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-13/1038 of 22 July 2019

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	Hilti screw anchor HUS3
Product family to which the construction product belongs	Concrete screw for use in concrete
Manufacturer	Hilti Aktiengesellschaft 9494 SCHAAN FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Werke
This European Technical Assessment contains	30 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 330011-00-0601 and EAD 330232-00-0601
This version replaces	ETA-13/1038 issued on 27 April 2018

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Specific Part

1 Technical description of the product

The Hilti screw anchor HUS3 is an anchor made of galvanised steel (HUS3-H, HUS3-HF, HUS3-C, HUS3-P, HUS3-PS, HUS3-PL, HUS3-A, HUS3-I, HUS3-I Flex) of sizes 6, 8, 10 and 14. The anchor is screwed into a predrilled cylindrical drill hole. The special thread of the anchor cuts an internal thread into the member while setting. The anchorage is characterised by mechanical interlock in the special thread.

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 anchor 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
to static and quasi-static loading	See Annex C1 – C3
to seismic performance Category C1 and C2	See Annex C4 – C5
Displacements	See Annex C9 – C10
Durability	See Annex B1

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for Class A1
Resistance to fire	See Annex C6 – C8

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

In accordance with the European Assessment Document EAD 330232-00-0601 and the European Assessment Document EAD 330011-00-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

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.

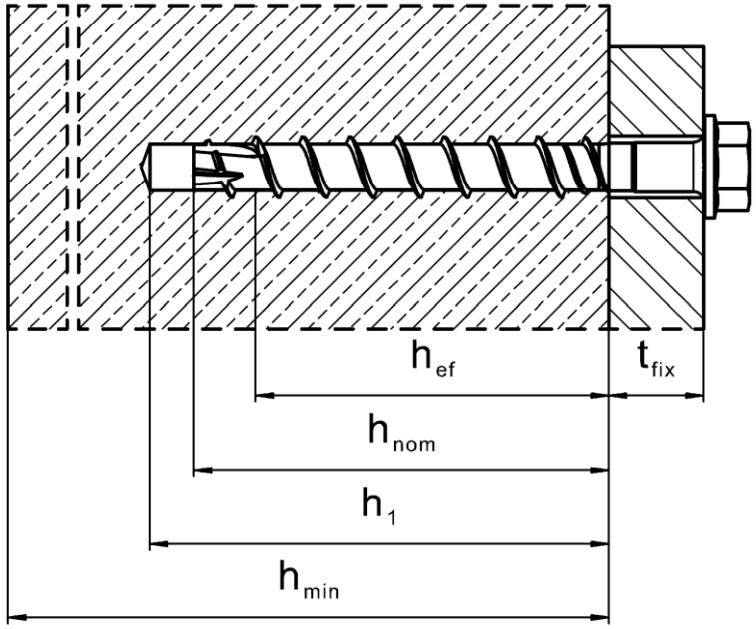
Issued in Berlin on 22 July 2019 by Deutsches Institut für Bautechnik

Dr.-Ing. Lars Eckfeldt
p. p. Head of Department

beglaubigt:
Lange

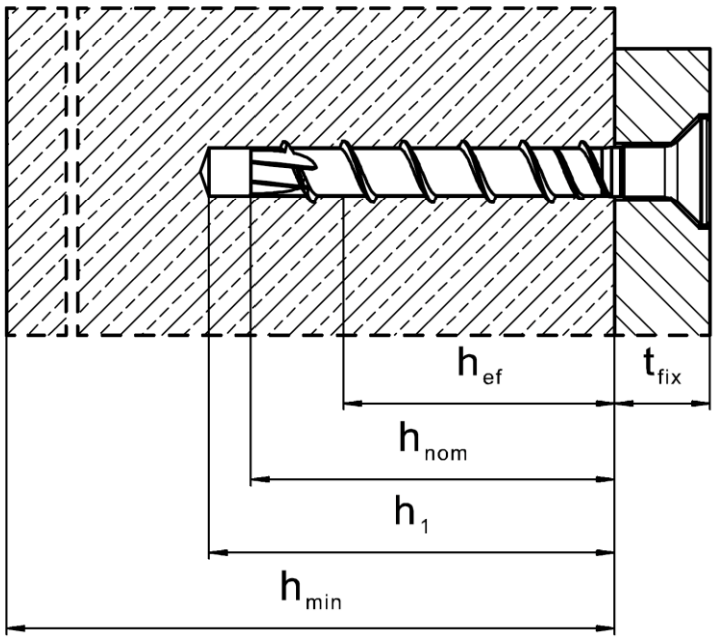
Deutsches Institut für Bautechnik DIBt

Installed condition without adjustment



HUS3-H (hexagon head configuration sizes 6, 8, 10 and 14)

HUS3-HF (hexagon head configuration sizes 8, 10 and 14)



HUS3-C (countersunk head configuration sizes 6, 8 and 10)

Hilti screw anchor HUS3	**Annex A1**
Product description Installed condition without adjustment	

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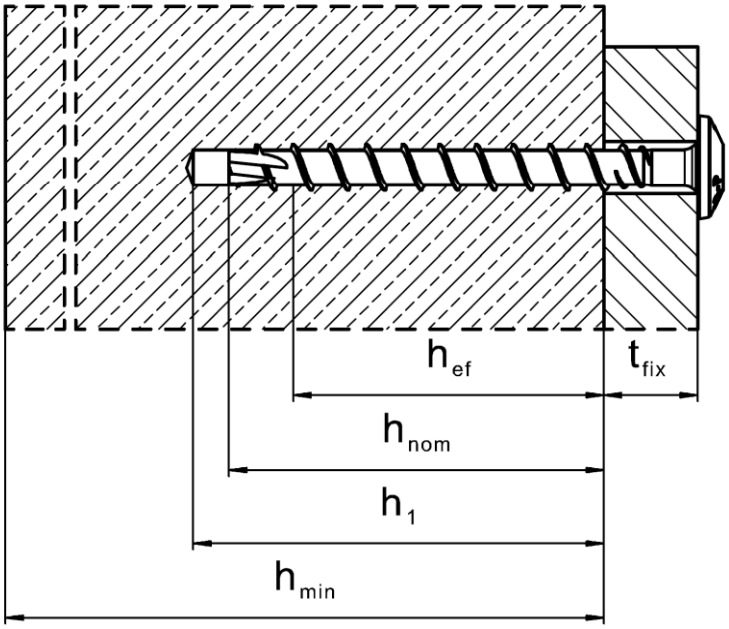
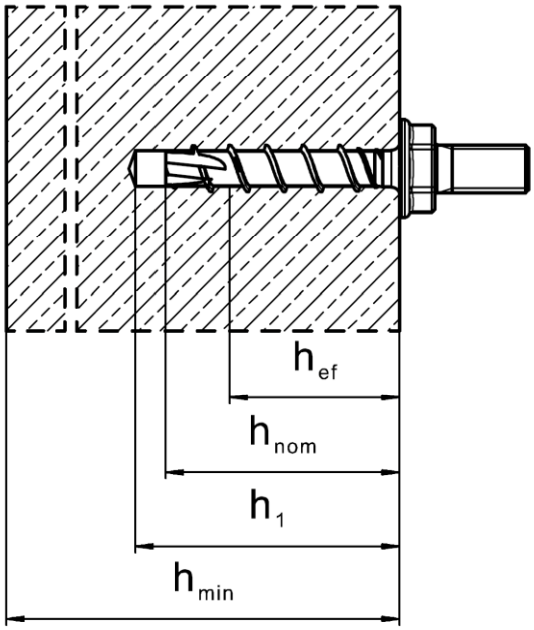
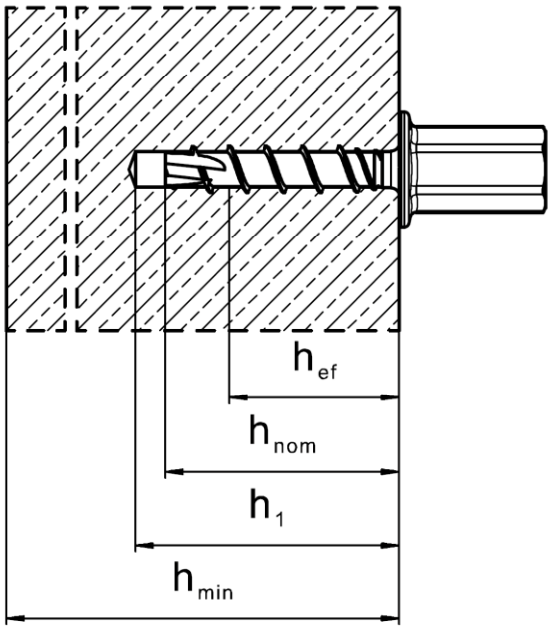
Installed condition without adjustment



HUS3-P/PS/PL (pan head configuration size 6)



HUS3-A (size 6 with external thread configuration M8 or M10)



HUS3-I (size 6 with internal thread configuration M8/M10)

Hilti screw anchor HUS3	**Annex A2**
Product description Installed condition without adjustment	

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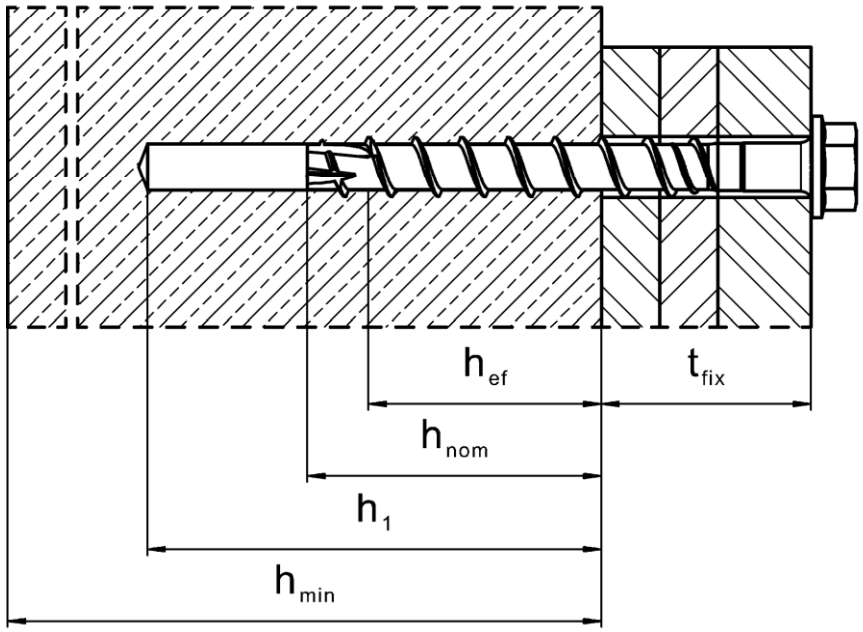
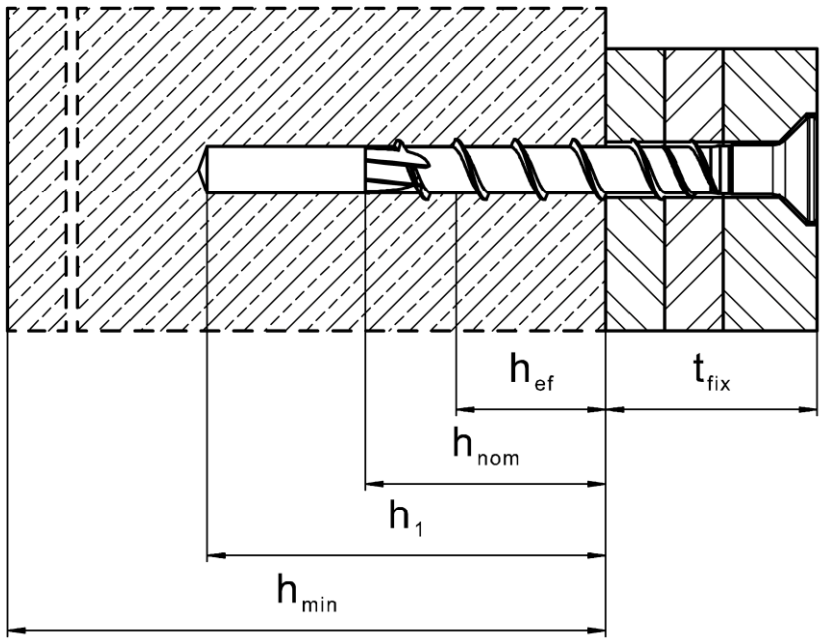
Installed condition with adjustment



HUS3-H (hexagon head configuration sizes 8, 10 – h_{nom2}, h_{nom3})

HUS3-HF (hexagon head configuration sizes 8 and 10 – h_{nom2}, h_{nom3})



HUS3-C (countersunk head configuration sizes 8 and 10 – h_{nom2}, h_{nom3})

Hilti screw anchor HUS3	**Annex A3**
Product description Installed condition with adjustment	

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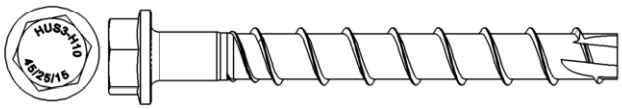
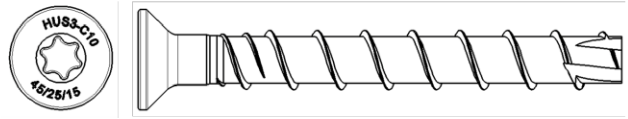
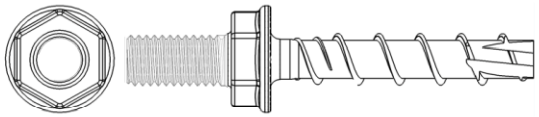
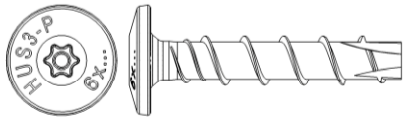
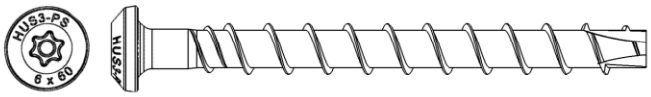
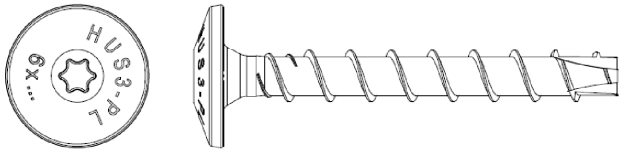
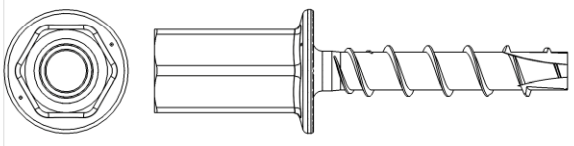
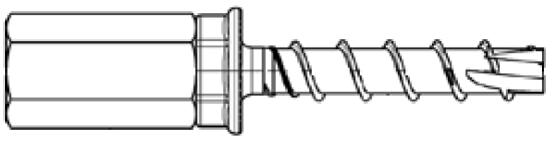
Table A1: Screw types

	1) Hilti HUS3-H, sizes 6, 8,10 and 14, hexagonal head configuration, galvanized 2) Hilti HUS3-HF, sizes 8,10 and 14, hexagonal head configuration, multilayer coating
	3) Hilti HUS3-C, sizes 6, 8 and 10, countersunk head configuration, galvanized
	4) Hilti HUS3-A, size 6, external thread M8/16 and M10/21, galvanized
	5) Hilti HUS3-P, size 6, pan head configuration, galvanized
	6) Hilti HUS3-PS, size 6, pan head (small) configuration, galvanized
	7) Hilti HUS3-PL, size 6, pan head (large) configuration, galvanized
	8) Hilti HUS3-I, size 6, internal thread M8 and M10, galvanized
	9) Hilti HUS3-I Flex, size 6, galvanized, with external thread - M8/16 preassembled with coupler M6 or M8, - M10/21 preassembled with coupler M10 or M12

Hilti screw anchor HUS3	**Annex A4**
Production description Screw types	

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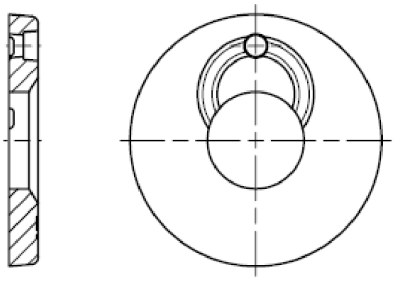
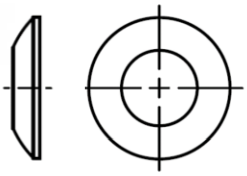
Hilti filling set (for HUS3-H only)

Sealing washer



Spherical washer



Injection mortar Hilti HIT-HY 200-A
Foil pack 330 ml and 500 ml

Marking:
HILTI HIT
Production number and production line
Expiry date mm/yyyy

Product name: “Hilti HIT-HY 200-A”

Static mixer Hilti HIT-RE-M

Hilti screw anchor HUS3	**Annex A5**
Production description Components of filling set	

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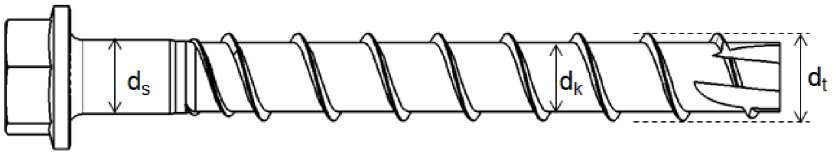
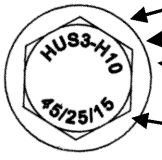
Table A2: Materials

Part	Designation	Material	
HUS3 screw anchor (all types in Table A1)	Size 6 all lengths	$f_{yk} \geq 745$ N/mm², $f_{uk} \geq 930$ N/mm²	Carbon steel Rupture elongation $A_5 \leq 8\%$
	Size 8 all lengths	$f_{yk} \geq 695$ N/mm², $f_{uk} \geq 810$ N/mm²	
	Size 10 all lengths	$f_{yk} \geq 690$ N/mm², $f_{uk} \geq 805$ N/mm²	
	Size 14 all lengths	$f_{yk} \geq 630$ N/mm², $f_{uk} \geq 730$ N/mm²	

Table A3: Fastener dimensions and marking

Fastener size HUS3			**6**	**8**			**10**			**14**		
Type			**H, C, A, P, PS, PL, I, I-Flex**	**H, HF, C**			**H, HF, C**			**H, HF**		**H**
Nominal embedment depth		[mm]	h_{nom}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
			55	50	60	70	55	75	85	65	85	115
Threaded outer diameter	d_t	[mm]	7,85	10,30			12,40			16,85		
Core diameter	d_k	[mm]	5,85	7,85			9,90			12,95		
Shaft diameter	d_s	[mm]	6,15	8,45			10,55			13,80		
Stressed section	A_s	[mm²]	26,9	48,4			77,0			131,7		





HUS3 : Hilti Universal Screw 3rd generation

H : Hexagonal head

10 : screw diameter

45/25/15 : maximum thickness fixture $t_{fix1}/t_{fix2}/t_{fix3}$ related to the embedment depth $h_{nom1}/h_{nom2}/h_{nom3}$ (see Annex B4 and B5)

Hilti screw anchor HUS3	**Annex A6**
Production description Materials and fastener dimensions	

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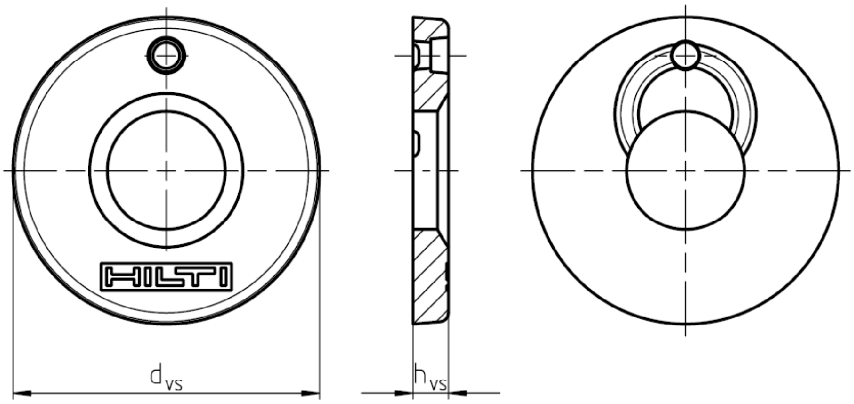
Table A4: Hilti filling washer dimensions

Fastener size	Hilti filling set size	Hilti filling washer	
		Diameter d_{vs} [mm]	Thickness h_{vs} [mm]
HUS3-H 8	M10	42	5
HUS3-H 10	M12	44	5
HUS3-H 14	M16	52	6

Hilti filling washer



Hilti screw anchor HUS3	Annex A7
Production description Filling washer dimensions	

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Specifications of intended use

Anchorages subject to:

- Static and quasi-static loadings: all sizes and all embedment depths.
- Seismic action for performance category C1:
  HUS3-H sizes 8, 10 and 14, standard and maximum embedment depth (h_{nom2}, h_{nom3}).
  HUS3-C and HUS3-HF sizes 8 and 10, standard and maximum embedment depth (h_{nom2}, h_{nom3}).
- Seismic action for performance category C2:
  HUS3-H sizes 8, 10 and 14, maximum embedment depth (h_{nom3}).
  HUS3-C and HUS3-HF sizes 8 and 10, maximum embedment depth (h_{nom3}).
- Fire exposure: All sizes and all embedment depths.

Base materials:

- Reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013.
- Strength classes C20/25 to C50/60 according to EN 206:2013.
- Non-cracked or cracked concrete.

Use conditions (Environmental conditions):

- Anchorages subject to dry internal conditions.

Design:

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the fastener is indicated on the design drawings (e. g. position of the fastener relative to reinforcement or to supports, etc.).
- Anchorages under static or quasi-static actions are designed in accordance with:
  EN 1992-4:2018
- Anchorages under seismic actions (cracked concrete) are designed in accordance with:
  EN 1992-4:2018 and EOTA Technical Report TR 045, 2/2013
- Anchorages shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure. Fastenings where shear loads act on fasteners with a lever arm, such as e.g.in stand-off installation or with a grout layer, are not covered.
- Anchorages under fire exposure are designed in accordance with:
  EN 1992-4:2018 and EOTA Technical Report TR 020, 4/2004
  In case of requirements to resistance to fire local spalling of the concrete cover must be avoided.
- For the HUS3-PL 6, installed as described in Table B1 (Annex B3), the characteristic resistance to shear loading of a group of two or three screws shall be limited to the characteristic value of one screw. The characteristic resistance to shear loading of a group of four or more screws shall be limited to the characteristic value of two screws.

Hilti screw anchor HUS3	**Annex B1**
Intended use Specifications	

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Specifications of intended use

Installation:

- Hammer drilling: all sizes and all embedment depths.
- Hollow drill bit: only size 14.
- Fastener installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- In case of aborted hole: new drilling at a minimum distance away of twice the depth of the aborted hole or smaller distance if the aborted hole is filled with high strength mortar and if under shear or oblique tension load it is not the direction of the load application.
- After installation further turning of the fastener must not be possible.
- The head of the fastener must be supported on the fixture and is not damaged.
- Adjustability according to Annex B8 for:
  HUS3-H, HUS3-HF and HUS3-C size 8 (h_{nom2} = 60 mm and h_{nom3} = 70 mm)
  HUS3-H, HUS3-HF and HUS3-C size 10 (h_{nom2} = 75 mm and h_{nom3} = 85 mm)
- Installation with Hilti filling set (HUS3-H only) according to Annex B7.

Hilti screw anchor HUS3	**Annex B2**
Intended use Specifications	

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Table B1: Installation parameters HUS3 size 6

Fastener size HUS3			**6**					
Type			**H**	**C**	**A**	**P-PS**	**I I-Flex**	**PL**
Nominal embedmenth depth	h_{nom}	[mm]	55					
Nominal drill hole diameter	d_0	[mm]	6					
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	6,40					
Clearance hole diameter	$d_f \leq$	[mm]	9					10
Wrench size (H, A, I -type)	SW	[mm]	13	-	13	-	13	-
Countersunk head diameter	d_h	[mm]	-	11,5	-	-	-	-
Torx size (C, P, PS, PL –type)	TX	-	-	30	-	30	-	30
Depth of drill hole in floor/ wall position	$h_1 \geq$	[mm]	65					
Depth of drill hole in ceiling position	$h_1 \geq$	[mm]	58					
Installation Torque	T_{inst}	[Nm]	25					
Setting tool[1)] Strength class		≥ C20/25	Hilti SIW 14 A or Hilti SIW 22 A					

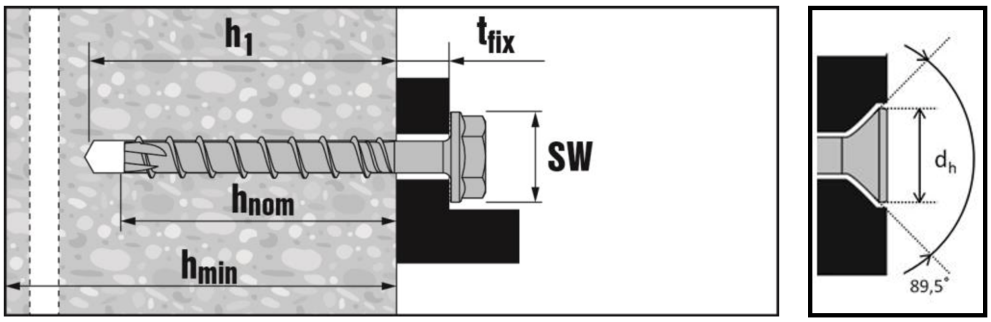
[1)] Installation with other impact screw driver of equivalent power is possible.

Table B2: Installation parameters HUS3 size 8, 10 and 14

Fastener size HUS3			**8**			**10**			**14**		
Type			**H, HF, C**			**H, HF, C**			**H, HF**		**H**
			h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedmenth depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Nominal drill hole diameter	d_0	[mm]	8			10			14		
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45			10,45			14,50		
Clearance hole diameter	$d_f \leq$	[mm]	12			14			18		
Wrench size (H, HF-type)	SW	[mm]	13			15			21		
Diameter of countersunk head	d_h	[mm]	18			21			-		
Torx size (C-type)	TX	-	45			50			-		
Depth of drill hole	$h_1 \geq$	[mm]	60	70	80	65	85	95	75	95	125
Depth of drill hole (with adjustability setting process)	$h_1 \geq$	[mm]	-	80	90	-	95	105	-		
Setting tool[1)] Strength class		C20/25	Hilti SIW 14 A or Hilti SIW 22 A or Hilti SIW 22 T-A			Hilti SIW 22 A or Hilti SIW 22 T-A			Hilti SIW 22 T-A		
		> C20/25	Hilti SIW 22 T-A								

[1)] Installation with other impact screw driver of equivalent power is possible.

Hilti screw anchor HUS3	**Annex B3**
Intended use Installation parameters	



Installation parameters for HUS3-H and -C

Table B3: Minimum thickness of concrete member, minimum edge distance and spacing HUS3 size 6

Fastener size HUS3				**6**
Nominal embedmenth depth		h_{nom}	[mm]	55
Minumum thickness of concrete member		h_{min}	[mm]	100
Cracked and non-cracked concrete	Minimum spacing	s_{min}	[mm]	35
	Minimum edge distance	c_{min}	[mm]	35

Table B4: Minimum thickness of concrete member, minimum edge distance and spacing HUS3 size 8, 10 and 14

Fastener size HUS3				**8**			**10**			**14**		
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedmenth depth		h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Minumum thickness of concrete member		h_{min}	[mm]	100	100	120	100	130	140	120	160	200
Cracked and non-cracked concrete	Minimum spacing	s_{min}	[mm]	50 40 if c ≥ 50	50	50	50	50	50	60	60	60
	Minimum edge distance	c_{min}	[mm]	40	40	40	50	50	50	60	60	60

Hilti screw anchor HUS3	**Annex B4**
Intended use Minimum concrete thickness and minimum edge distance and spacing	

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Table B5: Standard[1)] screw lengths and maximum thickness of fixture for HUS3 size 6

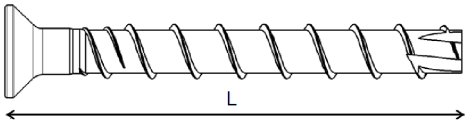
Fastener size	**6**					
	H	**C**	**A**	**I** I-Flex	**P**	**PS** **PL**
Nominal embedment depth [mm]	h_{nom} 55					
	Thickness of fixture [mm]					
Length of screw [mm]	t_{fix}	t_{fix}	t_{fix}	t_{fix}	t_{fix}	t_{fix}
55			0	0		
60	5	5			5	5
70		15				
80	25				25	
100	45					
120	65					
135			80			
155			100			
175			120			
195			140			

[1)] non-standard lengths, in the range 55 mm ≤ L ≤ 195 mm, are also in the scope of this ETA.

Table B6: Standard[1)] screw lengths and maximum thickness of fixture for HUS3-C size 8, 10

Fastener size	**8**			**10**		
Nominal embedment depth [mm]	h_{nom1} 50	h_{nom2} 60	h_{nom3} 70	h_{nom1} 55	h_{nom2} 75	h_{nom3} 85
	Thickness of fixture [mm]					
Length of screw [mm]	t_{fix1}	t_{fix2}	t_{fix3}	t_{fix1}	t_{fix2}	t_{fix3}
65	15	5	-	-	-	-
70	-	-	-	15	-	-
75	25	15	-	-	-	-
85	35	25	15	-	-	-
90	-	-	-	35	15	-
100	-	-	-	45	25	15

[1)] non-standard lengths, in the range 65 mm ≤ L ≤ 100 mm, are also in the scope of this ETA.



Hilti screw anchor HUS3	**Annex B5**
Intended use Standard screw lengths and thickness of fixture	

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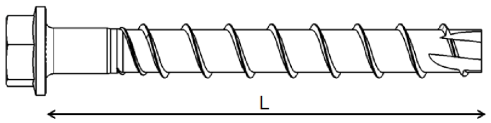
Table B7: Standard[1] screw lengths and maximum thickness of fixture for HUS3-H, HUS3-HF[2]

Fastener size	**8**			**10**			**14**		
Nominal embedment depth [mm]	h_{nom1} 50	h_{nom2} 60	h_{nom3} 70	h_{nom1} 55	h_{nom2} 75	h_{nom3} 85	h_{nom1} 65	h_{nom2} 85	h_{nom3} 115
	Thickness of fixture [mm]								
Length of screw [mm]	t_{fix1}	t_{fix2}	t_{fix3}	t_{fix1}	t_{fix2}	t_{fix3}	t_{fix1}	t_{fix2}	t_{fix3}
55	5	-	-	-	-	-	-	-	-
60	-	-	-	5	-	-	-	-	-
65	15	5	-	-	-	-	-	-	-
70	-	-	-	15	-	-	-	-	-
75	25	15	5	-	-	-	10	-	-
80	-	-	-	25	5	-	-	-	-
85	35	25	15	-	-	-	-	-	-
90	-	-	-	35	15	5	-	-	-
100	50	40	30	45	25	15	35	15	-
110	-	-	-	55	35	25	-	-	-
120	70	60	50	-	-	-	-	-	-
130	-	-	-	75	55	45	65	45	15
150	100	90	80	95	75	65	85	65	35

[1] non-standard lengths, in the range 55 mm ≤ L ≤ 150 mm, are also in the scope of this ETA.
[2] HUS3-HF available for size 14 with h_{nom1} and h_{nom2} only.



Hilti screw anchor HUS3	**Annex B6**
Intended use Standard screw lengths and thickness of fixture	

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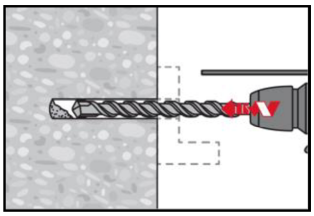
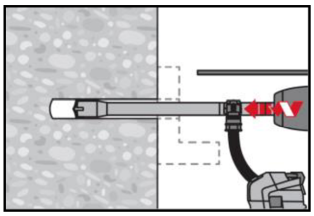
Installation instructions

Hole drilling

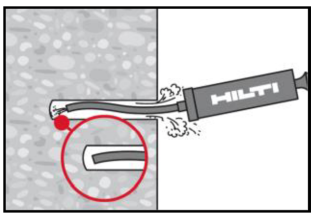
a) Hammer drilling (HD):
Size 6 to 14



b) Hammer drilling with Hilti hollow drill bit (HDB):
Size 14 only. After drilling, proceed to fastener setting



Drill hole cleaning



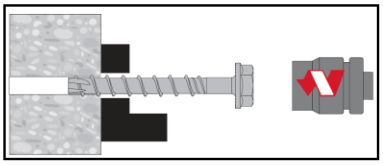
Clean the drill hole. For sizes 6 and 8, hole cleaning is not required when 3x ventilation[1)] after drilling is executed and one of the following conditions is fulfilled:
- drilling is in the vertical upwards orientation; or
- drilling is in vertical downwards direction and the drilling depth is increased[2)] by additional $3*d_0$.

For sizes 10 and 14, hole cleaning is not required when 3x ventilation[1)] after drilling is executed and one of the following conditions is fulfilled:
- drilling is in the vertical upwards orientation; or
- drilling is in vertical downwards or horizontal direction and the drilling depth is increased[2)] by additional $3*d_0$.

[1)] moving the drill bit in and out of the drill hole 3 times after the recommended drilling depth h_1 is achieved. This procedure shall be done with both revolution and hammer functions activated in the drilling machine. For more details read the relevant MPII.
[2)] it should be verified that the thickness of the concrete member in which the fastener is installed observes the minimum distance between the drilling end and the opposite end of the member, fulfilling the relation $h > h_1 + \Delta h$ with $\Delta h = \max(2*d_0; 30\ mm)$.

Fastener setting

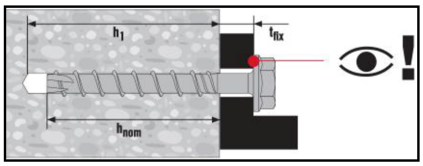
a) Setting by impact screw driver



b) Setting by torque wrench

Setting parameters listed in Table B1 and B2

Setting check



Hilti screw anchor HUS3	**Annex B7**
Intended use Installation instructions without adjustment	

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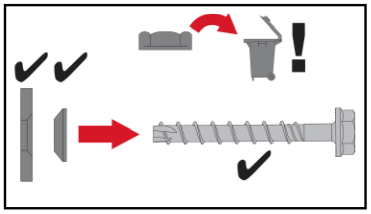
Fastener setting with Hilti filling set (HUS3-H only)

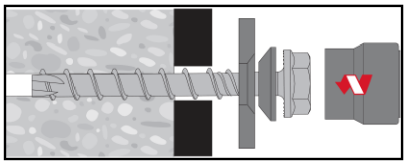
Installation of sealing washer



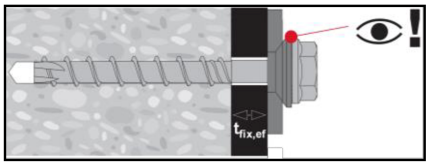
Size Seismic Set	Size HUS3	$t_{fix,\ effective}$ (mm)
M10	8	t_{fix} – 7 mm
M12	10	t_{fix} – 8 mm
M16	14	t_{fix} – 9 mm

The maximum fixture thickness t_{fix} is reduced by the overall thickness of the Hilti Filling Set after installation.

Setting by impact screw driver



Setting check



Injection of mortar

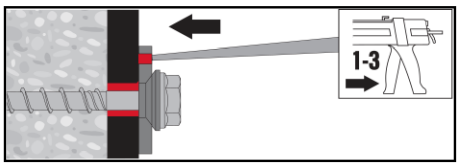


Table B8: Maximum working time and minimum curing time HY 200-A

Temperature in the base material T	Maximum working time t_{work}	Minimum curing time t_{cure}
> 0 °C to 5 °C	25 min	2 hours
> 5 °C to 10 °C	15 min	75 min
> 10 °C to 20 °C	7 min	45 min
> 20 °C to 30 °C	4 min	30 min
> 30 °C to 40 °C	3 min	30 min

Hilti screw anchor HUS3	Annex B8
Intended use Installation instructions with Hilti filling set	

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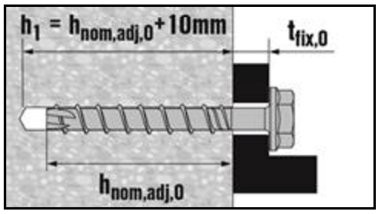
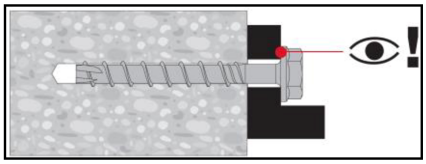
Fastener setting with adjustment

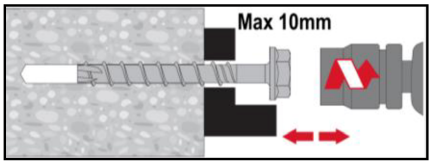
Drilling depth and fixture thickness



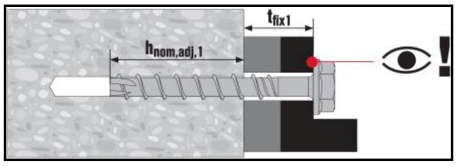
Adjusting process

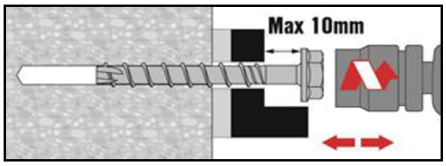
1st step



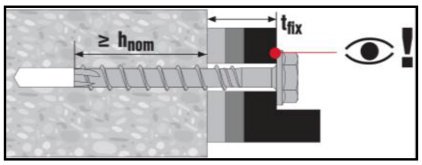


2nd step





Setting check



A screw can be adjusted maximum two times. The total allowed thickness of shims added during the adjustment process is 10 mm. The final embedment depth after adjustment process must be larger or equal than h_{nom2} or h_{nom3}.

Hilti screw anchor HUS3	**Annex B9**
Intended use Installation instructions with adjustment	

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Table C1: Essential characteristics under static and quasi-static load in concrete for HUS3 size 6

Fastener size HUS3				**6**					
Type				**H**	**C**	**A**	**I I-Flex**	**P**	**PS PL**
Nominal embedment depth		h_{nom}	[mm]	55					
Steel failure for tension and shear load									
Characteristic resistance		$N_{Rk,s}$	[kN]	24	22	24			21
Partial factor		$\gamma_{Ms,N}$ [1)]	[-]	1,4					
Characteristic resistance		$V_{Rk,s}$	[kN]	12,5					
Partial factor		$\gamma_{Ms,V}$ [1)]	[-]	1,5					
Ductility factor		k_7	[-]	0,8					
Characteristic resistance		$M^0_{Rk,s}$	[Nm]	21					
Pull-out failure									
Characteristic resistance in non-cracked concrete C20/25		$N_{Rk,p}$	[kN]	9				7,5	
Characteristic resistance in cracked concrete C20/25		$N_{Rk,p}$	[kN]	6					
Increasing factor for concrete ψ_c	C30/37		[-]	1,22					
	C40/50		[-]	1,41					
	C50/60		[-]	1,58					
Concrete cone and splitting failure									
Effective embedment depth		h_{ef}	[mm]	42					
Factor for	Cracked	$k_{cr,N}$	[-]	7,7					
	Non-cracked	$k_{ucr,N}$	[-]	11,0					
Concrete cone failure	Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}					
	Spacing	$s_{cr,N}$	[mm]	3 h_{ef}					
Splitting failure	Edge distance	$c_{cr,sp}$	[mm]	63					
	Spacing	$s_{cr,sp}$	[mm]	126					
Robustness		γ_{inst}	[-]	1,2					
Concrete pry-out failure									
Pry-out factor		k_8	[-]	1,5					
Concrete edge failure									
Effective length of fastener		$l_f = h_{ef}$	[mm]	42					
Outside diameter of fastener		d_{nom}	[mm]	6					

[1)] In absence of other national regulations.

Hilti screw anchor HUS3	**Annex C1**
Performances Essential characteristics under static and quasi-static load in concrete	

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Table C2: Essential characteristics under static and quasi-static load in concrete for HUS3 size 8, 10, 14

Fastener size HUS3				**8**			**10**			**14**		
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedment depth		h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Adjustment												
Total max. thickness of adjustment layers		t_{adj}	[mm]	-	10	10	-	10	10	-	-	-
Max. number of adjustments		n_a	[-]	-	2	2	-	2	2	-	-	-
Steel failure for tension load												
Characteristic resistance		$N_{Rk,s}$	[kN]	39,2			62,2			96,6		
Partial factor		$\gamma_{Ms,N}$ [1]	[-]	1,4								
Pull-out failure												
Characteristic resistance in non-cracked concrete C20/25		$N_{Rk,p}$	[kN]	9	12	16	12	20	[2]	[2]	[2]	[2]
Characteristic resistance in cracked concrete C20/25		$N_{Rk,p}$	[kN]	6	9	12	[2]	[2]	[2]	[2]	[2]	[2]
Increasing factor for concrete ψ_c	C30/37		[-]	1,22								
	C40/50		[-]	1,41								
	C50/60		[-]	1,58								
Concrete cone and splitting failure												
Effective embedment depth		h_{ef}	[mm]	40	46,4	54,9	41,6	58,6	67,1	49,3	66,3	91,8
Factor for	Cracked	$k_{cr,N}$	[-]	7,7								
	Non-cracked	$k_{ucr,N}$	[-]	11,0								
Concrete cone failure	Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}								
	Spacing	$s_{cr,N}$	[mm]	3 h_{ef}								
Splitting failure	Edge distance	$c_{cr,sp}$	[mm]	60	70	85	65	90	110	85	100	140
	Spacing	$s_{cr,sp}$	[mm]	120	140	170	130	180	220	170	200	280
Robustness		γ_{inst}	[-]	1,0								

[1] In absence of other national regulations.
[2] Pull-out failure is not decisive.

Hilti screw anchor HUS3	**Annex C2**
Performances Essential characteristics under static and quasi-static load in concrete	

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Table C2 continued

Fastener size HUS3			**8**			**10**			**14**		
			h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedment depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Adjustment											
Total max. thickness of adjustment layers	t_{adj}	[mm]	-	10	10	-	10	10	-	-	-
Max. number of adjustments	n_a	[-]	-	2	2	-	2	2	-	-	-
Steel failure for shear load											
Characteristic resistance	$V_{Rk,s}$	[kN]	19		22	30		34	55		62
Partial factor	$\gamma_{Ms,V}$ [1)]	[-]	1,5								
Ductility factor	k_7	[-]	0,8								
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	46			92			187		
Concrete pry-out failure											
Pry-out factor	k_8	[-]	1,0	2,0		1,0	2,0				
Concrete edge failure											
Effective length of fastener	$l_f = h_{ef}$	[mm]	40	46,4	54,9	41,6	58,6	67,1	49,3	66,3	91,8
Outside diameter of fastener	d_{nom}	[mm]	8			10			14		

[1)] In absence of other national regulations.

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Table C3: Essential characteristics for seismic performance category C1 in concrete

Fastener size HUS3				**8**		**10**		**14**	
				h_{nom2}	h_{nom3}	h_{nom2}	h_{nom3}	h_{nom2}	h_{nom3}
Nominal embedment depth		h_{nom}	[mm]	60	70	75	85	85	115
Steel failure for tension and shear load									
Characteristic resistance		$N_{Rk,s,seis}$	[kN]	39,2		62,2		96,6	
Partial factor		$\gamma_{Ms,N}$ [1)]	[-]	1,4					
Characteristic resistance		$V_{Rk,s,seis}$	[kN]	11,9		16,8	17,7	22,5	34,5
Partial factor		$\gamma_{Ms,V}$ [1)]	[-]	1,5					
Pull-out failure									
Characteristic resistance in cracked concrete		$N_{Rk,p,seis}$	[kN]	9	12	2)	2)	2)	2)
Concrete cone failure									
Effective embedment depth		h_{ef}	[mm]	46,4	54,9	58,6	67,1	66,3	91,8
Concrete cone failure	Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}					
	Spacing	$s_{cr,N}$	[mm]	3 h_{ef}					
Robustness		γ_{inst}	[-]	1,0					
Concrete pry-out failure									
Pry-out factor		k_8	[-]	2,0					
Concrete edge failure									
Effective length of fastener		$l_f = h_{ef}$	[mm]	46,4	54,9	58,6	67,1	66,3	91,8
Outside diameter of fastener		d_{nom}	[mm]	8		10		14	

1) In absence of other national regulations.
2) Pull-out failure is not decisive.

Hilti screw anchor HUS3	**Annex C4**
Performances Essential characteristics for seismic performance category C1 in concrete	

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Table C4: Essential characteristics for seismic performance category C2 in concrete

Fastener size HUS3				**8** h_{nom3}	**10** h_{nom3}	**14** h_{nom3}
Nominal embedment depth		h_{nom}	[mm]	70	85	115
Adjustment						
Total max. thickness of adjustment layers		t_{adj}	[mm]	10	10	-
Max. number of adjustments		n_a	[-]	2	2	-
Steel failure for tension load						
Characteristic resistance		$N_{Rk,s,seis}$	[kN]	39,2	62,2	96,6
Partial factor		$\gamma_{Ms,N}$ [1)]	[-]	1,4		
Pull out failure						
Characteristic resistance in cracked concrete		$N_{Rk,p,seis}$	[kN]	3,2	9,4	17,7
Concrete cone failure						
Effective embedment depth		h_{ef}	[mm]	54,9	67,1	91,8
Concrete cone failure	Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}		
	Spacing	$s_{cr,N}$	[mm]	3 h_{ef}		
Robustness		γ_{inst}	[-]	1,0		
Steel failure for shear load						
Installation with Hilti filling set (HUS3-H only); α_{gap} = 1,0						
Characteristic resistance		$V_{Rk,s,seis}$	[kN]	14,7	25,6	46,5
Partial factor		$\gamma_{Ms,V}$ [1)]	[-]	1,5		
Installation without Hilti filling set; α_{gap} = 0,5						
Characteristic resistance		$V_{Rk,s,seis}$	[kN]	10,8	17,7	34,4
Partial factor		$\gamma_{Ms,V}$ [1)]	[-]	1,5		
Concrete pry-out failure						
Pry-out factor		k_8	[-]	2,0		
Concrete edge failure						
Effective length of fastener		$l_f = h_{ef}$	[mm]	54,9	67,1	91,8
Outside diameter of fastener		d_{nom}	[mm]	8	10	14

[1)] In absence of other national regulations.

Hilti screw anchor HUS3	**Annex C5**
Performances Essential characteristics for seismic performance category C2 in concrete	

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Table C5: Essential characteristics under fire exposure in concrete for HUS3 size 6

Fastener HUS3				**6**						
Type				**H**	**C**	**A**	**I** **I-Flex**	**P**	**PS** **PL**
Nominal embedment depth		h_{nom}	[mm]	55					
Steel failure for tension and shear load ($F_{Rk,s,fi} = N_{Rk,s,fi} = V_{Rk,s,fi}$)									
Characteristic resistance	R30	$F_{Rk,s,fi}$	[kN]	1,6					
	R60	$F_{Rk,s,fi}$	[kN]	1,2					
	R90	$F_{Rk,s,fi}$	[kN]	0,8					
	R120	$F_{Rk,s,fi}$	[kN]	0,7					
	R30	$M^0_{Rk,s,fi}$	[Nm]	1,4					
	R60	$M^0_{Rk,s,fi}$	[Nm]	1,1					
	R90	$M^0_{Rk,s,fi}$	[Nm]	0,7					
	R120	$M^0_{Rk,s,fi}$	[Nm]	0,6					
Pull-out failure									
Characteristic resistance	R30 R60 R90	$N_{Rk,p,fi}$	[kN]	1,5					
	R120	$N_{Rk,p,fi}$	[kN]	1,2					
Concrete cone failure									
Characteristic resistance	R30 R60 R90	$N^0_{Rk,c,fi}$	[kN]	1,8					
	R120	$N^0_{Rk,c,fi}$	[kN]	1,5					
Edge distance									
	R30 to R120	$c_{cr,fi}$	[mm]	2 h_{ef}					
In case of fire attack from more than one side, the minimum edge distance shall be ≥ 300 mm									
Fastener spacing									
	R30 to R120	$s_{cr,fi}$	[mm]	2 $c_{cr,fi}$					
Concrete pry-out failure									
	R30 to R120	k_8	[-]	1,5					
The anchorage depth shall be increased for wet concrete by at least 30 mm compared to the given value									

Hilti screw anchor HUS3	**Annex C6**
Performances Essential characteristics under fire exposure in concrete	

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Table C6: Essential characteristics under fire exposure in concrete for HUS3-H and HUS3-HF

Fastener HUS3-H and HUS3-HF				**8**			**10**			**14**		
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedment depth		h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Steel failure for tension and shear load ($F_{Rk,s,fi} = N_{Rk,s,fi} = V_{Rk,s,fi}$)												
Characteristic resistance	R30	$F_{Rk,s,fi}$	[kN]	3,2	3,5	3,8	6,1	6,2		10,4	10,6	
	R60	$F_{Rk,s,fi}$	[kN]	2,4	2,6	2,8	4,6	4,7		7,8	8,1	
	R90	$F_{Rk,s,fi}$	[kN]	1,6	1,6	1,9	3,1	3,2		5,3	5,5	
	R120	$F_{Rk,s,fi}$	[kN]	1,2	1,2	1,5	2,4	2,5		4,0	4,3	
	R30	$M^0_{Rk,s,fi}$	[Nm]	3,8	4,1	4,4	9,1	9,2		20,4	20,6	
	R60	$M^0_{Rk,s,fi}$	[Nm]	2,8	3,0	3,4	6,9	7,0		15,4	15,7	
	R90	$M^0_{Rk,s,fi}$	[Nm]	1,9	1,9	2,3	4,6	4,8		10,4	10,7	
	R120	$M^0_{Rk,s,fi}$	[Nm]	1,5	1,4	1,7	3,5	3,7		7,9	8,3	
Pull-out failure												
Characteristic resistance	R30 R60 R90	$N_{Rk,p,fi}$	[kN]	1,5	2,3	3,0	2,4	4,0	4,9	3,1	4,8	7,8
	R120	$N_{Rk,p,fi}$	[kN]	1,2	1,8	2,4	1,9	3,2	3,9	2,5	3,8	6,3
Concrete cone failure												
Characteristic resistance	R30 R60 R90	$N^0_{Rk,c,fi}$	[kN]	1,8	2,6	4,0	2,0	4,7	6,6	3,0	6,4	14,4
	R120	$N^0_{Rk,c,fi}$	[kN]	1,4	2,1	3,2	1,6	3,8	5,3	2,4	5,1	11,5
Edge distance												
R30 to R120		$c_{cr,fi}$	[mm]	$2\ h_{ef}$								
In case of fire attack from more than one side, the minimum edge distance shall be ≥ 300 mm												
Fastener spacing												
R30 to R120		$s_{cr,fi}$	[mm]	$2\ c_{cr,fi}$								
Concrete pry-out failure												
R30 to R120		k_8	[-]	1,0	2,0		1,0	2,0				
The anchorage depth shall be increased for wet concrete by at least 30 mm compared to the given value												

Hilti screw anchor HUS3

Performances
Essential characteristics under fire exposure in concrete

Annex C7

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Table C7: Essential characteristics under fire exposure in concrete for HUS3-C

Fastener HUS3-C				**8**			**10**		
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedment depth		h_{nom}	[mm]	50	60	70	55	75	85
Steel failure for tension and shear load ($F_{Rk,s,fi} = N_{Rk,s,fi} = V_{Rk,s,fi}$)									
Characteristic resistance	R30	$F_{Rk,s,fi}$	[kN]	0,5			1,2		
	R60	$F_{Rk,s,fi}$	[kN]	0,4			1,0		
	R90	$F_{Rk,s,fi}$	[kN]	0,3			0,8		
	R120	$F_{Rk,s,fi}$	[kN]	0,2			0,6		
	R30	$M^0_{Rk,s,fi}$	[Nm]	0,6			1,7		
	R60	$M^0_{Rk,s,fi}$	[Nm]	0,5			1,5		
	R90	$M^0_{Rk,s,fi}$	[Nm]	0,4			1,1		
	R120	$M^0_{Rk,s,fi}$	[Nm]	0,3			0,9		
Pull-out failure									
Characteristic resistance	R30 R60 R90	$N_{Rk,p,fi}$	[kN]	1,5	2,3	3,0	2,4	4,0	5,0
	R120	$N_{Rk,p,fi}$	[kN]	1,2	1,8	2,4	1,9	3,2	4,0
Concrete cone failure									
Characteristic resistance	R30 R60 R90	$N^0_{Rk,c,fi}$	[kN]	1,8	2,6	4,0	2,0	4,7	6,6
	R120	$N^0_{Rk,c,fi}$	[kN]	1,5	2,1	3,2	1,6	3,8	5,3
Edge distance									
	R30 to R120	$c_{cr,fi}$	[mm]	2 h_{ef}					
In case of fire attack from more than one side, the minimum edge distance shall be ≥ 300 mm									
Fastener spacing									
	R30 to R120	$s_{cr,fi}$	[mm]	2 $c_{cr,fi}$					
Concrete pry-out failure									
	R30 to R120	k_8	[-]	1,0	2,0		1,0	2,0	
The anchorage depth shall be increased for wet concrete by at least 30 mm compared to the given value									

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Table C8: Displacements under tension loads

Fastener size HUS3				**6**	
Type				**H, C, A, I**	**P, PS, PL**
Nominal embedment depth		h_{nom}	[mm]	55	
Cracked concrete C20/25 to C50/60	Tension Load	N	[kN]	2,4	
	Displacement	δ_{N0}	[mm]	0,1	
		$\delta_{N\infty}$	[mm]	0,6	
		$\delta_{N,seis,C1}$	[mm]	-	
Non-cracked concrete C20/25 to C50/60	Tension Load	N	[kN]	3,6	3,0
	Displacement	δ_{N0}	[mm]	0,2	
		$\delta_{N\infty}$	[mm]	0,3	

Table C9: Displacements under tension loads

Fastener size HUS3				**8**			**10**			**14**		
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedment depth			[mm]	50	60	70	55	75	85	65	85	115
Cracked concrete C20/25 to C50/60	Tension Load	N	[kN]	4,3	5,7	7,6	5,7	9,5	13,2	8,3	13,0	21,2
	Displacement	δ_{N0}	[mm]	0,3	0,4	0,3	0,4	0,4	0,4	0,6	0,5	0,5
		$\delta_{N\infty}$	[mm]	0,7	0,7	0,6	0,4	0,4	0,5	0,9	1,2	1,0
		$\delta_{N,seis,C1}$	[mm]	-	-	0,6	-	-	0,9	-	-	1,3
Non-cracked concrete C20/25 to C50/60	Tension Load	N	[kN]	6,6	8,9	11,8	8,7	14,8	20,5	12,9	20,1	32,8
	Displacement	δ_{N0}	[mm]	0,1	0,2	0,1	0,1	0,1	0,1	0,1	0,2	0,3
		$\delta_{N\infty}$	[mm]	0,3			0,2			0,5		

Table C10: Displacements under shear loads

Fastener size HUS3				**6**	**8**			**10**			**14**		
				h_{nom}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedment depth			[mm]	55	50	60	70	55	75	85	65	85	115
Cracked concrete C20/25 to C50/60	Shear Load	V	[kN]	6,0	8,1			13,3			21,4		
	Displacement	δ_{V0}	[mm]	1,9	2,5	3,4	2,9	3,8	3,7	3,2	3,6	3,2	2,4
		$\delta_{V\infty}$	[mm]	2,8	3,7	5,1	4,4	5,7	5,5	4,9	5,4	6,9	3,5
		$\delta_{V,seis,C1}$	[mm]	-	-	-	0,6	-	-	0,9	-	-	1,3

Hilti screw anchor HUS3

Annex C9

Performances
Displacement values in case of static and quasi-static loading

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Table C11: Displacements under tension load for seismic performance category C2

Fastener size HUS3			**8** h_{nom3}	**10** h_{nom3}	**14** h_{nom3}
Nominal embedment depth			70	85	115
Displacement DLS	$\delta_{N,seis\ (DLS)}$	[mm]	0,35	0,57	1,43
Displacement ULS	$\delta_{N,seis\ (ULS)}$	[mm]	0,65	2,08	4,32

Table C12: Displacements under shear load for seismic performance category C2

Fastener size HUS3			**8** h_{nom3}	**10** h_{nom3}	**14** h_{nom3}
Nominal embedment depth			70	85	115
Installation with Hilti filling set (HUS3-H only)					
Displacement DLS	$\delta_{V,seis\ (DLS)}$	[mm]	1,81	1,80	2,52
Displacement ULS	$\delta_{V,seis\ (ULS)}$	[mm]	4,60	4,03	6,79
Installation without Hilti filling set					
Displacement DLS	$\delta_{V,seis\ (DLS)}$	[mm]	3,93	4,15	4,93
Displacement ULS	$\delta_{V,seis\ (ULS)}$	[mm]	5,55	6,15	9,14

Hilti screw anchor HUS3	**Annex C10**
Performances Displacement values in case of seismic performance category C2	