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European Assessment Document for

Wood concrete composite slab kits

This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

This EAD is applicable to wood-concrete composite slab kits designed in accordance with EN 1995-1-1[1] and CEN/TS 19103.

Wood-concrete composite slab kits may have different geometries and different sets of assembled components (see examples given in the Figures below) but **they shall always include**:

- **One of the base materials** listed below (wooden beams or slabs)
- **One of the shear resistant connections** listed below.

Base materials (wooden beams or slabs):

- Glued laminated timber of minimum strength class GL24c according to EN 14080[2].For examples, see Figure 1.1.1 (type 1) and Figure 1.1.3 (type 3).
- Cross laminated timber according to EAD 130005-00-0304 or EN 16351[3] with minimum 3 crosswise arranged layers. Minimum strength class of lamellas for cross laminated timber is C16/T11, average strength class of lamellas is at least C24/T14 according to EN 338. For examples, see Figure 1.1.2 to Figure 1.1.4 (type 2, type 3, type 4, and type 5).
- Prefabricated wood slab element made of square-sawn timber members according to EAD 130011-00-0304 or solid softwood according to EN 14081-1[4]. Minimum strength class of square-sawn timber members is C24 according to EN 338. For example, see Figure 1.1.5 (type 5).

The base materials may be provided with a special milling profile

- for mechanical fixation of a lattice girder in place (type 1), see Figure 1.1.1 where the geometry provides fully with the transfer of tensile and shear loads from the beam to the lattice girder, or
- for inserting a lattice girder/reinforcement and fixation with concrete (type 2), see Figure 1.1.2, or
- for direct application of concrete/screed (type 5), see Figure 1.1.5.

The geometry of the milling profile shall be defined in the ETA.

Shear resistant connections between base materials and the concrete material:

- Lattice girders according to Clause 1.1.1[5]. The lattice girder is fixed in place by a special milling profile (type 1) or inserted into a special milling profile (type 2) and fixed with concrete.
- Solid wood members (predefined grid or single boards) of softwood[4] with minimum characteristic density of 320 kg/m³ (raw material minimum strength class C16/T11) bonded to the base material by gluing with an adhesive of type I according to EN 301 or EN 15425 (type 3 and type 4), see Figure 1.1.3 and 1.1.4.
- Special milling profile in the base material (type 5), see example in Figure 1.1.5.

The shear resistant connections shall be able to transfer lifting forces (tensile stress) of at least 10% of the existing shear component in the composite joint according to CEN/TS 19103, Equation (10.19) at least in the area of negative bending moments in order to prevent separation of the concrete slab from the base material. This may be provided by vertically screwed screws (lift-stop), see e.g., Figure 1.1.3 and Figure 1.1.5, or by the geometry of the special milling profile.

The geometry of the shear resistant connection and the position in relation to the concrete slab shall be defined in the ETA.

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1 All undated references to standards or to EADs in this EAD are to be understood as references to the dated versions listed in chapter 4.

2 Only products falling under Commission Decision 2005/610/EC as amended by Commission Delegated Regulation (EU) 2017/1227 are covered by this EAD.

3 Only products falling under Commission Delegated Regulation (EU) 2017/2293 are covered by this EAD.

4 Only products falling under Commission Decision 2003/43/EC as amended by 2003/593/EC, 2006/673/EC and 2007/348/EC are covered by this EAD.

5 Only products falling under Commission Decision 96/603/EC as amended by Commission Decision 2000/605/EC and Commission Decision 2003/424/EC are covered by this EAD.

In addition, wood-concrete composite slab kits shall contain one of the following components not necessarily supplied by the manufacturer but part of assembled system at the building site:

- Reinforced or unreinforced concrete slab with minimum thickness of 60 mm, minimum concrete strength class C20/25 according to EN 206[5], grain size ≤ 16 mm. The concrete slab shall be defined in the ETA.
- Screed material and floor screeds according to EN 13813[5] with minimum thickness of 60 mm, minimum strength class C20, grain size ≤ 16 mm, which may be reinforced by steel Ø ≥ 5 mm and $f_{y,k}$ ≥ 450 MPa. The screed shall be defined in the ETA.

The kit may also contain the following components

One of the following mouldings in case of base material of wooden beams (type 1 and type 3):

- Permanent moulding, e.g., at least 12 mm spruce plywood according to EN 13986[4], to be added at site, or boards or other suitable materials. This moulding has no load-bearing function in the final product. There may be a polyethylene foil (not directly exposed to fire) above the moulding to prevent leakage of water when the concrete is poured on the construction. In this case, friction between the concrete and timber members cannot be taken into account.
- Permanent moulding, e.g., concrete blocks according to EN 15037-2[5], clay blocks according to EN 15037-3[5].
- Permanent moulding of extruded polystyrene foam products (XPS) according to EN 13164.

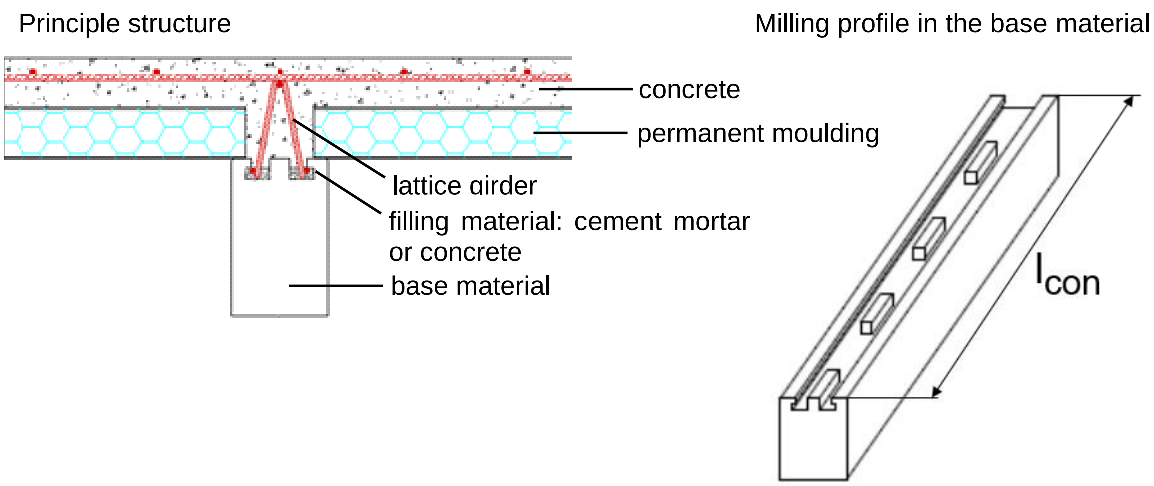
One of the following filling materials in case of shear resistant connections with lattice girders (type 1 and type 2):

- Cement mortar class R4 according to EN 1504-3[5] to fill up the special milling profile that fixes the lattice girder, see Figure 1.1.1 (type 1). Therefore, the cement mortar does not transfer (shear, tensile) loads.
- Concrete of minimum strength class C30/37 according to EN 206[5] for fixation of the lattice girder in the special milling profile, see Figure 1.1.2 (type 2).

For the lattice girder and the reinforcement, the minimum concrete cover c_{min} of EN 1992-1-1, Clause 6.5.2, shall be met or stainless steel shall be used. Otherwise, the restrictions regarding the service classes according to Clause 1.2.1 apply.

Figure 1.1.1: Example type 1 of wood-concrete composite slab kit

Base material: wooden beams provided with a special milling profile for fixation of a lattice girder in place
Shear resistant connection: lattice girders
Additional components: permanent moulding
filling material: cement mortar or concrete
Concrete/screed material as part of assembled system at the building site.



l_{con} length of connection

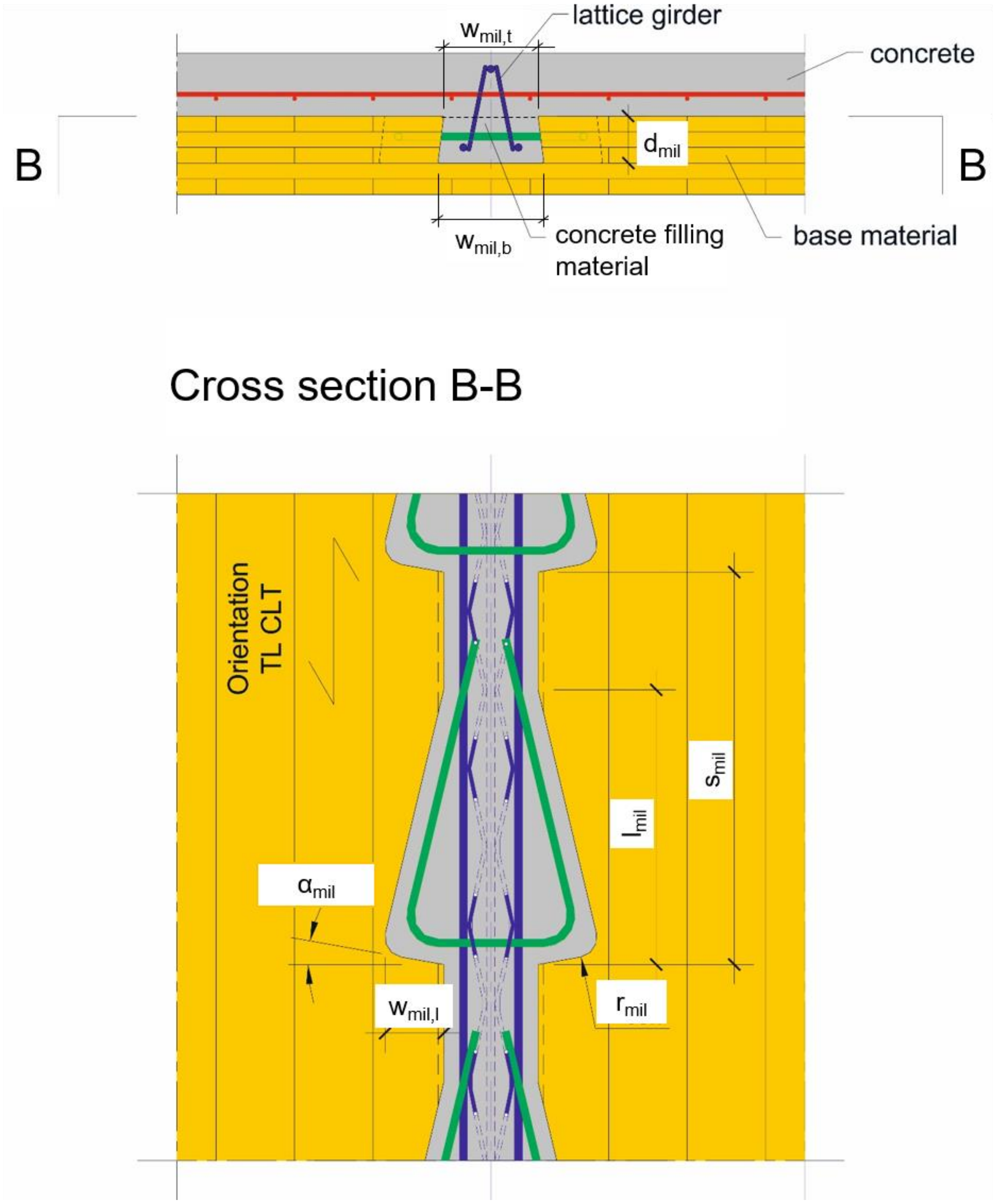
Figure 1.1.2: Example type 2 of wood-concrete composite slab kit

Base material: wooden slab provided with a special milling profile (e.g., drop-shaped millings with reinforcement) for inserting a lattice girder and fixation with concrete filling material

Shear resistant connection: lattice girders

Additional components: filling material: concrete

Concrete/screed material as part of assembled system at the building site.



$w_{mil,l}$ lateral width of milling
$w_{mil,t}$ width of milling on top
$w_{mil,b}$ width of milling on bottom
l_{mil} length of milling
s_{mil} spacing of millings
r_{mil} rounding off radius
α_{mil} angle of milling

Figure 1.1.3: Example type 3 of wood-concrete composite slab kit

Base material: wooden slab or wooden beams
Shear resistant connection: predefined grid of solid wood members bonded to the base material and exemplary lift-stop
Concrete/screed material as part of assembled system at the building site.

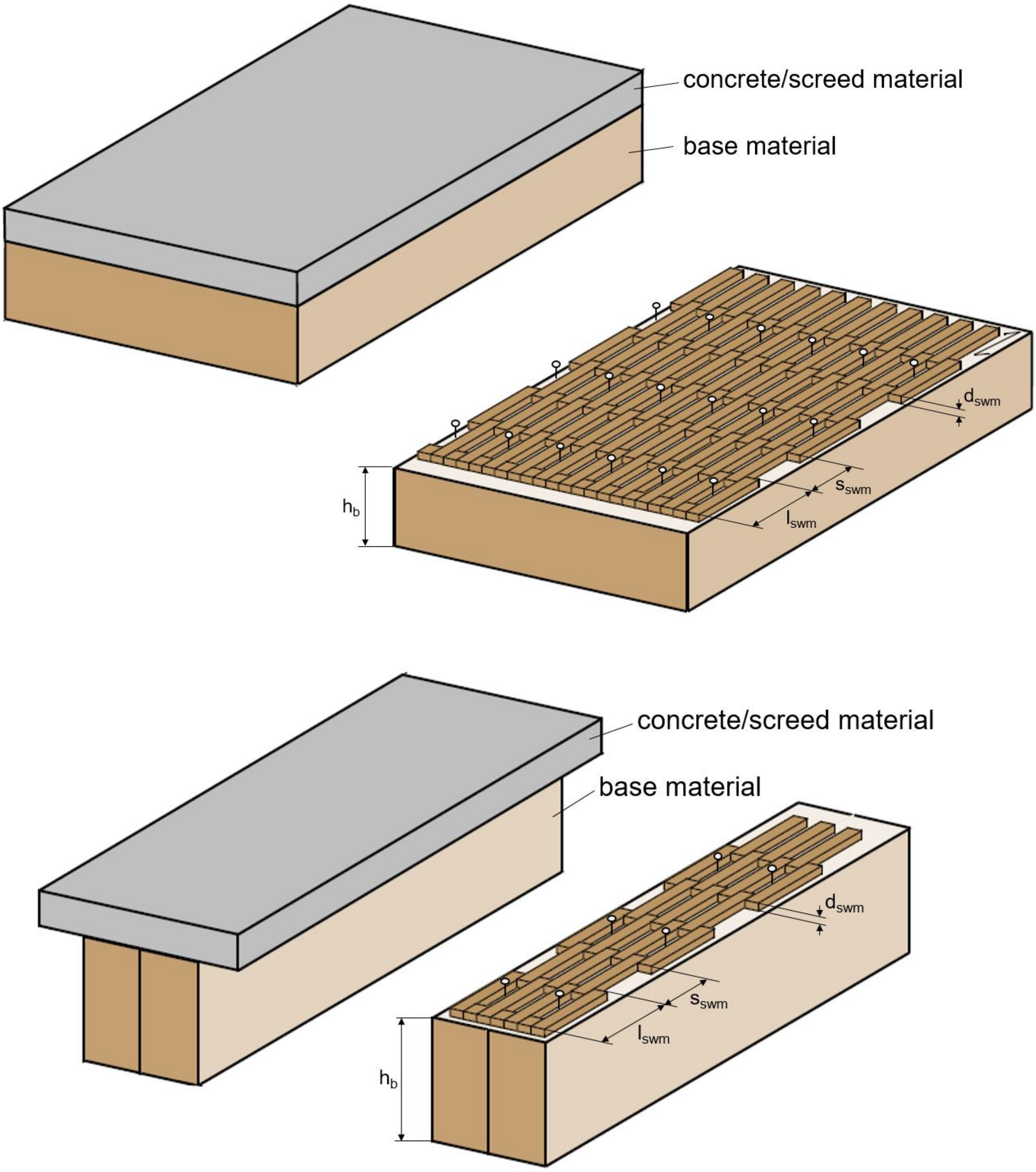


Figure 1.1.4: Example type 4 of wood-concrete composite slab kit

Base material: wooden slab
Shear resistant connection: single boards of solid wood members bonded to the base material
Concrete/screed material as part of assembled system at the building site.

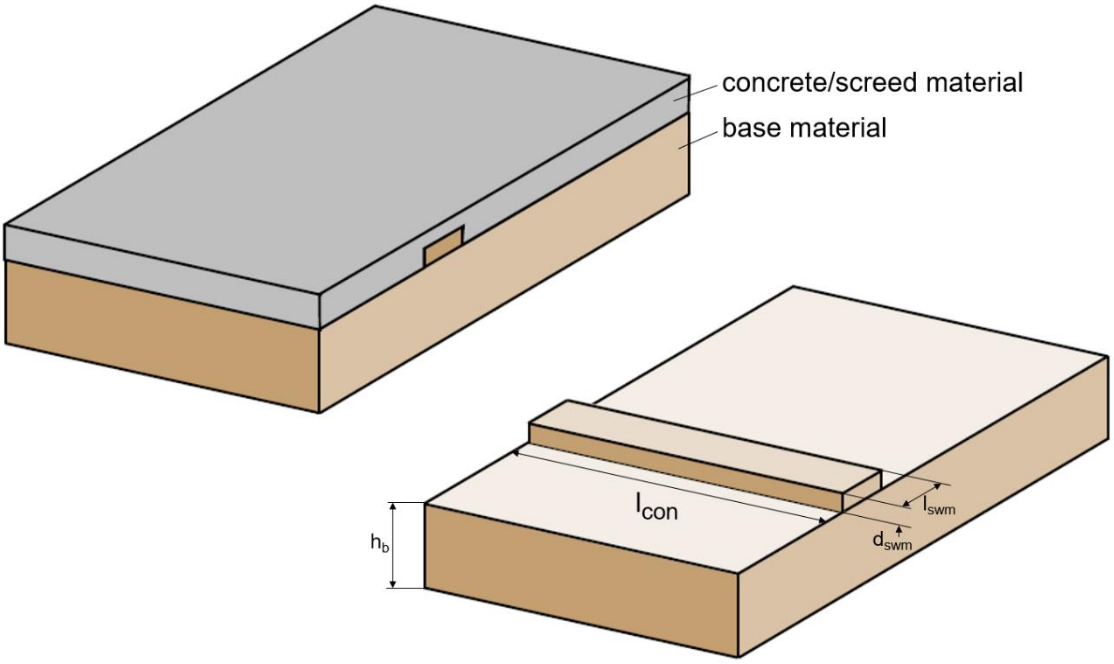
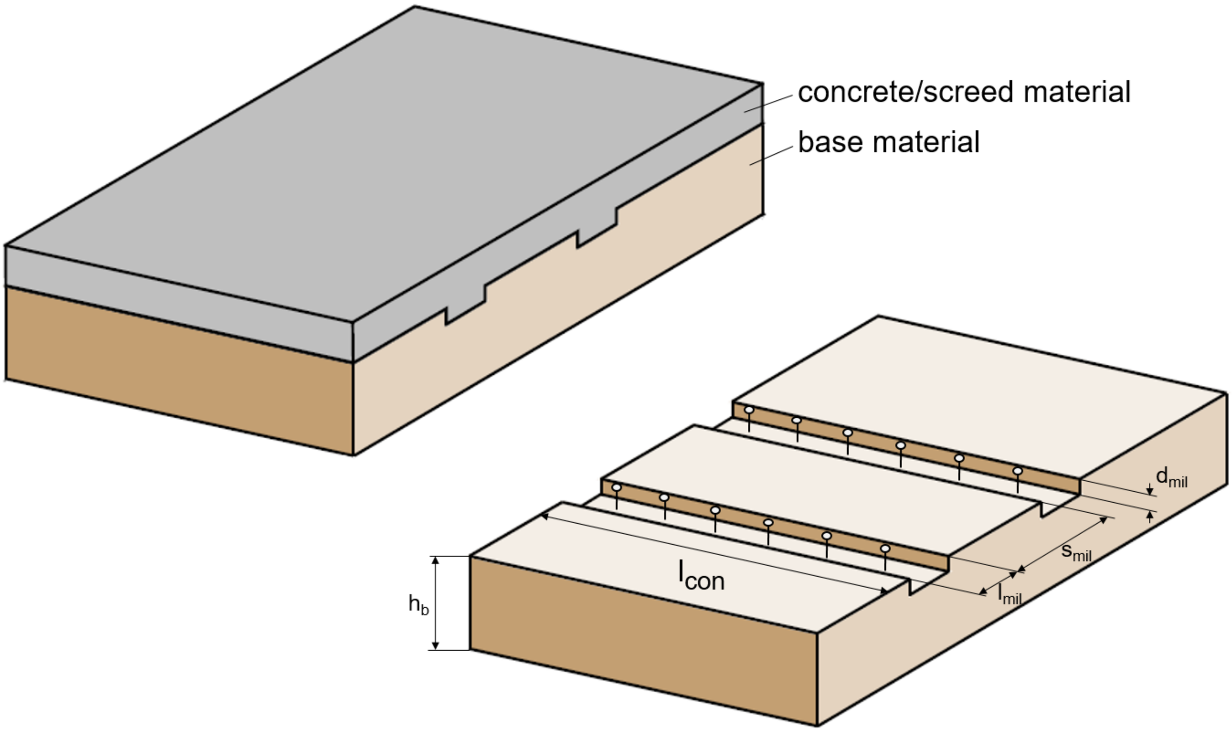
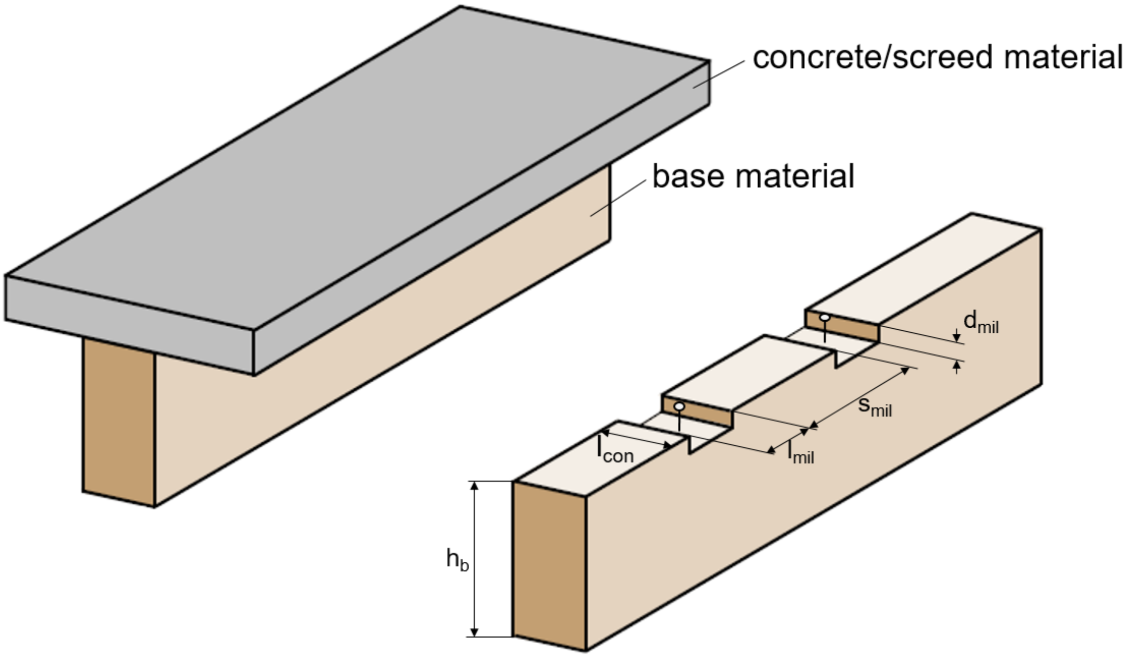


Figure 1.1.5: Example type 5 of wood-concrete composite slab kit

Base material: wooden slab or wooden beams provided with a special milling profile (e.g., milling in full element width)
Shear resistant connection: special milling profile in the base material and exemplary lift-stop
Concrete/screed material as part of assembled system at the building site.





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

This EAD is not applicable when
- timber treatments (preservatives, fire and flame retardants) are used, and/or
- recycled material is used.

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.

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

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document, shall be considered for the determination of the performance and detailed in the ETA.

1.1.1 Lattice girders

Lattice girders are three-dimensional metallic structures comprising an upper chord, one or more lower chords and continuous or discontinuous diagonals which are welded or mechanically assembled to the chords. Examples of weld points in lattice girder joints are given in EN 10080, Annex A.

The lattice girders are defined by
- the design height of the lattice girder H_1,
- the nominal dimensions of the upper chord, diagonal and lower chord, and
- the technical class(es) of the steel(s) for the upper chord, diagonal and lower chord. Technical classes are defined by the tensile strength R_m in MPa, the yield strength R_e in MPa, the ratio tensile strength/yield strength R_m/R_e, the percentage total elongation at maximum force A_{gt}, bendability, weldability, bond strength, strength of welded or clamped joints and tolerances on dimensions.

Lattice girders are described using the indications given in EN 10080, Figure 2, or by a fully dimensioned drawing.

The lattice girders are manufactured according to EN 10080, Clause 6.6.

This EAD covers lattice girders with
- maximum design height of the lattice girder $H_1 \leq 450$ mm and maximum nominal diameter of the reinforcing steel $d \leq 32$ mm, and
- dimensions of lattice girders (assessed according to EN ISO 15630-2, Clause 10.2, and EN 10080, Clause 8.2.1.4) according to EN 10080, Clause 7.3.6, and
- mass and tolerances (assessed according to EN ISO 15630-1, Clause 12) according to EN 10080, Clause 7.3.2, and
- given surface geometry for ribbed and indented reinforcing steel (assessed according to EN ISO 15630-2, Clause 10.3.1 to 10.3.8, and EN 10080, Clause 8.2.1.4), and
- given bond stresses for ribbed and indented reinforcing steel (assessed according to EN 10080, Annex D) and calculated average bond stress $\tau_{dm} = (\tau_{\Delta 0.01} + \tau_{\Delta 0.1} + \tau_{\Delta 1.0}) / 3$ with $\tau_{\Delta 0.01}$, $\tau_{\Delta 0.1}$, and $\tau_{\Delta 1.0}$ as the bond stresses at a slip of 0,01 mm, 0,1 mm, and 1 mm (rupture). If the maximum slip is < 1,0 mm the ultimate bond stress τ_u shall be used,
- maximum values of individual elements (determined according to EN ISO 15630-2, Clause 9) and the carbon equivalent (determined according to EN 10080, Clause 7.1.3) according to EN 10080, Table 2.

This EAD covers lattice girders manufactured of reinforcing steel with the following given mechanical properties according to EN 10080, Clause 7.2:
- tensile properties assessed according to EN ISO 15630-2, Clause 5, and EN 10080, Clause 7.2.3 and 8.2.1.4, and
- shear force of welded or clamped joints assessed according to EN ISO 15630-2, Clause 7.2, and EN 10080, Clause 7.2.4.2 and 8.2.1.4, and
- suitability for bending assessed according to EN ISO 15630-1, Clause 6.1 to 6.3 (bend) and Clause 7.1 to 7.3 (rebend), and EN 10080, Clause 7.2.6.

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

The wood-concrete composite slab kits are intended to be used as load-bearing element to construct floors and ceilings in buildings.

The wood-concrete composite slab kits are subjected to predominantly static loading.

The wood-concrete composite slab kits are intended to be used in service classes 1 and 2 according to EN 1995-1-1. When the minimum concrete cover does not meet the requirements of EN 1992-1-1, Clause 6.5.2, and no stainless steel is used the wood-concrete composite slab kits are intended to be used in service class 1, only.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the wood-concrete composite slab kit for the intended use of 50 years when installed in the works. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[6].

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 when drafting this EAD nor

6 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 may also be shorter than the working life referred to above.

by the Technical Assessment Body issuing an ETA based on this EAD, but are to be regarded only as a means for expressing the expected economically reasonable working life of the product.

1.3 Specific terms used in this EAD

1.3.1 Lift-stop

Protection against lifting up of concrete usually provided by screws screwed vertically into the millings in case of shear resistant connections between base materials and the concrete material, see Figures 1.1.3 and 1.1.5.

1.3.2 MPII

Manufacturer's product installation instructions.

1.3.3 Symbols

For the purpose of this EAD, the terms and definitions given in EN 10080 apply.

c_{min}	[mm]	minimum concrete cover according to EN 1992-1-1, Clause 6.5.2
l_{con}	[mm]	(variable) length of connection, see Figure 1.1.1, Figure 1.1.4 and Figure 1.1.5
$w_{mil,l}$	[mm]	lateral width of milling, see Figure 1.1.2
$w_{mil,t}$	[mm]	width of milling on top, see Figure 1.1.2
$w_{mil,b}$	[mm]	width of milling on bottom, see Figure 1.1.2
d_{mil}	[mm]	depth of milling, see Figure 1.1.2 and Figure 1.1.5
l_{mil}	[mm]	length of milling, see Figure 1.1.2 and Figure 1.1.5
s_{mil}	[mm]	spacing of milling, see Figure 1.1.2 and Figure 1.1.5
r_{mil}	[mm]	rounding off radius, see Figure 1.1.2
α_{mil}	[°]	angle of milling, see Figure 1.1.2
d_{swm}	[mm]	depth of solid wood members, see Figure 1.1.3 and Figure 1.1.4
l_{swm}	[mm]	length of solid wood members, see Figure 1.1.3 and Figure 1.1.4
s_{swm}	[mm]	spacing of solid wood members, see Figure 1.1.3
n_n	[-]	number of concrete notches on one specimen side, see Figure 2.2.1.1.1.5
h_b	[mm]	height of base material, see Figure 1.1.3 to Figure 1.1.5
w_s	[mm]	width of specimens in compression shear tests
w_c	[mm]	width of concrete element in compression shear tests
h_s	[mm]	height of specimens in compression shear tests
h_{con}	[mm]	connection height in compression shear tests
d_s	[mm]	depth of specimens in compression shear tests
l_s	[mm]	length of specimens in compression shear tests
a_{min}	[mm]	minimum distance between the edge of the concrete notch to the end grain
F_{con}	[N]	load bearing capacity of shear resistant connection
$F_{con,k}$	[N]	characteristic load bearing capacity of shear resistant connection
F_{max}	[N]	maximum load reached in tests
K_{ser}	[N/mm]	slip modulus for serviceability limit states of shear resistant connection
k_s	[N/mm]	slip modulus for serviceability limit states determined in compression shear tests according to EN 26891, Clause 8.5
h	[mm]	height of bending/shear specimens
h_c	[mm]	height of concrete element in bending/shear specimens
h_m	[mm]	height of moulding in bending/shear specimens
l	[mm]	span of bending/shear specimens
l_1	[mm]	measuring length for determination of local modulus of elasticity in bending/shear specimens
a	[mm]	distance support to load introduction in bending/shear specimens
Δw_g	[mm]	increase of global deformation $w_2 - w_1$ according to EN 408, Clause 10.3
F_v	[N]	shear capacity determined in full scale tests
F	[N]	load applied in one load introduction point in full scale tests
M_u	[Nmm]	moment capacity determined in full scale tests

(EI)	[Nmm²]	flexural rigidity
ΔF	[N]	increase of load $F_2 – F_1$ according to EN 408, Clause 9.3
$Δw_l$	[mm]	increase of local deformation $w_2 – w_1$ according to EN 408, Clause 9.3
k	[-]	moisture deformation factor for a change in moisture content of 1 %
$ε_{cc}$	[‰]	creep strain
$ε_{cs}$	[‰]	shrinkage strain.

Calculation models according to Clause 2.2.1.1.3:

EI^*	[Nmm²]	flexural rigidity of the truss elements replacing shear resistant connections
K_i	[N/mm]	slip modulus of the shear resistant connection
$z_{c,b}$	[mm]	distance of concrete/base material to shear resistant connection
$w_{g,calc}$	[mm]	mid deflection obtained in truss model
F_{calc}	[N]	load applied in calculation models
$F_{u,test}$	[N]	ultimate load determined in bending tests according to Clause 2.2.1.1.2
$(EI)_{g,calc}$	[Nmm²]	global flexural rigidity calculated in truss model
l	[mm]	span of specimens
a	[mm]	distance support to load introduction
r	[-]	utilisation factors
$\sigma_{b,t,0}$	[N/mm²]	stress in base material from normal force
$\sigma_{b,m}$	[N/mm²]	stress in base material from bending moment
$f_{b,t,0,k}$	[N/mm²]	tensile strength parallel to the grain of base material
$f_{b,m,k}$	[N/mm²]	bending strength of base material
$\tau_{v/r}$	[N/mm²]	shear stress in base material
V_b	[N]	shear force in the base material
$S_{v/r}$	[mm³]	static moment of base material for shear/rolling shear
I_b	[mm⁴]	moment of inertia of base material
b	[mm]	width of base material
$f_{b,v,k}$	[N/mm²]	shear strength of base material (shear/rolling shear)
$\sigma_{c,c}$	[N/mm²]	stress from normal force in concrete
$f_{c,k}$	[N/mm²]	compressive strength of concrete
τ_c	[N]	shear stress in concrete
$\tau_{Rk,c}$	[N]	shear stress resistance of concrete
$F_{v,con}$	[N]	shear force in shear resistant connection
$F_{con,k}$	[N]	shear resistance of shear resistant connection
$E_{c/b}$	[N/mm²]	E-Modulus of concrete/base material
$I_{c/b}$	[mm⁴]	moment of inertia of concrete/base material
$A_{c/b}$	[mm²]	cross-section of concrete/base material
$a_{c/b}$	[mm]	distance from the centre of gravity of the whole cross-section to the centre of gravity of concrete/base/material
s	[mm]	distance of shear resistant connections
M_{ges}	[Nmm]	bending moment acting in calculation method for mechanically jointed beams
$M_{b/c}$	[Nmm]	bending moment of base material/concrete
$N_{b/c}$	[N]	normal force of base material/concrete
$h_{c/b}$	[mm]	height of concrete/base material
$W_{c/b}$	[mm³]	section modulus of concrete/base material.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2.1.1 shows how the performance of the wood-concrete composite slab kit is assessed in relation to the essential characteristics.

Table 2.1.1 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

No	Essential characteristic	Method of assessment	Type of expression of product performance
Basic Works Requirement 1: Mechanical resistance and stability			
1	Mechanical resistance and stiffness	2.2.1	Description, level Calculation assisted by testing: Calculation method, $F_{con,k}$ [N] and K_{ser} [N/mm] together with description of components, shear resistant connection, cross section as well as M_u [Nmm], (EI) [Nmm²], F_v [N] for one standard cross-section Testing: M_u [Nmm], (EI) [Nmm²], F_v [N] together with description of components, shear resistant connection, cross section
2	Dimensional stability	2.2.2	Level For the wood-based components: $\delta l_{65,85}$ [mm/m], $\delta l_{65,30}$ [mm/m] $\delta w_{65,85}$ [mm/m], $\delta w_{65,30}$ [mm/m] k_{def} [-] For concrete/screed: ε_c [‰],ε_s [‰]
Basic Works Requirement 2: Safety in case of fire			
3	Reaction to fire	2.2.3	Class of components
4	Resistance to fire	2.2.4	Class
Basic Works Requirement 3: Hygiene, health and the environment			
5	Content, emission and/or release of dangerous substances	2.2.5	Level [mg/m³]
Basic Works Requirement 6: Energy economy and heat retention			
6	Thermal conductivity	2.2.6	Level λ [W/mK] of components
7	Air permeability	2.2.7	Level C [$m^3/s{\cdot}Pa^n$], n [-], A_L [m²] and Δp [Pa]

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as “shall be stated in the ETA” or “it has to be given in the ETA” shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose any obligations for the manufacturer and the TAB shall not carry out the assessment of the performance in relation to a given essential characteristic when the manufacturer does not wish to declare this performance in the Declaration of Performance.

If for any components covered by harmonised standards or European Technical Assessments the manufacturer of the component has included the performance regarding the relevant characteristic in the Declaration of Performance, retesting of that component for issuing the ETA under the current EAD is not required.

The assessment of the wood-concrete composite slab kits shall be carried out by means of assessment of specimens with concrete or screed of the lowest strength class with minimum reinforcement as specified in the MPII intended to be used in the wood-concrete composite slab kit.

2.2.1 Mechanical resistance and stiffness

The mechanical resistance and stiffness of the wood-concrete composite slab kit shall be assessed using one of the two following assessment methods:

1) Calculation assisted by testing (reference method, leads to conservative results)

If the manufacturer does not define predetermined cross-sections, a calculation method (or software) for determination of the mechanical resistance and stiffness of the kit shall be presented, see Clause 2.2.1.1. Calculation shall be performed using the strength and stiffness properties of the components as well as the input values for the mechanical resistance and stiffness of the shear resistant connection determined in compression-shear tests according to Clause 2.2.1.1.1.

2) Testing

If the manufacturer defines predetermined cross-sections, the mechanical resistance and stiffness of the kit can be determined by testing, see Clause 2.2.1.2. The test results are valid only for the cross-sections as tested.

2.2.1.1 Calculation assisted by testing

Purpose of the assessment and assessment method

For calculation assisted by testing the following steps shall be followed:

- Testing of the mechanical resistance and stiffness **of the shear resistant connection** in compression-shear tests according to Clause 2.2.1.1.1 as input values for calculation.
- Testing of the mechanical resistance and stiffness **of the kit** according to Clause 2.2.1.1.2 for validation of calculation method by comparison with this tests.
- Calculation of the mechanical resistance and stiffness of the kit according to Clause 2.2.1.1.3 and validation of the calculation method by comparison with tests according to Clause 2.2.1.1.2. Calculation shall be performed using the strength and stiffness properties of the components as well as the input values for the mechanical resistance and stiffness **of the shear resistant connection** determined in compression-shear tests according to Clause 2.2.1.1.1.

Expression of results

The calculation method together with the following input values for calculation of the mechanical resistance and stiffness of the kit shall be presented in the ETA:

- Mechanical properties (strength class or strength and stiffness properties) of the individual components.
- Mechanical resistance and stiffness of the shear resistant connection:

    - Characteristic load bearing capacity of the shear resistant connection $F_{con,k}$ in [N] and
    - mean value of the slip modulus K_{ser} in [N/mm].
- Type, geometry and arrangement of the shear resistant connection.
- Typical cross-section of the wood-concrete composite slab kit together with the dimensional limits covered by the calculation.

In addition the characteristic moment capacity M_u [Nmm], mean flexural rigidity (EI) [Nmm²] and shear capacity F_v [N] calculated for at least one standard cross section together with the input values shall be given in the ETA.

2.2.1.1.1 Testing of the mechanical resistance and stiffness of the shear resistant connection

Testing of the mechanical resistance and stiffness of the shear resistant connection between base and concrete material in compression-shear tests as input values for calculation.

Compression-shear tests shall be performed at least on specimen composed of components of the minimum strength class intended to be used.

The base materials shall be conditioned to constant mass and moisture content in a climate chamber at storage conditions of (20 ± 2) °C and (65 ± 5) % relative humidity prior to specimen manufacture. The density of the base materials shall fulfil the conditions according to EN ISO 8970, Clause 5.

NOTE: Constant mass is considered to be attained when the results of two successive weighings, carried out at an interval of 6 hours, do not differ by more than 0,1 % of the mass.

The tests shall be conducted at the earliest 28 days after sample preparation.

The minimum number of tests is 10 for each geometry of the shear resistant connection. Test specimens for the different types of shear resistant connections are described below:

- Compression shear tests for wood-concrete composite slab kits with wooden beams as base material and lattice girders as shear resistant connections - type 1 as of the Figure 1.1.1.
- Compression shear tests for wood-concrete composite slab kits with wooden slabs as base material and lattice girders as shear resistant connections - type 2 as of the Figure 1.1.2.
- Compression shear tests for wood-concrete composite slab kits with wooden beams or slabs as base material and solid wood members (predefined grid or single boards) or special milling profile in the base material as shear resistant connections - type 3 to 5 as of the Figure 1.1.3 to 1.1.5.

The load bearing capacity of the shear resistant connection F_{con} as well as the slip modulus for serviceability limit states K_{ser} shall be determined for each specimen. Calculation of k_s according to EN 26891, Clause 8.5. Hereby, each extensometer shall be evaluated and the mean value shall be determined.

Characteristic load bearing capacity of the shear resistant connection $F_{con,k}$ as well as the mean value of the slip modulus K_{ser} shall be determined in accordance with EN 14358, lognormal distribution.

The results may also be applied to wood-concrete composite kits composed of components of higher strength class and with larger cross-sections for the same geometry of the shear resistant connection.

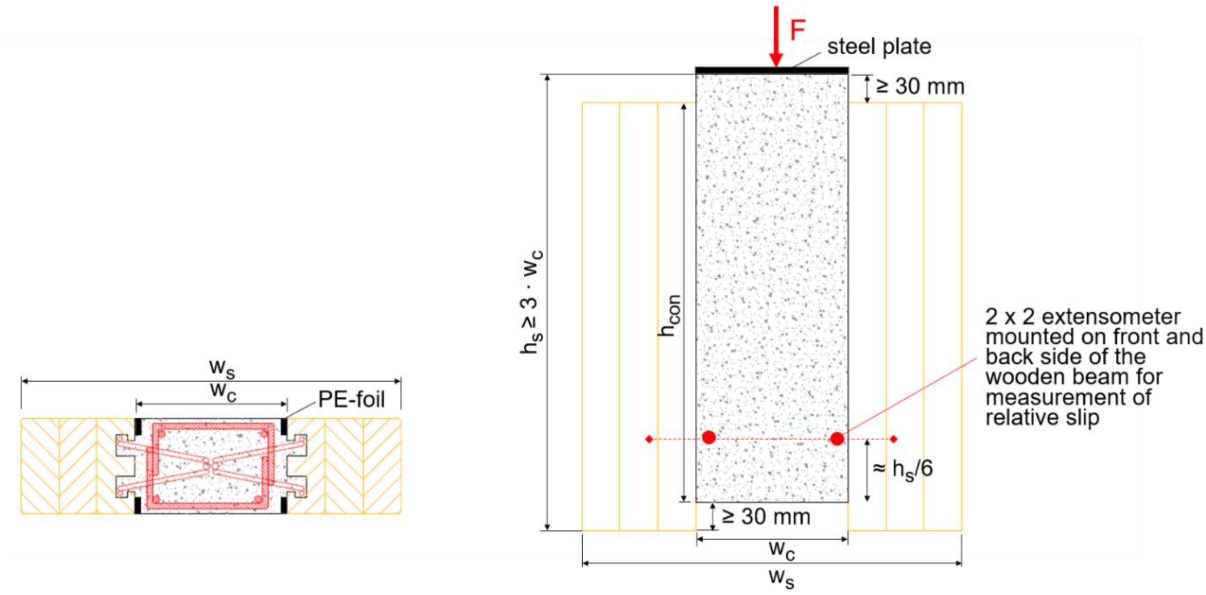
<u>Compression shear tests for wood-concrete composite slab kits with wooden beams as base material and lattice girders as shear resistant connections - type 1 as of the Figure 1.1.1.</u>

For wood-concrete composite slab kits according to Figure 1.1.1, compression shear tests shall be performed on symmetric specimens according to Figure 2.2.1.1.1.1:

- The symmetric specimens shall be composed of two wooden beams of smallest cross-section.
- Each wooden beam shall be provided with the milling profile as the manufacturer uses in his products e.g., for fixation of a lattice girder in place.
- Each wooden beam shall be provided with one lattice girder with the geometry as specified in the MPII.
- In order to exclude adhesion, a plastic foil (PE-foil) shall be placed between the concrete and the timber.
- Concrete or screed of the lowest strength class and minimum reinforcement as specified in the MPII shall be used. Possible reinforcement shall be provided before concreting. The minimum concrete cover of EN 1992-1-1 shall be met.

- The height of the specimens h_s is 3 times the width of the concrete element w_c whereas the width of the concrete element depends on the height of the lattice girders.
- The width of the concrete element w_c is 2 times the real middle height of lattice girders.
- The concrete element shall be concreted with 30 mm distance (bottom and top), see Figure 2.2.1.1.1.1.
- Force shall be applied evenly in the concrete part on the top following EN 26891, Figure 1, and load-deformation curves shall be recorded. F_{est} shall be established according to EN 26891, Clause 8.1. Displacements shall be measured with extensometers as given in Figure 2.2.1.1.1.1.

Figure 2.2.1.1.1.1: Exemplary configuration for compression shear test in structures with wooden beams as base material and lattice girders as shear resistant connections (symmetric arrangement)



Top view Side view

F_{con} and K_{ser} shall be calculated per shear resistant connection

$$K_{ser} = \frac{k_s}{2 \cdot h_{con}} \cdot l_{con} \text{ in N/mm} \quad (2.2.1.1.1.1)$$

$$F_{con} = \frac{F_{max}}{2 \cdot h_{con}} \cdot l_{con} \text{ in N} \quad (2.2.1.1.1.2)$$

with

k_s [N/mm]	slip modulus for serviceability limit states determined according to EN 26891, Clause 8.5
h_{con} [mm]	connection height in compression shear tests, see Figure 2.2.1.1.1.1
l_{con} [mm]	(variable) connection length, see Figure 1.1.1
F_{max} [N]	maximum load reached in the tests.

F_{con} and K_{ser} are applicable to the tested geometry of the milling profile and lattice girder and variable connection length.

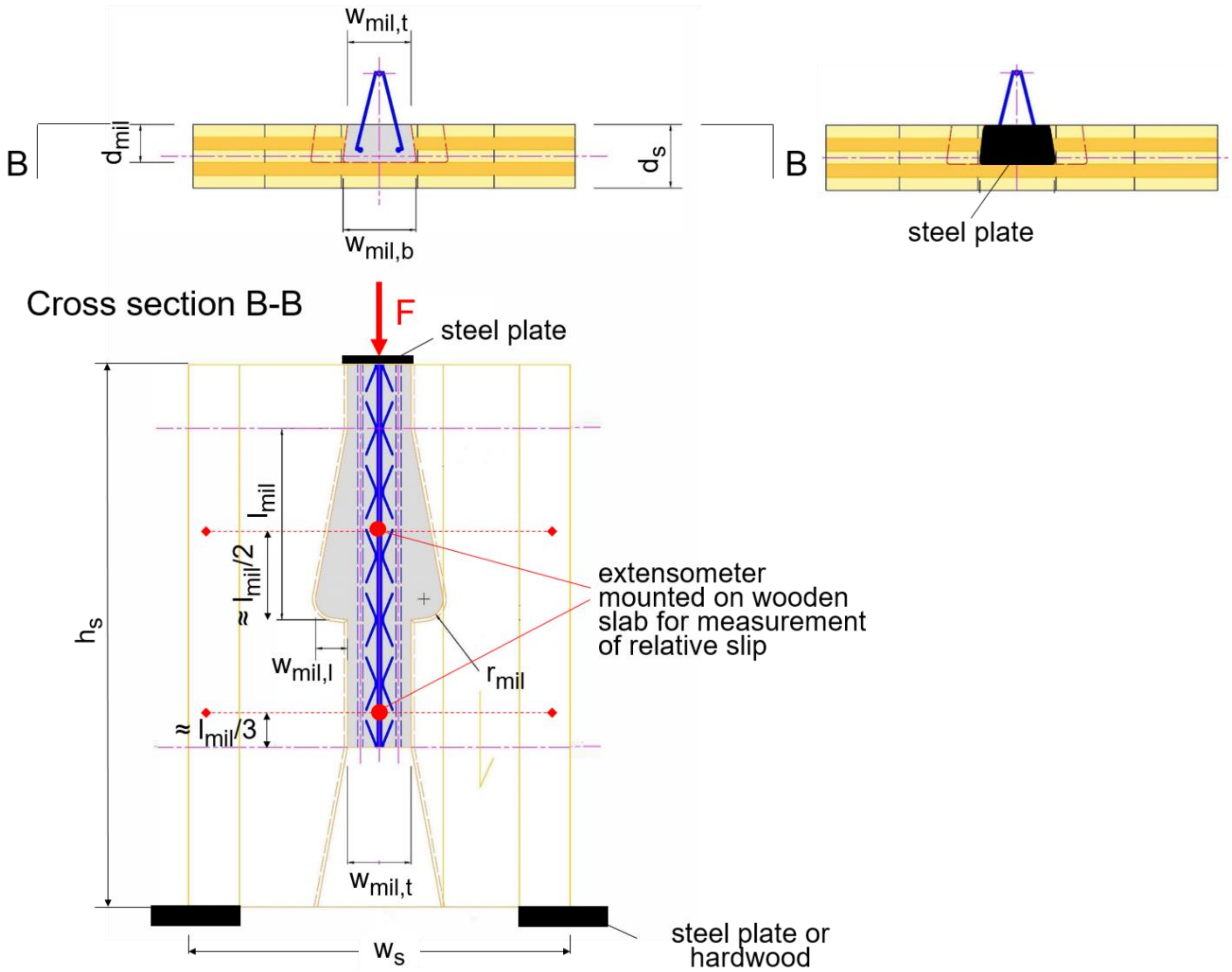
<u>Compression shear tests for wood-concrete composite slab kits with wooden slabs as base material and lattice girders as shear resistant connections - type 2 as of the Figure 1.1.2</u>

For wood-concrete composite slab kits according to Figure 1.1.2, compression shear tests shall be performed on asymmetric specimens according to Figure 2.2.1.1.1.2:

- The asymmetric specimens shall be composed of a wooden slab of smallest thickness.
- The wooden slab shall be provided with one milling profile as the manufacturer uses in his products e.g., for inserting a lattice girder and fixation with concrete.
- The wooden slab shall be provided with one lattice girder inside the milling profile.
- Concrete or screed of the lowest strength class and minimum reinforcement as specified in the MPII shall be used. Possible reinforcement shall be provided before concreting. The minimum concrete cover of EN 1992-1-1 shall be met.

- The height of the specimen shall be at least 2 times the length of the milling l_{mil}, the width of the specimen shall be at least 6 times the bottom width of the milling $w_{mil,b}$.
- Force shall be applied evenly in the concrete part on the top following EN 26891, Figure 1, and load-deformation curves shall be recorded. F_{est} shall be established according to EN 26891, Clause 8.1. Displacements shall be measured with extensometers as given in Figure 2.2.1.1.1.2.

Figure 2.2.1.1.1.2: Exemplary configuration for compression shear test in structures with wooden slabs as base material and lattice girders as shear resistant connections (asymmetric arrangement)



F_{con} and K_{ser} shall be calculated per shear resistant connection as

$$K_{ser} = k_s \text{ in N/mm} \quad (2.2.1.1.1.3)$$

$$F_{con} = F_{max} \text{ in N} \quad (2.2.1.1.1.4)$$

with

k_s [N/mm]	slip modulus for serviceability limit states determined according to EN 26891, Clause 8.5
F_{max} [N]	maximum load reached in the tests

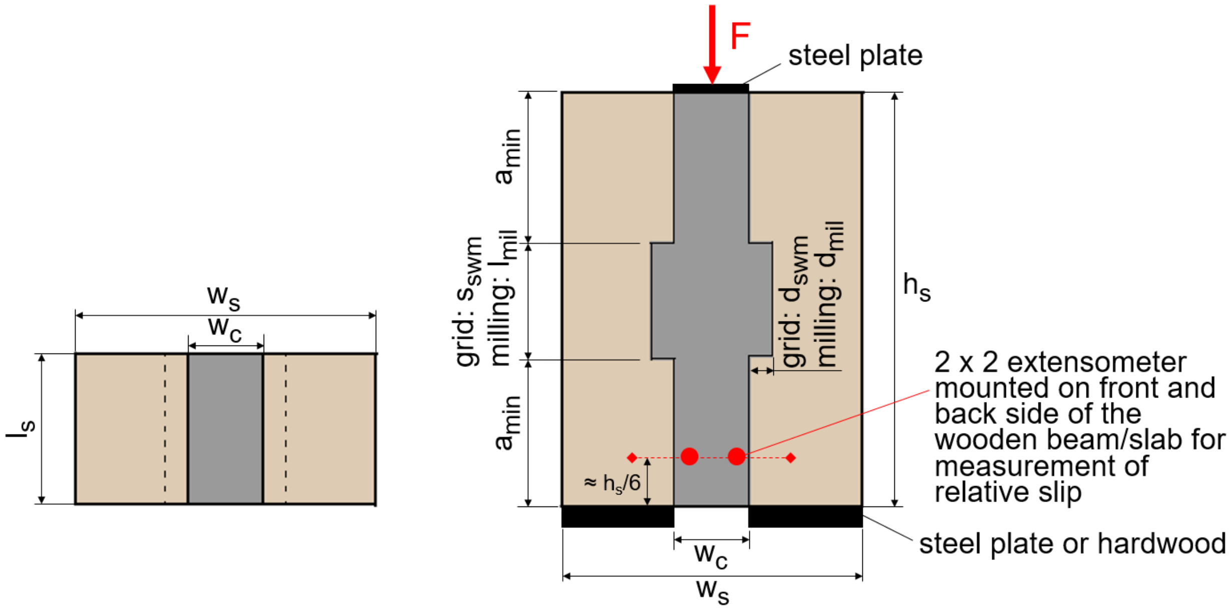
F_{con} and K_{ser} are applicable to the tested geometry of the milling profile and lattice girder.

<u>Compression shear tests for wood-concrete composite slab kits with wooden beams or slabs as base material and solid wood members (predefined grid or single boards) or special milling profile in the base material as shear resistant connections - type 3 to 5 as of the Figure 1.1.3 to 1.1.5</u>

For wood-concrete composite slab kits according to Figure 1.1.3 to 1.1.5, compression shear tests shall be performed on symmetric specimens, see Figure 2.2.1.1.1.3 and Figure 2.2.1.1.1.4:

- The symmetric specimens shall be composed of two wooden beams of smallest cross-section or two wooden slabs of smallest thickness.
- Each wooden beam/slab shall be provided with either a predefined grid or single boards of solid wood members or with a special milling profile.
- In order to exclude adhesion outside the area of the shear resistant connection, a plastic foil shall be placed between the concrete and the timber.
- Concrete or screed of the lowest strength class and minimum reinforcement as specified in the MPII shall be used. Possible reinforcement shall be provided before concreting. The minimum concrete cover of EN 1992-1-1 shall be met.
- The height of the specimen is the length of the concrete notch (s_{swm} for predefined grid, l_{swm} for single boards or l_{mil} according to the milling profile as the manufacturer uses in his products) adding the intended minimum distance between the edge of the concrete notch to the end grain a_{min} on the top and on the bottom.
- The width of the concrete element w_c is 2 times the minimum concrete thickness.
- Force shall be applied evenly in the concrete part on the top following EN 26891, Figure 1, and load-deformation curves shall be recorded. F_{est} shall be established according to EN 26891, Clause 8.1. Displacements shall be measured with extensometers as given in Figure 2.2.1.1.1.3 and 2.2.1.1.1.4.

Figure 2.2.1.1.1.3: Exemplary configuration for compression shear test in structures with wooden beams or slabs as base material and solid wood members (predefined grid) or special milling profile in the base material as shear resistant connections (symmetric arrangement)



Top view Side view

Figure 2.2.1.1.1.4: Exemplary configuration for compression shear test in structures with wooden beams or slabs as base material and solid wood members (single boards) as shear resistant connections (symmetric arrangement)

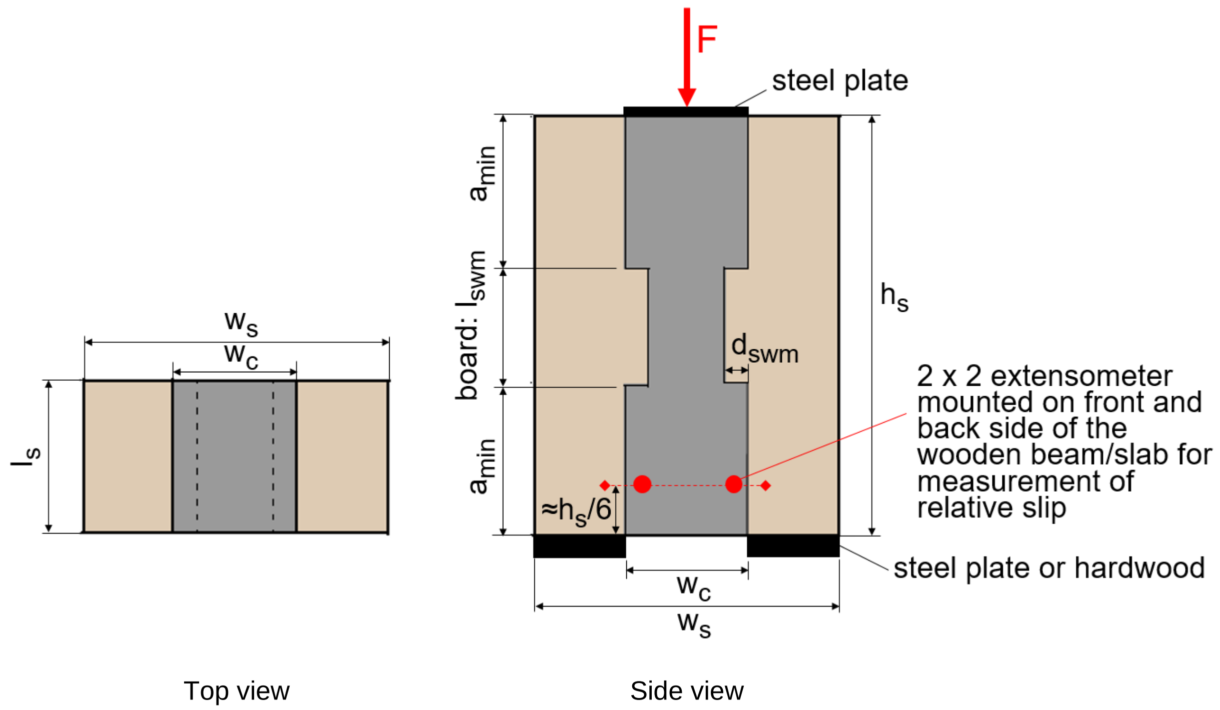
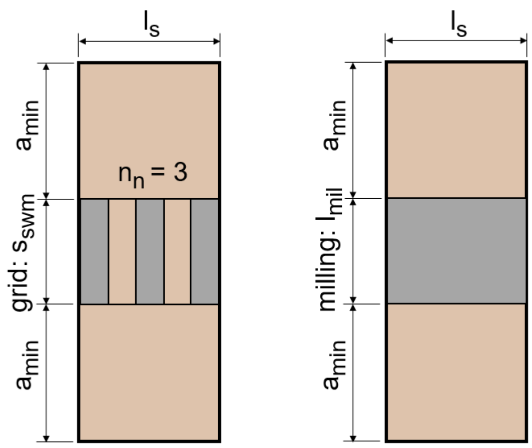


Figure 2.2.1.1.1.5: Determineation of F_{con} and K_{ser} for a shear resistant connection of a predefined grid (left e.g. n_n = 3) and for shear resistant connections over the full element width (right)



In case of a shear resistant connection of a predefined grid (see Figure 1.1.3 and Figure 2.2.1.1.1.5, left) F_{con} and K_{ser} shall be calculated per concrete notch as

$$K_{ser} = \frac{k_s}{2 \cdot n_n} \text{ in N/mm} \quad (2.2.1.1.1.5)$$

$$F_{con} = \frac{F_{max}}{2 \cdot n_n} \text{ in N} \quad (2.2.1.1.1.6)$$

In case of shear resistant connections over the full element width (see Figure 1.1.4, Figure 1.1.5 and Figure 2.2.1.1.1.5, right) F_{con} and K_{ser} shall be calculated per shear resistant connection

$$K_{ser} = \frac{k_s}{2 \cdot l_s} \cdot l_{con} \text{ in N/mm} \quad (2.2.1.1.1.7)$$

$$F_{con} = \frac{F_{max}}{2 \cdot l_s} \cdot l_{con} \text{ in N} \quad (2.2.1.1.1.8)$$

with

k_s [N/mm] slip modulus for serviceability limit states determined according to EN 26891, Clause 8.5

n_n [-] number of concrete notches on one specimen side, see Figure 2.2.1.1.1.5
F_{max} [N] maximum load reached in the tests
l_s [mm] length of specimens in compression shear tests, see Figure 2.2.1.1.1.3 and 2.2.1.1.1.4
l_{con} [mm] (variable) connection length, see Figure 1.1.4 and 1.1.5.

F_{con} and K_{ser} are applicable to the tested cross-section geometry of the milling profile and variable connection length.

2.2.1.1.2 Testing of the mechanical resistance and stiffness of the kit

Testing of the mechanical resistance and stiffness of the kit for validation of calculation method by comparison with these tests. Hereby, at least two component tests shall be performed for the intended loading condition (moment capacity and/or shear capacity). The test methods described in Clause 2.2.1.2 apply.

2.2.1.1.3 Calculation of the mechanical resistance and stiffness of the kit

The calculation of the mechanical resistance and stiffness of the kit shall be based on one of the following methods:

- Truss models for discontinuous arranged shear resistant connections. Truss models are applicable for all shear resistant connections when the shear resistant connections are not evenly distributed (type 2 as well as type 4 and type 5 when not evenly distributed).
- The calculation method for mechanically jointed beams for continuous arranged shear resistant connections. This calculation method is applicable for all evenly distributed shear resistant connections (type 1 and type 3 as well as type 4 and type 5 when evenly distributed).

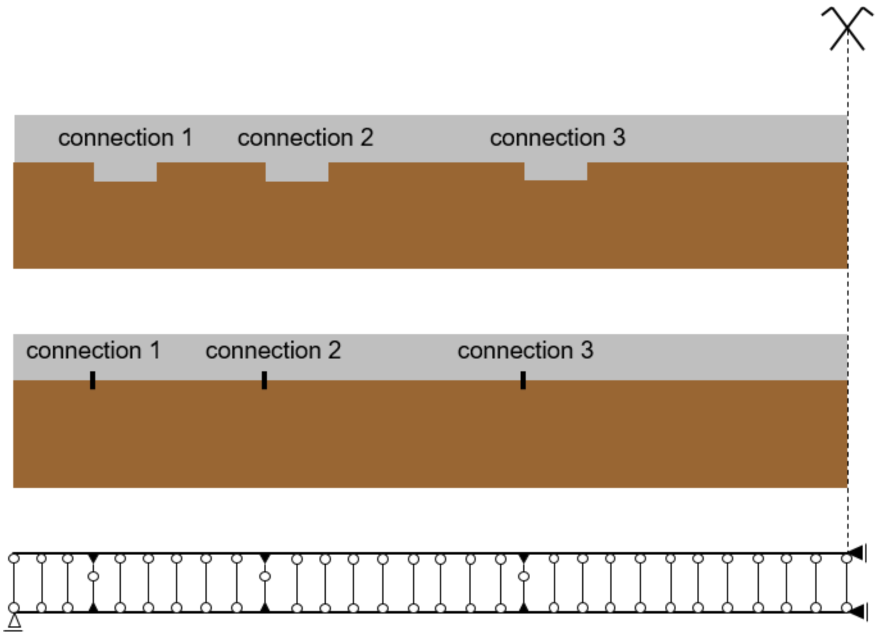
These methods are described in the following. More rigorous analysis (e.g., FE-calculation) of the internal forces may be carried out if the suitability of the calculation method can be proven.

Calculation of the moment capacity and/or shear capacity is performed at t_0 = 0 (the time when the 28 days characteristic compressive cylinder strength of the concrete is reached).

<u>Truss models</u>

In case of discontinuous arranged shear resistant connections between base materials and the concrete material, truss models shall be used. Hereby, the concrete element and the wooden element shall be simulated by trusses oriented in direction of the longitudinal axis, which are coupled by truss elements enforcing the same deflections, see Figure 2.2.1.1.3.1. In the area of shear resistant connections the truss elements are provided with an end hinge at the height of the shear resistant connection and the shear rigidity of the shear resistant connection is replaced by the flexural rigidity EI^* of the truss elements, see Figure 2.2.1.1.3.2.

Figure 2.2.1.1.3.1: Calculation of wood-concrete composite slab kits using truss models



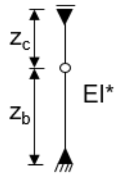
The flexural rigidity EI^* of the truss elements in the area of shear resistant connections shall be calculated as (e.g., when neglecting the deformation of the flange)

$$EI^* = \frac{K_i}{3} \cdot (z_c^3 + z_b^3) \tag{2.2.1.1.3.1}$$

with

$K_i = K_{ser}$ [N/mm]	slip modulus of the shear resistant connection, equal to the slip modulus K_{ser} determined in compression shear tests according to Clause 2.2.1.1.1
$z_{c,b}$ [mm]	distance of concrete/base material to shear resistant connection, see Figure 2.2.1.1.3.2.

Figure 2.2.1.1.3.2: Truss element in the area of shear resistant connection



From the mid deflection $w_{g,calc}$ obtained for a load $F_{calc} = 0{,}5 \cdot 0{,}4 \cdot F_{u,test}$, the flexural rigidity $(EI)_{g,calc}$ shall be calculated as

$$(EI)_{g,calc} = \frac{F_{calc} \cdot (3 \cdot a \cdot l^2 - 4 \cdot a^3)}{24 \cdot w_{g,calc}} \tag{2.2.1.1.3.2}$$

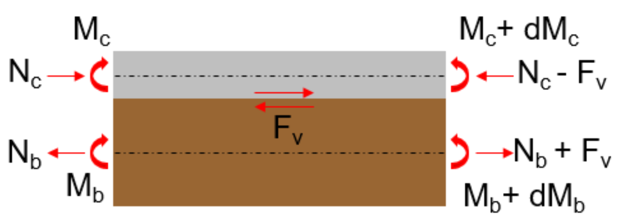
with

$w_{g,calc}$ [mm]	mid deflection obtained in truss model for a load $F_{calc} = 0{,}5 \cdot 0{,}4 \cdot F_{u,test}$
F_{calc} [N]	load applied in calculation models
$F_{u,test} = F_{max}$ [N]	ultimate load determined in bending tests according to Clause 2.2.1.1.2
l [mm]	span of specimens
a [mm]	distance support to load introduction

and compared to the flexural rigidity $(EI)_g$ of the tests according to Clause 2.2.1.1.2. A relation of the flexural rigidities $(EI)_{g,calc}/(EI)_g < 1$ indicate the applicability of the model.

The internal forces obtained directly from the model for the maximum load in the test (here $F_{calc} = 0{,}5 \cdot F_{u,test}$ as only one part of the symmetric specimen shall be considered in the truss model) are used to calculate the utilisation factors r for the cross-section:

Figure 2.2.1.1.3.3: Definition of internal forces in wood-concrete composite slab kits



Base material

- Stresses from normal force and bending moment

$$r_{b,1} = \frac{\sigma_{b,t,0}}{f_{b,t,0,k}} + \frac{\sigma_{b,m}}{f_{b,m,k}} \tag{2.2.1.1.3.3}$$

with

$$\sigma_{b,t,0} = \frac{N_b}{A_b}$$

$\sigma_{b,m} = \frac{M_b}{W_b}$

$\sigma_{b,t,0}$ [N/mm²]	stress in base material from normal force
$\sigma_{b,m}$ [N/mm²]	stress in base material from bending moment
N_b [N]	normal force of base material
A_b [mm²]	cross-section of base material
M_b [Nmm]	bending moment of base material
W_b [mm³]	section modulus of base material
$f_{b,t,0,k}$ [N/mm²]	tensile strength parallel to the grain of base material
$f_{b,m,k}$ [N/mm²]	bending strength of base material.

- Stresses from shear force (shear/rolling shear)

$$r_{b,2} = \frac{\tau_{v/r}}{f_{b,v,k}} \quad (2.2.1.1.3.4)$$

with

$\tau_{v/r} = \frac{V_b \cdot S_{v/r}}{I_b \cdot b}$

$\tau_{v/r}$ [N/mm²]	shear stress in base material
V_b [N]	shear force in the base material
$S_{v/r}$ [mm³]	static moment of base material for shear/rolling shear
I_b [mm⁴]	moment of inertia of base material
b [mm]	width of base material
$f_{b,v,k}$ [N/mm²]	shear strength of base material (shear/rolling shear).

Concrete

- Compressive stresses from normal force and bending moment

$$r_{c,1} = \frac{\sigma_{c,c}}{f_{c,k}} \quad (2.2.1.1.3.5)$$

with

$$\sigma_{c,c} = \frac{N_c}{A_c} \pm \frac{M_c}{W_c}$$

$\sigma_{c,c}$ [N/mm²]	stress from normal force in concrete
N_c [N]	normal force of concrete
A_c [mm²]	cross-section of concrete
M_c [Nmm]	bending moment of concrete
W_c [mm³]	section modulus of concrete
$f_{c,k}$ [N/mm²]	compressive strength of concrete.

- Stresses from shear force (shear/rolling shear)

$$r_{c,2} = \frac{\tau_c}{\tau_{Rk,c}} \quad (2.2.1.1.3.6)$$

with

τ_c [N]	shear stress in concrete
$\tau_{Rk,c}$ [N]	shear stress resistance of concrete e.g., calculated according to Equation (8.27) of EN 1992-1-1 with $\gamma_V = 1$ and $\sigma_{cp} = N_c/A_c$.

Shear resistant connection

- Load carrying capacity

$$r_{con} = \frac{F_{v,con}}{F_{con,k}} \quad (2.2.1.1.3.7)$$

$F_{v,con}$ [N]	shear force in shear resistant connection
$F_{con,k}$ [N]	characteristic shear resistance of shear resistant connection determined in tests according to Clause 2.2.1.1.1.

Utilisation factors $r > 1$ indicate the predominant failure modes. These failure modes shall be comparable to the failure modes observed in the tests according to Clause 2.2.1.1.2 to show the applicability of the model.

<u>Calculation method for mechanically jointed beams</u>

In case of continuous arranged shear resistant connections between base materials and the concrete material the calculation method for mechanically jointed beams according to EN 1995-1-1, Annex B, shall be used. Hereby, the effective moment of inertia is calculated as

$$I_{ef} = \left(\frac{E_c}{E_b} \cdot I_c + \gamma \cdot \frac{E_c}{E_b} \cdot A_c \cdot a_c^2\right) + (I_b + A_b \cdot a_b^2) \qquad (2.2.1.1.3.8)$$

and

$$\gamma = \frac{1}{1 + \pi^2 \frac{E_c \cdot A_c \cdot s}{K_i \cdot l^2}} \qquad (2.2.1.1.3.9)$$

with

$E_{c/b}$ [N/mm²]	E-Modulus of concrete/base material
$I_{c/b}$ [mm⁴]	moment of inertia of concrete/base material
$A_{c/b}$ [mm²]	cross-section of concrete/base material
$a_{c/b}$ [mm]	distance from the centre of gravity of the whole cross-section to the centre of gravity of concrete/base material
s [mm]	distance of shear resistant connections
$K_i = K_{ser}$ [N/mm]	slip modulus of the shear resistant connection, equal to the slip modulus K_{ser} determined in compression shear tests according to Clause 2.2.1.1.1
l [mm]	span of specimens.

The internal forces shall be calculated as

$$N_c = \frac{M_{ges}}{I_{ef}} \cdot \gamma \cdot a_c \cdot \frac{E_c}{E_b} \cdot A_c \qquad (2.2.1.1.3.10)$$

$$N_b = \frac{M_{ges}}{I_{ef}} \cdot a_b \cdot A_b \qquad (2.2.1.1.3.11)$$

$$M_c = \frac{M_{ges}}{I_{ef}} \cdot \frac{h_c}{2} \cdot \frac{E_c}{E_w} \cdot W_c \qquad (2.2.1.1.3.12)$$

$$M_b = \frac{M_{ges}}{I_{ef}} \cdot \frac{h_b}{2} \cdot W_b \qquad (2.2.1.1.3.13)$$

M_{ges} [Nmm]	bending moment acting on the model
$M_{b/c}$ [Nmm]	bending moment of base material/concrete
$N_{b/c}$ [N]	normal force of base material/concrete
$h_{c/b}$ [mm]	height of concrete/base material
$W_{c/b}$ [mm³]	section modulus of concrete/base material.

The flexural rigidity EI_{ef} shall be compared to the flexural rigidity $(EI)_g$ of the tests according to Clause 2.2.1.1.2. A relation of the flexural rigidities $(EI)_{g,calc}/(EI)_g < 1$ indicate the applicability of the model.

The internal forces obtained from the model for the maximum load in the test (here $F_{calc} = F_{u,test}$) are used to calculate the utilisation factors r for the cross-section as shown for the truss model.

2.2.1.2 Testing

Purpose of the assessment

If the manufacturer defines predetermined cross-sections, the mechanical resistance and stiffness can be determined by testing. At least 10 tests shall be conducted for each cross-section and characteristic strength and stiffness value to be determined. The mean and characteristic values shall be determined in accordance with EN 14358, lognormal distribution.

The following properties shall be determined:

- Moment capacity
- Shear capacity.

Assessment method

Tests shall be performed according to Figure 2.2.1.2.1 for cross-sections for slab or beam base material without moulding (type 2, type 3, type 4, and type 5) and according to Figure 2.2.1.2.2 for cross-sections for beam base material with moulding (type 1).

Deflection measurement according to Figure 2.2.1.2.1 and Figure 2.2.1.2.2 considering EN 408, Clause 9.2 and 10.2. The measuring length l_1 for determination of the modulus of elasticity is in between 3 h and 8 h.

Conditioning of the test specimens according to EN 408, Clause 8. The tests shall be conducted at the earliest 28 days after sample preparation.

The span l is in between 18 h and 21 h for determination of moment capacity and in between 10 h and 15 h for determination of shear capacity. The width w of the moment capacity specimens is minimum 600 mm and of the shear capacity specimens is minimum 450 mm.

Determination of moment capacity shall follow EN 408, Clause 19.2. The load shall be applied in the third points. The moment capacity M_u shall be determined as

$$M_u = \frac{F_{max} \cdot l}{6} \qquad (2.2.1.2.1)$$

with

M_u [Nmm]	moment capacity
F_{max} [N]	ultimate load determined in bending tests
l [mm]	span of specimens between supports
a [mm]	distance support to load introduction.

The local and global flexural rigidity (EI) shall be determined as

$$(EI)_l = \frac{\Delta F \cdot l \cdot l_1^2}{48 \cdot \Delta w_l} \qquad (2.2.1.2.2)$$

$$(EI)_g = \frac{\Delta F \cdot (3 \cdot a \cdot l^2 - 4 \cdot a^3)}{48 \cdot \Delta w_g} \qquad (2.2.1.2.3)$$

With

$(EI)_l$ [Nmm²]	local flexural rigidity
ΔF [N]	increase of load $F_2 – F_1$ according to EN 408, Clause 9.3
l [mm]	span of specimens
l_1 [mm]	measuring length for determination of local modulus of elasticity
Δw_l [mm]	increase of local deformation $w_2 – w_1$ according to EN 408, Clause 9.3
$(EI)_g$ [Nmm²]	global flexural rigidity
a [mm]	distance support to load introduction
Δw_g [mm]	increase of global deformation $w_2 – w_1$ according to EN 408, Clause 10.3.

For determination of the shear capacity the load shall be applied at a distance a ≈ 500 mm sufficient close to the support to result in shear failure. The following provisions of EN 408, Clause 19.2, shall be followed:

- Symmetric load application.
- Specimens supported on two supports.

- Lateral supports shall prevent lateral tipping, if necessary.
- Constant load application in order to reach the ultimate load within (300 ± 120) s.
- The maximum load F_{max} shall be recorded.
- Measurement uncertainty for applied loads is 1%.

The shear capacity F_v shall be determined as

$$F_v = \frac{F_{max}}{2} \qquad (2.2.1.2.4)$$

with

F_v [N]	shear capacity
F_{max} [N]	ultimate load determined in shear tests.

Figure 2.2.1.2.1: Test arrangement for full-scale tests and cross-sections for slab or beam base material without moulding

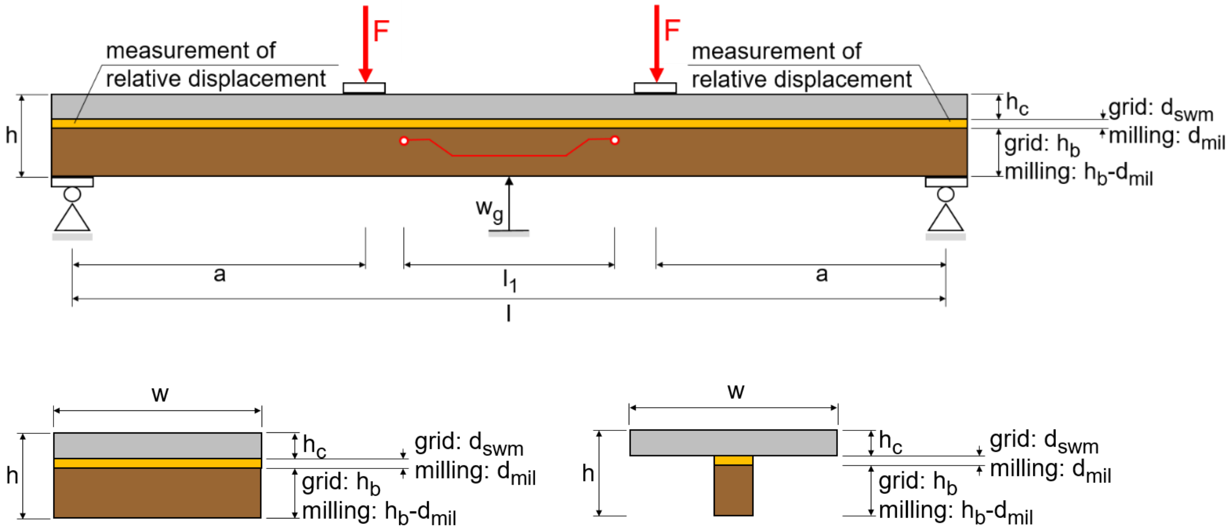
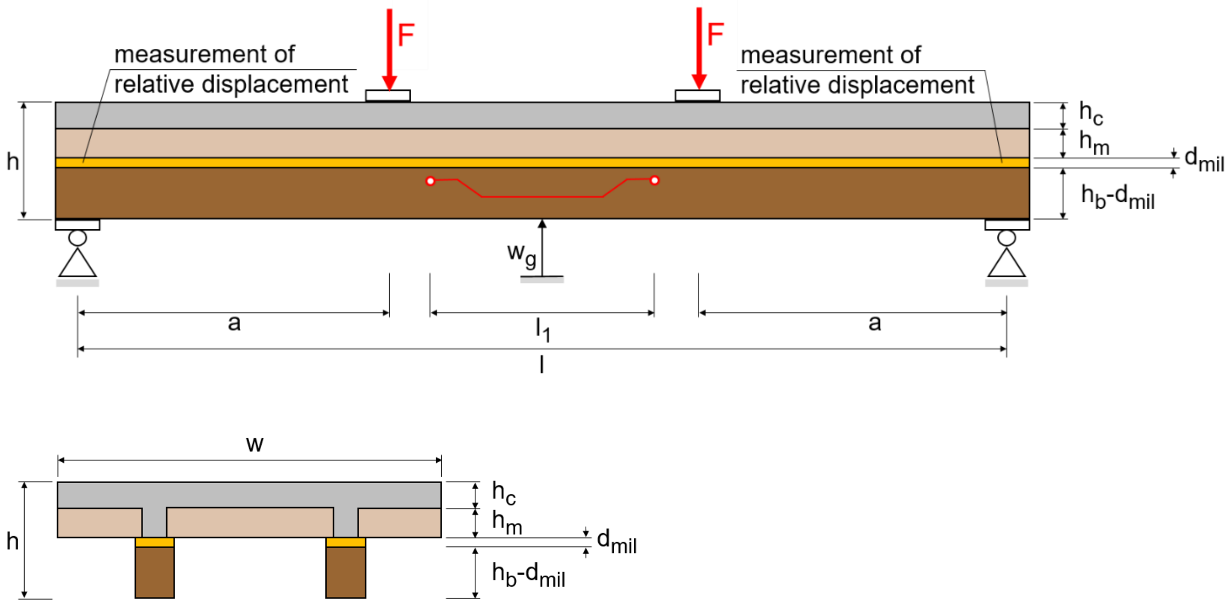


Figure2.2.1.2.2: Test arrangement for full-scale tests and cross-section for beam base material with moulding



Expression of results

The characteristic moment capacity M_u [Nmm], mean flexural rigidity (EI) [Nmm²] and shear capacity F_v [N] shall be given in the ETA together with the following information:

- Mechanical properties (strength class or strength and stiffness properties) of the individual components.
- Type, geometry and arrangement of the shear resistant connection.
- Tested cross-section of the wood-concrete composite slab kit.

2.2.2 Dimensional stability

Purpose of the assessment

Determination of factors for consideration of long-term effects of the components for shrinkage/swelling and creep.

Assessment method

In order to facilitate specific assessment at construction works level the ETA may contain the performances of the components.

In this respect the moisture deformation factor k for a change in moisture content of 1 % shall be expressed as individual values of the components (reference method)

- according to EN 14080, Table 14, for glued laminated timber, or
- according to EN 16351, Annex F.9, for cross laminated timber, or
- according to EN 336, Clause 4.2, for prefabricated wood slab elements made of square-sawn timber members or solid softwood.

If not covered by the standards above, testing and assessment of swelling/shrinkage of the wood-based components shall be performed according to EAD 130367-00-0304, Clause 2.2.13. Hereby, the relative changes in length $\delta l_{65,85}$ and $\delta l_{65,30}$ and the relative changes in width $\delta w_{65,85}$ and $\delta w_{65,30}$ shall be evaluated.

For concrete strength classes and compositions covered by EN 1992-1-1, Clause 5.1.5 (reference method), the creep strain ε_{cc} [‰] and shrinkage strain ε_{cs} [‰] shall be assessed according to EN 1992-1-1, Clause 5.1.5.

If not covered, testing and assessment of shrinkage and creep of the concrete and screed material shall be performed according to EAD 010003-00-0301, Clause 2.2.7, 2nd paragraph. The creep strain ε_{cc} [‰] and the shrinkage strain ε_{cs} [‰] shall be evaluated.

Expression of results

Factors for consideration of long-term effects of the components for shrinkage/swelling and creep shall be given in the ETA:

- moisture deformation factor k for a change in moisture content of 1 % or relative changes in length $\delta l_{65,85}$ [mm/m] and $\delta l_{65,30}$ [mm/m] and relative changes in width $\delta w_{65,85}$ [mm/m] and $\delta w_{65,30}$ [mm/m] for the wood-based components
- creep strain ε_{cc} [‰] for concrete/screed
- shrinkage strain ε_{cs} [‰] for concrete/screed.

2.2.3 Reaction to fire

Reaction to fire shall be assessed based on the components of the wood-concrete composite slab kit. The reaction to fire of the components shall be given in the ETA.

2.2.3.1 Wooden components without the need for (further) testing (CWFT)

The glued laminated timber is considered to satisfy the requirements for performance class D-s2,d0 of the characteristic reaction to fire in accordance with the Commission Decision 2005/610/EC as amended by Commission Delegated Regulation (EU) 2017/1227 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.

Therefore, the class of reaction to fire of glued laminated timber is D-s2,d0, given that the conditions and intended use referred to above are complied with.

The cross laminated timber is considered to satisfy the requirements for performance class D-s2,d0 of the characteristic reaction to fire in accordance with Commission Delegated Regulation (EU) 2017/2293 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.

Therefore, the class of reaction to fire of cross laminated timber is D-s2,d0, given that the conditions and intended use referred to above are complied with.

The structural timber (prefabricated wood slab elements made of square-sawn timber members and solid softwood) is considered to satisfy the requirements for performance class D-s2,d0 of the characteristic reaction to fire in accordance with the Commission Decision 2003/43/EC as amended by 2003/593/EC, 2006/673/EC and 2007/348/EC 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.

Therefore, the class of reaction to fire of structural timber is D-s2,d0, given that the conditions and intended use referred to above are complied with.

The permanent moulding of plywood is considered to satisfy the requirements for performance class D-s2,d0 of the characteristic reaction to fire in accordance with the Commission Decision 2003/43/EC as amended by 2003/593/EC, 2006/673/EC and 2007/348/EC 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.

Therefore, the class of reaction to fire of the permanent moulding of plywood is D-s2,d0, given that the conditions and intended use referred to above are complied with.

2.2.3.2 Components of steel and concrete/mortar/screed without the need for (further) testing (CWFT)

The steel members and concrete/mortar/screed are considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire in accordance with the Commission Decision 96/603/EC as amended by Commission Decision 2000/605/EC and Commission Decision 2003/424/EC 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.

Therefore, the class of reaction to fire of the steel members and concrete/mortar/screed is A1, given that the conditions and intended use referred to above are complied with.

2.2.3.3 Components not covered by the above mentioned Decisions/Regulations

The performance regarding reaction to fire of insulation materials according to EN 13164 shall be tested separately when directly exposed to fire (see e.g., Figure 1.1.1) or taken from the Declaration of Performance (DoP) of this component.
For mounting and fixing of insulation materials see EN 15715.
For extended application of insulation materials see EN 15715.

The PE-foil is located between moulding and concrete in the end use. Therefore, it may be assumed that the PE-foil in the end use application does not make any contribution to fire growth or to the fully developed fire and has no influence to smoke growth. In the context of this end use application of the wood-concrete composite slab kit the PE-foil can be considered to satisfy any reaction to fire requirements.

2.2.4 Resistance to fire

The resistance to fire of the wood-concrete composite slab kit shall be tested in its end use condition according to EN 1363-1 in conjunction with EN 1365-2 and classified according to EN 13501-2. The class and the corresponding field of application shall be given in the ETA.

2.2.5 Content, emission and/or release of dangerous substances

The performance of the product regarding the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer[7] after identifying the release scenarios taking into account the intended use(s) of the product and the Member States where the manufacturer intends his product to be made available on the market.

The identified intended release scenarios for this product and intended use with respect to dangerous substances are:

IA1: Product with direct contact to indoor air

IA2: Product with indirect contact to indoor air (e.g. covered products) but possible impact on indoor air.

2.2.5.1 Release of other dangerous substances - SVOC and VOC

Purpose of the assessment and assessment method

For the intended use covered by the release scenario IA1/IA2 semi-volatile organic compounds (SVOC) and volatile organic compounds (VOC) shall be determined in accordance with EN 16516. The loading factor to be used for emission testing shall be taken from EN 16516 depending on the intended use of the product.

The preparation of the test specimen is performed by using a representative sample of the product installed in accordance with the manufacturer's product installation instructions or in absence of such instructions the usual practice of the product installation. The size of the test specimen shall be chosen in consideration of the test chamber size and the intended loading factor (see above). As stated in the EN 16516, product samples shall be collected at the point of manufacture after the normal production processes are completed (including drying or curing if applicable) and immediately be placed in the emission test chamber[8]. This time is considered the starting time of the emission test.

Once the test specimen has been produced, as described above, it shall immediately be placed in the emission test chamber. This time is considered the starting time of the emission test.

The test results shall be reported for the relevant parameters (e.g., chamber size, temperature and relative humidity, air exchange rate, loading factor, size of test specimen, conditioning, production date, arrival date, test period, test result) after 3 days and 28 days testing.

Expression of results

The product performance shall be expressed in [mg/m³] and stated in the ETA.

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[7] The manufacturer may be asked to provide to the TAB the REACH related information which shall accompany the DoP (cf. Article 6(5) of Regulation (EU) No 305/2011).

The manufacturer is **not** obliged to:
- provide the chemical constitution and composition of the product (or of constituents of the product) to the TAB, or
- provide a written declaration to the TAB stating whether the product (or constituents of the product) contain(s) substances which are classified as dangerous according to Directive 67/548/EEC and Regulation (EC) No 1272/2008 and listed in the "Indicative list on dangerous substances" of the SGDS, taking into account the installation conditions of the construction product and the release scenarios resulting from there.

Any information provided by the manufacturer regarding the chemical composition of the products is not to be distributed to EOTA to other TABs or beyond.

[8] If specified in the relevant product standard a conditioning period shall be applied to test specimens before starting the test to enable the product to acquire properties representing in use conditions.

2.2.5.2 Release of formaldehyde

Purpose of the assessment and assessment method

The release of formaldehyde of the wood-concrete composite slab kits as a whole is normally not assessed as release of formaldehyde is assigned to the glued base materials.

In this respect the release of formaldehyde shall be expressed as E1 or E2 in case of glued base materials, either

- based on testing according to EN 14080, Clause 5.9, for glued laminated timber or according to EN 16351, Clause 4.6, for cross laminated timber, or
- taken from the manufacturers DoP.

Expression of results

The release of formaldehyde of the glued base materials shall be stated in the ETA as class E1 or E2.

2.2.6 Thermal conductivity

Purpose of the assessment and assessment method

The thermal conductivity of the wood-concrete composite slab kits as a whole is normally not assessed given the possibilities for different product variations and therefore a need for different assessment setups (i.e., it is difficult to provide detailed enough assessment method). However, in order to facilitate specific assessment at construction works level the ETA may contain the performances of the components to allow for such a specific assessment. In this respect the thermal conductivity shall be expressed as individual values of thermal conductivity λ [W/mK] of the components, either:

- based on testing, according to EN 12664, or
- taken from the manufacturers DoP.

Expression of results

The thermal conductivity λ [W/mK] of the wood-concrete composite slab kit components shall be stated in the ETA.

2.2.7 Air permeability

Purpose of the assessment and assessment method

Air permeability shall be tested according to EN 12114, Clause 7.2.2. The default maximum pressure difference Δp_{max} = 500 Pa. If the manufacturer wishes to test with another pressure difference, the test pressure shall be chosen according to EN 12114, Annex A.

Tests shall be performed on wood-concrete composite slab kit specimen composed of all components (including concrete) with the minimum overall thicknesses according to the end use conditions. Specimen width shall be 1 000 mm and length shall be 2 500 mm.

The flow coefficient C [$m^3/s{\cdot}Pa^n$] and flow exponent n [-] shall be assessed according to EN 12114, Clause 8.4 and Annex B. The equivalent leakage area A_L [m^2] shall be assessed according to EN 12114, Clause 8.5.

Test results are valid for wood-concrete composite slab kits composed of

- the same type/combination of components as tested,
- components with at least the density of the components tested, and
- components with at least the minimum overall thickness as in the specimen tested.

Expression of results

Air permeability shall be stated in the ETA as flow coefficient C [$m^3/s{\cdot}Pa^n$], flow exponent n [-], and equivalent leakage area A_L [m^2] together with the used pressure difference Δp [Pa].

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is Decision 2000/447/EC as amended by Commission Decision 2001/596/EC.

The system is 1.

In addition, with regard to reaction to fire for products covered by this EAD the applicable European legal act is Decision 2000/447/EC as amended by Commission Decision 2001/596/EC.

The systems are 1, 3, and 4.

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of verification of constancy of performance are laid down in Table 3.2.1.

The manufacturer (regarding the components he buys from the market with DoP) shall take into account the Declaration of Performance issued by the manufacturer of that component. No retesting is necessary.

Table 3.2.1 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
1	Mechanical resistance and stiffness of base materials	Check of incoming materials	According to Control plan	According to Control plan	Each delivery
2	Geometry of the milling profiles	Measuring the relevant dimensions using a calibrated device	According to Control plan	5 per production batch	Daily
3	Moisture content of base materials at delivery	EN 13183-2	According to Control plan	5	Per batch and delivery
4	Material properties of moulding	Check of incoming materials	According to Control plan	According to Control plan	Each delivery
5	Material properties of additional components	Check of incoming materials	According to Control plan	According to Control plan	Each delivery
6	Raw material of lattice girders	Checking supplier's declaration minimum 3.1 according to EN 10204	According to Control plan	According to Control plan	Per batch material

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
7	Geometry of lattice girders	EN ISO 15630-2, Clause 10.2	According to Control plan	≥ 1 each girder type	At any change in the material dimensions or technical classes of steel and at least once per day of production per machine. For each combination of nominal diameters, modifications to the lattice girder height and length do not affect the number of samples to be taken.
8	Mechanical properties R_e, R_m/R_e, A_{gt} of lattice girders	EN ISO 15630-2, Clause 5	According to Control plan	≥ 1 each chord and diagonal	
9	Shear force of welded or clamped joints	EN ISO 15630-2, Clause 7.2	According to Control plan	≥ 2 each chord	
10	Mass per metre	EN ISO 15630-1, Clause 12. This may be measured before welding.	According to Control plan	≥ 1 each chord and diagonal	
11	Bendability	EN ISO 15630-1, Clause 6 and 7 This may be evaluated on constituent wires, by a bend and/or re-bend test	According to Control plan	≥ 1	
12	Bonding quality of the predefined grid	EN 16351	According to Control plan	2 per production batch	Daily
13	Reinforced concrete slab	Check of incoming materials	According to Control plan	According to Control plan	Each delivery
14	Reaction to fire: limit of organic material and/or addition of fire retardants	Check of incoming materials	According to Control plan	According to Control plan	Each delivery

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken notified body in the procedure of assessment and verification of constancy of performance for the wood-concrete composite slab kit are laid down in Table 3.3.1.

Table 3.3.1 Control plan for the notified body; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control					
1	Notified Body will ascertain that the factory production control with the staff and equipment are suitable to ensure a continuous and orderly manufacturing of the " ***wood-concrete composite slab kit*** ".	Verification of the complete FPC as described in the control plan agreed between the TAB and the manufacturer.	According to Control plan	According to Control plan	When starting the production or a new line
Continuous surveillance, assessment and evaluation of factory production control					
2	The Notified Body will ascertain that the system of factory production control and the specified manufacturing process are maintained taking account of the control plan.	Verification of the controls carried out by the manufacturer as described in the control plan agreed between the TAB and the manufacturer with reference to the raw materials, to the process and to the product as indicated in Table 3.2.1.	According to Control plan	According to Control plan	2/year

4 REFERENCE DOCUMENTS

EAD 130005-00-0304	Solid wood slab element to be used as a structural element in buildings
EAD 130011-00-0304	Prefabricated wood slab element made of mechanically jointed square-sawn timber members to be used as a structural element in buildings
EAD 010003-00-0301	Precast balcony elements made of ultra high performance fibre reinforced concrete (UHPFRC)
EAD 130367-00-0304	Composite wood-based beams and columns
CEN/TS 19103:2021	Eurocode 5: Design of Timber Structures – Structural design of timber-concrete composite structures – Common rules and rules for buildings
EN 206:2013+A2:2021	Concrete – Specification, performance, production and conformity
EN 301:2023	Adhesives, phenolic and aminoplastic, for load-bearing timber structures – Classification and performance requirements
EN 336:2013	Structural timber – Sizes, permitted deviations
EN 338:2016	Structural timber – Strength classes
EN 408:2010+A1:2012	Timber structures – Structural timber and glued laminated timber – Determination of some physical and mechanical properties
EN 1363-1:2020	Fire resistance tests – Part 1: General requirements
EN 1365-2:2014	Fire resistance tests for loadbearing elements – Part 2: Floors and roofs
EN 1504-3:2005	Products and systems for the protection and repair of concrete structures – Definitions, requirements, quality control and evaluation of conformity – Part 3: Structural and non-structural repair
EN 1992-1-1:2023	Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings
EN 1995-1-1:2004+AC:2006+A1:2008+A2:2014	Eurocode 5 – Design of timber structures – Part 1 1: General – Common rules and rules for buildings
EN 10080:2005	Steel for the reinforcement of concrete – Weldable reinforcing steel – General
EN 10204:2004	Metallic products – Types of inspection documents
EN 12114:2000	Thermal performance of buildings – Air permeability of building components and building elements – Laboratory test method
EN 12664:2001	Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Dry and moist products of medium and low thermal resistance
EN 13164:2012+A1:2015	Thermal insulation products for buildings – Factory made extruded polystyrene foam (XPS) products – Specification
EN 13183-2:2002	Moisture content of a piece of sawn timber – Part 2: Estimation by electrical resistance method
EN 13813:2002	Screed material and floor screeds – Screed material – Properties and requirements
EN 13501-1:2018	Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests
EN 13501-2:2023	Fire classification of construction products and building elements – Part 2: Classification using data from fire resistance tests, excluding ventilation services

EN 13986:2004+A1:2015	Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking
EN 14080:2013	Timber structures – Glued laminated timber and glued solid timber – Requirements
EN 14081-1:2016+A1:2019	Timber structures – Strength graded structural timber with rectangular cross section – Part 1: General requirements
EN 14358:2016	Timber structures – Calculation of characteristic 5-percentile values and acceptance criteria for a sample
EN 15037-2:2009+A1:2011	Precast concrete products – Beam-and-block floor systems – Part 2: Concrete blocks
EN 15037-3:2009+A1:2011	Precast concrete products – Beam-and-block floor systems – Part 3: Clay blocks
EN 15425:2023	Adhesives – One component polyurethane for load bearing timber structures – Classification and performance requirements
EN 15715:2009	Thermal insulation products – Instructions for mounting and fixing for reaction to fire testing – Factory made products
EN 16351:2021	Timber structures – Cross laminated timber – Requirements
EN 16516:2017+A1:2020	Construction products: Assessment of release of dangerous substances – Determination of emissions into indoor air
EN 26891:1991	Timber structures – joints made with mechanical fasteners – General principles for the determination of strength and deformation characteristics
EN ISO 8970:2020	Timber structures – Testing of joints made with mechanical fasteners – Requirements for wood density
EN ISO 11925-2:2020	Reaction to fire tests – Ignitability of products subjected to direct impingement of flame – Part 2: Single-flame source test
EN ISO 15630-1:2019	Steel for the reinforcement and prestressing of concrete – Test methods – Part 1: Reinforcing bars, rods and wire
EN ISO 15630-2:2019	Steel for the reinforcement and prestressing of concrete – Test methods – Part 2: Welded fabric and lattice girders