Deutsches Institut für Bautechnik

Zulassungsstelle für Bauprodukte und Bauarten

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Authorised and notified according to Article 10 of the Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products (89/106/EEC)

Deutsches Institut für Bautechnik

DIBt

Mitglied der EOTA
Member of EOTA

European Technical Approval ETA-08/0105

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung *Trade name*		Injektionssystem Hilti HIT-RE 500 für Bewehrungsanschluss *Injection System Hilti HIT-RE 500 for rebar connection*
Zulassungsinhaber *Holder of approval*		Hilti Aktiengesellschaft Business Unit Anchors 9494 Schaan FÜRSTENTUM LIECHTENSTEIN
Zulassungsgegenstand und Verwendungszweck *Generic type and use of construction product*		Nachträglich eingemörtelter Bewehrungsanschluss mit Hilti Injektionsmörtel HIT-RE 500 *Post-installed rebar connections with Hilti injection mortar HIT-RE 500*
Geltungsdauer: *Validity:*	vom *from* bis *to*	12 October 2012 8 May 2013
verlängert *extended*	vom *from* bis *to*	9 May 2013 9 May 2018
Herstellwerk *Manufacturing plant*		Hilti Werke

Diese Zulassung umfasst *This Approval contains*	32 Seiten einschließlich 22 Anhänge *32 pages including 22 annexes*

I LEGAL BASES AND GENERAL CONDITIONS

1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1], modified by Council Directive 93/68/EEC[2] and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council[3];
- Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998[4], as amended by Article 2 of the law of 8 November 2011[5];
- Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC[6];
- Guideline for European technical approval of "Metal anchors for use in concrete - Part 5: Bonded anchors", ETAG 001-05.

2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.

3 This European technical approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European technical approval.

4 This European technical approval may be withdrawn by Deutsches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.

5 Reproduction of this European technical approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of Deutsches Institut für Bautechnik. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European technical approval.

6 The European technical approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

1 Official Journal of the European Communities L 40, 11 February 1989, p. 12
2 Official Journal of the European Communities L 220, 30 August 1993, p. 1
3 Official Journal of the European Union L 284, 31 October 2003, p. 25
4 *Bundesgesetzblatt Teil I 1998*, p. 812
5 *Bundesgesetzblatt Teil I 2011*, p. 2178
6 Official Journal of the European Communities L 17, 20 January 1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product/ products and intended use

1.1 Definition of the construction product

The subject of this approval is the post-installed connection, by anchoring or overlap connection joint, of reinforcing bars (rebars) in existing structures made of normal weight concrete, using the Hilti HIT-RE 500 injection mortar in accordance with the regulations for reinforced concrete construction.

Reinforcing bars made of steel with a diameter d_s from 8 to 40 mm according to Annex 4 or the Hilti tension anchor HZA-R sizes M12, M16, M20 and M24 according to Annex 6 and Hilti HIT-RE 500 injection mortar are used for Hilti rebar connections. The steel element is placed into a drilled hole filled with injection mortar and is anchored via the bond between embedded element, injection mortar and concrete.

1.2 Intended use

The rebar connection may be used in normal weight concrete of a minimum grade of C12/15 and maximum grade C50/60 according to EN 206-1:2000. It may be used in non-carbonated concrete with the allowable chloride content in concrete of 0.40% (CL 0.40) related to the cement content according to EN 206-1.

Rebar connections with reinforcing bars and Hilti tension anchor HZA-R may be used for predominantly static loads.

The fire resistance of post-installed rebar connections is not covered by this European technical approval. Fatigue, dynamic or seismic loading of post-installed rebar connections are not covered by this European technical approval.

Rebar connections may only be carried out in a manner, which is also possible with cast-in straight reinforcing bars, e.g. those in the following applications (see Annex 2):

- an overlap joint with existing reinforcement in a building component (Figures 1 and 2),
- anchoring of the reinforcement at a slab or beam support, (e.g. according to Figure 3: end support of a slab, designed simply supported, as well as an appropriate general reinforcement for restraint forces),
- anchoring of reinforcement of building components stressed primarily in compression (Figure 4),
- anchoring of reinforcement to cover the envelope line of tensile force in the bending member (Figure 5).

The post-installed rebar connections may be used in the temperature range of -40 °C to +80 °C (max short term temperature +80 °C and max long term temperature +50 °C).

This European technical approval covers anchoring in bore holes made with hammer drilling hollow drilling, compressed air drilling or diamond (dry or wet) drilling technique. The post-installed rebar connection may be installed in dry or wet concrete. It must not be installed in flooded holes.

Rebar connections with the Hilti tension anchor HZA-R may be used for the transmission of tensile forces in the direction of the bar axis only. The transmission of shear forces has to be ensured by appropriate measures. Examples for the application are given in Annex 3, Figures 6 to Figure 8.

- The tension anchor HZA-R made of stainless steel may be used in structures subject to dry internal conditions and also in structures subject to external atmospheric exposure (including industrial and marine environment), or exposure to permanently damp internal conditions, if no particular aggressive conditions exist. Such 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 materials are used).

The provisions made in this European technical approval are based on an assumed working life of the post-installed rebar connection of 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.

2 Characteristics of the product and methods of verification

2.1 Characteristics of the product

The post-installed rebar connection corresponds to the drawings and provisions given in Annexes 1 to 7. The characteristic material values, dimensions and tolerances not indicated in Annexes 1 to 7 shall correspond to the respective values laid down in the technical documentation[7] of this European technical approval.

The two components of the injection mortar are delivered in unmixed condition in foil packs of sizes 330 ml, 500 ml or 1400 ml according to Annex 13. Each foil pack is marked with the identifying mark "HILTI HIT-RE 500" with the production date and expiry date.

The rebar shall comply with the specifications given in Annex 4. The Hilti tension anchor HZA-R shall comply with the specifications given in Annex 6. Each tension anchor with connecting thread made of stainless steel is marked with "HZA-R" according to Annex 6.

2.2 Methods of verification

The assessment of fitness of the post-installed rebar connection for the intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 has been made in accordance with the "Guideline for European technical approval of Metal Anchors for use in concrete", Part 1 "Anchors in general" and Part 5 "Bonded anchors" and EOTA Technical Report TR 023 "Assessment of post-installed rebar connections"[8].

In addition to the specific clauses relating to dangerous substances contained in this European technical approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

[7] The technical documentation of this European technical approval is deposited at the Deutsches Institut für Bautechnik and, as far as relevant for the tasks of the approved bodies involved in the attestation of conformity procedure, is handed over to the approved bodies.

[8] The Technical Report TR 023 "Assessment of post-installed rebar connections" is published on EOTA website www.EOTA.eu.

3 Evaluation and attestation of conformity and CE marking

3.1 System of attestation of conformity

According to the Decision 96/582/EC of the European Commission[9] system 2(i) (referred to as System 1) of the attestation of conformity applies.

This system of attestation of conformity is defined as follows:

System 1: Certification of the conformity of the product by an approved certification body on the basis of:

(a) Tasks for the manufacturer:

(1) factory production control;

(2) further testing of samples taken at the factory by the manufacturer in accordance with a control plan;

(b) Tasks for the approved body:

(3) initial type-testing of the product;

(4) initial inspection of factory and of factory production control;

(5) continuous surveillance, assessment and approval of factory production control.

Note: Approved bodies are also referred to as "notified bodies".

3.2 Responsibilities

3.2.1 Tasks for the manufacturer

3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European technical approval.

The manufacturer may only use initial/raw/constituent materials stated in the technical documentation of this European technical approval.

The factory production control shall be in accordance with the control plan which is part of the technical documentation of this European technical approval. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited with Deutsches Institut für Bautechnik.[10]

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

3.2.1.2 Other tasks for the manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in the field of anchors in order to undertake the actions laid down in section 3.2.2 For this purpose, the control plan referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of this European technical approval.

9 Official Journal of the European Communities L 254 of 08.10.1996

10 The control plan is a confidential part of the European technical approval and only handed over to the approved body involved in the procedure of attestation of conformity. See section 3.2.2.

3.2.2 Tasks for the approved bodies

The approved body shall perform the

- initial type-testing of the product,
- initial inspection of factory and of factory production control,
- continuous surveillance, assessment and approval of factory production control,

in accordance with the provisions laid down in the control plan.

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the product stating the conformity with the provisions of this European technical approval.

In cases where the provisions of the European technical approval and its control plan are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform Deutsches Institut für Bautechnik without delay.

3.3 CE marking

The CE marking shall be affixed on each packaging of the injection mortar. The letters "CE" shall be followed by the identification number of the approved certification body, where relevant, and be accompanied by the following additional information:

- the name and address of the producer (legal entity responsible for the manufacture),
- the last two digits of the year in which the CE marking was affixed,
- the number of the EC certificate of conformity for the product,
- the number of the European technical approval,
- the number of the guideline for European technical approval.

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The European technical approval is issued for the product on the basis of agreed data/information, deposited with Deutsches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval shall be necessary.

4.2 Drafting

Rebar connections must be designed in keeping with good engineering practice. Considering the loads to be anchored, design calculations and design drawings must be produced which can be checked. At least the following items must be stated in the design drawings:

- grade of concrete strength,
- diameter, drilling technique, concrete cover, spacing and embedment depth of the rebar,
- length for markings ℓ_m and ℓ_v respectively $\ell_{e,ges}$ on the injection extension according to Annex 14,

- use of a guide device (drilling aid) for drilling holes close to edges (if necessary),
- kind of preparation of the joint between building component being connected including the diameter and thickness of concrete layer that has to be removed.

4.3 Design

4.3.1 General

- The actual position of the reinforcement in the existing structure shall be determined on the basis of the construction documentation and taken into account when designing.

The design of post-installed rebar connections according to Annex 2 and determination of the internal section forces to be transferred in the construction joint shall be verified in accordance with EN 1992-1-1:2004. When ascertaining the tensile force in the rebar, allowance shall be made for the statically effective height of the bonded-in reinforcement.

Hilti tension anchor HZA-R according to Annexes 6 and 7 shall be designed for the welded-on reinforcement steel B500B. The length of the bonded-in smooth shaft made of stainless steel may not be accounted as anchorage.

The verification of the immediate local force transfer to the concrete has been provided.

The verification of the transfer of the loads to be anchored to the building component shall be provided.

The spacing between post-installed rebars respectively Hilti tension anchor HZA-R shall be greater than the minimum of 5 d_s and 50 mm (according to Annex 5 respectively Annex 7).

4.3.2 Determination of the basic anchorage length

The required basic anchorage length $\ell_{b,rqd}$ shall be determined in accordance with EN 1992-1-1, Section 8.4.3:

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

with: d_s = diameter of the rebar

σ_{sd} = calculated design stress of the rebar

f_{bd} = design value of bond strength according to Annex 9, Table 5 or 6 in consideration of the coefficient related to the quality of bond conditions and of the coefficient related to the bar diameter and of the drilling technique

4.3.3 Determination of the design anchorage length

The required design anchorage length ℓ_{bd} shall be determined in accordance with EN 1992-1-1, Section 8.4.4:

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

with: $\ell_{b,rqd}$ = according to section 4.3.2

α_1 = 1.0 for straight bars

α_2 = 0.7…1.0 calculated acc. to EN 1992-1-1, Table 8.2

α_3 = 1.0 because of no transverse reinforcement

α_4 = 1.0 because of no welded transverse reinforcement

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

$\ell_{b,min}$ = minimum anchorage length acc. to EN 1992-1-1

= max {0.3 $\ell_{b,rqd}$; 10d_s; 100 mm} under tension

= max {0.6 $\ell_{b,rqd}$; 10d_s; 100 mm} under compression

In case of diamond wet drilling multiply the values by 1.5.

The maximum permissible anchorage depth is given in Annex 18 in relation to the dispenser to be used.

4.3.4 Overlap joints

The required design lap length ℓ_0 shall be determined in accordance with EN 1992-1-1, Section 8.7.3:

$\ell_0 = \alpha_1 \cdot \alpha_2 \cdot \alpha_3 \cdot \alpha_5 \cdot \alpha_6 \ell_{b,rqd} \geq \ell_{0,min}$

with: $\ell_{b,rqd}$ = according to Section 4.3.2

α_1 = 1.0 for straight bars

α_2 = 0.7…1.0 calculated acc. to EN 1992-1-1, Table 8.2

α_3 = 1.0 because of no transverse reinforcement

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

α_6 = 1.0…1.5 for influence of percentage of lapped bars relative to the total cross-section area acc. to EN 1992-1-1, Table 8.3

$\ell_{0,min}$ = minimum lap length acc. to EN 1992-1-1

= max {$0.3 \cdot \alpha_6 \ell_{b,rqd}$; $15 d_s$; 200 mm}

In case of diamond wet drilling multiply the values by 1.5.

The maximum permissible anchorage depth is given in Annex 18 in relation to the dispenser to be used.

4.3.5 Embedment depth for overlap joints

Overlap joint for rebars:

For calculation of the effective embedment depth of overlap joints the concrete cover at end-face of bonded-in rebar c_1 shall be considered (see Annex 5, Figure 10):

$\ell_v \geq \ell_0 + c_1$

with: ℓ_0 = required lap length acc. to Section 4.3.4 and to EN 1992-1-1

c_1 = concrete cover at end-face of bonded-in rebar (see also Annex 5)

If the clear distance between the overlapping rebars is greater than 4 d_s the lap length shall be enlarged by the difference between the clear distance and 4 d_s.

Overlap joint for Hilti tension anchor HZA-R:

The effective embedment depth is the same like the lap length $\ell_v = \ell_0$ (see Annex 7, Figure 12).

The total embedment depth $\ell_{e.ges}$ shall be determined as follows (see Annex 7, Figure 12):

$\ell_{e.ges} \geq \ell_0 + \ell_e$

with: ℓ_0 = required lap length acc. to Section 4.3.4 and to EN 1992-1-1

ℓ_e = length of the smooth shaft (see also Annex 7), $\ell_e > c_1$

If the clear distance between overlapping rods exceeds 4 d_s, the overlap length shall be increased by the difference between the actual clear distance and 4 d_s.

4.3.6 Concrete cover

The concrete cover required for bonded-in rebars and Hilti tension anchor HZA-R is shown in Annex 8, Table 3, in relation to the drilling method and the hole tolerance.

Furthermore the minimum concrete cover given in EN 1992-1-1, Section 4.4.1.2 shall be observed.

4.3.7 Transverse reinforcement

The requirements of transverse reinforcement in the area of the post-installed rebar connection or of the Hilti tension anchor HZA-R connection shall comply with EN 1992-1-1, Section 8.7.4.

4.3.8 Connection joint

- The transfer of shear forces between new concrete and existing structure shall be designed according to EN 1992-1-1. The joints for concreting must be roughened to at least such an extent that aggregate protrude.

In case of a carbonated surface of the existing concrete structure the carbonated layer shall be removed in the area of the post-installed rebar connection with a diameter of d_s + 60 mm prior to the installation of the new rebar.

The depth of concrete to be removed shall correspond to at least the minimum concrete cover for the respective environmental conditions in accordance with EN 1992-1-1.

The foregoing may be neglected if building components are new and not carbonated and if building components are in dry conditions.

4.4 Installation

The fitness for use of the post-installed rebar connection can only be assumed if the rebar respectively the Hilti tension anchor HZA-R is installed as follows:

- the installation of post-installed rebar respectively Hilti tension anchor HZA-R shall be done only by suitable trained installer and under supervision on site; the conditions under which an installer may be considered as suitable trained and the conditions for supervision on site are up to the Member States in which the installation is done,
- use of the injection system only as supplied by the manufacturer without exchanging the components of the Injection system,
- installation in accordance with the manufacturer's specifications and drawings using the tools indicated in the technical documentation of this European technical approval,
- checks before rebar installation to ensure that the strength class of the concrete in which the post-installed rebar connection is to be placed is in the range given and is not lower than that of the concrete to which the characteristic loads apply,
- check of concrete being well compacted, e.g. without significant voids,
- check the position of the existing rebars (if the position of existing rebars is not known, it shall be determined using a rebar detector suitable for this purpose as well as on the basis of the construction documentation and then marked on the building component for the overlap joint),
- keeping the anchorage depth as specified in the design drawings,
- keeping of concrete cover and spacing as specified in the design drawings,
- positioning of the drill holes without damaging the reinforcement,
- in case of aborted drill hole the drill hole shall be filled with mortar,
- the post-installed rebar connection must not be installed in flooded holes,
- the drilling and cleaning of the hole and the installation shall be performed only with the equipment specified by the manufacturer according to the manufacturer's installation instructions (see Annexes 10-18), it shall be ensured that this equipment is available on site and it is used,
- during curing of the injection mortar the temperature of the building component must not be less than +5 °C and no more than +40 °C; observing the curing time given in Annex 18.

5 Recommendations concerning packaging, transport and storage

5.1 Responsibility of the manufacturer

It is in the responsibility of the manufacturer to ensure that the information on the specific conditions according to sections 1 and 2 including Annexes referred to as well as section 4 is given to those who are concerned. This information may be made by reproduction of the respective parts of the European technical approval. In addition all installation data shall be shown clearly on the package and/or on an enclosed instruction sheet, preferably using illustration(s).

The minimum data required are:

- drill bit diameter,
- diameter of rebar,
- admissible service temperature range,
- curing time of the injection mortar,
- Installation instructions including cleaning of the drill hole,
- reference to any special installation equipment needed,
- identification of the manufacturing batch,

All data shall be presented in a clear and explicit form.

5.2 Packaging, transport and storage

The mortar foil packs shall be protected against sun radiation and shall be stored according to the manufacture's installation instructions in dry condition at temperatures of at least +5 °C to not more than +25 °C.

Mortar foil packs with expired shelf life must no longer be used.

Georg Feistel
Head of Department

beglaubigt:
Lange

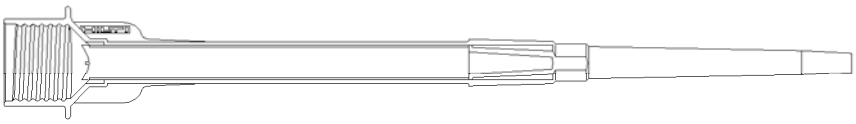
Deutsches Institut für Bautechnik DIBt

Product description and intended use:

The post-installed rebar connection consists of injection mortar Hilti HIT-RE 500 and an embedded straight deformed reinforcing bar with properties of class B and C according to Annex C of EN 1992-1-1 or the Hilti tension anchor HZA-R.

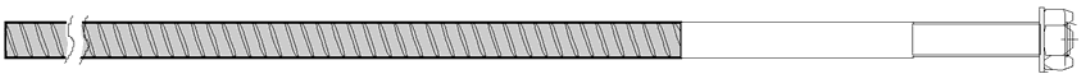
Injection mortar Hilti HIT-RE 500: Epoxy resin system with aggregate

Static mixer Hilti HIT-RE-M



Reinforcing bar (rebar) (see Annex 4)

Hilti tension anchor HZA-R (see Annex 6)



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 EC 2.

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

Temperature range: -40 ℃ to +80℃
(maximum long term temperature +50℃ and maximum sh ort term temperature +80℃)

Injection system Hilti HIT RE 500 for rebar connection	**Annex 1**
Product description and intended use	

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Figure 1: Overlap joint for rebar connections of slabs and beams

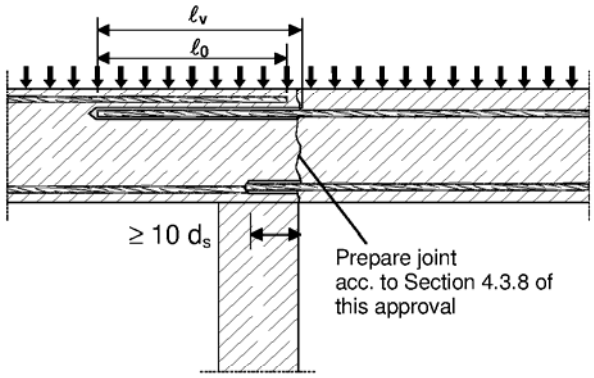


Figure 2: Overlap joint at a foundation of a column or wall where the rebars are stressed in tension

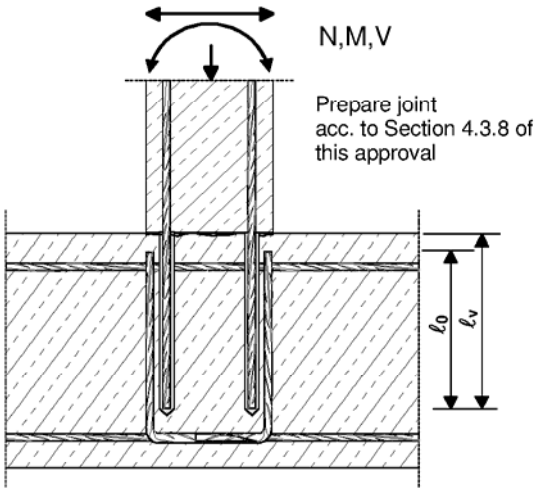


Figure 3: End anchoring of slabs or beams, designed as simply supported

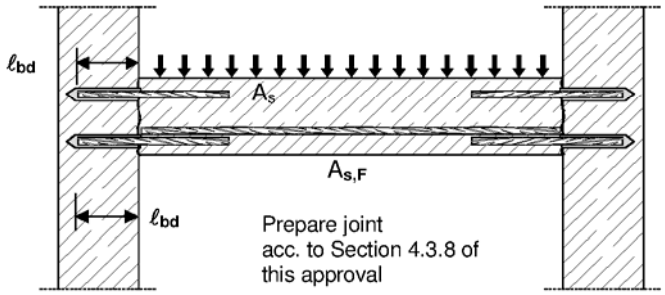


Figure 4: Rebar connection for components stressed primarily in compression. The rebars are stressed in compression.

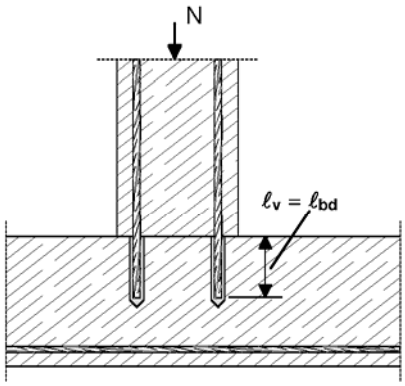
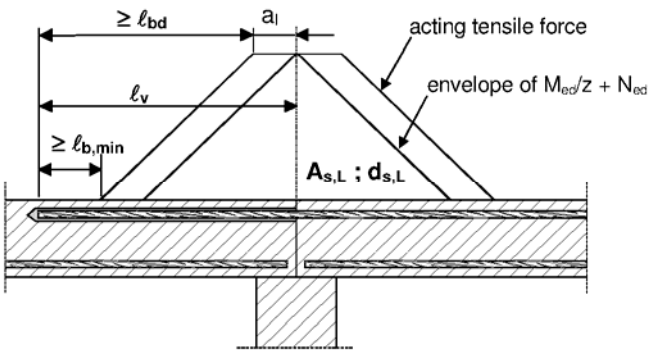


Figure 5: Anchoring of reinforcement to cover the line of acting tensile force



Note to Figure 1 to 5:

In the Figures no transverse reinforcement is plotted, the transverse reinforcement as required by EN 1992-1-1 shall be present.

The shear transfer between old and new concrete shall be designed according to EN 1992-1-1.

Description of the bonded-in rebars and overlap joints see Annex 4 and 5.

Injection system Hilti HIT RE 500 for rebar connection	**Annex 2**
Examples of use for rebars	

Deutsches Institut für Bautechnik DIBt

Figure 6: Overlap joint of a column stressed in bending to a foundation

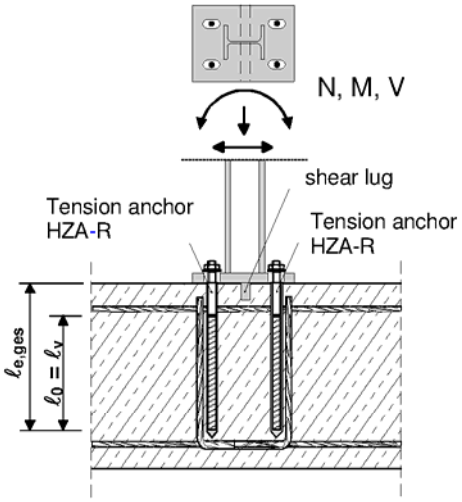


Figure 7: Overlap joint for the anchorage of barrier posts

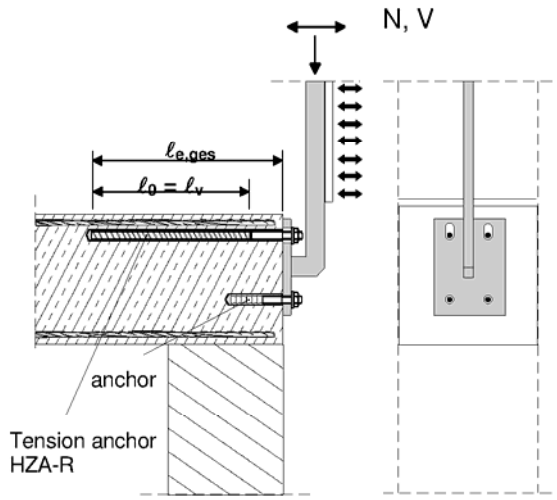
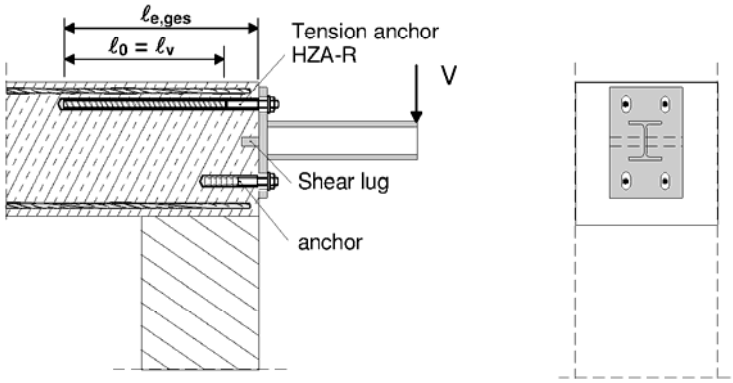


Figure 8: Overlap joint for the anchorage of cantilever members



Note to Figure 6 to 8:

In the Figures no transverse reinforcement is plotted, the transverse reinforcement as required by EN 1992-1-1 shall be present.

Only tension forces in the direction of the bar axis may be transmitted by the tension anchor HZA-R.

The tension force must be transferred via an overlap joint to the reinforcement in the building part.

The transmission of the shear load shall be ensured by appropriate additional measures, e.g. by shear lugs or by anchors with a European technical approval (ETA).

In the anchor plate, the holes for the tension anchor shall be executed as elongated holes with the axis in the direction of the shear force.

Description of anchorages and overlap joints see Annex 6 and 7.

Injection system Hilti HIT RE 500 for rebar connection	**Annex 3**
Examples of use for Hilti Tension anchor HZA-R	

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Figure 9: Properties of reinforcing bars "rebars"

Refer to EN1992-1-1 Annex C Table C.1 and C.2N Properties of reinforcement:

Product form		**Bars and de-coiled rods**	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ (MPa)		400 to 600	
Minimum value of $k = (f_t/f_y)k$		≥ 1,08	≥ 1,15 < 1,35
Characteristic strain at maximum force, ε_{uk} (%)		≥ 5,0	≥ 7,5
Bendability		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar) (%)	Nominal bar size (mm) ≤ 8 > 8	 ± 6,0 ± 4,5	
Bond: Minimum relative rib area, $f_{R,min}$ (determination according to EN 15630)	Nominal bar size (mm) 8 to 12 > 12	 0,040 0,056	

Rip height h:

The maximum outer rebar diameter over the rips shall be:
Nominal diameter of the bar d + 2∗h (h ≤ 0,07∗d)

Injection system Hilti HIT RE 500 for rebar connection	**Annex 4**
Description of rebars	

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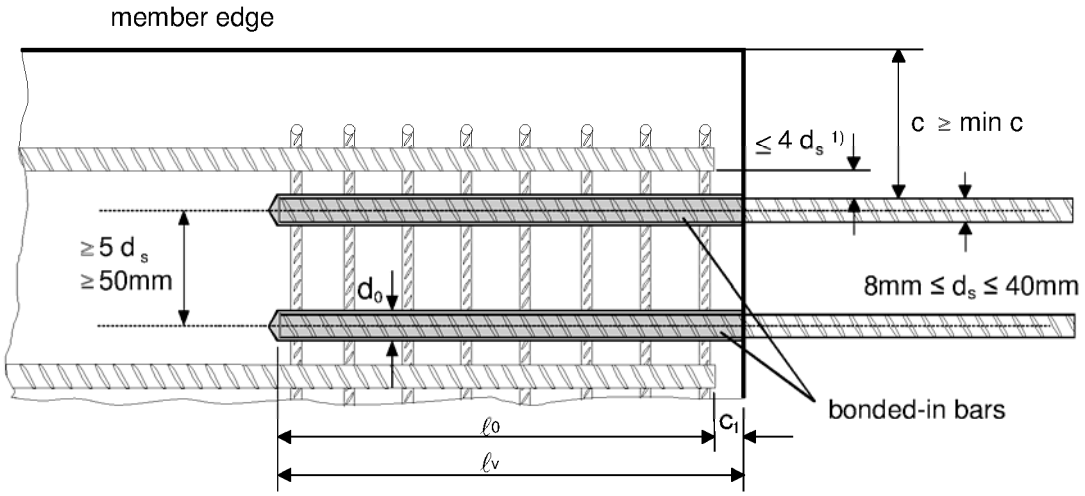
Figure 10: General design rules of construction for bonded-in rebars



1) If the clear distance between lapped bars exceeds $4d_s$, then the lap length shall be increased by the difference between the clear bar distance and $4d_s$.

The following applies to Figure 10:

- ℓ_v resp. ℓ_0 are in accordance with Section 4.3.5 respectively with Section 4.3.4 of the approval
- The provision of sufficient transverse reinforcement according to section 4.3.7 of this approval must be verified.

c	concrete cover of bonded-in bar
c_1	concrete cover at end-face of bonded-in bar
min c	minimum concrete cover acc. to Section 4.3.6 of this approval
d_s	diameter of bonded-in bar
ℓ_0	lap length
ℓ_v	effective embedment depth
d_0	nominal drill bit diameter, see Annex 16 and Annex 17

Injection system Hilti HIT RE 500 for rebar connection	**Annex 5**
Rebars spacing and edge distance and general design rules	

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Figure 11: Tension anchor HZA-R

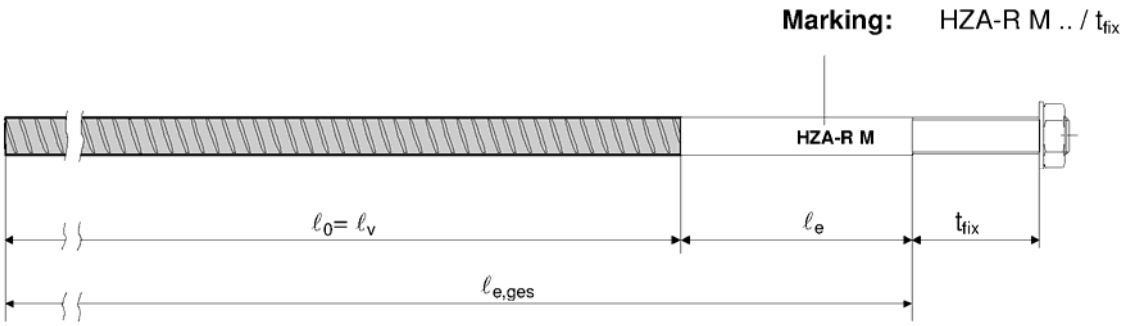


Table 1: Hilti tension anchor HZA-R Materials

Part	Designation	Material HZA-R			
		M12	M16	M20	M24
1	Reinforcement bar Characteristic yield strength $f_{k0,2}$ [N/mm²]	Carbon steel			
		500	500	500	460
2	Round steel smooth with thread	stainless steel, 1.4404 and 1.4571, 1.4362, EN 10088			
3	Washer	stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439 and 1.4362, EN 10088			
4	Hexagon nut	Strength class 70 EN ISO 3506-2 stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439 and 1.4362, EN 10088			

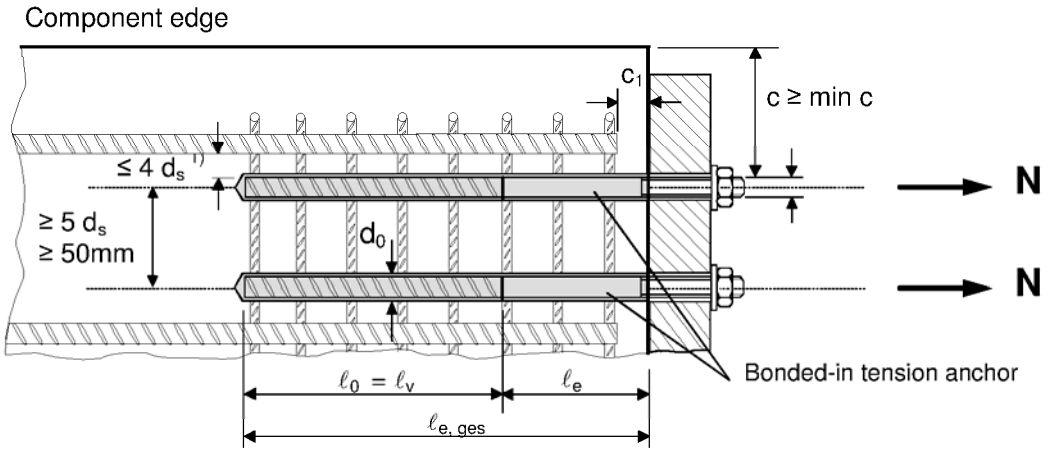
Table 2: Hilti tension anchor HZA-R dimensions

Anchor type / size			M12	M16	M20	M24
Diameter of reinforcement bar	d	[mm]	12	16	20	25
Width across nut flats	SW	[mm]	19	24	30	36
Effective embedment depth	$\ell_v \leq$ [1)]	[mm]	800	1300	1300	1300
Length of smooth shaft	$\ell_e \geq$	[mm]	100			
Maximum torque moment	T_{max}	[Nm]	40	80	150	200
Minimum thickness of fixture	t_{fix}	[mm]	5	5	5	5
Maximum thickness of fixture	t_{fix}	[mm]	200	200	200	400

1) May be shortened according to static calculation

Injection system Hilti HIT RE 500 for rebar connection	Annex 6
Hilti tension anchor HZA-R Dimensions and materials	

Figure 12: General design rules for Hilti tension anchor HZA-R



[1] If the clear distance between spliced bars exceeds $4d_s$, then the lap length shall be increased by the difference between the clear bar distance and $4d_s$.

The following applies to Figure 12:

- With the tension anchor HZA-R, only tensile forces in the direction of the bar axis may be transmitted.
- ℓ_v resp. ℓ_0 are in accordance with Section 4.3.5 respectively Section 4.3.4 of the approval
- The provision of sufficient transverse reinforcement according to Section 4.3.7 of this approval must be verified.

c	concrete cover of bonded-in bar
c_1	concrete cover at end-face of bonded-in bar
min c	minimum concrete cover acc. to Section 4.3.6 of this approval
d_s	diameter of bonded-in bar
ℓ_0	lap length
ℓ_v	effective embedment depth
ℓ_e	length of the smooth shaft; $\ell_e \geq 100$ mm
$\ell_{e,ges}$	total embedment depth
d_0	nominal drill bit diameter, see Annex 16 and Annex 17

Injection system Hilti HIT RE 500 for rebar connection	**Annex 7**
Hilti tension anchor HZA-R **spacing and edge distance and general design rules**	

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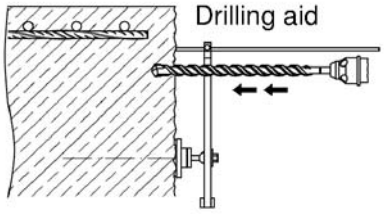
Table 3: Minimum concrete cover min c [1] of the bonded-in rebar or tension anchor HZA-R depending on drilling method and drilling tolerance



Drilling method	Bar diameter d_s	Without drilling aid	With drilling aid
Hammer drilling **(HD)** and **(HDB)** [2]	< 25 mm	30mm + 0,06 $\ell_v \geq$ 2 d_s	30mm + 0,02 $\ell_v \geq$ 2 d_s
	≥ 25 mm	40mm + 0,06 $\ell_v \geq$ 2 d_s	40mm + 0,02 $\ell_v \geq$ 2 d_s
Compressed air drilling **(CA)**	< 25 mm	50mm + 0,08 ℓ_v	50mm + 0,02 ℓ_v
	≥ 25 mm	60mm + 0,08 $\ell_v \geq$ 2 d_s	60mm + 0,02 $\ell_v \geq$ 2 d_s
Diamond coring dry **(PCC)** or wet **(DD)**	< 25 mm	Drill stand is used as drilling aid	30mm + 0,02 $\ell_v \geq$ 2 d_s
	≥ 25 mm		40mm + 0,02 $\ell_v \geq$ 2 d_s

[1] see Annexes 5 and 7, Figures 10 and 12
[2] HDB = hollow drill bit Hilti TE-CD and TE-YD
Comments: The minimum concrete cover acc. EN 1992-1-1 must be observed

Table 4: Minimum anchorage lengths and lap lengths for C20/25 and maximum installation length

according to EN 1992-1-1: $l_{b,min}$ (8.6) and $l_{0,min}$ (8.11) for good bond conditions and α_6 = 1,0 with maximum yield stress for rebar BSt 500S and γ_M = 1,15

Rebar		Drilling method **HD, HDB, CA, PCC**		Drilling method **DD**		
Ø d_s [mm]	$f_{y,k}$ [N/mm²]	$l_{b,min}$ [mm]	$l_{0,min}$ [mm]	$l_{b,min}$ [mm]	$l_{0,min}$ [mm]	l_{max} [mm]
8	500	113	200	170	300	1000
10	500	142	200	213	300	1000
12	500	170	200	255	300	1200
14	500	198	210	298	315	1400
16	500	227	240	340	360	1600
18	500	255	270	383	405	1800
20	500	284	300	425	450	2000
22	500	312	330	468	495	2200
24	500	340	360	510	540	2400
25	500	354	375	532	563	2500
26	500	369	390	553	585	2600
28	500	397	420	595	630	2800
30	500	425	450	638	675	3000
32	500	454	480	681	720	3200
34	500	482	510	723	765	3200
36	500	534	540	800	810	3200
40	500	621	621	932	932	3200

Injection system Hilti HIT RE 500 for rebar connection	Annex 8
Minimum concrete cover Minimum anchorage length and maximum installation length	

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Table 5: Design values of the ultimate bond resistance f_{bd} in N/mm² for Hammer drilling (HD) and (HDB), Compressed air drilling (CA) and Diamond coring, dry (PCC)

according to EN 1992-1-1 for good bond conditions
(for all other bond conditions multiply the values by 0.7)

Rebar	Concrete class								
Ø d_s [mm]	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 to 32	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
34	1,6	2,0	2,3	2,6	2,9	3,3	3,6	3,9	4,2
36	1,5	1,9	2,2	2,6	2,9	3,3	3,6	3,8	4,1
40	1,5	1,8	2,1	2,5	2,8	3,1	3,4	3,7	4,0

Table 6: Design values of the ultimate bond resistance f_{bd} in N/mm² for Diamond coring, wet (DD)

according to EN 1992-1-1 for good bond conditions
(for all other bond conditions multiply the values by 0.7)

Rebar	Concrete class								
Ø d_s [mm]	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 to 25	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
26 to 32	1,6	2,0	2,3	2,7					
34	1,6	2,0	2,3	2,6					
36	1,5	1,9	2,2	2,6					
40	1,5	1,8	2,1	2,5					

Injection system Hilti HIT RE 500 for rebar connection	Annex 9
Design values of ultimate bond resistance f_{bd}	

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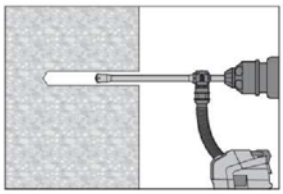
Safety Regulations: 	Review the Material Safety Data Sheet (MSDS) before use for proper and safe handling! Wear well-fitting protective goggles and protective gloves when working with Hilti HIT-RE 500. Important: Observe the Instructions for Use provided with each foil pack

1. Drill hole

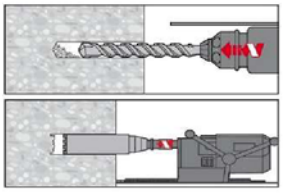
Note: Before drilling, remove carbonized concrete; clean contact areas (see section 4.3.8 in ETA)



Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit (HDB) with Hilti vacuum attachment. This drilling system removes the dust and cleans the bore hole during drilling when used in accordance with the user's manual.

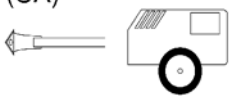
After drilling is complete, proceed to the "injection preparation" step in the instructions for use.

Drill bit size see Table 8

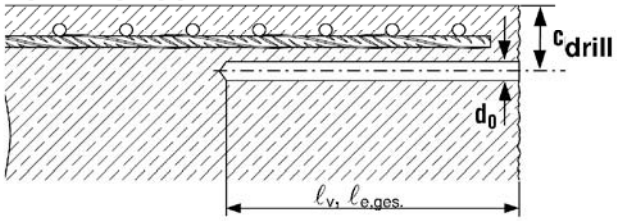


Or drill hole to the required embedment depth using a hammer-drill with carbide drill bit set in rotation hammer mode, a compressed air drill or a diamond coring machine.

Drill bit size for:

Hammer drill (HD)	Compressed air drill (CA)	Diamond core wet (DD) and dry (PCC)
		
see Table 7	see Table 7	see Table 7 and Table 8

Splicing applications:

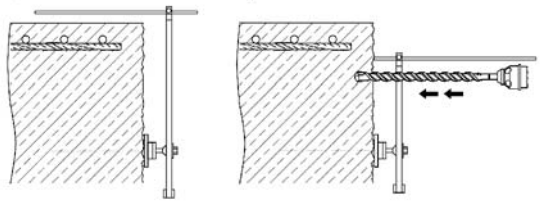


- Measure and control concrete cover c
- $c_{drill} = c + d_s/2$
- Drill parallel to surface edge and to existing rebar
- Where applicable use Hilti drilling aid HIT-BH.

Drilling aid

Example: HIT-BH

1) 2)



For holes $\ell_b > 20$ cm use drilling aid.
Three different options can be considered:

A) Hilti drilling aid HIT-BH
B) Slat or spirit level
C) Visual check

Injection system Hilti HIT RE 500 for rebar connection	Annex 10
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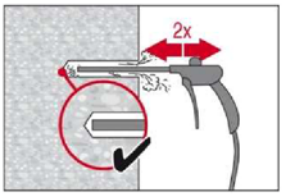
2. Clean hole

The borehole must be free of dust, debris, water, ice, oil, grease and other contaminants prior to mortar injection.
(not needed with Hollow Drill Bit (HDB))

Just before setting an rebar the hole must be cleaned of dust and debris by one of the two cleaning methods described below:

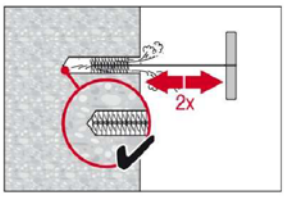
2.1. Compressed air cleaning:



Blowing

2 times from the back of the hole with oil-free compressed air (min. 6 bar at 100 litres per minute (LPM)) until return air stream is free of noticeable dust.

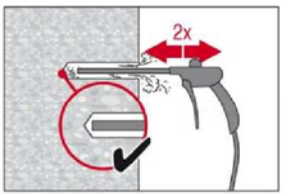
Bore hole diameter ≥ 32 mm the compressor must supply a minimum air flow of 140 m³/hour.



Brushing

2 times with the specified brush size (brush Ø ≥ borehole Ø) by inserting the round steel brush to the back of the hole in a twisting motion. The brush shall produce natural resistance as it enters the anchor hole. If this is not the case, please use a new brush or a brush with a larger diameter.

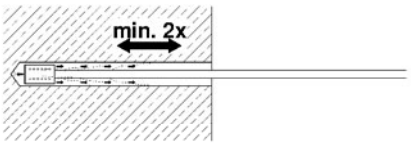
For appropriate brushes HIT-RB see Table 7 and Table 8.



Blowing

2 times again with compressed air until return air stream is free of noticeable dust.

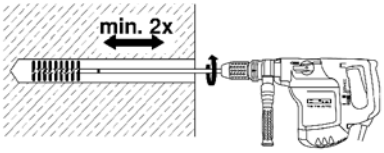
If required use additional accessories and extensions for air nozzle and brush to reach back of hole.



Deep Boreholes – Blowing:

For boreholes deeper than 250mm (for d_s = 8mm - 12mm) resp. deeper than 20xd_s (for d_s>12mm) use the appropriate air nozzle Hilti HIT-DL (see Table 7 and Table 8)

Safety tip: Do not inhale concrete dust.
The application of the Hilti HIT-DRS dust collector is recommended.



Deep boreholes – brushing

For boreholes deeper than 250mm (for d_s = 8mm - 12mm) resp. deeper than 20xd_s (for d_s>12mm) use machine brushing and brush extensions HIT-RBS.

Screw the round steel brush HIT-RB in one end of the brush extension(s) HIT-RBS, so that the overall length of the brush is sufficient to reach the base of the borehole. Attach the other end of the extension to the TE-C/TE-Y chuck.

Safety tip:

- Start machine brushing operation slowly.
- Start brushing operation once brush is inserted in borehole.

Injection system Hilti HIT RE 500 for rebar connection	Annex 11
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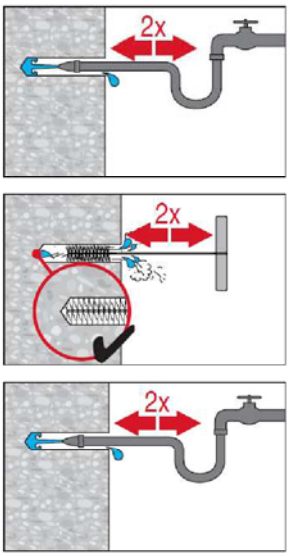
2.1. Compressed air cleaning:



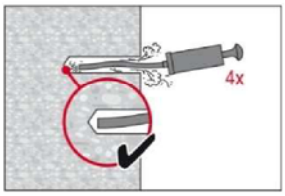
In addition for wet diamond coring:

For wet diamond coring please observe the following steps in addition to the compressed air cleaning:

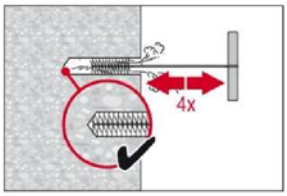
Remove all core fragments from the anchor hole. Flush the anchor hole with clear running water until water runs clear. Brush the anchor hole again 2 times with the appropriate sized brush over the entire depth of the anchor hole. Repeat the flushing process until water runs out of the anchor hole.

2.2. Manual cleaning:

Manual cleaning is permitted for hammer drilled boreholes up to hole diameters $d_0 \leq 20$mm and depths ℓ_v resp. $\ell_{e,ges.} \leq 250$ mm.

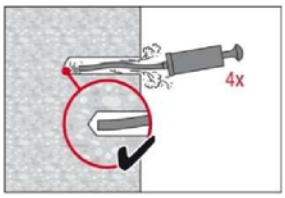


Blowing
4 strokes with Hilti blow-out pump from the back of the hole until return air stream is free of noticeable dust.



Brushing
4 times with the specified brush size (brush diameter ≥ borehole diameter d_0) by inserting the round steel wire brush to the back of the hole with a twisting motion. The brush shall produce natural resistance as it enters the anchor hole. If this is not the case, please use a new brush or a brush with a larger diameter.

For appropriate Brushes HIT-RB see Table 7and Table 8.



Blowing
4 strokes with Hilti blow-out pump from the back of the hole until return air stream is free of noticeable dust

Manual Cleaning:
Hilti hand pump recommended for blowing out bore holes with diameters $d_0 \leq 20$ mm and bore hole depth $h_0 \leq 250$ mm.

Injection system Hilti HIT RE 500 for rebar connection	Annex 12
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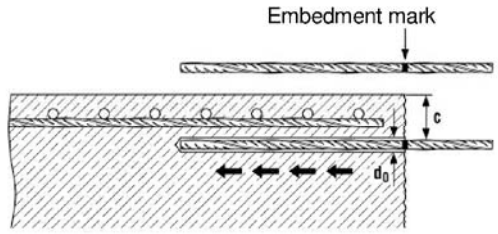
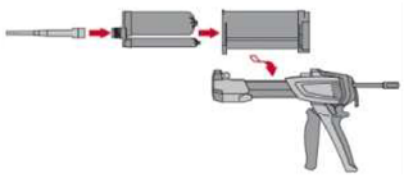
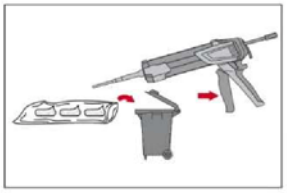
3. Rebar preparation and foil pack preparation



Before use, make sure the rebar is dry and free of oil or other residue.
Mark the embedment depth on the rebar
(e.g. with tape) → ℓ_v
Insert Rebar in borehole, to verify hole and setting depth ℓ_v resp. $\ell_{e,ges}$



Injection system preparation.
- Observe the Instruction for Use of the dispenser.
- Observe the Instruction for Use of the mortar.
- Tightly attach Hilti HIT-RE-M mixing nozzle to foil pack manifold.
- Insert foil pack into foil pack holder and put holder into the dispenser.



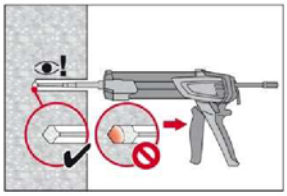
Discard initial adhesive. The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
After changing a mixing nozzle, the first few trigger pulls must be discarded as described above. For each new foil pack a new mixing nozzle must be used.
Discard quantities are:

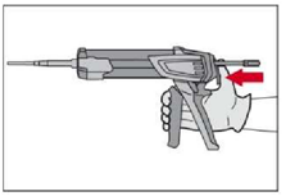
3 strokes	for 330 ml foil pack,
4 strokes	for 500 ml foil pack,
65 ml	for 1400 ml foil pack

4. Inject mortar into borehole

Forming air pockets shall be avoided.

Injection method for borehole depth ≤ 250 mm:





Inject the mortar from the back of the hole towards the front and slowly withdraw the mixing nozzle step by step after each trigger pull.

Fill holes approximately 2/3 full, or as required to ensure that the annular gap between the rebar and the concrete is completely filled with adhesive over the embedment length.

After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle.

Injection system Hilti HIT RE 500 for rebar connection	**Annex 13**
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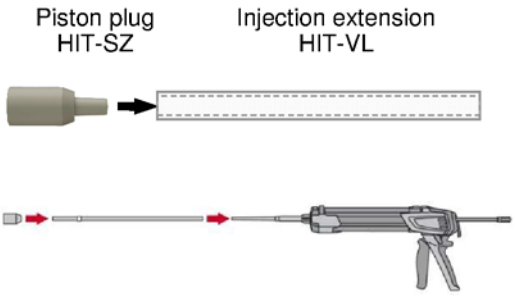
4. Inject mortar into borehole

Forming air pockets shall be avoided.

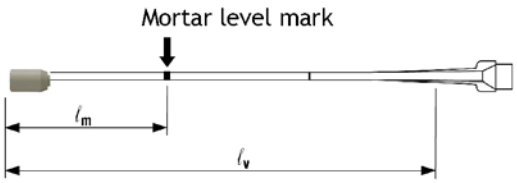
Injection method for borehole depth > 250 mm or overhead applications:



Assemble mixing nozzle, extension(s) and piston plug HIT-SZ (see Table 7 and Table 8)

For combinations of several injection extensions use coupler HIT-VL K. A substitution of the injection extension for a plastic hose or a combination of both is permitted.

The combination of HIT-SZ piston plug with HIT-VL 16 pipe and then HIT-VL 16 tube support proper injection.

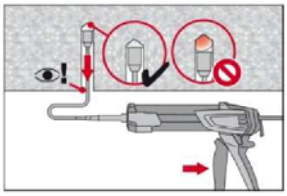


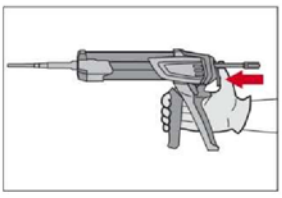
Mark the required mortar level ℓm and embedment depth ℓb resp. ℓe,ges with tape or marker on the injection extension.

A) Estimation: $\ell_m = 1/3 \cdot \ell v$ resp. $\ell_m = 1/3 \cdot \ell_{e,ges}$

B) Precise formula for optimum mortar volume:

$$\ell_m = \ell_v \; resp. \; \ell_{e,ges} \times \left((1{,}2 \times \frac{d_s^2}{d_0^2} - 0{,}2) \right) \; [mm]$$





Insert piston plug to back of the hole. Begin injection allowing the pressure of the injected adhesive mortar to push the piston plug towards the front of the hole.

Fill holes approximately 2/3 full, or as required to ensure that the annular gap between the rebar and the concrete is completely filled with adhesive over the embedment length.

When the required mortar level was marked continue injection until the mortar level mark ℓm becomes visible.

After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle.

Maximum embedment depth for different rebar diameter, drilling methods and dispensers see Table 7, Table 8 and Table 9

Injection system Hilti HIT RE 500 for rebar connection	Annex 14
Installation instruction	

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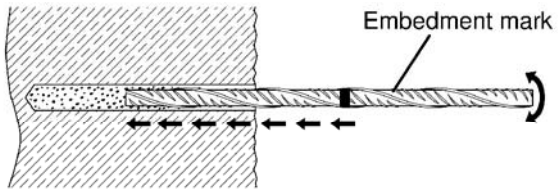
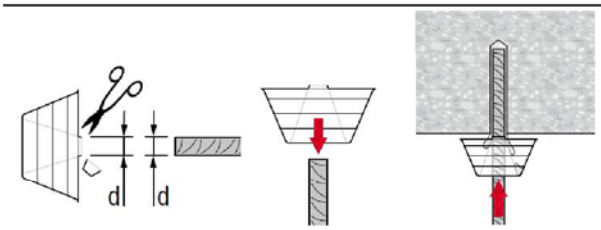
5. Insert rebar

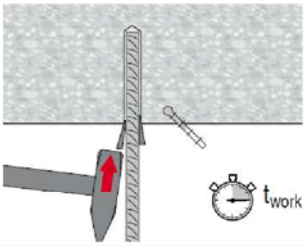


For ease installation insert the rebar slowly twisted into the borehole until the embedment mark is at the concrete surface level.

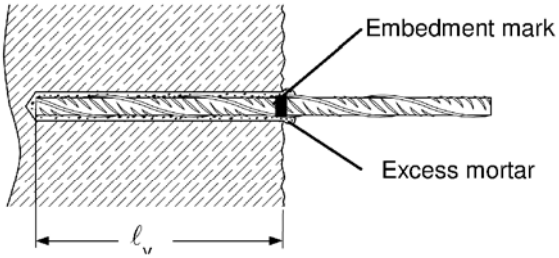


Overhead application:

During insertion of the rebar mortar might flow out of the bore hole. For collection of the flowing mortar HIT-OHC may be used.

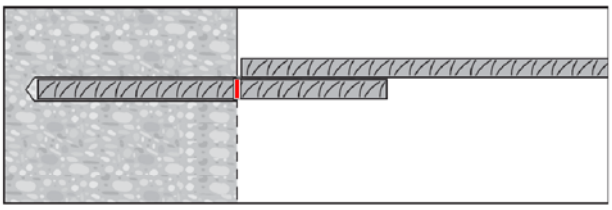


Support the rebar and secure it from falling till mortar started to harden, e.g. using HIT-OHW



After installing the rebar the annular gap must be completely filled with mortar.
Proper installation:

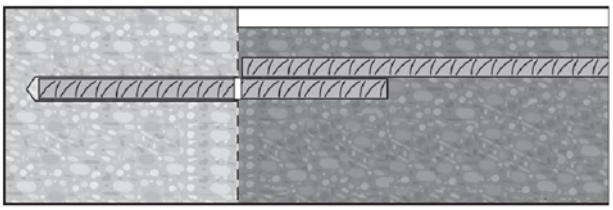
- Desired anchoring embedment is reached ∿: Embedment mark at concrete surface.
- Excess mortar flows out of the borehole after the rebar has been fully inserted until the embedment mark.
- Overhead application: Support the rebar and secure it from falling till mortar started to harden.



Observe the working time "t_{work}", which varies according to temperature of base material. Minor adjustments to the rebar position may be performed during the working time

After $t_{cure,ini}$ preparation work may continue.

"t_{work}" and "$t_{cure,ini}$" see Table 10.



Full load may be applied only after the curing time "t_{cure}" has elapsed (see Table 10).

Injection system Hilti HIT RE 500 for rebar connection	**Annex 15**
Installation instruction	

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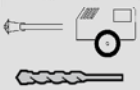
Table 7: Installation tools for drilling with hammer drill (HD) compressed air drill (CA) or with wet diamond coring (DD)

Elements	Drill and clean						Installation		
Rebar -Ø 	Hammer drilling **(HD)** 	Compressed air drill **(CA)** 	Diamond core wet **(DD)** 	Steel brush 	Air Nozzle	Extension for air nozzle 	Piston plug 	Extension for piston plug 	Maximum embed-ment depth
d_{nom} [mm]	d_0 [mm]	d_0 [mm]	d_0 [mm]	HIT-RB	HIT-DL		HIT-SZ		l_v or $l_{e,ges}$ [mm]
8	10	-	10	10	10	HIT-DL 10/0,8 or HIT-DL V10/1	-	HIT-VL 9/1,0	250
	12	-	12	12	12		12		1000
10	12	-	12	12	12		12		250
	14	-	14	14	14		14	HIT-VL 11/1.0	1000
12	14	-	14	14	14		14		250
	16	-	16	16	16		16		1200
	-	17	-	18	16		18		
14	18	17	18	18	18		18		1400
16	20	-	20	20	20	HIT-DL 16/0,8 or HIT-DL B and/or HIT-VL 16/0,7 and/or HIT-VL 16	20	HIT-VL 16/0,7 and/or HIT-VL 16	1600
	-	20	-	22	20		22		
18	22	22	22	22	22		22		1800
20	25	-	25	25	25		25		2000
	-	26	-	28	25		28		
22	28	28	28	28	28		28		2200
24	32	32	32	32	32		32		2400
25	32	32	32	32			32		2500
26	35	35	35	35			35		2600
28	35	35	35	35			35		2800
30	-	35	35	35			35		3000
	37	-	-	37			37		
32	40	40	40	40			40		3200
34	-	42	42	42			42		
	45	-	-	45			45		
36	45	45	-	45			45		
	-	-	47	47			47		
40	-	-	52	52			52		
	55	57	-	55			55		

Assemble extension HIT-VL 16/0.7 with coupler HIT-DL K for deeper anchor holes.

Injection system Hilti HIT RE 500 for rebar connection	**Annex 16**
Installation tools for drilling with hammer drill (HD), compressed air drill (CA) or with wet diamond coring (DD)	

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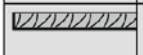
Table 8: Installation tools for drilling with hollow drill bit (HDB) or with dry diamond coring (PCC) --- no cleaning required

Elements	**Drill** (no cleaning required)					**Installation**		
Rebar -Ø	Hammer drilling, hollow drill bit **(HDB)**	Diamond coring dry **(PCC)**	Steel brush	Air Nozzle	Extension for air nozzle	Piston plug	Extension for piston plug	Maximum embed-ment depth
	 TE-CD / TE-YD							
d_{nom} [mm]	d_0 [mm]	d_0 [mm]	HIT-RB	HIT-DL		HIT-SZ		l_v or $l_{e,ges}$ [mm]
8	12	-	No cleaning required			12	HIT-VL 9/1,0	200
10	12	-				12		200
	14	-				14	HIT-VL 11/1.0	240
12	14	-				14		240
	16	-				16		400
14	18	-				18		400
16	20	-				20	HIT-VL 16/0,7 and/or HIT-VL 16	400
18	22	-				22		400
20	25	-				25		400
22	28	-				28		400
24	32	-				32		400
	-	35				35		2400
25	32	-				32		400
	-	35				35		2500
26	-	35				35		2600
28	-	35				35		2800
30	-	35				35		3000
32	-	47				45		3200
34	-	47				45		3200
36	-	47				45		3200
40	-	52				52		3200

Assemble extension HIT-VL 16/0.7 with coupler HIT-DL K for deeper anchor holes.

Injection system Hilti HIT RE 500 for rebar connection	**Annex 17**
Installation tools for drilling with hollow drill bit (HDB) or with dry diamond coring (PCC)	

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Table 9: Maximum permissible embedment depth [mm] corresponding to dispenser

Rebar	Dispenser		
Ø d_s [mm]	HDM 330, HDM 500, HIT-MD 2000, HIT-MD 2500	HDE 500, HIT-ED 3500, HIT-P300F, HIT-P3500F	HIT-P8000D
8	1000	1000	-
10			
12		1200	1200
14			1400
16		1500	1600
18	700	1300	1800
20			2000
22		1000	2200
24			2400
25			2500
26	500	700	2600
28			2800
30	-		3000
32			3200
34		500	
36			
40			

Table 10: Working time, initial curing time and minimum curing time

Temperature in the base material [℃]	Maximum working time t_{work} [min]	Initial curing time $t_{cure,ini}$ [h]	Minimum curing time t_{cure} [h]
5 to 9	120	18	72
10 to 14	90	12	48
15 to 19	30	8	24
20 to 24	25	6	12
25 to 29	20	5	10
30 to 39	12	4	8
40	12	2	4

Injection system Hilti HIT RE 500 for rebar connection	**Annex 18**
Maximum embedment depth per dispenser Working time and curing times	

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Values for pre-calculation of lap splice length with Hilti HIT-RE 500

Example for C20/25, good bond conditions, Rebar yield strength 500 N/mm², for all drilling procedures, excluding diamond wet (DD)

Rebar Ø [mm]	$\alpha_1=\alpha_2=\alpha_3=\alpha_4=\alpha_5=1,0$			α_2 or α_5= 0,7 $\alpha_1 = \alpha_3 = \alpha_4 = 1,0$		
	Anchorage length l_{bd} [mm]	Design value N_{Rd} [kN]	Mortar volume [ml]	Anchorage length l_{bd} [mm]	Design value N_{Rd} [kN]	Mortar volume [ml]
8	113*	6,56	9 (4)**	113*	9,37	9 (4)**
	200	11,57	15 (7)**	200	16,53	15 (7)**
	320	18,51	24	-	-	-
	378	21,87	**29**	**265**	21,87	**20**
10	142*	10,24	13 (6)**	142*	14,63	13 (6)**
	200	14,44	18 (8)**	200	20,63	18 (8)**
	300	21,67	27	300	30,95	27
	400	28,89	36	-	-	-
	473	34,13	**43**	**331**	**34,13**	**30**
12	170*	14,74	18 (8)**	170*	21,06	18 (8)**
	240	20,79	25 (12)**	240	29,70	25 (12)**
	360	31,19	38	360	44,55	38
	480	41,58	51			
	567	**49,13**	**60**	**397**	**49,13**	**42**
14	198*	20,09	24	198*	28,70	24
	280	28,34	34	280	40,48	34
	420	42,50	51	420	60,72	51
	560	56,67	68	-	-	-
	662	**66,96**	**80**	**463**	**66,96**	**56**
16	227*	26,22	31	227*	37,45	31
	320	36,98	43	320	52,83	43
	480	55,48	65	480	79,25	65
	640	73,97	87	-	-	-
	756	**87,39**	**103**	**529**	**87,39**	**72**
18	255*	33,13	38	255*	47,33	38
	360	46,74	54	360	66,77	54
	540	70,10	81	540	100,15	81
	720	93,47	109	-	-	-
	851	**110,48**	**128**	**595**	**110,35**	**90**
20	284*	40,96	60	284*	58,51	60
	400	57,78	85	400	82,54	85
	600	86,66	127	600	123,81	127
	800	115,55	170	-	-	-
	945	**136,52**	**200**	**662**	**136,52**	**140**
22	312*	49,57	88	312*	70,81	88
	440	69,92	124	440	99,89	124
	660	104,88	187	660	149,83	187
	880	139,84	249	-	-	-
	1040	**165,27**	**294**	**728**	**165,27**	**206**
24	340*	58,96	144	340*	84,22	144
	480	83,17	203	480	118,81	203
	720	124,75	304	720	178,22	304
	960	166,34	405	-	-	-
	1134	**196,48**	**479**	**794**	**196,53**	**335**

* Values corresponding to the minimum anchorage length.
** Values corresponding to the minimum drill bit size.
The design value is valid for "good bond conditions" as described in EN 1992-1-1. For all other conditions multiply the value by 0.7.
The volume of mortar correspond to the formula "$1,2*(d_0^2-d_S^2)*\pi*lb/4$"

Injection system Hilti HIT RE 500 for rebar connection

Pre-calculated values for the anchorage length Example for rebar ($f_{y,k}$ = 500 N/mm²) in C20/25

Annex 19

Deutsches Institut für Bautechnik DIBt

Values for pre-calculation of anchoring with Hilti HIT-RE 500

Example for C20/25, good bond conditions, Rebar yield strength 500 N/mm²,
For all drilling procedures, excluding diamond wet (DD)

Rebar Ø	$\alpha_1=\alpha_2=\alpha_3=\alpha_4=\alpha_5=1,0$			α_2 or α_5= 0,7 $\alpha_1 = \alpha_3 = \alpha_4 = 1,0$		
	Anchorage length l_{bd}	Design value N_{Rd}	Mortar volume	Anchorage length l_{bd}	Design value N_{Rd}	Mortar volume
[mm]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
25	354*	64,04	133	354*	91,49	133
	500	90,34	188	500	129,06	188
	750	135,52	282	750	193,59	282
	1000	180,69	376	-	-	-
	1181	**213,48**	**444**	**827**	**213,48**	**311**
26	369*	69,33	191	369*	99,05	191
	520	97,70	269	520	139,58	269
	780	146,56	404	780	209,37	404
	1040	195,41	538	-	-	-
	1229	**230,92**	**636**	**860**	**230,84**	**445**
28	397	80,35	165	397	114,78	165
	600	121,44	249	600	173,49	249
	840	170,02	349	840	242,88	349
	1120	226,69	466	-	-	-
	1323	**267,78**	**550**	**926**	**267,75**	**385**
30	425	92,22	188	425	131,74	188
	600	130,09	265	600	185,84	265
	900	195,13	398	900	278,76	398
	1200	260,18	530	-	-	-
	1418	**307,44**	**627**	**992**	**307,26**	**438**
32	454	104,87	246	454	149,81	246
	640	147,94	347	640	211,34	347
	960	221,90	521	960	317,01	521
	1280	295,87	695	-	-	-
	1512	**349,50**	**821**	**1059**	**349,70**	**575**
34	482*	118,43	395	482*	169,19	395
	680	167,07	557	680	238,67	557
	1020	250,61	835	1020	358,01	835
	1360	334,14	1114	-	-	-
	1607	**394,83**	**1316**	**1125**	**394,87**	**921**
36	534*	132,78	367	534*	189,69	367
	720	179,17	495	720	255,95	495
	1080	268,75	742	1080	383,93	742
	1440	358,34	989	-	-	-
	1779	**442,61**	**1222**	**1191**	**423,39**	**818**
40	621*	163,96	834	621*	234,22	834
	800	211,18	1074	800	301,68	1074
	1200	316,76	1612	1200	452,52	1612
	1600	422,35	2149	-	-	-
	2070	**546,52**	**2781**	**1323**	**498,90**	**1777**

* Values corresponding to the minimum anchorage length.
The design value is valid for "good bond conditions" as described in EN 1992-1-1. For all other conditions multiply by the value by 0.7.
The volume of mortar correspond to the formula "$1,2*(d_0^2-d_S^2)*\pi*l_b/4$"

Injection system Hilti HIT RE 500 for rebar connection

Pre-calculated values for the anchorage length
Example for rebar ($f_{y,k}$ = 500 N/mm²) in C20/25

Annex 20

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Values for pre-calculation of overlap joints with Hilti HIT-RE 500

Example for C20/25, good bond conditions, Rebar yield strength 500 N/mm²,
For all drilling procedures, excluding diamond wet (DD)

Rebar Ø	$\alpha_1=\alpha_2=\alpha_3=\alpha_5=\alpha_6=1,0$			α_2 or α_5= 0,7 $\alpha_1 = \alpha_3 = \alpha_6 = 1,0$		
	Lap length l_0	Design value N_{Rd}	Mortar volume	Lap length l_0	Design value N_{Rd}	Mortar volume
[mm]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
8	200*	11,57	15 (7)**	200*	16,53	15 (7)**
	320	18,51	24	-	-	-
	378	**21,87**	**29**	**265**	**21,90**	**20**
10	200*	14,44	18 (8)**	200*	20,63	18 (8)**
	300	21,67	27	300	30,95	27
	400	28,89	36	-	-	-
	473	**34,16**	**43**	**331**	**34,15**	**30**
12	200*	17,33	21 (10)**	200*	24,75	21 (10)**
	240	20,79	25 (12)**	240	29,70	25 (12)**
	360	31,19	38	360	44,55	38
	480	41,58	51			
	567	**49,12**	**60**	**397**	**49,13**	**42**
14	210*	21,25	25	210*	30,36	25
	280	28,34	34	280	40,48	34
	420	42,50	51	420	60,72	51
	560	56,67	68	-	-	-
	662	**66,99**	**80**	**463**	**66,94**	**56**
16	240*	27,74	33	240*	39,63	33
	320	36,98	43	320	52,83	43
	480	55,48	65	480	79,25	65
	640	73,97	87	-	-	-
	756	**87,37**	**103**	**529**	**87,34**	**72**
18	270*	35,05	41	270*	50,07	41
	360	46,74	54	360	66,77	54
	540	70,10	81	540	100,15	81
	720	93,47	109	-	-	-
	851	**110,48**	**128**	**595**	**110,35**	**90**
20	300*	43,33	64	300*	61,90	64
	400	57,78	85	400	82,54	85
	600	86,66	127	600	123,81	127
	800	115,55	170	-	-	-
	945	**136,50**	**200**	**662**	**136,60**	**140**
22	330*	52,44	93	330*	74,91	93
	440	69,92	124	440	99,89	124
	660	104,88	187	660	149,83	187
	880	139,84	249	-	-	-
	1040	**165,27**	**294**	**728**	**165,27**	**206**
24	360*	62,38	152	360*	89,11	152
	480	83,17	203	480	118,81	203
	720	124,75	304	720	178,22	304
	960	166,34	405	-	-	-
	1134	**196,48**	**479**	**794**	**196,53**	**335**

* Values corresponding to the minimum anchorage length.
** Values corresponding to the minimum drill bit size.
The design value is valid for "good bond conditions" as described in EN 1992-1-1. For all other conditions multiply the value by 0.7.
The volume of mortar correspond to the formula "$1,2*(d_0^2-d_S^2)*\pi*lb/4$"

Injection system Hilti HIT RE 500 for rebar connection

Pre-calculated values for the lap length
Example for rebar ($f_{y,k}$ = 500 N/mm²) in C20/25

Annex 21

Deutsches Institut für Bautechnik DIBt

Values for pre-calculation of overlap joints with Hilti HIT-RE 500

Example for C20/25, good bond conditions, Rebar yield strength 500 N/mm²,
For all drilling procedures, excluding diamond wet (DD)

Rebar Ø	$\alpha_1=\alpha_2=\alpha_3=\alpha_5=\alpha_6=1,0$			α_2 or α_5= 0,7 $\alpha_1 = \alpha_3 = \alpha_6 = 1,0$		
	Lap length l_0	Design value N_{Rd}	Mortar volume	Lap length l_0	Design value N_{Rd}	Mortar volume
[mm]	[mm]	[kN]	[ml]	[mm]	[kN]	[ml]
25	375*	67,76	141	375*	96,80	141
	500	90,34	188	500	129,06	188
	750	135,52	282	750	193,59	282
	1000	180,69	376	-	-	-
	1181	**213,39**	**444**	**827**	**213,47**	**311**
26	390*	73,28	202	390*	104,68	202
	520	97,70	269	520	139,58	269
	780	146,56	404	780	209,37	404
	1040	195,41	538	-	-	-
	1229	**230,92**	**636**	**860**	**230,84**	**445**
28	420*	85,01	175	420*	121,44	175
	600	121,44	249	600	173,49	249
	840	170,02	349	840	242,88	349
	1120	226,69	466	-	-	-
	1323	**267,78**	**550**	**926**	**267,75**	**385**
30	450*	97,57	199	450*	139,38	199
	600	130,09	265	600	185,84	265
	900	195,13	398	900	278,76	398
	1200	260,18	530	-	-	-
	1418	**307,44**	**627**	**992**	**307,26**	**438**
32	480*	110,95	261	480*	158,50	261
	640	147,94	347	640	211,34	347
	960	221,90	521	960	317,01	521
	1280	295,87	695	-	-	-
	1512	**349,50**	**821**	**1059**	**349,70**	**575**
34	510*	125,30	418	510*	179,01	418
	680	167,07	557	680	238,67	557
	1020	250,61	835	1020	358,01	835
	1360	334,14	1114	-	-	-
	1607	**394,83**	**1316**	**1125**	**394,87**	**921**
36	540*	134,38	371	540*	191,97	371
	720	179,17	495	720	255,95	495
	1080	268,75	742	1080	383,93	742
	1440	358,34	989	-	-	-
	1779	**442,61**	**1222**	**1191**	**423,39**	**818**
40	621*	163,93	834	621*	234,18	834
	800	211,18	1074	800	301,68	1074
	1200	316,76	1612	1200	452,52	1612
	1600	422,35	2149	-	-	-
	2070	**546,52**	**2781**	**1323**	**498,90**	**1777**

* Values corresponding to the minimum anchorage length.
The design value is valid for "good bond conditions" as described in EN 1992-1-1. For all other conditions multiply by the value by 0.7.
The volume of mortar correspond to the formula "$1,2*(d_0^2-d_S^2)*\pi*lb/4$"

Injection system Hilti HIT RE 500 for rebar connection

Pre-calculated values for the lap length
Example for rebar ($f_{y,k}$ = 500 N/mm²) in C20/25

Annex 22