Deutsches Institut für Bautechnik
DIBt

Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

European Technical Assessment

ETA-05/0255 of 19 January 2016

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 HVU with HAS and HIS elements
Product family to which the construction product belongs	Bonded anchor for use in non-cracked concrete
Manufacturer	Hilti Aktiengesellschaft Business Unit Anchors 9494 Schaan FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Werke
This European Technical Assessment contains	20 pages including 3 annexes
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	Guideline for European technical approval of "Metal anchors for use in concrete", ETAG 001 Part 5: "Bonded anchors", April 2013, used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011.

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Specific Part

1 Technical description of the product

The Hilti HVU is a bonded anchor consisting of a mortar capsule Hilti HVU and a steel element. The steel element consist of

- an anchor rod Hilti HAS-(E) with washer and hexagon nut of sizes M8 to M30 or
- an internally threaded sleeve HIS-(R)N of sizes M8 to M20

The mortar capsule is placed in the hole and the steel element is driven by machine with simultaneous hammering and turning.

The anchor rod is anchored via the bond between steel element, chemical mortar and concrete.

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
Characteristic values under static and quasi-static action, Displacements	See Annex C 1 to C 6

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for Class A1
Resistance to fire	No performance assessed

3.3 Hygiene, health and the environment (BWR 3)

Regarding dangerous substances there may be requirements (e.g. transposed European legislation and national laws, regulations and administrative provisions) applicable to the products falling within the scope of this European Technical Assessment. In order to meet the provisions of Regulation (EU) No 305/2011, these requirements need also to be complied with, when and where they apply.

3.4 Safety in use (BWR 4)

The essential characteristics regarding Safety in use are included under the Basic Works Requirement Mechanical resistance and stability.

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

In accordance with guideline for European technical approval ETAG 001, April 2013 used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011 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 19 January 2016 by Deutsches Institut für Bautechnik

Uwe Bender
Head of Department

beglaubigt:
G. Lange

Installed condition

Figure A1:

HVU with HAS-(E)…

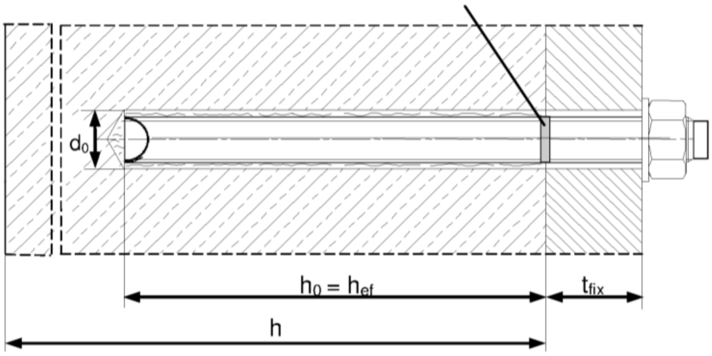
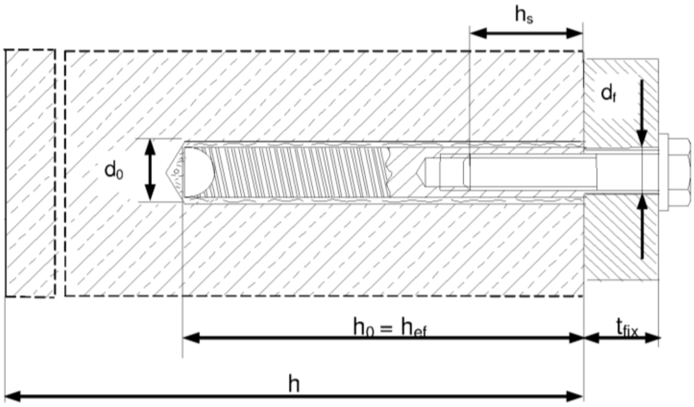


Figure A2:

HVU with internally threaded sleeve HIS-(R)N…



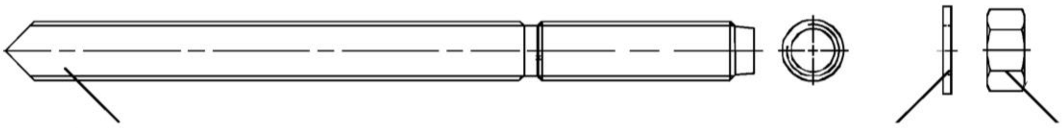
Hilti bonded anchor HVA, HVA R and HVA HCR	
Product description Installed condition	**Annex A1**

Product description: Mortar capsule and steel elements

Mortar capsule HVU: resin and hardener with aggregate

Marking:
HVU M …
Expiry date mm/yyyy

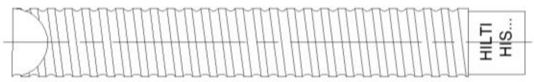
Steel elements



HAS-(E)...: M8 to M30

washer

nut



Internally threaded sleeve: HIS-(R)N M8 to M20

Hilti bonded anchor HVA, HVA R and HVA HCR	
Product description Mortar capsule / Steel elements	**Annex A2**

Table A1: Materials

Designation	Material
Metal parts made of zinc coated steel	
HAS-(E) (F) M8 to M24	Strength class 5.8, f_{uk} = 500 N/mm², f_{yk} = 400 N/mm² Elongation at fracture (l_0=5d) > 8% ductile Electroplated zinc coated ≥ 5 µm, (F) hot dip galvanized ≥ 45 µm
HAS-(E) (F) M8 to M30	Strength class 8.8, f_{uk} = 800 N/mm², f_{yk} = 640 N/mm² Elongation at fracture (l_0=5d) > 8% ductile Electroplated zinc coated ≥ 5 µm, (F) hot dip galvanized ≥ 45 µm
Internally threaded sleeve HIS-N	Electroplated zinc coated ≥ 5 µm
Washer	Electroplated zinc coated ≥ 5 µm, hot dip galvanized ≥ 45 µm
Nut	Strength class of nut adapted to strength class of threaded rod Electroplated zinc coated ≥ 5 µm, hot dip galvanized ≥ 45 µm
Metal parts made of stainless steel	
HAS-(E)R	For ≤ M24: strength class 70, f_{uk} = 700 N/mm², f_{yk} = 450 N/mm² For > M24: strength class 50, f_{uk} = 500 N/mm², f_{yk} = 210 N/mm² Elongation at fracture (l_0=5d) > 8% ductile Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1:2014
Internally threaded sleeve HIS-RN	Stainless steel 1.4401, 1.4571 EN 10088-1:2014
Washer	Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1:2014
Nut	Strength class of nut adapted to strength class of threaded rod Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1:2014
Metal parts made of high corrosion resistant steel	
HAS-(E)HCR	For ≤ M20: f_{uk} = 800 N/mm², f_{yk} = 640 N/mm² For > M20: f_{uk} = 700 N/mm², f_{yk} = 400 N/mm², Elongation at fracture (l_0=5d) > 8% ductile High corrosion resistant steel 1.4529, 1.4565 EN 10088-1:2014
Washer	High corrosion resistant steel 1.4529, 1.4565 EN 10088-1:2014
Nut	Strength class of nut adapted to strength class of threaded rod High corrosion resistant steel 1.4529, 1.4565 EN 10088-1:2014

Specifications of intended use

Anchorages subject to:

- Static and quasi static loading

Base material:

- Reinforced or unreinforced normal weight concrete according to EN 206:2013.
- Strength classes C20/25 to C50/60 according to EN 206:2013.
- Non-cracked concrete.

Temperature in the base material:

- **at installation**

  -5 °C to +40 °C
- **in-service**

  Temperature range I: -40 °C to +40 °C
  (max. long term temperature +24 °C and max. short term temperature +40 °C)
  Temperature range II: -40 °C to +80 °C
  (max. long term temperature +50 °C and max. short term temperature +80 °C)
  Temperature range III: -40 °C to +120 °C
  (max. long term temperature +72 °C and max. short term temperature +120 °C)

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions
  (zinc coated steel, stainless steel or high corrosion resistant steel).
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal conditions, if no particular aggressive conditions exist
  (stainless steel or high corrosion resistant steel).
- Structures subject to external atmospheric exposure and to permanently damp internal conditions, if other particular aggressive conditions exist
  (high corrosion resistant steel).
  Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution
  (e.g. in desulphurization plants or road tunnels where de-icing products are used).

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 anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages under static or quasi-static loading are designed in accordance with:
  “EOTA Technical Report TR 029, 09/2010” or “CEN/TS 1992-4:2009”

Installation:

- Use category: dry or wet concrete (not in flooded holes)
- Drilling technique: hammer drilling and hammer drilling with hollow drill bit TE-CD, TE-YD.
- Overhead installation is admissible.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

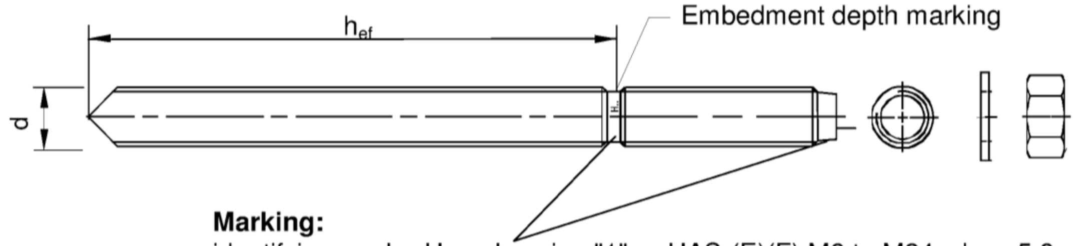
Hilti bonded anchor HVA, HVA R and HVA HCR	**Annex B1**
Intended Use Specifications	

Table B1: Installation parameters of HAS-(E)…

HAS-(E)…			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Foil capsule HVU M…			**8x80**	**10x90**	**12x110**	**16x125**	**20x170**	**24x210**	**27x240**	**30x270**
Diameter of element	d	[mm]	8	10	12	16	20	24	27	30
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	24	28	30	35
Effective embedment depth and drill hole depth	$h_{ef} = h_0$	[mm]	80	90	110	125	170	210	240	270
Maximum diameter of clearance hole in the fixture [1)]	d_f	[mm]	9	12	14	18	22	26	30	33
Minimum thickness of concrete member	h_{min}	[mm]	110	120	140	170	220	270	300	340
Maximum torque moment	T_{max}	[Nm]	10	20	40	80	150	200	270	300
Minimum spacing	s_{min}	[mm]	40	45	55	65	90	120	130	135
Minimum edge distance	c_{min}	[mm]	40	45	55	65	90	120	130	135

[1)] For larger clearance hole see “TR 029 section 1.1”

HAS-(E)…



Marking:
identifying mark - H, embossing "1" HAS-(E)(F) M8 to M24, class 5.8
identifying mark - H, embossing "8" HAS-(E)(F) M8 to M30, class 8.8
identifying mark - H, embossing “=” HAS-(E)R
identifying mark - H, embossing “CR” HAS-(E)HCR

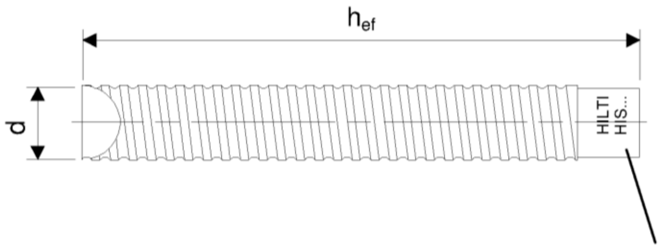
Hilti bonded anchor HVA, HVA R and HVA HCR	**Annex B2**
Intended Use Installation parameters	

Table B2: Installation parameters of internally threaded sleeve HIS-(R)N

HIS-(R)N			**M8**	**M10**	**M12**	**M16**	**M20**
Foil capsule HVU M…			**10x90**	**12x110**	**16x125**	**20x170**	**24x205**
Outer diameter of sleeve	d	[mm]	12,5	16,5	20,5	25,4	27,6
Nominal diameter of drill bit	d_0	[mm]	14	18	22	28	32
Effective embedment depth and drill hole depth	$h_{ef} = h_0$	[mm]	90	110	125	170	205
Maximum diameter of clearance hole in the fixture [1)]	d_f	[mm]	9	12	14	18	22
Minimum thickness of concrete member	h_{min}	[mm]	120	150	170	230	270
Maximum torque moment	T_{max}	[Nm]	10	20	40	80	150
Thread engagement length min-max	h_s	[mm]	8-20	10-25	12-30	16-40	20-50
Minimum spacing	s_{min}	[mm]	40	45	60	80	125
Minimum edge distance	c_{min}	[mm]	40	45	60	80	125

1) for larger clearance hole see “TR 029 section 1.1”

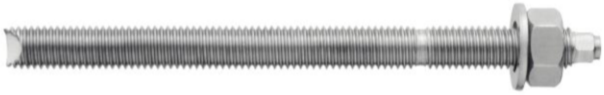
Internally threaded sleeve HIS-(R)N…



Marking:
Identifying mark - HILTI and
embossing "HIS-N" (for zinc coated steel)
embossing "HIS-RN" (for stainless steel)

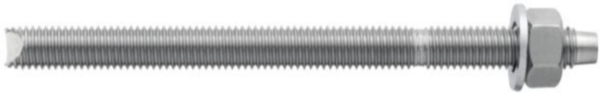
Setting tools threaded rods

HAS with outer hexagon head



HAS M8 to M16	**HAS M10 to M16**	**HAS M8 to M30**
 Socket head screw delivered with the threaded rod.		
Use with chuck of drilling machine	TE-C HEX (Socket head)	TE-C 1/2” for M8 to M16 TE-C 3/4” for M16 to M30
HAS M8 to M24	**HAS M8 to M24**	**HAS M10 to M16**
		
TE-C SM8 to M16 TE-Y SM20 and M24	Connection shaft TE-C; TE-FY Rod adapter SA 8 to SA 24	TE-C SM8 to M12 Thread connection 1 size smaller than HAS size

HAS-E with conical head



HAS-E M8 to M24	**HAS-E M8 to M24**	**HAS-E M8 to M30**
		
TE-C-E M8 to M16 TE-Y-E M20 and M24	TE-C SM8 to M16 TE-Y SM20 and M24	TE-C 1/2” for M8 to M16 TE-C 3/4” for M16 to M30
HAS M8 to M24		
		
Connection shaft TE-C; TE-FY Rod adapter SA 8 to SA 24		

Setting tools internal threaded sleeve

HIS-N 

HIS-N M8 to M20	**HIS-N M8 to M20**
	
HIS-S M8 to M20 with TE-C 1/2" for M8 to M16 TE-C 3/4" for M16 to M30	Screw M8 to M20 with TE-C 1/2" for M8 to M16 TE-C 3/4" for M16 to M30

Table B3: Curing time t_{rel} and t_{cure} [1)]

Temperature in the base material T	Curing time: release screwed on setting tool t_{rel}	Curing time: full load t_{cure}
-5 °C to -1 °C	60 min	5 hour
0 °C to 9 °C	30 min	1 hour
10 °C to 19 °C	20 min	30 min
20 °C to 40 °C	8 min	20 min

[1)] The curing time data are valid for dry base material only. In wet base material the curing times must be doubled.

Cleaning alternatives

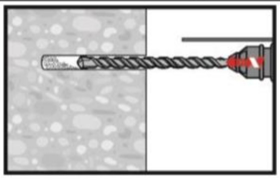
Manual Cleaning (MC): Hilti hand pump for blowing out drill holes.	
Compressed Air Cleaning (CAC): Air nozzle with an orifice opening of minimum 3,5 mm in diameter.	
Automatic Cleaning (AC): Cleaning is performed during drilling with Hilti TE-CD and TE-YD drilling system including vacuum cleaner.	

Hilti bonded anchor HVA, HVA R and HVA HCR	**Annex B5**
Intended Use Installation parameters Cleaning and setting tools	

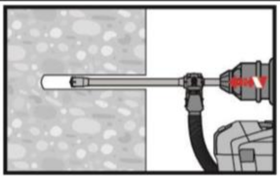
Installation instruction

Hole drilling

Hammer drilling



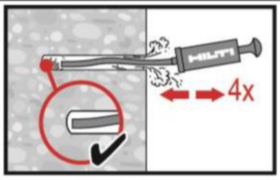
Drill hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.



Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment.
This drilling removes dust while drilling. After drilling is complete, proceed to the "check setting depth" step in the instructions for use.

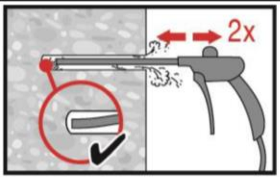
Drill hole cleaning Just before setting an anchor, the drill hole must be free of dust and debris. Inadequate hole cleaning = poor load values.

Manual Cleaning (MC)



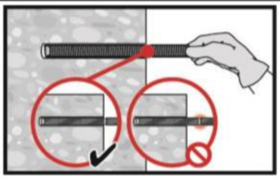
The Hilti hand pump may be used for blowing out drill hole.
Blow out at least 4 times from the back of the drill hole until return air stream is free of noticeable dust.

Compressed Air Cleaning (CAC)



Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust.

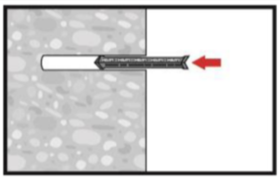
Check setting depth



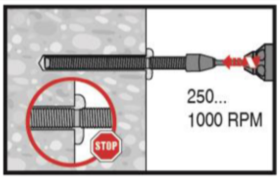
Check the setting depth with the marked element.
The hole depth should not exceed the anchor element embedment depth.
If it is not possible to insert the element to the required embedment depth, drill deeper.

Hilti bonded anchor HVA, HVA R and HVA HCR	
Intended Use Installation instructions	**Annex B6**

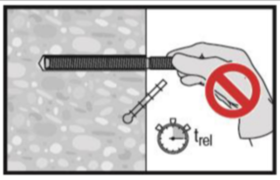
Setting the element



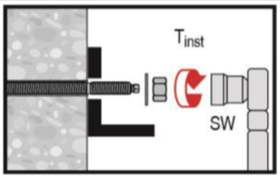
Insert the foil pack into the hole in the orientation shown.



Chuck the setting tool into the hammer drill. Insert the anchor rod in the setting tool (Annex B4/B5). Using hammer-drill mode, drive the anchor rod through the foil pack (250 - 1000 RPM) Do not continue to operate the hammer drill after the reaching the bottom of the hole.



After required curing time t_{rel} (see Table B3) the screwed on setting tool can be removed.



After required curing time t_{cure} (see Table B3) apply installation torque T_{inst} given in Table B1 and B2.

The anchor can be loaded.

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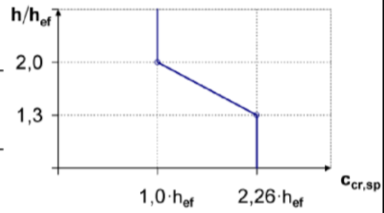
Table C1: Characteristic resistance for threaded rod HAS-(E)... under tension load in case of static and quasi static loading

HAS-(E)…			M8	M10	M12	M16	M20	M24	M27	M30
Effective anchorage depth	h_{ef}	[mm]	80	90	110	125	170	210	240	270
Installation safety factor	γ_2 [1)] = γ_{inst} [2)]	[-]	1,0							
Steel failure										
Characteristic resistance HAS-5.8	$N_{Rk,s}$	[kN]	16,6	26,4	38,1	72,1	112	160	-	-
Characteristic resistance HAS-8.8	$N_{Rk,s}$	[kN]	26,5	42,2	61,0	115	179	256	347	421
Characteristic resistance HAS-R	$N_{Rk,s}$	[kN]	23,2	37,0	53,3	101	157	224	217	263
Characteristic resistance HAS-HCR	$N_{Rk,s}$	[kN]	26,5	42,0	61,0	115	179	224	-	-
Combined pullout and concrete cone failure										
Characteristic resistance in non-cracked concrete C20/25										
Temperature range I: 40 °C/24 °C	$N_{Rk,p,ucr}$	[kN]	25	35	50	60	115	140	200	250
Temperature range II: 80 °C/50 °C	$N_{Rk,p,ucr}$	[kN]	20	25	40	50	75	115	140	170
Temperature range III: 120 °C/72 °C	$N_{Rk,p,ucr}$	[kN]	9	12	16	25	40	60	75	75
Factor acc. to section 6.2.2.3 of CEN/TS 1992-4:2009 part 5	$k_8 = k_{ucr}$ [2)]	[-]	10,1							
Increasing factors for τ_{Rk} in concrete	ψ_c	C30/37	1,06							
		C40/50	1,10							
		C50/60	1,13							
Splitting failure										
Edge distance $c_{cr,sp}$ [mm] for	$h / h_{ef} \geq 2{,}0$		$1{,}0 \cdot h_{ef}$							
	$2{,}0 > h / h_{ef} > 1{,}3$		$4{,}6\ h_{ef} - 1{,}8\ h$							
	$h / h_{ef} \leq 1{,}3$		$2{,}26\ h_{ef}$							
Spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$							



1) Parameter for design according to EOTA Technical Report TR 029.
2) Parameter for design according to CEN/TS 1992-4:2009.

Hilti bonded anchor HVA, HVA R and HVA HCR

Performances
Characteristic values of resistance under tension loading.
Design according to „EOTA Technical Report TR 029, 09/2010"or "CEN/TS 1992-4:2009"

Annex C1

Table C2: Characteristic resistance for threaded rod HAS-(E)... under shear load in case of static and quasi static loading

HAS-(E)…			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure without lever arm										
Factor according to section 6.3.2.1 of CEN/TS 1992-4: 2009 part 5	k_2[2)]	[-]	1,0							
Characteristic resistance HAS-5.8	$V_{Rk,s}$	[kN]	8,3	13,2	19,1	36,1	56,1	80,1	-	-
Characteristic resistance HAS-8.8	$V_{Rk,s}$	[kN]	13,3	21,1	30,5	57,7	89,7	128	174	211
Characteristic resistance HAS-R	$V_{Rk,s}$	[kN]	11,6	18,5	26,7	50,5	78,5	112	108	132
Characteristic resistance HAS-HCR	$V_{Rk,s}$	[kN]	13,3	21,1	30,5	57,7	89,7	112	-	-
Steel failure with lever arm										
Characteristic resistance HAS-5.8	$M^0_{Rk,s}$	[Nm]	16	33	56	147	284	486	-	-
Characteristic resistance HAS-8.8	$M^0_{Rk,s}$	[Nm]	26	53	90	234	455	777	1223	1637
Characteristic resistance HAS-R	$M^0_{Rk,s}$	[Nm]	23	45	79	205	398	680	764	1023
Characteristic resistance HAS-HCR	$M^0_{Rk,s}$	[Nm]	26	52	90	234	455	680	-	-
Concrete pry-out failure										
Factor acc. to equation (5.7) of TR 029 or acc. to equation (27) of CEN/TS 1992-4: 2009 part 5	k[1)] $= k_3$[2)]	[-]	2,0							
Concrete edge failure										
Effective length of anchor in shear loading	l_f	[mm]	80	90	110	125	170	210	240	270
Diameter of anchor	d[1)] $= d_{nom}$[2)]	[mm]	8	10	12	16	20	24	27	30

1) Parameter for design according to EOTA Technical Report TR 029.
2) Parameter for design according to CEN/TS 1992-4:2009.

Table C3: Displacements under tension load for threaded rod HAS-(E)... in case of static and quasi static loading

HAS-(E)...			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Temperature range I: 40 °C / 24 °C										
Tension load	N	[kN]	8,1	12,4	18,1	28,6	53,3	66,7	95,2	119
Displacement	δ_{N0}	[mm]	0,15	0,2	0,2	0,2	0,3	0,3	0,4	0,45
Displacement	$\delta_{N\infty}$	[mm]	0,4	0,45	0,5	0,55	0,8	0,8	1,0	1,1
Temperature range II: 80 °C / 50 °C										
Tension load	N	[kN]	8,1	11,9	18,1	23,8	35,7	54,8	66,7	81
Displacement	δ_{N0}	[mm]	0,15	0,15	0,2	0,2	0,2	0,25	0,25	0,3
Displacement	$\delta_{N\infty}$	[mm]	0,4	0,4	0,5	0,5	0,55	0,65	0,65	0,7
Temperature range III: 120 °C / 72 °C										
Tension load	N	[kN]	4,3	5,7	7,6	11,9	19,0	28,6	35,7	35,7
Displacement	δ_{N0}	[mm]	0,1	0,1	0,1	0,1	0,1	0,15	0,15	0,15
Displacement	$\delta_{N\infty}$	[mm]	0,2	0,2	0,2	0,25	0,3	0,35	0,35	0,35

Table C4: Displacements under shear load for threaded rod HAS-(E)... in case of static and quasi static loading

HAS-(E)...			M8	M10	M12	M16	M20	M24	M27	M30
Shear load	V	[kN]	4,9	7,4	10,9	20,6	32,0	45,7	99,4	120,6
Displacement	δ_{V0}	[mm]	0,4	0,6	0,7	0,9	1,1	1,3	2,8	3,4
Displacement	$\delta_{V\infty}$	[mm]	0,6	0,9	1,1	1,4	1,7	2,0	4,2	5,1

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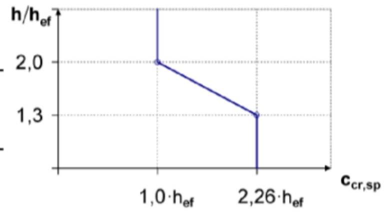
Table C5: Characteristic resistance for internal threaded sleeve HIS-N... under tension load in case of static and quasi static loading

HIS-(R)N			M8	M10	M12	M16	M20
Effective anchorage depth	h_{ef}	[mm]	90	110	125	170	205
Installation safety factor	γ_2 2) = γ_{inst} 3)	[-]	1,0				
Steel failure							
Characteristic steel resistance HIS-N with screw grade 8.8	$N_{Rk,s}$	[kN]	25	46	67	125	116
Partial safety factor	$\gamma_{Ms,N}$ 1)	[-]	1,5				
Characteristic steel resistance HIS-RN with with screw grade 70	$N_{Rk,s}$	[kN]	26	41	59	110	166
Partial safety factor	$\gamma_{Ms,N}$ 1)	[-]	1,87				2,4
Combined pullout and concrete failure							
Characteristic resistance in non-cracked concrete C20/25							
Temperature range I: 40 °C/24 °C	$N_{Rk,p,ucr}$	[kN]	25	40	60	95	140
Temperature range II: 80 °C/50 °C	$N_{Rk,p,ucr}$	[kN]	20	35	50	75	95
Temperature range III: 120 °C/72 °C	$N_{Rk,p,ucr}$	[kN]	9	16	20	40	50
Factor acc. to section 6.2.2.3 of CEN/TS 1992-4:2009 part 5	$k_8 = k_{ucr}$ 3)	[-]	10,1				
Increasing factors for τ_{Rk} in concrete	ψ_c	C30/37	1,12				
		C40/50	1,21				
		C50/60	1,28				
Splitting failure							
Edge distance $c_{cr,sp}$ [mm] for	$h / h_{ef} \geq 2,0$		$1,0 \cdot h_{ef}$				
	$2,0 > h / h_{ef} > 1,3$		$4,6\ h_{ef} - 1,8\ h$				
	$h / h_{ef} \leq 1,3$		$2,26\ h_{ef}$				
Spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$				

1) In absence of national regulations.
2) Parameter for design according to EOTA Technical Report TR 029.
3) Parameter for design according to CEN/TS 1992-4:2009.

Table C6: Characteristic resistance for internal threaded sleeve HIS-N... under shear load in case of static and quasi static loading

HIS-(R)N			**M8**	**M10**	**M12**	**M16**	**M20**
Steel failure without lever arm							
Factor according to section 6.3.2.1 of CEN/TS 1992-4: 2009 part 5	k_2 [3]	[-]	1,0				
Characteristic resistance HIS-N with screw grade 8.8	$V_{Rk,s}$	[kN]	13	23	34	63	58
Partial safety factor	$\gamma_{Ms,V}$ [1]	[-]	1,25				
Characteristic resistance HIS-RN with screw grade 70	$V_{Rk,s}$	[kN]	13	20	30	55	83
Partial safety factor	$\gamma_{Ms,V}$ [1]	[-]	1,56				2,0
Steel failure with lever arm							
Characteristic resistance HIS-N / screw strength class 8.8	$M_{Rk,s}$	[Nm]	30	60	105	266	519
Partial safety factor	$\gamma_{Ms,V}$ [1]	[-]	1,25				
Characteristic resistance HIS-RN / screw strength class 70	$M_{Rk,s}$	[Nm]	26	52	92	233	454
Partial safety factor	$\gamma_{Ms,V}$ [1]	[-]	1,56				
Concrete pry-out failure							
Factor acc. to equation (5.7) of TR 029 or acc. to equation (27) of CEN/TS 1992-4: 2009 part 5	k [2] $= k_3$ [3]	[-]	2,0				
Concrete edge failure							
Effective length of anchor in shear loading	l_f	[mm]	90	110	125	170	205
Diameter of anchor	d [2] $= d_{nom}$ [3]	[mm]	12,5	16,5	20,5	25,4	27,6

1) In absence of national regulations.
2) Parameter for design according to EOTA Technical Report TR 029.
3) Parameter for design according to CEN/TS 1992-4:2009.

Table C7: Displacements under tension load for internal threaded sleeve HIS-N... in case of static and quasi static loading

HIS-(R)N			M8	M10	M12	M16	M20
Non-cracked concrete							
Temperature range I: 40 °C / 24 °C							
Tension load	N	[kN]	11,9	19,0	28,6	45,2	53,0
Displacement	δ_{N0}	[mm]	0,2	0,2	0,25	0,3	0,35
Displacement	$\delta_{N\infty}$	[mm]	0,5	0,55	0,65	0,8	0,85
Temperature range II: 80 °C / 50 °C							
Tension load	N	[kN]	9,5	15,7	22,5	35,7	45,2
Displacement	δ_{N0}	[mm]	0,15	0,2	0,2	0,25	0,3
Displacement	$\delta_{N\infty}$	[mm]	0,4	0,45	0,5	0,65	0,7
Temperature range III: 120 °C / 72 °C							
Tension load	N	[kN]	4,3	7,6	9,5	19,0	23,8
Displacement	δ_{N0}	[mm]	0,1	0,1	0,1	0,15	0,15
Displacement	$\delta_{N\infty}$	[mm]	0,2	0,2	0,2	0,35	0,4

Table C8: Displacements under shear load for internal threaded sleeve HIS-N... in case of static and quasi static loading

HIS-(R)N			M8	M10	M12	M16	M20
Shear load	V	[kN]	7,2	13,2	19,3	35,8	33,3
Displacement	δ_{N0}	[mm]	0,7	1,0	1,1	2,0	2,5
Displacement	$\delta_{N\infty}$	[mm]	1,1	1,5	1,7	3,0	3,8