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-20/0867 of 2 December 2021

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 concrete screw HUS4
Product family to which the construction product belongs	Mechanical fastener for use in concrete
Manufacturer	Hilti Aktiengesellschaft Feldkircherstrasse 100 9494 SCHAAN FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Werke
This European Technical Assessment contains	27 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 330232-01-0601, Edition 08/2021

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Specific Part

1 Technical description of the product

The Hilti concrete screw HUS4 is an anchor in size 8, 10, 12, 14 and 16 mm made of galvanized steel. 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.

Product and product description are 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
Characteristic resistance to tension load (static and quasi-static loading)	See Annex B4 to B6, Annex C1 and C3
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C2 and C4
Displacements (static and quasi-static loading)	See Annex C11
Characteristic resistance for seismic performance category C1	See Annex C5 and C6
Durability	See Annex B1

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C7 to C10

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

In accordance with European Assessment Document EAD No. 330232-01-0601 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 at Deutsches Institut für Bautechnik.

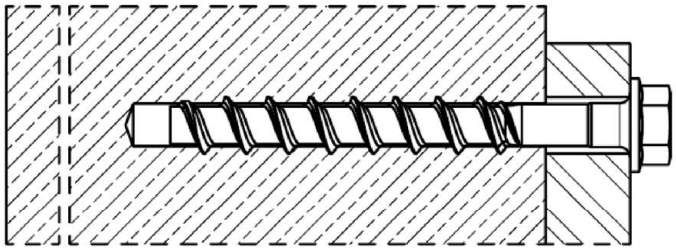
Issued in Berlin on 2 Dezember 2021 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Tempel

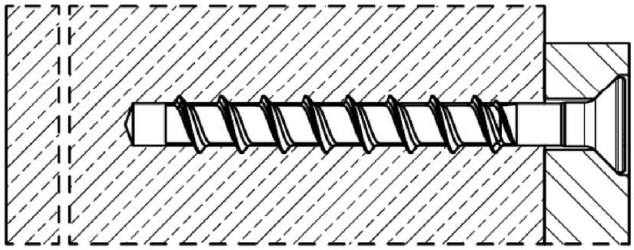
Deutsches Institut für Bautechnik DIBt

Installed condition without adjustment

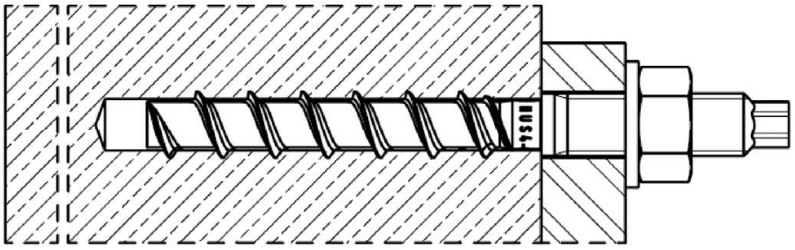


HUS4-H (hexagon head configuration sizes 8, 10, 12, 14 and 16)

HUS4-HF (hexagon head configuration sizes 8, 10, 14 and 16)



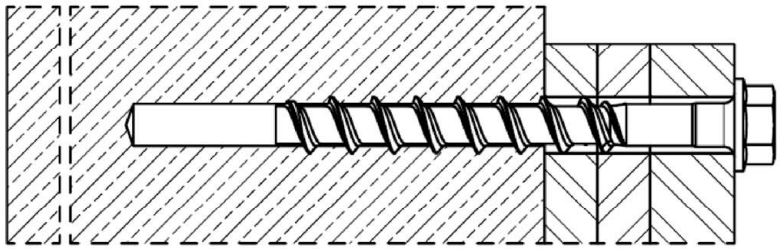
HUS4-C (countersunk head configuration sizes 8 and 10)



HUS4-A
(threaded rod connection
sizes 10 with M12 and 14 with M16)

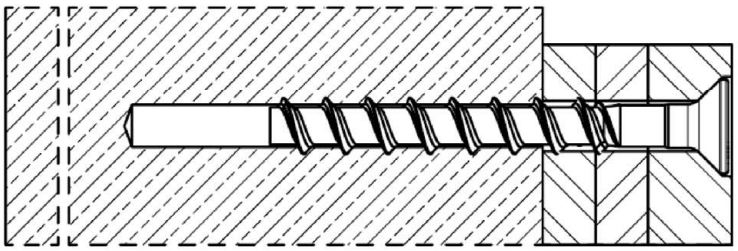
HUS4-AF
(threaded rod connection
sizes 10 with M12 and 14 with M16)

Installed condition with adjustment - h_{nom2}, h_{nom3}



HUS4-H (hexagon head configuration sizes 8, 10, 12, and 14)

HUS4-HF (hexagon head configuration sizes 8, 10, and 14)



HUS4-C (countersunk head configuration sizes 8 and 10)

Hilti screw anchor HUS4	**Annex A1**
Product description Installed condition with and without adjustment	

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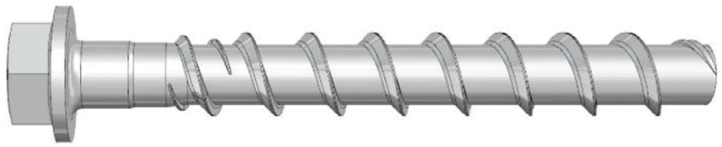
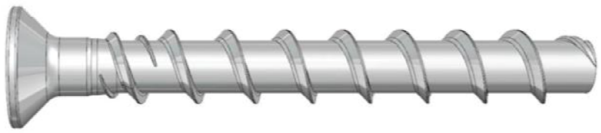
Table A1: Screw types

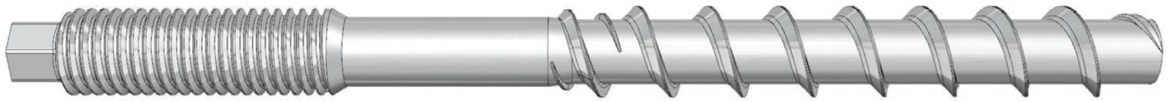
Hilti HUS4-H, sizes 8,10, 12, 14 and 16, hexagonal head configuration, galvanized
Hilti HUS4-HF, sizes 8,10, 14 and 16, hexagonal head configuration, multilayer coating



Hilti HUS4-C, sizes 8 and 10, countersunk head configuration, galvanized



Hilti HUS4-A, size 10 with external thread M12 and size 14 with external thread M16, galvanized
Hilti HUS4-AF, size 10 with external thread M12 and size 14 with external thread M16, multilayer coating



Hilti screw anchor HUS4	**Annex A2**
Product description HUS4 screw types	

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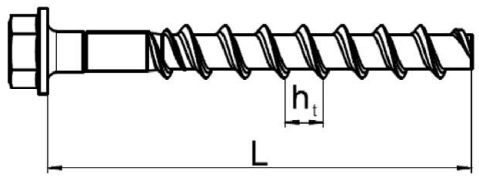
Table A2: Materials

Part	Material
HUS4 screw anchor (all types in Table A1)	Carbon steel Rupture elongation $A_5 \leq 8\%$

Table A3: Fastener dimensions and marking HUS4-H(F)

Fastener size HUS4-			H(F) 8			H(F) 10			H 12			H(F) 14			H(F) 16	
Nominal fastener diameter	d	[mm]	8			10			12			14			16	
Pitch of the thread	h_t	[mm]	8			10			12			14			13,2	
Nominal embedment depth	h_{nom}	[mm]	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}
			40	60	70	55	75	85	60	80	100	65	85	115	85	130
Effective embedment depth	h_{ef}	[mm]	$h_{ef} = 0{,}85 * (h_{nom} - 0{,}5 * h_t) \leq h_{ef,max}$													
Limits of effective embedment depth	$h_{ef,max}$	[mm]	56,1			68,0			79,9			91,8			104,9	
Length of screw min / max	L	[mm]	45 / 150			60 / 305			70 / 150			75 / 150			100 / 205	



HUS4: Hilti Universal Screw 4th generation	
H:	Hexagonal head, galvanized
HF:	Hexagonal head, multilayer coating
10:	Nominal screw diameter d [mm]
100:	Length of screw [mm]

Hilti screw anchor HUS4

Annex A3

Production description
Materials, fastener dimensions and head marking

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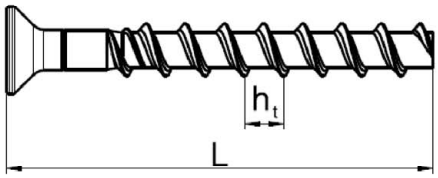
Table A4: Fastener dimensions and marking HUS4-C

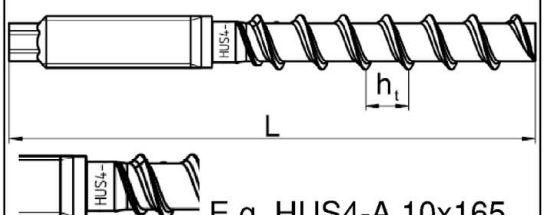
Fastener size HUS4-			**C 8**			**C 10**		
Nominal fastener diameter	d	[mm]	8			10		
Pitch of the thread	h_t	[mm]	8			10		
Nominal embedment depth			h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
	h_{nom}	[mm]	40	60	70	55	75	85
Effective embedment depth	h_{ef}	[mm]	$h_{ef} = 0{,}85 * (h_{nom} - 0{,}5 * h_t) \leq h_{ef,max}$					
Limits of effective embedment depth	$h_{ef,max}$	[mm]	56,1			68,0		
Length of screw min / max	L	[mm]	55 / 85			70 / 120		



HUS4: Hilti Universal Screw 4th generation	
C:	Countersunk head, galvanized
10:	Nominal screw diameter d [mm
100:	Length of screw [mm]

Table A5: Fastener dimensions and marking HUS4-A

Fastener size HUS4-			**A(F) 10**			**A(F) 14**		
Nominal fastener diameter	d	[mm]	10			14		
Metric thread conection			M12			M16		
Pitch of the thread	h_t	[mm]	10			14		
Nominal embedment depth			h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
	h_{nom}	[mm]	55	75	85	65	80	115
Effective embedment depth	h_{ef}	[mm]	$h_{ef} = 0{,}85 * (h_{nom} - 0{,}5 * h_t) \leq h_{ef,max}$					
Limits of effective embedment depth	$h_{ef,max}$	[mm]	68,0			91,8		
Length of screw min / max	L	[mm]	120 / 165			155 / 205		



HUS4:	Hilti Universal Screw 4th generation
A: **AF:**	Thread connection, galvanized Thread connection, multilayer coating
10:	Nominal screw diameter d [mm]
165:	Length of screw L [mm]
8:	Carbon steel
K:	Length identification HUS4-A 10x165

G	**I**	**K**	**J**	**L**	**N**
10x120	10x140	10x165	14x155	14x185	14x205

Hilti screw anchor HUS4

Production description
Fastener dimensions and head marking

Annex A4

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Specifications of intended use

Anchorages subject to:

- Static and quasi-static loadings
- Seismic action for performance category C1
- Fire exposure

Base materials:

- Compacted reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013 +A1:2016.
- Strength classes C20/25 to C50/60 according to EN 206-1:2010+A1:2016.
- Cracked and uncracked 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 are designed in accordance with:
  EN 1992-4:2018 and EOTA Technical Report TR 055 edition February 2018.
- In case of requirements to resistance to fire local spalling of the concrete cover must be avoided.

Installation:

- Fastener installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters on 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 (HUS4-H and HUS4-C) must be supported on the fixture and is not damaged.

Hilti screw anchor HUS4	**Annex B1**
Intended use Specifications	

Deutsches Institut für Bautechnik DIBt

Specifications of intended use: Drilling and cleaning

Table B1: Static and quasi static loading

HUS4		Fastener size and embedment depth h_{nom}
Cracked and uncracked concrete		
Hammer drilling (HD)[1)]	cleaned	sizes 8 to 16 at all h_{nom}
	not cleanded	sizes 8 to 14 at all h_{nom}
Hammer drilling with Hilti hollow drill bit TE-CD (HDB) [1)]		sizes 12 and 14 at all h_{nom}
Uncracked concrete		
Diamond coring (DD) DD30-W handheld and with stand DD-EC1 handheld		sizes 10 to 14 at h_{nom3}

[1)] Adjustment is possible for sizes 8 to 14 at h_{nom2+3}

Table B2: Seismic performance category C1

HUS4		Fastener size and embedment depth h_{nom}
Hammer drilling (HD)[1)]	cleaned	sizes 8 to 14 at h_{nom2+3} size 16 at h_{nom1+2}
	not cleanded	sizes 8 to 14 at h_{nom2+3}
Hammer drilling with Hilti hollow drill bit TE-CD (HDB) [1)]		sizes 12 and 14 at h_{nom2+3}

[1)] Adjustment is possible for sizes 8 to 14 at h_{nom2+3}

Table B3: Static and quasi static loading under fire exposure

HUS4		Fastener size and embedment depth h_{nom}
Hammer drilling (HD)[1)]	cleaned	sizes 8 to 16 at all h_{nom}
	not cleanded	sizes 8 to 14 at all h_{nom}
Hammer drilling with Hilti hollow drill bit TE-CD (HDB) [1)]		sizes 12 and 14 at all h_{nom}

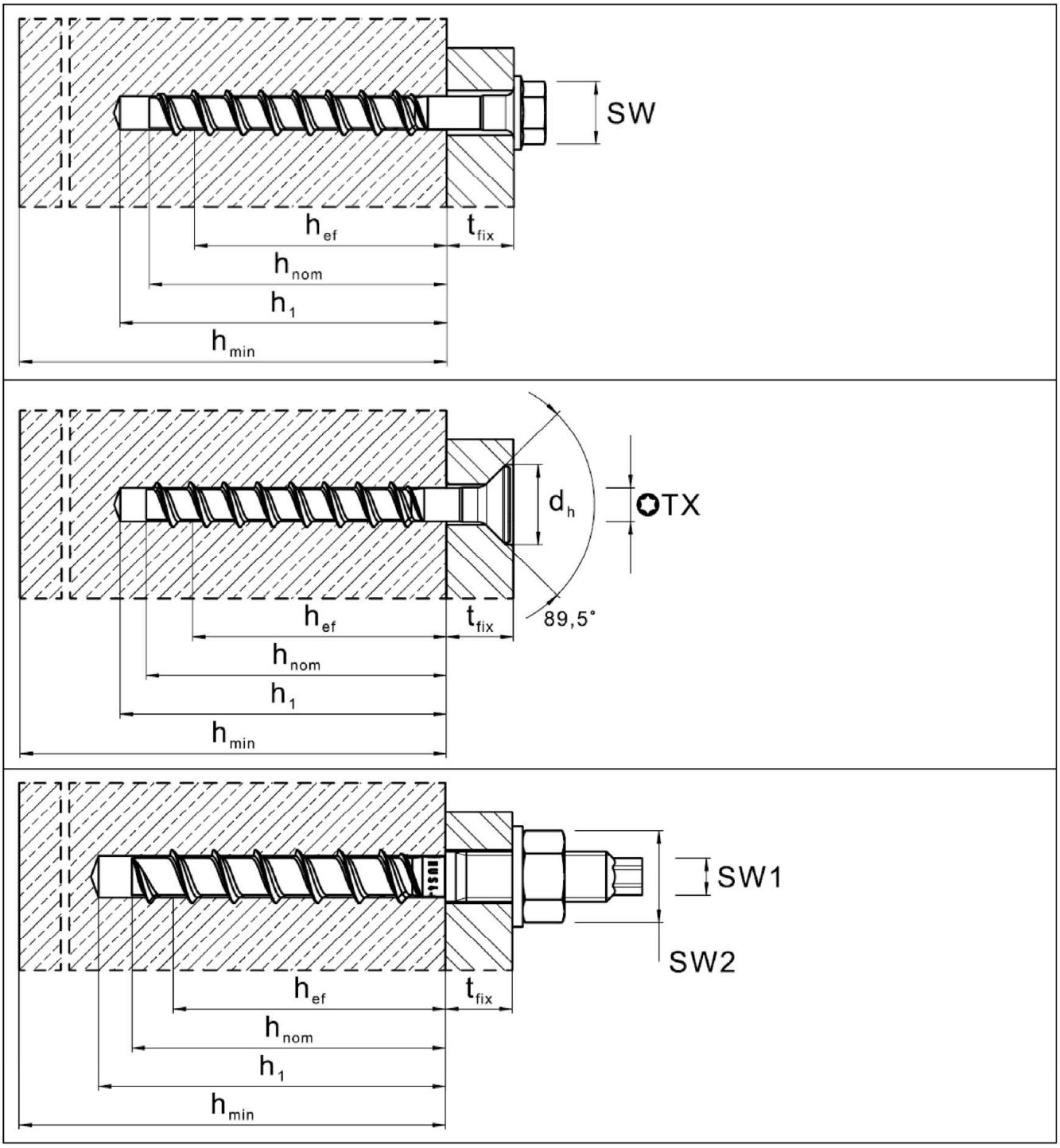
[1)] Adjustment is possible for sizes 8 to 14 at h_{nom2+3}

Hilti screw anchor HUS4	Annex B2
Intended use Specifications	

Deutsches Institut für Bautechnik

DIBt

Installation parameters



Hilti screw anchor HUS4	**Annex B3**
Intended use Installation parameters	

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Table B4: Installation parameters HUS4-8 and 10

Fastener size HUS4			**8**			**10**		
Type			**H, C**			**H, C, A**		
			h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedmenth depth	h_{nom}	[mm]	40	60	70	55	75	85
Nominal drill hole diameter	d_0	[mm]	8			10		
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45			10,45		
Cutting diameter of diamond core bit	$d_{cut} \leq$	[mm]	-			9,9		
Clearance hole diameter through setting	$d_f \leq$	[mm]	12			14		
Clearance hole diameter pre setting (A-type)	$d_f \leq$	[mm]	-			14		
Wrench size (H, HF-type)	SW	[mm]	13			15		
Wrench size for hex head (A-type)	SW1	[mm]	-			8		
Wrench size for nut (A-type)	SW2	[mm]	-			19		
Maximum installation torque (A-type)	max T_{inst}	[Nm]	-			20		
Torx size (C-type)	TX	-	45			50		
Diameter of countersunk head	d_h	[mm]	18			21		
Depth of drill hole for cleaned hole hammer drilling, diamond coring, or uncleanded hammer drilling overhead	$h_1 \geq$	[mm]	(h_{nom} + 10 mm)					
			50	70	80	65	85	95
Depth of drill hole for uncleanded hole hammer drilling in wall and floor position	$h_1 \geq$	[mm]	(h_{nom} + 10 mm) + 2 * d_0					
			66	86	96	85	105	115
Depth of drill hole (with adjustability) for cleaned hole hammer drilling, diamond coring, uncleanded hammer drilling overhead	$h_1 \geq$	[mm]	(h_{nom} + 20 mm)					
			-	80	90	-	95	105
Depth of drill hole (with adjustability) for uncleaned hole hammer drilling in wall and floor position	$h_1 \geq$	[mm]	(h_{nom} + 20 mm) + 2 * d_0					
			-	96	106	-	115	125
Minimum thickness of concrete member	$h_{min} \geq$	[mm]	(h_1 + 30 mm)					
			80	100	120	100	130	140
Minimum spacing	$s_{min} \geq$	[mm]	35			40		
Minimum edge distance	$c_{min} \geq$	[mm]	35			40		
Hilti Setting tool [1)]			SIW 6 AT-A22 SIW 6.2 AT-A22 gear 1			SIW 22T-A SIW 6 AT-A22 SIW 6.2 AT-A22 SIW 8.1 AT gear 1 SIW 9-A22		

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

Hilti screw anchor HUS4

Intended use
Installation parameters

Annex B4

Deutsches Institut für Bautechnik DIBt

Table B5: Installation parameters HUS4-12 and 14

Fastener size HUS4			**12**			**14**		
Type			**H**			**H, A**		
			h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedmenth depth	h_{nom}	[mm]	60	80	100	65	85	115
Nominal drill hole diameter	d_0	[mm]	12			14		
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	12,50			14,50		
Cutting diameter of diamond core bit	$d_{cut} \leq$	[mm]	12,2			-		
Clearance hole diameter through setting	$d_f \leq$	[mm]	16			18		
Clearance hole diameter pre setting (A-type)	$d_f \leq$	[mm]	-			18		
Wrench size (H, HF-type)	SW	[mm]	17			21		
Wrench size for hex head (A-type)	SW1	[mm]	-			12		
Wrench size for nut (A-type)	SW2	[mm]	-			24		
Maximum installation torque (A-type)	max T_{inst}	[Nm]	-			80		
Depth of drill hole for cleaned hole hammer drilling, hollow drill bit, diamond coring, or uncleanded hammer drilling overhead	$h_1 \geq$	[mm]	(h_{nom} + 10 mm)					
			70	90	110	75	95	125
Depth of drill hole for uncleanded hole hammer drilling in wall and floor position	$h_1 \geq$	[mm]	(h_{nom} + 10 mm) + 2 * d_0					
			94	114	134	103	123	153
Depth of drill hole (with adjustability) for cleaned hole hammer drilling, hollow drill bit, diamond coring, uncleanded hammer drilling overhead	$h_1 \geq$	[mm]	(h_{nom} + 20 mm)					
			-	100	120	-	105	135
Depth of drill hole (with adjustability) for uncleaned hole hammer drilling in wall and floor position	$h_1 \geq$	[mm]	(h_{nom} + 20 mm) + 2 * d_0					
			-	124	144	-	133	163
Minimum thickness of concrete member	$h_{min} \geq$	[mm]	(h_1 + 30 mm)					
			110	130	150	120	160	200
Minimum spacing	$s_{min} \geq$	[mm]	50			60		
Minimum edge distance	$c_{min} \geq$	[mm]	50			60		
Hilti Setting tool [1]			SIW 22T-A SIW 6.2 AT-A22 SIW 8.1 AT SIW 9-A22			SIW 22T-A SIW 6.2 AT-A22 SIW 8.1 AT SIW 9-A22		

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

Hilti screw anchor HUS4

Intended use
Installation parameters

Annex B5

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Table B6: Installation parameters HUS4-16

Fastener size HUS4			**16**	
Type			**H**	
			h_{nom1}	h_{nom2}
Nominal embedmenth depth	h_{nom}	[mm]	85	130
Nominal drill hole diameter	d_0	[mm]	16	
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	16,50	
Clearance hole diameter through setting	$d_f \leq$	[mm]	20	
Wrench size	SW	[mm]	24	
Depth of drill hole for cleaned hole hammer drilling,	$h_1 \geq$	[mm]	(h_{nom} + 10 mm)	
			95	140
Minimum thickness of concrete member	$h_{min} \geq$	[mm]	130	195
Minimum spacing	$s_{min} \geq$	[mm]	90	
Minimum edge distance	$c_{min} \geq$	[mm]	65	
Hilti Setting tool [1)]			SIW 22T-A SIW 6.2 AT-A22 SIW 8.1 AT SIW 9-A22	

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

Hilti screw anchor HUS4	**Annex B6**
Intended use Installation parameters	

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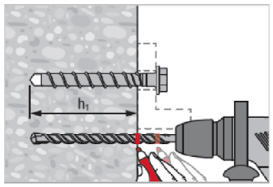
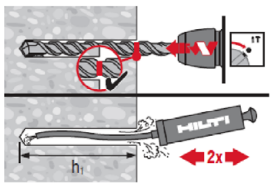
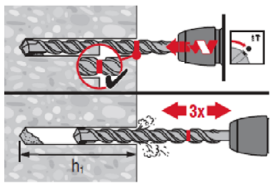
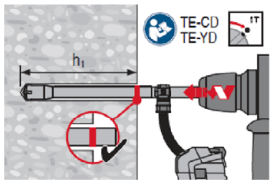
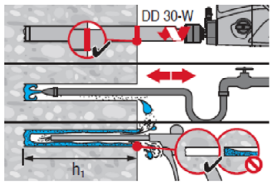
Installation instructions

Hole drilling and cleaning

Hammer drilling (HD) all sizes (size 16 with cleaning only)	
	Mark drilling depth h_1 for pre or through installation. Details for drilling depth h_1 see table B4 to B6.
	Cleaning needed in downward and horizontal installation direction with drill hole depth. $h_1 = h_{nom} + 10$ mm
	No cleaning is allowed in upward installation direction. No cleaning is allowed in downward and horizontal installation direction when 3x ventilation[1)] after drilling is executed. Drill hole depth $h_1 = h_{nom} + 10$ mm$+ 2 * d_0$ [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.
Hammer drilling with Hilti hollow drill bit (HDB) TE-CD size 12 and 14.	
	No cleaning needed. $h_1 = h_{nom} + 10$ mm
Diamond coring with DD-EC1 or DD-30W size 10 to 14	
	Cleaning needed in all installation directions. $h_1 = h_{nom} + 10$ mm

Hilti screw anchor HUS4	**Annex B7**
Intended use Installation instructions	

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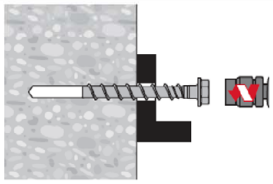
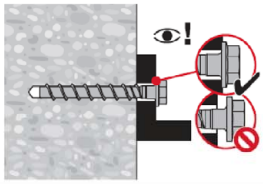
Fastener setting without adjustment

Setting by impact screw driver



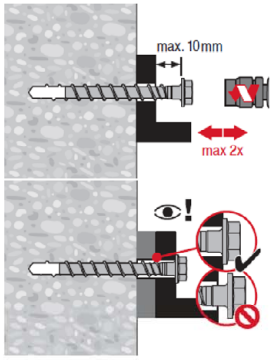
Setting parameters listed in Table B4 to B6

Setting check



Fastener setting with adjustment

Adjusting process



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 HUS4	**Annex B8**
Intended use Installation instructions	

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Table C1: Essential characteristics under static and quasi-static load in concrete for HUS4 size 8 and 10

Fastener size HUS4				**8**			**10**		
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedment depth		h_{nom}	[mm]	40	60	70	55	75	85
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]	36,0			55,0		
Partial factor		$\gamma_{Ms,N}$ [1]	[-]	1,5					
Pull-out failure									
Characteristic resistance in uncracked concrete C20/25		$N_{Rk,p}$	[kN]	≥ $N^0_{Rk,c}$ [3]			13	22	≥ $N^0_{Rk,c}$ [3]
Characteristic resistance in cracked concrete C20/25		$N_{Rk,p}$	[kN]	5,5	≥ $N^0_{Rk,c}$ [3]				
Increasing factor for $N_{Rk,p} = N_{Rk,p(C20/25)} * \psi_c$		ψ_c	[-]	$(f_{ck}/20)^{0,5}$					
Concrete cone and splitting failure									
Effective embedment depth		h_{ef} [2]	[mm]	30,6	47,6	56,1	42,5	59,5	68,0
Factor for	Uncracked	$k_{ucr,N}$	[-]	11,0					
	Cracked	$k_{cr,N}$	[-]	7,7					
Concrete cone failure	Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}					
	Spacing	$s_{cr,N}$	[mm]	3 h_{ef}					
Characteristic resistance		$N^0_{Rk,sp}$	[kN]	$N_{Rk,p}$					
Splitting failure	Edge distance	$c_{cr,sp}$	[mm]	1,5 h_{ef}			1,65 h_{ef}		
	Spacing	$s_{cr,sp}$	[mm]	3 h_{ef}			3,3 h_{ef}		
Robustness		γ_{inst}	[-]	1,0			1,2	1,0	

[1] In absence of other national regulations.
[2] In case $h_{nom} > h_{nom1}$ and $< h_{nom3}$ the actual h_{ef} for concrete failure can be calculated according to: $h_{ef} = 0,85 * (h_{nom} - 0,5 * h_t)$
[3] $N^0_{Rk,c}$ according to EN 1992-4:2018

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Table C1 continued

Fastener size HUS4			**8**			**10**		
			h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedment depth	h_{nom}	[mm]	40	60	70	55	75	85
Steel failure for shear load								
Characteristic resistance	$V^0_{Rk,s}$	[kN]	18,8		21,9	28,8		32,0
Partial factor	$\gamma_{Ms,V}$ [1)]	[-]	1,25					
Ductility factor	k_7	[-]	0,8					
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	32			64		
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	[mm]	40	60	70	55	75	85
Outside diameter of fastener	d_{nom}	[mm]	8			10		

[1)] In absence of other national regulations.

Hilti screw anchor HUS4

Annex C2

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 HUS4 size 12 to 16

Fastener size HUS4				**12**			**14**			**16**	
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}
Nominal embedment depth		h_{nom}	[mm]	60	80	100	65	85	115	85	130
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]	79,0			101,5			107,7	
Partial factor		$\gamma_{Ms,N}$ [1]	[-]	1,5							
Pull-out failure											
Characteristic resistance in uncracked concrete C20/25		$N_{Rk,p}$	[kN]	≥ $N^0_{Rk,c}$ [3]						22	46
Characteristic resistance in cracked concrete C20/25		$N_{Rk,p}$	[kN]	10,0	≥ $N^0_{Rk,c}$ [3]					16	32
Increasing factor for $N_{Rk,p} = N_{Rk,p(C20/25)} * \psi_c$		ψ_c	[-]	$(f_{ck}/20)^{0,5}$							
Concrete cone and splitting failure											
Effective embedment depth		h_{ef} [2]	[mm]	45,9	62,9	79,9	49,3	66,3	91,8	66,6	104,9
Factor for	Uncracked	$k_{ucr,N}$	[-]	11,0							
	Cracked	$k_{cr,N}$	[-]	7,7							
Concrete cone failure	Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}							
	Spacing	$s_{cr,N}$	[mm]	3 h_{ef}							
Characteristic resistance		$N^0_{Rk,sp}$	[kN]	$N_{Rk,p}$							
Splitting failure	Edge distance	$c_{cr,sp}$	[mm]	1,65 h_{ef}			1,60 h_{ef}				
	Spacing	$s_{cr,sp}$	[mm]	3,30 h_{ef}			3,20 h_{ef}				
Robustness		γ_{inst}	[-]	1,0							

[1] In absence of other national regulations.
[2] In case $h_{nom} > h_{nom1}$ and $< h_{nom3}$ the actual h_{ef} for concrete failure can be calculated according to: $h_{ef} = 0,85 * (h_{nom} - 0,5 * h_t)$
[3] $N^0_{Rk,c}$ according to EN 1992-4:2018

Hilti screw anchor HUS4

Annex C3

Performances
Essential characteristics under static and quasi-static load in concrete

Deutsches Institut für Bautechnik DIBt

Table C2 continued

Fastener size HUS4			**12**			**14**			**16**	
			h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}
Nominal embedment depth	h_{nom}	[mm]	60	80	100	65	85	115	85	130
Steel failure for shear load										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	38,9		44,9	55	62		65,1	73,1
Partial factor	$\gamma_{Ms,V}$ [1)]	[-]	1,25							
Ductility factor	k_7	[-]	0,8							
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	125			186			240	
Concrete pry-out failure										
Pry-out factor	k_8	[-]	2,0							
Concrete edge failure										
Effective length of fastener	l_f	[mm]	60	80	100	65	85	115	85	130
Outside diameter of fastener	d_{nom}	[mm]	12			14			16	

[1)] In absence of other national regulations.

Hilti screw anchor HUS4

Annex C4

Performances
Essential characteristics under static and quasi-static load in concrete

Deutsches Institut für Bautechnik DIBt

Table C3: Essential characteristics for seismic performance category C1 in concrete for HUS4

Fastener size HUS4			**8**		**10**		**12**		**14**	
			h_{nom2}	h_{nom3}	h_{nom2}	h_{nom3}	h_{nom2}	h_{nom3}	h_{nom2}	h_{nom3}
Nominal embedment depth	h_{nom}	[mm]	60	70	75	85	80	100	85	115
Steel failure for tension and shear load										
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	36,0		55,0		79,0		101,5	
Partial factor	$\gamma_{Ms,N}$ [1)]	[-]	1,5							
Characteristic resistance	$V_{Rk,s,C1}$	[kN]	18,8		26,7		38,9		22,5	34,5
Partial factor	$\gamma_{Ms,V}$ [1)]	[-]	1,25							
Partial factor	α_{gap}	[-]	0,5							
Pull-out failure										
Characteristic resistance in cracked concrete	$N_{Rk,p,C1}$	[kN]	$\geq N^0_{Rk,c}$ [3)]							
Concrete cone failure										
Effective embedment depth	h_{ef} [2)]	[mm]	47,6	56,1	59,5	68,0	62,9	79,9	66,3	91,8
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	[mm]	60	70	75	85	80	100	85	115
Outside diameter of fastener	d_{nom}	[mm]	8		10		12		14	

[1)] In absence of other national regulations.
[2)] In case $h_{nom} > h_{nom2}$ and $< h_{nom3}$ the actual h_{ef} for concrete failure can be calculated according to "$h_{ef} = 0,85 * (h_{nom} - 0,5 * h_t)$
[3)] $N^0_{Rk,c}$ according to EN 1992-4:2018

Hilti screw anchor HUS4

Annex C5

Performances
Essentials characteristics for seismic performance category C1 in concrete

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Table C3 continued

Fastener size HUS4				**16**	
				h_{nom1}	h_{nom2}
Nominal embedment depth		h_{nom}	[mm]	85	130
Steel failure for tension and shear load					
Characteristic resistance		$N_{Rk,s,C1}$	[kN]	107,7	
Partial factor		$\gamma_{Ms,N}$ [1)]	[-]	1,5	
Characteristic resistance		$V_{Rk,s,C1}$	[kN]	42,9	25,3
Partial factor		$\gamma_{Ms,V}$ [1)]	[-]	1,25	
Partial factor		α_{gap}	[-]	0,5	
Pull-out failure					
Characteristic resistance in cracked concrete		$N_{Rk,p,C1}$	[kN]	7,5	19,0
Concrete cone failure					
Effective embedment depth		h_{ef} [2)]	[mm]	66,6	104,9
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	[mm]	85	130
Outside diameter of fastener		d_{nom}	[mm]	16	

[1)] In absence of other national regulations.
[2)] In case $h_{nom} > h_{nom2}$ and $< h_{nom3}$ the actual h_{ef} for concrete failure can be calculated according to "$h_{ef} = 0,85 * (h_{nom} - 0,5 * h_t)$

Hilti screw anchor HUS4	**Annex C6**
Performances Essentials characteristics for seismic performance category C1 in concrete	

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Table C4: Essential characteristics under fire exposure in concrete for HUS4-H

Fastener size HUS4-H (F)				**8**			**10**		
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedment depth		h_{nom}	[mm]	40	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]	2,6			4,1	4,2	
	R60	$F_{Rk,s,fi}$	[kN]	1,9			3,1	3,1	
	R90	$F_{Rk,s,fi}$	[kN]	1,2			2,2	2,3	
	R120	$F_{Rk,s,fi}$	[kN]	0,9			1,5	1,7	
	R30	$M^0_{Rk,s,fi}$	[Nm]	2,3			4,8	4,9	
	R60	$M^0_{Rk,s,fi}$	[Nm]	1,7			3,6	3,7	
	R90	$M^0_{Rk,s,fi}$	[Nm]	1,1			2,6	2,7	
	R120	$M^0_{Rk,s,fi}$	[Nm]	0,8			1,8	1,9	
Pull-out failure									
Characteristic resistance	R30 R60 R90	$N^0_{Rk,p,fi}$	[kN]	1,3	2,8	3,6	2,3	3,9	4,7
	R120	$N^0_{Rk,p,fi}$	[kN]	1,0	2,2	2,8	1,9	3,1	3,7
Concrete cone failure									
Characteristic resistance	R30 R60 R90	$N^0_{Rk,c,fi}$	[kN]	0,8	2,6	4,0	2,0	4,7	6,5
	R120	$N^0_{Rk,c,fi}$	[kN]	0,7	2,1	3,2	1,6	3,7	5,2
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 h_{ef}					
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 C4 continued

Fastener size HUS4-H (F)				**12**			**14**			**16**	
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}
Nominal embedment depth		h_{nom}	[mm]	60	80	100	65	85	115	85	130
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]	7,5	7,6	7,6	10,3	10,4	10,5	10,6	10,7
	R60	$F_{Rk,s,fi}$		5,5	5,7	5,8	7,7	7,9	8,0	8,1	8,2
	R90	$F_{Rk,s,fi}$		3,7	3,9	4,1	5,2	5,6	5,8	5,7	5,9
	R120	$F_{Rk,s,fi}$		2,8	3,0	3,1	3,9	4,2	4,4	4,3	4,5
	R30	$M^0_{Rk,s,fi}$		11,4	11,6	11,6	18,9	19,2	19,3	23,7	23,9
	R60	$M^0_{Rk,s,fi}$		8,4	8,8	8,9	14,1	14,6	14,8	18,1	18,3
	R90	$M^0_{Rk,s,fi}$		5,7	6,0	6,2	9,5	10,2	10,7	12,7	13,2
	R120	$M^0_{Rk,s,fi}$		4,3	4,6	4,7	7,2	7,7	8,1	9,6	10,0
Pull-out failure											
Characteristic resistance	R30 R60 R90	$N^0_{Rk,c,fi}$	[kN]	2,6	4,2	6,1	2,9	4,5	7,5	4,6	8,7
	R120	$N^0_{Rk,c,fi}$	[kN]	2,1	3,4	4,9	2,3	3,6	6,0	3,7	7,0
Concrete cone failure											
Characteristic resistance	R30 R60 R90	$N^0_{Rk,c,fi}$	[kN]	2,4	5,4	9,8	2,9	6,1	13,9	6,2	19,4
	R120	$N^0_{Rk,c,fi}$	[kN]	1,9	4,3	7,8	2,3	4,9	11,1	4,9	15,5
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	[-]	2,0							
The anchorage depth shall be increased for wet concrete by at least 30 mm compared to the given value											

Hilti screw anchor HUS4

Performances
Essential characteristics under fire exposure in concrete

Annex C8

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Table C5: Essential characteristics under fire exposure in concrete for HUS4-C

Fastener size HUS4-C				**8**			**10**		
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedment depth		h_{nom}	[mm]	40	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			1,0		
	R60	$F_{Rk,s,fi}$	[kN]	0,4			0,9		
	R90	$F_{Rk,s,fi}$	[kN]	0,3			0,7		
	R120	$F_{Rk,s,fi}$	[kN]	0,2			0,6		
	R30	$M^0_{Rk,s,fi}$	[Nm]	0,4			1,2		
	R60	$M^0_{Rk,s,fi}$	[Nm]	0,3			1,0		
	R90	$M^0_{Rk,s,fi}$	[Nm]	0,2			0,8		
	R120	$M^0_{Rk,s,fi}$	[Nm]	0,2			0,6		
Pull-out failure									
Characteristic resistance	R30 R60 R90	$N_{Rk,p,fi}$	[kN]	1,3	2,8	3,6	2,3	3,9	4,7
	R120	$N_{Rk,p,fi}$	[kN]	1,0	2,2	2,8	1,9	3,1	3,7
Concrete cone failure									
Characteristic resistance	R30 R60 R90	$N^0_{Rk,c,fi}$	[kN]	0,8	2,6	4,0	2,0	4,7	6,5
	R120	$N^0_{Rk,c,fi}$	[kN]	0,7	2,1	3,2	1,6	3,7	5,2
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 HUS4

Annex C9

Performances
Essential characteristics under fire exposure in concrete

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Table C6: Essential characteristics under fire exposure in concrete for HUS4-A

Fastener size HUS4-A (F)				**10**			**14**		
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedment depth		h_{nom}	[mm]	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]	4,2			8,4		
	R60	$F_{Rk,s,fi}$	[kN]	3,3			6,8		
	R90	$F_{Rk,s,fi}$	[kN]	2,5			5,1		
	R120	$F_{Rk,s,fi}$	[kN]	2,1			4,3		
	R30	$M^0_{Rk,s,fi}$	[Nm]	4,8			15,4		
	R60	$M^0_{Rk,s,fi}$	[Nm]	3,8			12,4		
	R90	$M^0_{Rk,s,fi}$	[Nm]	2,9			9,3		
	R120	$M^0_{Rk,s,fi}$	[Nm]	2,4			7,8		
Pull-out failure									
Characteristic resistance	R30 R60 R90	$N_{Rk,p,fi}$	[kN]	2,3	3,9	4,7	2,9	4,5	7,5
	R120	$N_{Rk,p,fi}$	[kN]	1,9	3,1	3,7	2,3	3,6	6,0
Concrete cone failure									
Characteristic resistance	R30 R60 R90	$N^0_{Rk,c,fi}$	[kN]	2,0	4,7	6,5	2,9	6,1	13,9
	R120	$N^0_{Rk,c,fi}$	[kN]	1,6	3,7	5,2	2,3	4,9	11,1
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				
The anchorage depth shall be increased for wet concrete by at least 30 mm compared to the given value									

Hilti screw anchor HUS4

Performances
Essential characteristics under fire exposure in concrete

Annex C10

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Table C7: Displacements under tension loads

Fastener size HUS4				**8**			**10**		
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedment depth		h_{nom}	[mm]	40	60	70	55	75	85
Cracked concrete C20/25 to C50/60	Tension Load	N	[kN]	2,6	5,4	6,9	3,8	7,5	8,6
	Displacement	δ_{N0}	[mm]	0,1	0,3	0,4	0,2	0,4	0,4
		$\delta_{N\infty}$	[mm]	0,3	0,4	0,4	0,7	0,7	0,9
Uncracked concrete C20/25 to C50/60	Tension Load	N	[kN]	3,7	7,1	9,1	5,2	10,5	12,2
	Displacement	δ_{N0}	[mm]	0,1	0,2	0,2	0,1	0,3	0,3
		$\delta_{N\infty}$	[mm]	0,3	0,4	0,4	0,7	0,7	0,9

Fastener size HUS4				**12**			**14**			**16**	
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}
Nominal embedment depth		h_{nom}	[mm]	60	80	100	65	85	115	85	130
Cracked concrete C20/25 to C50/60	Tension Load	N	[kN]	5,1	8,2	11,7	5,7	8,6	14,4	8,7	16,7
	Displacement	δ_{N0}	[mm]	0,3	0,4	0,6	0,3	0,4	0,7	0,1	0,4
		$\delta_{N\infty}$	[mm]	0,9	0,9	1,2	1,3	1,3	1,5	1,3	1,4
Uncracked concrete C20/25 to C50/60	Tension Load	N	[kN]	6,8	10,8	15,5	7,5	11,7	19,1	11,5	22,9
	Displacement	δ_{N0}	[mm]	0,2	0,3	0,4	0,2	0,3	0,5	0,4	0,3
		$\delta_{N\infty}$	[mm]	0,9	0,9	1,2	1,3	1,3	1,5	1,3	1,4

Table C8: Displacements under shear loads

Fastener size HUS4				**8**			**10**		
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedment depth		h_{nom}	[mm]	40	60	70	55	75	85
Concrete C20/25 to C50/60	Shear Load	V	[kN]	10,7	10,7	12,5	16,5	16,5	18,3
	Displacement	δ_{V0}	[mm]	1,3	1,1	0,9	1,4	1,3	1,0
		$\delta_{V\infty}$	[mm]	2,0	1,7	1,4	2,1	2,0	1,5

Fastener size HUS4				**12**			**14**			**16**	
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}
Nominal embedment depth		h_{nom}	[mm]	60	80	100	65	85	115	85	130
Concrete C20/25 to C50/60	Shear Load	V	[kN]	22,2	22,2	25,7	31,4	35,4	35,4	37,2	41,8
	Displacement	δ_{V0}	[mm]	1,6	1,6	0,9	5,3	5,3	4,0	2,3	1,8
		$\delta_{V\infty}$	[mm]	2,3	2,4	1,4	7,9	7,9	6,0	3,5	2,7

Hilti screw anchor HUS4

Annex C11

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