Deutsches Institut für Bautechnik
DIBt

Approval body for construction products and types of construction

Bautechnisches Prüfamt

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European Technical Assessment — ETA-12/0028 of 27 August 2015

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	Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R
Product family to which the construction product belongs	Bonded anchor for use in concrete
Manufacturer	Hilti AG Feldkircherstraße 100 9494 Schaan FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Werke
This European Technical Assessment contains	20 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	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 injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R is a bonded anchor consisting of a foil pack with injection mortar Hilti HIT-HY 200-R and an anchor rod (including nut and washer) in the sizes of M8, M10, M12, M16 and M20. The anchor rod (including nut and washer) is made of galvanised steel (HIT-Z) or stainless steel (HIT-Z-R). The anchor rod is placed into a drill hole filled with injection mortar. The load transfer is realised by mechanical interlock of several cones in the bonding mortar and then via a combination of bonding and friction forces in the base material (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 resistance for static and quasi static action and displacements	See Annex C1 – C4
Characteristic resistance for seismic performance category C1 and displacements	See Annex C5
Characteristic resistance for seismic performance category C2 and displacements	See Annex C6

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 27 August 2015 by Deutsches Institut für Bautechnik

Uwe Bender
Head of Department

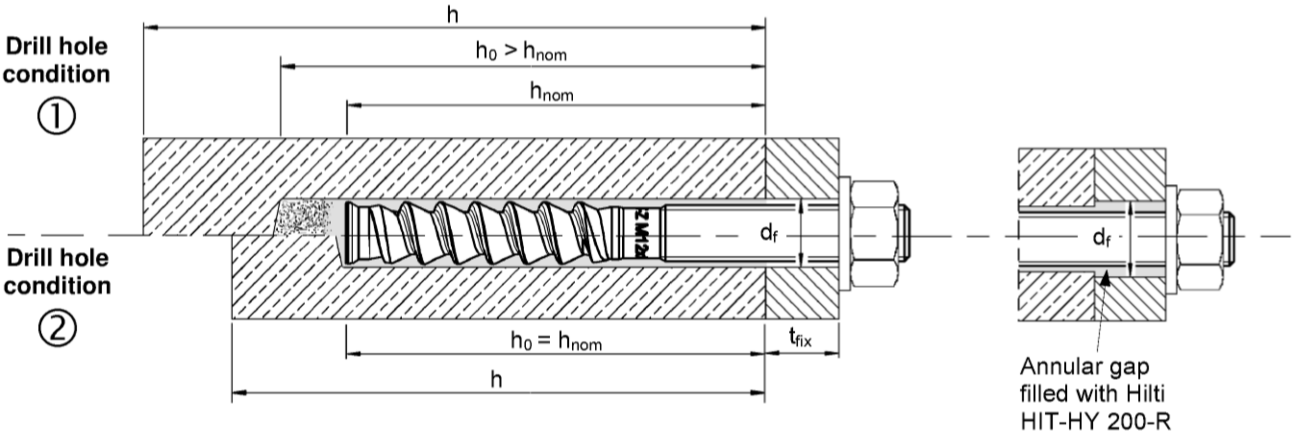
beglaubigt:
Baderschneider

Installed condition

Figure A1:
HIT-Z, HIT-Z-R

Pre-setting:
Install anchor before positioning fixture

Through-setting:
Install anchor through positioned fixture



Drill hole condition ① → non-cleaned drill hole
Drill hole condition ② → drilling dust is removed

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R

Product description
Installed condition

Annex A1

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Product description: Injection mortar and steel elements

Injection mortar Hilti HIT-HY 200-R: hybrid system with aggregate

330 ml and 500 ml

Marking:
HILTI HIT
HY 200-R
Production number and
production line
Expiry date mm/yyyy

Product name: "Hilti HIT-HY 200-R"

Static mixer Hilti HIT-RE-M

Steel elements

Hilti anchor rod: HIT-Z and HIT-Z-R: M8 to M20

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R	
Product description Injection mortar / Static mixer / Steel elements	**Annex A2**

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Table A1: Materials

Designation	Material
Metal parts made of zinc coated steel	
Anchor rod HIT-Z	For ≤ M12: f_{uk} = 650 N/mm², f_{yk} = 520 N/mm², For M16: f_{uk} = 610 N/mm², f_{yk} = 490 N/mm², For M20: f_{uk} = 595 N/mm², f_{yk} = 480 N/mm², Elongation at fracture (l_0=5d) > 8% ductile; Electroplated zinc coated ≥ 5 µm
Washer	Electroplated zinc coated ≥ 5 µm
Nut	Strength class of nut adapted to strength class of anchor rod. Electroplated zinc coated ≥ 5 µm
Metal parts made of stainless steel	
Anchor rod HIT-Z-R	For ≤ M12: f_{uk} = 650 N/mm², f_{yk} = 520 N/mm², For M16: f_{uk} = 610 N/mm², f_{yk} = 490 N/mm², For M20: f_{uk} = 595 N/mm², f_{yk} = 480 N/mm², Elongation at fracture (l_0=5d) > 8% ductile; Stainless steel 1.4401, 1.4404 EN 10088-1:2014
Washer	Stainless steel A4 EN 10088-1:2014
Nut	Strength class of nut adapted to strength class of anchor rod. Stainless steel 1.4401, 1.4404 EN 10088-1:2014

Specifications of intended use

Anchorages subject to:
- Static and quasi static loading: size M8 to M20.
- Seismic performance category: C1(size M8 to M20) or C2 (size M12 and M16) in hammer drilled holes.

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.
- Cracked and 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 or stainless 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).
  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, design method A"
- Anchorages under seismic actions (cracked concrete) are designed in accordance with:
  "EOTA Technical Report TR 045, 02/2013"
  Anchorages shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure. Fastenings in stand-off installation or with a grout layer under seismic action are not covered in this European technical assessment (ETA).

Installation:
- Use category: dry or wet concrete (not in flooded holes).
- Drilling technique: hammer drilling, diamond coring or 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.

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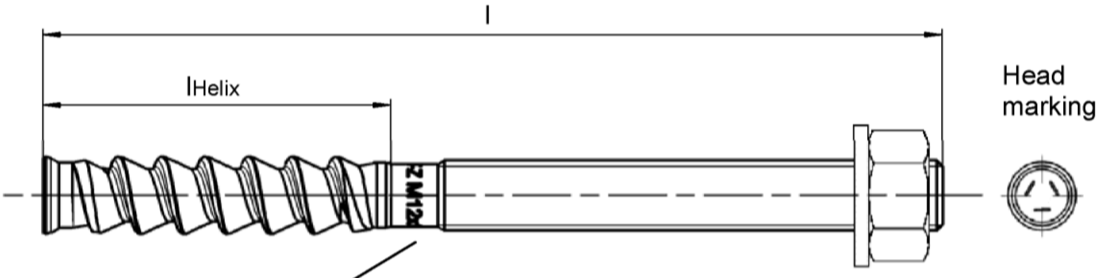
Table B1: Installation parameters HIT-Z, HIT-Z-R

HIT-Z, HIT-Z-R			M8	M10	M12	M16	M20
Nominal diameter	d	[mm]	8	10	12	16	20
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	22
Length of anchor	min l	[mm]	80	95	105	155	215
	max l	[mm]	120	160	196	420	450
Length of helix	l_{Helix}	[mm]	50	60	60	96	100
Nominal anchorage depth	$h_{nom,min}$	[mm]	60	60	60	96	100
	$h_{nom,max}$	[mm]	100	120	144	192	220
Drill hole condition ① Minimum thickness of concrete member	h_{min}	[mm]	h_{nom} + 60 mm			h_{nom} + 100 mm	
Drill hole condition ② Minimum thickness of concrete member	h_{min}	[mm]	h_{nom} + 30 mm ≥ 100 mm			h_{nom} + 45 mm	
Maximum depth of drill hole	h_0	[mm]	h – 30 mm			h – 2 d_0	
Pre-setting: [1] Maximum diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22
Through-setting: [1] Maximum diameter of clearance hole in the fixture	d_f	[mm]	11	14	16	20	24
Maximum fixture thickness	t_{fix}	[mm]	48	87	129	303	326
Installation torque moment	T_{inst}	[Nm]	10	25	40	80	150

[1] for larger clearance hole see "TR 029 section 1.1"



Marking:
Embossing "HIT-Z M…x l " zinc coated steel
Embossing "HIT-Z-R M…x l" stainless steel
(e.g. HIT-Z M 12 x 155)

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R

Intended Use
Installation parameters

Annex B2

Minimum edge distance and spacing

For the calculation of minimum spacing and minimum edge distance of anchors in combination with different embedment depth and thickness of concrete member the following equation shall be fulfilled:

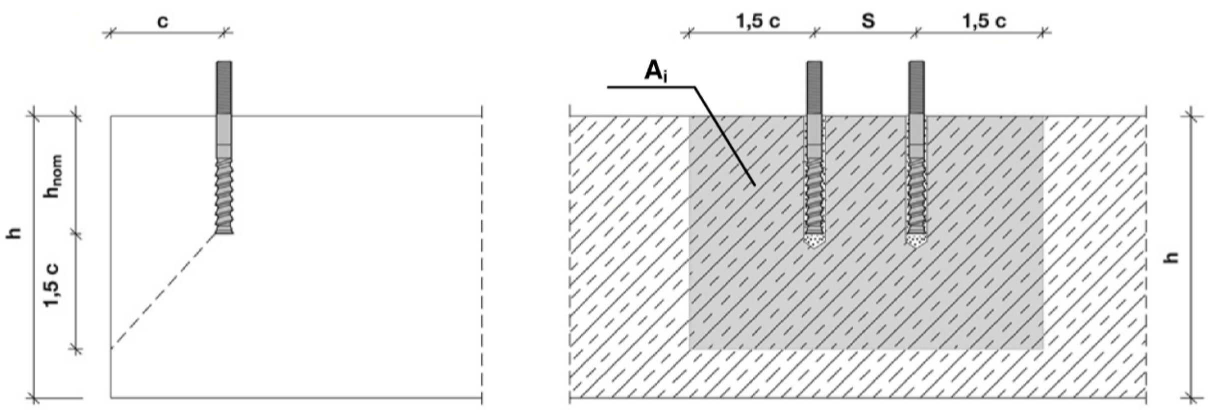
$$\mathbf{A_{i,req} < A_{i,ef}}$$

Table B2: Required area $A_{i,req}$

HIT-Z, HIT-Z-R			M8	M10	M12	M16	M20
Cracked concrete	$A_{i,req}$	[mm^2]	19200	40800	58800	94700	148000
Non-cracked concrete	$A_{i,req}$	[mm^2]	22200	57400	80800	128000	198000

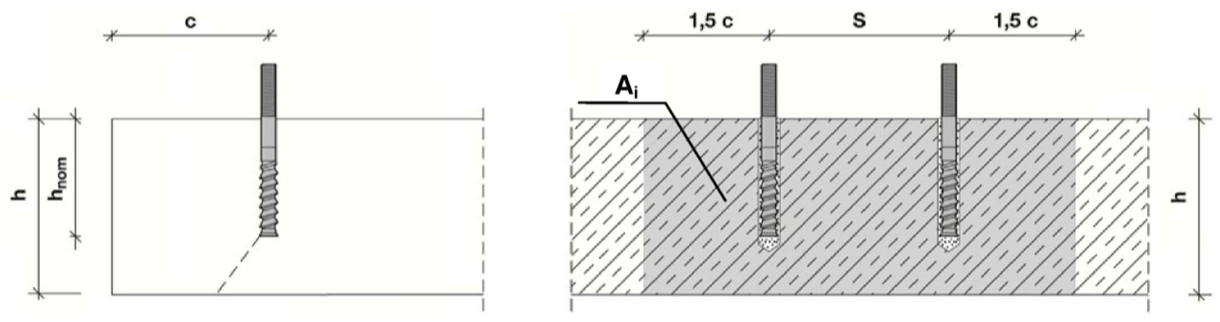
Table B3: Effective area $A_{i,ef}$

Member thickness $h > h_{nom} + 1{,}5 \cdot c$



Single anchor and group of anchors with $s > 3 \cdot c$	[mm²]	$\mathbf{A_{i,ef} = (6 \cdot c) \cdot (h_{nom} + 1{,}5 \cdot c)}$	with $c \geq 5 \cdot d$
Group of anchors with $s \leq 3 \cdot c$	[mm²]	$\mathbf{A_{i,ef} = (3 \cdot c + s) \cdot (h_{nom} + 1{,}5 \cdot c)}$	with $c \geq 5 \cdot d$ and $s \geq 5 \cdot d$

Member thickness $h \leq h_{nom} + 1{,}5 \cdot c$



Single anchor and group of anchors with $s > 3 \cdot c$	[mm²]	$\mathbf{A_{i,ef} = (6 \cdot c) \cdot h}$	with $c \geq 5 \cdot d$
Group of anchors with $s \leq 3 \cdot c$	[mm²]	$\mathbf{A_{i,ef} = (3 \cdot c + s) \cdot h}$	with $c \geq 5 \cdot d$ and $s \geq 5 \cdot d$

c_{min} and s_{min} in 5 mm steps

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R

Intended Use
Installation parameters: member thickness, spacing and edge distances

Annex B3

Table B4: Maximum working time and minimum curing time

Temperature in the base material T	Maximum working time t_{work}	Minimum curing time t_{cure}
5 °C	1 hour	4 hours
6 °C to 10 °C	40 min	2,5 hours
11 °C to 20 °C	15 min	1,5 hours
21 °C to 30 °C	9 min	1 hour
31 °C to 40 °C	6 min	1 hour

Table B5: Parameters of drilling and setting tools

Elements	Drill			Installation
Anchor rod HIT-Z / HIT-Z-R	Hammer drilling		Diamond coring	Piston plug
		Hollow drill bit TE-CD, TE-YD		
				
size	d_0 [mm]	d_0 [mm]	d_0 [mm]	HIT-SZ
M8	10	-	10	-
M10	12	12	12	12
M12	14	14	14	14
M16	18	18	18	18
M20	22	22	22	22

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R

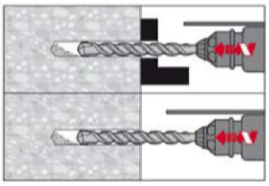
Intended Use
Maximum working time and minimum working time
Cleaning and setting tools

Annex B4

Installation instruction

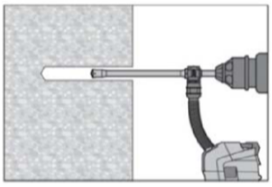
Hole drilling

a) Hammer drilling



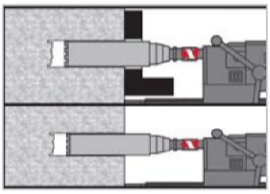
Through-setting: Drill hole through the clearance hole in the fixture to the required drilling depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.
Pre-setting: Drill hole to the required drilling depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.
After drilling is complete, proceed to the "injection preparation" step in the installation instruction.

b) Hammer drilling with hollow drill bit



Pre- / Through-setting: 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 system removes the dust and cleans the drill hole during drilling when used in accordance with the user's manual (see Annex A1 - Borehole condition ②).
After drilling is completed, proceed to the "injection preparation" step in the installation instruction.

c) Diamond coring

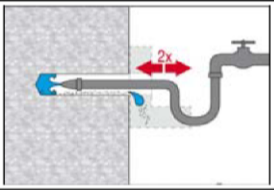


Diamond coring is permissible when suitable diamond core drilling machines and corresponding core bits are used.
Through-setting: Drill hole through the clearance hole in the fixture to the required drilling depth.
Pre-setting: Drill hole to the required embedment depth.

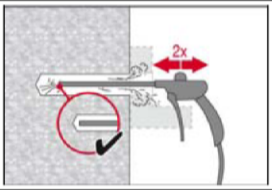
Drill hole cleaning

a) No cleaning required for hammer drilled holes.

b) Hole flushing and evacuation required for wet-drilled diamond cored holes.



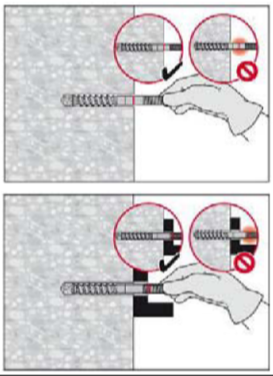
Flush 2 times from the back of the hole over the whole length until water runs clear. Water-line pressure is sufficient.



Blow 2 times from the back of the hole (if needed with nozzle extension) with oil-free compressed air (min. 6 bar at 6 m³/h) to evacuate the water.

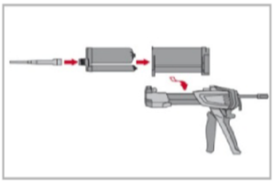
Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R	**Annex B5**
Intended Use Installation instructions	

Checking of setting depth

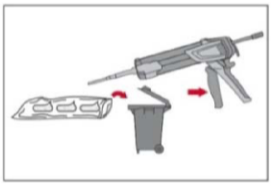


Mark the element and check the setting depth. The element has to fit in the hole until the required embedment depth. If it is not possible to insert the element to the required embedment depth, remove the dust in the drill hole or drill deeper.

Injection preparation



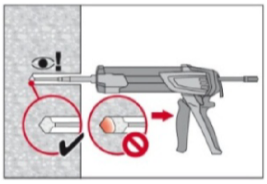
Tightly attach Hilti mixing nozzle HIT-RE-M to foil pack manifold. Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser.
Check foil pack holder for proper function. Insert foil pack into foil pack holder and put holder into the dispenser.



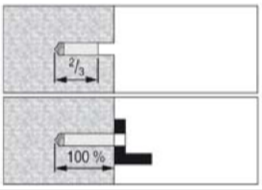
The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded. Discarded quantities are:

2 strokes	for 330 ml foil pack,
3 strokes	for 500 ml foil pack.

Inject adhesive from the back of the drill hole without forming air voids.

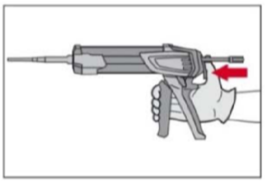


Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.



Pre-setting: Fill approximately 2/3 of the drill hole.

Through-setting: Fill 100% of the drill hole.



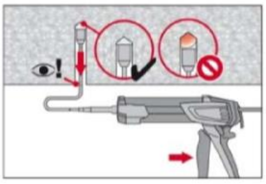
After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R

Intended Use
Installation instructions

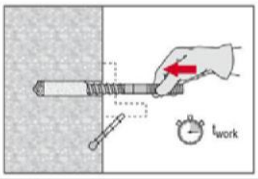
Annex B6

Overhead installation

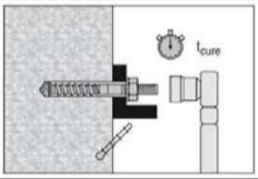


For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (see Table B5). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the drill hole by the adhesive pressure.

Setting the element



Before use, verify that the element is dry and free of oil and other contaminants.
Set element to the required embedment depth before working time t_{work} has elapsed. The working time t_{work} is given in Table B4. After setting the element the annular gap between the anchor and the fixture (through-setting) or concrete (pre-setting) has to be filled with mortar.



After required curing time t_{cure} (see Table B4) remove excess mortar.
The required installation torque T_{inst} is given in Table B1. The anchor can be loaded.

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R	**Annex B7**
Intended Use Installation instructions	

Deutsches Institut für Bautechnik DIBt

Table C1: Characteristic resistance for HIT-Z-(R) under tension load in case of static and quasi static loading

HIT-Z, HIT-Z-R				**M8**	**M10**	**M12**	**M16**	**M20**
Installation safety factor	$\gamma_2^{1)} = \gamma_{inst}^{2)}$		[-]	1,0				
Steel failure								
Characteristic resistance HIT-Z	$N_{Rk,s}$		[kN]	24	38	55	96	146
Characteristic resistance HIT-Z-R	$N_{Rk,s}$		[kN]	24	38	55	96	146
Combined pull-out and concrete cone failure								
Effective anchorage depth for calculation of $N^0_{Rk,p}$ (TR 029, 5.2.2.3 respectively CEN/TS 1992-4:2009 part 5, 6.2.2)	$h_{ef} = l_{Helix}$		[mm]	50	60	60	96	100
Characteristic bond resistance in non-cracked concrete C20/25								
Temperature range I: 40 °C / 24 °C	$\tau_{Rk,ucr}$		[N/mm²]	24				
Temperature range II: 80 °C / 50 °C	$\tau_{Rk,ucr}$		[N/mm²]	22				
Temperature range III: 120 °C / 72 °C	$\tau_{Rk,ucr}$		[N/mm²]	20				
Factor acc. to section 6.2.2.3 of CEN/TS 1992-4:2009 part 5	$k_8^{2)}$		[-]	10,1				
Characteristic bond resistance in cracked concrete C20/25								
Temperature range I: 40 °C / 24 °C	$\tau_{Rk,cr}$		[N/mm²]	22				
Temperature range II: 80 °C / 50 °C	$\tau_{Rk,cr}$		[N/mm²]	20				
Temperature range III: 120 °C / 72 °C	$\tau_{Rk,cr}$		[N/mm²]	18				
Factor acc. to section 6.2.2.3 of CEN/TS 1992-4:2009 part 5	$k_8^{2)}$		[-]	7,2				
Increasing factor for τ_{Rk} in concrete	Ψ_c		C30/37	1,0				
			C40/50	1,0				
			C50/60	1,0				
Concrete cone failure								
Effective embedment depth for calculation of $N_{Rk,c}$ (TR 029, 5.2.2.4 or CEN/TS 1992-4:2009 part 5, 6.2.3)	h_{ef}		[mm]	h_{nom}				
Factor according to section 6.2.3 of CEN/TS 1992-4:2009 part 5	$k_{cr}^{2)}$		[-]	7,2				
Factor according to section 6.2.3 of CEN/TS 1992-4:2009 part 5	$k_{ucr}^{2)}$		[-]	10,1				
Edge distance	$c_{cr,N}$		[mm]	$1{,}5 \cdot h_{ef}$				
Spacing	$s_{cr,N}$		[mm]	$3{,}0 \cdot h_{ef}$				

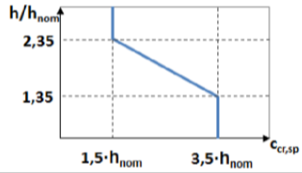
Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R

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

Annex C1

Deutsches Institut für Bautechnik DIBt

Table C1 continued

Splitting failure				
Effective embedment depth for calculation of $N_{Rk,sp}$ (TR 029, 5.2.2.6 respectively CEN/TS 1992-4:2009 part 5, 6.2.4)	h_{ef}	[mm]	h_{nom}	
Factor according to section 6.2.3 of CEN/TS 1992-4:2009 part 5	k_{cr} [2)]	[-]	7,2	
Factor according to section 6.2.3 of CEN/TS 1992-4:2009 part 5	k_{ucr} [2)]	[-]	10,1	
Edge distance $c_{cr,sp}$ [mm] for	$h / h_{nom} \geq 2{,}35$		$1{,}5 \cdot h_{nom}$	
	$2{,}35 > h / h_{nom} > 1{,}35$		$6{,}2 \cdot h_{nom} - 2{,}0 \cdot h$	
	$h / h_{nom} \leq 1{,}35$		$3{,}5 \cdot h_{nom}$	
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

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R

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

Annex C2

Deutsches Institut für Bautechnik DIBt

Table C2: Characteristic resistance for HIT-Z-(R) under shear load in case of static and quasi static loading

HIT-Z, HIT-Z-R			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 2)		1,0				
Characteristic resistance HIT-Z	$V_{Rk,s}$	[kN]	12	19	27	48	73
Characteristic resistance HIT-Z-R	$V_{Rk,s}$	[kN]	14	23	33	57	88
Steel failure with lever arm							
Characteristic resistance HIT-Z	$M^0_{Rk,s}$	[Nm]	24	49	85	203	386
Characteristic resistance HIT-Z-R	$M^0_{Rk,s}$	[Nm]	24	49	85	203	386
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]	h_{nom}				
Diameter of anchor	d 1) = d_{nom} 2)	[mm]	8	10	12	16	20

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

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R

Performances
Characteristic resistance under shear load - static and quasi-static loading
Design according to „EOTA Technical Report TR 029, 09/2010" or "CEN/TS 1992-4:2009"

Annex C3

Table C3: Displacements under tension load[1)] for HIT-Z-(R) in case of static and quasi static loading

HIT-Z, HIT-Z-R			M8	M10	M12	M16	M20
Non-cracked concrete							
Temperature range I: 40 °C / 24 °C							
Displacement	δ_{N0}-Factor	[mm/(N/mm²)]	0,03	0,03	0,04	0,05	0,07
Displacement	$\delta_{N\infty}$-Factor	[mm/(N/mm²)]	0,06	0,08	0,10	0,13	0,17
Temperature range I: 80 °C / 50 °C							
Displacement	δ_{N0}-Factor	[mm/(N/mm²)]	0,03	0,04	0,04	0,06	0,07
Displacement	$\delta_{N\infty}$-Factor	[mm/(N/mm²)]	0,07	0,09	0,11	0,15	0,18
Temperature range I: 120 °C / 72 °C							
Displacement	δ_{N0}-Factor	[mm/(N/mm²)]	0,03	0,04	0,05	0,06	0,08
Displacement	$\delta_{N\infty}$-Factor	[mm/(N/mm²)]	0,07	0,10	0,12	0,16	0,20
Cracked concrete							
Temperature range I: 40 °C / 24 °C							
Displacement	δ_{N0}-Factor	[mm/(N/mm²)]	0,06	0,07	0,08	0,09	0,10
Displacement	$\delta_{N\infty}$-Factor	[mm/(N/mm²)]	0,21				
Temperature range I: 80 °C / 50 °C							
Displacement	δ_{N0}-Factor	[mm/(N/mm²)]	0,07	0,08	0,08	0,10	0,11
Displacement	$\delta_{N\infty}$-Factor	[mm/(N/mm²)]	0,23				
Temperature range I: 120 °C / 72 °C							
Displacement	δ_{N0}-Factor	[mm/(N/mm²)]	0,07	0,08	0,09	0,11	0,12
Displacement	$\delta_{N\infty}$-Factor	[mm/(N/mm²)]	0,25				

[1)] Calculation of the displacement
$\delta N0 = \delta N0\text{-factor} \cdot \tau$; $\delta N\infty = \delta N\infty\text{-factor} \cdot \tau$;   ($\tau$: action bond strength).

Table C4: Displacements under shear load[1)] for HIT-Z-(R) in case of static and quasi static loading

HIT-Z, HIT-Z-R			M8	M10	M12	M16	M20
Displacement	δ_{V0}-Factor	[mm/kN]	0,06	0,06	0,05	0,04	0,04
Displacement	$\delta_{V\infty}$-Factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06

[1)] Calculation of the displacement
$\delta V0 = \delta V0\text{-factor} \cdot V$; $\delta V\infty = \delta V\infty\text{-factor} \cdot V$;   (V: action shear load)

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R

Performances
Displacements in case of static and quasi-static loading

Annex C4

Table C5: Characteristic resistance under tension load for HIT-Z-(R) in case of seismic performance category C1

HIT-Z, HIT-Z-R			**M8**	**M10**	**M12**	**M16**	**M20**
Installation safety factor	γ_2	[-]	1,0				
Steel failure							
Characteristic resistance HIT-Z	$N_{Rk,s,seis}$	[kN]	24	38	55	96	146
Characteristic resistance HIT-Z-R	$N_{Rk,s,seis}$	[kN]	24	38	55	96	146
Combined pull-out and concrete cone failure							
Characteristic bond resistance in cracked concrete C20/25							
Effective anchorage depth for calculation of $N_{Rk,p,seis}$	$h_{ef} = l_{Helix}$	[mm]	50	60	60	96	100
Temperature range I: 40 °C / 24 °C	$\tau_{Rk,seis}$	[N/mm²]	21				
Temperature range II: 80 °C / 50 °C	$\tau_{Rk,seis}$	[N/mm²]	19				
Temperature range III: 120 °C / 72 °C	$\tau_{Rk,seis}$	[N/mm²]	17				

Table C6: Characteristic resistance under shear load for HIT-Z-(R) in case of seismic performance category C1

HIT-Z, HIT-Z-R			**M8**	**M10**	**M12**	**M16**	**M20**
Steel failure							
Characteristic resistance HIT-Z	$V_{Rk,s,seis}$	[kN]	7	17	16	28	45
Characteristic resistance HIT-Z-R	$V_{Rk,s,seis}$	[kN]	8	19	22	31	48

Table C7: Displacements under tension load for HIT-Z-(R) in case of seismic performance category C1[1)]

HIT-Z, HIT-Z-R			**M8**	**M10**	**M12**	**M16**	**M20**
Displacement	$\delta_{N,seis}$	[mm]	1,2	1,9	1,7	1,3	1,8

[1)] Maximum displacement during cycling (seismic event).

Table C8: Displacements under shear load for HIT-Z-(R) in case of seismic performance category C1[1)]

HIT-Z, HIT-Z-R			**M8**	**M10**	**M12**	**M16**	**M20**
Displacement HIT-Z	$\delta_{V,seis}$	[mm]	4,0	5,0	4,9	4,3	5,5
Displacement HIT-Z-R	$\delta_{V,seis}$	[mm]	5,0	5,6	5,9	6,0	6,4

[1)] Maximum displacement during cycling (seismic event).

Table C9: Characteristic resistance under tension load for HIT-Z-(R) in case of seismic performance category C2

HIT-Z, HIT-Z-R			**M12**	**M16**
Installation safety factor	γ_2	[-]	1,0	
Steel failure				
Characteristic resistance HIT-Z	$N_{Rk,s,seis}$	[kN]	55	96
Characteristic resistance HIT-Z-R	$N_{Rk,s,seis}$	[kN]	55	96
Combined pull-out and concrete cone failure				
Characteristic bond resistance in cracked concrete C20/25				
Effective anchorage depth for calculation of $N_{Rk,p,seis}$	$h_{ef} = l_{Helix}$	[mm]	60	96
Temperature range I: 40 °C / 24 °C	$\tau_{Rk,seis}$	[N/mm²]	13	19
Temperature range II: 80 °C / 50 °C	$\tau_{Rk,seis}$	[N/mm²]	12	17
Temperature range III: 120 °C / 72 °C	$\tau_{Rk,seis}$	[N/mm²]	10	16

Table C10: Characteristic resistance under shear load for HIT-Z-(R) in case of seismic performance category C2

HIT-Z, HIT-Z-R			**M12**	**M16**
Steel failure				
Characteristic resistance HIT-Z	$V_{Rk,s,seis}$	[kN]	11	17
Characteristic resistance HIT-Z-R	$V_{Rk,s,seis}$	[kN]	16	21

Table C11: Displacements under tension load for HIT-Z-(R) in case of seismic performance category C2

HIT-Z, HIT-Z-R			**M12**	**M16**
Displacement DLS	$\delta_{N,seis(DLS)}$	[mm]	1,3	1,9
Displacement ULS	$\delta_{N,seis(ULS)}$	[mm]	3,2	3,6

Table C12: Displacements under shear load for HIT-Z-(R) in case of seismic performance category C2

HIT-Z, HIT-Z-R			**M12**	**M16**
Displacement DLS HIT-Z	$\delta_{V,seis(DLS)}$	[mm]	2,8	3,1
Displacement ULS HIT-Z	$\delta_{V,seis(ULS)}$	[mm]	4,6	6,2
Displacement DLS HIT-Z-R	$\delta_{V,seis(DLS)}$	[mm]	3,0	3,1
Displacement ULS HIT-Z-R	$\delta_{V,seis(ULS)}$	[mm]	6,2	6,2

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R

Performances
Characteristic resistances and displacements – seismic performance category C2
Design according to „EOTA Technical Report TR 045, 02/2013“

Annex C6