

EAD 010001-00-0301

April 2015

**PRECAST CONCRETE COMPOSITE WALL WITH
POINT CONNECTORS**

Adopted European Assessment Document according to
Regulation (EU) № 305/2011, Annex II 7.



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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) No 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

The precast concrete composite wall with point connectors consists of two layers of precast reinforced normal weight concrete joined with connectors of smooth stainless steel wires and a corrugated steel sheet (see Figure 1).

Every connector is composed of three steel wires spot welded to the steel sheet. To increase the bond resistance the steel wires are corrugated and notched along the connectors length embedded in concrete. Both ends of the steel wires folded at 180°.

The connectors are used to connect the two precast layers and to establish the thickness of the finished wall. The stability and stiffness of the unfilled wall is provided by the steel sheet which joins up the three point connectors.

The two layers of precast concrete are reinforced with ribbed reinforcing steel, welded ribbed reinforcing steel with non-loadbearing welded joints or welded fabric. The layers have a minimum concrete strength class of C20/25.

During construction the gap between the precast reinforced layers is filled with concrete whereas the point connectors resist to the concrete pressure. The assembly and amount of connectors depends on the dimensions of the individual wall.

The thickness of the precast reinforced layers of concrete is in a range of 45 to 70 mm.

The thickness of the concrete core is greater than 70 mm.



Figure 1: Precast concrete composite wall with point connectors

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 of the construction product

1.2.1 Intended use

The precast concrete composite wall with point connectors is intended to be used for the construction of external walls above or below ground and internal walls which are load bearing or non-load bearing, including those that are subject to fire regulations.

The precast concrete composite wall with point connectors shall be subjected to static and quasi static actions 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 precast concrete composite wall with point connectors for the intended use of 50 years when installed in the works provided that the is subject to appropriate installation, see Clause 1.1. 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 regarded only as a means for expressing the expected economically reasonable working life of the product.

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.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

According to EN 14992 the evaluation of the essential characteristics of the product shall be carried out by applying method 1² for CE marking.

Table 1 to 3 show how the performance of the precast composite element with point connectors, the connector and the precast reinforced layers of concrete is established in relation to the essential characteristics.

Table 1: Essential characteristics of the precast concrete composite wall with point connectors and assessment methods and criteria for the performance of the product in relation to those essential characteristics

No	Essential characteristic	Assessment method	Type of expression of product performance (Level, class, description)
Basic requirement for construction works 1: Mechanical resistance and stability¹⁾			
1	Shape	2.2.1.1	Description
2	Dimensions and tolerances	2.2.1.2	Description
3	Absorption of shear forces at construction joints	2.2.1.3	Level
Basic requirement for construction works 2: Safety in case of fire			
4	Reaction to fire	2.2.1.4	Class
5	Resistance to fire	2.2.1.5	Class
Basic requirement for construction works 3: Hygiene, health and environment			
6	Water vapour permeability	2.2.1.6	Level
Basic requirement for construction works 4: Safety and accessibility in use			
7	Resistance to filling pressure	2.2.1.7	Level
8	Relative displacement of the precast reinforced layers of concrete	2.2.1.8	Description
9	Surface characteristics of the precast reinforced layers of concrete	2.2.1.9	Description
Basic requirement for construction works 5: Protection against noise			
10	Airborne sound insulation	2.2.1.10	Level
Basic requirement for construction works 6: Energy economy and heat retention			
11	Thermal conductivity	2.2.1.11	Level
12	Thermal resistance	2.2.1.12	Level
13	Specific heat capacity	2.2.1.13	Level
¹⁾ These characteristics also relate to Basic requirement for construction works 4.			

² Method 1: Declaration of geometrical data and material properties.

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

No	Essential characteristic	Assessment method	Type of expression of product performance (level, class, description)
Basic requirement for construction works 1: Mechanical resistance and stability			
1	Shape	2.2.2.1	Description
2	Dimensions	2.2.2.2	Description
3	Material	2.2.2.3	Description
4	Steel failure due to tensile loading	2.2.2.4	Level
5	Combined pull-out and concrete edge failure		
6	Concrete cone failure	2.2.2.5	Level
7	Splitting failure	2.2.2.6	Level
8	Steel failure due to shear loading	2.2.2.7	Level
9	Concrete pry-out failure	2.2.2.8	Level
10	Concrete edge failure	2.2.2.9	Level
11	Edge distance	2.2.2.10	Description
12	Centre spacing	2.2.2.11	Description
13	Corrosion protection	2.2.2.12	Description
Basic requirement for construction works 2: Safety in case of fire			
14	Reaction to fire	2.2.2.13	Class
Basic requirement for construction works 4: Safety and accessibility in use			
15	Same as BWR 1		

Table 3: Essential characteristics of the two precast reinforced layers of concrete and methods and assessment methods and criteria for the performance of the product in relation to those essential characteristics

No	Essential characteristic	Assessment method	Type of expression of product performance (level, class, description)
Basic requirement for construction works 1: Mechanical resistance and stability¹⁾			
Ribbed steel bar used as reinforcement			
1	Nominal diameter d and mass per metre	2.2.3.1.1	Level
2	Yield strength R_e	2.2.3.1.2	Level
3	Tensile strength R_m		
4	Percentage total elongation at maximum force A_{gt}		
5	Ratio tensile strength / yield strength R_m / R_e		
6	Bendability	2.2.3.1.3	Description
7	Relative rib area f_R	2.2.3.1.4	Level
8	Rib spacing c	2.2.3.1.5	Description, Level
9	Rib inclination β	2.2.3.1.6	Description, Level
10	Rib height h	2.2.3.1.7	Description, Level
11	Material and weldability	2.2.3.1.8	Description
Sheets of factory-made machine-welded fabric used as reinforcement			
12	Diameter of transverse and longitudinal wires in welded fabric d_C, d_L	2.2.3.2.1	Level
13	Pitch of transverse and longitudinal wires in welded fabric P_C, P_L	2.2.3.2.2	Level
14	Overhang of the transverse and longitudinal wires in welded fabric u_1, u_2, u_3, u_4		Level
15	Shear force of welded connections in welded fabric F_S	2.2.3.2.3	Level
16	Yield strength R_e	2.2.3.2.4	Level
17	Tensile strength R_m		Level
18	Percentage total elongation at maximum force A_{gt}		Level
19	Ratio tensile strength / yield strength R_m / R_e		Level
20	Bendability	2.2.3.2.5	Description
21	Relative rib area f_R	2.2.3.2.6	Level
22	Rib spacing c	2.2.3.2.7	Description, Level
23	Rib inclination β	2.2.3.2.8	Description, Level
24	Rib height h	2.2.3.2.9	Description, Level
25	Material and weldability	2.2.3.2.10	Description

No	Essential characteristic	Assessment method	Type of expression of product performance (level, class, description)
Concrete layers			
26	Dimensions and tolerances	2.2.3.3.1	Description, Level
27	Shape	2.2.3.3.2	Description
28	Adequate content of cement and additions	2.2.3.3.3	Level
29	Water / binder ratio	2.2.3.3.4	Level
30	Chloride content	2.2.3.3.5	Level
31	Alkali content	2.2.3.3.6	Level
32	Protection of newly cast concrete against drying out	2.2.3.3.7	Description
33	Minimum and maximum concrete strength	2.2.3.3.8	Level
34	Concrete cover and concrete quality of cover	2.2.3.3.9	Description, Level
35	Air content	2.2.3.3.10	Level
36	Adequate hydration by heat treatment	2.2.3.3.11	Level
37	Specific requirements to ensure internal integrity	2.2.3.3.12	Description
38	Specific requirements to ensure surface integrity	2.2.3.3.13	Description
39	Water absorption	2.2.3.3.14	Level
40	Compressive strength	2.2.3.3.15	Level
41	Reinforcement detailing	2.2.3.3.16	Description
Basic requirement for construction works 2: Safety in case of fire			
42	Reaction to fire	2.2.3.4	Class
Basic requirement for construction works 4: Safety and accessibility in use			
43	Surface characteristics of the precast reinforced layers of concrete	2.2.3.5	Description
¹⁾ These characteristics also relate to Basic requirement for construction works 4.			

2.2 Assessment methods and criteria for the performance of the product in relation to essential characteristics of the product

2.2.1 Precast concrete composite wall with point connectors

Basic requirement for construction works 1 – Mechanical resistance and stability

2.2.1.1 Shape

Exemplary drawings and figures of the shape shall be stated in the ETA.

2.2.1.2 Dimensions and tolerances

Dimensions of the wall shall be stated in the ETA.

Verification of the fabrication tolerances according to EN 14992, Clause 4.3.1

Acceptance criteria of the fabrication tolerances are defined in EN 14992, Clause 4.3.1.

2.2.1.3 Absorption of shear forces at construction joints

Verification according to EN 1992-1-1, Clause 6.2.5

Acceptance criteria are defined in EN 1992-1-1, Clause 6.2.5.

Basic requirement for construction works 2 – Safety in case of fire

2.2.1.4 Reaction to fire

The precast concrete composite wall with point connectors is considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire in accordance with the EC Decision 96/603/EC³, 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 product is A1.

2.2.1.5 Resistance to fire

For the verification of the resistance to fire of the precast concrete composite wall with point connectors one of the methods described in EN 13369, Clause 4.3.4.2 can be chosen.

Depending on the chosen method of verification, the product shall be classified according to EN 13501-2 or EN 1992-1-2.

2.2.1.6 Water vapour permeability

Assessment by tabulated data given in EN ISO 10456.

The characteristic value shall be stated in the ETA.

Basic requirement for construction works 4 – Safety and accessibility in use

2.2.1.7 Resistance to filling pressure

The resistance to filling pressure of the point connectors is defined by the tensile resistance of the steel wires, see Clause 2.2.2.4, and the minimum tensile bending resistance of the precast reinforced layers of concrete. The number of connectors per m² required to resist filling pressure determined by the rate of concreting and the class of consistency of concrete according to EN 14992, Annex B, figure B.1 shall be determined as follows:

$$n \geq \frac{\sigma_{k,max} \cdot \gamma_f}{m \cdot F_d}$$

Where

n.....number of connectors

³ Official Journal of the European Communities № L 267, 19.10.1996

$\sigma_{k,max}$characteristic filling pressure

γ_fsafety factor for impact

m.....number of point connectors per connector

F_ddesign value of the tensile resistance of the individual point connector

Depending on the filling pressure the number of connectors per m^2 shall be determined.

The minimum tensile bending resistance of the precast reinforced layers of concrete shall be calculated for the maximum centre spacing between the connectors according to EN 15498, Annex C, Clause C.4.2, where the maximum filling pressure shall be taken from EN 14992, Annex B, figure B.1.

The characteristic value of the minimum tensile bending resistance of the reinforced layers of concrete shall be less than the mean centric tensile strength of the used concrete strength class. Tabulated values for the concrete strength classes and the corresponding mean centric tensile strength shall be taken from EN 1992-1-1, Table 3.1.

The precast reinforced layers of concrete shall resist to a formwork pressure of a defined rate of concreting and the class of consistency of concrete as defined in EN 14992, Annex B, figure B.1. The maximum centre spacing between the connectors has to be observed.

If the minimum tensile bending resistance of the precast reinforced layers of concrete is greater than the mean centric tensile strength of the used concrete additionally reinforcement with verification according to EN 1992-1-1 is necessary.

2.2.1.8 Relative displacement of the reinforced layers of concrete

Testing of relative displacement of the reinforced layers of concrete shall show that during transportation or assembly the corrugated steel sheet avoids unfavourable stress for the stainless steel wires and maintains the stiffness of the unfilled wall.

Two unfilled precast concrete composite walls of different thickness shall

- be lifted from horizontal position to the vertical assembly position by a crane, dial gauges shall be installed and the lateral transportation anchorages shall be cut. The composite elements shall then be lifted again and one layer shall be set down on an underlayment thus the other layer does not touch the ground anymore and is held by the steel sheet and the transportation anchorages at the top of the composite elements only. The relative displacement shall be recorded.
- The layers shall be lifted again and jerkily dropped on the underlayment. The relative displacement shall be recorded.
- The layers shall then be tilt over the concrete edge of one layer to a 45° position. The relative displacement in this position shall be recorded.

The displacements shall not exceed the permitted deviations defined in EN 14992, Clause 4.3.1.1.

2.2.1.9 Surface characteristics of the precast reinforced layers of concrete

The surface characteristic shall correspond to the recommended maximum deviation values given in EN 13369, Annex J, Clause J.4.

Other maximum deviations may be specified.

Basic requirement for construction works 5 – Protection against noise

2.2.1.10 Air borne sound insulation

The airborne sound insulation of the finished wall of precast concrete wall with point connectors may be estimated by calculation following Annex B of EN 12354-1 or measured according to EN ISO 10140-2. In this case it shall be expressed according to EN ISO 717-1.

The characteristic value shall be stated in the ETA.

Basic requirement for construction works 6 – Energy economy and heat retention

2.2.1.11 Thermal conductivity

The design thermal conductivity of the materials shall be obtained from tabulated values in EN ISO 10456.
The characteristic value shall be stated in the ETA.

2.2.1.12 Thermal resistance

The thermal resistance and thermal transmittance of concrete products may be calculated in accordance with EN ISO 6946 or measured in a hot box in accordance with EN ISO 8990 or EN 1934.
The characteristic value shall be stated in the ETA.

2.2.1.13 Specific heat capacity

The specific heat capacity of the materials shall be obtained from tabulated values in EN ISO 10456.
The specific heat capacity shall be stated in the ETA.

2.2.2 Connector

Basic requirement for construction works 1 – Mechanical resistance and stability

2.2.2.1 Shape

Exemplary drawings and figures of the shape shall be stated in the ETA.

2.2.2.2 Dimensions

The relevant dimensions of the connector shall be determined.

The dimensions shall conform to the connector's specification.

2.2.2.3 Material

Material characteristics of the components of the connector shall be determined according to the respective reference standards. For the stainless steel wires EN 10088-1 and EN 1993-1-4 applies. The steel sheet shall be determined according to EN 10130.

Acceptance criteria shall conform to the respective reference standard of the component's material. The components shall be accompanied by an inspection certificate 3.1.

Results of tensile tests to compare with the figures of the inspection certificate 3.1 are to be provided.

2.2.2.4 Steel failure due to tensile loading and combined pull-out and concrete cone failure

Due to corrugation and notches of the steel wires the characteristic resistance in case of steel failure, $N_{Rk,s}$, cannot be calculated according to EOTA TR 029, Clause 5.2.2.2 but shall be assessed during testing of combined pull-out and concrete cone failure.

The occurrence of steel failure due to tensile loading or combined pull-out and concrete cone failure depends on the embedment depth of the steel wires and concrete strength class. The embedment depth is equal to the thickness of the concrete layers.

Testing shall be carried out on concrete layers of different thickness. The minimum layer thickness where combined pull-out and concrete cone failure does not occur anymore but steel failure shall be assessed as well as the characteristic values of both failure modes.

The compressive strength of the precast reinforced layers of concrete shall be verified according to EN 12390-1, EN 12390-2 and EN 12390-3.

5 pull-out failure tests for one thickness of precast reinforced layer of concrete shall be summarized in one test series. The mean value of steel failure at maximum load as well as for combined pull-out and concrete cone failure shall be calculated. The 5 %-fractile value at a confidence level of 90 % shall be determined. The 5 %-fractile value shall then be converted to a concrete compressive strength of 25 N/mm² (cube compressive strength of C20/25):

$$N_{u, 5\%, 25} = \sqrt{\frac{25}{f_{c, test}}} \cdot N_{u, 5\%}$$

Where

$N_{u, 5\%, 25}$ 5 %-fractile value converted to C20/25

$f_{c, test}$ Concrete compressive strength at the day of testing

$N_{u, 5\%}$ 5 %-fractile value of the values of steel failure at maximum load

The characteristic resistance in case of combined pull-out and concrete cone failure at the corresponding embedment depth shall be stated in the ETA.

The characteristic value of steel failure due to tensile loading shall be stated in the ETA.

2.2.2.5 Concrete cone failure

The characteristic resistance of the group of connectors in case of concrete cone failure depending on the embedment depth, concrete strength class, edge distance and centre spacing between the connectors shall be calculated according to EOTA TR 029, Clause 5.2.2.4.

The characteristic value shall be stated in the ETA.

2.2.2.6 Splitting failure

According to EOTA TR 029, Clause 5.2.2.6, the calculation of the characteristic splitting resistance may be omitted if the following two conditions are fulfilled:

- A reinforcement is present which limits the crack width to $w_k \sim 0.3$ mm, taking into account the splitting forces according to EOTA TR 029, Clause 7.3.
- The characteristic resistance for concrete cone failure and pull-out failure is assessed for cracked concrete.

In all other cases a minimum reinforcement is required to avoid splitting of the member. The splitting reinforcement shall be calculated for 50 % of the tensile force of the steel wires. The necessary cross-section of the minimum reinforcement in mm² is determined as follows:

$$\min A_s = 0.5 \frac{\sum N_{sd}}{f_{yk} / \gamma_{Mh}}$$

Where

$\sum N_{sd}$sum of the tensile forces of the anchor bolts under tension under the design value of the actions [N]

f_{yk}characteristic value of the yield point of the reinforcing steel [N/mm²]

γ_{Mh}partial safety factor for the reinforcement according to national rules; in the absence of such rules, the partial safety factor can be taken with 1.15 from EN 1992-1-1.

In all other cases the characteristic minimum reinforcement to avoid splitting of the layers shall be stated in the ETA.

2.2.2.7 Steel failure due to shear loading

The characteristic resistance of the stainless steel wires in case of steel failure due to shear loading, $V_{Rk,s}$, shall be calculated according to EOTA TR 029, Clause 5.2.3.2.

The characteristic value shall be stated in the ETA.

2.2.2.8 Concrete pry-out failure

Anchorage with short stiff anchors can fail by a concrete pry-out failure at the side opposite to load direction. The corresponding characteristic resistance, $V_{Rk,op}$, shall be calculated according to EOTA TR 029, Clause 5.2.3.3.

The characteristic value of concrete pry-out failure shall be stated in the ETA.

2.2.2.9 Concrete edge failure

The characteristic resistance for the steel wires in the case of concrete edge failure shall be calculated according to EOTA TR 029, Clause 5.2.3.4.

The characteristic value of concrete edge failure shall be stated in the ETA.

2.2.2.10 Edge distance

The minimum edge distance shall be determined by calculation of the failure modes, see Clause 2.2.2.5, 2.2.2.8 and 2.2.2.9.

The minimum edge distance of the connector at the corresponding embedment depth of the steel wires shall be stated in the ETA.

2.2.2.11 Centre spacing

The centre spacing between the steel wires is defined by the shape of the connector, see Clause 2.2.2.1.

The maximum centre spacing between the connectors shall be determined by calculation of the resistance to filling pressure, see Clause 2.2.1.7.

The centre spacing between the steel wires shall be given in the ETA.

The centre spacing between the connectors shall be in accordance with Clause 2.2.1.7.

2.2.2.12 Corrosion protection

The stainless steel wires shall meet the requirements given in EN 1993-1-4 and EN 10088-1.

Basic requirement for construction works 2 – Safety in case of fire

2.2.2.13 Reaction to fire

The connector is considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire in accordance with the EC Decision 1996/603/EC⁴, 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 product is A1.

Basic requirement for construction works 4 – Safety and accessibility in use

Same as for Basic requirement for construction works 1.

⁴ Official Journal of the European Communities № L 267, 19.10.1996

2.2.3 Precast reinforced layers of concrete

Basic requirement for construction works 1 – Mechanical resistance and stability

2.2.3.1 Ribbed steel bar used as reinforcement

2.2.3.1.1 Nominal diameter and mass per metre

Declaration of the nominal diameter according to EN 10080, Clause 7.3.1.

The values for the nominal mass per metre shall be calculated from the values of the nominal cross-sectional area using a density value of 7.85 kg/dm³, see EN 10080, Clause 7.3.2.

The characteristic values for the nominal diameter and mass per metre of the ribbed reinforcing steel bars shall be stated in the ETA.

2.2.3.1.2 Strength properties

The tensile test shall be carried out in accordance with EN ISO 15630-1, Clause 5. Tensile strength, R_m , yield strength, R_e , ratio tensile strength to yield strength, $\frac{R_m}{R_e}$, and total elongation at maximum load, A_{gt} , shall be determined according to EN 10080, Clause 7.2.3.

Acceptance criteria regarding the strength properties shall be in accordance with EN 10080, Clause 8.1.3.1. In the product specification, the lower limit of the statistical tolerance interval applies in regard to

- Yield strength, R_e , with a 5 % fractile as characteristic value;
- Ratio tensile strength to yield strength, $\frac{R_m}{R_e}$, and elongation at maximum load, A_{gt} , with a 10 % fractile as characteristic value.
- The ratio tensile strength to yield strength shall meet

$$\text{Type A}^2 \dots\dots\dots 1.05 \leq \left(\frac{R_m}{R_e}\right)_k$$

$$\text{Type B}^5 \dots\dots\dots 1.08 \leq \left(\frac{R_m}{R_e}\right)_k$$

$$\text{Type C}^2 \dots\dots\dots 1.15 \leq \left(\frac{R_m}{R_e}\right)_k \leq 1.35$$

Where

$$\left(\frac{R_m}{R_e}\right)_k \dots\dots\dots \text{Characteristic value of the ratio tensile strength to yield strength}$$

NOTE Type C is to be used where violent earthquakes have to be considered.

2.2.3.1.3 Bendability

According to EN 10080, Clause 7.2.6 the bent and re-bend test shall be performed according to EN 15630-1.

Acceptance criteria are defined in EN 10080, Clauses 7.2.6.2 and 7.2.6.3.

2.2.3.1.4 Relative rib area

Assessment according to EN ISO 15630-1, Clause 11.

The relative rib area shall correspond to the minimum relative rib area stated in EN 1992-1-1, Annex C.

2.2.3.1.5 Rib spacing

Assessment according to EN ISO 15630-1, Clause 10.

The characteristic value for rib spacing shall be within the ranges given in EN 10080, Table 7.

⁵ According to Eurocode 2, Annex C.

- 2.2.3.1.6 Rib inclination
Assessment according to EN ISO 15630-1, Clause 10.
The characteristic value for rib inclination shall be within the ranges given in EN 10080, Table 7.
- 2.2.3.1.7 Rib height
Assessment according to EN ISO 15630-1, Clause 10.
The characteristic value for rib height shall be within the ranges given in EN 10080, Table 7.
- 2.2.3.1.8 Material and weldability
The ribbed reinforcing steel bar shall meet the requirements of EN 10080, Clause 6.
According to EN 13369, Clause 4.2.3.1 welded connection of reinforcing bars may only be used when the weldability of the steel is fully documented.
Acceptance criteria are defined in EN 10080, Clause 6. Declaration according to EN 1992-1-1, Annex C, Table C.1.
The material shall be accompanied by an inspection certificate 3.1.
- 2.2.3.2 Sheets of factory-made machine-welded fabric used as reinforcement
- 2.2.3.2.1 Diameter of transverse and longitudinal wires in welded fabric
Assessment according to EN ISO 15630-2, Clause 10.
Acceptance criteria are defined in EN 10080, Clause 7.3.5.1.2.
The nominal value shall be stated in the ETA.
- 2.2.3.2.2 Pitch and overhang of transverse and longitudinal wires in welded fabric
Assessment according to EN ISO 15630-2, Clause 10.
Acceptance criteria are defined in EN 10080, Clause 7.3.5.1.3.
- 2.2.3.2.3 Shear force of welded connections in welded fabric
Assessment according to EN ISO 15630-2, Clause 7.
The characteristic value shall be stated in the ETA.
- 2.2.3.2.4 Strength properties
See Clause 2.2.3.1.2.
- 2.2.3.2.5 Bendability
Assessment and declaration according to EN ISO 15630-2, Clause 6.
- 2.2.3.2.6 Relative rib area
See Clause 2.2.3.1.4.
- 2.2.3.2.7 Rib spacing
See Clause 2.2.3.1.5.
- 2.2.3.2.8 Rib inclination
See Clause 2.2.3.1.6.
- 2.2.3.2.9 Rib height
See Clause 2.2.3.1.7.
- 2.2.3.2.10 Material and weldability
See Clause 2.2.3.1.8.

2.2.3.3 Concrete layers

2.2.3.3.1 Dimensions and tolerances

See Clause 2.2.1.2.

2.2.3.3.2 Shape

Exemplary drawings and figures of the shape shall be stated in the ETA.

2.2.3.3.3 Adequate content of cement and additions

Assessment according to EN 206-1, Clause 5.4.2.

Requirements of the respective exposure class according to EN 206-1 shall be fulfilled.

2.2.3.3.4 Water / binder ratio

Assessment according to EN 206-1, Clause 5.4.2.

Requirements of the respective exposure class according to EN 206-1 shall be fulfilled.

2.2.3.3.5 Chloride content

Assessment according to EN 206-1, Clause 5.2.7.

Depending on the usage of the concrete requirements of EN 206-1, Table 10 shall be fulfilled.

2.2.3.3.6 Alkali content

According to EN 206-1, Clause 5.2.2, the potential reactivity of the aggregates with the alkalis of the raw material shall be taken under consideration when selecting the appropriate cement.

To prevent damaging alkali-silica reactions precautions with proven suitability shall be taken.

2.2.3.3.7 Protection of newly cast concrete against drying out

According to EN 13369, Clause 4.2.1.3 the concrete shall be protected during curing so that loss in strength and cracking due to temperature and shrinkage and that, if relevant, detrimental effects on durability, are avoided. Methods of protections against drying out are defined by EN 13369, Table 1.

Acceptance criteria of the minimum strength of the concrete at the end of protection against drying out are defined in EN 13369, Table 2.

2.2.3.3.8 Minimum and maximum concrete strength

The minimum and maximum concrete strength according to EN 206-1, Table 7 shall be stated in the ETA.

2.2.3.3.9 Concrete cover and concrete quality of cover

Exposure class according to EN 206-1, Clause 4.

Declaration of the concrete cover and concrete quality of cover according to EN 13369, Annex A, Table A.2 by means of the corresponding exposure classes and environmental conditions given in EN 13369, Annex A, Table A.1.

2.2.3.3.10 Air content

Assessment according to EN 12350-7.

The characteristic minimum value of the air content shall be stated in the ETA.

2.2.3.3.11 Adequate hydration by heat treatment

Where heat treatment at atmospheric pressure is applied to concrete during production in order to accelerate its hardening, it shall be demonstrated by initial testing that the required strength is achieved for each concrete family concerned, see EN 13369, Clause 4.2.1.4.

2.2.3.3.12 Specific requirements to ensure internal integrity

The potential properties concerning resistance and durability of the concrete mix shall be safeguarded during production by adequate hydration, possibly by heat treatment (where applicable) and limitation of early cracking of concrete, see EN 13369, Clause 4.2.1.3 and 4.2.1.4.

2.2.3.3.13 Specific requirements to ensure surface integrity

The performance related design method stated in EN 206-1, Clause 5.3.3 and Annex J shall be used to facilitate performance checking.

2.2.3.3.14 Water absorption

Assessment according to the test method given in EN 13369, Annex G.

The characteristic value shall be stated in the ETA.

2.2.3.3.15 Compressive strength

The concrete strength shall be verified according to EN 12390-1, EN 12390-2 and EN 12390-3.

Declaration according to EN 206-1, Table 7.

2.2.3.3.16 Reinforcement detailing

Requirements of EN 14992 shall be fulfilled.

Requirements of TR 029, Clause 5.2.2.4, d) for a shell spalling factor $\psi_{re,N}=1.0$ shall be fulfilled.

Basic requirement for construction works 2 – Safety in case of fire**2.2.3.4 Reaction to fire**

The precast reinforced layer of 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/EC⁶, 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 product is A1.

Basic requirement for construction works 4 – Safety and accessibility in use**2.2.3.5 Surface characteristic of the precast reinforced layers of concrete**

See Clause 2.2.1.9.

⁶ Official Journal of the European Communities № L 267, 19.10.1996

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 Systems 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 1999/94/EC⁷ as amended by Corrigendum to Decision 1999/94/EC⁸ and Commission Implementing Decision 2012/202/EU⁹.

The systems are: **2+** for structural use

4 for non-structural or light structural use

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the precast concrete composite wall with point connectors in the procedure of assessment and verification of constancy of performance are laid down in Table 7.

Table 7: Test 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	Equipment inspection	According to EN 13369, Annex D, Table D.1			
2	Materials inspection	According to EN 13369, Annex D, Table D.2			
		Check if material properties of the steel components of the steel components correspond to the material properties stated in the inspection certificate "type 3.1"	Inspection certificate "type 3.1" according to EN 10204 (to be furnished by supplier of components) 100% compliance to material properties stated in ETA	Every component	Every production unit
		Tensile test of the notched and corrugated steel wires	Test results shall correspond to the material properties stated in the inspection document "type 3.1"	3	Per batch
3	Process inspection	According to EN 13369, Annex D, Table D.3 ¹⁰			

⁷ Official Journal of the European Communities/Union L 29, 3 2.1999

⁸ Official Journal of the European Communities/Union L 83, 27.3 1999

⁹ Official Journal of the European Communities/Union L 109, 21.4.2012

¹⁰ Considering remarks of EN 14992, Annex C, Clause C.1

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
4	Finished product inspection	According to EN 13369, Annex D, Table D.4 and according to EN 14992, Annex C, Table C.1			

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for the precast concrete composite wall with point connectors are laid down in Table 8.

Table 8: Test 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 <i>(for system 2+)</i>					
1	It shall be ascertained that, in accordance with the test plan, the manufacturing plant of the single product manufacturer, in particular personnel and equipment, and the factory production control are suitable to ensure a continuous and orderly manufacturing of the precast concrete composite wall with point connectors according the European Technical Assessment.				-
Continuous surveillance, assessment and evaluation of factory production control <i>(for system 2+)</i>					
2	It shall be verified that the system of factory production control and the specified manufacturing process are maintained taking account of the test plan.				1/year

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.

EN 1992-1-1 (12.2004) EN 1992-1-1/AC (01.2008) EN 1992-1-1/AC (11.2010)	Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings
EN 1992-1-2 (12.2004) EN 1992-1-2/AC (07.2008)	Eurocode 2: Design of concrete structures - Part 1-2: General rules - Structural fire design
EN 1993-1-4 (10.2006)	Eurocode 3 - Design of steel structures - Part 1-4: General rules - Supplementary rules for stainless steels
EN 206-1+A1 (07.2004) +A2 (06.2005)	Concrete - Part 1: Specification performance, production and conformity
EN 1934 (03.1998)	Thermal Performance of buildings - Determination of thermal resistance by hot box method using heat flow meter - Masonry
EN 10080 (05.2005)	Steel for the reinforcement of concrete - Weldable reinforcing steel - General
EN 10088-1 (06.2005)	Stainless steels - Part 1: List of stainless steels
EN 10130 (12.2006)	Cold rolled low carbon steel flat products for cold forming - Technical delivery conditions
EN 10204 (10.2004)	Metallic products - Types of inspection documents
EN 12350-7 (04.2009)	Testing fresh concrete - Part 7: Air content - Pressure methods
EN 12354-1 (04.2000)	Building Acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 1: Airborne sound insulation between rooms
EN 12390-1 (09.2012)	Testing hardened concrete - Part 1: Shape, dimensions and other requirements for specimens and moulds
EN 12390-2 (04.2009)	Testing hardened concrete - Part 2: Making and curing specimens for strength tests
EN 12390-3 (02.2009) EN 12390-3 /AC (08.2011)	Testing hardened concrete - Part 3: Compressive strength of test specimens
EN 13369 (04.2013)	Common rules for precast concrete products
EN 13501-2+A1 (09.2009)	Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services
EN 14992+A1 (06.2012)	Precast concrete products - Wall elements
EN 15498 (04.2008)	Precast concrete products - Wood-chip concrete shuttering blocks - Product properties and performance
EN ISO 717-1 (03.2013)	Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation
EN ISO 6946 (12.2007)	Building components and building elements - Thermal resistance and thermal transmittance - Calculation method
EN ISO 8990 (08.1996)	Thermal insulation - Determination of steady-state thermal transmission properties - Calibrated and guarded hot box
EN ISO 10456 (12.2007) EN ISO 10456/AC (12.2009)	Building materials and products - Hygrothermal properties – Tabulated design values and procedures for determining declared and design thermal values

EN ISO 10140-2 (09.2010)	Acoustics - Laboratory measurement of sound insulation of building elements - Part 2: Measurement of airborne sound insulation
EN ISO 15630-1 (10.2010)	Steel for the reinforcement and prestressing of concrete - test methods - Part 1: Reinforcing bars, wire rod and wire
EN ISO 15630-2 (10.2010)	Steel for the reinforcement and prestressing of concrete - Test methods - Part 2: Welded fabric
EOTA TR 029	Design of Bonded Anchors