



EUROPEAN ASSESSMENT DOCUMENT

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**WOOD-CONCRETE COMPOSITE
SLAB WITH DOWEL-TYPE
FASTENERS**

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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) 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

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1 SCOPE OF THE EAD

1.1 Description of the construction product

This EAD is applicable to wood-concrete composite slab kits with a maximum span width of 10 m. The kit may contain the following components:

Base materials

- Sawn timber according to EN 14081-1.
- Glued laminated timber according to EN 14080.
- Laminated veneer lumber according to EN 14374.
- Cross laminated timber according to a European Technical Assessment.

The base materials are part of the kit.

Moulding

- Permanent moulding, e.g. at least 12 mm spruce plywood according to EN 13986 and EN 636 for load-bearing applications in exterior use, to be added at site, or boards or other suitable materials. This moulding has no function in the final product. There may be a polyethylene foil 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.

No essential characteristics are assessed for the moulding.

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

- Special screws made of steel, installed under an angle of 45° and/or 90° into the timber members, and
- Steel cylinders according to EN 10217-1 (outer diameter $d_a = 45$ to 55 mm, min. wall thickness $t = 2.6$ mm, length $L \geq 80$ mm) filled with high-strength cement mortar according to EN 1504-6 (filling height $h_v \geq 80$ to 90 % of L) reinforced by fibre-like steel parts (steel according to EN ISO 16120-2), installed vertically into the timber members by drilling (drilling length $l_E \geq 40$ mm).

The dowel-type fasteners are part of the kit.

Figure 1: Principle structure of wood-concrete composite slab kit

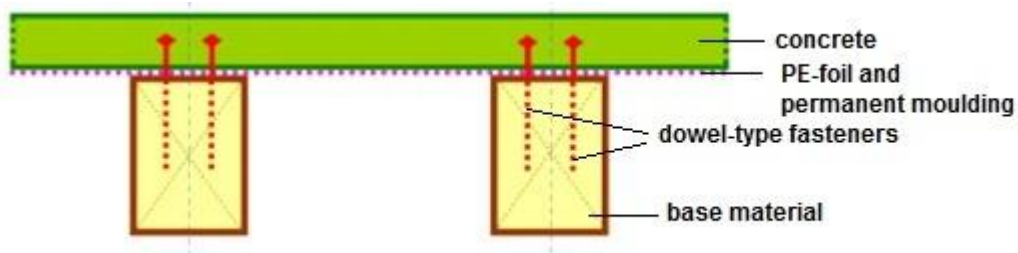
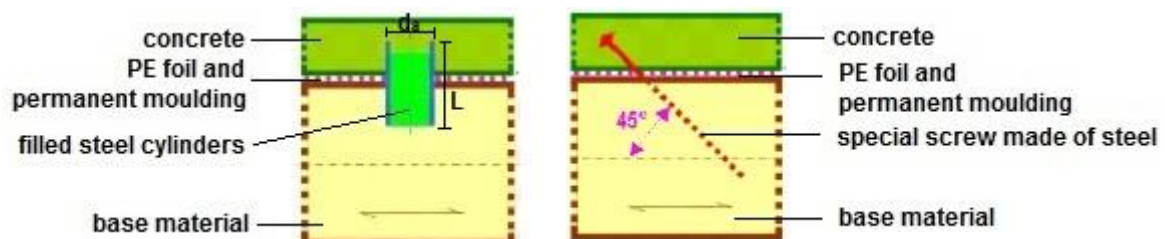


Figure 2: Dowel-type fasteners for wood-concrete composite slab kit



Finalisation of wood-concrete composite slab kit

- Concrete slab cast on site or in a prefabricating plant and reinforced according to standards and regulations in force at the place of use.

The concrete slab is not part of the kit. No characteristics are assessed for the concrete slab.

The characteristics and performances of the components are specified in the ETA according to the above mentioned standards or what is stated in this EAD.

The detailed geometry of the components are defined in the ETA, especially the geometry of the dowel-type fasteners for composite action and their positions in relation to the concrete slab.

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

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

This EAD is not applicable when recycled material is used.

The product is not covered by a harmonised European standard (hEN).

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 instructions 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.

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

1.2.1 Intended use(s)

The wood-concrete composite slab kit is used as load-bearing element in buildings with predominantly static loading in service class 1 and 2 according to EN 1995-1-1 (Eurocode 5).

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 works¹.

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 by the Technical Assessment Body issuing an ETA based on this EAD, but are to be

¹ 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.

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 Dowel-type fasteners

Connectors for shear resistant connection between base materials and the concrete material e.g. special screws made of steel, installed under an angle of 45° and/or 90° into the timber members, and steel cylinders filled with fibre reinforced high-strength grouting mortar, installed vertically into the timber members.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 to Table 3 show how the performance of the wood-concrete composite slab kit is assessed in relation to the essential characteristics.

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

No	Essential characteristic	Method of assessment	Type of expression of product performance
Basic Works Requirement 1: Mechanical resistance and stability ¹⁾			
1	Mechanical resistance	2.2.1	Description
2	Dimensional stability	2.2.2	Description
3	Stiffness	2.2.3	Description
Basic Works Requirement 2: Safety in case of fire			
4	Reaction to fire	2.2.14	Class
Basic Works Requirement 3: Hygiene, health and the environment			
5	Vapour permeability	2.2.15	Description, level
Basic Works Requirement 4: Safety and accessibility in use			
6	Same as BWR 1		
Basic Works Requirement 6: Energy economy and heat retention			
7	Thermal resistance	2.2.16	Description, level
8	Air permeability	2.2.17	Description, level
9	Thermal inertia	2.2.18	Description, level
¹⁾	This characteristic also relates to BWR 4.		

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

No	Essential characteristic	Method of assessment	Type of expression of product performance
Basic Works Requirement 1: Mechanical resistance and stability ¹⁾			
1	Mechanical resistance	2.2.4	Description, level
2	Dimensional stability	2.2.5	Description, level
3	Stiffness	2.2.6	Description, level
4	In-service environment	2.2.7	Description, level
Basic Works Requirement 2: Safety in case of fire			
5	Reaction to fire	2.2.14	Class
Basic Works Requirement 4: Safety and accessibility in use			
6	Same as BWR 1		
Basic Works Requirement 6: Energy economy and heat retention			
7	Thermal resistance	2.2.16	Description, level
8	Thermal inertia	2.2.18	Description, level
¹⁾ This characteristic also relates to BWR 4.			

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

No	Essential characteristic	Method of assessment	Type of expression of product performance
Basic Works Requirement 1: Mechanical resistance and stability ¹⁾			
1	Material	2.2.8	Description
2	Geometry	2.2.9	Description, level
3	Mechanical strength	2.2.10	Description, level
4	Mechanical stiffness	2.2.11	Description, level
5	Corrosion protection	2.2.12	Description, level
6	Shear resistance	2.2.13	Description, level
Basic Works Requirement 4: Safety and accessibility in use			
7	Same as BWR 1		
¹⁾ This characteristic also relates to BWR 4.			

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

Characterisation of products to be assessed shall be done in accordance with available specifications, notably according to Table 4.

Table 4: Characterisation of products to be assessed

No	Component	Characterisation	
1	Base material	Mechanical resistance and stiffness	EN 14081-1, EN 14080, EN 14374 or European Technical Assessment
2	Moulding	Type, bending strength	EN 13986, EN 636
3	Composite action	Special screws and steel cylinders	According to this EAD

WOOD-CONCRETE COMPOSITE SLAB KIT

2.2.1 Mechanical resistance

The derivation of characteristic values for the wood-concrete composite slab kits may be done by:

- Calculation assisted by testing or
- Testing.

In case of calculation assisted by testing the calculation method shall be assessed by comparison with tests. Hereby, at least two component tests shall be performed for the intended loading condition (e.g. bending, shear). Test methods (test arrangement, load application and deflection measurements) shall be based on EN 408 and EOTA TR 002. The span shall be approx. 5 m. Test specimens shall be representative for the intended composition of the kit. If the width of the slab exceeds four similar units, it will be sufficient to test a slab width four units.

The calculation method of the mechanical resistance of the kit shall be based on EN 1992-1-1 and EN 1995-1-1 taking into account the shear resistance of the dowel-type fasteners, see Clause 2.2.13.

In addition to this concept, the capability of the product can be tested. Hereby, the number of tests for each configuration shall be at least 30. Characteristic values shall be determined according to EN 14358.

In addition, long term effects (e.g. shrinkage of the concrete, dimensional changes of timber, creep) shall be verified by calculation. Concrete and timber properties and models as used in verifications of long term effects should be based on EN 1992 1-1 and EN 1995-1-1 considering the environmental and climatic conditions in place of use.

The parameters needed for calculation or in case of testing the respective tested mechanical resistance shall be given in the ETA.

2.2.2 Dimensional stability

Dimensions of cross section shall be measured according to EN 1309-1.

Moisture content at delivery shall be measured according to EN 13183-2.

Tolerances of dimensions

Tolerances of the dimensions are to be assessed from the measured dimensions.

Numeric values of the nominal dimensions and tolerances, e.g. on length, width and depth, shall be given in the ETA.

Stability of dimensions

Dimensional stability shall be considered as swelling and shrinkage of the product due to changes of its moisture content. An assessment shall be made of the effect on the product dimensions of variations in moisture content based on calculation according to EN 1992-1-1 and EN 1995-1-1 considering the environmental and climatic conditions in place of use.

The moisture content at delivery shall be given in the ETA.

Thermal expansion

Assessment of thermal expansion with the thermal expansion coefficient as given in EN 1991-1-5, Table C.1.

2.2.3 Stiffness

The method as described in 2.2.1 shall comprise evaluation of deformations (stiffness).

BASE MATERIALS

2.2.4 Mechanical resistance

For the performance of the base materials, covered by hENs or European Technical Assessments, the essential characteristics are declared already by the component manufacturers in their Declaration of Performance (DoP) when the product will be assessed by the TAB. The performance of those components for ETA purposes will be considered to be the performance declared by the manufacturers of the component.

The mechanical resistance of the base materials shall be given in the ETA.

2.2.5 Dimensional stability

See 2.2.2.

2.2.6 Stiffness

For the performance of the base materials, covered by hENs or European Technical Assessments, the essential characteristics are declared already by the component manufacturers in their Declaration of Performance (DoP) when the product will be assessed by the TAB. The performance of those components for ETA purposes will be considered to be the performance declared by the manufacturers of the component.

The stiffness of the base materials shall be given in the ETA.

2.2.7 In-service environment

Durability of timber shall be assessed according to EN 335, Table 1, EN 350-2, Table 2, and EN 460.

The service classes according to EN 1995-1-1, Clause 2.3.1.3 shall be given in the ETA.

DOWEL-TYPE FASTENERS

2.2.8 Material

The material specification of the special screws of steel as well as the steel cylinders filled with high-strength cement mortar and reinforced by fibre-like steel parts shall be given in the ETA.

2.2.9 Geometry

The dimensions of the special screws are to be determined by measuring the relevant dimensions using a calibrated device capable of achieving an accuracy of $\pm 1\%$ of the measurement. Length, shape and tolerances shall be given in the ETA.

The steel cylinders with outer diameter $d_a = 45$ to 55 mm, minimum wall thickness $t = 2.6$ mm and length $L = 80$ mm are filled with high-strength cement mortar to a filling height $h_v = 60$ to 70 mm and reinforced by fibre-like steel parts. The geometry of the steel cylinders shall be given in the ETA.

2.2.10 Mechanical strength

For the performance of the dowel-type fasteners, covered by hENs, the essential characteristics are declared already by the component manufacturers in their Declaration of Performance (DoP) when the product will be assessed by the TAB. The performance of those components for ETA purposes will be considered to be the performance declared by the manufacturers of the component.

For the special screws, the characteristic tensile strength, the characteristic yield moment, the characteristic torsional strength and insertion moment are determined according to EN 14592 and given in the ETA.

For the steel cylinders the mechanical strength according to EN 10217-1 as well as the strength of the high-strength cement mortar according to EN 1504-6 and fibre-like steel parts according to EN ISO 16120-2 are to be given in the ETA.

2.2.11 Mechanical stiffness

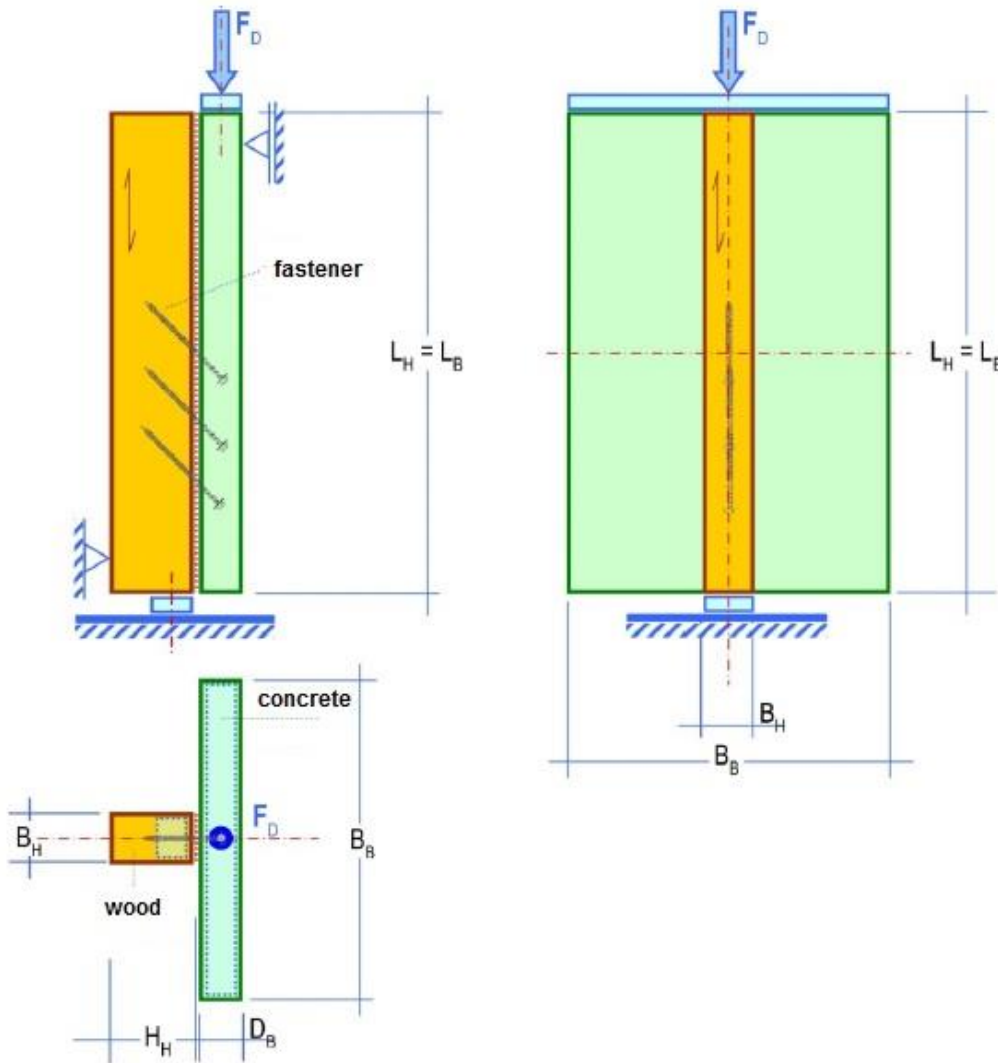
For dowel-type fasteners, the slip modulus is determined in combination with the function in concrete, see Clause 2.2.13 "Shear resistance".

2.2.12 Corrosion protection

Corrosion protection shall be assessed according to EN 1995-1-1 and EN 1992-1-1.

2.2.13 Shear resistance

Shear resistance of the dowel-type fasteners shall be determined by calculation assisted by testing. Hereby, compression-shear tests shall be performed, see Figure 3. The minimum number of tests is 10 for each dowel configuration. Loading shall be applied following EN 26891.

Figure 3: Compression shear tests

The base material is solid wood of strength class C24 according to EN 14081-1 or glued laminated timber of strength class GL 24h according to EN 14080 with a density fulfilling the conditions according to EN ISO 8970. If additional base materials shall be assessed, material properties and conditioning shall correspond to those intended to be used in the kit. The cross section shall be representative to the intended use.

The cross section of the concrete part shall be chosen so that the thickness corresponds to the intended one and the width is at least twice the spacing of the dowel-type fasteners. The length of the specimen shall be at least 4 times the intended spacing of the dowel-type fasteners.

Between concrete slab and base material, a non load-bearing moulding may be placed. Moisture protection of the base material is assured by a separating layer (foil) placed between the concrete slab and the base material (or moulding).

At least a group of minimum 3 dowel-type fasteners in a row shall be tested. Number of rows and spacing depend on the intended use. In case of the additional use of steel cylinders at least the following configurations shall be tested if intended to be used:

- 1) Shear resistance for special screws made of steel
- 2) Shear resistance for steel cylinders filled with reinforced high-strength cement mortar
- 3) Combination of 1) and 2)

Evaluation of test results shall be according to EN 14358. The mean value of the slip modulus shall be calculated and given in the ETA.

2.2.14 Reaction to fire

The base material sawn timber is considered to satisfy the requirements for performance class D-s2,d0 of the characteristic reaction to fire in accordance with the EC Decision 2003/593/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.

Therefore the performance of the base material sawn timber is D-s2,d0.

The base materials glued laminated timber and cross laminated timber are considered to satisfy the requirements for performance class D-s2,d0 of the characteristic reaction to fire in accordance with the EC Decision 2005/610/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.

Therefore the performance of the base materials glued laminated timber and cross laminated timber is D-s2,d0.

The steel members and concrete 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.

Therefore the performance of the steel members and concrete is A1.

The plywood members are considered to satisfy the requirements for performance class D-s2,d0 of the characteristic reaction to fire in accordance with the EC Decision 2003/43/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.

Therefore the performance of the plywood members is D-s2,d0.

When the components / the product do not meet the provisions of the aforementioned EC Decisions or when a higher classification is sought, testing shall be done using the procedures/test method(s) according to EN 13501-1 and relevant for the corresponding reaction to fire class. The product shall be classified according to Commission Delegated Regulation (EU) No 2016/364.

2.2.15 Vapour permeability

Design values of components may be taken according to EN ISO 10456 and given in the ETA for further calculations.

2.2.16 Thermal resistance

Thermal resistance shall be calculated according to EN ISO 6946. Design values of components may be taken from EN ISO 10456 and given in the ETA.

Alternatively, the thermal resistance may be verified by testing according to EN ISO 8990.

2.2.17 Air permeability

Testing according to EN 12114 and expression of results according to EN 12207.

2.2.18 Thermal inertia

Design values of components may be taken according to EN ISO 10456 and given in the ETA for further calculations.

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: 2000/447/EC

The system to be applied is: 1

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 5 and 5a.

Table 5 Control plan for the wood-concrete composite slab kit; 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)					
1	Incoming material	Batch identification and traceability Acceptance test or supplier's declaration of performance			Each delivery
2	Mechanical resistance and stiffness of base materials	According to base materials manufacturer's specifications			Each delivery
3	Moisture content of base materials at delivery	EN 13183-2	Product specification of the manufacturer	5	Per batch and delivery
4	Type and bending strength of moulding	According to moulding manufacturer's specifications			Each delivery
5	Dowel type fasteners	See Table 5a			

Table 5a Control plan for the dowel-type fasteners; 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)					
Special screws					
1	Raw material of special screws	Suppliers declaration according to EN 10204 ¹⁾	Product specification of the manufacturer	–	Per batch material
2	Geometry of special screws	2.2.9	Drawings in the ETA including tolerances	5 per production batch	Daily
3	Characteristic tensile strength of special screws	EN 14592 ¹⁾	EN 14592	5	Every 6 months
4	Characteristic torsional strength of special screws	EN 14592 ¹⁾	EN 14592	5	Per production or heat treatment batch
5	Insertion moment of special screws	EN 14592	EN 14592	10	Every 6 months
Steel cylinders					
1	Raw material of steel cylinders and high-strength cement mortar	Suppliers declaration according to EN 10204 and EN 1504-6	Product specification of the manufacturer	–	Per batch material
2	Geometry of steel cylinders	2.2.9	Drawings in the ETA including tolerances	5 per production batch	Daily

¹⁾ For dowel-type fasteners covered by a harmonised European standard (hEN): Supplier's DoP according to EN 14592.

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 are laid down in Table 6. The tasks of the notified body are referred to assessment and verification of constancy of performance on the level of the wood-concrete composite slab kit manufacturer as detailed on the table thereafter.

Table 6 Control plan for the notified body for the wood-concrete composite slab kit; 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	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.	As defined in the control plan	As defined in the control plan	As defined in the control plan	1
Continuous surveillance, assessment and evaluation of factory production control					
2	Continuous surveillance, assessment and evaluation of the factory production control carried out by the manufacturer (parameters according to Table 5 and 5a ¹⁾ of this EAD).	As defined in the control plan	As defined in the control plan	As defined in the control plan	2 / year

¹⁾ For dowel-type fasteners covered by a harmonised European standard (hEN): Verification of DoP of the supplier of the dowel-type fastener in comparison with the ETA values.

4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment, is of relevance.

EOTA TR 002 (2000-10): Test methods for light composite wood-based beams and columns

EOTA TR 034 (2009-07) and am (2012-03): General ER 3 Checklist - Content and/or release of dangerous substances in products/kits

EN 206: Concrete – Specification, performance, production and conformity

EN 408: Timber structures – Structural timber and glued laminated timber – Determination of some physical and mechanical properties

EN 636: Plywood – Specifications

EN 1363-1: Fire resistance tests – Part 1: General Requirements

EN 1365-2: Fire resistance tests for loadbearing elements – Part 2: Floors and roofs

EN 1504-6: Products and systems for the protection and repair of concrete structures – Definitions, requirements, quality control and evaluation of conformity – Part 6: Anchoring of reinforcing steel bar

EN 1990 (04.2002) +AC (12.2008) + AC (04.2010): Eurocode – Basis of structural design

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

EN 1995-1-1: Eurocode 5 – Design of timber structures – Part 1 1: General – Common rules and rules for buildings

EN 1995-1-2: Eurocode 5 – Design of timber structures - Part 1-2: General – Structural fire design

EN 10217-1: Welded steel tubes for pressure purposes – Technical delivery conditions Part 1: Electric welded and submerged arc welded non -alloy steel tubes with specified room temperature properties

EN 12114: Thermal performance of buildings – Air permeability of building components and building elements - Laboratory test method

EN 12207: Windows and doors — Air permeability — Classification

EN 13183-2: Moisture content of a piece of sawn timber – Part 2: Estimation by electrical resistance method

EN 13501: Fire classification of construction products and building elements

EN 13986: Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking

EN 14080: Timber structures — Glued laminated timber and glued solid timber — Requirements

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

EN 14358: Timber structures — Calculation of characteristic 5-percentile values and acceptance criteria for a sample

EN 14374: Timber structures — Structural laminated veneer lumber — Requirements

EN 14592: Timber structures — Dowel-type fasteners — Requirements

EN 26891: Timber structures – joints made with mechanical fasteners – General principles for the determination of strength and deformation characteristics

EN ISO 6946: Building components and building elements — Thermal resistance and thermal transmittance — Calculation method

EN ISO 8970: Timber structures - Testing of joints made with mechanical fasteners - Requirements for wood density

EN ISO 8990: Thermal insulation – Determination of steady-state thermal transmission properties - Calibrated and guarded hotbox

EN ISO 10456: Building materials and products - Hygrothermal properties - Tabulated design values and procedures for determining declared and design thermal values

EN ISO 16120-2: Non-alloy steel wire rod for conversion to wire Part 2: Specific requirements for general-purpose wire rod

96/603/EC

Commission Decision of 4 October 1996 establishing the list of products belonging to Classes A 'No contribution to fire' provided for in Decision 94/611/EC implementing Article 20 of Council Directive 89/106/EEC on construction products (OJ L 267 of 19 October 1996) as amended

2003/43/EC

Commission Decision of 17 January 2003 establishing the classes of reaction-to-fire performance for certain construction products (OJ L 13 of 18 January 2003) as amended

2003/593/EC

Commission Decision of 7 August 2003 amending Decision 2003/43/EC establishing the classes of reaction-to-fire performance of certain construction products (OJ L 201 of 8 August 2003) as amended

2005/610/EC

Commission Decision of 9 August 2005 establishing the classes of reaction-to-fire performance for certain construction products (OJ L 208 of 11 August 2005) as amended