Technical Application Document

Technical Evaluation Report **3 / 13-749**

Injection system for rebar connections

Hilti HIT-HY 200-A
Hilti HIT-HY 200-R

Subject to European Technical Approval	**ETA-11/0492** **ETA-12/0083**

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Technical evaluation commission
(decree of March 21, 2012)

Technical department no. 3

Concrete and fastenings

Structures, floors and other structural parts

Reviewed on March 18, 2014

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The Technical Department no. 3 of the Technical Evaluation Commission examined on September 10, 2013 the injection system for rebar connection HIT-HY 200-A and HIT-HY 200-R presented by the company Hilti. This document, together with the attached Technical Documentation prepared by the applicant, represents the evaluation issued by the Technical Department, which summarises the complementary information for the user of the system, such as intended use as well as planning and installation instructions that are needed to ensure normal behaviour of the structures concerned. This report has been prepared for use in the European territory of France.

1. Brief definition

1.1 Brief description

The subject of this approval is the setting, by anchoring or overlap connection joint, of reinforcing bars (rebars) in new structures made of normal weight concrete, using the Hilti injection systems HIT-HY 200-A holder of European Technical Approval ETA-11/0492 or HIT-HY 200-R holder of European Technical Approval ETA-12/0083 in accordance with the regulations for concrete structures.

1.2 Placing on the market

Both Hilti injection systems HIT-HY 200-A and HIT-HY 200-R are subject of declarations of performance established by the manufacture on the basis of the European Technical Approvals ETA-11/0492 and ETA-12/0083 used as a European Technical Assessment.

1.3 Identification of the components

The injection system Hilti HIT-HY 200-A and HIT-HY 200-R are delivered in 330 ml and 550 ml cartridges. The product marking is in accordance with the specifications provided in the European Technical Approvals ETA-11/0492 and ETA-12/0083 respectively.

The injection system Hilti HIT-HY 200-A and HIT-HY 200-R differ only in how fast the curing starts (working time)

The products carry CE marking which contains all information specified in the European Technical Approvals ETA-11/0492 and ETA-12/0083 respectively.

2. ATTESTATION

2.1 Approved field of application

The product may be used only for the execution of new works or major repair works (new parts on new supports) of importance classes I, II or III according to the Eurocode 8, for seismic zones from 1 to 4, according to the updated regulation of October 22nd, 2010.

2.2 Assessment of the system

2.21 Compliance with all applicable laws and regulations and other requirements relating to fitness for use

Use in seismic zones

The system may be used for the execution of principal structural elements of buildings subject to the provisions of § 2.3 of this document and using the design method described in the technical documentation.

Fire protection

The system as such is not required to meet a fire protection criterion. The fire resistance requirements can be however obtained with the participation of an added fire protection. This should be appreciated by a laboratory and allow the limitation of the temperature of the mortar to the one defined in the ETA-11/0492 for the injection system HIT-HY 200-A and ETA-12/0083 for HY-HY 200-R injection system.

Thermal insulation

The HIT-HY 200-A and HIT-HY 200-R injection systems have no effect on the thermal performance of an existing conventional system using in-situ cast reinforcements.

Acoustic insulation

The HIT-HY 200-A and HIT-HY 200-R injection systems have no effect on the noise control rates of an existing conventional system using in-situ cast reinforcements.

Environment and health

There is no FDES while this document is written. It is here recalled that the FDES are not taken into account in the evaluation procedure of this application.

The product has a Material Safety Datasheet. The objective of this document is to inform the user about the process and its danger for the application and the different measures to adopt to avoid any of these dangers, by using appropriate personal protective equipment (PPE).

2.22 Durability / maintenance

The durability of the injection systems HIT-HY 200-A and HIT-HY 200-R are equivalent to that of conventional systems used under comparable conditions.

2.23 Manufacturing

The manufacturer, the company Hilti, shall implement a permanent factory production control schedule to supervise the production of the sealing resins. The manufacturer shall ensure the continued validity of the CE certificate of conformity by facilitating the application of an in-house quality control system.

2.24 Installation

The system shall be installed by a skilled worker.

2.3 Particular technical specifications

2.31 Design conditions

In order to be used outside seismic zone, the injection systems for post-installed rebars HIT-HY 200-A and HIT-HY 200-R shall be designed to meet the requirements described in European Technical Approvals ETA-11/0492 and ETA-12/0083 respectively; in particular the issues described in section 4.1 of the technical documentation shall be checked.

The injection system may be used for tensile and compression forces. It is not scheduled to work as a stud. Therefor the provisions of construction joints are necessary (see Technical Document).

When planning the structural works the design office shall review the specific properties of the system and calculate the reinforcements with a view to ensuring the transfer of loads within the structure.

The reinforcements for reinforced concrete shall have a specific elasticity limit which is lower than or equal to 500 MPa.

The resistance of the concrete structure shall be C20/25 minimum and C50/60 maximum.

Anchoring in existing structures that are subject to large-scale repair work shall be limited to the newly built parts.

2.32 Planning conditions where seismic is required

To ensure that the reinforcements have a specific elasticity limit below 500 MPa, the calculation of $l_{b,rqd,seism}$ as defined in the technical documentation shall be made using f_y=500MPa in order to ensure that the anchoring length of the reinforcement is not reduced.

When the normal force in a column is a tensile force, the anchor lengths must be increased by 50 % with reference to the lengths specified in EN 1992-1-1 for the part that is situated in the critical zone. Whenever possible, overlaps in the critical zone shall be avoided. In the overlap zones the transversal reinforcements shall comply with the tie bar measure resulting from the transmission of forces between the longitudinal bars.

The design load in the reinforcement bar $\sigma_{sd,seism}$ shall be calculated under combined seismic assumptions, with particular attention to compliance with § 4.4 - Verification of safety of EN 1998-1-1 (Eurocode 8).

2.33 Conditions of installation

The installation of the injection systems for post-installed rebars HIT-HY 200-A and HIT-HY 200-R shall be in accordance with the specifications provided in European Technical Approvals ETA-11/0492 and ETA-12/0083 respectively.

The holder of this attestation shall offer a training program on how to use the injection system, in particular to the companies which install the system (distribution of approvals, observance of the enclosed provisions, ...).

The concrete retakes should be done in such a way that the shear plan is within the poured concrete.

The control points of the table 4 of the Technical file should be documented using a jobsite control sheet.

Conclusions

Global assessment

The examination of the use of the system in the proposed field of application has produced a favorable assessment.

Validity

Same as European Technical Approval ETA-11/0492, i.e. until December 23 2016.

For the Technical Department no. 3
The President
R.LARQUETOUX

3. Complementary remarks of the Technical Department

Bore holes are made with hammer drilling (Hollow Drill Bits or standard drill bits) or compressed air drilling, and holes are cleaned with compressed air using the equipment listed in ETA-11/0492 and ETA-12/0083 respectively.

The structure in which the rebar is set shall be designed for seismic action and the reinforcement shall be designed to pick up the forces that are generated by the subsequently post-installed rebars.

The groups pointed out that this document can not be separated from ETA-11/0492 and ETA-12/0083 and all requirements from the ETAs shall be fulfilled.

The Examiner of Technical Department No. 3
Anca CRONOPOL

Technical documentation

prepared by the applicant

A. Description

1. Description

The Hilti injection systems HIT-HY 200-A and HIT-HY 200-R are used for the connection, by anchoring or overlap connection joint, of reinforcing bars (rebars) in new structures made with concrete of strength classes C20/25 to C50/60 (where seismic is required). The design for these post-installed rebars is performed in accordance with ETA-11/0492 and ETA-12/0083 respectively and EN 1992-1-1: October, 2005 (Eurocode 2).

2. Materials and elements

2.1 Resin HIT-HY 200-A and HIT-HY 200-R

The injection systems HIT-HY 200-A and HIT-HY 200-R are based on a two-component resin. These two components are kept separate in dual-component cartridges of 330 ml or 500 ml in accordance with Annex 1 of ETA-11/0492 and ETA-12/0083 respectively.

2.2 Reinforcement bars

The injection systems HIT-HY 200-A and HIT-HY 200-R are used with straight reinforcement bars with diameters ranging from 8 to 32 mm and properties complying with Annex C of EN 1992-1-1 and EN 10080. The characteristics are described in Annex 4 of ETA-11/0492 and ETA-12/0083 respectively.

3. Manufacturing and control

3.1 Production process

The resins HIT-HY 200-A and HIT-HY 200-R are manufactured in the Hilti plant of Kaufering with the aid of an automated production line. The plant has been certified acc. to ISO 9001 and ISO 14001 by the Swiss Association for Quality Management Systems.

3.2 Marking

The resins HIT-HY 200-A and HIT-HY 200-R are identified by a marking affixed to their packaging.

The marking indicates the name of the product, the production date and time, the expiry date, the number of the European Technical Approval and the number of the CE marking.

All cartridges containing HIT-HY 200-A and HIT-HY 200-R resins are individually packed in plastic bags containing both the mixing nozzle and the setting instructions.

3.3 Controls

The manufacturing of the resins HIT-HY 200-A and HIT-HY 200-R are under an internal production control system. All requirements and provisions applicable to the production process are systematically adopted in operating procedures and written rules. The manufacturing plant is audited by an independent body once a year within the framework of the follow-up audits for the CE marking.

4. Design

4.1 Design outside of seismic zones

For use outside of seismic zones, the injection systems for the post-installed rebars HIT-HY 200-A and HIT-HY 200-R shall be designed to meet the provisions of European Technical Approval ETA-11/0492 and ETA-12/0083 respectively verifying in particular:

- The position of the reinforcement in the part of the structure receiving the anchoring shall be determined on the basis of the as-built construction plans that were used for designing the anchoring.
- The design of post-installed rebar connections and determination of the internal section forces to be transferred in the construction joint shall be verified in accordance with EN 1992-1-1 at the same time as the design of the building.
- The verification of the local transfer of loads in the concrete shall be performed.
- The verification of the transfer of anchored loads in the structure shall be performed.
- The spacing between the post-installed rebars shall be greater than the maximum of $5d_s$ and 50mm according to ETA-11/0492 and ETA-12/0083 respectively.

  d_s = diameter of reinforcement bar
- The reference anchorage length $l_{b,rqd}$ required for transferring force $A_s.f_{yd}$ in the reinforcement bar where a hypothetical constant load equal to f_{bd} over the length of the bar is equal to:

  $l_{b,rqd}=(d_s/4).(\sigma_{sd}/f_{bd})$

  where:

  d_s = diameter of the rebar

  σ_{sd} = design stress in the rebar under design load

  f_{bd} = design bond strength (according to table 5 of annex 8 of European Technical Approval ETA-11/0492 and ETA-12/0083 respectively and as listed in table 1 of this DTA).
- The design anchorage length l_{bd} shall be determined according to EN 1992-1-1, section 8.4.3:

  $l_{bd} = \alpha_1\ \alpha_2\ \alpha_3\ \alpha_4\ \alpha_5\ l_{b,,rqd} \geq l_{b,min}$

  where:

  α_1 = 1.0 for straight bars

  α_2 = 1.0 as calculated acc. to EN 1992-1-1.Table 8.2.

  α_3 = 1.0 in the absence of transverse reinforcement

  α_4 = 1.0 in the absence of welded transverse reinforcement

  α_5 = between 0.7 and 1.0 for influence of transverse pressure acc. to EN 1992-1-1.Table 8.2.

  The product verifies $(\alpha_2.\alpha_3.\alpha_5) \geq 0.7$

  $l_{b,min}$ = minimum anchorage length according to EN 1992-1-1

  = Max (0.3 $l_{b,rqd}$; 10 d_s; 100mm) under tension

  = Max (0.6 $l_{b,rqd}$; 10 d_s; 100mm) under compression

  The permissible maximum anchoring length is specified in European Technical Approval ETA-11/0492 and ETA-12/0083 respectively.
- The design lap length l_{bd} shall be determined according to EN 1992-1, section 1.8.7:

  $l_0 = \alpha_1\ \alpha_2\ \alpha_3\ \alpha_5\ \alpha_6\ l_{b,,rqd} \geq l_{b,min}$

  where:

  α_1 = 1.0 for straight bars

  α_2 = 1.0 as calculated acc. to EN 1992-1-1.Table 8.2.

  α_3 = 1.0 in the absence of transverse reinforcement

  α_5 = between 0.7 and 1.0 for influence of transverse pressure acc. to EN 1992-1-1.Table 8.2.

  α_6 = between 1.0 and 1.5 for influence of percentage of lapped length relative to total cross-section area according to EN 1992-1-1 Table 8.3.

  $l_{0,min}$ = minimum lap length according to EN 1992-1-1

  = Max ($0.3.\alpha_6.l_{b,rqd}$; 15 ϕ; 200mm)

  The permissible maximum anchorage length is specified in European Technical Approval ETA-11/0492 and ETA-12/0083 respectively.

4.2 Design where seismic is required

For use in seismic zones, the injection system for the anchoring of reinforcement bars HIT-HY 200-A and HIT-HY 200-R shall be designed by verifying in particular:

- Use of the system is limited to new constructions or structures undergoing major repair work
- The structure in which the rebar is set shall be designed for seismic action and the reinforcement shall be designed to pick up the forces that are generated by the subsequently post-installed rebars.
- The design study shall be performed at the same time as the reinforcement of the initial structure is tested.

- The process can be used to take some traction or compression stresses. The application is not designed to work as a stud.
- The calculation of the post-installed rebar and the determination of the internal forces shall be performed in accordance with EN 1992-1-1 (Eurocode 2) and EN 1998-1-1 (Eurocode 8), and shall coincide with the design of the structure.
- The loads applied to the reinforcements taking account of the acceleration shall be the responsibility of the design office. The office may decide to set additional reinforcements or greater anchorage lengths.
- The verification of the local transfer of loads in the concrete shall be performed.
- The verification of the transfer of anchored loads in the structure shall be performed.
- The distance between the reinforcement bars shall be greater than the maximum of $5d_s$ and 50mm acc. to European Technical Approval ETA-11/0492 and ETA-12/0083 respectively.

  d_s = diameter of rebar
- The basic anchorage length $l_{b,rqd,\ seism}$ required for transferring force $A_s.f_{yd}$ in the reinforcement bar where a hypothetical constant load equal to $f_{bd,\ seism}$ over the length of the bar is equal to:

  $l_{b,rqd,seism}=(d_s/4).(\sigma_{sd,seism}/f_{bd,seism})$

  where:

  d_s = diameter of the rebar

  $\sigma_{sd,seism}$ = design stress in the reinforcement bar calculated according to § 4.4 - Verification of safety of EN 1998-1-1 (EC 8)

  $f_{bd,seism}$ = design bond strength in seismic zones as listed in table 2 of this DTA
- The design anchorage length $l_{bd,seism}$ shall be determined using the following formula:

  $l_{bd,seism} = \alpha_1\ \alpha_2\ \alpha_3\ \alpha_4\ \alpha_5\ l_{b,rqd,seism} \geq l_{b,min,seism}$

  where:

  α_1 = 1.0 for straight bars

  α_2 = 1.0 as calculated acc. to EN 1992-1-1.Table 8.2.

  α_3 = 1.0 even in the presence of transverse reinforcement

  α_4 = 1.0 in the absence of welded transverse reinforcement

  α_5 = between 0.7 and 1.0 for influence of transverse pressure according to EN 1992-1-1.Table 8.2.

  The product verifies $(\alpha_2.\alpha_3.\alpha_5) \geq 0.7$

  $l_{b,min,\ seism}$= minimum anchorage length

  $l_{b,min,\ seism}$ = Max (0.3 $l_{b,rqd,seism}$; 10 d_s; 100mm) under tension

  = Max (0.6 $l_{b,rqd,seism}$; 10 d_s; 100mm) under compression

  The permissible maximum anchorage depth is specified in European Technical Approval ETA-11/0492 and ETA-12/0083 respectively.
- The design lap length l_{bd} shall be determined according to EN 1992-1-1, section 8.7.3:

  $l_{bd,seism} = \alpha_0\ \alpha_1\ \alpha_2\ \alpha_3\ \alpha_5\ l_{b,rqd,seism} \geq l_{b,min,seism}$

  where:

  α_1 = 1.0 for straight bars

  α_2 = 1.0 as calculated acc. to EN 1992-1-1.Table 8.2.

  α_3 = 1.0 even in the presence of transverse reinforcement

  α_5 = between 0.7 and 1.0 for influence of transverse pressure compression acc. to EN 1992-1-1.Table 8.2.

  α_6 = between 1.0 and 1.5 for influence of percentage of lapped length relative to total cross-section area according to EN 1992-1-1 Table 8.3.

  $l_{0,min,\ seism}$= minimum lap length

  $l_{0,min,seism}$ = Max (0.3.α_6.$l_{b,rqd,seism}$; 15 ϕ; 200mm)

  The permissible maximum anchorage depth is specified in European Technical Approval ETA-11/0492 and ETA-12/0083 respectively.

  When the normal force in a column is a tensile force, the anchorage length shall be increased by 50 % with reference to the lengths specified in EN 1992-1-1 for the part that is situated in the critical zone.

A table with pre-calculated values is provided in Table 3 of this DTA.

5. Installation

5.1 Construction site phases

The decision to design for seismic zone is taken by the site supervisor, who commissions the design office.

The design office calculates the stresses acting on the bars (taking account of the acceleration applicable to the respective zone) and determines the anchorage length of the post-installed rebars using the formulas quoted in this DTA. The office is free to contact the company Hilti for dimensioning support.

The design office checks the structure for its aptitude to pick up the loads and the tie bars for proper design engineering.

5.2 Setting procedure

The installation of the injection system for rebar connection HIT-HY 200-A and HIT-HY 200-R shall be performed according to the setting instructions provided by the manufacturer and the annexes of ETA-11/0492 and ETA-12/0083 respectively.

Bore holes are made with hammer drilling, compressed air drilling, or the TE-CD or TE-YD hollow drill-bit, or a TE-C or a TE-Y drill-bit. If needed, holes shall be cleaned with compressed air using the equipment listed in ETA-11/0492 and ETA-12/0083. Diamond coring is not covered by the present DTA.

5.3 Operating procedure

The installation of the reinforcement bars shall be performed by a skilled worker.

Hilti may provide training for workers via Hilti representatives or key project managers having the required expertise and a license to provide training courses on post-installed rebars in concrete.

Participants in these training courses are required to sign an attendance list which will be forwarded to the quality department of Hilti France, which will then issue training certificates.

Training will cover the following issues:

- Drilling of bore holes of appropriate diameter and length (indicated on the plans)
- Cleaning the bore hole in compliance with the requirements of ETA-11/0492 and ETA-12/0083 (proper use of tools and accessories and observance of procedure)
- Injection of the resin in compliance with the requirements of ETA-11/0492 and ETA-12/0083 (proper use of tools and accessories and observance of procedure)

5.4 Aspects to observe for proper setting

Table 4 of this DTA offers a checklist of items to be checked in order to ensure the correct settings of reinforcement bars.

B. Experimental results

Within the framework of the issuance of ETA-11/0492 and ETA-12/0083, the systems HIT-HY 200-A and HIT-HY 200-R have been the subject of test reports of the laboratory KIWA-Bautest, n° A9036-44/2010 and n° A9036-50/2010 (laboratory DAkks-accredited under the no. D-PL-11217-02-00). These tests were performed in accordance with the European Technical Approval Guideline ETAG001 + Technical Report TR023 relating to post-installed rebars and the American code AC308 (Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Element) for the part relating to seismic tests.

C. References

C1. Health, safety, environment

The HIT-HY 200-A and HIT-HY 200-R are not covered by a *Fiche de Déclaration Environmentale et Sanitaire* (FDES).

The data coming from the FDES have as a goal to estimate and calculate the environmental impact of the works where the mentioned products (or processes) have a possibility to be used.

C2. Other references

The systems HIT-HY 200-A and HIT-HY 200-R which are the subject of this technical documentation have been in production since 01/01/2012. By 31/08/2013, this accounted for a volume of 347,322,000 ml already installed in France.

The systems HIT-HY 200-A and HIT-HY 200-R described in the present document have been used in France in the following projects:

Lyon: rehabilitation of old Hospital; foundations

Monaco: renovation of building "Le Neptune"

Montpellier: Hilot H, diaphragm walls and 8 buildings type ERP; 2100 foil packs used.

High-speed line Rennes-Le Mans: 182km of roads, 32 km of various connections.

High-speed line Poitiers: bridges and tunnels; 300 foil packs used.

Airbus Toulouse: Assembly hall, 600 foil packs used.

Description of product and intended use

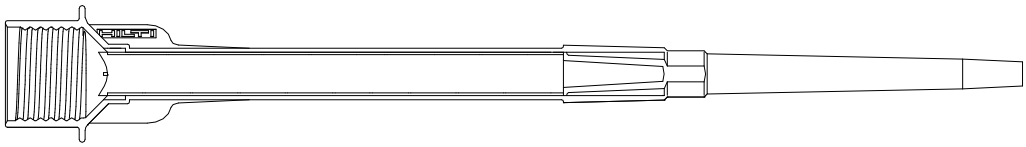
The post-installed rebar connection consists of the injection system Hilti HIT-HY 200-A or HIT-HY 200-R and a straight reinforcement bar with properties corresponding to classes B and C in accordance with annex C of Eurocode 2 (EC2).

Injection system HIT-HY 200-A and HIT-HY 200-R:

Marking:
Hilti HIT-HY 200-A or
Hilti HIT-HY 200-R
Production date
Production time
Expiry date

Foil pack:
330 ml and 500 ml

Static mixer Hilti HIT-RE-M:



Reinforcing bar in conformity with EC2:

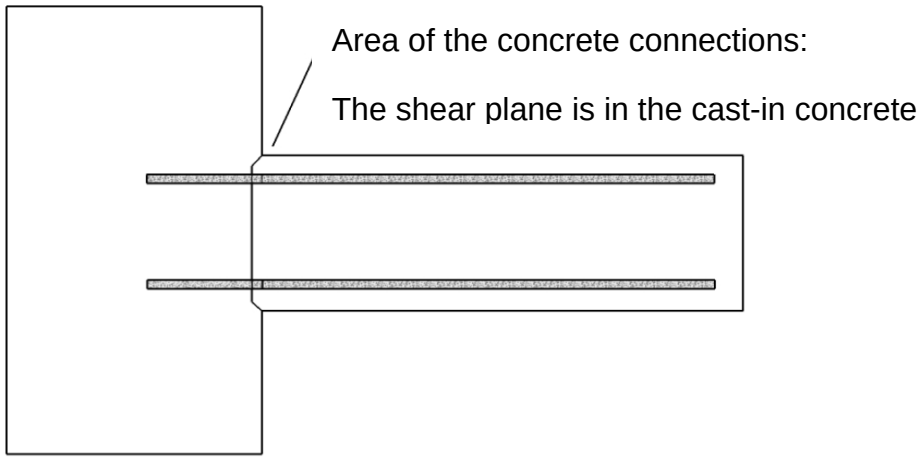
Covered are post-installed rebar connections in non-carbonated concrete on the assumption only that the design of post-installed rebar connections is done in accordance to EN 1992-1-1.

Installation in dry or wet concrete, it must not installed in flooded holes

Temperature range: -40 °C to +80 °C

(maximum long term temperature +50 °C and maximum short term temperature +80 °C)

Concrete connections



Example to illustrate how to ensure monolithic behavior avoiding the load transfer as a

Design bond strength

Table 1: Design values of bond strength f_{bd} in N/mm² where seismic is not required

hammer drilling or compressed air drilling acc. to EC 2 for good bond conditions
(for all other bond conditions, multiply the values by 0.7)

Rebar Ø	Concrete class						
d_s	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 mm	2,3	2,7	3,0	3,4	3,7	4,0	4,3
10 mm	2,3	2,7	3,0	3,4	3,7	4,0	4,3
12 mm	2,3	2,7	3,0	3,4	3,7	4,0	4,3
14 mm	2,3	2,7	3,0	3,4	3,7	4,0	4,3
16 mm	2,3	2,7	3,0	3,4	3,7	4,0	4,3
18 mm	2,3	2,7	3,0	3,4	3,7	4,0	4,3
20 mm	2,3	2,7	3,0	3,4	3,7	4,0	4,3
22 mm	2,3	2,7	3,0	3,4	3,7	4,0	4,3
24 mm	2,3	2,7	3,0	3,4	3,7	4,0	4,3
25 mm	2,3	2,7	3,0	3,4	3,7	4,0	4,3
26 mm	2,3	2,7	3,0	3,4	3,7	4,0	4,3
28 mm	2,3	2,7	3,0	3,4	3,7	4,0	4,3
30 mm	2,3	2,7	3,0	3,4	3,7	4,0	4,3
32 mm	2,3	2,7	3,0	3,4	3,7	4,0	4,3

Table 2: Design values of bond strength fbd,seism in N/mm² where seismic is required

hammer drilling or compressed air drilling acc. to EC 2 for good bond conditions
(for all other bond conditions, multiply the values by 0.7)

Rebar Ø	Concrete class						
d_s	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 mm	2,3	2,7	2,7	2,7	2,7	2,7	2,7
10 mm	2,3	2,7	2,7	2,7	2,7	2,7	2,7
12 mm	2,3	2,7	2,7	2,7	2,7	2,7	2,7
14 mm	2,3	2,7	2,7	2,7	2,7	2,7	2,7
16 mm	2,3	2,7	2,7	2,7	2,7	2,7	2,7
18 mm	2,3	2,7	2,7	2,7	2,7	2,7	2,7
20 mm	2,3	2,7	2,7	2,7	2,7	2,7	2,7
22 mm	2,3	2,7	2,7	2,7	2,7	2,7	2,7
24 mm	2,3	2,7	2,7	2,7	2,7	2,7	2,7
25 mm	2,3	2,7	2,7	2,7	2,7	2,7	2,7
26 mm	2,3	2,7	2,7	2,7	2,7	2,7	2,7
28 mm	2,3	2,7	2,7	2,7	2,7	2,7	2,7
30 mm	2,3	2,7	2,7	2,7	2,7	2,7	2,7
32 mm	2,3	2,7	2,7	2,7	2,7	2,7	2,7

Pre-calculated values

Table 3: Pre-calculated values for post-installed rebars using Hilti HIT-HY 200-A or HIT-HY 200-R where seismic is required

Examples of C20/25, good bond conditions, rebar yield strength 500 N/mm² with hammer drilling for all drilling methods

Rebar diameter	Hole diameter	Load applied to bar under accidental seismic action	Anchorage length	Mortar volume	Load applied to bar under accidental seismic action	Anchorage length	Mortar volume
mm	mm	daN	mm	ml	daN	mm	ml
		All α = 1			One of the α = 0.7		
8	12 (10)	754	130	10 (4)	1,077	130	10 (4)
		1,156	200	15 (7)	1,404	170	13 (6)
		1,619	280	21	1,734	210	16 (7)
		2,023	350	26	2,147	260	20
		2,513	435	33	2,513	304	23
10	14 (12)	1,178	163	15 (7)	1,683	163	15 (7)
		1,806	250	23 (10)	2,168	210	19 (9)
		2,529	350	32	2,787	270	24
		3,179	440	40	3,303	320	29
		3,927	543	49	3,927	380	34
12	16 (14)	1,696	196	21 (10)	2,424	196	21 (10)
		2,601	300	32	3,221	260	27
		3,642	420	44	3,964	320	34
		4,596	530	56	4,831	390	41
		5,655	652	69	5,655	457	48
14	18	2,309	228	28	3,299	228	28
		3,642	360	43	4,335	300	36
		4,957	490	59	5,492	380	46
		6,272	620	75	6,503	450	54
		7,697	761	92	7,697	533	64
16	20	3,016	261	35	4,308	261	35
		4,740	410	56	5,615	340	46
		6,474	560	76	7,102	430	58
		8,208	710	96	8,588	520	71
		10,053	870	118	10,053	609	83
20	25	4,712	326	69	6,732	326	69
		7,081	490	104	8,464	410	87
		9,538	660	140	10,529	510	108
		11,995	830	176	12,387	600	127
		14,541	1,000	212	14,451	700	148
25	32	7,363	408	153	10,519	408	153
		9,935	550	207	12,387	480	181
		12,645	700	263	14,193	550	207
		15,355	850	320	16,000	620	233
		18,064	1,000	376	18,064	700	263
32	40	12,064	522	283	17,234	522	283
		14,798	640	347	18,498	560	304
		17,573	760	413	20,149	610	331
		20,347	880	478	21,471	650	353
		23,122	1,000	543	23,122	700	380

NOTE: The required volume of resin, calculated by increasing the theoretical volume by 20% in order to account for any losses occurring on site during the setting.

For small diameters (10, 12 and 14), the bracketed values correspond to the minimum drilling diameter when the anchor length is below 250 mm.

Table 4: Aspects to observe for proper setting

There is a certain number of parameters which cannot be controlled subsequently. It is recommended that such parameters are checked prior to the injection of the resin. If this is not possible, the table below offers recommendations for subsequent control.

Element to be verified	**Type of verification**	**Prerequisites**
1. Recommended injection depth	Information available at the construction site level	Design by a design office is mandatory, and the results shall be forwarded to the construction site.
2. Correspondence of diameter of bar with diameter of drilling	Geometry	According to table below

Nominal diameter of HA bar d_s **(mm)**	8	10	12	14	16	18	20	22	24	25	26	28	30	32
Drilling with hammer drill (mm)	12	14	16	18	20	22	25	28	32	32	35	35	37	40
All drill holes with lengths of anchoring below 250 mm	10	12	14	-	-	-	-	-	-	-	-	-	-	-

3. Quantity of injected resin	The resin must spill over the hole	
4. Verification of the availability of tools and accessories required for setting and cleaning	Drills and machines for the required drilling diameter and injection depth Compressed air, air nozzle and metal brush of appropriate diameter Injection nozzle	Diameter of bar, bore hole and depth of injection Cleaning using compressed air is mandatory If injection depth greater than 250 mm

Rebar diameter	**Hole diameter**	**Air nozzle HIT-DL**	**Round metal brush HIT-RB**	**Injection nozzle HIT-SZ**
				
d_s**(mm)**	**(mm)**	**Designation**	**Designation**	**Designation**
8	10	HIT-DL 10	HIT-RB 10	HIT-SZ 10
	12	HIT-DL 12	HIT-RB 12	HIT-SZ 12
10	12	HIT-DL 12	HIT-RB 12	HIT-SZ 12
	14	HIT-DL 14	HIT-RB 14	HIT-SZ 14
12	14	HIT-DL 14	HIT-RB 14	HIT-SZ 14
	16	HIT-DL 16	HIT-RB 16	HIT-SZ 16
14	18	HIT-DL 18	HIT-RB 18	HIT-SZ 18
16	20	HIT-DL 20	HIT-RB 20	HIT-SZ 20
18	22	HIT-DL 22	HIT-RB 22	HIT-SZ 22
20	25	HIT-DL 25	HIT-RB 25	HIT-SZ 25
22	28	HIT-DL 28	HIT-RB 28	HIT-SZ 28
24	32	HIT-DL 32	HIT-RB 32	HIT-SZ 32
25	32	HIT-DL 32	HIT-RB 32	HIT-SZ 32
26	35	HIT-DL 32	HIT-RB 35	HIT-SZ 35
28	35	HIT-DL 32	HIT-RB 35	HIT-SZ 35
30	37	HIT-DL 32	HIT-RB 37	HIT-SZ 37
32	40	HIT-DL 32	HIT-RB 40	HIT-SZ 40

5. Mortar	Expiry date (if there are remaining cartridges)	