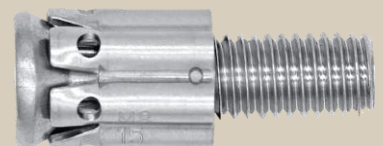




HSU-R STONE UNDERCUT ANCHOR

Technical Datasheet

Update: May-19





HSU-R stone undercut anchor

Undercut anchor for the rear fixing of façade panels made of natural stones

Anchor version

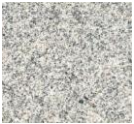


HSU-R (M6-M8)

Benefits

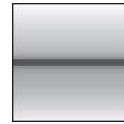
- Performance assessed by European Approval body per the latest standard.
- Impossible for damaging spinning lock or undercut elements during installation
- Clear visual check for undercut completion (Hilti red line mark for undercut portfolio)
- Optimized sleeve size for reducing the possibility of spinning after installation

Base material



Natural stone

Load conditions



Static / quasi-static

Other information



European
Technical
Assessment



Corrosion
resistance

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European Technical Assessment	DIBt, Berlin	ETA-16/0784 / 2019-03-13

Basic loading data (for a single anchor)

All data in this section applies to:

- All data in this section applies to correct anchor setting (see instruction for use, setting parameters).
- The resistance of steel failure provided by this technical data manual may not be lowest resistance for all failure modes of a stone undercut anchor placed into nature stone.
- The resistance in natural stone provided by this technical data manual are valid only for the anchors of the same natural stone panels with equal or higher flexural strength, equal or larger edge distances and thicknesses.
- The resistance of the stone panel shall be verified in addition to the anchor resistance.
- For natural stone panels, which are not listed in this technical data manual, additional tests and evaluation per EAD 330030-00-0601 shall be used by responsible engineer to define the resistance.

Characteristic resistance under tension and shear load for steel failure

Anchor size		M6	M8
Tension $N_{Rk,s}$	[kN]	16,1	29,3
Shear $V_{Rk,s}$	[kN]	9,7	17,6

Design resistance under tension and shear load for steel failure^{a)}

Anchor size		M6	M8
Tension $N_{Rd,s}$	[kN]	10,7	19,,5
Shear $V_{Rd,s}$	[kN]	7,8	14,1

^{a)} Safety factor used: $\gamma_{Ms,N} = 1,5$; $\gamma_{Ms,V} = 1,25$ per EOTA Technical Report 062 Design of fasteners for façade panels made of natural stone

Characteristic resistance for natural stone panel failure

- All load information relates to the base material information table at the end of this section.
- The resistance is the minimal characteristic value among all failure modes relevant with natural stone panels.
- Steel failure

No	Base material ^{a)}	Data	Anchor size		M6				M8			
			Setting depth h _s [mm]		13			15	15		21	
			Edge distance a _r [mm]		50 ^{b)} 100	70	100	150	150	100	150	150
1	Group I, Granite, Padang Cristallo G603(G3503), China	ETA 16/0784	N _{Rk}	[kN]	-	-	4,0 ^{c)}	-	-	6,0	-	-
			V _{Rk}	[kN]	-	-	6,6 ^{c)}	-	-	6,9	-	-
2	Group I, Gabbro, Nero Assoluto, Zimbabwe	ETA 16/0784	N _{Rk}	[kN]	-	-	-	11,6	-	-	17,0	-
			V _{Rk}	[kN]	-	-	-	9,7	-	-	17,6	-
3	Group IV, Limestone, Jura Limestone (yellow), Germany	ETA 16/0784	N _{Rk}	[kN]	-	-	-	-	6,2	-	-	10,2
			V _{Rk}	[kN]	-	-	-	-	8,4	-	-	11,1
4	Group I, Granite, Sesame Grey G3554, China	Hilti Technical Data	N _{Rk}	[kN]	-	-	-	9,5	12,1	-	12,4	19,4
			V _{Rk}	[kN]	-	-	-	9,7	9,7	-	13,4	17,6
5	Group I, Granite, Sesame Grey G3554, China	Hilti Technical Data	N _{Rk}	[kN]	3,7	-	-	-	-	-	-	-
			V _{Rk}	[kN]	4,5	-	-	-	-	-	-	-
6	Group III, Basalt, Fuding Black G3518, China	Hilti Technical Data	N _{Rk}	[kN]	-	-	-	11,5	14,5	-	14,6	20,8
			V _{Rk}	[kN]	-	-	-	9,7	9,7	-	12,0	17,6
7	Group I, Granite, Wulian Leopard Skin G3742, China	Hilti Technical Data	N _{Rk}	[kN]	-	-	-	7,3	7,3	-	8,4	13,2
			V _{Rk}	[kN]	-	-	-	7,7	7,7	-	7,3	11,1
8	Group I, Granite, Laizhou Sesame White G3765, China	Hilti Technical Data	N _{Rk}	[kN]	-	-	-	6,1	6,9	-	8,1	13,9
			V _{Rk}	[kN]	-	-	-	9,7	9,7	-	13,5	13,5
9	Group I, Granite, Cenxi Red G4562, China	Hilti Technical Data	N _{Rk}	[kN]	-	-	-	8,6	8,8	-	10,7	15,8
			V _{Rk}	[kN]	-	-	-	9,7	9,7	-	15,0	15,0
10	Group IV, Limestone, Moca Cream, Portugal	Hilti Technical Data	N _{Rk}	[kN]	-	1,9	1,9	1,9	-	-	-	-
			V _{Rk}	[kN]	-	2,0	2,0	2,7	-	-	-	-

a) Number code for Chinese Stones according to GB 17670-2016

b) Edge distance in horizontal direction a_r = 50 mm, vertical direction a_r = 100mm

c) Factor X for stone No. 1 Padang Cristallo and stone No. 3 Jura Limestone X=1,2

Design resistance – in natural stone panels

- Design resistance is the minimal design resistance of all failure modes, by using partial safety factor for $\gamma_M = 1,8$ for natural stone panel failure and 1.5 in tension and 1.25 in shear for steel failure.
- Design principle

$$\frac{N_{Ed}}{N_{Rd}} \leq 1,0 \quad \text{and} \quad \frac{V_{Ed}}{V_{Rd}} \leq 1,0$$

Equation 1 and 2

$$\frac{N_{Ed}}{N_{Rd}} + \frac{V_{Ed}}{V_{Rd}} \leq X$$

Equation 3

- Combined tension and shear resistance factor X in Equation 3 is 1.0, unless special noted.

No	Base material ^a	Data	Anchor size		M6				M8			
			Setting depth h_s [mm]		13			15	15		21	
			Edge distance a_r [mm]		50 ^{b)} 100	70	100	150	150	100	150	150
1	Group I, Granite, Padang Cristallo G603(G3503), China	ETA 16/0784	N_{Rd}	[KN]	-	-	2,2 ^{c)}	-	-	3,3	-	-
			V_{Rd}	[KN]	-	-	3,6 ^{c)}	-	-	3,8	-	-
2	Group I, Gabbro, Nero Assoluto, Zimbabwe	ETA 16/0784	N_{Rd}	[KN]	-	-	-	6,4	-	-	9,4	-
			V_{Rd}	[KN]	-	-	-	6,5	-	-	11,9	-
3	Group IV, Limestone, Jura Limestone (yellow), Germany	ETA 16/0784	N_{Rd}	[KN]	-	-	-	-	3,4	-	-	5,6
			V_{Rd}	[KN]	-	-	-	-	4,6	-	-	6,1
4	Group I, Granite, Sesame Grey G3554, China	Hilti Technical Data	N_{Rd}	[KN]	-	-	-	5,3	6,7	-	6,9	10,7
			V_{Rd}	[KN]	-	-	-	5,9	5,9	-	7,4	10,8
5	Group I, Granite, Sesame Grey G3554, China	Hilti Technical Data	N_{Rd}	[KN]	2,0	-	-	-	-	-	-	-
			V_{Rd}	[KN]	2,5	-	-	-	-	-	-	-
6	Group III, Basalt, Fuding Black G3518, China	Hilti Technical Data	N_{Rd}	[KN]	-	-	-	6,4	8,0	-	8,1	11,5
			V_{Rd}	[KN]	-	-	-	5,5	5,5	-	6,6	10,7
7	Group I, Granite, Wulian Leopard Skin G3742, China	Hilti Technical Data	N_{Rd}	[KN]	-	-	-	4,0	4,0	-	4,7	7,3
			V_{Rd}	[KN]	-	-	-	4,3	4,3	-	4,0	6,2
8	Group I, Granite, Laizhou Sesame White G3765, China	Hilti Technical Data	N_{Rd}	[KN]	-	-	-	3,4	3,8	-	4,5	7,7
			V_{Rd}	[KN]	-	-	-	5,8	5,8	-	7,5	7,5
9	Group I, Granite, Cenxi Red G4562, China	Hilti Technical Data	N_{Rd}	[KN]	-	-	-	4,8	4,9	-	5,9	8,8
			V_{Rd}	[KN]	-	-	-	6,0	6,0	-	8,3	8,3
10	Group IV, Limestone, Moca Cream, Portugal	Hilti Technical Data	N_{Rd}	[KN]	-	1,0	1,0	1,0	-	-	-	-
			V_{Rd}	[KN]	-	1,1	1,1	1,5	-	-	-	-

a) Number code for Chinese Stones according to GB 17670-2016

b) Edge distance in horizontal direction $a_r = 50$ mm, **vertical direction $a_r = 100$ mm**

c) Factor X for stone No. 1 Padang Cristallo and stone No. 3 Jura Limestone X=1,2

Base material information corresponding to the resistance in natural stone panels

No.	Base material ^{a)}	Characteristic Flexural strength of panel per EN 12372 [MPa]	Anchor size		M6			M8	
			Setting depth h _s [mm]		13	15	15	21	
1	Group I, Granite, Padang Cristallo G603(G3503), China	12,4	Edge distance	[mm]	100	-	100	-	
			Panel thickness	[mm]	30	-	30	-	
2	Group I, Gabbro, Nero Assoluto, Zimbabwe	26,3	Edge distance	[mm]	150	-	150	-	
			Panel thickness	[mm]	25	-	25	-	
3	Group IV, Limestone, Jura Limestone (yellow), Germany	14,1	Edge distance	[mm]	-	150	-	150	
			Panel thickness	[mm]	-	35	-	35	
4	Group I, Granite, Sesame Grey G3554, China	15,0	Edge distance	[mm]	150	150	150	150	
			Panel thickness	[mm]	30	30	30	50	
5	Group I, Granite, Sesame Grey G3554, China	17,0	Edge distance	[mm]	50/100 ^{b)}			-	-
			Panel thickness	[mm]	20	-	-	-	
6	Group III, Basalt, Fuding Black G3518, China	18,6	Edge distance	[mm]	150	150	150	150	
			Panel thickness	[mm]	50	50	50	50	
7	Group I, Granite, Wulian Leopard Skin G3742, China	6,6	Edge distance	[mm]	150	150	150	150	
			Panel thickness	[mm]	30	30	30	50	
8	Group I, Granite, Laizhou Sesame White G3765, China	10,3	Edge distance	[mm]	150	150	150	150	
			Panel thickness	[mm]	50	50	50	50	
9	Group I, Granite, Cenxi Red G4562, China	12,3	Edge distance	[mm]	150	150	150	150	
			Panel thickness	[mm]	50	50	50	50	
10	Group IV, Limestone, Moca Cream, Portugal	6,0	Edge distance	[mm]	70	100	150	-	-
			Panel thickness	[mm]	30			-	-

a) Number code for Chinese Stones according to GB 17670-2016

b) Edge distance in horizontal direction a_h = 50 mm, **vertical direction a_v = 100mm**

All stone groups are applicable

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“	quartzite, 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/dm ³ basaltic lava: 2,2 kg/dm ³
IV	Sedimentary rocks with „hard stone characteristics“ ¹⁾	Sandstone, limestone and marble	Minimum density ρ : sandstone: 2,1 kg/dm ³

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 %.

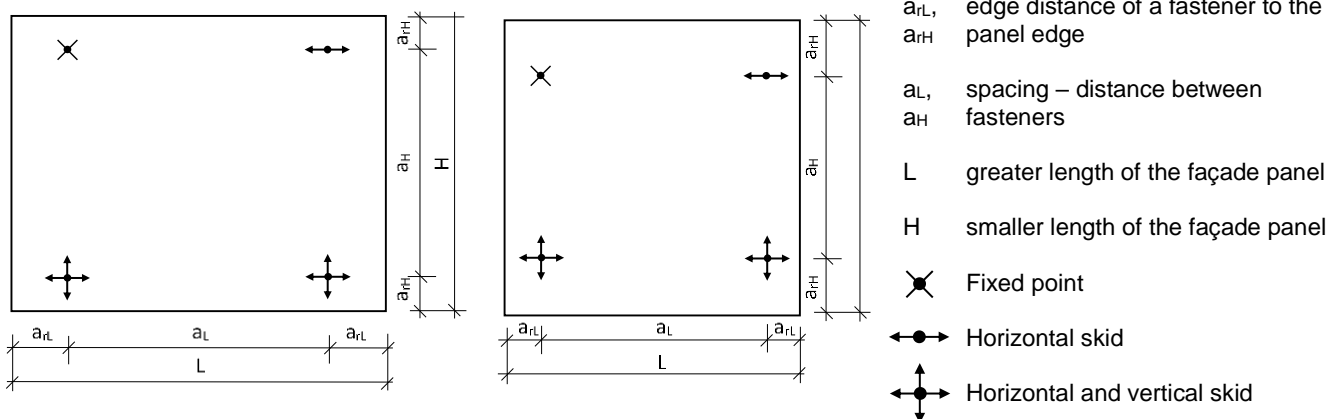
Properties of applicable natural stone panels			
Nominal panel thickness (stone group I / II)	h_{nom}	[mm]	$20 \leq h_{nom}$
Minimum panel thickness (stone group I / II)	$h_{min}^{1)}$	[mm]	$h_s + 5 \text{ mm}$
Nominal panel thickness (stone group III / IV)	h_{nom}	[mm]	$25 (30)^2 \leq h_{nom}$
Minimum panel thickness (stone group III / IV)	$h_{min}^{1)}$	[mm]	$h_s + 10 \text{ mm}$
Maximum panel size	A	[m ²]	3,0
Maximum side length	H und L	[m]	3,0
Number of anchors (rectangular arrangement)	N	[-]	4 or 6
Minimum edge distance ³⁾	$a_{rH,min}$, $a_{rL,min}$	[mm]	50
Maximum edge distance	$a_{rH,max}$, $a_{rL,max}$	[mm]	$0,25 \cdot L$ and $0,25 \cdot H$
Minimum spacing ³⁾	a_L and a_H	[mm]	$8 \cdot h_s$

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

2) For sandstone, limestone and basaltic lava: panel thickness $\geq 30 \text{ mm}$, if the panel manufacturer warranted lowest expected value (5 % fractile) of the flexural strength is $< 8 \text{ N/mm}^2$.

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



Design example

Stone Material Property Information

Stone Material name: Padang Crisallo

flexural strength σ_{rk} : 13 [MPa] characteristic value

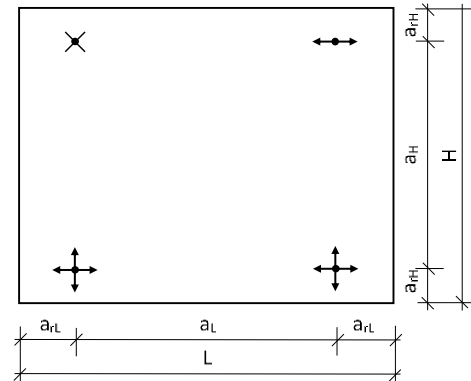
Length L: 650 [mm]

Height H: 1200 [mm]

Thickness h: 30 [mm]

Position a_{rH} : 150 [mm]

Position a_{rL} : 100 [mm]



Action on the most loaded anchor:

Tension Load N_{Ed} 1.3 [kN]

Shear Load V_{Ed} 2.1 [kN]

Design

1. Application feasibility check:

Stone group is No.1.

Maximum panel size L and H < 3m; OK

Thickness $h > 20\text{mm} > h_s + 5\text{mm} = 18\text{mm}$; OK

Position a_{rL} and $a_{rH} > 50\text{mm}$, $a_{rL} < 0.25 \times 650\text{mm}$, $a_{rH} < 0.25 \times 1200\text{mm}$; OK

This stone panel is applicable.

2. Design resistance check:

Stone panel used has a larger edge distance and flexural strength than the data No.1 provided in this FTM, and has the same thickness, therefore the technical data No.1 in this FTM can be used directly for this design.

$$\frac{N_{Ed}}{N_{Rd}} = 1.3/2.2 \leq 1.0 \quad \text{and} \quad \frac{V_{Ed}}{V_{Rd}} = 2.1/3.6 \leq 1.0$$

$$\frac{N_{Ed}}{N_{Rd}} + \frac{V_{Ed}}{V_{Rd}} = 0.59 + 0.58 = 1.17 \leq X \quad (1.2)$$

Conclusion: HSU-R M6X13 fulfills the requirement

Materials

Mechanical properties

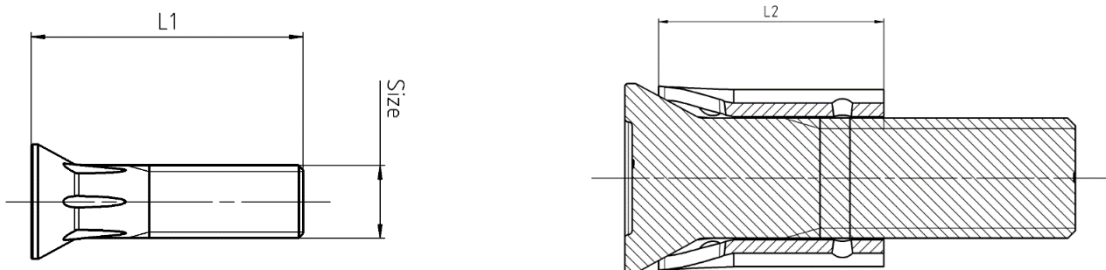
Anchor size		M6	M8
Nominal tensile strength f_{uk}	[N/mm ²]	800	800
Stressed cross-section A_s	[mm ²]	20,1	36,6

Material quality

Type	Material
HSU-R cone bolt with expansion steel	Stainless steel, grade A4
HSU-R FN serrated flange nut	Stainless steel, grade A4-80
Spring washer	Stainless steel, grade A4-80
Hexagon nut	Stainless steel, grade A4-80

Anchor dimensions

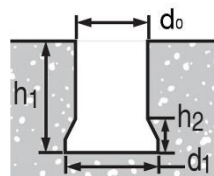
Anchor size		M6	M8
Minimum length of the anchor	$L_{1, \min}$ [mm]	24	28
Maximum length of the anchor	$L_{1, \max}$ [mm]	32	44
Length of expansion sleeve	L_2 [mm]	13/15	15/21



Setting information

Setting details

Anchor size		M6	M8
Setting depth	h_s [mm]	$(10 \leq h_s \leq 38) + 0,4/-0,1$	
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]	$13,5 \pm 0,3$	$15,5 \pm 0,3$
Height of undercut	h_2 [mm]	$4,5 \pm 0,5$	$4,5 \pm 0,5$
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 acc. to ETA 16/0784	t_{fix} [mm]	10	14
Max. fixture thickness not covered by ETA	t_{fix} [mm]	10	14



Setting instructions

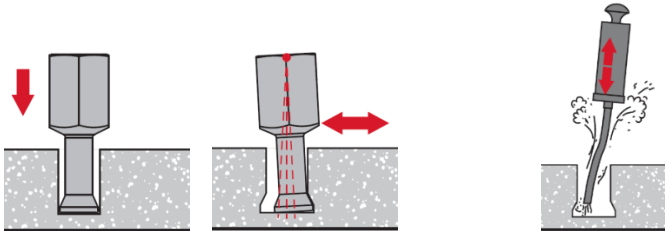
*For detailed information on installation see instruction for use given with the package of the product



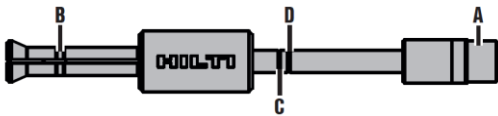
Safety regulations.

Review the Material Safety Data Sheet (MSDS) before use for proper and safe handling! Wear well-fitting protective goggles and protective gloves when working with Hilti HSU-R

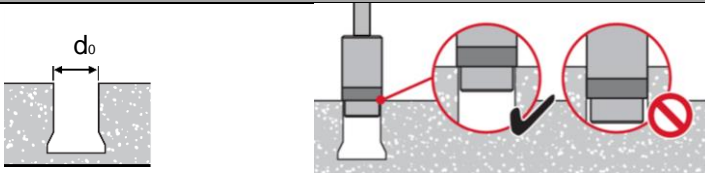
Drilling and cleaning of the undercut drill hole



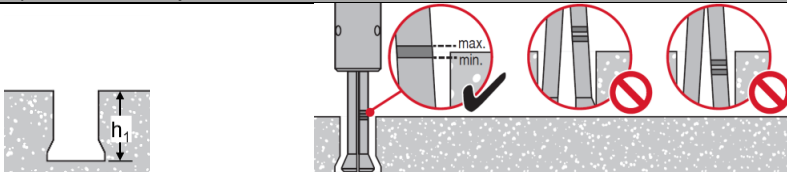
Checking dimensions of drill hole with gauge



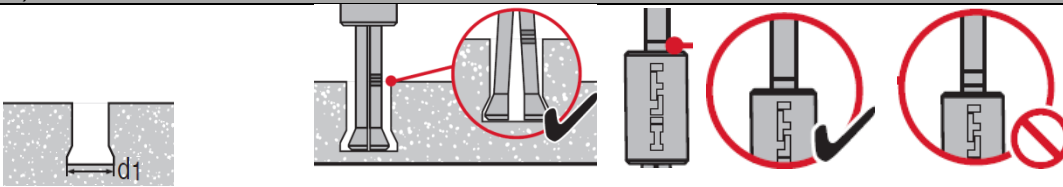
A) Drill hole diameter d_0



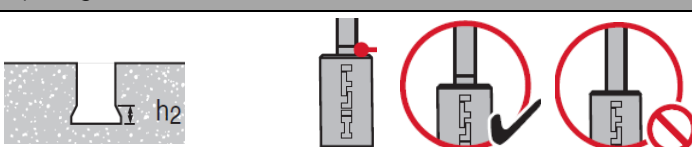
B) Drill hole depth h_1



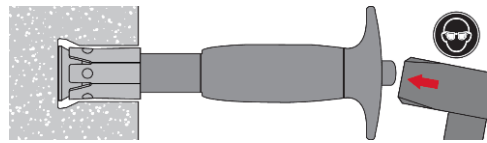
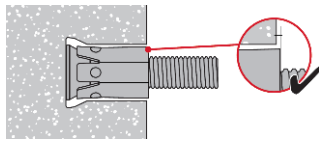
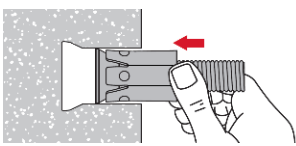
C) Diameter of the undercut d_1



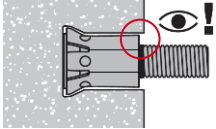
D) Height of the undercut h_2



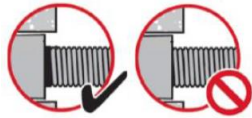
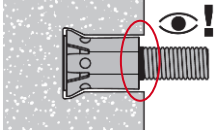
Installation of the undercut anchor



Checking of the setting depth



Checking of red ring visibility (proof of correct expansion)



Installation of the fixture

