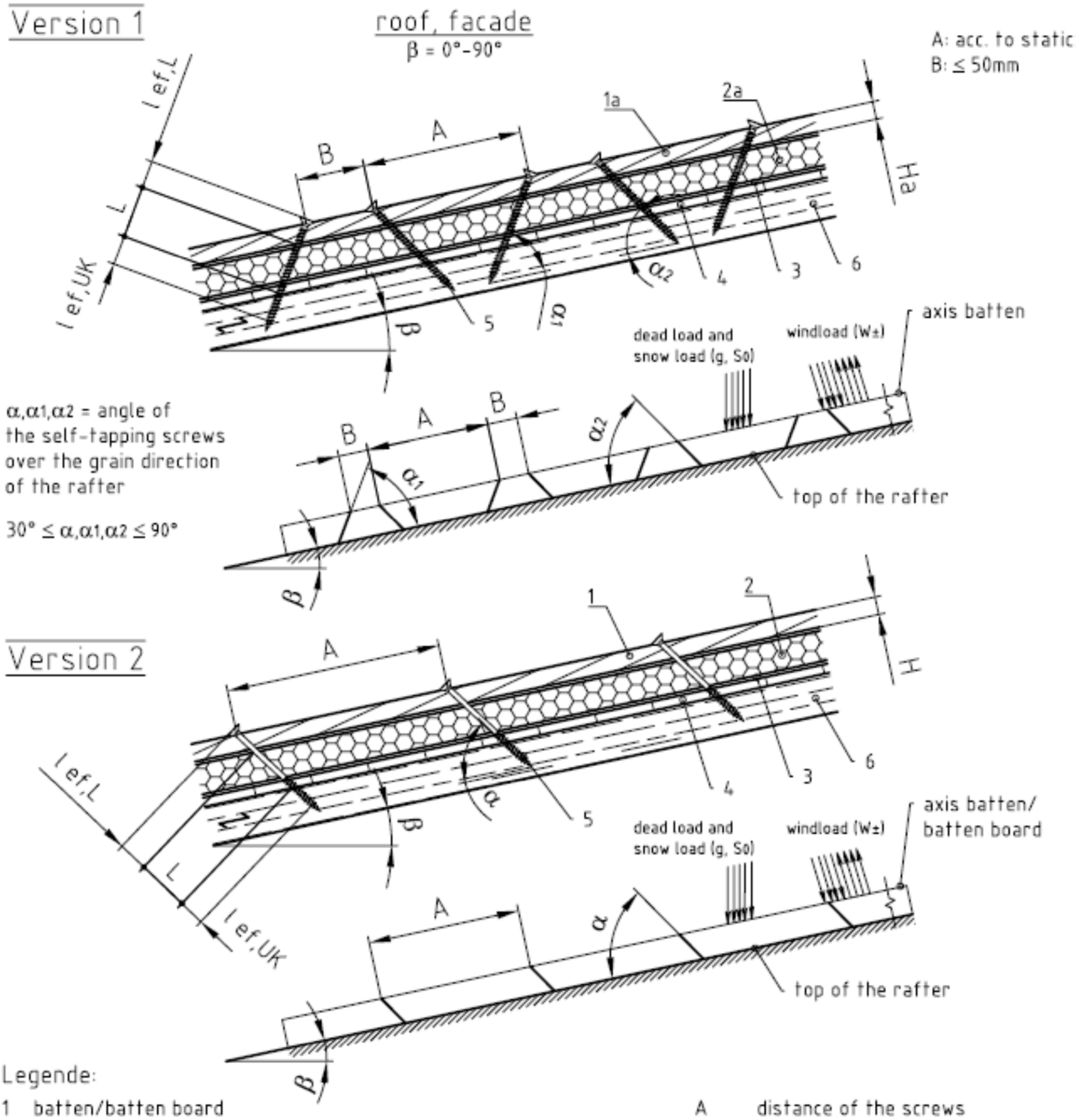
- System 1: Alternately inclined screws (only screws with full thread, double thread)

  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

OIB
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), 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

Simpson Strong-Tie® screws SIMPSON Strong-Tie	Annex 10 of European Technical Assessment ETA-13/0796 of 16.02.2022
Fastening of thermal insulation material	

A.10.2 Alternately inclined screws (only screws with full thread and ESCRT2R/ ESCRT2R-S)

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
α	=	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 A.10.2.

Table A10.2 Buckling capacity of the screws

Free screw length l between lath and rafter (mm)	$\kappa_c * N_{pl,k}$ (kN) for Simpson Strong-Tie® screws				
	Outer thread diameter d				
	6	8	10	12	16
	Inner thread diameter d_i				
	3.8	5.2	6.2	6.9	10.7
≤35	4.396	11.681	19.024	25.125	71.392
60	2.497	7.576	13.516	18.834	62.440
80	1.706	5.416	10.070	14.470	54.654
100	1.232	4.008	7.621	11.154	46.825
120	0.930	3.068	5.912	8.747	39.595
140	0.726	2.418	4.699	7.000	33.360
160	0.582	1.952	3.815	5.710	28.195
180	0.477	1.608	3.156	4.739	23.991
200	0.398	1.347	2.652	3.992	20.582
220	0.337	1.144	2.259	3.407	17.808
240	0.289	0.984	1.947	2.941	15.535
260	0.251	0.855	1.695	2.563	13.657
280	0.220	0.750	1.489	2.254	12.092
300	0.194	0.663	1.318	1.997	10.776
320	-	0.591	1.175	1.781	9.660
340	-	0.529	1.054	1.599	8.707
360	-	0.477	0.950	1.443	7.887
380	-	0.432	0.862	1.309	7.176
400	-	0.393	0.785	1.193	6.557

A.10.3 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 A7.1 and A7.2

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

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

$d_{Dä.}$ = 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

EN 826 (03.2013), Thermal insulating products for building applications – Determination of compression behaviour

EN 1993-1-4 (10.2006) +A1 (06.2015), Eurocode 3 – Design of steel structures – Part 1-4: General rules – Supplementary rules for stainless steels

EN 1995-1-1 (11.2004), +AC (6.2006), +A1 (06.2008), +A2 (05.2014), Eurocode 5 – Design of timber structures – Part 1-1: General – Common rules and rules for buildings

EN 10088-1 (10.2014), Stainless steels – Part 1: List of stainless steels

EN 13353:2008+A1 (05.2011), Solid wood panels (SWP) – Requirements

EN 13986:2004+A1 (04.2015), Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking

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

EN 14081-1:2016+A1 (08.2019), Timber structures – Strength graded structural timber with rectangular cross section – Part 1: General requirements

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