

Approval body for construction products  
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and  
Laender Governments



## European Technical Assessment

ETA-16/0091  
of 30 March 2017

English translation prepared by DIBt - Original version in German language

### General Part

Technical Assessment Body issuing the  
European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

KEIL undercut anchor KH for "STARON facade panels"

Product family  
to which the construction product belongs

Fastener for rear fixing for facade panels made of one-  
third of acrylic resine and two-third of natural mineral  
aluminium hydroxide.

Manufacturer

LOTTE Advanced Materials Europe GmbH  
Kölner Straße 12  
65760 Eschborn  
DEUTSCHLAND

Manufacturing plant

Werk 1

This European Technical Assessment  
contains

15 pages including 3 annexes which form an integral part  
of this assessment

This European Technical Assessment is  
issued in accordance with Regulation (EU)  
No 305/2011, on the basis of

European Assessment Document (EAD)  
330030-00-0601

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## Specific Part

### 1 Technical description of the product

The KEIL undercut anchor KH is a special anchor made of stainless steel, consisting of a crosswise slotted anchor sleeve with an M6 internal thread, at the upper edge of which a hexagon is formed to it and a respective hexagon bolt with an integrated tooth lock washer. The anchor is put into an undercut drill hole and by driving-in the screw it is placed form-fitted and deformation-controlled.

The "STARON façade panel" is a solid surface made of one-third of acrylic resin and two-third of natural mineral aluminium hydroxide with white colour and a thickness of 12 mm.

The product description is given in Annex A.

### 2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the anchor is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchors of at least 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.

### 3 Performance of the product and references to the methods used for its assessment

#### 3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance for tension and shear loads	See Annex C 1
Anchor distances	See Annex C 1

#### 3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	No performance assessed

### 4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with EAD No. 330030-00-0601 the applicable European legal act is: [97/161/EG].  
The system to be applied is: 2+

**5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document**

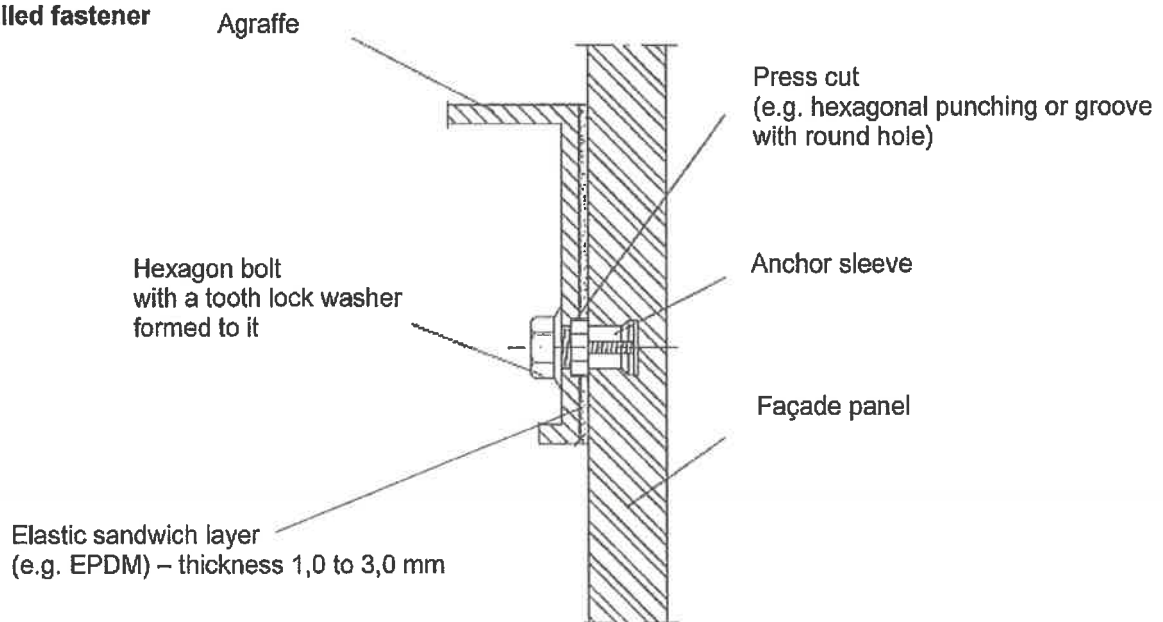
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 30 March 2017 by Deutsches Institut für Bautechnik

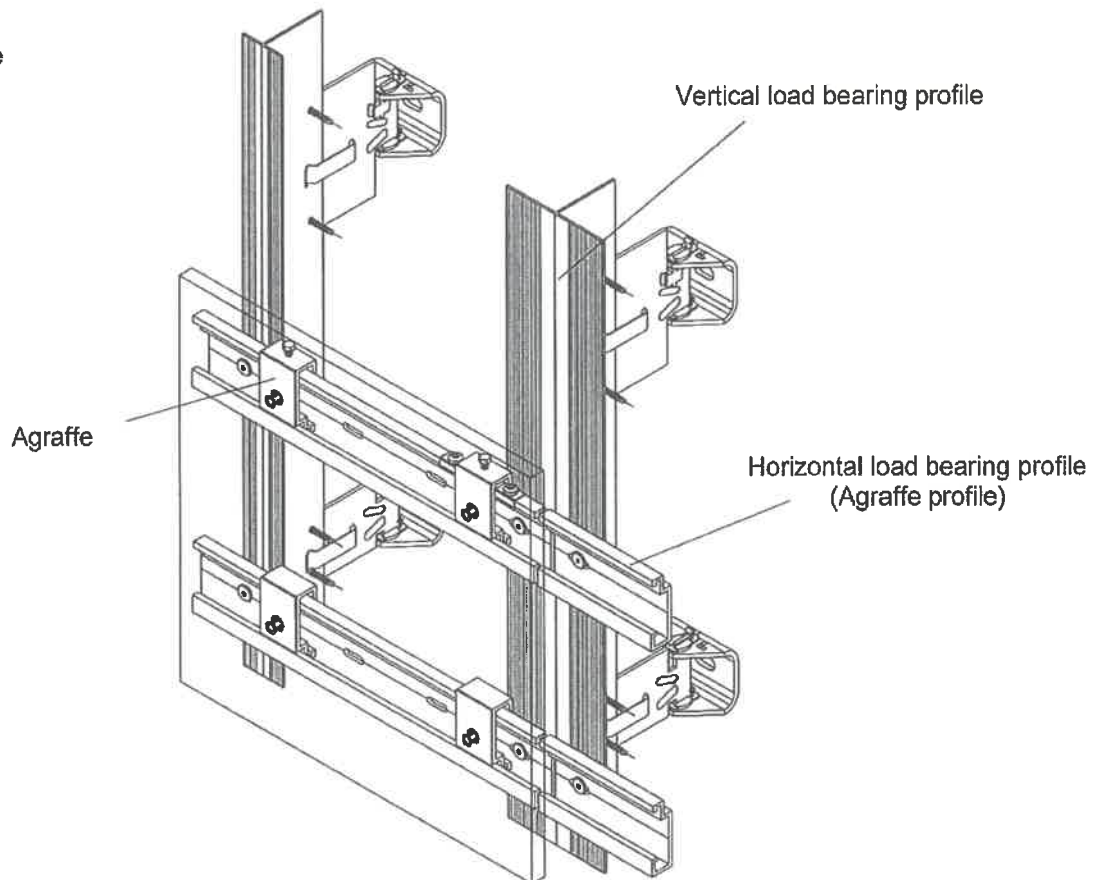
Uwe Bender  
Head of Department

*beglaubigt:*  
Aksünger

**Installed fastener**



**Fixing example**



KEIL undercut anchor KH for "STARON facade panels"

**Product description**  
Installed fastener and fixing example

Annex A 1

Anchor (dimension in mm)

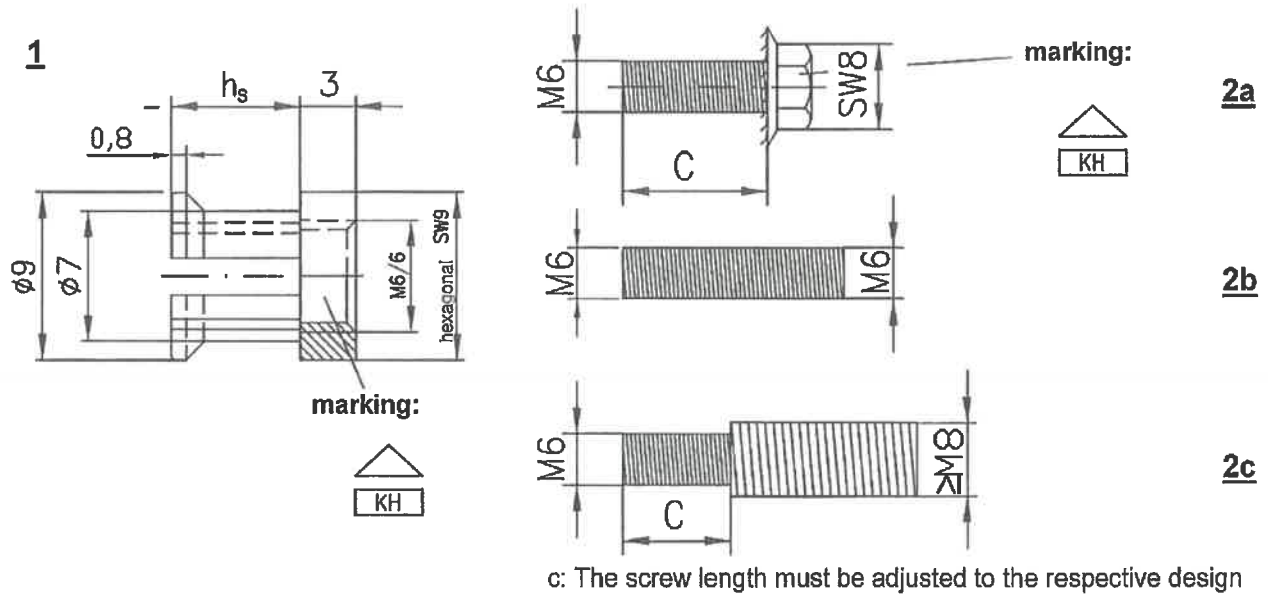


Table A1: Dimensions and Materials

Anchor type		KH 7,0
anchorage depth	$h_s =$ [mm]	7,0
screw length	$c =$ [mm]	$h_s + 3\text{mm} + t_{\text{fix}}$
installation torque moment	$T_{\text{inst}}$ [Nm]	$2,5 \leq T_{\text{inst}} \leq 4,0$
Materials		
1	anchor sleeve	Stainless steel 1.4404 according to EN 10 088:2014
2a	hexagon screw with tooth lock washer	Stainless steel 1.4401, 1.4404 or 1.4578 according to EN 10 088:2014
2b	Threaded pin	Stainless steel 1.4401, 1.4404 or 1.4578 according to EN 10 088:2014
2c	Threaded bold	Stainless steel 1.4401, 1.4404 or 1.4578 according to EN 10 088:2014

KEIL undercut anchor KH for "STARON facade panels"

Product description  
Dimensions and Materials

Annex A 2

## Specifications of intended use

### Anchorage subject to:

- Static and quasi-static loads.

### Base materials:

- the "STARON facade panels" made of one-third of acryl resin and two-third of natural mineral aluminium hydroxide correspond to the drawings and specifications of the Annexes B and Annex C 1.

### Use conditions (Environmental conditions):

- Structures subject to dry internal conditions.
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist.

Note: 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 desulphurization plants or road tunnels where de-icing materials are used).

### Design:

- The design of the façade panels and their fixing is carried out according to the conditions given in Annex B 2 to Annex B 4.

### Installation:

- 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.
- Making of the undercut drilling is done with the drill bit according to Annex B 5 and a special drilling device in accordance with the information deposited with Deutsches Institut für Bautechnik.
- The drillings are removed from the drill hole
- In case of aborted hole: new drilling at a minimum distance away of twice the depth of the aborted hole.
- 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 a measuring device according to Annex B 5:
  - Volume of the undercut drill hole.
  - Depth position of the undercut; the distance between the lower edge of the measuring device and the façade panel is between 0,0 and 0,3 mm (see Annex B 5).

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 the 25 panels (this corresponds to 100 drillings in façade panels with four anchors) one drilling shall be checked. If the tolerances given in Annex A 2, Table A1 are exceeded the extent of the control shall be increase to 25 % of the drillings, i.e. one drilling each shall be checked on all the 25 panels.

- 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.
- The façade panels are arranged in a "reclined" or "upright" position, they also may be fixed at façade soffits.

KEIL undercut anchor KH for "STARON facade panels"

Intended use  
Specifications

Annex B 1



## Design method

### 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  $F_{Ek,G}$  (permanent action) and wind  $F_{Ek,w}$  (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:

$$F_{Ed||} = F_{Ek,G} \cdot \gamma_G$$

Fundamental combination for loads perpendicular to the panel:

$$F_{Ed\perp} = F_{Ek,w} \cdot \gamma_Q$$

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

For hanging panels (over head mounting) or reveals respectively the load direction shall be taken into consideration and the combinations of actions shall be based on EN 1990.

The calculation shall be carried out in a linear elastic manner. The stiffness of the substructure shall be considered for the respective case of application.

- Each façade panel is fixed with at least four anchors in a rectangular arrangement via single agraffes or double agraffes on the substructure (for small panels or small fitted pieces, differential or fill- in pieces the number and position of the anchors shall be chosen constructively).
- 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.
- 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.
- Verifiable calculation notes and drawings shall be prepared taking account of the loads to be anchored, the nature and strength of the base materials and the dimensions of the anchorage members as well as of the relevant tolerances. The position of the anchor is indicated on the design drawings.
- 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.

KEIL undercut anchor KH for "STARON facade panels"

**Intended use**  
Design method

Annex B 2



### Verification of the anchor loads

In addition to the actions from dead load and wind load the following actions shall be considered as permanent loads in direction to the anchor axes:

- in case of flush fixing of the anchor and when using horizontal load-bearing profiles: due to torsion of the load-bearing profile resulting from dead load of the façade panel the following load  $N_{V,Ek}$  shall be considered:

$$N_{V,Ek} = V_{Ek} \cdot e/z$$

with  $V_{Ek}$  = shear load due to dead load of the façade panel;  $e$  und  $z$  [mm] (see Figure 2)

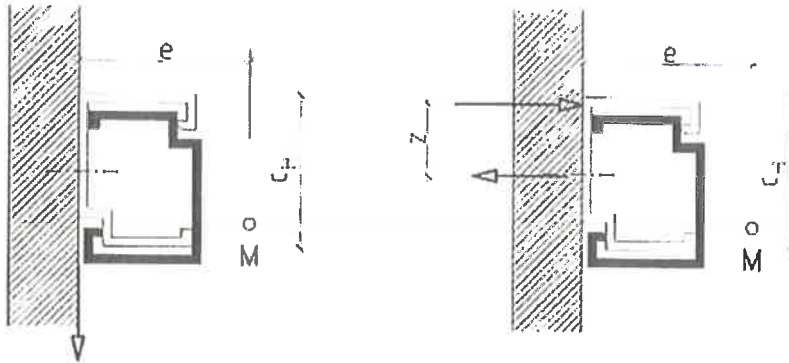


Figure 2: torsion of horizontal load-bearing profiles resulting from dead load of the façade panels

For the determined anchor forces it shall be verified, that the following equation are met:

Equation 1:  $\frac{\Sigma N_{Ed}}{N_{Rd}} \leq 1$

Equation 2:  $\frac{V_{Ed}}{V_{Rd}} \leq 1$

Equation 3:  $\frac{\Sigma N_{Ed}}{N_{Rd}} + \frac{V_{Ed}}{V_{Rd}} \leq 1,2$

With:

$\Sigma N_{Ed}$  = design value of existing anchor tension load

$$\Sigma N_{Ed} = N_{Ed} + N_{V,Ed}$$

$V_{Ed}$  = design value of existing anchor shear load

$N_{Rd}$  = design value of anchor load-bearing capacity for tension load:  $N_{Rd} = N_{Rk} / \gamma_M$  (with  $N_{Rk}$  and  $\gamma_M$  according to Annex C 1)

$V_{Rd}$  = design value of anchor load-bearing capacity for shear load:  $V_{Rd} = V_{Rk} / \gamma_M$  (with  $V_{Rk}$  and  $\gamma_M$  according to Annex C 1)

### Verification of the bending stresses

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

Equation 4:  $\sigma_{Ed} \leq \sigma_{Rd}$

With

$\sigma_{Ed}$  = design value of existing bending stress in the façade panel

$\sigma_{Rd}$  = design value of bending strength:  $\sigma_{Rd} = \sigma_{Rk} / \gamma_M$  with  $\sigma_{Rk}$ ;  $\gamma_M$  according to Annex C 1, Table C1

KEIL undercut anchor KH for "STARON facade panels"	Annex B 3
Intended use Design method	

### Requirements to the STARON façade panels

The bending strength of STARON-façade panels shall be determined according to EN ISO 178:2013-09.

The characteristic material values, dimensions and tolerances of the façade panels not indicated shall correspond to the respective values laid down in the technical documentation of this European technical assessment.

**Table B1: characteristic values of the façade panels – geometrical and physical properties**

panel thickness	$h \geq$	[mm]	12
Mean value of modulus of elasticity	$E_{\text{mean}} \geq$	[N/mm <sup>2</sup> ]	9500
bending resistance	$\sigma_{u5\%}^{1)} \geq$	[N/mm <sup>2</sup> ]	56,0

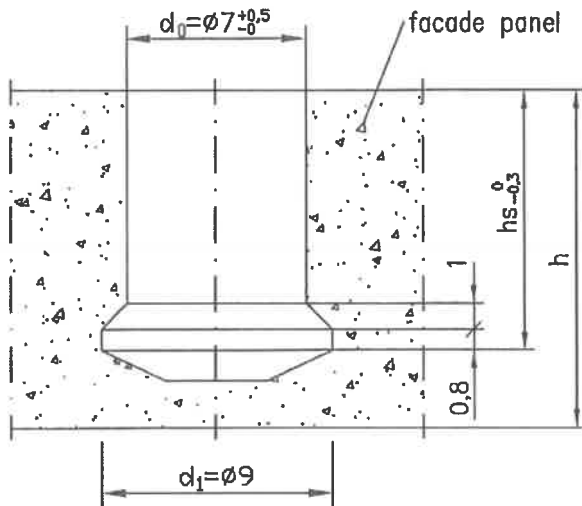
<sup>1)</sup> 5%-Quantil by a confidence level of 75 % and unknown standard deviation

KEIL undercut anchor KH for "STARON facade panels"

**Intended use**  
Requirements to the STARON façade panels

Annex B 4

Geometry of the drill hole

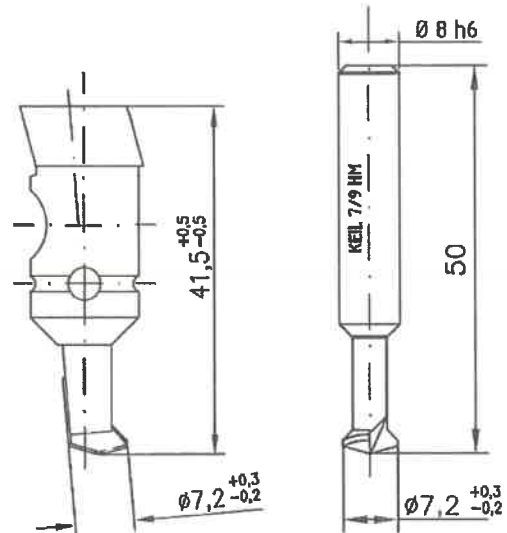


Geometry of the KEIL facade drill

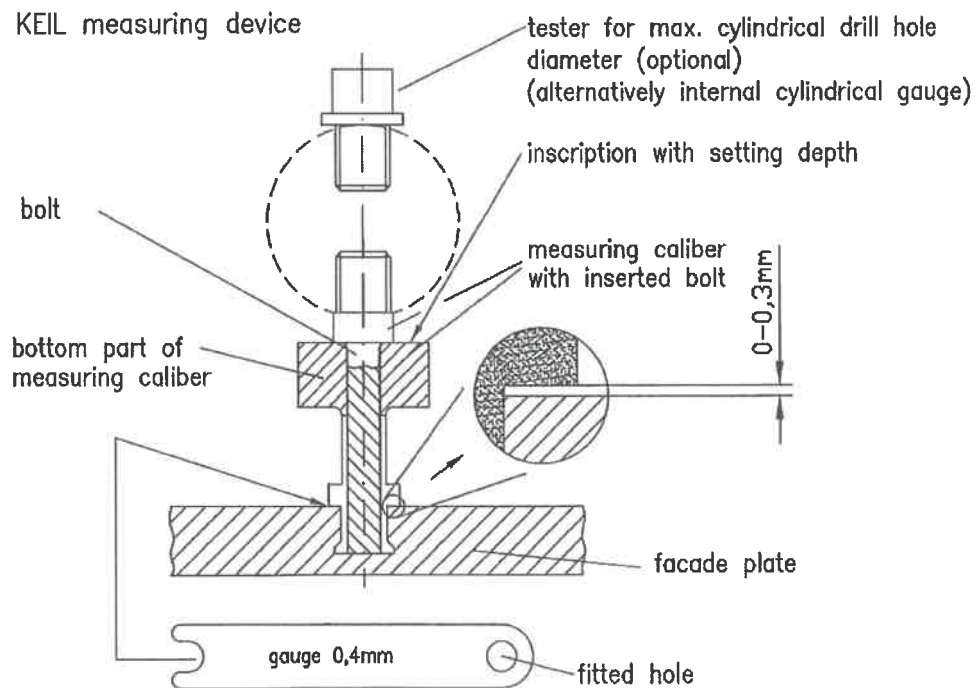
for KEIL facade drill bit 7/9

HM 12/0,8

HM CNC 13/0,8



KEIL measuring device

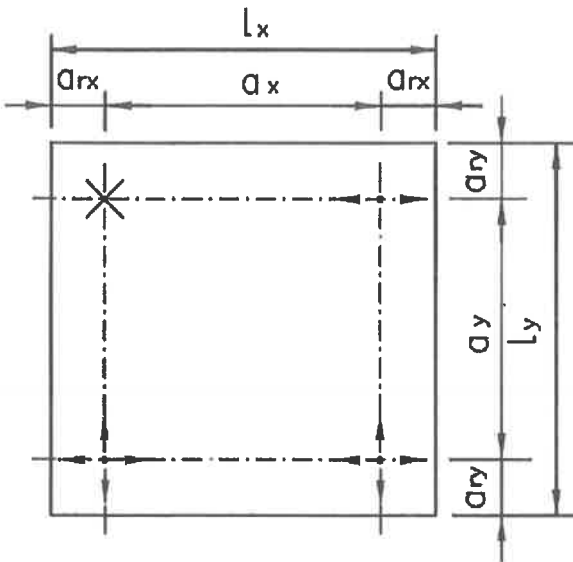


KEIL undercut anchor KH for "STARON facade panels"

**Intended use**  
Drill hole dimensions  
Setting tools and testing equipment

Annex B 5

### Definition of edge distance and spacing

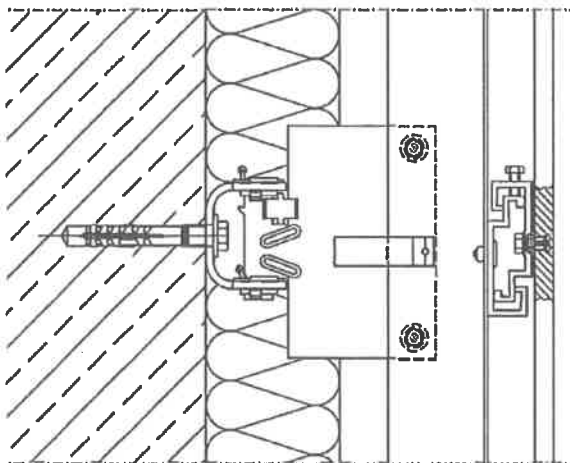


#### Legend:

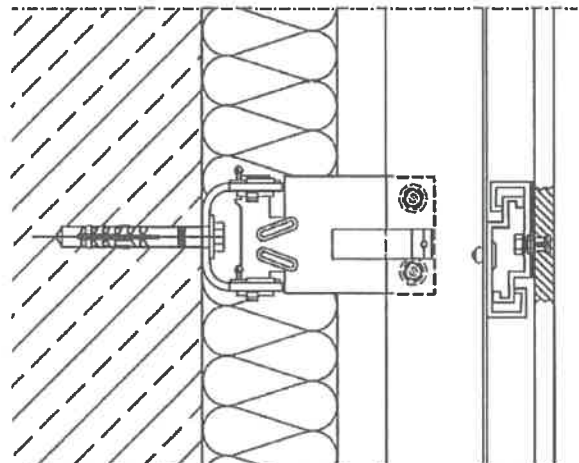
- $a_{r,x,y}$  = edge distance – distance of an anchor to the panel edge
- $a_{x,y}$  = spacing – distance between anchors
- $L_x$  = greater length of the façade panel
- $L_y$  = smaller length of the façade panel
- $\times$  = fixed point (fixed bearing)
- $\leftrightarrow$  = horizontal skid (loose bearing)
- $\leftrightarrow\updownarrow$  = horizontal and vertical skid (loose bearing)

### Example for fixed point and loose bearing

fixed bearing (fixed point)



loose bearing (skid)



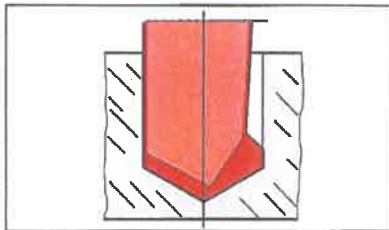
KEIL undercut anchor KH for "STARON facade panels"

**Intended use**  
Definition of edge distance and spacing,  
Example for fixed point and loose bearing

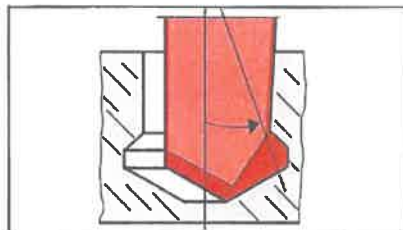
Annex B 6

## Installation instructions

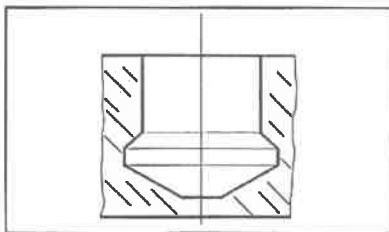
### 1. Drilling the undercut hole



a) Cylindrical drilling

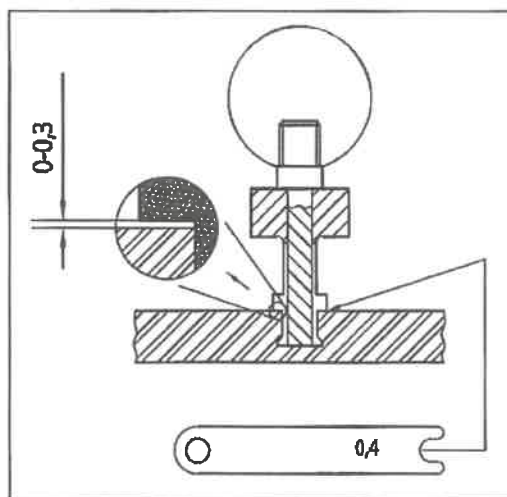


b) Undercutting and cleaning



c) Finished undercut hole

### 2. Checking the undercut hole



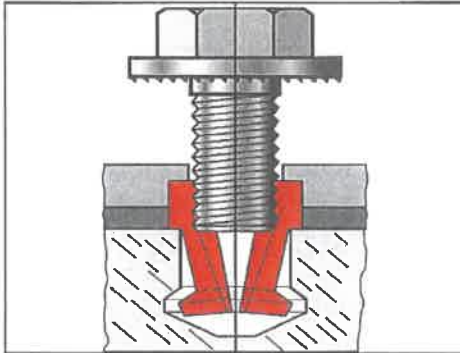
With KEIL depth control guide

KEIL undercut anchor KH for "STARON facade panels"

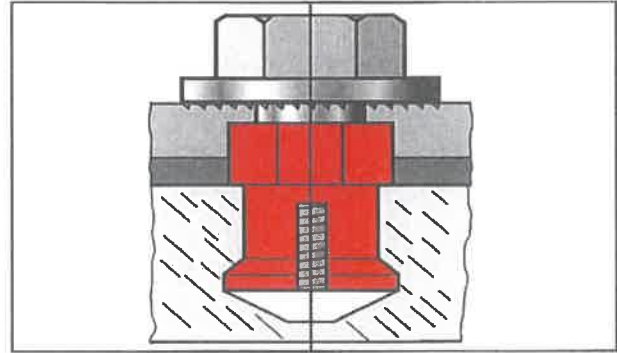
**Intended use**  
Installation instructions

Annex B 7

### 3. Installation of anchor (sleeve and screw)

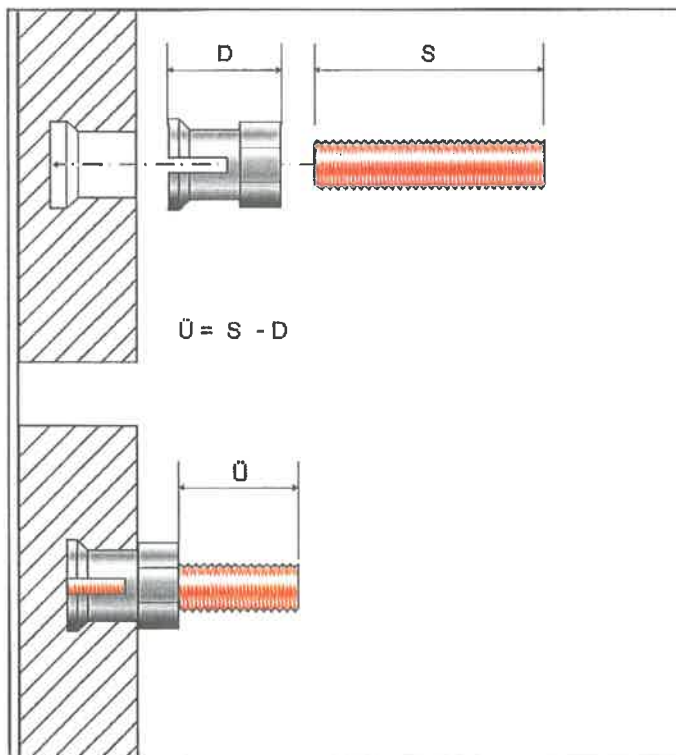


a) Insert the sleeve in the undercut hole and drill the screw in the sleeve



b) Installed anchor

### 4. Installation of anchor (sleeve and grub screw)



a) Insert the sleeve in the undercut hole

b) Drill the grub screw in the sleeve

c) Installed anchor

KEIL undercut anchor KH for "STARON facade panels"

Intended use  
Installation instructions

Annex B 8

**Table C1: Characteristic values of the anchor and façade panel**

of values characteristic façade panel	panel thickness	$h \geq$	[mm]	12,0		
	char. resistance to bending stress	$\sigma_{Rk} =$	[N/mm <sup>2</sup> ]	37,5		
	Mean value of modulus of elasticity	$E_{mean} =$	[N/mm <sup>2</sup> ]	9500		
	thermal coefficient	$\alpha_T =$	[1/K]	$36,0 \times 10^{-6}$		
	dead load	$g_k =$	[kN/m <sup>2</sup> ]	0,22		
	partial safety factor <sup>1)</sup>	$\gamma_M =$	[-]	1,8		
characteristic values of anchor	anchorage depth	$h_s =$	[mm]	7		
	characteristic resistance to	tension load <sup>2)</sup>	$N_{Rk} =$	[kN]	2,5	2,6
		shear load <sup>2)</sup>	$V_{Rk} =$		2,6	3,2
	edge distance <sup>3)</sup>	$a_r \geq$	[mm]	50	100	
	spacing	$a \geq$	[mm]	100		
	double agraffe	$a_D \geq$	[mm]	45		
	partial safety factor <sup>1)</sup>	$\gamma_M =$	[-]	1,8		

<sup>1)</sup> In absence of other national regulations.

<sup>2)</sup> in case of coincident stress of an anchor due to tension and shear load the equation according to Annex B 3 shall be observed

<sup>3)</sup> For small fitted pieces, differential and fill-in pieces the edge distance and spacing shall be chosen constructively

KEIL undercut anchor KH for "STARON facade panels"

**Performances**  
Characteristic values of the anchor and façade panel

Annex C 1