Deutsches Institut für Bautechnik

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

# European Technical Assessment ETA-16/0784 of 16 January 2018

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 | HSU-R |
| Product family to which the construction product belongs | Fastener for the rear fixing of facade panels made of selected natural stones according to EN 1469:2015 |
| Manufacturer | Hilti Aktiengesellschaft<br>9494 SCHAAN<br>FÜRSTENTUM LIECHTENSTEIN |
| Manufacturing plant | Hilti Werke |
| This European Technical Assessment contains | 13 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 | EAD 330030-00-0601 |

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## Specific Part

### 1 Technical description of the product

The HSU-R is a fastener of sizes M6 and M8 which consists of a cone bolt with an external thread on one end and a cone with an attached expansion sleeve on the other end. It is used in combination with a flange nut or a spring washer and nut.

The product description is given in Annex A. The material values, dimensions and tolerances of the components of the fastener not indicated in the annexes shall correspond to the values laid down in the technical documentation[1].

### 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 fastener 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 fasteners 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 |
| Fastener distances and spacing | See Annex B 3 and C 1 |
| Durability | Corrosion Resistance Class (CRC) III accoding to EN 1993-1-4:2015 |

### 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+

[1] The technical documentation comprises all information of the holder of this ETA necessary for the production, installation and maintenance of the fastener; these are in particular design drawings. 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 be handed over to the approved body.

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

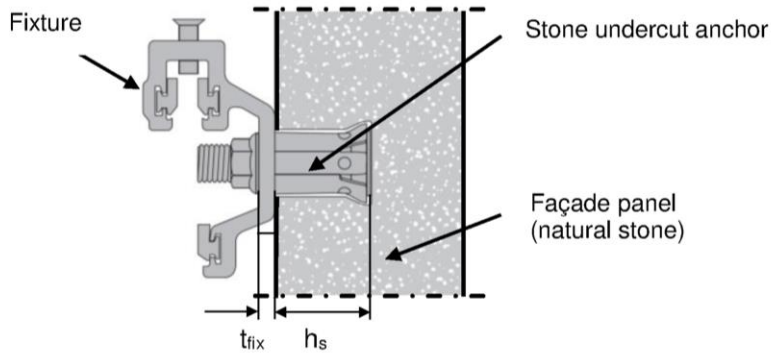
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 16 January 2018 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

*beglaubigt:*
Aksünger

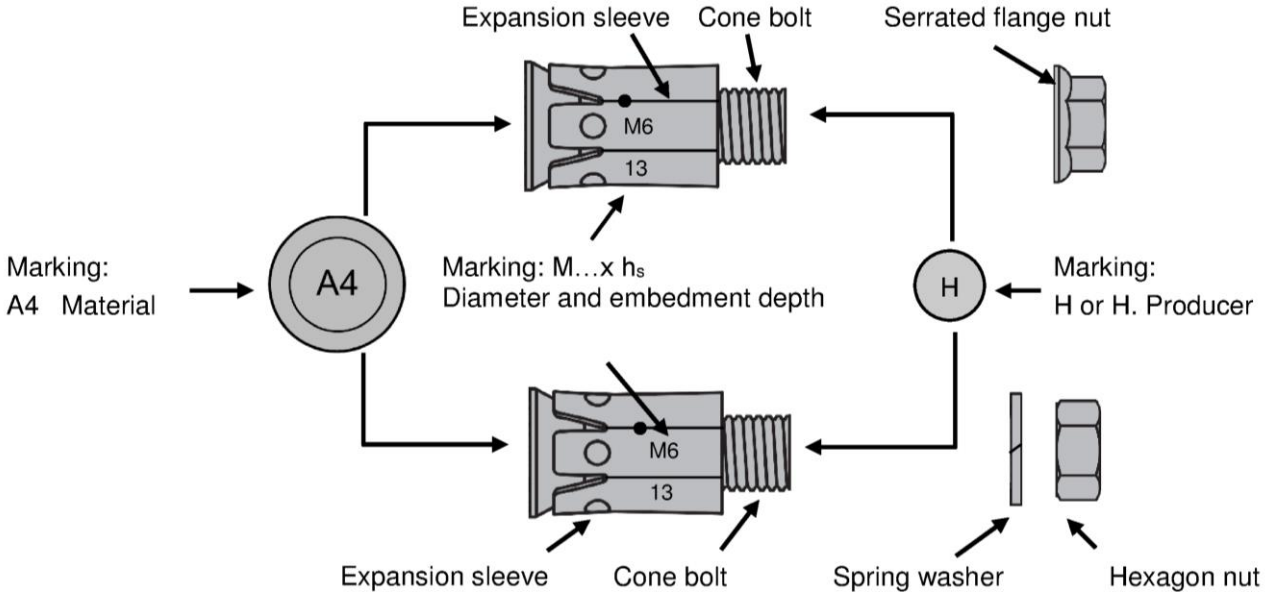
## Installed condition




## Product description:

**Hilti undercut anchor HSU-R with flange nut HSU-R FN**

**or with commercial standard spring washer and nut**




## Table A1: Materials

| Designation | Material |
|---|---|
| HSU-R Cone bolt with expansion sleeve | Stainless steel A4 according to EN 10 088: 2014 |
| HSU-R FN Serrated flange nut | Stainless steel A4-80, according to EN 10 088: 2014 |
| Spring washer | Stainless steel A4-80, according to EN 10 088: 2014 |
| Hexagon nut | Stainless steel A4-80, according to EN 10 088: 2014 |

| **Stone undercut anchor HSU-R** | **Annex A1** |
|---|---|
| **Product description**<br>Installed condition and marking<br>Materials | |

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## Specifications of intended use

**Anchorages subject to:**

- Static and quasi-static loading.

**Base material:**

- Façade panels made of natural stone in accordance with EN 1469:2015.
- Natural stone free of open seams and mechanically active cracks and alterations.
- Natural stone classified in accordance with Table B1.
- Characteristic values of the panels correspond to Table B2.

**Table B1: Stone groups**

| Stone group | | Natural stone type | Boundary conditions |
|---|---|---|---|
| I | High-quality intrusive rocks (plutonic rocks) | granite, granitite, tonalite, diorite, monzonite, gabbro, other magmatic plutonic rocks | None |
| II | Metamorphic rocks with „hard stone characteristics“ | quarzite, granulite, gneiss, migmatite | None |
| III | High-quality extrusive rocks (volcanic rocks) | basalt and basaltlava without harmful ingredients (e.g. sun burner basalt) | Minimum density ρ: basalt: 2,7 kg/dm³ basaltic lava: 2,2 kg/dm³ |
| IV | Sedimentary rocks with „hard stone characteristics“[1)] | Sandstone and limestone | Minimum density ρ: sandstone: 2,1 kg/dm³ |

[1)] For façade panels made of natural stones with planes of anisotropies, the difference between the flexural strength determined parallel to the planes of anisotropy and perpendicular to the edges of the planes of anisotropy shall not be more than 50 %.

**Use conditions (Environmental conditions):**

- According to EN 1993-1-4:2015 dependent on Corrosion Resistancy Class (see ETA sect 3.1).

**Design:**

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and façade design.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored.
- Anchorages under static or quasi-static loading are designed in accordance with:
  EOTA Technical Report TR Design of fasteners for façade panels made of natural stone.



| Stone undercut anchor HSU-R | Annex B1 |
|---|---|
| **Intended use**<br>Specifications | |

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**Installation:**

- The undercut drill holes are prepared at the factory or on site under workshop conditions. In case of drilling on site, supervision of the person responsible for technical matters of the site or a skilled representative thereof is required.
- The undercut drill holes are drilled with a special drill bit according to Table B4. The drill bit should be used with a special HSU ADT/MDT drilling machine. Other suitable drilling machines may also be used.
- The drill dust shall be removed from the drill hole.
- In case of an aborted drill hole, the newly drilled hole must be placed with a minimum spacing of twice the depth of the aborted drill hole.
- The geometry of the drill holes shall be checked in 1% of all drillings. The following dimensions are to be checked and documented following the manufacturer's instructions and using the gauge in accordance with Table B3.
  - Diameter of the drill hole $d_0$,
  - Depth of the drill hole $h_1$,
  - Diameter $d_1$
  - Height of the undercut $h_2$.

  If the tolerances in accordance with Table B3 are not met, the drill hole geometry shall be checked in 25 % of the performed drillings. No subsequently checked drill hole may exceed the tolerances, otherwise all drill holes shall be controlled. Drill holes not meeting the tolerances shall not be used for anchor installation.

  Note: Checking the drill hole geometry of 1% of the drill holes means that on one out of 25 slabs with four drill holes in each slab (100 drill holes) one drill hole shall be checked. If the tolerances given in Table B3 are not met, then the control shall be increased to 25 % of the drillings e.g. one drill hole on each of the 25 slabs.
- During transport and storage on site the façade panels are protected from damages. The façade panels shall not be mounted with jerking motions to avoid damage to the panels. If necessary, lifting devices can be used. Façade panels or reveal slabs with incipient cracks shall not be installed.

| **Stone undercut anchor HSU-R** | |
|---|---|
| **Intended use**<br>Specifications | **Annex B2** |

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## Table B2: Properties of natural stone panels

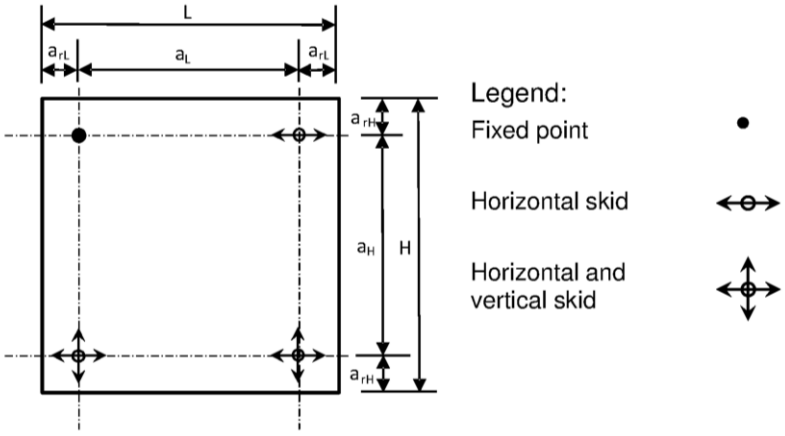
| | | | | |
|---|---|---|---|---|
| Nominal panel thickness (stone group I / II (Tab. B1)) | | $h_{nom}$ | [mm] | $20 \le h_{nom} \le 70$ |
| Minimum panel thickness (stone group I / II (Tab. B1)) | | $h_{min}$ [1)] | [mm] | $h_s + 5$ mm |
| Nominal panel thickness (stone group III / IV (Tab. B1)) | | $h_{nom}$ | [mm] | $25\ (30)^{2)} \le h_{nom} \le 70$ |
| Minimum panel thickness (stone group III / IV (Tab. B1)) | | $h_{min}$ [1)] | [mm] | $h_s + 10$ mm |
| Maximum panel size | | A | [m²] | 3,0 |
| Maximum side length | | H und L | [m] | 3,0 |
| Number of anchors (rectangular arrangement) | | N | [-] | 4 |
| Minimum edge distance[3)] | | $a_{rH,min}$, $a_{rL,min}$ | [mm] | 50 |
| Maximum edge distance | | $a_{rH,max}$, $a_{rL,max}$ | [mm] | 0,25 · L and 0,25 · H |
| Minimum spacing[3)] | | $a_L$ and $a_H$ | [mm] | $8 \cdot h_s$ |
| Minimum characteristic flexural strength in accordance with EN 12372 | | | | |
| Padang Cristallo G603, China | stone group I | $\sigma_{5\%}$ | [N/mm²] | 12,4 |
| Nero Assoluto, Zimbabwe | stone group I | $\sigma_{5\%}$ | [N/mm²] | 26,3 |
| Jura Limestone (yellow), Germany | stone group IV | $\sigma_{5\%}$ | [N/mm²] | 14,1 |

1) Minimum panel thickness is equal to the lower limit of tolerance.

2) For sandstone, limestone and basaltic lava: panel thickness ≥ 30 mm, if the panel manufacturer warranted lowest expected value (5 % fractile) of the flexural strength is < 8 N/mm².

3) For small fitting or fill-in pieces the minimum edge distance or spacing shall be chosen according to the geometrical boundary conditions. In case of design under static loading using FEM, smaller edge distances are allowed.

## Figure B1: Façade panel with fixing points






**Stone undercut anchor HSU-R**

**Intended use**
Specifications

**Annex B3**

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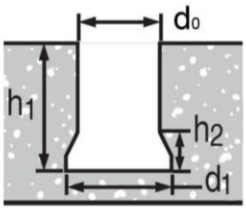
## Table B3: Installation parameters

| Size | | | M6 | M8 |
|---|---|---|---|---|
| Embedment depth | $h_s$ | [mm] | $(10 \le h_s \le 25)$ +0,4 / -0,1 | |
| Drill hole depth | $h_1$ | [mm] | $h_s$ + 0,5 | |
| Diameter of drill hole | $d_0$ | [mm] | 11 +0,4 / -0,2 | 13 +0,4 / -0,2 |
| Diameter of undercut | $d_1$ | [mm] | 13,5 ± 0,3 | 15,5 ± 0,3 |
| Height of undercut | $h_2$ | [mm] | 4,5 ±0 ,5 | 4,5 ± 0,5 |
| Installation torque moment | $T_{inst}$ | [Nm] | 6 | 10 |
| Width across flats | SW | [mm] | 10 | 13 |
| Max. diameter of clearance hole in fixture | $d_f$ | [mm] | 7 | 9 |
| Max. fixture thickness | $t_{fix}$ | [mm] | 10 | 8 |

## Figure B2: Geometry of drill hole






| Stone undercut anchor HSU-R | Annex B4 |
|---|---|
| **Intended use**<br>Installation parameters | |

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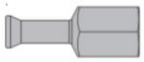
### Drill bit HSU CDB…


### Hilti gauge HSU IG…


### Hilti setting tool HSU ST-G…


### Table B4: Drilling and setting tools

| Anchor | Drilling | Drill hole check | Installation |
|---|---|---|---|
|  |  |   |  |
| HSU-R M6 | HSU CDB M6 | HSU IG 11/13.5 | HSU ST-G M6 |
| HSU-R M8 | HSU CDB M8 | HSU IG 13/15.5 | HSU ST-G M8 |

| Stone undercut anchor HSU-R | Annex B5 |
|---|---|
| **Intended use**<br>Drill bit, gauge and setting tool | |

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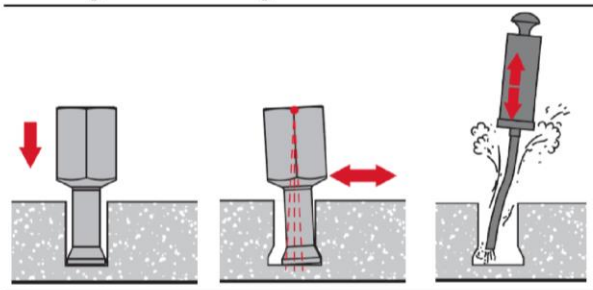
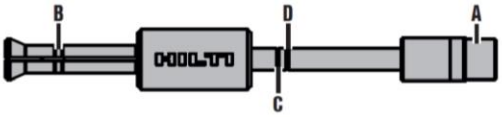
## Installation instruction

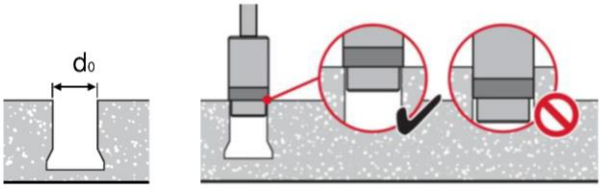
### Drilling and cleaning of the undercut drill hole



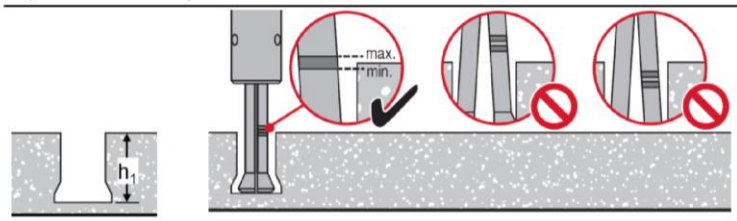
### Checking dimensions of drill hole with gauge



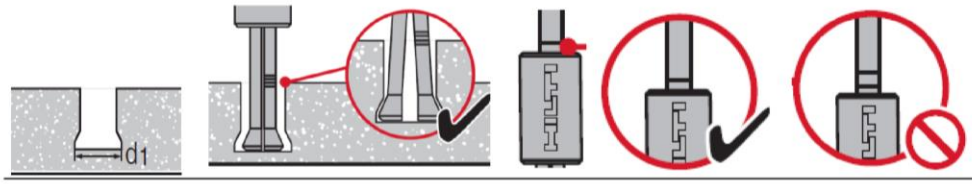

### A) Drill hole diameter $d_0$



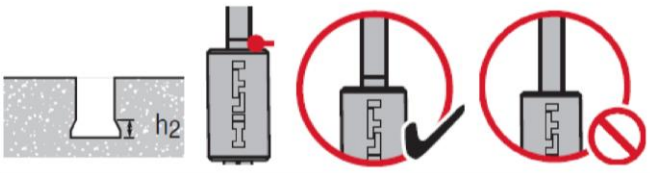

### B) Drill hole depth $h_1$




### C) Diameter of the undercut $d_1$




### D) height of the undercut $h_2$




| **Stone undercut anchor HSU-R** | **Annex B6** |
|---|---|
| **Intended use**<br>Installation instructions | |

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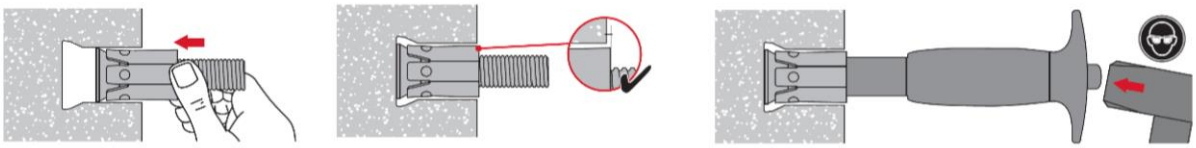
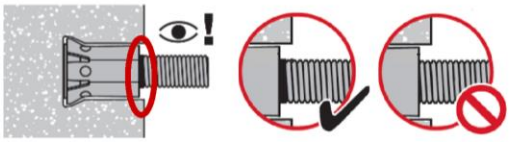
**Installation of the undercut anchor**

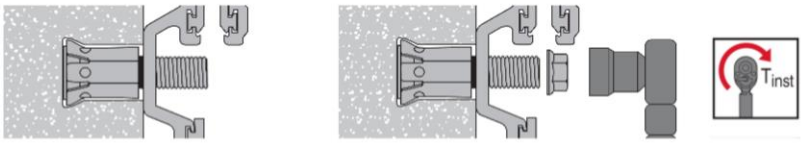


**Checking of the embedment depth**

**Checking of red ring visibility (proof of correct expansion)**



**Installation of the fixture**




**Stone undercut anchor HSU-R**

**Intended use**
Installation instructions

**Annex B7**

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## Table C1: Characteristic resistance

| Size | | | M6 | | | M8 | | |
|---|---|---|---|---|---|---|---|---|
| Designation of natural stone | | | Padang Cristallo G603 | Nero Assoluto | Jura Limestone (yellow) | Padang Cristallo G603 | Nero Assoluto | Jura Limestone (yellow) |
| Country of origin | | | China | Zimbabwe | Germany | China | Zimbabwe | Germany |
| Petrographic description | | | Granite | Gabbro | Limestone | Granite | Gabbro | Limestone |
| Panel thickness | $h$ | [mm] | 30 | 25 | 35 | 30 | 25 | 35 |
| Edge distance | $a_r$ | [mm] | 100 | 150 | 150 | 100 | 150 | 150 |
| Embedment depth | $h_s$ | [mm] | 13 | 13 | 15 | 15 | 15 | 21 |
| **Characteristic resistance** | | | | | | | | |
| Tension load | $N_{Rk}$ [1),2)] | [kN] | 4,0 | 11,6 | 5,4 | 6,0 | 17,0 | 8,9 |
| Shear load | $V_{Rk}$ [1), 2)] | [kN] | 6,6 | 11,8 | 7,3 | 6,9 | 21,4 | 9,6 |
| Partial safety factor | $\gamma_M$ | [-] | 1,8 | | | | | |
| **Combined tension and shear load:** | | | | | | | | |
| | X | | 1,2 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 |

1) Reduction factor $\alpha$ based on stone class is already included in these values. Reduction factor $\alpha$ in accordance with Technical Report Design of fasteners for façade panels made of natural stone.
2) For other natural stones according to Table B1, the resistance is determined in accordance with EAD 33-0030-06.01 and Technical Report Design of fasteners for façade panels made of natural stone.

## Table C2: Characteristic resistance for steel failure

| Size | | | M6 | M8 |
|---|---|---|---|---|
| Characteristic resistance under tension load | $N_{Rk,s}$ | [kN] | 16,1 | 29,3 |
| Partial safety factor | $\gamma_{Ms,N}$ [1)] | [-] | 1,5 | |
| Characteristic resistance under shear load | $V_{Rk,s}$ | [kN] | 9,7 | 17,6 |
| Partial safety factor | $\gamma_{Ms,V}$ [1)] | [-] | 1,25 | |

1) In absence of national regulations.



**Stone undercut anchor HSU-R**

**Performances**
Characteristic resistance in natural stone and steel resistance

**Annex C1**