



EUROPEAN ASSESSMENT DOCUMENT

EAD 333220-00-0601

January 2021

PRE-INSTALLED ANCHOR FOR FASTENING CONCRETE FAÇADE ELEMENTS

The reference title and language for this EAD is English. The applicable rules of copyright refer to the document elaborated in and published by EOTA.

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).

Contents

1	Scope of the EAD.....	4
1.1	Description of the construction product	4
1.2	Information on the intended use(s) of the construction product	5
1.2.1	Intended use(s).....	5
1.2.2	Working life/Durability.....	6
1.3	Specific terms used in this EAD	6
1.3.1	General.....	6
1.3.2	Symbols.....	6
2	Essential characteristics and relevant assessment methods and criteria.....	7
2.1	Essential characteristics of the product	7
2.2	Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product	7
2.2.1	Characteristic resistance to concrete failure under inclined load not influenced by edges, spacing and reinforcement.....	8
2.2.2	Characteristic resistance to concrete failure under inclined load influenced by edges, and reinforcement.....	8
2.2.3	Characteristic resistance to steel failure under inclined load	10
2.2.4	Reaction to fire	10
2.2.5	Corrosion and durability of coating.....	11
3	Assessment and verification of constancy of performance	12
3.1	System of assessment and verification of constancy of performance to be applied	12
3.2	Tasks of the manufacturer	12
3.3	Tasks of the notified body	12
4	Reference documents	14
	Annex A: Characteristic resistance to breakout or pull-out failure under inclined load with or without edge influence.....	15
	Annex B: Characteristic resistance to steel failure under inclined load	16

1 SCOPE OF THE EAD

1.1 Description of the construction product

This EAD covers an assessment of pre-installed anchors embedded in concrete according to EN 206¹ and anchored by mechanical interlock.

The anchor is made from stainless steel or carbon steel with coating, which is cast into concrete façade element.

It consists of a lower part that is cast-in with reinforcement stirrups (see figure 1.2, detail no. 2) in the substrate (detail no. 4), a tension bar (detail no. 5) that is connected through a joint with the lower part and through a screwed connection with the upper part (detail no. 1). The upper part will be connected to a fastener that is cast-in the substrate (detail no. 4). Spacer bolts will be set on the upper and the lower part of the substrate (detail 3). On the lower spacer bolt, a bolt restraint will be set.

The anchor is to be cast in façade panels made from normal weight reinforced concrete, minimum strength class C25/30 according to EN 206.

The angle of the tension bar (see figure 1.2) are either $20^{\circ} \pm 3^{\circ}$; $22,5^{\circ} \pm 3^{\circ}$ or $25^{\circ} \pm 3^{\circ}$.

It is part of a complete anchoring system (see figure 1.2) for fastening façade elements to the loadbearing substructure. The other parts of the anchoring system that will be fixed to the exterior wall (such as anchor channels or other fixings) are covered and specified by harmonized standards or ETA's and are not part of this EAD.

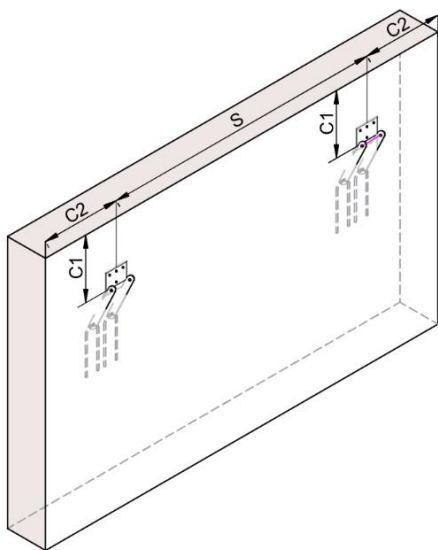


Figure 1.1: Illustration of an example of the product and its intended use (where applicable)

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

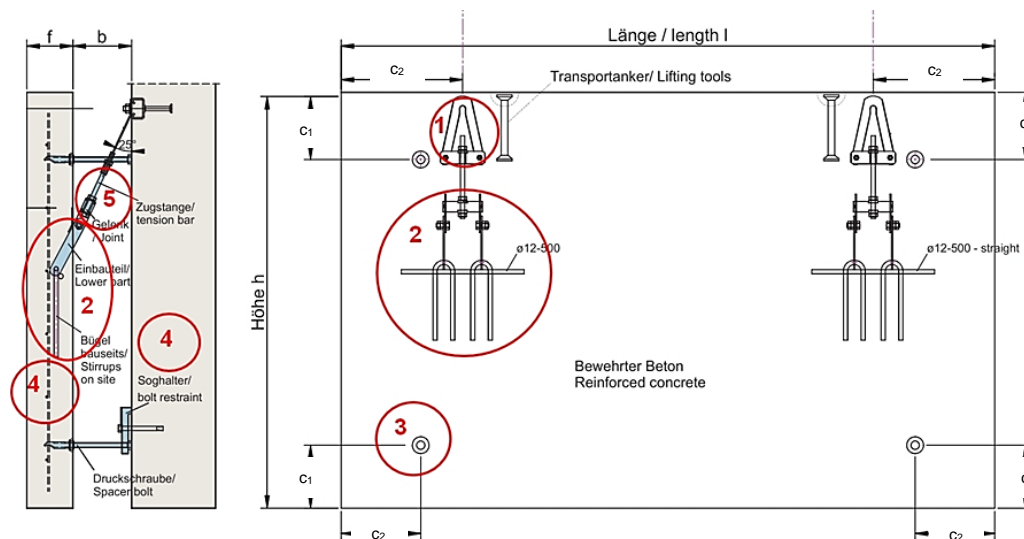


Figure 1.2: Illustration of an example of the product and its intended use (where applicable)

The product is not fully covered by the following harmonised technical specification: EAD, 330747-00-060, 1EAD 330232-00-0601, and EAD 330030-00-0601.

The assessment methods in these EAD's do not cover the specific configuration of the anchor.

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 cast-in anchor is intended to be used for permanent anchorages of concrete façade panels under predominantly static actions or quasi-static actions in reinforced normal weight concrete with minimum strength class C25/30.

The cast-in anchor is intended to be anchored in uncracked concrete.

The cast-in anchor is intended to be used for transmission inclined force.

The cast-in anchor is intended to be embedded surface-flush or sunk in the concrete member.

Depending on the materials used for the cast-in anchor it shall be used in structures subjected to external atmospheric exposure or exposure in permanently damp internal conditions.

The cast-in anchor is intended to be used in the temperature range of -40°C to +80°C without special assessment.

The anchor is intended to be used for anchorages which are designed according to the design method given in EN 1992-4.

The hardened concrete is at least 21 days old.

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 consider a working life of the pre-installed anchoring system for the intended use of 50 years when installed in the works (provided that the pre-installed anchoring system is subject to appropriate installation (see 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 works².

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.

1.3 Specific terms used in this EAD

1.3.1 General

Façade panels = panels used for external wall claddings ventilated at rear

Fastener = product for fixing the façade panel to the substructure

1.3.2 Symbols

c_1 = edge distance in direction 1

c_2 = edge distance in direction 2

CV_F = coefficient of variation [%] related to loads

$F_{u,m}$ = mean failure (ultimate) load of a test series

$F_{Rk,0}$ = characteristic reference resistance (initial value)

$F_{u,5\%}$ = 5% fractile of failure (ultimate) loads of a test series

$V_{Rk,s}$ = characteristic fastener resistance to steel failure under inclined load

$V_{u,5\%,s}$ = 5% fractile of steel failure (ultimate) loads of a test series under inclined load

β_{cV} = reduction factor to large scatter according to A2.2 of EAD 330232-00-0601

h_{nom} = overall embedment depth in the concrete

h_{ef} = effective embedment depth

² 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 referred to above.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2.1 shows how the performance of the pre-installed anchor for fastening façade elements is assessed in relation to the essential characteristics.

Table 2.1 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	Assessment method	Type of expression of product performance
Basic Works Requirement 1: Mechanical resistance and stability			
1	Characteristic resistance to concrete failure under inclined load not influenced by edges, spacing and reinforcement	2.2.1	Level
2	Characteristic resistance to concrete failure under inclined load influenced by edges, and reinforcement	2.2.2	Level
3	Characteristic resistance to steel failure under inclined load	2.2.3	Level
Basic Works Requirement 2: Safety in case of fire			
4	Reaction to fire	2.2.4	Class
Aspects of durability			
5	Corrosion	2.2.5	Description

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.

Testing will be limited only to the essential characteristics which the manufacturer intends to declare. 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 5%-fractile of the ultimate loads of a test series shall be calculated according to statistical methods for a confidence level of 75%. In general, a normal distribution and an unknown standard deviation shall be assumed.

$$F_{5\%} = F_m \cdot (1 - k_s \cdot V_{test})$$

F_m = mean failure load of a test series

k_s = tolerance factor corresponding to a 5 percent probability of non-exceedance with a confidence to 75%, in general derived from a Gaussian distribution for which the population standard deviation is unknown, values for specific sample sizes n may be taken from statistical handbooks (e.g. [3])

n = 5 tests: $k_s = 2,47$

n = 10 tests: $k_s = 2,11$

n = 20 tests: $k_s = 1,94$

V_{test} = coefficient of variation of failure loads of a test series

2.2.1 Characteristic resistance to concrete failure under inclined load not influenced by edges, spacing and reinforcement

The tests are performed to determine the characteristic resistance to breakout or pull-out failure under inclined load with minimum edges distances in all directions of c_1 and $c_2 \geq 2 h_{nom}$, maximum angle α (see figure in Annex A) and minimum reinforcement, and thereby establishing the baseline values for the assessment of the performance under inclined load $F_{Rk,0}$. The test series is also needed to confirm spacing “s” (defined through the applicant) between anchor and spacer bolt and between two anchors. A minimum distance for the system between the anchor and the spacer bolts and between two anchors respective. The spacer bolt shall be set in a way that the characteristic resistance of the anchor is not influenced (above the anchor or at the same height). This shall be proofed through single anchor testing and the shown failure mode.

The minimum number of samples shall be tested is 5.

The tests may be omitted, if the tests in 2.2.2 will be valid for 2.2.1 as well. If neither test according to 2.2.1 nor to 2.2.3 are done, steel failure must be checked in test in accordance with 2.2.2 or detail no. 5 and/or 1 (see figure 1.2) shall be calculated according to equation 2.2.3.

No tests are required if $F_{Rk,0} \leq F_{Rk,1}$ is accepted ($F_{Rk,1}$: Characteristic resistance of the anchor system with edge and spacing influence, see section 2.2.2 of this EAD).

The tests are performed on the pre-installed anchor system in concrete with minimum strength class C25/30 and with minimum edges distances in all directions of c_1 and $c_2 \geq 2 h_{nom}$, maximum angle α (see figure in Annex A) and minimum reinforcement. The test conditions are given in Annex A, A.1 Test procedure 1.

If the manufacturer applies for one characteristic resistance for all concrete strength classes, the tests in high strength concrete may be omitted.

The pre-installed anchor system shall be cast-in according to the manufacturer’s instructions. According to the manufacturer’s instructions, the product relevant angles of the system shall be tested.

It is permitted to use grouping to reduce the test program. Where grouping is used, the tests shall be performed with the smallest anchor system of a group. Using anchors with the lowest specified steel strength for the test. The anchors shall be grouped, if the equal anchor system/product is used for different sizes and the manufacturing method is constant (see annex A).

The following assessment shall be made for each anchor size and for each embedment depth or for grouped anchor system sizes:

- Assessment of the mean value of failure loads $F_{u,m}$ [kN], converted to the nominal concrete strength (see EAD 330232-00-0601 Annex A2.1)
- Assessment of $F_{Rk,0}$ from the 5% fractile of the failure loads $F_{u,5\%}$ [kN], converted to the nominal concrete strength. (The compression strength of concrete shall be assessed according to EN 12390-1)
- Verify the coefficient of variation of failure loads. If the coefficient of variation exceeds 15% ($V_{test} > 15\%$), assessment of the reduction factor for large scatter of failure loads β_{cV} according to A.2.2 of EAD 330232-00-0601.

Spacing’s shall be assessed through failure. The area of influence through failure will be measured and stated in the ETA as a distance for spacing between the anchors and/or between anchor and spacer bolt.

The level of the characteristic resistance of the anchor system $F_{Rk,0}$ shall be stated in the ETA.

2.2.2 Characteristic resistance to concrete failure under inclined load influenced by edges, and reinforcement

The tests are performed to assess the characteristic resistance to breakout or pull-out failure under inclined load with minimum edges distances in all directions of c_1 and $c_2 = c_{min} = 2h_{nom}$ ($2h_{eff}$) with h_{eff} = member thickness – minimum concrete coverage (the test results may be influenced through bending). Maximum angle (see figure in Annex A) and if applicable minimum reinforcement under inclined load

FRk,1. The test series is also needed to confirm spacing “s” (defined through the applicant) between anchor and spacer bolt test method.

The tests are performed on the pre-installed anchor system in concrete with minimum strength class C25/30 and with minimum edges distances in all directions of c_1 and $c_2 = c_{\min} = 2h_{\text{nom}} (2h_{\text{eff}})$, maximum angle α (see figure in Annex A) and if applicable minimum reinforcement. The test conditions are given in Annex A, A.2 Test procedure 2.

If the manufacturer applies for one characteristic resistance for all concrete strength classes, the tests in high strength concrete may be omitted.

The pre-installed anchor system shall be cast-in, and the product-relevant angles of the system according to the manufacturer’s instructions shall be tested.

A minimum of 5 samples shall be tested.

As a minimum, the mechanically weakest system shall be tested. If no minimum reinforcement is required through the applicant, then tests on specimen without reinforcement shall be executed. The weakest system is defined as the minimum reinforcement or the concrete specimen without reinforcement according to the manufacturers specifications. The manufacturer can specify for example a minimum edge reinforcement steel with 6 mm diameter and cast-in at the edge of the concrete specimen according to EN 1992-4.

An example of the concrete member is given in Figure 2.1.

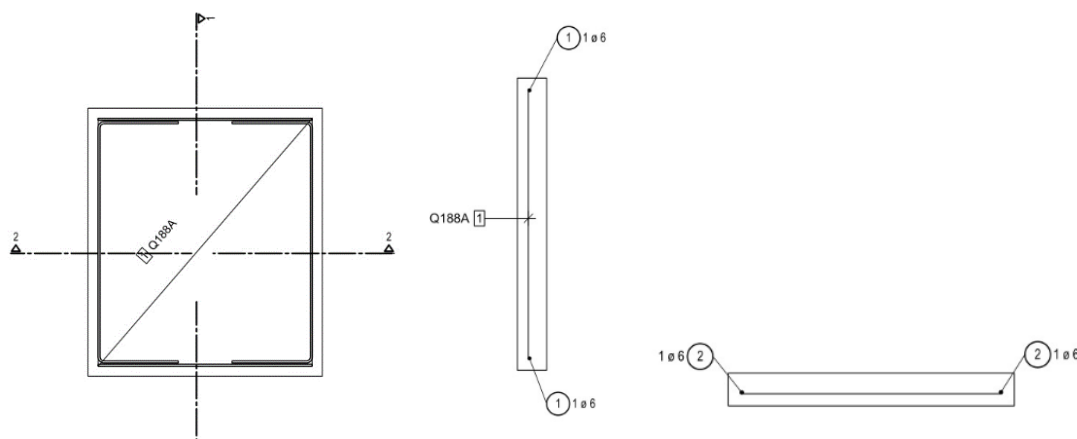


Figure 2.1: plan view of the concrete member

The characteristic resistance to steel failure shall be assessed through performing the tests in annex B, with all product parts (detail no. 1, 2 and 5, see figure 1.2). The tests shall be assessed at least with detail no 2, detail no 1 and 5 shall then be calculated according to equation 2.2.3 in section 2.2.3 if not included in testing.

It is permitted to use grouping to reduce the test program. Where grouping is used, the tests shall be performed with the smallest anchor system of a group. Use anchors with the lowest specified steel strength. The anchors shall be grouped, if the equal anchor system/product is used for different sizes and the manufacturing method is constant.

The following assessment shall be made for each anchor size and for each embedment depth or for grouped anchor system sizes:

- Assessment of the mean value of failure loads $F_{u,m}$ [kN], converted to the nominal concrete strength (see EAD 330232-00-0601 Annex A2.1)
- Assessment of $F_{Rk,1}$ from the 5% fractile of the failure loads $F_{u,5\%}$ [kN], converted to the nominal concrete strength (The compression strength of concrete shall be determined according to EN 12390-1)

- Verify the coefficient of variation of failure loads. If the coefficient of variation exceeds 15% ($V_{\text{test}} > 15\%$), determine the reduction factor for large scatter of failure loads β_{cV} according to A.2.2 of EAD 330232-00-0601.
- If there are no tests according to 2.2.1 and 2.2.3, then $F_{Rk,s} = F_{Rk,0} = F_{Rk,1}$

The level of the characteristic resistance of the anchor system with edge and spacing's influencing $F_{Rk,1}$ shall be stated in the ETA.

2.2.3 Characteristic resistance to steel failure under inclined load

Assessment of the steel failure under inclined load. Tests are needed only if calculation of the characteristic resistance to steel failure is not reasonable because the distribution of the steel strength of the finished product along the length of the system is not known or cannot easily be determined.

A minimum of 5 samples shall be tested

Tests may be omitted, if detail no. 2, 5 and 1 (see Figure 1.2) are tested in 2.2.1 or 2.2.2 and no steel failure has been observed or if the calculation shows higher values then the test results in 2.2.1 or 2.2.2.

No tests are required if $F_{Rk,s} \leq F_{Rk,0}$ or $F_{Rk,s} \leq F_{Rk,1}$ is accepted and verified through tests with all parts of the product (detail no 1, 2 and 5). If calculation of steel parts 1 and / or 5 are performed according to equation 2.2.3 detail no 1 and 5 have not to be included in testing.

The characteristic resistance $N_{Rk,s}$ of the façade anchor system shall be determined according to Equation (2.2.3).

$$N_{Rk,s} = A_s \cdot f_{uk} \quad (2.2.3)$$

$N_{Rk,s}$ = characteristic resistance under tension
 A_s = stressed cross section of steel element (smallest cross section in the area of load transfer applies)
 f_{uk} = nominal characteristic steel ultimate strength

The characteristic resistance to steel failure under inclined load may also be determined by tests (see Annex B).

The following assessment shall be made for each anchor size and for each embedment depth or for grouped anchor system sizes:

- Assessment of the mean value of failure loads $F_{u,m}$ [kN], converted to the nominal steel strength
- Assessment of $F_{Rk,s}$ from the 5% fractile of the failure loads $F_{u,5\%,s}$ [kN], converted to the nominal steel strength of the failed steel part

The tension rod and the lower part of the system that are not fully cast-in should be tested under inclined (see Figure 1.2) to simulate real conditions. The level of the characteristic resistance to steel failure under inclined load shall be stated in the ETA.

2.2.4 Reaction to fire

The pre-installed anchor system shall be tested, using the test method(s) relevant for the corresponding reaction to fire class, in order to be classified according to Delegated Regulation (EU) 2016/364 and EN 13501-1.

The classification shall be stated in the ETA.

The pre-installed anchor system is considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire in accordance with the Decision 96/603/EC as amended by Decision 2000/605/EC establishing the list of products belonging to Classes A "No contribution to fire", without the need for testing on the basis of it fulfilling the conditions and intention for use set out in this Decision.

2.2.5 Corrosion and durability of coating

The corrosion resistance class (CRC) is stated in the ETA according to EN 1993-1-4, table A.3

The durability of the coating that ensures the functioning and the bearing behaviour of the fastener shall be shown. No special test conditions can be given in this EAD for checking the durability of any coating because they depend on the type of coating. Any appropriate tests shall be decided on by the responsible TAB based on the specific type of coating and the intended conditions of use (i.e. dry internal or external conditions).

The following environmental conditions shall be taken into account in assessing durability of coatings:

Dry internal conditions:

- High alkalinity (pH \geq 13.2)
- Temperature in range: -5° to +40°C

Other environmental conditions:

- High alkalinity (pH \geq 13.2)
- Temperature in range: -40° to +80°C
- Condensed water
- Chlorides
- Sulphur dioxide
- Nitrogen oxide
- Ammonia

Zinc coatings (electroplated or hot dip galvanized) need not be subjected to testing if used under dry internal conditions.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act for the AVCPs systems is the Commission Decision 97/161/EC, this Decision was as regards of metal anchors for use in concrete for fixing lightweight systems. The intended use for the system covered by this EAD is for concrete elements, thus the AVCP system applicable is 2+ for any use.

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.1.

Table 3.1 Control plan for the manufacturer; cornerstones

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]				
Dimensions and tolerances	Measuring	As defined in the control plan	As defined in the control plan	According to the control plan
Tensile strength	EN ISO 3506-1			
Yield strength	EN ISO 3506-1			
Core hardness and Surface hardness (at specified functioning relevant points of the product) (where relevant)	EN ISO 6506-1 or EN ISO 6507-1			

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.2.

In this case of AVCP system 2+ applies the cornerstones of the tasks to be undertaken by the notified body are laid down in Table 3.

Table 3.2 Control plan for the notified body; cornerstones

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				
The Notified Body will ascertain that the factory production control with the staff and equipment are suitable to ensure a continuous and orderly manufacturing related to the issues in table 3.1.	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				
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 related to the issued in table 3.1	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 3.1	According to Control plan	According to Control plan	1/year

4 REFERENCE DOCUMENTS

EAD 330747-00-0601, 2018	Fasteners for use in concrete for redundant non-structural systems
EAD 330030-00-0601, 2018	Fastener of external wall claddings
EAD 330232-00-0601, 2016	Mechanical fasteners for use in concrete
EN 1992-4:2018	Design of fastenings for use in concrete
EN 1993-1-:2006/A1:2015	Design of steel structures – Part 1-4: General rules – Supplementary rules for stainless steels
EN 12390-1:2013	Testing hardened concrete – Part 1: Shape, dimensions and other requirements for specimens and moulds
EN 13501-1:2018	Fire classification of construction products and building elements; Part 1: Classification using data from reaction to fire tests; Part 2: Classification using data from fire resistance tests, excluding ventilation services
EN ISO 3506-1:2009	Mechanical properties of corrosion-resistant steel fasteners – Part 1: Bolts, screws and studs
EN ISO 6506-1:2014	Metallic materials – Brinell hardness test – Part 1: Test method
EN ISO 6507-1:2018	Metallic materials – Vickers Hardness test Part 1: Test method (ISO 6507-1:2008)

ANNEX A: CHARACTERISTIC RESISTANCE TO BREAKOUT OR PULL-OUT FAILURE UNDER INCLINED LOAD WITH OR WITHOUT EDGE INFLUENCE

Grouping is permitted, if different product sizes under the same influence parameters (e.g., edge distances and spacing, concrete member thickness, material combination) and the same manufacturing method are considered. In this case, with the smallest size shall be tested with the unfavourable material combination and angle.

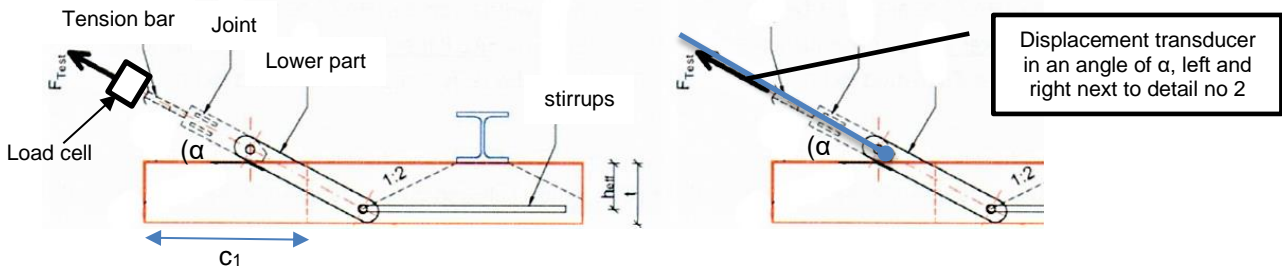
A.1 Test procedure 1

The inclined load tests without edge influence shall be performed with anchors with minimum fastener dimensions and tolerances of the system. The tests shall be performed to the free edge in load direction.

A.2 Test procedure 2

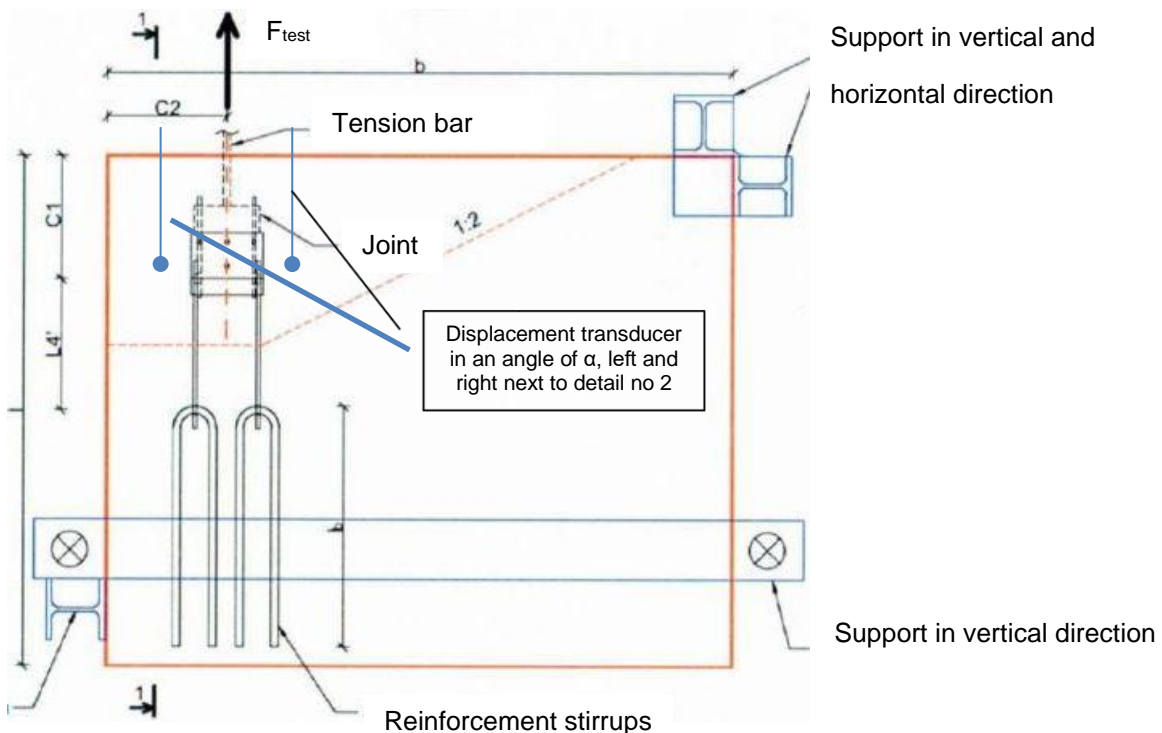
The inclined load tests with edge influence shall be performed with anchors with minimum fastener dimensions within the tolerances of the system. The test shall be performed in the free edge in load direction.

The edge influence shall be set according to section 2.2.2 ($c_1 = c_2 = c_{min} = 2 h_{eff}$)



(dashed lines are illustrations to set an example)

The specimen should be tested in a rigid test rig with free edges on the loaded side of the specimen. The displacement transducer shall be aligned to the axis of the tension bar in the angle of α .



ANNEX B: CHARACTERISTIC RESISTANCE TO STEEL FAILURE UNDER INCLINED LOAD

The inclined load tests shall be performed on a rigid test rig.

