ZAVOD ZA GRADBENIŠTVO SLOVENIJE
SLOVENIAN NATIONAL BUILDING AND CIVIL ENGINEERING INSTITUTE

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

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European Technical Assessment

ETA-23/0537
of 08.01.2025

English version prepared by ZAG

General Part

Technical Assessment Body issuing the European Technical Assessment	**ZAG**
Trade name of the construction product	**EFG PSK connectors**
Product family to which the construction product belongs	**13: Structural timber products, elements and ancillaries**
Manufacturer	**Heco Italia EFG S.r.l.** **Largo Parolini 117** **IT-36061 Bassano del Grappa (VI)** **Italy** https://www.heco.it/
Manufacturing plant	**Plant 1, 2, 3**
This European Technical Assessment contains	**17 pages including Annex A which forms 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 130090-00-0303, Wood-concrete composite slab with dowel-type fasteners, edition December 2017**

Specific parts

1 Technical description of the product

EFG PSK connectors are wood-concrete composite slab kits with dowel-type fasteners, intended as structural components in wood-concrete composite slabs with dowel type fasteners with a max. span with of 10 m (larger spans are also possible). The composite slabs may be produced as prefabricated members, in the factory, or on construction site.

The following components form the wood-concrete composite slabs:

a.) Base material

Wood and various wood based materials / structural members can be used as base material:

- Structural timber with rectangular cross section (EN 14081-1);
- Structural finger jointed solid timber (EN 15497);
- Glued solid timber, glue laminated timber (glulam), blocked glued glulam (EN 14080);
- Cross laminated timber (ETA according to EAD 130005-00-0304);
- Solid wood slab element (ETA according to EAD 130002-00-0304);
- Laminated veneer lumber / Glue laminated timber made of hardwood LVL (EN 14374 or ETA according to EAD 130010-01-0304);

No timber treatments (preservatives, fire and flame retardants) or other dangerous substances are used.

b.) Moulding

Moulding (boards, wood based panels, etc.) is needed for installation of concrete layer but it has no function in the final product.

Additionally polyethylene (PE) or other foil can be added above the moulding to prevent leakage of water when pouring concrete, but friction between concrete and timber cannot be taken into consideration.

No essential characteristics are assessed for moulding.

c.) Dowel-type fasteners – shear resistance connection between base materials and concrete

EFG PSK connectors consists of steel plates (EFG PSK1 – one screw, EFG PSK2 – two screws, _90 – installation at 90°, _45 – installation at 45°), material S355, zinc plated and fully threaded carbon steel self-tapping screws, a.) HECO-TOPIX-plus fully threaded screws diameter 8 mm flange head (mod. T69) for 45° installation and b.) HECO-TOPIX-plus fully threaded screws diameter 10 mm hexagon head (mod. T59) for 90° installation (acc. to ETA-19/0553).

The use of other types of screws and screws with other diameters is not subject of this ETA.

Dimensions of products (steel plates, screws) are presented in Annex A2.

d.) Finalisation of wood-concrete composite slab

Concrete slab cast (EN 206) on site or in a prefabricating plant and reinforced according to EN 10080 and national regulations. Minimum required concrete strength is C20/25. Minimum concrete layer thickness is 50 mm (Fibre reinforced concrete – FRC: 30 mm).

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

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

Products are to be used as load bearing elements in buildings in Service Classes 1 and 2 as defined in EN 1995-1-1:2004/A2:2014, subject to static and quasi static load or in Use classes 1 and 2 as defined in EN 335:2013. Use in Use class 3.1 (wood and wood products will not remain wet for long periods, water will not accumulate) is permitted only if it is not contradicted with member states provisions / recommendations.

The provisions made in this ETA are based on an assumed intended working life (not the same as producer guarantee) for the intended of product taking into consideration proper use and maintenance of 50 years. These provisions are based upon the current state of the art and the available knowledge and experience. The actual working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for the works.

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

The assessment is performed according to EAD 130090-00-0303, Wood-concrete composite slab with dowel-type fasteners, edition December 2017. If not dated the latest release of referenced documents should always be taken into consideration.

The ETA is issued for the product on the basis of agreed data, deposited with Slovenian National Building and Civil Engineering Institute (hereinafter ZAG), which identifies the product that has been assessed and judged. Changes to the production process or the product itself, which could result in this deposited data being incorrect, should be notified to ZAG before the changes are introduced. ZAG will decide whether or not such changes affect the ETA and consequently the validity of the CE marking on the basis of the ETA and if so whether further assessment, and / or alteration to the ETA, shall be necessary.

Product characteristics are based on proved data provided by producer or by appropriate standards. Relevance of defined product characteristics is related to validity of standard / reports used in preparation of ETA.

a.) **Wood-concrete composite slab kit**

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.

Basic Work Requirements (BWR)	Essential characteristics of construction product	Assessment method	Product performance*
BWR 1 (Mechanical resistance and stability)	Mechanical resistance	Clause 3.1.1	Clause 3.1.1
	Dimensional stability	Clause 3.1.2	Clause 3.1.2
	Stiffness	Clause 3.1.3	Clause 3.1.3 Annex A7 – A9
BWR 2 (Safety in case of fire)	Reaction to fire	Clause 3.2.1	Clause 3.2.1
BWR 3 (Hygiene, health and the environment)	Vapour permeability	Clause 3.3.1	Clause 3.3.1
BWR 4 (Safety and accessibility in use)	Same as BWR 1		
BWR 6 (Energy economy and heat retention)	Thermal resistance	Clause 3.4.1	Clause 3.4.1
	Air permeability	Clause 3.4.2	NPA
	Thermal inertia	Clause 3.4.3	Clause 3.4.3

* NPA – No performance assessed

3.1 Mechanical resistance and stability (BWR 1)

3.1.1. Mechanical resistance

According to EAD 130090-00-0303, Ch. 2.2.1., the calculation method shall be based on EN 1995-1-1:2004/A2:2014 and EN 1992-1-1:2004/A1:2014, taking into account the shear resistance of dowel type fasteners (Ch. 3.8.6).

3.1.2. Dimensional stability

Moisture content (MC) of timber based component should be in the ranges defined in the product standards, MC should be appropriate for specific use / Use class. Additionally tolerances of all components should be in the ranges defined in the product standards.

Moisture content in the exploitation shall not change to such extent that adverse deformation can occur.

3.1.3. Stiffness

Stiffness is assessed according to EAD 130090-00-0303, Ch. 2.2.1. Mechanical properties are given in Annexes A7 – A9.

3.2 Safety in case of fire (BWR 2)

3.2.1 Reaction to fire

According to several Commission Decisions (2003/593/EC, 2005/610/EC and 2017/2293/EC) timber base material are classified in performance class D-s2,d0.

Concrete and steel members are considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire in accordance with the EC Decision 96/603/EC as amended without the need for testing on the basis of it fulfilling the conditions set out in that Decision and its intended use being covered by that decision.

3.3 Hygiene, health and the environment (BWR 3)

3.3.1 Vapour permeability

Tabulated water vapour resistance factors μ of components according to EN ISO 10456 are assessed as vapour permeability essential characteristic.

3.4 Energy economy and heat retention

3.4.1 Thermal resistance

Tabulated thermal conductivity values λ of components according to EN ISO 10456 are assessed as thermal resistance essential characteristic.

3.4.2 Air permeability

No performance assesses (NPA) option is applied.

3.4.3 Thermal inertia

Tabulated values of components according to EN ISO 10456 are assessed as thermal inertia essential characteristic.

b.) **Base materials**

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.

Basic Work Requirements (BWR)	Essential characteristics of construction product	Assessment method	Product performance
BWR 1 (Mechanical resistance and stability)	Mechanical resistance	Clause 3.5.1	Clause 3.5.1 Annex A1
	Dimensional stability	Clause 3.5.2	Clause 3.5.2
	Stiffness	Clause 3.5.3	Clause 3.5.3
	In-service environment	Clause 3.5.4	Clause 3.5.4
BWR 2 (Safety in case of fire)	Reaction to fire	Clause 3.6.1	Clause 3.6.1
BWR 4 (Safety and accessibility in use)	Same as BWR 1		
BWR 6 (Energy economy and heat retention)	Thermal resistance	Clause 3.7.1	Clause 3.7.1
	Thermal inertia	Clause 3.7.2	Clause 3.7.2

3.5 Mechanical resistance and stability (BWR 1)

3.5.1. Mechanical resistance

Performances of base materials are given in Annex A1 as references on harmonized technical specifications, minimum mechanical characteristics / dimensions.

3.5.2. Dimensional stability

As defined in Ch. 3.1.2.

3.5.3. Stiffness

As defined in Ch. 3.1.3.

3.5.4. In-service environment

Products are to be used in Use classes 1 and 2 as defined in EN 335:2013. Use is use class 3.1 (wood and wood products will not remain wet for long periods, water will not accumulate) is permitted only if it is not contradicted with member states provisions / recommendations.

Use is specified classes corresponds use in Service Classes 1 and 2 as defined in EN 1995-1-1:2004/A2:2014.

3.6 Safety in case of fire (BWR 2)

3.6.1 Reaction to fire

As defined in Ch. 3.2.1.

3.7 Energy economy and heat retention

3.7.1 Thermal resistance

As defined in Ch. 3.4.1.

3.7.2 Thermal inertia

As defined in Ch. 3.4.3.

c.) **Dowel-type fasteners**

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.

Basic Work Requirements (BWR)	Essential characteristics of construction product	Assessment method	Product performance*
BWR 1 (Mechanical resistance and stability)	Material	Clause 3.8.1	Clause 3.8.1 Annex A1
	Geometry	Clause 3.8.2	Clause 3.8.2 Annex A2
	Mechanical strength	Clause 3.8.3	Clause 3.8.3 Annex A2
	Mechanical stiffness	Clause 3.8.4	Clause 3.8.4 Annex A7 – A9
	Corrosion protection	Clause 3.8.5	Clause 3.8.5 Annex A1
	Shear resistance	Clause 3.8.6	Clause 3.8.6 Annex A7 – A9
BWR 4 (Safety and accessibility in use)	Same as BWR 1		

* NPA – No performance assessed

3.8 Mechanical resistance and stability (BWR 1)

3.8.1. Material

Material of dowel type fasteners and shear connectors are presented in Annex A1.

3.8.2. Geometry

Geometry of dowel type fasteners and shear connectors are presented in Annex A2.

3.8.3. Mechanical strength

Mechanical strength of dowel type fasteners is presented in Annex A2.

3.8.4. Mechanical stiffness

Mechanical stiffness of dowel type fasteners is presented in Annex A7 – A9.

3.8.5. Corrosion protection

The specified corrosion protection of dowel type fasteners and shear connectors is identified as sufficient for use in Service classes 1 and 2 according to EN 1995-1-1:2005/A2:2014/AC:2015, Table 4.1.

3.8.6. Shear resistance

Shear resistance of dowel type fasteners is presented in Annex A7 – A9.

3.9 General aspects

3.9.1 Assembly and installation

The products shall be installed on the basis of individual structural design for each wood-concrete composite slab installation, based on load bearing capacities given in Annex A4.

The design shall take into account any aspects regarding installation of the wood-concrete composite slab, as well as any temporary supporting and bracing.

Wood-concrete composite slabs shall be installed by appropriately qualified personnel, following the installation plan. Details on the installation of the connectors are given in Annex A5 – A6.

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

According to the Commission Decision 2000/447/EC, the system of assessment and verification of constancy of performance (AVCP) (see Annex V of Regulation (EU) No 305/2011 and Commission Delegated Regulation (EU) No 568/2014) to be applied for specified use of the product **is 1**. Two audits per year are normally foreseen.

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

Technical details necessary for the implementation of the AVCP system are laid down in the Control Plan deposited at ZAG.

Issued in Ljubljana on 08.01.2025

Signed by:
mag. Franc Capuder, univ. dipl. inž. grad.
Head of Service of TAB

ANNEX A: Detailed information on wood-composite slab composed with EFG PSK connectors

Index Annex A:

A1: Base material specification

Table A1: Components.

Component	Type	Specifications / Dimensions
Shear connectors - Screws	Heco TOPIX plus 8 x 100 – 180 mm (T69 A FT)	EN 14592 / ETA according to EAD 130118-01-0603, carbon steel, zinc plated – min. 5 µm (Figure A2 left)
	Heco TOPIX plus TE 10 x 80 – 120 mm (T59 A FT)	EN 14592 / ETA according to EAD 130118-01-0603, carbon steel, zinc plated – min. 5 µm (Figure A2 right)
Shear connectors - Plate	EFG PSK1, EFG PSK2	Carbon steel S355, zinc plated, min. 5 µm (Figure A3)
Base material (timber or timber based)	Structural timber with rectangular cross section	EN 14081-1 (min. C24 / D24)
	Structural finger jointed solid timber	EN 15497 (min. C24 / D24)
	Glued solid timber, glue laminated timber (glulam), blocked glued glulam	EN 14080 (min. GL 24)
	Cross laminated timber	ETA according to EAD 130005-00-0304
	Solid wood slab element	ETA according to EAD 130002-00-0304
	Laminated veneer lumber Glue laminated timber made of hardwood LVL	EN 14374 ETA according to EAD 130010-01-0304
Moulding	Timber boards Wood based panels	EN 14081-1 / defined strength EN 13986 / defined strength
Foil	Non-permeable foil Vapour permeable foil	EN 13984 EN 13859-1, -2
Concrete	Concrete slab cast, reinforced Fibre reinforced concrete	EN 206, min. thickness 50 mm, min. C20/25 EN 206, min. thickness 30 mm, $f_{f,average}$ = 20 MPa

A2: Screws - geometry / mechanical specifications

Figure A2: HECO-TOPIX-plus FT 8 mm flange head (mod. T69) (left), HECO-TOPIX-plus FT 10 mm hex head (mod. T59) (right).

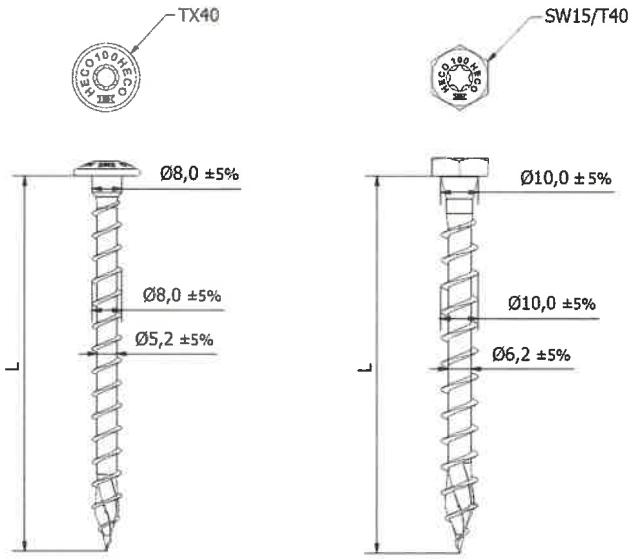
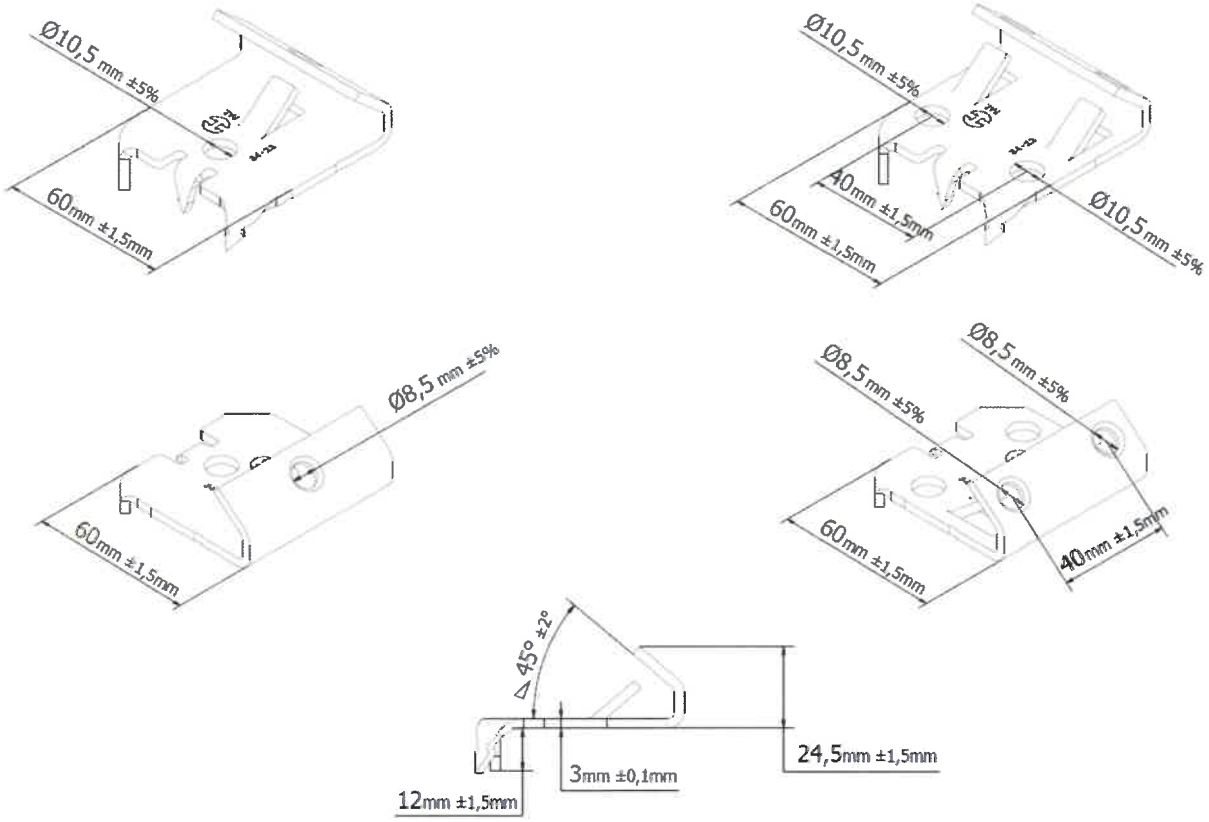


Table A2: Mechanical characteristics of HECO-TOPIX-plus FT screws.

Nominal diameter - d [mm]	8	10
Inner thread diameter - d_1 [mm]	5.2	6.25
Characteristic yield moment - $M_{y,k}$ [Nmm]	20000	36000
Characteristic withdrawal strength - $f_{ax,k}$ [N/mm²] (softwood)	11.8	11.8
Characteristic tensile strength (capacity) - $f_{tens,k}$ [kN]	20	30
Characteristic torsional strength - $f_{tor,k}$ [Nmm]	25000	42000
Mean insertion moment - $R_{tor\ mean}$	$f_{tor,k} / R_{tor\ mean} \geq 1.5$	

A3: Shear connectors - geometry / mechanical specifications

Figure A3: EFG PSK1 (left) and EFG PSK2 (right) connector plate.



A4: Geometry and installation of shear connectors

Figure A4: Installation of products.

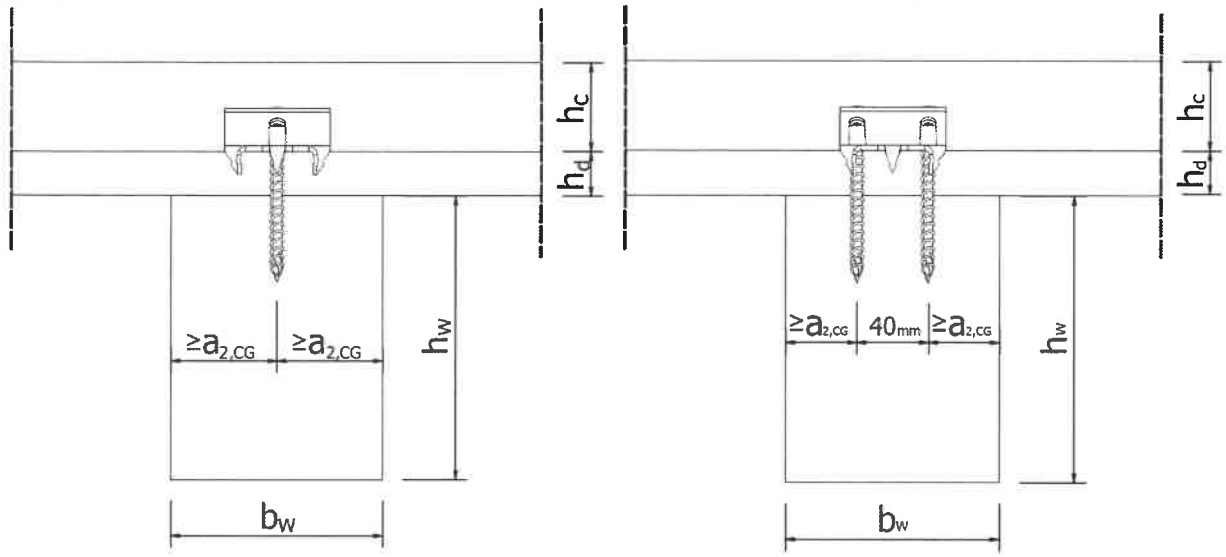


Table A4: Minimum screw spacing / distances / dimensions.

Nominal diameter - d [mm]	8	10
Spacing between screws - a_2 [mm]	40	40
Minimum spacing parallel to grain - a_1 [mm]	80	80
Minimum end distance - $a_{1,CG}$ [mm]	100	120
Minimum edge distance - $a_{2,CG}$ [mm]	32	40
Minimum height of base material (without moulding) - h_w [mm]*	80	110
Minimum width of base material (without moulding) - b_w [mm]*	104	120
Minimum thickness of concrete slab - h_c [mm]	50	
Minimum thickness of FRC slab - h_c [mm]	30	
Thickness of moulding - h_d [mm]	0 - 50	

* One PSK1 / PSK2 connector per width of base material - timber beam.

A5: Installation of shear connectors (1)

Figure A5_1: Installation of products: EFG PSK1-45 (25 mm) – top, beam distribution – bottom.

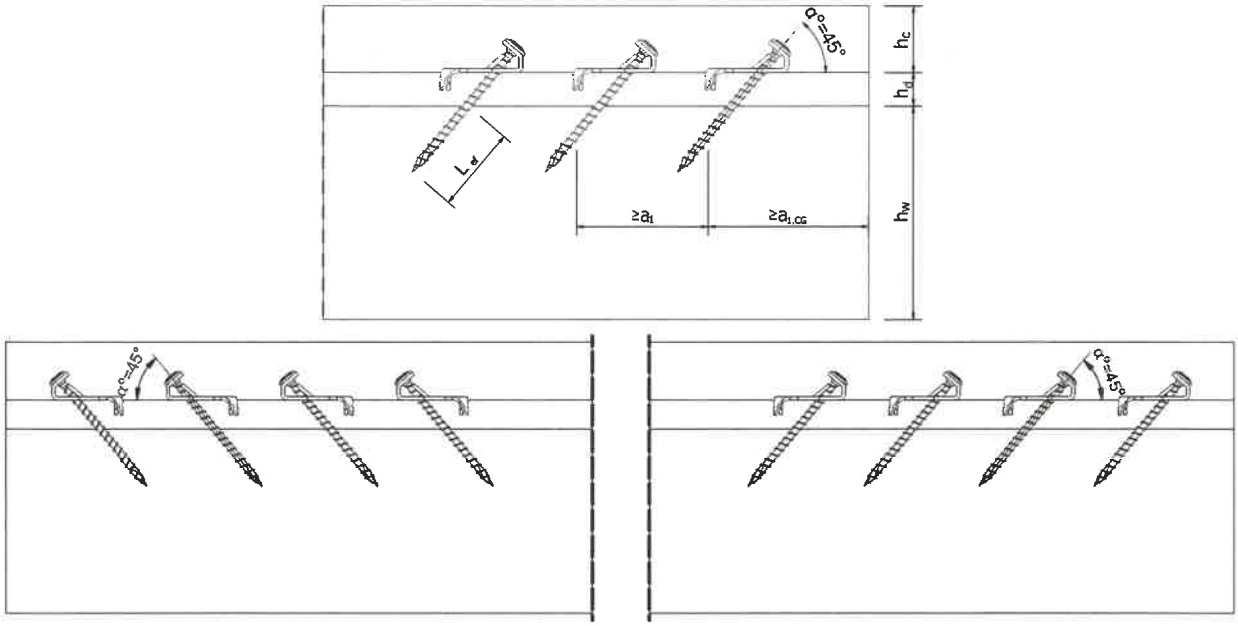


Figure A5_2: Installation of products: EFG PSK1-45 (h_d = 50 mm).

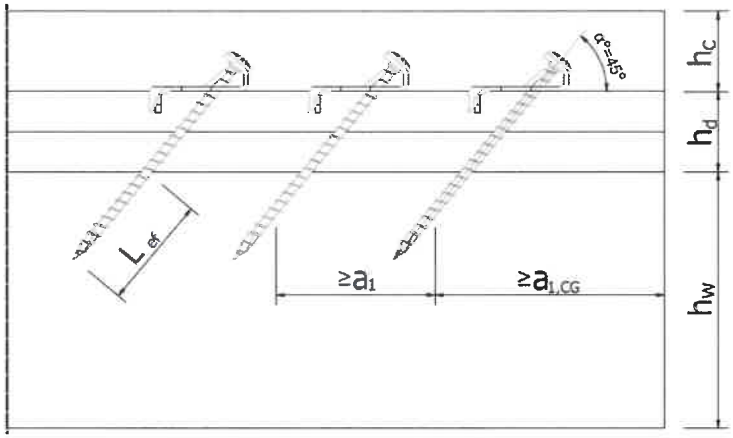
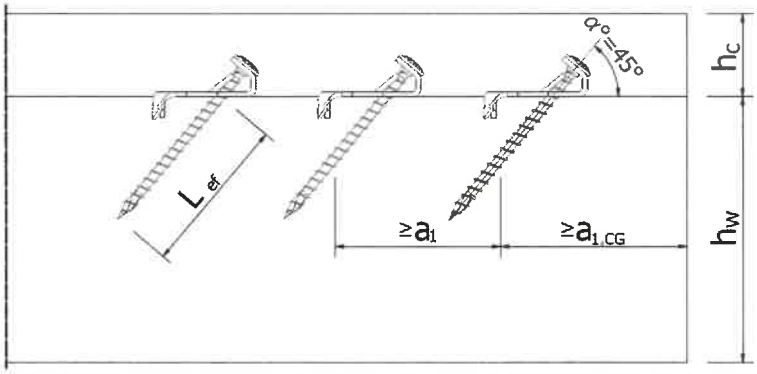


Figure A5_3: Installation of products: EFG PSK1-45 (moulding absent).



A6: Installation of shear connectors (2)

Figure A6_1: Installation of products: EFG PSK1-90 (25 mm).

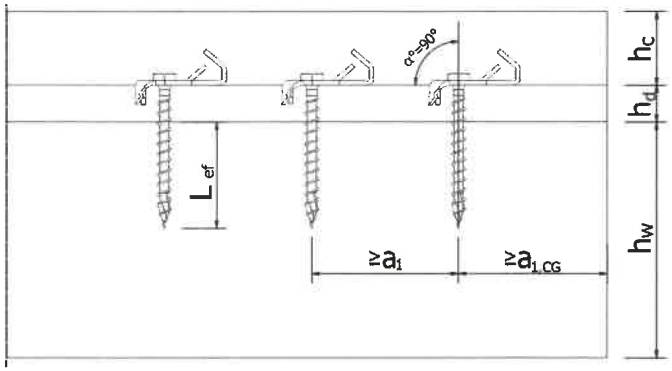
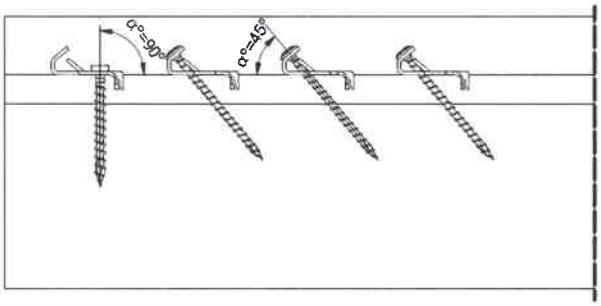
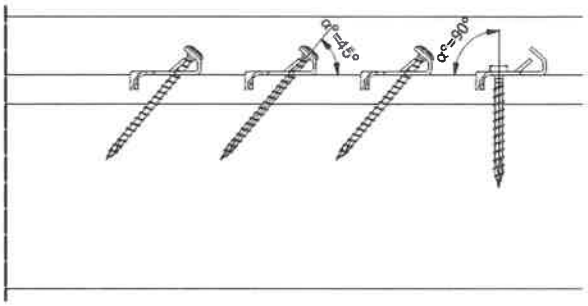


Figure A6_2: Installation of products: EFG PSK1-45+90 (25 mm).





A7: Mechanical properties

a.) Introduction

The calculation method for the load bearing capacity and the deformation of mechanically jointed beams shall follow EN 1995-1-1:2004/A2:2014 (Annexes B, C) and EN 1992-1-1:2004/A1:2014, taking into account the characteristics of the dowel-type fasteners, calculation shall assume linear relationship between force and slip occurring in the joints. National requirements valid in the place of use may be applied.

The threaded part of the screw in timber / timber based material is considered elastic, parallel to the screw axis and f the concrete is considered as infinitively stiff.

Friction forces between timber and concrete are not to be considered.

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

b.) Design of the wood-concrete composite slab

The design of the wood-concrete composite slab with dowel-type fasteners 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 shall 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 1995-1-1:2004/A2:2014 and EN 1992-1-1:2004/A1:2014.

The values of the deformation factors K_{def} for timber and connectors should be taken from EN 1995-1-1:2004/A2:2014. The values of the deformation factor φ for concrete should be taken from EN 1992-1-1:2004/A1:2014. For composite beams in service class = 1, φ for concrete may be taken = 2.5. For prefabricated concrete slabs, the concrete shrinkage may be disregarded.

Additionally, 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. A proposed effective width of the concrete slab b_{eff} according to EN 1992-1-1:2004/A1:2014 (Ch. 5.3.2): $b_{eff} = b_w + 0.2\ l_o \leq s$ (l_o - span of base material - timber beam, s - spacing between consecutive base material - timber beams).

A8: Values of K_{ser}, K_u and $F_{v,Rk}$ (reinforced concrete)

Table A8: Values of K_{ser}, K_u and $F_{v,Rk}$ (reinforced concrete, min C20/25, timber C24 or higher).

Connector type*	Moulding	$F_{v,Rk}$ [kN]	K_{ser} [kN/mm]	K_u [kN/mm]
EFG PSK1-45-100	absent	10.991	18.52	14.94
EFG PSK1-45-120		13.557	20.81	12.49
EFG PSK1-90-80		13.022	10.00	3.63
EFG PSK2-45-100		26.131	31.24	25.43
EFG PSK2-45-120		22.818	36.34	35.51
EFG PSK2-90-80		16.065	24.27	5.12
EFG PSK1-45-120	25 mm	10.040	8.71	9.68
EFG PSK1-45-160		16.473	13.04	11.01
EFG PSK1-90-120		10.914	2.01	1.38
EFG PSK2-45-120		18.711	17.28	17.49
EFG PSK2-45-160		30.967	20.84	19.28
EFG PSK2-90-120		20.627	3.39	2.38
EFG PSK2-45-160	2x25 mm	20.104	21.77	24.58
EFG PSK2-90-120		15.715	3.48	3.02

* type (EFG PSK 1 or 2) - angle (45° of 90°) - length of screws (80, 100, 120 and 160 mm).

Design formulations for alternative geometries (only for EFG PSK with 45° screws):

$$F_{v,Rk} = 698 \cdot n \cdot \frac{L_{ef}}{d \cdot sin\alpha} + 1899$$

$$K_{ser} = 1.366 \cdot n \cdot \left(\frac{\rho_m^{1.5}}{1000} \cdot \frac{d}{23} \cdot a \cdot \frac{L_{ef}}{6d}\right) + 4.3$$

$$K_u = \frac{2}{3} K_{ser}$$

n - number of the screws (n = 1 for EFG PSK1, n = 2 for EFG PSK2)
L - length of screws (L = 100, 120, 160 and 180 mm)
L_{ef} - effective thread length in timber element (excluding intermediate decking), $L_{ef} = L - g - h_d / \cos\alpha$ [mm]
g - screw gap between screw head and concrete layer [mm] (g = 23 mm for α = 45°)
d - screw diameter [mm] (d = 8 mm, d = 10 mm)
a - parameter to consider the presence of intermediate decking (a = 2 for no intermediate decking; a = 1 for intermediate decking)
ρ - timber element mean density [kg/m^3] (420 - 480 kg/m^3)
α - angle between screw axis and direction of grain [°] (α = 45°)

A9: Values of K_{ser}, K_u and $F_{v,Rk}$ (FCR concrete)

Table A9: Values of K_{ser}, K_u and $F_{v,Rk}$ (FRC concrete $f_{f,average}$ = 20 MPa, timber C24 or higher):

Connector type*	Moulding	$F_{v,Rk}$ [kN]	K_{ser} [kN/mm]	K_u [kN/mm]
EFG PSK1-45-100	absent	13.323	16.12	19.30
EFG PSK1-45-120		13.991	16.52	15.71
EFG PSK1-90-80		11.267	6.46	4.48
EFG PSK2-45-100		21.236	21.99	20.93
EFG PSK2-45-120		24.455	23.01	17.44
EFG PSK2-90-80		16.798	9.78	6.15
EFG PSK1-45-120	25 mm	9.876	7.62	10.39
EFG PSK1-45-160		14.568	10.68	9.45
EFG PSK1-90-120		9.496	1.83	1.63
EFG PSK2-45-120		21.832	14.86	16.64
EFG PSK2-45-160		31.402	14.95	11.69
EFG PSK2-90-120		19.805	4.04	2.26
EFG PSK2-45-160	2x25 mm	23.303	16.57	13.36
EFG PSK2-90-120		13.558	2.90	2.15

* type (EFG PSK 1 or 2) - angle (45° of 90°) - length of screws (80, 100, 120 and 160 mm).

Design formulations for alternative geometries (only for EFG PSK with 45° screws):

$$F_{v,Rk} = 718 \cdot n \cdot \frac{L_{ef}}{d \cdot sin\alpha} + 1863$$

$$K_{ser} = 0.7315 \cdot n \cdot \left(\frac{\rho_m^{1.5}}{1000} \cdot \frac{d}{23} \cdot a \cdot \frac{L_{ef}}{6d}\right) + 6.9$$

$$K_u = \frac{2}{3} K_{ser}$$

n - number of the screws (n = 1 for EFG PSK1, n = 2 for EFG PSK2)
L - length of screws (L = 100, 120, 160 and 180 mm)
L_{ef} - effective thread length in timber element (excluding intermediate decking), L_{ef} = L – g – h_d / cos α [mm]
g - screw gap between screw head and concrete layer [mm] (g = 23 mm for α = 45°)
d - screw diameter [mm] (d = 8 mm, d = 10 mm)
a - parameter to consider the presence of intermediate decking (a = 2 for no intermediate decking; a = 1 for intermediate decking)
ρ - timber element mean density [kg/m³] (420 - 480 kg/m³)
α - angle between screw axis and direction of grain [°] (α = 45°)