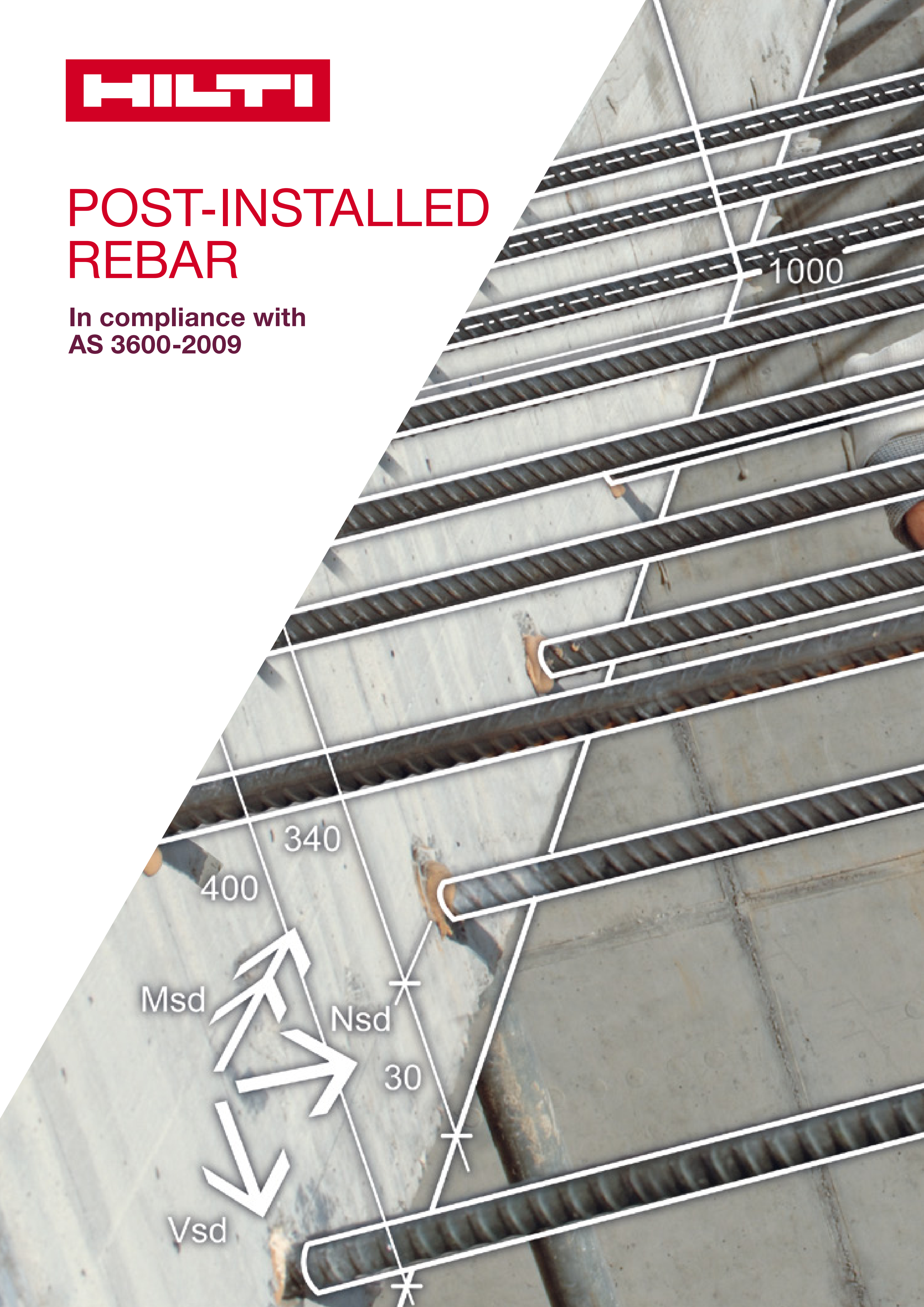
POST-INSTALLED REBAR

In compliance with AS 3600-2009

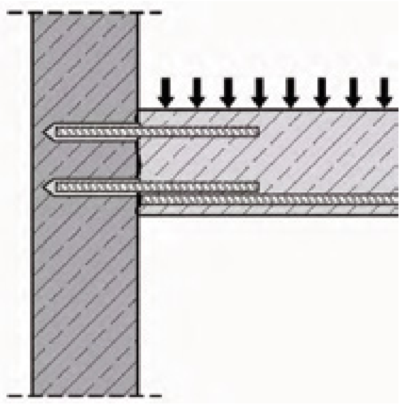


POST-INSTALLED REBAR CONNECTIONS

Basics of post-installed rebar connections

Hilti HIT-RE 500 V3 post-installed rebar

Hilti HIT-HY 200 post-installed rebar



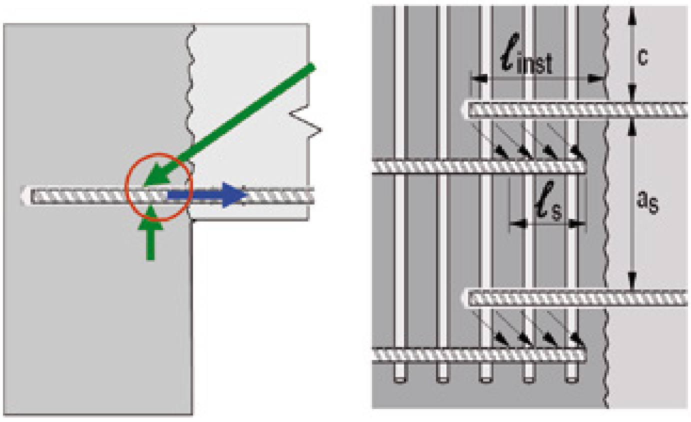
CONTENTS

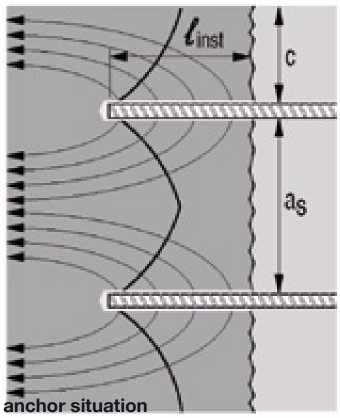
HILTI

1. BASICS OF POST-INSTALLED REBAR CONNECTIONS

1.1 Definition of rebar

Reinforcement anchorages or splices that are fixed into already cured concrete by Hilti HIT injection adhesives in drilled holes are called “Post-installed rebar connections” as opposed to normal, so called “cast-in” reinforcement. Many connections of rebars installed for good detailing practice will not require specific design considerations. But post-installed rebars which become part of the structural system have to be designed as carefully as the entire structure. While European Technical Approvals prove that in basic load situations, post-installed rebars behave like cast-in bars, a number of differences needs to be considered in special design situations such as fire or load cases where hooks or bends would be required for cast-in anchorages. The following chapters are intended to give the necessary information to safely design and specify post-installed reinforcement connections.





structural rebar situations: “anchorage node in equilibrium” and “splice”

This section of the Fastening Technology Manual deals with reinforcement connections designed according to structural reinforced concrete design principles. The task of structural rebars is to take tensile loads and since concrete failure is always brittle, reinforced concrete design assumes that concrete has no tensile strength. Therefore structural rebars can end / be anchored in only two situations:

- the bar is not needed anymore (the anchorage is a node in equilibrium without tensile stress in concrete)

- another bar takes over the tensile load (overlap splice)

Situations where the concrete needs to take up tensile load from the anchorage or where rebars are designed to carry shear loads should be considered as “rebar used as anchors” and designed according to anchor design principles as given e.g. in the guidelines of SA TS101.

Unlike in anchor applications, reinforcement design is normally done for yielding of the steel in order to obtain ductile behaviour of the structure with a good serviceability. The deformations are rather small in correlation to the loads and the crack width limitation is around wk ~0.3mm. This is an important factor when considering resistance to the environment, mainly corrosion of the reinforcement.

In case of correct design and installation the structure can be assumed as monolithic which allows us to look at the situation as if the concrete was poured in one. Due to the allowed high loads the required embedment depth can be up to 80d (diameter of rebar).

1.2 Advantages of post-installed rebar connections

With the use of the Hilti HIT injection systems it is possible to connect new reinforcement to existing structures with maximum confidence and flexibility.

- design flexibility
- reliable like cast-in
- horizontal, vertical and overhead
- form work simplification
- defined load characteristics
- simple, high confidence application

1.3 Application examples

Post-installed rebar connections are used in a wide range of applications, which vary from new construction projects, to structure upgrades and infrastructure requalifications.

POST-INSTALLED REBAR CONNECTIONS IN NEW CONSTRUCTION PROJECTS

Diaphragm walls

Slab connections

Misplaced bars

Vertical/horizontal connections

POST-INSTALLED REBAR CONNECTIONS IN STRUCTURE UPGRADES

Wall strengthening

New slab constructions

Joint strengthening

Cantilevers/balconies

POST-INSTALLED REBAR CONNECTIONS IN INFRASTRUCTURE REQUALIFICATIONS

Slab widening

Structural upgrade

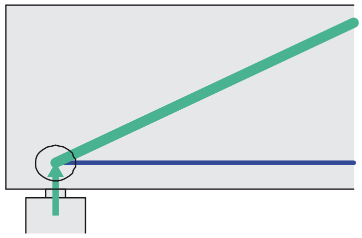
Slab strengthening

Sidewalk upgrade

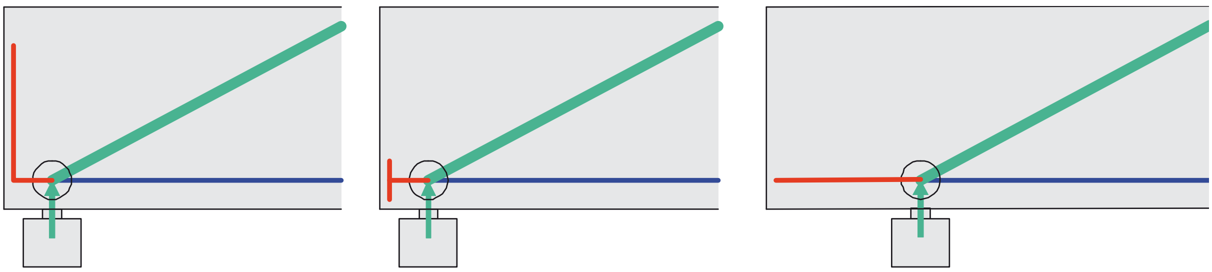
1.4 Anchorage and splice

Development length

Reinforced concrete is often designed using strut and tie models. The forces are represented by trusses and the nodes of these trusses have to be in equilibrium like in the figure to the left: the concrete compression force (green line), the support force (green arrow) and the steel tensile force (blue). The model assumes that the reinforcing bar can provide its tensile force on the right side of the node while there is no steel stress at all on the left side, i.e. the bar is not needed any more on the left side of the node. Physically this is not possible, the strut and tie model is an idealisation. The steel stress has to be developed on the left side of the node. This is operated by bond between steel and concrete. For the bar to be able to develop stress it needs to be extended on the left side of the node. This extension is called “development length” or “anchorage length”. The space on the left side of the node shown in the figure above is not enough to allow a sufficient development of steel stress by bond. Possible approaches to solve this problem are shown the figure below: either an extension of the concrete section over the support or a reduction of the development length with appropriate methods. Typical solutions are hooks, heads, welded transverse reinforcement or external anchorage.



Simple support



Typical solutions for anchoring of the reinforcement

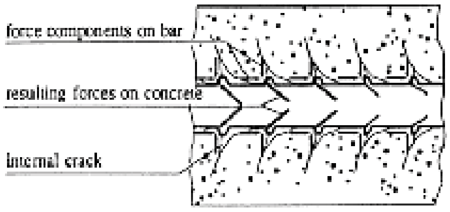
Overlap splices

In case that the equilibrium of a node cannot be established without using the tensile capacity of the concrete, the tensile force of a (ending) bar must be transmitted to other reinforcement bars. A common example is starter bars for columns or walls. Due to practical reasons foundations are often built with rebars much shorter than the final column height, sticking out of the concrete. The column reinforcement will later be spliced with these. The resulting tension load in the column reinforcement due to bending on the column will be transferred into the starter bars through an overlap splice.

Forces are transmitted from one bar to another by lapping the bars.
The detailing of laps between bars shall be such that:

- the transmission of the forces from one bar to the next is assured
- spalling of the concrete in the neighbourhood of the joints does not occur
- large cracks which affect the performance of the structure do not develop

1.5 Bond of cast-in ribbed bars

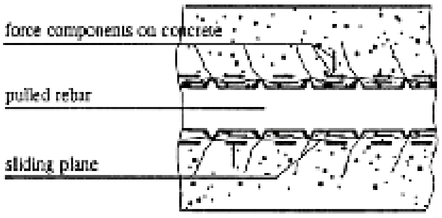


Load transfer from ribbed bars into

General behaviour
For ribbed bars, the load transfer in concrete is governed by the bearing of the ribs against the concrete. The reacting force within the concrete is assumed to be a compressive strut with an angle of 45°.

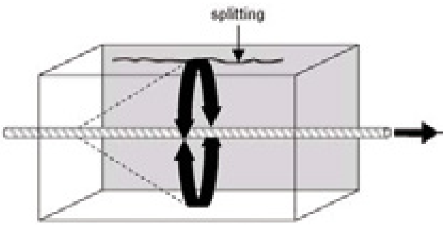
For higher bond stress values, the concentrated bearing forces in front of the ribs cause the formation of cone-shaped cracks starting at the crest of the ribs. The resulting concrete keyed between the ribs transfer the bearing forces into the surrounding concrete, but the wedging action of the ribs remains limited. In this stage the displacement of the bar with respect to the concrete (slip) consists of bending of the keys and crushing of the concrete in front of the ribs.

The bearing forces, which are inclined with respect to the bar axis, can be decomposed into directions parallel and perpendicular to the bar axis. The sum of the parallel components equals the bond force, whereas the radial components induce circumferential tensile stresses in the surrounding concrete, which may result in longitudinal radial (splitting / spalling) cracks. Two failure modes can be considered:



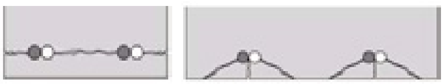
Bond failure of ribbed bars

Bond failure
Bond failure is caused by pull-out of the bar if the confinement (concrete cover, transverse reinforcement) is sufficient to prevent splitting of the concrete cover. In that case the concrete keys are sheared off and a sliding plane around the bar is created. Thus, the force transfer mechanism changes from rib bearing to friction. The shear resistance of the keys can be considered as a criterion for this transition. It is attended by a considerable reduction of the bond stress. Under continued loading, the sliding surface is smoothed due to wear and compaction, which will result in a further decrease of the bond stress, similar to the case of plain bars.

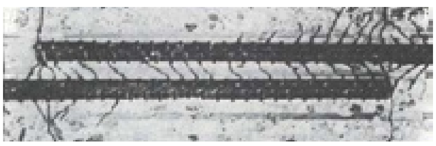


Splitting

Splitting failure
Bond splitting failure is decisive if the radial cracks propagate through the entire cover. In that case the maximum bond stress follows from the maximum concrete confinement, which is reached when the radial cracks have penetrated the cover for about 70%. Further crack propagation results in a decrease of the confining stresses. At reaching the outer surface these stresses are strongly reduced, which results in a sudden drop of the bond stress.



Influence of spacing and cover on splitting and spalling of concrete
In most cases the reinforcement bars are placed close to the surface of the concrete member to achieve good crack distribution and economical bending capacity. For splices at wide spacing (normally in slabs, left part of figure left), the bearing capacity of the concrete depends only on the thickness of the concrete cover. At narrow spacing (normally in beams, right part of figure above) the bearing capacity depends on the spacing and on the thickness of the cover. In the design codes the reduction of bearing capacity of the cover is taken into account by means of multiplying factors for the splice length.


Load transfer at lap splices

Load transfer in overlap splices
The load transfer between bars is performed by means of compressive struts in the concrete, see figure left. A 45° truss model is assumed. The resulting perpendicular forces act as splitting forces. The splitting forces are normally taken up by the transverse reinforcement. Small splitting forces are attributed to the tensile capacity of the concrete. The amount of the transverse or tie reinforcement necessary is specified in the design codes.

1.6 Specifics of post-installed reinforcing bars

General behaviour
The load transfer for post-installed bars is similar to cast-in bars if the stiffness of the overall load transfer mechanism is similar to the cast-in system. The efficiency depends on the strength of the adhesive mortar against the concentrated load near the ribs and on the capacity of load transfer at the interface of the drilled hole.

In many cases the bond values of post-installed bars are higher compared to cast-in bars due to better performance of the adhesive mortar. But for small edge distance and/or narrow spacing, splitting or spalling forces become decisive due to the low tensile capacity of the concrete.

Post-installed reinforcement approvals
There are European Technical Approvals for post-installed rebar connections. Systems getting such approvals have to be assessed according to the EOTA technical guideline TR023 [2] (available in the EOTA website). Requirements for a positive assessment are an installation system providing high installation quality for deep holes and an adhesive fulfilling the test requirements of the guideline TR023. Obtaining the approval is basically the proof that the post-installed rebars work at least as well as cast-in rebars (with respect to bond strength and displacement); consequently, the design of the rebar anchorage is performed according to structural concrete design codes, in the case of Europe this is Eurocode 2 [1].

High quality adhesives required
<u>Assessment criteria</u>

EOTA TR023 [2] specifies a number of tests in order to qualify products for post-installed rebar applications. These are the performance areas checked by the tests:

1. Bond strength in different strengths of concrete
2. Substandard hole cleaning
3. Wet concrete
4. Sustained load and temperature influence
5. Freeze-thaw conditions
6. Installation directions
7. Maximum embedment depth
8. Avoidance of air bubbles during injection
9. Durability (corrosion, chemical attack)

<u>Approvals with or without exceptions</u>

If an adhesive fulfills all assessment criteria of EOTA TR023, rebar connections carried out with this adhesive can be designed with the bond strength and minimum anchorage length according to Eurocode 2 [1] as outlined in section 2.2 of this document.

Adhesives which do not fully comply with all assessment criteria can still obtain an “approval with exceptions”.

- If the bond strength obtained in tests does not fulfill the specified requirements, then bond strengths lower than those given by Eurocode 2 shall be applied. These values are given in the respective ETA.
- If it cannot be shown that the bond strength of rebars post-installed with a selected product and cast-in rebars in cracked concrete (w=0.3mm) is similar, then the minimum anchorage length $l_{b,min}$ and the minimum overlap length $l_{0,min}$ shall be increased by a factor 1.5.

2. DESIGN OF POST-INSTALLED REINFORCEMENT

There are two design methods which are supported by Hilti:

1. Based on the approval (ETA) for the mortar system qualified according to EOTA TR023 [2] which allows to use the accepted structural code Eurocode 2 EN 1992-1-1:2011, chapters 8.4: “anchorage of longitudinal reinforcement” and 8.7 “Laps and mechanical couplers” taking into account some adhesive specific parameters. This method is called

   “ETA/EC2 design method”

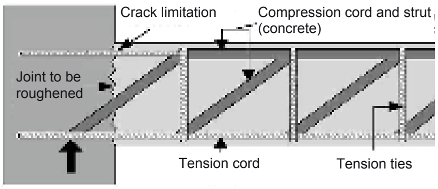
   Paragraph 2.2 shows application range.

2. The design approach of Eurocode 2 has been extended on the basis of extensive internal as well as external research as well as assessments. This method is called

   “HIT rebar design method”

   See section 2.3 for an overview of the design approach.

2.1 Loads on reinforcing bars



Strut and tie model

Strut and tie model

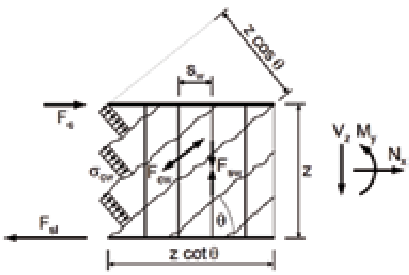
Strut and tie models are used to calculate the load path in reinforced concrete members. Where a non-linear strain distribution exists (e.g. supports) strut and tie models may be used {Clause 6.5.1(1), EC2: EN 1992-1- 1:2011}.

Strut and tie models consist of struts representing compressive stress fields, of ties representing the reinforcement and of the connecting nodes. The forces in the elements of a strut and tie model should be determined by maintaining the equilibrium with the applied loads in ultimate limit state. The ties of a strut and tie model should coincide in position and direction with the corresponding reinforcement {Clause 5.6.4, EC2: EN 1992-1-1:2011 Analysis with strut and tie models}.

In modern concrete design codes the strut angle θ can be selected within certain limits, roughly between 30° and 60°. Many modern concrete design codes show a figure similar to the following:

The equilibrium equations in horizontal direction gives the force in the reinforcement:

$$F_{sl} = \frac{M_y}{z} + \frac{N_x}{2} + \frac{V_z \cot\theta}{2}$$



Truss model in modern codes

2.2 Approval based ETA/EC2 design method

Application range

The principle that rebars are anchored “where they are not needed any more” (anchorage) or where the force is taken over by another bar (splice) and the fact that only straight rebars can be post-installed lead to the application range shown by the figures taken from EOTA TR023 [2]:

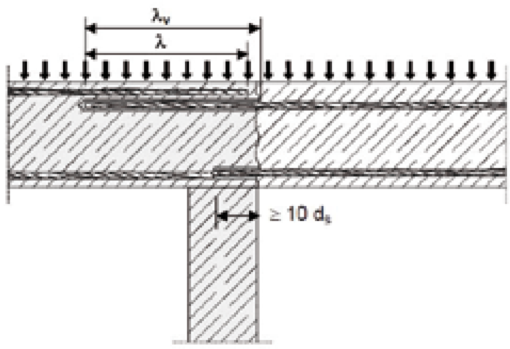


Figure 1.1: Overlap joint for rebar connections of slabs and beams

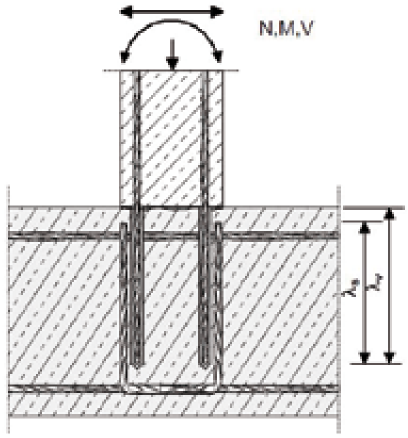


Figure 1.2: Overlap joint at a foundation of a column or wall where the rebars are stressed in tension

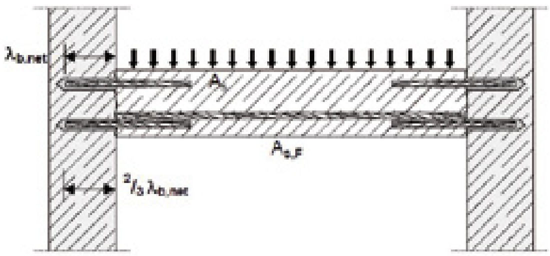


Figure 1.3: End anchoring of slabs or beams, designed as simply supported

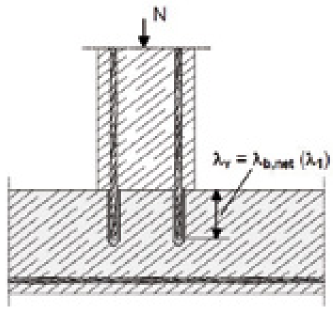


Figure 1.4: Rebar connection for components stressed primarily in compression. The rebars are stressed in compression

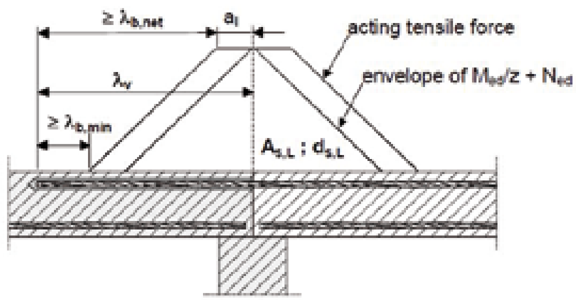


Figure 1.5: Anchoring of reinforcement to cover the line of acting tensile force

Note to Figure 1.1 to 1.5:

In the Figures no transverse reinforcement is plotted, the transverse reinforcement as required by EC 2 shall be present.

The shear transfer between old and new concrete shall be designed according to EC 2.

Application range according to EOTA TR023

All other applications lead to tensile stress in the concrete. Therefore, the principle “works like cast-in” would not be true any more. Such cases must be considered with specific models exceeding the approval based approach to post-installed rebar connections.

2.3 HIT-rebar design method

While the EC2/ETA design method is of direct and simple use, it has two main drawbacks

- The connection of simply supported slabs to walls is only possible if the wall is thick enough to accommodate the anchorage length. As reductions of the anchorage length with hooks or welded transverse reinforcement cannot be made with post-installed reinforcement, it often occurs that the wall is too small. However, if the confinement of the concrete is large enough, it is actually possible to use the full bond strength of the adhesive rather than the bond strength given by Eurocode 2. The so-called "splitting design" allows to design for the full strength of the adhesive.

- According to traditional reinforced concrete principles, moment resisting frame node connections required bent connection bars. In this logic, they can therefore not be made with straight post-installed rebar connections.

2.3.1 Splitting design

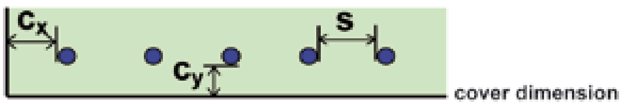
The factor α_2 of Eurocode 2 [1] gives an explicit consideration for splitting and spalling as a function of concrete cover and bar spacing. European Technical Approvals recommend the same procedure for post-installed rebar connections:

$$l_{bd,spl} = \frac{\phi}{4} \cdot \frac{\sigma_{sd}}{f_{bd}} \cdot \alpha_2 \qquad (1)$$

f_{bd} according to technical data (ETA's for post – installed anchor.

$$\alpha_2 = 1 - 0.15 \cdot \frac{c_d - \phi}{\phi}$$

$$c_d = \min(c_x; c_y; s/2)$$



This function is adapted and extended for post-installed reinforcement for the HIT-Rebar design concept: Eurocode 2 limits the α_2 value to $\alpha_2 \geq 0.7$. This can be interpreted as follows: as long as α_2 exceeds 0.7, spalling of the concrete cover or splitting between bars will be the controlling mode of failure. If α_2 is less than 0.7, corresponding to cover dimensions of $c_d/\phi > 3$, the cover is large enough so that splitting cannot occur any more and pullout will control. Assuming an infinitely strong adhesive, there would be no such lower limit on α_2 and the bond stress, at which splitting occurs can be expressed as:

$$f_{bd,spl1} = \frac{f_{bd}}{1 - 0.15 \cdot \frac{c_d - \phi}{\phi}}$$

For cover dimensions exceeding the range of Eurocode 2, i.e. for $c_d/\phi > 3$ (bonded-in bars only), an adapted factor α_2' is used to create a linear extension of the bond strength function:

$$\alpha_2' = \frac{1}{\frac{1}{0.7} + \delta \cdot \frac{c_d - 3 \cdot \phi}{\phi}}$$

$$f_{bd,spl2} = \frac{f_{bd}}{\max[\alpha_2'; \ 0.25]}$$

where δ is a factor defining the growth of the linear function for $f_{bd,spl,2}$; it is calibrated on the basis of tests.
In order to avoid unreasonably low values of α_2', its value is limited to $\alpha_2' \geq 0.25$

2.3.2 Extension of the AS3600-2009 approach – HIT-rebar design method

The basic development length for a deformed bar in tension is calculated from

$$L_{sy.tb} = \frac{0.5k_1 k_3 f_{sy} d_b}{k_2 \sqrt{f'_c}} \geq 29k_1 d_b$$

where,

K_1 = 1.3 for a horizontal bar with more than 300mm of concrete cast below the bar;
or
= 1.0 otherwise

K_2 = (132 – d_b) / 100, and

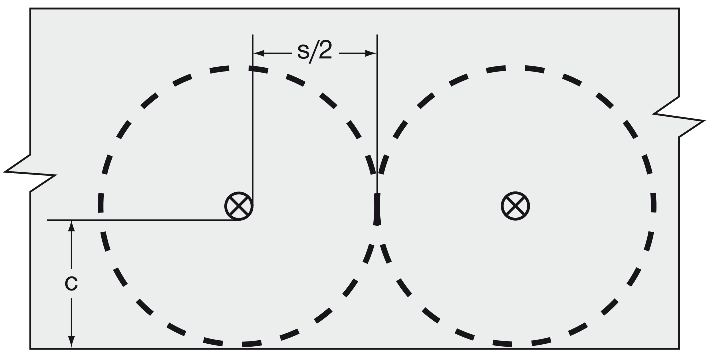
K_3 = 1.0 - 0.15 x (c_d– d_b) / d_b (within the limits $0.7 \leq k_3 \leq 1.0$)

Based on section 2.3.1, the same approach can be applied to AS3600-2009. Accordingly, the k_3 value may be replaced by:

$$K'_3 = \frac{1}{\frac{1}{0.7} + \delta \frac{c_d - 3d_b}{d_b}} \geq 0.25 \text{ for } c_d > 3d_b$$

δ is the reduction factor for splitting with large concrete cover – Hilti additional data, based on further testing.

The confinement Cd is defined as:



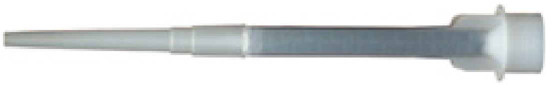
$$c_d \leq \min\left\{c; \frac{s}{2}\right\}$$

3. HILTI HIT-RE 500 V3 POST-INSTALLED REBARS

Injection mortar system

Hilti HIT-RE 500 V3
330 ml foil pack

(also available as 500 ml and 1400 ml foil pack)



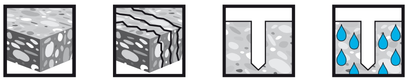
Static mixer

Rebar

Benefits

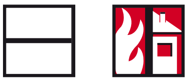
- SAFEset technology: Hilti hollow drill bit for hammer drilling and roughening tool for diamond coring
- suitable for concrete C 12/15 to C 50/60
- high loading capacity
- suitable for dry and water saturated concrete
- for rebar diameters up to 40 mm
- non corrosive to rebar elements
- long working time at elevated temperatures
- suitable for embedment length till 3200 mm
- fire time exposure up to 4h

Base material



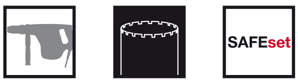
Concrete (uncracked) | Concrete (cracked) | Dry concrete | Wet concrete

Load conditions



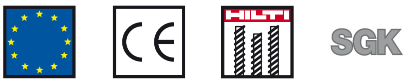
Static/ quasi-static | Fire resistance

Installation conditions



Hammer drilling | Diamond coring | Hilti SAFEset technology with Hollow Drill Bit and roughening tool

Other information



European Technical Approval | CE conformity | PROFIS rebar design software | Corrosion tested

Service temperature range

Temperature range: -40°C to +80°C (max. long term temperature +50°C, max. short term temperature +80°C) .

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval	CSTB, Marne la Vallée	ETA-16/0142 / 07-11-2016
European technical approval	CSTB, Marne la Vallée	ETA-16/0143 / 30-11-2016
Fire evaluation	CSTB, Marne la Vallée	MRF 1526054277/B / 12-04-2016

All data given in this section according to the approvals mentioned above ETA-16/0142 issue 07-11-2016 and ETA-16/0143 issue 30-11-2016.

SETTING DETAILS

For detailed information on installation see instruction for use given with the package of the product.

Curing time for general conditions[1)]

Data according ETA-16/0142, issue 07-11-2016			
Temperature of the base material	Working time in which rebar can be inserted and adjusted t_{gel}	Initial curing time $t_{cure,ini}$	Curing time before rebar can be fully loaded t_{cure}
-5 °C ≤ T_{BM} < -1 °C	2 h	48 h	168 h
0 °C ≤ T_{BM} < 4 °C	2 h	24 h	48 h
5 °C ≤ T_{BM} < 9 °C	2 h	16 h	24 h
10 °C ≤ T_{BM} < 14 °C	1.5 h	12 h	16 h
15 °C ≤ T_{BM} < 19 °C	1 h	8 h	16 h
20 °C ≤ T_{BM} < 24 °C	30 min	4 h	7 h
25 °C ≤ T_{BM} < 29 °C	20 min	3.5 h	6 h
30 °C ≤ T_{BM} < 34 °C	15 min	3 h	5 h
35 °C ≤ T_{BM} < 39 °C	12 min	2 h	4.5 h
T_{BM} = 40 °C	10 min	2 h	4 h

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

SETTING INSTRUCTIONS

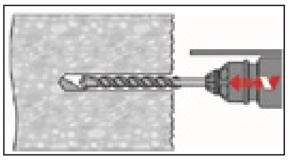
Safety regulations

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 V3.
Important: Observe the installation instruction of the manufacturer provided with each foil pack.

Hole drilling

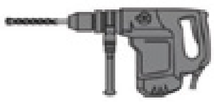
Note: Before drilling, remove carbonised concrete; clean contact areas.
In case of aborted drill hole the drill hole shall be filled with mortar.

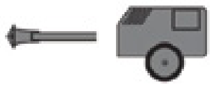
a) Hammer drilling



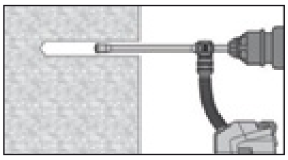
Drill hole to the required embedment depth with a hammer drill set in rotation-hammer mode or a compressed air drill using an appropriately sized carbide drill bit.

Hammer drill (HD) Compressed air (CA)



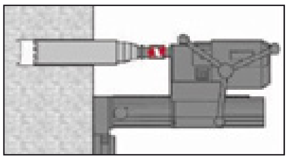


b) Hammer drilling with Hilti hollow drill bit: for dry and wet concrete only



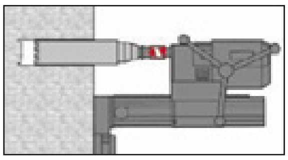
Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment.
This drilling system removes the dust and cleans the drill hole during drilling when used in accordance with the user’s manual. After drilling is complete, proceed to the “injection preparation” step in the installation instruction.

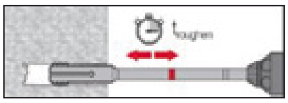
c) Diamond coring: for dry and wet concrete only



Diamond coring is permissible when suitable diamond core drilling machines and the corresponding core bits are used.

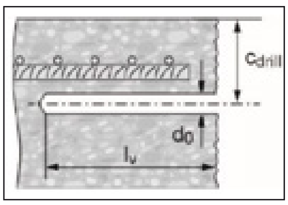
d) Diamond coring followed by roughening with Hilti Roughening tool: for dry and wet concrete only





Diamond coring is permissible when suitable diamond core drilling machines and the corresponding core bits are used.
For the use in combination with Hilti roughening tool TE-YRT.
Before roughening the borehole needs to be dry. Check usability of the roughening tool with the wear gauge RTG.
Roughen the borehole over the whole length to the required h_{ef}.

Splicing applications

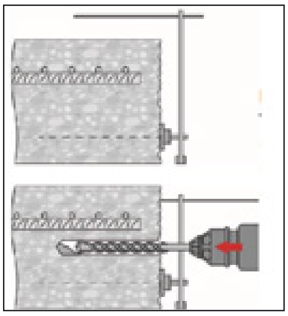


Measure and control concrete cover c.
$c_{drill} = c + d_0/2$
Drill parallel to surface edge and to existing rebar.
Where applicable use Hilti drilling aid HIT-BH.

SETTING INSTRUCTIONS

Hole drilling (cont'd)

Drilling aid



For holes l_v > 20cm use drilling aid

Ensure that the drill hole is parallel to the existing rebar.

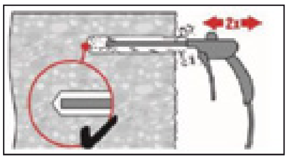
Three different options can be considered:

- Hilti drilling aid HIT-BH
- Lath or spirit level
- Visual check

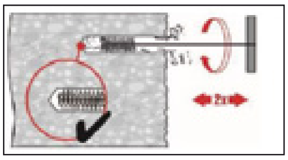
Drill hole cleaning

Just before setting the bar, the drill hole must be free of dust and debris by using the suitable cleaning method for the hole depth and size described below. Inadequate hole cleaning = poor load values.

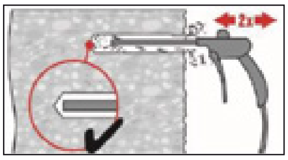
Compressed air cleaning (CAC): for all drill diameters d_0 and all drill hole depths $h_0 \leq 20 \cdot d$



Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m^3/h) until return air stream is free of noticeable dust.

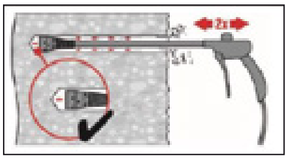


Brush 2 times with the specified brush HIT-RB size (brush Ø ≥ borehole Ø) by inserting the round steel brush to the back of the hole (if needed with nozzle extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the drill hole. If this is not the case, please use a new brush or a brush with a larger diameter.

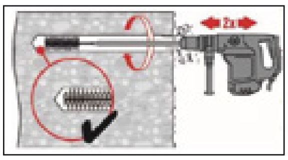


Blow 2 times again with compressed air until return air stream is free of noticeable dust.
If required use additional accessories and extensions for air nozzle and brush to reach back of hole.

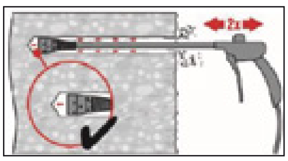
Compressed Air Cleaning (CAC): for drill holes deeper than 250 mm (for ϕ 8 to ϕ 12) or deeper than 20·ϕ (for ϕ > 12 mm)



Use the appropriate air nozzle Hilti HIT-DL.
Blow two times from the back of the hole over the hole length with oil-free compressed air until return air stream is free of noticeable dust.
Safety tip: Do not inhale concrete dust.
Use of the dust collector Hilti HIT-DRS is recommended.



Screw the round steel brush HIT-RB in one end of the brush extension HIT-RBS, so that the overall length of the brush is sufficient to reach the base of the drill hole. 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 the brush is inserted in the borehole

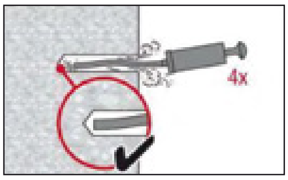


Use the appropriate air nozzle Hilti HIT-DL.
Blow two times from back of the hole over the hole length with oil-free compressed air until return air stream is free of noticeable dust.
Safety tip: Do not inhale the concrete dust.
Use of the dust collector Hilti HIT-DRS is recommended.

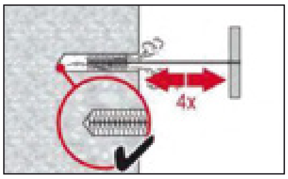
SETTING INSTRUCTIONS

Drill hole cleaning (cont'd)

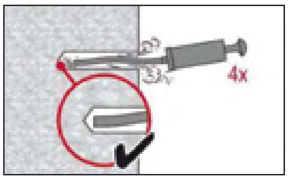
Manual Cleaning (MC): for drill hole diameters $d_0 \leq 20$ mm and all drill hole depths $h_0 \leq 10 \cdot \phi$



The Hilti hand pump may be used for blowing out drill holes up to diameters $d_0 \leq 20$ mm and drill hole depths $h_0 \leq 10 \cdot \phi$.
Blow out at least 4 times from the back of the drill hole until return air stream is free of noticeable dust.

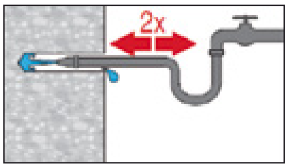


Brush 4 times with the specified brush by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.

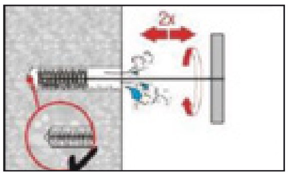


Blow again with the Hilti hand pump at least 4 times until return air stream is free of noticeable dust.

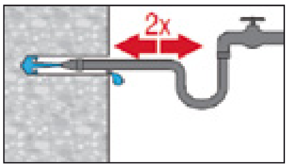
Cleaning of diamond cored holes: for all drill hole diameters d_0 and all drill hole depths h_0



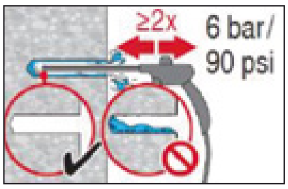
Flush 2 times by inserting a water hose (water-line-pressure) to the back of the hole until water runs clear.



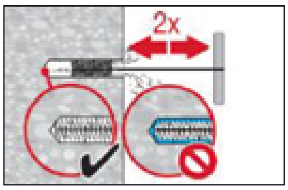
Brush 2 times with the specified brush by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø). If this is not the case, please use a new brush or a brush with a larger diameter.



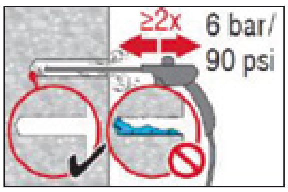
Flush 2 times by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.



Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m^3/h) until return air stream is free of noticeable dust and water.
For drill hole diameters ≥ 32 mm the compressor has to supply a minimum air flow of 140 m^3/h.



Brush 2 times with the specified brush size (brush Ø ≥ drill hole Ø) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø). If this is not the case, please use a new brush or a brush with a larger diameter.

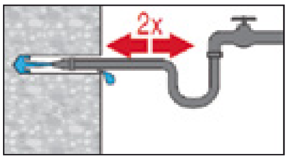


Blow 2 times with compressed air until return air stream is free of noticeable dust and water.

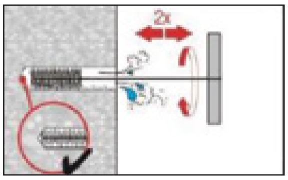
SETTING INSTRUCTIONS

Drill hole cleaning (cont'd)

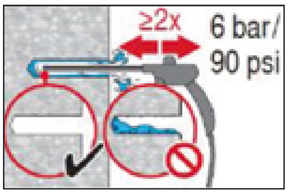
Cleaning of diamond cored holes followed by roughening: for all drill hole diameters d_0 and all drill hole depths h_0



Flush 2 times by inserting a water hose (water-line-pressure) to the back of the hole until water runs clear.

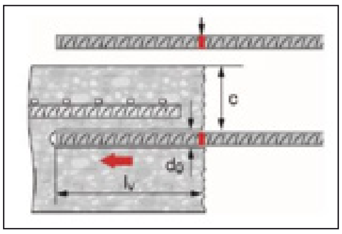


Brush 2 times with the specified brush by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø). If this is not the case, please use a new brush or a brush with a larger diameter.



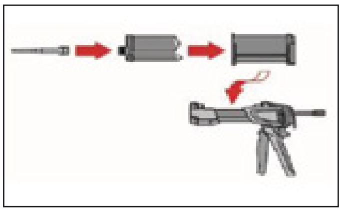
Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m^3/h) until return air stream is free of noticeable dust and water.
For drill hole diameters ≥ 32 mm the compressor has to supply a minimum air flow of 140 m^3/h.

Rebar preparation

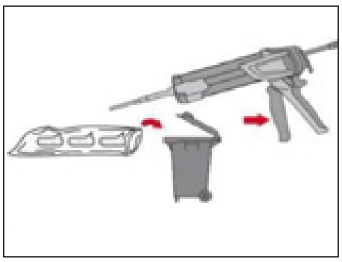


Before use, make sure the rebar is dry and free of oil or other residue.
Mark the embedment depth on the rebar. (e.g. with tape) , l_v
Insert rebar in borehole, to verify hole and setting depth l_v.

Injection preparation



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



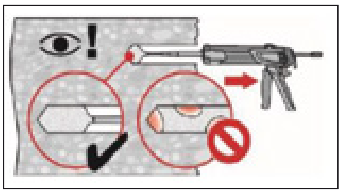
The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
After changing a mixing nozzle, the first few trigger pulls must be discarded as described above. For each new foil pack a new mixing nozzle must be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

SETTING INSTRUCTIONS

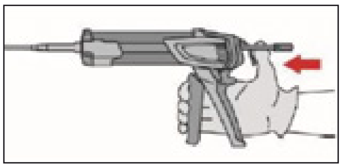
Inject adhesive

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

Injection method for hole depth ≤ 250mm (without overhead applications)

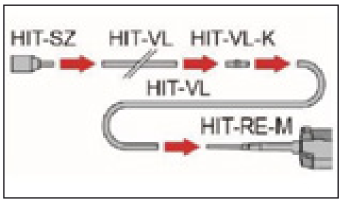


Inject the adhesive from the back of the hole towards the front and slowly withdraw the mixing nozzle step by step after each trigger pull.
Fill holes approximately 2/3 full to ensure that the annular gap between the rebar and the concrete is completely filled with adhesive over the embedment length.

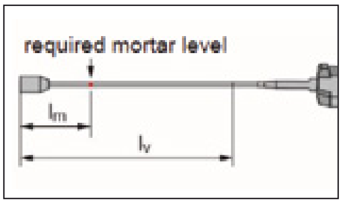


After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle.

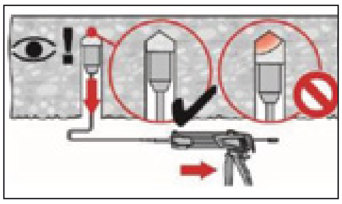
Injection method for drill hole depth > 250 mm or overhead applications



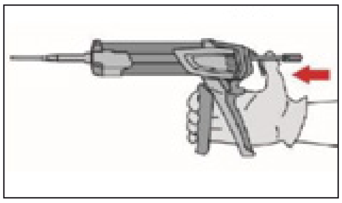
Assemble mixing nozzle HIT-RE-M, extension(s) and piston plug HIT-SZ.
For combinations of several injection extensions use coupler HIT-VL-K. A substitution of the injection extension for a plastic hose or a combination of both is permitted.
The combination of HIT-SZ piston plug with HIT-VL 16 pipe and then HIT-VL 16 tube support proper injection.



Mark the required mortar level l_m and embedment depth l_v with tape or marker on the injection extension.
estimation:
$l_m = 1/3 \cdot l_v$
precise formula for optimum mortar volume:
$l_m = l_v \cdot (1{,}2 \cdot (\phi^2 / d_0^2) - 0{,}2)$



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

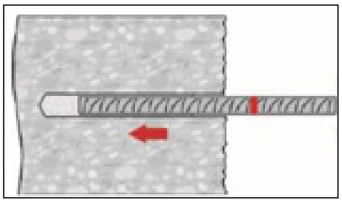


After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle.

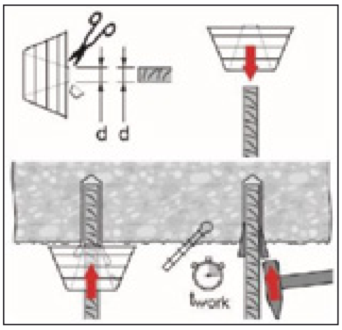
SETTING INSTRUCTIONS

Setting the element

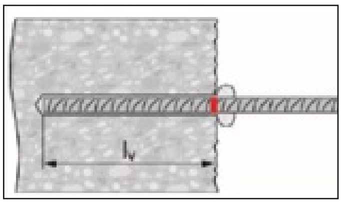
Before use, verify that the element is dry and free of oil and other contaminants.



For easy installation, insert the rebar into the drill hole while slowly twisting until the embedment mark is at the concrete surface level.

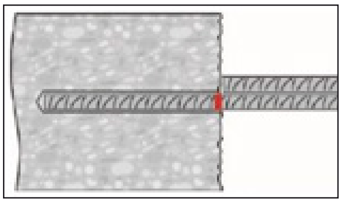


For overhead application:
During insertion of the rebar, mortar might flow out of the borehole. For collection of the flowing mortar, HIT-OHC may be used.
Support the rebar and secure it from falling until mortar has started to harden, e.g. using wedges HIT-OHW.
For overhead installation, use piston plugs and fix embedded parts with e.g. wedges.

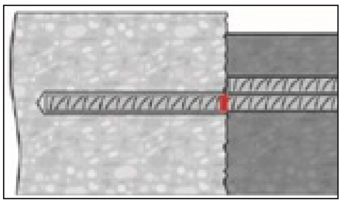


After installing the rebar, the annular gap must be completely filled with mortar.
Proper installation:

- desired anchoring embedment l_v is reached: embedment mark at concrete surface.
- excess mortar flows out of the drill hole after the rebar has been fully inserted until the embedment mark.



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.



Full load may be applied only after the curing time t_{cure} has elapsed.

HILTI

FITNESS FOR USE

Some creep tests have been conducted in accordance with EAD 330087-00-0601 in the following conditions: in dry environment at 50°C during 90 days.
These tests show an excellent behaviour of the post-installed connection made with HIT-RE 500 V3: low displacements with long term stability, failure load after exposure above reference load.

Resistance to chemical substances

Categories	Chemical substances	Resistant	Non resistant
Alkaline products	Drilling dust slurry pH = 12,6	+	
	Potassium hydroxide solution (10%) pH = 14	+	
Acids	Acetic acid (10%)		+
	Nitric acid (10%)		+
	Hydrochloric acid (10%)		+
	Sulfuric acid (10%)		+
Solvents	Benzyl alcohol		+
	Ethanol		+
	Ethyl acetate		+
	Methyl ethyl ketone (MEK)		+
	Trichlorethylene		+
	Xylol (mixture)	+	
Products from job site	Concrete plasticizer	+	
	Diesel	+	
	Engine oil	+	
	Petrol	+	
	Oil for form work	+	
Environment	Salt water	+	
	De-mineralised water	+	
	Sulphurous atmosphere (80 cycles)	+	

Electrical Conductivity

HIT-RE 500 V3 in the hardened state is not conductive electrically. Its electric resistivity is $66 \cdot 10^{12}$ Ω.m (DIN IEC 93 – 12.93). It is adapted well to provide electrically insulating anchorings (ex: railway applications, subway).

Drilling diameters

Rebar (mm)	Drill bit diameters d_0 [mm]					
	Hammer drill (HD)	Hollow Drill Bit (HDB)	Compressed air drill (CA)	Diamond coring		
				Dry (PCC)	Wet (DD)	With roughening tool (RT)
10	14 (12[a])	14 (12[a])	-	-	14 (12[a])	-
12	16 (14[a])	16 (14[a])	17	-	16 (14[a])	-
16	20	20	20	-	20	20
20	25	25	26	-	25	25
24	32	32	32	-	32	32
28	35	35	35	35	35	35
30	37	-	35/37	35	37	-
32	40	-	40	47	40	-
36	45	-	45	47	47	-
40	55	-	57	52	52	-

[a] Max. installation length ℓ = 250mm

DESIGN PROCESS – 3 STEPS

STEP 1: Determine anchorage length based on the bond strength of the product

Non-cracked concrete C20/25							
	Bar diameter						
	Data according to ETA -16/0143, issued 30-11-2016						
	N10	N12	N16	N20	N24	N28	N32
Sectional Area of As (mm²)	79	113	201	314	452	616	804
Design Yield Fsy (KN)	40	57	101	157	226	308	402
fbd,po (MPa) - Hammer drilling	9.33	9.33	9.33	9.33	8.67	8.67	8.67
Required Length (mm) Lsb - Hammer drilling	136	162	215	268	346	404	461
fbd,po (MPa) - Hammer drilling with Hollow drill bit TE-CD or TE-YD	-	9.33	9.33	9.33	8.67	8.67	-
Required Length (mm) Lsb - Hammer drilling with hollow drill bit TE-CD or TE-YD	-	162	215	268	346	404	-
fbd,po (MPa) - Diamond coring	5.00	5.00	4.29	4.29	4.29	4.52	4.52
Required Length (mm) Lsb - Diamond coring	255	302	468	582	699	775	885
fbd,po (MPa) - Diamond coring then holes roughen with TE-YRT	-	-	9.33	9.33	8.67	8.67	-
Required Length (mm) Lsb - Diamond coring then holes roughen with TE-YRT	-	-	215	268	346	404	-
fbd,po (MPa) - Hammer drilling in water-filled holes	5.71	5.71	5.71	5.71	5.24	5.24	5.24
Required Length (mm) Lsb - Hammer drilling in water-filled holes	223	265	352	438	572	668	763

*Design bond strength in N/mm² according to ETA 04/0027 $f_{bd,po} = \tau Rk/\gamma Mp$).
Valid for temperature range I : 40°C / 24°C

**For wet diamond coring, the anchors shall not be installed in flooded hole.

Effect of concrete compressive strength:

For hammer drilled holes, hammer drilled holes with Hilti hollow bit and diamond cored holes.

Concrete compressive strength f‘c,cyl (Mpa)	20	25	32	40	45	50
$f_{B,p}$	1	1.02	1.048	1.07	1.08	1.09

For diamond cored holes with Hilti roughening tool.

Concrete compressive strength f‘c,cyl (Mpa)	20	25	32	40	45	50
$f_{B,p}$	1					

The final required length is equal to: **Lsb,f = Lsb / $f_{B,p}$**

DESIGN PROCESS – 3 STEPS

STEP 2: Calculate of the basic anchorage depth $L_{sy,\,tb}$ (mm) to develop yield of post-installed rebar in tension as per AS 3600-2009. Extension Approach

With the Reduction factor for splitting with large concrete cover / confinement: δ = 0.306 (HILTI additional data), applicable for both HILTI products HIT-RE 500 V3 and HIT-HY 200, K'_3 shall be calculated from:

$$K'_3 = \frac{1}{\frac{1}{0.7} + \delta \frac{C_d - 3d_b}{d_b}} \geq 0.25 \text{ for } C_d > 3d_b$$

The basic anchorage depth $L_{sy,tb}$ can therefore be taken from the following tables:

$L_{sy,tb}$ for diameter of rebar = 10mm					
Confinement c_d	$f'_{c,cy}$ = 20MPa	$f'_{c,cy}$ = 25MPa	$f'_{c,cy}$ = 32MPa	$f'_{c,cy}$ = 40MPa	$f'_{c,cy}$ = 50MPa
$2.d_b$	389	348	308	275	246
$3.d_b$	321	287	254	227	203
$4.d_b$	264	236	209	187	167
$5.d_b$	225	201	178	159	142
$6.d_b$	195	175	154	138	-
$7.d_b$	173	155	137	-	-
$8.d_b$	155	139	-	-	-
$9.d_b$	140	-	-	-	-

$L_{sy,tb}$ for diameter of rebar = 12mm					
Confinement c_d	$f'_{c,cy}$ = 20MPa	$f'_{c,cy}$ = 25MPa	$f'_{c,cy}$ = 32MPa	$f'_{c,cy}$ = 40MPa	$f'_{c,cy}$ = 50MPa
$2.d_b$	475	425	376	336	301
$3.d_b$	391	350	309	277	247
$4.d_b$	322	288	255	228	204
$5.d_b$	274	245	217	194	173
$6.d_b$	238	213	188	168	151
$7.d_b$	211	188	167	-	-
$8.d_b$	189	169	-	-	-
$9.d_b$	171	-	-	-	-

$L_{sy,tb}$ for diameter of rebar = 16mm					
Confinement c_d	$f'_{c,cy}$ = 20MPa	$f'_{c,cy}$ = 25MPa	$f'_{c,cy}$ = 32MPa	$f'_{c,cy}$ = 40MPa	$f'_{c,cy}$ = 50MPa
$2.d_b$	655	586	518	463	415
$3.d_b$	540	483	427	382	341
$4.d_b$	445	398	351	314	281
$5.d_b$	378	338	299	267	239
$6.d_b$	329	294	260	232	208
$7.d_b$	291	260	230	206	-
$8.d_b$	261	233	206	-	-
$9.d_b$	236	211	-	-	-
$10.d_b$	216	-	-	-	-

DESIGN PROCESS – 3 STEPS

$L_{sy,tb}$ for diameter of rebar = 20mm					
Confinement c_d	**$f'_{c,cy}$ = 20MPa**	**$f'_{c,cy}$ = 25MPa**	**$f'_{c,cy}$ = 32MPa**	**$f'_{c,cy}$ = 40MPa**	**$f'_{c,cy}$ = 50MPa**
$2.d_b$	849	759	671	600	537
$3.d_b$	699	625	552	494	442
$4.d_b$	575	515	455	407	364
$5.d_b$	489	438	387	346	309
$6.d_b$	425	380	336	301	269
$7.d_b$	376	337	298	266	-
$8.d_b$	337	302	267	-	-
$9.d_b$	306	273	-	-	-
$10.d_b$	224	-	-	-	-

$L_{sy,tb}$ for diameter of rebar = 24mm					
Confinement c_d	**$f'_{c,cy}$ = 20MPa**	**$f'_{c,cy}$ = 25MPa**	**$f'_{c,cy}$ = 32MPa**	**$f'_{c,cy}$ = 40MPa**	**$f'_{c,cy}$ = 50MPa**
$2.d_b$	1056	944	835	747	668
$3.d_b$	870	778	687	615	550
$4.d_b$	716	641	566	506	453
$5.d_b$	609	545	481	430	385
$6.d_b$	529	474	419	374	335
$7.d_b$	468	419	370	331	-
$8.d_b$	420	376	332	-	-
$9.d_b$	381	340	-	-	-
$10.d_b$	348	-	-	-	-

$L_{sy,tb}$ for diameter of rebar = 28mm					
Confinement c_d	**$f'_{c,cy}$ = 20MPa**	**$f'_{c,cy}$ = 25MPa**	**$f'_{c,cy}$ = 32MPa**	**$f'_{c,cy}$ = 40MPa**	**$f'_{c,cy}$ = 50MPa**
$2.d_b$	1279	1144	1011	905	809
$3.d_b$	1054	942	833	745	666
$4.d_b$	868	776	686	614	549
$5.d_b$	738	660	583	522	466
$6.d_b$	641	574	507	454	406
$7.d_b$	567	507	449	401	-
$8.d_b$	509	455	402	-	-
$9.d_b$	461	412	-	-	-
$10.d_b$	422	-	-	-	-

$L_{sy,tb}$ for diameter of rebar = 32mm					
Confinement c_d	**$f'_{c,cy}$ = 20MPa**	**$f'_{c,cy}$ = 25MPa**	**$f'_{c,cy}$ = 32MPa**	**$f'_{c,cy}$ = 40MPa**	**$f'_{c,cy}$ = 50MPa**
$2.d_b$	1521	1360	1202	1075	962
$3.d_b$	1252	1120	990	885	792
$4.d_b$	1031	922	815	729	652
$5.d_b$	877	784	693	620	554
$6.d_b$	762	682	603	539	482
$7.d_b$	674	603	533	477	-
$8.d_b$	605	541	478	-	-
$9.d_b$	548	490	433	-	-
$10.d_b$	501	448	-	-	-
$11.d_b$	461	-	-	-	-

DESIGN PROCESS – 3 STEPS

STEP 3: Determine the basic anchorage depth Lsy (mm) to develop yield of post-installed rebar shall be:

$$L_{sy} \geq \left\{ L_{sb,f}\,;\, L_{sy,tb} \right\}$$

Embedment depth to develop less than the yield strength

The embedment depth to develop less than the yield of the bar shall be as per clause 13.1.2.4 of AS 3600-2009.

Spliced connection

When a post-installed rebar is required to form a splice with an existing cast-in rebar, the rules of AS 3600-2009, 13.2.2 shall be applied to calculate the required embedment depth of the post-installed rebar with HIT-RE 500 V3.

Post-installed rebar in compression

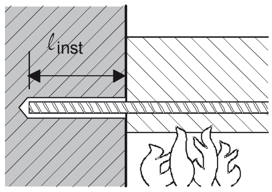
The required embedment depth of a post-installed rebar in compression with HIT-RE 500 V3 shall be calculated in compliance with AS 3600-2009, 13.1.5.

Note: For bars greater than 32mm please contact your local Hilti Field Engineer for support.

FIRE RESISTANCE ACCORDING TO MRF 1526054277 / B

a) Anchoring application

a) Anchoring application beam-wall connection with a concrete cover of 20 mm



Maximum force in rebar in conjunction with HIT-RE 500 V3 as a function of embedment depth for the fire resistance classes F30 to F240 (yield strength f_{yk} = 500 N/mm² and concrete class C20/25) according EC2[a].

Rebar [mm]	Max. $F_{s,T}$ [kN]	ℓ_{inst} [mm]	Fire resistance of bar in [kN] R30	R60	R90	R120	R180	R240
10	26.2	110	5.8	2.4	1.1	0.6	0.0	0.0
		150	10.1	6.5	3.8	2.5	1.2	0.5
		190	14.5	10.8	8.1	6.0	3.3	2.0
		230	18.8	15.1	12.4	10.3	6.7	4.4
		300	26.2	22.7	20.0	17.9	14.3	11.2
		340		26.2	24.3	22.2	18.6	15.6
		360			26.2	24.4	20.8	17.7
		380				26.2	23.0	19.9
		410					26.2	23.1
		440						26.2
12	37.7	140	10.9	6.5	3.5	2.3	1.0	0.3
		200	18.7	14.3	11.0	8.5	4.8	3.0
		260	26.5	22.1	18.8	16.3	12.0	8.3
		320	34.3	29.9	26.6	24.1	19.8	16.1
		350	37.7	33.8	30.5	28.0	23.7	20.0
		390		37.7	35.7	33.2	28.9	25.2
		410			37.7	35.8	31.5	27.8
		430				37.7	34.1	30.4
		460					37.7	34.3
		490						37.7
14	51.3	160	15.7	10.6	6.7	4.4	2.3	1.1
		220	24.8	19.7	15.8	12.9	8.0	5.1
		280	33.9	28.8	24.9	22.0	17.0	12.7
		340	43.0	37.9	34.1	31.1	26.1	21.8
		400	51.3	47.0	43.2	40.2	35.2	30.9
		430		51.3	47.7	44.8	39.7	35.4
		460			51.3	49.3	44.3	40.0
		480				51.3	47.3	43.0
		510					51.3	47.6
		540						51.3

Rebar [mm]	Max. $F_{s,T}$ [kN]	ℓ_{inst} [mm]	Fire resistance of bar in [kN]					
			R30	R60	R90	R120	R180	R240
16	67	180	21.4	15.5	11.2	7.8	4.3	2.5
		240	31.8	25.9	21.6	18.2	12.5	8.2
		300	42.2	36.3	32.0	28.6	22.9	18.0
		360	52.6	46.8	42.4	39.0	33.3	28.4
		450	67.0	62.4	58.0	54.6	48.9	44.0
		480		67.0	63.2	59.8	54.1	49.2
		510			67.0	65.1	59.3	54.4
		530				67.0	62.8	57.8
		560					67.0	63.0
		590						67.0
20	104.7	220	35.5	28.1	22.6	18.5	11.4	7.3
		280	48.5	41.1	35.6	31.5	24.3	18.1
		340	61.5	54.1	48.6	44.5	37.3	31.1
		400	74.5	67.1	61.7	57.5	50.3	44.1
		460	87.5	80.1	74.7	70.5	63.3	57.1
		540	104.7	97.5	92.0	87.8	80.6	74.5
		580		104.7	100.7	96.5	89.3	83.1
		600			104.7	100.8	93.6	87.5
		620				104.7	98.0	91.8
		660					104.7	100.5
		680						104.7

b) **anchoring application beam-wall connection with a concrete cover of 40 mm**

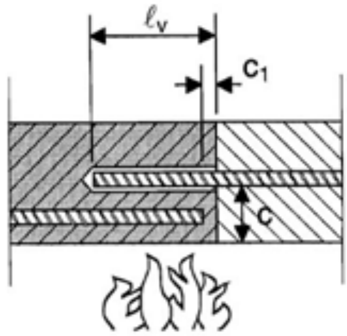
Rebar [mm]	Max. $F_{s,T}$ [kN]	ℓ_{inst} [mm]	Fire resistance of bar in [kN]					
			R30	R60	R90	R120	R180	R240
10	26.2	110	7.3	3.1	1.5	0.9	0.0	0.0
		150	11.6	7.3	4.5	3.0	1.3	0.6
		190	15.9	11.7	8.9	6.7	3.5	2.1
		230	20.3	16.0	13.2	11.0	7.2	4.6
		290	26.2	22.5	19.7	17.5	13.7	10.5
		330		26.2	24.0	21.9	18.0	14.9
		350			26.2	24.0	20.2	17.0
		370				26.2	22.3	19.2
		410					26.2	23.6
		440						26.2
12	37.7	140	12.6	7.5	4.3	2.8	1.1	0.3
		200	20.4	15.3	11.9	9.3	5.2	3.2
		260	28.2	23.1	19.7	17.1	12.5	8.8
		320	36.0	30.9	27.6	25.0	20.3	16.6
		340	37.7	33.5	30.2	27.6	22.9	19.2
		380		37.7	35.4	32.8	28.1	24.4
		400			37.7	35.4	30.7	27.0
		420				37.7	33.3	29.6
		460					37.7	34.8
		490						37.7
14	51.3	160	17.8	11.8	7.9	5.2	2.5	1.2
		220	26.9	20.9	17.0	13.9	8.5	5.5
		280	36.0	30.0	26.1	23.0	17.6	13.2
		340	45.1	39.1	35.2	32.1	26.7	22.4
		390	51.3	46.7	42.8	39.7	34.3	29.9
		430		51.3	48.8	45.8	40.4	36.0
		450			51.3	48.8	43.4	39.0
		470				51.3	46.4	42.1
		510					51.3	48.1
		540						51.3

Rebar	Max. $F_{s,T}$	ℓ_{inst}	Fire resistance of bar in [kN]					
[mm]	[kN]	[mm]	R30	R60	R90	R120	R180	R240
16	67	180	23.8	16.9	12.5	9.0	4.6	2.7
		240	34.2	27.3	22.9	19.4	13.2	8.7
		300	44.6	37.7	33.3	29.8	23.6	18.6
		360	55.0	48.2	43.7	40.2	34.0	29.0
		430	67.0	60.3	55.8	52.3	46.1	41.2
		470		67.0	62.7	59.3	53.1	48.1
		500			67.0	64.5	58.3	53.3
		520				67.0	61.7	56.8
		560					67.0	63.7
		580						67.0
20	104.7	220	38.4	29.8	24.2	19.9	12.2	7.8
		300	55.7	47.2	41.6	37.3	29.5	23.3
		380	73.1	64.5	58.9	54.6	46.8	40.6
		460	90.4	81.9	76.3	71.9	64.2	57.9
		530	104.7	97.0	91.4	87.1	79.3	73.1
		570		104.7	100.1	95.8	88.0	81.8
		600			104.7	102.3	94.5	88.3
		620				104.7	98.9	92.6
		650					104.7	99.1
		680						104.7
25	163.6	280	64.2	53.6	46.6	41.1	31.4	23.7
		370	88.6	77.9	70.9	65.5	55.8	48.0
		460	113.0	102.3	95.3	89.9	80.2	72.4
		550	137.4	126.7	119.7	114.3	104.6	96.8
		650	163.6	153.8	146.8	141.4	131.7	123.9
		690		163.6	157.7	152.2	142.5	134.7
		720			163.6	160.4	150.7	142.9
		740				163.6	156.1	148.3
		770					163.6	156.4
		800						163.6
28	205.3	310	81.1	69.1	61.3	55.2	44.3	35.6
		370	99.3	87.3	79.5	73.4	62.5	53.8
		430	117.5	105.5	97.7	91.6	80.7	72.0
		490	135.7	123.7	115.9	109.8	98.9	90.2
		550	153.9	141.9	134.1	128.0	117.2	108.4
		610	172.1	160.1	152.3	146.2	135.4	126.6
		670	190.3	178.3	170.5	164.4	153.6	144.8
		720	205.3	193.5	185.7	179.6	168.7	160.0
		760		205.3	197.8	191.8	180.9	172.2
		790			205.3	200.9	190.0	181.3
		810				205.3	196.1	187.3
		850					205.3	199.5
		870						205.3
32	268.1	350	106.5	92.8	83.9	76.9	64.5	54.6
		410	127.3	113.6	104.7	97.8	85.3	75.4
		470	148.1	134.5	125.5	118.6	106.1	96.2
		530	168.9	155.3	146.3	139.4	127.0	117.0
		590	189.7	176.1	167.1	160.2	147.8	137.8
		650	210.6	196.9	187.9	181.0	168.6	158.6
		710	231.4	217.7	208.7	201.8	189.4	179.4
		820	268.1	255.8	246.9	240.0	227.5	217.6
		860		268.1	260.8	253.8	241.4	231.4
		890			268.1	264.2	251.8	241.8
		910				268.1	258.7	248.8
		940					268.1	259.2
		970						268.1

b) Overlap joint application

Max. bond stress, $f_{bd,FIRE}$, depending on actual clear concrete cover for classifying the fire resistance.
It must be verified that the actual force in the bar during a fire, $F_{s,T}$, can be taken up by the bar connection of the selected length, ℓ_{inst}. Note: Cold design for ULS is mandatory.

$F_{s,T} \leq (\ell_{inst} - c_f) \cdot \phi \cdot \pi \cdot f_{bd,FIRE}$ where: $(\ell_{inst} - c_f) \geq \ell_s$;



ℓ_s = lap length

ϕ = nominal diameter of bar

$\ell_{inst} - c_f$ = selected overlap joint length; this must be at least ℓ_s, but may not be assumed to be more than 80 ϕ

$f_{bd,FIRE}$ = bond stress when exposed to fire

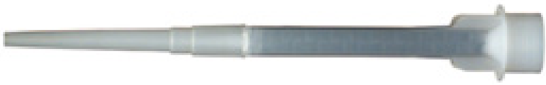
Critical temperature-dependent bond stress, $f_{bd,FIRE}$, concerning "overlap joint" for Hilti HIT-RE 500 V3 injection adhesive in relation to fire resistance class and required minimum concrete coverage c.

<table>
<tr><th>Clear concrete cover c</th><th colspan="6">Max. bond stress, τ_c [N/mm²]</th></tr>
<tr><th>[mm]</th><th>R30</th><th>R60</th><th>R90</th><th>R120</th><th>R180</th><th>R240</th></tr>
<tr><td>30</td><td></td><td rowspan="4"></td><td rowspan="6"></td><td rowspan="6"></td><td rowspan="10"></td><td rowspan="10"></td></tr>
<tr><td>40</td><td>0.8</td></tr>
<tr><td>50</td><td>1.1</td></tr>
<tr><td>60</td><td>1.5</td></tr>
<tr><td>70</td><td>2.1</td><td>0.9</td></tr>
<tr><td>80</td><td>2.9</td><td>1.2</td></tr>
<tr><td>90</td><td rowspan="21">3.5</td><td>1.5</td><td>0.9</td><td></td></tr>
<tr><td>100</td><td>1.8</td><td>1.1</td><td>0.8</td></tr>
<tr><td>110</td><td>2.3</td><td>1.4</td><td>1.0</td></tr>
<tr><td>120</td><td>2.8</td><td>1.6</td><td>1.2</td></tr>
<tr><td>130</td><td>3.4</td><td>2.0</td><td>1.4</td><td>0.9</td><td></td></tr>
<tr><td>140</td><td rowspan="16">3.5</td><td>2.3</td><td>1.6</td><td>1.0</td><td></td></tr>
<tr><td>150</td><td>2.8</td><td>1.9</td><td>1.1</td><td>0.8</td></tr>
<tr><td>160</td><td>3.3</td><td>2.2</td><td>1.3</td><td>0.9</td></tr>
<tr><td>170</td><td rowspan="13">3.5</td><td>2.5</td><td>1.5</td><td>1.1</td></tr>
<tr><td>180</td><td>2.9</td><td>1.7</td><td>1.2</td></tr>
<tr><td>190</td><td>3.4</td><td>1.9</td><td>1.4</td></tr>
<tr><td>200</td><td rowspan="10">3.5</td><td>2.2</td><td>1.5</td></tr>
<tr><td>210</td><td>2.5</td><td>1.7</td></tr>
<tr><td>220</td><td>2.8</td><td>1.9</td></tr>
<tr><td>230</td><td>3.1</td><td>2.1</td></tr>
<tr><td>240</td><td rowspan="6">3.5</td><td>2.3</td></tr>
<tr><td>250</td><td>2.6</td></tr>
<tr><td>260</td><td>2.9</td></tr>
<tr><td>270</td><td>3.2</td></tr>
<tr><td>280</td><td rowspan="2">3.5</td></tr>
<tr><td>290</td></tr>
</table>

4. HILTI HIT-HY 200-R POST-INSTALLED REBARS

Injection mortar system

Hilti HIT-HY 200-R
500 ml foil pack
(also available as 330 ml foil pack)



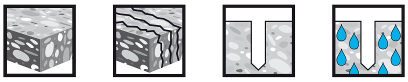
Static mixer

Rebar

Benefits

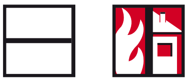
- HY 200-R version is formulated for best handling and cure time specifically for rebar applications - Suitable for concrete C 12/15 to C 50/60
- Suitable for dry and water saturated concrete
- For rebar diameters up to 32 mm
- Non corrosive to rebar elements
- Good load capacity at elevated temperatures
- Suitable for embedment length up to 1000 mm
- Suitable for applications down to -10 °C

Base material



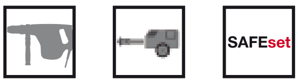
Concrete (uncracked) | Concrete (cracked) | Dry concrete | Wet concrete

Load conditions



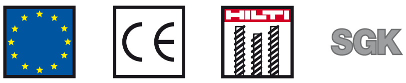
Static/ quasi-static | Fire resistance

Installation conditions



Hammer drilling | Compressed air drill (CA) | Hilti SAFEset technology

Other information



European Technical Approval | CE conformity | PROFIS rebar design software | Corrosion tested

Service temperature range

Temperature range: -40°C to +80°C (max. long term temperature +50°C, max. short term temperature +80°C) .

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval	DIBt, Berlin	ETA-12/0083 / 26-06-2014
European technical approval	DIBt, Berlin	ETA-12/0084 / 03-02-2017
Fire evaluation	CSTB, Paris	26033756

All data given in this section according to the approvals mentioned above ETA 12/0083 issue 26-06-2014 and ETA-12/0084 issue 03-02-2017.

SETTING DETAILS

For detailed information on installation see instruction for use given with the package of the product.

Working time, curing time

Temperature of the base material	HIT-HY 200-R	
	Working time t_{work} in which anchor can be inserted and adjusted	**Curing time t_{cure}** before anchor can be fully loaded
-10 °C to -5 °C	3 hour	20 hours
> -5 °C to 0 °C	2 hour	8 hours
> 0 °C to 5 °C	1 hour	4 hours
> 5 °C to 10 °C	40 min	2.5 hours
> 10 °C to 20 °C	15 min	1.5 hour
> 20 °C to 30 °C	9 min	1 hour
> 30 °C to 40 °C	6 min	1 hour

SETTING INSTRUCTIONS

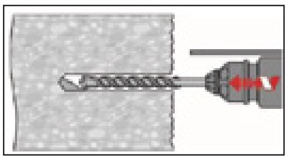
Safety regulations

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-HY 200-R.
Important: Observe the installation instruction of the manufacturer provided with each foil pack.

1. Drill hole

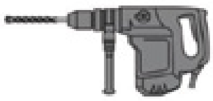
Note: Before drilling, remove carbonised concrete; clean contact areas.
In case of aborted drill hole, the drill hole shall be filled with mortar.

a) Hammer drilling

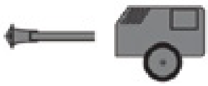


Drill hole to the required embedment depth using a hammer drill set in rotation-hammer mode or a compressed air drill using an appropriately sized carbide drill bit.

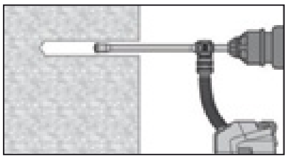
Hammer drill (HD)



Compressed air (CA)

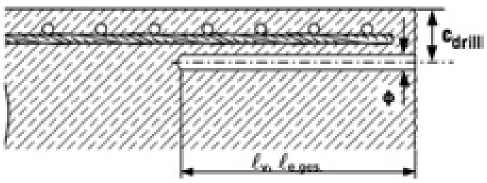


b) Hammer drilling with Hilti hollow drill bit



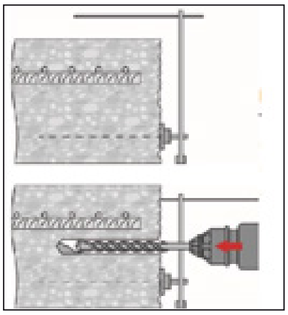
Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment.
This drilling system removes the dust and cleans the drill hole during drilling when used in accordance with the user's manual. After drilling is complete, proceed to Step 3 in the installation instruction.

Splicing applications



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

Drilling aid



Ensure that the drill hole is parallel to the existing rebar.

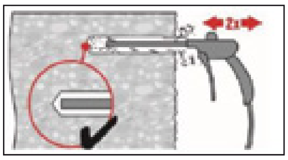
Three different options can be considered:

- Hilti drilling aid HIT-BH
- Lath or spirit level
- Visual check

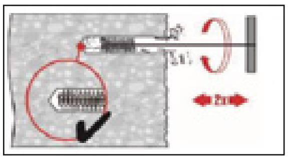
2. Clean hole

Just before setting the bar, the drill hole must be free of dust and debris by using the suitable cleaning method for the hole depth and size described below. Inadequate hole cleaning = poor load values.

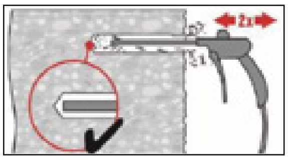
Compressed air cleaning (CAC): for all drill diameters d_0 and all drill hole depths $h_0 \leq 20 \cdot d$.



Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m^3/h) until return air stream is free of noticeable dust.

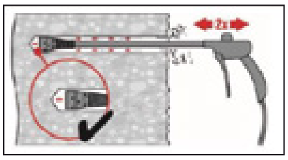


Brush 2 times with the specified brush HIT-RB size (brush Ø ≥ borehole Ø) by inserting the round steel brush to the back of the hole (if needed with nozzle extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the drill hole. If this is not the case, please use a new brush or a brush with a larger diameter.

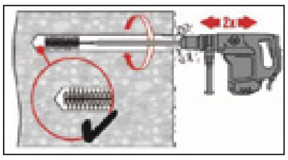


Blow 2 times again with compressed air until return air stream is free of noticeable dust.
If required use additional accessories and extensions for air nozzle and brush to reach back of hole.

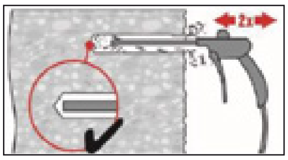
Compressed Air Cleaning (CAC): for drill holes deeper than 250 mm (for ϕ 8 to ϕ 12) or deeper than 20·ϕ (for ϕ > 12 mm)



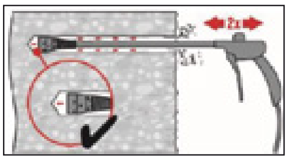
Use the appropriate air nozzle Hilti HIT-DL.
Blow two times from the back of the hole over the hole length with oil-free compressed air until return air stream is free of noticeable dust.
Safety tip: Do not inhale concrete dust.
Use of the dust collector Hilti HIT-DRS is recommended.



Screw the round steel brush HIT-RB in one end of the brush extension HIT-RBS, so that the overall length of the brush is sufficient to reach the base of the drill hole. 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 the brush is inserted in the borehole



Blow 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.

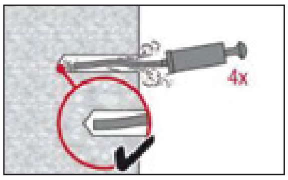


Use the appropriate air nozzle Hilti HIT-DL.
Blow two times from back of the hole over the hole length with oil-free compressed air until return air stream is free of noticeable dust.
Safety tip: Do not inhale the concrete dust.
Use of the dust collector Hilti HIT-DRS is recommended.

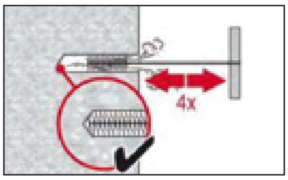
SETTING INSTRUCTIONS

2. Clean hole (cont'd)

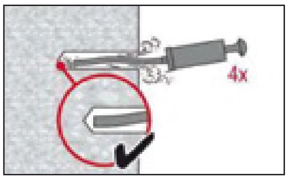
Manual Cleaning: permitted for hammer drilled boreholes up to hole diameters $d_0 \leq 20$·mm and depths l_v or $l_{e.ges} \leq 160$·mm



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 Ø ≧ borehole Ø) by inserting the round steel wire brush to the back of the hole with a twisting motion. The brush must produce natural resistance as it enters the drill hole. If this is not the case, please use a new brush or a brush with a larger diameter.

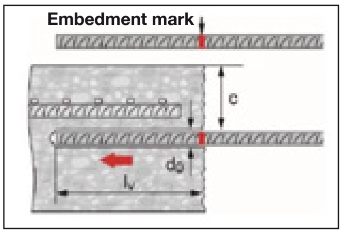


Blowing: 4 strokes with Hilti blow-out pump from the back of the hole until return airstream is free of noticeable dust.

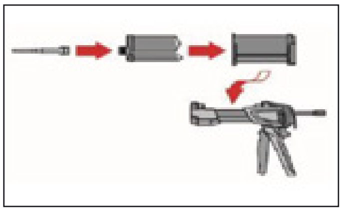
Manual Cleaning (MC)

Hilti hand pump recommended for blowing out bore holes with diameters $d_0 \leq 20$·mm and bore hole depth $h_0 \leq 160$ mm.

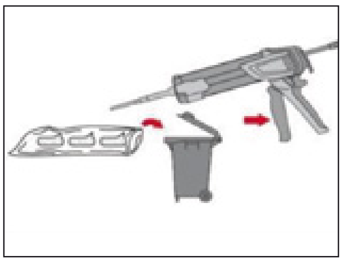
3. Rebar preparation and foil pack preparation



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 $l_{e.ges}$.



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



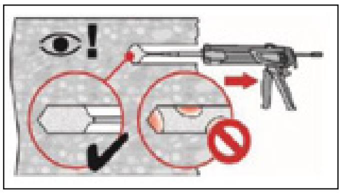
Discard initial mortar. The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
After changing a mixing nozzle, the first few trigger pulls must be discarded as described above. For each new foil pack a new mixing nozzle must be used.
Discard quantities are
2 strokes for 330 ml foil pack,
3 strokes for 500 ml foil pack,
4 strokes for 500 ml foil pack < 5˚C

SETTING INSTRUCTIONS

4. Inject mortar into borehole

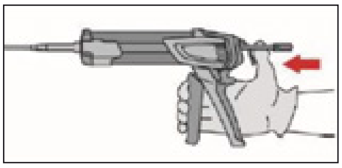
Inject adhesive from the back of the drill hole without forming air voids.

Injection method for borehole depth ≤ 250mm



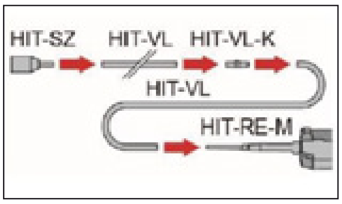
Inject the mortar from the back of the hole towards the front and slowly withdraw the mixing nozzle step by step after each trigger pull.

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



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

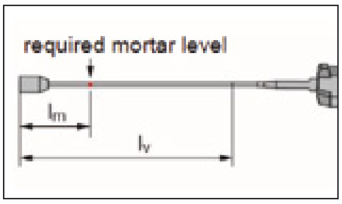
Injection method for drill hole depth > 250 mm or overhead application



Assemble mixing nozzle HIT-RE-M, extension(s) and piston plug HIT-SZ.

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.

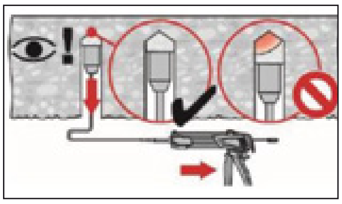
The combination of HIT-SZ piston plug with HIT-VL 16 pipe and then HIT-VL 16 tube support proper injection.

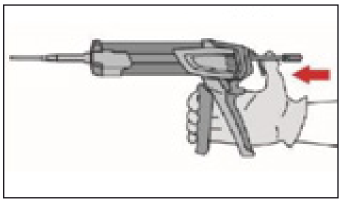


Mark the required mortar level l_m and embedment depth l_b resp. $l_{e.ges}$ with tape or marker on the injection extension.

A) Estimation: $l_m = 1/3 \cdot l_v$ resp. $l_m = 1/3\ l_{e.ges}$

B) Precise formula for optimum mortar volume:
$l_m = l_v$ or $l_{e.ges}$ x $\left[(1{,}2 \cdot (\phi^2 / d_0^{\,2}) - 0{,}2)\right]$ (mm)





For overhead installation the injection is only possible with the aid of extensions and piston plugs. 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.

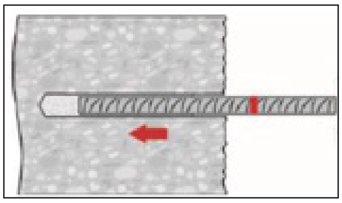
Injection until the mortar level mark l_m becomes visible.

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

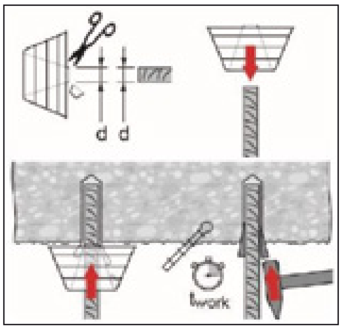
SETTING INSTRUCTIONS

Setting the element

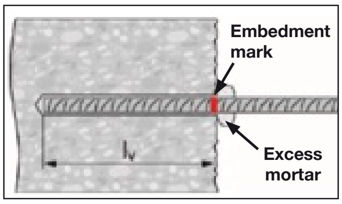
Before use verify that the element is dry and free of oil and other contaminants.



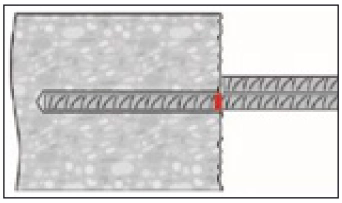
For easy installation insert the rebar slowly twisted into the drill hole until the embedment mark is at the concrete surface level.



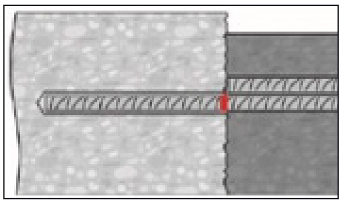
For overhead application:
During insertion of the rebar, mortar might flow out of the borehole. For collection of the flowing mortar, HIT-OHC may be used.
Support the rebar and secure it from falling till mortar started to harden, e.g. using wedges HIT-OHW.
For overhead installation use piston plugs and fix embedded parts with e.g. wedges.



After installing the rebar the annular gap must be completely filled with mortar.
Proper installation:
- desired anchoring embedment l_v is reached: embedment mark at concrete surface.
- excess mortar flows out of the drill hole after the rebar has been fully inserted until the embedment mark.



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.



Full load may be applied only after the curing time t_{cure} has elapsed.

RESISTANCE TO CHEMICAL SUBSTANCES

Chemical	Resistance		Chemical	Resistance
Air	+		Gasoline	+
Acetic acid 10%	+		Glycole	o
Acetone	o		Hydrogen peroxide 10%	o
Ammonia 5%	+		Lactic acid 10%	+
Benzyl alcohol	-		Maschinery oil	+
Chloric acid 10%	o		Methyl ethyl ketone (MEK)	o
Chlorinated lime 10%	+		Nitric acid 10%	o
Citric acid 10%	+		Phosphoric acid 10%	+
Concrete plasticizer	+		Potassium Hydroxide pH 13,2	+
De-icing salt (Calcium chloride)	+		Sea water	+
Demineralized water	+		Sewage sludge	+
Diesel fuel	+		Sodium carbonate 10%	+
Drilling dust suspension pH 13,2	+		Sodium hypochlorite 2%	+
Ethanol 96%	-		Sulfuric acid 10%	+
Ethylacetate	-		Sulfuric acid 30%	+
Formic acid 10%	+		Toluene	o
Formwork oil	+		Xylene	o

+ resistant
o resistant in short term (max. 48h) contact
- not resistant

Electrical Conductivity

HIT-HY 200 in the hardened state **is not conductive electrically**. Its electric resistivity is 15,5 10^9 Ωcm (DIN IEC 93 – 12.93). It is adapted well to realize electrically insulating anchorings (ex: railway applications, subway).

Drilling diameters

Rebar (mm)	Drill bit diameters d_0 [mm]	
	Hammer drill (HD)	Compressed air drill (CA)
10	14 (12[a])	-
12	16 (14[a])	17
16	20	20
20	25	26
24	32	32
28	35	35
32	40	40

[a] Max. installation length ℓ = 250mm

DESIGN PROCESS – 3 STEPS

STEP 1: Determine anchorage length based on the bond strength of the product

Hammer or compressed air drilling. Dry or wet concrete. Uncracked concrete C20/25.							
temperature range	**Bar diameter**						
	Data according to ETA -12/0084						
	N10	N12	N16	N20	N24	N28	N32
Sectional Area of As (mm^2)	79	113	201	314	452	616	804
Design Yield Fsy (KN)	40	57	101	157	226	308	402
$f^*_{bd,po}$ (MPa)	8.0						
Required Length based on ETABond (mm) Lsb	**159**	**189**	**251**	**312**	**375**	**438**	**500**

*Design bond strength in N/mm² according to ETA -12/0084 $f_{bd,po} = \tau Rk/\gamma Mp$).
Valid for temperature range I : 40°C / 24°C

Effect of concrete compressive strength:

For concrete with different compressive strength, L_{sb} shall be divided by $f_{B,p}$

Concrete compressive strength f'c,cyl (Mpa)	20	25	32	40	50
$f_{B,p}$	1	1.02	1.048	1.07	1.09

The final required length is equal to: **Lsb,f = Lsb / $f_{B,p}$**

DESIGN PROCESS – 3 STEPS

STEP 2: Calculate of the basic anchorage depth $L_{sy,\,tb}$ (mm) to develop yield of post-installed rebar in tension as per AS 3600-2009. Extension Approach

With the Reduction factor for splitting with large concrete cover / confinement: δ = 0.306 (HILTI additional data), applicable for both HILTI products HIT-RE 500 and HIT-HY 200, K'_3 shall be calculated from:

$$K'_3 = \frac{1}{\frac{1}{0.7} + \delta \frac{C_d - 3d_b}{d_b}} \geq 0.25 \text{ for } C_d > 3d_b$$

The basic anchorage depth $L_{sy,tb}$ can therefore be taken from the following tables:

$L_{sy,tb}$ for diameter of rebar = 10mm					
Confinement c_d	**$f'_{c,cy}$ = 20MPa**	**$f'_{c,cy}$ = 25MPa**	**$f'_{c,cy}$ = 32MPa**	**$f'_{c,cy}$ = 40MPa**	**$f'_{c,cy}$ = 50MPa**
$2.d_b$	389	348	308	275	246
$3.d_b$	321	287	254	227	203
$4.d_b$	264	236	209	187	167
$5.d_b$	225	201	178	159	146
$6.d_b$	195	175	152	149	-
$7.d_b$	173	156	-	-	-
$8.d_b$	159	-	-	-	-

$L_{sy,tb}$ for diameter of rebar = 12mm					
Confinement c_d	**$f'_{c,cy}$ = 20MPa**	**$f'_{c,cy}$ = 25MPa**	**$f'_{c,cy}$ = 32MPa**	**$f'_{c,cy}$ = 40MPa**	**$f'_{c,cy}$ = 50MPa**
$2.d_b$	475	425	376	336	301
$3.d_b$	391	350	309	277	247
$4.d_b$	322	288	255	228	204
$5.d_b$	274	245	217	194	173
$6.d_b$	238	213	189	177	-
$7.d_b$	211	185	180	-	-
$8.d_b$	189	-	-	-	-

$L_{sy,tb}$ for diameter of rebar = 16mm					
Confinement c_d	**$f'_{c,cy}$ = 20MPa**	**$f'_{c,cy}$ = 25MPa**	**$f'_{c,cy}$ = 32MPa**	**$f'_{c,cy}$ = 40MPa**	**$f'_{c,cy}$ = 50MPa**
$2.d_b$	655	586	518	463	415
$3.d_b$	540	483	427	382	341
$4.d_b$	445	398	351	314	281
$5.d_b$	378	338	299	267	239
$6.d_b$	329	294	260	235	230
$7.d_b$	291	260	240	-	-
$8.d_b$	261	246	-	-	-
$9.d_b$	251	-	-	-	-

DESIGN PROCESS – 3 STEPS

$L_{sy,tb}$ for diameter of rebar = 20mm					
Confinement c_d	**$f'_{c,cy}$ = 20MPa**	**$f'_{c,cy}$ = 25MPa**	**$f'_{c,cy}$ = 32MPa**	**$f'_{c,cy}$ = 40MPa**	**$f'_{c,cy}$ = 50MPa**
$2.d_b$	849	759	671	600	537
$3.d_b$	699	625	552	494	442
$4.d_b$	575	515	455	407	364
$5.d_b$	489	438	387	346	309
$6.d_b$	425	380	336	301	286
$7.d_b$	376	337	298	292	-
$8.d_b$	337	306	-	-	-
$9.d_b$	312	-	-	-	-

$L_{sy,tb}$ for diameter of rebar = 24mm					
Confinement c_d	**$f'_{c,cy}$ = 20MPa**	**$f'_{c,cy}$ = 25MPa**	**$f'_{c,cy}$ = 32MPa**	**$f'_{c,cy}$ = 40MPa**	**$f'_{c,cy}$ = 50MPa**
$2.d_b$	1056	944	835	747	668
$3.d_b$	870	778	687	615	550
$4.d_b$	716	641	566	506	453
$5.d_b$	609	545	481	430	385
$6.d_b$	529	474	419	374	344
$7.d_b$	468	419	370	350	-
$8.d_b$	420	375	358	-	-
$9.d_b$	381	368	-	-	-
$10.d_b$	375	-	-	-	-

$L_{sy,tb}$ for diameter of rebar = 28mm					
Confinement c_d	**$f'_{c,cy}$ = 20MPa**	**$f'_{c,cy}$ = 25MPa**	**$f'_{c,cy}$ = 32MPa**	**$f'_{c,cy}$ = 40MPa**	**$f'_{c,cy}$ = 50MPa**
$2.d_b$	1279	1144	1011	905	809
$3.d_b$	1054	942	833	745	666
$4.d_b$	868	776	686	614	549
$5.d_b$	738	660	583	522	466
$6.d_b$	641	574	507	454	402
$7.d_b$	567	507	449	409	-
$8.d_b$	509	455	418	-	-
$9.d_b$	461	429	-	-	-
$10.d_b$	438	-	-	-	-

$L_{sy,tb}$ for diameter of rebar = 32mm					
Confinement c_d	**$f'_{c,cy}$ = 20MPa**	**$f'_{c,cy}$ = 25MPa**	**$f'_{c,cy}$ = 32MPa**	**$f'_{c,cy}$ = 40MPa**	**$f'_{c,cy}$ = 50MPa**
$2.d_b$	1521	1360	1202	1075	962
$3.d_b$	1252	1120	990	885	792
$4.d_b$	1031	922	815	729	652
$5.d_b$	877	784	693	620	554
$6.d_b$	762	682	603	539	482
$7.d_b$	674	603	533	477	459
$8.d_b$	605	541	477	467	-
$9.d_b$	548	490	-	-	-
$10.d_b$	500	-	-	-	-

DESIGN PROCESS – 3 STEPS

STEP 3: Determine the basic anchorage depth Lsy (mm) to develop yield of post-installed rebar shall be:

$$L_{sy} \geq \{L_{sb,f}\,;\,L_{sy,tb}\}$$

Embedment depth to develop less than the yield strength

The embedment depth to develop less than the yield of the bar shall be as per clause 13.1.2.4 of AS3600-2009.

Spliced connection

When a post-installed rebar is required to form a splice with an existing cast-in rebar, the rules of AS 3600-2009, 13.2.2 shall be applied to calculate the required embedment depth of the post-installed rebar with HIT-HY 200.

Post-installed rebar in compression

The required embedment depth of a post-installed rebar in compression with HIT-HY 200 shall be calculated in compliance with AS 3600-2009, 13.1.5.

EVERYTHING YOU NEED FOR FAST, EASY AND RELIABLE POST-INSTALLED REBAR

Design

Hilti PROFIS Rebar puts post-installed rebar connection design and the calculation of overlap and anchorage lengths at your fingertips.

Detection

Ferroscan PS 200 – for the detection of reinforcing bars in concrete. Reduces the risk of hitting rebars when drilling. Provides accurate positioning, depth and diameter of rebar.

Drilling

Drill faster and safer with Hilti combihammers and extra-rugged hammer drill bits, or with Hilti diamond core drilling systems.

Cleaning

Hilti HIT Profi Rebar sets keep all the required cleaning accessories conveniently at hand.

Cutting

Hilti angle grinders featuring Smart Power and Hilti AC-D cutting discs for cutting rebars to length. Alternatively, use Hilti cordless reciprocating saws for total mobility.

Setting

Make a quick, easy, professional job of post-installed rebar connections – with Hilti HIT injectable mortars and efficient Hilti dispensers.

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