Deutsches Institut für Bautechnik
Zulassungsstelle für Bauprodukte und Bauarten
Bautechnisches Prüfamt
Eine vom Bund und den Ländern gemeinsam getragene Anstalt des öffentlichen Rechts

Kolonnenstraße 30 B
D-10829 Berlin
Tel.: +49 30 78730-0
Fax: +49 30 78730-320
E-Mail: dibt@dibt.de
www.dibt.de

Authorised and notified according to Article 10 of the Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products (89/106/EEC)

Deutsches Institut für Bautechnik

DIBt

Mitglied der EOTA
Member of EOTA

European Technical Approval ETA-13/0137

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung *Trade name*		fischer-Zykon-Plattenanker FZP II T für "Resoplan F Schichtpressstoff" *fischer-Zykon-panel anchor FZP II T for "Resoplan F laminate"*
Zulassungsinhaber *Holder of approval*		fischerwerke GmbH & Co. KG Weinhalde 14 -18 72178 Waldachtal DEUTSCHLAND
Zulassungsgegenstand und Verwendungszweck *Generic type and use of construction product*		Spezialanker zur rückseitigen Befestigung von Fassadenplatten aus Resoplan F Schichtpressstoff *Special Anchor for the rear fixing of façade panels made of Resoplan F laminate*
Geltungsdauer: *Validity:*	vom *from* bis *to*	27 June 2013 27 June 2018
Herstellwerke *Manufacturing plants*		fischerwerke Resopal, Deutschland

Diese Zulassung umfasst *This Approval contains*	22 Seiten einschließlich 14 Anhänge *22 pages including 14 annexes*

I LEGAL BASES AND GENERAL CONDITIONS

1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1], modified by Council Directive 93/68/EEC[2] and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council[3];
- *Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998[4], as amended by Article 2 of the law of 8 November 2011[5];*
- Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC[6].

2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.

3 This European technical approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European technical approval.

4 This European technical approval may be withdrawn by Deutsches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.

5 Reproduction of this European technical approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of Deutsches Institut für Bautechnik. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European technical approval.

6 The European technical approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

1 Official Journal of the European Communities L 40, 11 February 1989, p. 12
2 Official Journal of the European Communities L 220, 30 August 1993, p. 1
3 Official Journal of the European Union L 284, 31 October 2003, p. 25
4 *Bundesgesetzblatt Teil I 1998*, p. 812
5 *Bundesgesetzblatt Teil I 2011*, p. 2178
6 Official Journal of the European Communities L 17, 20 January 1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1 Definition of the construction product

The fischer-Zykon-panel anchor FZP II for "Resoplan F laminate" is a special anchor of size M 6 which consists of a cone bolt with external thread, made of stainless steel, an expansion part made of stainless steel, a shim washer made of polyamide and, if need to be, a hexagon nut made of stainless steel or aluminium. The anchor is put into an undercut drill hole in the façade panels and is placed form-fit by driving-in the shim washer or by applying a torque moment to the hexagon nut.

Annex 1 shows the anchor at built-in state.

1.2 Intended use

The fischer-Zykon-panel anchor FZP II may be used for the rear fixing of Resoplan F laminate - façade panels. The "Resoplan F laminate" - façade panels shall be made of High-pressure decorative laminates (HPL) according to EN 438-7 and shall correspond to the specifications given in this European technical approval.

The façade panels with rear fixing by the anchor may be used for front curtain walls. Each façade panel shall be fixed technically strain-free with at least four anchors in a rectangular arrangement via single agraffes, double agraffes or panel load-bearing profiles on a capable substructure.

The anchor may be used in structures subject to dry internal conditions and also in structures subject to external atmospheric exposure (including industrial and marine environment), if no particular aggressive conditions exist. Such particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurisation plants or road tunnels where de-icing materials are used).

The provisions made in this European technical approval are based on an assumed working life of the anchor of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

2 Characteristics of the product and method of verification

2.1 Characteristics of the product

The anchor corresponds to the drawings and specifications given in Annex 2 and 3. The characteristic material values, dimensions and tolerances of the anchor not indicated in Annex 2 and 3 shall correspond to the respective values laid down in the technical documentation[7] of this European technical approval.

[7] The technical documentation comprises all information necessary for the production, installation and maintenance of the anchor; these are in particular the design drawings and the installation instructions. The part to be treated confidentially is deposited with Deutsches Institut für Bautechnik and, as far as this is relevant to the tasks of the approved bodies involved in the procedure of attestation of conformity, shall only be handed over to the approved body.

The anchor is considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire, in accordance with the provisions of EC decision 96/603/EC (as amended) without the need for testing on the basis of its listing in that decision.

In addition to the specific clauses relating to dangerous substances contained in this European technical approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

The characteristic values for the design of the façade panels and the anchor are given in Annex 6.

Every anchor is marked with the identifying mark of the producer and the anchorage depth according to Annex 3. The hexagon nut is marked with "AI" for Aluminium or "A4" for stainless steel according to Annex 3.

The anchor shall be packed and delivered as fixing unit (cone bolt, expansion part and shim washer). The hexagon nut may be packed and delivered separately.

2.2 Methods of verification

The assessment of fitness of the anchor for the intended use in relation to the requirement for safety in use in the sense of the essential requirement N°4 of Council Directive 89/106/EEC has been made based on the following verifications:

(1) Axial tension tests
(2) Shear tests
(3) Tests with combined tension and shear loading
(4) Tests on structural members
(5) Tests on functioning under repeated loads
(6) Tests on functioning under temperature
(7) Tests on functioning under oblique position
(8) Tests on functioning under freeze/thaw conditions

3 Evaluation and attestation of conformity and CE marking

3.1 System of attestation of conformity

According to the communication of the European Commission[8] the system 2 (ii)-1 (referred to as System 2+) of attestation of conformity applies.

These systems of attestation of conformity are defined as follows:

System 2+: Declaration of conformity of the product by the manufacturer on the basis of:

(a) Tasks for the manufacturer:
  (1) initial type-testing of the product;
  (2) factory production control;
  (3) testing of samples taken at the factory in accordance with a prescribed test plan.
(b) Tasks for the approved body:
  (4) certification of factory production control on the basis of:
    - initial inspection of factory and of factory production control;
    - continuous surveillance, assessment and approval of factory production control.

[8] Letter of the European Commission of 22/07/2002 to EOTA

3.2 Responsibilities

3.2.1 Tasks for the manufacturer

3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European technical approval.

The manufacturer may only use initial materials and components stated in the technical documentation of this European technical approval.

The factory production control shall be in accordance with the control plan[9] which is part of the technical documentation of this European technical approval. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited with Deutsches Institut für Bautechnik.

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

3.2.1.2 Other tasks for the manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in the field of "anchors" in order to undertake the actions laid down in section 3.2.2. For this purpose, the control plan referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of this European technical approval.

3.2.2 Tasks of approved bodies

The approved body shall perform the following tasks in accordance with the provisions laid down in the control plan:

- initial inspection of factory and of factory production control,
- continuous surveillance, assessment and approval of factory production control.

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the factory production control stating the conformity with the provisions of this European technical approval.

In cases where the provisions of the European technical approval and its "control plan" are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform Deutsches Institut für Bautechnik without delay.

[9] The control plan is a confidential part of the European technical approval and only handed over to the approved body involved in the procedure of attestation of conformity. See section 3.2.2.

3.3 CE marking

The CE marking shall be affixed on the packaging or accompanying commercial document, e.g. the EC declaration of conformity. The letters "CE" shall be followed by the identification number of the approved certification body, where relevant, and be accompanied by the following additional information:

- the name and address of the producer (legal entity responsible for the manufacturer),
- the last two digits of the year in which the CE marking was affixed,
- the number of the EC certificate for the factory production control,
- the number of the European technical approval,
- use category (25 freeze/thaw cycles),
- size.

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacture

The anchor is manufactured in accordance with the provisions of the European technical approval using the automated manufacturing process as identified in the inspection of the plant by Deutsches Institut für Bautechnik and the approved body and laid down in the technical documentation.

The European technical approval is issued for the product on the basis of agreed data/information, deposited with Deutsches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the European technical approval and consequently the validity of the CE marking on the basis of the European technical approval and if so whether further assessment or alterations to the European technical approval shall be necessary.

4.2 Installation

4.2.1 Design of the fixings

The fitness of the anchor for the intended use is given under the following conditions:

- the Resoplan F laminate - façade panels are classified according to EN 438-7 "High-pressure decorative laminates (HPL) and fulfil the requirements of type EDF according to EN 438-6
- each façade panel is fixed with at least four anchors in a rectangular arrangement via single agraffes, double agraffes or panel load-bearing profiles on the substructure
- the substructure is constructed such that the façade panels are fixed technically strain-free via skids (loose bearings) and one fixed point (fixed bearing); the fixed point may be placed at the panel edge or in the panel field
- two fixing points of the façade panel are designed such that they are able to carry the dead load of the façade panel
- when using agraffes on horizontal load-bearing profiles the fixing points of a façade panel situated horizontally at the same height are fastened in each case to the same load-bearing profile
- the façade panels neither are used to transmit impact loads nor for guard rail

- joint construction between the façade panels is done by a joint filler or are kept open; it is ensured that additional stresses (e.g. by temperature) do not lead to important additional loadings
- taking account of the loads to be fixed checkable calculations and construction drawings are prepared; the position of the anchor is given in the construction drawing
- the façade panels, their fixings as well as the substructure including its connection to wall brackets and their connection to the construction works are designed for the respective case of application under the responsibility of an engineer skilled in the field of façade construction taking account the conditions given in Annex 7 to Annex 14
- for the design relevant characteristic values of the anchor (resistance) as well as the characteristic values of the façade panels (bending strength, modulus of elastic, specific weight) are taken from Annex 6
- the edge distances, spacing and anchorage depth of the anchor as well as the nominal panel thickness of the façade panels according to Annex 6 are observed

4.2.2 Installation of the anchors

The fitness for use of the anchor can be assumed only, if the following installation conditions are observed:

- installation by appropriately qualified personnel under the supervision of the project supervisor
- installation only as delivered by the manufacturer without exchanging the individual parts
- installation according to manufacturer's specifications and construction drawings using the tools indicated in the installation instructions
- keeping of the edge distance and spacing to the specified values
- Making of the undercut drilling is done with the drill bit according to Annex 4 and a special drilling device in according with the information deposited with Deutsches Institut für Bautechnik.
- The drillings are done at the factory or on site under workshop conditions; when making the drillings on site the execution is supervised by the responsible project supervisor or a skilled representative of the project supervisor.
- cleaning of the drill hole
- in case of aborted hole: new drilling at a minimum distance away of twice the depth of the aborted hole
- keeping of the anchorage depth
- the geometry of the drill hole is checked on 1 % of all drillings; the following dimensions shall be checked and documented according to manufacturer's information and testing instructions by means of the testing and measuring devices according to Annex 5:
  - diameter of the cylindrical drill hole with testing device DPL
  - volume of the undercut with testing device HVL
  - drill hole depth with calliper
  - diameter of the undercut with dial gauge every 500 drill holes or if the drill is changed

  if the tolerances are exceeded, the geometry of the drill hole shall be checked on 25% of the drillings performed; no further drill hole may exceed the tolerances otherwise all the drill holes shall be controlled; drilling holes falling below or exceeding the tolerances shall be rejected

Note: Checking the geometry of the drill hole on 1% of all drillings means that on one of 100 drillings shall be checked. If the tolerances given in Annex 4 are exceeded the extend of the control shall be increase to 25% of the drillings, i.e. every fourth drilling shall be checked.

- The installation of the anchor is performed with a torque wrench only or with a drive-in device specifically for this purpose and a setting device respectively
- The positive fit of the anchor in the drill hole is checked by measuring the projection of the bolt "b" acc. Annex 5
- During transport and storage on site the façade panels are protected from damages; the façade panels are not be hung up jerkily (if need be lifters shall be used for hanging up the façade panels); façade panels and reveal panels respectively with incipient cracks are not be installed
- The façade are installed by skilled specialists and the laying instructions of the manufacturer shall be paid attention to.

5 Indications to the manufacturer

It is in the responsibility of the manufacturer to ensure that the information on the specific conditions according to 1 and 2 including Annexes referred to and 4.2.1 and 4.2.2 is given to those who are concerned. This information may be made by reproduction of the respective parts of the European technical approval. In addition all installation data shall be shown clearly on the package and/or on an enclosed instruction sheet, preferably using illustration(s).

The minimum data required are:

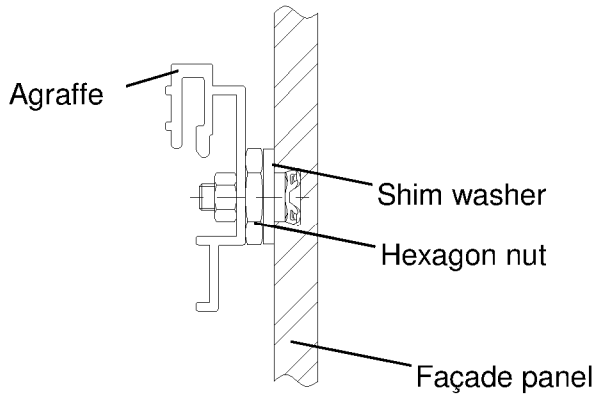
- drill hole depth
- thickness of the fixing member
- diameter of the cylindrical drilling;
- free thread length after setting anchor.
- information on the installation procedure, including cleaning of the hole, preferably by means of an illustration

All data shall be presented in a clear and explicit form.

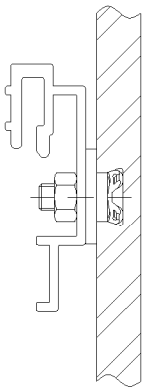
Andreas Kummerow
p. p. Head of Department

beglaubigt:
Aksünger

Deutsches Institut für Bautechnik

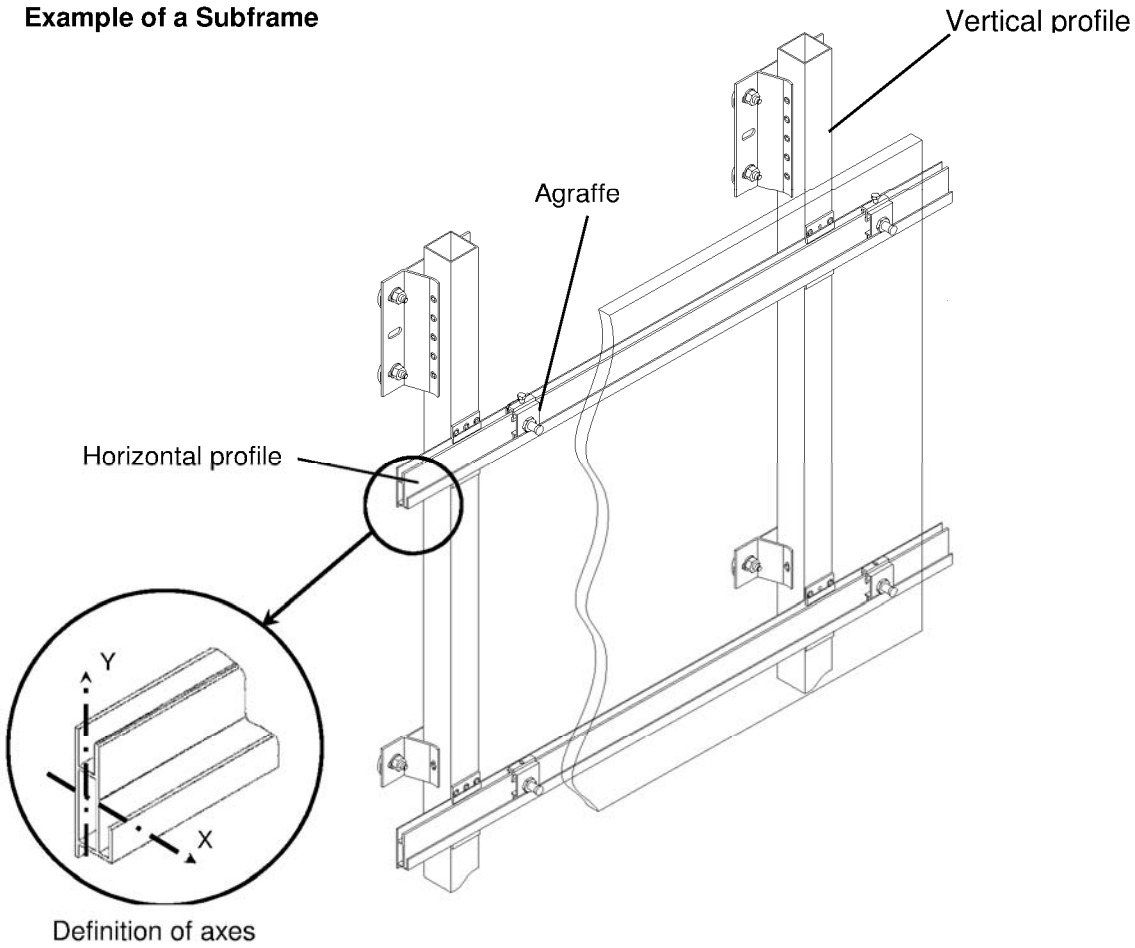


with hexagon nut



without hexagon nut

Example of a Subframe



Definition of axes

fischer-Zykon-panel anchor FZP II T	Annex 1
Product and application	

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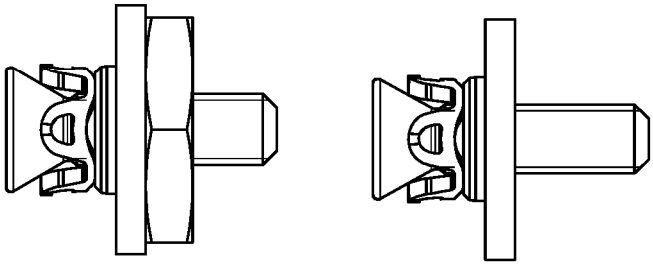
Types of anchors

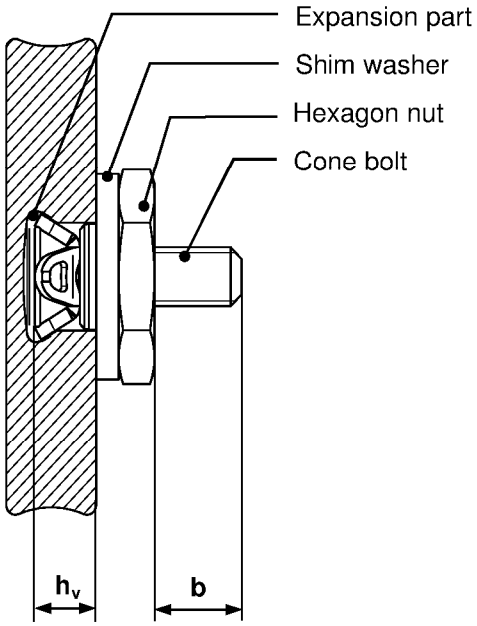
Anchor with external thread M6

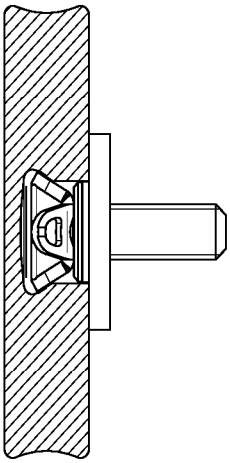
with hexagon nut **without hexagon nut**

FZP II T



Types of mounting / System of designation





Optional without hexagon nut

Example:
FZP II 11x6 M6 T/9 Al
- Hexagon nut material (optional)
- Bolt projection length **b**
- Thin materials
- Thread diameter
- Installed anchor length
- Cylindrical drill hole ∅
- **F**ischer **Z**ykon **P**anel anchor **II**
- Drill hole geometry: cylindrical conical

fischer-Zykon-panel anchor FZP II T	Annex 2
Product and built-in state	

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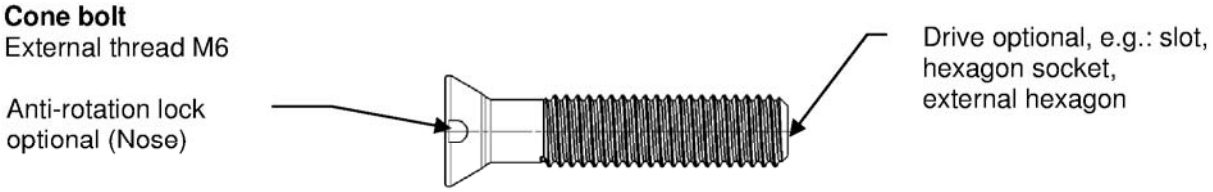
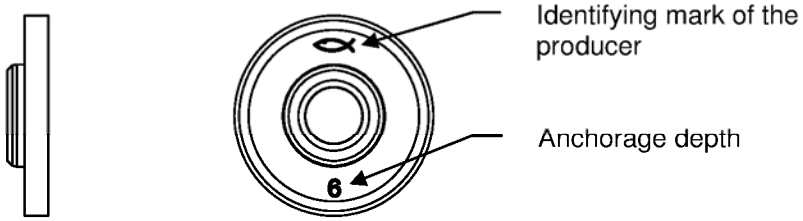
Anchor parts and materials

Cone bolt
External thread M6



Expansion part
For cone bolts with external thread M6

Shim washer
For cone bolts with external thread M6



Hexagon nut
For cone bolts with external thread M6

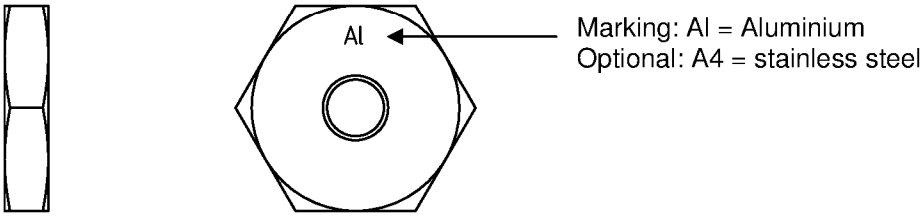


Table 1: Material of anchor parts

Anchor parts	Material
Cone bolt	Stainless steel, EN 10088
Expansion part	Stainless steel, EN 10088
Shim washer	Polyamide 6.6
Hexagon nut	Aluminum, EN 755 optional: Stainless steel, EN 10088

fischer-Zykon-panel anchor FZP II T	Annex 3
Parts of anchor and material	

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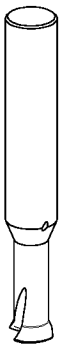
Drill bit



Dimension of drill hole

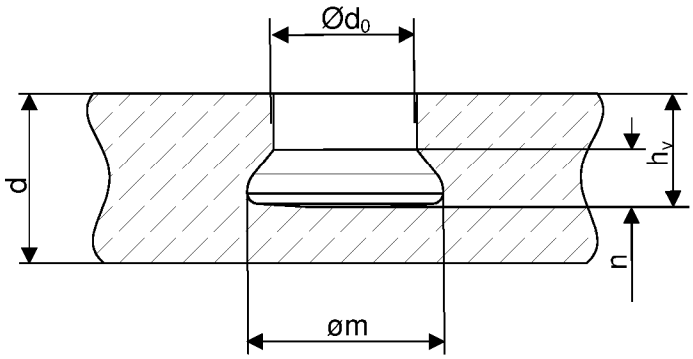


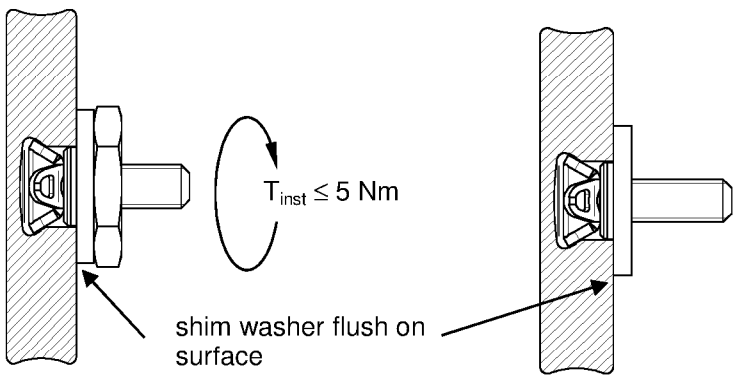
Table 2: Drill bit assignment and dimensions of drill bit and drill hole

Drill hole	d ≥	[mm]	8	10	12
	∅ d_0 [1)]	[mm]	11 $^{+0,4}_{-0,2}$		
	∅ m [1)]	[mm]	13,5 ±0,3		
	Drill bit [2)]		FZPB-11-T-CNC		
	n	[mm]	≈ 4		
	h_v	[mm]	6 $^{+0,4}_{-0,1}$	8 $^{+0,4}_{-0,1}$	10 $^{+0,4}_{-0,1}$

[1)] Measurements can be proved by diameter or volume gauge (see Annex 5)
[2)] Drill bit for different drill methods respectively drilling machine

Table 3: Installation parameters

Anchor type			FZP II T 11x6	FZP II T 11x8	FZP II T 11x10
Anchorage depth	h_v =	[mm]	6	8	10
Panel thickness	d ≥	[mm]	8	10	12



fischer-Zykon-panel anchor FZP II T	Annex 4
Drill bit, geometry of the drill hole and Installation parameters	

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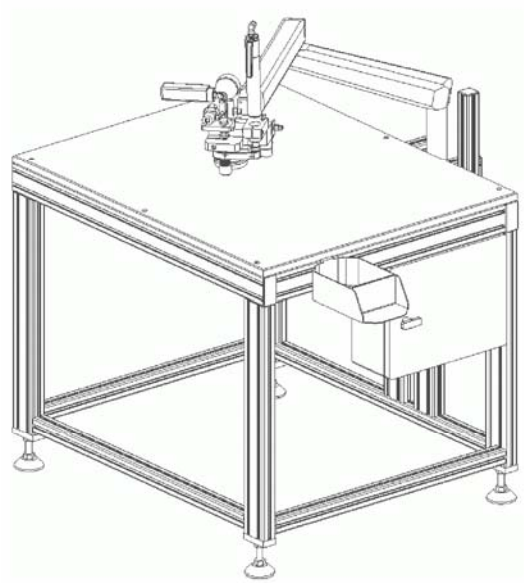
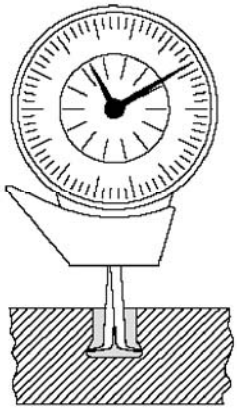
Example of an anchor setting device

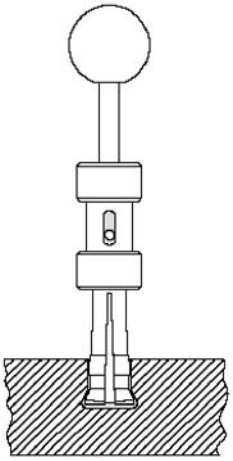


Example of a drill bit

Testing equipment for checking the undercut



Dial gauge



Undercut minimum volume gauge

Go/ no Go gauge for checking cylindrical drill hole diameter

fischer-Zykon-panel anchor FZP II T	Annex 5
Setting devices and testing equipment	

Table 4: Characteristic values for the design of the anchor and façade panel

characteristic values of Resopal façade panels	nominal panel thickness		$d \geq$	[mm]	8	10	12
	char. resistance to bending stress		σ_{Rk} =	[N/mm²]	110		
	partial safety factor [1]		γ_M =	[-]	1,8		
	modulus of elasticity		E_L =	[N/mm²]	14000		
			E_Q =		10000		
	specific weight		γ =	[kN/m³]	14		
characteristic values of fischer-Zykon-undercut anchor	anchor type		FZP II T	[-]			
	anchorage depth		h_v =	[mm]	6	8	10
	char. resistance to [2]	tension load 50 / 50 [3]	N_{Rk} =	[kN]	2,0	2,6	3,7
		tension load 100 / 100 [3]			2,0	2,6	4,1
		shear load 50 / 50 [3]	V_{Rk} =	[kN]	2,9	4,0	4,9
	edge distance		$a_r \geq$	[mm]	50		
	spacing		a	[mm]	400 [4] $\leq$ a $\leq$ 700		

[1] In absence of other national regulations

[2] In case of coincident stress of an anchor due to tension and shear load the equation according to Annex 8 shall be observed

[3] Min. Distance to Edge: a_r [mm]

[4] In exceptional cases: 100 mm $\leq$ a < 400 mm possible.

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Design method

1. General

The design values of the actions shall be calculated on basis of EN 1990 in consideration of the existing loads. The combinations of actions shall be equal to EN 1990. The actions shall be specified according to EN 1991-1-1 to EN 1991-1-7. Corresponding national regulations shall be taken into consideration. The unfavourable combination is decisive. Where necessary for the design of the anchor and the façade panel several combinations shall be analysed separately.
The typical fundamental combination for façade panels considers actions from dead load $F_{Sk,G}$ (permanent action) and wind $F_{Sk,w}$ (leading variable action).
According to EN 1990 the following fundamental combination depending on the load direction results for a vertical façade panel:

Fundamental combination for loads parallel to the panel: $F_{Sd}\ \text{II} = F_{Sk,G} \cdot \gamma_G$

Fundamental combination for loads perpendicular to the panel: $F_{Sd}\ \perp = F_{Sk,w} \cdot \gamma_Q$

with $\gamma_G = 1{,}35$; $\gamma_Q = 1{,}50$

2. Structural calculation by means of Finite Element (FE) Method

The design of the facade panels and its fixation can be performed with finite element programs taking into account the resilience of the sub-structure. The mesh size at the fixing range shall not exceed 50 mm. The results of the finite element calculation shall be adjusted with the following calibration:

- Determine the maximum internal bending moments m_{FE} [kNm/m] with the finite element program at the system given below. Use the modulus of elasticity of the panel according to Table 4 and a point load F of 1 kN.
- Determine calibration factor $f_{Kalibr} = m_{FE,u} / m_{FE}$

  with $m_{FE,u}$ = ultimate bending moments of tests of the façade panel under a single load of 1 kN given in Table 5 for different panel thicknesses
- Apply the calibration factor f_{kalibr} for the support moments on the results of the finite element calculation for the structure.

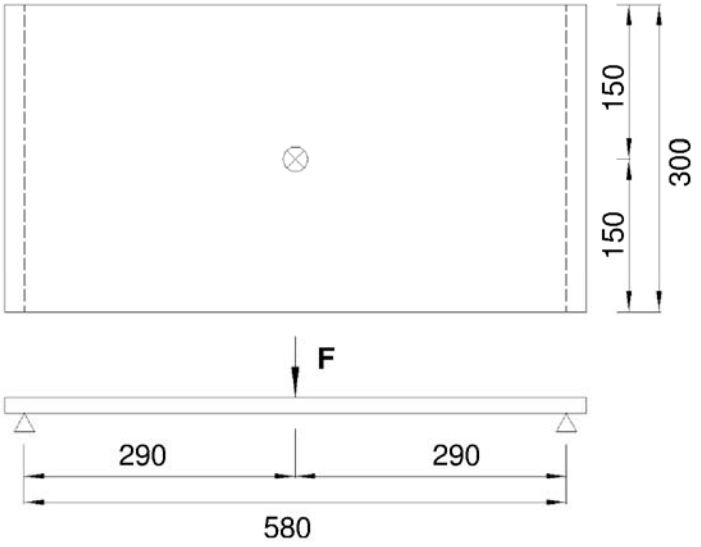

Table 5

Panel Thickness	$m_{FE,u}$
[mm]	[kNm/m]
8	1,205
10	1,353
12	1,028

fischer-Zykon-panel anchor FZP II T	Annex 7
Design method: General, structural calculation	

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Verification of anchor loads

For the determined anchor forces it shall be verified that the Equation (1) and (2) are fulfilled.
For combined tension and shear forces additional Equation (3) has to be fulfilled:

Tension / compression load: $N_{Sd} \leq N_{Rd}$ (1)

Shear load: $V_{Sd} \leq V_{Rd}$ (2)

Combined tension and shear load: $(N_{Sd} / N_{Rd}) + (V_{Sd} / V_{Rd}) \leq 1{,}2$ (3)

with:

N_{Sd} design value of existing anchor tension load resulting from FE Calculation

V_{Sd} design value of existing anchor shear load resulting from FE Calculation

N_{Rd} design value of load-bearing capacity to tension load

$N_{Rd} = \alpha_{FE} \times N_{Rk} / \gamma_M$ with N_{Rk} and γ_M according to Table 4

α_{FE} = 0,827 reduction factor

V_{Rd} design value of load-bearing capacity to shear load

$V_{Rd} = \alpha_{FE} \times V_{Rk} / \gamma_M$ with V_{Rk} and γ_M according to Table 4

α_{FE} = 0,827 reduction factor

Verification of the bending stresses

For the determined bending stresses it shall be verified, that the following Equation is met:

$\sigma_{Sd} \leq \sigma_{Rd}$ (4)

with

σ_{Sd} design value of existing bending stress in the façade panel resulting from FE Calculation

σ_{Rd} design value of bending strength

$\sigma_{Rd} = \frac{\sigma_{Rk}}{\gamma_M}$ with σ_{Rk} and γ_M according to Table 4

Verification of deformation

In the area of the anchor the angle of deflection (resultant angle of bending) shall fulfil following Equation:

$\alpha \leq 2°$ (5)

fischer-Zykon-panel anchor FZP II T	Annex 8
Verification for façade panel calculated by Finite Element Method	

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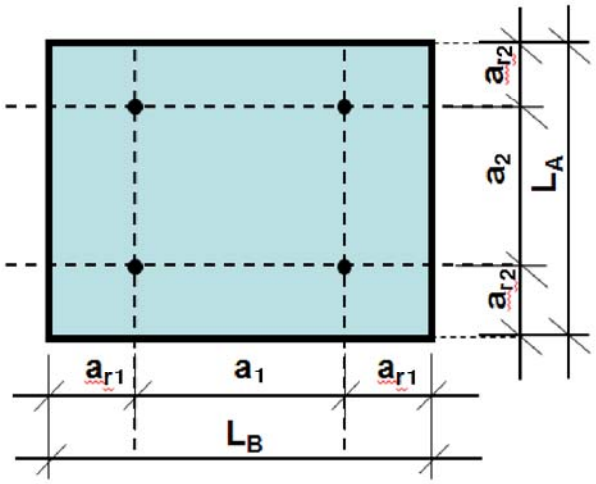
3. Simple method

3.1 Verification of façade panel with 4 Anchors



$L_B \geq L_A$

$1 \leq L_B / L_A \leq 4$

$a_{r1}; a_{r2} \geq a_r$ (Table 4)

$a_{r1} / a_1 = a_{r2} / a_2 = a_r / a$

all variables in [m]

Table 6: Influence factor for bending stress

Influencing factor for bending stress (d= 8 mm)		
At support	$f_{\sigma,D}$	$2{,}483 \cdot \left(\frac{L_B}{L_A}\right)^2 - 3{,}845 \cdot \frac{L_B}{L_A} + 63{,}94$
At span	$f_{\sigma,F}$	$\left(-166{,}6 \cdot \frac{a_r}{a} + 43{,}28\right) \cdot \frac{L_B}{L_A} - 69{,}83 \cdot \left(\frac{a_r}{a}\right) + 13{,}15$
Influencing factor for bending stress (d= 10 mm)		
At support	$f_{\sigma,D}$	$1{,}785 \cdot \left(\frac{L_B}{L_A}\right)^2 - 2{,}764 \cdot \frac{L_B}{L_A} + 45{,}96$
At span	$f_{\sigma,F}$	$\left(-106{,}6 \cdot \frac{a_r}{a} + 27{,}70\right) \cdot \frac{L_B}{L_A} - 44{,}69 \cdot \left(\frac{a_r}{a}\right) + 8{,}42$
Influencing factor for bending stress (d= 12 mm)		
At support	$f_{\sigma,D}$	$0{,}938 \cdot \left(\frac{L_B}{L_A}\right)^2 - 1{,}453 \cdot \frac{L_B}{L_A} + 24{,}16$
At span	$f_{\sigma,F}$	$\left(-73{,}97 \cdot \frac{a_r}{a} + 19{,}22\right) \cdot \frac{L_B}{L_A} - 31{,}00 \cdot \left(\frac{a_r}{a}\right) + 5{,}84$

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Verification of anchor loads

For the determined anchor forces it shall be verified that the Equation (1) and (2) are fulfilled.
For combined tension and shear forces additional Equation (3) has to be fulfilled:

Tension / compression load:	$N_{Sd} \le N_{Rd}$	(1)
Shear load:	$V_{Sd} \le V_{Rd}$	(2)
Combined tension and shear load:	$(N_{Sd} / N_{Rd}) + (V_{Sd} / V_{Rd}) \le 1{,}2$	(3)

with:

N_{Sd} design value of existing anchor tension load
$N_{Sd} = L_A \cdot L_B \cdot w_{Ed} / 4$ with w_{Ed} - design value of wind load in kN/m²

V_{Sd} design value of existing anchor shear load
$V_{Sd} = L_A \cdot L_B \cdot g_{Ed} / 2$ with g_{Ed} - design value of dead load in kN/m²

N_{Rd} design value of load-bearing capacity to tension load
$N_{Rd} = N_{Rk} / \gamma_M$ with N_{Rk} and γ_M according to Table 4

V_{Rd} design value of load-bearing capacity to shear load
$V_{Rd} = V_{Rk} / \gamma_M$ with V_{Rk} and γ_M according to Table 4

Verification of the bending stresses

For the determined bending stresses it shall be verified, that the following Equation is met:

$$\sigma_{Sd,D} \le \sigma_{Rd} \quad (4a)$$

$$\sigma_{Sd,F} \le \sigma_{Rd} \quad (4b)$$

with:

$\sigma_{Sd,D}$ design value of existing bending stress in the façade panel at support
$\sigma_{Sd,D} = f_{\sigma,D} \cdot N_{Sd}$ with $f_{\sigma,D}$ according to Table 6

$\sigma_{Sd,F}$ design value of existing bending stress in the façade panel at support
$\sigma_{Sd,F} = f_{\sigma,F} \cdot N_{Sd}$ with $f_{\sigma,F}$ according to Table 6

σ_{Rd} design value of bending strength
$\sigma_{Rd} = \sigma_{Rk} / \gamma_M$ with σ_{Rk} and γ_M according to Table 4

fischer-Zykon-panel anchor FZP II T	Annex 10
Simple method for façade panel with 4 anchors	

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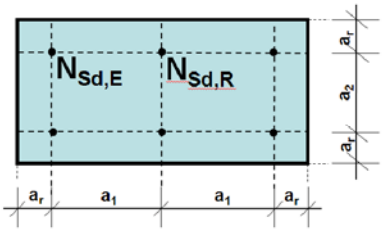
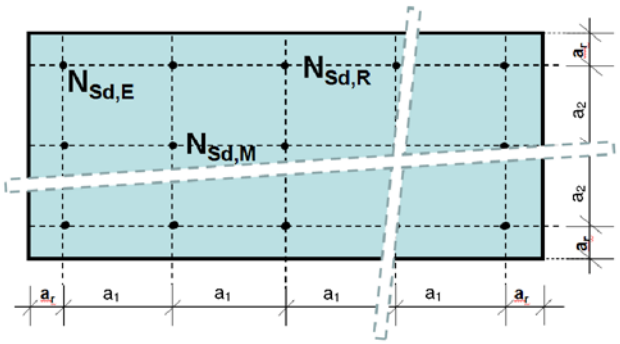
3.2 Verification of façade panel with 6 and more anchors

with 6 anchors



At facade panels with 6 anchors:
a_1 is the spacing between the anchors in the row with 3 anchors.

with > 6 anchors



At facade panels with more than 6 anchors:
a_1 is the smallest anchor spacing. $a_1 \leq a_2$

a1 and a2 in [m]

Table 7: Influence factor for anchor loads

Influence factor anchor load (d= 8 mm)		
corner	f_E	$-0{,}567 \cdot a_1 - 0{,}167 \cdot a_2 + 0{,}894$
edge	f_R	$(-1{,}333 \cdot a_2 + 0{,}267) \cdot a_1 + 0{,}433 \cdot a_2 + 0{,}943$
center	f_M	$-1{,}4 \cdot a_1 + 2{,}385$
Influence factor anchor load (d= 10 mm)		
corner	f_E	$(0{,}111 \cdot a_2 - 0{,}744) \cdot a_1 - 0{,}211 \cdot a_2 + 1{,}014$
edge	f_R	$-(0{,}332 \cdot a_2 + 0{,}600) \cdot a_1 - 0{,}384 \cdot a_2 + 1{,}617$
center	f_M	$-2{,}066 \cdot a_1 + 3{,}046$
Influence factor anchor load (d= 12 mm)		
corner	f_E	$(0{,}333 \cdot a_2 - 0{,}967) \cdot a_1 - 0{,}367 \cdot a_2 + 1{,}190$
edge	f_R	$(-0{,}111 \cdot a_2 - 0{,}956) \cdot a_1 - 0{,}356 \cdot a_2 + 1{,}802$
center	f_M	$-2{,}7 \cdot a_1 + 3{,}66$

Table 8: Influence factor for bending stress

Influence factor bending stress (d= 8 mm)		
edge	$f_{\sigma,R}$	87,9
center	$f_{\sigma,M}$	71,6
Influence factor bending stress (d= 10 mm)		
edge	$f_{\sigma,R}$	63,2
center	$f_{\sigma,M}$	51,5
Influence factor bending stress (d= 12 mm)		
edge	$f_{\sigma,R}$	33,2
center	$f_{\sigma,M}$	27,1

fischer-Zykon-panel anchor FZP II T	Annex 11
Simple method for façade panel with 6 and more anchors	

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Verification of anchor loads

For the determined anchor forces it shall be verified that the Equation (1) and (2) are fulfilled.
For combined tension and shear forces additional Equation (3) has to be fulfilled:

Tension / compression load:	$N_{Sd,E} \le N_{Rd}$	(1a)
	$N_{Sd,R} \le N_{Rd}$	(1b)
	$N_{Sd,M} \le N_{Rd}$	(1c)
Shear load:	$V_{Sd} \le V_{Rd}$	(2)
Combined tension and shear load:	$(N_{Sd} / N_{Rd}) + (V_{Sd} / V_{Rd}) \le 1.2$	(3)

with:

$N_{Sd,E}$ design value of existing anchor tension load at the corner
$N_{Sd,E} = a_1 \cdot a_2 \cdot w_{Ed} \cdot f_E$ with w_{Ed} - design value of wind load in kN/m²
f_E - according to Table 7

$N_{Sd,R}$ design value of existing anchor tension load at the edge
$N_{Sd,R} = a_1 \cdot a_2 \cdot w_{Ed} \cdot f_R$ with w_{Ed} - design value of wind load in kN/m²
f_R - according to Table 7

$N_{Sd,M}$ design value of existing anchor tension load at the center
$N_{Sd,M} = a_1 \cdot a_2 \cdot w_{Ed} \cdot f_M$ with w_{Ed} - design value of wind load in kN/m²
f_M - according to Table 7

V_{Sd} design value of existing anchor shear load
$V_{Sd} = L_A \cdot L_B \cdot g_{Ed} / 2$ with g_{Ed} - design value of dead load in kN/m²

N_{Rd} design value of load-bearing capacity to tension load
$N_{Rd} = N_{Rk} / \gamma_M$ with N_{Rk} and γ_M according to Table 4

V_{Rd} design value of load-bearing capacity to shear load
$V_{Rd} = V_{Rk} / \gamma_M$ with V_{Rk} and γ_M according to Table 4

Verification of the bending stresses

For the determined bending stresses it shall be verified, that the following Equations are met:

$\sigma_{Sd,R} \le \sigma_{Rd}$ (4a)
$\sigma_{Sd,M} \le \sigma_{Rd}$ (4b)

with:

$\sigma_{Sd,R}$ design value of existing bending stress in the façade panel at the support at the edge
$\sigma_{Sd,R} = f_{\sigma,R} \cdot N_{Sd,R}$ with $f_{\sigma,R}$ according to Table 8

$\sigma_{Sd,M}$ design value of existing bending stress in the façade panel at the support at the center
$\sigma_{Sd,M} = f_{\sigma,M} \cdot N_{Sd,M}$ with $f_{\sigma,M}$ according to Table 8

σ_{Rd} design value of bending strength
$\sigma_{Rd} = \sigma_{Rk} / \gamma_M$ with σ_{Rk} and γ_M according to Table 4

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3.3 Verification of deformation for façade panel with 4 and more anchors

In the area of the anchor the angle of deflection (resultant angle of bending) shall fulfil following Equation:

$$\alpha \leq 2° \qquad (5)$$

with

α according to Table 9

with w_{EK} characteristic value of wind load in kN/m²
d thickness of the façade panel in mm
a_r edge distance in m
a spacing in m

Table 9: Deflection

Deflection in the area of the anchor	
Single-span panel	$\alpha = \left\| \frac{18000 \cdot w_{Ek}}{d^3 \cdot \pi} \left((-1{,}092 \cdot a + 0{,}405) \cdot \frac{a_r}{a} + 0{,}744 \cdot a - 0{,}349 \right) \right\|$
Two-span panel	$\alpha = \left\| \frac{18000 \cdot w_{Ek}}{d^3 \cdot \pi} \left((-0{,}554 \cdot a + 0{,}190) \cdot \frac{a_r}{a} + 0{,}386 \cdot a - 0{,}176 \right) \right\|$
Three-span panel	$\alpha = \left\| \frac{18000 \cdot w_{Ek}}{d^3 \cdot \pi} \left((-0{,}680 \cdot a + 0{,}248) \cdot \frac{a_r}{a} + 0{,}460 \cdot a - 0{,}213 \right) \right\|$
Four-span panel or multi-span panel	$\alpha = \left\| \frac{18000 \cdot w_{Ek}}{d^3 \cdot \pi} \left((-0{,}577 \cdot a + 0{,}156) \cdot \frac{a_r}{a} + 0{,}433 \cdot a - 0{,}197 \right) \right\|$

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3.4 Requirements on substructures

The substructure has to be symmetrical.
There may be 2 anchors at maximum on a substructure between two supports (see Figure below).

The fixed supports of the substructure must be vertically or horizontally on a line.

The moment of inertia of profiles must be at minimum

$L_i < 0{,}60$ m $\quad I_Y\,[cm^4] \geq 2{,}8$

$0{,}60\text{ m} \leq L_i \leq 2{,}10$ m $\quad I_Y\,[cm^4] \geq 25 \cdot L_i^2 - 32 \cdot L_i + 13$

with:

I_y moment of inertia of profiles, in direction parallel to the façade panel layer (resistance normal to the façade panel layer)
The module of elasticity of the profiles has to be $E \geq 70.000$ N/mm².
For other E-moduli, the moments of inertia can be increased or reduced in proportion to the E-modulus given above.

L_i equivalent support spacing ≤ 2,10 in m

fischer-Zykon-panel anchor FZP II T	Annex 14
Requirements on substructures	