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and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and
Laender Governments



European Technical Assessment

ETA-13/0699
of 14 June 2018

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General Part

Technical Assessment Body issuing the
European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

SFS VB screws

Product family
to which the construction product belongs

SFS VB screws as fasteners in wood-concrete composite
slab kits

Manufacturer

SFS intec AG
FasteningSystems
Rosenbergsaustraße 10
9435 HEERBRUGG
SCHWEIZ

Manufacturing plant

factory HW-1, factory HW-2

This European Technical Assessment
contains

16 pages including 6 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

EAD 130090-01-0303

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Specific Part

1 Technical description of the product

This European Technical Assessment (ETA) applies to wood-concrete composite slab kits with SFS VB screws as dowel type fasteners.

The kit contains of the following components:

Base Materials

- Sawn timber (softwood and hardwood) according to EN 14081-1,
- Glued laminated timber according to EN 14080,
- Laminated veneer lumber according to EN 14374 and
- Cross laminated timber according to European technical assessments.

Dowel type fasteners for shear resistant connection between base materials and the concrete material

- SFS VB screws, installed under an angle of $\pm 45^\circ$ and/or 90° into the base material (timber members). Shape and tolerances of the SFS VB screws are given in Annex 3.

Moulding

- In the case of concrete cast at the building site: Formwork, e.g. timber boards or wood based panel. This is an optional intermediate layer between the concrete and the timber. When the concrete slabs are prefabricated, no intermediate layer between timber and concrete is needed.
- Lateral moulding along the edges of the slab. This moulding has no function in the final product. No essential characteristics are assessed for the moulding

Finalisation of wood-concrete composite slab kit

- Concrete slab cast on site or in a prefabricating plant and reinforced according to standards and regulations in force at the place of use.
- Concrete slab, according to EN 206-1 and national regulations either prefabricated or cast at the building site. The minimum concrete strength class is C20/25.
- The concrete slab is not part of the kit. No characteristics are assessed for the concrete slab.

Finished floor or ceiling covering as well as possible sound reducing courses are not part of the kit.

A principle structure of the wood-concrete composite slab kits is shown in Figure A.2.1 of Annex 2. The area of concrete is subjected to compression. The timber members usually run parallel or nearly parallel to each other.

The screws are made of case hardened steel and are corrosion protected with a zinc coating or brown patina. The geometry of the screws is shown in Annex 3.

This European Technical Assessment covers screws for composite members with a minimum concrete flange depth according to the provisions on the slab depth at the place use (national provisions), but not less than 50 mm and a minimum depth of the timber member of 100 mm. The maximum concrete flange depth is 70 % of the timber member depth. Typical spans for the construction are up to 8 m with sawn softwood timber members, 10 m with LVL members and 14 m with glulam members, but larger spans are also possible.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the wood-concrete composite slab kit are used in compliance with the specifications and conditions given in Annex 1 to 5.

The provisions made in this European technical assessment are based on an assumed working life of SFS VB screw for wood-concrete composite slab kits of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

3.1 Essential characteristics of the product

Table 1: Essential characteristics of the wood-concrete composite slab kit and methods and criteria for assessment of the performance of the product in relation to those essential characteristics

Essential characteristic	Assessment of characteristic
Mechanical resistance and stability (BWR 1) ¹⁾	
Mechanical resistance	Annex 4, Table 4.2
Dimensional stability	Annex 4, Table 4.2
Stiffness	Annex 4, Table 4.2
Safety in case of fire (BWR 2)	
Reaction to fire	Annex 2, Table 4.2
Hygiene, health and the environment (BWR 3)	
Water vapour permeability	Annex 4, Table 4.2
Safety and accessibility in use (BWR 4)	
Same as BWR 1	
Energy economy and heat retention (BWR 6)	
Thermal resistance	Annex 4, Table 4.2
Air permeability	no performance assessed
Thermal inertia	Annex 4, Table 4.2

¹⁾ This characteristic also relates to BWR 4.

Table 2: Essential characteristics of the base materials and methods and criteria for assessment of the performance of the product in relation to those essential characteristics

Essential characteristic	Assessment of characteristic
Mechanical resistance and stability (BWR 1) ¹⁾	
Mechanical resistance	Annex 4, Table 4.1
Dimensional stability	Annex 4, Table 4.2
Stiffness	Annex 4, Table 4.1
In service environment	Annex 4, Table 4.2
Safety in case of fire (BWR 2)	
Reaction to fire	Annex 4, Table 4.2
Safety and accessibility in use (BWR 4)	
Same as BWR 1	
Energy economy and heat retention (BWR 6)	
Thermal resistance	Annex 2, Table 4.2
Thermal inertia	Annex 2, Table 4.2

¹⁾ This characteristic also relates to BWR 4.

Table 3: Essential characteristics of the dowel type fasteners and methods and criteria for assessment of the performance of the product in relation to those essential characteristics

Essential characteristic	Assessment of characteristic
Mechanical resistance and stability (BWR 1) ¹⁾	
Material	Annex 2
Geometry	Annex 3
Mechanical strength	Annex 5, Table A.5.4
Mechanical stiffness	Annex 5, Table A.5.2
Corrosion protection	Annex 2
Shear resistance	Annex 5, Table A.5.3
Safety and accessibility in use (BWR 4)	
Same as BWR 1	

¹⁾ This characteristic also relates to BWR 4.

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

In accordance with EAD No. 130090-00-0303 the applicable European legal act is: 2000/447/EC

The system to be applied is: 1

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

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 14 June 2018 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Deniz

Annex 1

A.1.1 Intended use, load and design

SFS VB screws are intended to be used in structural composite members such as floor, roof, or wall constructions in service classes 1 and 2 as defined in EN 1995-1-1 subject to static or quasi static loading. The screws may be used for protected exterior constructions provided that they are classified in service class 2.

The concrete slab shall be arranged on top of the timber beams. The support of the wood concrete composite elements shall be carried out via the timber beams.

The wood-concrete composite slab kits are individually designed in order to meet the requirements for the works.

Wood-concrete composite slab kits including SFS VB screws are manufactured and used according to an individual design made by a structural engineer responsible for the design of works on a case by case basis (floors) may function as directly load-bearing and structural bracing members.

A.1.2 Manufacturing

SFS intec AG delivers the SFS VB screws for use as components in wood-concrete composite slab kits in accordance with the provisions of this European Technical Assessment. The SFS VB screws are manufactured in the factory in accordance with the provisions of this European technical assessment.

At the building site, additional components of the kit shall be assembled according to the design of each individual kit as specified by the designer of the works.

A.1.3 Assembly and installation of the wood-concrete composite slab kit into the works

SFS VB screws shall be installed on the basis of a specific structural design for each wood-concrete composite slab kit installation. The values of the load-bearing capacities to be used for design are given in Annex 5. The design shall be prepared by a structural engineer responsible for the design of works according to the provisions of the Member State.

The design shall also take any aspects regarding installation of the wood-concrete composite slab kit components, as well as any temporary bracing and supporting into account. Wood-concrete composite slab kits shall be installed by appropriately qualified personnel, following the installation plan. Only screws without any defects are allowed to be used. Before concrete is poured, the person responsible for the design of the works shall check the set of the SFS VB screws to be in accordance with the design.

The manufacturer shall ensure that the parties involved will be informed of these provisions.

SFS VB screws	Annex 1
Specifications of intended use	

Annex 2

Wood-concrete composite slab kits composed with SFS VB screws

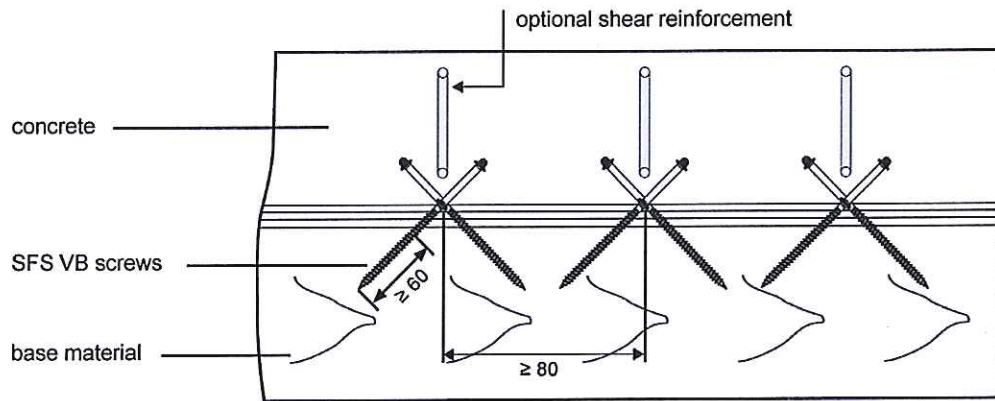


Figure A.2.1 Principle structure of wood-concrete composite slab kit with SFS VB screws

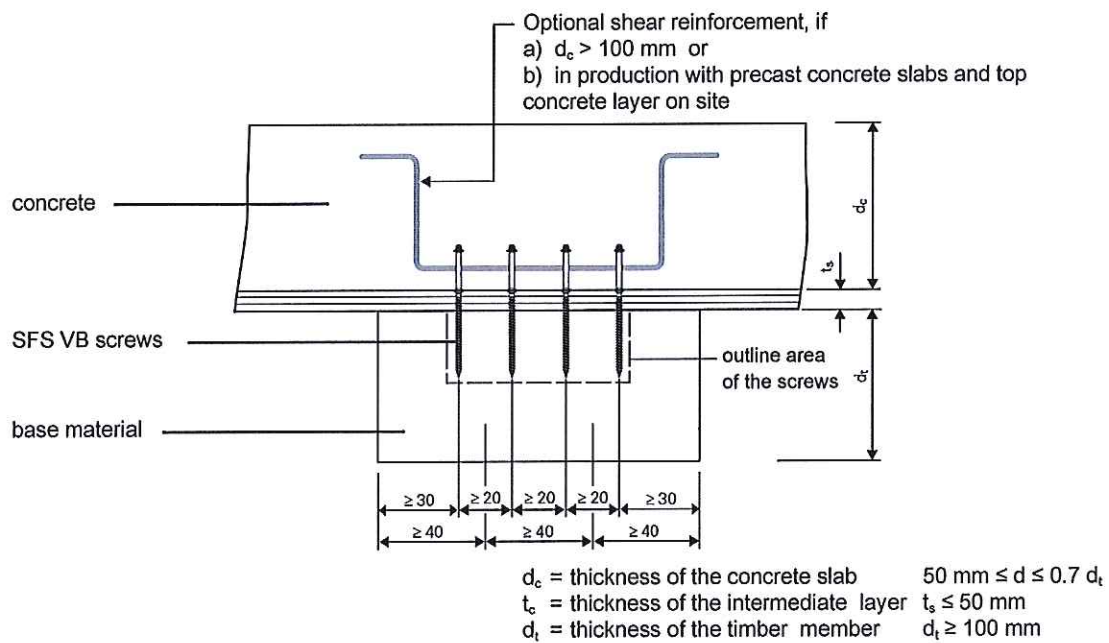


Figure A.2.2 Cross section through a composite member with SFS VB screws

SFS VB screws

Structure of wood-concrete composite slab kit with SFS VB screws

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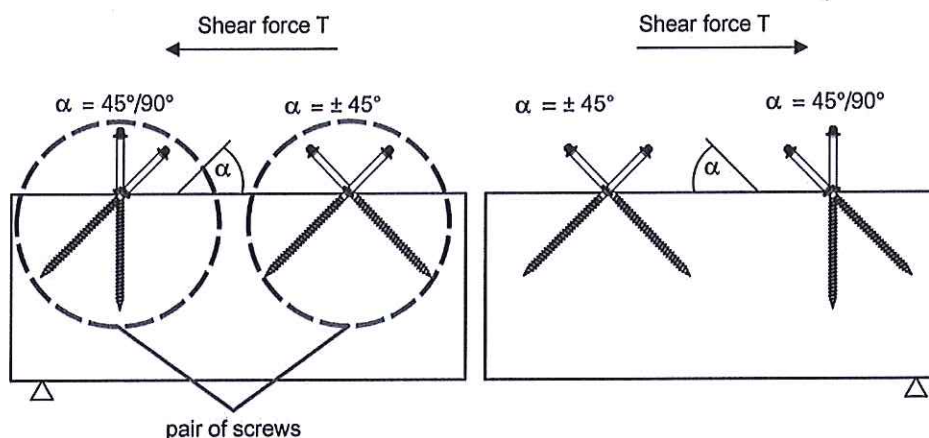


Figure A.2.3 Arrangement of SFS VB screws in wood-concrete composite slabs kits

SFS VB screws

The screws are made of case hardened steel and are corrosion protected with a zinc coating or brown patina. The geometry of the screws are shown in Annex 3. A more exact description of the shape and tolerances of the screws can be found in the control plan. The composition of the screw materials is deposited with Deutsches Institut für Bautechnik.

The mechanical properties of SFS VB screws and the coefficients for creep and duration of load factors for composite members are given in Annex 5.

Table A.2.1 Minimum spacing, end and edge distances for SFS VB screws in mm

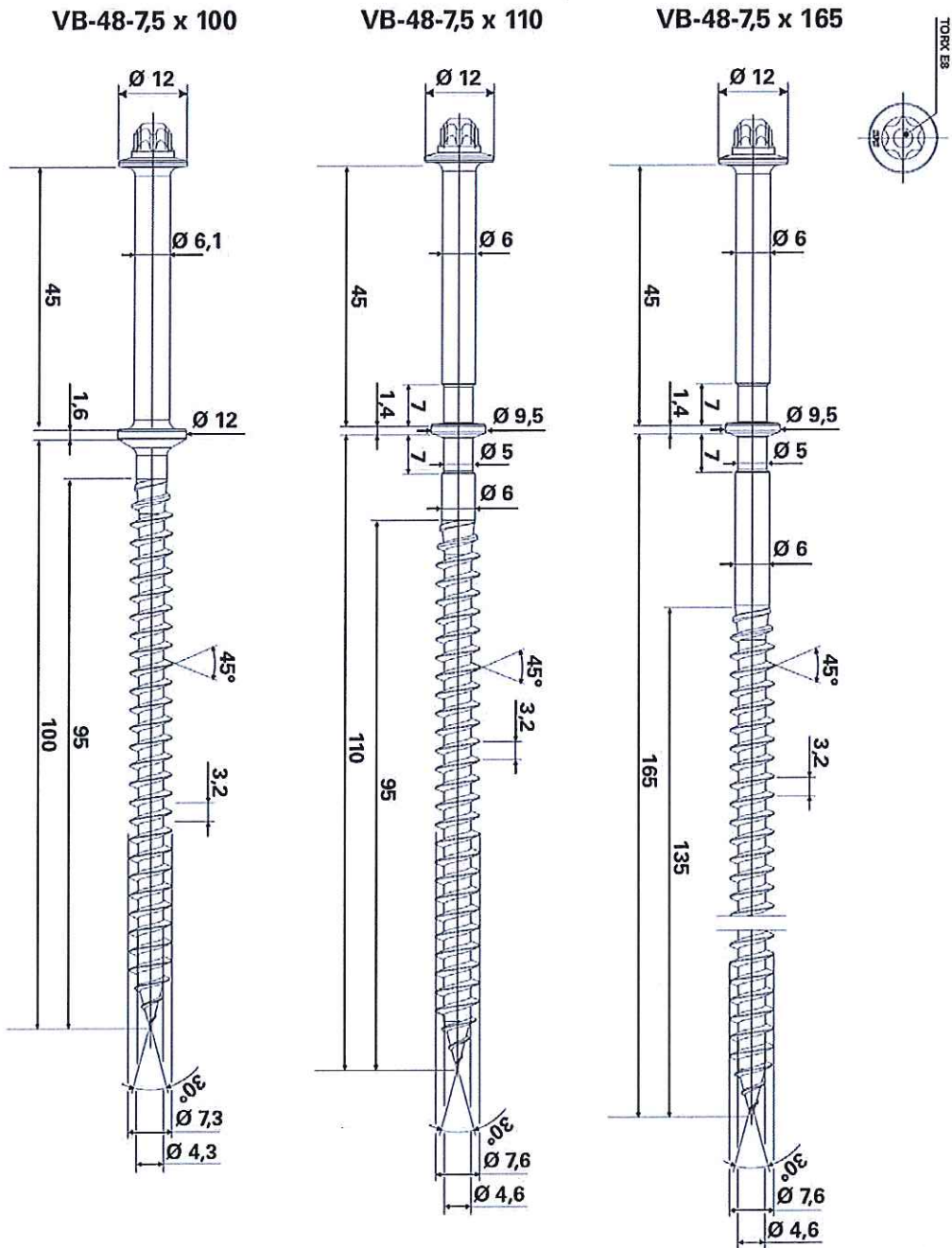
SFS VB screw	$7.5 \times \lambda$
Spacing parallel to grain a_1	80
Spacing perpendicular to grain a_2	20
End distance (end of end-grain) $a_{3,c}$	80
Edge distance $a_{4,c}$	30

Structural elements of hardwood have to be pre-drilled for screws. Oak timber has to be used installed dry.

Annex 3

Drawings showing the properties of the SFS VB screws

SFS VB screws made of carbon steel



SFS VB screws

Geometry of the SFS VB screws VB-48-7.5 x λ

Annex 3

Annex 4

Table A.4.1: Dimensions and specifications

Characteristic	Dimension / Specification
Wood-concrete composite slab kit	
Width	acc. to manufacturer's specification
Length	Typical spans for the construction are up to 8 m with sawn softwood timber members, 10 m with LVL members and 14 m with glulam members, but larger spans are also possible.
Components	
SFS VB screws	See Annex 3
Concrete	≥ concrete strength class C20/25 acc. to EN 206-1
Timber members	Glued laminated timber acc. to EN 14080
	sawn softwood or hardwood acc. to EN 14081-1
	LVL according to EN 14374
	cross laminated timber according to European technical assessments
Formwork ¹⁾	e.g. timber boards or wood based panels

¹⁾ This is an optional intermediate layer between the concrete and the timber

SFS VB screws

Dimensions and specifications

Annex 4
page 1 of 2

Table A.4.2: Product characteristics of the wood-concrete composite slab kit

BWR	Essential characteristic	Assessment	Class / Level / Value / Description
1	Mechanical resistance and stability ¹⁾		
	Mechanical resistance	EN 1995-1-1 and 1992-1-1, see Annex 5	
	Creep and duration of load	See Annex 5	
	Dimensional stability	Moisture content during use shall not change to such extent that adverse deformations can occur.	
	Stiffness (t = 0)		
	Slip modulus k_{ser}	EAD 130090-00-0303	See Annex 5
	In-service environment	EN 1995-1-1	Service class 1 and 2
2	Safety in case of fire		
	Reaction to fire		
	sawn timber	Commission Decision 2003/593/EC	Euroclass D-s2, d0
	Glued laminated timber	Commission Decision 2005/610/EC	Euroclass D-s2, d0
	cross laminated timber	Commission Decision 2005/610/EC	Euroclass D-s2, d0
	LVL	Commission Decision 2017/2293/EC	Euroclass D-s2, d0
	plywood	Commission Decision 2003/593/EC	Euroclass D-s2, d0
Steel members and concrete	EC Decision 96/603/EC	Euroclass A1	
3	Hygiene, health and the environment		
	Vapour permeability μ	acc. to EN ISO 10456 for the respective material	
4	Safety and accessibility in use		
	Same as BWR 1		
6	Energy economy and heat retention		
	Thermal resistance	acc. to EN ISO 10456 for the respective material	
	Air permeability	EN 12114	no performance assessed
	Thermal inertia	acc. to EN ISO 10456 for the respective material	
¹⁾ This characteristic also relates to BWR 4.			

SFS VB screws

Product characteristics of the wood-concrete composite slab kit

Annex 4
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Annex 5

Static model and general information

Composite constructions with SFS VB screws are to be designed taking into account the influence of the slip occurring in the joints. A method for the calculation of the load-bearing capacity and the deformation of mechanically jointed beams or columns is given in Annexes B and C of EN 1995-1-1. National requirements valid in the place of use may apply.

Calculations should be carried out assuming a linear relationship between force and slip. Alternative methods for the calculation based on numerical models are also applicable.

The mechanical model describing the shear force transfer is shown in Figure A.5.

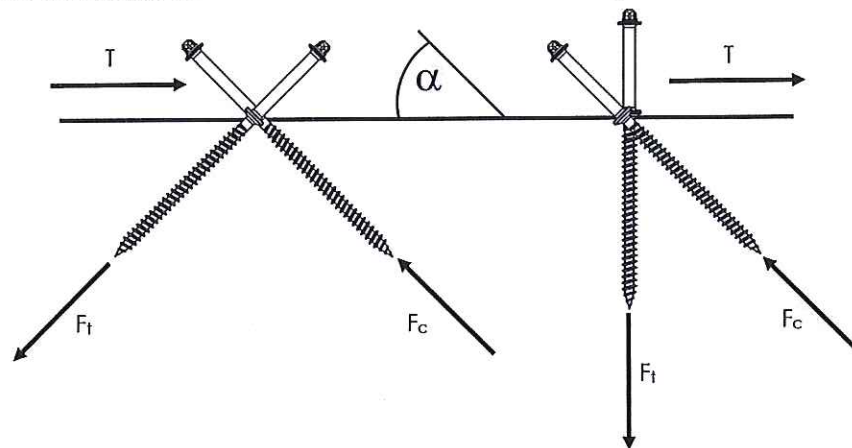


Figure A.5: Mechanical model according to truss analogy

A truss analogy is used. The threaded part of the screw in the timber is considered elastically founded parallel to the screw axis. The foundation in the concrete is considered infinitely stiff. An interlayer with the thickness t may be arranged between timber and concrete.

The shear force T parallel to the joint between timber and concrete is divided into a component parallel to the tensile screw axis and a component parallel to the compressive screw axis. Friction forces between timber and concrete are not considered. The tensile force F_t and the compressive force F_c follow the shear force T and the angle α :

$$F_t = F_c = \frac{T}{\sqrt{2}} \quad \text{for screw arrangement } \pm 45^\circ$$

$$F_t = T \quad \text{for screw arrangement } 45^\circ/90^\circ$$

$$F_c = T \cdot \sqrt{2} \quad \text{for screw arrangement } 45^\circ/90^\circ$$

For calculation of internal forces the mean or nominal values of the elasticity and slip modulus shall be used.

SFS VB screws

Design considerations

Annex 5
page 1 of 3

Design of the wood-concrete composite slab kit

SFS VB screws may be used in service class 1 and 2 according to Eurocode 5.

The design of the wood-concrete composite slab kit in the ultimate and the serviceability limit states shall take into account the influence of creep, concrete shrinkage and moisture changes. The verification of the limit states is to be performed both for the initial state ($t = 0$) and the final state ($t = \infty$).

The influence of creep and moisture changes may be taken into account by reducing the modulus of elasticity of the timber and concrete and the slip modulus to be used in calculations analogous with EN 1995-1-1. For the deformation factors k_{def} see Table A.5.1.

Table A.5.1 – Values of k_{def} for timber, concrete and SFS VB screws

Material	Service class	
	1	2
Solid timber, EN 14081-1	0.6	2.0
Glued Laminated timber, EN 14080	0.6	2.0
LVL, EN 14374	0.6	2.0
Cross laminated timber, ETA	0.8	2.0
Concrete, EN 206-1	2.5	2.5
SFS VB screw connection	0.6	4.0

For timber-concrete composite joints made with SFS VB screws the slip modulus K_{ser} per pair of screws under service load parallel to the shear plane should be taken from Table A.5.2 with l_{ef} in mm.

Table A.5.2 – Values of K_{ser} for timber-concrete joints with SFS VB screws

SFS VB screw orientation α in °	K_{ser} in N/mm
$\pm 45^\circ$	$240 \cdot l_{ef}$
$45^\circ/90^\circ$	$100 \cdot l_{ef}$

with

l_{ef} is the penetration depth of the SFS VB screw in the timber member in mm,
for screw arrangement $45^\circ/90^\circ$ is l_{ef} the penetration depth of the 90° screw

For timber-concrete composite joints made with SFS VB screws the characteristic load bearing capacity per pair of screws F_{Rk} parallel to the shear plane shall be taken from Table A.5.3. with ρ_k in kg/m^3 and l_{ef} in mm.

SFS VB screws	Annex 5 page 2 of 3
Design considerations	

Table A.5.3 – Values of F_{Rk} for timber-concrete-joints with SFS VB screws

F_{Rk} in N	
$F_{Rk} = k_{\alpha} \cdot \min \begin{cases} F_{ax,\alpha,Rk} \\ 13000 \end{cases}$	
where:	
F_{Rk}	is the characteristic load-carrying capacity per pair of SFS VB screw in N;
k_{α}	is a factor taking into account the screw arrangement; $k_{\alpha} = 1,414$ for $\alpha = \pm 45^{\circ}$ $k_{\alpha} = 1,0$ for $\alpha = 45^{\circ}/90^{\circ}$
$F_{ax,\alpha,Rk}$	is the characteristic withdrawal capacity in N;
	$F_{ax,\alpha,Rk} = 90 \cdot l_{ef} \cdot \left(\frac{\rho_k}{350}\right)^{0,8}$ for SFS VB screws in softwood
	$F_{ax,\alpha,Rk} = 180 \cdot l_{ef} \cdot \left(\frac{\rho_k}{530}\right)^{0,8}$ for SFS VB screws in pre-drilled hardwood
l_{ef}	is the penetration depth of the SFS VB screw in the timber member in mm, for screw arrangement $45^{\circ}/90^{\circ}$ is l_{ef} the penetration depth of the 90° screw;
ρ_k	is the characteristic timber member density in kg/m^3 ;
α	is the angle between screw axis and grain direction.

Table A.5.4 – Properties of SFS VB screws

SFS VB screw	VB-48-7,5x100	VB-48-7,5x110	VB-48-7,5x165
Tensile strength $f_{tens,k}$ [kN]	16	17	17
Torsional strength $R_{tor,k}$ [Nm]	16	18	18

Apart from the design of the composite member, the load-carrying-capacity of the concrete layer spanning between the timber beams and the shear capacity of the timber member in the perimeter area around the screws should be checked.

SFS VB screws	Annex 5 page 3 of 3
Design considerations	

Annex 6

Reference documents

EAD 130090-00-0303, European Assessment Document for "Wood-Concrete composite slab with dowel-type fasteners", Edition December 2017

EN 14081-1:2016 Timber structures – Strength graded structural timber with rectangular cross section – Part 1: General requirements

EN 14080:2013, Timber structures - Glued laminated timber and glued solid timber - Requirements

EN 14374-2005: Timber structures - Structural laminated veneer lumber – Requirements

EN 206-1:2001+A1:2004+A2:2005: Concrete- Part 1: Specification, performance, production and conformity

EN 338:2016 Structural timber - Strength classes

EN 1995-1-1:2004 + A1:2008 + A2:2014, Eurocode 5: Design of timber structures - Part 1-1: General - Common rules and rules for buildings

EN 1992-1-1:2011, Eurocode 2 - Design of concrete structures - Part 1-1: General rules and rules for buildings

EN ISO 10456:2007 + AC:2009, Building materials and products – Hygrothermal properties – Tabulated design values and procedures for determining declared and design thermal values

SFS VB screws	Annex 6
Reference documents	