Anchor Fastening Technology Manual

09 / 2014

Foreword

Dear customer,

As it is our ambition to be the worldwide leader in fastening technology, we are continously striving to provide you with state-of-the-art technical information reflecting the latest developments in codes, regulations and approvals and technical information for our products.

The Fastening Technology Manuals for Post-installed Anchors and for Anchor Channel reflect our ongoing investment into long term research and development of leading fastening products.

This Fastening Technology Manual for Post-installed Anchors should be a valuable support tool for you when solving fastening tasks with Post-installed Anchor fastening technology. It should provide you with profound technical know-how, and help you to be more productive in your daily work without any compromise regarding reliability and safety.

As we strive to be a reliable partner for you, we would very much appreciate your feedback for improvements. We are available at any time to answer additional questions that even go beyond this content.

Raimund Zaggl

Business Unit Anchors

Important notices

1. Construction materials and conditions vary on different sites. If it is suspected that the base material has insufficient strength to achieve a suitable fastening, contact the Hilti Technical Advisory Service.
2. The information and recommendations given herein are based on the principles, formulae and safety factors set out in the Hilti technical instructions, the operating manuals, the setting instructions, the installation manuals and other data sheets that are believed to be correct at the time of writing. The data and values are based on the respective average values obtained from tests under laboratory or other controlled conditions. It is the users responsibility to use the data given in the light of conditions on site and taking into account the intended use of the products concerned. The user has to check the listed prerequisites and criteria conform with the conditions actually existing on the job-site. Whilst Hilti can give general guidance and advice, the nature of Hilti products means that the ultimate responsibility for selecting the right product for a particular application must lie with the customer.
3. All products must be used, handled and applied strictly in accordance with all current instructions for use published by Hilti, i.e. technical instructions, operating manuals, setting instructions, installation manuals and others.
4. All products are supplied and advice is given subject to the Hilti terms of business.
5. Hilti´s policy is one of continuous development. We therefore reserve the right to alter specifications, etc. without notice.
6. The given mean ultimate loads and characteristic data in the Anchor Fastening Technology Manual reflect actual test results and are thus valid only for the indicated test conditions. Due to variations in local base materials, on-site testing is required to determine performance at any specific site.
7. Hilti is not obligated for direct, indirect, incidental or consequential damages, losses or expenses in connection with, or by reason of, the use of, or inability to use the products for any purpose. Implied warranties of merchantability or fitness for a particular purpose are specifally excluded.

Hilti Corporation
FL-9494 Schaan
Principality of Liechtenstein
www.hilti.com

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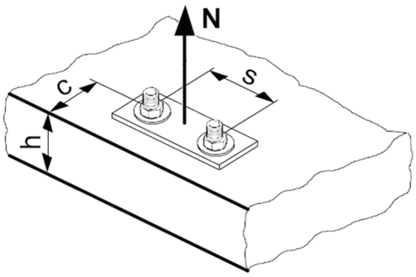
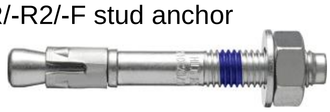
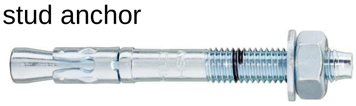
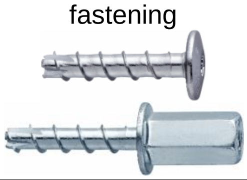


Anchor selector

Anchor type	Base material							Approvals					Application
	Cracked concrete	Uncracked concrete	Lightweight concrete	Aerated concrete	Solid brick masonry	Hollow brick masonry	Pre-stressed concrete hollow deck	European Technical Approval	Seismic approval	Fatigue approval or test report	Shock approval	Fire tested	
Mechanical anchor systems													
Heavy duty anchors													
HSL-3 heavy duty anchor 	●	●						●	●	●	●	●	Fastening heavy loads e.g. from columns, high racks, machines
HSL-GR heavy duty anchor 		●											Fastening heavy loads
HDA-T/ -TR/TF/-P/-PR/-PF undercut anchor 	●	●						●	●	●	●	●	Anchor fastening for high loads e.g. in steel construction and plant construction
HMU-PF Undercut anchor 	●	●						●	●	●	●	●	Fastening heavy loads
HSC-A(R) /-I(R) safety anchor 	●	●						●			●	●	Safety relevant fastening at facades and ceilings where short embedment depth is required
Medium duty anchors													
HST/-R/-HCR stud anchor 	●	●						●	●		●	●	Fastening through in place parts e.g. angles, tracks, channels, wooden beams, etc.
HSA/-R/-R2/-F stud anchor 		●						●				●	Fastening through in place parts like wooden beams, metal sections, columns, brackets, etc.
HSV stud anchor 		●											Fastening through in place parts

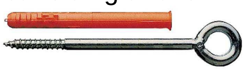
● = very suitable ○ = may be suitable per application ● = technical report 1) redundant fastening

Advantages	Drill bit diameter resp. anchor size	Specification							Setting		Page
		Steel, galvanised	Steel, sheradised, hot dipped galv.	Stainless steel A2 (1.4303)	Stainless steel A4 (1.4401)	HCR steel (1.4529)	External thread	Internal thread	Pre-setting	Through-fastening	
▪ Integrated plastic section to telescope and pull down tightly ▪ The bolt can be retorqued	Drill bit dia.: 12 – 32 mm Anchor size: M8 – M24	●					●			●	76
▪ Integrated plastic section to telescope and pull down tightly ▪ The bolt can be retorqued	Drill bit dia.: 12 – 28 mm Anchor size: M8 – M20				●						88
▪ Automatic undercutting ▪ High load capacity ▪ Approved for all dynamic loads	Drill bit dia.: 20 – 37 mm Anchor size: M10 – M20	●	●		●		●		●	●	98
▪ Reliable mechanical interlock ▪ Easy verification of correct setting due to red setting mark	Drill bit dia.: 18 – 22 mm Anchor size: M12 – M16		●				●		●		114
▪ Automatic undercutting ▪ Small edge distances and spacings ▪ Small setting depth	Drill bit dia.: 14 – 20 mm Anchor size: M6 – M12	●			●		●	●	●		128 138
▪ Quick and simple setting operation ▪ Setting mark ▪ Safety wedge for certain follow up expansion	Drill bit dia.: 8 – 24 mm Anchor size: M8 – M24	●			●	●	●		●	●	148
▪ Three setting depths ▪ Setting mark ▪ Extremely ductile steel for high bending capacity	Drill bit dia.: 6 – 20 mm Anchor size: M6 – M20	●	●		●		●		●	●	162 182
▪ Quick and simple setting operation	Drill bit dia.: 8 – 16 mm Anchor size: M8 – M16	●					●		●	●	196

Anchor type	Base material							Approval					Application
	Cracked concrete	Uncracked concrete	Lightweight concrete	Aerated concrete	Solid brick masonry	Hollow brick masonry	Pre-stressed concrete hollow deck	European Technical Approval	Seismic approval	Fatigue approval or test report	Shock approval	Fire tested	
Medium duty anchors													
HLC sleeve anchor 		●			●							●	Suitable for a large range of temporary applications and fixing of small devices
HLV Sleeve anchor 		●											Light and medium-duty fastenings in concrete
HAM hard sleeve anchor 		●			●								Secure fastenings in various base materials
HUS3 screw anchor 	●	●		●	●	●		●	●			●	Fastening base plates, railings and handrailings, structural stell and temporary applications
HUS-HR CR screw anchor, stainless steel 	●	●		●	●			●	●			●	Fastening channels, railings, façade panels and tunnel construction
HUS-V screw anchor 	●	●											Fastening base plates, railings and handrailings and temporary applications
HUS- 6 screw anchor, redundant fastening 	● 1)	●		●	●		●	●				●	Fastening channels, brackets, racks, seating
HUS 6 / HUS-S 6 screw anchor 		●	●	●	●	●						●	Fastening light channels, brackets, interior panelling or cladding

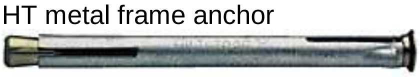
● = very suitable ○ = may be suitable per application ● = technical report 1) redundant fastening

Advantages	Drill bit diameter resp. anchor size	Specification							Setting		Page
		Steel, galvanised	Steel, sheradised, hot dipped galv.	Stainless steel A2 (1.4303)	Stainless steel A4 (1.4401)	HCR steel (1.4529)	External thread	Internal thread	Pre-setting	Through-fastening	
▪ Different base materials ▪ Ideal for through applications	Drill bit dia.: 6,5 – 20 mm Anchor size: M5 – M16	•					•		•	•	206
▪ Available in a variety of sizes Pre-setting and through fastening configurations	Drill bit dia.: 6,5 – 16 mm Anchor size: M5 – M12	•					•		•	•	212
▪ Wings to prevent spinning in the bore hole ▪ Plastic cap in cone to prevent dust entrance	Drill bit dia.: 12 – 20 mm Thread: M6 – M12	•						•	•		216
▪ Screw driven straight into base material ▪ Higher productivity ▪ Approval for reusability in fresh concrete	Drill bit dia.: 8 – 14 mm	•								•	218
▪ Screw driven straight into base material ▪ Higher productivity	Drill bit dia.: 6 – 14 mm				•					•	252
▪ Approval for reusability in fresh concrete	Drill bit dia.: 8 – 10 mm										272
▪ Screw driven straight into base material ▪ Forged on washer ▪ Matched system of screw anchor and screw driver	Drill bit dia.: 6 mm	•						•		•	304
▪ Screw driven straight into base material ▪ Small drill bit diameter ▪ Matched system of screw anchor and screw driver	Drill bit dia.: 6 mm	•								•	318

Anchor type	Base material								Approvals					Application
	Cracked concrete	Uncracked concrete	Lightweight concrete	Aerated concrete	Solid brick masonry	Hollow brick masonry	Dry wall	Pre-stressed concrete hollow deck	European Technical Approval	Seismic approval	Fatigue approval or test report	Shock approval	Fire tested	
Medium duty anchors														
HKD push-in anchor 	● 1)	●							●				●	Fastening with threaded rods for pipe suspensions, air ducts, suspended ceilings
HKV push-in anchor 		●												Fastening with threaded rods for pipe suspensions, air ducts, suspended ceilings
Light duty anchors														
HUD-1 universal anchor 		●	●	●	●	●	●							Light duty applications such as pipe clamps, electrical boxes, sanitary fixures, etc.
HUD-L universal anchor 		●	●	●	●	●	●							Light duty applications such as pipe clamps, electrical boxes sanitary fixures, etc.
HLD light duty anchor 		●				●	●	○						Fastenings to weak material with cavities
HRD-U/-S frame anchor 		●	●	●	●	●			●				●	Securing support frames, timber frames, fascade panels, curtain walling
HRD frame anchor 	● 1)	●	●	●	●	●		●	●				●	Universal fram anchor for façade panels, courtain walling and other applications
HRV Frame anchor 		●			●									Fastening metal substructures for ventilated facades
GD 14 + GRS Scaffolding anchor 		●			●									Light duty scaffold tie for use with hooks
HPS-1 impact anchor 		●	○	●	●	●								Fastening wood battens, channel installations for dry wall fixings, components for electrical and plumbing installations

● = very suitable ○ = may be suitable per application ● = technical report 1) redundant fastening

Advantages	Drill bit diameter resp. anchor size	Specification							Setting		Page
		Steel, galvanised	Steel, sheradised, hot dipped galv.	Stainless steel A2 (1.4303)	Stainless steel A4 (1.4401)	HCR steel (1.4529)	External thread	Internal thread	Pre-setting	Through-fastening	
▪ Visual verification of full expansion ▪ Small setting depth	Drill bit dia.: 8 – 25 mm Anchor size: M6 – M20	●			●			●	●		324 338
▪ Visual verification of full expansion ▪ Small setting depth	Drill bit dia.: 8 – 20 mm Anchor size: M6 – M16	●						●	●		346
▪ Fast setting ▪ Flexibility of screw length ▪ An anchor for every base material	Drill bit dia.: 5 – 14 mm								●	●	350
▪ Fast setting ▪ Flexibility of screw length ▪ An anchor for every base material	Drill bit dia.: 6 – 10 mm								●	●	356
▪ Flexibility of screw length ▪ Resilient toggling action to suit every base material	Drill bit dia.: 10 mm								●		360
▪ Preassembled with screw ▪ Screw of steel strength 5.8	Drill bit dia.: 10 and 14 mm	●								●	364
▪ Impact and temperature resistant ▪ high quality plastic	Drill bit dia.: 8 – 10 mm	●	●	●	●					●	370
▪ Integrated plastic and steel washers	Drill bit dia.: 10 mm	●	●							●	388
▪ Various lengths are available to suit specific requirements	Drill bit dia.: 14 mm										396
▪ impact and temperature resistant ▪ high quality plastic	4 – 8 mm	●		●						●	400

Anchor type	Base material								Approvals					Application
	Cracked concrete	Uncracked concrete	Lightweight concrete	Aerated concrete	Solid brick masonry	Hollow brick masonry	Dry wall	Pre-stressed concrete hollow deck	European Technical Approval	Seismic approval	Fatigue approval or test report	Shock approval	Fire tested	
Light duty anchors														
HHD-S cavity anchor 						●	●							Fastening battens, channels panels
HCA coil anchor 		●												Temporary external fastenings
HSP/HFPdrywall plug 								●						Fastenings in dry walls
HA8 ring/ hook anchor 	● 1)	●											●	For suspended ceilings and other items from concrete ceilings
DBZ wedge anchor 	● 1)	●							●				●	Suspension from concrete ceilings e.g. using steel straps, punched band, Nonius system hanger
HT metal frame anchor 		●	●	●	●	●							●	Fastening door and window frames
HK ceiling anchor 	● 1)	●							●				●	Fastening of suspended ceilings, cable trays, pipes
HPD aerated concrete anchor 				●									●	Various fastenings
HKH hollow deck anchor 								●	●				●	Suspension from pre-stressed concrete hollow decks
HTB 						●	●	●						Ingenious and strong for hollow base materials

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Advantages	Drill bit diameter resp. anchor size	Specification							Setting		Page
		Steel, galvanised	Steel, sheradised, hot dipped galv.	Stainless steel A2 (1.4303)	Stainless steel A4 (1.4401)	HCR steel (1.4529)	External thread	Internal thread	Pre-setting	Through-fastening	
▪ Controlled setting ▪ Deliverable with or without prefitted screw	Drill bit dia.: 8 – 10 mm	●						●	●		404
▪ Re-usable up to 140 times ▪ Removable ▪ High load capacity	Drill bit dia.: 16 mm										406
▪ Self-drilling tip ▪ One bit for anchor and screw ▪ Removable	-								●		412
▪ Quick and easy setting ▪ Automatic follow up expansion	Drill bit dia.: 8 mm	●							●		414
▪ Small drill bit diameter ▪ Quick setting by impact extension ▪ Automatic follow up expansion	Drill bit dia.: 6 mm	●								●	418
▪ No risk of distortion or forces of constraint ▪ Expansion cone can not be lost	Drill bit dia.: 8 – 10 mm	●								●	422
▪ Small bore hole ▪ Quick and easy setting	Drill bit dia.: 6 mm M6	●					●		●		426
▪ Approved (DIBt) ▪ Fire resistance ▪ Immediately loadable	Without predrilling Thread: M6 – M10	●					●		●		432
▪ Approval for single point fastenings ▪ Approved for sprinkler systems	Drill bit dia.: 10 – 14 mm Thread: M6 – M10	●					●		●	●	438
▪ Load carried by strong metal channel and screw ▪ Convincing simplicity when setting	Drill bit dia.: 13 – 14 mm								●		442

Anchor type	Base material								Approvals					Application
	Cracked concrete	Uncracked concrete	Lightweight concrete	Aerated concrete	Solid brick masonry	Hollow brick masonry	Dry wall	Pre-stressed concrete hollow deck	European Technical Approval	Seismic approval	Fatigue approval or test report	Shock approval	Fire tested	
Insulation fasteners														
HIF insulation fastener 		●	●	●	●	●								Fasteming of insulating materials in different base materials
IDP insulation fastener 		●	●		●	●								Fastening of hard, self supporting insulating materials
IZ expandable insulation fastener 		●	●		●	●								Fastening of soft and hard, self supporting insulating materials
IDMS / IDMR insulation fastener 		●	●		●	●							●	Fastening of soft and hard, self supporting insulating materials and non self supporting insulation materials

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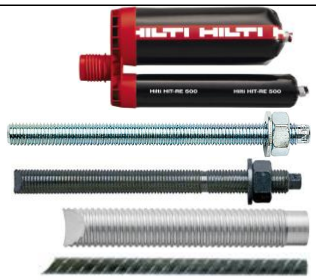
Advantages	Drill bit diameter resp. anchor size	Specification							Setting		Page
		Steel, galvanised	Steel, sheradised, hot dipped galv.	Stainless steel A2 (1.4303)	Stainless steel A4 (1.4401)	HCR steel (1.4529)	External thread	Internal thread	Pre-setting	Through-fastening	
▪ No additional plate needed, do not sink in soft insulation material ▪ Speed due to less drilling effort	Drill bit dia.: 8 mm Mat. thickness up to 240mm									●	446
▪ One piece element ▪ Corrosion resistant ▪ No heat bridge	Drill bit dia.: 8 mm Mat. thickness up tp 150mm									●	450
▪ Corrosion resistant ▪ No heat bridge ▪ Reliable bonding of plaster	Drill bit dia.: 8 mm Mat. thickness up to 180mm									●	454
▪ One piece element ▪ Corrosion resistant ▪ Fire resistant	Drill bit dia.: 8 mm Mat. thickness up to 150mm	●		●						●	458

Anchor type	Base material							Approvals					Application
	Cracked concrete	Uncracked concrete	Lightweight concrete	Aerated concrete	Solid brick masonry	Hollow brick masonry	Pre-stressed concrete hollow deck	European Technical Approval	Seismic approval	Fatigue approval or test report	Shock approval	Fire tested	
Adhesive anchor systems													
Adhesive capsule systems													
HVZ adhesive anchor 	●	●						●		●	●	●	Heavy-duty fastenings with small spacing and edge distances
HVU adhesive anchor 		●						●				●	Heavy duty fastenings with small spacing and edge distances
Injection mortar systems													
HIT-RE 500–SD 	●	●						●	●		●	●	Adhesive anchor in cracked concrete
HIT-RE 500 		●						●				●	Adhesive anchor
HIT-HY 200 	●	●						●	●		●	●	Adhesive anchor in cracked concrete

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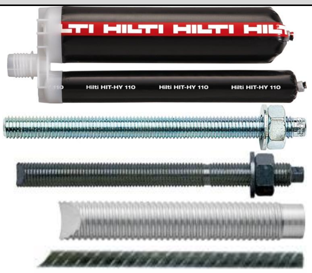
Advantages	Drill bit diameter resp. anchor size	Specification							Setting		Page
		Steel, galvanised	Steel, sheradised, hot dipped galv.	Stainless steel A2 (1.4303)	Stainless steel A4 (1.4401)	HCR steel (1.4529)	External thread	Internal thread	Pre-setting	Through-fastening	
▪ No expansion pressure ▪ Small edge distances and spacing ▪ A strong and flexible foil capsule	M10 – M20	●			●	●	●		●		464
▪ No expansion pressure ▪ Small edge distances and spacing ▪ A strong and flexible foil capsule	HAS M8 – M39 HIS-M8 - M20 Rebar dia. 8 – 40 mm	●			●	●	●	●	●		476 486
▪ No expansion pressure ▪ Long working time ▪ SateSet with hollow drill bit	HIT-V M8 – M30 HIS-M8 - M20 Rebar dia. 8 – 32 mm	●			●	●	●	●	●		496 516 530 546 920(post)
▪ No expansion pressure ▪ Long working time ▪ SateSet with hollow drill bit	HIT-V M8 – M39 HIS-M8 - M20 Rebar dia. 8 – 40 mm	●			●	●	●	●	●		556 576 592 936(post)
▪ No expansion pressure ▪ Flexibility in terms of working time ▪ No styrene content ▪ No plasticizer content ▪ Environmental protection due to the minimized packaging ▪ SateSet with hollow drill bit and HIT-Z rod	HIT-V M8 – M30 HIS-Z M8 - M20 Rebar dia. 8 – 32 mm	●	●	●	●	●	●	●	●	●	610 632 652 668 950(post)

Anchor type	Base material							Approvals					Application
	Cracked concrete	Uncracked concrete	Lightweight concrete	Aerated concrete	Solid brick masonry	Hollow brick masonry	Pre-stressed concrete hollow deck	European Technical Approval	Seismic approval	Fatigue approval or test report	Shock approval	Fire tested	
Injection mortar systems													
HIT-HY 110 		●						●					Adhesive anchor for use in concrete
HIT-HY 100 	●	●						●					Adhesive anchor for use in concrete
HIT-HY 70 		●			●	●						●	Universal mortar for solid and hollow brick
HIT-CT 1 		●						●					Hilti Clean technology adhesive anchor
HIT ICE 		●											Adhesive anchor for low installation temperatures

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Advantages	Drill bit diameter resp. anchor size	Specification							Setting		Page
		Steel, galvanised	Steel, sheradised, hot dipped galv.	Stainless steel A2 (1.4303)	Stainless steel A4 (1.4401)	HCR steel (1.4529)	External thread	Internal thread	Pre-setting	Through-fastening	
▪ Suitable for dry and water saturated concrete ▪ Small edge distance and anchor spacing possible ▪ Variable embedment depth	HIT-V M8 – M30 HIS-M8 - M20 Rebar dia. 8 – 25 mm	●	●		●	●	●	●	●		686 700 712 958(post)
▪ Suitable for dry and water saturated concrete ▪ Small edge distance and anchor spacing possible ▪ Variable embedment depth	HIT-V M8 – M30 HIS-M8 - M20 Rebar dia. 8 – 25 mm	●	●		●	●	●	●	●		726 744 756 966(post)
▪ No expansion pressure ▪ mortar filling control with HIT-SC sleeves	Drill bit dia.: 10 – 22 mm Thread: M6 – M12	●			●		●	●	●		772
▪ No expansion pressure ▪ Environmentaly and user friendly: clean of critical hazardous substances	HIT-V M8 – M24	●	●		●	●	●				798 974(post)
▪ No expansion pressure	HAS M8 – M24 HIS-M8 - M20 Rebar dia. 8 – 25 mm	●	●		●	●	●	●	●		818 830 842

Legal environment

Technical data

The technical data presented in this Anchor Fastening Technology Manual are all based on numerous tests and evaluation according to the state-of-the art. Hilti anchors are tested in our test labs in Kaufering (Germany), Schaan (Principality of Liechtenstein) or Tulsa (USA) and evaluated by our experienced engineers and/or tested and evaluated by independent testing institutes in Europe and the USA. Where national or international regulations do not cover all possible types of applications, additional Hilti data help to find customised solutions.

In addition to the standard tests for admissible service conditions and suitability tests, for safety relevant applications fire resistance, shock, seismic and fatigue tests are performed.

European Assessment Documents (From 1st of July 2013)

The European Assessment Document (EAD) is a harmonised technical specification. Due to the new Construction Products Regulation (CPR) (EU/305/2011) this type of harmonised technical specification will be applicable as of 1st of July 2013. The EAD is the basis for the issuing of ETAs.

The EAD is developed by the European Organisation of Technical Assessment (EOTA) in cases where a product is not or not fully covered by a harmonised European Standard.

The elaboration of an EAD is based on a consensus of the designated Technical Assessment Bodies (TABs) within a determined procedure. It may follow the request of a manufacturer for a European Technical Assessment (ETA).

The EAD contributes to the safe assessment of construction products, enables manufacturers to comply with European legislation, facilitates the uptake of innovation, research and technical development, and promotes the interoperability of products and sustainability. The EAD contains the following information:

- General information on the scope and use
- A list of essential characteristics, relevant for the intended use of the products as foreseen by the manufacturer and agreed upon between the manufacturer and the TAB
- Assessment methods of the performance of the construction product
- Reference to the Assessment and Verification of Constancy of Performance (AVCP)
- Assumptions for the assessment of the performances
- Identification of the construction product
- Reference documents such as other EADs, standards, technical reports etc.
- Product related example for a Declaration of Performance

Current transition period – Changes after 1st of July 2013 with regards to ETAGs

Formerly, European Technical Approval Guidelines (ETA Guidelines or ETAGs) were elaborated upon the mandate of the European Commission in order to establish how Approval Bodies should evaluate the specific characteristics/requirements of a construction product or a family of construction products. ETAGs were used as basis for European Technical Approvals (ETAs).

As of 1st of July 2013 no new ETAGs will be developed. ETAGs remain valid and can be used as EADs. The technical development and agreements amongst Approval Bodies for the issuing of European Technical Approvals will be considered in the EAD development.

European Technical Approval Guidelines (Currently valid as EADs)

Approval based data given in this manual are either according to European Technical Approval Guidelines (ETAG) or have been evaluated according to this guidelines and/or national regulations.

The European Technical Approval Guideline ETAG 001 „METAL ANCHORS FOR USE IN CONCRETE“ sets out the basis for assessing anchors to be used in concrete (cracked and non-cracked). It consists of:

- Part 1 Anchors in general
- Part 2 Torque-controlled expansion anchors
- Part 3 Undercut anchors
- Part 4 Deformation-controlled expansion anchors
- Part 5 Bonded anchors
- Part 6 Anchors for multiple use for non-structural applications
- Annex A Details of test
- Annex B Tests for admissible service conditions – detailed information
- Annex C Design methods for anchorages

For special anchors for use in concrete, additional Technical Reports (TR) related to ETAG 001 set out additional requirements:

- TR 018 Assessment of torque-controlled bonded anchors
- TR 020 Evaluation of Anchorages in Concrete concerning Resistance to Fire
- TR 029 Design of Bonded Anchors

The European Technical Approval Guideline ETAG 020 „ PLASTIC ANCHORS FOR MULTIPLE USE IN CONCRETE AND MASONRY FOR NON-STRUCTURAL APPLICATIONS“ sets out the basis for assessing plastic anchors to be used in concrete or masonry for redundant fastenings (multiple use). It consists of:

- Part 1 General
- Part 2 Plastic anchors for use in normal weight concrete
- Part 3 Plastic anchors for use in solid masonry materials
- Part 4 Plastic anchors for use in hollow or perforated masonry
- Part 5 Plastic anchors for use in autoclaved aerated concrete (AAC)
- Annex A Details of tests
- Annex B Recommendations for tests to be carried out on construction works
- Annex C Design methods for anchorages

The European Technical Approval Guidelines including related Technical Reports set out the requirements for anchors and the acceptance criteria they shall meet.

The general assessment approach adopted in the Guideline is based on combining relevant existing knowledge and experience of anchor behaviour with testing. Using this approach, testing is needed to assess the suitability of anchors.

The requirements in European Technical Approval Guidelines are set out in terms of objectives and of relevant actions to be taken into account. ETAGs specify values and characteristics, the conformity with which gives the presumption that the requirements set out are satisfied, whenever the state of art permits to do so. The Guidelines may indicate alternate possibilities for the demonstration of the satisfaction of the requirements.

European Technical Assessment (Previously European Technical Approval)

The European Technical Assessment (ETA) is a document providing information on the assessment of the performance of a construction product, in relation to its essential characteristics. This definition is provided in the new Construction Products Regulation (EU/305/2011) entered into force on 1st of July 2013 in all European Members States and in the European Economic Area.

The ETA provides a way for the manufacturer to CE-mark a product. The ETA can be issued in the following cases:

- The product is not or not fully covered by any harmonised technical specification such as European Assessment Documents (EADs) or European Standards (hENs)
- The product is covered by a European Assessment Document (EAD)

The ETA is valid in all 28 European Member States and those of the European Economic Area, as well as in Switzerland. It may be recognised also in countries where a mutual recognition agreement is concluded with the European Community. The ETA is the basis for a Declaration of Performance (DoP) by the manufacturer.

The ETA creates confidence in the performance of the essential characteristics of a construction product for its intended use. The ETA contributes to the free movement of construction products and thus to the Single European Market.

An ETA is delivered by a Technical Assessment Body (TAB) upon request by a manufacturer (or its authorised representative being established within the European Union).

An ETA contains the following information:

- General information on the manufacturer and the product type
- Description of the product and its intended use
- Performances of the product and references to the methods used for its assessment
- Assessment and Verification of Constancy of Performance systems (AVCP) applied
- Technical details necessary for the implementation of the AVCP

An ETA which has been issued after 1st of July 2013 is valid of indeterminate duration. On the EOTA website the actual ETAs are published.

The status after the changes on 1st of July 2013 with regards to ETAs is the following:

ETAs which were issued up to 30 June 2013 (so called European Technical Approvals) remain valid until the end of their validity period. They can be used as European Technical Assessments. This type of ETAs will disappear from the market throughout the year 2018. These ETAs are based on ETA Guidelines or issued upon common agreement of the Approval Bodies.

As of 1st of July 2013 ETAs are based on European Assessment Documents (EADs).

Post-installed rebar connections

The basis for the assessment of post-installed rebar connections is set out in the following Technical Report:

- TR 023 Assessment of post-installed rebar connections

The Technical Report TR 023 covers post-installed rebar connections designed in accordance with EN 1992 - 1-1: 2004 (EC2) only. ETAG 001 (Part 1 and Part 5) is the general basic of this application. The Technical Report TR 023 deals with the preconditions, assumptions and the required tests and assessments for postinstalled rebars.

System of attestation of conformity

For anchors having an approval, the conformity of the product shall be certified by an approved certification body (notified body) on the basis of tasks for the manufacturer and tasks for the approved body.

Tasks for the manufacturer are:

- Factory production control (permanent internal control of production and documentation according to a prescribed test plan)
- involve a body which is approved for the tasks

Tasks for the approved body are:

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

Base material

General

Different anchoring conditions

The wide variety of building materials used today provide different anchoring conditions for anchors. There is hardly a base material in or to which a fastening cannot be made with a Hilti product. However, the properties of the base material play a decisive role when selecting a suitable fastener / anchor and determining the load it can hold.

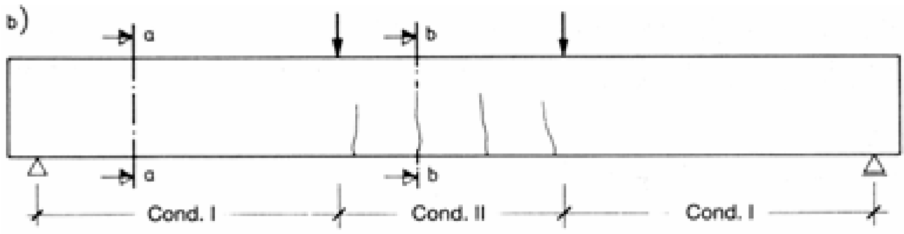
The main building materials suitable for anchor fastenings have been described in the following.

Concrete

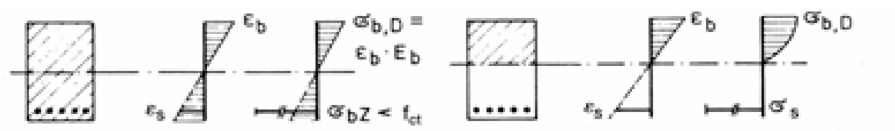
A mixture of cement, aggregates and water

Concrete is synthetic stone, consisting of a mixture of cement, aggregates and water, possibly also additives, which is produced when the cement paste hardens and cures. Concrete has a relatively high compressive strength, but only low tensile strength. Steel reinforcing bars are cast in concrete to take up tensile forces. It is then referred to as reinforced concrete.

Cracking from bending



Stress and strain in sections withconditions I and II



$\sigma_{b,D}$ calculated compressive stress
$\sigma_{b,Z}$ calculated tensile stress
f_{ct} concrete tensile strength

If cracks in the tension zone exist, suitable anchor systems are required

If the tensile strength of concrete is exceeded, cracks form, which, as a rule, cannot be seen. Experience has shown that the crack width does not exceed the figure regarded as admissible, i.e. $w \cong 0.3$mm, if the concrete is under a constant load. If it is subjected predominately to forces of constraint, individual cracks might be wider if no additional reinforcement is provided in the concrete to restrict the crack width. If a concrete component is subjected to a bending load, the cracks have a wedge shape across the component cross-section and they end close to the neutral axis. It is recommended that anchors that are suitable in cracked concrete be used in the tension zone of concrete components. Other types of anchors can be used if they are set in the compression zone.

Observe curing of concrete when using expansion anchors

Anchors are set in both low-strength and high-strength concrete. Generally, the range of the cube compressive strength, $f_{ck,cube, 150}$, is between 25 and 60 N/mm². Expansion anchors should not be set in concrete which has not cured for more than seven days. If anchors are loaded immediately after they have been set, the loading capacity can be assumed to be only the actual strength of the concrete at that time. If an anchor is set and the load applied later, the loading capacity can be assumed to be the concrete strength determined at the time of applying the load.

Cutting through reinforcement when drilling anchor holes must be avoided. If this is not possible, the design engineer responsible must be consulted first.

Avoid cutting reinforcement

Masonry

Masonry is a heterogeneous base material. The hole being drilled for an anchor can run into mortar joints or cavities. Owing to the relatively low strength of masonry, the loads taken up locally cannot be particularly high. A tremendous variety of types and shapes of masonry bricks are on the market, e.g. clay bricks, sand-lime bricks or concrete bricks, all of different shapes and either solid or with cavities. Hilti offers a range of different fastening solutions for this variety of masonry base material, e.g. the HPS-1, HRD, HUD, HIT, etc.

Different types and shapes

If there are doubts when selecting a fastener / anchor, your local Hilti sales representative will be pleased to provide assistance.

When making a fastening, care must be taken to ensure that a lay of insulation or plaster is not used as the base material. The specified anchorage depth (depth of embedment) must be in the actual base material.

Plaster coating is not a base material for fastenings

Other base materials

Aerated concrete: This is manufactured from fine-grained sand as the aggregate, lime and/or cement as the binding agent, water and aluminium as the gas-forming agent. The density is between 0.4 and 0.8 kg/dm³ and the compressive strength 2 to 6 N/mm². Hilti offers the HGN and HRD-U anchors for this base material.

Aerated concrete

Lightweight concrete: This is concrete which has a low density, i.e. ≤ 1800 kg/m³, and a porosity that reduces the strength of the concrete and thus the loading capacity of an anchor. Hilti offers the HRD, HUD, HGN, etc anchor systems for this base material.

Lightweight concrete

Drywall (plasterboard/gypsum) panels: These are mostly building components without a supporting function, such as wall and ceiling panels, to which less important, so-called secondary fastenings are made. The Hilti anchors suitable for this material are the HTB, HLD and HHD.

Drywall / gypsum panels

In addition to the previously named building materials, a large variety of others, e.g. natural stone, etc, can be encountered in practice. Furthermore, special building components are also made from the previously mentioned materials which, because of manufacturing method and configuration, result in base materials with peculiarities that must be given careful attention, e.g. hollow ceiling floor components, etc.

Variety of base materials

Descriptions and explanations of each of these would go beyond the bounds of this manual. Generally though, fastenings can be made to these materials. In some cases, test reports exist for these special materials. It is also recommended that the design engineer, company carrying out the work and Hilti technical staff hold a discussion in each case.

In some cases, testing on the jobsite should be arranged to verify the suitability and the loading capacity of the selected anchor.

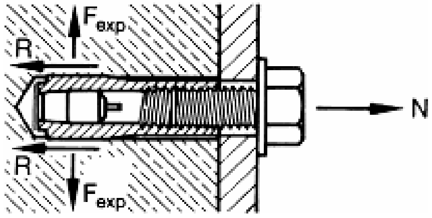
Jobsite tests

Why does an anchor hold in a base material?

Working principles

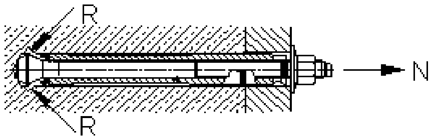
There are three basic working principles which make an anchor hold in a building material:

Friction



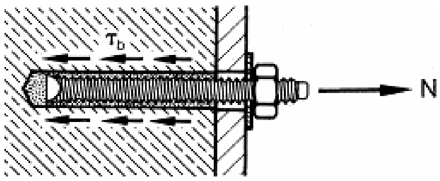
The tensile load, N, is transferred to the base material by friction, R. The expansion force, Fexp, is necessary for this to take place. It is produced, for example, by driving in an expansion plug (HKD).

Keying



The tensile load, N, is in equilibrium with the supporting forces, R, acting on the base material, such as with the HDA anchor.

Bonding



An adhesive bond is produced between the anchor rod and the hole wall by a synthetic resin adhesive, such as with HVU with HAS anchor rods.

Combination of working principles

Many anchors obtain their holding power from a combination of the above mentioned working principles.

For example, an anchor exerts an expansion force against wall of its hole as a result of the displacement of a cone relative to a sleeve. This permits the longitudinal force to be transferred to the anchor by friction. At the same time, this expansion force causes permanent local deformation of the base material, above all in the case of metal anchors. A keying action results which enables the longitudinal force in the anchor to be transferred additionally to the base material

Force-controlled and displacement-controlled expansion anchors

In the case of expansion anchors, a distinction is made between force-controlled and movement-controlled types. The expansion force of force-controlled expansion anchors is dependent on the tensile force in the anchor (HSL-3 heavy-duty anchor). This tensile force is produced, and thus controlled, when a tightening torque is applied to expand the anchor.

In the case of movement-controlled types, expansion takes place over a distance that is predetermined by the geometry of the anchor in the expanded state. Thus an expansion force is produced (HKD anchor) which is governed by the modulus of elasticity of the base material.

Adhesive/resin anchor

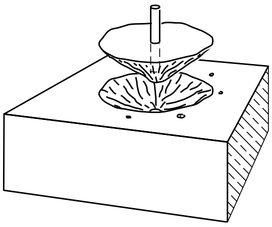
The synthetic resin of an adhesive anchor infiltrates into the pores of the base material and, after it has hardened and cured, achieves a local keying action in addition to the bond.

Failure modes

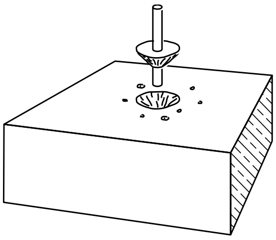
Effects of static loading

Failure patterns

The failure patterns of anchor fastenings subjected to a continually increased load can be depicted as follows:



1.



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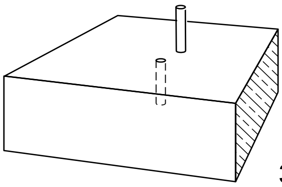
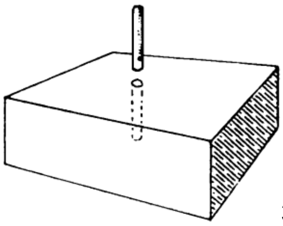
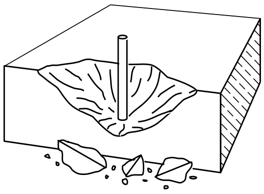


3.



3a.



4.

Causes of failure

The weakest point in an anchor fastening determines the cause of failure. Modes of failure, 1. break-out, 2. anchor pull-away and, 3., 3a., failure of anchor parts, occur mostly when single anchors that are a suitable distance from an edge or the next anchor, are subjected to a pure tensile load. These causes of failure govern the max. loading capacity of anchors. On the other hand, a small edge distance causes mode of failure 4. edge breaking. The ultimate loads are then smaller than those of the previously mentioned modes of failure. The tensile strength of the fastening base material is exceeded in the cases of break-out, edge breaking and splitting.

Combined load

Basically, the same modes of failure take place under a combined load. The mode of failure 1. break-out, becomes more seldom as the angle between the direction of the applied load and the anchor axis increases.

Shear load

Generally, a shear load causes a conchoidal (shell-like) area of spall on one side of the anchor hole and, subsequently, the anchor parts suffer bending tension or shear failure. If the distance from an edge is small and the shear load is towards the free edge of a building component, however, the edge breaks away.

Influence of cracks

Very narrow cracks are not defects in a structure

It is not possible for a reinforced concrete structure to be built which does not have cracks in it under working conditions. Provided that they do not exceed a certain width, however, it is not at all necessary to regard cracks as defects in a structure. With this in mind, the designer of a structure assumes that cracks will exist in the tension zone of reinforced concrete components when carrying out the design work (condition II). Tensile forces from bending are taken up in a composite construction by suitably sized reinforcement in the form of ribbed steel bars, whereas the compressive forces from bending are taken up by the concrete (compression zone).

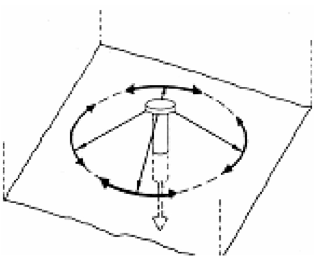
Efficient utilisation of reinforcement

The reinforcement is only utilised efficiently if the concrete in the tension zone is permitted to be stressed (elongated) to such an extent that it cracks under the working load. The position of the tension zone is determined by the static / design system and where the load is applied to the structure. Normally, the cracks run in one direction (line or parallel cracks). Only in rare cases, such as with reinforced concrete slabs stressed in two planes, can cracks also run in two directions.

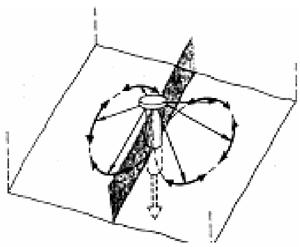
Testing and application conditions for anchors are currently being drafted internationally based on the research results of anchor manufacturers and universities. These will guarantee the functional reliability and safety of anchor fastenings made in cracked concrete.

Loadbearing mechanisms

When anchor fastenings are made in non-cracked concrete, equilibrium is established by a tensile stress condition of rotational symmetry around the anchor axis. If a crack exists, the loadbearing mechanisms are seriously disrupted because virtually no annular tensile forces can be taken up beyond the edge of the crack. The disruption caused disrupted by the crack reduces the loadbearing capacity of the anchor system.



a) Non-cracked concrete



b) Cracked concrete

Reduction factor for cracked concrete

The width of a crack in a concrete component has a major influence on the tensile loading capacity of all fasteners, not only anchors, but also cast-in items, such as headed studs. A crack width of about 0.3mm is assumed when designing anchor fastenings. The reduction factor which can be used for the ultimate tensile loads of anchor fastenings made in cracked concrete as opposed to non-cracked concrete may be assumed to be 0.65 to 0.70 for the HSC anchor, for example. Larger reduction factors for ultimate tensile loads must be anticipated (used in calculations) in the case of all those anchors which were set in the past without any consideration of the above-mentioned influence of cracks. In this respect, the safety factor to use to allow for the failure of cracked concrete is not the same as the figure given in product information, i.e. all previous figures in the old anchor manual. This is an unacceptable situation which is being eliminated through specific testing with anchors set in cracked concrete, and adding suitable information to the product description sheets.

Since international testing conditions for anchors are based on the above-mentioned crack widths, no theoretical relationship between ultimate tensile loads and different crack widths has been given.

Pretensioning force in anchor bolts / rods

The statements made above apply primarily to static loading conditions. If the loading is dynamic, the clamping force and pretensioning force in an anchor bolt / rod play a major role. If a crack propagates in a reinforced concrete component after an anchor has been set, it must be assumed that the pretensioning force in the anchor will decrease and, as a result, the clamping force from the fixture (part fastened) will be reduced (lost). The properties of this fastening for dynamic loading will then have deteriorated.

Loss of pretensioning force due to cracks

To ensure that an anchor fastening remains suitable for dynamic loading even after cracks appear in the concrete, the clamping force and pretensioning force in the anchor must be upheld. Suitable measures to achieve this can be sets of springs or similar devices.

Seismic loads and cracked concrete

As a structure responds to earthquake ground motion it experiences displacement and consequently deformation of its individual members. This deformation leads to the formation and opening of cracks in members. Consequently all anchorages intended to transfer earthquake loads should be suitable for use in cracked concrete and their design should be predicted on the assumption that cracks in the concrete will cycle open and closed for the duration of the ground motion.

Parts of the structures may be subjected to extreme inelastic deformation. In the reinforced areas yielding of the reinforcement and cycling of cracks may result in cracks width of several millimetres, particularly in regions of plastic hinges. Qualification procedures for anchors do not currently anticipate such large crack widths. For this reason, anchorages in this region where plastic hinging is expected to occur, such as the base of shear wall and joint regions of frames, should be avoided unless apposite design measures are taken.

Anchor design

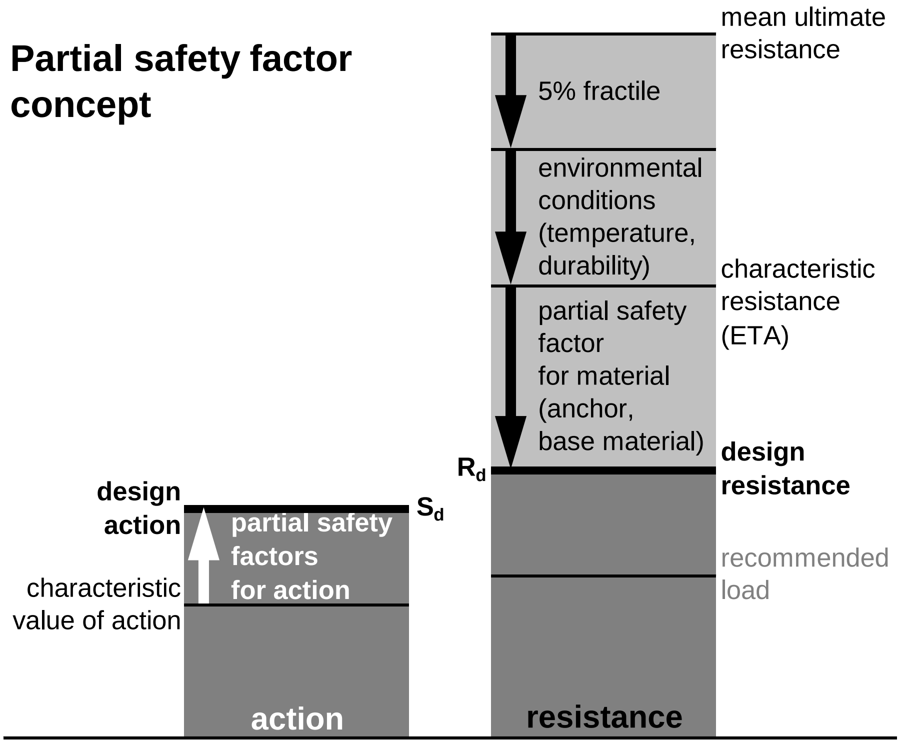
Safety concept

Depending on the application and the anchor type one of the following two concepts can be applied:

For anchors for use in concrete having an European Technical Approval (ETA) the partial safety factor concept according to the European Technical Approval Guidelines ETAG 001 or ETAG 020 shall be applied. It has to be shown, that the value of design actions does not exceed the value of the design resistance: $S_d \leq R_d$.

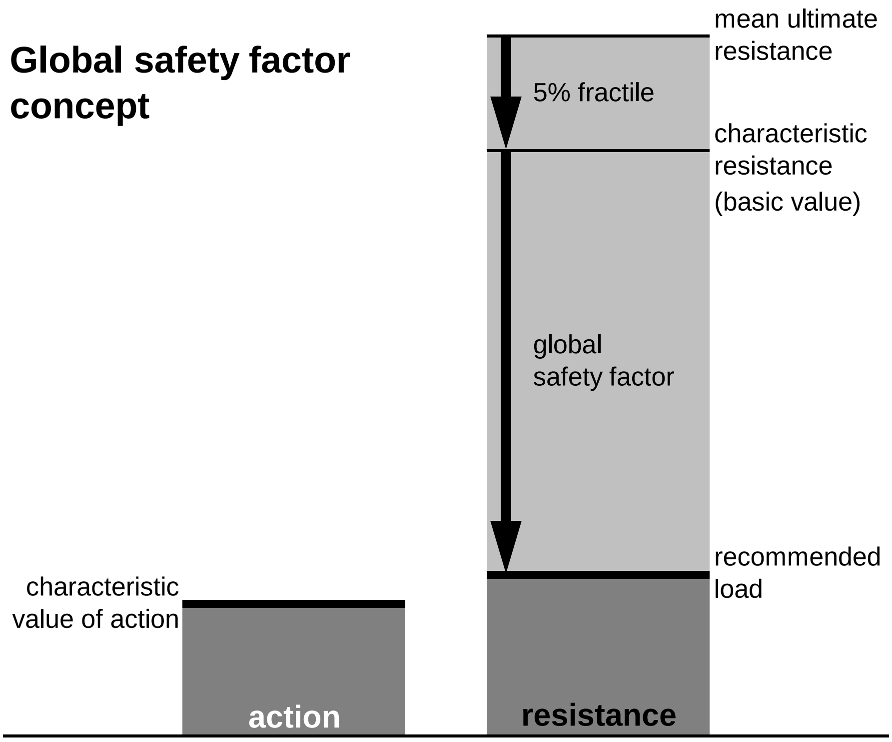
For the characteristic resistance given in the respective ETA, reduction factors due to e.g. freeze/thaw, service temperature, durability, creep behaviour and other environmental or application conditions are already considered.

In addition to the design resistance, in this manual recommended loads are given, using an overall partial safety factor for action γ = 1,4.



For the global safety factor concept it has to be shown, that the characteristic value of action does not exceed the recommend load value.

The characteristic resistance given in the tables is the 5% fractile value obtained from test results under standard test conditions. With a global safety factor all environmental and application conditions for action and resistance are considered, leading to a recommended load.



Design methods

Metal anchors for use in concrete according ETAG 001

The design methods for metal anchors for use in concrete are described in detail in Annex C of the European Technical Approval guideline ETAG 001 and for bonded anchors with variable embedment depth in EOTA Technical Report TR 029. Additional design rules for redundant fastenings are given in Part 6 of ETAG 001.

The design method given in this Anchor Fastening Technology Manual is based on these guidelines. The calculations according to this manual are simplified and lead to conservative results, i.e. the results are on the save side. Tables with basic load values and influecing factors and the calculation method are given for each anchor in the respective section.

Anchors for use in other base materials and for special applications

If no special calculation method is given, the basic load values given in this manual are valid, as long as the application conditions (e.g. base material, geometrie, environmental conditions) are observed.

Redundant fastenings with plastic anchors

Design rules for redundant fastings with plastic anchors for use in concrete and masonry for non-structural applications are given in Annex C of ETAG 020. The additional design rules for redundant fastenings are considered in this manual.

Resistance to fire

When resistance to fire has to be considered, the load values given in the section “resistance to fire” should be observed. The values are valid for a single anchor.

Hilti design software PROFIS Anchor

For a more complex and accurate design according to international and national guidelines and for applications beyond the guidelines, e.g. group of anchors with more than four anchors close to the edge or more than eight anchors far away from the edge, the Hilti design software PROFIS Anchor yields customised fastening solutions. The results can be different from the calculations according to this manual.

The following methods can be used for design using PROFIS Anchor:

- ETAG
- CEN/TS
- ACI 318-08
- CSA (Canadian standard)
- Solution for Fastening (Hilti internal design method)

Simplified design method

Simplified version of the design method A according ETAG 001, Annex C or EOTA Technical Report TR 029. Design resistance according data given in the relevant European Technical Approval (ETA)

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

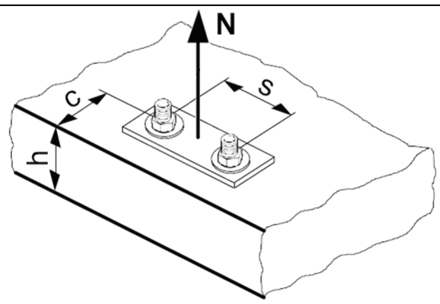
The differences to the design method given in the guideline are shown in the following.

Annex C of ETAG 001 and EOTA TR 029 compared to simplified design

Design tensile resistance

The design tensile resistance is the lower value of

- Design steel resistance $N_{Rd,s}$
- Design pull-out resistance (Design combined pull-out and concrete cone resistance for bonded anchors) $N_{Rd,p}$
- Design concrete cone resistance $N_{Rd,c}$
- Design splitting resistance $N_{Rd,sp}$



Design steel resistance $N_{Rd,s}$

Annex C of ETAG 001 / EOTA TR 029 and relevant ETA	Simplified design method
$N_{Rd,s} = N_{Rk,s} / \gamma_{Ms}$ * $N_{Rk,s}$: characteristic steel resistance * γ_{Ms}: partial safety factor for steel failure * Values given in the relevant ETA	** $N_{Rd,s}$ ** Value given in the respective tables in this manual

Design pull-out resistance $N_{Rd,p}$ for anchors designed according Annex C of ETAG 001

Annex C of ETAG 001 and relevant ETA	Simplified design method
$N_{Rd,p} = (N_{Rk,p} / \gamma_{Mp}) \cdot \psi_c$ * $N_{Rk,p}$: characteristic pull-out resistance * γ_{Mp}: partial safety factor for pull-out failure * ψ_c: influence of concrete strength * Values given in the relevant ETA	$N_{Rd,p} = N^0_{Rd,p} \cdot f_B$ ** $N^0_{Rd,p}$: Basic design pull-out resistance ** f_B: influence of concrete strength ** Values given in the respective tables in this manual

Design combined pull-out and concrete cone resistance $N_{Rd,p}$ for bonded anchors designed according EOTA TR 029

EOTA TR 029 and relevant ETA

$N_{Rd,p} = (N^0_{Rk,p} / \gamma_{Mp}) \cdot (A_{p,N} / A^0_{p,N}) \cdot \psi_{s,Np} \cdot \psi_{g,Np} \cdot \psi_{ec,Np} \cdot \psi_{re,Np} \cdot \psi_c$

where $N^0_{Rk,p} = \pi \cdot d \cdot h_{ef} \cdot \tau_{Rk}$

$\psi_{g,Np} = \psi^0_{g,Np} - (s / s_{cr,Np})^{0,5} \cdot (\psi^0_{g,Np} - 1) \geq 1$

$\psi^0_{g,Np} = n^{0,5} - (n^{0,5} - 1) \cdot \{(d \cdot \tau_{Rk})/[k \cdot (h_{ef} \cdot f_{ck,cube})^{0,5}]\}^{1,5} \geq 1$

$s_{cr,Np} = 20 \cdot d \cdot (\tau_{Rk,ucr} / 7,5)^{0,5} \leq 3 \cdot h_{ef}$

- * γ_{Mp}: partial safety factor for combined pull-out and concrete cone failure
- \+ $A^0_{p,N}$: influence area of an individual anchor with large spacing and edge distance at the concrete surface (idealised)
- \+ $A_{p,N}$: actual influence area of the anchorage at the concrete surface, limited by overlapping areas of adjoining anchors and by edges of the concrete member
- \+ $\psi_{s,Np}$: influence of the disturbance of the distribution of stresses due to edges
- \+ $\psi_{ec,Np}$: influence of excentricity
- \+ $\psi_{re,Np}$: influence of dense reinforcement
- * ψ_c: influence of concrete strength
- * **d**: anchor diameter
- * h_{ef}: (variable) embedment depth
- * τ_{Rk}: characteristic bond resistance
- **s**: anchor spacing
- $s_{cr,Np}$: critical anchor spacing
- **n**: number of anchors in a anchor group
- **k**: = 2,3 in cracked cocrete; = 3,2 in non-cracked cocrete
- $f_{ck,cube}$: concrete compressive strength
- * $\tau_{Rk,ucr}$: characteristic bond resistance for non-cracked concrete

* Values given in the relevant ETA

\+ Values have to be calculated according data given in the relavant ETA (details of calculation see TR 029. The basis of the calculations may depend on the critical anchor spacing).

Simplified design method

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

- ** $N^0_{Rd,p}$: Basic design combined pull-out and concrete cone resistance
- ** $f_{B,p}$: influence of concrete strength
- ** $f_{1,N}$, $f_{2,N}$: influence of edge distance
- ** $f_{3,N}$: influence of anchor spacing
- ** $f_{h,p}$: influence of (variable) embedment depth
- ** $f_{re,N}$: influence of dense reinforcement

** Values given in the respective tables in this manual

For the simplified design method the factor $\psi_{g,Np}$ (see TR 029) is assumed to be 1 and the critical anchor spacing is assumed to be $s_{cr,Np} = 3 \cdot h_{ef}$, both leading to conservative results = beeing on the save side.

Design concrete cone resistance $N_{Rd,c}$

Annex C of ETAG 001 / EOTA TR 029 and relevant ETA

$N_{Rd,c} = (N^0_{Rk,c} / \gamma_{Mc}) \cdot (A_{c,N} / A^0_{c,N}) \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec,N}$

where $N^0_{Rk,c} = k_1 \cdot f_{ck,cube}^{0,5} \cdot h_{ef}^{1,5}$

- * γ_{Mc}: partial safety factor for concrete cone failure
- \+ $A^0_{c,N}$: area of concrete cone of an individual anchor with large spacing and edge distance at the concrete surface (idealised)
- \+ $A_{c,N}$: actual area of concrete cone of the anchorage at the concrete surface, limited by overlapping concrete cones of adjoining anchors and by edges of the concrete member
- \+ $\psi_{s,N}$: influence of the disturbance of the distribution of stresses due to edges
- \+ $\psi_{re,N}$: influence of dense reinforcement
- \+ $\psi_{ec,N}$: influence of excentricity
- k_1: = 7,2 for anchorages in cracked concrete
  = 10,1 for anchorages in non-cracked concrete
- $f_{ck,cube}$: concrete compressive strength
- * h_{ef}: effective anchorage depth

* Values given in the relevant ETA

\+ Values have to be calculated according data given in the relavant ETA (details of calculation see Annex C of ETAG 001 or EOTA TR 029)

Simplified design method

$N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$

- ** $N^0_{Rd,c}$: Basic design concrete cone resistance
- ** f_B: influence of concrete strength
- ** $f_{1,N}$, $f_{2,N}$: influence of edge distance
- ** $f_{3,N}$: influence of anchor spacing
- ** $f_{h,N}$: influence of embedment depth
- ** $f_{re,N}$: influence of dense reinforcement

** Values given in the respective tables in this manual

Design concrete splitting resistance $N_{Rd,sp}$

Annex C of ETAG 001 / EOTA TR 029 and relevant ETA

$N_{Rd,sp} = (N^0_{Rk,c} / \gamma_{Mc}) \cdot (A_{c,N} / A^0_{c,N}) \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec,N} \cdot \psi_{h,sp}$

where $N^0_{Rk,c} = k_1 \cdot f_{ck,cube}^{0,5} \cdot h_{ef}^{1,5}$

- * γ_{Mc}: partial safety factor for concrete cone failure
- ++ $A^0_{c,N}$: area of concrete cone of an individual anchor with large spacing and edge distance at the concrete surface (idealised)
- ++ $A_{c,N}$: actual area of concrete cone of the anchorage at the concrete surface, limited by overlapping concrete cones of adjoining anchors and by edges of the concrete member
- \+ $\psi_{s,N}$: influence of the disturbance of the distribution of stresses due to edges
- \+ $\psi_{re,N}$: influence of dense reinforcement
- \+ $\psi_{ec,N}$: influence of excentricity
- k_1: = 7,2 for anchorages in cracked concrete; = 10,1 for anchorages in non-cracked concrete
- \+ $\psi_{h,sp}$: influence of the actual member depth
- $f_{ck,cube}$: concrete compressive strength
- * h_{ef}: embedment depth

* Values given in the relevant ETA

\+ Values have to be calculated according data given in the relavant ETA (details of calculation see Annex C of ETAG 001 or EOTA TR 029)

++ Values of $A^0_{c,N}$ and $A_{c,N}$ for splitting failure may be different from those for concrete cone failure, due to different values for the critical edge distance and critical anchor spacing

Simplified design method

$N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

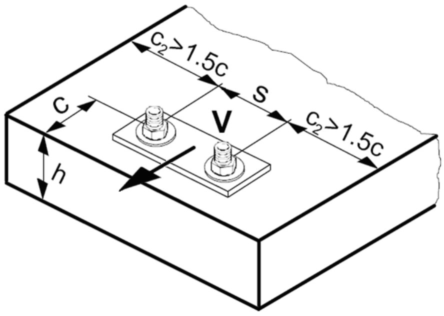
- ** $N^0_{Rd,c}$: Basic design concrete cone resistance
- ** f_B: influence of concrete strength
- ** $f_{1,sp}$, $f_{2,sp}$: influence of edge distance
- ** $f_{3,sp}$: influence of anchor spacing
- ** $f_{h,N}$: influence of base material thickness (concrete member depth)
- ** $f_{re,N}$: influence of dense reinforcement

** Values given in the respective tables in this manual

Design shear resistance

The design shear resistance is the lower value of

- Design steel resistance $V_{Rd,s}$
- Design concrete pryout resistance $V_{Rd,cp}$
- Design concrete edge resistance $V_{Rd,c}$



Design steel resistance $V_{Rd,s}$ (without lever arm)

Annex C of ETAG 001 / EOTA TR 029 and relevant ETA	Simplified design method
$V_{Rd,s} = V_{Rk,s} / \gamma_{Ms}$ * $V_{Rk,s}$: characteristic steel resistance * γ_{Ms}: partial safety factor for steel failure ***** Values given in the relevant ETA For steel failure with lever arm see Annex C of ETAG 001 or EOTA TR 029	** $V_{Rd,s}$ ****** Value given in the respective tables in this manual Steel failure with lever arm is not considered for the simplified design method

Design concrete pryout resistance $V_{Rd,cp}$ for anchors designed according Annex C of ETAG 001

Annex C of ETAG 001 and relevant ETA	Simplified design method
$V_{Rd,cp} = (V_{Rk,cp} / \gamma_{Mp/Mc}) = k \cdot N_{Rd,c}$ $N_{Rd,c} = N_{Rk,c} / \gamma_{Mc}$ $N_{Rk,c}$: characteristic tension resistance for concrete cone failure (see design concrete cone failure) * γ_{Mc}: partial safety factor for concrete cone failure (see design concrete cone failure) * **k**: influence of embedment depth ***** Values given in the relevant ETA	$V_{Rd,cp} = k \cdot N_{Rd,c}$ *** $N_{Rd,c}$: characteristic tension resistance for concrete cone failure (see design concrete cone failure) ** **k**: influence of embedment depth ****** Value given in the respective tables in this manual

Design concrete pryout resistance $V_{Rd,cp}$ for bonded anchors designed according EOTA TR 029

EOTA TR 029 and relevant ETA

$V_{Rd,cp}$ = $(V_{Rk,cp} / \gamma_{Mp/Mc})$ = **k** · lower value of $N_{Rd,p}$ and $N_{Rd,c}$

$N_{Rd,p} = N_{Rk,p} / \gamma_{Mp}$

$N_{Rd,c} = N_{Rk,c} / \gamma_{Mc}$

$N_{Rd,p}$: characteristic tension resistance for combined pull-out and concrete cone failure (see design combined pull-out and concrete cone failure)

$N_{Rk,c}$: characteristic tension resistance for concrete cone failure (see design concrete cone failure)

* γ_{Mp}: partial safety factor for combined pull-out and concrete cone failure (see design combined pull-out and concrete cone failure)

* γ_{Mc}: partial safety factor for concrete cone failure (see design concrete cone failure)

* **k**: influence of embedment depth

***** Values given in the relevant ETA

Simplified design method

$V_{Rd,cp}$ = **k** · lower value of $N_{Rd,p}$ and $N_{Rd,c}$

$N_{Rd,p}$: characteristic tension resistance for combined pull-out and concrete cone failure (see design combined pull-out and concrete cone failure)

$N_{Rk,c}$: characteristic tension resistance for concrete cone failure (see design concrete cone failure)

** **k**: influence of embedment depth

****** Values given in the respective tables in this manual

Design concrete edge resistance $V_{Rd,c}$

Annex C of ETAG 001 / EOTA TR 029 and relevant ETA

$$V_{Rd,c} = (V^0_{Rk,c} / \gamma_{Mc}) \cdot (A_{c,V} / A^0_{c,V}) \cdot \psi_{s,V} \cdot \psi_{h,V} \cdot \psi_{\alpha,V} \cdot \psi_{ec,V} \cdot \psi_{re,V}$$

where $V^0_{Rk,c} = k_1 \cdot d^{\alpha} \cdot h_{ef}^{\beta} \cdot f_{ck,cube}^{0,5} \cdot c_1^{1,5}$

$\alpha = 0{,}1 \cdot (h_{ef} / c_1)^{0,5}$

$\beta = 0{,}1 \cdot (d / c_1)^{0,2}$

- * γ_{Mc}: partial safety factor for concrete edge failure
- \+ $A^0_{c,V}$: area of concrete cone of an individual anchor at the lateral concrete surface not affected by edges (idealised)
- \+ $A_{c,V}$: actual area of concrete cone of anchorage at the lateral concrete surface, limited by overlapping concrete cones of adjoining anchors, by edges of the concrete member and by member thickness
- \+ $\psi_{s,V}$: influence of the disturbance of the distribution of stresses due to further edges
- \+ $\psi_{h,V}$: takes account of the fact that the shear resistance does not decrease proportially to the memebr thickness as assumed by the idealised ratio $A_{c,V} / A^0_{c,V}$
- ++ $\psi_{\alpha,V}$: Influence of angle between load applied and the direction perpendicular to the free edge
- ++ $\psi_{ec,V}$: influence of excentricity
- ++ $\psi_{re,V}$: influence of reinforcement
- k_1: = 1,7 for anchorages in cracked concrete
  = 2,4 for anchorages in non-cracked concrete
- * d: anchor diameter
- $f_{ck,cube}$: concrete compressive strength
- c_1: edge distance

***** Values given in the relevant ETA

\+ Values have to be calculated according data given in the relavant ETA (details of calculation see Annex C of ETAG 001 or EOTA TR 029)

++ Details see Annex C of ETAG 001 or EOTA TR 029

Simplified design method

$$V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$$

- ** $V^0_{Rd,c}$: Basic design concrete edge resistance
- ** f_B: influence of concrete strength
- ** $f_ß$: Influence of angle between load applied and the direction perpendicular to the free edge
- ** f_h: Influence of base material thickness
- ** f_4: Influence of anchor spacing and edge distance
- ** f_{hef}: influence of embedment depth
- ** f_c: influence of edge distance

****** Values given in the respective tables in this manual

The factors f_{hef} and f_c replace the function $d^{\alpha} \cdot h_{ef}^{\beta}$, leading to conservative results = beeing on the save side.

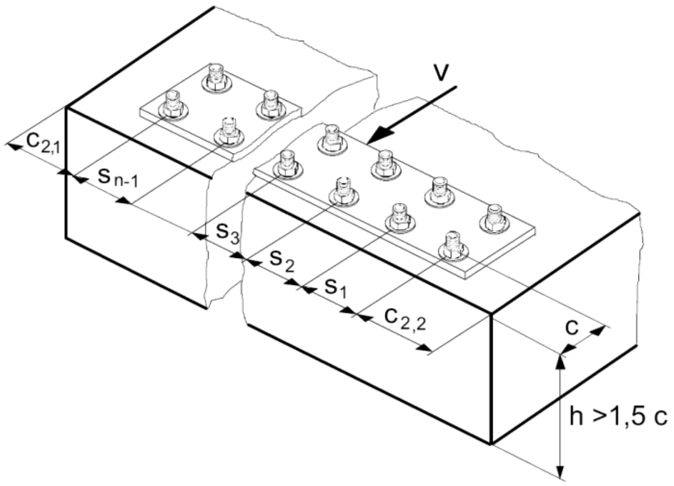
Special case: more than 2 anchors close to an edge

For a group of anchors f_4 can be calculated according to the following equation, if all anchors are equally loaded. This can be achieved by filling the annular gaps with a high performance injection mortar (e.g. Hilti HIT-RE 500-SD or Hilti HIT-HY 150 MAX.

$$f_4 = \left(\frac{c}{h_{ef}}\right)^{1,5} \cdot \left(1 + \frac{s_1 + s_2 + \ldots + s_{n-1}}{3 \cdot c}\right) \cdot \frac{1}{n}$$

Where $s_1, s_2, \ldots s_{n-1} \leq 3\,c$

And $c_{2,1}, c_{2,2} \geq 1{,}5\,c$



Combined tension and shear loading

The following equations must be satisfied

$\beta_N \leq 1$

$\beta_V \leq 1$

$\beta_N + \beta_V \leq 1{,}2$ **or** $\beta_N^{\alpha} + \beta_V^{\alpha} \leq 1$

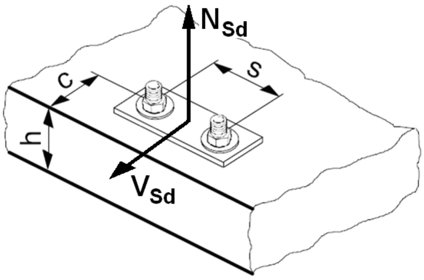
With

$\beta_N = N_{Sd} / N_{Rd}$ and

$\beta_V = V_{Sd} / V_{Rd}$

N_{Sd} (V_{Sd}) = **tension (shear) design action**

N_{Rd} (V_{Rd}) = **tension (shear) design resistance**



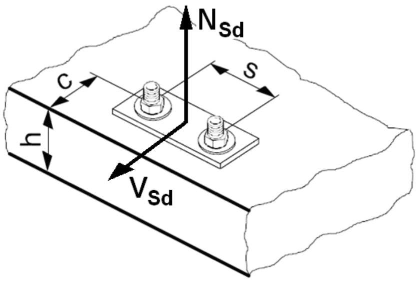
Annex C of ETAG 001	Simplified design method
α = **2,0** if N_{Rd} and V_{Rd} are governed by steel failure α = **1,5** for all other failure modes	Failure mode is not considered for the simplified method α = **1,5** for all failure modes (leading to conservative results = beeing on the save side)

Design example

Adhesive anchoring system with variable embedment depth in non-cracked concrete

Anchoring conditions

concrete		Non-cracked concrete C50/60
service temperature range of base material		temperature range II
number of anchors		Group of two anchors close to the edge
base material thickness	h	100 mm
anchor spacing	s	150 mm
edge distance	c	100 mm
shear load direction perpendicular to free edge	β	0 °
TENSION design action (fixing point)	N_{Sd}	15,0 kN
SHEAR design action (fixing point)	V_{Sd}	15,0 kN
TENSION design action per anchor	$N_{Sd}^{(1)}$	7,5 kN
SHEAR design action per anchor	$V_{Sd}^{(1)}$	7,5 kN
effective anchorage depth	h_{ef}	70 mm



anchor		Hilti HIT-RE 500-SD with HIT-V 5.8, size M12
external diameter	d	12 mm
typical anchorage depth	$h_{ef,typ}$	110 mm
minimum edge distance	s_{min}	60 mm
minimum spacing	c_{min}	60 mm

The parameters are given in the anchor-section in the tables "setting details" and "setting parameters" (for HIT-RE 500-SD with HIT-V 5.8, size M12)

Critical spacings and edge distances

critical spacing for concrete cone failure $s_{cr,N}$ and critical spacing for combined pull-out and concrete cone failure $s_{cr,Np}$			
h_{ef} =	70 mm	$s_{cr,N} = s_{cr,Np} = 3\ h_{ef}$ =	210 mm

critical edge distance for concrete cone failure $c_{cr,N}$ and critical edge distance for combined pull-out and concrete cone failure $c_{cr,Np}$			
h_{ef} =	70 mm	$c_{cr,N} = c_{cr,Np} = 1{,}5\ h_{ef}$ =	105 mm

critical edge distance for splitting failure							
		for $h \leq 1{,}3\ h_{ef}$			$c_{cr,sp} = 2{,}26\ h_{ef}$		
		for $1{,}3\ h_{ef} < h < 2\ h_{ef}$			$c_{cr,sp} = 4{,}6\ h_{ef} - 1{,}8\ h$		
		for $h \geq 2\ h_{ef}$			$c_{cr,sp} = 1{,}0\ h_{ef}$		
h =	100 mm	h_{ef} =	70 mm	h/h_{ef} =	1,43	→ $c_{cr,sp}$ =	142 mm

critical spacing for splitting failure			
$c_{cr,sp}$ =	142 mm	$s_{cr,sp} = 2\ c_{cr,sp}$ =	284 mm

General remarks

According EOTA Technical Report TR 029, concrete cone, combined concrete cone and pull-out, splitting, pryout and concrete edge design resistance must be verified for the anchor group. Steel design resistance must be verified for the most unfavourable anchor of the anchor group.

According to the simplified design method given in this Fastening Technology Manual all anchors of a group are loaded equally, the design resistance values given in the tables are valid for one anchor.

Tension loading

Design steel resistance

$N_{Rd,s}$ =	**28,0 kN**

See “basic design tensile resistance” (for HIT-RE 500-SD with HIT-V 5.8, size M12)

Design combined pull-out and concrete cone resistance

basic resistance						$N^0_{Rd,p}$	29,9 kN
concrete		Non-cracked concrete C50/60				$f_{B,p}$	1,09
h_{ef} =	70 mm	$h_{ef,typ}$ =	110 mm	$f_{h,p} = h_{ef}/h_{ef,typ}$ =			0,64
c =	100 mm	$c_{cr,N}$ =	105 mm	$c/c_{cr,N}$ =	0,95 →	$f_{1,N}$	0,99
						$f_{2,N}$	0,97
s =	150 mm	$s_{cr,N}$ =	210 mm	$s/s_{cr,N}$ =	0,71 →	$f_{3,N}$	0,86
h_{ef} =	70 mm				→	$f_{re,N}$	1,00
$N_{Rd,p} = N^0_{Rd,p}\ f_{B,p}\ f_{1,N}\ f_{2,N}\ f_{3,N}\ f_{h,p}\ f_{re,N}$ =							**17,1 kN**

See “basic design tensile resistance” (for HIT-RE 500-SD with HIT-V 5.8, size M12)

Design concrete cone resistance

basic resistance						$N^0_{Rd,c}$	32,4 kN
concrete		Non-cracked concrete C50/60				f_B	1,55
h_{ef} =	70 mm	$h_{ef,typ}$ =	110 mm	$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$ =			0,51
c =	100 mm	$c_{cr,N}$ =	105 mm	$c/c_{cr,N}$ =	0,95 →	$f_{1,N}$	0,99
						$f_{2,N}$	0,97
s =	150 mm	$s_{cr,N}$ =	210 mm	$s/s_{cr,N}$ =	0,71 →	$f_{3,N}$	0,86
h_{ef} =	70 mm				→	$f_{re,N}$	1,00
$N_{Rd,c} = N^0_{Rd,c}\ f_B\ f_{h,N}\ f_{1,N}\ f_{2,N}\ f_{3,N}\ f_{re,N}$ =							**21,1 kN**

See “basic design tensile resistance” (for HIT-RE 500-SD with HIT-V 5.8, size M12) and “influencing factors” (for HIT-RE 500-SD with HIT-V 5.8, size M12)

Influencing factors may be interpolated.

Design splitting resistance

basic resistance						$N^0_{Rd,c}$	32,4 kN
concrete		Non-cracked concrete C50/60				f_B	1,55
h_{ef} =	70 mm	$h_{ef,typ}$ =	110 mm	$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$ =			0,51
c =	100 mm	$c_{cr,sp}$ =	142 mm	$c/c_{cr,sp}$ =	0,70 →	$f_{1,sp}$	0,91
						$f_{2,sp}$	0,85
s =	150 mm	$s_{cr,sp}$ =	284 mm	$s/s_{cr,sp}$ =	0,53 →	$f_{3,sp}$	0,76
h_{ef} =	70 mm				→	$f_{re,N}$	1,00
$N_{Rd,sp} = N^0_{Rd,c}\ f_B\ f_{h,N}\ f_{1,sp}\ f_{2,sp}\ f_{3,sp}\ f_{re,N}$ =							**15,0 kN**

See “basic design tensile resistance” (for HIT-RE 500-SD with HIT-V 5.8, size M12) and “influencing factors” (for HIT-RE 500-SD with HIT-V 5.8, size M12)

Influencing factors may be interpolated.

Tension design resistance: lowest value	N_{Rd} =	**15,0 kN**

Shear loading

Design steel resistance

	$V_{Rd,s}$ =	**16,8 kN**

See “basic design shear resistance” (for HIT-RE 500-SD with HIT-V 5.8, size M12)

Concrete pryout design resistance

lower value of $N_{Rd,p}$ and $N_{Rd,c}$			V^0 =	17,1 kN
h_{ef} =	70 mm	→	k	2
			$V_{Rd,cp} = k\ V^0$ =	**34,3 kN**

See “basic design shear resistance” (for HIT-RE 500-SD with HIT-V 5.8, size M12) and “influencing factors” (for HIT-RE 500-SD with HIT-V 5.8, size M12)

Concrete edge design resistance

basic resistance						$V^0_{Rd,c}$	11,6 kN
concrete		Non-cracked concrete C50/60				f_B	1,55
shear load direction perpendicular to free edge				0 °	→	f_β	1,00
h =	100 mm	c =	100 mm	h/c = 1,00	→	f_h	0,82
c =	100 mm	h_{ef} =	70 mm	c/h_{ef} = 1,43	→	f_4	1,28
s =	150 mm	h_{ef} =	70 mm	s/h_{ef} = 2,14			
h_{ef} =	70 mm	d =	12 mm	h_{ef}/d = 5,83	→	f_{hef}	0,97
c =	100 mm	d =	12 mm	c/d = 8,33	→	f_c	0,67
						$V_{Rd,c} = V^0_{Rd,c}\ f_B\ f_\beta\ f_h\ f_4\ f_{hef}\ f_c$ =	**12,3 kN**

See “basic design shear resistance” (for HIT-RE 500-SD with HIT-V 5.8, size M12) and “influencing factors” (for HIT-RE 500-SD with HIT-V 5.8, size M12)

Influencing factors may be interpolated.

Shear design resistance: lowest value	V_{Rd} =	**12,3 kN**

Combined tension and shear loading

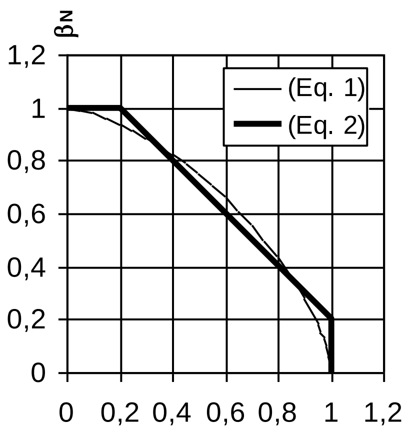
The following equation must be satisfied for combined tension and shear loads:

(Eq. 1) $(\beta_N)^{1,5} + (\beta_V)^{1,5} \le 1$

β_N (β_V) ratio between design action and design resistance for tension (shear) loading

According to ETAG 001, Annex C, the following simplified equation may be applied:

(Eq. 2) $\beta_N + \beta_V \le 1,2$ and $\beta_N \le 1$, $\beta_V \le 1$



Example (load values are valid for one anchor)

$N_{Sd}^{(1)}$ =	7,5 kN	$\beta_N = N_{Sd}^{(1)}/N_{Rd}$ =	0,500	≤ 1	✓
$V_{Sd}^{(1)}$ =	7,5 kN	$\beta_V = V_{Sd}^{(1)}/V_{Rd}$ =	0,612	≤ 1	✓
		$\beta_N + \beta_V$ =	1,112	≤ 1,2	✓
N_{Rd} =	15,0 kN				
V_{Rd} =	12,3 kN	$(\beta_N)^{1,5} + (\beta_V)^{1,5}$ =	0,832	≤ 1	✓

Dynamic loads (seismic, fatigue, shock)

Dynamic design for anchors

Actions

Common engineering design usually focuses around static loads. This chapter is intended to point out those cases, where static simplification may cause severe misjudgement and usually under-design of important structures.

Static loads

Static loads can be segregated as follows:

- Own (dead) weight
- Permanent actions
- Loads of non-loadbearing components
- Changing actions
- working loads (fitting / furnishing , machines, ”normal“ wear)
- Snow, Wind, Temperature

Material behaviour under static loading

The material behaviour under static loads is described essentially by the strength (tensile and compressive) and the elastic-plastic behaviour of the material. These properties are generally determined by carrying out tests according to the assessment guidelines.

Dynamic actions

The main difference between static and dynamic loads is the effectiveness of inertia and damping forces. These forces result from induced acceleration and must be taken into account when determining section forces and anchoring forces.

Typical Dynamic Actions

Dynamic actions can generally be classified into 3 different groups:

- Seismic loads
- Fatigue loads
- Shock loads

Seismic loads

Earthquakes

Seismic anchorage applications can include strengthening or retrofitting an existing structure, as well as standard anchorage applications that exist both in seismic and non-seismic geographies. In addition to an engineers focus on the anchoring of structural elements, it is crucial for an adequate seismic design to attend to non-load bearing and non-structural elements. These elements failure can severely compromise the building/structure functionality or repair costs after a seismic event.

Concrete should be assumed cracked

As a structure responds to earthquake ground motion it experiences displacement and consequently deformation of its individual members. This deformation leads to the formation and opening of cracks in members. Consequently all anchorages intended to transfer earthquake loads should be suitable for use in cracked concrete and their design should be predicted on the assumption that cracks in the concrete will cycle open and closed for the duration of the ground motion.

Anchors not recommended in plastic hinges areas

Parts of the structures may be subjected to extreme inelastic deformation as exposed in Fig. 1. In the reinforced areas yielding of the reinforcement and cycling of cracks may result in cracks width of several millimetres, particularly in regions of plastic hinges. Qualification procedures for anchors do not currently anticipate such large crack widths. For this reason, anchorages in this region where plastic hinging is expected to occur, such as the base of shear wall and joint regions of frames, should be avoided unless apposite design measures are taken.

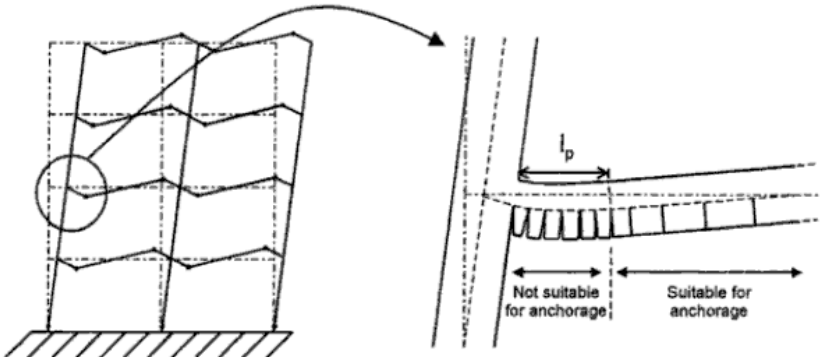


Fig 1: Member cracking assuming a strong-column, weak girder design

An anchor suitable (approved) to perform in a commonly defined cracked concrete, about 0.3 mm, is not consequently suitable to resist seismic actions, it's just a starting point.

Specific testing programs are needed to asses anchors

During an earthquake cyclic loading of the structure and of the fastenings is induced simultaneously. Due to this the width of the cracks will vary between a minimum and a maximum value and the fastenings will be loaded cyclically. Specific testing programs and evaluation requirements are then necessary in order to evaluate the performance of an anchor subjected to seismic actions. Only the anchors approved after the mentioned procedure shall be specified for any safety relevant connection.

Anchors suitable to endure seismic loading

Anchors generally suitable for taking up seismic actions are those which can be given a controlled and sustained pre-tensioning force and are capable of re-expanding when cracking occurs. Also favorable are anchors which have an anchoring mechanism based on a keying (mechanical interlock) as it is the case for undercut anchors and concrete screws. Furthermore, some specific chemical anchors have also been recognized good performance to resist seismic actions, specially bond expansion anchors.

Full scale system testing

Additionally, Hilti's seismic research includes detailed investigation of product performance under simulated seismic conditions and full-scale system testing. This multilevel approach helps to capture the complexity of anchored system behaviour under seismic conditions.

Seismic anchor design regulations landscape

In the United States the anchor seismic resistance shall be evaluated in accordance with ACI 318 Appendix D. Created in accordance with the ACI 355.2 regulated testing procedures and acceptance criteria ICC-ES AC193 and AC308, pre-qualification reports provide sound data in a proper design format.

With the release of the ETAG 001 Annex E in the first half of 2013, the seismic pre-qualification of anchors became regulated in Europe. Anchors submitted to these new test procedures will now also incorporate in the ETA (European Technical Approval) all the required technical data for seismic design. Until the release of the EN 1992-4, planned for 2015, EOTA TR045 (Technical Report) will set the standard for the seismic design of steel to concrete connections.

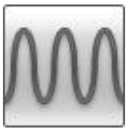
Therefore, the design framework for the seismic design of anchors is already available through both the U.S. and European regulations.

After an earthquake

After a strong or design earthquake occasion, the ultimate loading capacity of an anchor is considerably reduced (30 to 80% of the original resistance). Proper inspection shall then be carried to ensure the level of performance not only for a future earthquake but also for the static load combinations.

Fatigue loads

Fatigue



If an anchor is subjected to a sustained load that changes with respect to time, it can fail after a certain number of load cycles even though the upper limit of the load withstood up to this time is clearly lower than the ultimate tensile strength under static loading. This loss of strength is referred to as material fatigue. When evaluating actions causing fatigue also the planned or anticipated fastening life expectancy is of major importance.

Material behaviour under fatigue impact

The grade and quality of steel has a considerable influence on the alternating strength. In the case of structural and heat-treatable steels, the final strength (i.e. after 2 million load cycles or more) is approx. 25-35% of the static strength.

In the non-loaded state, concrete already has micro-cracks in the zone of contact of the aggregates and the cement paste, which are attributable to the aggregates hindering shrinkage of the cement paste. The fatigue strength of concrete is directly dependent on the grade of concrete. Concrete strength is reduced to about 55 – 65% of the initial strength after 2’000’000 load cycles.

Examples for Fatigue Loads

Two main groups of fatigue type loading can be identified:

- Vibration type loading of fasteners with very high recurrence and usually low amplitude (e.g. ventilators, production machinery, etc.).
- Repeated loading and unloading of structures with high loads and frequent recurrence (cranes, elevators, robots, etc.).

Shock loads

Shock

Shock-like phenomena have a very short duration and generally tremendously high forces which, however, only occur as individual peaks. As the probability of such a phenomenon to occur during the life expectancy of the building components concerned is comparably small, plastic deformations of fasteners and structural members are permitted according to the pre-qualification criteria.

Examples of Shock Loading

Shock loads are mostly unusual loading situations, even though sometimes they are the only loading case a structure is designed for (e.g. crash barriers, protection nets, ship or aeroplane impacts and falling rocks, avalanches and explosions, etc.).

Shock Testing

Load increase times in the range of milliseconds can be simulated during tests on servo-hydraulic testing equipment. The following main effects can then be observed:

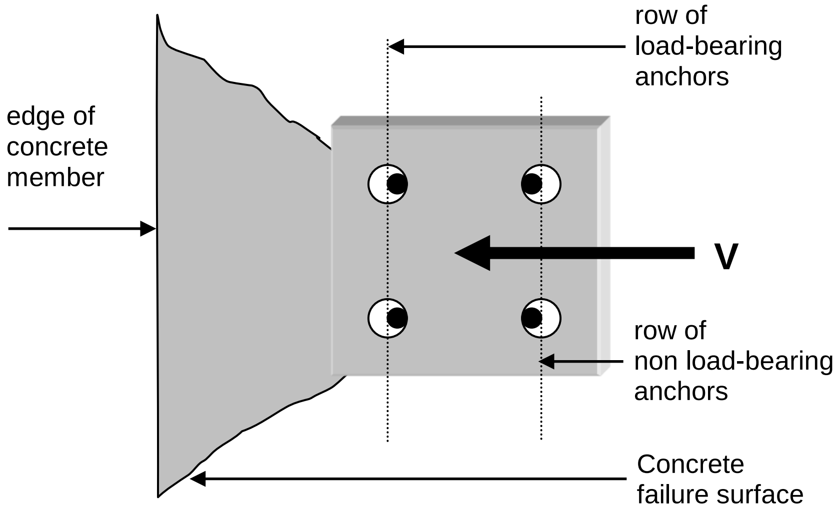
- Deformation is greater when the breaking load is reached
- The energy absorbed by an anchor is also much higher
- Breaking loads are of roughly the same magnitude during static loading and shock-loading tests

In this respect, more recent investigations show that the base material (cracked or non-cracked concrete), has no direct effect on the load-bearing behaviour.

Dynamic set for shear resistance upgrade

Uneven shear load distribution

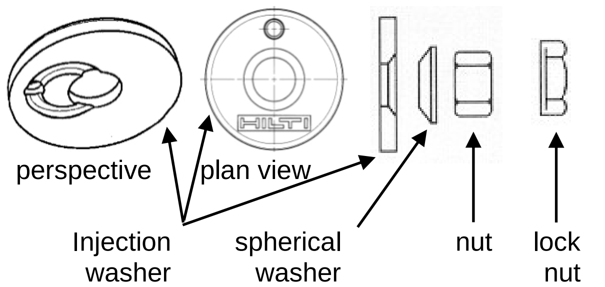
If a multiple-anchor fastening is loaded towards the edge of a concrete member (shear load), the gap between anchor shaft and clearance hole has an important role. An uneven shear load distribution within the anchors in the fastening is the result as the clearance hole is always larger than the anchor diameter to ensure an easy installation. Design methods take this fact into account by assuming that only the row of anchors nearest to the concrete edge takes up all shear load.



Activating the second row of anchors

The second row of anchors can be activated only after a considerable slip of the anchoring plate. This slip normally takes place after the edge failure of the outside row. The effect of the clearance hole gap on the internal load distribution increases if the shear load direction changes during the service life. To make anchors suitable for alternating shear loads, Hilti developed the so called Dynamic Set. This consists of a special washer, which permits HIT injection adhesive to be dispensed into the clearance hole, a spherical washer, a nut and a lock nut.

Dynamic Set



Improvements with Dynamic Set

Injection washer: Fills clearance hole and thus guarantees that the load is uniformly distributed among all anchors.

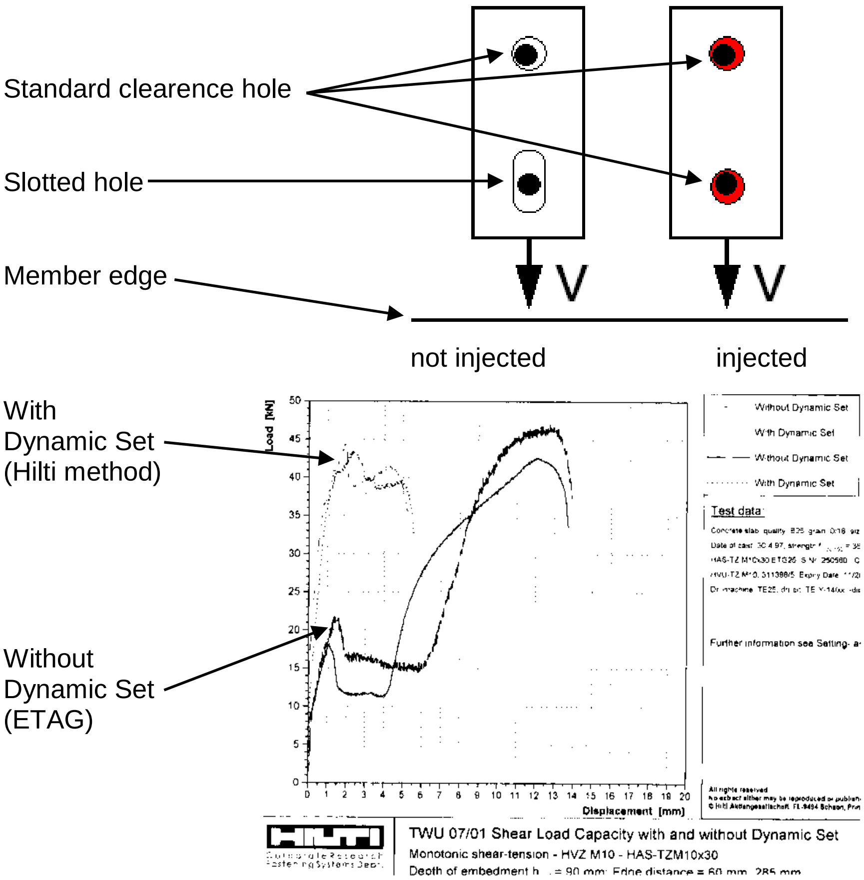
Spherical washer: Reduces bending moment acting on anchor shaft not set at right angles and thus increases the tensile loading capacity.

Lock nut: Prevents loosening of the nut and thus lifting of the anchoring plate away from the concrete in case of cyclic loading.

Delivery programme Dynamic Set: M10, M12, M16, M20

Shear resistance improvement with Dynamic Set

By using the dynamic set for static fastenings, the shear resistance is improved significantly. The unfavourable situation that only one row of anchors takes up all loads no longer exists and the load is distributed uniformly among all anchors. A series of experiments has verified this assumption. An example from this test programme, double fastenings with HVZ M10 anchors with and without the Dynamic Set are shown to compare resulting shear resistance and stiffness.



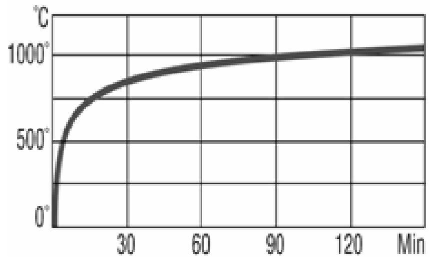
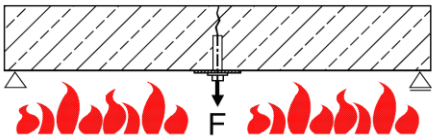
The test results show clearly that according to the current practice the second row of anchors takes up the load only after significant deformation of the plate, when the concrete edge has already failed. The injection and the Dynamic Set resulted in a continuous load increase until the whole multiple fastening fails.

When carrying out a simple fastening design, it may be assumed if the Dynamic Set is used the overall load bearing capacity of the multiple fastening is equal to the resistance of the first row of anchors multiplied by the number of rows in the fastening. In addition to that it must be checked whether the concrete edge resistance of the farest row is smaller than the above metioned resistance. If injection with the Dynamic Set is used, the ETAG restrictions on more than 6 anchor fastenings can be overcome.

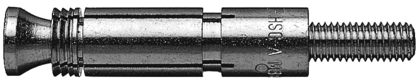
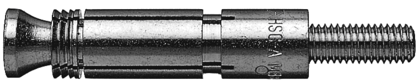
Resistance to fire

Tested fasteners for passive structural fire prevention

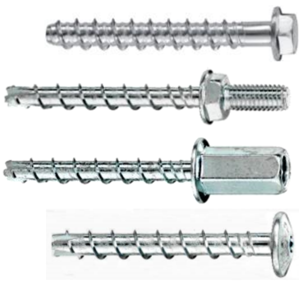
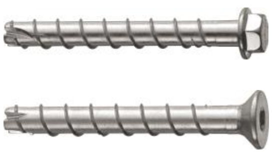
Tested according to the international standard temperature curve

MFPA Leipzig GmbH MFPA	Tested according to the international standard temperature curve (ISO 834, DIN 4102 T.2) and/or to EOTA Technical Report TR 020 (Evaluation of Anchorages in Concrete concerning Resistance to Fire)	
iBMB MPA TU BRAUNSCHWEIG		
Bodycote warringtonfire	Tested when set in cracked concrete and exposed to flames without insulating or protective measures.	

Anchor / fastener	Size	Max. loading (kN) for specified fire resistance time (fire resistance time in minutes)				Authority / No.
		F30	F60	F90	F120	
HDA  Fire resistance data for F 180 please refer to the test reports	M10	4,5	2,2	1,3	1,0	IBMB Braunschweig UB 3039/8151 Warringtonfire WF Report No 327804/A
	M12	10,0	3,5	1,8	1,2	
	M16	15,0	7,0	4,0	3,0	
	M20	25,0	9,0	7,0	5,0	
HDA-F 	M10	4,5	2,2	1,3	1,0	IBMB Braunschweig UB 3039/8151 Warringtonfire WF Report No 327804/A
	M12	10,0	3,5	1,8	1,2	
	M16	15,0	7,0	4,0	3,0	
HDA-R 	M10	20,0	9,0	4,0	2,0	IBMB Braunschweig UB 3039/8151 Warringtonfire WF Report No 327804/A
	M12	30,0	12,0	5,0	3,0	
	M16	50,0	15,0	7,5	6,0	
HSL-3 	M8	3,0	1,1	0,6	0,4	IBMB Braunschweig UB 3041/1663-CM Warringtonfire WF Report No 327804/A
	M10	7,0	2,0	1,3	0,8	
	M12	10,0	3,5	2,0	1,2	
	M16	19,4	6,6	3,5	2,2	
	M20	30,0	10,3	5,4	3,5	
	M24	43,0	14,8	7,9	5,0	

Anchor / fastener	Size	Max. loading (kN) for specified fire resistance time (fire resistance time in minutes)				Authority / No.
		F30	F60	F90	F120	
HSL-3-G 	M8	3,0	1,1	0,6	0,4	IBMB Braunschweig report No, 3041/1663-CM Warringtonfire WF Report No 327804/A
	M10	7,0	2,0	1,3	0,8	
	M12	10,0	3,5	2,0	1,2	
	M16	19,4	6,6	3,5	2,2	
	M20	30,0	10,3	5,4	3,5	
	M24	43,0	14,8	7,9	5,0	
HSL-3-B 	M12	10,0	3,5	2,0	1,2	IBMB Braunschweig report No. 3041/1663-CM Warringtonfire WF Report No 327804/A
	M16	19,4	6,6	3,5	2,2	
	M20	30,0	10,3	5,4	3,5	
	M24	43,0	14,8	7,9	5,0	
HSL-3-SH 	M8	1,9	1,1	0,6	0,4	IBMB Braunschweig report No. 3041/1663-CM Warringtonfire WF Report No 327804/A
	M10	4,5	2,0	1,3	0,8	
	M12	8,5	3,5	2,0	1,2	
HSL-3-SK 	M8	3,0	1,1	0,6	0,4	IBMB Braunschweig report No. 3041/1663-CM Warringtonfire WF Report No 327804/A
	M10	7,0	2,0	1,3	0,8	
	M12	10,0	3,5	2,0	1,2	
HSC-A 	M8x40	1,5	1,5	1,5	-	IBMB Braunschweig UB 3177/1722-1 Warringtonfire WF Report No 327804/A
	M8x50	1,5	1,5	1,5	-	
	M10x40	1,5	1,5	1,5	-	
	M12x60	3,5	3,5	2,0	-	
HSC-I 	M8x40	1,5	1,5	1,5	-	IBMB Braunschweig UB 3177/1722-1 Warringtonfire WF Report No 327804/A
	M10x50	2,5	2,5	2,5	-	
	M10x60	2,5	2,5	2,5	-	
	M12x60	2,0	2,0	2,0	-	
HSC-AR 	M8x40	1,5	1,5	1,5	-	IBMB Braunschweig UB 3177/1722-1 Warringtonfire WF Report No 327804/A
	M8x50	1,5	1,5	1,5	-	
	M10x40	1,5	1,5	1,5	-	
	M12x60	3,5	3,5	3,5	3,0	
HSC-IR 	M8x40	1,5	1,5	1,5	-	IBMB Braunschweig UB 3177/1722-1 Warringtonfire WF Report No 327804/A
	M10x50	2,5	2,5	2,5	-	
	M10x60	2,5	2,5	2,5	-	
	M12x60	3,5	3,5	3,5	3,0	
HST 	M8	0,9	0,7	0,6	0,5	DIBt Berlin ETA-98/0001 Warringtonfire WF Report No 327804/A Data valid for *steel* failure, for other failure modes see ETA-98/0001
	M10	2,5	1,5	1,0	0,7	
	M12	5,0	3,5	2,0	1,0	
	M16	9,0	6,0	3,5	2,0	
	M20	15,0	10,0	6,0	3,5	
	M24	20,0	15,0	8,0	5,0	

Anchor / fastener	Size	Max. loading (kN) for specified fire resistance time (fire resistance time in minutes)				Authority / No.
		F30	F60	F90	F120	
HST-R 	M8	*4,9*	*3,6*	*2,4*	*1,7*	DIBt Berlin ETA-98/0001 Warringtonfire WF Report No 327804/A Data valid for *steel* failure, for other failure modes see ETA-98/0001
	M10	*11,8*	*8,4*	*5,0*	*3,3*	
	M12	*17,2*	*12,2*	*7,3*	*4,8*	
	M16	*32,0*	*22,8*	*13,5*	*8,9*	
	M20	*49,9*	*35,5*	*21,1*	*13,9*	
	M24	*71,9*	*51,2*	*30,4*	*20,0*	
HST-HCR 	M8	4,9	3,6	2,4	1,7	DIBt Berlin ETA-98/0001 Warringtonfire WF Report No 327804/A Data valid for *steel* failure, for other failure modes see ETA-98/0001
	M10	11,8	8,4	5,0	3,3	
	M12	17,2	12,2	7,3	4,8	
	M16	32,0	22,8	13,5	8,9	
HSA, HSA-BW, HSA-R2, HSA-R 	M6	0,20	0,18	0,14	0,10	IBMB Braunschweig 3215/229/12 Data valid for *steel* failure, for other failure modes see report 3215/229/12 Warringtonfire WF Report No 327804/A
	M8	0,37	0,33	0,26	0,18	
	M10	0,87	0,75	0,58	0,46	
	M12	1,69	1,26	1,10	0,84	
	M16	3,14	2,36	2,04	1,57	
	M20	4,90	3,68	3,19	2,45	
HLC-Standard 	6,5 (M5)	0,5	0,29	0,2	0,17	IBMB Braunschweig PB 3093/517/07–CM Warringtonfire WF Report No 327804/A
	8 (M6)	0,9	0,5	0,37	0,3	
	10 (M8)	1,9	0,99	0,6	0,5	
	12(M10)	3,0	1,5	1,0	0,8	
	16(M12)	4,0	2,2	1,5	1,1	
	20(M16)	4,0	3,7	2,7	2,2	
HLC-H 	8 (M6)	0,9	0,5	0,37	0,3	IBMB Braunschweig PB 3093/517/07-CM Warringtonfire WF Report No 327804/A
	10 (M8)	1,9	0,99	0,6	0,5	
	12(M10)	3,0	1,5	1,0	0,8	
	16(M12)	4,0	2,2	1,5	1,18	
HLC-L 	10 (M8)	1,9	0,99	0,67	0,5	IBMB Braunschweig PB 3093/517/07-CM Warringtonfire WF Report No 327804/A
HLC-EC 	8 (M6)	0,9	0,5	0,37	0,3	IBMB Braunschweig PB 3093/517/07-CM Warringtonfire WF Report No 327804/A
	10 (M8)	1,9	0,99	0,67	0,5	
	16(M12)	3,0	1,5	1,0	0,79	

Anchor / fastener	Size	Max. loading (kN) for specified fire resistance time (fire resistance time in minutes)				Authority / No.
		F30	F60	F90	F120	
HUS-HR 	6x30	0,5	0,5	0,5	0,4	Hilti Tech. data
	6x35	0,7	0,7	0,7	0,5	DIBt Berlin / ETA-10/0005 acc. Part 6
	6x55	1,3	1,3	1,3	1,0	DIBt Berlin ETA-08/0307
	8x60	1,5	1,5	1,5	1,2	
	8x80	3,0	3,0	3,0	1,7	
	10x70	2,3	2,3	2,3	1,8	
	10x90	4,0	4,0	4,0	2,4	
	14x70	3,0	3,0	3,0	2,4	
	14x90	6,3	6,3	6,3	5,0	
HUS-A/-H/-I/-P 	6x35	0,5	0,5	0,5	0,4	DIBt Berlin / ETA-10/0005 acc. Part 6
	6x55	1,5	1,2	0,8	0,7	DIBt Berlin ETA-08/0307
	8x60	1,5	1,5	1,3	0,8	
	8x75	2,3	2,2	1,3	0,8	
	10x70	1,9	1,9	1,9	1,5	
	10x85	4,0	3,6	2,2	1,5	
HUS3 	M8	*3,2*	*2,4*	*0,5*	*0,4*	DIBt Berlin / ETA-13/1038 Table C3
	M10	*6,1*	*4,6*	*3,1*	*2,4*	Data valid for *steel* failure, for other failure modes see ETA-13/1038
	M14	*10,4*	*7,8*	*5,3*	*4,0*	
HUS (aerated concrete, plates and bricks, strength catgegory $\geq$ 6)	6	*1,0*	*0,6*	*0,4*	*0,3*	IBMB Braunschweig BB 3707/983/11 Warringtonfire WF Report No 327804/A
	-H 6					
	-A 6					
HKD 	M6x25	0,5	0,4	0,3	0,2	DIBt Berlin ETA-06/0047 acc. Part 6 Warringtonfire WF Report No 327804/A
	M8x25	0,6	0,6	0,6	0,5	
	M8x30	0,9	0,9	0,9	0,7	
	M8x40	1,3	1,3	1,3	0,7	
	M10x25	0,6	0,6	0,6	0,5	
	M10x30	0,9	0,9	0,9	0,7	
	M10x40	1,8	1,8	1,8	1,5	
	M12x25	0,6	0,6	0,6	0,5	
	M12x50	2,3	2,3	2,3	1,8	
	M16x65	4,0	4,0	4,0	3,2	
HKD-SR  HKD-ER 	M6x30	0,5	0,5	0,4	0,3	DIBt Berlin ETA-06/0047 acc. Part 6 Warringtonfire WF Report No 327804/A
	M8x30	0,9	0,9	0,9	0,7	
	M10x40	1,8	1,8	1,8	1,5	
	M12x50	2,3	2,3	2,3	1,8	

Anchor / fastener	Size	Max. loading (kN) for specified fire resistance time (fire resistance time in minutes)				Authority / No.
		F30	F60	F90	F120	
HRD 8 / HRD 10 	only shear loads	1,9	1,4	1,0	0,7	MFPA Leipzig GS 3.2/10-157-1
HA 8 R1 	8	0,35	0,20	0,10	0,05	IBMB Braunschweig UB 3245/1817-5 Warringtonfire WF Report No 327804/A
DBZ 	6/4,5	0,6	0,5	0,3	0,2	DIBt Berlin; ETA-06/0179 acc. Part 6 Warringtonfire WF Report No 327804/A
	6/35					
HT 	HT 8 L	0,85	0,44	0,27	0,19	IBMB Braunschweig UB 3016/1114-CM Warringtonfire WF Report No 327804/A
	HT 10 L	0,74	0,41	0,3	0,24	
	HT 10 S					
HK 	HK6	0,3	0,3	0,3	0,2	DIBt Berlin ETA-04/0043, acc. Part 6 Warringtonfire WF Report No 327804/A
	HK6L	0,6	0,5	0,3	0,2	
	HK8	1,2	1,0	0,6	0,4	
HPD 	M6	0,85	0,5	0,35	0,3	IBMB Braunschweig UB 3077/3602 -Nau- Warringtonfire WF Report No 327804/A
	M8	1,4	0,7	0,45	0,35	
	M10	2,2	1,3	0,95	0,75	
	M12	2,2	1,3	0,95	0,75	
HKH/HKH-L 	M6	1,2	0,65	0,45	0,35	IBMB Braunschweig UB 3606 / 8892 Warringtonfire WF Report No 327804/A
	M8	1,9	0,95	0,65	0,5	
	M10	3,2	1,6	1,1	0,85	
IDMS/IDMR 	Tested withTektalan-slabs classification according to DIN EN 13 502-2:2003 for REI 90 and RE 90 recommended					IBMB Braunschweig PB 3136/2315

Anchor / fastener	Size	Max. loading (kN) for specified fire resistance time (fire resistance time in minutes)				Authority / No.
		F30	F60	F90	F120	
HVZ + HAS-TZ 	M10	4,5	2,2	1,3	1,0	IBMB Braunschweig UB 3357/0550-1 Warringtonfire WF Report No 327804/B
	M12	10,0	3,5	1,8	1,2	
	M16	15,0	7,0	4,0	3,0	
	M20	25,0	9,0	7,0	5,0	
HVZ + HAS-R/HAS-HCR-TZ 	M10	10,0	4,5	2,7	1,7	
	M12	15,0	7,5	4,0	3,0	
	M16	20,0	11,5	7,5	6,0	
	M20	35,0	18,0	11,5	9,0	
HVU + HAS 	M8	1,5	0,8	0,5	0,4	IBMB Braunschweig UB- 3333/0891-1 Warringtonfire WF Report No 327804/B
	M10	4,5	2,2	1,3	0,9	
	M12	10,0	3,5	1,8	1,0	
	M16	15,0	5,0	4,0	3,0	
	M20	25,0	9,0	7,0	5,0	
	M24	35,0	12,0	9,5	8,0	
	M27	40,0	13,5	11,0	9,0	
	M30	50,0	17,0	14,0	11,0	
	M33	60,0	20,0	16,5	13,5	
	M36	70,0	24,0	19,5	16,0	
	M39	85,0	29,0	23,5	19,5	
HVU + HAS-R/HAS-E-R + HVU + HAS-HCR/HAS-E-HCR 	M8	2,0	0,8	0,5	0,4	
	M10	6,0	3,5	1,5	1,0	
	M12	10,0	6,0	3,0	2,5	
	M16	20,0	13,5	7,5	6,0	
	M20	36,0	25,5	15,0	10,0	
	M24	56,0	38,0	24,0	16,0	
	M27	65,0	44,0	27,0	18,0	
	M30	85,0	58,0	36,0	24,0	
	M33	100,0	68,0	42,0	28,0	
	M36	120,0	82,0	51,0	34,0	
	M39	140,0	96,0	60,0	40,0	
HVU + HIS-N 	M8	1,5	0,8	0,5	0,4	
	M10	4,5	2,2	1,3	0,9	
	M12	10,0	3,5	1,8	1,0	
	M16	15,0	5,0	4,0	3,0	
	M20	25,0	9,0	7,0	5,0	
HVU + HIS-RN 	M8	10,0	5,0	1,8	1,0	
	M10	20,0	9,0	4,0	2,0	
	M12	30,0	12,0	5,0	3,0	
	M16	50,0	15,0	7,5	6,0	
	M20	65,0	35,0	15,0	10,0	

Anchor / fastener	Size	Max. loading (kN) for specified fire resistance time (fire resistance time in minutes)				Authority / No.
		F30	F60	F90	F120	
HIT-RE 500-SD + HIT-V 	M8	2,3	1,08	0,5	0,28	MFPA Leipzig GS-III/B-07-070 Warringtonfire WF Report No 327804/B Loads for standard embedment depth, for variable embedment depth see test report.
	M10	3,7	1,9	0,96	0,59	
	M12	5,3	2,76	1,59	1,0	
	M16	10,0	5,4	3,1	1,97	
	M20	15,6	8,46	4,5	2,79	
	M24	22,5	12,19	7,0	4,4	
	M27	29,2	15,8	9,1	5,7	
	M30	35,7	19,3	11,1	7,0	
HIT-RE 500-SD + HIT-VR/HIT-V-HCR 	M8	2,42	1,08	0,5	0,28	
	M10	3,8	1,9	0,96	0,59	
	M12	6,5	4,2	2,3	1,5	
	M16	12,1	8,6	4,8	3,2	
	M20	18,8	15,9	12,2	10,5	
	M24	27,2	23,0	18,8	16,7	
	M27	35,3	29,9	24,4	21,7	
	M30	43,2	36,5	29,9	26,5	
HIT-RE 500-SD + HIS-N 	M8	2,3	1,26	0,73	0,46	MFPA Leipzig GS-III/B-07-070 Warringtonfire WF Report No 327804/B
	M10	3,7	2,0	1,15	0,73	
	M12	5,3	2,9	1,68	1,06	
	M16	10,0	5,4	3,1	1,97	
	M20	15,6	8,4	4,87	3,08	
HIT-RE 500-SD + HIS-RN 	M8	2,4	1,88	1,3	1,07	
	M10	3,8	2,98	2,1	1,69	
	M12	6,5	5,5	4,5	4,0	
	M16	12,1	10,2	8,3	7,4	
	M20	18,8	15,9	13,0	11,6	

Anchor / fastener	Size	Max. loading (kN) for specified fire resistance time (fire resistance time in minutes)				Authority / No.
		F30	F60	F90	F120	
HIT-RE 500 + HAS/HAS-E/HIT-V 	M8	2,3	1,26	0,73	0,46	IBMB Braunschweig PB 3588/4825-CM, & supplement letter 412/2008 Warringtonfire WF Report No 327804/B
	M10	3,7	2,0	1,15	0,73	
	M12	5,3	2,9	1,68	1,06	
	M16	10,0	5,4	3,1	1,97	
	M20	15,6	8,4	4,8	3,08	
	M24	22,5	12,1	7,0	4,4	
	M27	29,2	15,8	9,1	5,7	
	M30	35,7	19,3	11,1	7,0	
	M33	44,2	23,9	13,8	8,7	
	M36	58,5	31,6	18,2	11,5	
	M39	62,2	33,6	19,4	12,2	
HIT-RE 500 + HAS-R/HAS-ER/ HAS-HCR/HIT-V-R/HIT-V-HCR 	M8	2,4	1,88	1,34	1,07	IBMB Braunschweig Test Report 3565 / 4595, & supplement letter 414/2008 Warringtonfire WF Report No 327804/B
	M10	3,8	2,98	2,1	1,69	
	M12	6,5	5,5	4,5	4,0	
	M16	12,1	10,2	8,3	7,4	
	M20	18,8	15,9	13,0	11,6	
	M24	27,2	23,0	18,8	16,7	
	M27	35,3	29,9	24,4	21,7	
	M30	43,2	36,5	29,9	26,5	
	M33	53,4	45,2	37,0	32,8	
	M36	70,6	59,7	48,9	43,4	
	M39	75,2	63,6	52,0	46,2	
HIT-RE 500 +HIS-N 	M8	2,3	1,2	0,7	0,4	IBMB Braunschweig PB 3588/4825-CM Brunswick Warringtonfire WF Report No 327804/B
	M10	3,7	2,0	1,1	0,7	
	M12	5,3	2,9	1,68	1,06	
	M16	10,0	5,4	3,1	1,97	
	M20	15,6	8,4	4,87	3,08	
HIT-RE 500 +HIS-RN 	M8	2,3	1,2	0,7	0,4	
	M10	3,8	2,98	2,1	1,69	
	M12	6,5	5,5	4,5	4,0	
	M16	12,1	10,2	8,3	7,4	
	M20	18,9	15,9	13,0	11,6	

Anchor / fastener	Size	Max. loading (kN) for specified fire resistance time (fire resistance time in minutes)				Authority / No.
		F30	F60	F90	F120	
HIT-HY 200-A + HIT-Z 	M8	1,64	0,45	0,24	0,17	IBMB Braunschweig 3501/676/12 Loads for typical embedment depth, cracked concrete. For variable embedment depth and non-cracked concrete see test report. Warringtonfire WF Report No 327804/B
	M10	2,75	0,75	0,40	0,28	
	M12	4,90	1,80	0,89	0,59	
	M16	10,5	6,07	2,95	1,83	
	M20	16,4	12,3	7,70	4,72	
HIT-HY 200-A + HIT-Z-R 	M8	1,64	0,45	0,24	0,17	
	M10	2,75	0,75	0,40	0,28	
	M12	6,67	1,80	0,89	0,59	
	M16	20,1	6,07	2,95	1,83	
	M20	31,4	16,01	7,70	4,72	
HIT-HY 200-A + HIT-V 5.8 	M8	1,20	0,45	0,24	0,17	
	M10	2,00	0,75	0,40	0,28	
	M12	3,00	1,80	0,89	0,59	
	M16	6,20	2,55	1,29	0,86	
	M20	9,70	7,80	5,85	3,61	
	M24	14,0	11,3	8,60	7,20	
	M27	18,3	14,7	11,2	9,40	
	M30	22,3	17,9	13,6	11,5	
HIT-HY 200-A + HIT-V 8.8 	M8	1,64	0,45	0,24	0,17	
	M10	2,75	0,75	0,40	0,28	
	M12	4,90	1,80	0,89	0,59	
	M16	9,09	2,55	1,29	0,86	
	M20	16,4	12,01	5,85	3,61	
	M24	23,6	17,7	11,8	8,80	
	M27	30,9	23,1	15,3	11,5	
	M30	37,6	28,1	18,7	14,0	
HIT-HY 200-A + HIT-V-R 	M8	1,64	0,45	0,24	0,17	
	M10	2,75	0,75	0,40	0,28	
	M12	6,67	1,80	0,89	0,59	
	M16	9,09	2,55	1,29	0,86	
	M20	31,4	12,01	5,85	3,61	
	M24	45,2	29,8	14,4	8,83	
	M27	30,9	23,1	15,3	11,5	
	M30	71,9	52,2	32,5	21,08	

Anchor / fastener	Size	Max. loading (kN) for specified fire resistance time (fire resistance time in minutes)				Authority / No.
		F30	F60	F90	F120	
HIT-HY 70 h_{ef} = 80 mm (HLz, MVz, KSL, KSV) 	M8	2,0	0,4	0,2	-	MFPA Leipzig PB 3.2/12-055-1 Warringtonfire WF Report No 327804/B
	M10	2,0	0,4	0,2	-	
	M12	2,0	0,4	0,2	-	
HIT-HY 70 h_{ef} = 130 mm (HLz, MVz, KSL, KSV)	M8	2,0	1,2	0,7	-	
	M10	3,6	1,9	1,1	-	
	M12	5,9	3,0	1,5	-	
HIT-HY 70 h_{ef} = 80 mm (Autoclaved aerated concrete masonry units)	M8	2,0	0,4	0,2	-	
	M10	2,0	0,4	0,2	-	
	M12	2,0	0,4	0,2	-	
HIT-HY 70 h_{ef} = 130 mm (Autoclaved aerated concrete masonry units)	M8	2,0	0,8	0,6	-	
	M10	2,0	1,0	0,8	-	
	M12	2,0	1,2	1,0	-	
HIT-HY 70 h_{ef} = 80 and 130mm (Brick ceiling)	M6	0,7	0,4	0,2	-	

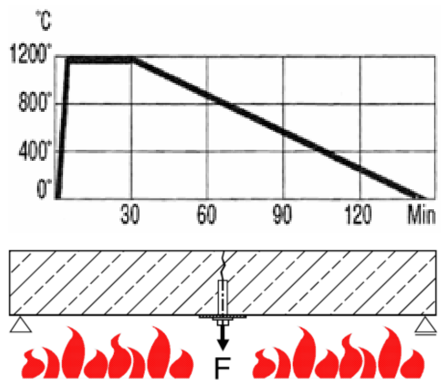
Tested fasteners
for passive structural fire prevention

Tested according to the german tunnel temperature curve

MFPA Leipzig GmbH

Tested according to the german tunnel temperature curve (ZTV-ING, part 5).

Tested when set in cracked concrete and exposed to flames without insulating or protective measures.



Anchor / fastener	Size	Max. loading (kN) for specified fire rating/integrity	Authority/No.
HST-HCR 	M10	1,0	IBMB Braunschweig UB 3332/0881-2-CM & supplement letter 13184/2006 Warringtonfire WF-Report No 327804/A
	M12	1,5	
	M16	2,5	
	M20	6,0	
HUS-HR 	6	0,20 a)	MFPA Leipzig PB III/08-354 Warringtonfire WF-Report No 327804/A
	8	0,30 a)	
	10	0,50 a)	
	14	1,10 a)	
HKD-SR 	M8	0,5	IBMB Braunschweig UB 3027/0274-4 & supplement letter 133/00-Nau- Warringtonfire WF-Report No 327804/A
	M10	0,8	
	M12	2,5	
	M16	5,0	
	M20	6,0	
HVU-TZ + HAS-HCR 	M10	1,5	IBMB Braunschweig UB 3357/0550-2 Warringtonfire WF Report No 327804/B
	M12	2,5	
	M16	6,0	
	M20	8,0	
HVU + HAS-HCR 	M8	0,5	IBMB Braunschweig UB 3333/0891-2 Warringtonfire WF Report No 327804/B
	M10	1,5	
	M12	1,5	
	M16	5,0	

a) Tested according tunnel temperature curve EBA

Corrosion

Atmospheric corrosion of anchors

Importance

Corrosion is a process that affects metals due to their exposure to atmospheric influence. A greater concern is the safety risks, where corrosion can lead to significant impairment to the functionality of the fastening systems of the structural elements.

Hilti conducts comprehensive laboratory and field based tests to assess the corrosion resistance of its products. Thanks to the in-house research and close collaboration with renowned universities and laboratories, Hilti can offer the right solutions with the suitable corrosion protection for a wide variety of environmental conditions.

Process

Corrosion is expected to occur when the material, the protection or the structural design of a metallic component do not match the requirements imposed by the surrounding environment.

To evaluate the risk of corrosion, it is essential to assess the interaction between environmental conditions, material properties, material combinations and design characteristics.

To understand this interaction, you would need to consider the following influencing factors to atmospheric corrosion:

- **Humidity:** Is a requirement for all atmospheric corrosion reactions**.**
- **Temperature:** The higher the temperatures, the higher rate of corrosive attack.
- **Salt:** Salt-laden air near the sea coast and the salt used for de-icing in winter accelerate corrosion.
- **Industrial pollution:** The high content of sulphur dioxide accelerates corrosive reactions.
- **Bimetallic corrosion:** Is caused by the contact of dissimilar metals (where one metal is less noble than the other).

Corrosion protection

Corrosion protection is the principle measure to mitigate these risks.

Active corrosion protection comprises the measures that directly influence the corrosion reaction, e.g. galvanic separation, resistant materials, or cathodic protection.

Passive Corrosion Protection prevents or at least decelerates corrosion through the isolation of the metal material from the corrosive agent by the application of metallic or non-metallic protective layers of coating.

For fastening and installation systems, such as anchors, screws or channel supports, the use of resistant material or a protective coating is considered to be the safest and most economical corrosion protection method.

This chapter presents a general guideline for selecting a suitable corrosion protection method for fastening systems in commonly accepted applications for given environmental conditions.

Special applications demand special attention to the corrosion protection of the metallic components. This could be for example the conditions prevailing in road tunnels, buildings with indoor swimming pools, or in chemical plants. For such specific applications, it is advisable to consult a specialist. Your local, qualified Hilti engineers will be pleased to provide you with technical support on your application.

Zinc-coated carbon steel

Zinc coated steel typically corrodes uniformly. Steel corrosion starts when the zinc protection is mostly consumed.

On duplex-coated products the zinc is further protected by an organic or inorganic coating.

Stainless steel

Stainless steel has the ability to form very thin but dense oxide layers to protect the surface against corrosion. However, in highly corrosive environments, stainless steel may suffer from pitting corrosion, which is a localised attack that significantly decreases the lifetime of stainless steel.

Selection of corrosion protection for anchors

Environmental Conditions	Anchors / Fastened part	HSA HUS HST HIT-V	HUS-HF	HSA-F HIT-V-F	HSA-R2	HUS-HR HSA-R HST-R HIT-V-R HIT-Z-R	HST-HCR
	Coating/Material	Electro galvanize	Duplex coated carbon steel	HDG/sherardized 45-50 µm	A2 AISI 304	A4 AISI 316	HCR, e.g. 1.4529
Dry indoor	Steel (zinc-coated, painted), aluminum, stainless steel	■	■	■	■	■	■
Indoor with temporary condensation	Steel (zinc-coated, painted), aluminium	-	■	■	■	■	■
	Stainless steel		-	-			
Outdoor with low pollution	Steel (zinc-coated, painted), aluminium	-	□ *	□ *	■ *	■	■
	Stainless steel		-	-			
Outdoor with moderate concentration of pollutants	Steel (zinc-coated, painted), aluminium	-	□ *	□ *	■ *	■	■
	Stainless steel		-	-			
Coastal areas	Steel (zinc-coated, painted), aluminum, stainless steel	-	-	-	-	■	■
Outdoor, areas with heavy industrial pollution	Steel (zinc-coated, painted), aluminum, stainless steel	-	-	-	-	■	■
Close proximity to roads treated with de-icing salts	Steel (zinc-coated, painted), aluminum, stainless steel	-	-	-	-	■	■
Special applications	-	Consult experts					■

■ = expected lifetime of anchors made from this material is typically satisfactory in the specified environment based on the typically expected lifetime of a building. The assumed service life in ETA approvals for powder-actuated and screw fasteners is 25 years, and for concrete anchors it is 50 years.

□ = a decrease in the expected lifetime of non-stainless fasteners in these atmospheres must be taken into account (≤ 25 years). Higher expected lifetime needs a specific assessment.

- = fasteners made from this material are not suitable in the specified environment. Exceptions need a specific assessment.

* From a technical point of view, HDG/duplex coatings and A2/304 material are suitable for outdoor environments with certain lifetime and application restrictions. This is based on longterm experience with these materials as reflected e.g. in the corrosion rates for Zn given in the ISO 9224:2012 (corrosivity categories, C-classes), the selection table for stainless steel grades given in the national technical approval issued by the DIBt Z.30.3-6 (April 2009) or the ICC-ES evaluation reports for our KB-TZ anchors for North America (e.g. ESR-1917, May 2013). The use of those materials in outdoor environments however is currently not covered by the European Technical Approval (ETA) of anchors, where it is stated that anchors made of galvanized carbon steel or stainless steel grade A2 may only be used in structures subject to dry indoor conditions, based on an assumed working life of the anchor of 50 years.

Environment categories

Applications can be classified into various environmental categories, by taking the following factors into account:

Indoor applications	
	**Dry indoor environments**
	(Heated or air-conditioning areas) without condensation, e.g. office buildings, schools.
	**Indoor environments with temporary condensation**
	(Unheated areas without pollutant) e.g. storage sheds

Outdoor applications	
	**Outdoor, rural or urban environment with low population**
	Large distance (> 10 km) from the sea
	**Outdoor, rural or urban environment with moderate concentration of pollutants and/or salt from sea water**
	Distance from the sea 1-10 km
	**Coastal areas**
	Distance from sea <1 km
	**Outdoor areas with heavy industrial pollution**
	Close to plants < 1 km (e.g. petrochemical, coal industry)
	**Close proximity to roadways threated with de-icing salts**
	Distance to roadways < 10 m

Outdoor applications	
 	**Special applications**
	Areas with special corrosive conditions, e.g. road tunnels with de-icing salt, indoor swimming pools, special applications in the chemical industry (exceptions possible).

Important notes

The ultimate decision on the required corrosion protection must be made by the customer. Hilti accepts no responsibility regarding the suitability of a product for a specific application, even if informed of the application conditions.

The tables are based on an average service life for typical applications.

For metallic coatings, e.g. zinc layer systems, the end of lifetime is the point at which red rust is visible over a large fraction of the product and widespread structural deterioration can occur – the initial onset of rust may occur sooner.
National or international codes, standards or regulations, customer and/or industry specific guidelines must be independently considered and evaluated.
These guidelines apply to atmospheric corrosion only. Special types of corrosion, such as crevice corrosion or hydrogen assisted cracking must be independently evaluated.
The tables published in this brochure describe only a general guideline for commonly accepted applications in typical atmospheric environments.
Suitability for a specific application can be significantly affected by localised conditions, including but not limited to:

Elevated temperatures and humidity; High levels of airborne pollutants; Direct contact with corrosive products, such as found in some types of chemically-treated wood, waste water, concrete additives, cleaning agents, etc. ;Direct contact to soil, stagnant water; Electrical current; Contact with dissimilar metals; Confined areas, e.g. crevices; Physical damage or wear; Extreme corrosion due to combined effects of different influencing factors; Enrichment of pollutants on the product

Typical examples of applications

Application	General conditions		Material
Initial/carcass construction			
Temporary fastening, maximum up to one year: Forming, site fixtures, scaffolding	Outdoor and indoor applications		Electrogalvanised
Structural fastening: Brackets, columns, beams	Dry indoor environments without condensation		Electrogalvanised
	Damp inside rooms with occasional condensation due to high humidity and temperature fluctuations		Hot-dipped galvanised / sherardized min. 45 microns, A2 (304) and A4 (316) steel
	Outdoor, rural or urban environment with low pollution. Large distance (>10km) from the sea.		Hot-dipped galvanised / sherardized min. 45 microns, A2 (304) and A4 (316) steel
	1-10km / 0-1km: Frequent and long-lasting condensation (greenhouses), open inside rooms or open halls/sheeds Or Outdoor, rural or urban environment with low pollution Or Coastal areas and areas with heavy industrial pollution		A4 (316) steel, possibly hot-dipped galvanised (depends on time of use)
Interior finishing			
Drywalls, suspended ceilings, windows, doors, railings / fences, elevators, fire escapes	Dry indoor environments without condensation		Electrogalvanised
Facades / roofing			
Profiled metal sheets, curtain wall cladding, insulation fastenings, facade support framing	Outdoor, rural or urban atmosphere with low pollution	Indoor	Electrogalvanised
		Outside application	Hot-dipped galvanised / sherardized min. 45 microns, A2 (304) and A4 (316) steel
	1-10km: Outdoor, rural or urban environment with moderate concentration of pollutants	Indoor	Electrogalvanised
		Outside application	Hot-dipped galvanised / sherardized min. 45 microns, A2 (304) and A4 (316) steel
	0-1km: *Outdoor, areas with heavy industrial pollutionand (e.g. petrochemical and coal industy) or coastal areas*	Indoor	Electrogalvanised
		Outside application	A4 (316) steel, Hilti HCR if chlorides and industrial pollution are combined,

Application	General conditions		Material
Installations			
Conduit installation, cable runs, air ducts *Electrical systems:* Runs, lighting, aerials *Industrial equipment:* Crane rails, barriers, conveyors, machine fastening		Dry indoor environments without condensation	Electrogalvanised
		Damp inside rooms with occasional condensation due to high humidity and temperature fluctuations	Hot-dipped galvanised / sherardized min. 45 microns, A2 (304) and A4 (316) steel
		Outdoor, rural or urban environment with low pollution. Large distance (>10km) from the sea.	Hot-dipped galvanised / sherardized min. 45 microns, A2 (304) and A4 (316) steel
	1-10km 0-1km	Frequent and long-lasting condensation (greenhouses), open inside rooms or open halls/sheeds Or Outdoor, rural or urban environment with low pollution Or Coastal areas and areas with heavy industrial pollution	A4 (316) steel, possibly hot-dipped galvanised (depends on time of use)
Dock/harbour / port facilities / off-shore rigs			
Fastenings to quaysides, dock / harbour	0-1km	Secondary relevance for safety, temporary fastenings	Electrogalvanised
		On the platform / rig	A4 (316) steels
		High humidity & temperature,, chlorides, often a superimposed "industrial atmosphere" or changes of oil / sea water, no whasing off	Hilti-HCR steel
Industry / chemical industry			
Conduit installation, cable runs, connecting structures, lighting		Dry indoor environments without condensation	Electrogalvanised
		Corrosive inside rooms, e.g. fastenings in laboratories, galvanising / plating plants etc., very corrosive vapours	A4 (316) steel, Hilti-HCR
		Outside applications, very heavy exposure to SO_2 and additional corrosive substances	A4 (316) steel, Hilti-HCR
Sewage / waste water treatment			
Conduit installation, cable runs, connecting structures etc		In the atmosphere, high humidity, sewage / digester gases etc.	A4 (316) steel, hot-dipped galvanised / sherardized min. 45 microns
	0-1km	Underwater applications, municipal sewage / waste water, industrial waste water	A4 (316) steel or Hilti-HCR depending on the water composition

Application	General conditions		Material
Tunnel construction - (Check Hilti tunnel brochure)			
Tunnel foils / sheeting, reinforcing mesh, traffic signs, lighting, tunnel wall cladding / lining, air ducts, ceiling suspensions, etc.		Secondary relevance for safety	A4 (316) steel
		Highly relevant to safety	Hilti-HCR steel
Road and bridge construction			
Conduit installation, cable runs, traffic signs, noise-insulating walls, crash barriers / guard rails, connecting structures		Directly weathered (chlorides are regularly washed off)	A4 (316) steel
		Frequently heavy exposure to deicing salt, no washing off, highly relevant to safety	Hilti HCR steel
Multi-storey car parks			
Fastening of, for example, guard rails, handrails, balustrades		Large amounts of chlorides (deicing salt) carried in by vehicles, many wet and dry cycles	A4 (316) steel, Hilti-HCR
Indoor swimming pools			
Fastening of, for example, service ladders, handrails, suspended ceilings		Fastenings relevant to safety	Hilti-HCR steel
Sports grounds / facilities / stadiums			
Fastening of, for example, seats, handrails, fences		Outdoor, rural or urban atmosphere with low pollution	Hot-dipped galvanised / sherardized min. 45 microns, A2 (304) and A4 (316) steel
		Outdoor, rural or urban environment with low pollution	Hot-dipped galvanised / sherardized min. 45 microns, A2 (304) and A4 (316) steel
		Coastal areas, inaccessible fastenings	A4 (316) steel

The following table shows the suitability of the respective metal couple. It also shows which two metals in contact are permissible in field practice and which should rather be avoided.

	Fastener (small area)			
Fastened part (Large area)	Electrogalvanised	Duplex coated carbon steel	Hot-dipped galvanised	Stainless steel
Electrogalvanised	□	□	□	□
Hot-dipped galvanised	□	□	□	□
Aluminium	■	▒	▒	□
Structural or cast steel	■	■	■	□
Stainless steel (CrNi or CrNiMo)	■	■	■	□
Tin	■	■	■	□
Copper	■	■	■	□
Brass	■	■	■	□

□ Slightly or no corrosion of fastener

▒ Moderate corrosion of fastener, technically acceptable in many cases

■ Heavy corrosion of fastener

Hilti SAFEset

SAFEset system

Hilti Innovation

Cleaning the holes after drilling is seen by contractors around the world as a tedious and time-consuming part of the chemical anchor installation process. It requires the use of inconvenient tools and equipment such as steel brushes, compressed air or manual pumps. Proper borehole cleaning is essential for reliable anchor performance; however, this step in the installation process has long been a major concern for chemical anchor users everywhere.

Contractors and engineers who design anchor points and post-installed rebar can now have greater peace of mind regarding the installation quality by specifying Hilti **SAFEset** systems. The load performance on the jobsite will be as robust as the level it has been designed for.

Hilti **SAFEset** systems are a combination of anchor system components that significantly increase the anchor's robustness and dramatically reduce potential user errors during the installation process.

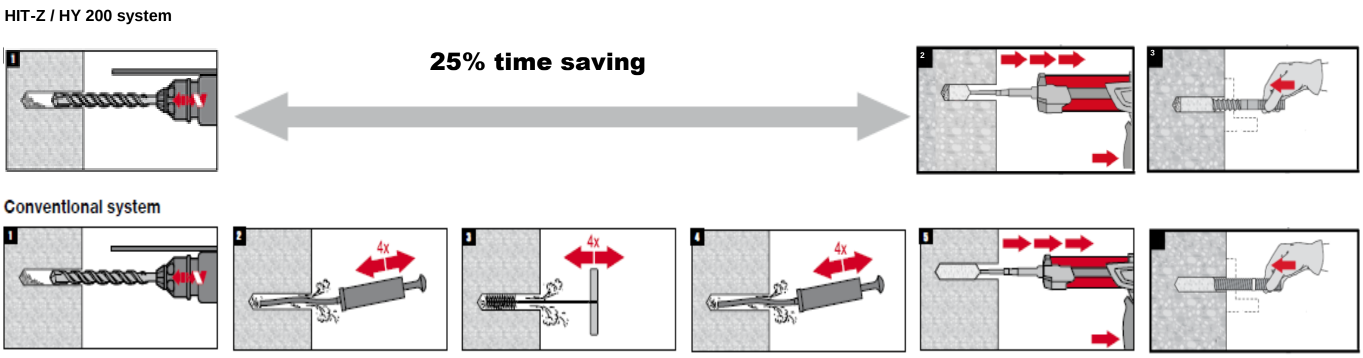
The new system eliminates the need for traditional borehole cleaning and makes dustless working possible for key applications. The Hilti **SAFEset** systems are supported with an ETA approval.

This unique approach to chemical anchor installation greatly increases customer productivity by reducing the time and labor costs associated with the traditional method.

Anchoring solutions:

Hilti HY 200 + HIT-Z

Drilling and installing the HIT-Z rod without borehole cleaning



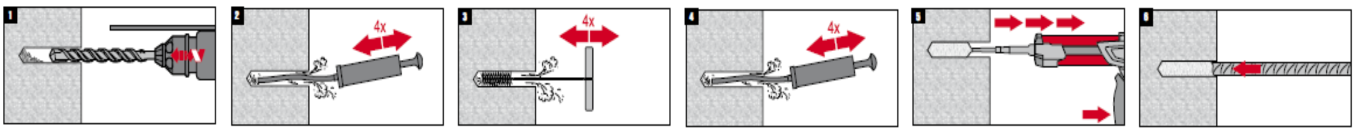
Rebar solutions:

Hilti HY 200 + TE CD-YD
Hilti CT 1 + TE CD-YD
Hilti RE 500 + TE CD-YD

Drilling and borehole cleaning in one step

TE CD-YD / HY 200 system

Conventional system

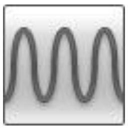


Mechanical anchoring systems

Heavy duty anchors
Medium duty anchors
Light duty anchors
Insulation fasteners

HSL-3 Heavy duty anchor, carbon steel

Anchor version		Benefits
	HSL-3 Bolt version	- suitable for non-cracked and cracked concrete C 20/25 to C 50/60 - high loading capacity - force-controlled expansion - reliable pull-down of the part fastened - no rotation in hole when tightening bolt
	HSL-3-G Threaded rod version	
	HSL-3-B Safety cap version	
	HSL-3-SH Hexagonal socked head screws	
	HSL-3-SK Countersunk version	

								
Concrete	Tensile zone	Fire resistance	Fatigue	Shock	Seismic	European Technical Approval	CE conformity	PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	CSTB, Paris	ETA-02/0042 / 2013-01-10
ICC-ES report incl. seismic	ICC evaluation service	ESR 1545 / 2014-02-01
Shockproof fastenings in civil defence installations	Federal Office for Cicil Protection, Bern	BZS D 08-601 / 2008-06-30
Fire test report	IBMB, Braunschweig	UB 3041/1663-CM / 2004-03-22
Assessment report (fire)	warringtonfire	WF 327804/A / 2013-07-10

a) All data given in this section according ETA-02/0042, issue 2013-01-10.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete as specified in the table
- *Steel* failure
- Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

Mean ultimate resistance

		Non-cracked concrete						Cracked concrete					
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Tensile $N_{Ru,m}$	[kN]	31,1	39,2	47,9	66,9	93,5	122,9	15,9	21,2	34,2	47,8	66,8	87,8
Shear $V_{Ru,m}$													
HSL-3, HSL-3-B, HSL-3-SK a), HSL-3-SH a)	[kN]	*43,0*	*68,0*	95,8	133,8	187,0	*245,3*	40,0	56,0	68,4	95,6	133,6	175,6
HSL-3-G b)	[kN]	*36,1*	*48,1*	*75,1*	*118,5*	187,0	-	*36,1*	*48,1*	68,4	95,6	133,6	-

Characteristic resistance

		Non-cracked concrete						Cracked concrete					
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Tensile N_{Rk}	[kN]	23,4	29,5	36,1	50,4	70,4	92,6	12,0	16,0	25,8	36,0	50,3	66,1
Shear V_{Rk}													
HSL-3, HSL-3-B, HSL-3-SK a), HSL-3-SH a)	[kN]	*31,1*	*49,2*	*71,7*	100,8	140,9	*177,4*	30,1	42,2	51,5	72,0	100,6	132,3
HSL-3-G b)	[kN]	*26,1*	*34,8*	*54,3*	*85,7*	140,9	-	*26,1*	*34,8*	51,5	72,0	100,6	-

Design resistance

		Non-cracked concrete						Cracked concrete					
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Tensile N_{Rd}	[kN]	15,6	19,7	24,0	33,6	47,0	61,7	6,7	10,7	17,2	24,0	33,5	44,1
Shear V_{Rd}													
HSL-3, HSL-3-B, HSL-3-SK a), HSL-3-SH a)	[kN]	24,9	39,4	48,1	67,2	93,9	123,5	20,1	28,1	34,3	48,0	67,1	88,2
HSL-3-G b)	[kN]	20,9	27,8	43,4	67,2	93,9	-	20,1	27,8	34,3	48,0	67,1	-

Recommended loads

		Non-cracked concrete						Cracked concrete					
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Tensile N_{rec} c)	[kN]	11,2	14,1	17,2	24,0	33,5	44,1	4,8	7,6	12,3	17,1	24,0	31,5
Shear V_{rec} c)													
HSL-3, HSL-3-B, HSL-3-SK a), HSL-3-SH a)	[kN]	17,8	28,1	34,3	48,0	67,1	88,2	14,3	20,1	24,5	34,3	47,9	63,0
HSL-3-G b)	[kN]	14,9	19,9	31,0	48,0	67,1	-	14,3	19,9	24,5	34,3	47,9	-

a) HSL-3-SK and HSL-3-SH is only available up to M12
b) HSL-3-G is only available up to M20
c) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

Mechanical properties of HSL-3, HSL-3-G, HSL-3-B, HSL-3-SH, HSL-3-SK

Anchor size		M8	M10	M12	M16	M20	M24
Nominal tensile strength f_{uk}	[N/mm²]	800	800	800	800	830	830
Yield strength f_{yk}	[N/mm²]	640	640	640	640	640	640
Stressed cross-section A_s	[mm²]	36,6	58,0	84,3	157	245	353
Moment of resistance W	[mm³]	31,3	62,5	109,4	277,1	540,6	935,4
Design bending resistance without sleeve $M_{Rd,s}$	[Nm]	24,0	48,0	84,0	212,8	415,2	718,4

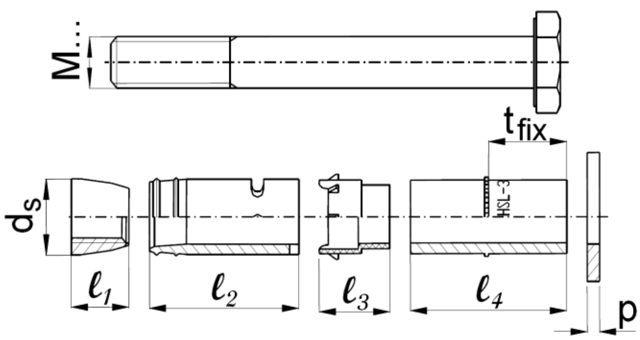
Material quality

Part	Material
Bolt, threaded rod	steel strength 8.8, galvanised to min. 5 µm

Anchor dimensions

Dimensions of HSL-3, HSL-3-G, HSL-3-B, HSL-3-SH, HSL-3-SK

Anchor version	Thread size	t_{fix} [mm]		d_s [mm]	ℓ_1 [mm]	ℓ_2 [mm]	ℓ_3 [mm]	ℓ_4 [mm]		p [mm]
		min	max					min	max	
HSL-3 HSL-3-G	M8	5	200	11,9	12	32	15,2	19	214	2
	M10	5	200	14,8	14	36	17,2	23	218	3
HSL-3 HSL-3-G HSL-3-B	M12	5	200	17,6	17	40	20	28	223	3
	M16	10	200	23,6	20	54,4	24,4	34,5	224,5	4
	M20	10	200	27,6	20	57	31,5	51	241	4
HSL-3 HSL-3-B	M24	10	200	31,6	22	65	39	57	247	4
HSL-3-SH	M8	5		11,9	12	32	15,2	19		2
	M10	20		14,8	14	36	17,2	38		3
	M12	25		17,6	17	40	20	48		3
HSL-3-SK	M8	10	20	11,9	12	32	15,2	18,2	28,2	2
	M10	20		14,8	14	36	17,2	32,2		3
	M12	25		17,6	17	40	20	40		3

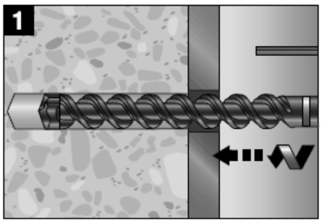


Setting

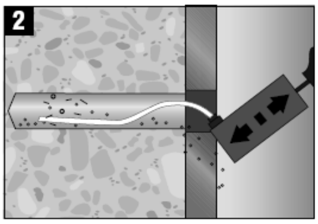
installation equipment

Anchor size	M8	M10	M12	M16	M20	M24
Rotary hammer	TE2 – TE16			TE40 – TE70		
Other tools	hammer, torque wrench, blow out pump					

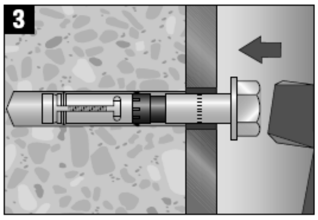
Setting instruction



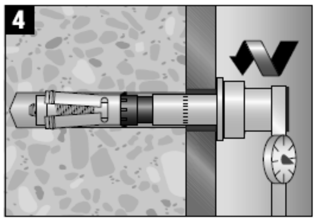
Drill hole.



Blow out dust and fragments.



Install anchor.

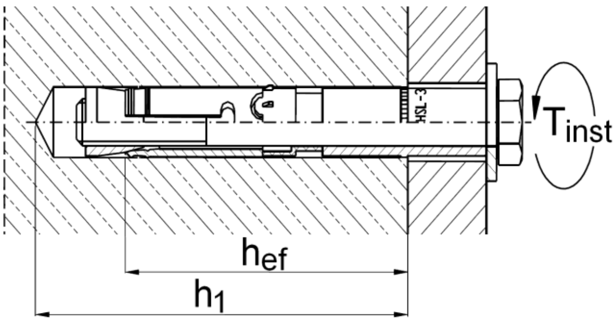


Apply tightening torque
(for HSL-3-B: no torque wrench is needed)

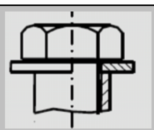
For detailed information on installation see instruction for use given with the package of the product.

For technical data for anchors in diamond drilled holes please contact the Hilti Technical advisory service.

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}



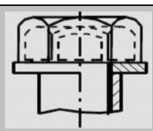
Setting details HSL-3

Anchor version HSL-3 			M8	M10	M12	M16	M20	M24
Nominal diameter of drill bit	d_o	[mm]	12	15	18	24	28	32
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	12,5	15,5	18,5	24,55	28,55	32,7
Depth of drill hole	$h_1 \geq$	[mm]	80	90	105	125	155	180
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	14	17	20	26	31	35
Effective anchorage depth	h_{ef}	[mm]	60	70	80	100	125	150
Torque moment	T_{inst}	[Nm]	25	50	80	120	200	250
Width across	SW	[mm]	13	17	19	24	30	36

Setting details HSL-3-G

Anchor version HSL-3-G 			**M8**	**M10**	**M12**	**M16**	**M20**
Nominal diameter of drill bit	d_o	[mm]	12	15	18	24	28
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	12,5	15,5	18,5	24,55	28,55
Depth of drill hole	$h_1 \geq$	[mm]	80	90	105	125	155
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	14	17	20	26	31
Effective anchorage depth	h_{ef}	[mm]	60	70	80	100	125
Torque moment	T_{inst}	[Nm]	20	35	60	80	160
Width across	SW	[mm]	13	17	19	24	30

Setting details HSL-3-B

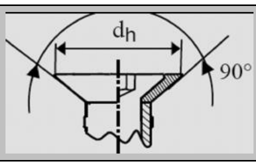
Anchor version HSL-3-B 			**M12**	**M16**	**M20**	**M24**
Nominal diameter of drill bit	d_o	[mm]	18	24	28	32
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	18,5	24,55	28,55	32,7
Depth of drill hole	$h_1 \geq$	[mm]	105	125	155	180
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	20	26	31	35
Effective anchorage depth	h_{ef}	[mm]	80	100	125	150
Width across	SW	[mm]	24	30	36	41

The torque moment is controlled by the safety cap

Setting details HSL-3-SH

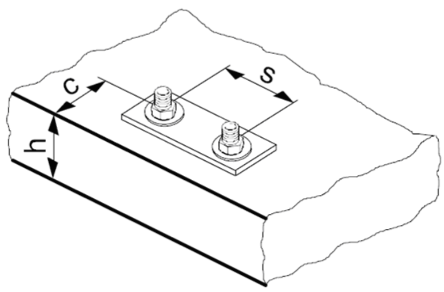
Anchor version HSL-3-SH 			**M8**	**M10**	**M12**
Nominal diameter of drill bit	d_o	[mm]	12	15	18
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	12,5	15,5	18,5
Depth of drill hole	$h_1 \geq$	[mm]	85	95	110
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	14	17	20
Effective anchorage depth	h_{ef}	[mm]	60	70	80
Torque moment	T_{inst}	[Nm]	25	35	60
Width across	SW	[mm]	6	8	10

Setting details HSL-3-SK

Anchor version HSL-3-SK			**M8**	**M10**	**M12**
Nominal diameter of drill bit	d_o	[mm]	12	15	18
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	12,5	15,5	18,5
Depth of drill hole	$h_1 \geq$	[mm]	80	90	105
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	14	17	20
Diameter of countersunk hole in the fixture	$d_h =$	[mm]	22,5	25,5	32,9
Effective anchorage depth	h_{ef}	[mm]	60	70	80
Torque moment	T_{inst}	[Nm]	25	50	80
Width across	SW	[mm]	5	6	8

Setting parameters

Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Minimum base material thickness	h_{min}	[mm]	120	140	160	200	250	300
Minimum spacing	s_{min}	[mm]	60	70	80	100	125	150
	for $c \geq$	[mm]	100	100	160	240	300	300
Minimum edge distance	c_{min}	[mm]	60	70	80	100	150	150
	for $s \geq$	[mm]	100	160	240	240	300	300
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	230	270	300	380	480	570
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	115	135	150	190	240	285
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	180	210	240	300	375	450
Critical edge distance for concrete cone failure	$c_{cr,N}$	[mm]	90	105	120	150	187,5	225



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

Critical spacing and critical edge distance for splitting failure apply only for non-cracked concrete. For cracked concrete only the critical spacing and critical edge distance for concrete cone failure are decisive.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according data given in ETA-02/0042, issue 2013-01-10.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

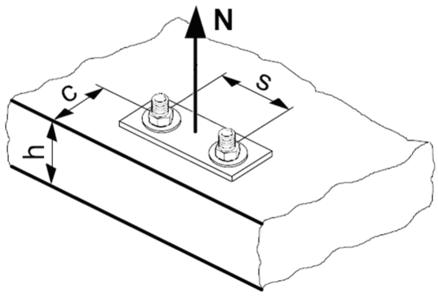
For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):

$$N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size		M8	M10	M12	M16	M20	M24
$N_{Rd,s}$	[kN]	19,5	30,9	44,9	83,7	130,7	188,3

Design pull-out resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$ (only M8, M10 in cracked concrete)

		Non-cracked concrete						Cracked concrete					
Anchor size		M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
$N^0_{Rd,p}$	[kN]	No pull-out failure						6,7	10,7	No pull-out failure			

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

		Non-cracked concrete						Cracked concrete					
Anchor size		M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
$N^0_{Rd,c}$	[kN]	15,6	19,7	24,0	33,6	47,0	61,7	11,2	14,1	17,2	24,0	33,5	44,1

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
f_B = $(f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N}$ = $0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp}$ = $0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N}$ = $0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp}$ = $0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N}$ = $0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp}$ = $0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of base material thickness

h/h_{ef}	2,0	2,2	2,4	2,6	2,8	3,0	3,2	3,4	3,6	≥ 3,68
$f_{h,sp}$ = $[h/(2 \cdot h_{ef})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

Influence of reinforcement

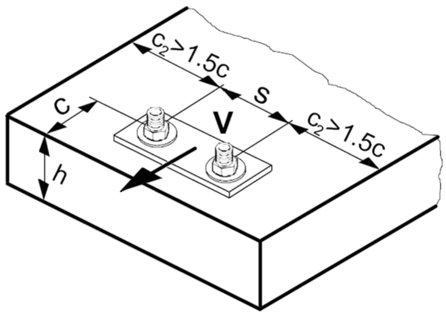
Anchor size	M8	M10	M12	M16	M20	M24
$f_{re,N}$ = $0,5 + h_{ef}/200mm \leq 1$	0,8 a)	0,85 a)	0,9 a)	1	1	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24
$V_{Rd,s}$	HSL-3, HSL-3-B, HSL-3-SK[a], HSL-3-SH[a]	[kN]	24,9	39,4	57,4	80,9	113,5	141,9
	HSL-3-G	[kN]	20,9	27,8	43,4	68,6	113,5	-

a) HSL-3-SK and HSL-3-SH is only available up to M12

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$ [a)]

Anchor size	M8	M10	M12	M16	M20	M24
k	1,8	2,0				

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance [a)] $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

	Non-cracked concrete						Cracked concrete					
Anchor size	M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
$V^0_{Rd,c}$ [kN]	11,7	16,9	22,9	36,8	47,7	59,7	8,3	12,0	16,2	26,1	33,8	42,3

a) For anchor groups only the anchors close to the edge must be considered.

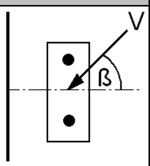
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \frac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20	M24
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,75	0,67	0,61	0,55	0,62	0,67

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

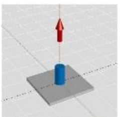
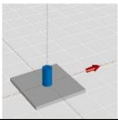
Precalculated values

Design resistance calculated according ETAG 001, Annex C and data given in ETA-02/0042, issue 2013-01-10. All data applies to concrete C 20/25 – $f_{ck,cube}$ =25 N/mm². HSL-3-SK and HSL-3-SH is only available up to M12.

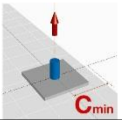
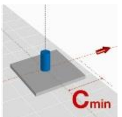
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Design resistance

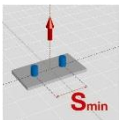
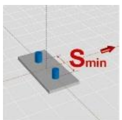
Single anchor, no edge effects

			Non-cracked concrete						Cracked concrete					
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Min. base material thickness h_{min} [mm]			120	140	160	200	250	300	120	140	160	200	250	300
	**Tensile N_{Rd}**													
	HSL-3, HSL-3-B, HSL-3-SK, HSL-3-SH HSL-3-G	[kN]	15,6	19,7	24,0	33,6	47,0	61,7	6,7	10,7	17,2	24,0	33,5	44,1
	**Shear V_{Rd}, without lever arm**													
	HSL-3, HSL-3-B, HSL-3-SK, HSL-3-SH	[kN]	24,9	39,4	48,1	67,2	93,9	123,5	20,1	28,1	34,3	48,0	67,1	88,2
	HSL-3-G	[kN]	20,9	27,8	43,4	67,2	93,9	-	20,1	27,8	34,3	48,0	67,1	-

Single anchor, min. edge distance ($c = c_{min}$)

			Non-cracked concrete						Cracked concrete					
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Min. base material thickness h_{min} [mm]			120	140	160	200	250	300	120	140	160	200	250	300
Min. edge distance c_{min} [mm]			60	70	80	100	125	150	60	70	80	100	125	150
	**Tensile N_{Rd}**													
	HSL-3, HSL-3-B, HSL-3-SK, HSL-3-SH HSL-3-G	[kN]	10,2	12,8	15,9	22,0	33,9	40,4	6,7	10,5	12,9	18,0	28,4	33,1
	**Shear V_{Rd}, without lever arm**													
	HSL-3, HSL-3-B, HSL-3-SK, HSL-3-SH HSL-3-G	[kN]	6,4	8,4	10,6	15,5	28,1	30,0	4,5	5,9	7,5	11,0	19,9	21,3

Double anchor, no edge effects, min. spacing ($s = s_{min}$), (load values are valid for one anchor)

			Non-cracked concrete						Cracked concrete					
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Min. base material thickness h_{min} [mm]			120	140	160	200	250	300	120	140	160	200	250	300
Min. spacing s_{min} [mm]			60	70	80	100	125	150	60	70	80	100	125	150
	**Tensile N_{Rd}**													
	HSL-3, HSL-3-B, HSL-3-SK, HSL-3-SH HSL-3-G	[kN]	9,8	12,4	15,2	21,2	29,6	39,0	6,7	9,4	11,4	16,0	22,4	29,4
	**Shear V_{Rd}, without lever arm**													
	HSL-3, HSL-3-B, HSL-3-SK, HSL-3-SH HSL-3-G	[kN]	18,7	26,2	32,1	44,8	62,6	82,3	13,4	18,7	22,9	32,0	44,7	58,8

HSL-GR Heavy duty anchor, stainless steel

Anchor version		Benefits
	HSL-GR	- suitable for non-cracked C 20/25 to C 50/60 - high loading capacity - force-controlled expansion - reliable pull-down of the part fastened - no rotation in hole when tightening bolt

Concrete

PROFIS Anchor design software

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete as specified in the table
- *Steel* failure
- Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

Mean ultimate resistance

		Hilti technical data for non-cracked concrete				
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Tensile $N_{Ru,m}$	[kN]	*26,9*	39,2	47,9	66,9	93,5
Shear $V_{Ru,m}$	[kN]	*26,3*	*42,0*	*57,8*	*84,0*	*115,5*

Characteristic resistance

		Hilti technical data for non-cracked concrete				
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Tensile N_{Rk}	[kN]	23,4	29,5	36,1	50,4	70,4
Shear V_{Rk}	[kN]	*25,0*	*40,0*	*55,0*	*80,0*	*110,0*

Design resistance

		Hilti technical data for non-cracked concrete				
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Tensile N_{Rd}	[kN]	13,0	16,4	20,1	28,1	39,2
Shear V_{Rd}	[kN]	16,0	25,6	35,3	51,3	70,5

Recommended loads [a)]

		Hilti technical data for non-cracked concrete				
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Tensile N_{rec}	[kN]	9,3	11,7	14,3	20,0	28,0
Shear V_{rec}	[kN]	11,4	18,3	25,2	36,6	50,4

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

Mechanical properties of HSL-GR

Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Nominal tensile strength f_{uk}	[N/mm²]	700	700	700	700	700
Yield strength f_{yk}	[N/mm²]	450	450	450	450	450
Stressed cross-section A_s	[mm²]	36,6	58,0	84,3	157	245
Moment of resistance W	[mm³]	31,2	62,3	109,2	277,5	540,9
Design bending resistance without sleeve $M_{Rd,s}$	[Nm]	16,8	33,5	58,8	149,4	291,3

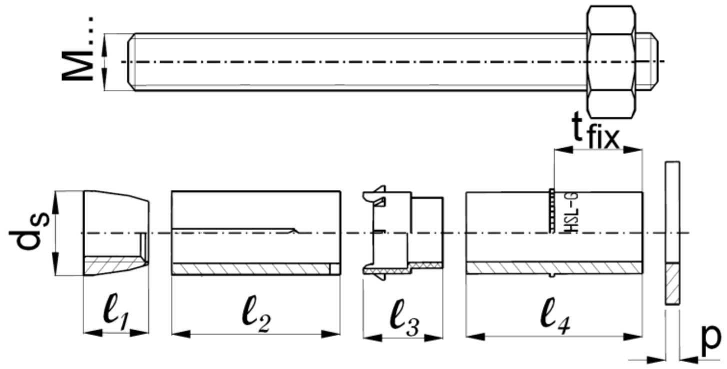
Material quality

Part	**Material**
Bolt, threaded rod	steel grade A4

Anchor dimensions

Dimensions of HSL-GR

Thread size	t_{fix} [mm]		d_s [mm]	ℓ_1 [mm]	ℓ_2 [mm]	ℓ_3 [mm]	ℓ_4 [mm]		p [mm]
	min	max					min	max	
M8	5	200	11,8	8,5	26	15,2	26	221	3
M10	5	200	14,8	10,8	30	17,2	29	224	4
M12	5	200	17,6	12	32	20	32	227	5
M16	10	200	23,6	18	46	24,4	43	233	5
M20	10	200	27,6	22	57	31,5	51	241	6

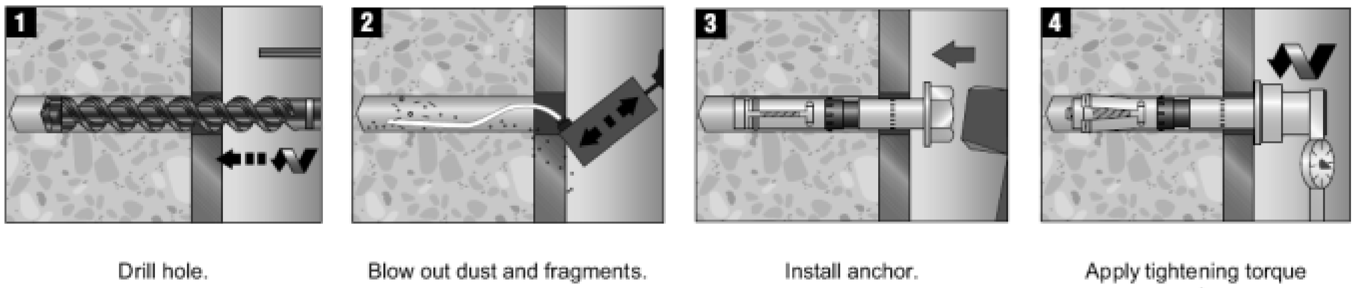


Setting

installation equipment

Anchor size	M8	M10	M12	M16	M20
Rotary hammer	TE2 – TE16			TE40 – TE70	
Other tools	hammer, torque wrench, blow out pump				

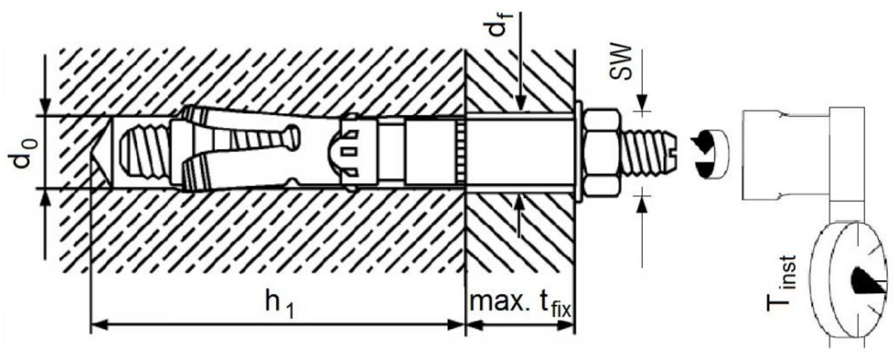
Setting instruction



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

For technical data for anchors in diamond drilled holes please contact the Hilti Technical advisory service.

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}

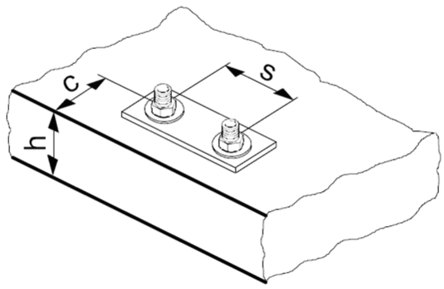


Setting details

Anchor size			M8	M10	M12	M16	M20
Nominal diameter of drill bit	d_o	[mm]	12	15	18	24	26
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	12,5	15,5	18,5	24,55	28,55
Depth of drill hole	$h_1 \geq$	[mm]	80	90	105	125	155
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	14	17	20	26	31
Effective anchorage depth	h_{ef}	[mm]	60	70	80	100	125
Torque moment	T_{inst}	[Nm]	25	50	80	120	200
Width across	SW	[mm]	13	17	19	24	30

Setting parameters

Anchor size			M8	M10	M12	M16	M20
Minimum base material thickness	h_{min}	[mm]	120	140	160	200	250
Minimum spacing	s_{min}	[mm]	100	160	240	240	300
Minimum edge distance	c_{min}	[mm]	60	70	80	100	150
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	270	300	330	380	480
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	135	150	165	190	240
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	180	210	240	300	375
Critical edge distance for concrete cone failure	$c_{cr,N}$	[mm]	90	105	120	150	187,5



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

Critical spacing and critical edge distance for splitting failure apply only for non-cracked concrete. For cracked concrete only the critical spacing and critical edge distance for concrete cone failure are decisive.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance

and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C.)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

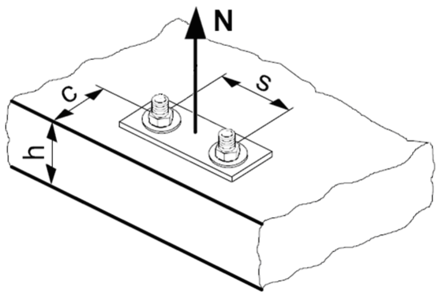
For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):

$$N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size		M8	M10	M12	M16	M20
$N_{Rd,s}$	[kN]	13,7	21,7	31,6	58,8	91,7

Design pull-out resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$

Anchor size		M8	M10	M12	M16	M20
$N^0_{Rd,p}$	[kN]	No pull-out failure				

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

Anchor size		M8	M10	M12	M16	M20
$N^0_{Rd,c}$	[kN]	13,0	16,4	20,1	28,1	39,2

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0{,}7 + 0{,}3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0{,}7 + 0{,}3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0{,}5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0{,}5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0{,}5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0{,}5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of base material thickness

h/h_{ef}	2,0	2,2	2,4	2,6	2,8	3,0	3,2	3,4	3,6	≥ 3,68
$f_{h,sp} = [h/(2 \cdot h_{ef})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

Influence of reinforcement

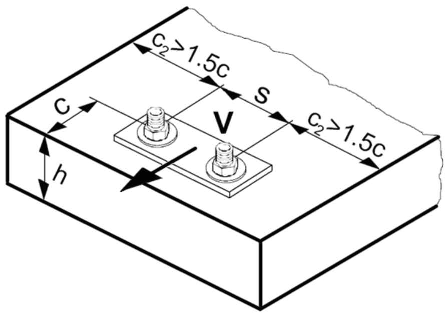
Anchor size	M8	M10	M12	M16	M20
$f_{re,N} = 0{,}5 + h_{ef}/200mm \leq 1$	0,8 a)	0,85 a)	0,9 a)	1	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size	M8	M10	M12	M16	M20
$V_{Rd,s}$ [kN]	16,0	25,6	35,3	51,3	70,5

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}{}^{a)}$

Anchor size	M8	M10	M12	M16	M20
k	1,8	2,0			

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance ${}^{a)}$ $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	M8	M10	M12	M16	M20
$V^0_{Rd,c}$ [kN]	11,4	16,5	22,4	36,2	46,9

a) For anchor groups only the anchors close to the edge must be considered.

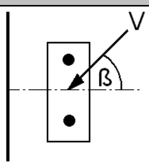
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \frac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2{,}5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1{,}5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a] for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,75	0,67	0,61	0,55	0,62

Influence of edge distance [a]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

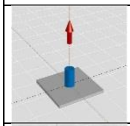
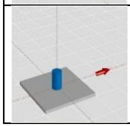
For combined tension and shear loading see section “Anchor Design”.

Precalculated values

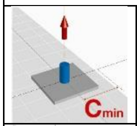
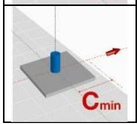
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Design resistance

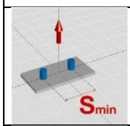
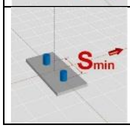
Single anchor, no edge effects

Anchor size			M8	M10	M12	M16	M20
Min. base material thickness h_{min} [mm]			120	140	160	200	250
	**Tensile N_{Rd}**						
	HSL-GR	[kN]	13,0	16,4	20,1	28,1	39,2
	**Shear V_{Rd}, without lever arm**						
	HSL-GR	[kN]	16,0	25,6	35,3	51,3	70,5

Single anchor, min. edge distance ($c = c_{min}$)

Anchor size			M8	M10	M12	M16	M20
Min. base material thickness h_{min} [mm]			120	140	160	200	250
Min. edge distance c_{min} [mm]			60	70	80	100	125
	**Tensile N_{Rd}**						
	HSL-GR	[kN]	7,8	10,1	12,6	18,4	28,3
	**Shear V_{Rd}, without lever arm**						
	HSL-GR	[kN]	6,4	8,4	10,6	15,5	28,1

Double anchor, no edge effects, min. spacing ($s = s_{min}$), (load values are valid for one anchor)

Anchor size			M8	M10	M12	M16	M20
Min. base material thickness h_{min} [mm]			120	140	160	200	250
Min. spacing s_{min} [mm]			100	160	240	240	300
	**Tensile N_{Rd}**						
	HSL-GR	[kN]	8,9	12,6	17,3	22,9	31,9
	**Shear V_{Rd}, without lever arm**						
	HSL-GR	[kN]	16,0	25,6	35,3	51,3	70,5

HDA Design anchor

Anchor version		Benefits
	HDA-P HDA-PR HDA-PF Anchor for pre-setting	- suitable for non-cracked and cracked concrete C 20/25 to C 50/60 - mechanical interlock (undercut) - low expansion force (thus small edge distance / spacing) - automatic undercutting (without special undercutting tool) - high loading capacity, performance of a headed stud - complete system (anchor, stop drill bit, setting tool, drill hammer) - setting mark on anchor for control (easy and safe) - completely removable - test reports: fire resistance, fatigue, shock, seismic
	HDA-T HDA-TR HDA-TF Anchor for through-fasting	

Concrete | Tensile zone | Performance of a headed stud | Small edge distance and spacing | Nuclear power plant approval | Fire resistance | Fatigue | Shock | Seismic

Corrosion resistance | European Technical Approval | CE conformity | PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	CSTB, Paris	ETA-99/0009 / 2013-03-25
ICC-ES report incl. seismic	ICC evaluation service	ESR 1546 / 2014-02-01
Shockproof fastenings in civil defence installations	Federal Office for Cicil Protection, Bern	BZS D 09-601/ 2009-10-21
Nuclear power plants	DIBt, Berlin	Z-21.1-1987 / 2014-07-22
Fatigue loading	DIBt, Berlin	Z-21.1-1693 / 2013-07-29
Fire test report	IBMB, Braunschweig	UB 3039/8151-CM / 2001-01-31
Assessment report (fire)	warringtonfire	WF 327804/A / 2013-07-10

a) All data for HDA-P(R) and HDA-T(R) given in this section according ETA-99/0009, issue 2013-03-25. Sherardized versions HDA-PF and HDA-TF anchors are not covered by the approvals.

Basic loading data (for a single anchor)

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete as specified in the table
- *Steel* failure
- Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

For details see Simplified design method

Mean ultimate resistance

		Non-cracked concrete				Cracked concrete			
Anchor size		**M10**	**M12**	**M16**	**M20 a)**	**M10**	**M12**	**M16**	**M20 a)**
Tensile $N_{Ru,m}$									
HDA-P(F), HDA-T(F) b)	[kN]	*48,7*	*70,9*	*133,3*	*203,2*	33,3	46,7	100	126,7
HDA-PR, HDA-TR	[kN]	*48,7*	*70,9*	*133,3*	*203,2*	33,3	46,7	100	126,7
Shear $V_{Ru,m}$									
HDA-P, HDA-PF b)	[kN]	*23,3*	*31,7*	*65,6*	*97,4*	*23,3*	*31,7*	*65,6*	*97,4*
HDA-PR	[kN]	*24,3*	*36,0*	*66,7*	-	*24,3*	*36,0*	*66,7*	-
HDA-T, HDA-TF b) c)	[kN]	*68,8*	*84,7*	*148,2*	*216,9*	*68,8*	*84,7*	*148,2*	*216,9*
HDA-TR c)	[kN]	*75,1*	*92,1*	*160,9*	-	*75,1*	*92,1*	*160,9*	-

a) HDA M20: only a galvanized 5µm version is available
b) HDA-PF and HDA-TF anchors are not covered by ETA-99/0009
c) Values are valid for minimum thickness of the base plate $t_{fix,min}$ without use of centering washer (see setting details)

Characteristic resistance

		Non-cracked concrete				Cracked concrete			
Anchor size		**M10**	**M12**	**M16**	**M20 a)**	**M10**	**M12**	**M16**	**M20 a)**
Tensile N_{Rk}									
HDA-P(F), HDA-T(F) b)	[kN]	*46*	*67*	*126*	*192*	25	35	75	95
HDA-PR, HDA-TR	[kN]	*46*	*67*	*126*	-	25	35	75	-

Non-cracked and cracked concrete

Anchor size		**M10**	**M12**	**M16**	**M20 a)**
Shear V_{Rk}					
HDA-P, HDA-PF b)	[kN]	*22*	*30*	*62*	*92*
HDA-PR		*23*	*34*	*63*	-

Anchor size		M10		M12			M16					M20 a)			
for t_{fix}	[mm]	10≤	15≤	10≤	15≤	20≤	15≤	20≤	25≤	30≤	35≤	20≤	25≤	40≤	55≤
	[mm]	<15	≤20	<15	<20	≤50	<20	<25	<30	<35	≤60	<25	<40	<55	≤100
HDA-T, HDA-TF b)	[kN]	*65 c)*	*65*	*80 c)*	*80*	*100*	*140 c)*	*140*	*155*	*170*	*190*	*205 c)*	*205*	*235*	*250*

Anchor size		M10		M12				M16				M20 a)
for t_{fix}	[mm]	10≤	15≤	10≤	15≤	20≤	30≤	20≤	25≤	30≤	35≤	-
	[mm]	<15	≤20	<15	<20	<30	≤50	<25	<30	<35	≤60	-
HDA-TR	[kN]	*71 c)*	*71*	*87 c)*	*87*	*94*	*109*	*152 c)*	*152*	*158*	*170*	-

a) HDA M20: only a galvanized 5µm version is available
b) HDA-PF and HDA-TF anchors are not covered by ETA-99/0009
c) With use of centering washer (t = 5 mm) only

Design resistance

		Non-cracked concrete				Cracked concrete			
Anchor size		**M10**	**M12**	**M16**	**M20 a)**	**M10**	**M12**	**M16**	**M20 a)**
Tensile N_{Rd}									
HDA-P(F), HDA-T(F) b)	[kN]	30,7	44,7	84,0	128,0	16,7	23,3	50,0	63,3
HDA-PR, HDA-TR	[kN]	28,8	41,9	78,8	-	16,7	23,3	50,0	-

		Non-cracked and cracked concrete			
Anchor size		**M10**	**M12**	**M16**	**M20 a)**
Shear V_{Rd}					
HDA-P, HDA-PF b)	[kN]	17,6	24,0	49,6	73,6
HDA-PR		17,3	25,6	47,4	-

		M10		M12			M16					M20 a)			
for t_{fix}	[mm]	10≤	15≤	10≤	15≤	20≤	15≤	20≤	25≤	30≤	35≤	20≤	25≤	40≤	55≤
	[mm]	<15	≤20	<15	<20	≤50	<20	<25	<30	<35	≤60	<25	<40	<55	≤100
HDA-T, HDA-TF b)	[kN]	43 c)	43	53 c)	53	67	93 c)	93	103	113	127	137 c)	137	157	167

		M10		M12				M16				M20 a)
for t_{fix}	[mm]	10≤	15≤	10≤	15≤	20≤	30≤	20≤	25≤	30≤	35≤	-
	[mm]	<15	≤20	<15	<20	<30	≤50	<25	<30	<35	≤60	-
HDA-TR	[kN]	53 c)	53	65 c)	65	71	82	114 c)	114	119	128	-

a) HDA M20: only a galvanized 5µm version is available
b) HDA-PF and HDA-TF anchors are not covered by ETA-99/0009
c) With use of centering washer (t = 5 mm) only

Recommended loads

		Non-cracked concrete				Cracked concrete			
Anchor size		**M10**	**M12**	**M16**	**M20 a)**	**M10**	**M12**	**M16**	**M20 a)**
Tensile N_{Rec} b)									
HDA-P(F), HDA-T(F) c)	[kN]	21,9	31,9	60,0	91,4	11,9	16,7	35,7	45,2
HDA-PR, HDA-TR	[kN]	20,5	29,9	56,3	-	11,9	16,7	35,7	-

		Non-cracked and cracked concrete			
Anchor size		**M10**	**M12**	**M16**	**M20 a)**
Shear V_{Rec} b)					
HDA-P, HDA-PF c)	[kN]	12,6	17,1	35,4	52,6
HDA-PR		12,3	18,2	33,8	-

		M10		M12			M16					M20 a)			
for t_{fix}	[mm]	10≤	15≤	10≤	15≤	20≤	15≤	20≤	25≤	30≤	35≤	20≤	25≤	40≤	55≤
	[mm]	<15	≤20	<15	<20	≤50	<20	<25	<30	<35	≤60	<25	<40	<55	≤100
HDA-T, HDA-TF c)	[kN]	31 d)	31	38 d)	38	48	67 d)	67	74	81	90	98 d)	98	112	119

		M10		M12				M16				M20 a)
for t_{fix}	[mm]	10≤	15≤	10≤	15≤	20≤	30≤	20≤	25≤	30≤	35≤	-
	[mm]	<15	≤20	<15	<20	<30	≤50	<25	<30	<35	≤60	-
HDA-TR	[kN]	38 d)	38	47 d)	47	50	59	82 d)	82	85	91	-

a) HDA M20: only a galvanized 5µm version is available
b) With overall partial safety factor for action γ_F = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.
c) HDA-PF and HDA-TF anchors are not covered by ETA-99/0009
d) With use of centering washer (t = 5 mm) only

Materials

Mechanical properties of HDA

Anchor size		HDA-P(F), HDA-T(F)				HDA-PR, HDA-TR		
		M10	M12	M16	M20 [a)]	M10	M12	M16
Anchor bolt								
Nominal tensile strength f_{uk}	[N/mm²]	800	800	800	800	800	800	800
Yield strength f_{yk}	[N/mm²]	640	640	640	640	600	600	600
Stressed cross-section A_s	[mm²]	58,0	84,3	157	245	58,0	84,3	157
Moment of resistance W_{el}	[mm³]	62,3	109,2	277,5	540,9	62,3	109,2	277,5
Characteristic bending resistance without sleeve $M^0_{Rk,s}$ [b)]	[Nm]	60	105	266	519	60	105	266
Anchor sleeve								
Nominal tensile strength f_{uk}	[N/mm²]	850	850	700	550	850	850	700
Yield strength f_{yk}	[N/mm²]	600	600	600	450	600	600	600

a) HDA M20: only a galvanized 5µm version is available

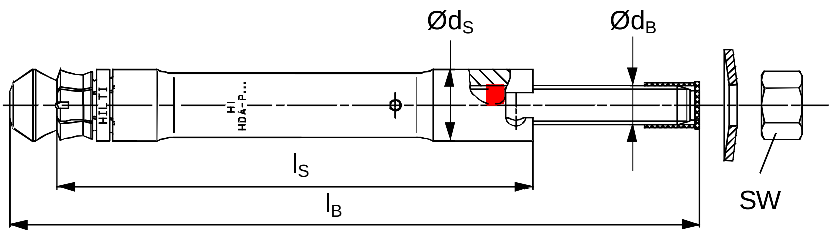
b) The recommended bending moment of the HDA anchor bolt may be calculated from $M_{rec} = M_{Rd,s} / \gamma_F = M_{Rk,s} / (\gamma_{Ms} \cdot \gamma_F) = = (1,2 \cdot W_{el} \cdot f_{uk}) / (\gamma_{Ms} \cdot \gamma_F)$, where the partial safety factor for bolts of strength 8.8 is γ_{MS} = 1,25, for A4-80 equal to 1,33 and the partial safety factor for action may be taken as γ_F = 1,4. In case of HDA-T/TR/TF the bending capacity of the sleeve is neglected, only the capacity of the bolt is taken into account.

Material quality

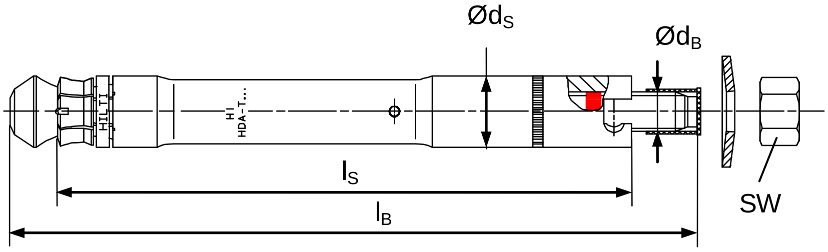
Part	Material
HDA-P / HDA-T (Carbon steel version)	
Sleeve:	Machined steel with brazed tungsten carbide tips, galvanised to min. 5 µm
Bolt M10 - M16:	Cold formed steel, strength 8.8, galvanised to min. 5 µm
Bolt M20:	Cone machined, rod strength 8.8, galvanised to min. 5 µm
HDA-PR / HDA-TR (Stainless steel version)	
Sleeve:	Machined stainless steel with brazed tungsten carbide tips
Bolt M10 - M16:	Cone/rod: machined stainless steel
HDA-PF / HDA-TF (Sherardized version)	
Sleeve:	Machined steel with brazed tungsten carbide tips, shearadized
Bolt M10 - M16:	Cold formed steel, strength 8.8, shearadized

Anchor dimensions

HDA-P / HDA-PR / HDA-PF



HDA-T / HDA-TR / HDA-TF



Dimensions of HDA

Anchor size			HDA-P / HDA-PR / HDA-PF / HDA-T / HDA-TR / HDA-TF						
			M10	M12		M16		M20	
			x100/20	x125/30	x125/50	x190/40	x190/60	x250/50	x250/100
Length code letter			I	L	N	R	S	V	X
Total length of bolt	l_B	[mm]	150	190	210	275	295	360	410
Diameter of bolt	d_B	[mm]	10	12		16		20	
Total length of sleeve									
HDA-P	l_s	[mm]	100	125	125	190	190	250	250
HDA-T	l_s	[mm]	120	155	175	230	250	300	350
Max. diameter of sleeve	d_S	[mm]	19	21		29		35	
Washer diameter	d_w	[mm]	27,5	33,5		45,5		50	
Width across flats	S_w	[mm]	17	19		24		30	

Setting

Drilling

The stop drill is required for drilling in order to achieve the correct hole depth.

Anchor	Stop drill bit with TE-C (SDS plus) connection end	Stop drill bit with TE-Y (SDS max) connection end
HDA-P/ PF/ PR M10x100/20	TE-C-HDA-B 20x100	TE-Y-HDA-B 20x100
HDA-T/ TF/ TR M10x100/20	TE-C-HDA-B 20x120	TE-Y-HDA-B 20x120
HDA-P/ PF/ PR M12x125/30 HDA-P/ PF/ PR M12x125/50	TE-C HDA-B 22x125	TE-Y HDA-B 22x125
HDA-T/ TF/ TR M12x125/30	TE-C HDA-B 22x155	TE-Y HDA-B 22x155
HDA-T/ TF/ TR M12x125/50	TE-C HDA-B 22x175	TE-Y HDA-B 22x175
HDA-P/ PF/ PR M16 x190/40 HDA-P/ PF/ PR M16 x190/60		TE-Y HDA-B 30x190
HDA-T/ TF/ TR M16x190/40		TE-Y HDA-B 30x230
HDA-T/ TF/ TR M16x190/60		TE-Y HDA-B 30x250
HDA-P M20 x250/50 HDA-P M20 x250/100		TE-Y HDA-B 37x250
HDA-T M20x250/50		TE-Y HDA-B 37x300
HDA-T M20x250/100		TE-Y HDA-B 37x350

Setting

Drilling hammer

Setting tool

The setting system (tool and setting tool) is required for transferring the specific energy for the undercutting process.

Anchor 	TE 24 a) TE 25 a)	TE 35	TE 40 TE 40 AVR	TE 56 TE 56-ATC	TE 60 TE 60-ATC	TE 70 TE 70-ATC	TE 75	TE 76 TE 76-ATC	TE 80-ATC TE 80-ATC AVR	Setting tool 
HDA-P/T20-M10x100/20	■		■							TE-C-HDA-ST 20 M10
				■	■					TE-Y-HDA-ST 20 M10
HDA-P/T 22-M12x125/30	■		■							TE-C-HDA-ST 22 M12
HDA-P/T 22-M12x125/50	■		■	■	■					TE-Y-HDA-ST 22 M12
HDA-P/T 30-M16x190/40 HDA-P/T 30-M16x190/60						■	■	■	■	TE-Y-HDA-ST 30 M16
HDA-P/T 37-M20x250/50 HDA-P/T 37-M20x250/100						■		■	■	TE-Y-HDA-ST 37 M20

a) 1^{st} gear

Anchor 	TE 24 a) TE 25 a)	TE 35	TE 40 TE 40 AVR	TE 56 TE 56-ATC	TE 60 TE 60-ATC	TE 70 TE 70-ATC	TE 75	TE 76 TE 76-ATC	TE 80-ATC TE 80-ATC AVR	Setting tool 
HDA-PR/TR20-M10x100/20	■	■	■							TE-C-HDA-ST 20 M10
				■	■					TE-Y-HDA-ST 20 M10
HDA-PR/TR 22-M12x125/30	■	■	■							TE-C-HDA-ST 22 M12
HDA-PR/TR 22-M12x125/50	■	■	■	■	■					TE-Y-HDA-ST 22 M12
HDA-PR/TR 30-M16x190/40 HDA-PR/TR 30-M16x190/60						■	■	■	■	TE-Y-HDA-ST 30 M16

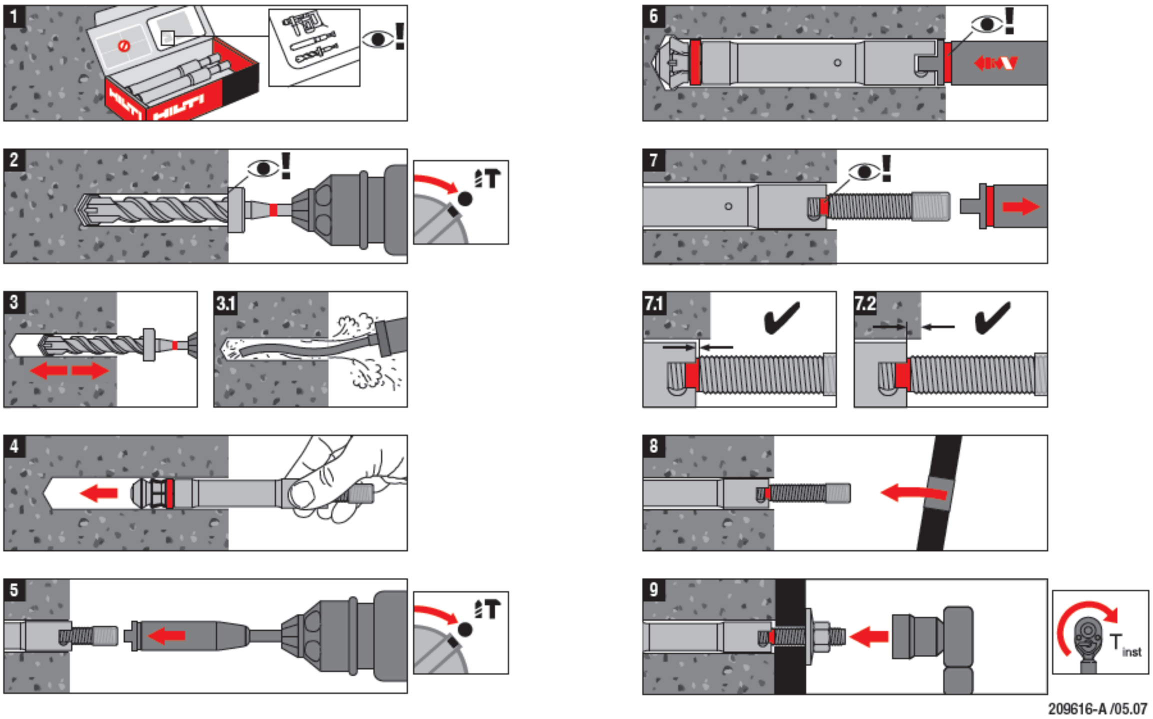
a) 1^{st} gear

Anchor 	TE 24 a) TE 25 a)	TE 35	TE 40 TE 40 AVR	TE 56 TE 56-ATC	TE 60 TE 60-ATC	TE 70 TE 70-ATC	TE 75	TE 76 TE 76-ATC	TE 80-ATC TE 80-ATC AVR	Setting tool 
HDA-PF/TF 20-M10x100/20		■	■		■					TE-C-HDA-ST 20 M10
HDA-PF/TF 22-M12x125/30 HDA-PF/TF 22-M12x125/50		■	■		■					TE-C-HDA-ST 22 M12
HDA-PF/TF 30-M16x190/40 HDA-PF/TF 30-M16x190/60						■	■	■	■	TE-Y-HDA-ST 30 M16

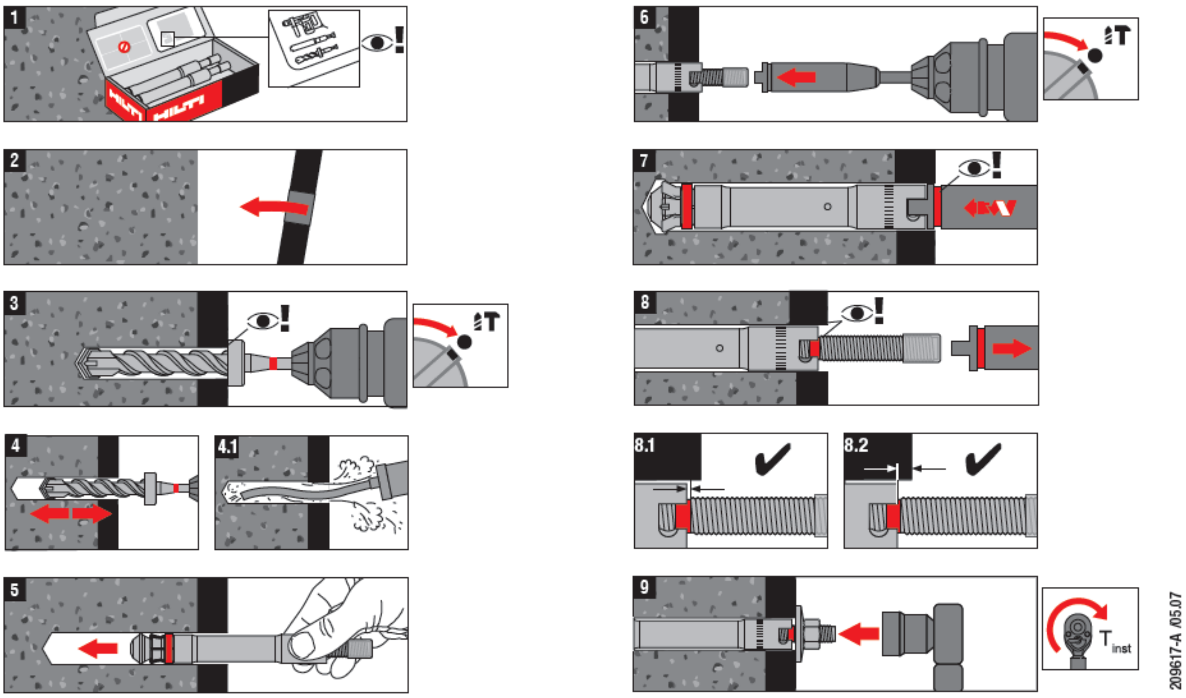
a) 1^{st} gear

Setting instruction

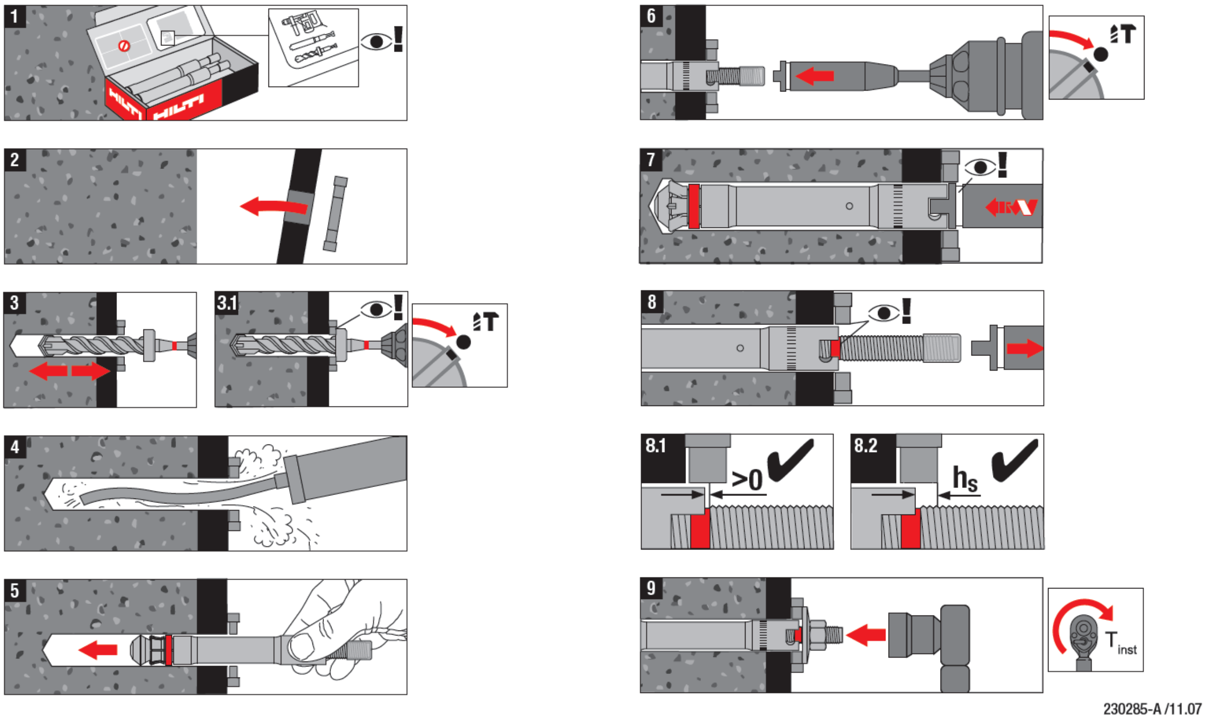
HDA-P, HDA-PR, HDA-PF



HDA-T, HDA-TR, HDA-TF



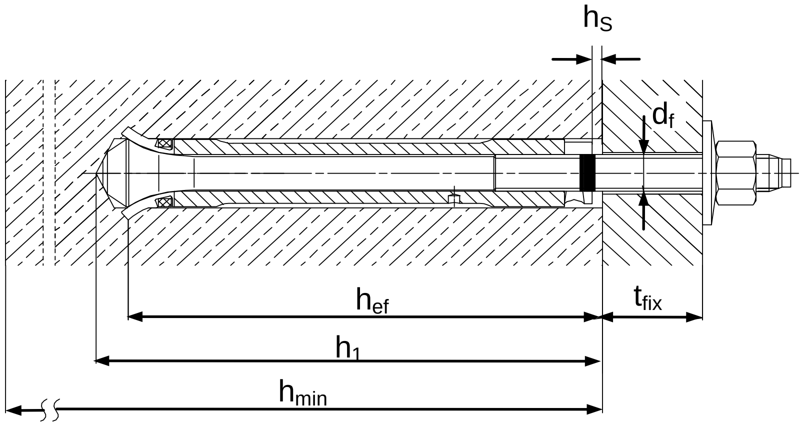
HDA-F-CW, HDA-R-CW (to be set with HDA-T, HDA-TF, HDA-TR)



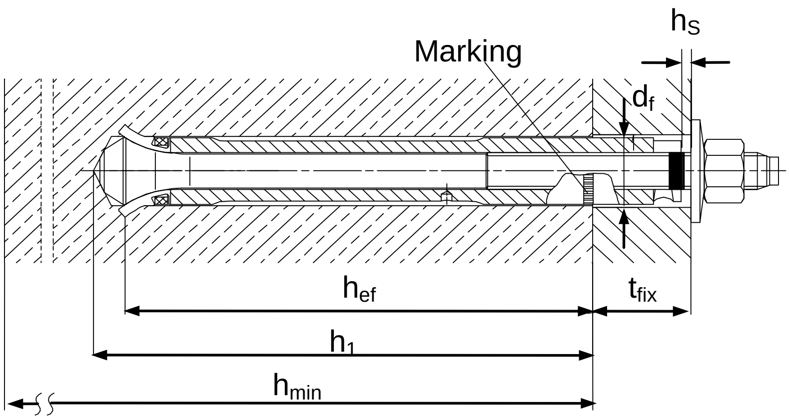
For detailed information on installation see instruction for use given with the package of the product.

Setting details

HDA-P / HDA-PR / HDA-PF



HDA-T / HDA-TR / HDA-TF

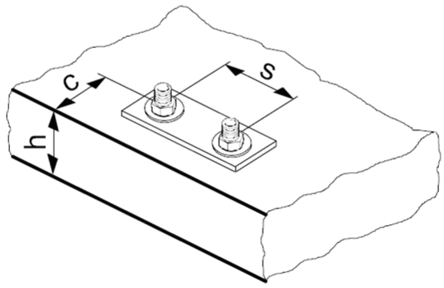


Anchor size			**HDA-P / HDA-PR / HDA-PF / HDA-T / HDA-TR / HDA-TF**						
			M10	**M12**		**M16**		**M20**	
			x100/20	x125/30	x125/50	x190/40	x190/60	x250/50	x250/100
Head marking			I	L	N	R	S	V	X
Nominal drill bit diameter	d_0	[mm]	20	22		30		37	
Cutting diameter of drill bit	$d_{cut,min}$	[mm]	20,10	22,10		30,10		37,15	
	$d_{cut,max}$	[mm]	20,55	22,55		30,55		37,70	
Depth of drill hole [a)]	$h_1 \geq$	[mm]	107	133		203		266	
Anchorage depth	h_{ef}	[mm]	100	125		190		250	
Sleeve recess	$h_{s,min}$	[mm]	2	2		2		2	
	$h_{s,max}$	[mm]	6	7		8		8	
Torque moment	T_{inst}	[Nm]	50	80		120		300	
For HDA-P/-PF/-PR									
Clearance hole	d_f	[mm]	12	14		18		22	
Minimum base material thickness	h_{min}	[mm]	180	200		270		350	
Fixture thickness	$t_{fix,min}$	[mm]	0	0		0		0	
	$t_{fix,max}$	[mm]	20	30	50	40	60	50	100
For HDA-T/-TF/-TR									
Clearance hole	d_f	[mm]	21	23		32		40	
Minimum base material thickness	h_{min}	[mm]	200-t_{fix}	230-t_{fix}	250-t_{fix}	310-t_{fix}	330-t_{fix}	400-t_{fix}	450-t_{fix}
Min. fixture thickness									
-Tension load only!	$t_{fix,min}$	[mm]	10	10		15		20	50
-Shear load - **without** use of centering washer	$t_{fix,min}$	[mm]	15	15		20		25	50
-Shear load - **with** use of centering washer	$t_{fix,min}$ [b)]	[mm]	10	10		15		20	-
Max. fixture thickness	$t_{fix,max}$	[mm]	20	30	50	40	60	50	100

a) use specified stop drill bit
b) with use of centering washer a reduction of $t_{fix,min}$ is possible for shear loading, details see ETA-99/0009

Setting parameters

Anchor size			HDA-P / HDA-PR / HDA-PF / HDA-T / HDA-TR / HDA-TF						
			M10	M12		M16		M20	
			x100/20	x125/30	x125/50	x190/40	x190/60	x250/50	x250/100
Minimum spacing	s_{min}	[mm]	100	125		190		250	
Minimum edge distance	c_{min}	[mm]	80	100		150		200	
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	300	375		570		750	
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	150	190		285		375	
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	300	375		570		750	
Critical edge distance for concrete cone failure	$c_{cr,N}$	[mm]	150	190		285		375	



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

Critical spacing and critical edge distance for splitting failure apply only for non-cracked concrete. For cracked concrete only the critical spacing and critical edge distance for concrete cone failure are decisive.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according data given in ETA-99/0009, issue 2013-03-25.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

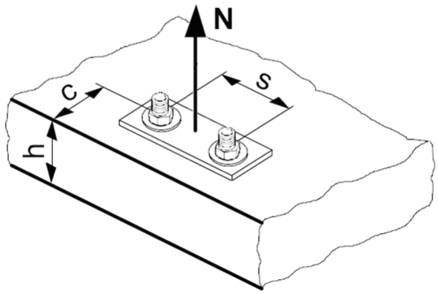
For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):

$$N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M10	M12	M16	M20 a)
$N_{Rd,s}$	HDA-P(F), HDA-T(F)	[kN]	30,7	44,7	84,0	128,0
	HDA-PR, HDA-TR	[kN]	28,8	41,9	78,8	-

a) HDA M20: only a galvanized 5µm version is available

Design pull-out resistance a) $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$ (only in cracked concrete)

		Non-cracked concrete				Cracked concrete			
Anchor size		M10	M12	M16	M20 b)	M10	M12	M16	M20 b)
$N^0_{Rd,p}$	[kN]	-	-	-	-	16,7	23,3	50,0	63,3

a) Design pull-out resistance is not decisive in non-cracked concrete
b) HDA M20: only a galvanized 5µm version is available

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

		Non-cracked concrete				Cracked concrete			
Anchor size		M10	M12	M16	M20 b)	M10	M12	M16	M20 b)
$N^0_{Rd,c}$	[kN]	38,7	54,1	101,4	153,1	27,7	38,7	72,5	109,3

a) Splitting resistance must only be considered for non-cracked concrete
b) HDA M20: only a galvanized 5µm version is available

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0{,}7 + 0{,}3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0{,}7 + 0{,}3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0{,}5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0{,}5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0{,}5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0{,}5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of base material thickness

h/h_{ef}	2	2,2	2,4	2,6	2,8	3	3,2	3,4	3,6	≥ 3,68
$f_{h,sp} = [h/(2 \cdot h_{ef})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

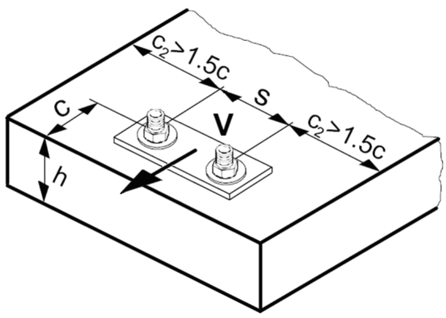
Influence of reinforcement

Anchor size	M10	M12	M16	M20
$f_{re,N} = 0{,}5 + h_{ef}/200mm \leq 1$	1			

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M10	M12	M16	M20 [a)]
$V_{Rd,s}$	HDA-P, HDA-PF	[kN]	17,6	24,0	49,6	73,6
	HDA-PR	[kN]	17,3	25,6	47,4	-
	HDA-T, HDA-TF [b)]	[kN]	43,3	53,3	93,3	136,7
	HDA-TR [b)]	[kN]	53,4	65,4	114,3	-

a) HDA M20: only a galvanized 5µm version is available

b) Values are valid for minimum thickness of the base plate $t_{fix,min}$. For characteristic resistance to shear loads with thicker base plates see ETA-99/0009 or use PROFIS software.

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$ [a)]

Anchor size	M10	M12	M16	M20
k	2,0			

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance [a)] $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

		Non-cracked concrete				Cracked concrete			
Anchor size		M10	M12	M16	M20 [b)]	M10	M12	M16	M20 [b)]
$V^0_{Rd,c}$	[kN]	25,1	29,8	51,1	70,0	17,8	21,1	36,2	49,6

a) For anchor groups with more than two anchors only the anchors close to the edge must be considered.

b) HDA M20: only a galvanized 5µm version is available

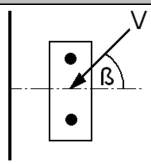
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M10	M12	M16	M20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,81	1,00	1,18	1,36

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

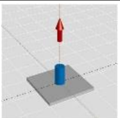
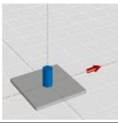
Precalculated values

Design resistance calculated according ETAG 001, Annex C and data given in ETA-99/0009, issue 2013-03-25. All data applies to concrete C 20/25 – $f_{ck,cube}$ =25 N/mm². HDA-PF and HDA-TF anchors are not covered by the approval. For HDA-T and HDA-TR anchors the resistance to shear loads is calculated for the minimum thickness of the base plate given in chapter setting details.

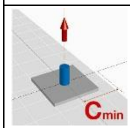
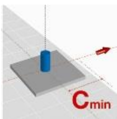
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Design resistance

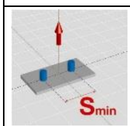
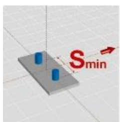
Single anchor, no edge effects, shear without lever arm

			Non-cracked concrete				Cracked concrete			
Anchor size			**M10**	**M12**	**M16**	**M20**	**M10**	**M12**	**M16**	**M20**
Min. base material thickness h_{min} [mm]			180	200	270	350	180	200	270	350
HDA-T: Min. fixture thickness t_{fix} [mm]			15	15	20	25	15	15	20	25
	**Tensile N_{Rd}**									
	HDA-P(F), HDA-T(F)	[kN]	30,7	44,7	84,0	128,0	16,7	23,3	50,0	63,3
	HDA-PR, HDA-TR	[kN]	28,8	41,9	78,8	-	16,7	23,3	50,0	-
	**Shear V_{Rd}**									
	HDA-P, HDA-PF	[kN]	17,6	24,0	49,6	73,6	17,6	24,0	49,6	73,6
	HDA-PR	[kN]	17,3	25,6	47,4	-	17,3	25,6	47,4	-
	HDA-T, HDA-TF	[kN]	43,3	53,3	93,3	136,7	43,3	53,3	93,3	136,7
	HDA-TR	[kN]	53,4	65,4	114,3	-	53,4	65,4	114,3	-

Single anchor, min. edge distance ($c = c_{min}$), shear without lever arm

			Non-cracked concrete				Cracked concrete			
Anchor size			**M10**	**M12**	**M16**	**M20**	**M10**	**M12**	**M16**	**M20**
Min. base material thickness h_{min} [mm]			180	200	270	350	180	200	270	350
HDA-T: Min. fixture thickness t_{fix} [mm]			15	15	20	25	15	15	20	25
Min. edge distance c_{min} [mm]			80	100	150	200	80	100	150	200
	**Tensile N_{Rd}**									
	HDA-P(F), HDA-T(F) HDA-PR, HDA-TR	[kN]	25,5	35,9	66,4	100,9	16,7	23,3	47,4	63,3
	**Shear V_{Rd}**									
	HDA-P, HDA-PF HDA-PR HDA-T, HDA-TF HDA-TR	[kN]	10,4	14,8	26,4	41,8	7,3	10,5	18,7	29,6

Double anchor, no edge effects, min. spacing ($s = s_{min}$), shear without lever arm (load values are valid for one anchor)

			Non-cracked concrete				Cracked concrete			
Anchor size			**M10**	**M12**	**M16**	**M20**	**M10**	**M12**	**M16**	**M20**
Min. base material thickness h_{min} [mm]			180	200	270	350	180	200	270	350
HDA-T: Min. fixture thickness t_{fix} [mm]			15	15	20	25	15	15	20	25
Min. spacing s_{min} [mm]			100	125	190	250	100	125	190	250
	**Tensile N_{Rd}**									
	HDA-P(F), HDA-T(F) HDA-PR, HDA-TR	[kN]	25,8	36,0	67,6	102,1	16,7	23,3	48,3	63,3
	**Shear V_{Rd}**									
	HDA-P, HDA-PF	[kN]	17,6	24,0	49,6	73,6	17,6	24,0	49,6	73,6
	HDA-PR	[kN]	17,3	25,6	47,4	-	17,3	25,6	47,4	-
	HDA-T, HDA-TF	[kN]	43,3	53,3	93,3	136,7	36,9	51,4	93,3	136,7
	HDA-TR	[kN]	51,6	65,4	114,3	-	36,9	51,4	96,6	-

HMU-PF Undercut anchor

Anchor version	Benefits
 M12 HMU-PF  M16 HMU-PF	- reliable mechanical interlock due to consistent high quality undercut - comes standard with a hot-dip galvanized protective coating against corrosion - cost efficient heavy duty anchoring solution for high volume fastenings - easy verification of correct setting due to red setting mark - optimized and matching system components enable efficient and reliable installation

Concrete | Tensile zone | Small edge distance and spacing | European Technical Approval | Fire resistance | CE conformity | Seismic C1 | PROFIS Anchor

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European Technical Assessment	CSTB, Paris	ETA-14/0069 / 2014-04-02

a) All data given in this section for HMU-PF M12 and M16 according to ETA-14/0001, issue 2014-04-02.

Basic loading data (for a single anchor)

All data in this section is applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete as specified in the table
- *Steel* failure
- Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

Mean ultimate resistance

		Non-cracked concrete			Cracked concrete		
Anchor size	**HMU-PF**	**M12x80**	**M16x100**	**M16x125**	**M12x80**	**M16x100**	**M16x125**
Effective anchorage depth $h_{ef} \geq$	[mm]	80	100	125	80	100	125
Tensile $N_{Ru,m}$	[kN]	48,0	67,0	93,7	26,6	47,8	53,1
Shear $V_{Ru,m}$	[kN]	*35,4*	*65,9*	*65,9*	*35,4*	*65,9*	*65,9*

Characteristic resistance

		Non-cracked concrete			Cracked concrete		
Anchor size	**HMU-PF**	**M12x80**	**M16x100**	**M16x125**	**M12x80**	**M16x100**	**M16x125**
Effective anchorage depth $h_{ef} \geq$	[mm]	80	100	125	80	100	125
Tensile N_{Rk}	[kN]	36,1	50,5	70,6	20,0	36,0	40,0
Shear V_{Rk}	[kN]	*33,7*	*62,8*	*62,8*	*33,7*	*62,8*	*62,8*

Design resistance

		Non-cracked concrete			Cracked concrete		
Anchor size	**HMU-PF**	**M12x80**	**M16x100**	**M16x125**	**M12x80**	**M16x100**	**M16x125**
Effective anchorage depth $h_{ef} \geq$	[mm]	80	100	125	80	100	125
Tensile N_{Rd}	[kN]	24,1	33,7	47,1	13,3	24,0	26,7
Shear V_{Rd}	[kN]	27,0	50,2	50,2	27,0	48,0	50,2

Recommended loads

		Non-cracked concrete			Cracked concrete		
Anchor size	**HMU-PF**	**M12x80**	**M16x100**	**M16x125**	**M12x80**	**M16x100**	**M16x125**
Effective anchorage depth $h_{ef} \geq$	[mm]	80	100	125	80	100	125
Tensile N_{rec} a)	[kN]	17,2	24,0	33,6	9,5	17,1	19,0
Shear V_{rec} a)	[kN]	19,3	35,9	35,9	19,3	34,3	35,9

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

Mechanical properties of the anchor bolt

Anchor size			**HMU-PF M12x80**	**HMU-PF M16x100**	**HMU-PF M16x125**
Nominal tensile strength	f_{uk}	[N/mm²]	800		
Yield strength	f_{yk}	[N/mm²]	640		
Stressed cross-section, thread	A_s	[mm²]	84,3	157	
Moment of resistance	W	[mm³]	109	278	
Char. bending resistance	$M^0_{Rk,s}$	[Nm]	105	266	

Material quality

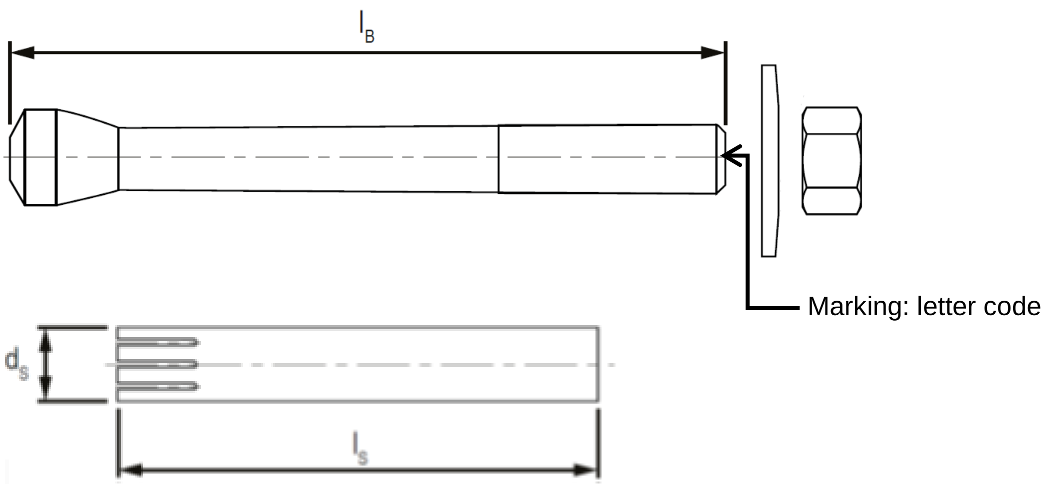
Part	Material
Bolt	Carbon steel strength 8.8, hot dip galvanized to min. 50 µm
Expansion sleeve	Carbon steel, hot dip galvanized min. 50µm
Hexagon nut	Steel grade 8, hot dip galvanized min. 50µm
Washer	According to DIN 125-1, 140 HV, hot dip galvanized min. 50µm

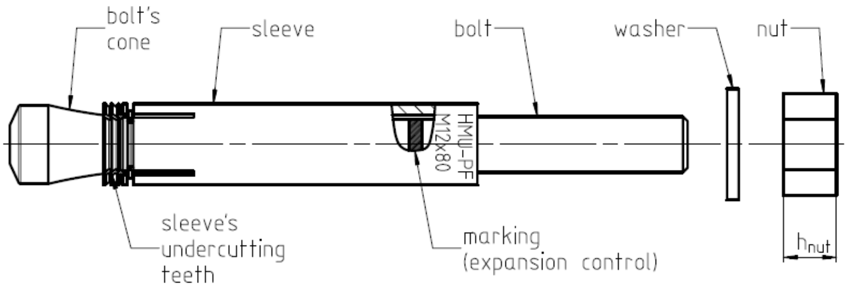
Letter code for anchor length

Anchor size	HMU-PF M12	M12x80/20	M12x80/35	M12x80/65
Letter code		H	I	K
Anchor size	**HMU-PF M16**	**M16x100/30**	**M16x100/60**	M16x125/60
Letter code		K	M	O

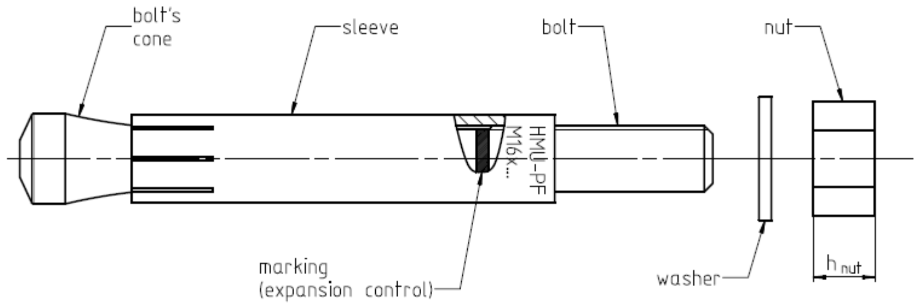
Anchor dimensions

Anchor size	HMU-PF		HMU-PF M12x80	HMU-PF M16x100	HMU-PF M16x125
Total length of bolt L_B	Min	[mm]	133	167	222
	max	[mm]	176	197	-
Diameter of sleeve	d_s	[mm]	17,5	21,6	
Length of sleeve	l_s	[mm]	80,6	102	127





HMU-PF M12



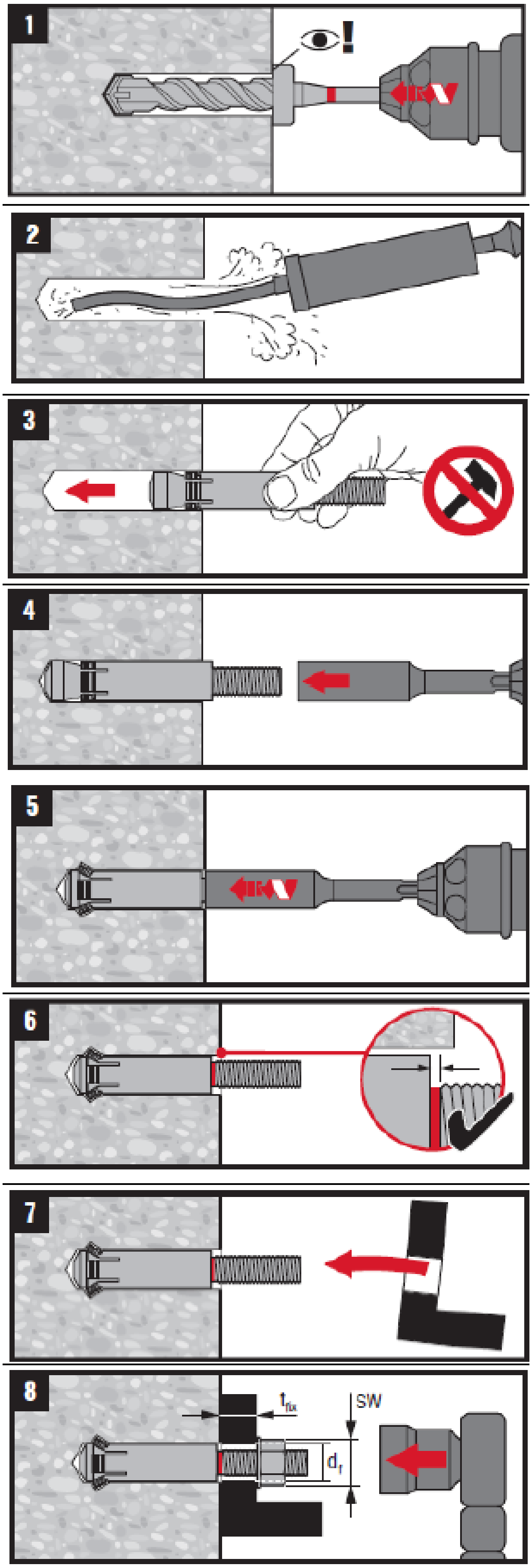
HMU-PF M16

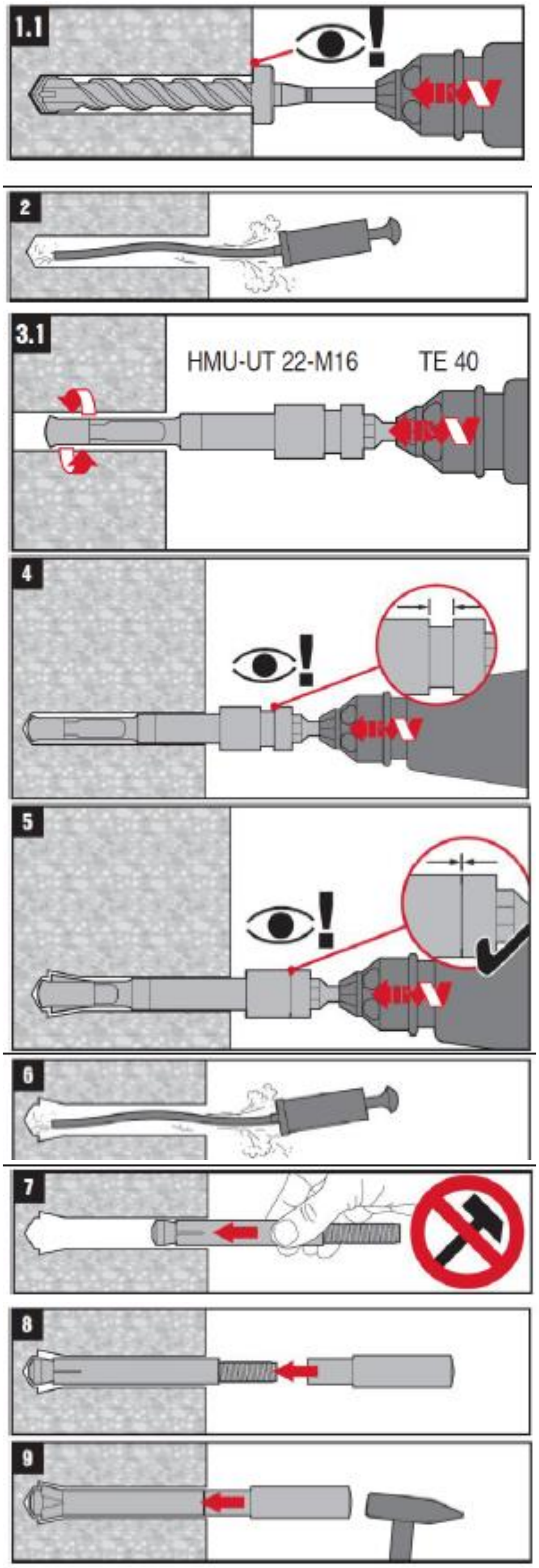
Setting

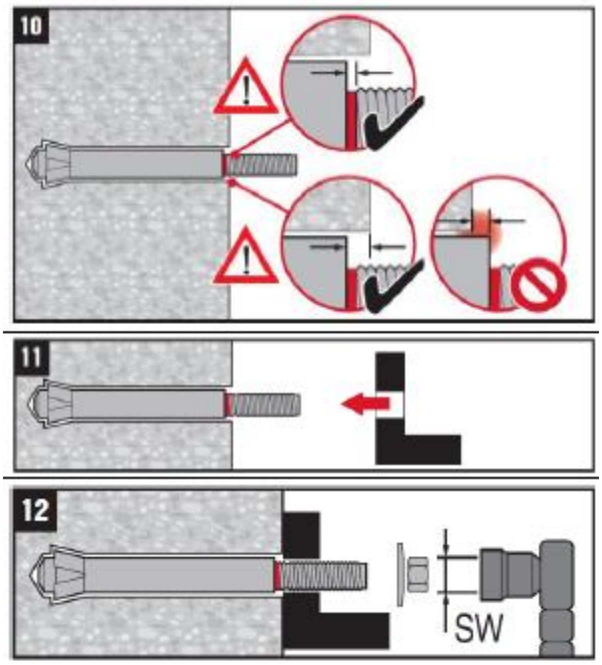
Installation equipment

Anchor size	HMU-PF M12x80	HMU-PF M16x100	HMU-PF M16x125
Rotary hammer For undercutting 	TE 30 TE 30-A36 TE 40	TE 40	
Stop drill bit 	TE-C-HMU B 18x80-M12	TE-C-HMU B 22x100-M16	TE-C-HMU B 22x125-M16
Undercutting tool 	Not needed	TE-C HMU-UT 22-M16	
Setting tool 	HMU-ST M12 + recommended TE tool (see IFU)	HMU-ST M16 + hammer	
Other tools	Blow-out bulb		

Setting instructions for M12 (left hand side) and M16 (right hand side) HMU undercut anchor





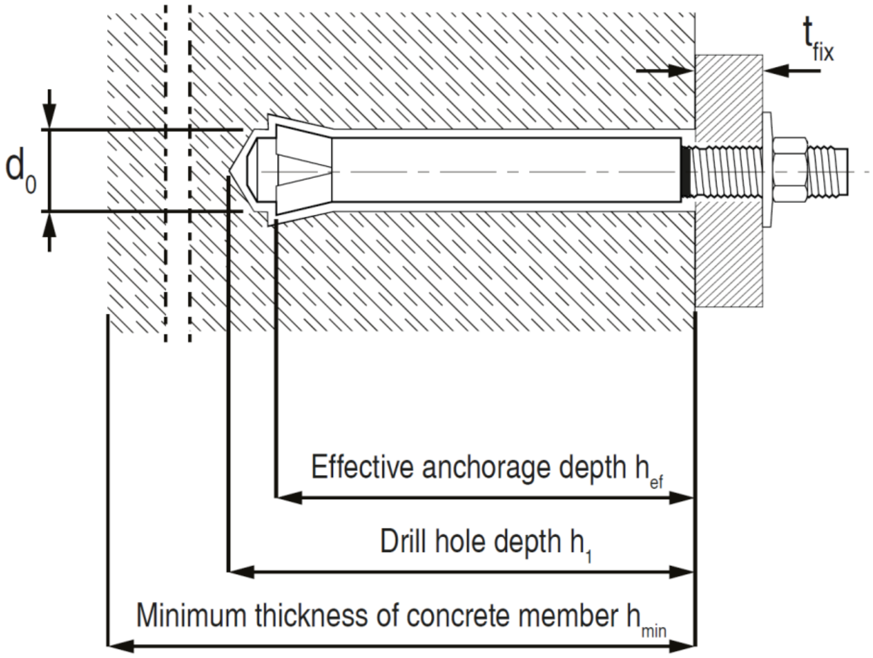


For detailed information on installation see instruction for use given with the package of the product.

Setting details

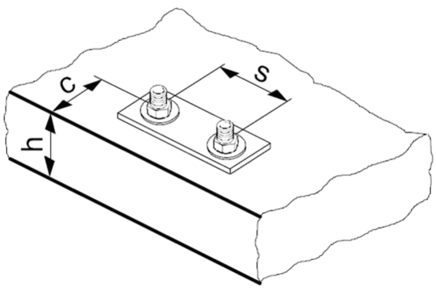
Anchor size			HMU-PF M12x80	HMU-PF M16x100	HMU-PF M16x125
Effective anchorage depth	h_{ef}	[mm]	80	100	125
Nominal Diameter of drill bit	d_0	[mm]	18	22	
Cutting diameter of drill bit [a)]	$d_{cut} \leq$	[mm]	18,5	22,8	
Depth of drill hole [a)]	$h_1 =$	[mm]	92	108	132
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	14	18	
Thickness of fixture	t_{fix}	[mm]	2 … 65	5 … 60	5 … 60
Torque moment	T_{inst}	[Nm]	45	120	
Width across nut flats	SW	[mm]	19	24	

a) use special stop drill bit TE-C-HMU-B only



Setting parameters [a)]

Anchor size			HMU-PF M12x80	HMU-PF M16x100	HMU-PF M16x125
Effective anchorage depth	h_{ef}	[mm]	80	100	125
Minimum base material thickness	$h_{min} \geq$	[mm]	160	200	250
Minimum spacing	$s_{min} \geq$	[mm]	90	100	100
Minimum edge distance	$c_{min} \geq$	[mm]	90	100	100
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	300	300	375
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	150	150	188
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	240	300	375
Critical edge distance for concrete cone failure	$c_{cr,N}$	[mm]	120	150	188



b) In case of smaller edge distance and spacing than $c_{cr,sp}$, $s_{cr,sp}$, $c_{cr,N}$ and $s_{cr,N}$ the load values shall be reduced according ETAG 001, Annex C

Critical spacing and critical edge distance for splitting failure apply only for non-cracked concrete. For cracked concrete only the critical spacing and critical edge distance for concrete cone failure are decisive.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according data given in ETA-14/0069, issue 2014-04-02.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C.

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

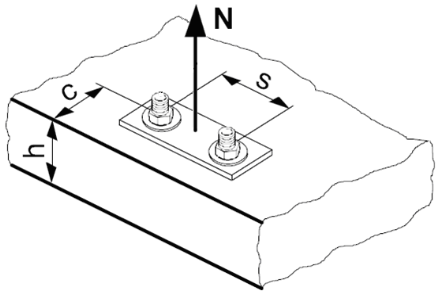
For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):

$$N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size HMU-PF		M12x80	M16x100	M16x125
$N_{Rd,s}$	[kN]	44,9	83,7	

Design pull-out resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$

		Non-cracked concrete			Cracked concrete		
Anchor size HMU-PF		M12x80	M16x100	M16x125	M12x80	M16x100	M16x125
Effective anchorage depth $h_{ef} \geq$	[mm]	80	100	125	80	100	125
$N^0_{Rd,p}$	[kN]	N.A.			13,3	N.A.	26,7

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance [a] $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

		Non-cracked concrete			Cracked concrete		
Anchor size HMU-PF		M12x80	M16x100	M16x125	M12x80	M16x100	M16x125
Effective anchorage depth $h_{ef} \geq$	[mm]	80	100	125	80	100	125
$N^0_{Rd,c}$	[kN]	24,1	33,7	47,1	17,2	24,0	33,5

Influencing factors

Influence of concrete strength on pull-out, concrete cone and splitting resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance [a)]

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N}$ = $0{,}7 + 0{,}3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp}$ = $0{,}7 + 0{,}3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N}$ = $0{,}5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp}$ = $0{,}5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing [a)]

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N}$ = $0{,}5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp}$ = $0{,}5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of base material thickness

h/h_{ef}	2,0	2,2	2,4	2,6	2,8	3,0	3,2	3,4	3,6	≥ 3,68
$f_{h,sp}$ = $[h/(2 \cdot h_{ef})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

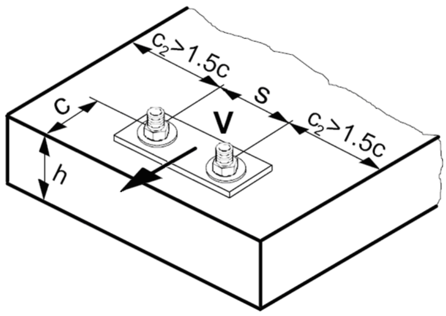
Influence of reinforcement

Anchor size	M12x80	M16x100	M16x125
$f_{re,N}$ = $0{,}5 + h_{ef}/200mm \leq 1$	0,9	1	1

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size	HMU-PF M12x80	HMU-PF M16x100	HMU-PF M16x125
$V_{Rd,s}$ [kN]	27,0	50,2	

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$ [a)]

Anchor size	HMU-PF M12x80	HMU-PF M16x100	HMU-PF M16x125
k		2	

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance [a)] $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_c$

		Non-cracked concrete			Cracked concrete		
Anchor size	**HMU-PF**	**M12x80**	**M16x100**	**M16x125**	**M12x80**	**M16x100**	**M16x125**
Effective anchorage depth $h_{ef} \geq$	[mm]	80	100	125	80	100	125
$V^0_{Rd,c}$	[kN]	22,9	36,8	47,7	16,2	26,1	33,8

a) For anchor groups only the anchors close to the edge must be considered.

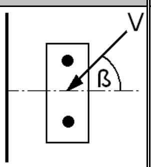
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

The following equations must be satisfied

$ß_N \leq 1$

$ß_V \leq 1$

$ß_N + ß_V \leq 1,2$ or $ß_N^{\alpha} + ß_V^{\alpha} \leq 1$

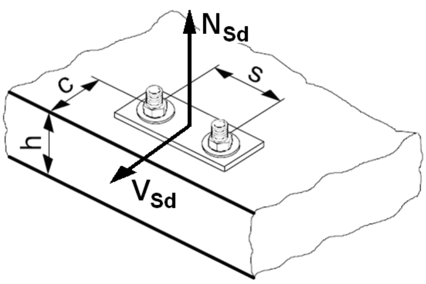
With

$ß_N = N_{Sd} / N_{Rd}$ and

$ß_V = V_{Sd} / V_{Rd}$

N_{Sd} (V_{Sd}) = tension (shear) design action

N_{Rd} (V_{Rd}) = tension (shear) design resistance



Annex C of ETAG 001	Simplified design method
α = **2,0** if N_{Rd} and V_{Rd} are governed by steel failure	Failure mode is not considered for the simplified method
α = **1,5** for all other failure modes	α = **1,5** for all failure modes (leading to conservative results

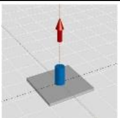
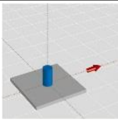
Precalculated values

Design resistance calculated according ETAG 001, Annex C and data given in ETA-14/0069, issue 2014-04-02. All data applies to concrete C 20/25 – $f_{ck,cube}$ =25 N/mm².

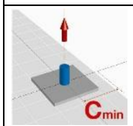
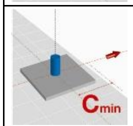
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Design resistance

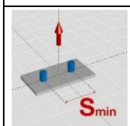
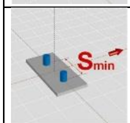
Single anchor, no edge effects, shear without lever arm

			Non-cracked concrete			Cracked concrete		
Anchor size		**HMU-PF**	**M12x80**	**M16x100**	**M16x125**	**M12x80**	**M16x100**	**M16x125**
Min. base material thickness h_{min} [mm]			160	200	250	160	200	250
	**Tensile N_{Rd}**	[kN]	24,1	33,7	47,1	13,3	24,0	26,7
	**Shear V_{Rd}**	[kN]	27,0	50,2	50,2	27,0	48,0	50,2

Single anchor, min. edge distance ($c = c_{min}$), shear without lever arm

			Non-cracked concrete			Cracked concrete		
Anchor size			**M12x80**	**M16x100**	**M16x125**	**M12x80**	**M16x100**	**M16x125**
Min. base material thickness h_{min} [mm]			160	200	250	160	200	250
Min. edge distance c_{min} [mm]			90	100	100	90	100	100
	**Tensile N_{Rd}**	[kN]	17,0	25,3	31,0	12,1	18,0	22,1
	**Shear V_{Rd}**	[kN]	12,2	15,2	16,0	8,7	10,8	11,3

Double anchor, no edge effects, min. spacing ($s = s_{min}$), shear without lever arm (load values are valid for one anchor)

			Non-cracked concrete			Cracked concrete		
Anchor size			**M12x80**	**M16x100**	**M16x125**	**M12x80**	**M16x100**	**M16x125**
Min. base material thickness h_{min} [mm]			160	200	250	160	200	250
Min. spacing s_{min} [mm]			90	100	100	90	100	100
	**Tensile N_{Rd}**	[kN]	15,7	22,4	29,8	11,2	16,0	21,2
	**Shear V_{Rd}**	[kN]	27,0	44,9	50,2	23,6	32,0	42,5

Seismic design C1

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:
- Seismic design according to TR045

The following technical data are based on: ETA-14/0069 issue 2014-04-02

Anchorage depth range

Anchor size§			HMU-PF M12x80	HMU-PF M16x100	HMU-PF M16x125
Effective anchorage depth range	h_{ef}	[mm]	80	100	125

Tension resistance in case of seismic performance category C1

Anchor size			HMU-PF M12x80	HMU-PF M16x100	HMU-PF M16x125
Characteristic tension resistance to steel failure					
	$N_{Rk,s,seis}$	[kN]	67,5	125,6	
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5		
Characteristic pull-out resistance in cracked concrete C20/25 to C50/60					
	$N_{Rk,p,seis}$	[kN]	17,3	26,8	29,8
Partial safety factor	$\gamma_{Mp,seis}$	[-]	1,5		

Shear resistance in case of seismic performance category C1

Anchor size			HMU-PF M12x80	HMU-PF M16x100	HMU-PF M16x125
Characteristic shear resistance to steel failure					
	$V_{Rk,s,seis}$	[kN]	33,7	62,8	
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25		

For seismic resistent fastening applications please use the anchor design software PROFIS Anchor.

HSC-A Safety anchor

Anchor version	Benefits
 Bolt version HSC-A Carbon Steel version HSC-AR Stainless steel version	- the perfect solution for small edge and space distance - suitable for thin concrete blocks due to low embedment depth - suitable for cracked concrete - self-cutting undercut anchor - available as bolt version for through applications - stainless steel available for external applications

Concrete	Tensile zone	Small edge distance and spacing	Fire resistance	Shock	Corrosion resistance	European Technical Approval	CE conformity	PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	CSTB, Paris	ETA-02/0027 / 2012-09-20
Shockproof fastenings in civil defence installations	Federal Office for Cicil Protection, Bern	BZS D 06-601 / 2006-07-10
Fire test report	IBMB, Braunschweig	UB 3177/1722-1 / 2006-06-28
Assessment report (fire)	warringtonfire	WF 327804/A / 2013-07-10

a) All data given in this section according ETA-02/0027 issue 2012-09-20.

Basic loading data

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete as specified in the table
- *Steel* failure
- Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

Mean ultimate resistance

		Non-cracked concrete				Cracked concrete			
Anchor size		**M8x40**	**M10x40**	**M8x50**	**M12x60**	**M8x40**	**M10x40**	**M8x50**	**M12x60**
Tensile $N_{Ru,m}$									
HSC-A HSC-AR	[kN]	16,6	16,6	23,3	30,6	13,3	13,3	18,6	24,5
Shear $V_{Ru,m}$									
HSC-A	[kN]	19,0	30,2	19,0	43,8	19,0	30,2	19,0	43,8
HSC-AR	[kN]	16,6	26,4	16,6	38,4	16,6	26,4	16,6	38,4

Characteristic resistance

		Non-cracked concrete				Cracked concrete			
Anchor size		**M8x40**	**M10x40**	**M8x50**	**M12x60**	**M8x40**	**M10x40**	**M8x50**	**M12x60**
Tensile N_{Rk}									
HSC-A	[kN]	12,8	12,8	17,8	23,4	9,1	9,1	12,7	16,7
HSC-AR	[kN]	12,8	12,8	17,8	23,4	9,1	9,1	12,7	16,7
Shear V_{Rk}									
HSC-A	[kN]	14,6	23,2	14,6	33,7	14,6	18,2	14,6	33,5
HSC-AR	[kN]	12,8	20,3	12,8	29,5	12,8	18,2	12,8	29,5

Design resistance

		Non-cracked concrete				Cracked concrete			
Anchor size		**M8x40**	**M10x40**	**M8x50**	**M12x60**	**M8x40**	**M10x40**	**M8x50**	**M12x60**
Tensile N_{Rd}									
HSC-A	[kN]	8,5	8,5	11,9	15,6	6,1	6,1	8,5	11,2
HSC-AR	[kN]	8,5	8,5	11,9	15,6	6,1	6,1	8,5	11,2
Shear V_{Rd}									
HSC-A	[kN]	11,7	17,0	11,7	27,0	11,7	12,1	11,7	22,3
HSC-AR	[kN]	8,2	13,0	8,2	18,9	8,2	12,1	8,2	18,9

Recommended loads

		Non-cracked concrete				Cracked concrete			
Anchor size		**M8x40**	**M10x40**	**M8x50**	**M12x60**	**M8x40**	**M10x40**	**M8x50**	**M12x60**
Tensile N_{rec} a)									
HSC-A	[kN]	6,1	6,1	8,5	11,2	4,3	4,3	6,1	8,0
HSC-AR	[kN]	6,1	6,1	8,5	11,2	4,3	4,3	6,1	8,0
Shear V_{rec} a)									
HSC-A	[kN]	8,3	12,1	8,3	19,3	8,3	8,7	8,3	15,9
HSC-AR	[kN]	5,9	9,3	5,9	13,5	5,9	8,7	5,9	13,5

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

Mechanical properties

Anchor size		HSC	M8x40	M10x40	M8x50	M12x60
Nominal tensile strength f_{uk}	[N/mm²]	-A	800	800	800	800
		-AR	700	700	700	700
Yield strength f_{yk}	[N/mm²]	-A	640	640	640	640
		-AR	450	450	450	450
Stressed cross-section for bolt version $A_{s,A}$	[mm²]	-A, AR	36,6	58,0	36,6	84,3
Moment of resistance W	[mm³]	-A, AR	31,2	62,3	31,2	109,2
Design bending resistance without sleeve $M_{Rd,s}$	[Nm]	-A	24	48	24	84
		-AR	16,7	33,3	16,7	59,0

Material quality

Part		Material
Carbon steel		
HSC-A	Cone bolt with , with internal or external thread	steel strength 8.8, galvanised to min. 5 µm
	Expansion sleeve and washer	Galvanised steel
	Hexagon nut	Strength 8
Sainless steel		
HSC-AR	Cone bolt with , with internal or external thread	steel grade 1.4401, 1.4571 A4-70
	Expansion sleeve and washer	steel grade 1.4401, 1.4571
	Hexagon nut	steel grade 1.4401, 1.4571 A4-70

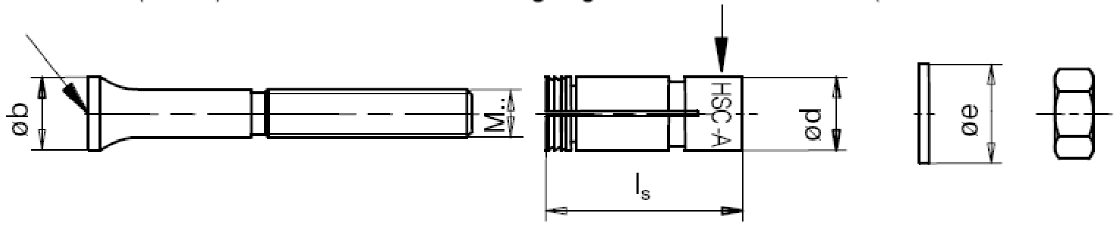
Anchor dimensions

Dimensions of HSC-A and HSC-AR

Anchor version	Thread size	t_{fix} [mm] max	b [mm]	l_s [mm]	d [mm]	e [mm]
HSC-A(R) M8x40	M8	150	13,5	40,8	13,5	16
HSC-A(R) M10x40	M10	200	15,5	40,8	15,5	20
HSC-A(R) M8x50	M8	150	13,5	50,8	13,5	16
HSC-A(R) M12x60	M12	200	17,5	60,8	17,5	24

marking HILTI 8.8 (or A4)

marking e.g. HSC-A M8 x 40 /t_{fix} (or HSC-AR M8 x 40 /t_{fix}A4)

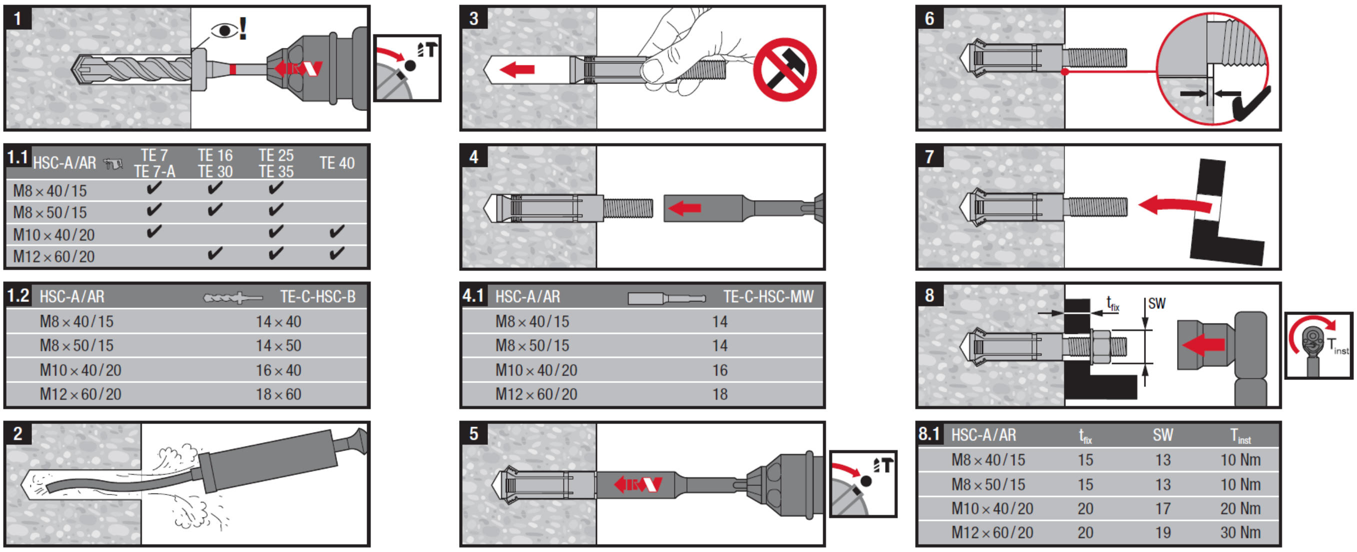


Setting

Installation equipment

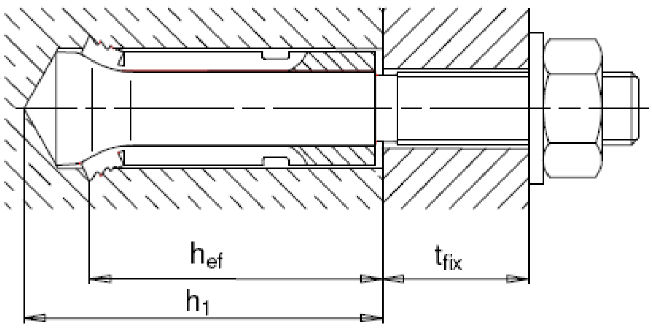
Anchor size		HSC-A/AR M8x40	HSC-A/AR M8x50	HSC-A/AR M10x40	HSC-A/AR M12x60
Rotary hammer for setting		TE 7-C; TE 7-A; TE 16; TE 16-C; TE 16-M; TE 25; TE 30; TE 35		TE 7-C; TE 7-A; TE 25; TE 35	TE 16; TE 16-C; TE 16-M; TE 25; TE 30; TE 35; TE 40; TE 40-AVR
Stop drill bit	TE-C-HSC-B	14x40	14x50	16x40	18x60
Setting Tool	TE-C-HSC-MW	14	14	16	18

Setting instruction



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

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}

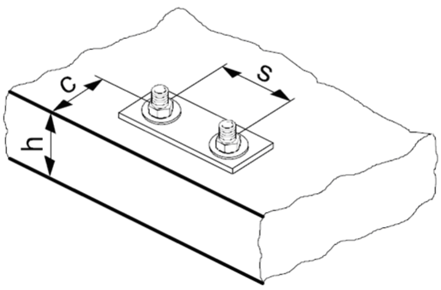


Setting details HSC-A (R)

Anchor version			M8x40	M10x40	M8x50	M12x60
Nominal diameter of drill bit	d_o	[mm]	14	16	14	18
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	14,5	16,5	14,5	18,5
Depth of drill hole	$h_1 \geq$	[mm]	46	46	56	68
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	9	12	10	30
Effective anchorage depth	h_{ef}	[mm]	40	40	50	60
Maximum fastening thickness	t_{fix}	[mm]	15	20	15	20
Torque moment	T_{inst}	[Nm]	10	20	10	30
Width across	SW	[mm]	13	17	13	19

Base material thickness, anchor spacing and edge distance

Anchor size			M8x40	M10x40	M8x50	M12x60
Minimum base material thickness	h_{min}	[mm]	100	100	100	130
Minimum spacing	s_{min}	[mm]	40	40	50	60
Minimum edge distance	c_{min}	[mm]	40	40	50	60
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	120	120	150	180
Critical edge distance for concrete cone failure	$c_{cr,N}$	[mm]	60	60	75	90
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	130	120	170	180
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	65	60	85	90



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

Critical spacing and critical edge distance for splitting failure apply only for non-cracked concrete. For cracked concrete only the critical spacing and critical edge distance for concrete cone failure are decisive.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according data given in ETA-02/0027 issue 2012-09-20.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

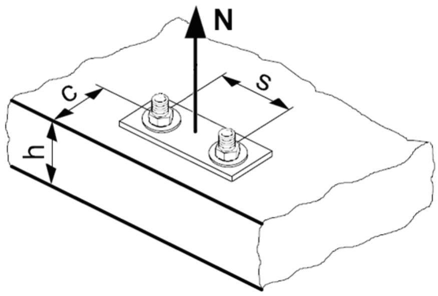
For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):

$$N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8x40	M10x40	M8x50	M12x60
$N_{Rd,s}$	HSC-A	[kN]	19,5	30,9	19,5	44,9
	HSC-AR	[kN]	13,7	21,7	13,7	31,6

Design pull-out resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$ for HSC-A and HSC-AR

	Non-cracked concrete				Cracked concrete			
Anchor size	M8x40	M10x40	M8x50	M12x60	M8x40	M10x40	M8x50	M12x60
$N^0_{Rd,p}$ [kN]	No pull-out failure				No pull-out failure			

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

	Non-cracked concrete				Cracked concrete			
Anchor size	M8x40	M10x40	M8x50	M12x60	M8x40	M10x40	M8x50	M12x60
$N^0_{Rd,c}$ [kN]	8,5	8,5	11,9	15,6	6,1	6,1	8,5	11,2

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2\ a)}$	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of base material thickness

h/h_{ef}	2,0	2,2	2,4	2,6	2,8	3,0	3,2	3,4	3,6	≥ 3,68
$f_{h,sp} = [h/(2 \cdot h_{ef})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

Influence of reinforcement

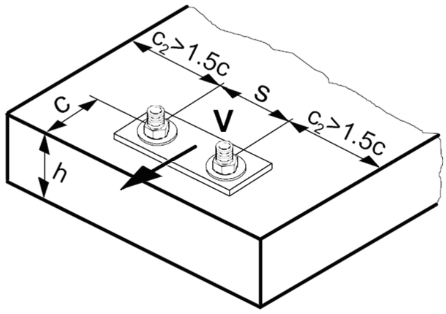
Anchor size	M8x40	M10x40	M8x50	M12x60
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 a)	0,7 a)	0,75 a)	0,8 a)

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8x40	M10x40	M8x50	M12x60
$V_{Rd,s}$	HSC-A	[kN]	11,7	18,6	11,7	27,0
	HSC-AR	[kN]	8,2	13,0	8,2	18,9

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$ a)

Anchor size	M8x40	M10x40	M8x50	M12x60
k	2,0			

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance a) $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

		Non-cracked concrete				Cracked concrete			
Anchor size		M8x40	M10x40	M8x50	M12x60	M8x40	M10x40	M8x50	M12x60
$V^0_{Rd,c}$	[kN]	14,9	18,5	15,0	22,7	10,5	13,1	10,6	16,1

a) For anchor groups only the anchors close to the edge must be considered.

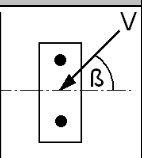
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \frac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1{,}5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4
$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M8x40	M10x40	M8x50	M12x60
$f_{hef} = 0{,}05 \cdot (h_{ef} / d)^{1,68}$	0,29	0,23	0,42	0,38

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

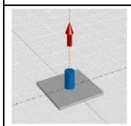
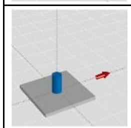
Precalculated values

Design resistance calculated according ETAG 001, Annex C and data given in ETA-02/0027, issue 2012-09-20.
All data applies to concrete C 20/25 – $f_{ck,cube}$ =25 N/mm².

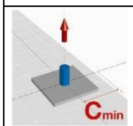
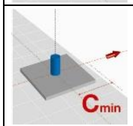
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Design resistance

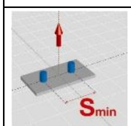
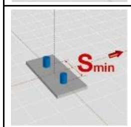
Single anchor, no edge effects

			Non-cracked concrete				Cracked concrete			
Anchor size			**M8x40**	**M10x40**	**M8x50**	**M12x60**	**M6x40**	**M8x40**	**M10x50**	**M10x60**
Min. base material thickness h_{min} [mm]			100	100	100	130	100	100	100	130
	**Tensile N_{Rd}**									
	HSC-A HSC-AR	[kN]	8,5	8,5	11,9	15,6	6,1	6,1	8,5	11,2
	**Shear V_{Rd}, without lever arm**									
	HSC-A	[kN]	11,7	17,0	11,7	27,0	11,7	12,1	11,7	22,3
	HSC-AR	[kN]	8,2	13,0	8,2	18,9	8,2	12,1	8,2	18,9

Single anchor, min. edge distance ($c = c_{min}$)

			Non-cracked concrete				Cracked concrete			
Anchor size			**M8x40**	**M10x40**	**M8x50**	**M12x60**	**M6x40**	**M8x40**	**M10x50**	**M10x60**
Min. base material thickness h_{min} [mm]			100	100	100	130	100	100	100	130
Min. edge distance c_{min} [mm]			40	40	50	60	40	40	50	60
	**Tensile N_{Rd}**									
	HSC-A HSC-AR	[kN]	6,1	6,4	8,3	11,7	4,6	4,6	6,4	8,4
	**Shear V_{Rd}, without lever arm**									
	HSC-A HSC-AR	[kN]	3,6	3,6	5,0	6,8	2,5	2,6	3,5	4,9

Double anchor, no edge effects, min. spacing ($s = s_{min}$), (load values are valid for one anchor)

			Non-cracked concrete				Cracked concrete			
Anchor size			**M8x40**	**M10x40**	**M8x50**	**M12x60**	**M8x40**	**M10x40**	**M8x50**	**M12x60**
Min. base material thickness h_{min} [mm]			100	100	100	130	100	100	100	130
Min. spacing s_{min} [mm]			40	40	50	60	40	40	50	60
	**Tensile N_{Rd}**									
	HSC-A HSC-AR	[kN]	5,6	5,7	7,7	10,4	4,0	4,0	5,7	7,4
	**Shear V_{Rd}, without lever arm**									
	HSC-A	[kN]	11,3	11,3	11,7	20,8	8,1	8,1	11,3	14,9
	HSC-AR	[kN]	8,2	11,3	8,2	18,9	8,1	8,1	8,2	14,9

HSC-I Safety anchor

	Anchor version	Benefits
	Internal threaded version: HSC-I carbon steel internal version HSC-IR Stainless steel version ((A4)	- the perfect solution for small edge and space distance - suitable for thin concrete blocks due to low embedment depth - suitable for cracked concrete - self-cutting undercut anchor - internal threaded - stainless steel available for external applications

Concrete	Tensile zone	Small edge distance and spacing	Fire resistance	Shock	Corrosion resistance	European Technical Approval	CE conformity	PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	CSTB, Paris	ETA-02/0027 / 2012-09-20
Shockproof fastenings in civil defence installations	Federal Office for Cicil Protection, Bern	BZS D 06-601 / 2006-07-10
Fire test report	IBMB, Braunschweig	UB 3177/1722-1 / 2006-06-28
Assessment report (fire)	warringtonfire	WF 327804/A / 2013-07-10

- All data given in this section according ETA-02/0027 issue 2012-09-20.

Basic loading data

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete as specified in the table
- *Steel* failure
- Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

Mean ultimate resistance HSC-I and HSC-IR

		Non-cracked concrete					Cracked concrete				
Anchor size		M6x 40	M8x 40	M10x 50	M10x 60	M12x 60	M6x 40	M8x 40	M10x 50	M10x 60	M12x 60
Tensile $N_{Ru,m}$											
HSC-I	[kN]	16,6	16,6	23,3	30,6	30,6	13,3	13,3	18,6	24,5	24,5
HSC-IR	[kN]	*14,8*	16,6	23,3	30,6	30,6	13,3	13,3	18,6	24,5	24,5
Shear $V_{Ru,m}$											
HSC-I	[kN]	*10,4*	*15,9*	*19,8*	*19,8*	*23,4*	*10,4*	*15,9*	*19,8*	*19,8*	*23,4*
HSC-IR	[kN]	*9,1*	*13,9*	*17,3*	*17,3*	*20,8*	*9,1*	*13,9*	*17,3*	*17,3*	*20,8*

Characteristic resistance HSC-I and HSC-IR

		Non-cracked concrete					Cracked concrete				
Anchor size		**M6x 40**	**M8x 40**	**M10x 50**	**M10x 60**	**M12x 60**	**M6x 40**	**M8x 40**	**M10x 50**	**M10x 60**	**M12x 60**
Tensile N_{Rk}											
HSC-I	[kN]	12,8	12,8	17,8	23,4	23,4	9,1	9,1	12,7	16,7	16,7
HSC-IR	[kN]	12,8	12,8	17,8	23,4	23,4	9,1	9,1	12,7	16,7	16,7
Shear V_{Rk}											
HSC-I	[kN]	*8,0*	*12,2*	*15,2*	*15,2*	*18,2*	*8,0*	*12,2*	*15,2*	*15,2*	*18,2*
HSC-IR	[kN]	*7,0*	*10,7*	*13,3*	*13,3*	*16,0*	*7,0*	*10,7*	*13,3*	*13,3*	*16,0*

Design resistance HSC-I and HSC-IR

		Non-cracked concrete					Cracked concrete				
Anchor size		**M6x 40**	**M8x 40**	**M10x 50**	**M10x 60**	**M12x 60**	**M6x 40**	**M8x 40**	**M10x 50**	**M10x 60**	**M12x 60**
Tensile N_{Rd}											
HSC-I	[kN]	8,5	8,5	11,9	15,6	15,6	6,1	6,1	8,5	11,2	11,2
HSC-IR	[kN]	*7,5*	8,5	11,9	*14,2*	15,6	6,1	6,1	8,5	11,2	11,2
Shear V_{Rd}											
HSC-I	[kN]	*6,4*	*9,8*	*12,2*	*12,2*	*14,6*	*6,4*	*9,8*	*12,2*	*12,2*	*14,6*
HSC-IR	[kN]	*4,5*	*6,9*	*8,5*	*8,5*	*10,3*	*4,5*	*6,9*	*8,5*	*8,5*	*10,3*

Recommended loads HSC-I and HSC-IR

		Non-cracked concrete					Cracked concrete				
Anchor size		**M6x 40**	**M8x 40**	**M10x 50**	**M10x 60**	**M12x 60**	**M6x 40**	**M8x 40**	**M10x 50**	**M10x 60**	**M12x 60**
Tensile N_{rec} [a)]											
HSC-I	[kN]	6,1	6,1	8,5	11,2	11,2	4,3	4,3	6,1	8,0	8,0
HSC-IR	[kN]	5,4	6,1	8,5	10,1	11,2	4,3	4,3	6,1	8,0	8,0
Shear V_{rec} [a)]											
HSC-I	[kN]	4,6	7,0	8,7	8,7	10,4	4,6	7,0	8,7	8,7	10,4
HSC-IR	[kN]	3,2	4,9	6,1	6,1	7,3	3,2	4,9	6,1	6,1	7,3

- With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

Mechanical properties

Anchor size		**HSC**	**M6x40**	**M8x40**	**M10x50**	**M10x60**	**M12x60**
Nominal tensile strength f_{uk}	[N/mm²]	-I	800	800	800	800	800
		-IR	600	600	700	700	700
Yield strength f_{yk}	[N/mm²]	-I	640	640	640	640	640
		-IR	355	355	350	350	340
Stressed cross-section for internal threaded version $A_{s,I}$	[mm²]	-I,IR	22,0	28,3	34,6	34,6	40,8
Stressed cross-section for bolt version $A_{s,A}$	[mm²]	-I,IR	20,1	36,6	58,0	58,0	84,3
Moment of resistance W	[mm³]	-I,IR	12,7	31,2	62,3	62,3	109,2
Design bending resistance without sleeve $M_{Rd,s}$	[Nm]	-I	9,6	24	48	48	84
		-IR	7,1	16,7	33,3	33,3	59,0

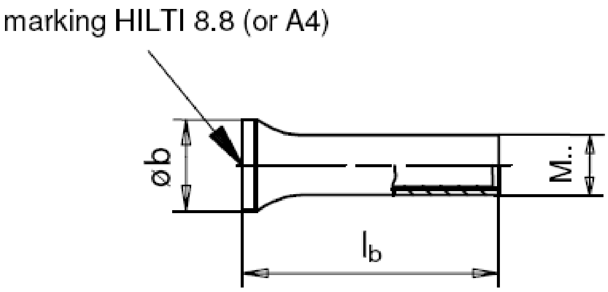
Material quality

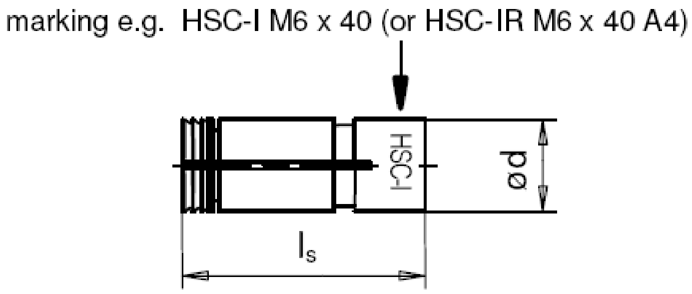
Part		Material
Carbon steel		
HSC-I	Cone bolt with , with internal or external thread	steel strength 8.8, galvanised to min. 5 µm
	Expansion sleeve and washer	Galvanised steel
	Hexagon nut	Strength 8
Stainless steel		
HSC-IR	Cone bolt with , with internal or external thread	steel grade 1.4401, 1.4571 A4-70
	Expansion sleeve and washer	steel grade 1.4401, 1.4571
	Hexagon nut	steel grade 1.4401, 1.4571 A4-70

Anchor dimensions

Dimensions of HSC-I and HSC-IR

Anchor version	Thread size	b [mm]	l_s [mm]	d [mm]	l_b [mm]
HSC-I(R) M6x40	M6	13,5	40,8	13,5	43,3
HSC-I(R) M8x40	M8	15,5	40,8	15,5	43,8
HSC-I(R) M10x50	M10	17,5	50,8	17,5	54,8
HSC-I(R) M10x60	M10	17,5	60,8	17,5	64,8
HSC-I(R) M12x60	M12	19,5	60,8	19,5	64,8



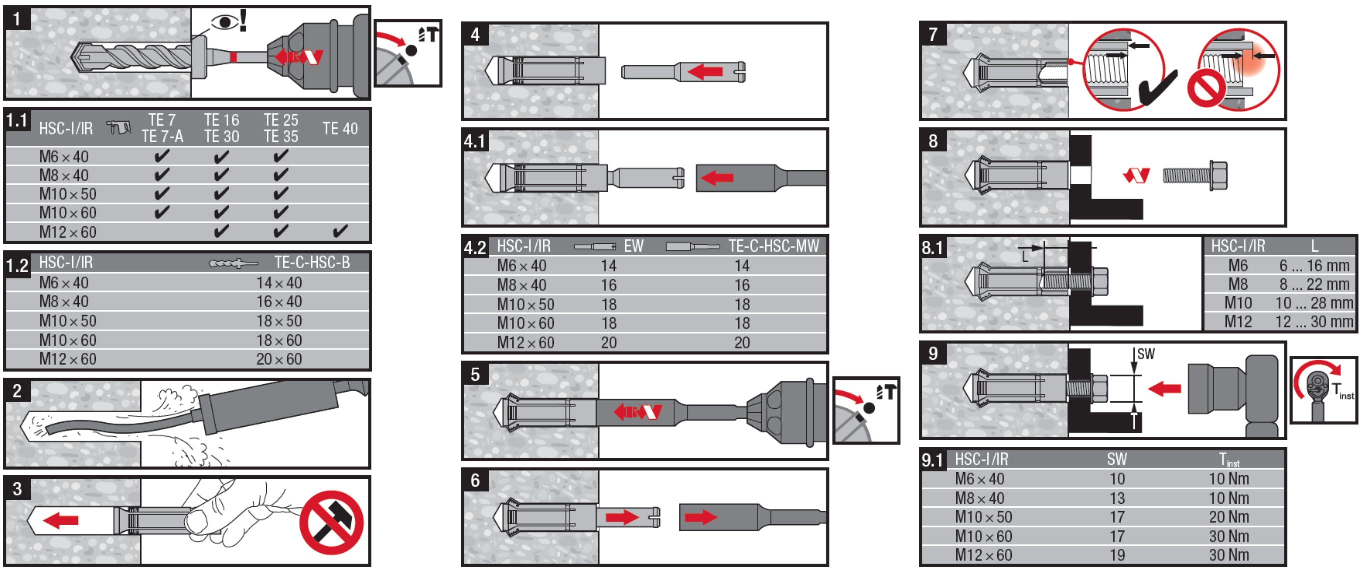


Setting

Installation equipment

Anchor size		HSC-I/IR M6x40	HSC-I/IR M8x40	HSC-I/IR M10x50	HSC-I/IR M10x60	HSC-I/IR M12x60
Rotary hammer for setting		TE 7-C; TE 7-A; TE 16; TE 16-C; TE 16-M; TE 25; TE 30; TE 35				TE 16; TE 16-C; TE 16-M; TE 25, TE 30; TE 35; TE 40; TE 40-AVR
Stop drill bit	TE-C HSC-B	14x40	16x40	18x50	18x60	20x60
Setting Tool	TE-C HSC-MW	14	16	18	18	20
Insert Tool	TE-C HSC-EW	14	16	18	18	20

Setting instruction



1.1 HSC-I/IR	TE 7 / TE 7-A	TE 16 / TE 30	TE 25 / TE 35	TE 40
M6 × 40	✔	✔	✔	
M8 × 40	✔	✔	✔	
M10 × 50	✔	✔	✔	
M10 × 60	✔	✔	✔	
M12 × 60		✔	✔	✔

1.2 HSC-I/IR	TE-C-HSC-B
M6 × 40	14 × 40
M8 × 40	16 × 40
M10 × 50	18 × 50
M10 × 60	18 × 60
M12 × 60	20 × 60

4.2 HSC-I/IR	EW	TE-C-HSC-MW
M6 × 40	14	14
M8 × 40	16	16
M10 × 50	18	18
M10 × 60	18	18
M12 × 60	20	20

8.1 HSC-I/IR	L
M6	6 ... 16 mm
M8	8 ... 22 mm
M10	10 ... 28 mm
M12	12 ... 30 mm

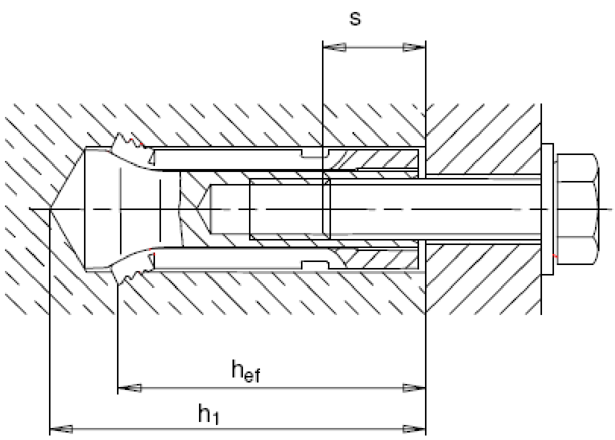
9.1 HSC-I/IR	SW	T_{inst}
M6 × 40	10	10 Nm
M8 × 40	13	10 Nm
M10 × 50	17	20 Nm
M10 × 60	17	30 Nm
M12 × 60	19	30 Nm

For HSC-I: fastening carbon steel screw or threaded rod. Minimum strength class 8.8

For HSC-IR: fastening stainless steel screw or threaded rod: minimum strength class A4-70

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

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}

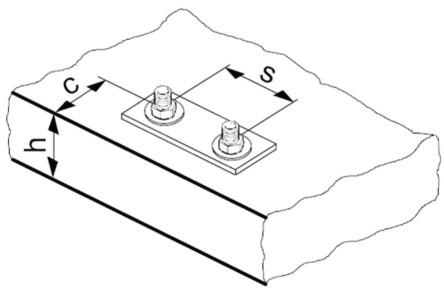


Setting details

Anchor version			M6x40	M8x40	M10x50	M10x60	M12x60
Nominal diameter of drill bit	d_0	[mm]	14	16	18	18	20
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	14,5	16,5	18,5	18,5	20,5
Depth of drill hole	$h_1 \geq$	[mm]	46	46	56	68	68
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	7	9	12	12	14
Effective anchorage depth	h_{ef}	[mm]	40	40	50	60	60
Screwing depth	min s	[mm]	6	8	10	10	12
	max s	[mm]	16	22	28	28	30
Width across	SW	[mm]	10	13	17	17	19
Installation torque	T_{inst}	[Nm]	10	10	20	30	30

Base material thickness, anchor spacing and edge distance

Anchor size			M6x40	M8x40	M10x50	M10x60	M12x60
Minimum base material thickness	h_{min}	[mm]	100	100	110	130	130
Minimum spacing	s_{min}	[mm]	40	40	50	60	60
Minimum edge distance	c_{min}	[mm]	40	40	50	60	60
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	120	120	150	180	180
Critical edge distance for concrete cone failure	$c_{cr,N}$	[mm]	60	60	75	90	90
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	130	120	170	180	180
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	65	60	85	90	90



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

Critical spacing and critical edge distance for splitting failure apply only for non-cracked concrete. For cracked concrete only the critical spacing and critical edge distance for concrete cone failure are decisive.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according data given in ETA-02/0027 issue 2012-09-20.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

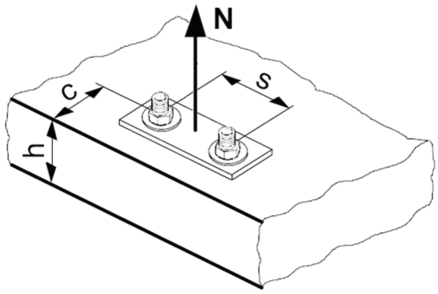
For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):

$$N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M6x40	M8x40	M10x50	M10x60	M12x60
$N_{Rd,s}$	HSC-I	[kN]	10,7	16,3	20,2	20,2	24,3
	HSC-IR	[kN]	7,5	11,4	14,2	14,2	17,1

Design pull-out resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$

	Non-cracked concrete					Cracked concrete				
Anchor size	M6x 40	M8x 40	M10x 50	M10x 60	M12x 60	M6x 40	M8x 40	M10x 50	M10x 60	M12x 60
$N^0_{Rd,p}$ [kN]	No pull-out failure					No pull-out failure				

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance [a)] $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

	Non-cracked concrete					Cracked concrete				
Anchor size	M6x 40	M8x 40	M10x 50	M10x 60	M12x 60	M6x 40	M8x 40	M10x 50	M10x 60	M12x 60
$N^0_{Rd,c}$ [kN]	8,5	8,5	11,9	15,6	15,6	6,1	6,1	8,5	11,2	11,2

- Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2\ a)}$	1	1,1	1,22	1,34	1,41	1,48	1,55

- $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance [a)]

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

- The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing [a)]

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

- The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of base material thickness

h/h_{ef}	2,0	2,2	2,4	2,6	2,8	3,0	3,2	3,4	3,6	≥ 3,68
$f_{h,sp} = [h/(2 \cdot h_{ef})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

Influence of reinforcement

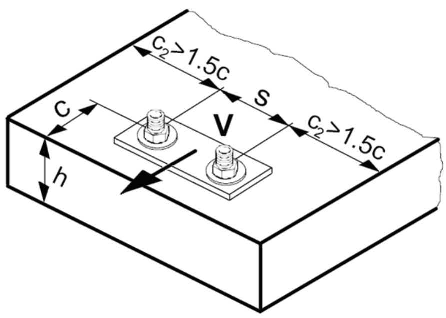
Anchor size	M6x40	M8x40	M10x50	M10x60	M12x60
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 [a)]	0,7 [a)]	0,75 [a)]	0,8 [a)]	0,8 [a)]

- This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M6x40	M8x40	M10x50	M10x60	M12x60
$V_{Rd,s}$	HSC-I	[kN]	6,4	9,8	12,2	12,2	14,6
	HSC-IR	[kN]	4,5	6,9	8,5	8,5	10,3

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$ [a)]

Anchor size	M6x40	M8x40	M10x50	M10x60	M12x60
k	2,0				

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance [a)] $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

	Non-cracked concrete					Cracked concrete				
Anchor size	M6x 40	M8x 40	M10x 50	M10x 60	M12x 60	M6x 40	M8x 40	M10x 50	M10x 60	M12x 60
$V^0_{Rd,c}$ [kN]	14,9	18,5	22,6	22,7	27,0	10,5	13,1	16,0	16,1	19,1

- For anchor groups only the anchors close to the edge must be considered.

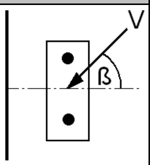
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

- $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \frac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

- The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M6x40	M8x40	M10x50	M10x60	M12x60
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,29	0,23	0,28	0,38	0,32

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

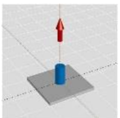
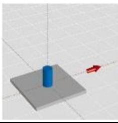
Precalculated values

Design resistance calculated according ETAG 001, Annex C and data given in ETA-02/0027, issue 2012-09-20. All data applies to concrete C 20/25 – $f_{ck,cube}$ =25 N/mm².

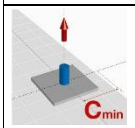
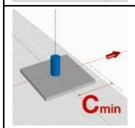
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Design resistance

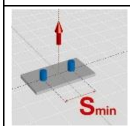
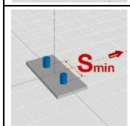
Single anchor, no edge effects

			Non-cracked concrete					Cracked concrete				
Anchor size			M6x 40	M8x 40	M10x 50	M10x 60	M12x 60	M6x 40	M8x 40	M10x 50	M10x 60	M12x 60
Min. base material thickness h_{min} [mm]			100	100	110	130	130	100	100	110	130	130
	Tensile N_{Rd}											
	HSC-I	[kN]	8,5	8,5	11,9	15,6	15,6	6,1	6,1	8,5	11,2	11,2
	HSC-IR	[kN]	7,5	8,5	11,9	14,2	15,6	6,1	6,1	8,5	11,2	11,2
	Shear V_{Rd}, without lever arm											
	HSC-I	[kN]	6,4	9,8	12,2	12,2	14,6	6,4	9,8	12,2	12,2	14,6
	HSC-IR	[kN]	4,5	6,9	8,5	8,5	10,3	4,5	6,9	8,5	8,5	10,3

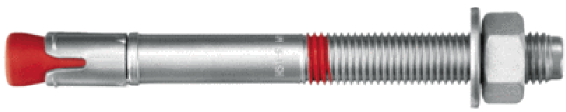
Single anchor, min. edge distance ($c = c_{min}$)

			Non-cracked concrete					Cracked concrete				
Anchor size			M6x 40	M8x 40	M10x 50	M10x 60	M12x 60	M6x 40	M8x 40	M10x 50	M10x 60	M12x 60
Min. base material thickness h_{min} [mm]			100	100	110	130	130	100	100	110	130	130
Min. edge distance c_{min} [mm]			40	40	50	60	60	40	40	50	60	60
	Tensile N_{Rd}											
	HSC-I HSC-IR	[kN]	6,1	6,4	4,2	11,7	11,7	4,6	4,6	6,4	8,4	8,4
	Shear V_{Rd}, without lever arm											
	HSC-I HSC-IR	[kN]	3,6	3,6	5,2	6,8	7,0	2,5	2,6	3,7	4,9	4,9

Double anchor, no edge effects, min. spacing ($s = s_{min}$), (load values are valid for one anchor)

			Non-cracked concrete					Cracked concrete				
Anchor size			M6x 40	M8x 40	M10x 50	M10x 60	M12x 60	M6x 40	M8x 40	M10x 50	M10x 60	M12x 60
Min. base material thickness h_{min} [mm]			100	100	110	130	130	100	100	110	130	130
Min. spacing s_{min} [mm]			40	40	50	60	60	40	40	50	60	60
	Tensile N_{Rd}											
	HSC-I HSC-IR	[kN]	5,6	5,7	7,7	10,4	10,4	4,0	4,0	5,7	7,4	7,4
	Shear V_{Rd}, without lever arm											
	HSC-I	[kN]	6,4	9,8	12,2	12,2	14,6	6,4	8,1	11,3	12,2	14,6
	HSC-IR	[kN]	4,5	6,9	8,5	8,5	10,3	4,5	6,9	8,5	8,5	10,3

HST Stud anchor

	Anchor version	Benefits
	HST Carbon steel	- suitable for non-cracked and cracked concrete C 20/25 to C 50/60 - quick and simple setting operation - safety wedge for certain follow up expansion
	HST-R Stainless steel HST-HCR High corrosion resistance steel	

Concrete | Tensile zone | Fire resistance | Shock | Seismic | Corrosion resistance | High corrosion resistance | European Technical Approval | CE conformity

PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-98/0001 / 2013-05-08
Shockproof fastenings in civil defence installations	Federal Office for Cicil Protection, Bern	BZS D 08-602 / 2008-12-15
Fire test report	DIBt, Berlin	ETA-98/0001 / 2013-05-08
Fire test report ZTV-Tunnel	IBMB, Braunschweig	UB 3332/0881-2 / 2003-07-02
Assessment report (fire)	warringtonfire	WF 327804/A / 2013-07-10

a) All data given in this section according ETA-98/0001, issue 2013-05-08.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete as specified in the table
- *Steel* failure
- Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

Mean ultimate resistance

		Non-cracked concrete						Cracked concrete					
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Tensile $N_{Ru,m}$													
HST	[kN]	16,6	22,3	35,2	48,7	76,0	86,1	10,3	11,6	21,9	31,1	44,9	60,2
HST-R	[kN]	18,1	26,7	35,1	49,8	77,4	79,1	12,7	18,4	20,1	36,0	55,1	70,5
HST-HCR	[kN]	15,2	22,7	32,4	45,5	-	-	13,8	16,2	21,5	32,4	-	-
Shear $V_{Ru,m}$													
HST	[kN]	*17,6*	*27,8*	*40,5*	*67,8*	*102,9*	*112,3*	*17,6*	*27,8*	*40,5*	*67,8*	*102,9*	*112,3*
HST-R	[kN]	*15,8*	*24,4*	*35,4*	*61,2*	*95,6*	*137,7*	*15,8*	*24,4*	*35,4*	*61,2*	*95,6*	*137,7*
HST-HCR	[kN]	*17,6*	*27,8*	*40,5*	*75,4*	-	-	*17,6*	*27,8*	*40,5*	*75,4*	-	-

Characteristic resistance

		Non-cracked concrete						Cracked concrete					
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Tensile N_{Rk}													
HST	[kN]	9,0	16,0	20,0	35,0	50,0	60,0	5,0	9,0	12,0	20,0	30,0	40,0
HST-R	[kN]	9,0	16,0	20,0	35,0	50,0	60,0	5,0	9,0	12,0	25,0	30,0	40,0
HST-HCR	[kN]	9,0	16,0	20,0	35,0	-	-	5,0	9,0	12,0	25,0	-	-
Shear V_{Rk}													
HST	[kN]	*14,0*	*23,5*	*35,0*	*55,0*	*84,0*	*94,0*	*14,0*	*23,5*	*35,0*	*55,0*	*84,0*	*94,0*
HST-R	[kN]	*13,0*	*20,0*	*30,0*	*50,0*	*80,0*	*115,0*	*13,0*	*20,0*	*30,0*	*50,0*	*80,0*	*115,0*
HST-HCR	[kN]	*13,0*	*20,0*	*30,0*	*55,0*	-	-	*13,0*	*20,0*	*30,0*	53,5	-	-

Design resistance

		Non-cracked concrete						Cracked concrete					
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Tensile N_{Rd}													
HST	[kN]	5,0	10,7	13,3	23,3	33,3	40,0	2,8	6,0	8,0	13,3	20,0	26,7
HST-R		6,0	10,7	13,3	23,3	33,3	40,0	3,3	6,0	8,0	16,7	20,0	26,7
HST-HCR	[kN]	6,0	10,7	13,3	23,3	-	-	3,3	6,0	8,0	16,7	-	-
Shear V_{Rd}													
HST	[kN]	*11,2*	*18,8*	*28,0*	*44,0*	*67,2*	*62,7*	*11,2*	*18,8*	*28,0*	*44,0*	60,9	*62,7*
HST-R	[kN]	*10,4*	*16,0*	*24,0*	*38,5*	*55,6*	*79,9*	*10,4*	*16,0*	*24,0*	35,6	*55,6*	*79,9*
HST-HCR	[kN]	*10,4*	*16,0*	*24,0*	*44,0*	-	-	*10,4*	*16,0*	*24,0*	35,6	-	-

Recommended loads

		Non-cracked concrete						Cracked concrete					
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Tensile N_{rec} a)													
HST	[kN]	3,6	7,6	9,5	16,7	23,8	28,6	2,0	4,3	5,7	9,5	14,3	19,0
HST-R	[kN]	4,3	7,6	9,5	16,7	23,8	28,6	2,4	4,3	5,7	11,9	14,3	19,0
HST-HCR	[kN]	4,3	7,6	9,5	16,7	-	-	2,4	4,3	5,7	11,9	-	-
Shear V_{rec} a)													
HST	[kN]	8,0	13,4	20,0	31,4	48,0	44,8	8,0	13,4	20,0	31,4	43,5	44,8
HST-R	[kN]	7,4	11,4	17,1	27,5	39,7	57,0	7,4	11,4	17,1	25,5	39,7	57,0
HST-HCR	[kN]	7,4	11,4	17,1	31,4	-	-	7,4	11,4	17,1	25,5	-	-

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

Mechanical properties of HST, HST-R, HST-HCR

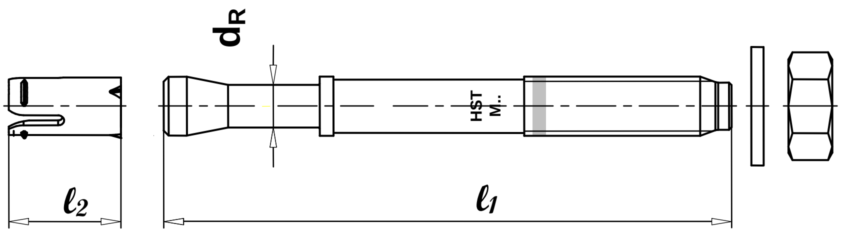
Anchor size			M8	M10	M12	M16	M20	M24
Nominal tensile strength f_{uk}	HST	[N/mm²]	800	800	800	720	700	530
	HST-R	[N/mm²]	720	700	700	650	650	650
	HST-HCR	[N/mm²]	800	800	800	800	-	-
Yield strength f_{yk}	HST	[N/mm²]	640	640	640	580	560	451
	HST-R	[N/mm²]	575	560	560	500	450	450
	HST-HCR	[N/mm²]	640	640	640	640	-	-
Stressed cross-section A_s		[mm²]	36,6	58,0	84,3	157	245	353
Moment of resistance W		[mm³]	31,2	62,3	109,2	277,5	540,9	935,5
Char. bending resistance $M^0_{Rk,s}$	HST	[Nm]	30	60	105	240	454	595
	HST-R	[Nm]	27	53	92	216	422	730
	HST-HCR	[Nm]	30	60	105	266	-	-

Material quality

Part		Material
Bolt	HST	Carbon steel, galvanised to min. 5 µm
	HST-R	Stainless steel
	HST-HCR	High corrosion resistant steel

Anchor dimensions

Anchor size			M8	M10	M12	M16	M20	M24
Minimum thickness of fixture	$t_{fix,min}$	[mm]	2	2	2	2	2	2
Maximum thickness of fixture	$t_{fix,max}$	[mm]	195	200	200	235	305	330
Shaft diameter at the cone	d_R	[mm]	5,5	7,2	8,5	11,6	14,6	17,4
Minimum length of the anchor	$\ell_{1,min}$	[mm]	75	90	115	140	170	200
Maximum length of the anchor	$\ell_{1,max}$	[mm]	260	280	295	350	450	500
Length of expansion sleeve	ℓ_2	[mm]	14,8	18,2	22,7	24,3	28,3	36

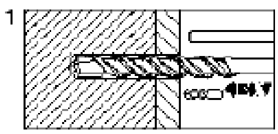


Setting

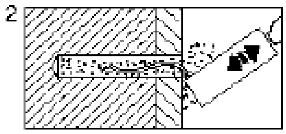
Installation equipment

Anchor size	M8	M10	M12	M16	M20	M24
Rotary hammer	TE2 – TE16				TE40 – TE70	
Other tools	hammer, torque wrench, blow out pump					

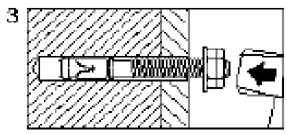
Setting instruction



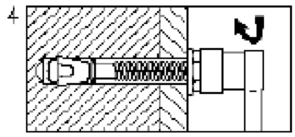
Drill hole with drill bit.



Blow out dust and fragments.



Install anchor.

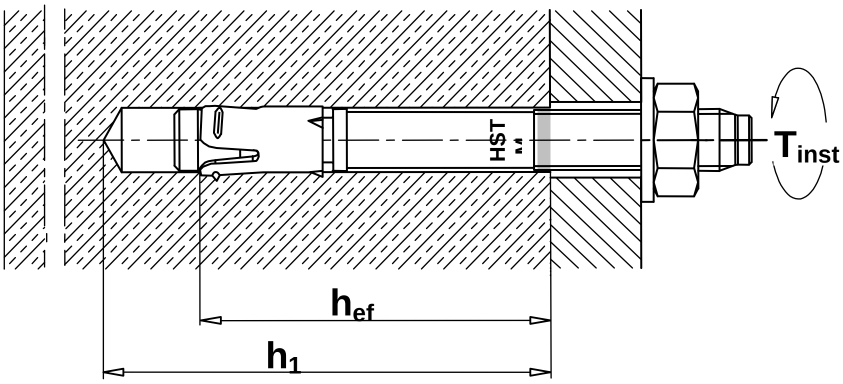


Apply tightening torque.

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

For technical data for anchors in diamond drilled holes please contact the Hilti Technical advisory service.

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}

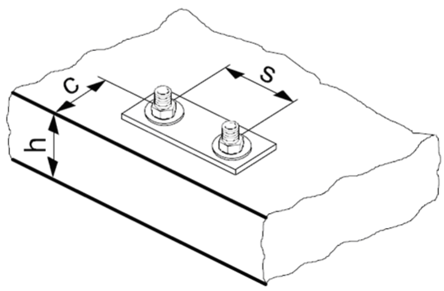


Setting details HST, HST-R, HST-HCR

			M8	M10	M12	M16	M20	M24
Nominal diameter of drill bit	d_o	[mm]	8	10	12	16	20	24
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45	10,45	12,5	16,5	20,55	24,55
Depth of drill hole	$h_1 \geq$	[mm]	65	80	95	115	140	170
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	9	12	14	18	22	26
Effective anchorage depth	h_{ef}	[mm]	47	60	70	82	101	125
Torque moment	T_{inst}	[Nm]	20	45	60	110	240	300
Width across	SW	[mm]	13	17	19	24	30	36

Setting parameters

Anchor size				M8	M10	M12	M16	M20	M24
Minimum base material thickness		h_{min}	[mm]	100	120	140	160	200	250
Minimum spacing in non-cracked concrete	HST	s_{min}	[mm]	60	55	60	70	100	125
		for c ≥	[mm]	50	80	85	110	225	255
	HST-R	s_{min}	[mm]	60	55	60	70	100	125
		for c ≥	[mm]	60	70	80	110	195	205
	HST-HCR	s_{min}	[mm]	60	55	60	70	-	-
		for c ≥	[mm]	50	70	80	110	-	-
Minimum spacing in cracked concrete	HST	s_{min}	[mm]	40	55	60	70	100	125
		for c ≥	[mm]	50	70	75	100	160	180
	HST-R	s_{min}	[mm]	40	55	60	70	100	125
		for c ≥	[mm]	50	65	75	100	130	130
	HST-HCR	s_{min}	[mm]	40	55	60	70	-	-
		for c ≥	[mm]	50	70	75	100	-	-
Minimum edge distance in non-cracked concrete	HST	c_{min}	[mm]	50	55	55	85	140	170
		for s ≥	[mm]	60	115	145	150	270	295
	HST-R	c_{min}	[mm]	60	50	55	70	140	150
		for s ≥	[mm]	60	115	145	160	210	235
	HST-HCR	c_{min}	[mm]	60	55	55	70	-	-
		for s ≥	[mm]	60	115	145	160	-	-
Minimum edge distance in cracked concrete	HST	c_{min}	[mm]	45	55	55	70	100	125
		for s ≥	[mm]	50	90	120	150	225	240
	HST-R HST-HCR	c_{min}	[mm]	45	50	55	60	100	125
		for s ≥	[mm]	50	90	110	160	160	140
Critical spacing for splitting failure and concrete cone failure		$s_{cr,sp}$ $s_{cr,N}$	[mm]	141	180	210	246	303	375
Critical edge distance for splitting failure and concrete cone failure		$c_{cr,sp}$ $c_{cr,N}$	[mm]	71	90	105	123	152	188



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according data given in ETA-98/0001, issue 2013-05-08.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

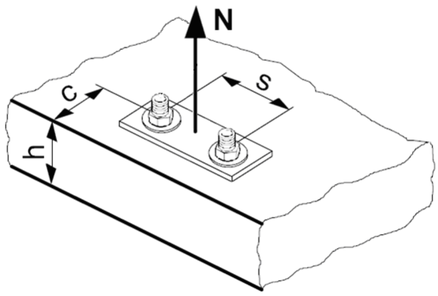
For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):

$$N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24
$N_{Rd,s}$	HST	[kN]	12,7	21,3	30,0	50,7	78,0	90,1
	HST-R	[kN]	11,3	18,7	26,7	44,2	63,0	90,2
	HST-HCR	[kN]	12,9	21,5	30,5	56,3	-	-

Design pull-out resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$

			Non-cracked concrete						Cracked concrete					
Anchor size			M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
$N^0_{Rd,p}$	HST	[kN]	5,0	10,7	13,3	23,3	33,3	40,0	2,8	6,0	8,0	13,3	20,0	26,7
	HST-R	[kN]	6,0	10,7	13,3	23,3	33,3	40,0	3,3	6,0	8,0	16,7	20,0	26,7
	HST-HCR	[kN]	6,0	10,7	13,3	23,3	-	-	3,3	6,0	8,0	16,7	-	-

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance [a] $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

		Non-cracked concrete						Cracked concrete					
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
$N^0_{Rd,c}$	HST [kN]	9,0	15,6	19,7	24,9	34,1	47	6,4	11,2	14,1	17,8	24,4	33,5
	HST-R [kN]	10,8	15,6	19,7	24,9	34,1	47	7,7	11,2	14,1	17,8	24,4	33,5
	HST-HCR [kN]	10,8	15,6	19,7	24,9	-	-	7,7	11,2	14,1	17,8	-	-

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance [a]

$c/c_{cr,N}$ / $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ / $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ / $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing [a]

$s/s_{cr,N}$ / $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ / $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of base material thickness

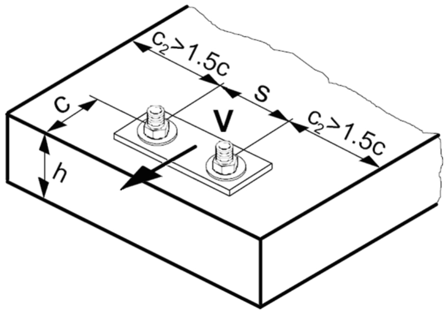
h/h_{ef}	2,0	2,2	2,4	2,6	2,8	3,0	3,2	3,4	3,6	≥ 3,68
$f_{h,sp} = [h/(2 \cdot h_{ef})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

Influence of reinforcement

Anchor size	M8	M10	M12	M16	M20	M24
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,74 [a]	0,8 [a]	0,85 [a]	0,91 [a]	1	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N} = 1$ may be applied.

Shear loading



The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24
$V_{Rd,s}$	HST	[kN]	11,2	18,8	28,0	44,0	67,2	62,7
	HST-R	[kN]	10,4	16,0	24,0	38,5	55,6	79,9
	HST-HCR	[kN]	10,4	16,0	24,0	44,0	-	-

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$ a)

Anchor size	M8	M10	M12	M16	M20	M24
k	2	2	2,2	2,5	2,5	2,5

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance a) $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

		Non-cracked concrete						Cracked concrete					
Anchor size		M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,7	18,9	27,3	37,1	4,2	6,1	8,3	13,4	19,3	26,3

a) For anchor groups only the anchors close to the edge must be considered.

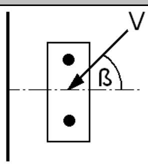
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20	M24
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,98	1,01	0,97	0,78	0,76	0,80

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

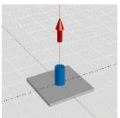
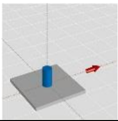
Precalculated values

Design resistance calculated according ETAG 001, Annex C and data given in ETA-98/0001, issue 2013-05-08.
All data applies to concrete C 20/25 – $f_{ck,cube}$ =25 N/mm².

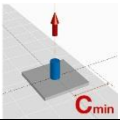
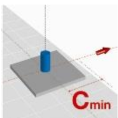
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Design resistance

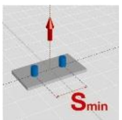
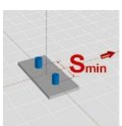
Single anchor, no edge effects

			Non-cracked concrete						Cracked concrete					
Anchor size			M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
Min. base material thickness h_{min} [mm]			100	120	140	160	200	250	100	120	140	160	200	250
	Tensile N_{Rd}													
	HST	[kN]	5,0	10,7	13,3	23,3	33,3	40,0	2,8	6,0	8,0	13,3	20,0	26,7
	HST-R	[kN]	6,0	10,7	13,3	23,3	33,3	40,0	3,3	6,0	8,0	16,7	20,0	26,7
	HST-HCR	[kN]	6,0	10,7	13,3	23,3	-	-	3,3	6,0	8,0	16,7	-	-
	Shear V_{Rd}, without lever arm													
	HST	[kN]	11,2	18,8	28,0	44,0	67,2	62,7	11,2	18,8	28,0	44,0	60,9	62,7
	HST-R	[kN]	10,4	16,0	24,0	38,5	55,6	79,9	10,4	16,0	24,0	38,5	55,6	79,9
	HST-HCR	[kN]	10,4	16,0	24,0	44,0	-	-	10,4	16,0	24,0	44,0	-	-

Single anchor, min. edge distance ($c = c_{min}$)

			Non-cracked concrete						Cracked concrete					
Anchor size			M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
Min. base material thickness h_{min} [mm]			100	120	140	160	200	250	100	120	140	160	200	250
Min. edge distance c_{min}	HST	[mm]	50	55	55	85	140	170	45	55	55	70	100	125
	HST-R	[mm]	60	50	55	70	140	150	45	50	55	60	100	125
	HST-HCR	[mm]	60	55	55	70	-	-	45	50	55	60	-	-
	Tensile N_{Rd}													
	HST	[kN]	5,0	10,7	12,9	19,1	32,1	40,0	2,8	6,0	8,0	12,2	18,2	25,2
	HST-R	[kN]	6,0	10,5	12,9	17,0	32,1	39,7	3,3	6,0	8,0	11,2	18,2	25,2
	HST-HCR	[kN]	6,0	10,7	12,9	17,0	-	-	3,3	6,0	8,0	11,2	-	-
	Shear V_{Rd}, without lever arm													
	HST	[kN]	4,5	5,6	5,9	11,3	22,8	32,0	2,8	3,9	4,2	6,2	10,7	15,4
	HST-R	[kN]	5,8	4,9	5,9	8,8	22,8	27,5	2,8	3,5	4,2	5,1	10,7	15,4
	HST-HCR	[kN]	5,8	5,6	5,9	8,8	-	-	2,8	3,5	4,2	5,1	-	-

Double anchor, no edge effects, min. spacing ($s = s_{min}$), (load values are valid for one anchor)

			Non-cracked concrete						Cracked concrete					
Anchor size			M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
Min. base material thickness h_{min} [mm]			100	120	140	160	200	250	100	120	140	160	200	250
Min. spacing s_{min} [mm]			60	55	60	70	100	125	40	55	60	70	100	125
	Tensile N_{Rd}													
	HST	[kN]	5,0	10,2	12,7	16,0	22,7	31,3	2,8	6,0	8,0	11,4	16,2	22,4
	HST-R	[kN]	6,0	10,2	12,7	16,0	22,7	31,3	3,3	6,0	8,0	11,4	16,2	22,4
	HST-HCR	[kN]	6,0	10,2	12,7	16,0	-	-	3,3	6,0	8,0	11,4	-	-
	Shear V_{Rd}, without lever arm													
	HST	[kN]	11,2	18,8	27,8	40,1	56,7	62,7	8,3	14,6	19,9	22,9	40,5	55,9
	HST-R	[kN]	10,4	16,0	24,0	38,5	55,6	78,4	9,9	14,6	19,9	28,6	40,5	55,9
	HST-HCR	[kN]	10,4	16,0	24,0	40,1	-	-	9,9	14,6	19,9	28,6	-	-

Seismic design C1 and C2

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:
- Seismic design according to TR045

The following technical data are based on: ETA-98/0001 issue 2013-05-08

Anchorage depth range

Anchor size			M8	M10	M12	M16	M20	M24
Nominal anchorage depth range	h_{nom}	[mm]	55	69	80	95	117	143

Tension resistance in case of seismic performance category C1

Anchor size			M10	M12	M16
Characteristic tension resistance to steel failure					
HST (steel galvanized)					
Characteristic resistance	$N_{Rk,s,seis}$	[kN]	32	45	76
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5		
HST-R (stainless steel)					
Characteristic resistance	$N_{Rk,s,seis}$	[kN]	28	40	69
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5		1,56
Pullout failure					
HST (steel galvanized) and **HST-R** (stainless steel)					
Characteristic resistance	$N_{Rk,p,seis}$	[kN]	8,0	10,7	18,0
Partial safety factor	$\gamma_{Mp,seis}$	[-]	1,5		
Concrete cone and splitting failure					
HST (steel galvanized) and **HST-R** (stainless steel)					
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]	1,5		

Displacement under tension load in case of seismic performance category C1 [1)]

Anchor size			M10	M12	M16
Displacement HST and **HST-R**	$\delta_{N,seis}$	[mm]	1,1	0,8	1,0

1) Maximum displacement during cycling (seismic event).

Shear resistance in case of seismic performance category C1 [1)]

Anchor size			M10	M12	M16
Steel failure					
HST (steel galvanized)					
Characteristic resistance	$V_{Rk,s,seis}$	[kN]	16	27	41,3
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25		
HST-R (stainless steel)					
Characteristic resistance	$V_{Rk,s,seis}$	[kN]	13,6	23,1	37,5
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25		1,3
Concrete pryout and concrete edge failure					
HST (steel galvanized) and **HST-R** (stainless steel)					
Partial safety factor	$\gamma_{Mcp,seis} = \gamma_{Mc,seis}$	[-]	1,5		

1) Reduction factor α_{gap} = 1,0 when using the Hilti Dynamic Set

Displacement under shear load for seismic loading, performance category C1 [1)]

Anchor size			M10	M12	M16
Displacement HST and **HST-R**	$\delta_{V,seis}$	[mm]	6,2	7,3	6,2

1) Maximum displacement during cycling (seismic event).

For seismic resistent fastening applications please use the anchor design software PROFIS Anchor.

Tension resistance in case of seismic performance category C2

Anchor size			M10	M12	M16
Characteristic tension resistance to steel failure					
HST (steel galvanized)					
Characteristic resistance	$N_{Rk,s,seis}$	[kN]	32	45	76
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5		
HST-R (stainless steel)					
Characteristic resistance	$N_{Rk,s,seis}$	[kN]	28	40	69
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5		1,56
Pullout failure					
HST (steel galvanized) and **HST-R** (stainless steel)					
Characteristic resistance	$N_{Rk,p,seis}$	[kN]	3,3	10,0	12,8
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5		
Concrete cone and splitting failure					
HST (steel galvanized) and **HST-R** (stainless steel)					
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]	1,5		

Displacement under tension load in case of seismic performance category C2

Anchor size			M10	M12	M16
HST and **HST-R**					
Displacement DLS	$\delta_{N,seis(DLS)}$	[mm]	1,4	6,7	4,0
Displacement ULS	$\delta_{N,seis(ULS)}$	[mm]	8,6	15,9	13,3

Shear resistance in case of seismic performance category C2 1)

Anchor size			M10	M12	M16
Steel failure					
HST (steel galvanized)					
Characteristic resistance	$V_{Rk,s,seis}$	[kN]	14,3	21	41,3
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25		
HST-R (stainless steel)					
Characteristic resistance	$V_{Rk,s,seis}$	[kN]	12	18	37,5
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25		1,3
Concrete pryout and concrete edge failure					
HST (steel galvanized) and **HST-R** (stainless steel)					
Partial safety factor	$\gamma_{Mcp,seis} = \gamma_{Mc,seis}$	[-]	1,5		

1) Reduction factor α_{gap} = 1,0 when using the Hilti Dynamic Set

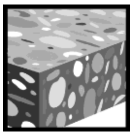
Displacement under shear load in case of seismic performance category C2

Anchor size			M10	M12	M16
HST and **HST-R**					
Displacement DLS	$\delta_{V,seis(DLS)}$	[mm]	4,2	5,3	5,7
Displacement ULS	$\delta_{V,seis(DLS)}$	[mm]	7,5	7,9	8,9

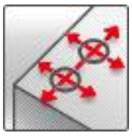
For seismic resistent fastening applications please use the anchor design software PROFIS Anchor.

HSA Stud anchor

	Anchor version	Benefits
	HSA Carbon steel with DIN 125 washe HSA-R Stainless steel A4 HSA-R2 Stainless steel A2 with DIN 125 washer HSA-BW Carbon steel with DIN 9021 washer	- Fast & convenient setting behaviour - Reliable ETA approved torqueing using impact wrench with torque bar for torque control - Small edge and spacing distances - High loads - Three embedment depths for maximal design flexibility - M12, M16 and M20 ETA approved for diamond cored holes using DD 30-W and matching diamond core bit - Suitable for pre- and through fastening



Concrete



Small edge distance and spacing

Fire resistance

A4 316

Corrosion resistance

Diamond drilled holes

European Technical Approval

CE conformity

PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-11/0374 / 2012-07-19
Fire test report	IBMB, Braunschweig	3215/229/12 / 2012-08-09

a) All data given in this section according ETA-11/0374, issue 2012-07-19.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Minimum base material thickness
- Non-cracked Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

Mean ultimate resistance

Anchor size			M6			M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	60	30	40	70	40	50	80
Tensile $N_{Ru,m}$											
HSA, HSA-BW		[kN]	8,0	*9,5*	*9,5*	11,0	17,0	*17,3*	17,0	23,7	*29,4*
HSA-R2, HSA-R		[kN]	8,0	10,0	11,9	11,0	17,0	*19,2*	17,0	23,7	33,2
Shear $V_{Ru,m}$											
HSA, HSA-BW		[kN]	*6,8*	*6,8*	*6,8*	11,0	*11,1*	*11,1*	*19,8*	*19,8*	*19,8*
HSA-R2, HSA-R		[kN]	*7,6*	*7,6*	*7,6*	11,0	*12,9*	*12,9*	*23,7*	*23,7*	*23,7*

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Tensile $N_{Ru,m}$											
HSA, HSA-BW		[kN]	23,7	35,1	*43,5*	35,1	48,0	66,4	43,5	67,0	82,7
HSA-R2, HSA-R		[kN]	23,7	35,1	46,5	35,1	48,0	66,4	43,5	67,0	82,7
Shear $V_{Ru,m}$											
HSA, HSA-BW		[kN]	*31,0*	*31,0*	*31,0*	*53,6*	*53,6*	*53,6*	87,1	*90,1*	*90,1*
HSA-R2, HSA-R		[kN]	*30,8*	*30,8*	*30,8*	*59,3*	*59,3*	*59,3*	87,1	*96,5*	*96,5*

Characteristic resistance

Anchor size			M6			M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	60	30	40	70	40	50	80
Tensile N_{Rk}											
HSA, HSA-BW		[kN]	6,0	7,5	*9,0*	8,3	12,8	16,0	12,8	17,9	25,0
HSA-R2, HSA-R		[kN]	6,0	7,5	9,0	8,3	12,8	16,0	12,8	17,9	25,0
Shear V_{Rk}											
HSA, HSA-BW		[kN]	*6,5*	*6,5*	*6,5*	8,3	*10,6*	*10,6*	*18,9*	*18,9*	*18,9*
HSA-R2, HSA-R		[kN]	*7,2*	*7,2*	*7,2*	8,3	*12,3*	*12,3*	*22,6*	*22,6*	*22,6*

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Tensile N_{Rk}											
HSA, HSA-BW		[kN]	17,9	26,5	35,0	26,5	36,1	50,0	32,8	50,5	62,3
HSA-R2, HSA-R		[kN]	17,9	26,5	35,0	26,5	36,1	50,0	32,8	50,5	62,3
Shear V_{Rk}											
HSA, HSA-BW		[kN]	*29,5*	*29,5*	*29,5*	*51,0*	*51,0*	*51,0*	65,6	*85,8*	*85,8*
HSA-R2, HSA-R		[kN]	*29,3*	*29,3*	*29,3*	*56,5*	*56,5*	*56,5*	65,6	*91,9*	*91,9*

Design resistance

Anchor size			M6			M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	60	30	40	70	40	50	80
Tensile N_{Rd}											
HSA, HSA-BW		[kN]	4,0	5,0	6,0	5,5	8,5	10,7	8,5	11,9	16,7
HSA-R2, HSA-R		[kN]	4,0	5,0	6,0	5,5	8,5	10,7	8,5	11,9	16,7
Shear V_{Rd}											
HSA, HSA-BW		[kN]	5,2	5,2	5,2	5,5	8,5	8,5	15,1	15,1	15,1
HSA-R2, HSA-R		[kN]	5,5	5,8	5,8	5,5	9,8	9,8	18,1	18,1	18,1

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Tensile N_{Rd}											
HSA, HSA-BW		[kN]	11,9	17,6	23,3	17,6	24,1	33,3	21,9	33,7	41,5
HSA-R2, HSA-R		[kN]	11,9	17,6	23,3	17,6	24,1	33,3	21,9	33,7	41,5
Shear V_{Rd}											
HSA, HSA-BW		[kN]	23,6	23,6	23,6	40,8	40,8	40,8	43,7	68,6	68,6
HSA-R2, HSA-R		[kN]	23,4	23,4	23,4	45,2	45,2	45,2	43,7	73,5	73,5

Recommended loads

Anchor size			M6			M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	60	30	40	70	40	50	80
Tensile N_{rec} [a)]											
HSA, HSA-BW		[kN]	2,9	3,6	4,3	4,0	6,1	7,6	6,1	8,5	11,9
HSA-R2, HSA-R		[kN]	2,9	3,6	4,3	4,0	6,1	7,6	6,1	8,5	11,9
Shear V_{rec} [a)]											
HSA, HSA-BW		[kN]	3,7	3,7	3,7	4,0	6,1	6,1	10,8	10,8	10,8
HSA-R2, HSA-R		[kN]	4,0	4,1	4,1	4,0	7,0	7,0	12,9	12,9	12,9

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Tensile N_{rec} [a)]											
HSA, HSA-BW		[kN]	8,5	12,6	16,7	12,6	17,2	23,8	15,6	24,0	29,7
HSA-R2, HSA-R		[kN]	8,5	12,6	16,7	12,6	17,2	23,8	15,6	24,0	29,7
Shear V_{rec} [a)]											
HSA, HSA-BW		[kN]	16,9	16,9	16,9	29,1	29,1	29,1	31,2	49,0	49,0
HSA-R2, HSA-R		[kN]	16,7	16,7	16,7	32,3	32,3	32,3	31,2	52,5	52,5

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

Mechanical properties

Anchor size			M6	M8	M10	M12	M16	M20
Nominal tensile strength $f_{uk,thread}$	HSA HSA-BW	[N/mm²]	650	580	650	700	650	700
	HSA- R2 HSA-R	[N/mm²]	650	560	650	580	600	625
Yield strength $f_{yk,thread}$	HSA HSA-BW	[N/mm²]	520	464	520	560	520	560
	HSA-R2 HSA-R	[N/mm²]	520	448	520	464	480	500
Stressed cross-section $A_{s,thread}$	HSA HSA-BW HSA-R2 HSA-R	[mm²]	20,1	36,6	58,0	84,3	157,0	245,0
Moment of resistance W	HSA HSA-BW HSA-R2 HSA-R	[mm³]	12,7	31,2	62,3	109,2	277,5	540,9
Char. bending resistance $M^0_{Rk,s}$	HSA HSA-BW	[Nm]	9,9	21,7	48,6	91,7	216,4	454,4
	HSA-R2 HSA-R	[Nm]	9,9	21,0	48,6	76,0	199,8	405,7

Material quality

Type	Part	Material	Coating
HSA **HSA-BW** Carbon Steel	Bolt	Carbon-steel	Galvanized (≥5 µm)
	Sleeve	Carbon-steel	
	Washer	HSA :carbon steel, HSA-BW: carbon steel	
	Hexagon nut	Steel, strength class 8	
HSA-R2 Stainless Steel Grade A2	Bolt	Stainless steel A2, 1.4301 or 1.4162	M6 - M20 coated
	Sleeve	Stainless steel A2, 1.4301 or 1.4404	-
	Washer	Stainless steel grade A2	-
	Hexagon nut	Stainless steel grade A2	M6 - M20 coated
HSA-R Stainless Steel Grade A4	Bolt	Stainless steel grade A4, 1.4401 or 1.4362	M6 - M20 coated
	Sleeve	Stainless steel A2, 1.4301 or 1.4404	-
	Washer	Stainless steel grade A4	-
	Hexagon nut	Stainless steel grade A4	M6 - M20 coated

Geometry washer

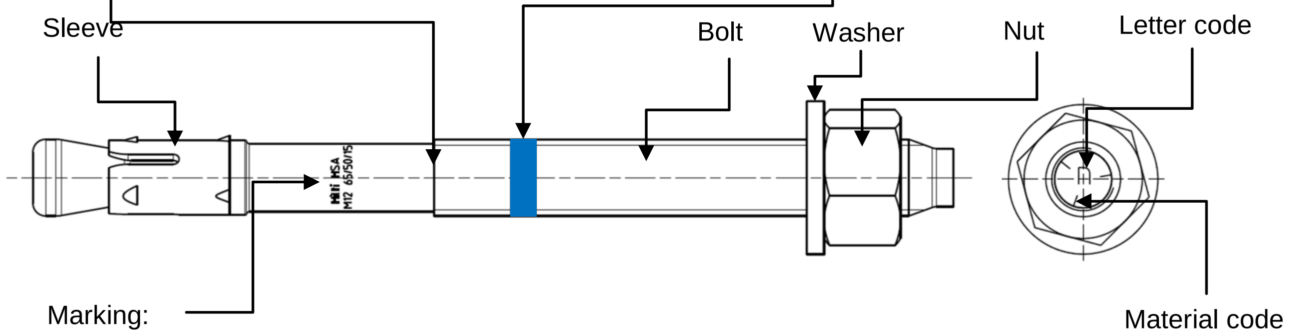
Anchor Size			M6	M8	M10	M12	M16	M20
Inner diameter d_1								
HSA, HSA-R2/ R	d_1	[mm]	6,4	8,4	10,5	13,0	17,0	21
HSA-BW	d_1	[mm]	6,4	8,4	10,5	13,0	17,0	22
Outer diameter d_2								
HSA, HSA-R2/ R	d_2	[mm]	12,0	16,0	20,0	24,0	30,0	37,0
HSA-BW	d_2	[mm]	18,0	24,0	30,0	37,0	50,0	60,0
Thickness h								
HSA, HSA-R2/ R	h	[mm]	1,6	1,6	2,0	2,5	3,0	3,0
HSA-BW	h	[mm]	1,8	2,0	2,5	3,0	3,0	4,0

Anchor dimensions and coding

Product marking and identification of anchor

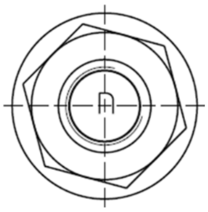
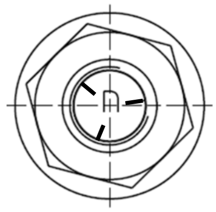
Beginning of thread: setting depth indicator for $h_{nom,1}$
$h_{nom,1}$ is reached when non-threaded part of the bolt is completely below the concrete surface

Blue ring: setting depth indicator for $h_{nom,2}$
$h_{nom,2}$ is reached when the blue ring is completely below the concrete surface



e.g.
Hilti HSA … Brand and Anchor type
M12 65/50/15 … Anchor Size and the max. $t_{fix,1}$/ $t_{fix,2}$/ $t_{fix,3}$ for the corresponding $h_{nom,1}$/ $h_{nom,2}$/ $h_{nom,3}$

Material code for identification of different materials

Type	**HSA/ HSA-BW** (carbon steel)	**HSA-R2** (stainless steel grade A2)	**HSA-R** (stainless steel grade A4)
Material Code	 Letter code without mark	 Letter code with two marks	 Letter code with three marks

Effective and nominal anchorage depth

Anchor size			**M6**			**M8**			**M10**		
Effective anchorage depth	h_{ef}	[mm]	30	40	60	30	40	70	40	50	80
Nominal anchorage depth	h_{nom}	[mm]	37	47	67	39	49	79	50	60	90

Anchor size			**M12**			**M16**			**M20**		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Nominal anchorage depth	h_{nom}	[mm]	64	79	114	77	92	132	90	115	130

Letter code for anchor length and maximum thickness of the fixture t_{fix}

Type	HSA, HSA-BW, HSA-R2, HSA-R					
Size	M6	M8	M10	M12	M16	M20
h_{nom} [mm]	37 / 47 / 67	39 / 49 / 79	50 / 60 / 90	64 / 79 / 114	77 / 92 / 132	90 / 115 / 130
Letter \ t_{fix}	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$
z	**5/-/-**	**5/-/-**	**5/-/-**	**5/ -/-**	**5/-/-**	5/-/-
y	10/-/-	10/-/-	10/-/-	10/-/-	10/-/-	**10/-/-**
x	15/5/-	15/5/-	15/5/-	15/-/-	15/-/-	15/-/-
w	**20/10/-**	**20/10/-**	**20/10/-**	**20/5/-**	**20/5/-**	20/-/-
v	25/15/-	25/15/-	25/15	25/10/-	25/10/-	25/-/-
u	30/20/-	30/20/-	30/20/-	30/15/-	30/15/-	30/5/-
t	35/25/5	**35/25/-**	**35/25/-**	**35/20/-**	35/20/-	35/10/-
s	**40/30/10**	40/30/-	40/30/-	40/25/-	**40/25/-**	40/15/-
r	45/35/15	45/35/5	45/35/5	45/30/-	45/30/-	45/20/5
q	50/40/20	50/40/10	**50/40/10**	50/35/-	50/35/-	50/25/10
p	**55/45/25**	**55/45/15**	55/45/15	55/40/5	55/40/-	**55/30/15**
o	60/50/30	60/50/20	60/50/20	60/45/10	60/45/5	60/35/20
n	65/55/35	65/55/25	65/55/25	**65/50/15**	65/50/10	65/40/25
m	70/60/40	70/60/30	**70/60/30**	70/55/20	70/55/15	70/45/30
l	75/65/45	75/65/35	75/65/35	75/60/25	75/60/20	75/50/35
k	80/70/50	**80/70/40**	80/70/40	80/65/30	80/65/25	80/55/40
j	85/75/55	85/75/45	85/75/45	85/70/35	**85/70/30**	85/60/45
i	90/80/60	90/80/50	**90/80/50**	90/75/40	90/75/35	90/65/50
h	95/85/65	95/85/55	95/85/55	**95/80/45**	95/80/40	95/70/55
g	100/90/70	100/90/60	100/90/60	100/85/50	100/85/45	100/75/60
f	105/95/75	105/95/65	**105/95/65**	105/90/55	105/90/50	105/80/65
e	110/100/80	110/100/70	110/100/70	110/95/60	110/95/55	110/85/70
d	115/105/85	115/105/75	115/105/75	115/100/65	115/100/60	115/90/75
c	120/110/90	120/110/80	120/110/80	**125/110/75**	120/105/65	120/95/80
b	125/115/95	125/115/85	125/115/85	135/120/85	125/110/70	125/100/85
a	130/120/100	130/120/90	130/120/90	**145/130/95**	**135/120/80**	130/105/90

Anchor length in bolt type and grey shaded are standard items. For selection of other anchor length, check availability of the items.

Setting

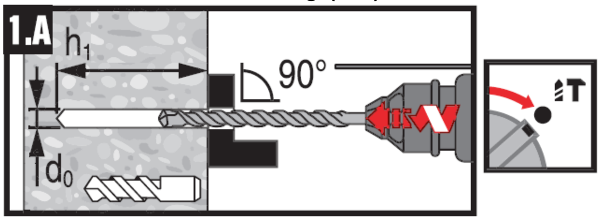
Installation equipment

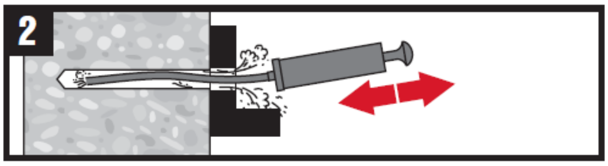
Anchor size	M6	M8	M10	M12	M16	M20
Rotary hammer	TE2 – TE16					TE40 – TE70
Other tools	hammer, torque wrench, blow out pump					

Setting instruction

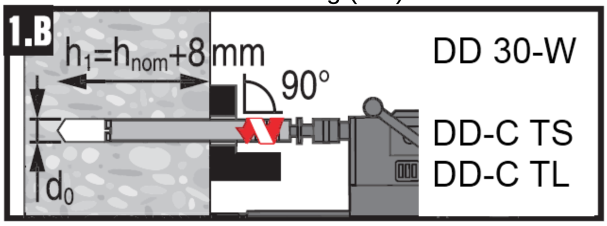
Drill and clean borehole

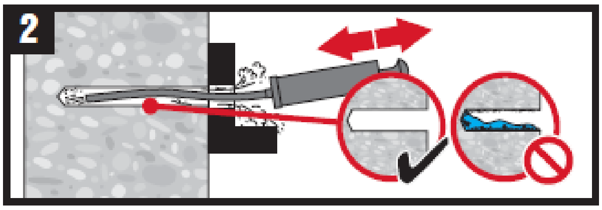
Standard drilling method
M6 – M20: Hammer drilling (HD)





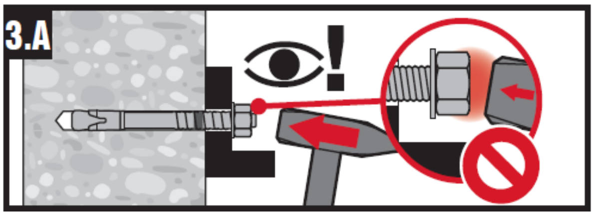
Alternative drilling method
M12 – M20: Diamond drilling (DD)



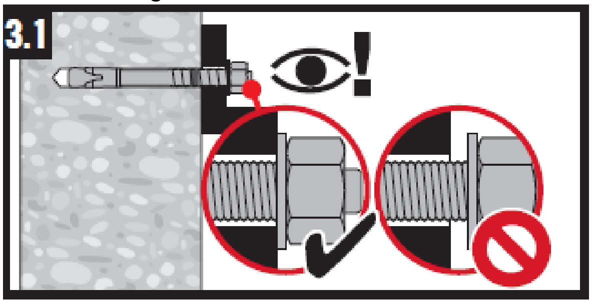


Install anchor with hammer or machine setting tool

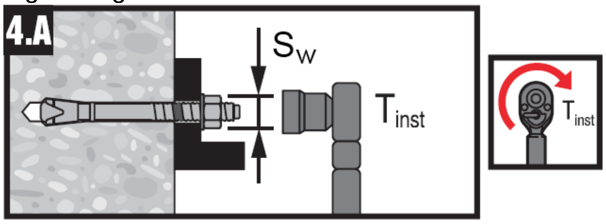
Standard setting method
M6 – M20: Hammer setting



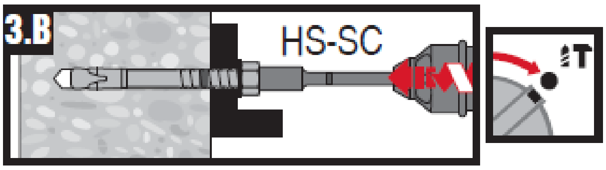
Check setting



Tightening the anchor



Alternative setting method
M8 – M16: Machnine setting



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

Machine tightening of the anchor for standard installation torque

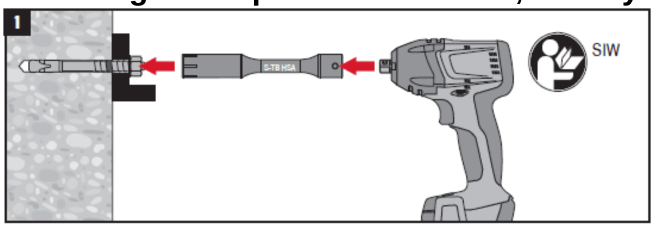
Type	HSA, HSA-BW, HSA-R2, HSA-R																	
Anchor Size	**M6**			**M8**			**M10**			**M12**			**M16**			**M20**		
Setting position	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Nominal anchorage depth h_{nom} [mm]	37	47	67	39	49	79	50	60	90	64	79	114	77	92	132	90	115	130
Standard installation torque T_{inst} [Nm]	-			15			25			50			80			-		
Setting tool	-			S-TB HSA M8			S-TB HSA M10			S-TB HSA M12			S-TB HSA M16			-		
Impact screw driver				Hilti SIW 14-A Hilti SIW 22-A									Hilti SIW 22T-A					
Speed: HSA, HSA-BW				1			1			3			-[1]					
Speed: HSA-R2, HSA-R				3			3											
Setting time t_{set} [sec.]				4														

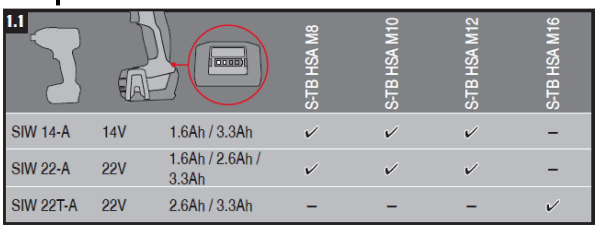
[1] The impact screw driver operates with a fixed speed.

Setting instruction for HSA, HSA-BW, HSA-R2 and HSA-R M8 – M16

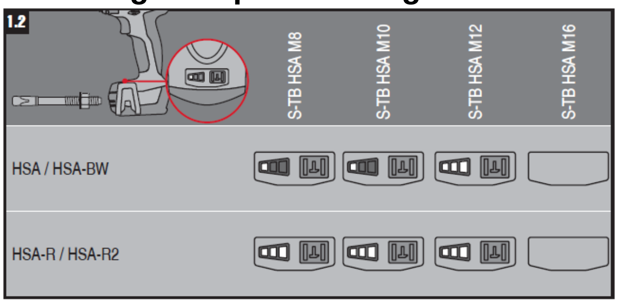
Tightening the anchor - alternatively with imact screw driver and special socket

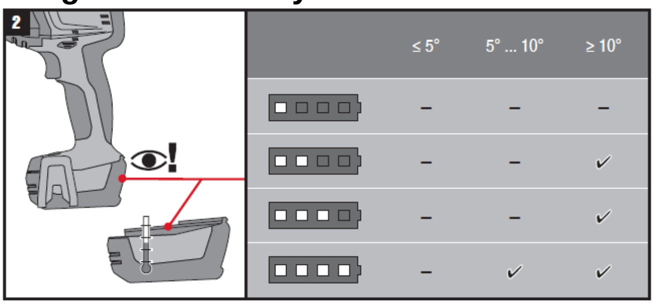
Selecting the impact screw driver, battery and special socket



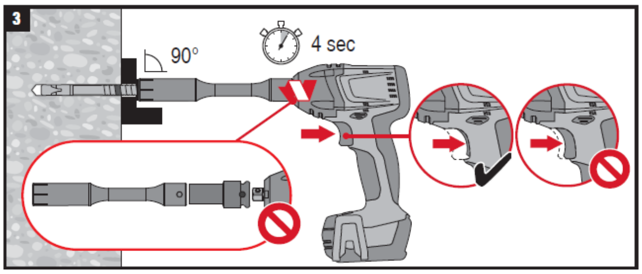


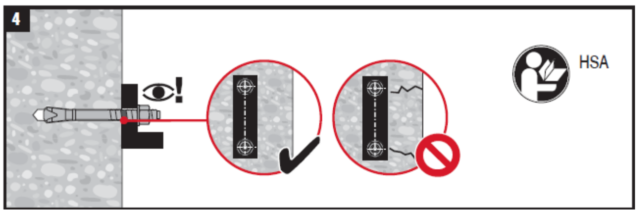
Selecting the speed setting and state of charge of the battery





Tighten the anchor and check the installation

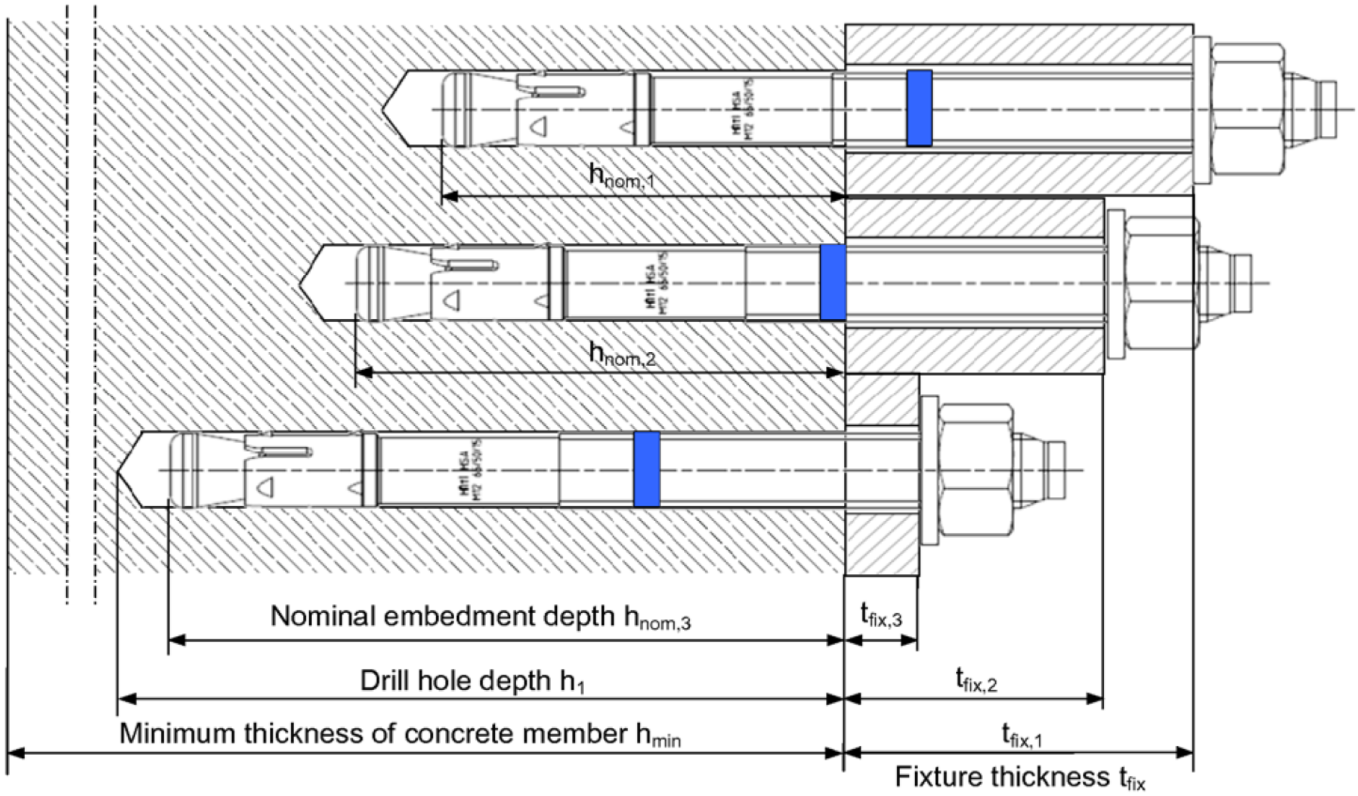




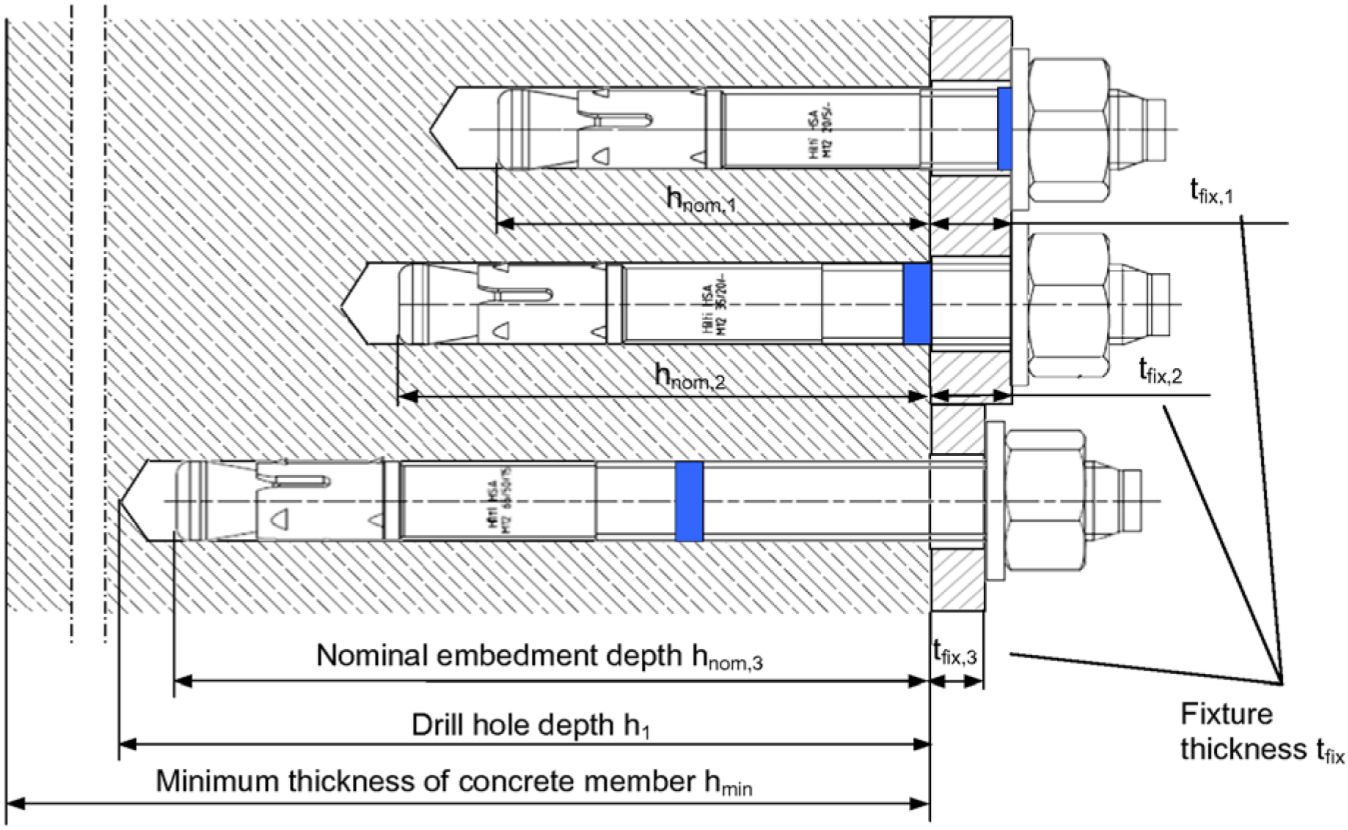
For detailed information on installation see instruction for use given with the package of the product.

Setting details

One anchor length for different fixture thickness t_{fix} and the corresponding setting positions



Different anchor length for different setting positions and the corresponding fixture thickness t_{fix}



Setting details

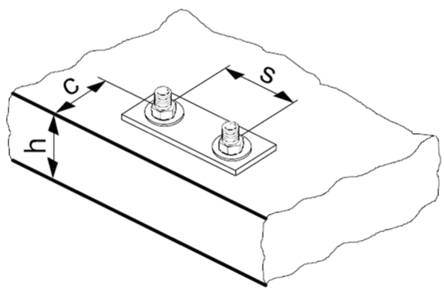
Anchor size			M6			M8			M10		
Nominal anchorage depth	h_{nom}	[mm]	37	47	67	39	49	79	50	60	90
Minimum base material thickness	h_{min}	[mm]	100	100	120	100	100	120	100	120	160
Minimum spacing	s_{min}	[mm]	35	35	35	35	35	35	50	50	50
Minimum edge distance	c_{min}	[mm]	35	35	35	40	35	35	50	40	40
Nominal diameter of drill bit	d_o	[mm]	6			8			10		
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	6,4			8,45			10,45		
Depth of drill hole	$h_1 \geq$	[mm]	42	52	72	44	54	84	55	65	95
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	7			9			12		
Torque moment	T_{inst}	[Nm]	5			15			25		
Width across	SW	[mm]	10			13			17		

Anchor size			M12			M16			M20		
Nominal anchorage depth	h_{nom}	[mm]	64	79	114	77	92	132	90	115	130
Minimum base material thickness	h_{min}	[mm]	100	140	180	140	160	180	160	220	220
Minimum spacing	s_{min}	[mm]	70	70	70	90	90	90	195	175	175
Minimum edge distance	c_{min}	[mm]	70	65	55	80	75	70	130	120	120
Nominal diameter of drill bit	d_o	[mm]	12			16			20		
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	12,5			16,5			20,55		
Depth of drill hole	$h_1 \geq$	[mm]	72	87	122	85	100	140	98	123	138
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	14			18			22		
Torque moment	T_{inst}	[Nm]	50			80			200		
Width across	SW	[mm]	19			24			30		

Design parameters

Anchor size			M6			M8			M10		
Nominal anchorage depth	h_{nom}	[mm]	37	47	67	39	49	79	50	60	90
Effective anchorage depth	h_{ef}	[mm]	30	40	60	30	40	70	40	50	80
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	100	120	130	130	180	200	190	210	290
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	50	60	65	65	90	100	95	105	145
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	90	120	180	90	120	210	120	150	240
Critical edge distance for concrete cone failure	$c_{cr,N}$	[mm]	45	60	90	45	60	105	60	75	120

Anchor size			M12			M16			M20		
Nominal anchorage depth	h_{nom}	[mm]	64	79	114	77	92	132	90	115	130
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	200	250	310	230	280	380	260	370	400
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	100	125	155	115	140	190	130	185	200
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	150	195	300	195	240	360	225	300	345
Critical edge distance for concrete cone failure	$c_{cr,N}$	[mm]	75	97,5	150	97,5	120	180	112,5	150	172,5



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according ETA-11/0374, issue 2012-07-19.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then conservative: They will be lower than the exact values according ETAG 001, Annex C. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

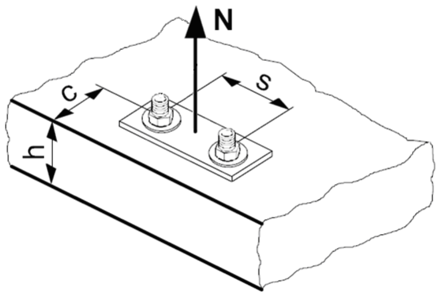
For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):

$$N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M6	M8	M10	M12	M16	M20
$N_{Rd,s}$	HSA, HSA-BW	[kN]	6,4	11,8	20,0	29,6	59,0	88,5
	HSA-R2, HSA-R	[kN]	8,7	13,1	25,0	31,9	62,6	68,5

Design pull-out resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$

Anchor size			M6			M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	60	30	40	70	40	50	80
$N^0_{Rd,p}$	HSA, HSA-BW, HSA-R2, HSA-R	[kN]	4,0	5,0	6,0	No pull-out		10,7	No pull-out		16,7

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
$N^0_{Rd,p}$	HSA, HSA-BW, HSA-R2, HSA-R	[kN]	No pull-out		23,3	No pull-out		33,3	No pull-out		

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

Anchor size			M6			M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	60	30	40	70	40	50	80
$N^0_{Rd,p}$	HSA, HSA-BW, HSA-R2, HSA-R	[kN]	5,5	8,5	15,6	5,5	8,5	19,7	8,5	11,9	24,1

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
$N^0_{Rd,p}$	HSA, HSA-BW, HSA-R2, HSA-R	[kN]	11,9	17,6	33,7	17,6	24,1	44,3	21,9	33,7	41,5

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
Pull-out , concrete cone and splitting resistance							
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2\ a)}$	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ / $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \le 1$ / $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \le 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \le 1$ / $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \le 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing [a)]

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N}$ = $0,5\cdot(1 + s/s_{cr,N}) \le 1$ $f_{3,sp}$ = $0,5\cdot(1 + s/s_{cr,sp}) \le 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of base material thickness

h/h_{min}	1,0	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	≥ 1,84
$f_{h,sp}$ = $[h/(h_{min})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

Influence of reinforcement [a)]

Anchor size	M6			M8			M10		
Effective anchorage depth h_{ef} [mm]	30	40	60	30	40	70	40	50	80
$f_{re,N}$ = $0,5 + h_{ef}/200mm \le 1$	0,65	0,7	0,8	0,65	0,7	0,85	0,7	0,75	0,9

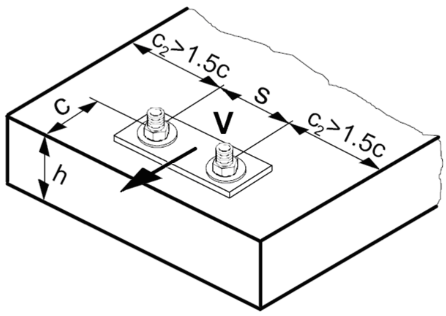
Anchor size	M12			M16			M20		
Effective anchorage depth h_{ef} [mm]	50	65	100	65	80	120	75	100	115
$f_{re,N}$ = $0,5 + h_{ef}/200mm \le 1$	0,75	0,83	1	0,83	0,9	1	0,88	1	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size		M6	M8	M10	M12	M16	M20
$V_{Rd,s}$	HSA, HSA-BW [kN]	5,2	8,5	15,1	23,6	40,8	68,6
	HSA-R2, HSA-R [kN]	5,8	9,8	18,1	23,4	45,2	73,5

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$ [a)]

Anchor size			M6			M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	60	30	40	70	40	50	80
k			1	1	2	1	1,5	2	2,4	2,4	2,4

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
k			2	2	2	2,9	2,9	2,9	2	3,5	3,5

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance [a)] $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size			M6			M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	60	30	40	70	40	50	80
$V^0_{Rd,c}$		[kN]	3,6	3,6	3,7	5,8	5,9	6,0	8,5	8,5	8,6

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
$V^0_{Rd,c}$		[kN]	11,6	11,6	11,7	18,7	18,8	18,9	27,2	27,3	27,4

a) For anchor groups only the anchors close to the edge must be considered.

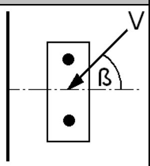
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size			M6			M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	60	30	40	70	40	50	80
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$			0,75	1,21	2,39	0,46	0,75	1,91	0,51	0,75	1,64

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$			0,55	0,85	1,76	0,53	0,75	1,48	0,46	0,75	0,94

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

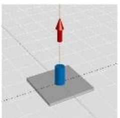
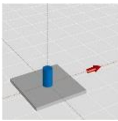
Precalculated values

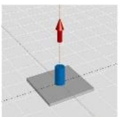
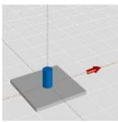
Design resistance calculated according ETAG 001, Annex C and Hilti technical data.
All data applies to concrete C 20/25 – $f_{ck,cube}$ =25 N/mm².

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

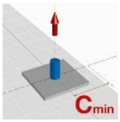
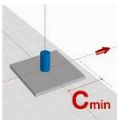
Design resistance

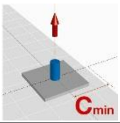
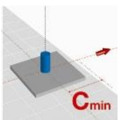
Single anchor, no edge effects

Anchor size			**M6**			**M8**			**M10**		
Effective anchorage depth	h_{ef}	[mm]	30	40	60	30	40	70	40	50	80
Min. base material thickness h_{min} [mm]			100	100	120	100	100	120	100	120	160
	**Tensile N_{Rd}**										
	HSA, HSA-BW	[kN]	4,0	5,0	6,0	5,5	8,5	10,7	8,5	11,9	16,7
	HSA-R2, HSA-R	[kN]	4,0	5,0	6,0	5,5	8,5	10,7	8,5	11,9	16,7
	**Shear V_{Rd}, without lever arm**										
	HSA, HSA-BW	[kN]	5,2	5,2	5,2	5,5	8,5	8,5	15,1	15,1	15,1
	HSA-R2, HSA-R	[kN]	5,5	5,8	5,8	5,5	9,8	9,8	18,1	18,1	18,1

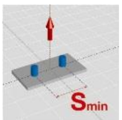
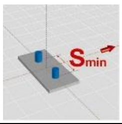
Anchor size			**M12**			**M16**			**M20**		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Min. base material thickness h_{min} [mm]			100	140	180	140	160	180	160	220	220
	**Tensile N_{Rd}**										
	HSA, HSA-BW	[kN]	11,9	17,6	23,3	17,6	24,1	33,3	21,9	33,7	41,5
	HSA-R2, HSA-R	[kN]	11,9	17,6	23,3	17,6	24,1	33,3	21,9	33,7	41,5
	**Shear V_{Rd}, without lever arm**										
	HSA, HSA-BW	[kN]	23,6	23,6	23,6	40,8	40,8	40,8	43,7	68,6	68,6
	HSA-R2, HSA-R	[kN]	23,4	23,4	23,4	45,2	45,2	45,2	43,7	73,5	73,5

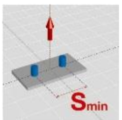
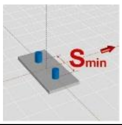
Single anchor, min. edge distance ($c = c_{min}$)

Anchor size			**M6**			**M8**			**M10**		
Effective anchorage depth	h_{ef}	[mm]	30	40	60	30	40	70	40	50	80
Min. base material thickness	h_{min}	**[mm]**	100	100	120	100	100	120	100	120	160
Min. edge distance	c_{min}	[mm]	35	35	35	40	35	35	50	40	40
	**Tensile N_{Rd}**										
	HSA, HSA-BW	[kN]	4,0	5,0	6,0	4,0	4,8	10,5	5,6	6,7	12,0
	HSA-R2, HSA-R	[kN]	4,0	5,0	6,0	4,0	4,8	10,5	5,6	6,7	12,0
	**Shear V_{Rd}, without lever arm**										
	HSA, HSA-BW	[kN]	2,5	2,6	2,8	3,1	2,7	3,0	4,5	3,5	3,9
	HSA-R2, HSA-R	[kN]	2,5	2,6	2,8	3,1	2,7	3,0	4,5	3,5	3,9

Anchor size			**M12**			**M16**			**M20**		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Min. base material thickness	h_{min}	**[mm]**	100	140	180	140	160	180	160	220	220
Min. edge distance	c_{min}	[mm]	70	65	55	80	75	70	130	120	120
	**Tensile N_{Rd}**										
	HSA, HSA-BW	[kN]	9,2	11,5	18,4	13,6	15,9	24,5	21,9	24,8	29,2
	HSA-R2, HSA-R	[kN]	9,2	11,5	18,4	13,6	15,9	24,5	21,9	24,8	29,2
	**Shear V_{Rd}, without lever arm**										
	HSA, HSA-BW	[kN]	7,4	7,2	6,4	9,9	9,5	9,6	18,1	19,1	19,6
	HSA-R2, HSA-R	[kN]	7,4	7,2	6,4	9,9	9,5	9,6	18,1	19,1	19,6

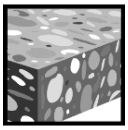
Double anchor, no edge effects, min. spacing (s = s_{min}), (load values are valid for one anchor)

Anchor size			M6			M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	60	30	40	70	40	50	80
Min. base material thickness	**h_{min}**	**[mm]**	100	100	120	100	100	120	100	120	160
Min. spacing	**s_{min}**	[mm]	35	35	35	35	35	35	50	50	50
	**Tensile N_{Rd}**										
	HSA, HSA-BW	[kN]	3,7	5,0	6,0	3,5	5,1	10,7	5,4	7,4	14,1
	HSA-R2, HSA-R	[kN]	3,7	5,0	6,0	3,5	5,1	10,7	5,4	7,4	14,1
	**Shear V_{Rd}, without lever arm**										
	HSA, HSA-BW	[kN]	3,8	5,2	5,2	3,8	8,3	8,5	14,5	15,1	15,1
	HSA-R2, HSA-R	[kN]	3,8	5,5	5,8	3,8	8,3	9,8	14,5	18,1	18,1

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Min. base material thickness	**h_{min}**	**[mm]**	100	140	180	140	160	180	160	220	220
Min. spacing	**s_{min}**	[mm]	70	70	70	90	90	90	195	175	175
	**Tensile N_{Rd}**										
	HSA, HSA-BW	[kN]	8,0	11,3	20,6	12,3	15,9	27,4	19,1	24,8	29,8
	HSA-R2, HSA-R	[kN]	8,0	11,3	20,6	12,3	15,9	27,4	19,1	24,8	29,8
	**Shear V_{Rd}, without lever arm**										
	HSA, HSA-BW	[kN]	17,5	23,6	23,6	37,4	40,8	40,8	40,8	68,6	68,6
	HSA-R2, HSA-R	[kN]	17,5	23,4	23,4	37,4	45,2	45,2	40,8	73,5	73,5

HSA-F Stud anchor

	Anchor version	Benefits
	HSA-F; Carbon steel, hot dipped galvanized, min 35 mircons coating thickness DIN 125 washer	- Hot dipped galvanized material for increased corrosion resistance - Three embedment depths for maximal design flexibility - Suitable for pre- and through fastening



Concrete

Basic loading data (for a single anchor)

For details see Simplified design method

All data in this section applies to

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Minimum base material thickness
- Non-cracked Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

Mean ultimate resistance

Anchor size			**M6**		**M8**			**M10**		
Effective anchorage depth	h_{ef}	[mm]	30	40	30	40	70	40	50	80
Tensile	$N_{Ru,m}$	[kN]	8,0	*9,5*	11,0	17,0	*17,3*	17,0	21,2	26,6
Shear	$V_{Ru,m}$	[kN]	*6,8*	*6,8*	11,0	*11,1*	*11,1*	*19,8*	*19,8*	*19,8*

Anchor size			**M12**			**M16**			**M20**		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Tensile	$N_{Ru,m}$	[kN]	23,7	33,2	33,2	26,6	39,8	53,1	43,5	67,0	82,7
Shear	$V_{Ru,m}$	[kN]	*31,0*	*31,0*	*31,0*	*53,6*	*53,6*	*53,6*	87,1	*90,1*	*90,1*

Characteristic resistance

Anchor size			M6		M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	30	40	70	40	50	80
Tensile	N_{Rk}	[kN]	6,0	7,5	8,3	12,8	16,0	12,8	16,0	20,0
Shear	V_{Rk}	[kN]	*6,5*	*6,5*	8,3	*10,6*	*10,6*	*18,9*	*18,9*	*18,9*

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Tensile	N_{Rk}	[kN]	17,9	25,0	25,0	20,0	30,0	40,0	32,8	50,5	62,3
Shear	V_{Rk}	[kN]	*29,5*	*29,5*	*29,5*	*51,0*	*51,0*	*51,0*	65,6	*85,8*	*85,8*

Design resistance

Anchor size			M6		M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	30	40	70	40	50	80
Tensile	N_{Rd}	[kN]	4,0	5,0	5,5	8,5	10,7	8,5	10,7	13,3
Shear	V_{Rd}	[kN]	5,2	5,2	5,5	8,5	8,5	15,1	15,1	15,1

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Tensile	N_{Rd}	[kN]	11,9	16,7	16,7	13,3	20,0	26,7	21,9	33,7	41,5
Shear	V_{Rd}	[kN]	23,6	23,6	23,6	40,8	40,8	40,8	43,7	68,6	68,6

Recommended loads

Anchor size			M6		M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	30	40	70	40	50	80
Tensile	N_{rec}	[kN]	2,9	3,6	4,0	6,1	7,6	6,1	7,6	9,5
Shear	V_{rec}	[kN]	3,7	3,7	4,0	6,1	6,1	10,8	10,8	10,8

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Tensile	N_{rec}	[kN]	8,5	11,9	11,9	9,5	14,3	19,0	15,6	24,0	29,7
Shear	V_{rec}	[kN]	16,9	16,9	16,9	29,1	29,1	29,1	31,2	49,0	49,0

Materials

Mechanical properties

Anchor size		M6	M8	M10	M12	M16	M20
Nominal tensile strength $f_{uk,thread}$	[N/mm²]	650	580	650	700	650	700
Yield strength $f_{yk,thread}$	[N/mm²]	520	464	520	560	520	560
Stressed cross-section $A_{s,thread}$	[mm²]	20,1	36,6	58,0	84,3	157,0	245,0
Moment of resistance W	[mm³]	12,7	31,2	62,3	109,2	277,5	540,9
Char. bending resistance $M^0_{Rk,s}$	[Nm]	9,9	21,7	48,6	91,7	216,4	454,4

Material quality

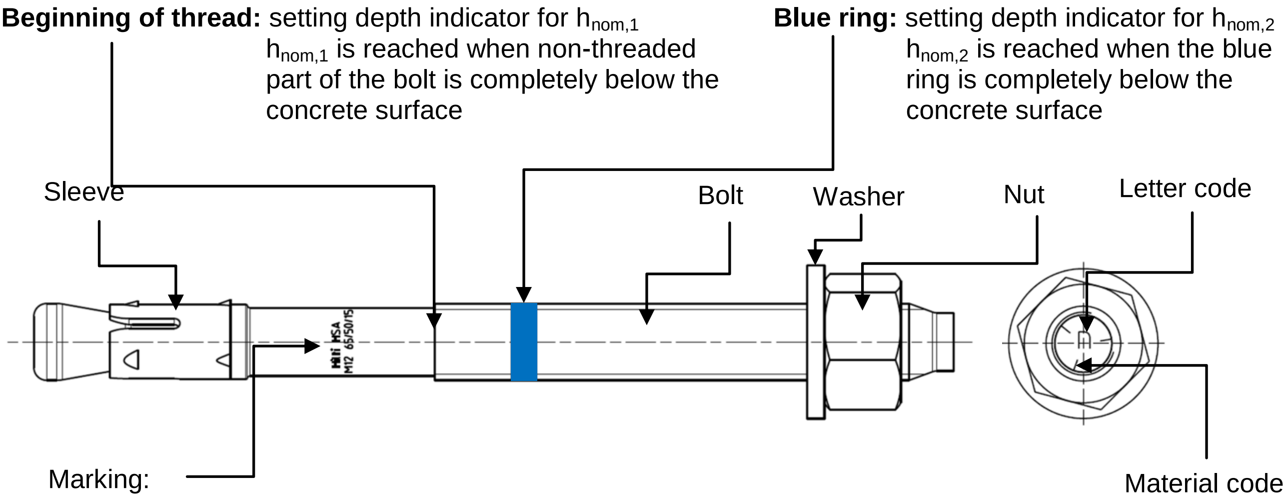
Type	Part	Material	Coating
HSA-F Carbon Steel	Sleeve	Stainless steel A2 1.4301	-
	Bolt	Carbon steel, Rupture elongation A_5 > 8%	Hot dipped galvanized (≥35 µm)
	Washer	HSA :carbon steel	
	Hexagon nut	Steel, strength class 8	

Geometry washer

Anchor Size			M6	M8	M10	M12	M16	M20
Inner diameter d_1								
HSA-F	d_1	[mm]	6,4	8,4	10,5	13,0	17,0	21
Outer diameter d_2								
HSA-F	d_2	[mm]	12,0	16,0	20,0	24,0	30,0	37,0
Thickness h								
HSA-F	h	[mm]	1,6	1,6	2,0	2,5	3,0	3,0

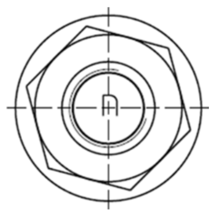
Anchor dimensions and coding

Product marking and identification of anchor



e.g.
Hilti HSA-F … Brand and Anchor type
M12 65/50/15 … Anchor Size and the max. $t_{fix,1}$/ $t_{fix,2}$/ $t_{fix,3}$ for the corresponding $h_{nom,1}$/ $h_{nom,2}$/ $h_{nom,3}$

Material code for identification of different materials

Type	**HSA-F** (carbon steel, hot dipped galvanized)
Material Code	 Letter code without mark

Effective and nominal anchorage depth

Anchor size			M6		M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	30	40	70	40	50	80
Nominal anchorage depth	h_{nom}	[mm]	37	47	39	49	79	50	60	90

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Nominal anchorage depth	h_{nom}	[mm]	64	79	114	77	92	132	90	115	130

Letter code for anchor length and maximum thickness of the fixture t_{fix}

Type	HSA-F					
Size	M6	M8	M10	M12	M16	M20
h_{nom} [mm]	37 / 47 / -	39 / 49 / 79	50 / 60 / 90	64 / 79 / 114	77 / 92 / 132	90 / 115 / 130
Letter \ t_{fix}	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$
z	5/-/-	5/-/-	5/-/-	5/ -/-	5/-/-	
y						10/-/-
w	20/10/-	20/10/-	20/10/-	20/5/-		
t		35/25/-	35/25/-	35/20/-		
s					40/25/-	
q			50/40/10			
p		55/45/15				55/30/15
n				65/50/15		
k		80/70/40				
j					85/70/30	
a				145/130/95		

Setting

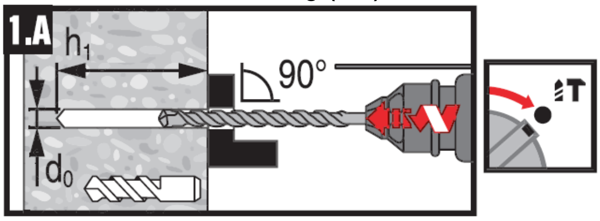
Installation equipment

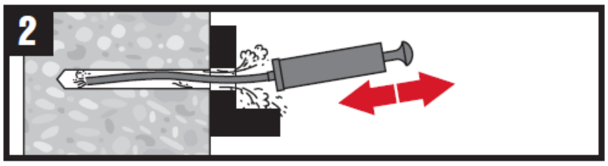
Anchor size	M6	M8	M10	M12	M16	M20
Rotary hammer	TE2 – TE16					TE40 – TE70
Other tools	hammer, torque wrench, blow out pump					

Setting instruction

Drill and clean borehole

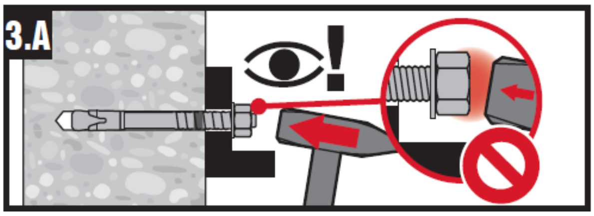
Standard drilling method
M6 – M20: Hammer drilling (HD)



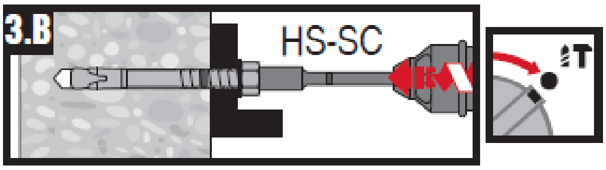


Install anchor with hammer or machine setting tool

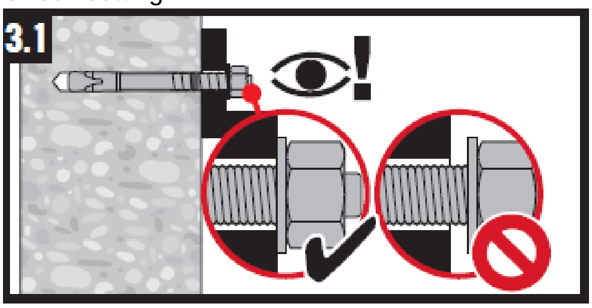
Standard setting method
M6 – M20: Hammer setting



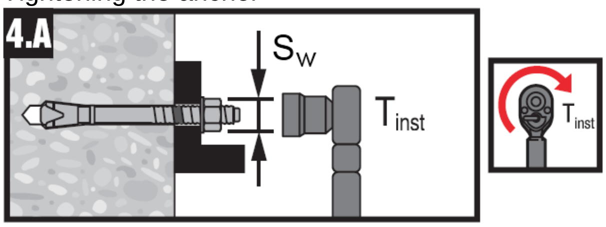
Alternative setting method
M8 – M16: Machnine setting



Check setting



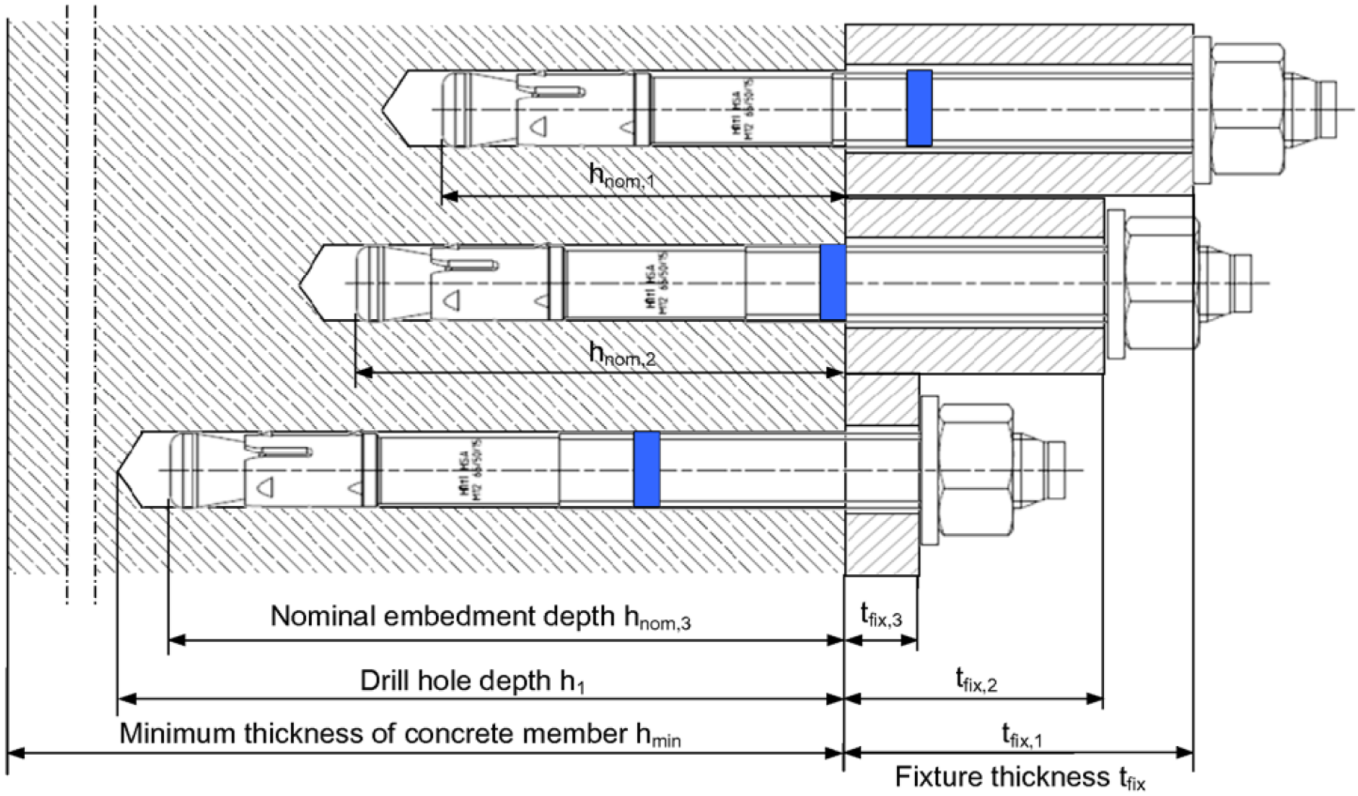
Tightening the anchor



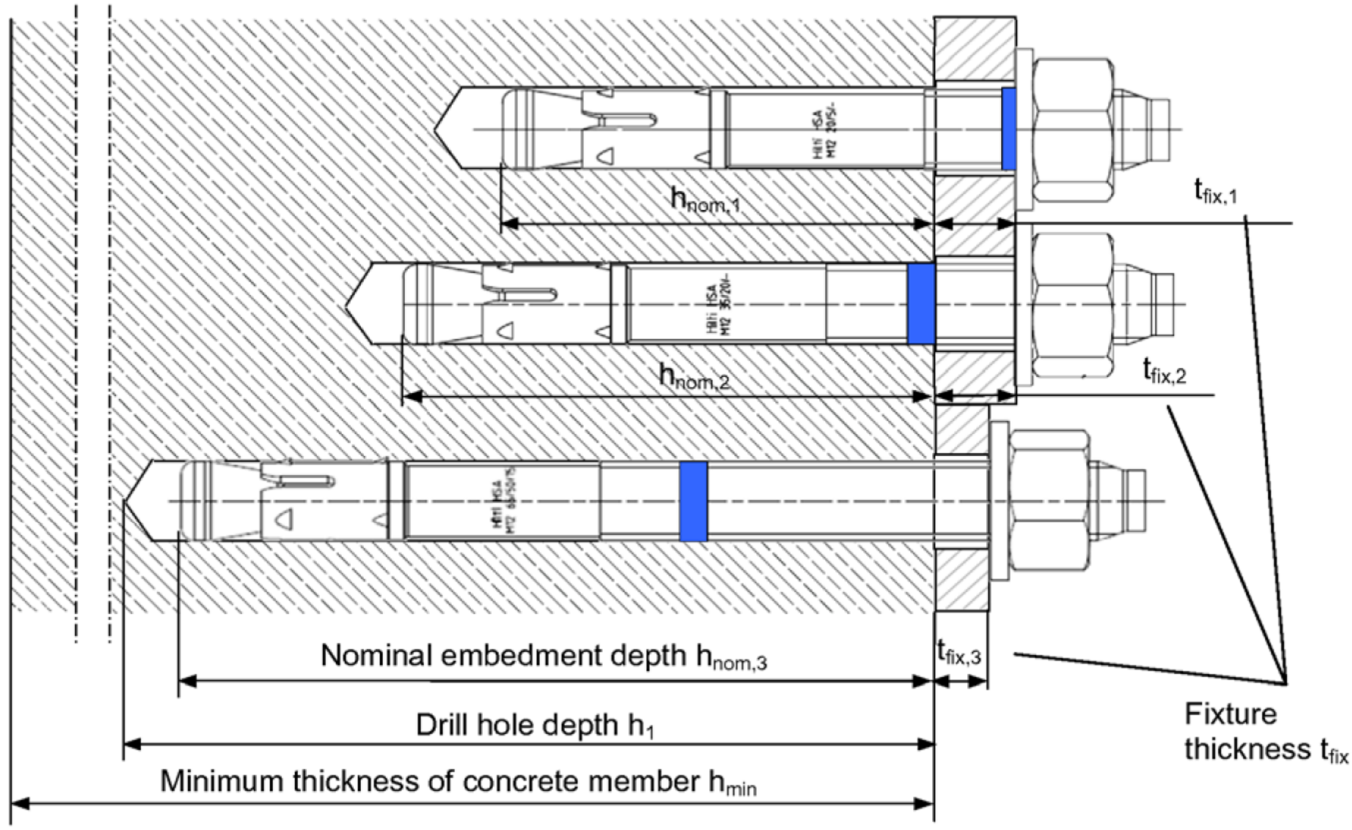
For detailed information on installation see instruction for use given with the package of the product.

Setting details

One anchor length for different fixture thickness t_{fix} and the corresponding setting positions



Different anchor length for different setting positions and the corresponding fixture thickness t_{fix}



Setting details

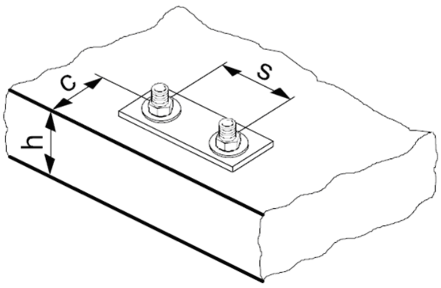
Anchor size			M6		M8			M10		
Nominal anchorage depth	h_{nom}	[mm]	37	47	39	49	79	50	60	90
Minimum base material thickness	h_{min}	[mm]	100	100	100	100	120	100	120	160
Minimum spacing	s_{min}	[mm]	35	35	85	85	85	100	100	100
Minimum edge distance	c_{min}	[mm]	35	35	75	75	60	60	60	55
Nominal diameter of drill bit	d_o	[mm]	6		8			10		
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	6,4		8,45			10,45		
Depth of drill hole	$h_1 \geq$	[mm]	42	52	44	54	84	55	65	95
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	7		9			12		
Torque moment	T_{inst}	[Nm]	5		15			25		
Width across	SW	[mm]	10		13			17		

Anchor size			M12			M16			M20		
Nominal anchorage depth	h_{nom}	[mm]	64	79	114	77	92	132	90	115	130
Minimum base material thickness	h_{min}	[mm]	100	140	180	140	160	180	160	220	220
Minimum spacing	s_{min}	[mm]	100	100	100	190	190	190	200	200	200
Minimum edge distance	c_{min}	[mm]	175	140	90	170	140	120	185	165	165
Nominal diameter of drill bit	d_o	[mm]	12			16			20		
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	12,5			16,5			20,55		
Depth of drill hole	$h_1 \geq$	[mm]	72	87	122	85	100	140	98	123	138
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	14			18			22		
Torque moment	T_{inst}	[Nm]	50			80			200		
Width across	SW	[mm]	19			24			30		

Design parameters

Anchor size			M6		M8			M10		
Nominal anchorage depth	h_{nom}	[mm]	37	47	39	49	79	50	60	90
Effective anchorage depth	h_{ef}	[mm]	30	40	30	40	70	40	50	80
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	126	150	162	226	250	238	262	362
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	63	75	81	113	125	119	131	181
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	90	120	90	120	210	120	150	240
Critical edge distance for concrete cone failure	$c_{cr,N}$	[mm]	45	60	45	60	105	60	75	120

Anchor size			M12			M16			M20		
Nominal anchorage depth	h_{nom}	[mm]	64	79	114	77	92	132	90	115	130
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	250	312	388	288	350	476	326	462	500
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	125	156	194	144	175	238	163	231	250
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	150	195	300	195	240	360	225	300	345
Critical edge distance for concrete cone failure	$c_{cr,N}$	[mm]	75	97,5	150	97,5	120	180	112,5	150	172,5



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according Hilti technical data.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then conservative: They will be lower than the exact values according ETAG 001, Annex C. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

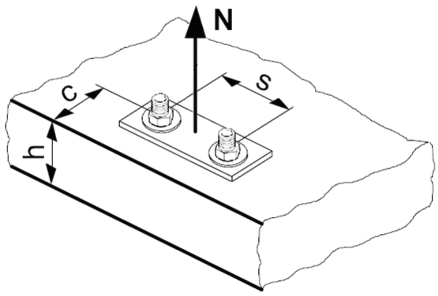
For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $\mathbf{N_{Rd,s}}$
- Concrete pull-out resistance: $\mathbf{N_{Rd,p} = N^0_{Rd,p}}$
- Concrete cone resistance: $\mathbf{N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}}$
- Concrete splitting resistance:

$$\mathbf{N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M6	M8	M10	M12	M16	M20
$N_{Rd,s}$	HSA-F	[kN]	6,4	11,8	20,0	29,6	59,0	88,5

Design pull-out resistance $N_{Rd,p} = N^0_{Rd,p}$

Anchor size			M6		M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	30	40	70	40	50	80
$N^0_{Rd,p}$	HSA-F	[kN]	4,0	5,0	No pull-out		10,7	No pull-out	10,7	13,3

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
$N^0_{Rd,p}$	HSA-F	[kN]	No pull-out	16,7	16,7	13,3	20,0	26,7	No pull-out		

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

Anchor size			**M6**		**M8**			**M10**		
Effective anchorage depth	h_{ef}	[mm]	30	40	30	40	70	40	50	80
$N^0_{Rd,p}$	HSA-F	[kN]	5,5	8,5	5,5	8,5	19,7	8,5	11,9	24,1

Anchor size			**M12**			**M16**			**M20**		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
$N^0_{Rd,p}$	HSA-F	[kN]	11,9	17,6	33,7	17,6	24,1	44,3	21,9	33,7	41,5

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
Pull-out, concrete cone and splitting resistance							
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
$f_{1,N} = 0{,}7 + 0{,}3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0{,}7 + 0{,}3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0{,}5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0{,}5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
$f_{3,N} = 0{,}5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0{,}5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of base material thickness

h/h_{min}	**1,0**	**1,1**	**1,2**	**1,3**	**1,4**	**1,5**	**1,6**	**1,7**	**1,8**	**≥ 1,84**
$f_{h,sp} = [h/(h_{min})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

Influence of reinforcement a)

Anchor size			M6		M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	30	40	70	40	50	80
$f_{re,N}$ =	0,5 + h_{ef}/200mm ≤ 1		0,65	0,7	0,65	0,7	0,85	0,7	0,75	0,9

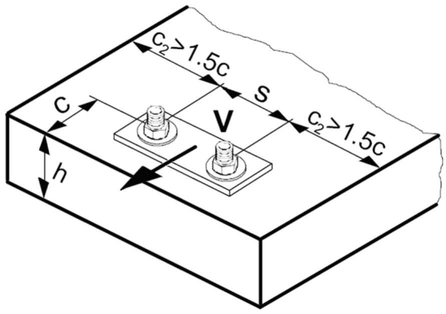
Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
$f_{re,N}$ =	0,5 + h_{ef}/200mm ≤ 1		0,75	0,83	1	0,83	0,9	1	0,88	1	1

b) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M6	M8	M10	M12	M16	M20
$V_{Rd,s}$	HSA-F	[kN]	5,2	8,5	15,1	23,6	40,8	68,6

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$ a)

Anchor size			M6		M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	30	40	70	40	50	80
k			1	1	1	1,5	2	2,4	2,4	2,4

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
k			2	2	2	2,9	2,9	2,9	2	3,5	3,5

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance [a] $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size			M6		M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	30	40	70	40	50	80
$V^0_{Rd,c}$		[kN]	3,6	3,6	5,8	5,9	6,0	8,5	8,5	8,6

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
$V^0_{Rd,c}$		[kN]	11,6	11,6	11,7	18,7	18,8	18,9	27,2	27,3	27,4

b) For anchor groups only the anchors close to the edge must be considered.

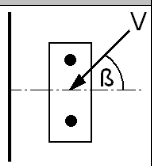
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size			M6		M8			M10		
Effective anchorage depth	h_{ef}	[mm]	30	40	30	40	70	40	50	80
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$			0,75	1,21	0,46	0,75	1,91	0,51	0,75	1,64

Anchor size			M12			M16			M20		
Effective anchorage depth	h_{ef}	[mm]	50	65	100	65	80	120	75	100	115
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$			0,55	0,85	1,76	0,53	0,75	1,48	0,46	0,75	0,94

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

HSV Stud anchor

	Anchor versions	Benefits
	**HSV** Carbon steel with DIN 125 washer	- torque-controlled mechanical expansion allows immediate load application - setting mark - cold-formed to prevent breaking during installation - raised impact section prevents thread damage during installation - drill bit size is same as anchor size for easy installation.
	**HSV-BW** Carbon steel with DIN 9021 washer and DIN 127b spring washer	


Concrete

Basic loading data (for a single anchor)

All data in this section applies to

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete as specified in the table
- *Steel* failure
- Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

Mean ultimate resistance

Anchor size		M8		M10		M12		M16	
Effective anchorage depth $h_{ef} \geq$	[mm]	30	40	40	50	50	65	65	80
Tensile $N_{Ru,m}$	[kN]	11,0	15,9	15,9	18,6	19,2	26,6	35,1	48,0
Shear $V_{Ru,m}$	[kN]	*8,9*	*8,9*	*15,1*	*15,1*	23,7	*23,7*	*44,5*	*44,5*

Characteristic resistance

Anchor size		M8		M10		M12		M16	
Effective anchorage depth $h_{ef} \geq$	[mm]	30	40	40	50	50	65	65	80
Tensile N_{Rk}	[kN]	8,3	12,0	12,0	14,0	14,5	20,0	26,5	36,1
Shear V_{Rk}	[kN]	8,3	*8,5*	12,8	*14,4*	17,9	*22,6*	*42,4*	*42,4*

Design resistance

Anchor size		M8		M10		M12		M16	
Effective anchorage depth $h_{ef} \geq$	[mm]	30	40	40	50	50	65	65	80
Tensile N_{Rd}	[kN]	4,6	6,7	8,0	9,3	9,7	13,3	14,7	20,1
Shear V_{Rd}	[kN]	5,5	6,8	8,5	11,5	11,9	18,1	33,9	33,9

Recommended loads

Anchor size		M8		M10		M12		M16	
Effective anchorage depth $h_{ef} \geq$	[mm]	30	40	40	50	50	65	65	80
Tensile N_{rec} [a]	[kN]	3,3	4,8	5,7	6,7	6,9	9,5	10,5	14,3
Shear V_{rec} [a]	[kN]	4,0	4,9	6,1	8,2	8,5	12,9	24,2	24,2

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

Mechanical properties of HSV

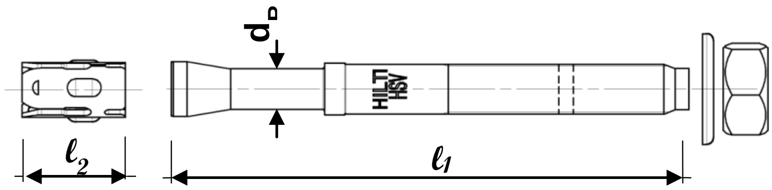
Anchor size			M8	M10	M12	M16
Nominal tensile strength	f_{uk}	[N/mm²]	580	660	660	660
Yield strength	f_{yk}	[N/mm²]	464	528	528	528
Stressed cross-section, thread	A_s	[mm²]	36,6	58,0	84,3	157
Stressed cross-section, neck	$A_{s,neck}$	[mm²]	26,9	39,6	63,6	105,7
Moment of resistance	W	[mm³]	31,2	62,3	109,2	277,5
Char. bending resistance	$M^0_{Rk,s}$	[Nm]	19,5	41,1	72,1	166,5

Material quality

Part	Material
Bolt	Carbon steel, galvanised to min. 5 µm

Anchor dimensions

Anchor size			M8	M10	M12	M16
Shaft diameter at the cone	d_R	[mm]	5,85	7,1	9	11,6
Maximum length of the anchor	ℓ_1	[mm]	75	100	150	140
Length of expansion sleeve	ℓ_2	[mm]	15	17,6	20,6	24

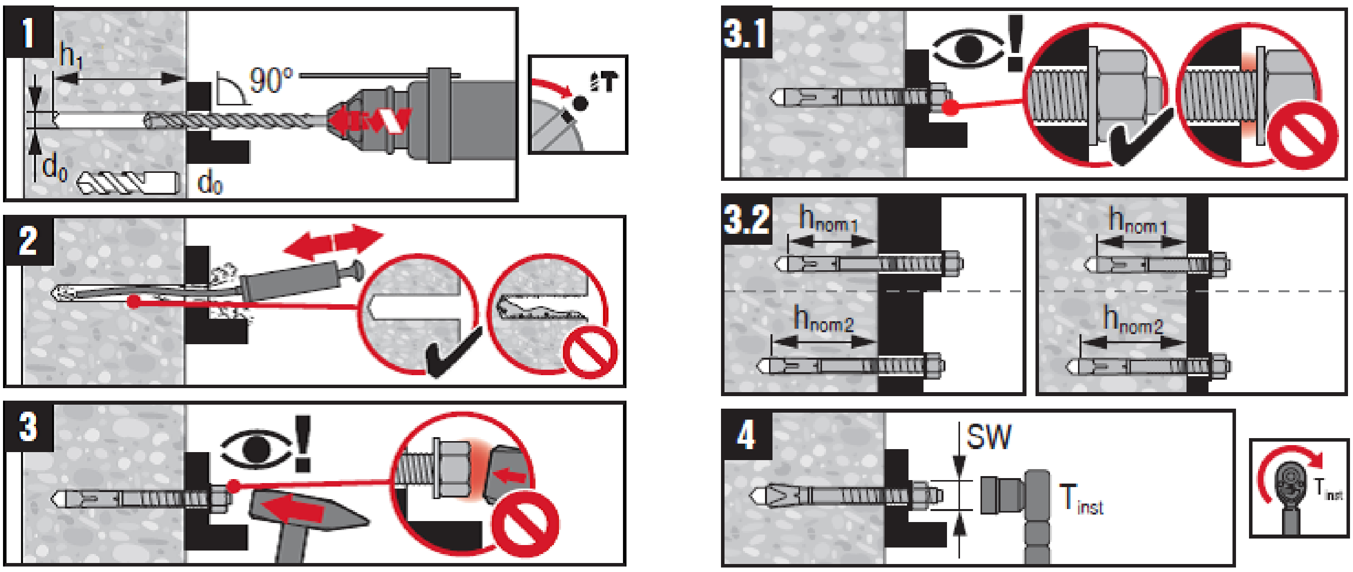


Setting

Installation equipment

Anchor size	M8	M10	M12	M16
Rotary hammer	TE1 – TE30			
Other tools	blow out pump, hammer, torque wrench			

Setting instruction

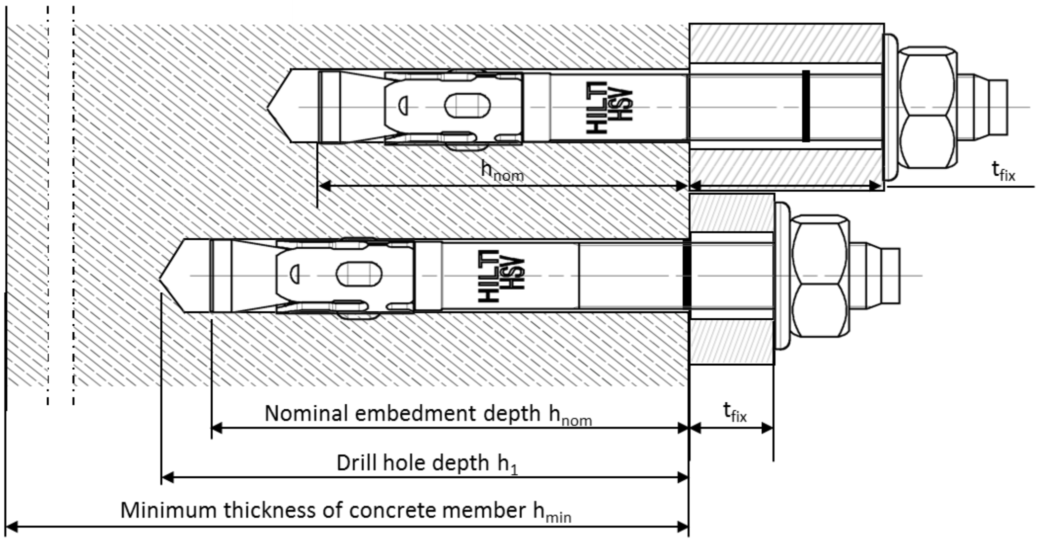


For detailed information on installation see instruction for use given with the package of the product.

Setting details

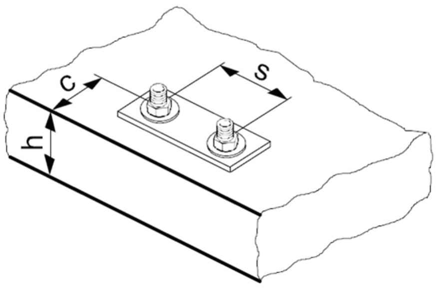
Anchor size			M8		M10		M12		M16	
Effective anchorage depth	h_{ef}	[mm]	30	40	40	50	50	65	65	80
Nominal embedment depth	h_{nom}	[mm]	39	49	51	61	62	77	81	96
Nominal Diameter of drill bit	d_0	[mm]	8		10		12		16	
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45		10,45		12,5		16,5	
Depth of drill hole	$h_1 \geq$	[mm]	45	55	60	70	70	85	90	105
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	9		12		14		18	
Minimum thickness of fixture a)	$t_{fix,min}$	[mm]	5	0	5	0	5	0	5	0
Maximum thickness of fixture a)	$t_{fix,max}$	[mm]	20	10	35	25	70	55	35	20
Torque moment	T_{inst}	[Nm]	15		30		50		100	
Width across nut flats	SW	[mm]	13		17		19		24	

a) The values are only valid for HSV with standard washer. For HSV-BW with DIN 9021 washer and DIN 127b spring washer the thickness of the fixture has to be reduced.



Setting parameters [a)]

Anchor size			M8		M10		M12		M16	
Effective anchorage depth	h_{ef}	[mm]	30	40	40	50	50	65	65	80
Minimum base material thickness	$h_{min} \geq$	[mm]	100	100	100	120	140	140	130	170
Minimum spacing	$s_{min} \geq$	[mm]	60	60	70	70	80	80	120	100
Minimum edge distance	$c_{min} \geq$	[mm]	60	60	70	70	90	90	120	100
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	180	240	240	300	300	390	390	480
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	90	120	120	150	150	195	195	240
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	90	120	120	150	150	195	195	240
Critical edge distance for concrete cone failure	$c_{cr,N}$	[mm]	45	60	60	75	75	97,5	97,5	120



c) In case of smaller edge distance and spacing than $c_{cr,sp}$, $s_{cr,sp}$, $c_{cr,N}$ and $s_{cr,N}$ the load values shall be reduced according ETAG 001, Annex C

Simplified design method

Simplified version of the design method according ETAG 001, Annex C.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C.

The design method is based on the following simplification:

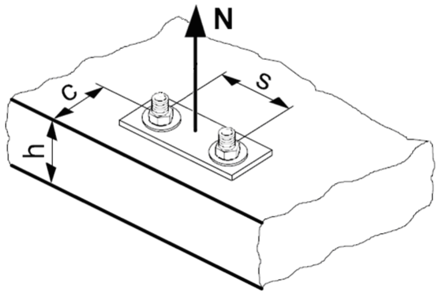
- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8		M10		M12		M16	
Effective anchorage depth	h_{ef}	[mm]	30	40	40	50	50	65	65	80
$N_{Rd,s}$		[kN]	10,4		17,4		28,0		46,5	

Design pull-out resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$

Anchor size			M8		M10		M12		M16	
Effective anchorage depth	h_{ef}	[mm]	30	40	40	50	50	65	65	80
$N^0_{Rd,p}$		[kN]	6,7	6,7	8,0	9,3	9,7	13,3	16,6	20,8

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

Anchor size			M8		M10		M12		M16	
Effective anchorage depth	h_{ef}	[mm]	30	40	40	50	50	65	65	80
$N^0_{Rd,c}$		[kN]	4,6	7,1	8,5	11,9	11,9	17,6	14,7	20,1

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
Pull-out resistance							
f_B =	1						
Concrete cone and splitting resistance							
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance [a)]

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0{,}7 + 0{,}3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0{,}7 + 0{,}3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0{,}5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0{,}5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing [a)]

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0{,}5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0{,}5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of base material thickness

h/h_{ef}	2,0	2,2	2,4	2,6	2,8	3,0	3,2	3,4	3,6	≥ 3,68
$f_{h,sp} = [h/(2 \cdot h_{ef})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

Influence of reinforcement

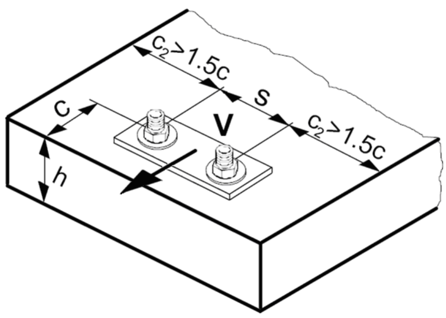
Anchor size	M8		M10		M12		M16	
Effective anchorage depth h_{ef} [mm]	30	40	40	50	50	65	65	80
$f_{re,N} = 0{,}5 + h_{ef}/200mm \leq 1$	0,65 [a)]	0,7 [a)]	0,7 [a)]	0,75 [a)]	0,75 [a)]	0,825 [a)]	0,825 [a)]	0,9 [a)]

c) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8		M10		M12		M16	
Effective anchorage depth	h_{ef}	[mm]	30	40	40	50	50	65	65	80
$V_{Rd,s}$		[kN]	6,8		11,5		18,1		33,9	

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$ [a)]

Anchor size			M8		M10		M12		M16	
Effective anchorage depth	h_{ef}	[mm]	30	40	40	50	50	65	65	80
k			1					2		

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance [a)] $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size			M8		M10		M12		M16	
Effective anchorage depth	h_{ef}	[mm]	30	40	40	50	50	65	65	80
$V^0_{Rd,c}$		[kN]	9,1	9,0	13,0	13,0	17,6	17,6	28,3	28,2

a) For anchor groups only the anchors close to the edge must be considered.

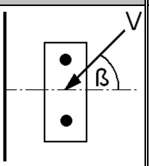
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \le 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	**1,50**	**2,25**	**3,00**	**3,75**	**4,50**	**5,25**	**6,00**	**6,75**	**7,50**	**8,25**	**9,00**	**9,75**	**10,50**	**11,25**
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size			**M8**		**M10**		**M12**		**M16**	
Effective anchorage depth	h_{ef}	[mm]	30	40	40	50	50	65	65	80
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$			0,46	0,75	0,51	0,75	0,55	0,85	0,53	0,75

Influence of edge distance a)

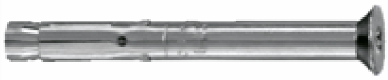
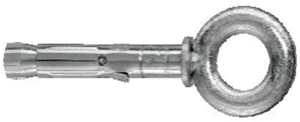
c/d	**4**	**6**	**8**	**10**	**15**	**20**	**30**	**40**
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

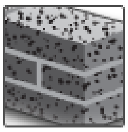
Combined tension and shear loading

For combined tension and shear loading see section "Anchor Design".

HLC Sleeve anchor

Anchor version			Benefits
	HLC	Hex head nut with pressed-on washer	HLC offers various head shapes and fastening thicknesses.
	HLC-H	Bolt version with washer	
	HLC-L	Torx round head	
	HLC-SK	Torx Counter sunk head	
	HLC-EC	Loop –hanger head, eyebold closed	
	HLC-EO	Loop –hanger head, eyebold open	
	HLC-T	Ceiling hanger	


Concrete


Solid brick


Fire resistance

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Fire test report	IBMB, Braunschweig	PB 3093/517/07-CM / 2007-09-10
Assessment report (fire)	warringtonfire	WF 327804/A / 2013-07-10

Basic loading data (for a single anchor)

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete as specified in the table
- *Steel* failure
- Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

Characteristic resistance

Anchor size		6,5	8	10	12	16	20
Tensile N_{Rk}	[kN]	2,1	3,5	4,5	7,2	10,0	13,2
Shear V_{Rk}	[kN]	3,2	7,0	8,8	14,4	20,0	20,0

Design resistance

Anchor size		6,5	8	10	12	16	20
Tensile N_{Rd}	[kN]	1,2	2,0	2,5	4,0	5,6	7,4
Tensile N_{Rd}	[kN]	1,8	3,9	4,9	8,0	11,1	11,1

Recommended loads

Anchor size		6,5	8	10	12	16	20
Tensile N_{rec} a)	[kN]	0,8	1,4	1,8	2,9	4,0	5,3
Shear V_{rec} a)	[kN]	1,3	2,8	3,5	5,7	7,9	7,9

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

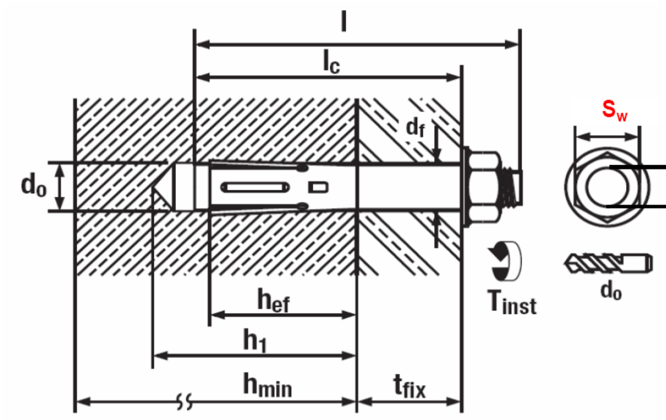
Material quality

Part		Material
Anchor	HLC HLC-EC HLC-EO	Carbon steel minimum tensile strength 500 MPa galvanised to min. 5 µm
	HLC-H HLC-L HLC-SK HLC-T	Steel Bolt Strength 8.8, galvanised to min. 5 µm

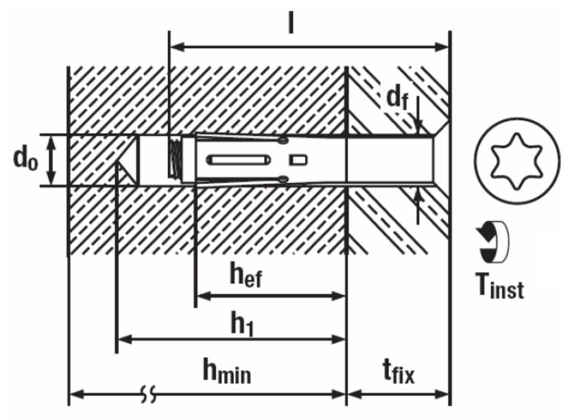
Anchor dimensions

Anchor version	Thread size	h_{ef} [mm]	d [mm]	l [mm]	l_c [mm]	t_{fix} [mm]
HLC, HLC-H, HLC-EC/EO carbon steel anchors	6,5 x 25/5	16	M5	30	25	5
	6,5 x 40/20			45	40	20
	6,5 x 60/40			65	60	40
	8 x 40/10	26	M6	46	40	10
	8 x 55/25			61	55	25
	8 x 70/40			76	70	40
	8 x 85/55			91	85	55
	10 x 40/5	31	M8	48	40	5
	10 x 50/15			58	50	15
	10 x 60/25			68	60	25
	10 x 80/45			88	80	45
	10 x 100/65			108	100	65
	12 x 55/15	33	M10	65	55	15
	12 x 75/35			85	75	35
	12 x 100/60			110	100	60
	16 x 60/10	41	M12	72	60	10
	16 x 100/50			112	100	50
	16 x 140/90			152	140	90
	20 x 80/25	41	M16	95	80	25
	20 x 115/60			130	115	60
	20 x 150/95			165	150	95
HLC-SK carbon steel anchors	6,5 x 45/20	16	M5	45	-	20
	6,5 x 65/40			65		40
	6,5 x 85/60			85		60
	8 x 60/25	26	M6	60	-	25
	8 x 75/40			75		40
	8 x 90/55			90		55
	10 x 45/5	31	M8	45	-	5
	10 x 85/45			85		45
	10 x 105/65			105		65
	10 x 130/95			130		95
	12 x 55/15	33	M10	80	-	35

HLC, HLC-H, HLC-EC/EO, HLC-L



HLC-SK

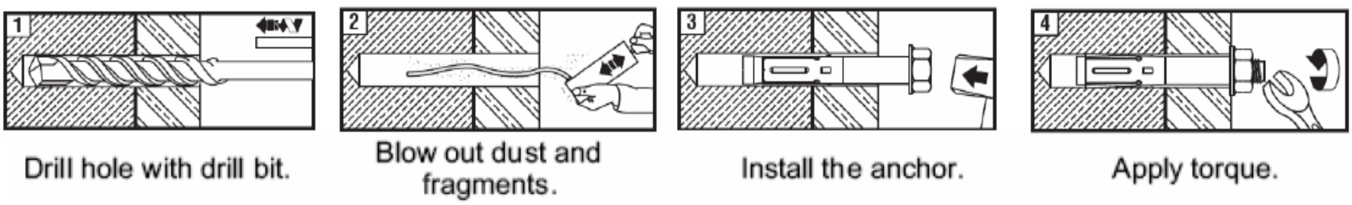


Setting

Installation equipment

Anchor size	6,5	8	10	12	16	20
Rotary hammer	TE 2 – TE 16					
Other tools	hammer, torque wrench, blow out pump					

Setting instruction



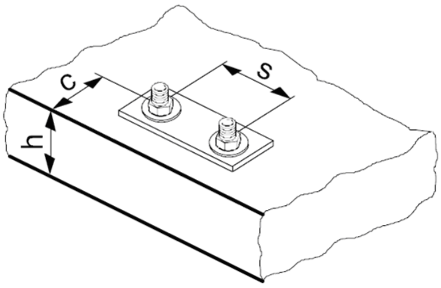
For detailed information on installation see instruction for use given with the package of the product.

Setting details HLC

Thread size		d	[mm]	M5 6,5	M6 8	M8 10	M10 12	M12 16	M16 20
Nominal diameter of drill bit		d_o	[mm]	6,5 (1/4")	8	10	12	16	20
Cutting diameter of drill bit		$d_{cut} \le$	[mm]	6,4	8,45	10,45	12,5	16,5	20,55
Depth of drill hole		$h_1 \ge$	[mm]	30	40	50	65	75	85
Width across nut flats	HLC	SW	[mm]	8	10	13	15	19	24
	HLC-H	SW	[mm]				17		
	HLS-SK	Driver		PZ 3	T 30	T 40	T 40		
Diameter of clearance hole in the fixture		$d_f \le$	[mm]	7	10	12	14	18	21
Effective anchorage depth		h_{ef}	[mm]	16	26	31	33	41	41
Max. torque moment concrete		T_{inst}	[Nm]	5	8	25	40	50	80
Max. torque moment masonry		T_{inst}	[Nm]	2,5	4	13	20	25	-

Base material thickness, anchor spacing and edge distance

Anchor size			6,5	8	10	12	16	20
Minimum base material thickness	h_{min}	[mm]	60	70	80	100	100	120
Critical spacing for splitting failure and concrete cone failure	s_{cr}	[mm]	60	100	120	130	160	160
Critical edge distance for splitting failure and concrete cone failure	c_{cr}	[mm]	30	50	60	65	80	80



Basic loading data for single anchor in solid masonry units

All data in this section applies to

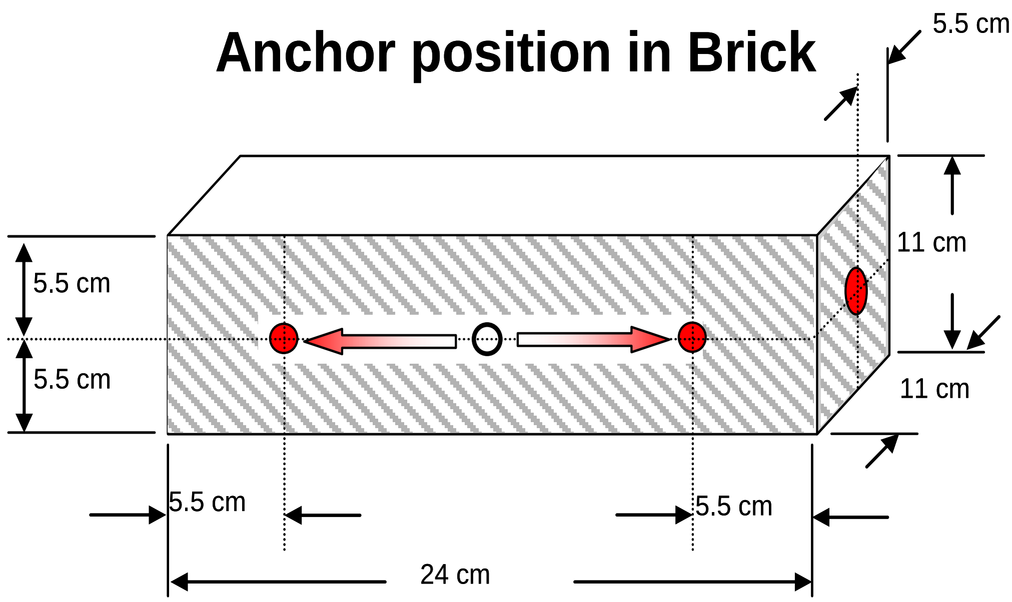
- Load values valid for holes drilled with TE rotary hammers in hammering mod
- Correct anchor setting (see instruction for use, setting details)
- The core / material ratio may not exceede 15% of a bed joint area.
- The brim area around holes must be at least 70mm
- Edge distances, spacing and other influences,see below

Recommended loads[a)]

				Hilti				
Base material		**Anchor size**		**6,5**	**8**	**10**	**12**	**16**
Germany, Austria, Switzerland		h_{nom}	[mm]	**16**	**26**	**31**	**33**	**41**
Solid clay brick Mz12/2,0 	DIN 105/ EN 771-1 f_b [b)] ≥ 12 N/mm²	Tensile N_{rec} [c)]	[kN]	0,3	0,5	0,6	0,7	0,8
		Shear V_{rec} [c)]	[kN]	0,45	1,0	1,2	1,4	1,6
Solid sand-lime brick KS 12/2,0 	DIN 106/ EN 771-2 f_b [b)] ≥12 N/mm²	Tensile N_{rec} [d)]	[kN]	0,4	0,5	0,6	0,8	0,8
		Shear V_{rec} [d)]	[kN]	0,65	1,0	1,2	1,6	1,6

a) Recommended load values for German base materials are based on national regulations.
b) f_b = brick strength
c) Values only valid for Mz (DIN 105) with brick strength ≥ 19 N/mm², density 2,0 kg/dm³, minimum brick size NF (24,0cm x 11,5cm x 11,5cm)
d) Values only valid for KS (DIN 106) with brick strength ≥ 29 N/mm², density 2,0 kg/dm³, minimum brick size NF (24,0cm x 11,5cm x 11,5cm)

Permissible anchor location in brick and block walls



Edge distance and spacing influences

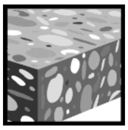
- The technical data for the HLC sleeve anchors are reference loads for MZ 12 and KS 12. Due to the large variation of natural stone solid bricks, on site anchor testing is recommended to validate technical data.
- The HLC anchor was installed and tested in center of solid bricks as shown. The HLC anchor was not tested in the mortar joint between solid bricks or in hollow bricks, however a load reduction is expected.
- For brick walls where anchor position in brick can not be determined, 100% anchor testing is recommended.
- Distance to free edge free edge to solid masonry (Mz and KS) units ≥ 300 mm
- The minimum distance to horizontal and vertical mortar joint (c_{min}) is stated in the drawing above.
- Minimum anchor spacing (s_{min}) in one brick/block is ≥ 2*c_{min}

Limits

- Applied load to individual bricks may not exceet 1,0 kN without compression or 1,4 kN with compression
- All data is for multiple use for non structural applications
- Plaster, graveling, lining or levelling courses are regarded as non-bearing and may not be taken into account for the calculation of embedment depth.

HLV Sleeve anchor

Anchor version	Benefits
 **Pre-setting** HLV 6,5x22/7 HLV 8x35/4 HLV 10x45/10 HLV 12x48/10 HLV 12x60/17 HLV 16x68/20  **Through fastening** HLV 8x35/10 HLV 10x75/45 HLV 12x95/60 HLV 16x130/90	- Available in a variety of sizes in both pre-setting and through fastening configurations - Carbon steel grade 4.8, zinc galvanized to min 5µm


Concrete

Basic loading data (for a single anchor)

All data in this section is Hilti technical data and applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Minimum base material thickness
- Concrete C20/25 – C50/60, $f_{ck,cube}$ = 25 N/mm² - 60 N/mm^2

Characteristic resistance

		Pre-setting						Through fastening			
Anchor size HLV		**6,5x22/7**	**8x35/4**	**10x45/10**	**12x48/10**	**12x60/17**	**16x68/20**	**8x35/10**	**10x75/45**	**12x95/60**	**16x130/90**
Tensile N_{Rk}	[kN]	5,2	7,1	13,0	15,9	21,9	28,3	5,6	8,3	10,5	12,8
Shear V_{Rk}	[kN]	3,3	5,6	11,4	13,0	13,0	19,7	5,6	8,3	10,5	12,8

Design resistance

		Pre-setting						Through fastening			
Anchor size HLV		**6,5x22/7**	**8x35/4**	**10x45/10**	**12x48/10**	**12x60/17**	**16x68/20**	**8x35/10**	**10x75/45**	**12x95/60**	**16x130/90**
Tensile N_{Rd}	[kN]	2,5	3,4	6,1	7,5	10,4	13,5	2,7	4,0	5,0	6,1
Shear V_{Rd}	[kN]	1,5	2,6	5,4	6,1	6,1	9,4	2,7	4,0	5,0	6,1

Recommended loads

Anchor size HLV		Pre-setting 6,5x22/7	Pre-setting 8x35/4	Pre-setting 10x45/10	Pre-setting 12x48/10	Pre-setting 12x60/17	Pre-setting 16x68/20	Through fastening 8x35/10	Through fastening 10x75/45	Through fastening 12x95/60	Through fastening 16x130/90
Tensile N_{rec} [a)]	[kN]	1,7	2,4	4,3	5,3	7,4	9,6	1,9	2,8	3,6	4,3
Shear V_{rec} [a)]	[kN]	1,0	1,8	3,8	4,3	4,3	6,7	1,9	2,8	3,6	4,3

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

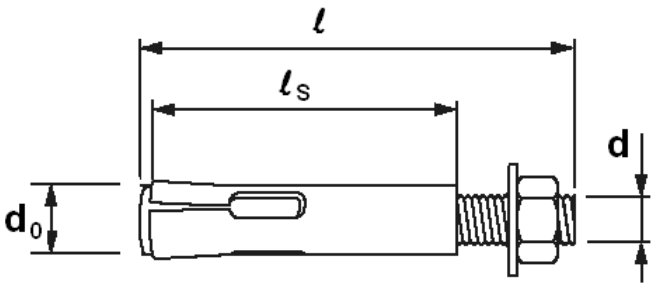
Materials

Material quality

Part	Material
Anchor bolt	Carbon steel, $f_{uk} \geq 400$ N/mm², galvanised to min. 5 µm

Anchor dimensions

Anchor size HLV			Pre-setting 6,5x22/7	Pre-setting 8x35/4	Pre-setting 10x45/10	Pre-setting 12x48/10	Pre-setting 12x60/17	Pre-setting 16x68/20	Through fastening 8x35/10	Through fastening 10x75/45	Through fastening 12x95/60	Through fastening 16x130/90
Thread size	d	[-]	M5	M6	M8	M10		M12	M6	M8	M10	M12
Diameter of anchor	d_o	[mm]	6,5	8	10	12		16	8	10	12	16
Length of anchor bolt	ℓ	[mm]	39	51	68	76	95	109	47	88	114	152
Length of sleeve	ℓ_S	[mm]	22	35	45	48	60	68	35	75	95	130



Setting

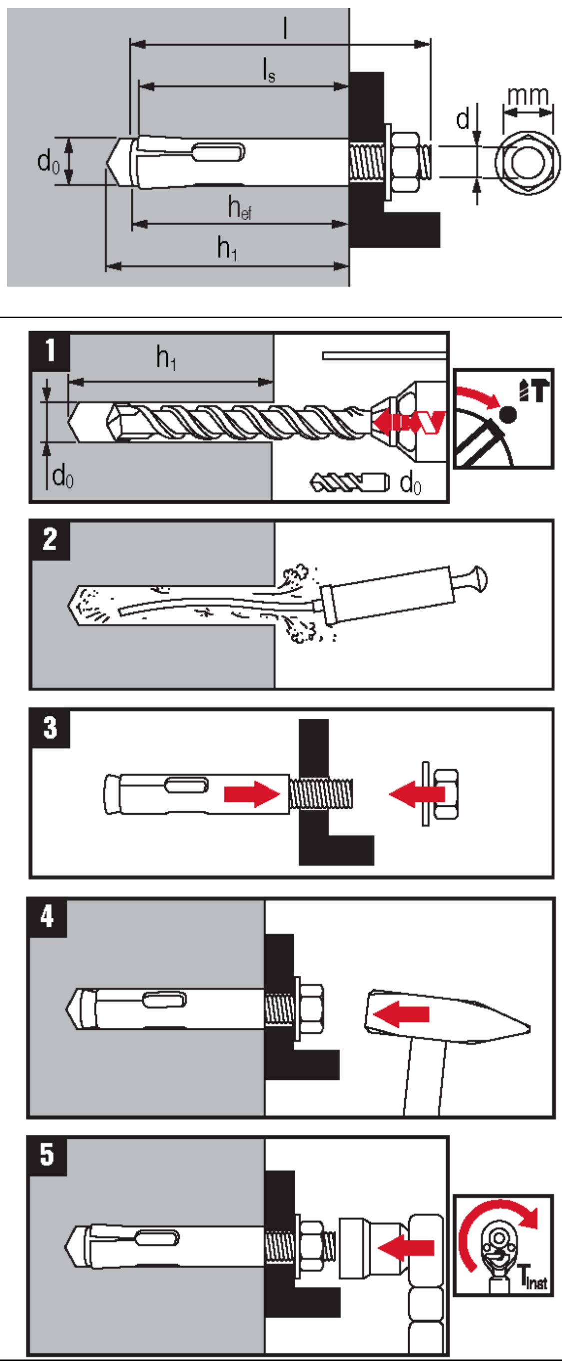
Installation equipment

Anchor size	6,5	8	10	12	16
Rotary hammer	TE 2 – TE 16				
Other tools	hammer, torque wrench, blow out pump				

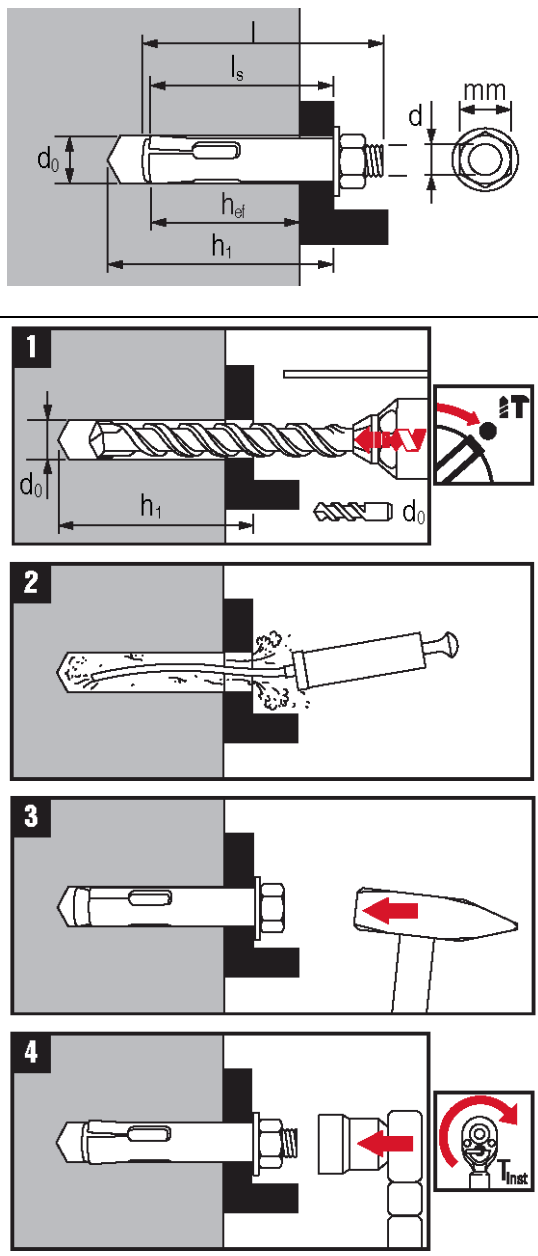
Setting instruction

Pre-setting	Through fastening

Pre-setting



Through fastening



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

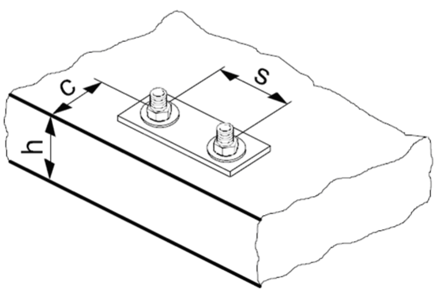
Setting details HLV

			Pre-setting						Through fastening			
Anchor size HLV			**6,5x22/7**	**8x35/4**	**10x45/10**	**12x48/10**	**12x60/17**	**16x68/20**	**8x35/10**	**10x75/45**	**12x95/60**	**16x130/90**
Thread size		[kN]	M5	M6	M8	M10		M12	M6	M8	M10	M12
Thickness of fixture	$t_{fix} \leq$	[mm]	7	4	10	10	17	20	10	45	60	90
Nominal diameter of drill bit	d_o	[mm]	6,5 (1/4”)	8	10	12		16	8	10	12	16
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	6,4	8,45	10,45	12,5		16,5	8,45	10,45	12,5	16,5
Depth of drill hole	$h_1 \geq$	[mm]	40	50	65	70	80	100	40	50	55	70
Width across nut flats	SW	[mm]	8	10	13	17		19	10	13	17	19
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	6	7	9	11	11	14	10	12	14	18
Effective anchorage depth	h_{ef}	[mm]	22	35	45	48	60	68	25	30	35	40
Max. torque moment	T_{inst}	[Nm]	2	4	25	40		50	4	25	40	50

Base material thickness, anchor spacing and edge distance

			Pre-setting						Through fastening			
Anchor size HLV			**6,5x22/7**	**8x35/4**	**10x45/10**	**12x48/10**	**12x60/17**	**16x68/20**	**8x35/10**	**10x75/45**	**12x95/60**	**16x130/90**
Minimum base material thickness	h_{min}	[mm]	80	80	90	100	120	140	80 [a)]	80 [a)]	80 [a)]	80 [a)]
Minimum spacing	s_{min}	[mm]	200	200	200	200	240	280	200	200	200	200
Minimum edge distance	c_{min}	[mm]	100	105	135	150	180	210	100	100	105	120

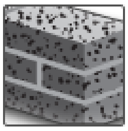
[a)] in case of deeper embedment than h_{ef}: $h_{min} \geq 2$ x embedment depth



HAM Hard sleeve anchor

Anchor version		Benefits
	HAM with steel strength 8.8 screw	- secure fastenings in various base materials - cone attached to sleeve to ensure pre-setting - wings to prevent spinning in the borehole - plastic cap in cone to prevent dust entrance - blue-chromate zinc coating - 8.8 steel strength of screw
	HAM	


Concrete


Solid brick

Basic loading data (for a single anchor)

All data in this section applies to

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete as specified in the table
- Steel failure
  Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

Recommended Loads in uncracked concrete C20/25

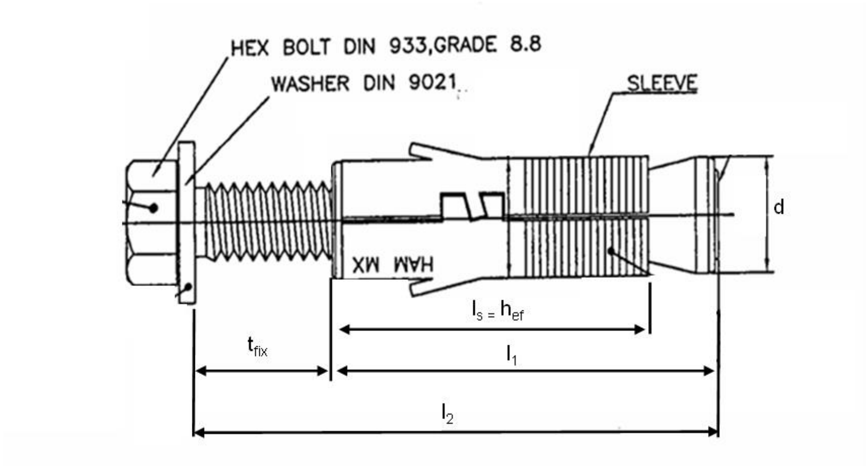
Thread Diameter	d	[mm]	M6x50	M8x60	M10x80	M12x90
Tension	N_{rec}	[kN]	4,0	4,8	5,8	8,7
Shear	V_{rec}	[kN]	4,6	8,4	13,3	19,3

Recommended Loads in solid brick

Thread Diameter	d	[mm]	M6x50	M8x60	M10x80	M12x90
Tension	N_{rec}	[kN]	For solid brick, load values need to be determined on the building site			
Shear	V_{rec}	[kN]				

Materials

Part		Material
HAM Anchor	Sleeve	Carbon steel
	Hex head Bolt	Carbon steel DIN 933, Strength 8.8
	Washer	Carbon steel, DIN 9021



Anchor dimensions

Anchor version	Anchor	h_{ef} [mm]	d [mm]	l_s [mm]	l_1 [mm]	l_2 [mm]	t_{fix} [mm]
HAM	M6 x 50	30	12	30	40	50	10
	M8 x 60	35	14	35	50	60	10
	M10 x 80	43	16	43	60	80	20
	M12 x 90	55	19	55	70	90	20

Setting

Installation equipment

Anchor size		M6x50	M8x60	M10x80	M12x90
Rotary hammer		TE 2 – TE 16			
Drill bit	TE-C3X	12	14	16	20
Other tools		hammer, torque wrench, blow out pump			

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

Setting details for HAM with 8.8 screw

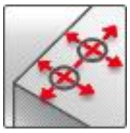
Thread Diameter	d	[mm]	M6x50	M8x60	M10x80	M12x90
Nominal diameter of drill bit	d_o	[mm]	12	14	16	20
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	12,5	14,5	16,5	20,55
Depth of drill hole	$h_1 \geq$	[mm]	65	80	90	110
Width across nut flats	SW	[mm]	10	13	17	19
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	7	9	12	14
Max. torque moment concrete	T_{inst}	[Nm]	10	25	45	75
Max. torque moment masonry	T_{inst}	[Nm]	5	10	20	30

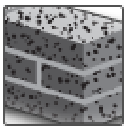
HUS3 Screw anchor

	Anchor version	Benefits
	HUS3-H 8 / 10 / 14 Carbon steel concrete screw with hexagonal head	- High productivity – less drilling and fewer operations than with conventional anchors - ETA approval for cracked and non-cracked concrete - Seismic approval ETA C1 - High loads - Small edge and spacing distances - abZ (DIBt) approval for adjustability (unscrew-rescrew) - abZ (DIBt) approval for reusability in fresh concrete ($f_{ck,cube}$=10/15/20 Nmm^2) for temporary applications - Three embedment depths for maximum design flexibility - HUS3-HF with multilayer coatings for additional corrosion protection
	HUS3-C 8 / 10 Carbon steel concrete screw with countersunk head	
	HUS3-HF 10 / 14 Carbon steel concrete screw with multilayer coating (≥14 µm) and hexagonal head	


Concrete


Tensile zone


Small edge distance and spacing


Solid brick


Autoclaved aerated concrete


Fire resistance


Seismic


European Technical Approval

DIBt Approval Adjustability

DIBt Approval Reusability


CE conformity


Sprinkler approved


PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical assessment [a)]	DIBt, Berlin	ETA-13/1038 / 2014-03-26
DIBt approval (Adjustability)	DIBt, Berlin	Z-21.1-2021 / 2014-03-26
DIBt approval (Reusability)	DIBt, Berlin	Z-21.8-2018 / 2014-04-01

a) All data given in this section for HUS3-H and HUS3-C according ETA-13/1038, issue 2014-03-26.

Basic loading data (for a single anchor)

All data in this section applies to For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Minimum base material thickness
- Cracked and non-cracked Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Adjustment allowed during the installation for size 8 and 10, types H, C and h_{nom2} only.

Mean ultimate resistance

			Data according ETA-13/1038, issue 2014-03-26.								
Anchor size			**8**			**10**			**14**		
Type		**HUS3**	**H, C**			**H, C**			**H**		
Nominal embedment depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Non-cracked concrete											
Tensile $N_{Ru,m}$		[kN]	11,9	15,9	21,2	15,9	26,6	36,8	23,2	36,2	59,0
Shear $V_{Ru,m}$		[kN]	17,0	*17,9*	*17,9*	18,0	*29,4*	*29,4*	46,4	*47,3*	*47,3*
Cracked concrete											
Tensile $N_{Ru,m}$		[kN]	8,0	11,9	15,9	12,8	21,4	26,3	16,5	25,8	42,0
Shear $V_{Ru,m}$		[kN]	12,1	*17,9*	*17,9*	12,8	*29,4*	*29,4*	33,1	*47,3*	*47,3*

			Hilti Tech. Data				
Anchor size			**10**			**14**	
Type		**HUS3**	**HF**			**HF**	
Nominal embedment depth	h_{nom}	[mm]	55	75	85	65	85
Non-cracked concrete							
Tensile $N_{Ru,m}$		[kN]	15,9	26,6	36,8	23,2	36,2
Shear $V_{Ru,m}$		[kN]	18,0	*25,7*	*25,7*	46,4	*47,3*
Cracked concrete							
Tensile $N_{Ru,m}$		[kN]	12,8	21,4	26,3	16,5	25,8
Shear $V_{Ru,m}$		[kN]	12,8	*25,7*	*25,7*	33,1	*47,3*

Characteristic resistance

			Data according ETA-13/1038, issue 2014-03-26.								
Anchor size			**8**			**10**			**14**		
Type		**HUS3**	**H, C**			**H, C**			**H**		
Nominal embedment depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Non-cracked concrete											
Tensile N_{Rk}		[kN]	9,0	12,0	16,0	12,0	20,0	27,8	17,5	27,3	44,4
Shear V_{Rk}		[kN]	12,8	*17,0*	*17,0*	13,5	*28,0*	*28,0*	35,0	*45,0*	*45,0*
Cracked concrete											
Tensile N_{Rk}		[kN]	6,0	9,0	12,0	9,7	16,1	19,8	12,5	19,4	31,7
Shear V_{Rk}		[kN]	9,1	*17,0*	*17,0*	9,7	*28,0*	*28,0*	24,9	38,9	*45,0*

			Hilti Tech. Data				
Anchor size			**10**			**14**	
Type		**HUS3**	**HF**			**HF**	
Nominal embedment depth	h_{nom}	[mm]	55	75	85	65	85
Non-cracked concrete							
Tensile N_{Rk}		[kN]	12,0	20,0	27,8	17,5	27,3
Shear V_{Rk}		[kN]	13,5	*24,5*	*24,5*	35,0	*45,0*
Cracked concrete							
Tensile N_{Rk}		[kN]	9,7	16,1	19,8	12,5	19,4
Shear V_{Rk}		[kN]	9,7	*24,5*	*24,5*	24,9	38,9

Design resistance

			Data according ETA-13/1038, issue 2014-03-26.								
Anchor size			**8**			**10**			**14**		
Type		**HUS3**	**H, C**			**H, C**			**H**		
Nominal embedment depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Non-cracked concrete											
Tensile N_{Rd}		[kN]	6,0	8,0	10,7	8,0	13,3	18,5	11,7	18,2	29,6
Shear V_{Rd}		[kN]	8,5	*11,3*	*11,3*	9,0	*18,7*	*18,7*	23,3	*30,0*	*30,0*
Cracked concrete											
Tensile N_{Rd}		[kN]	4,0	6,0	8,0	6,4	10,8	13,2	8,3	13,0	21,1
Shear V_{Rd}		[kN]	6,1	*11,3*	*11,3*	6,4	*18,7*	*18,7*	16,6	25,9	*30,0*

			Hilti Tech. Data				
Anchor size			**10**			**14**	
Type		**HUS3**	**HF**			**HF**	
Nominal embedment depth	h_{nom}	[mm]	55	75	85	65	85
Non-cracked concrete							
Tensile N_{Rd}		[kN]	8,0	13,3	18,5	11,7	18,2
Shear V_{Rd}		[kN]	9,0	*16,3*	*16,3*	23,3	*30,0*
Cracked concrete							
Tensile N_{Rd}		[kN]	6,4	10,8	13,2	8,3	13,0
Shear V_{Rd}		[kN]	6,4	*16,3*	*16,3*	16,6	25,9

Recommended load

			Data according ETA-13/1038, issue 2014-03-26,							
Anchor size			**8**			**10**			**14**	
Type		**HUS3**	**H, C**			**H, C**			**H**	
Nominal embedment depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Non-cracked concrete											
Tensile N_{Rec}		[kN]	4,3	5,7	7,6	5,7	9,5	13,2	8,3	13,0	21,2
Shear V_{Rec}		[kN]	6,1	8,1	8,1	6,5	13,3	13,3	16,6	21,4	21,4
Cracked concrete											
Tensile N_{Rec}		[kN]	2,9	4,3	5,7	4,6	7,7	9,4	5,9	9,3	15,1
Shear V_{Rec}		[kN]	4,3	8,1	8,1	4,6	13,3	13,3	11,9	18,5	21,4

			Hilti Tech. Data				
Anchor size			**10**			**14**	
Type		**HUS3**	**HF**			**HF**	
Nominal embedment depth	h_{nom}	[mm]	55	75	85	65	85
Non-cracked concrete							
Tensile N_{Rec}		[kN]	5,7	9,5	13,2	8,3	13,0
Shear V_{Rec}		[kN]	6,5	11,7	11,7	16,6	21,4
Cracked concrete							
Tensile N_{Rec}		[kN]	4,6	7,7	9,4	5,9	9,3
Shear V_{Rec}		[kN]	4,6	11,7	11,7	11,9	18,5

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

Mechanical properties

Anchor size		**8**	**10**	**10**	**14**
Type	**HUS3**	**H, C**	**H, C**	**HF**	**H, HF**
Nominal tensile strength f_{uk}	[N/mm²]	810	805	705	730
Yield strength f_{yk}	[N/mm²]	695	690	605	630
Stressed cross-section $A_{s,}$	[mm²]	48,4	77,0	77,0	131,7
Moment of resistance W	[mm³]	47	95	95	213
Char, bending resistance $M^0_{Rk,s}$	[Nm]	46	92	81	187

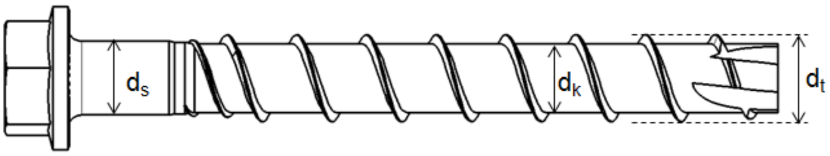
Material quality

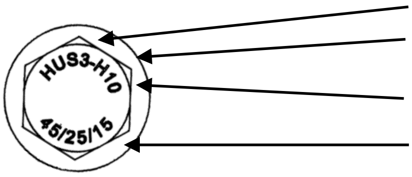
Type	Material	Coating
HUS3-H / HUS3-C	Carbon-steel	Galvanized (≥5 μm)
HUS3-HF	Carbon-steel	Multilayer coating (≥14 μm)

Anchor dimensions

Dimensions

Anchor size			8	10	14
Type		**HUS3**	**H, C**	**H, C, HF**	**H, HF**
Threaded outer diameter	d_t	[mm]	10,30	12,40	16,85
Core diameter	d_k	[mm]	7,85	9,90	12,95
Shaft diameter	d_s	[mm]	8,45	10,55	13,80
Stressed section	A_s	[mm^2]	48,4	77,0	131,7





HUS3 : Hilti Universal Screw 3rd generation

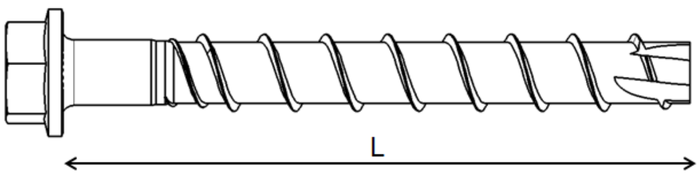
H : Hexagonal head

10 : screw diameter

45/25/15 : maximum thickness fixture $t_{fix1}/t_{fix2}/t_{fix3}$ related to the embedment depth $h_{nom1}/h_{nom2}/h_{nom3}$ (see Annex B3)

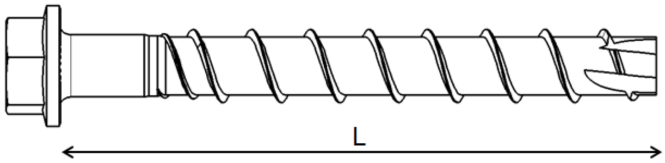
Screw length and thickness of fixture for HUS3-H (hex head, galvanized)

Anchor size **HUS3-H**	8			10			14		
Nominal anchorage depth [mm]	h_{nom1} 50	h_{nom2} 60	h_{nom3} 70	h_{nom1} 55	h_{nom2} 75	h_{nom3} 85	h_{nom1} 65	h_{nom2} 85	h_{nom3} 115
	Thickness of fixture [mm]								
Length of anchor [mm]	t_{fix1}	t_{fix2}	t_{fix3}	t_{fix1}	t_{fix2}	t_{fix3}	t_{fix1}	t_{fix2}	t_{fix3}
55	5	-	-	-	-	-	-	-	-
60	-	-	-	5	-	-	-	-	-
65	15	5	-	-	-	-	-	-	-
70	-	-	-	15	-	-	-	-	-
75	25	15	5	-	-	-	10	-	-
80	-	-	-	25	5	-	-	-	-
85	35	25	15	-	-	-	-	-	-
90	-	-	-	35	15	5	-	-	-
100	50	40	30	45	25	15	35	15	-
110	-	-	-	55	35	25	-	-	-
120	70	60	50	-	-	-	-	-	-
130	-	-	-	75	55	45	65	45	15
150	100	90	80	95	75	65	85	65	35



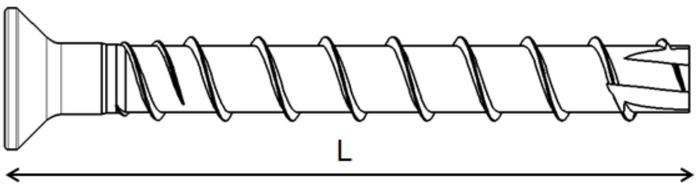
Screw length and thickness of fixture for HUS3-HF (hex head, multilayer coating)

Anchor size HUS3-HF	10			14	
Nominal anchorage depth [mm]	h_{nom1} 55	h_{nom2} 75	h_{nom3} 85	h_{nom1} 65	h_{nom2} 85
	Thickness of fixture [mm]				
Length of anchor [mm]	t_{fix1}	t_{fix2}	t_{fix3}	t_{fix1}	t_{fix2}
60	5	-	-	-	-
75	-	-	-	10	-
80	25	5	-	-	-
100	45	25	15	35	15
110	55	35	25	-	-



Screw length and thickness of fixture for HUS3-C (countersunk head, galvanized)

Anchor size HUS3-C	8			10		
Nominal anchorage depth [mm]	h_{nom1} 50	h_{nom2} 60	h_{nom3} 70	h_{nom1} 55	h_{nom2} 75	h_{nom3} 85
	Thickness of fixture [mm]					
Length of anchor [mm]	t_{fix1}	t_{fix2}	t_{fix3}	t_{fix1}	t_{fix2}	t_{fix3}
65	15	5	-	-	-	-
70	-	-	-	15	-	-
75	25	15	-	-	-	-
85	35	25	15	-	-	-
90	-	-	-	35	15	-
100	-	-	-	45	25	15



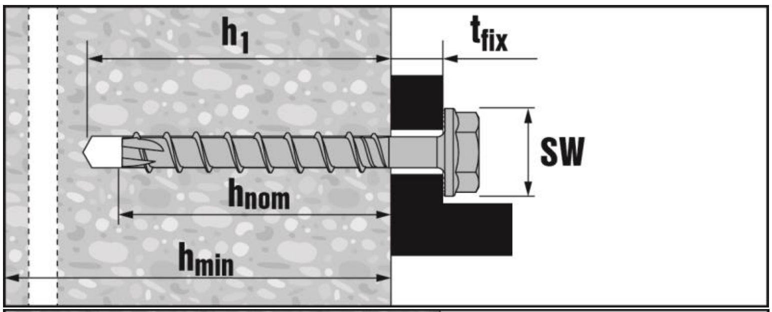
Setting

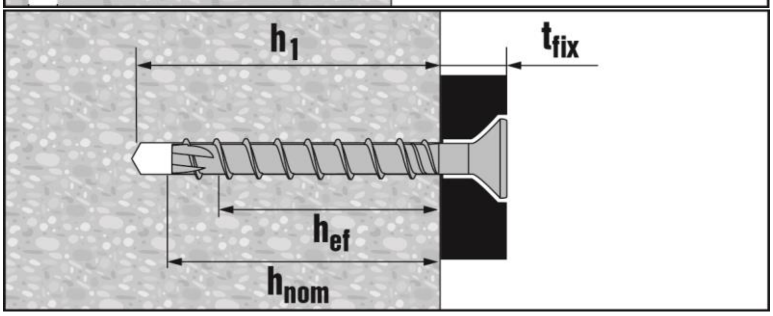
Installation equipment

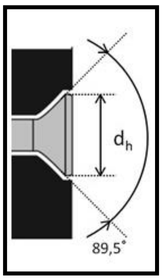
Anchor size		8	10	14
Type	**HUS3**	**H, C**	**H, C, HF**	**H, HF**
Rotary hammer		TE 2 – TE 30	TE 2 – TE 30	TE 2 – TE 30
Drill bit for concrete, solid clay brick and solid sand-lime brick		CX 8	CX 10	CX 14
Drill bit for aerated concrete		CX 6	CX 8	-
Socket wrench insert		S-NSD 13 1/2	S-NSD 15 1/2	S-NSD 21 1/2
Torx		S-SY TX45	S-SY TX50	-
Tube for temporary application (only for H type)		HRG 8	HRG 10	HRG 14
Setting tool for concrete C12/15 to C50/60		SIW 22T-A		
Setting tool for solid brick and aerated concrete		SFH 22A		
Setting tool for hollow core slab		SIW 22 A		

Setting details for concrete

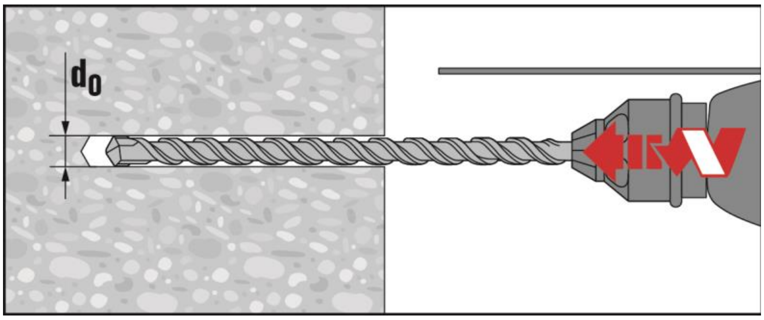
Anchor size			8			10			14		
Type		**HUS3**	**H, C**			**H, C, HF**			**H, HF**		**H**
Nominal anchorage depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Nominal diameter of drill bit	d_o	[mm]	8			10			14		
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45			10,45			14,50		
Depth of drill hole	$h_1 \geq$	[mm]	60	70	80	65	85	95	75	95	125
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	12			14			18		
Diameter of countersunk head	d_h	[mm]	18			21			-		
Width across (H, HF types)	SW	[mm]	13			15			21		
Torx (C type)	TX	[-]	45			50			-		
Impact screw driver			Hilti SIW 22 T-A								



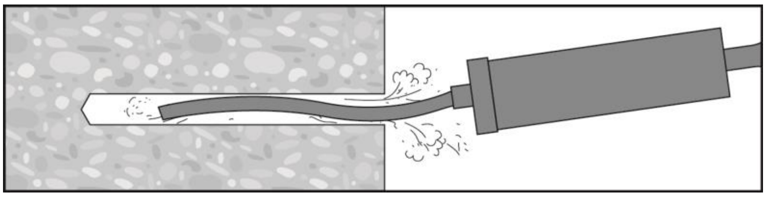


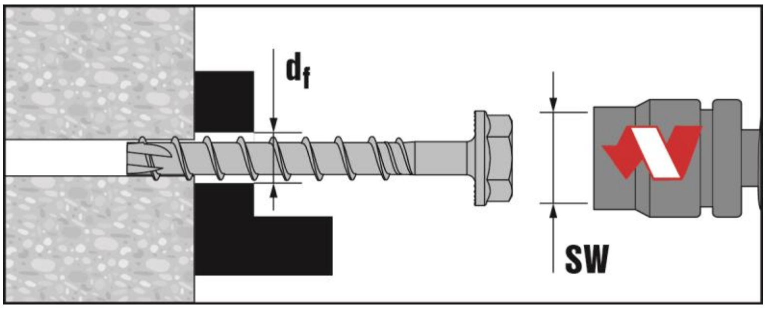


Setting instruction

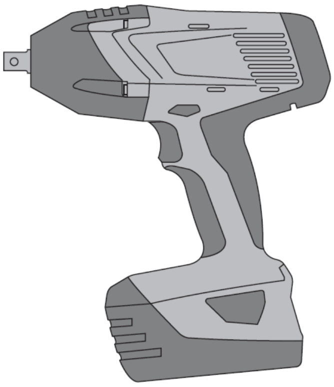


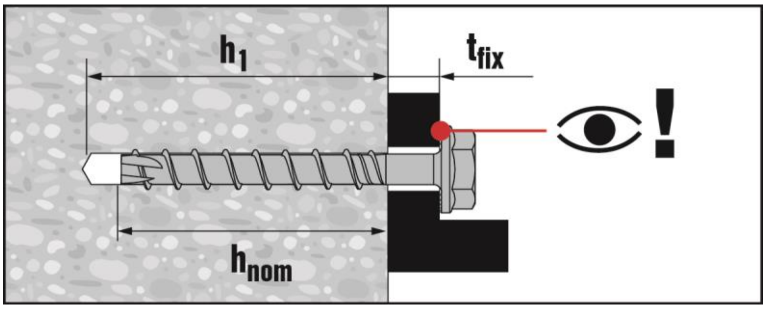
Make a cylindrical hole


Clean the borehole



Install the screw anchor by impact screw driver Hilti SIW 22T-A

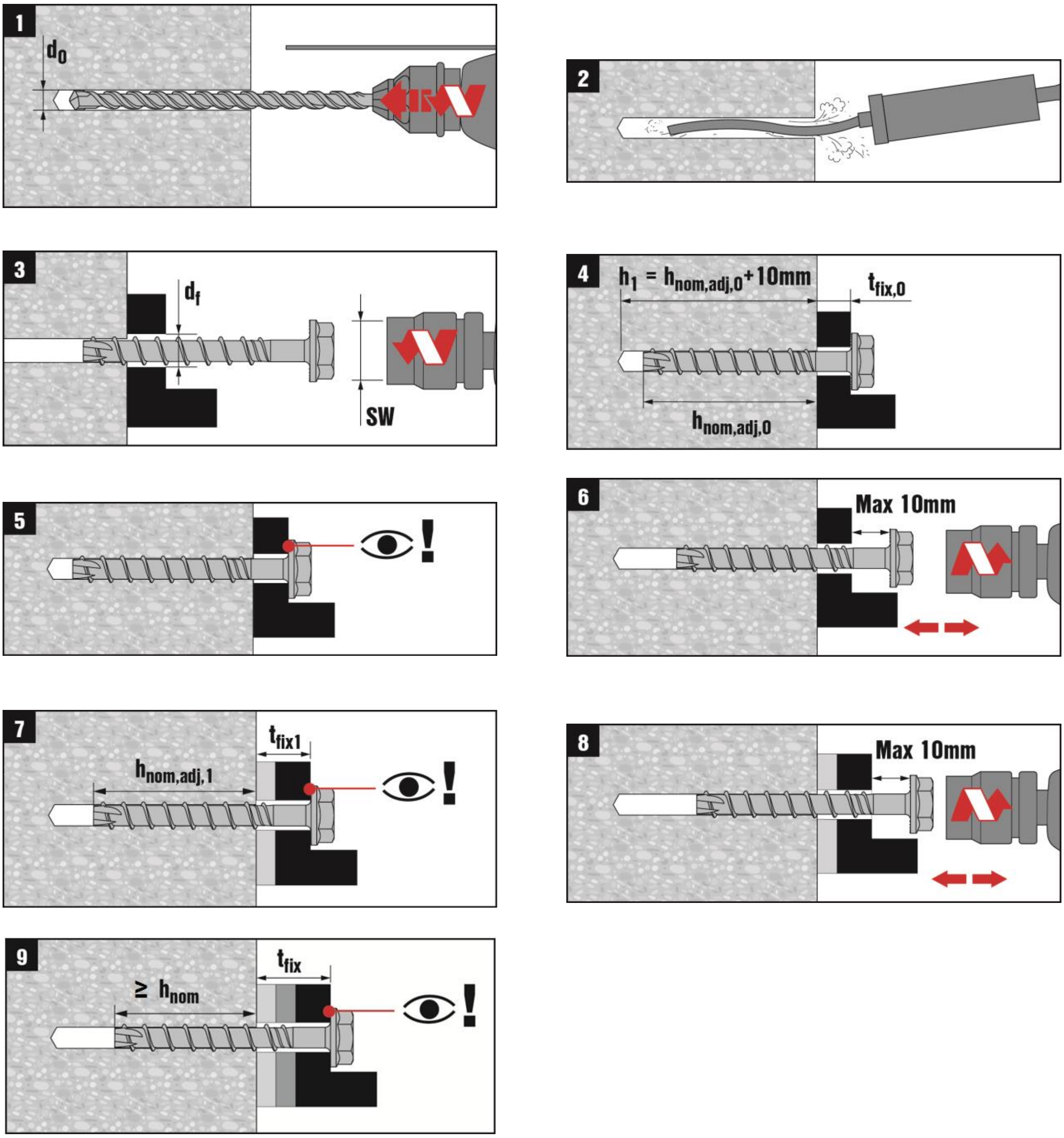




Ensure that the fixture is caught

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

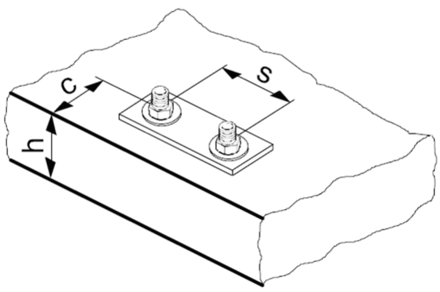
Setting instruction in case of adjustment process (recommended for HUS3-H,C size 8 and 10 for standard embedment depth h_{nom2} only)



For setting HUS3-H,C 8 (h_{nom2}=60mm) and HUS3-H,C 10 (h_{nom2}=75mm) it is allowed to adjust (loosening max. 10mm and re-tightening) the screw. The adjustment can be done maximum two times. The final embedment depth after adjustment process must be larger or equal than h_{nom2}.
The total allowed thickness of shims added during the adjustment process is 10mm.

Design parameters

Anchor size			8			10			14		
Type	**HUS3**		**H, C**			**H, C, HF**			**H, HF**		**H**
Nominal anchorage depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Effective anchorage depth	h_{ef}	[mm]	40	46,4	54,9	41,6	58,6	67,1	49,3	66,3	91,8
Minimum base material thickness	h_{min}	[mm]	100	100	120	100	130	140	120	160	200
Minimum spacing	s_{min}	[mm]	40	50	50	50	50	60	60	75	75
Minimum edge distance	c_{min}	[mm]	50	50	50	50	50	60	60	75	75
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	120	140	170	130	180	220	170	200	280
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	60	70	85	65	90	110	85	100	140
Critical spacing for concrete failure	$s_{cr,N}$	[mm]	120	140	170	130	180	202	150	200	280
Critical edge distance for concrete cone failure	$c_{cr,N}$	[mm]	60	70	85	65	90	101	75	100	140



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according ETA-13/1038, issue 2014-03-26 (HUS3-H and C types only).

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then conservative: They will be lower than the exact values according ETAG 001, Annex C. To avoid this, it is recommended to use the anchor design software PROFIS anchor).

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

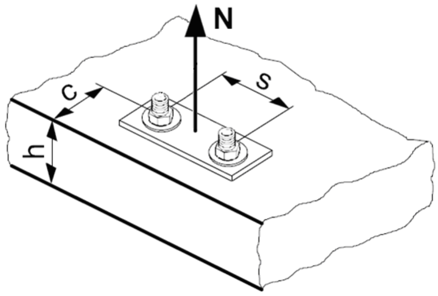
For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):

$$N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

		Data according ETA-13/1038, issue 2014-33-26.		
Anchor size		**8**	**10**	**14**
Type	**HUS3**	**H, C**	**H, C**	**H**
$N_{Rd,s}$	[kN]	28,0	44,4	69,0
		Hilti Tech. Data		
Anchor size		**10**	**14**	
Type	**HUS3**	**HF**	**HF**	
$N_{Rd,s}$	[kN]	38,7	69,0	

Design pull-out resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$

			Data according ETA-13/1038, issue 2014-33-26.							
Anchor size			**8**			**10**			**14**	
Type		**HUS3**	**H, C**			**H, C**			**H**	
Nominal anchorage depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Non-cracked concrete										
$N^0_{Rd,p}$		[kN]	6,0	8,0	10,7	8,0	13,3	No pull-out	No pull-out		
Cracked concrete										
$N^0_{Rd,p}$		[kN]	4,0	6,0	8,0	No pull-out			No pull-out		

			Hilti Tech. Data				
Anchor size			**10**			**14**	
Type		**HUS3**	**HF**			**HF**	
Nominal anchorage depth	h_{nom}	[mm]	55	75	85	65	85
Non-cracked concrete							
$N^0_{Rd,p}$		[kN]	8,0	13,3	No pull-out	No pull out	
Cracked concrete							
$N^0_{Rd,p}$		[kN]	No pull-out			No pull-out	

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance [a)] $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

			Data according ETA-13/1038, issue 2014-33-26.							
Anchor size			**8**			**10**			**14**	
Type		**HUS3**	**H, C**			**H, C**			**H**	
Nominal anchorage depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Non-cracked concrete											
$N^0_{Rd,c}$		[kN]	8,5	10,6	13,7	9,0	15,1	18,5	11,7	18,2	29,6
Cracked concrete											
$N^0_{Rd,c}$		[kN]	6,1	7,6	9,8	6,4	10,8	13,2	8,3	13,0	21,1

			Hilti Tech. Data				
Anchor size			**10**			**14**	
Type		**HUS3**	**HF**			**HF**	
Nominal anchorage depth	h_{nom}	[mm]	55	75	85	65	85
Non-cracked concrete							
$N^0_{Rd,p}$		[kN]	9,0	15,1	18,5	11,7	18,2
Cracked concrete							
$N^0_{Rd,p}$		[kN]	6,4	10,8	13,2	8,3	13,0

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
Pull-out , concrete cone and splitting resistance							
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length.

Influence of edge distance [a)]

$c/c_{cr,N}$ / **$c/c_{cr,sp}$**	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ / $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ / $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details, These influencing factors must be considered for every edge distance.

Influence of anchor spacing [a)]

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0{,}5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0{,}5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of base material thickness

h/h_{min}	1,0	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	≥ 1,84
$f_{h,sp} = [h/(h_{min})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

Influence of reinforcement [a)]

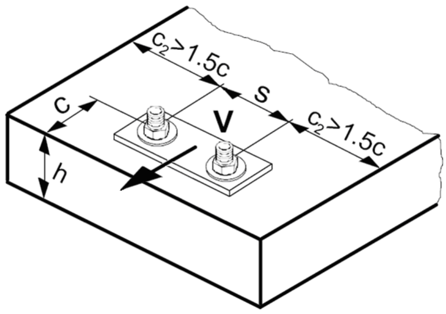
Anchor size		8			10			14		
Type	HUS3	H, C, HF			H, C, HF			H, HF		
Nominal anchorage depth	h_{nom} [mm]	50	60	70	55	75	85	65	85	115
$f_{re,N} = 0{,}5 + h_{ef}/200mm \leq 1$		0,70	0,73	0,77	0,71	0,79	0,84	0,75	0,83	0,96

d) This factor applies only for dense reinforcement, If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

		Data according ETA-13/1038, issue 2014-33-26.		
Anchor size		**8**	**10**	**14**
Type	**HUS3**	**H, C**	**H, C**	**H,**
$V_{Rd,s}$	[kN]	11,3	18,7	30,0

		Hilti Tech. Data	
Anchor size		**10**	**14**
Type	**HUS3**	**HF**	**HF**
$V_{Rd,s}$	[kN]	16,3	30,0

Design concrete pry-out resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$ [a)]

			Data according ETA-13/1038, issue 2014-33-26.								
Anchor size			**8**			**10**			**14**		
Type		**HUS3**	**H, C**			**H, C, HF**			**H, HF**		**H**
Nominal anchorage depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
k			1,0	2,0	2,0	1,0	2,0	2,0	2,0	2,0	2,0

			Hilti Tech. Data				
Anchor size			**10**			**14**	
Type		**HUS3**	**HF**			**HF**	
Nominal anchorage depth	h_{nom}	[mm]	55	75	85	65	85
k		[kN]	1,0	2,0	2,0	2,0	2,0

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance [a] $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

			Data according ETA-13/1038, issue 2014-33-26.								
Anchor size			**8**			**10**			**14**		
Type		**HUS3**	**H, C**			**H, C**			**H**		
Nominal anchorage depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Non-cracked concrete											
$V^0_{Rd,c}$		[kN]	6,0	6,0	6,0	8,6	8,6	8,6	15,0	15,1	15,2
Cracked concrete											
$V^0_{Rd,c}$		[kN]	4,2	4,2	4,2	6,1	6,1	6,1	10,6	10,7	10,7

			Hilti Tech. Data				
Anchor size			**10**			**14**	
Type		**HUS3**	**HF**			**HF**	
Nominal anchorage depth	h_{nom}	[mm]	55	75	85	65	85
Non-cracked concrete							
$V^0_{Rd,c}$		[kN]	8,6	8,6	8,6	15,0	15,1
Cracked concrete							
$V^0_{Rd,c}$		[kN]	6,1	6,1	6,1	10,6	10,7

c) For anchor groups only the anchors close to the edge must be considered.

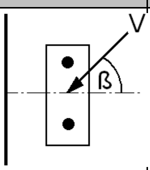
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length.

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	**0°**	**10°**	**20°**	**30°**	**40°**	**50°**	**60°**	**70°**	**80°**	**≥ 90°**
$f_\beta = \frac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	**0,15**	**0,3**	**0,45**	**0,6**	**0,75**	**0,9**	**1,05**	**1,2**	**1,35**	**≥ 1,5**
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size			8			10			14		
Type		HUS3	H, C			H, C, HF			H, HF		H
Nominal anchorage depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$			0,75	0,96	1,27	0,55	0,98	1,22	0,41	0,68	1,18

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

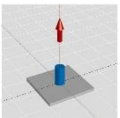
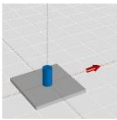
a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

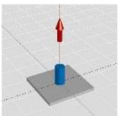
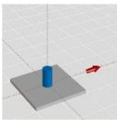
Precalculated values

Design resistance calculated according ETAG 001, Annex C and data given in ETA-13/1038 issue 2013-03-26,
All data applies to concrete C 20/25 – $f_{ck,cube}$ =25 N/mm².

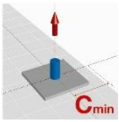
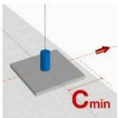
Design resistance

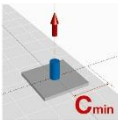
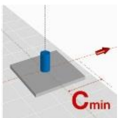
Single anchor, no edge effects

			Data according ETA-13/1038, issue 2014-03-26.								
Anchor size			**8**			**10**			**14**		
Type		**HUS3**	**H, C**			**H, C**			**H**		
Nominal anchorage depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Min, base material thickness h_{min} [mm]			100	100	120	100	130	140	120	160	200
	**Tensile N_{Rd}**										
	Non-cracked concrete										
		[kN]	6,0	8,0	10,7	8,0	13,3	18,5	11,7	18,2	29,6
	Cracked concrete										
		[kN]	4,0	6,0	8,0	6,4	10,8	13,2	8,3	13,0	21,1
	**Shear V_{Rd}, without lever arm**										
	Non-cracked concrete										
		[kN]	8,5	11,3	11,3	9,0	18,7	18,7	23,3	30,0	30,0
	Cracked concrete										
		[kN]	6,1	11,3	11,3	6,4	18,7	18,7	16,6	25,9	30,0

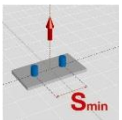
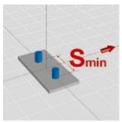
			Hilti Tech. Data				
Anchor size			**10**			**14**	
Type		**HUS3**	**HF**			**HF**	
Nominal anchorage depth	h_{nom}	[mm]	55	75	85	65	85
Min, base material thickness h_{min} [mm]			100	100	100	130	140
	**Tensile N_{Rd}**						
	Non-cracked concrete						
		[kN]	8,0	13,3	18,5	11,7	18,2
	Cracked concrete						
		[kN]	6,4	10,8	13,2	8,3	13,0
	**Shear V_{Rd}, without lever arm**						
	Non-cracked concrete						
		[kN]	9,0	16,3	16,3	23,3	30,0
	Cracked concrete						
		[kN]	6,4	16,3	16,3	16,6	25,9

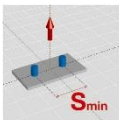
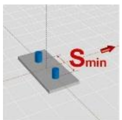
Single anchor, min. edge distance ($c = c_{min}$)

		Data according ETA-13/1038, issue 2014-03-26.								
Anchor size		**8**			**10**			**14**		
Type	**HUS3**	**H, C**			**H, C**			**H**		
Nominal anchorage depth	h_{nom} [mm]	50	60	70	55	75	85	65	85	115
Min. base material thickness	h_{min} **[mm]**	100	100	120	100	130	140	120	160	200
Min. edge distance	c_{min} [mm]	50	50	50	50	50	60	60	75	75
	**Tensile N_{Rd}**									
	Non-cracked concrete									
	[kN]	6,0	8,0	9,5	7,4	10,2	12,3	9,1	14,7	19,6
	Cracked concrete									
	[kN]	4,0	5,9	6,8	5,3	7,3	8,8	6,5	10,5	14,0
	**Shear V_{Rd}, without lever arm**									
	Non-cracked concrete									
	[kN]	4,4	4,5	4,6	4,6	4,9	6,4	6,3	9,0	9,6
	Cracked concrete									
	[kN]	3,1	3,2	3,3	3,2	3,5	4,5	4,5	6,4	6,8

		Hilti Tech. Data				
Anchor size		**10**			**14**	
Type	**HUS3**	**HF**			**HF**	
Nominal anchorage depth	h_{nom} [mm]	55	75	85	65	85
Min. base material thickness	h_{min} **[mm]**	100	100	100	130	140
Min. edge distance	c_{min} [mm]	50	50	60	60	75
	**Tensile N_{Rd}**					
	Non-cracked concrete					
	[kN]	7,4	10,2	12,3	9,1	14,7
	Cracked concrete					
	[kN]	5,3	7,3	8,8	6,5	10,5
	**Shear V_{Rd}, without lever arm**					
	Non-cracked concrete					
	[kN]	4,6	4,9	6,4	6,3	9,0
	Cracked concrete					
	[kN]	3,2	3,5	4,5	4,5	6,4

Double anchor, no edge effects, min. spacing (s = s_{min}),
(load values are valid for one anchor)

	Data according ETA-13/1038, issue 2014-03-26.								
Anchor size	**8**			**10**			**14**		
Type **HUS3**	**H, C**			**H, C**			**H**		
Nominal anchorage depth h_{nom} [mm]	50	60	70	55	75	85	65	85	115
Min. base material thickness h_{min} [mm]	100	100	120	100	130	140	120	160	200
Min. spacing s_{min} [mm]	40	50	50	50	50	60	60	75	75
 **Tensile N_{Rd}**									
Non-cracked concrete [kN]	5,7	7,2	8,9	6,3	9,6	11,8	7,9	12,5	18,8
Cracked concrete [kN]	4,0	5,1	6,3	4,5	6,9	8,4	5,6	8,9	13,4
 **Shear V_{Rd}, without lever arm**									
Non-cracked concrete [kN]	5,7	11,3	11,3	6,3	18,7	18,7	16,4	25,0	30,0
Cracked concrete [kN]	4,0	10,3	11,3	4,5	13,8	17,1	11,7	17,8	26,9

	Hilti Tech. Data				
Anchor size	**10**			**14**	
Type **HUS3**	**HF**			**HF**	
Nominal anchorage depth h_{nom} [mm]	55	75	85	65	85
Min. base material thickness h_{min} [mm]	100	100	100	130	140
Min. spacing s_{min} [mm]	50	50	60	60	75
 **Tensile N_{Rd}**					
Non-cracked concrete [kN]	6,3	9,6	11,8	7,9	12,5
Cracked concrete [kN]	4,5	6,9	8,4	5,6	8,9
 **Shear V_{Rd}, without lever arm**					
Non-cracked concrete [kN]	6,3	16,3	16,3	16,4	25,0
Cracked concrete [kN]	4,5	13,8	16,3	11,7	17,8

Fire resistance

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:
- Correct setting (see setting instruction)
- No edge distance and spacing influence
- Minimum base material thickness
- HUS3-H only.

The following technical data are based on: ETA-13/1038 issue 2014-03-26.

Recommended loads under fire exposure

Anchor size			**HUS3 H**	**8**			**10**			**14**		
				h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}	h_{nom1}	h_{nom2}	h_{nom3}
Nominal embedment depth		h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Steel failure for tension and shear load ($F_{Rec,s,fi} = N_{Rec,s,fi} = V_{Rec,s,fi}$)												
Recommended tensile and shear load	R30	$F_{Rec,s,fi}$	[kN]	2,3	2,5	2,7	4,4	4,4		7,4	7,6	
	R60	$F_{Rec,s,fi}$	[kN]	1,7	1,9	2,0	3,3	3,4		5,6	5,8	
	R90	$F_{Rec,s,fi}$	[kN]	1,1	1,1	1,4	2,2	2,3		3,8	3,9	
	R120	$F_{Rec,s,fi}$	[kN]	0,9	0,9	1,1	1,7	1,8		2,9	3,1	
	R30	$M^0_{Rec,s,fi}$	[Nm]	10,4	11,4	12,3	25,1	25,4		56,4	57,0	
	R60	$M^0_{Rec,s,fi}$	[Nm]	7,9	8,4	9,3	19,0	19,4		42,6	43,4	
	R90	$M^0_{Rec,s,fi}$	[Nm]	5,3	5,3	6,3	12,9	13,3		28,7	29,8	
	R120	$M^0_{Rec,s,fi}$	[Nm]	4,1	3,8	4,9	9,8	10,3		21,9	22,9	
Pull-out failure												
Recommended resistance	R30 R60 R90	$N_{Rec,p,fi}$	[kN]	1,1	1,6	2,1	1,7	2,9	3,5	2,2	3,4	5,6
	R120	$N_{Rec,p,fi}$	[kN]	0,9	1,3	1,7	1,4	2,3	2,8	1,8	2,7	4,5
Concrete cone failure												
Characteristic resistance	R30 R60 R90	$N^0_{Rec,c,fi}$	[kN]	1,3	1,9	2,9	1,4	3,4	4,7	2,1	4,6	10,3
	R120	$N^0_{Rec,c,fi}$	[kN]	1,0	1,5	2,3	1,1	2,7	3,8	1,7	3,6	8,2
Edge distance												
	R30 to R120	$c_{cr,N}$	[mm]	$2\ h_{ef}$								
Anchor spacing												
	R30 to R120	$s_{cr,N}$	[mm]	$4\ h_{ef}$								
Concrete pry-out failure												
	R30 to R120	k	[-]	1,0	2,0		1,0	2,0				

a) The recommended loads under fire exposure include a safety factor for resistance under fire exposure $\gamma_{M,fi}$ = 1,0 and the partial safety factor for action $\gamma_{F,fi}$ = 1,0. The partial safety factors for action shall be taken from national regulations.

Seismic design

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:
- Seismic design according to TR045
- HUS3-H and HUS3-C only

The following technical data are based on: ETA-13/1038 issue 2014-03-26

Anchorage depth range

Anchor size			8	10	14
Type		**HUS3**	**H, C**	**H, C**	**H**
Nominal anchorage depth range	h_{nom}	[mm]	70	85	115

Tension resistance in case of seismic performance category C1

Anchor size			8	10	14
Type		**HUS3**	**H, C**	**H, C**	**H**
Characteristic tension resistance to steel failure					
	$N_{Rk,s,seis}$	[kN]	39,2	62,2	96,6
Partial safety factor	$\gamma_{Ms,seis}$	[-]		1,4	
Characteristic pull-out resistance in cracked concrete C20/25 to C50/60					
	$N_{Rk,p,seis}$	[kN]	12	19,8	31,7
Partial safety factor	$\gamma_{Mp,seis}$	[-]		1,5	
Concrete cone resistance and splitting resistance					
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]		1,5	

Displacement under tension load in case of seismic performance category C1 1)

Anchor size			8	10	14
Type		**HUS3**	**H, C**	**H, C**	**H**
Displacement	$\delta_{N,seis}$	[mm]	0,6	0,9	1,3

1) Maximum displacement during cycling (seismic event).

Shear resistance in case of seismic performance category C1 1)

Anchor size			8	10	14
Type		**HUS3**	**H, C**	**H, C**	**H**
Characteristic shear resistance to steel failure					
	$V_{Rk,s,seis}$	[kN]	11,9	16,8	22,5
Partial safety factor	$\gamma_{Ms,seis}$	[-]		1,5	
Concrete pryout resistance and concrete edge resistance					
Partial safety factor	$\gamma_{Mc,seis}$	[-]		1,5	

1) Reduction factor α_{gap} = 1,0 when using the Hilti Dynamic Set

Displacement under tension load in case of seismic performance category C1 1)

Anchor size			8	10	14
Type		**HUS3**	**H, C**	**H, C**	**H**
Displacement	$\delta_{V,seis}$	[mm]	5,3	4,3	5,5

1) Maximum displacement during cycling (seismic event)

Basic loading data for temporary application in standard and fresh concrete < 28 days old, $f_{ck,cube}$ ≥ 10 N/mm²:

All data in this section applies to the following conditions:

- Strength class, $f_{ck,cube}$ ≥ 10 N/mm²
- Only temporary use
- Screw is reusable, before each usage it must be checked according Hilti instruction for use with the suited tube Hilti HRG
- Design resistance and recommended load are valid for single anchor only
- Design resistance as well as the recommended load are valid for all load direction and valid for both cracked and non-cracked concrete
- Minimum base material thickness
- No edge distance and spacing influence
- Valid for HUS3-H only.

a) All data given in this section for HUS3-H sizes 10 and 14 according DIBt approval Z-21.8-2018 issue 2014-04-01

Design resistance

	Hilti Tech. Data			DIBt approval Z-21.8-2018					
Anchor size HUS3-H	**8**			**10**			**14**		
Nominal embedment depth h_{nom} [mm]	50	60	70	55	75	85	65	85	115
Cracked and non-cracked concrete									
Tensile N_{Rd} = Shear V_{Rd}									
$f_{ck,cube}$ ≥ 10 N/mm² [kN]	2,5	3,2	4,7	3,3	5,3	6,3	4,4	7,0	12,3
$f_{ck,cube}$ ≥ 15 N/mm² [kN]	3,1	4,0	5,7	4,0	6,4	7,8	5,4	8,5	15,0
$f_{ck,cube}$ ≥ 20 N/mm² [kN]	3,6	4,6	6,6	4,7	7,4	9,0	6,2	9,9	17,3

Recommended load

	Hilti Tech. Data			DIBt approval Z-21.8-2018					
Anchor size HUS3-H	**8**			**10**			**14**		
Nominal embedment depth h_{nom} [mm]	50	60	70	55	75	85	65	85	115
Tensile N_{rec} = Shear V_{rec}									
$f_{ck,cube}$ ≥ 10 N/mm² [kN]	1,8	2,3	3,4	2,4	3,8	4,5	3,1	5,0	8,8
$f_{ck,cube}$ ≥ 15 N/mm² [kN]	2,2	2,9	4,1	2,9	4,6	5,5	3,8	6,1	10,7
$f_{ck,cube}$ ≥ 20 N/mm² [kN]	2,6	3,3	4,7	3,3	5,3	6,4	4,4	7,1	12,4

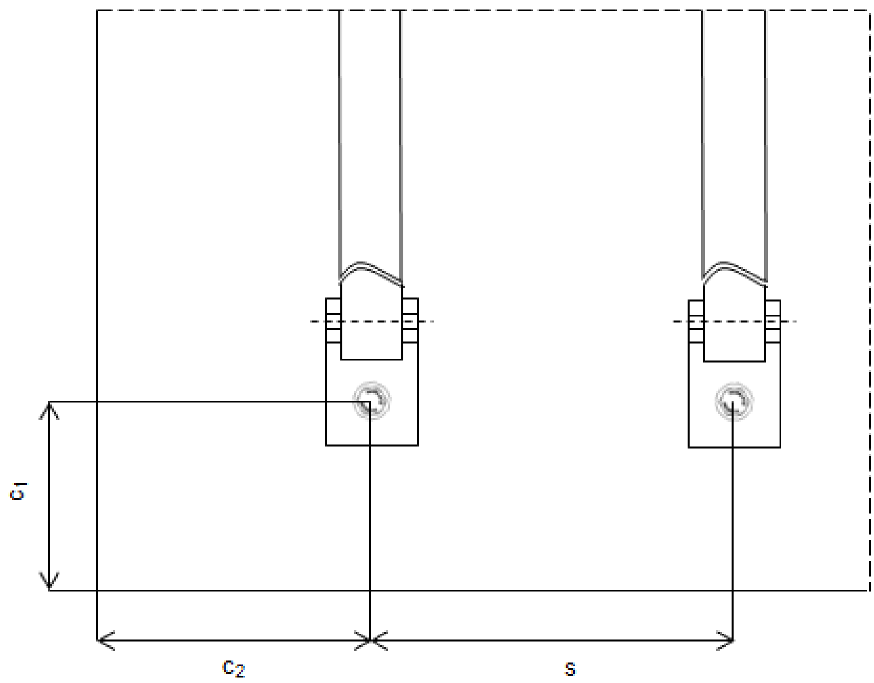
a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

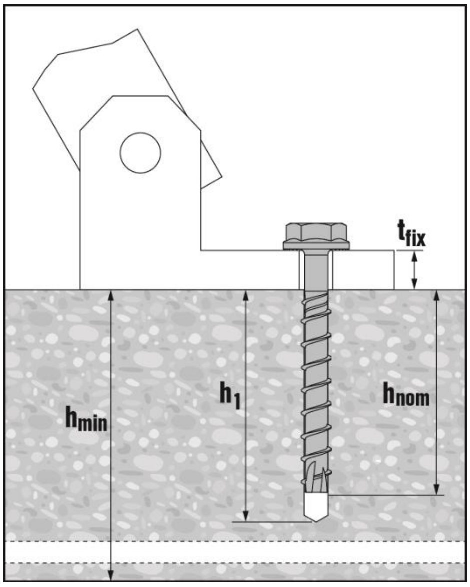
Setting details

			Hilti			DIBt approval Z-21.8-2018					
Anchor size		**HUS3-H**	**8**			**10**			**14**		
Nominal anchorage depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Minimum base material thickness	h_{min}	[mm]	100	115	145	115	150	175	130	175	255
Minimum spacing	s_{min}	[mm]	180	225	285	225	300	345	255	345	510
Minimum edge distance direction 1	c_1	[mm]	60	75	95	75	100	115	85	115	170
Minimum edge distance direction 2	c_2	[mm]	95	115	145	115	150	175	130	180	260

Setting details

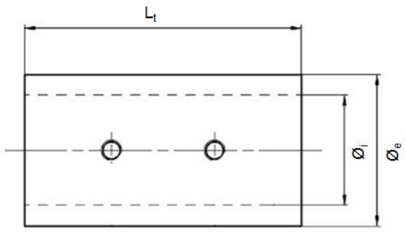
			Hilti			DIBt approval Z-21.8-2018					
Anchor size		**HUS3-H**	**8**			**10**			**14**		
Nominal anchorage depth	h_{nom}	[mm]	50	60	70	55	75	85	65	85	115
Nominal diameter of drill bit	d_o	[mm]	8			10			14		
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45			10,45			14,50		
Depth of drill bit	$h_1 \leq$	[mm]	60	70	80	65	85	95	75	95	125
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	12			14			18		
Width across	SW	[mm]	13			15			21		
Impact screw driver			Hilti SIW 22 T-A								
Suited tube			Hilti HRG 8			Hilti HRG 10			Hilti HRG 14		



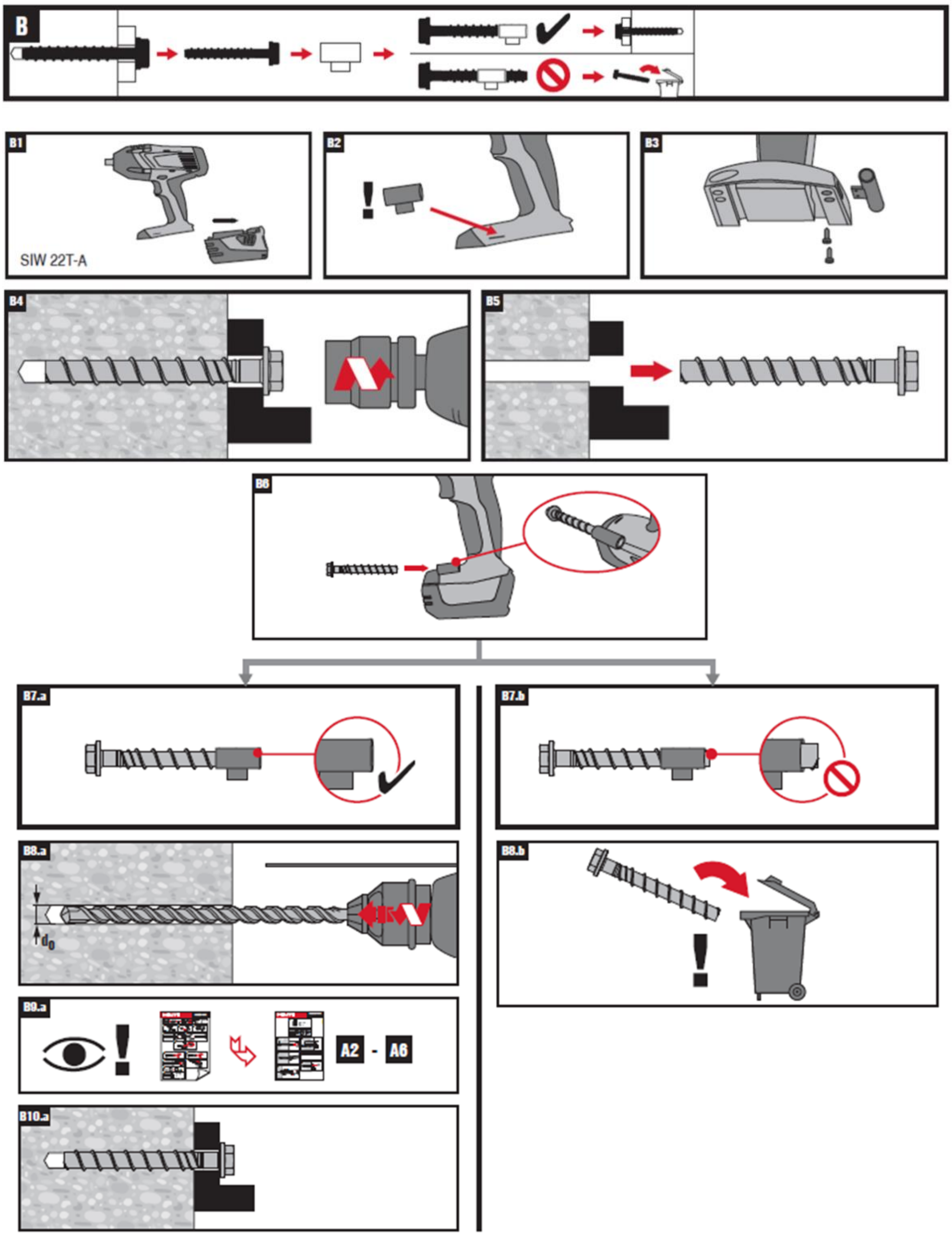


Tube specification

Anchor size / tube			8 / HRG 8	10 / HRG 10	14 / HRG 14
Inner tube diameter	$Ø_i$	[mm]	9,7	11,7	16,0
Outer tube diameter	$Ø_e$	[mm]	15,0	17,0	22,0
Tube length	Lt	[mm]	23,0	28,0	40,3



Instruction for use – re-use of screw



Basic loading data for single anchor in solid masonry units:

All data in this section applies to the following conditions:

Solid bricks: a reduction of the cross section area by a vertical perforation perpendicular to the bed joint area must not be greater than 15%

Drilling:

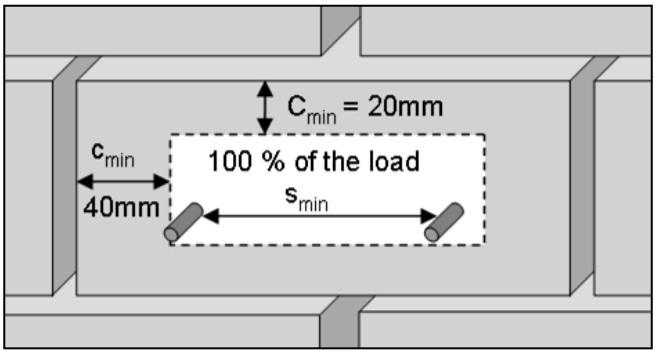
- Holes in Mz and KS drilled with TE rotary hammers drilled with hammering mode
- Holes in PPW drilled with TE rotary hammers drilled without hammering mode

Installation:

- The anchor is correct mounted, if there is neither a turn-through or spinning of the screw in the drill hole nor that an easy turning of the screw is possible after the installation procedure when the head of the screw has touched the fixture
- The recommended setting tool is Hilti SFH 22A

Edge distance and spacing influences:

- Distance to free edge free edge to solid masonry (Mz and KS) units $c_{min,free} \geq 200$ mm
- Distance to free edge free edge to solid masonry (autoclaved aerated gas concrete) units $c_{min,free} \geq 170$ mm
- The minimum distance to horizontal and vertical mortar joint $c_{min,h}$ and $c_{min,v}$ is stated in drawing below
- Minimum anchor spacing in one brick/block is s_{min} = 80 mm



The minimum edge distance to vertical mortar join for aerated gas concrete is 100mm,

Recommended loads

			Hilti	
Base material		Anchor size	8	10
		Type HUS3	H, C	H, C, HF
		h_{nom} [mm]	60	75
		Compressive strength class [N/mm²]	F_{rec} a) [kN] Tensile and Shear	
	**Solid clay brick** **Mz 2,0-2DF** DIN V 105-100 / EN 771-1 H [mm]: 240x115x113 h_{min} [mm]: 115	≥ 12	1,1	1,4
		≥ 20	1,6	2,0
	**Solid sand-lime brick** **KS 2,0-2DF** DIN V 106-100 / EN 771-2 LxWxH [mm]: 240x115x113 h_{min} [mm]: 115	≥ 12	1,3	1,4
		≥ 20	1,7	2,1
	**Aerated concrete** **PPW 6-0,4** DIN 4165 / EN 771-4 LxWxH [mm]: 499x240x249 h_{min} [mm]: 240	≥ 6	0,7	0,9

a) Characteristic resistance for tension, shear or combined tension and shear loading.
The characteristic resistance is valid for single anchor or for a group of two or four anchors with spacing equal or larger than the minimum spacing s_{min} according to specification.

Load values:

- The technical data for the HUS3 anchors are reference loads for MZ 12 2,0-2DF, KS 12 2,0-2DF and PPW 6-0,4.
- The load Values are valid for non-structural applications.
- Due to the natural variation of stone solid bricks, on site anchor testing is recommended to validate technical data.
- The HUS3 anchor was installed and tested in the center area of solid bricks as shown considering minimal edge and space distances.
- The HUS3 anchor was not tested in the mortar joint between solid bricks or in hollow bricks; however a load reduction is expected.
- For brick walls where anchor position in brick cannot be determined, 100% anchor testing is recommended.

Limitations of loads:

- All data is for redundant fastening for not structural applications
- Plaster, graveling, lining or leveling courses are regarded as non-bearing and may not be taken into account for the calculation of embedment depth,
- The decisive resistance to tension loads is the lower value of N_{rec} (brick breakout, pull out) and $N_{max,pb}$ (pull out of one brick),

Pull out of one brick:

The allowable load of an anchor or a group of anchors in case of single brick pull out, $N_{max,pb}$ [kN], is given in the following tables:

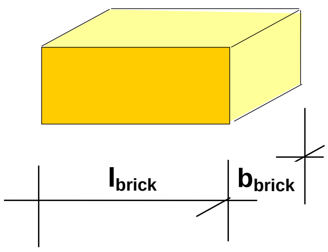
Clay bricks:

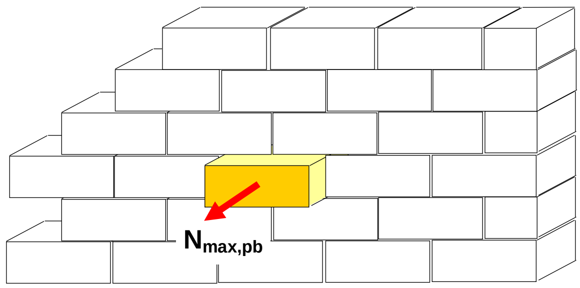
$N_{max,pb}$ [kN]		brick breadth b_{brick} [mm]					
		80	120	200	240	300	360
brick length l_{brick} [mm]	240	1,1	1,6	2,7	3,3	4,1	4,9
	300	1,4	2,1	3,4	4,1	5,1	6,2
	500	2,3	3,4	5,7	6,9	8,6	10,3

All other brick types:

$N_{max,pb}$ [kN]		brick breadth b_{brick} [mm]					
		80	120	200	240	300	360
brick length l_{brick} [mm]	240	0,8	1,2	2,1	2,5	3,1	3,7
	300	1,0	1,5	2,6	3,1	3,9	4,6
	500	1,7	2,6	4,3	5,1	6,4	7,7

$N_{max,pb}$ = resistance for pull out of one brick
l_{brick} = length of the brick
b_{brick} = breadth of the brick

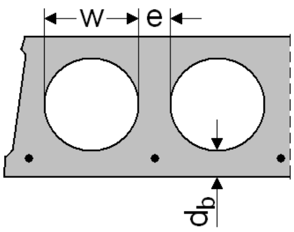




Basic loading data for single anchor in Hollow core slab:

Basic loading data

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Ratio core width / web thickness w/e ≤ 4,2
- Concrete C 30/37 to C 50/60



Characteristic resistance

Anchor size			**8**	**10**
Type		**HUS3**	**C, H**	**C, H, HF**
Bottom flange thickness	$d_b \geq$	[mm]	30	30
All load directions	F_{Rk}	[kN]	2,0	2,0

Design resistance

Anchor size			**8**	**10**
Type		**HUS3**	**C, H**	**C, H, HF**
Bottom flange thickness	$d_b \geq$	[mm]	30	30
All load directions	F_{Rd}	[kN]	1,3	1,3

Recommended loads

Anchor size			**8**	**10**
Type		**HUS3**	**C, H**	**C, H, HF**
Bottom flange thickness	$d_b \geq$	[mm]	30	30
All load directions a)	F_{rec}	[kN]	0,95	0,95

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Requirements for redundant fastening

The definition of redundant fastening according to Member States is given in the ETAG 001 Part six, Annex 1, In Absence of a definition by a Member State the following default values may be taken

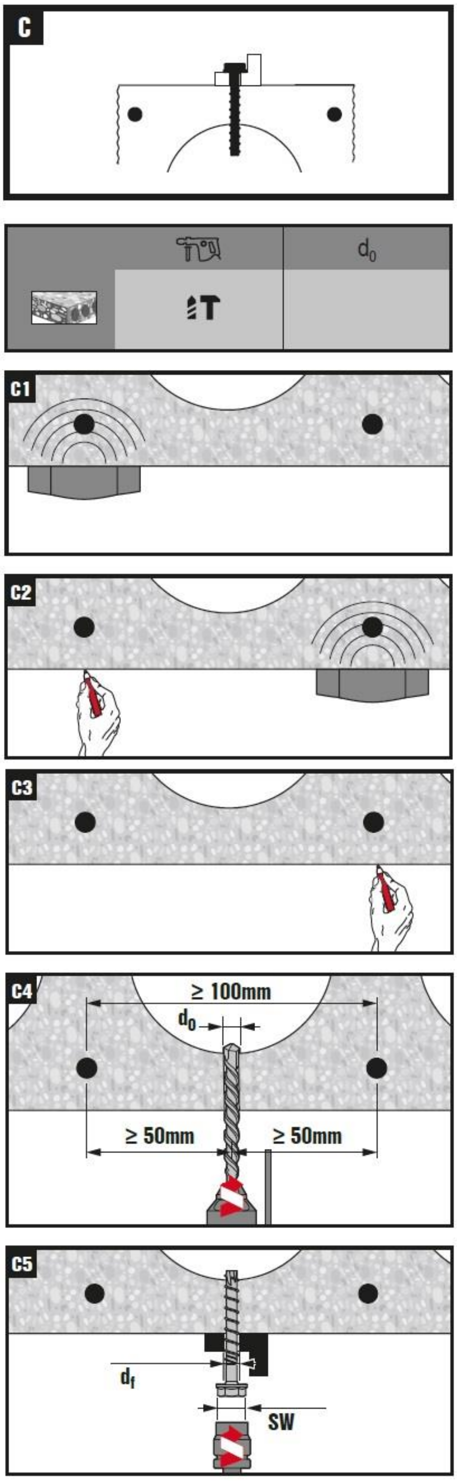
Minimum number of fixing points	**Minimum number of anchors per fixing point**	**Maximum design load of action N_{Sd} per fixing point a)**
3	1	2 kN
4	1	3 kN

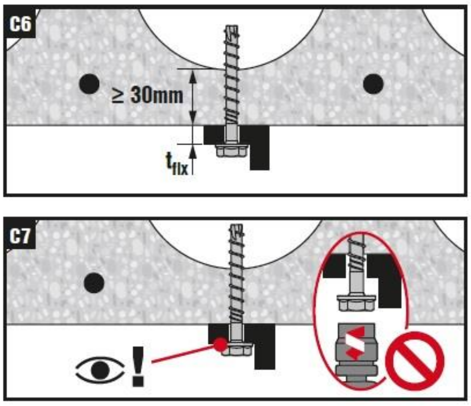
a) The value for maximum design load of actions per fastening point N_{Sd} is valid in general that means all fastening points are considered in the design of the redundant structural system. The value N_{Sd} may be increased if the failure of one (= most unfavourable) fixing point is taken into account in the design (serviceability and ultimate limit state) of the structural system e.g. suspended ceiling.

Setting

Anchor size	8	10
Type **HUS3**	**C, H**	**C, H, HF**
Rotary hammer	Hilti TE 6 / TE 7	
drill bit	TE-CX 4	
Impact screw driver	SIW 22 A, 1st or 2nd gear	

Setting instruction



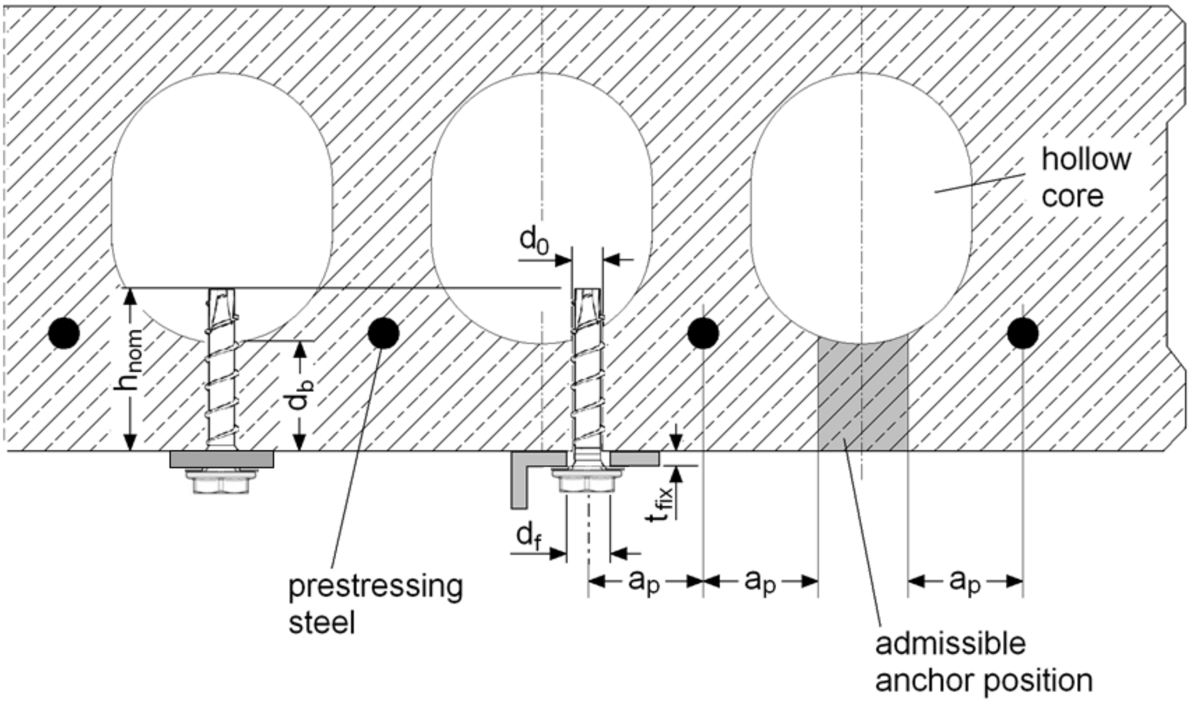


Setting details

Anchor size			8	10
Type		HUS3	C, H	C, H, HF
Nominal embedment depth	$h_{nom} \geq$	[mm]	40	45
Bottom flange thickness	$d_b \geq$	[mm}	30	30
Nominal diameter of drill bit	d_o	[mm]	8	10
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45	10,45
Nominal depth of drill hole [a)]	$h_1 \geq$	[mm]	40	40
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	12	14
Nominal effective anchorage depth	h_{ef}	[mm]	30	30
Distance between anchor position and prestressing steel	$a_p \geq$	[mm]	50	50

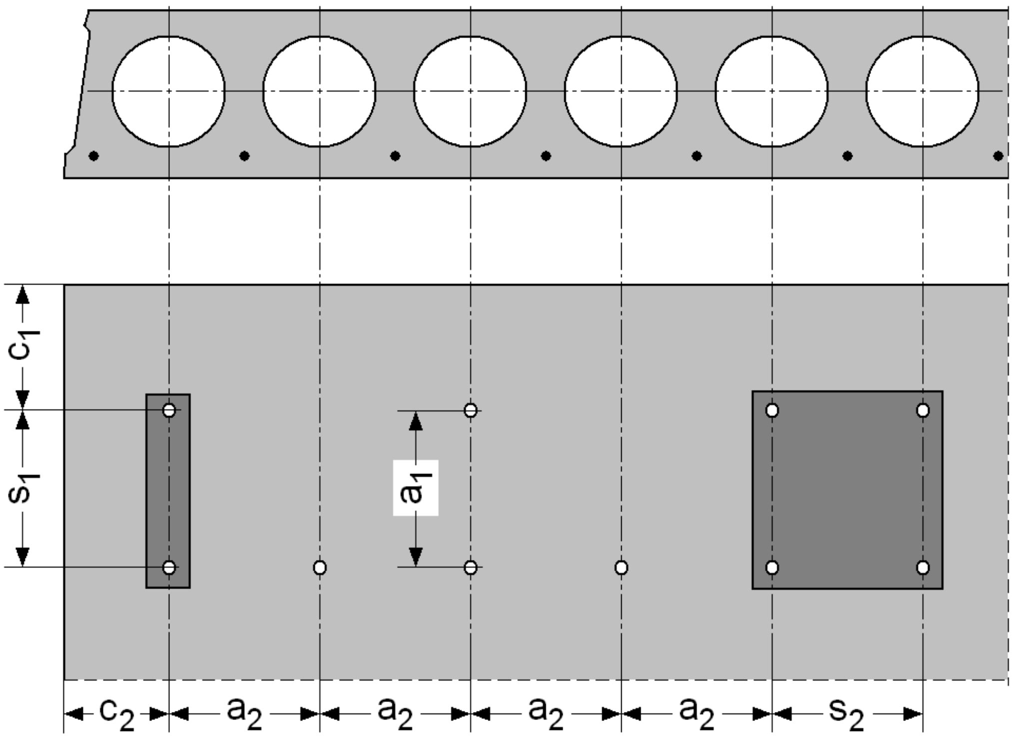
a) Nominal depth of drill hole may be deeper than bottom flange thickness

Type	Size	Length	d_b=30 [mm]		d_b=35 [mm]		d_b=40 [mm]		d_b=50 [mm]	
	[mm]	[mm]	$t_{fix,min}$ [mm]	$t_{fix,max}$ [mm]	$t_{fix,min}$ [mm]	$t_{fix,max}$ [mm]	$t_{fix,min}$ [mm]	$t_{fix,max}$ [mm]	$t_{fix,min}$ [mm]	$t_{fix,max}$ [mm]
HUS3-H	8	55	5	15	5	10	5	5	5	5
		65	5	25	5	20	5	15	5	5
		75	5	35	5	30	5	25	5	15
		85	15	45	15	40	15	35	15	25
		100	30	60	30	55	30	50	30	40
		120	50	80	50	75	50	70	50	60
		150	80	110	80	105	80	100	80	90
HUS3-C	8	65	15	25	15	20	15	15	15	5
		75	15	35	15	30	15	25	15	15
		85	15	45	15	40	15	35	15	25
HUS3-H	10	60	5	15	5	10	5	5	5	5
		70	15	25	15	20	15	15	15	5
		80	5	35	5	30	5	25	5	15
		90	5	45	5	40	5	35	5	25
		100	15	55	15	50	15	45	15	35
		110	25	65	25	60	25	55	25	45
		130	45	85	45	80	45	75	45	65
		150	65	105	65	100	65	95	65	85
HUS3-HF	10	60	5	15	5	10	5	5	5	5
		80	5	35	5	30	5	25	5	15
		100	15	55	15	50	15	45	15	35
		110	25	65	25	60	25	55	25	45
HUS3-C	10	70	15	25	15	20	15	15	15	10
		90	15	45	15	40	15	35	15	25
		100	15	55	15	50	15	45	15	35



Anchor spacing and edge distance

Anchor size			8	10
Type		**HUS3**	**C, H**	**C, H, HF**
Minimum edge distance	$c_{min} \geq$	[mm]	100	
Minimum anchor spacing	$s_{min} \geq$	[mm]	100	
Minimum distance between anchor groups	$a_{min} \geq$	[mm]	100	

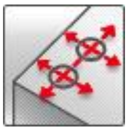


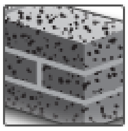
HUS-HR, CR Screw anchor, stainless steel

	Anchor version	Benefits
	HUS-HR 6 / 8 / 10 / 14 Stainless steel concrete Screw with hexagonal head	- High productivity – less drilling and fewer operations than with conventional anchors - ETA approval for cracked and non-cracked concrete - Seismic approval ETA C1 - Small edge and spacing distances
	HUS-CR 10 Stainless steel concrete screw with countersunk head	


Concrete


Tensile zone


Small edge distance and spacing


Solid brick


Autoclaved aerated concrete


Fire resistance

A4
316
Corrosion Resistance


Seismic

European Technical Approval

CE conformity


Sprinkler approved


PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No, / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-08/0307 / 2014-04-29
Fire test report	DIBt, Berlin	ETA-08/0307 / 2014-04-29
Fire test report ZTV – Tunnel (EBA)	MFPA, Leipzig	PB III / 08-354 / 2008-11-27

a) Data for HUS-HR with standard and reduced embedment depth is given in this section according ETA-08/0307 issue 2014-04-29,

Basic loading data

All data in this section applies to

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete as specified in the table
- *Steel* failure
- Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

For details see Simplified design method

Mean ultimate resistance

		Non-cracked concrete				Cracked concrete			
Anchor size		**6**	**8**	**10**	**14**	**6**	**8**	**10**	**14**
Type	**HUS**	**HR**	**HR**	**HR,CR**	**HR**	**HR**	**HR**	**HR,CR**	**HR**
Extra reduced embedment (Hilti Tech Data)									
h_{nom}	[mm]	**30**	**50**	**60**	**-**	**30**	**50**	**60**	**-**
Tensile $N_{Ru,m}$	[kN]	- [a)]	12,0	16,0	-	- [a)]	6,7	10,0	-
Shear $V_{Ru,m}$	[kN]	- [a)]	31,5	41,9	-	- [a)]	22,5	30,0	-
Reduced embedment (ETA-08/0307)									
h_{nom}	[mm]	**-**	**60**	**70**	**70**	**-**	**60**	**70**	**70**
Tensile $N_{Ru,m}$	[kN]	-	16,0	21,3	25,2	-	8,0	12,0	16,0
Shear $V_{Ru,m}$	[kN]	-	34,7	44,0	50,4	-	30,9	38,1	36,0
Standard embedment (ETA-08/0307)									
h_{nom}	[mm]	**55**	**80**	**90**	**110**	**55**	**80**	**90**	**110**
Tensile $N_{Ru,m}$	[kN]	12,0	21,3	33,3	53,6	6,7	16,0	21,3	33,3
Shear $V_{Ru,m}$	[kN]	22,7	34,7	44,0	102,7	21,7	34,7	44,0	76,6

a) Please refer to resistance table in all load directions for multiple use fastenings in section HUS 6 screw anchor for redundant fastening,

Characteristic resistance

		Non-cracked concrete				Cracked concrete			
Anchor size		**6**	**8**	**10**	**14**	**6**	**8**	**10**	**14**
Type	**HUS**	**HR**	**HR**	**HR,CR**	**HR**	**HR**	**HR**	**HR,CR**	**HR**
Extra reduced embedment (Hilti Tech Data)									
h_{nom}	[mm]	**30**	**50**	**60**	**-**	**30**	**50**	**60**	**-**
Tensile N_{Rk}	[kN]	- [a)]	9,0	12,0	-	- [a)]	5,0	7,5	-
Shear V_{Rk}	[kN]	- [a)]	23,6	31,4	-	- [a)]	16,9	22,5	-
Reduced embedment (ETA-08/0307)									
h_{nom}	[mm]	**-**	**60**	**70**	**70**	**-**	**60**	**70**	**70**
Tensile N_{Rk}	[kN]	-	12,0	16,0	18,9	-	6,0	9,0	12,0
Shear V_{Rk}	[kN]	-	26,0	33,0	37,8	-	23,2	28,6	27,0
Standard embedment (ETA-08/0307)									
h_{nom}	[mm]	**55**	**80**	**90**	**110**	**55**	**80**	**90**	**110**
Tensile N_{Rk}	[kN]	9,0	16,0	25,0	40,2	5,0	12,0	16,0	25,0
Shear V_{Rk}	[kN]	17,0	26,0	33,0	77,0	16,3	26,0	33,0	57,4

a) Please refer to resistance table in all load directions for multiple use fastenings in section HUS 6 screw anchor for redundant fastening,

Design resistance

		Non-cracked concrete				Cracked concrete			
Anchor size		**6**	**8**	**10**	**14**	**6**	**8**	**10**	**14**
Type	**HUS**	**HR**	**HR**	**HR,CR**	**HR**	**HR**	**HR**	**HR,CR**	**HR**
Extra reduced embedment (Hilti Tech Data)									
h_{nom}	[mm]	**30**	**50**	**60**	**-**	**30**	**50**	**60**	**-**
Tensile N_{Rd}	[kN]	- a)	5,0	6,7	-	- a)	2,8	4,2	-
Shear V_{Rd}	[kN]	- a)	15,7	21,0	-	- a)	11,2	15,0	-
Reduced embedment (ETA-08/0307)									
h_{nom}	[mm]	**-**	**60**	**70**	**70**	**-**	**60**	**70**	**70**
Tensile N_{Rd}	[kN]	-	6,7	8,9	10,5	-	3,3	5,0	6,7
Shear V_{Rd}	[kN]	-	17,3	22,0	25,2	-	15,5	19,0	18,0
Standard embedment (ETA-08/0307)									
h_{nom}	[mm]	**55**	**80**	**90**	**110**	**55**	**80**	**90**	**110**
Tensile N_{Rd}	[kN]	4,3	8,9	13,9	22,3	2,4	6,7	8,9	13,9
Shear V_{Rd}	[kN]	11,3	17,3	22,0	51,3	10,9	17,3	22,0	38,3

a) Please refer to resistance table in all load directions for multiple use fastenings in section HUS 6 screw anchor for redundant fastening,

Recommended loads

		Non-cracked concrete				Cracked concrete			
Anchor size		**6**	**8**	**10**	**14**	**6**	**8**	**10**	**14**
Type	**HUS**	**HR**	**HR**	**HR,CR**	**HR**	**HR**	**HR**	**HR,CR**	**HR**
Extra reduced embedment (Hilti Tech Data)									
h_{nom}	[mm]	**30**	**50**	**60**	**-**	**30**	**50**	**60**	**-**
Tensile N_{rec} a)	[kN]	- b)	3,6	4,8	-	- b)	2,0	3,0	-
Shear V_{rec} a)	[kN]	- b)	11,2	15,0	-	- b)	8,0	10,7	-
Reduced embedment (ETA-08/0307)									
h_{nom}	[mm]	**-**	**60**	**70**	**70**	**-**	**60**	**70**	**70**
Tensile N_{rec} a)	[kN]	-	4,8	6,3	7,5	-	2,4	3,6	4,8
Shear V_{rec} a)	[kN]	-	12,4	15,7	18,0	-	11,0	13,6	12,9
Standard embedment (ETA-08/0307)									
h_{nom}	[mm]	**55**	**80**	**90**	**110**	**55**	**80**	**90**	**110**
Tensile N_{rec} a)	[kN]	3,1	6,3	9,9	16,0	1,7	4,8	6,3	9,9
Shear V_{rec} a)	[kN]	8,1	12,4	15,7	36,7	7,8	12,4	15,7	27,3

a) With overall partial safety factor for action γ = 1,4, The partial safety factors for action depend on the type of loading and shall be taken from national regulations,

b) Please refer to resistance table in all load directions for multiple use fastenings in section HUS 6 screw anchor for redundant fastening,

Materials

Mechanical properties

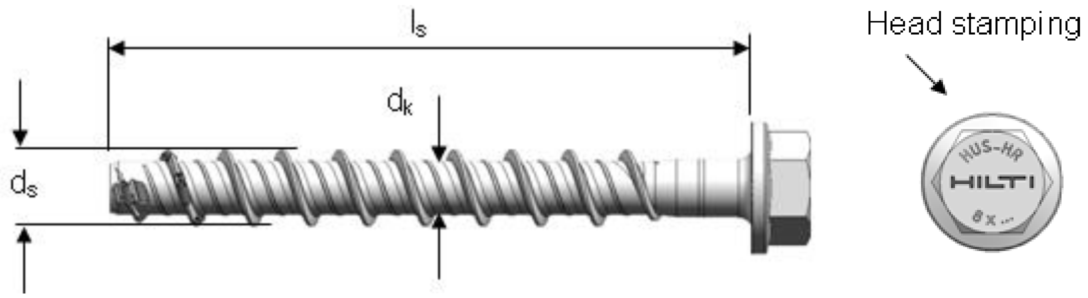
Anchor size		6	8	10	14
Type		**HUS-HR**	**HUS-HR**	**HUS-HR,CR**	**HUS-HR**
Nominal tensile strength f_{uk}	[N/mm²]	1050	870	950	690
Nominal yield strength f_{yk}	[N/mm²]	900	745	815	590
Stressed cross-section A_s	[mm²]	22,9	39,0	55,4	143,1
Moment of resistance W	[mm³]	15	34	58	255
Design bending resistance $M_{Rd,s}$	[Nm]	19	36	66	193

Part	Material
Stainless steel hexagonal head concrete screw	Stainless steel (grade A4)

Anchor dimensions

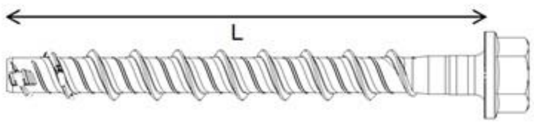
Dimensions

Anchor version	d_s [mm]	d_k [mm]	A_s [mm^2]
HUS-HR 6	7,6	5,4	22,9
HUS-HR 8	10,1	7,05	39,0
HUS-HR 10	12,3	8,40	55,4
HUS-CR 10	12,3	8,40	55,4
HUS-HR 14	16,6	12,6	143,1



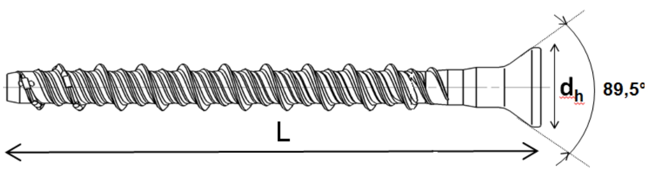
Screw length and thickness of fixture for HUS-HR (hex head)

Anchor size HUS HR	6		8			10			14	
Nominal anchorage depth [mm]	h_{nom} 30	h_{nom} 55	h_{nom} 50	h_{nom} 60	h_{nom} 80	h_{nom} 60	h_{nom} 70	h_{nom} 90	h_{nom} 70	h_{nom} 110
	Thickness of fixture [mm]									
Length of anchor [mm]	t_{fix1}	t_{fix2}	t_{fix1}	t_{fix2}	t_{fix3}	t_{fix1}	t_{fix2}	t_{fix3}	t_{fix1}	t_{fix2}
35	5	-	-	-	-	-	-	-	-	-
45	15	-	-	-	-	-	-	-	-	-
60	30	5	-	-	-	-	-	-	-	-
65	-	-	15	5	-	5	-	-	-	-
70	40	15	-	-	-	-	-	-	-	-
75	-	-	25	15	-	15	5	-	-	-
80	-	-	-	-	-	-	-	-	10	-
85	-	-	35	25	5	25	15	-	-	-
95	-	-	45	35	15	35	25	5	-	-
105	-	-	55	45	25	45	35	15	-	-
115	-	-	-	-	-	55	45	25	-	-
120	-	-	-	-	-	-	-	-	50	10
130	-	-	-	-	-	70	60	40	-	-
135	-	-	-	-	-	-	-	-	65	25



Screw length and thickness of fixture for HUS-CR (countersunk head)

Anchor size HUS HR	10		
Nominal anchorage depth [mm]	h_{nom} 60	h_{nom} 70	h_{nom} 90
	Thickness of fixture [mm]		
Length of anchor [mm]	t_{fix1}	t_{fix2}	t_{fix3}
75	15	-	-
85	25	15	-
105	45	35	15

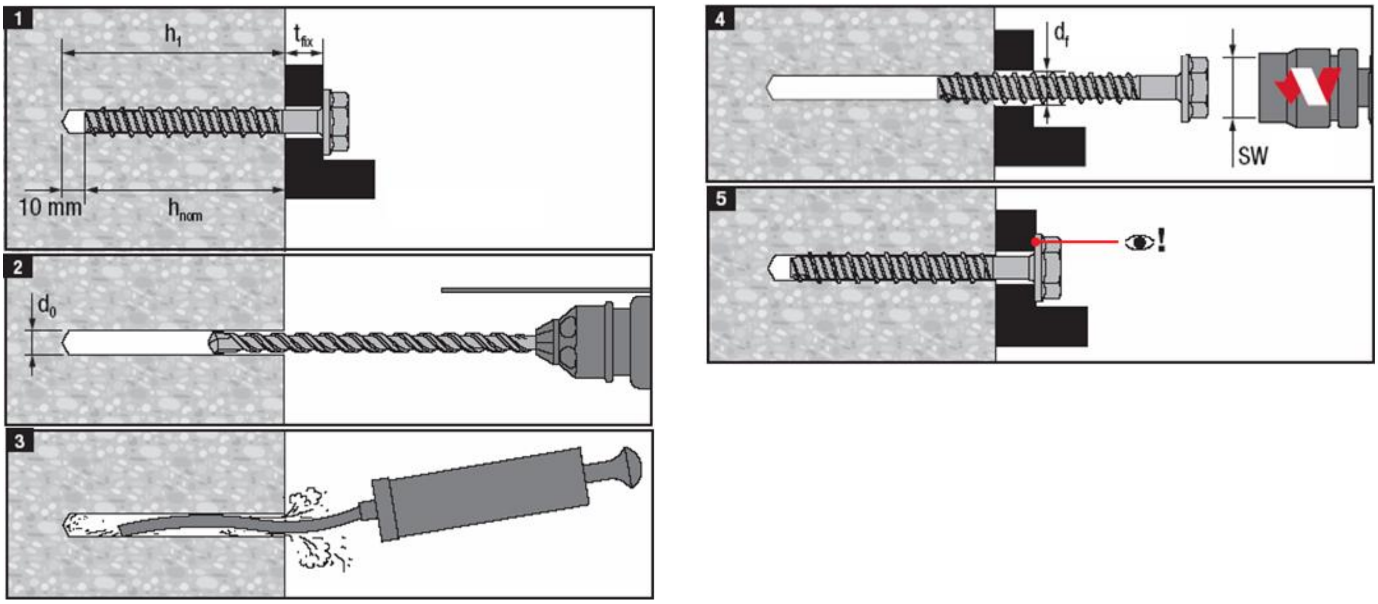


Setting

Recommended installation equipment

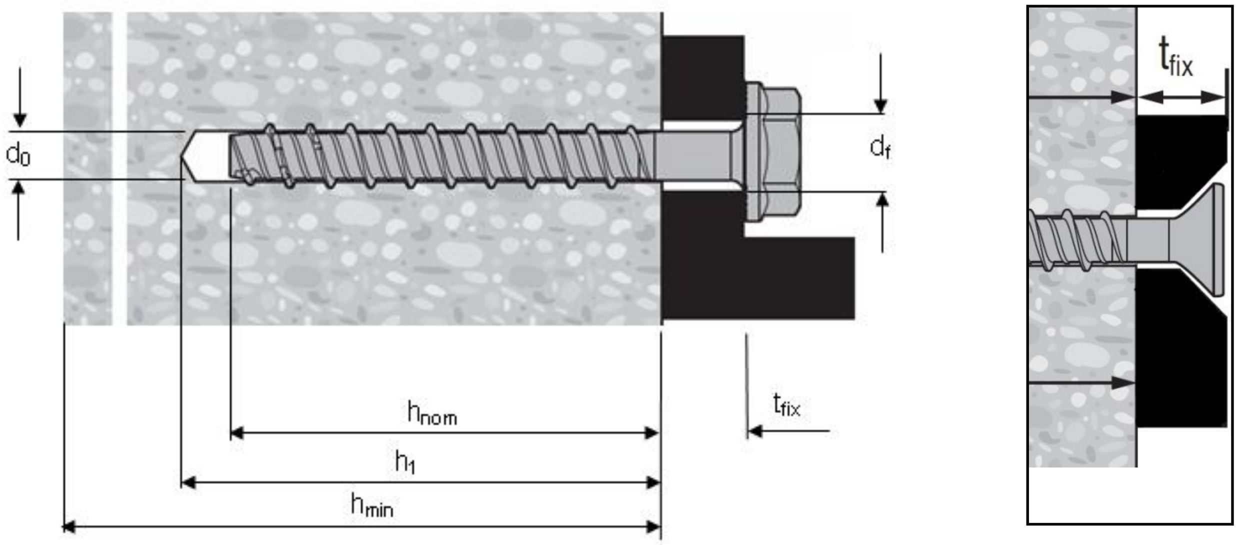
Anchor size	HUS	6	8	10	14
Rotary hammer		Hilti TE 2 – TE 30	Hilti TE 2 – TE 30	Hilti TE 2 – TE 30	Hilti TE 2 – TE 30
drill bit		TE-C3X 6/17	TE-C3X 8/17	TE-C3X 10/22	TE-C3X 14/22
Socket wrench insert		S-NSD 13 ½ (L)	S-NSD 13 ½ (L)	S-NSD 15 ½ (L)	S-NSD 21 ½
Torx (CR type only)		-	-	S-SY TX50	-
Impact screw driver		Hilti SIW 14-A, 22-A	Hilti SIW 22 T-A		

Setting instruction



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

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}



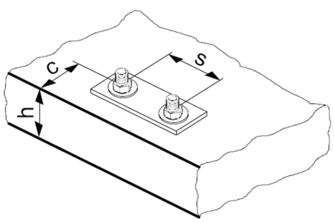
Setting details

Anchor version				6		8			10			14	
Type			HUS	HR		HR			HR, CR a)			HR	
Nominal embedment depth		h_{nom}	[mm]	30	55	50	60	80	60	70	90	70	110
Nominal diameter of drill bit		d_o	[mm]	6		8			10			14	
Cutting diameter of drill bit		$d_{cut} \leq$	[mm]	6,4		8,45			10,45			14,5	
Depth of drill hole		$h_1 \geq$	[mm]	40	65	60	70	90	70	80	100	80	120
Diameter of countersunk head		d_h	[mm]	-		-			21			-	
Diameter of clearance hole in the fixture		$d_f \leq$	[mm]	9		12			14			18	
Effective anchorage depth		h_{ef}	[mm]	23	45	38	47	64	46	54	71	52	86
Max, installation torque	Concrete	T_{inst}	[Nm]	20	- a)	35	- a)	- a)	45 c)			65	
	Solid m, Mz 12	T_{inst}	[Nm]	- b)	10	- b)	16	16	-	20	20	- b)	- b)
	Solid m, KS 12	T_{inst}	[Nm]	- b)	10	- b)	16	16	-	20	20	- b)	- b)
	Aerated conc,	T_{inst}	[Nm]	- b)	4	- b)	8	8	-	10	10	- b)	- b)

a) Hilti recommends machine setting only in concrete
b) Hilti does not recommend this setting process for this application,
c) Intallation torque refer to HUS-HR only

Base material thickness, anchor spacing and edge distance

Anchor size			6		8			10			14	
Type			HUS-HR		HUS-HR			HUS-HR, CR			HUS-HR	
Nominal embedment depth	h_{nom}	[mm]	30	55	50	60	80	60	70	90	70	110
Minimum base material thickness non-cracked concrete	h_{min}	[mm]	100	100	100	100	120	120	120	140	140	160
Minimum spacing	s_{min}	[mm]	35	35	45	45	50	50	50	50	50	60
Minimum edge distance	c_{min}	[mm]	35	35	45	45	50	50	50	50	50	60
Critical spacing for concrete cone and splitting failure	$s_{cr,N} =$ $s_{cr,sp}$	[mm]	69	135	114	141	192	166	194	256	187	310
Critical edge distance for concrete cone and splitting failure	$c_{cr,N} =$ $c_{cr,sp}$	[mm]	35	68	57	71	96	83	97	128	94	155



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced (see system design resistance),

Critical spacing and critical edge distance for splitting failure apply only for non-cracked concrete, For cracked concrete only the critical spacing and critical edge distance for concrete cone failure are decisive,

Simplified design method

Simplified version of the design method according ETAG 001, Annex C, Design resistance according data given in ETA-08/0307 issue 2011,01,21,

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors, (The method may also be applied for anchor groups with more than two anchors or more than one edge, The influencing factors must then be considered for each edge distance and spacing, The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C, To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

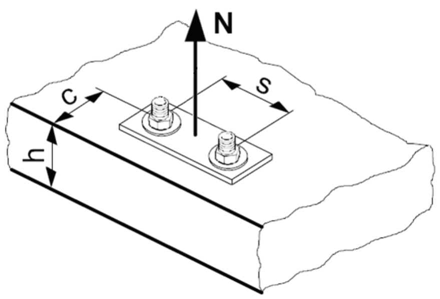
The values are valid for one anchor (single point fastening), multiple use applications are not part of this design method,

For more complex fastening applications please use the anchor design software PROFIS Anchor,

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete): $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size		6	8	10	14
Type		HUS-HR	HUS-HR	HUS-HR, CR	HUS-HR
$N_{Rd,s}$	[kN]	17,0	24,3	37,6	73,0

Design pull-out resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$

		Non-cracked concrete				Cracked concrete			
Anchor size		**6**	**8**	**10**	**14**	**6**	**8**	**10**	**14**
Extra reduced embedment (Hilti Tech Data)									
h_{nom}	[mm]	**30**	**50**	**60**	**-**	**30**	**50**	**60**	**-**
Tensile N_{Rd}	[kN]	-	5,0	6,7	-	-	2,8	4,2	-
Reduced embedment									
h_{nom}	[mm]	**-**	**60**	**70**	**70**	**-**	**60**	**70**	**70**
Tensile N_{Rd}	[kN]	-	6,7	8,9	10,5	-	3,3	5,0	6,7
Standard embedment									
h_{nom}	[mm]	**55**	**80**	**90**	**110**	**55**	**80**	**90**	**110**
Tensile N_{Rd}	[kN]	4,3	8,9	13,9	22,3	2,4	6,7	8,9	13,9

Design concrete cone $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance* $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{re,N}$

		Non-cracked concrete				Cracked concrete			
Anchor size		**6**	**8**	**10**	**14**	**6**	**8**	**10**	**14**
Type	**HUS**	**HR**	**HR**	**HR,CR**	**HR**	**HR**	**HR**	**HR,CR**	**HR**
Extra reduced embedment (Hilti Tech Data)									
h_{nom}	[mm]	**30**	**50**	**60**	**-**	**30**	**50**	**60**	**-**
$N^0_{Rd,c}$	[kN]	-	6,6	8,7	-	-	4,7	6,2	-
Reduced embedment									
h_{nom}	[mm]	**-**	**60**	**70**	**70**	**-**	**60**	**70**	**70**
$N^0_{Rd,c}$	[kN]	-	9,0	11,1	10,5	-	6,4	7,9	7,5
Standard embedment									
h_{nom}	[mm]	**55**	**80**	**90**	**110**	**55**	**80**	**90**	**110**
$N^0_{Rd,c}$	[kN]	7,2	14,3	16,8	22,3	5,2	10,2	12,0	16,0

a) Splitting resistance must only be considered for non-cracked concrete

ETA: Data according ETA-08/0307 issue 2008-12-12 Hilti: Additional Hilti technical data

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0{,}7 + 0{,}3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0{,}7 + 0{,}3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0{,}5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0{,}5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details, These influencing factors must be considered for every edge distance,

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0{,}5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0{,}5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details, This influencing factor must be considered for every anchor spacing,

Influence of base material thickness

h/h_{ef}	2,0	2,2	2,4	2,6	2,8	3,0	3,2	3,4	3,6	≥ 3,68
$f_{h,sp} = [h/(2 \cdot h_{ef})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

Influence of reinforcement

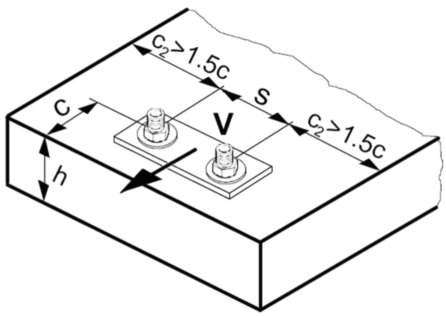
Anchor size	6		8			10			14	
Type HUS	HR		HR			HR, CR			HR	
h_{nom} [mm]	30	55	50	60	80	60	70	90	70	110
h_{ef} [mm]	23	45	38	47	64	46	54	71	52	86
$f_{re,N} = 0{,}5 + h_{ef}/200mm \leq 1$	0,62	0,73	0,69	0,74	0,82	0,73	0,77	0,86	0,76	0,93

a) This factor applies only for dense reinforcement, If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N} = 1$ may be applied,

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			6	8	10	14
Type		**HUS**	**HR**	**HR**	**HR, CR**	**HR**
Extra reduced embedment	$V_{Rd,s}$	[kN]	11,3	17,3	22,0	-
Reduced embedment	$V_{Rd,s}$	[kN]	-	17,3	22,0	36,7
Standard embedment	$V_{Rd,s}$	[kN]	11,3	17,3	22,0	51,3

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$ [a)]

Anchor size		6		8			10			14	
Type	**HUS**	**HR**		**HR**			**HR, CR**			**HR**	
h_{nom}	**[mm]**	30	55	50	60	80	60	70	90	70	110
k		1,0	1,5	2,0							

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

		Non-cracked concrete				Cracked concrete			
Anchor size		6	8	10	14	6	8	10	14
Type	**HUS**	**HR**	**HR**	**HR,CR**	**HR**	**HR**	**HR**	**HR,CR**	**HR**
Extra reduced embedment (Hilti Tech Data)									
h_{nom}	[mm]	**30**	**50**	**60**	**-**	**30**	**50**	**60**	**-**
$V^0_{Rd,c}$	[kN]	-	5,9	8,6	-	-	4,2	6,1	-
Reduced embedment									
h_{nom}	[mm]	**-**	**60**	**70**	**70**	**-**	**60**	**70**	**70**
$V^0_{Rd,c}$	[kN]	-	5,9	8,6	15	-	4,2	6,1	10,6
Standard embedment									
h_{nom}	[mm]	**55**	**80**	**90**	**110**	**55**	**80**	**90**	**110**
$V^0_{Rd,c}$	[kN]	3,6	5,9	8,6	15,1	2,6	4,2	6,1	10,7

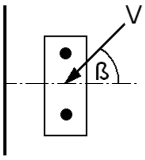
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß		0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$		1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min},

Influence of embedment depth

Anchor size		6		8			10			14	
Type	HUS	HR		HR			HR, CR			HR	
h_{nom}	[mm]	30	55	50	60	80	60	70	90	70	110
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$		-	1,48	0,69	0,98	1,64	0,65	0,85	1,35	0,45	1,06

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min},

Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”,

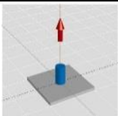
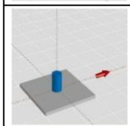
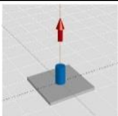
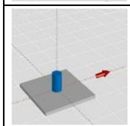
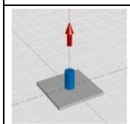
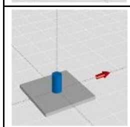
Precalculated values

Design resistance calculated according ETAG 001, Annex C and data given in ETA-08/0307, issue 2011,01,21,
All data applies to concrete C 20/25 – $f_{ck,cube}$ =25 N/mm², Hilti technical data for the extra reduced embedment depth is not part of the approval,

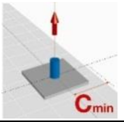
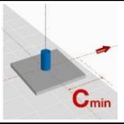
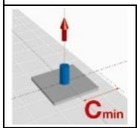
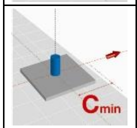
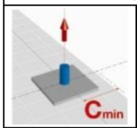
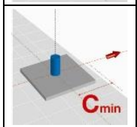
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4, The partial safety factors for action depend on the type of loading and shall be taken from national regulations,

Design resistance

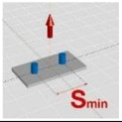
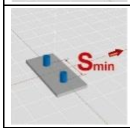
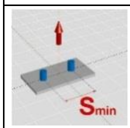
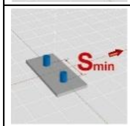
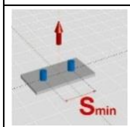
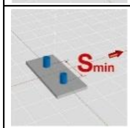
Single anchor, no edge effects ($c \geq c_{cr}$), shear without lever arm

		Non-cracked concrete				Cracked concrete			
Anchor size		**6**	**8**	**10**	**14**	**6**	**8**	**10**	**14**
Type	**HUS**	**HR**	**HR**	**HR,CR**	**HR**	**HR**	**HR**	**HR,CR**	**HR**
Extra reduced embedment (Hilti Tech Data)									
h_{nom}	[mm]	**30**	**50**	**60**	**-**	**30**	**50**	**60**	**-**
Min, base material thickness h_{min}	**[mm]**	80	100	120	-	80	100	120	-
 **Tensile N_{Rd}**	[kN]	-	5,0	6,7	-	-	2,8	4,2	-
 **Shear V_{Rd}**	[kN]	-	15,7	21,0	-	-	11,2	15,0	-
Reduced embedment									
h_{nom}	[mm]	**-**	**60**	**70**	**70**	**-**	**60**	**70**	**70**
Min, base material thickness h_{min}	**[mm]**	-	100	120	140	-	100	120	140
 **Tensile N_{Rd}**	[kN]	-	6,7	8,9	10,5	-	3,3	5,0	6,7
 **Shear V_{Rd}**	[kN]	-	17,3	22,0	25,2	-	15,5	19,0	18,0
Standard embedment									
h_{nom}	[mm]	**55**	**80**	**90**	**110**	**55**	**80**	**90**	**110**
Min, base material thickness h_{min}	**[mm]**	100	120	140	160	100	120	140	160
 **Tensile N_{Rd}**	[kN]	4,3	8,9	13,9	22,3	2,4	6,7	8,9	13,9
 **Shear V_{Rd}**	[kN]	11,3	17,3	22,0	51,3	10,9	17,3	22,0	38,3

Single anchor, min, edge distance ($c = c_{min}$), shear without lever arm

			Non-cracked concrete				Cracked concrete			
Anchor size			**6**	**8**	**10**	**14**	**6**	**8**	**10**	**14**
Type		**HUS**	**HR**	**HR**	**HR,CR**	**HR**	**HR**	**HR**	**HR,CR**	**HR**
Extra reduced embedment (Hilti Tech Data)										
h_{nom}		[mm]	**30**	**50**	**60**	**-**	**30**	**50**	**60**	**-**
	Min, base material thickness h_{min}	**[mm]**	80	100	120	-	80	100	120	-
	Min, edge distance c_{min}	**[mm]**	40	45	50	-	40	45	50	-
	**Tensile N_{Rd}**	[kN]	-	5,0	6,7	-	-	2,8	4,2	-
	**Shear V_{Rd}**	[kN]	-	3,8	4,7	-	-	2,7	3,3	-
Reduced embedment										
h_{nom}		[mm]	**-**	**60**	**70**	**70**	**-**	**60**	**70**	**70**
	Min, base material thickness h_{min}	**[mm]**	-	100	120	140	-	100	120	140
	Min, edge distance c_{min}	**[mm]**	-	45	50	50	-	45	50	50
	**Tensile N_{Rd}**	[kN]	-	6,6	8,0	7,7	-	3,3	5,0	4,9
	**Shear V_{Rd}**	[kN]	-	3,9	4,8	5,0	-	2,8	3,4	3,6
Standard embedment										
h_{nom}		[mm]	**55**	**80**	**90**	**110**	**55**	**80**	**90**	**110**
	Min, base material thickness h_{min}	**[mm]**	100	120	140	160	100	120	140	160
	Min, edge distance c_{min}	**[mm]**	40	50	50	60	40	50	50	60
	**Tensile N_{Rd}**	[kN]	4,3	8,9	10,4	13,8	2,4	6,7	6,8	9,0
	**Shear V_{Rd}**	[kN]	3,2	4,8	5,1	7,1	2,2	3,4	3,6	5,0

Double anchor, no edge effects ($c \geq c_{cr}$), min, spacing ($s = s_{min}$), shear without lever arm (load values are valid for one anchor)

			Non-cracked concrete				Cracked concrete			
Anchor size			**6**	**8**	**10**	**14**	**6**	**8**	**10**	**14**
Type		**HUS**	**HR**	**HR**	**HR,CR**	**HR**	**HR**	**HR**	**HR,CR**	**HR**
Extra reduced embedment (Hilti Tech Data)										
h_{nom}		[mm]	**30**	**50**	**60**	**-**	**30**	**50**	**60**	**-**
Min, base material thickness h_{min} [mm]			80	100	120	-	80	100	120	-
Min, spacing s_{min} [mm]			40	45	50	-	40	45	50	-
	**Tensile N_{Rd}**	[kN]	-	4,6	6,0	-	-	3,3	4,3	-
	**Shear V_{Rd}**	[kN]	-	11,0	14,3	-	-	7,8	10,2	-
Reduced embedment										
h_{nom}		[mm]	**-**	**60**	**70**	**70**	**-**	**60**	**70**	**70**
Min, base material thickness h_{min} [mm]			-	100	120	140	-	100	120	140
Min, spacing s_{min} [mm]			-	45	50	50	-	45	50	50
	**Tensile N_{Rd}**	[kN]	-	6,0	7,3	6,9	-	4,3	5,2	5,0
	**Shear V_{Rd}**	[kN]	-	14,3	17,5	16,7	-	10,2	12,5	11,9
Standard embedment										
h_{nom}		[mm]	**55**	**80**	**90**	**110**	**55**	**80**	**90**	**110**
Min, base material thickness h_{min} [mm]			100	120	140	160	100	120	140	160
Min, spacing s_{min} [mm]			40	50	50	60	40	50	50	60
	**Tensile N_{Rd}**	[kN]	4,7	9,1	10,4	13,8	3,4	6,5	7,4	9,8
	**Shear V_{Rd}**	[kN]	9,9	17,3	22,0	33,1	7,0	15,5	17,7	23,6

Fire resistance

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:
- Correct setting (see setting instruction)
- No edge distance and spacing influence
- Minimum base material thickness

The following technical data are based on: ETA-08/0307 issue 2014-04-29

Characteristic loads under fire exposure

Anchor Size				**6**	**8**		**10**		**14**	
Type			**HUS**	**HR**	**HR**		**HR, CR**		**HR, CR**	
				h_{nom}	h_{nom}	h_{nom}	h_{nom}	h_{nom}	h_{nom}	h_{nom}
Nominal embedment depth		h_{nom}	[mm]	50	60	80	70	90	70	110
Steel failure for tension and shear load ($F_{Rec,s,fi} = N_{Rec,s,fi} = V_{Rec,s,fi}$)										
Recommended tensile and shear load	R30	$F_{Rec,s,fi}$	[kN]	2,3	4,4		8,8		19,9	
	R60	$F_{Rec,s,fi}$	[kN]	1,6	3,0		5,7		12,8	
	R90	$F_{Rec,s,fi}$	[kN]	0,9	1,5		2,6		5,8	
	R120	$F_{Rec,s,fi}$	[kN]	0,5	0,8		1,1		2,6	
	R30	$M^0_{Rec,s,fi}$	[Nm]	1,9	3,9		9,2		31,2	
	R60	$M^0_{Rec,s,fi}$	[Nm]	1,3	2,6		6,0		20,2	
	R90	$M^0_{Rec,s,fi}$	[Nm]	0,7	1,3		2,7		9,1	
	R120	$M^0_{Rec,s,fi}$	[Nm]	0,4	0,7		1,2		4,0	
Pull out failure										
Recommended resistance	R30 R60 R90	$N_{Rec,p,fi}$	[kN]	0,6	0,7	1,4	1,1	1,9	1,4	3,0
	R120	$N_{Rec,p,fi}$	[kN]	0,5	0,6	1,1	0,9	1,5	1,1	2,4
Concrete cone failure										
Edge distance										
	R30 to R120	$c_{cr,N}$	[mm]	$2h_{ef}$						
Spacing										
	R30 to R120	$s_{cr,N}$	[mm]	$4h_{ef}$						
Concrete pry-out failure										
	R30 to R120	k	[-]	1,5	2,0		2,0		2,0	

b) gThe recommended loads under fire exposure include a safety factor for resistance under fire exposure $\gamma_{M,fi}$ = 1,0 and the partial safety factor for action $\gamma_{F,fi}$ = 1,0, The partial safety factors for action shall be taken from national regulations,

Seismic design

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:
- Seismic design according to TR045

The following technical data are based on: ETA-08/0307 issue 2014-04-30

Anchorage depth range

Anchor size			8	10	14
Type		**HUS**	**HR**	**HR, CR**	**HR**
Nominal anchorage depth range	h_{nom}	[mm]	80	90	110

Tension resistance in case of seismic performance category C1

Anchor size			8	10	14
Type		**HUS**	**HR**	**HR, CR**	**HR**
Characteristic tension resistance to steel failure					
	$N_{Rk,s,seis}$	[kN]	34,0	52,6	102,2
Partial safety factor	$\gamma_{Ms,seis}$	[-]		1,4	
Characteristic pull-out resistance in cracked concrete C20/25 to C50/60					
	$N_{Rk,p,seis}$	[kN]	7,7	12,5	17,5
Partial safety factor	$\gamma_{Mp,seis}$	[-]		1,8	
Concrete cone resistance and splitting resistance					
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]		1,8	

Displacement under tension load in case of seismic performance category C1 1)

Anchor size			8	10	14
Type		**HUS**	**HR**	**HR, CR**	**HR**
Displacement	$\delta_{N,seis}$	[mm]	1,2	1,2	0,4

1) Maximum displacement during cycling (seismic event),

Shear resistance in case of seismic performance category C1 1)

Anchor size			8	10	14
Type		**HUS**	**HR**	**HR, CR**	**HR**
Characteristic shear resistance to steel failure					
	$V_{Rk,s,seis}$	[kN]	11,1	17,9	53,9
Partial safety factor	$\gamma_{Ms,seis}$	[-]		1,5	
Concrete pryout resistance and concrete edge resistance					
Partial safety factor	$\gamma_{Mc,seis}$	[-]		1,5	

1) Reduction factor α_{gap} = 1,0 when using the Hilti Dynamic Set

Displacement under tension load in case of seismic performance category C1 1)

Anchor size			8	10	14
Type		**HUS**	**HR**	**HR, CR**	**HR**
Displacement	$\delta_{V,seis}$	[mm]	4,8	5,3	7,6

1) Maximum displacement during cycling (seismic event)

Basic loading data for single anchor in solid masonry units

All data in this section applies to

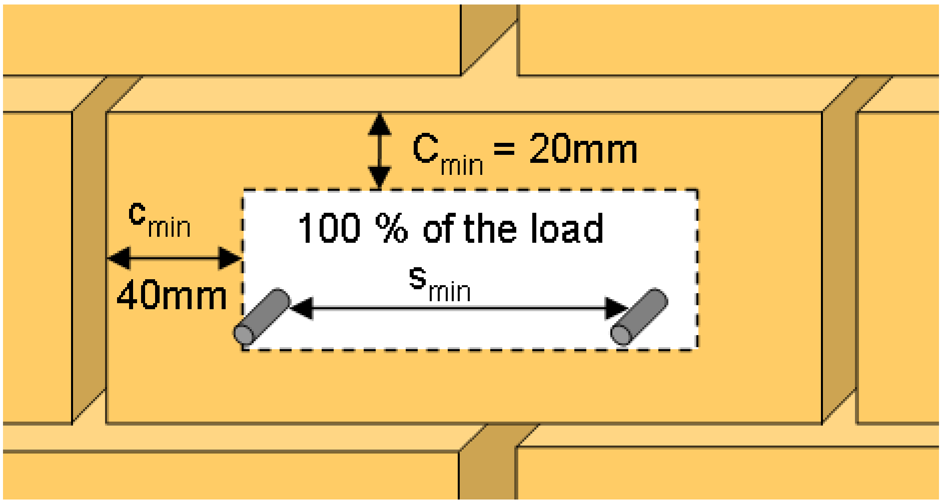
- Load values valid for holes drilled with TE rotary hammers in hammering mod
- Correct anchor setting (see instruction for use, setting details)
- The core / material ratio may not exceed 15% of a bed joint area,
- The brim area around holes must be at least 70mm
- Edge distances, spacing and other influences, see below

Recommended loads

				Hilti	
Base material		**Anchor size Type**	**6 HUS-HR**	**8 HUS-HR**	**10 HUS-HR, CR**
Germany, Austria, Switzerland		h_{nom} [mm]	**55**	**60**	**70**
Solid clay brick Mz12/2,0 	DIN 105/ EN 771-1 f_b a) ≥ 12 N/mm²	Tensile N_{rec} [kN]	0,9	1,0	1,1
		Shear V_{rec} [kN]	1,4	2,0	2,3
Solid sand-lime brick KS 12/2,0 	DIN 106/ EN 771-2 f_b a) ≥12 N/mm²	Tensile N_{rec} [kN]	0,6	0,6	1,0
		Shear V_{rec} [kN]	0,9	1,1	1,7
Aerated concrete PPW 6-0,4 	DIN 4165/ EN 771-4 f_b a) ≥ 6 N/mm²	Tensile N_{rec} [kN]	0,2	0,2	0,4
		Shear V_{rec} [kN]	0,4	0,4	0,9

a) f_b = brick strength

Permissible anchor location in brick and block walls



Edge distance and spacing influences

- The technical data for the HUS-HR anchors are reference loads for MZ 12 and KS 12, Due to the large variation of natural stone solid bricks, on site anchor testing is recommended to validate technical data,
- The HUS-HR anchor was installed and tested in center of solid bricks as shown, The HUS-HR anchor was not tested in the mortar joint between solid bricks or in hollow bricks; however a load reduction is expected,
- For brick walls where anchor position in brick can not be determined, 100% anchor testing is recommended,
- Distance to free edge free edge to solid masonry (Mz and KS) units ≥ 200 mm
- Distance to free edge free edge to solid masonry (autoclaved aerated gas concrete) units ≥ 170 mm
- The minimum distance to horizontal and vertical mortar joint (c_{min}) is stated in drawing above,
- Minimum anchor spacing (s_{min}) in one brick/block is ≥ $2*c_{min}$

Limits

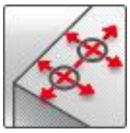
- Applied load to individual bricks may not exceed 1,0 kN without compression or 1,4 kN with compression
- All data is for multiple use for non structural applications
- Plaster, graveling, lining or levelling courses are regarded as non-bearing and may not be taken into account for the calculation of embedment depth,

HUS-V Screw anchor

Anchor version		Benefits
	HUS-V 8 / 10 Carbon steel concrete screw with hexagonal head	- High productivity – less drilling and fewer operations than with conventional anchors - Technical data for cracked and non-cracked concrete - Technical data for reusability in fresh concrete ($f_{ck,cube}$=10/15/20 Nmm^2) for temporary applications - Two embedment depths for maximum design flexibility


Concrete


Tensile zone


Small edge distance and spacing

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Minimum base material thickness
- Cracked and non-cracked Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Adjustment allowed during the installation for size 8 and 10, h_{nom2} only,.

Mean ultimate resistance

Anchor size		HUS-V	8		10	
Nominal embedment depth	h_{nom}	[mm]	50	65	55	75
Non-cracked concrete						
Tensile $N_{Ru,m}$		[kN]	11,9	21,2	11,9	26,6
Shear $V_{Ru,m}$		[kN]	16,4	*16,7*	18,6	*20,5*
Cracked concrete						
Tensile $N_{Ru,m}$		[kN]	5,3	11,9	8,0	21,2
Shear $V_{Ru,m}$		[kN]	11,7	*16,7*	13,2	*20,5*

Characteristic resistance

Anchor size		HUS-V	8		10	
Nominal embedment depth	h_{nom}	[mm]	50	65	55	75
Non-cracked concrete						
Tensile N_{Rk}		[kN]	9,0	16,0	9,0	20,0
Shear V_{Rk}		[kN]	12,3	*15,9*	14,0	*19,5*
Cracked concrete						
Tensile N_{Rk}		[kN]	4,0	9,0	6,0	16,0
Shear V_{Rk}		[kN]	8,8	*15,9*	10,0	*19,5*

Design resistance

Anchor size		HUS-V	8		10	
Nominal embedment depth	h_{nom}	[mm]	50	65	55	75
Non-cracked concrete						
Tensile N_{Rd}		[kN]	5,0	8,9	5,0	9,5
Shear V_{Rd}		[kN]	6,9	*10,6*	7,8	*13,0*
Cracked concrete						
Tensile N_{Rd}		[kN]	2,2	5,0	3,3	7,6
Shear V_{Rd}		[kN]	4,9	*10,6*	5,5	*13,0*

Recommended load

Anchor size		HUS-V	8		10	
Nominal embedment depth	h_{nom}	[mm]	50	65	55	75
Non-cracked concrete						
Tensile N_{Rec}		[kN]	3,6	6,3	3,6	6,8
Shear V_{Rec}		[kN]	4,9	*7,6*	5,6	9,3
Cracked concrete						
Tensile N_{Rec}		[kN]	1,6	3,6	2,4	5,4
Shear V_{Rec}		[kN]	3,5	*7,6*	4,0	9,3

a) With overall partial safety factor for action γ = 1,4, The partial safety factors for action depend on the type of loading and shall be taken from national regulations,

Materials

Mechanical properties

Anchor size	HUS-V	8	10
Nominal tensile strength f_{uk}	[N/mm²]	880	715
Yield strength f_{yk}	[N/mm²]	755	610
Stressed cross-section $A_{s,}$	[mm²]	36,6	59,4
Moment of resistance W	[mm³]	35	65
Char, bending resistance $M^0_{Rk,s}$	[Nm]	37,1	55,5

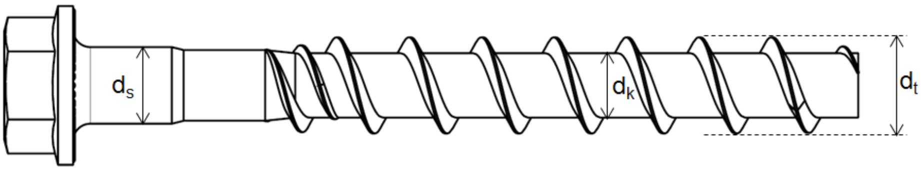
Material quality

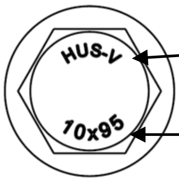
Type	Material	Coating
HUS-V	Carbon steel	Galvanized (≥5 µm)

Anchor dimensions

Dimensions

Anchor size		HUS-V	8	10
Threaded outer diameter	d_t	[mm]	10,60	12,65
Core diameter	d_k	[mm]	7,1	8,70
Shaft diameter	d_s	[mm]	8,45	10,55
Stressed section	A_s	[mm^2]	36,6	59,4



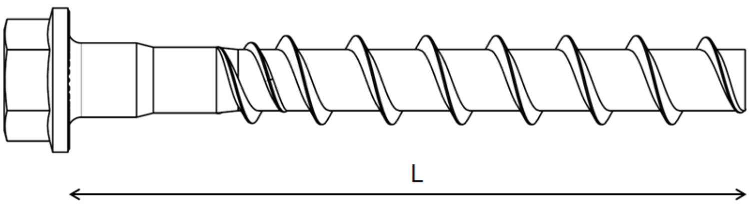


HUS-V : Hilti Universal Screw – hexagonal head

10x95 : screw diameter x screw length

Screw length and thickness of fixture for HUS-V (hex head)

Anchor size HUS-V	8		10	
Nominal anchorage depth [mm] / Length of anchor [mm]	h_{nom1} 50	h_{nom2} 60	h_{nom1} 55	h_{nom2} 75
	thickness of ficture			
	t_{fix1}	t_{fix2}	t_{fix1}	t_{fix2}
55	5	-	-	-
60	-	-	5	-
75	25	15	-	-
85	35	25	30	10
95	45	35	40	20
105	-	-	50	30



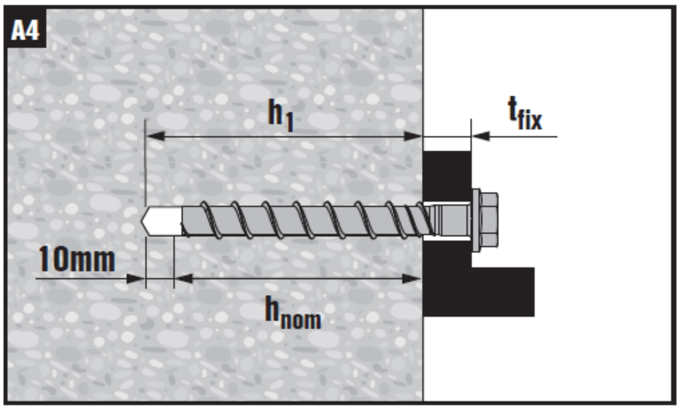
Setting

Installation equipment

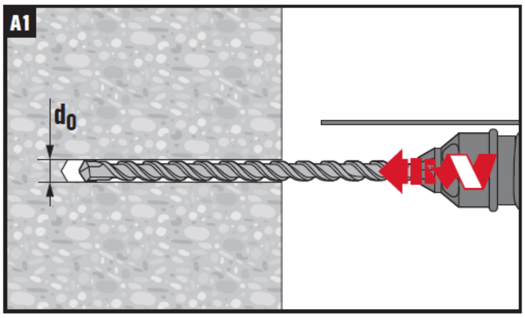
Anchor size HUS-V	8	10
Rotary hammer	TE 2 – TE 30	TE 2 – TE 30
Drill bit for concrete	CX 8	CX 10
Socket wrench insert	S-NSD 13 1/2	S-NSD 15 1/2
Tube for temporary application	HRG 8	HRG 10
Setting tool for concrete C12/15 to C50/60	SIW 22T-A – SIW 22-A	

Setting details for concrete

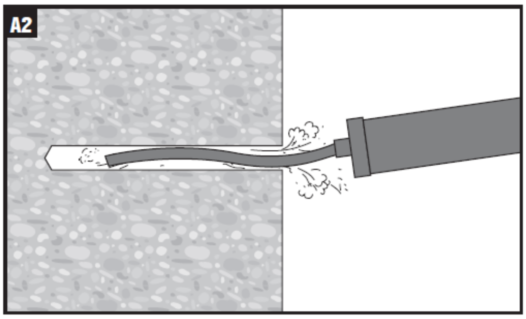
Anchor size		HUS-V	8		10	
Nominal anchorage depth	h_{nom}	[mm]	50	65	55	75
Nominal diameter of drill bit	d_o	[mm]	8		10	
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45		10,45	
Depth of drill hole	$h_1 \geq$	[mm]	60	75	65	85
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	12		14	
Width across	SW	[mm]	13		15	
Impact screw driver			Hilti SIW 22 T-A or SIW 22-A			



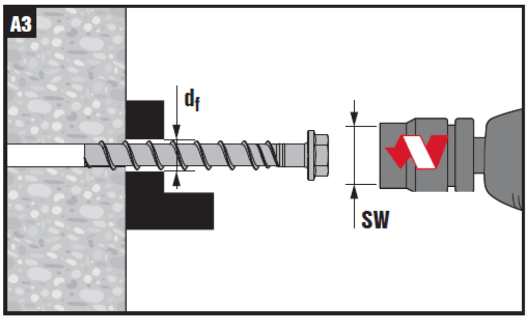
Setting instruction



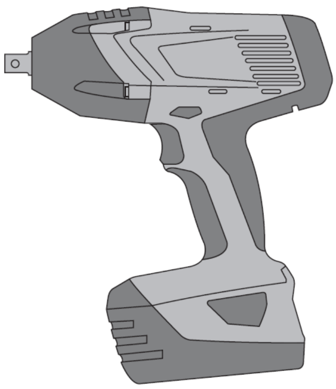
Make a cylindrical hole

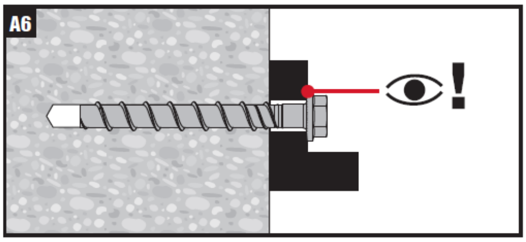


Clean the borehole



Install the screw anchor by impact screw driver Hilti SIW 22T-A or SIW22-A



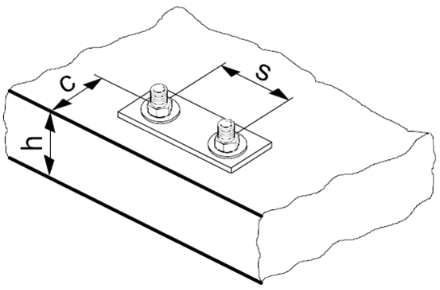


Ensure that the fixture is caught

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

Design parameters

Anchor size		HUS-V	8		10	
Nominal anchorage depth	h_{nom}	[mm]	50	65	55	75
Effective anchorage depth	h_{ef}	[mm]	39,1	51,9	42,5	59,5
Minimum base material thickness	h_{min}	[mm]	100	110	100	130
Minimum spacing	s_{min}	[mm]	40	50	50	50
Minimum edge distance	c_{min}	[mm]	50	50	50	50
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	117,3	140	130	180
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	58,65	70	65	90
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	117,3	177,3	127,5	178,5
Critical edge distance for concrete cone failure	$c_{cr,N}$	[mm]	58,65	88,65	63,75	89,25



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced,

Simplified design method

Simplified version of the design method according ETAG 001, Annex C,

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors, (The method may also be applied for anchor groups with more than two anchors or more than one edge, The influencing factors must then be considered for each edge distance and spacing, The calculated design loads are then conservative: They will be lower than the exact values according ETAG 001, Annex C.

The design method is based on the following simplification:

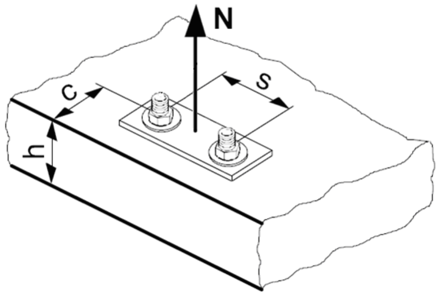
- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor,

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size HUS-V	8	10
$N_{Rd,s}$ [kN]	25	30,3

Design pull-out resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$

Anchor size HUS-V	8		10	
Nominal anchorage depth h_{nom} [mm]	50	65	55	75
Non-cracked concrete				
$N^0_{Rd,p}$ [kN]	5	8,9	5	9,5
Cracked concrete				
$N^0_{Rd,p}$ [kN]	2,2	5	3,3	7,6

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance [a)] $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

Anchor size HUS-V	8		10	
Nominal anchorage depth h_{nom} [mm]	50	65	55	75
Non-cracked concrete				
$N^0_{Rd,c}$ [kN]	6,9	10,5	7,8	11,0
Cracked concrete				
$N^0_{Rd,c}$ [kN]	4,9	7,5	5,5	7,9

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
Pull-out , concrete cone and splitting resistance							
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2\ a)}$	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0{,}7 + 0{,}3\cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0{,}7 + 0{,}3\cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0{,}5\cdot(1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0{,}5\cdot(1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details, These influencing factors must be considered for every edge distance,

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0{,}5\cdot(1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0{,}5\cdot(1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details, This influencing factor must be considered for every anchor spacing,

Influence of base material thickness

h/h_{min}	1,0	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	≥ 1,84
$f_{h,sp} = [h/(h_{min})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

Influence of reinforcement a)

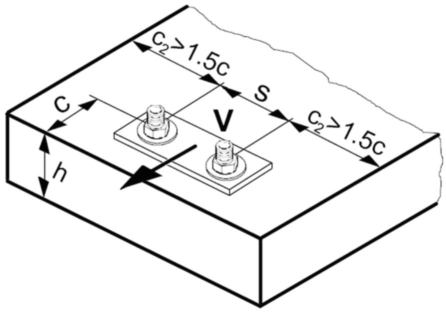
Anchor size	8		10	
Type HUS-V				
Nominal anchorage depth h_{nom} [mm]	50	65	55	75
$f_{re,N} = 0{,}5 + h_{ef}/200mm \leq 1$	0,70	0,76	0,71	0,80

e) This factor applies only for dense reinforcement, If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied,

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size HUS-V	8	10
$V_{Rd,s}$ [kN]	10,6	13

Design concrete pry-out resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$ a)

Anchor size HUS-V	8		10	
Nominal anchorage depth h_{nom} [mm]	50	65	55	75
k	1	2	1	2

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance a) $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size HUS-V	8		10	
Nominal anchorage depth h_{nom} [mm]	50	65	55	75
Non-cracked concrete				
$V^0_{Rd,c}$ [kN]	5,0	5,0	7,2	6,2
Cracked concrete				
$V^0_{Rd,c}$ [kN]	3,5	3,5	5,1	4,4

d) For anchor groups only the anchors close to the edge must be considered,

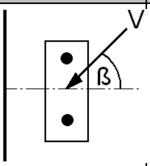
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß		0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$		1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min},

Influence of embedment depth

Anchor size HUS-V	8		10	
Nominal anchorage depth h_{nom} [mm]	50	65	55	75
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,72	1,15	0,56	1,00

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

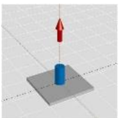
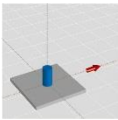
a) The edge distance shall not be smaller than the minimum edge distance c_{min},

Precalculated values

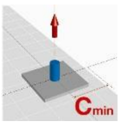
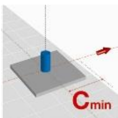
Design resistance calculated according ETAG 001, Annex C,
All data applies to concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²,

Design resistance

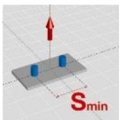
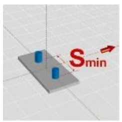
Single anchor, no edge effects

Anchor size		**HUS-V**	**8**		**10**	
Nominal anchorage depth	h_{nom}	[mm]	50	65	55	75
Min, base material thickness	h_{min}	**[mm]**	100	110	100	130
	**Tensile N_{Rd}**					
	Non-cracked concrete					
		[kN]	5,0	8,9	5,0	9,5
	Cracked concrete					
		[kN]	2,2	5,0	3,3	7,6
	**Shear V_{Rd}, without lever arm**					
	Non-cracked concrete					
		[kN]	6,9	10,6	7,8	13,0
	Cracked concrete					
		[kN]	4,9	10,6	5,5	13,0

Single anchor, min, edge distance (c = c_{min})

Anchor size		**HUS-V**	**8**		**10**	
Nominal anchorage depth	h_{nom}	[mm]	50	65	55	75
Min, base material thickness	h_{min}	**[mm]**	100	110	100	130
Min, edge distance	c_{min}	[mm]	50	50	50	50
	**Tensile N_{Rd}**					
	Non-cracked concrete					
		[kN]	5,0	7,7	5,0	7,4
	Cracked concrete					
		[kN]	2,2	5,0	3,3	5,3
	**Shear V_{Rd}, without lever arm**					
	Non-cracked concrete					
		[kN]	3,7	3,9	3,8	3,5
	Cracked concrete					
		[kN]	2,6	2,8	2,7	2,5

Double anchor, no edge effects, min, spacing ($s = s_{min}$),
(load values are valid for one anchor)

Anchor size **HUS-V**	**8**		**10**	
Nominal anchorage depth h_{nom} [mm]	50	65	55	75
Min, base material thickness h_{min} [mm]	100	110	100	130
Min, spacing s_{min} [mm]	40	50	50	50
 **Tensile N_{Rd}**				
Non-cracked concrete				
[kN]	4,6	6,9	5,4	7,1
Cracked concrete				
[kN]	3,3	4,9	3,8	5,0
 **Shear V_{Rd}, without lever arm**				
Non-cracked concrete				
[kN]	4,6	10,6	5,4	13,0
Cracked concrete				
[kN]	3,3	9,9	3,9	10,1

Basic loading data for temporary application in standard and fresh concrete < 28 days old, $f_{ck,cube}$ ≥ 10 N/mm²:

All data in this section applies to the following conditions:

- Strength class, $f_{ck,cube}$ ≥ 10 N/mm²
- Only temporary use
- Screw is reusable, before each usage it must be checked according Hilti instruction for use with the suited tube Hilti HRG
- Design resistance and recommended load are valid for single anchor only
- Design resistance as well as the recommended load are valid for all load direction and valid for both cracked and non-cracked concrete
- Minimum base material thickness
- No edge distance and spacing influence

Design resistance

Anchor size		HUS-V	8		10	
Nominal embedment depth	h_{nom}	[mm]	50	65	55	75
Cracked and non-cracked concrete						
Tensile N_{Rd} = Shear V_{Rd}						
	$f_{ck,cube}$ ≥ 10 N/mm^2	[kN]	1,4	3,0	1,7	3,2
	$f_{ck,cube}$ ≥ 15 N/mm^2	[kN]	1,7	3,7	2,1	3,9
	$f_{ck,cube}$ ≥ 20 N/mm^2	[kN]	2,0	4,2	2,4	4,5

Recommended load

Anchor size		HUS-V	8		10	
Nominal embedment depth	h_{nom}	[mm]	50	65	55	75
Tensile N_{rec} = Shear V_{rec}						
	$f_{ck,cube}$ ≥ 10 N/mm^2	[kN]	1,0	2,1	1,2	2,3
	$f_{ck,cube}$ ≥ 15 N/mm^2	[kN]	1,2	2,6	1,5	2,8
	$f_{ck,cube}$ ≥ 20 N/mm^2	[kN]	1,4	3,0	1,7	3,2

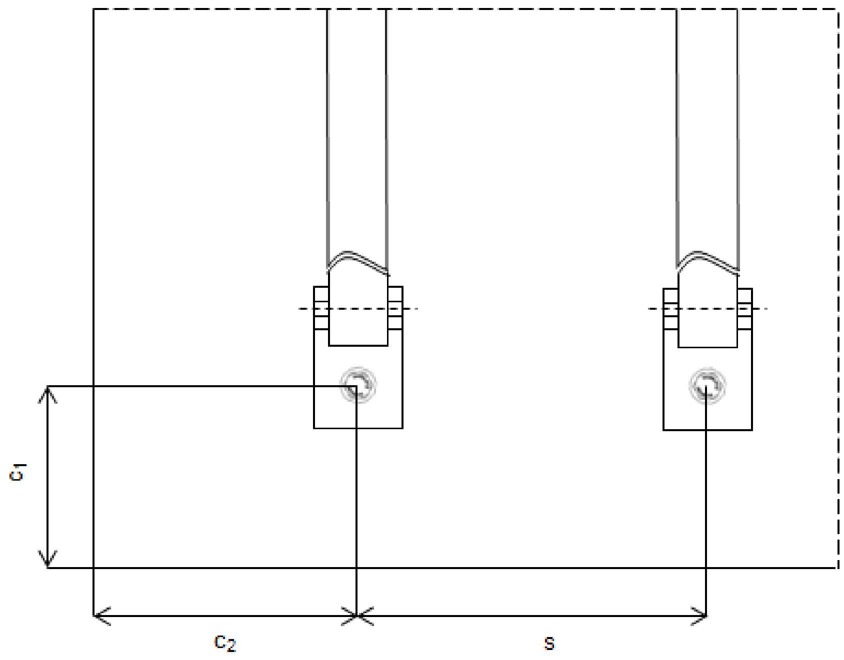
a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

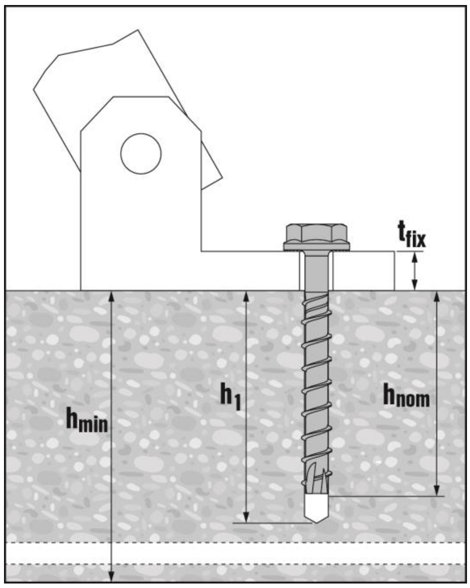
Setting details

Anchor size		HUS-V	8		10	
Nominal anchorage depth	h_{nom}	[mm]	50	65	55	75
Minimum base material thickness	h_{min}	[mm]	100	110	100	130
Minimum spacing	s_{min}	[mm]	135	225	150	240
Minimum edge distance direction 1	c_1	[mm]	45	75	50	80
Minimum edge distance direction 2	c_2	[mm]	70	115	75	120

Setting details

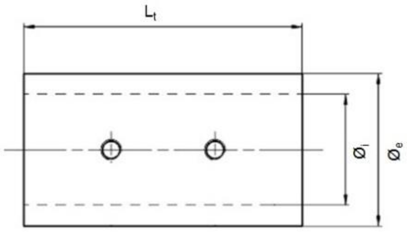
Anchor size		HUS-V	8		10	
Nominal anchorage depth	h_{nom}	[mm]	50	65	55	75
Nominal diameter of drill bit	d_o	[mm]	8		10	
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45		10,45	
Depth of drill bit	$h_1 \leq$	[mm]	60	75	65	85
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	12		14	
Width across	SW	[mm]	13		15	
Impact screw driver			Hilti SIW 22 T-A or SIW 22 A			
Suited tube			Hilti HRG 8		Hilti HRG 10	



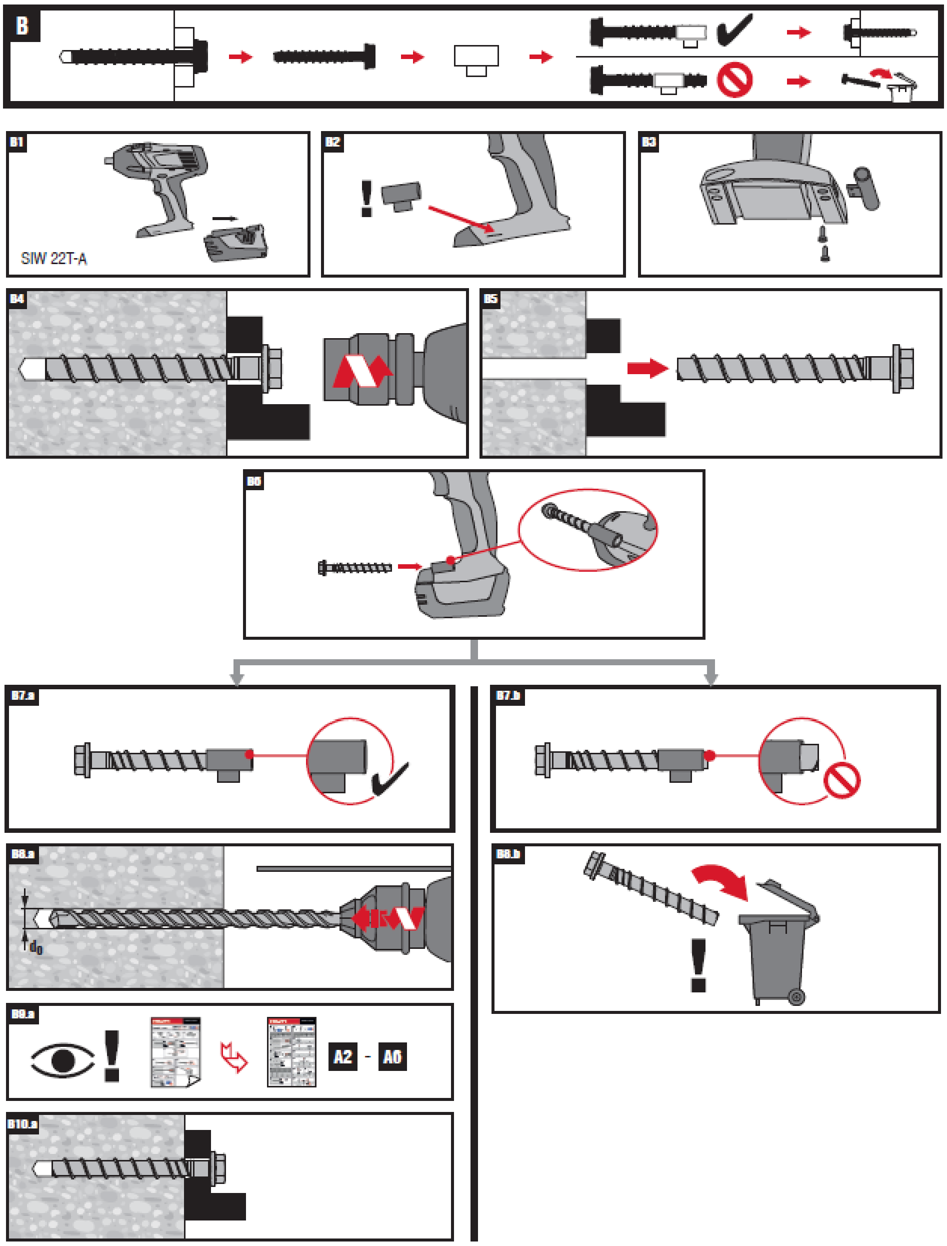


Tube specification

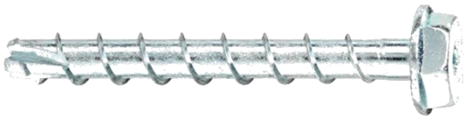
Anchor size / tube			8 / HRG 8	10 / HRG 10
Inner tube diameter	$Ø_i$	[mm]	9,7	11,7
Outer tube diameter	$Ø_e$	[mm]	15,0	17,0
Tube length	Lt	[mm]	23,0	28,0



Instruction for use – re-use of screw

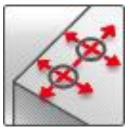


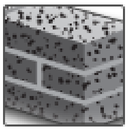
HUS Screw anchor, carbon steel

	Anchor version	Benefits
	HUS-A 6 Carbon steel Concrete Screw with hex head	- Quick and easy setting - Low expansion forces in base materials - Through fastening - Removable - Forged-on washer and hexagon head with no protruding thread
	HUS-H 6 Carbon steel Concrete Screw with hex head	
	HUS-H 8 HUS-H 10 HUS-H 14 Carbon steel Concrete Screw with hex head	
	HUS-I 6 Carbon steel Concrete Screw with hex head	
	HUS-P 6 Carbon steel Concrete Screw with pan head	


Concrete


Tensile zone


Small edge distance and spacing


Solid brick


Autoclaved aerated concrete


Fire resistance


European Technical Approval


CE conformity


PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval a) with fire assessment according TR020	DIBt, Berlin	ETA-08/0307/ 2014-04-29
Fire test report	IBMB, Brunswick	UB3574/5146/ 2006-05-20
Fire Assessment report	Exova Warringtonfire	WF 166402/ 2007-10-26

a) Does not include HUS-H 14

Basic loading data for concrete C20/25

All data in this section applies to

For details see simplified design method

- Correct setting (see setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

The following technical data are based on:

ETA: Data according ETA-08/0307 issue 2014-04-29
Hilti: Additional Hilti technical data

Mean ultimate resistance

		ETA-08/0307						Hilti				
Anchor size		6		8		10		8	10	14		
Type	**HUS-**	A, H, I	P	H		H		H	H	H		
h_{nom}	**[mm]**	55	55	60	75	70	85	50	60	70	90	110
Non-cracked concrete												
Tensile $N_{Ru,m}$	[kN]	12,0	10,0	16,0	21,3	16,0	26,7	11,2	16,0	23,8	36,9	56,0
Shear $V_{Ru,m}$	[kN]	13,2	13,2	16,7	16,7	25,1	25,1	16,7	25,1	47,6	53,8	53,8
Cracked concrete												
Tensile $N_{Ru,m}$	[kN]	8,0		8,0	12,0	10,0	21,3	5,2	8,5	-	19.1	-
Shear $V_{Ru,m}$	[kN]	13,2		16,7	16,7	25,1	25,1	16,7	25,1	-	53,8	-

Characteristic resistance

		ETA-08/0307						Hilti				
Anchor size		6		8		10		8	10	14		
Type	**HUS-**	A, H, I	P	H		H		H	H	H		
h_{nom}	**[mm]**	55	55	60	75	70	85	50	60	70	90	110
Non-cracked concrete												
Tensile N_{Rk}	[kN]	9,0	7,5	12,0	16,0	12,0	20,0	8,4	12,0	17,8	27,6	42
Shear V_{Rk}	[kN]	12,5	12,5	15,9	15,9	23,8	23,8	15,9	23,8	35,6	51,2	51,2
Cracked concrete												
Tensile N_{Rk}	[kN]	6,0		6,0	9,0	7,5	16,0	3,9	6,4	-	14,3	-
Shear V_{Rk}	[kN]	12,5		15,9	15,9	23,8	23,8	15,6	21,0	-	39,5	-

Design resistance

		ETA-08/0307						Hilti				
Anchor size		6		8		10		8	10	14		
Type	**HUS-**	A, H, I	P	H		H		H	H	H		
h_{nom}	**[mm]**	55	55	60	75	70	85	50	60	70	90	110
Non-cracked concrete												
Tensile N_{Rd}	[kN]	5,0	4,2	6,7	8,9	6,7	9,5	4,7	6,7	9,9	15,4	24,0
Shear V_{Rd}	[kN]	8,3	8,3	10,6	10,6	15,9	15,9	10,6	15,9	23,8	34,1	34,1
Cracked concrete												
Tensile N_{Rd}	[kN]	3,3		3,3	5,0	4,2	7,6	2,2	3,6	-	9,5	-
Shear V_{Rd}	[kN]	8,3		10,6	10,6	15,9	15,9	10,4	14,0	-	26,3	-

Recommended loads

		ETA-08/0307						Hilti				
Anchor size		6		8		10		8	10	14		
Type	**HUS-**	A, H, I	P	H		H		H	H	H		
h_{nom}	**[mm]**	55	55	60	75	70	85	50	60	70	90	110
Non-cracked concrete												
Tensile N_{rec}	[kN]	3,6	3,0	4,8	6,3	4,8	6,8	3,3	4,8	7,1	11,0	17,1
Shear V_{rec}	[kN]	6,0	6,0	7,6	7,6	11,3	11,3	7,6	11,3	17,0	24,4	24,4
Cracked concrete												
Tensile N_{rec}	[kN]	2,4		2,4	3,6	3,0	5,4	1,5	2,5	-	6,8	-
Shear V_{rec}	[kN]	6,0		7,6	7,6	11,3	11,3	7,4	10,0	-	18,8	-

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Basic loading data for concrete < 28 days old and $f_{ck,cube}$ ≥ 15 N/mm²:

All data in this section applies to the following conditions:

Concrete:
- Strength class C 20/25, $f_{ck,cube}$ ≥ 15 N/mm²

Installation:
- For hand installation $T_{inst,rec}$ = 40 Nm

The anchor is correct mounted, if there is neither a turn-through or spinning of the screw in the drill hole nor that an easy turning of the screw is possible after the installation procedure when the head of the screw has touched the fixture.

Loads:
- No edge distance and spacing influence
- Minimum base material thickness

Recommended loads in non-cracked concrete

		Hilti		
Anchor size		**14**	**14**	**14**
Type	**HUS-**	**H**	**H**	**H**
h_{nom}	**[mm]**	**70**	**90**	**110**
Non-cracked concrete				
Tensile N_{rec} a)	[kN]	3,5	5,5	7,5
Shear V_{rec} a)	[kN]	6,6	14,0	16,5

a) Values serve as a reference, onsite testing is recommended to determine actual loading potential of the anchors

Basic loading data for single anchor in solid masonry units:

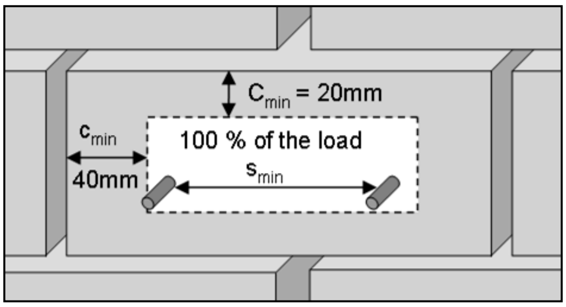
All data in this section applies to the following conditions:

Solid bricks: a reduction of the cross section area by a vertical perforation perpendicular to the bed joint area must not be greater than 15%

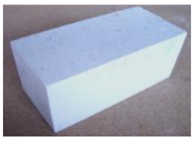
Drilling:
- Holes in Mz and KS drilled with TE rotary hammers drilled with hammering mode
- Holes in PPW drilled with TE rotary hammers drilled without hammering mode

Installation:
- The anchor is correct mounted, if there is neither a turn-through or spinning of the screw in the drill hole nor that an easy turning of the screw is possible after the installation procedure when the head of the screw has touched the fixture

Edge distance and spacing influences:
- Distance to free edge free edge to solid masonry (Mz and KS) units $c_{min,free}$ ≥ 200 mm
- Distance to free edge free edge to solid masonry (autoclaved aerated gas concrete) units $c_{min,free}$ ≥ 170 mm
- The minimum distance to horizontal and vertical mortar joint $c_{min,h}$ and $c_{min,v}$ is stated in drawing below
- Minimum anchor spacing in one brick/block is s_{min} = 80 mm



Recommended loads

Base material		Anchor size	Hilti 6	Hilti 8	Hilti 10
		Type HUS-	A, H, I, P	H	H
		h_{nom} [mm]	55	60	70
		Compressive strength class [N/mm²]	F_{rec} a) [kN] Tensile and Shear		
	**Solid clay brick** **Mz 2,0-2DF** DIN V 105-100 / EN 771-1 LxWxH [mm]: 240x115x113 h_{min} [mm]: 115	≥ 8	0,6	0,8	1,0
		≥ 10	0,7	0,9	1,2
		≥ 12	0,8	1,0	1,3
		≥ 16	0,9	1,2	1,5
		≥ 20	0,9	1,3	1,7
	**Solid sand-lime brick** **KS 2,0-2DF** DIN V 106-100 / EN 771-2 LxWxH [mm]: 240x115x113 h_{min} [mm]: 115	≥ 8	0,8	1,0	1,1
		≥ 10	0,9	1,1	1,2
		≥ 12	1,0	1,2	1,3
		≥ 16	1,1	1,3	1,5
		≥ 20	1,2	1,5	1,7
	**Aerated concrete** **PPW -0,65** DIN 4165/ EN 771-4 LxWxH [mm]: 499x240x249 h_{min} [mm]: 240	≥ 6	0,4	0,5	1,3

a) Characteristic resistance for tension, shear or combined tension and shear loading.
The characteristic resistance is valid for single anchor or for a group of two or four anchors with a spacing equal or larger than the minimum spacing s_{min} according to specification.

Load values:

- The technical data for the HUS-H anchors are reference loads for MZ 12 2,0-2DF, KS 12 2,0-2DF and PPW 6-0,65.
- The load Values are valid for non-structural applications.
- Due to the natural variation of stone solid bricks, on site anchor testing is recommended to validate technical data.
- The HUS-H anchor was installed and tested in the centre area of solid bricks as shown considering minimal edge and space distances.
- The HUS-H anchor was not tested in the mortar joint between solid bricks or in hollow bricks; however a load reduction is expected.
- For brick walls where anchor position in brick can not be determined, 100% anchor testing is recommended.

Limitations of loads:

- All data is for redundant fastening for non structural applications
- Plaster, graveling, lining or leveling courses are regarded as non-bearing and may not be taken into account for the calculation of embedment depth.
- The decisive resistance to tension loads is the lower value of N_{rec} (brick breakout, pull out) and $N_{max,pb}$ (pull out of one brick).

Pull out of one brick:

The allowable load of an anchor or a group of anchors in case of single brick pull out, $N_{max,pb}$ [kN], is given in the following tables:

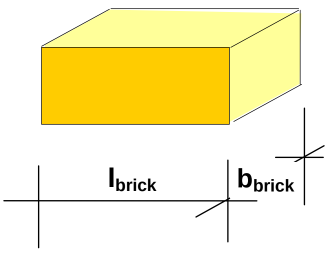
Clay bricks:

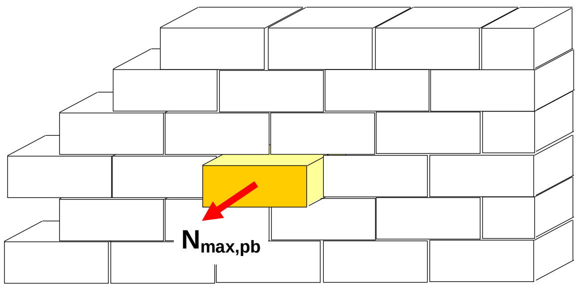
$N_{max,pb}$ [kN]		brick breadth b_{brick} [mm]					
		80	120	200	240	300	360
brick length l_{brick} [mm]	240	1,1	1,6	2,7	3,3	4,1	4,9
	300	1,4	2,1	3,4	4,1	5,1	6,2
	500	2,3	3,4	5,7	6,9	8,6	10,3

All other brick types:

$N_{max,pb}$ [kN]		brick breadth b_{brick} [mm]					
		80	120	200	240	300	360
brick length l_{brick} [mm]	240	0,8	1,2	2,1	2,5	3,1	3,7
	300	1,0	1,5	2,6	3,1	3,9	4,6
	500	1,7	2,6	4,3	5,1	6,4	7,7

$N_{max,pb}$ = resistance for pull out of one brick
l_{brick} = length of the brick
b_{brick} = breadth of the brick





Materials

Mechanical properties

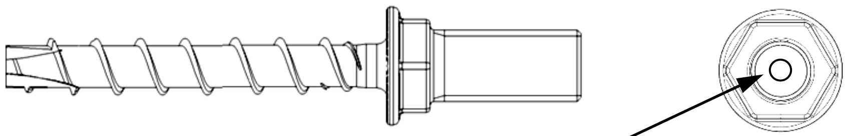
Anchor size		6	8	10	14
Type	**HUS-**	**A, H, I, P**	**H**	**H**	**H**
Nominal tensile strength f_{uk}	[N/mm²]	930	950	1000	770
Yield strength f_{yk}	[N/mm²]	750	855	900	700
Stressed cross-section A_s	[mm²]	26,9	39,0	55,4	143,1
Moment of resistance W	[mm³]	19,6	34,4	58,2	191,7
Design bending resistance $M_{Rd,s}$	[Nm]	21,9	26,1	46,5	118

Material quality

Part	Designation	Material
Screw anchor	HUS-A 6 HUS-H 6 HUS-I 6 HUS-P 6 HUS-H 8 HUS-H 10 HUS-H 14	Carbon Steel, galvanized (≥ 5 µm)

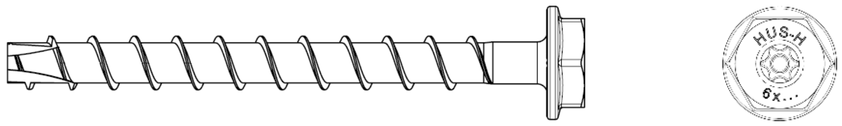
Head configuration

HUS-A 6
External thread
M8 or M10

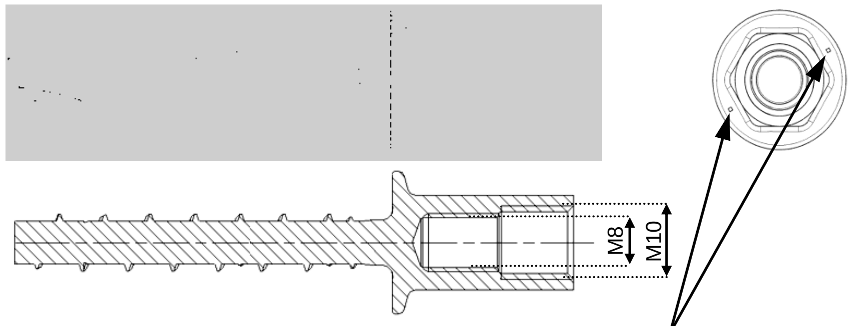


Circle mark with d = 2,5 mm for h_{nom} = 55 mm

HUS-H 6
Hex head

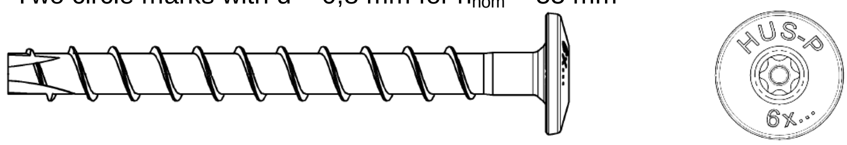


HUS-I 6
Internal threads
M8 and M10



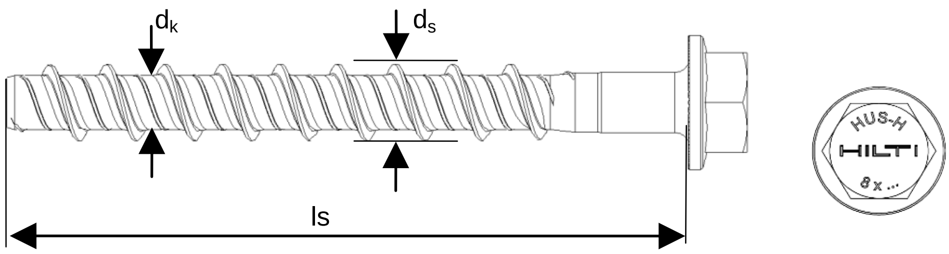
Two circle marks with d = 0,8 mm for h_{nom} = 55 mm

HUS-P 6
Pan head



HUS-H 8
HUS-H 10
HUS-H 14

Hex head



Anchor dimensions:

Dimensions

Anchor size			6				8	10	14
Type		**HUS-**	**A**	**H**	**I**	**P**	**H**	**H**	**H**
Nominal length	l_S	[mm]	55	60..120	55	60..80	65..150	75..280	80..160
Outer diameter of thread	d_S	[mm]	7,85				10,1	12,3	16,55
Core diameter	d_k	[mm]	5,85				7,1	8,4	12,6

Setting:

Recommended installation equipment

Anchor Size		6				8			10			14		
Type	**HUS-**	**A**	**I**	**H**	**P**	**H**			**H**			**H**		
h_{nom}	**[mm]**	**55**				**50**	**60**	**70**	**60**	**70**	**85**	**70**	**90**	**110**
Rotary hammer		TE 2 - TE 7				TE 2 - TE 30								
drill bit for concrete, solid clay brick solid sand-lime brick		TE -CX 6				TE -CX 8			TE -CX 10			TE -CX 14		
drill bit for aerated concrete		TE -CX 5				TE -CX 6			TE -CX 8			-		
Socket wrench insert		S-NSD 13 1/2 L			-	S-NSD 13 1/2 L			S-NSD 15 1/2			S-NSD 21 1/2		
TORX		-		TXI 30		-			-			-		
Setting tool		SIW/ SID 121 SIW/ SID 144 TKI 2500				SIW 22T-A SI 100								

Setting details for concrete from C20/25 to C50/60

Anchor size			6				8			10			14		
Type		**HUS-**	**A**	**I**	**H**	**P**	**H**			**H**			**H**		
h_{nom}		**[mm]**	**55**				**50**	**60**	**70**	**60**	**70**	**85**	**70**	**90**	**110**
Nominal diameter of drill bit	d_0	[mm]	6				8			10			14		
Cutting diameter of drill bit	d_{cut} ≤	[mm]	6,4				8,45			10,45			14,50		
Clearance hole diameter	d_f	[mm]	9				12			14			18		
Depth of drill hole in floor/ wall position	h_1 ≥	[mm]	h_{nom}+10 mm				h_{nom} +10 mm			h_{nom} +10 mm			h_{nom} +10 mm		
Depth of drill hole in ceiling position	h_1 ≥	[mm]	h_{nom}+3 mm												
Thickness of fixture	t_{fix}	[mm]	l_s - h_{nom}												
Max. installation torque for hand setting	max. T_{inst}	[Nm]	25				35	35	45	45	45	55	65 (40)[a)]		
Impact screw driver for machine setting			SIW/SID 121,144 TKI 2500				SIW 22T-A SI 100						SIW 22T-A SI 100 [b)]		

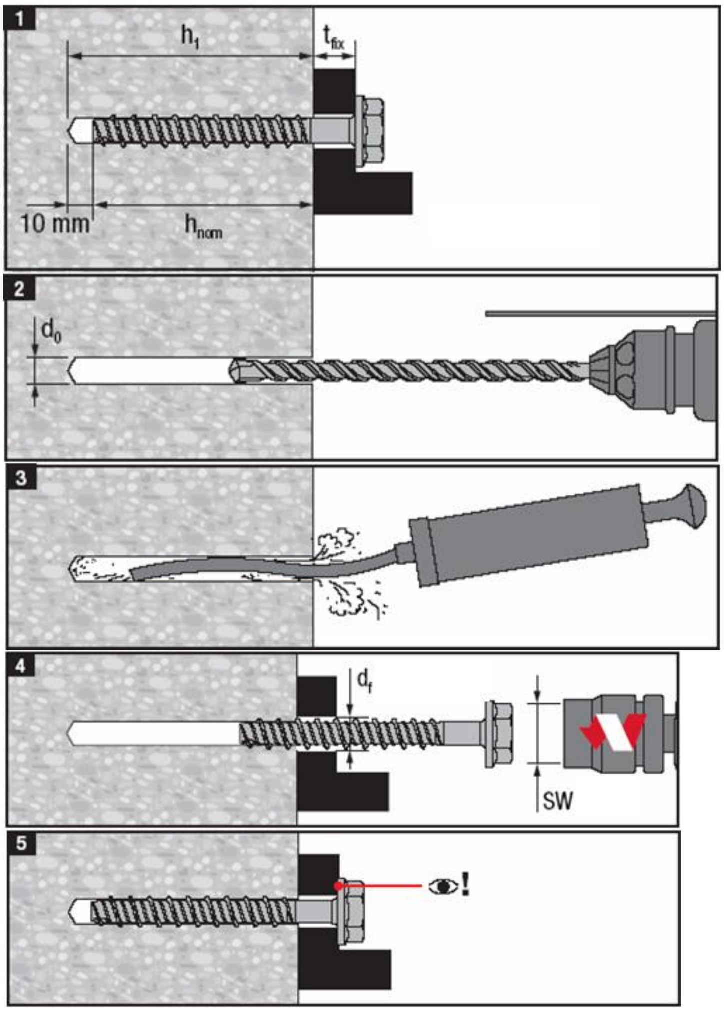
[a)] For concrete < 28 days old and $f_{ck,cube}$ ≥ 15 N/mm²
[b)] For concrete < 28 days old and $f_{ck,cube}$ ≥ 15 N/mm² only hand setting is recommended

Setting details for masonry

Anchor size			6				8	10
Type		**HUS-**	**A**	**I**	**H**	**P**	**H**	**H**
h_{nom}		**[mm]**	**55**				**60**	**70**
Nominal diameter of drill bit diameter for solid clay (Mz) and sand-lime brick (KS)	d_0	[mm]	6				8	10
Nominal diameter of drill bit Aerated concrete (PPW)	d_0	[mm]	5				6	8
Clearance hole diameter	d_f	[mm]	9				12	14
Depth of drill hole	h_1 ≥	[mm]	h_{nom}+10 mm					
Thickness of fixture	t_{fix}	[mm]	$l_s - h_{nom}$					
Max. installation torque for hand setting [a)]								
Solid clay brick (MZ)	max. T_{inst}	[Nm]	8				8	8
Solid sand-lime brick (KS)	max. T_{inst}	[Nm]	12				16	16
Aerated concrete (PPW)	max. T_{inst}	[Nm]	5				5	8

a) Only hand setting is recommended

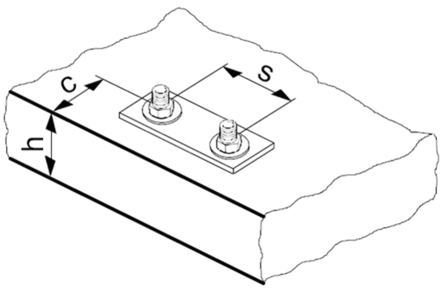
Setting instruction



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

Base material thickness, anchor spacing and edge distance for concrete from C20/25 to C50/60

Anchor size				6	8			10			14		
Type			**HUS-**	**A, I, H, P**	**H**			**H**			**H**		
h_{nom}			**[mm]**	**55**	**50**	**60**	**75**	**60**	**70**	**85**	**70**	**90**	**110**
Minimum base material thickness		h_{min}	[mm]	100	100	110	120	110	130	130	130	170	210
non-cracked concrete	Minimum spacing	s_{min}	[mm]	35	55			65			80		
	Minimum edge distance	c_{min}	[mm]	35	55			65			60		
cracked concrete	Minimum spacing	s_{min}	[mm]	35	55	40	40	65	50	50	-	80	-
	Minimum edge distance	c_{min}	[mm]	35	55	50	50	65	50	50	-	60	-
Effective anchorage depth		h_{ef}	[mm]	42	36	47	60	44	54	67	50	69	90
Critical spacing for concrete cone failure		$s_{cr,N}$	[mm]	3 h_{ef}									
Critical spacing for splitting failure		$s_{cr,sp}$	[mm]										
Critical edge distance for concrete cone failure		$c_{cr,N}$	[mm]	1,5 h_{ef}									
Critical edge distance for splitting failure		$c_{cr,sp}$	[mm]										



For spacing and/ or edge distance smaller than critical spacing and/ or critical edge distance the design loads have to be reduced.

Critical spacing and critical edge distance for splitting failure apply only for non-cracked concrete. For cracked concrete only the critical spacing and critical edge distance for concrete cone failure are decisive.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according data given in ETA-08/0307 issue 2014-04-29.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing

- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

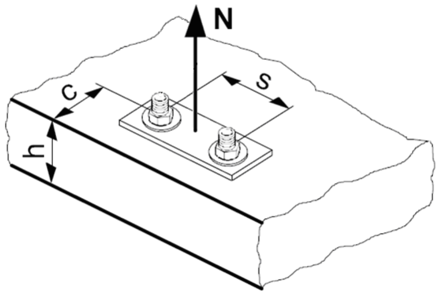
Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):

For HUS-A, H, I, P $N_{Rd,sp} = N^0_{Rd,p} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

For all the other HUS $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

		ETA-08/0307			Hilti
Anchor size		**HUS-A, H, I, P**	**HUS-H 8**	**HUS-H 10**	**HUS-H 14**
$N_{Rd,s}$	[kN]	16,7	26,5	39,6	67,5

ETA: Data according ETA-08/0307 issue 2014-04-29 Hilti: Additional Hilti technical data

Design pull-out resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$

		ETA-08/0307						Hilti				
Anchor size		**6**		**8**		**10**		**8**	**10**	**14**		
Type	**HUS-**	**A, H, I**	**P**	**H**		**H**		**H**		**H**		
h_{nom}		**55**	**55**	**60**	**75**	**70**	**85**	**50**	**60**	**70**	**90**	**110**
Non-cracked concrete												
Tensile $N^0_{Rd,p}$	[kN]	5	4,2	6,7	8,9	6,7	9,5	4,7	6,7	14,7	22,7	28,0
Cracked concrete												
Tensile $N^0_{Rd,p}$	[kN]	3,3	3,3	3,3	5,0	4,2	7,6	2,2	3,6	-	9,5	-

ETA: Data according ETA-08/0307 issue 2014-04-29 Hilti: Additional Hilti technical data

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$
b) $N_{Rd,sp} = N^0_{Rd,p} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

		ETA-08/0307					Hilti				
Anchor size		**6**	**8**	**8**	**10**	**10**	**8**	**10**	**14**	**14**	**14**
h_{nom}		**55**	**60**	**75**	**70**	**85**	**50**	**60**	**70**	**90**	**110**
Non-cracked concrete											
Tensile $N^0_{Rd,c}$	[kN]	7,6	9,0	13,0	11,1	13,2	6,0	8,2	11,9	18,4	28,7
Cracked concrete											
Tensile $N^0_{Rd,c}$	[kN]	5,4	6,4	9,3	7,9	9,4	4,3	5,8	-	13,2	-

a) Splitting resistance must only be considered for non-cracked concrete
b) Equation valid for HUS-A, H, I, P 6

ETA: Data according ETA-08/0307 issue 2014-04-29 Hilti: Additional Hilti technical data

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	HUS	h_{nom}	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	6	55	1	1,10	1,22	1,34	1,41	1,48	1,55
	8	50...75							
	10	85							
	14	70...110							
$f_B = (f_{ck,cube}/25N/mm^2)^{0,4}$ a)	10	60...70	1	1,08	1,17	1,27	1,32	1,37	1,42

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \le 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \le 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \le 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \le 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \le 1$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \le 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of base material thickness

h/h_{ef}	2,0	2,2	2,4	2,6	2,8	3,0	3,2	3,4	3,6	≥ 3,68
$f_{h,sp} = [h/(2 \cdot h_{ef})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

Influence of reinforcement

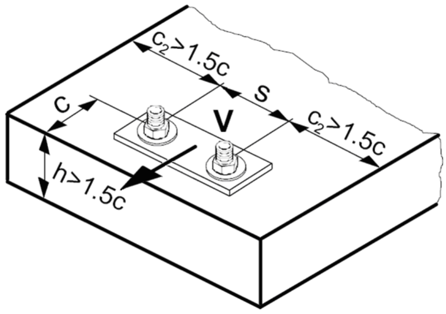
Anchor size	6	8			10			14		
Type HUS-	A, H, I, P	H			H			H		
h_{nom} [mm]	55	50	60	75	60	70	85	70	90	110
h_{ef} [mm]	42	36	46,9	59,6	44	52,7	66,8	50	67	90
$f_{re,N}$ a) $= 0,5 + h_{ef}/200mm \le 1$	0,71	0,68	0,73	0,8	0,72	0,76	0,83	0,7	0,84	0,95

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

		ETA-08/0307			Hilti
Anchor size		**HUS-A, H, I, P 6**	**HUS-H 8**	**HUS-H 10**	**HUS-H 14**
$V_{Rd,s}$	[kN]	8,3	10,6	15,9	34,1

Design concrete pryout resistance $V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$

		ETA-08/0307					Hilti				
Anchor size		**6**	**8**	**8**	**10**	**10**	**8**	**10**	**14**	**14**	**14**
h_{nom}		**55**	**60**	**75**	**70**	**85**	**50**	**60**	**70**	**90**	**110**
Non-cracked concrete											
$V^0_{Rd,cp}$	[kN]	13,7	21,7	31,2	26,7	36,9	14,5	19,6	23,8	36,9	57,4
Cracked concrete											
$V^0_{Rd,cp}$	[kN]	9,8	15,5	22,3	19,0	26,3	10,4	14,0	-	26,3	-

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_4$

		ETA-08/0307					Hilti				
Anchor size		**6**	**8**	**8**	**10**	**10**	**8**	**10**	**14**	**14**	**14**
h_{nom}		**55**	**60**	**75**	**70**	**85**	**50**	**60**	**70**	**90**	**110**
Non-cracked concrete											
$V^0_{Rd,c}$	[kN]	2,1	2,7	4,1	3,7	5,3	1,7	2,6	3,6	5,9	9,7
Cracked concrete											
$V^0_{Rd,c}$	[kN]	1,5	1,9	3,0	2,6	3,8	1,2	1,9	-	4,2	-

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	HUS	h_{nom}	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	6	55	1	1,10	1,22	1,34	1,41	1,48	1,55
	8	50...75							
	10	85							
	14	70...110							
$f_B = (f_{ck,cube}/25N/mm^2)^{0,4}$ a)	10	60...70	1	1,08	1,17	1,27	1,32	1,37	1,42

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

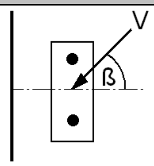
a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influence factor must be considered for every anchor spacing.

Influence of reinforcement

Anchor size		6	8			10			14		
Type	HUS-	A, H, I, P	H			H			H		
h_{nom}	[mm]	55	50	60	75	60	70	85	70	90	110
h_{ef}	[mm]	42	36	46,9	59,6	44	52,7	66,8	50	67	90
$f_{re,N}$ a) $= 0,5 + h_{ef}/200mm \leq 1$		0,71	0,68	0,73	0,8	0,72	0,76	0,83	0,7	0,84	0,95

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N} = 1$ may be applied.

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0° - 55°	60°	65°	70°	75°	80°	85°	90° - 180°
$f_ß$ 	1,00	1,07	1,14	1,23	1,35	1,50	1,71	2,00

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{2/3} \leq 1$	0,22	0,34	0,45	0,54	0,63	0,71	0,79	0,86	0,93	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4
$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

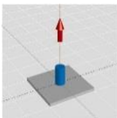
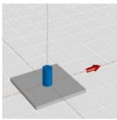
Precalculated values

Design resistance calculated according ETAG 001, Annex C and data given in ETA-08/0307 issue 2014-04-29.
All data applies to concrete C 20/25 – $f_{ck,cube}$ =25 N/mm².

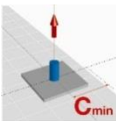
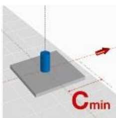
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Design resistance

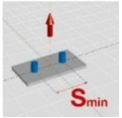
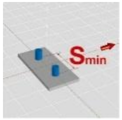
Single anchor, no edge effects

	ETA-08/0307					Hilti				
Anchor size	**6**	**8**	**8**	**10**	**10**	**8**	**10**	**14**	**14**	**14**
h_{nom} [mm]	**55**	**60**	**75**	**70**	**85**	**50**	**60**	**70**	**90**	**110**
Base material thickness h_{min}= [mm]	100	110	120	130	130	100	110	130	170	210
 **Tensile N_{Rd} [kN]**										
Non cracked concrete										
HUS-H [kN]	4,2	6,7	8,9	6,7	9,5	4,7	6,7	9,9	15,4	24,0
Cracked concrete										
HUS-H [kN]	3,3	3,3	5,0	4,2	7,6	2,2	3,6	-	9,5	-
 **Shear V_{Rd}, without lever arm [kN]**										
Non cracked concrete										
HUS-H [kN]	8,3	10,6	10,6	15,9	15,9	10,6	15,9	23,8	34,1	34,1
Cracked concrete										
HUS-H [kN]	8,3	10,6	10,6	15,9	15,9	10,6	15,9	-	26,3	-

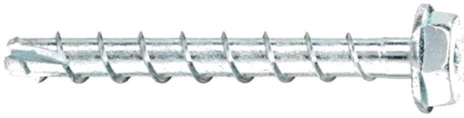
Single anchor, min. edge distance ($c = c_{min}$)

	ETA-08/0307					Hilti				
Anchor size	**6**	**8**	**8**	**10**	**10**	**8**	**10**	**14**	**14**	**14**
h_{nom} [mm]	**55**	**60**	**75**	**70**	**85**	**50**	**60**	**70**	**90**	**110**
Base material thickness h_{min}= [mm]	100	110	120	130	130	100	110	130	170	210
 **Tensile N_{Rd} [kN]**										
Non cracked concrete										
Edge distance c_{min} [mm]	35	55	55	65	65	55	65	60	60	60
HUS-H [kN]	5,1	7,5	9,3	9,4	9,7	6,1	8,1	8,4	10,8	14,4
Cracked concrete										
Edge distance c_{min} [mm]	35	50	50	50	50	55	65	-	60	-
HUS-H [kN]	3,7	5,0	6,3	5,7	6,0	4,3	5,8	-	7,7	-
 **Shear V_{Rd}, without lever arm [kN]**										
Non cracked concrete										
Edge distance c_{min} [mm]	35	55	55	65	65	55	65	60	60	60
HUS-H [kN]	2,6	5,1	5,4	6,8	7,1	4,9	6,6	6,3	6,7	7,2
Cracked concrete										
Edge distance c_{min} [mm]	35	50	50	50	50	55	65	-	60	-
HUS-H [kN]	1,9	3,2	3,3	3,4	3,5	3,5	4,7	-	4,8	-

Double anchor, no edge effects, min. spacing ($s = s_{min}$), (load values are valid for one anchor)

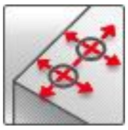
		ETA-08/0307					Hilti				
Anchor size		**6**	**8**	**8**	**10**	**10**	**8**	**10**	**14**	**14**	**14**
h_{nom}	**[mm]**	**55**	**60**	**75**	**70**	**85**	**50**	**60**	**70**	**90**	**110**
Base material thickness h_{min}=	[mm]	100	110	120	130	130	100	110	130	170	210
	Tensile N_{Rd} [kN]										
	Non cracked concrete										
	Spacing s_{min} [mm]	35	55	55	65	65	55	65	80	80	80
	HUS-H [kN]	4,9	6,3	8,5	7,8	8,7	4,6	6,1	7,6	10,8	15,5
	Cracked concrete										
	Spacing s_{min} [mm]	35	40	40	50	50	55	65	-	80	-
	HUS-H [kN]	3,5	4,1	5,7	5,2	5,9	3,3	4,4	-	7,7	-
	Shear V_{Rd}, without lever arm [kN]										
	Non cracked concrete										
	Spacing s_{min} [mm]	35	55	55	65	65	55	65	80	80	80
	HUS-H [kN]	8,3	10,6	10,6	15,9	15,9	10,6	14,7	18,3	25,8	34,1
	Cracked concrete										
	Spacing s_{min} [mm]	35	40	40	50	50	55	65	-	80	-
	HUS-H [kN]	6,3	9,9	10,6	12,5	15,9	7,8	10,5	-	18,4	-

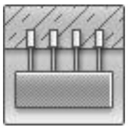
HUS 6 Screw anchor, Redundant fastening

	Anchor version	Benefits
	HUS-A 6 Carbon steel Concrete Screw with hex head	- Quick and easy setting - Low expansion forces in base materials - Through fastening - Removable - Forged-on washer and hexagon head with no protruding thread
	HUS-H 6 Carbon steel Concrete Screw with hex head	
	HUS-I 6 Carbon steel Concrete Screw with hex head	
	HUS-P 6 Carbon steel Concrete Screw with pan head	
	HUS-HR 6 Stainless steel Concrete Screw	


Concrete


Tensile zone


Small edge distance and spacing


Redundant fastening


Fire resistance

Corrosion Resistance


European Technical Approval

CE conformity

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-10/0005 / 2013-06-26
Fire test report	DIBt, Berlin	ETA-10/0005 / 2013-06-26

a) Data for HUS-HR 6 with nominal embedment depth = 30 mm for multiple use for non-structural applications (= redundant fastening) are not part of ETA-10/0005 issue 2013-06-26

Basic loading data

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

The following technical data are based on:
ETA: Data according ETA-05/0005 issue 2013-06-26 **Hilti:** Additional Hilti technical data

Characteristic resistance

				Hilti tech. data	Data according ETA-10/0005, issue 2013-06-26	
Anchor version				**HUS-HR 6**		**HUS-A, -H, -I, -P 6**
Nominal embedment depth		h_{nom}	[mm]	30	35	35
All load directions	35 ≤ c < 80 mm	F^0_{Rk}	[kN]	2,0	3,0	2,0
	c ≥ 80 mm	F^0_{Rk}	[kN]		5,0	3,0

Design resistance

				Hilti tech. data	Data according ETA-10/0005, issue 2013-06-26	
Anchor version				**HUS-HR 6**		**HUS-A, -H, -I, -P 6**
Nominal embedment depth		h_{nom}	[mm]	30	35	35
All load directions	35 ≤ c < 80 mm	F^0_{Rd}	[kN]	1,0	1,4	1,3
	c ≥ 80 mm	F^0_{Rd}	[kN]		2,4	2,0

Recommended loads

				Hilti tech. data	Data according ETA-10/0005, issue 2013-06-26	
Anchor version				**HUS-HR 6**		**HUS-A, -H, -I, -P 6**
Nominal embedment depth		h_{nom}	[mm]	30	35	35
All load directions [a)]	35 ≤ c < 80 mm	F^0_{Rec}	[kN]	0,7	1,0	0,9
	c ≥ 80 mm	F^0_{Rec}	[kN]		1,7	1,4

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Requirements for redundant fastening

The definition of redundant fastening according to Member States is given in the ETAG 001 Part six, Annex 1. In Absence of a definition by a Member State the following default values may be taken

Minimum number of fixing points	Minimum number of anchors per fixing point	Maximum design load of action N_{Sd} per fixing point [a)]
3	1	2 kN
4	1	3 kN

b) The value for maximum design load of actions per fastening point N_{Sd} is valid in general that means all fastening points are considered in the design of the redundant structural system. The value N_{Sd} may be increased if the failure of one (= most unfavourable) fixing point is taken into account in the design (serviceability and ultimate limit state) of the structural system e.g. suspended ceiling.

Materials

Mechanical properties

Anchor version			HUS-HR 6	HUS-A, -H, -I, -P 6
Nominal tensile strength	f_{uk}	[N/mm²]	1040	930
Stressed cross-section	A_s	[mm²]	23	26,9
Moment of resistance	W	[mm³]	15,5	19,7
Design bending resistance	$M_{Rd,s}$	[Nm]	12,9	14,6

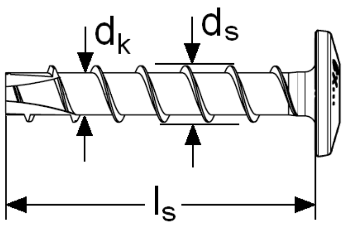
Material quality

Anchor version	HUS-HR 6	HUS-A, -H, -I, -P 6
Material	Stainless steel (grade A4)	Steel, Galvanised ≥ 5 µm

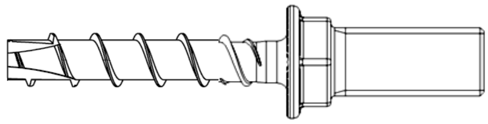
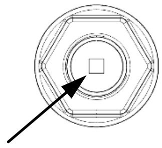
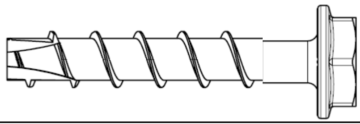
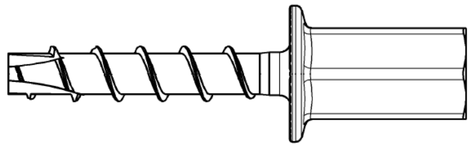
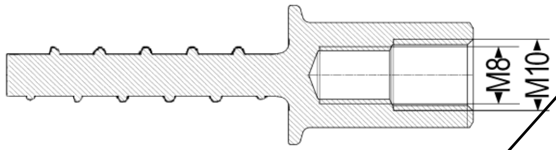
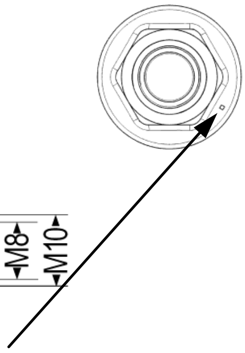
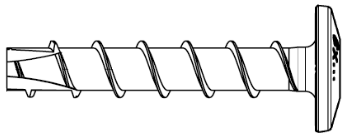
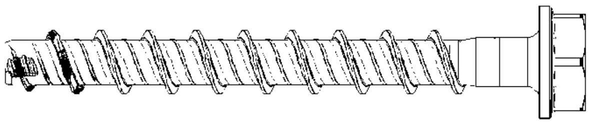
Anchor dimensions

Dimensions

Anchor version			HUS-HR 6	HUS-A 6	HUS-H 6	HUS-I 6	HUS-P 6
Nominal length	l_S	[mm]	35 … 70	35	40..120	35	40..80
Outer diameter of thread	d_S	[mm]	7,6	7,85			
Core diameter	d_k	[mm]	5,4	5,85			



Head configuration

HUS-A 6	External thread M8 or M10		
		Square mark with d = 2 mm edge length for h_{nom} = 35 mm	
HUS-H 6	Hex head and Torx T30		
HUS-I 6	Internal threads M8 and M10	 	
		One circle mark with d = 0.8 mm for h_{nom} = 35 mm	
HUS-P 6	Pan head with		
HUS-HR 6	Hexagon head SW = 13 mm		

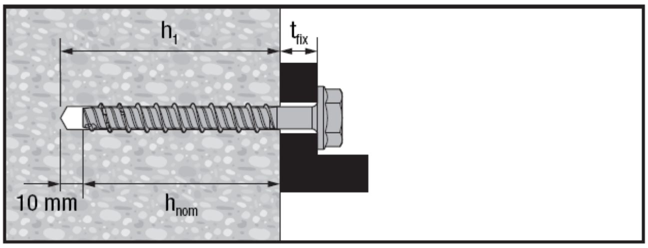
Setting

Recommended installation equipment

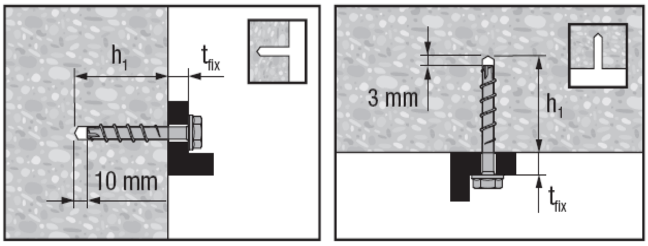
Anchor size	HUS-HR 6	HUS-A 6	HUS-I 6	HUS-H 6	HUS-P 6
Rotary hammer	Hilti TE 6 / TE 7				
drill bit	TE-CX 6				
Socket wrench insert	S-NSD 13 ½ (L)	S-NSD 13 ½ L	S-NSD 13 ½ (L)		-
Torx	-			T30	
Impact screw driver	See setting instruction				

Setting instruction

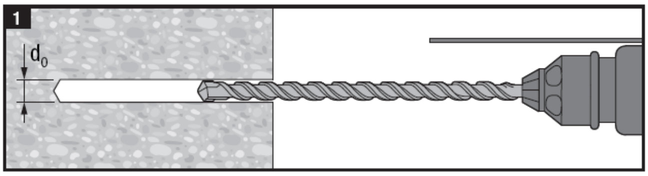
HUS-HR 6

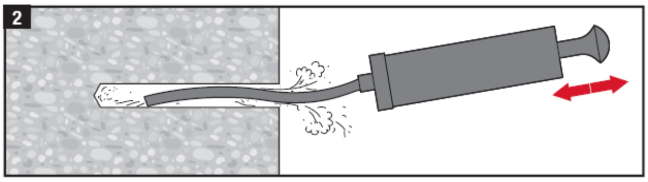


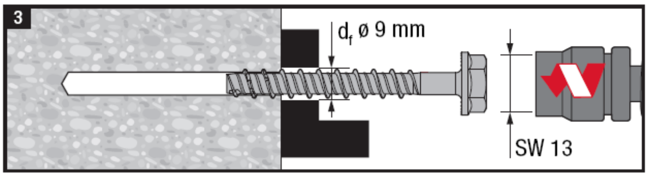
HUS-P 6, HUS-I 6



reduced drilling depth
for overhead installation

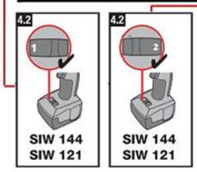


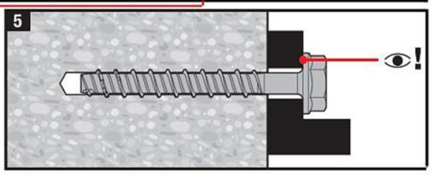


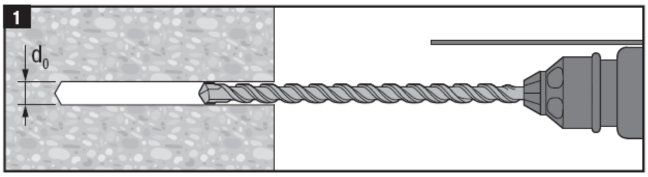


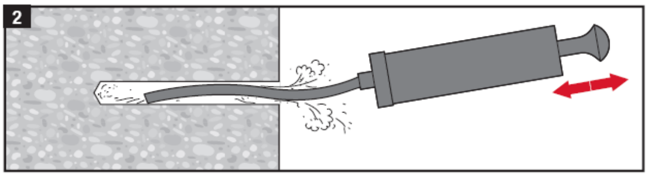
3.1

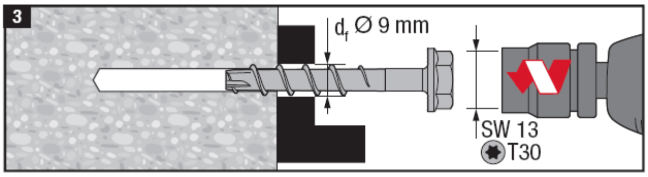
hnom	30 mm	35 mm	55 mm	55 mm	55 mm
SIW/SID 121	✔	✔	✔	⊘	⊘
SIW/SID 144	✔	✔	✔	⊘	⊘
SIW 22T-A	⊘	⊘	⊘	⊘	⊘
SI 100	⊘	⊘	⊘	⊘	⊘
TKI 2500	✔	✔	✔	⊘	⊘
Torque wrench	⊘	⊘	⊘	12 Nm	6 Nm





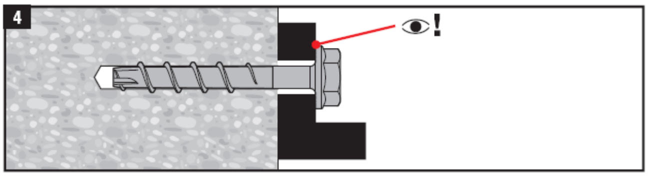






3.1

SIW/SID 121	✔
SIW/SID 144	✔
TKI 2500	✔
Torque wrench	18 Nm

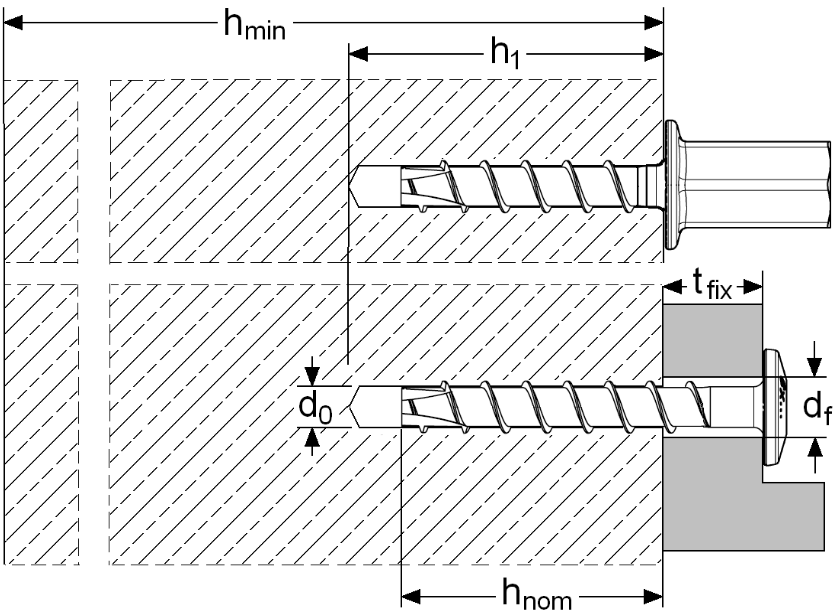


For detailed information on installation see instruction for use given with the package of the product.

Setting details

Anchor version			HUS-HR 6		HUS-A 6	HUS-H 6	HUS-I 6	HUS-P 6
Nominal embedment depth	$h_{nom} \geq$	[mm]	30	35	35			
Nominal diameter of drill bit	d_o	[mm]	6					
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	6,4					
Depth of drill hole	$h_1 \geq$	[mm]	40	45	45			
Depth of drill hole for overhead installation	$h_1 \geq$	[mm]	40	45	38			
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	9		-	9	-	9
Effective anchorage depth	h_{ef}	[mm]	23	27	25			
Nominal length of screw	l_s	[mm]	35 … 70	60 … 70	35	40 … 120	35	40 … 80
Max. fastening thickness	t_{fix}	[mm]	$l_s - h_{nom}$		-	$l_s - h_{nom}$	-	$l_s - h_{nom}$
Max. installation torque	T_{inst}	[Nm]	- a)	- a)	18			

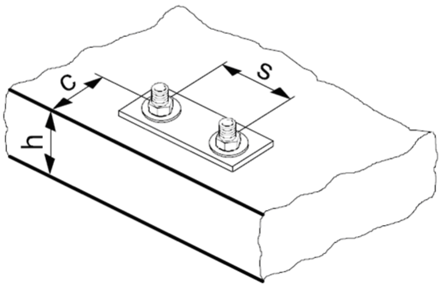
a) Hilti recommends machine setting only



Base material thickness, anchor spacing and edge distance

Anchor version			HUS-HR 6		HUS-A, -H, -I, -P 6
Nominal embedment depth	h_{nom}	[mm]	30	35	35
Effective anchorage depth	h_{ef}	[mm]	23	27	25
Minimum base material thickness	h_{min}	[mm]	80	80	80
Minimum spacing	s_{min}	[mm]	35	35	35
Minimum edge distance	c_{min}	[mm]	35	35 (80)[1)]	35 (80)[1)]
Critical spacing	s_{cr}	[mm]	3 h_{ef}		
Critical edge distance	c_{cr}	[mm]	1,5 h_{ef}		

1) see basic loading data



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced (see system design resistance).

Simplified design method for multiple use for non-structural applications (= redundant fastening)

Simplified version of the design method according ETAG 001, Annex C. Design resistance according data given in ETA-10/0005 issue 2013-06-26.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C.

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

Design load – all load directions

Design resistance $F_{Rd} = F^0_{Rd} \cdot f_B \cdot f_1 \cdot f_2 \cdot f_3 \cdot f_{re}$

Basic design resistance

				Hilti tech. data	Data according ETA-10/0005, issue 2013-06-26	
Anchor version				**HUS-HR 6**		**HUS-A, -H, -I, -P 6**
Nominal embedment depth		h_{nom}	[mm]	30	35	35
Basic design resistance in all load directions	$35 \le c < 80$ mm	F^0_{Rd}	[kN]	1,0	1,4	1,3
	$c \ge 80$ mm	F^0_{Rd}	[kN]		2,4	2,0

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

c/c_{cr},	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_1 = 0,7 + 0,3 \cdot c/c_{cr} \le 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_2 = 0,5 \cdot (1 + c/c_{cr}) \le 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. The influencing factors must be considered for every edge distance.

Influence of anchor spacing a)

s/s_{cr}	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_3 = 0,5 \cdot (1 + s/s_{cr}) \le 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

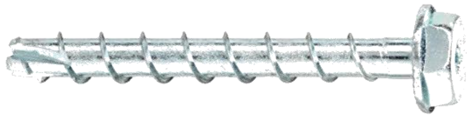
a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of reinforcement

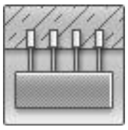
	Dense reinforcement		Standard reinforcement a)	
h_{nom} [mm]	30	35	30	35
$f_{re} = 0,5 + h_{ef}/200mm \le 1$	0,62	0,63	1	

a) If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter
≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N} = 1$ may be applied.

HUS-A 6 / HUS-H 6 / HUS-I 6 / HUS-P 6 Screw anchor in precast prestressed hollow core slabs

	Anchor version	Benefits
	HUS-A 6 Carbon steel Concrete Screw with hex head	- Quick and easy setting - Low expansion forces in base materials - Through fastening - Removable - Forged-on washer and hexagon head with no protruding thread
	HUS-H 6 Carbon steel Concrete Screw with hex head	
	HUS-I 6 Carbon steel Concrete Screw with hex head	
	HUS-P 6 Carbon steel Concrete Screw with pan head	


Prestressed hollow core slabs


Redundant fastening


European Technical Approval


CE conformity

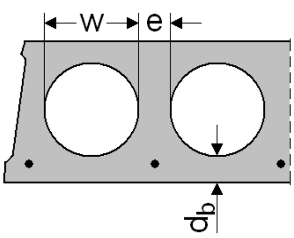
Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-10/0005 / 2013-06-26

a) All data given in this section according ETA-10/0005 issue 2013-06-26.

Basic loading data

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Ratio core width / web thickness w/e ≤ 4,2
- Concrete C 30/37 to C 50/60



Characteristic resistance

Anchor version			HUS-A, -H, -I, -P 6		
Bottom flange thickness	d_b	[mm]	25	30	35
All load directions	F_{Rk}	[kN]	1,0	2,0	3,0

Design resistance

Anchor version			HUS-A, -H, -I, -P 6		
Bottom flange thickness	d_b	[mm]	25	30	35
All load directions	F_{Rd}	[kN]	0,7	1,3	2,0

Recommended loads

Anchor version			HUS-A, -H, -I, -P 6		
Bottom flange thickness	d_b	[mm]	25	30	35
All load directions [a)]	F_{rec}	[kN]	0,5	1,0	1,4

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Requirements for redundant fastening

The definition of redundant fastening according to Member States is given in the ETAG 001 Part six, Annex 1. In Absence of a definition by a Member State the following default values may be taken

Minimum number of fixing points	Minimum number of anchors per fixing point	Maximum design load of action N_{Sd} per fixing point [a)]
3	1	2 kN
4	1	3 kN

c) The value for maximum design load of actions per fastening point N_{Sd} is valid in general that means all fastening points are considered in the design of the redundant structural system. The value N_{Sd} may be increased if the failure of one (= most unfavourable) fixing point is taken into account in the design (serviceability and ultimate limit state) of the structural system e.g. suspended ceiling.

Materials

Mechanical properties

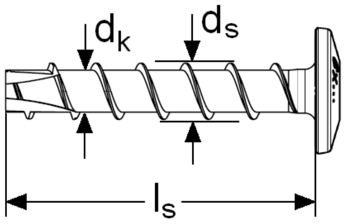
Anchor version		HUS-A, -H, -I, -P 6
Nominal tensile strength f_{uk}	[N/mm²]	930
Stressed cross-section A_s	[mm²]	26,9
Moment of resistance W	[mm³]	19,7
Design bending resistance $M_{Rd,s}$	[Nm]	14,6

Material quality

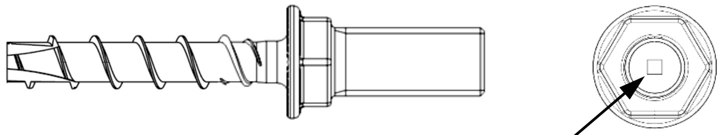
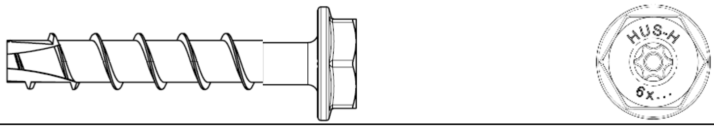
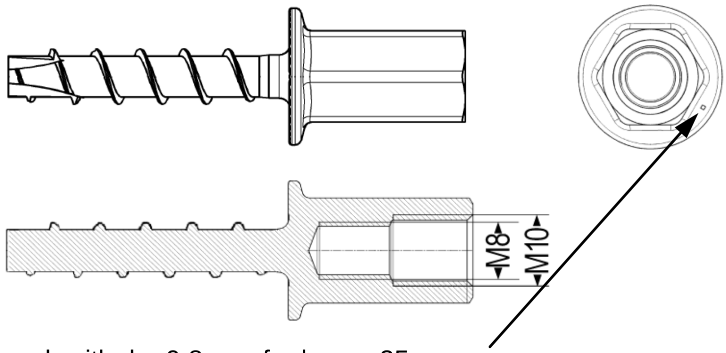
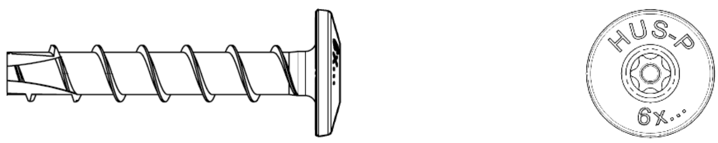
Anchor version	HUS-A, -H, -I, -P 6
Material	Carbon steel, galvanised to min. 5 µm

Anchor dimensions

Anchor version			HUS-A 6	HUS-H 6	HUS-I 6	HUS-P 6
Nominal length	l_S	[mm]	35	40..120	35	60..80
Outer diameter of thread	d_S	[mm]	7,85			
Core diameter	d_k	[mm]	5,85			



Head configuration

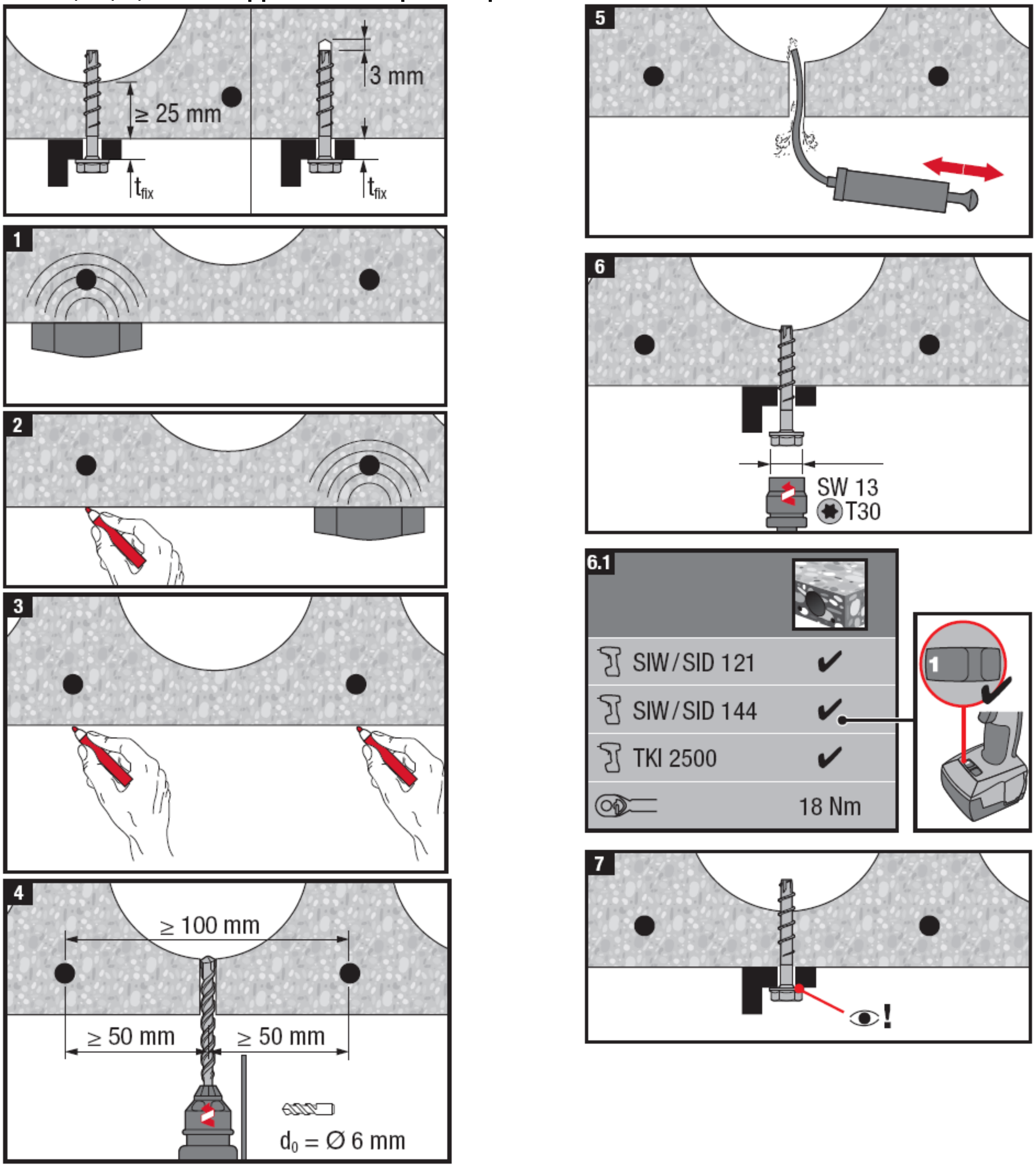
HUS-A 6	External thread M8 or M10	 Square mark with d = 2 mm edge length for h_{nom} = 35 mm	
HUS-H 6	Hex head and Torx T30		
HUS-I 6	Internal threads M8 and M10	 One circle mark with d = 0,8 mm for h_{nom} = 35 mm	
HUS-P 6	Pan head with		

Setting

Anchor size	HUS-A 6	HUS-I 6	HUS-H 6	HUS-P 6
Rotary hammer	Hilti TE 6 / TE 7			
drill bit	TE-CX 6			
Socket wrench insert	S-NSD 13 ½ L	S-NSD 13 ½ (L)		-
Torx	-		T30	
Impact screw driver	See setting instruction			

Setting instruction

HUS-A, -H, -I, -P 6 for applications in precast prestressed hollow core slabs

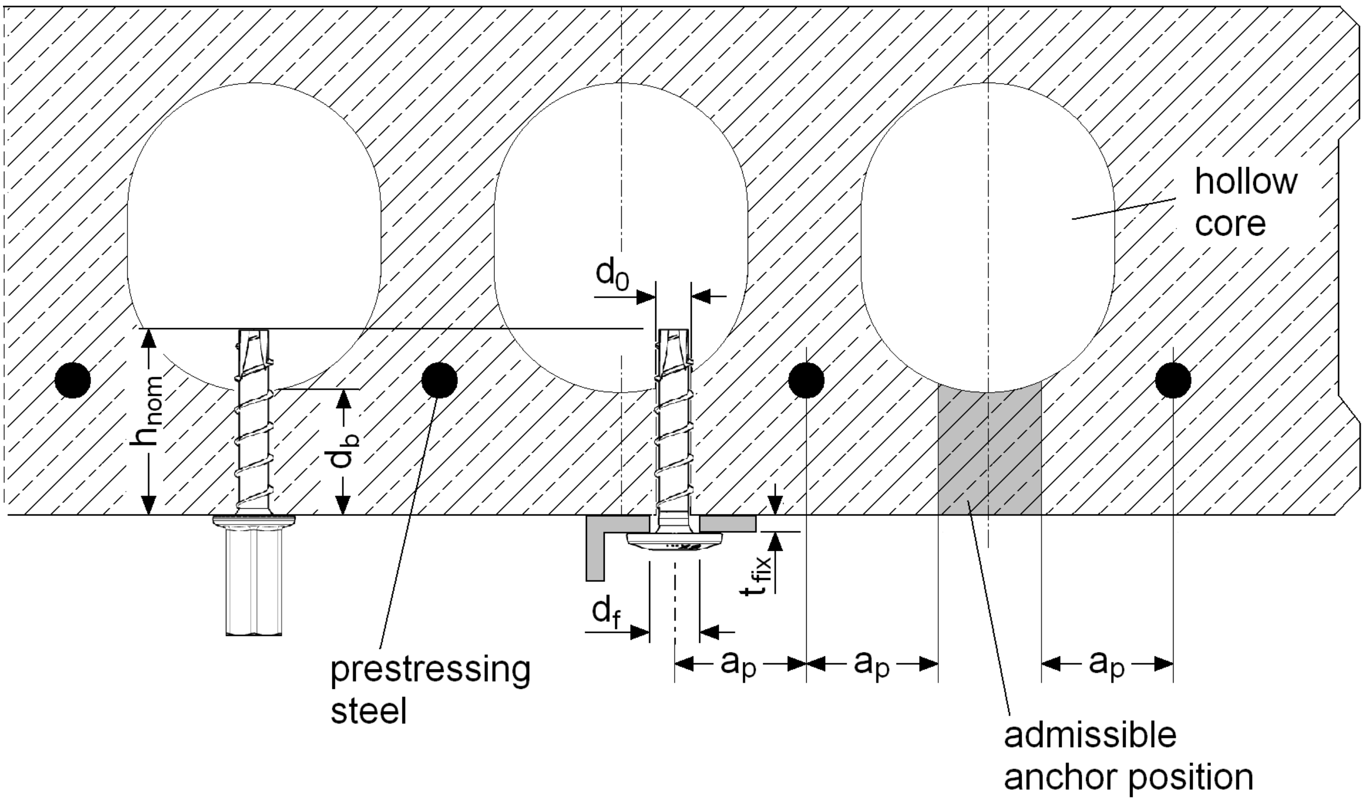


For detailed information on installation see instruction for use given with the package of the product.

Setting details

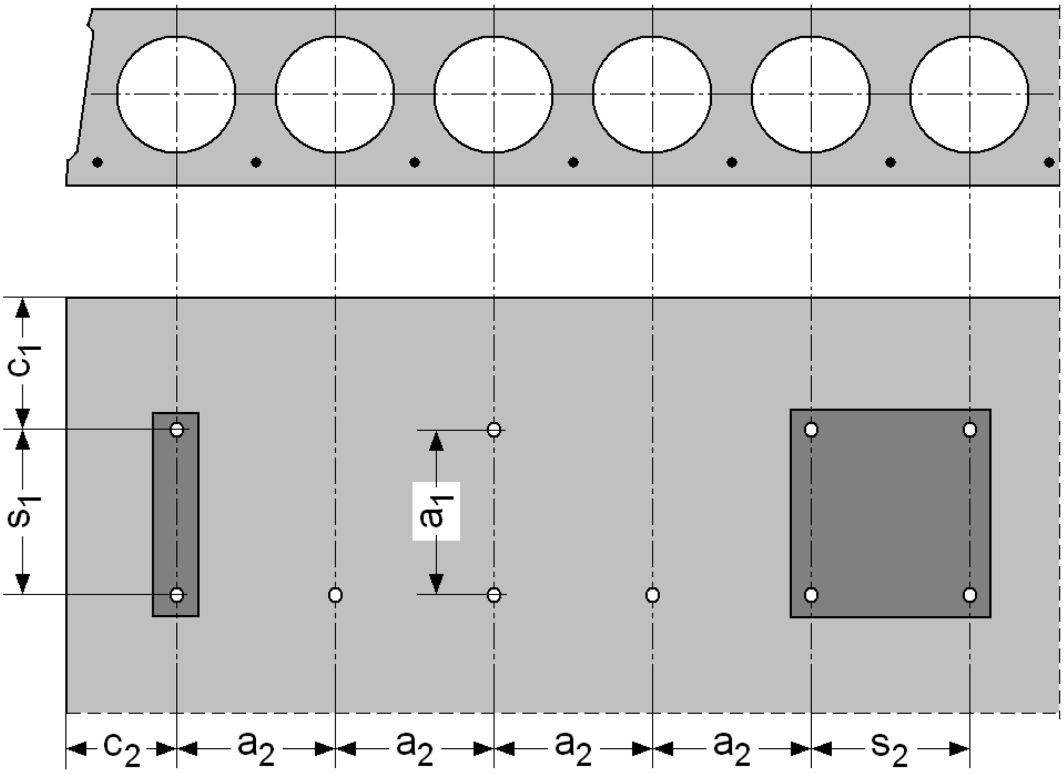
Anchor version			HUS-A, -H, -P 6					HUS-A, -I 6
Nominal embedment depth	h_{nom}	[mm]	35					
Bottom flange thickness	$d_b \geq$	[mm9	25					
Nominal diameter of drill bit	d_o	[mm]	6					
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	6,4					
Nominal depth of drill hole [a)]	$h_1 \geq$	[mm]	38					
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	9					-
Nominal effective anchorage depth	h_{ef}	[mm]	25					
Distance between anchor position and prestressing steel	$a_p \geq$	[mm]	50					
Nominal length of screw	l_s	[mm]	40	60	80	100	120	35
Thickness of fixture	$t_{fix} \geq$	[mm]	0	2	5	25	45	-
	$t_{fix} \leq$	[mm]	5	25	45	65	85	-
Max. installation torque	T_{inst}	[Nm]	18					

a) Nominal depth of drill hole may be deeper than bottom flange thickness

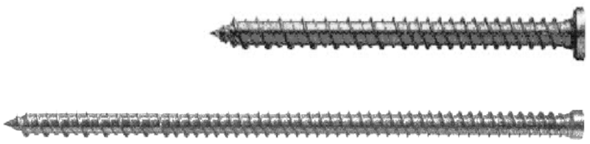


Anchor spacing and edge distance

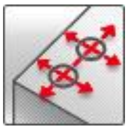
Anchor version			HUS-A, -H, -I, -P 6
Minimum edge distance	$c_{min} \geq$	[mm]	100
Minimum anchor spacing	$s_{min} \geq$	[mm]	100
Minimum distance between anchor groups	$a_{min} \geq$	[mm]	100

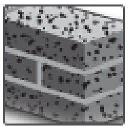


HUS 6 / HUS-S 6 Screw anchor

Anchor version			Benefits
	HUS 6 HUS-S 6	Carbon steel Concrete Screw	- Quick and easy setting - Low expansion forces in base materials - Through fastening - Removable

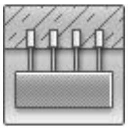

Concrete


Small edge distance and spacing


Solid brick


Hollow brick


Autoclaved aerated concrete


Redundant fastening


Fire resistance

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Fire test report	IBMB, Braunschweig DIBt, Berlin	UB 3574/5146 / 2006-05-20
Assessment report (fire)	warringtonfire	WF 327804/A / 2013-07-10

Basic loading data

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete as specified in the table
- *Steel* failure
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

Note:
When tightening the screw anchor in soft base materials and in hollow brick, care must be taken not to apply too much torque. If the screw anchor is over-tightened the fastening point is unusable for the HUS 6.

- Solid masonry units:
    - Mz 12 ➔ solid brick, compressive strength $12N/mm^2$, bulk density $1,8N/mm^2$, format ≥ 240/175/113 mm (length/width/height)
    - KS 12 ➔ solid lime block, compressive strength $12N/mm^2$, bulk density $2,0N/mm^2$, format ≥ 240/175/113 mm (length/width/height)
      The core/material ratio in bricks and solid sand lime blocks may not exceed 15% of a bed joint area.
- Autoclaved aerated concrete:
    - PB6 ➔ block, compressive strength 6 N/mm2, bulk density 0,6 N/mm2
    - PB2 ➔ block, compressive strength 2 N/mm2, bulk density 0,2 N/mm2

- Other Limits:
  - Applied loads to individual bricks/blocks without compression may not exceed 1,0 kN
  - Applied loads to individual bricks/blocks with compression may not exceed 1,4 kN
  - Data applies only to bricks/blocks, there is no test data available for loads in mortar joints. Hilti recommends at least a 50% load reduction or on site testing, if the location of the anchor in relation to the joint (see drawing) can not be specified because of wall plaster or insulation.
  - Plaster, gravelling, lining or levelling courses are regarded as non-bearing and may not be taken into account for calculation of embedment depth.
  - All data is for redundant fastening for non structural applications.

Recommended loads

		concrete C20/25			MZ 20 solid brick [b]		KS sand Lime Block [b]		Hlz 0.8/12 Hollow Brick [b]		Aerated concrete			
		Non-cracked		Cracked [a]							PB2 / PB4 [c]		PB6	
Anchor size		HUS 6		HUS 6	HUS 6		HUS 6		HUS 6		HUS 6		HUS 6	
h_{nom}	[mm]	34		44	44		44		64		64		64	
Edge distance c ≥	[mm]	60	30	100	60	30	60	30	60	30	60	30	60	30
Tensile N_{rec} [d]	[kN]	1,0	1,0	0,5	0,2	0,2	1,0	1,0	0,1	0,1	0,2	0,2	0,2	0,2
Shear V_{rec} [d]	[kN]	1,6	0,5	0,5	0,4	0,3	1,1	0,4	0,4	0,2	0,3	0,1	0,6	0,2

a) Redundant fastening
b) Holes must be drilled using rotary action only (no hammering action)
c) No anchor hole drilling required in PB2/PB4 gas aerated concrete
d) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

Mechanical properties

Anchor size		**HUS 6 / HUS-S 6**
Nominal tensile strength f_{uk}	[N/mm²]	1000
Yield strength f_{yk}	[N/mm²]	900
Stressed cross-section A_s	[mm²]	5,2
Moment of resistance W	[mm³]	13,8
Design bending resistance $M_{Rd,s}$	[Nm]	11

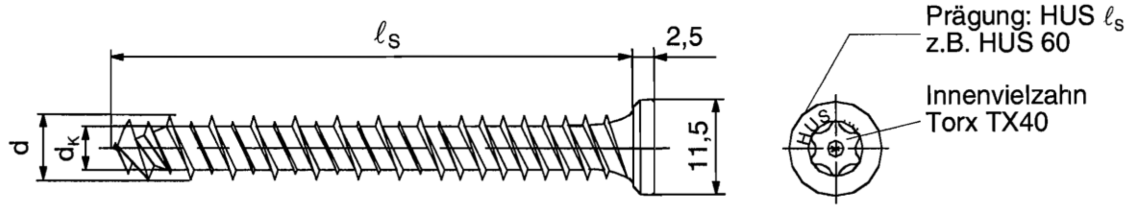
Material quality

Part	**Material**
Screw anchor	Carbon Steel, galvanised to min. 5 µm

Anchor dimensions

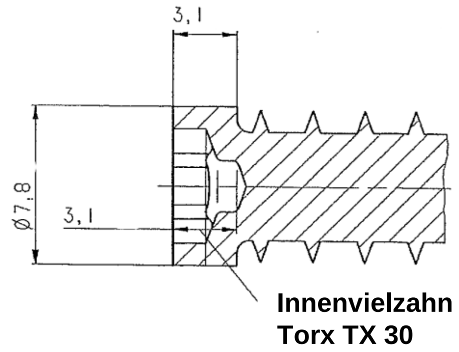
Dimensions

Anchor version	l_s [mm]	d_k [mm]	d [mm]
HUS 6	35..220	5,3	7,5
HUS-S 6	100..220		7,5



HUS 6

Head configuration HUS-S



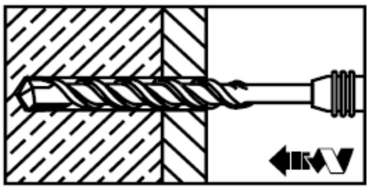
Setting

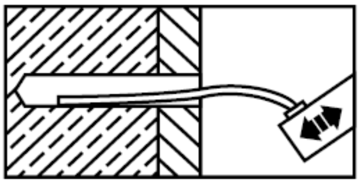
Recommended installation equipment

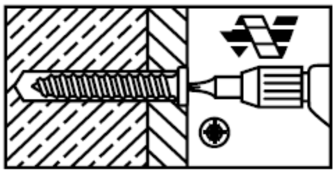
Anchor size	HUS 6			HUS-S 6
Rotary hammer	TE 6 / TE 7			
Drill bit	TE-C3X 6/17			
Recommended Setting Tool	SID/SIW 121, SID/SIW 144, TKI 2500			
Accessories	S-B TXI 40 bit			S-B TXI 30 bit

Setting instruction

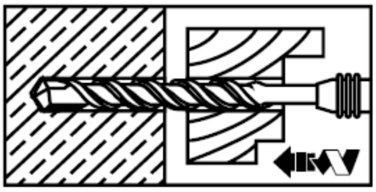
HUS:

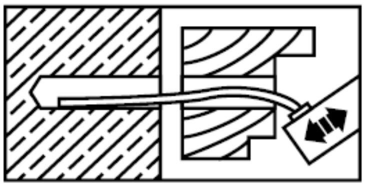

Drill hole with drill bit.

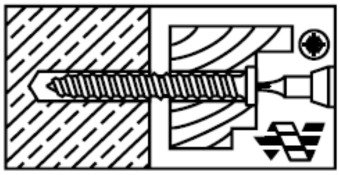

Blow out dust and fragments.


Install anchor with an electric screwdriver.

HUS-S:

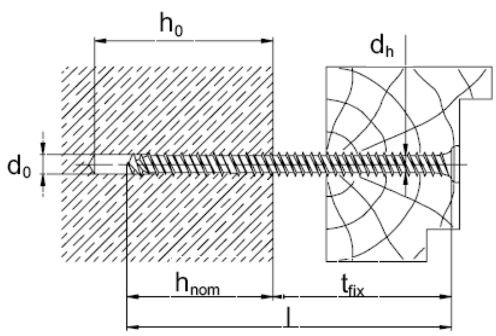

Drill hole with drill bit.


Blow out dust and fragments.

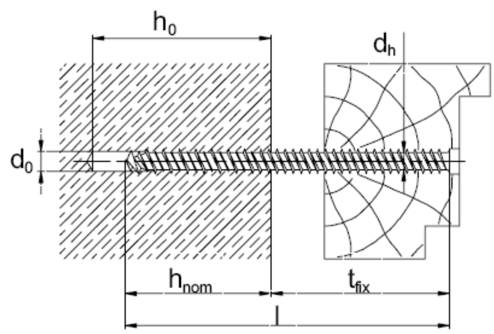

Install anchor with an electric screwdriver.

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

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}



HUS



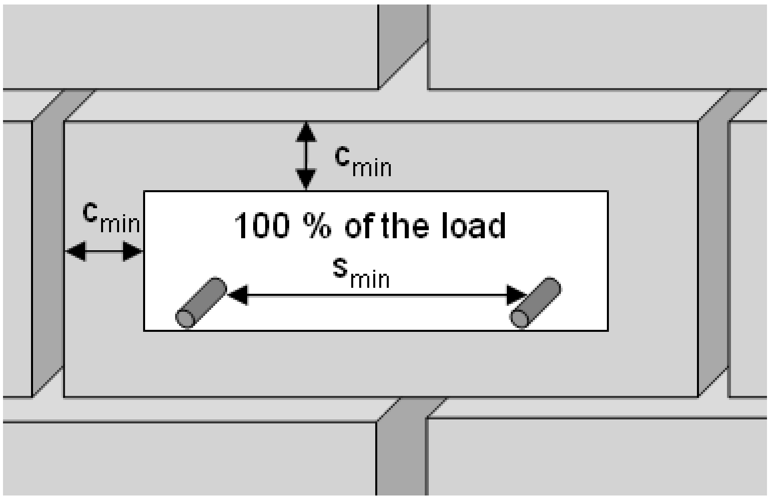
HUS-S

Setting details

			C20/25 Concrete	MZ 20 Brick/ KS 12 Block	Hollow Brick	Aerated Concrete	
						PB2/PB4	PB6
Nominal embedment depth	h_{nom}	[mm]	34	44	64	64	64
Nominal diameter of drill bit	d_o	[mm]	6	6	6	-	6
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	6,4	6,4	6,4	-	6,4
Minimum depth of drill hole	$h_1 \geq$	[mm]	50	54 [b)]	64 [a)]	- [b)]	70
Diameter of clearance hole in the fixture to clamp a fixture	$d_f \leq$	[mm]	8,5				
Diameter of clearance hole in the fixture for stand-off applications	$d_f \leq$	[mm]	6,2				
Max. fastening thickness	t_{fix}	[mm]	l_s - h_{nom}				
Max. installation torque	T_{inst}	[Nm]	10	4	2	2	2

a) Holes must be drilled using rotary action only (no hammering action)
b) No anchor hole drilling required in PB2/PB4 gas aerated concrete

Permissible anchor location in brick and block walls



- Distance to free edge free edge to solid masonry (Mz and KS) units ≥ 200 mm
- Distance to free edge free edge to solid masonry (HLz and autoclaved aerated gas concrete) units ≥ 170 mm
- The minimum distance to horizontal and vertical mortar joint (c_{min}) is stated in the recommended load table.
- Data applies only to bricks/blocks, there is no test data available for loads in mortar joints. Hilti recommends at least a 50% load reduction or on site testing, if the location of the anchor in relation to the joint (see drawing) can not be specified because of wall plaster or insulation.
- Minimum anchor spacing (s_{min}) in one brick/block is ≥ 2*c_{min}

HKD Push-in anchor, Single anchor application

	Anchor version	Benefits
	HKD Carbon steel with lip	- simple and well proven - approved, tested and confirmed by everyday jobsite experience - reliable setting thanks to simple visual check - versatile - for medium-duty fastening with bolts or threaded rods - available in various materials and sizes for maximized coverage of possible applications
	HKD-S(R) Carbon steel, stainless steel with lip	
	HKD-E(R) Carbon steel, stainless steel without lip	

				
Concrete	Corrosion resistance	European Technical Approval	CE conformity	PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-02/0032 / 2012-10-18

a) Anchors with anchorage depth h_{ef} = 25mm are not coverd by ETA

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete as specified in the table
- *Steel* failure
- Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- screw or rod with steel strength 5.8 (carbon steel) and/or A4-70 (stainless steel)

Mean Ultimate Resistance

		Hilti technical data											
Anchor size		**M6x25**	**M8x25**	**M10x25**	**M12x25**	**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M16x65**	**M20x80**
Tensile $N_{Ru,m}$													
HKD	[kN]	8,4	8,4	8,4	8,4	-	11,0	13,1	11,0	17,0	23,8	32,9	48,1
HKD-S, HKD-E	[kN]	8,2	-	-	-	10,6	10,8	16,6	10,8	16,6	23,3	34,5	47,1
HKD-SR, HKD-ER	[kN]	8,2	-	-	-	10,6	10,8	-	-	16,6	23,3	34,5	47,1
Shear $V_{Ru,m}$													
HKD	[kN]	*5,5*	6,9	6,9	6,9	-	*9,4*	*10,1*	*11,0*	*12,2*	*20,1*	*37,1*	*53,9*
HKD-S, HKD-E	[kN]	*6,5*	-	-	-	*6,5*	*9,1*	*9,1*	*9,6*	*10,4*	*18,3*	*28,5*	*45,1*
HKD-SR, HKD-ER	[kN]	*8,3*	-	-	-	*7,0*	*10,9*	-	-	*13,7*	*24,3*	*41,7*	*66,3*

Characteristic Resistance

		Hilti technical data				according ETA-02/0032, issue 2012-10-18							
Anchor size		**M6x25**	**M8x25**	**M10x25**	**M12x25**	**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M16x65**	**M20x80**
Tensile N_{Rk}													
HKD	[kN]	6,3	6,3	6,3	6,3	-	8,3	9,0	8,3	12,8	17,8	26,4	36,1
HKD-S, HKD-E	[kN]	6,3	-	-	-	8,3	8,3	9,0	8,3	12,8	17,8	26,4	36,1
HKD-SR, HKD-ER	[kN]	6,3	-	-	-	8,3	8,3	-	-	12,8	17,8	26,4	36,1
Shear V_{Rk}													
HKD	[kN]	*5,0*	6,3	6,3	6,3	-	*8,6*	*9,2*	*10,0*	*11,0*	*18,3*	*33,8*	*49,0*
HKD-S, HKD-E	[kN]	*5,0*	-	-	-	*5,0*	*7,0*	*7,0*	*7,4*	*8,0*	*14,1*	*21,9*	*34,7*
HKD-SR, HKD-ER	[kN]	*6,2*	-	-	-	*6,4*	*8,4*	-	-	*10,5*	*18,7*	*32,1*	*51,0*

Design Resistance

		Hilti technical data				according ETA-02/0032, issue 2012-10-18							
Anchor size		**M6x25**	**M8x25**	**M10x25**	**M12x25**	**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M16x65**	**M20x80**
Tensile N_{Rd}													
HKD	[kN]	4,2	4,2	4,2	4,2	-	5,5	6,0	5,5	8,5	11,9	17,6	24,0
HKD-S, HKD-E	[kN]	3,0	-	-	-	4,6	4,6	5,0	4,6	7,1	9,9	17,6	24,0
HKD-SR, HKD-ER	[kN]	3,0	-	-	-	4,6	4,6	-	-	7,1	9,9	17,6	24,0
Shear V_{Rd}													
HKD	[kN]	*4,0*	4,2	4,2	4,2	-	*6,9*	*7,3*	*8,0*	*8,8*	*14,6*	*27,0*	*39,4*
HKD-S, HKD-E	[kN]	*3,9*	-	-	-	*3,9*	*5,5*	*5,5*	*5,9*	*6,4*	*11,3*	*17,5*	*27,8*
HKD-SR, HKD-ER	[kN]	*4,1*	-	-	-	*4,2*	*5,5*	-	-	*6,9*	*12,3*	*21,1*	*33,6*

Recommended load

		Hilti technical data				according ETA-02/0032, issue 2012-10-18							
Anchor size		**M6x25**	**M8x25**	**M10x25**	**M12x25**	**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M16x65**	**M20x80**
Tensile N_{rec} a)													
HKD	[kN]	3,0	3,0	3,0	3,0	-	3,9	4,3	3,9	6,1	8,5	12,6	17,2
HKD-S, HKD-E	[kN]	2,1	-	-	-	3,3	3,3	3,6	3,3	5,1	7,1	12,6	17,2
HKD-SR, HKD-ER	[kN]	2,1	-	-	-	3,3	3,3	-	-	5,1	7,1	12,6	17,2
Shear V_{rec} a)													
HKD	[kN]	2,9	3,0	3,0	3,0	-	4,9	5,2	5,7	6,3	10,5	19,3	28,3
HKD-S, HKD-E	[kN]	2,8	-	-	-	2,8	3,9	4,2	3,9	4,6	8,1	12,5	19,8
HKD-SR, HKD-ER	[kN]	2,9	-	-	-	3,0	3,9	-	-	4,9	8,8	15,1	24,0

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

Mechanical properties of HKD, HKD-S, HKS-E, HKD-SR and HKD-ER

Anchor size			**M6**	**M8**	**M10**	**M12**	**M16**	**M20**
Nominal tensile strength f_{uk}	HKD	[N/mm²]	570	570	570	570	640	590
	HKD-S HKD-E	[N/mm²]	560	560	510	510	-	460
	HKD-SR HKD-ER	[N/mm²]	540	540	540	540	-	540
Yield strength f_{yk}	HKD	[N/mm²]	460	460	460	480	510	470
	HKD-S HKD-E	[N/mm²]	440	440	410	410	-	375
	HKD-SR HKD-ER	[N/mm²]	355	355	355	355	-	355
Stressed cross-section A_s	HKD	[mm²]	20,7	26,7	32,7	60,1	105	167
	HKD-S (R) HKD-E (R)	[mm²]	20,9	26,1	28,8	58,7	-	163
Moment of resistance W	HKD	[mm³]	32,3	54,6	82,9	184	431	850
	HKD-S (R) HKD-E (R)	[mm³]	50	79	110	264	602	1191
Char. bending resistance for rod or bolt $M^0_{Rk,s}$	With 5.8 Gr. Steel	[Nm]	7,6	18,7	37,4	65,5	167	325
	HKD-SR HKD-ER with A4-70	[Nm]	11	26	52	92	187	454

Material quality

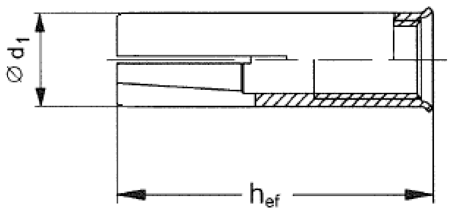
Part		Material
Anchor Body	HKD	Steel Fe/Zn5 galvanised to min. 5 µm
	HKD-S HKD-E	Steel Fe/Zn5 galvanised to min. 5 µm
	HKD-SR HKD-ER	Stainless steel, 1.4401, 1.4404, 1.4571
Tapered expansion plug	HKD	Steel material
	HKD-S HKD-E	Steel material
	HKD-SR HKD-ER	Stainless steel, 1.4401, 1.4404, 1.4571

Anchor dimensions

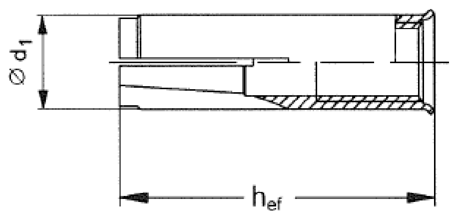
Anchor size **Anchor version** HKD HKD-S (R) HKD-E (R)			**M6x25**	**M8x25**	**M10x25**	**M12x25**	**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M16x65**	**M20x80**
Effective anchorage depth	h_{ef}	[mm]	25	25	25	25	30	30	40	30	40	50	60	80
Anchor diameter	d_1	[mm]	7,9	9,95	11,9	14,9	8	9,95	9,95	11,8	11,95	14,9	19,75	24,75
Plug diameter	d_2	[mm]	5,1	6,35	8,1	9,7	5	6,5	6,35	8,2	8,2	10,3	13,8	16,4
Plug length	l_1	[mm]	10	7	7	7,2	15	12	16	12	16	20	29	30

Anchor body

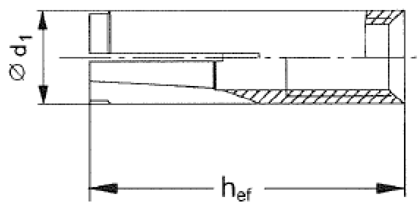
HKD



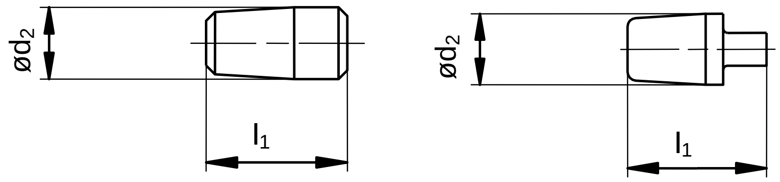
HKD-S and HKD-SR



HKD-E and HKD ER



Expansions plugs

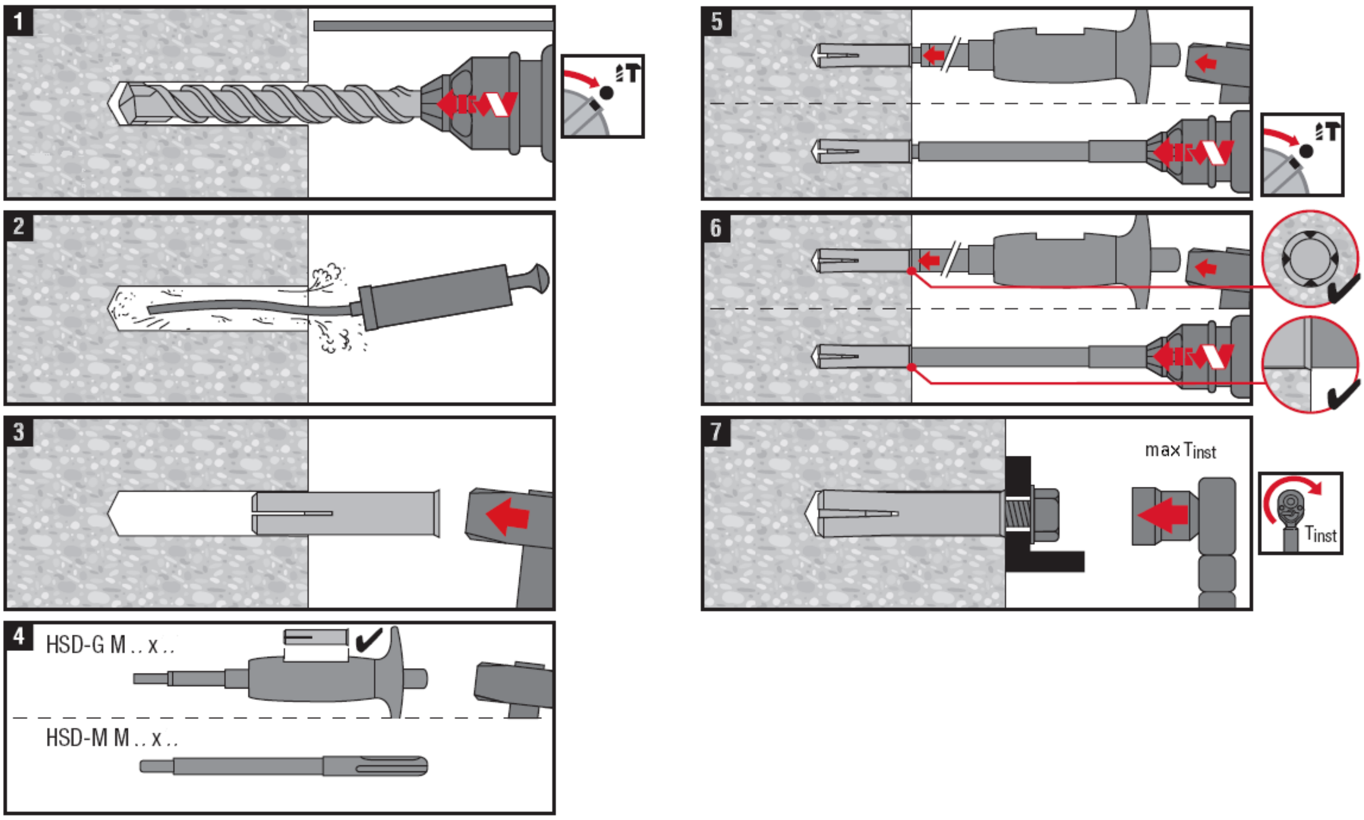


Setting

Installation equipment

Anchor size		M6x25	M6x30	M8x25	M8x30	M8x40	M10x25	M10x30	M10x40	M12x25	M12x50	M16x65	M20x80
Rotary hammer		TE 2 – TE 16										TE 40 – 80	
Machine setting tool	HSD-M	6x25/30		8x25/30		8x40	10x25/30		10x40	12x25	12x50	16x65	20x80
Hand Setting tool	HSD-G	6x25/30		8x25/30		8x40	10x25/30		10x40	12x25	12x50	16x65	20x80
Other tools		hammer, torque wrench, blow out pump											

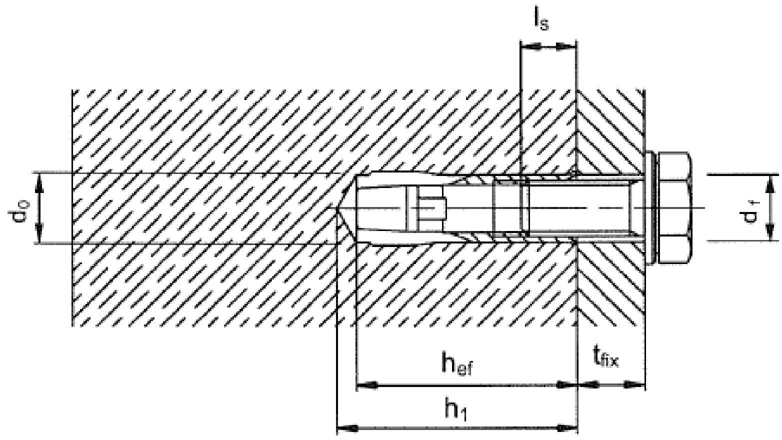
Setting instruction



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

For technical data for anchors in diamond drilled holes please contact the Hilti Technical advisory service.

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}

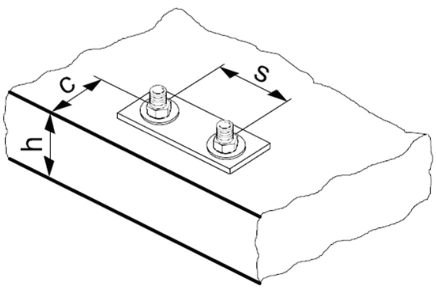


Setting details

Anchor size			M6x25	M8x25	M10x25	M12x25	M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M16x65	M20x80
Nominal diameter of drill bit	d_o	[mm]	8	10	12	15	8	10	10	12	12	15	20	25
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45	10,5	12,5	15,5	8,45	10,5	10,5	12,5	12,5	15,5	20,5	25,5
Depth of drill hole	$h_1 \geq$	[mm]	27	27	27	27	32	33	43	33	43	54	70	85
Screwing depth	$l_{s,min}$	[mm]	6	8	10	12	6	8	8	10	10	12	16	20
	$l_{s,max}$	[mm]	12	11,5	12	12	12,5	14,5	17,5	13	18	22	30,5	42
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	7	9	12	14	7	9	9	12	12	14	18	22
Effective anchorage depth	h_{ef}	[mm]	25	25	25	25	30	30	40	30	40	50	65	80
Max. torque moment	T_{inst}	[Nm]	4	8	15	35	4	8	8	15	15	35	60	120

Base material thickness, anchor spacing and edge distances

Anchor size			M6x25 M8x25 M10x25 M12x25	M6x30 M8x30 M10x30	M8x40 M10x40	M12x50	M16x65	M20x80
Minimum base material thickness	h_{min}	[mm]	100	100	100	100	130	160
Minimum spacing and minimum edge distance HKD-S (R) HKD-E (R)	s_{min}	[mm]	60	60	80	125	130	160
	c_{min}	[mm]	88	105	140	175	230	280
Minimum spacing HKD	s_{min}	[mm]	80	60	80	125	130	160
	for c≥	[mm]	140	105	140	175	230	280
Minimum edge distance HKD	c_{min}	[mm]	100	80	140	175	230	280
	for s≥	[mm]	150	120	80	125	130	160
Critical spacing and edge distance for concrete cone failure HKD HKD-S (R) HKD-E (R)	$s_{cr,N}$	[mm]	80	90	120	150	200	240
	$c_{cr,N}$	[mm]	40	45	60	75	100	120
Critical spacing and edge distance for splitting failure – HKD	$s_{cr,sp}$	[mm]	200	210	280	350	455	560
	$c_{cr,sp}$	[mm]	100	105	140	175	227	280
Critical spacing and edge distance for splitting failure – HKD-S (R) HKD-E (R)	$s_{cr,sp}$	[mm]	176	210	280	350	455	560
	$c_{cr,sp}$	[mm]	88	105	140	175	227	280



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according data given in ETA-02/0032, issue 2012-10-18.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

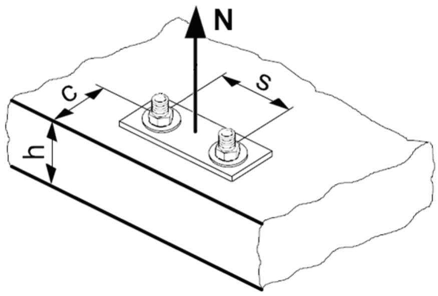
For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):

$$N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$ for HKD / HKD-E/S Steel Strength 5.8 and for HKD-ER/SR A4-70

			Hilti technical data				according ETA-02/0032, issue 2012-10-18							
Anchor size			M6x25	M8x25	M10x25	M12x25	M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M16x65	M20x80
$N_{Rd,s}$	HKD	[kN]	6,7	10,3	12,6	23,6	-	11,4	12,2	13,3	14,7	24,4	45,0	65,3
	HKD-S, HKD-E	[kN]	6,7	-	-	-	6,7	11,4	11,4	12,4	13,4	23,7	37,2	59,1
	HKD-SR, HKD-ER	[kN]	6,9	-	-	-	7,0	9,2	-	-	11,5	20,4	35,1	55,7

Design pull-out resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$

			Non-cracked concrete											
			Hilti technical data				according ETA-02/0032, issue 2012-10-18							
Anchor size			**M6x25**	**M8x25**	**M10x25**	**M12x25**	**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M16x65**	**M20x80**
$N^0_{Rd,p}$	HKD	[kN]	-	-	-	-	-	-	6,0	-	-	-	-	-
	HKD-S, HKD-E	[kN]	-	-	-	-	-	-	5,0	-	-	-	-	-
	HKD-SR, HKD-ER	[kN]	-	-	-	-	-	-	-	-	-	-	-	-

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
Design splitting resistance[a)] $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,}$

			Non-cracked concrete											
			Hilti technical data				according ETA-02/0032, issue 2012-10-18							
Anchor size			**M6x25**	**M8x25**	**M10x25**	**M12x25**	**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M16x65**	**M20x80**
$N^0_{Rd,c}$	HKD	[kN]	4,2	4,2	4,2	4,2	-	5,5	8,5	5,5	8,5	11,9	17,6	24,0
	HKD-S, HKD-E	[kN]	3,0	-	-	-	4,6	4,6	7,1	4,6	7,1	9,9	17,6	24,0
	HKD-SR, HKD-ER	[kN]	3,0	-	-	-	4,6	4,6	-	-	7,1	9,9	17,6	24,0

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0{,}7 + 0{,}3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0{,}7 + 0{,}3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0{,}5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0{,}5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing [a)]

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0{,}5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0{,}5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of base material thickness

h/h_{ef}	2,0	2,2	2,4	2,6	2,8	3,0	3,2	3,4	3,6	≥ 3,68
$f_{h,sp} = [h/(2 \cdot h_{ef})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

Influence of reinforcement

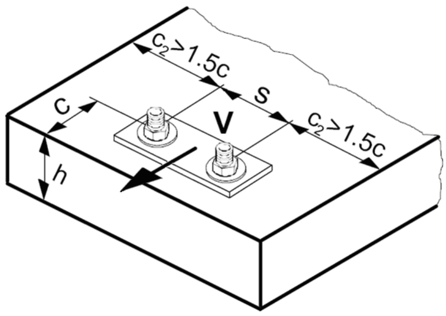
Anchor size	M6x25	M8x25	M10x25	M12x25	M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M16x65	M20x80
$f_{re,N} = 0{,}5 + h_{ef}/200mm \leq 1$	0,63[a)]	0,63[a)]	0,63[a)]	0,63[a)]	0,65[a)]	0,65[a)]	0,7[a)]	0,65[a)]	0,7[a)]	0,75[a)]	0,83[a)]	0,9[a)]

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$ for HKD / HKD-E/S Steel Strength 5.8 and for HKD-ER/SR A4-70

			Hilti technical data				according ETA-02/0032, issue 2012-10-18							
Anchor size			M6x25	M8x25	M10x25	M12x25	M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M16x65	M20x80
$V_{Rd,s}$	HKD	[kN]	4,0	6,2	7,5	14,1	-	6,9	7,3	8,0	8,8	14,6	27,0	39,6
	HKD-S, HKD-E	[kN]	3,9	-	-	-	3,9	5,5	5,5	5,9	6,4	11,3	17,5	27,8
	HKD-SR, HKD-ER	[kN]	4,1	-	-	-	4,2	5,5	-	-	6,9	12,3	21,1	33,6

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$ [a)]

	Hilti technical data				according ETA-02/0032, issue 2012-10-18							
Anchor size	**M6x25**	**M8x25**	**M10x25**	**M12x25**	**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M16x65**	**M20x80**
k	1				2							

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance[a)] $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		**M6x25**	**M8x25**	**M10x25**	**M12x25**	**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M16x65**	**M20x80**
$V^0_{Rd,c}$	[kN]	5,8	8,4	11,3	16,4	5,9	8,5	8,5	11,4	11,5	16,8	27,1	39,2

a) For anchor groups only the anchors close to the edge must be considered

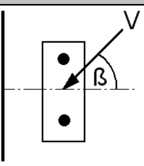
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	**0°**	**10°**	**20°**	**30°**	**40°**	**50°**	**60°**	**70°**	**80°**	**≥ 90°**
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	**0,15**	**0,3**	**0,45**	**0,6**	**0,75**	**0,9**	**1,05**	**1,2**	**1,35**	**≥ 1,5**
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50	8.25	9.00	9.75	10.50	11.25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M6x25	M8x25	M10x25	M12x25	M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M16x65	M20x80
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,34	0,23	0,17	0,12	0,46	0,32	0,51	0,23	0,38	0,38	0,36	0,35

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

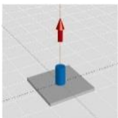
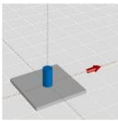
Precalculated values

Design resistance calculated according ETAG 001, Annex C and data given in ETA-02/0032, issue 2012-10-18.
All data applies to concrete C 20/25 – $f_{ck,cube}$ =25 N/mm² and steel strength 5.8 and/or A4-70.

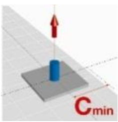
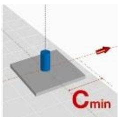
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Design resistance

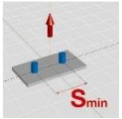
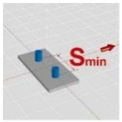
Single anchor, no edge effects

			Non-cracked concrete											
			Hilti technical data				according ETA-02/0032, issue 2012-10-18							
Anchor size			**M6x25**	**M8x25**	**M10x25**	**M12x25**	**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M16x65**	**M20x80**
Min. base material thickness h_{min}		[mm]	100	100	100	100	100	100	100	100	100	100	130	160
	**Tensile N_{Rd}**													
	HKD	[kN]	4,2	4,2	4,2	4,2	-	5,5	8,5	5,5	8,5	11,9	17,6	24,0
	HKD-S HKD-E	[kN]	3,0	-	-	-	4,6	4,6	5,0	4,6	7,1	9,9	17,6	24,0
	HKD-SR HKD-ER	[kN]	3,0	-	-	-	4,6	4,6	-	-	7,1	9,9	17,6	24,0
	**Shear V_{Rd}, without lever arm**													
	HKD	[kN]	4,0	4,2	4,2	4,2	-	6,9	7,4	8,0	8,8	14,6	27,0	39,6
	HKD-S HKD-E	[kN]	3,9	-	-	-	3,9	5,5	5,6	5,8	6,4	11,3	17,5	27,8
	HKD-SR HKD-ER	[kN]	4,1	-	-	-	4,2	5,5	-	-	6,9	12,3	21,1	33,6

Single anchor, min. edge distance ($c = c_{min}$)

			Non-cracked concrete											
			Hilti technical data				according ETA-02/0032, issue 2012-10-18							
Anchor size			**M6x25**	**M8x25**	**M10x25**	**M12x25**	**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M16x65**	**M20x80**
Min. base material thickness h_{min}		[mm]	100	100	100	100	100	100	100	100	100	100	130	160
Min. edge distance c_{min}		[mm]	100	100	100	100	105	105	140	105	140	175	230	280
	**Tensile N_{Rd}**													
	HKD	[kN]	4,2	4,2	4,2	4,2	-	5,5	8,5	5,5	8,5	11,9	17,6	24,0
	HKD-S HKD-E	[kN]	3,0	-	-	-	4,6	4,6	7,1	4,6	7,1	9,9	17,6	24,0
	HKD-SR HKD-ER	[kN]	3,0	-	-	-	4,6	4,6	-	-	7,1	9,9	17,6	24,0
	**Shear V_{Rd}, without lever arm**													
	HKD	[kN]	4,0	4,2	4,2	4,2	-	6,9	7,4	8,0	8,8	14,6	26,0	36,0
	HKD-S HKD-E	[kN]	3,9	-	-	-	4,0	5,5	5,6	5,8	6,4	11,3	17,5	27,8
	HKD-SR HKD-ER	[kN]	4,1	-	-	-	4,2	5,5	-	-	6,9	12,3	21,1	33,6

Double anchor, no edge effects, min. spacing (s = s_{min}), (load values are valid for one anchor)

			Non-cracked concrete											
			Hilti technical data				according ETA-02/0032, issue 2012-10-18							
Anchor size			**M6x25**	**M8x25**	**M10x25**	**M12x25**	**M6x30**	**M8x30**	**M8x40**	**M10x30**	**M10x40**	**M12x50**	**M16x65**	**M20x80**
Min. base material thickness h_{min}		[mm]	100	100	100	100	100	100	100	100	100	100	130	160
Min. spacing s_{min}		[mm]	80	80	80	80	60	60	80	60	80	125	130	160
	**Tensile N_{Rd}**													
	HKD	[kN]	2,9	2,9	2,9	2,9	-	3,5	5,5	3,5	5,5	8,1	11,3	15,5
	HKD-S HKD-E	[kN]	2,0	-	-	-	3,0	3,0	4,6	3,0	4,6	6,7	11,3	15,5
	HKD-SR HKD-ER	[kN]	2,0	-	-	-	3,0	3,0	-	-	4,6	6,7	11,3	15,5
	**Shear V_{Rd}, without lever arm**													
	HKD	[kN]	4,0	4,2	4,2	4,2	-	6,9	7,4	8,0	8,8	14,6	27,0	39,6
	HKD-S HKD-E	[kN]	3,8	-	-	-	3,9	5,5	5,6	5,8	6,4	11,3	17,5	27,8
	HKD-SR HKD-ER	[kN]	3,8	-	-	-	4,2	5,5	-	-	6,9	12,3	21,1	33,6

HKD Push-in anchor, Redundant fastening

Anchor version		Benefits
	HKD Carbon steel with lip HKD-S(R) Carbon steel, stainless steel with lip HKD-E(R) Carbon steel, stainless steel without lip	- simple and well proven - approved, tested and confirmed by everyday jobsite experience - reliable setting thanks to simple visual check - versatile - for medium-duty fastening with bolts or threaded rods - available in various materials and sizes for maximized coverage of possible applications

Concrete | Tensile zone | Sprinkler approved | Redundant fastening | Fire resistance | Corrosion resistance | European Technical Approval | CE conformity

a) Redundant fastening only

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-06/0047 / 2012-23-28
Fire test report	DIBt, Berlin	ETA-06/0047 / 2012-23-28
Assessment report (fire)	warringtonfire	WF 327804/A / 2013-07-10

a) All data given in this section for HKD-S(R) and HKD-E(R), according ETA-06/0047, issue 2012-09-28 . The anchor is to be used only for redundant fastening for non-structural applications.

Basic loading data for all load directions according design method B of ETAG 001

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete C 20/25 $f_{ck,cube}$ = 25 N/mm² to C50/60, $f_{ck,cube}$ = 60 N/mm²
- Minimum base material thickness
- Anchors in redundant fastening

Characteristic Resistance, all load directions

Anchor size		M6x25	M6x30	M8x25	M8x30	M8x40	M10x25	M10x30	M10x40	M12x25	M12x50	M16x65
Load F_{Rk}												
HKD	kN	2,0	-	3,0	5,0	5,0	4,0	5,0	7,5	4,0	9,0	16,0
HKD-S, HKD-E	kN	-	3,0	-	3,0	5,0	-	4,0	6,0	-	6,0	-
HKD-SR, HKD-ER	kN	-	3,0	-	3,0	-	-	-	6,0	-	6,0	-

Design Resistance, all load directions

Anchor size		M6x25	M6x30	M8x25	M8x30	M8x40	M10x25	M10x30	M10x40	M12x25	M12x50	M16x65
Load F_{Rd}												
HKD	kN	1,3	-	2,0	2,8	3,3	2,2	3,3	5,0	2,7	6,0	10,7
HKD-S, HKD-E	kN	-	2,0	-	2,0	3,3	-	2,7	4,0	-	4,0	-
HKD-SR, HKD-ER	kN	-	2,0	-	2,0	-	-	-	4,0	-	4,0	-

Recommended loads a), all load directions

Anchor size		M6x25	M6x30	M8x25	M8x30	M8x40	M10x25	M10x30	M10x40	M12x25	M12x50	M16x65
Load F_{rec}												
HKD	kN	1,0	-	1,4	2,0	2,4	1,6	2,4	3,6	1,9	4,3	7,6
HKD-S, HKD-E	kN	-	1,4	-	1,4	2,4	-	1,9	2,9	-	2,9	-
HKD-SR, HKD-ER	kN	-	1,4	-	1,4	-	-	-	2,9	-	2,9	-

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Requirements for redundant fastening

The definition of redundant fastening according to Member States is given in the ETAG 001 Part six, Annex 1. In Absence of a definition by a Member State the following default values may be taken

Minimum number of fixing points	Minimum number of anchors per fixing point	Maximum design load of action N_{Sd} per fixing point a)
3	1	2 kN
4	1	3 kN

a) The value for maximum design load of actions per fastening point N_{Sd} is valid in general that means all fastening points are considered in the design of the redundant structural system. The value N_{Sd} may be increased if the failure of one (= most unfavourable) fixing point is taken into account in the design (serviceability and ultimate limit state) of the structural system e.g. suspended ceiling.

Materials

Mechanical properties of HKD, HKD-S, HKS-E, HKD-SR and HKD-ER

Anchor size			**M6**	**M8**	**M10**	**M12**	**M16**
Nominal tensile strength f_{uk}	HKD	[N/mm²]	570	570	570	570	640
	HKD-S HKD-E	[N/mm²]	560	560	510	510	-
	HKD-SR HKD-ER	[N/mm²]	540	540	540	540	-
Yield strength f_{yk}	HKD	[N/mm²]	460	460	460	480	510
	HKD-S HKD-E	[N/mm²]	440	440	410	410	-
	HKD-SR HKD-ER	[N/mm²]	355	355	355	355	-
Stressed cross-section A_s	HKD	[mm²]	20,7	26,7	32,7	60,1	105
	HKD-S (R) HKD-E (R)	[mm²]	20,9	26,1	28,8	58,7	-
Moment of resistance W	HKD	[mm³]	32,3	54,6	82,9	184	431
	HKD-S (R) HKD-E (R)	[mm³]	50	79	110	264	-
Char. bending resistance for rod or bolt $M^0_{Rk,s}$	With 5.8 Gr. Steel	[Nm]	7,6	18,7	37,4	65,5	167
	HKD-SR HKD-ER with A4-70	[Nm]	11	26	52	92	-

Material quality

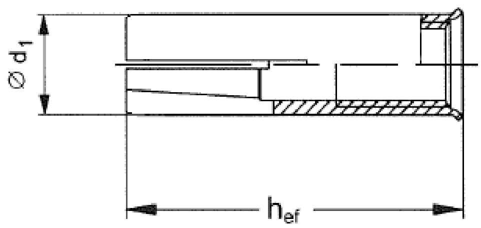
Part		**Material**
Anchor Body	HKD	Steel Fe/Zn5 galvanised to min. 5 µm
	HKD-S HKD-E	Steel Fe/Zn5 galvanised to min. 5 µm
	HKD-SR HKD-ER	Stainless steel, 1.4401, 1.4404, 1.4571
Tapered expansion plug	HKD	Steel material
	HKD-S HKD-E	Steel material
	HKD-SR HKD-ER	Stainless steel, 1.4401, 1.4404, 1.4571

Anchor dimensions

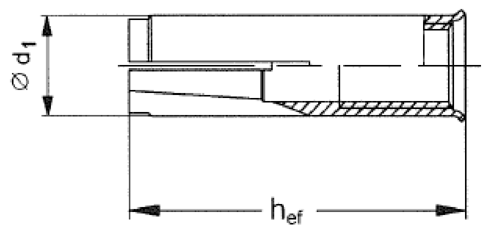
Anchor size Anchor version HKD HKD-S (R) HKD-E (R)			M6x25	M6x30	M8x25	M8x30	M8x40	M10x25	M10x30	M10x40	M12x25	M12x50	M16x65
Effective anchorage depth	h_{ef}	[mm]	25	30	25	30	40	25	30	40	25	50	65
Anchor diameter	d_1	[mm]	7,9	8	9,95	9,95	9,95	11,9	11,8	11,95	14,9	14,9	19,75
Plug diameter	d_2	[mm]	5,1	5	6,35	6,5	6,35	8,1	8,2	8,2	9,7	10,3	13,8
Plug length	l_1	[mm]	10	15	7	12	16	7	12	16	7,2	20	29

Anchor body

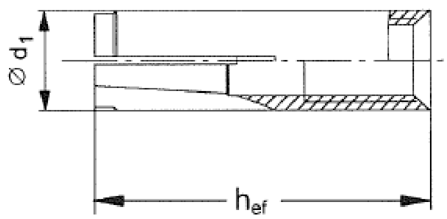
HKD



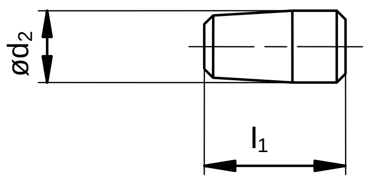
HKD-S and HKD-SR

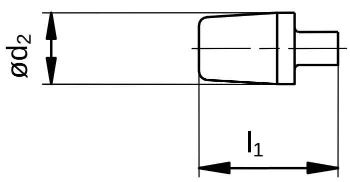


HKD-E and HKD ER



Expansions plugs



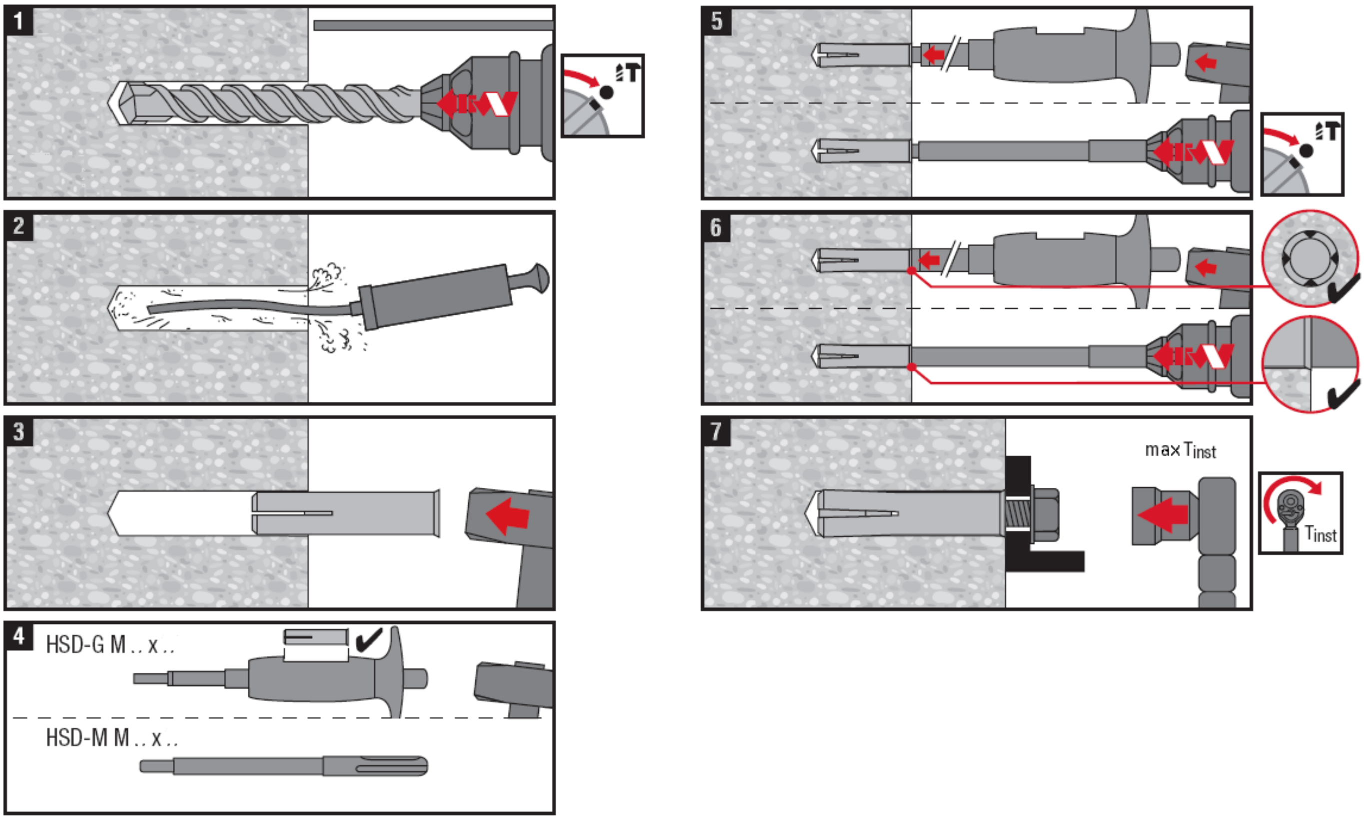


Setting

Installation equipment

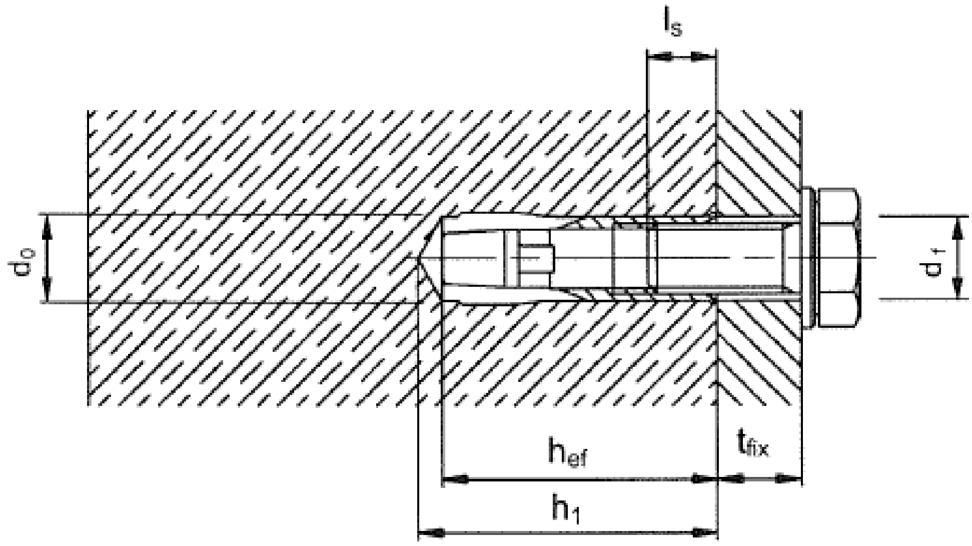
Anchor size		M6x25	M6x30	M8x25	M8x30	M8x40	M10x25	M10x30	M10x40	M12x25	M12x50	M16x65
Rotary hammer		TE 2 – TE 16									TE 16 – 50	
Machine setting tool	HSD-M	6x25/30		8x25/30		8x40	10x25/30		10x40	12x25	12x50	16x65
Hand Setting tool	HSD-G											
Other tools		hammer, torque wrench, blow out pump										

Setting instruction



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

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}

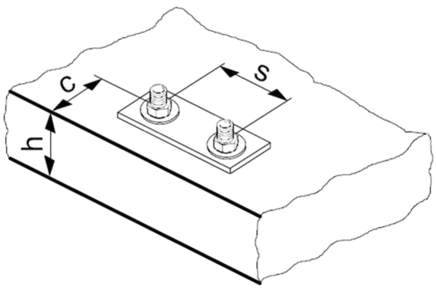


Setting details

Anchor size			M6x25	M6x30	M8x25	M8x30	M8x40	M10x25	M10x30	M10x40	M12x25	M12x50	M16x65
Nominal diameter of drill bit	d_o	[mm]	8	8	10	10	10	12	12	12	15	15	20
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45	8,45	10,5	10,5	10,5	12,5	12,5	12,5	15,5	15,5	20,5
Depth of drill hole	$h_1 \geq$	[mm]	27	32	27	33	43	27	33	43	27	54	70
Screwing depth	$l_{s,min}$	[mm]	6	6	8	8	8	10	10	10	12	12	16
	$l_{s,max}$	[mm]	12	12,5	11,5	14,5	17,5	12	13	18	12	22	30,5
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	7	7	9	9	9	12	12	12	14	14	18
Effective anchorage depth	h_{ef}	[mm]	25	30	25	30	40	25	30	40	25	50	65
Max. torque moment	T_{inst}	[Nm]	4	4	8	8	8	15	15	15	35	35	60

base material thickness, anchor spacing and edge distances

Anchor size			M6x25 M8x25 M10x25 M12x25	M6x30 M8x30 M10x30	M8x40 M10x40	M12x50	M16x65
Minimum base material thickness	h_{min}	[mm]	80	80	80	-	-
Minimum spacing and Minimum edge distance HKD HKD-S (R) HKD-E (R)	s_{min}	[mm]	200	200	200	-	-
	c_{min}	[mm]	150	150	150	-	-
Minimum base material thickness	h_{min}	[mm]	100	100	100	100	130
Minimum spacing and minimum edge distance HKD-S (R) HKD-E (R)	s_{min}	[mm]	80	60	80	125	130
	c_{min}	[mm]	140	105	140	175	230
Minimum spacing HKD	s_{min}	[mm]	80	60	80	125	130
	for c≥	[mm]	140	105	140	175	230
Minimum edge distance HKD	c_{min}	[mm]	100	80	140	175	230
	for s≥	[mm]	150	120	80	125	130



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

HKV Push-in anchor, Single anchor application

Anchor version		Benefits
	HKV Carbon steel without lip	- simple and well proven - approved, tested and confirmed by everyday jobsite experience - reliable setting thanks to simple visual check - versatile - for medium-duty fastening with bolts or threaded rods - available in various materials and sizes for maximized coverage of possible applications


Concrete

Basic loading data (for a single anchor)

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete as specified in the table
- Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- screw or rod with steel strength 5.8 (carbon steel) and/or A4-70 (stainless steel)

Mean Ultimate Resistance

Anchor size		M6x25	M8x30	M10x30	M10x40	M12x50	M16x65
Tensile $N_{Ru,m}$	[kN]	5,6	7,8	7,8	12,1	16,9	35,3
Shear $V_{Ru,m}$	[kN]	5,5	9,4	11,0	12,2	20,1	37,1

Characteristic Resistance

Anchor size		M6x25	M8x30	M10x30	M10x40	M12x50	M16x65
Tensile N_{Rk}	[kN]	4,2	5,9	5,9	9,1	12,7	26,5
Shear V_{Rk}	[kN]	5,0	8,6	10,0	11,0	18,3	33,8

Design Resistance

Anchor size		M6x25	M8x30	M10x30	M10x40	M12x50	M16x65
Tensile N_{Rd}	[kN]	2,8	3,9	3,9	6,1	8,5	17,6
Shear V_{Rd}	[kN]	4,0	6,9	8,0	8,8	14,6	27,0

Recommended loads a)

Anchor size		M6x25	M8x30	M10x30	M10x40	M12x50	M16x65
Tensile N_{rec}	[kN]	2,0	2,8	2,8	4,3	6,0	12,6
Shear V_{rec}	[kN]	2,9	4,9	5,7	6,3	10,5	19,3

b) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

Mechanical properties of HKV

Anchor size		M6x25	M8x30	M10x30	M10x40	M12x50	M16x65
Nominal tensile strength f_{uk}	[N/mm²]	570	570	570	570	570	640
Yield strength f_{yk}	[N/mm²]	460	460	460	460	460	510
Stressed cross-section A_s	[mm²]	20,7	26,7	32,7	32,7	60,1	105
Moment of resistance W	[mm³]	32,3	54,6	82,9	82,9	184	431
Char. bending resistance for rod or bolt $M^0_{Rk,s}$ with 5.8 Steel Strength	[Nm]	7,6	18,7	37,4	37,4	65,5	167

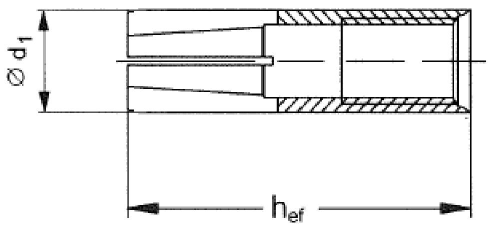
Material quality

Part	Material
Anchor Body	Steel Fe/Zn5 galvanised to min. 5 µm
expansion plug	Steel material

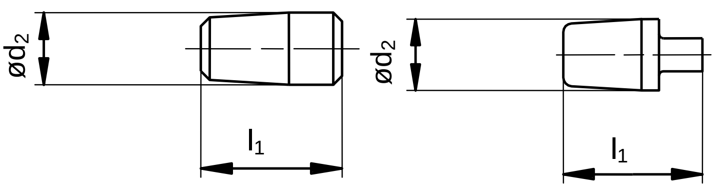
Anchor dimensions

Anchor size			M6x25	M8x30	M10x30	M10x40	M12x50	M16x65
Effective anchorage depth	h_{ef}	[mm]	25	30	30	40	50	65
Anchor diameter	d_1	[mm]	7,9	9,95	11,8	11,95	14,9	19,75
Plug diameter	d_2	[mm]	5,1	6,5	8,2	8,2	10,3	13,8
Plug length	l_1	[mm]	10	12	12	16	20	29

Anchor body



Expansions plugs

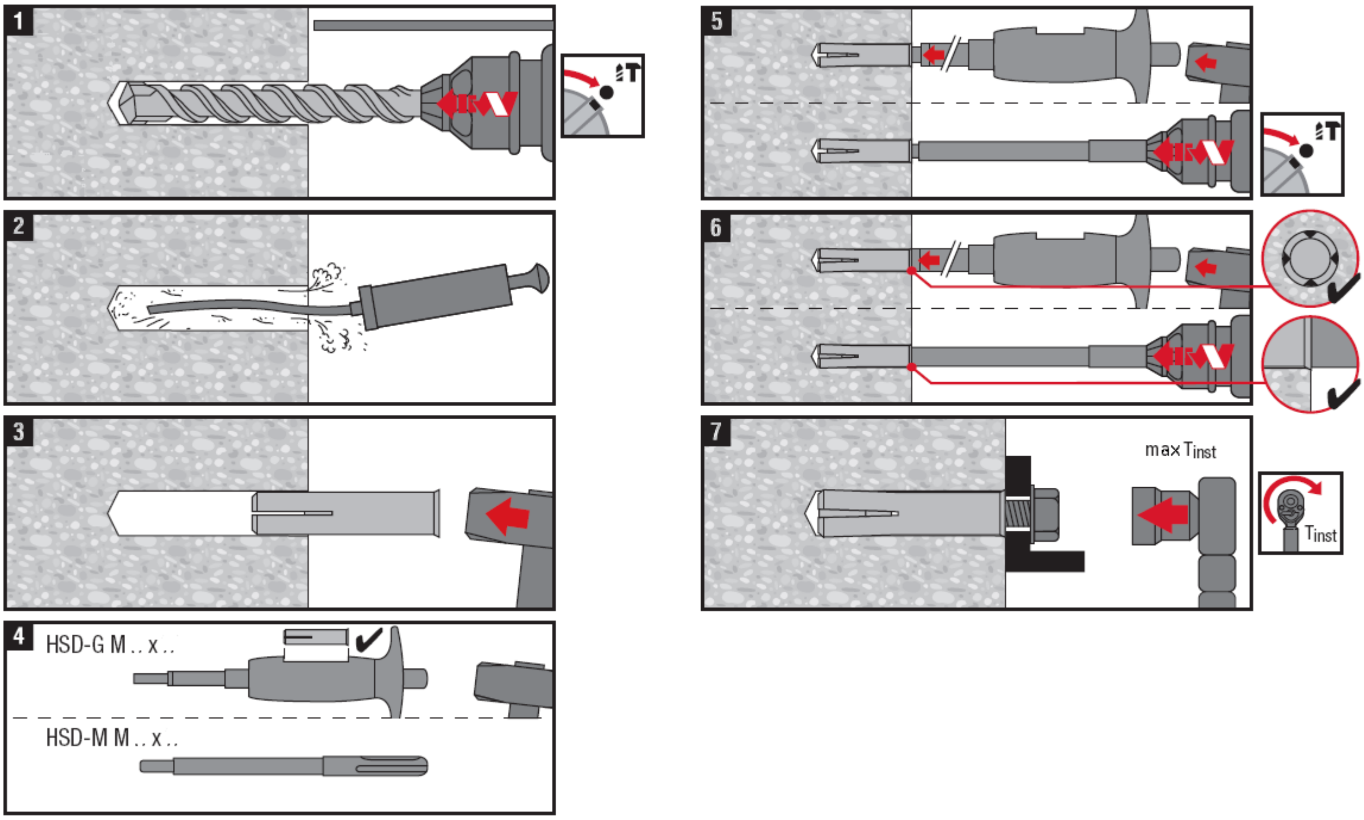


Setting

Installation equipment

Anchor size		M6x25	M8x30	M10x30	M10x40	M12x50	M16x65
Rotary hammer		TE 2 – TE 16				TE 16 – TE 50	
Machine setting tool Hand Setting tool	HSD-M HSD-G	6x25/30	8x25/30	10x25/30	10x40	12x50	16x65
Other tools		hammer, torque wrench, blow out pump					

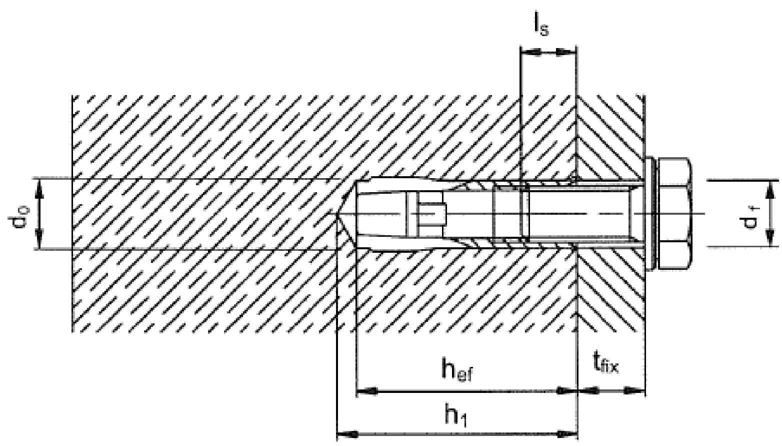
Setting instruction



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

For technical data for anchors in diamond drilled holes please contact the Hilti Technical advisory service.

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}

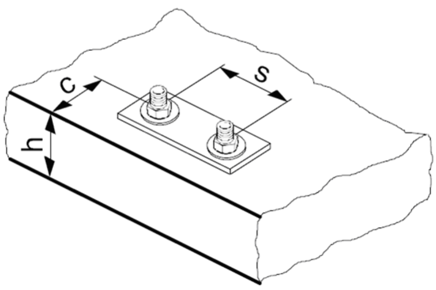


Setting details

Anchor size			M6x25	M8x30	M10x30	M10x40	M12x50	M16x65
Nominal diameter of drill bit	d_o	[mm]	8	10	12	12	15	20
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45	10,5	13	12,5	15,5	20,5
Depth of drill hole	$h_1 \geq$	[mm]	27	33	33	43	54	70
Screwing depth	$l_{s,min}$	[mm]	6	8	10	10	12	16
	$l_{s,max}$	[mm]	12	14,5	13	18	22	30,5
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	7	9	12	12	14	18
Effective anchorage depth	h_{ef}	[mm]	25	30	30	40	50	65
Max. torque moment	T_{inst}	[Nm]	4	8	15	15	35	60

Base material thickness, anchor spacing and edge distances

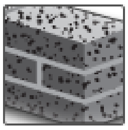
Anchor size			M6x25	M8x30	M10x30	M10x40	M12x50	M16x65
Minimum base material thickness	h_{min}	[mm]	100	100	100	100	100	130
Minimum spacing and minimum edge distance	s_{min}	[mm]	80	60	60	80	125	130
	c_{min}	[mm]	140	105	105	140	175	230



HUD-1 Universal anchor

	Anchor version	Benefits
	HUD-1	- fast setting - flexibility of screw length - an anchor for every base material


Concrete


Solid brick


Hollow brick


Autoclaved aerated concrete


Drywall

Basic loading data (for a single anchor)

All data in this section applies to

- Correct setting (See setting instruction)
- Load data are only valid for the specified woodscrew type
- No edge distance and spacing influence
- Base material as specified in the table
- Minimum base material thickness

Characteristic resistance

Anchor size			5x25		6x30		8x40		10x50		12x60	14x70
Screw type[d]			W Size 4 DIN 96	C Size 4	W Size 5 DIN 96	C Size 5	W Size 6 DIN 96	C Size 6	W Size 8 DIN 96	C Size 8	W Size 10 DIN 571	W Size 12 DIN 571
Concrete ≥ C16/20	N_{Rk}	[kN]	1,5	0,5	2,75	1,75	4,25	2,5	7	-	10	15
	V_{Rk}	[kN]	2	-	4,5	-	6,25	-	11	-	15	28
Solid clay brick Mz 20	N_{Rk}	[kN]	0,85	0,3	1,75	0,75	3	1,75	4	-	5	5 [a)]
	V_{Rk}	[kN]	1,2	-	1,5	-	2,2	-	-	-	-	-
Solid sand-lime brick KS 12	N_{Rk}	[kN]	1,25	0,75	2,5	1,5	4,25	2	5	-	7,5	7,5 [a)]
	V_{Rk}	[kN]	1,25	-	2,8	-	3,7	-	6,6	-	-	-
Hollow clay brick HlzB 12	N_{Rk}	[kN]	0,4	0,25	0,5	0,4	1	0,6	1,25	-	1,4	1,6
	V_{Rk}	[kN]	1,15	-	1,75	-	-	-	-	-	-	-
Hollow clay brick HlzB 12 – 15mm plastered	N_{Rk}	[kN]	0,4	0,25	0,75	0,5	1,25	0,75	1,5	-	1,75	2
	V_{Rk}	[kN]	1,15	-	1,75	-	-	-	-	-	-	-
Autoclaved aerated concrete AAC 2	N_{Rk}	[kN]	0,3	0,2	0,5	0,3	0,75	0,5	1	-	1,25	1,5
	V_{Rk}	[kN]	0,2	-	0,25	-	0,4	-	-	-	-	-
Autoclaved aerated concrete AAC 4	N_{Rk}	[kN]	0,5	0,3	0,75	0,5	1,5	1	2	-	2,5	3
	V_{Rk}	[kN]	0,65	-	0,9	-	1,5	-	-	-	-	-
Gypsum board Thickness 12,5mm	N_{Rk}	[kN]	0,2	0,3	0,25	0,4	0,3	0,5	-	0,75 [b)]	-	-
	V_{Rk}	[kN]	0,45	-	0,7	-	-	-	-	-	-	-
Gypsum board Thickness 2x12,5mm	N_{Rk}	[kN]	0,3	0,3	0,4	0,4	0,5	0,5	0,75 [b)]	1 [b)]	1,5 [c)]	-
	V_{Rk}	[kN]	0,45	-	0,7	-	-	-	-	-	-	-
Fibre reinforced gypsum board Thickness 12,5mm	N_{Rk}	[kN]	0,45	-	0,6	-	0,9	-	-	-	-	-
	V_{Rk}	[kN]	0,72	-	0,96	-	1,44	-	-	-	-	-
Fibre reinforced gypsum board Thickness 2x12,5mm	N_{Rk}	[kN]	0,45	-	1,2	-	1,8	-	2,1	-	-	-
	V_{Rk}	[kN]	0,72	-	1,92	-	2,88	-	3,36	-	-	-

a) only with screw diameter 6mm
b) only with screw diameter 8mm
c) only with screw diameter 10mm
d) Screw type: W: Wood-screw C: Chipboard screw
Load data are valid for the mentioned woodscrew type, if other types or different screws are used the load capacity may decrease.

Design resistance

Anchor size			5x25		6x30		8x40		10x50		12x60	14x70
Screw type[d]			W Size 4 DIN 96	C Size 4	W Size 5 DIN 96	C Size 5	W Size 6 DIN 96	C Size 6	W Size 8 DIN 96	C Size 8	W Size 10 DIN 571	W Size 12 DIN 571
Concrete ≥ C16/20	N_{Rd}	[kN]	0,42	0,14	0,77	0,49	1,19	0,70	1,96		2,80	4,20
	V_{Rd}	[kN]	0,56		1,26		1,75		3,08		4,20	7,84
Solid clay brick Mz 20	N_{Rd}	[kN]	0,24	0,08	0,49	0,21	0,84	0,49	1,12		1,40	1,40 [c]
	V_{Rd}	[kN]	0,34		0,42		0,62					
Solid sand-lime brick KS 12	N_{Rd}	[kN]	0,35	0,21	0,70	0,42	1,19	0,56	1,40		2,10	2,10 [c]
	V_{Rd}	[kN]	0,35		0,78		1,04		1,85			
Hollow clay brick HlzB 12	N_{Rd}	[kN]	0,11	0,07	0,14	0,11	0,28	0,17	0,35		0,39	0,45
	V_{Rd}	[kN]	0,32		0,49							
Hollow clay brick HlzB 12 – 15mm plastered	N_{Rd}	[kN]	0,11	0,07	0,21	0,14	0,35	0,21	0,42		0,49	0,56
	V_{Rd}	[kN]	0,32		0,49							
Autoclaved aerated concrete AAC 2	N_{Rd}	[kN]	0,08	0,06	0,14	0,08	0,21	0,14	0,28		0,35	0,42
	V_{Rd}	[kN]	0,06		0,07		0,11					
Autoclaved aerated concrete AAC 4	N_{Rd}	[kN]	0,14	0,08	0,21	0,14	0,42	0,28	0,56		0,70	0,84
	V_{Rd}	[kN]	0,18		0,25		0,42					
Gypsum board Thickness 12,5mm	N_{Rd}	[kN]	0,06	0,08	0,07	0,11	0,08	0,14		0,21 [a]		
	V_{Rd}	[kN]	0,13		0,20							
Gypsum board Thickness 2x12,5mm	N_{Rd}	[kN]	0,08	0,08	0,11	0,11	0,14	0,14	0,21 [a]	0,28 [a]	0,42 [b]	
	V_{Rd}	[kN]	0,13		0,20							
Fibre reinforced gypsum board Thickness 12,5mm	N_{Rd}	[kN]	0,13		0,17		0,25					
	V_{Rd}	[kN]	0,20		0,27		0,40					
Fibre reinforced gypsum board Thickness 2x12,5mm	N_{Rd}	[kN]	0,13		0,34		0,50		0,59			
	V_{Rd}	[kN]	0,20		0,54		0,81		0,94			

a) only with screw diameter 6mm
b) only with screw diameter 8mm
c) only with screw diameter 10mm
d) Screw type: W: Wood-screw C: Chipboard screw
Load data are valid for the mentioned woodscrew type, if other types or different screws are used the load capacity may decrease.

Recommended loads [e)]

Anchor size / Screw type [d)]			5x25 W	5x25 C	6x30 W	6x30 C	8x40 W	8x40 C	10x50 W	10x50 C	12x60 W	14x70 W
Concrete ≥ C16/20	N_{rec}	[kN]	0,3	0,1	0,55	0,35	0,85	0,5	1,4		2	3
	V_{rec}	[kN]	0,4		0,9		1,25		2,2		3	5,6
Solid clay brick Mz 20	N_{rec}	[kN]	0,17	0,06	0,35	0,15	0,6	0,35	0,8		1	1
	V_{rec}	[kN]	0,24		0,3		0,44					
Solid sand-lime brick KS 12	N_{rec}	[kN]	0,25	0,15	0,5	0,3	0,85	0,4	1		1,5	1,5
	V_{rec}	[kN]	0,25		0,56		0,74		1,32			
Hollow clay brick HlzB 12	N_{rec}	[kN]	0,08	0,05	0,1	0,08	0,2	0,12	0,25		0,28	0,32
	V_{rec}	[kN]	0,23		0,35							
Hollow clay brick HlzB 12 – 15mm plastered	N_{rec}	[kN]	0,08	0,05	0,15	0,1	0,25	0,15	0,3		0,35	0,4
	V_{rec}	[kN]	0,23		0,35							
Autoclaved aerated concrete AAC 2	N_{rec}	[kN]	0,06	0,04	0,1	0,06	0,15	0,1	0,2		0,25	0,3
	V_{rec}	[kN]	0,04		0,05		0,08					
Autoclaved aerated concrete AAC 4	N_{rec}	[kN]	0,1	0,06	0,15	0,1	0,3	0,2	0,4		0,5	0,6
	V_{rec}	[kN]	0,13		0,18		0,3					
Gypsum board Thickness 12,5mm	N_{rec}	[kN]	0,04	0,06	0,05	0,08	0,06	0,1		0,15		
	V_{rec}	[kN]	0,09		0,14							
Gypsum board Thickness 2x12,5mm	N_{rec}	[kN]	0,06	0,06	0,08	0,08	0,1	0,1	0,15	0,2	0,3	
	V_{rec}	[kN]	0,09		0,14							
Fibre reinforced gypsum board Thickness 12,5mm	N_{rec}	[kN]	0,09		0,12		0,18					
	V_{rec}	[kN]	0,14		0,19		0,29					
Fibre reinforced gypsum board Thickness 2x12,5mm	N_{rec}	[kN]	0,09		0,24		0,36		0,42			
	V_{rec}	[kN]	0,14		0,38		0,58		0,67			

a) only with screw diameter 6mm
b) only with screw diameter 8mm
c) only with screw diameter 10mm
d) Screw type: W: Wood-screw C: Chipboard screw
Load data are valid for the mentioned woodscrew type, if other types or different screws are used the load capacity may decrease.
e) With overall global safety factor γ = 5 to the characteristic loads and a partial safety factor of γ = 1,4 to the design values.

Service temperature range

Hilti HUD-1 universal anchor may be applied in the temperature range given below.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Material quality

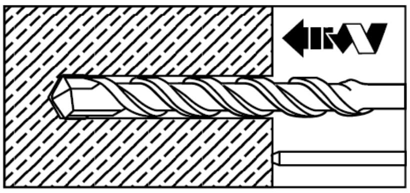
Part	Material
Plastic sleeve	Polyamide 6

Setting

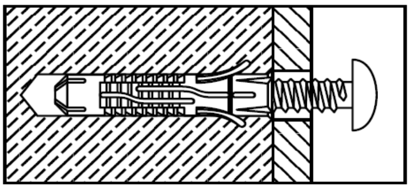
Installation equipment

Anchor size	5x25	6x30	8x40	10x50	12x60	14x70
Rotary hammer	TE 2 – TE 16					
Other tools	Screwdriver					

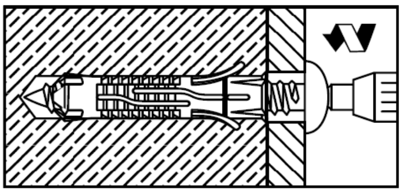
Setting instruction



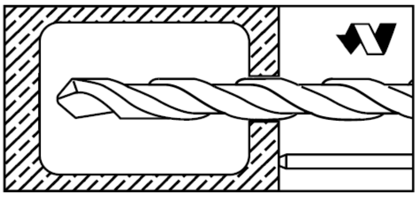
Drill hole with drill bit.



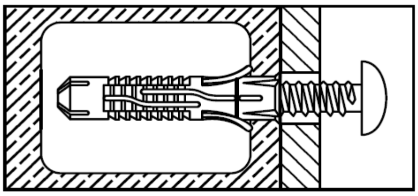
Install anchor.



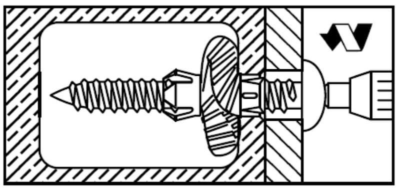
Drive screw into anchor.



Drill hole with drill bit.



Install anchor.

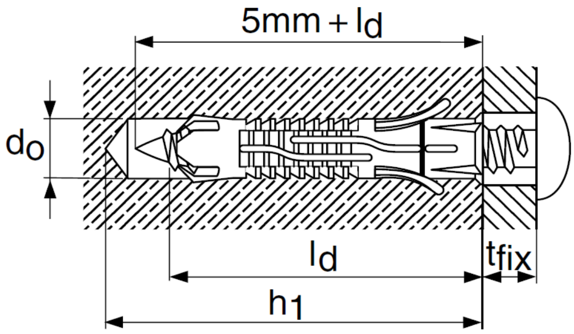


Drive screw into anchor.

Use only for wall and floor applications. Not applicable for ceiling and façade applications.

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

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}



Setting details HUD-1

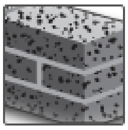
Anchor version			**5x25**	**6x30**	**8x40**	**10x50**	**12x60**	**14x70**
Nominal diameter of drill bit	d_o	[mm]	5	6	8	10	12	14
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	5,35	6,4	8,45	10,45	12,5	14,5
Depth of drill hole	$h_1 \geq$	[mm]	35	40	55	65	80	90
Effective anchorage depth	h_{nom}	[mm]	25	30	40	50	60	70
Anchor length	l	[mm]	25	30	40	50	60	70
Max fixture thickness	t_{fix}	[mm]	Depending on screw length					
Installation temperature		[°C]	-10 to +40					
Woodscrew diameter [a)]	d	[mm]	3,5 - **4**	4,5 - **5**	5 - **6**	7 - **8**	8 - **10**	10 - **12**

a) The basic loading data are depending on the woodscrew diameters, if other types or different screws are used the load capacity may decrease. Highlighted diameters refer to basic loading data table, except footnotes [a),b),c)] of basic loading data tables.

HUD-L Universal anchor

	Anchor version	Benefits
	HUD-L 6 HUD-L 8 HUD-L 10	- universal plastic anchor for weak base materials and renovation - for many base materials - daily application - excellent setting behaviour


Concrete


Solid brick


Hollow brick


Autoclaved aerated concrete


Drywall

Basic loading data (for a single anchor)

All data in this section applies to

- Correct setting (See setting instruction)
- Load data are only valid for the specified woodscrew type
- Load data given in the tables is independent of load direction
- No edge distance and spacing influence
- Base material as specified in the table
- Minimum base material thickness

Characteristic resistance

Anchor size			**HUD-L 6x50**	**HUD-L 8x60**	**HUD-L 10x70**
	Screw type c)		Woodscrew 4,5x80 DIN 96	Woodscrew 5x90 DIN 96	Woodscrew 8mm DIN 571
Concrete ≥ C16/20	F_{Rk}	[kN]	1,15	1,4	9,0
Solid clay brick Mz 12	F_{Rk}	[kN]	0,85	1,0	-
Solid clay brick Mz 20	F_{Rk}	[kN]	-	-	7,0
Solid sand-lime brick KS 12	F_{Rk}	[kN]	0,85	1,0	2
Hollow clay brick Hlz 12 a)	F_{Rk}	[kN]	0,5	0,75	1,5
Hollow sand-lime brick KSL 12	F_{Rk}	[kN]	0,7	0,8	-
Autoclaved aerated concrete AAC 2 a)	F_{Rk}	[kN]	0,25	0,55	2,0
Gypsum board Thickness 2x12,5mm a)	F_{Rk}	[kN]	0,3	0,7	0,6 b)

a) Drilling without hammering
b) Suitable for fitting hexagonal screws by hand
c) Load data are valid for the mentioned woodscrew type, if other types or different screws are used the load capacity may decrease.

Design resistance

Anchor size			HUD-L 6x50	HUD-L 8x60	HUD-L 10x70
	Screw type [c]		Woodscrew 4,5x80 DIN 96	Woodscrew 5x90 DIN 96	Woodscrew 8mm DIN 571
Concrete ≥ C16/20	F_{Rd}	[kN]	0,32	0,39	2,52
Solid clay brick Mz 12	F_{Rd}	[kN]	0,24	0,28	-
Solid clay brick Mz 20	F_{Rd}	[kN]	-	-	1,96
Solid sand-lime brick KS 12	F_{Rd}	[kN]	0,24	0,28	0,56
Hollow clay brick Hlz 12 [a]	F_{Rd}	[kN]	0,14	0,21	0,42
Hollow sand-lime brick KSL 12	F_{Rd}	[kN]	0,20	0,22	-
Autoclaved aerated concrete AAC 2 [a]	F_{Rd}	[kN]	0,07	0,15	0,56
Gypsum board Thickness 2x12,5mm [a]	F_{Rd}	[kN]	0,08	0,20	0,17 [b]

a) Drilling without hammering
b) Suitable for fitting hexagonal screws by hand
c) Load data are valid for the mentioned woodscrew type, if other types or different screws are used the load capacity may decrease.

Recommended loads [d]

Anchor size			HUD-L 6x50	HUD-L 8x60	HUD-L 10x70
	Screw type [c]		Woodscrew 4,5x80 DIN 96	Woodscrew 5x90 DIN 96	Woodscrew 8mm DIN 571
Concrete ≥ C16/20	F_{rec}	[kN]	0,23	0,28	1,8
Solid clay brick Mz 12	F_{rec}	[kN]	0,17	0,2	-
Solid clay brick Mz 20	F_{rec}	[kN]	-	-	1,4
Solid sand-lime brick KS 12	F_{rec}	[kN]	0,17	0,2	0,4
Hollow clay brick Hlz 12 [a]	F_{rec}	[kN]	0,1	0,15	0,3
Hollow sand-lime brick KSL 12	F_{rec}	[kN]	0,14	0,16	-
Autoclaved aerated concrete AAC 2 [a]	F_{rec}	[kN]	0,05	0,11	0,4
Gypsum board Thickness 2x12,5mm [a]	F_{rec}	[kN]	0,06	0,14	0,12 [b]

a) Drilling without hammering
b) Suitable for fitting hexagonal screws by hand
c) Load data are valid for the mentioned woodscrew type, if other types or different screws are used the load capacity may decrease.
d) With overall global safety factor $\gamma = 5$ to the characteristic loads and a partial safety factor of $\gamma = 1{,}4$ to the design values.

Service temperature range

Hilti HUD-L universal anchor may be applied in the temperature range given below.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Material quality

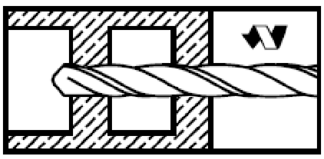
Part	Material
Plastic sleeve	Polyamide 6

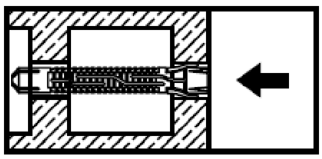
Setting

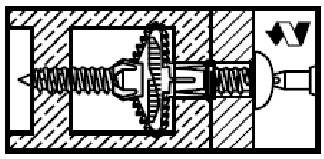
Installation equipment

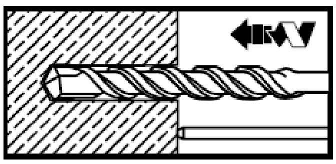
Anchor size	HUD-L 6x50	HUD-L 8x60	HUD-L 10x70
Rotary hammer	TE 2 – TE 16		
Other tools	Screwdriver		

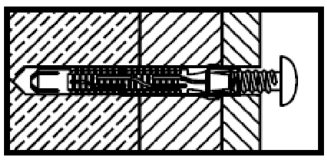
Setting instruction

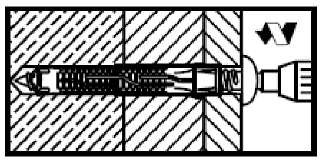

Drill hole with drill bit.


Install anchor.


Put part being fastened in place and drive screw into anchor.


Drill hole with drill bit.

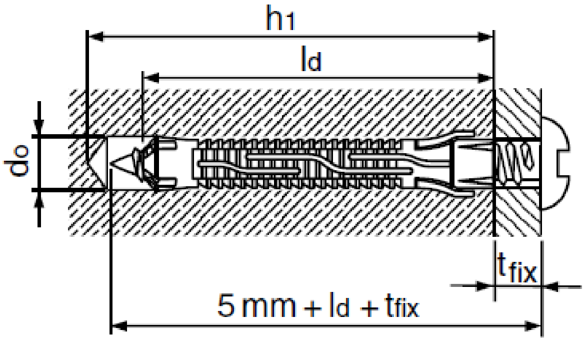

Put part being fastened in place and install anchor.


Drive screw into anchor.

Use only for wall and floor applications. Not applicable for ceiling and façade applications.

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

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}



Setting details HUD-L

Anchor version HUD-L			HUD-L 6x50	HUD-L 8x60	HUD-L 10x70
Nominal diameter of drill bit	d_o	[mm]	6	8	10
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	6,4	8,45	10,45
Depth of drill hole	$h_1 \geq$	[mm]	70	80	90
Effective anchorage depth	h_{nom}	[mm]	47	57	70
Anchor length	l	[mm]	47	57	70
Max fixture thickness	t_{fix}	[mm]	Depending on screw length		
Installation temperature		[°C]	-10 to +40		
Recommended length of screw in base material	l_d	[mm]	55	65	75
Woodscrew diameter [a)]	d	[mm]	**4,5** - 5	**5** - 6	7 - **8**

a) The basic loading data are depending on the woodscrew diameters, if other types or different screws are used the load capacity may decrease. Highlighted diameters refer to basic loading data table.

HLD Light duty anchor

Anchor version		Benefits
	HLD	- plastic undercut anchor - simple setting - esp. for drywall applications


Drywall

Basic loading data (for a single anchor)

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Base material as specified in the table
- Load data given in the tables is independent of load direction

Characteristic resistance

Anchor size				HLD 2	HLD 3	HLD 4
	Anchoring principle [a]					
Gypsum board Thickness 12,5mm	B	F_{Rk}	[kN]	0,4	0,4	0,4
Fibre reinforced gypsum board Thickness 12,5mm	A	F_{Rk}	[kN]	0,3	-	-
Fibre reinforced gypsum board Thickness 2x12,5mm	A	F_{Rk}	[kN]	-	0,6	-
Hollow clay brick	A / B	F_{Rk}	[kN]	0,75	0,75	
Concrete ≥ C16/20	C	F_{Rk}	[kN]	1,25	2	2,5

a) See setting details

Desgin resistance

Anchor size				HLD 2	HLD 3	HLD 4
Anchoring principle a)						
Gypsum board Thickness 12,5mm	B	F_{Rd}	[kN]	0,11	0,11	0,11
Fibre reinforced gypsum board Thickness 12,5mm	A	F_{Rd}	[kN]	0,08	-	-
Fibre reinforced gypsum board Thickness 2x12,5mm	A	F_{Rd}	[kN]	-	0,17	-
Hollow clay brick	A / B	F_{Rd}	[kN]	0,21	0,21	-
Concrete ≥ C16/20	C	F_{Rd}	[kN]	0,35	0,56	0,70

a) See setting details

Recommended loads b)

Anchor size				HLD 2	HLD 3	HLD 4
Anchoring principle a)						
Gypsum board Thickness 12,5mm	B	F_{rec}	[kN]	0,08	0,08	0,08
Fibre reinforced gypsum board Thickness 12,5mm	A	F_{rec}	[kN]	0,06	-	-
Fibre reinforced gypsum board Thickness 2x12,5mm	A	F_{rec}	[kN]	-	0,12	-
Hollow clay brick	A / B	F_{rec}	[kN]	0,15	0,15	-
Concrete ≥ C16/20	C	F_{rec}	[kN]	0,25	0,4	0,5

a) See setting details
b) With overall global safety factor γ = 5 to the characteristic loads and a partial safety factor of γ = 1,4 to the design values.

Service temperature range

Hilti HLD light duty anchor may be applied in the temperature range given below.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Material quality

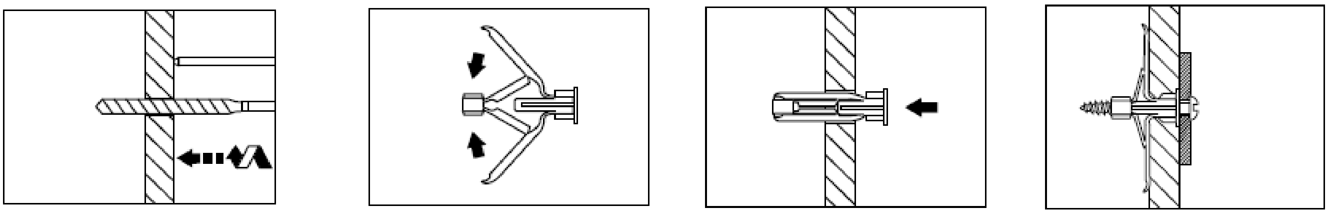
Part	Material
Sleeve	Polyamide PA 6

Setting

Installation equipment

Anchor size	
Rotary hammer	TE 2 – TE 16
Other tools	Screwdriver

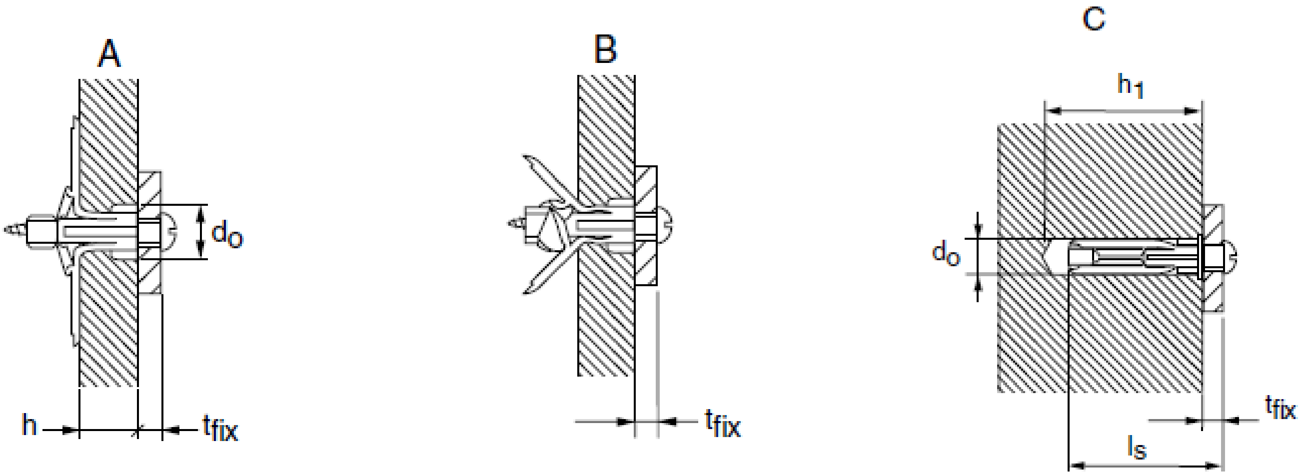
Setting instruction



Drill hole with drill bit. Install the HLD anchor. Drive in the screw.

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

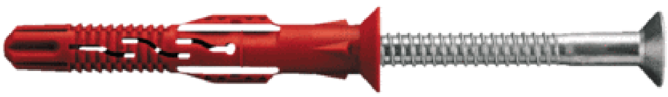
Setting details and anchoring principles:



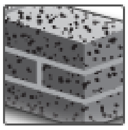
Setting details HSP / HFP

Anchor version				HLD 2	HLD 3	HLD 4
Nominal diameter of drill bit		d_o	[mm]		10	
Depth of drill hole	(only anchoring principle C)	$h_1 \geq$	[mm]	50	56	66
Screw length	(anchoring principle A/B)	l_S	[mm]	33 + t_{fix}	40 + t_{fix}	49 + t_{fix}
	(anchoring principle C)	l_S	[mm]	40 + t_{fix}	46 + t_{fix}	56 + t_{fix}
Screw diameter	(anchoring principle A/B)	d_S	[mm]		4 – 5	
	(anchoring principle C)	d_S	[mm]		5 – 6	
Wall / panel thickness	(anchoring principle A)	h	[mm]	4 – 12	15 – 19	24 – 28
	(anchoring principle B)	h	[mm]	12 – 16	19 – 25	28 – 32
	(anchoring principle C)	$h \geq$	[mm]	35	42	50
Installation temperature			[°C]		-10 to +40	

HRD-U 10 / - S 10 / -U 14 Frame anchor

Anchor version		Benefits
	HRD-U 10 Carbon steel Stainless steel	- universal frame anchor for façade, steelwork, and mechanical installation - base material versatility - excellent setting behaviour
	HRD-S 10 Carbon steel Stainless steel	
	HRD-U 14 Carbon steel Stainless steel	


Concrete


Solid brick


Hollow brick


Autoclaved aerated concrete


Fire resistance

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Fire test report	IBMB, Braunschweig	UB 3613/3891-1 Nau / 2001-11-23 UB 3613/3891-2 Nau / 2001-11-26

Basic loading data (for a single anchor)

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Base materials as specified in the table
  Minimum base material thickness
- Anchor is set in the brick, not in the joints

Recommended loads

Anchor size				HRD-U 10	HRD-S 10	HRD-U 14
Concrete	≥ C12/15	F_{rec}	[kN]	1,6	1,2	1,8
Solid clay brick	Mz 12	F_{rec}	[kN]	0,6	0,6	0,6
Solid clay brick	Mz 20	F_{rec}	[kN]	1,2	0,8	1,25
Solid sand-lime brick	KS 12/2,0	F_{rec}	[kN]	0,6	0,6	0,6
Lightweight solid block	V 2	F_{rec}	[kN]	0,25	0,25	0,5
Hollow clay brick	Hlz 12 – 1,0	F_{rec}	[kN]	0,3	-	0,5
Hollow sand-lime brick	KSL 6	F_{rec}	[kN]	0,4	0,4	0,6
Lightweight hollow brick	Hbl 2	F_{rec}	[kN]	0,25	0,25	0,3
AAC blocks	AAC 2	F_{rec}	[kN]	0,2	0,2	0,3
	≥ AAC 4	F_{rec}	[kN]	0,5	0,35	0,6
AAC members	P 3,3	F_{rec}	[kN]	0,2	0,2	0,3
	≥ P 4,4	F_{rec}	[kN]	0,5	0,35	0,6
AAC acc. TGL	Plant Laussig	F_{rec}	[kN]	0,3	-	-
	Plant Parchim	F_{rec}	[kN]	0,15	-	-
Thin skins of external wall paneels		F_{rec}	[kN]	0,6	0,6	-
hwpLb acc. TGL		F_{rec}	[kN]	0,5	-	0,7

Service temperature range

Hilti HRD-U 10 / -S 10 / -U 14 frame anchor may be applied in the temperature range given below.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HRD-U 10 / S 10 / U 14

Anchor size			U 10	S 10	U 14
Nominal tensile strength f_{uk}	Carbon steel	[N/mm²]	600		
	Stainless steel	[N/mm²]	580		500
Yield strength f_{yk}	Carbon steel	[N/mm²]	480		
	Stainless steel	[N/mm²]	450		400
Stressed cross-section A_s		[mm²]	31,2		56,8
Moment of resistance W		[mm³]	24,6		60,4
Char. bending resistance $M^0_{Rk,s}$	Carbon steel	[Nm]	17,7		43,5
	Stainless steel	[Nm]	17,1		36,2

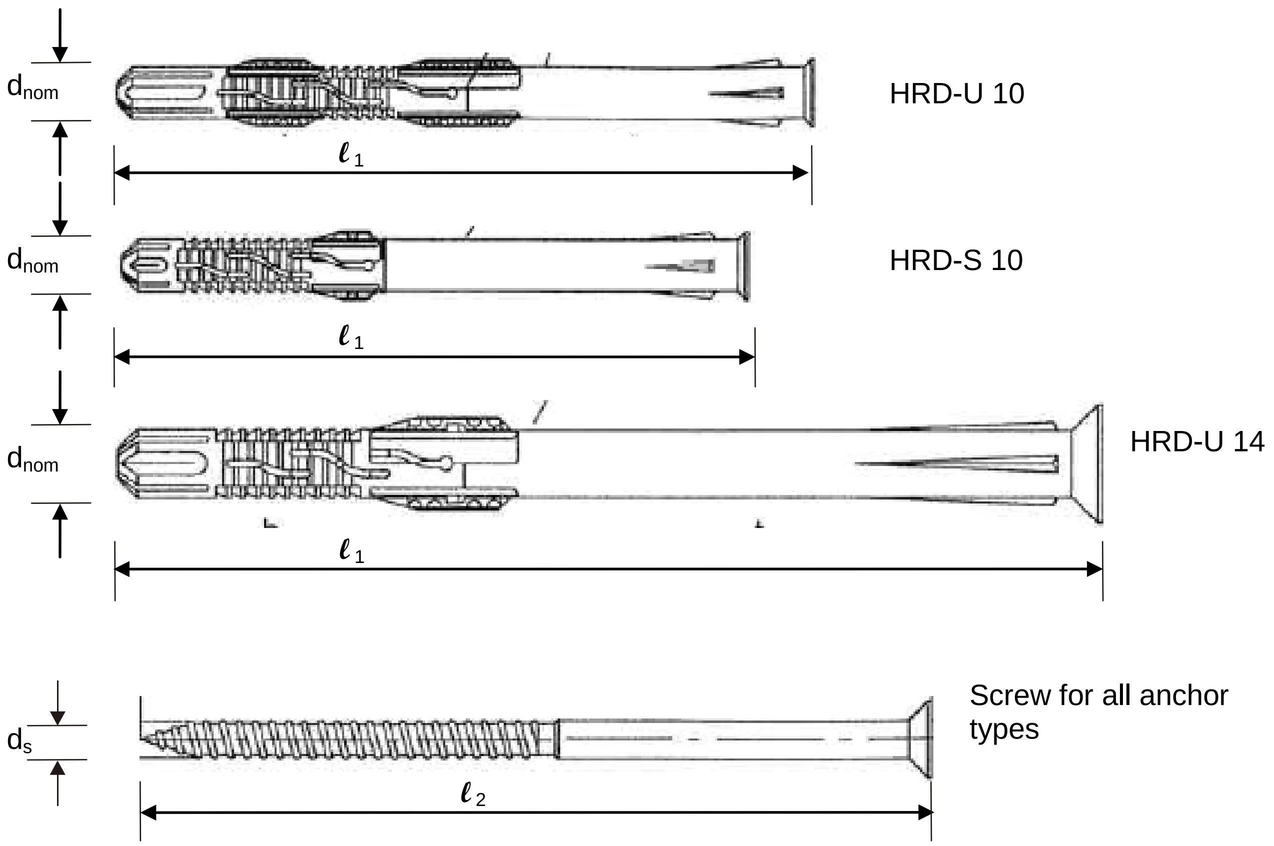
The recommended bending moment shall be calculated by dividing the characteristic bending moment by 1,4 and 1,25

Material quality

Part		Material
Sleeve	HRD	Polyamide
Screw	HRD-UG	Carbon steel, galvanised to min. 5 µm
	HRD-UR	Stainless steel

Anchor dimensions

Anchor size			U 10	S 10	U 14	UP 14
Minimum thickness of fixture	$t_{fix,min}$	[mm]	10	10	10	10
Maximum thickness of fixture	$t_{fix,max}$	[mm]	160	130	280	250
Diameter of the sleeve	d_{nom}	[mm]	10	10	14	14
Minimum length of the sleeve	$\ell_{1,min}$	[mm]	80	60	80	110
Maximum length of the sleeve	$\ell_{1,max}$	[mm]	230	180	350	330
Diameter of the screw	d_S	[mm]	7	7	10	10
Minimum length of the screw	$\ell_{2,min}$	[mm]	85	65	85	115
Maximum length of the screw	$\ell_{2,max}$	[mm]	235	285	355	335

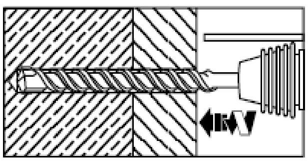


Setting

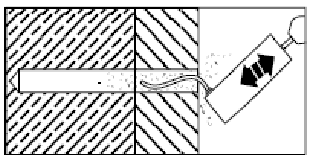
Installation equipment

Anchor size	U 10	S 10	U 14
Rotary hammer	TE2 … TE16		TE16… TE40
Other tools	hammer, screw driver		

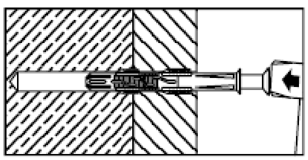
Setting instruction



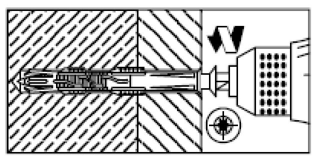
Drill hole with drill bit.



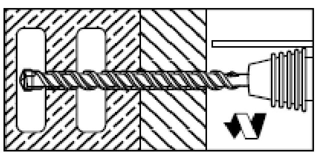
Blow out dust and fragments.



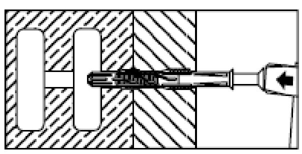
Install anchor.



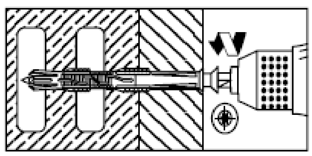
Drive screw into anchor.



Drill hole with drill bit.



Install anchor.

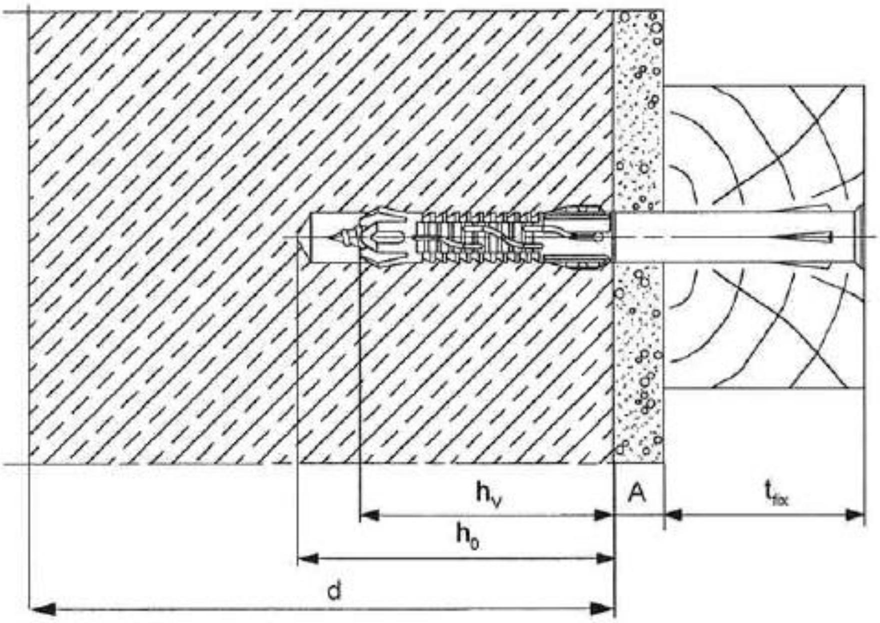


Drive screw into anchor.

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

For technical data for anchors in diamond drilled holes please contact the Hilti Technical advisory service.

Setting details: depth of drill hole h_1 and effective anchorage depth h_{nom}

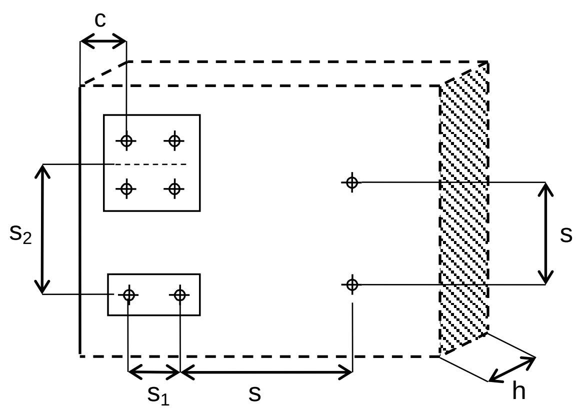


Setting details HRD-U 10 / S 10 / U 14

			U 10	S 10	U 14
Nominal diameter of drill bit	d_o	[mm]	10	10	14
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	10,45	10,45	14,5
Depth of drill hole	$h_1 \geq$	[mm]	80	60	85
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	10,5	10,5	14,5
Overall embedment depth in the base material	h_{nom}	[mm]	70	50	70
Installation temperature		[°C]	-10 - +40		

Base material thickness, anchor spacing and edge distance

Anchor size				**U 10**	**S 10**	**U 14**
Minimum base material thickness	Concrete	h_{min}	[mm]	120	100	120
	Masonry	h_{min}	[mm]	115	115	115
	AAC	h_{min}	[mm]	115	115	115
	Wetterschale	h_{min}	[mm]	40	40	-
	hwpLb	h_{min}	[mm]	40	40	-
Minimum spacing of single anchors	Concrete	s_{min}	[mm]	150	100	150
	Solid masonry	s_{min}	[mm]	100	100	250
	Hollow masonry	s_{min}	[mm]	250	250	250
	AAC	s_{min}	[mm]	100[a)]	-	-
	Wetterschale	s_{min}	[mm]	100	100	-
	hwpLb	s_{min}	[mm]	100	-	100
Minimum spacing in a group in concrete		s_{min1}	[mm]	50	50	50
Minimum spacing of groups in concrete		s_{min2}	[mm]	300	240	300
Minimum edge distance	Concrete	c_{min}	[mm]	100	80	100
	Solid masonry	c_{min}	[mm]	100	100	100
	Hollow masonry	c_{min}	[mm]	100	100	100
	AAC	c_{min}	[mm]	150	-	-
	Wetterschale	c_{min}	[mm]	50	50	-
	hwpLb	c_{min}	[mm]	100	100	100

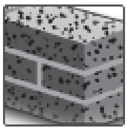


HRD Frame anchor, Redundant fastening

	Anchor version	Benefits
	HRD-C 8x HRD CR 8x	Innovative screw design for better hold Suitable on practically all base materials
	HRD-C 10x… HRD-CR 10x… HRD-CR2 10x…	Flexible embedment depth (approved at 50mm and 70mm)
	HRD-H 10x… HRD-HR 10x… HRD-HR2 10x… HRD-HF 10x…	Suitable for fastening thicknesses up to 260mm Available in 4 different materials for optimum suitability in all
	HRD-K 10x… HRD-KR 10x… HRD-KR2 10x…	corrosive environments Pre-assembled for optimum handling and fastening quality
	HRD-P 10x… HRD-PR 10x… HRD-PR2 10x…	


Concrete

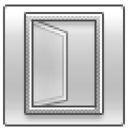

Tensile zone*)


Solid brick


Hollow brick


Autoclaved aerated concrete


Prestressed hollow core slabs


Window frame


Fire resistance


European Technical Approval


CE conformity

a) Redundant fastening only

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval a)	DIBt, Berlin	ETA-07/0219 / 2012-09-18
Fire test report	MFPA, Leipzig	GS 3.2/10-157-1/ 2010-09-02
Window frame report b)	Ift, Rosenheim	Ift report 105 33035 / 2007-07-09

a) All data given in this section according ETA-07/0219, issue 2012-09-18. The anchor is to be used only for redundant fastening for non-structural applications.

b) only available for HRD 8

c) only valid for HRD 10

Basic loading data according ETAG 020

All data in this section applies to

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Base material as specified in the table
  Minimum base material thickness
- *Steel* failure
- Shear without lever arm
- Anchors in redundant fastening

- The data that are highlighted in light grey are additional Hilti recommended data and not part of the approval

Characteristic resistance

Anchor size				HRD 8	HRD 10		
				h_{nom} =50mm	h_{nom} =50mm	h_{nom} =70mm	h_{nom} =90mm
Concrete C 12/15		N_{Rk}	[kN]	2,0	3,0	6,0	-
		V_{Rk}	[kN]	6,9 / 6,6 [b)]	10,6 / 10,1 [b)] / 11,1 [c)]		-
Concrete C 16/20 –C 50/60		N_{Rk}	[kN]	3,0	4,5	8,5	-
		V_{Rk}	[kN]	6,9 / 6,6 [b)]	10,6 / 10,1 [b)] / 11,1 [c)]		-
Solid clay brick Mz 2,0 DIN V 105-100 / EN 771-1	$f_b \geq 20$ N/mm²	F_{Rk}	[kN]	1,5	3,0 4,5 [d)]	[f)]	-
	$f_b \geq 10$ N/mm²	F_{Rk}	[kN]	1,2	2,0 3,0 [d)]	[f)]	-
Solid sand-lime brick KS 2,0 DIN V 106 / EN 771-2	$f_b \geq 20$ N/mm²	F_{Rk}	[kN]	2,5	3,0 4,5 [d)]	[f)]	-
	$f_b \geq 10$ N/mm²	F_{Rk}	[kN]	2,0	2,0 3,0 [d)]	[f)]	-
Lightweight solid block Vbl 0,9 DIN V 18151-100 / EN 771-3	$f_b \geq 20$ N/mm²	F_{Rk}	[kN]	-	3,5 6,0 [d)]	[f)]	-
	$f_b \geq 10$ N/mm²	F_{Rk}	[kN]	-	2,5 4,5 [d)]	[f)]	-
	$f_b \geq 6$ N/mm^2	F_{Rk}	[kN]	0,50	-	-	-
Ital. solid brick Tufo	$f_b \geq$ n/a	F_{Rk}	[kN]	1,4	-	-	-
Hollow clay brick Hlz B 12/1,2 brick **A** [e)]	$f_b \geq 12$ N/mm^2	F_{Rk}	[kN]	0,50	-	-	-
Vertically perforated clay brick Hlz 1,2-2DF brick **F** [e)]	$f_b \geq 8$ N/mm²	F_{Rk}	[kN]	-	1,5	-	-
	$f_b \geq 10$ N/mm²	F_{Rk}	[kN]	-	2,0	-	-
	$f_b \geq 12$ N/mm²	F_{Rk}	[kN]	-	2,0	-	-
Vertically perforated clay brick Hlz 1,0-2DF brick **G** [e)]	$f_b \geq 8$ N/mm²	F_{Rk}	[kN]	-	0,4	0,75	-
	$f_b \geq 10$ N/mm²	F_{Rk}	[kN]	-	0,5	0,9	-
	$f_b \geq 12$ N/mm²	F_{Rk}	[kN]	-	0,6	0,9	-
	$f_b \geq 20$ N/mm²	F_{Rk}	[kN]	-	0,9	1,5	-
Vertically perforated clay brick VHlz 1,6-2DF brick **H** [e)]	$f_b \geq 28$ N/mm²	F_{Rk}	[kN]	-	2,0	2,5	-
	$f_b \geq 50$ N/mm²	F_{Rk}	[kN]	-	3,0	3,5	-
Vertically perforated clay brick Poroton T8 brick **M** [e)]	$f_b \geq 6$ N/mm²	F_{Rk}	[kN]	-	0,75	1,5	-
Vertically perforated clay brick Hlz 1,0-9DF brick **L** [e)]	$f_b \geq 8$ N/mm²	F_{Rk}	[kN]	-	1,2	1,5	-
	$f_b \geq 10$ N/mm²	F_{Rk}	[kN]	-	1,5	1,5	-
	$f_b \geq 12$ N/mm²	F_{Rk}	[kN]	-	1,5	2,0	-
	$f_b \geq 16$ N/mm²	F_{Rk}	[kN]	-	2,0	3,0	-

Characteristic resistance

Anchor size				HRD 8	HRD 10		
				h_{nom} =50mm	h_{nom} =50mm	h_{nom} =70mm	h_{nom} =90mm
Hollow sand-lime brick KSL 12/1,4 brick **O** [e)]	$f_b \geq 12$ N/mm²	F_{Rk}	[kN]	0,75	-	-	-
Vertically perforated sand-lime brick KSL 1,6-2DF brick **P** [e)]	$f_b \geq 8$ N/mm²	F_{Rk}	[kN]	-	1,5	-	-
	$f_b \geq 10$ N/mm²	F_{Rk}	[kN]	-	1,5	-	-
	$f_b \geq 12$ N/mm²	F_{Rk}	[kN]	-	2,0	-	-
Vertically perforated sand-lime brick KSL 1,4-3DF brick **Q** [e)]	$f_b \geq 8$ N/mm²	F_{Rk}	[kN]	-	-	2,0	-
	$f_b \geq 10$ N/mm²	F_{Rk}	[kN]	-	-	2,5	-
	$f_b \geq 12$ N/mm²	F_{Rk}	[kN]	-	-	3,0	-
Vertically perforated sand-lime brick KSL R 1,6-16DF brick **R** [e)]	$f_b \geq 8$ N/mm²	F_{Rk}	[kN]	-	0,9	1,2	-
	$f_b \geq 10$ N/mm²	F_{Rk}	[kN]	-	1,2	1,5	-
	$f_b \geq 12$ N/mm²	F_{Rk}	[kN]	-	1,5	2,0	-
	$f_b \geq 16$ N/mm²	F_{Rk}	[kN]	-	2,0	2,5	-
Lightweight hollow brick Hbl 2/0,8 brick **S** [e)]	$f_b \geq 2$ N/mm²	F_{Rk}	[kN]	0,30	-	-	-
Lightweight concrete hollow block Hbl 1,2-12DF brick **T** [e)]	$f_b \geq 2$ N/mm²	F_{Rk}	[kN]	-	0,5	0,75	-
	$f_b \geq 6$ N/mm²	F_{Rk}	[kN]	-	1,2	2,0	-
Ital. Hollow brick Mattone brick **E** [e)]	$f_b \geq 22$ N/mm²	F_{Rk}	[kN]	1,5	-	-	-
Ital. Hollow brick Poroton P700 brick **N** [e)]	$f_b \geq 15$ N/mm²	F_{Rk}	[kN]	-	-	0,6	-
Ital. Hollow brick Doppio Uni brick **C+I** [e)]	$f_b \geq 25$ N/mm²	F_{Rk}	[kN]	0,9 (C)	-	1,5 (I)	-
Span. Hollow brick Rojo hydrofugano brick **D** [e)]	$f_b \geq 40$ N/mm²	F_{Rk}	[kN]	0,60	-	-	-
Span. Hollow brick Ladrillo perforado brick **J** [e)]	$f_b \geq 26$ N/mm²	F_{Rk}	[kN]	-	1,5	2,0	-
Span. Hollow brick Clinker mediterraneo brick **K** [e)]	$f_b \geq 75$ N/mm²	F_{Rk}	[kN]	-	-	1,5	-
French Hollow brick Brique Creuse brick **B** [e)]	$f_b \geq 6$ N/mm²	F_{Rk}	[kN]	0,50	-	-	-
Autoclaved aerated concrete AAC	AAC 2	F_{Rk}	[kN]	-	-	0,9	0,9
	AAC 4	F_{Rk}	[kN]	-	-	2,0	2,5
	AAC 6	F_{Rk}	[kN]	-	-	2,0	2,5
		F_{Rk}	[kN]		-	3,5 [d)]	4,5 [d)]

Design resistance

Anchor size				HRD 8	HRD 10		
				h_{nom} =50mm	h_{nom} =50mm	h_{nom} =70mm	h_{nom} =90mm
Concrete C 12/15		N_{Rd}	[kN]	1,1	1,7	3,3	-
		V_{Rd}	[kN]	5,5 / 5,2 [b)]	8,5 / 8,1 [b)] / 8,5 [c)]		-
Concrete C 16/20 –C 50/60		N_{Rd}	[kN]	1,7	2,5	4,7	-
		V_{Rd}	[kN]	5,5 / 5,2 [b)]	8,5 / 8,1 [b)] / 8,5 [c)]		-
Solid clay brick Mz 2,0 DIN V 105-100 / EN 771-1	f_b ≥ 20 N/mm²	F_{Rd}	[kN]	0,6	1,2 1,8 [d)]	[f)]	-
	f_b ≥ 10 N/mm²	F_{Rd}	[kN]	0,48	0,8 1,2 [d)]	[f)]	-
Solid sand-lime brick KS 2,0 DIN V 106 / EN 771-2	f_b ≥ 20 N/mm²	F_{Rd}	[kN]	1,0	1,2 1,8 [d)]	[f)]	-
	f_b ≥ 10 N/mm²	F_{Rd}	[kN]	0,8	0,8 1,2 [d)]	[f)]	-
Lightweight solid block Vbl 0,9 DIN V 18151-100 / EN 771-3	f_b ≥ 20 N/mm²	F_{Rd}	[kN]	-	1,4 2,4 [d)]	[f)]	-
	f_b ≥ 10 N/mm²	F_{Rd}	[kN]	-	1,0 1,8 [d)]	[f)]	-
	f_b ≥ 6 N/mm^2	F_{Rd}	[kN]	0,2	-	-	-
Ital. solid brick Tufo	f_b ≥ n/a	F_{Rd}	[kN]	0,56	-	-	-
Hollow clay brick Hlz B 12/1,2 brick **A** [e)]	f_b ≥ 12 N/mm^2	F_{Rd}	[kN]	0,2	-	-	-
Vertically perforated clay brick Hlz 1,2-2DF brick **F** [e)]	f_b ≥ 8 N/mm²	F_{Rd}	[kN]	-	0,6	-	-
	f_b ≥ 10 N/mm²	F_{Rd}	[kN]	-	0,8	-	-
	f_b ≥ 12 N/mm²	F_{Rd}	[kN]	-	0,8	-	-
Vertically perforated clay brick Hlz 1,0-2DF brick **G** [e)]	f_b ≥ 8 N/mm²	F_{Rd}	[kN]	-	0,16	0,3	-
	f_b ≥ 10 N/mm²	F_{Rd}	[kN]	-	0,2	0,36	-
	f_b ≥ 12 N/mm²	F_{Rd}	[kN]	-	0,24	0,36	-
	f_b ≥ 20 N/mm²	F_{Rd}	[kN]	-	0,36	0,6	-
Vertically perforated clay brick VHlz 1,6-2DF brick **H** [e)]	f_b ≥ 28 N/mm²	F_{Rd}	[kN]	-	0,8	1,0	-
	f_b ≥ 50 N/mm²	F_{Rd}	[kN]	-	1,2	1,4	-
Vertically perforated clay brick Poroton T8 brick **M** [e)]	f_b ≥ 6 N/mm²	F_{Rd}	[kN]	-	0,3	0,6	-
Vertically perforated clay brick Hlz 1,0-9DF brick **L** [e)]	f_b ≥ 8 N/mm²	F_{Rd}	[kN]	-	0,48	0,6	-
	f_b ≥ 10 N/mm²	F_{Rd}	[kN]	-	0,6	0,6	-
	f_b ≥ 12 N/mm²	F_{Rd}	[kN]	-	0,6	0,8	-
	f_b ≥ 16 N/mm²	F_{Rd}	[kN]	-	0,8	1,2	-

Design resistance

Anchor size				HRD 8	HRD 10		
				h_{nom} =50mm	h_{nom} =50mm	h_{nom} =70mm	h_{nom} =90mm
Hollow sand-lime brick KSL 12/1,4 brick **O** [e)]	$f_b \geq 12\ N/mm^2$	F_{Rd}	[kN]	0,3	-	-	-
Vertically perforated sand-lime brick KSL 1,6-2DF brick **P** [e)]	$f_b \geq 8\ N/mm^2$	F_{Rd}	[kN]	-	0,6	-	-
	$f_b \geq 10\ N/mm^2$	F_{Rd}	[kN]	-	0,6	-	-
	$f_b \geq 12\ N/mm^2$	F_{Rd}	[kN]	-	0,8	-	-
Vertically perforated sand-lime brick KSL 1,4-3DF brick **Q** [e)]	$f_b \geq 8\ N/mm^2$	F_{Rd}	[kN]	-	-	0,8	-
	$f_b \geq 10\ N/mm^2$	F_{Rd}	[kN]	-	-	1,0	-
	$f_b \geq 12\ N/mm^2$	F_{Rd}	[kN]	-	-	1,2	-
Vertically perforated sand-lime brick KSL R 1,6-16DF brick **R** [e)]	$f_b \geq 8\ N/mm^2$	F_{Rd}	[kN]	-	0,36	0,48	-
	$f_b \geq 10\ N/mm^2$	F_{Rd}	[kN]	-	0,48	0,6	-
	$f_b \geq 12\ N/mm^2$	F_{Rd}	[kN]	-	0,6	0,8	-
	$f_b \geq 16\ N/mm^2$	F_{Rd}	[kN]	-	0,8	1,0	-
Lightweight hollow brick Hbl 2/0,8 brick **S** [e)]	$f_b \geq 2\ N/mm^2$	F_{Rd}	[kN]	0,12	-	-	-
Lightweight concrete hollow block Hbl 1,2-12DF brick **T** [e)]	$f_b \geq 2\ N/mm^2$	F_{Rd}	[kN]	-	0,2	0,3	-
	$f_b \geq 6\ N/mm^2$	F_{Rd}	[kN]	-	0,48	0,8	-
Ital. Hollow brick Mattone brick **E** [e)]	$f_b \geq 22\ N/mm^2$	F_{Rk}	[kN]	0,6	-	-	-
Ital. Hollow brick Poroton P700 brick **N** [e)]	$f_b \geq 15\ N/mm^2$	F_{Rd}	[kN]	-	-	0,24	-
Ital. Hollow brick Doppio Uni brick **C+I** [e)]		F_{Rd}	[kN]	0,36 (C)	-	0,6 (I)	-
Span. Hollow brick Rojo hydrofugano brick **D** [e)]	$f_b \geq 40\ N/mm^2$	F_{Rd}	[kN]	0,24	-	-	-
Span. Hollow brick Ladrillo perforado brick **J** [e)]	$f_b \geq 26\ N/mm^2$	F_{Rd}	[kN]	-	0,6	0,8	-
Span. Hollow brick Clinker mediterraneo brick **K** [e)]	$f_b \geq 75\ N/mm^2$	F_{Rd}	[kN]	-	-	0,6	-
French Hollow brick Brique Creuse brick **B** [e)]	$f_b \geq 6\ N/mm^2$	F_{Rd}	[kN]	0,20	-	-	-
Autoclaved aerated concrete AAC EN 771-4	AAC 2	F_{Rd}	[kN]	-	-	0,45	0,45
	AAC 4	F_{Rd}	[kN]	0,21	-	1,0	1,25
	AAC 6	F_{Rd}	[kN]	0,21	-	1,0	1,25
		F_{Rd}	[kN]		-	1,75 [d)]	2,25 [d)]

Recommended loads [a]

Anchor size				HRD 8	HRD 10		
				h_{nom} =50mm	h_{nom} =50mm	h_{nom} =70mm	h_{nom} =90mm
Concrete C 12/15		N_{rec}	[kN]	0,8	1,2	2,4	-
		V_{rec}	[kN]	3,9 / 3,7 [b]	6,1 / 5,8 [b] / 6,1 [c]		-
Concrete C 16/20 –C 50/60		N_{rec}	[kN]	1,2	1,8	3,4	-
		V_{rec}	[kN]	3,9 / 3,7 [b]	6,1 / 5,8 [b] / 6,1 [c]		-
Solid clay brick Mz 2,0 DIN V 105-100 / EN 771-1	f_b ≥ 20 N/mm²	F_{rec}	[kN]	0,42	0,85 / 1,28 [d]	[f]	-
	f_b ≥ 10 N/mm²	F_{rec}	[kN]	0,34	0,57 / 0,85 [d]	[f]	-
Solid sand-lime brick KS 2,0 DIN V 106 / EN 771-2	f_b ≥ 20 N/mm²	F_{rec}	[kN]	0,7	0,85 / 1,28 [d]	[f]	-
	f_b ≥ 10 N/mm²	F_{rec}	[kN]	0,57	0,57 / 0,85 [d]	[f]	-
Lightweight solid block Vbl 0,9 DIN V 18151-100 / EN 771-3	f_b ≥ 20 N/mm²	F_{rec}	[kN]	-	1,0 / 1,71 [d]	[f]	-
	f_b ≥ 10 N/mm²	F_{rec}	[kN]	-	0,71 / 1,28 [d]	[f]	-
	f_b ≥ 6 N/mm^2	F_{rec}	[kN]	0,14	-	-	-
Ital. solid brick Tufo	f_b ≥ n/a	F_{rec}	[kN]	0,4	-	-	-
Hollow clay brick Hlz B 12/1,2 brick **A** [e]	f_b ≥ 12 N/mm^2	F_{rec}	[kN]	0,14	-	-	-
Vertically perforated clay brick Hlz 1,2-2DF brick **F** [e]	f_b ≥ 8 N/mm²	F_{rec}	[kN]	-	0,42	-	-
	f_b ≥ 10 N/mm²	F_{rec}	[kN]	-	0,57	-	-
	f_b ≥ 12 N/mm²	F_{rec}	[kN]	-	0,57	-	-
Vertically perforated clay brick Hlz 1,0-2DF brick **G** [e]	f_b ≥ 8 N/mm²	F_{rec}	[kN]	-	0,11	0,21	-
	f_b ≥ 10 N/mm²	F_{rec}	[kN]	-	0,14	0,25	-
	f_b ≥ 12 N/mm²	F_{rec}	[kN]	-	0,17	0,25	-
	f_b ≥ 20 N/mm²	F_{rec}	[kN]	-	0,25	0,42	-
Vertically perforated clay brick VHlz 1,6-2DF brick **H** [e]	f_b ≥ 28 N/mm²	F_{rec}	[kN]	-	0,57	0,71	-
	f_b ≥ 50 N/mm²	F_{rec}	[kN]	-	0,85	1,0	-
Vertically perforated clay brick Poroton T8 brick **M** [e]	f_b ≥ 6 N/mm²	F_{rec}	[kN]	-	0,21	0,42	-
Vertically perforated clay brick Hlz 1,0-9DF brick **L** [e]	f_b ≥ 8 N/mm²	F_{rec}	[kN]	-	0,34	0,42	-
	f_b ≥ 10 N/mm²	F_{rec}	[kN]	-	0,42	0,42	-
	f_b ≥ 12 N/mm²	F_{rec}	[kN]	-	0,42	0,57	-
	f_b ≥ 16 N/mm²	F_{rec}	[kN]	-	0,57	0,85	-

Recommended loads [a]

Anchor size				HRD 8	HRD 10		
				h_{nom} =50mm	h_{nom} =50mm	h_{nom} =70mm	h_{nom} =90mm
Hollow sand-lime brick KSL 12/1,4 brick **O** [e]	$f_b \geq 12$ N/mm²	F_{rec}	[kN]	0,21	-	-	-
Vertically perforated sand-lime brick KSL 1,6-2DF brick **P** [e]	$f_b \geq 8$ N/mm²	F_{rec}	[kN]	-	0,42	-	-
	$f_b \geq 10$ N/mm²	F_{rec}	[kN]	-	0,42	-	-
	$f_b \geq 12$ N/mm²	F_{rec}	[kN]	-	0,57	-	-
Vertically perforated sand-lime brick KSL 1,4-3DF brick **Q** [e]	$f_b \geq 8$ N/mm²	F_{rec}	[kN]	-	-	0,57	-
	$f_b \geq 10$ N/mm²	F_{rec}	[kN]	-	-	0,71	-
	$f_b \geq 12$ N/mm²	F_{rec}	[kN]	-	-	0,85	-
Vertically perforated sand-lime brick KSL R 1,6-16DF brick **R** [e]	$f_b \geq 8$ N/mm²	F_{rec}	[kN]	-	0,25	0,34	-
	$f_b \geq 10$ N/mm²	F_{rec}	[kN]	-	0,34	0,42	-
	$f_b \geq 12$ N/mm²	F_{rec}	[kN]	-	0,42	0,57	-
	$f_b \geq 16$ N/mm²	F_{rec}	[kN]	-	0,57	0,71	-
Lightweight hollow brick Hbl 2/0,8 brick **S** [e]	$f_b \geq 2$ N/mm²	F_{rec}	[kN]	0,09	-	-	-
Lightweight concrete hollow block Hbl 1,2-12DF brick **T** [e]	$f_b \geq 2$ N/mm²	F_{rec}	[kN]	-	0,14	0,21	-
	$f_b \geq 6$ N/mm²	F_{rec}	[kN]	-	0,34	0,57	-
Ital. Hollow brick Mattone brick **E** [e]	$f_b \geq 22$ N/mm²	F_{rec}	[kN]	0,43	-	-	-
Ital. Hollow brick Poroton P700 brick **N** [e]	$f_b \geq 15$ N/mm²	F_{rec}	[kN]	-	-	0,17	-
Ital. Hollow brick Doppio Uni brick **C+I** [e]	$f_b \geq 25$ N/mm²	F_{rec}	[kN]	0,25 (C)	-	0,42 (I)	-
Span. Hollow brick Rojo hydrofugano brick **D** [e]	$f_b \geq 40$ N/mm²	F_{rec}	[kN]	0,17	-	-	-
Span. Hollow brick Ladrillo perforado brick **J** [e]	$f_b \geq 26$ N/mm²	F_{rec}	[kN]	-	0,42	0,57	-
Span. Hollow brick Clinker mediterraneo brick **K** [e]	$f_b \geq 75$ N/mm²	F_{rec}	[kN]	-	-	0,42	-
French Hollow brick Brique Creuse brick **B** [e]	$f_b \geq 6$ N/mm²	F_{rec}	[kN]	0,14	-	-	-
Autoclaved aerated concrete AAC EN 771-4	AAC 2	F_{rec}	[kN]	-	-	0,32	0,32
	AAC 4	F_{rec}	[kN]	0,15	-	0,71	0,89
	AAC 6	F_{rec}	[kN]	0,15	-	0,71	0,89
		F_{rec}	[kN]		-	1,25 [d]	1,6 [d]

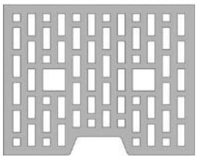
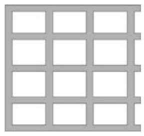
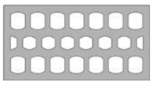
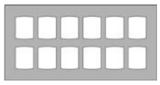
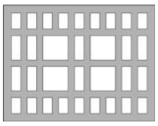
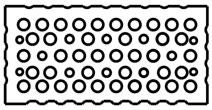
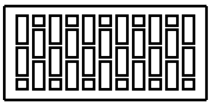
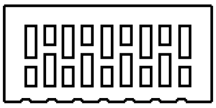
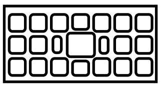
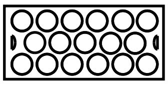
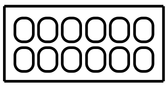
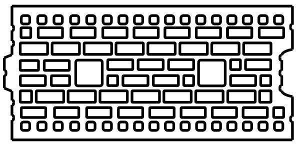
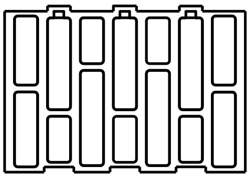
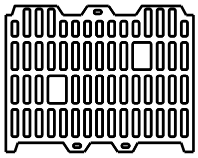
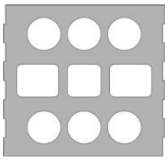
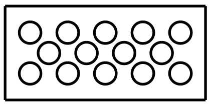
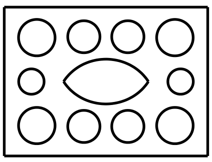
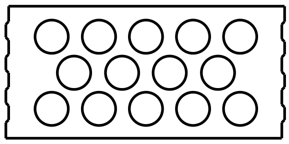
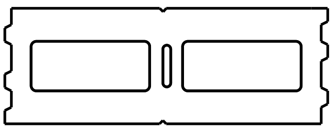
a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.
b) Values for hot-dip galanized carbon steel
c) Values for stainless steel
d) Valid for edge distance c≥150mm, intermediate values can be interpolated
e) Specification of hollow base material brick types see separate table below
f) Data can be determined by job-site testing, data for h_{nom} = 50mm can be applied.

Characteristic resistance for pull-out failure (plastic sleeve) for use in concrete

Anchor type					HRD 8	HRD 10	
Pull-out failure in standard concrete slabs							
Embedment depth			$h_{nom} \geq$	[mm]	50	50	70
Characteristic resistance		≥ C16/20	$N_{Rk,p}$	[kN]	3,0	4,5	8,5
		C12/15	$N_{Rk,p}$	[kN]	2,0	3,0	6,0
Partial safety factor			γ_{Mc} a)		1,8		
Pull-out failure in thin skins (weather resistant skins of external wall panels)							
Embedment depth			$h_{nom} \geq$	[mm]	-	50	-
Characteristic resistance	h = 40mm to 100mm	≥ C16/20	$N_{Rk,p}$	[kN]	-	3,5	-
		C12/15	$N_{Rk,p}$	[kN]	-	2,5	-
Partial safety factor			γ_{Mc} a)		1,8		
Pull-out failure in precast prestressed hollow core slabs							
Embedment depth			$h_{nom} \geq$	[mm]	-	50	-
Characteristic resistance	$d_b \geq$ 25mm	≥ C35/45	$N_{Rk,p}$	[kN]	-	0,6	-
	$d_b \geq$ 30mm	≥ C35/45	$N_{Rk,p}$	[kN]	-	1,5	-
	$d_b \geq$ 35mm	≥ C35/45	$N_{Rk,p}$	[kN]	-	2,5	-
	$d_b \geq$ 40mm	≥ C35/45	$N_{Rk,p}$	[kN]	-	3,5	-
Partial safety factor			γ_{Mc} a)		1,8		

a) In absence of other national regulations

Specification of hollow base material brick types

Specification	Picture / drilling method	Specification	Picture / drilling method
Hollow clay bricks according EN 771-1			
brick **A** Hlz B 12/1,2 LxWxH [mm]: 300x240x248 hmin [mm]: 240	 Rotary drilling	brick **B** Brique Creuse LxWxH [mm]: 210x198x… hmin [mm]: 210	 Rotary drilling
brick **C** Doppio Uni LxWxH [mm]: 230x120x100 hmin [mm]: 120	 Rotary drilling	brick **D** Rojo hydrofugano LxWxH [mm]: 240x115x50 hmin [mm]: 115	 Rotary drilling
brick **E** Mattone LxWxH [mm]: 240x180x100 hmin [mm]: 180	 Rotary drilling	brick **F** Hlz 1,2-2DF LxWxH [mm]: 240x115x113 hmin [mm]: 115	 Hammer drilling
brick **G** Hlz 1,0-2DF LxWxH [mm]: 240x115x113 hmin [mm]: 110	 Hammer drilling	brick **H** VHlz 1,6-2DF LxWxH [mm]: 240x115x113 hmin [mm]: 115	 Hammer drilling
brick **I** Doppio Uni LxWxH [mm]: 250x120x190 h_{min} [mm]: 120	 Rotary drilling	brick **J** Ladrillo perforado LxWxH [mm]: 240x110x100 hmin [mm]: 110	 Rotary drilling
brick **K** Clinker mediterraneo LxWxH [mm]: 240x113x50 hmin [mm]: 113	 Hammer drilling	brick **L** Hlz 1,0-9DF LxWxH [mm]: 372x175x238 hmin [mm]: 175	 Rotary drilling
brick **M** Poroton T8 LxWxH [mm]: 248x365x249 hmin [mm]: 365	 Rotary drilling	brick **N** Poroton P700 LxWxH [mm]: 225x300x190 hmin [mm]: 300	 Rotary drilling
Hollow sand-lime bricks according EN 771-2			
brick **O** KSL 12/1,4 LxWxH [mm]: 240x248x248 h_{min} [mm]: 240	 Hammer drilling	brick **P** KS L 1,6-2DF LxWxH [mm]: 240x115x113 hmin [mm]: 115	 Hammer drilling
brick **Q** KS L 1,4-3DF LxWxH [mm]: 240x175x113 hmin [mm]: 175	 Hammer drilling	brick **R** KS L R 1,6-16DF LxWxH [mm]: 480x240x248 hmin [mm]: 240	 Rotary drilling
Lightweight concrete hollow block according EN 771-3			
brick **S** Hbl 2/0,8 LxWxH [mm]: 497x240x248 hmin [mm]: 240	 Hammer drilling	brick **T** Hbl 1,2-12DF LxWxH [mm]: 497x175x238 hmin [mm]: 175	 Rotary drilling

Requirements for redundant fastening

The definition of redundant fastening according to Member States is given in the ETAG 020. In Absence of a definition by a Member State the following default values may be taken		
Minimum number of fixing points	**Minimum number of anchors per fixing point**	**Maximum design load of action N_{Sd} per fixing point [a)]**
3	1	3 kN
4	1	4,5 kN

a) The value for maximum design load of actions per fastening point N_{Sd} is valid in general that means all fastening points are considered in the design of the redundant structural system.

Service temperature range

Hilti HRD frame anchors may be applied in the temperature range given below.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties

Anchor size		HRD 8		HRD 10		
		Galv. steel	Stainless steel	Galv. steel	Hot-dip galvanised	Stainless steel
Nominal tensile strength f_{uk}	[N/mm²]	600	580	600	600	630
Yield strength f_{yk}	[N/mm²]	480	450	480	480	480
Stressed cross-section A_s	[mm²]	22,9	22,9	35,3	33,7	35,3
Moment of resistance W	[mm³]	15,5	15,5	29,5	27,6	29,5
Char. bending resistance $M^0_{Rk,s}$	[Nm]	11,1	10,8	21,3	19,9	22,3

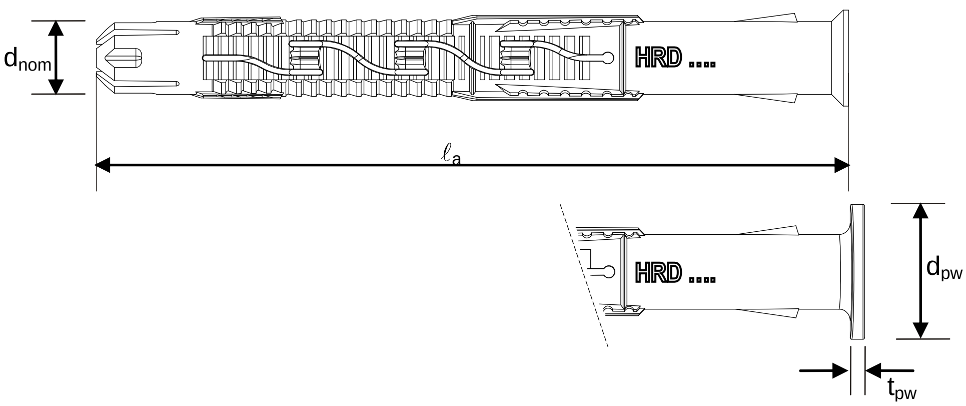
Material quality

Part		Material
Sleeve		Polyamide, colour red
Screw	HRD-C, -H, -K, -P	Carbon steel, galvanised to min. 5 µm
	HRD-HF	Carbon steel, hot-dip galvanized to min. 65 µm
	HRD-CR2, -HR2, -KR2, -PR2	Stainless steel, corrosion class II: 1.4301 / 1.4567
	HRD-CR, -HR, -KR, -PR	Stainless steel, corrosion class III: 1.4362 / 1.4401 / 1.4404 / 1.4571

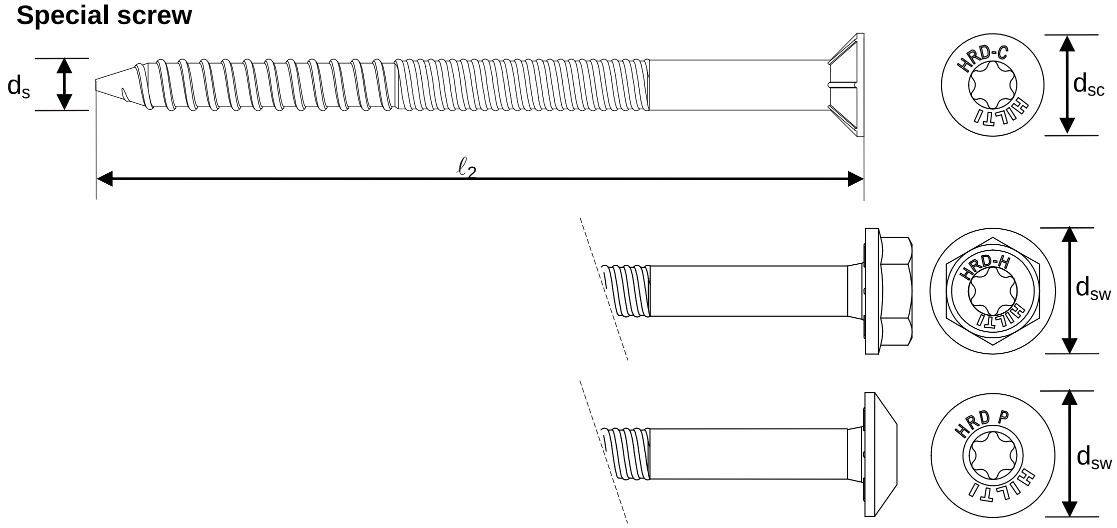
Anchor dimensions

Anchor size			HRD 8	HRD 10
Minimum thickness of fixture	$t_{fix,min}$	[mm]	0	0
Maximum thickness of fixture	$t_{fix,max}$	[mm]	90	260
Diameter of the sleeve	d_{nom}	[mm]	8	10
Minimum length of the sleeve	$\ell_{1,min}$	[mm]	60	60
Maximum length of the sleeve	$\ell_{1,max}$	[mm]	140	310
Diameter of plastic washer	d_{pw}	[mm]	-	17,5
Thickness of plastic washer	t_{pw}	[mm]	-	2
Diameter of the screw	d_S	[mm]	6	7
Minimum length of the screw	$\ell_{2,min}$	[mm]	65	65
Maximum length of the screw	$\ell_{2,max}$	[mm]	145	315
Head diameter of countersunk screw	d_{sc}	[mm]	11	14
Head diameter of hexhead screw	d_{sw}	[mm]	-	17,5

Anchor sleeve



Special screw

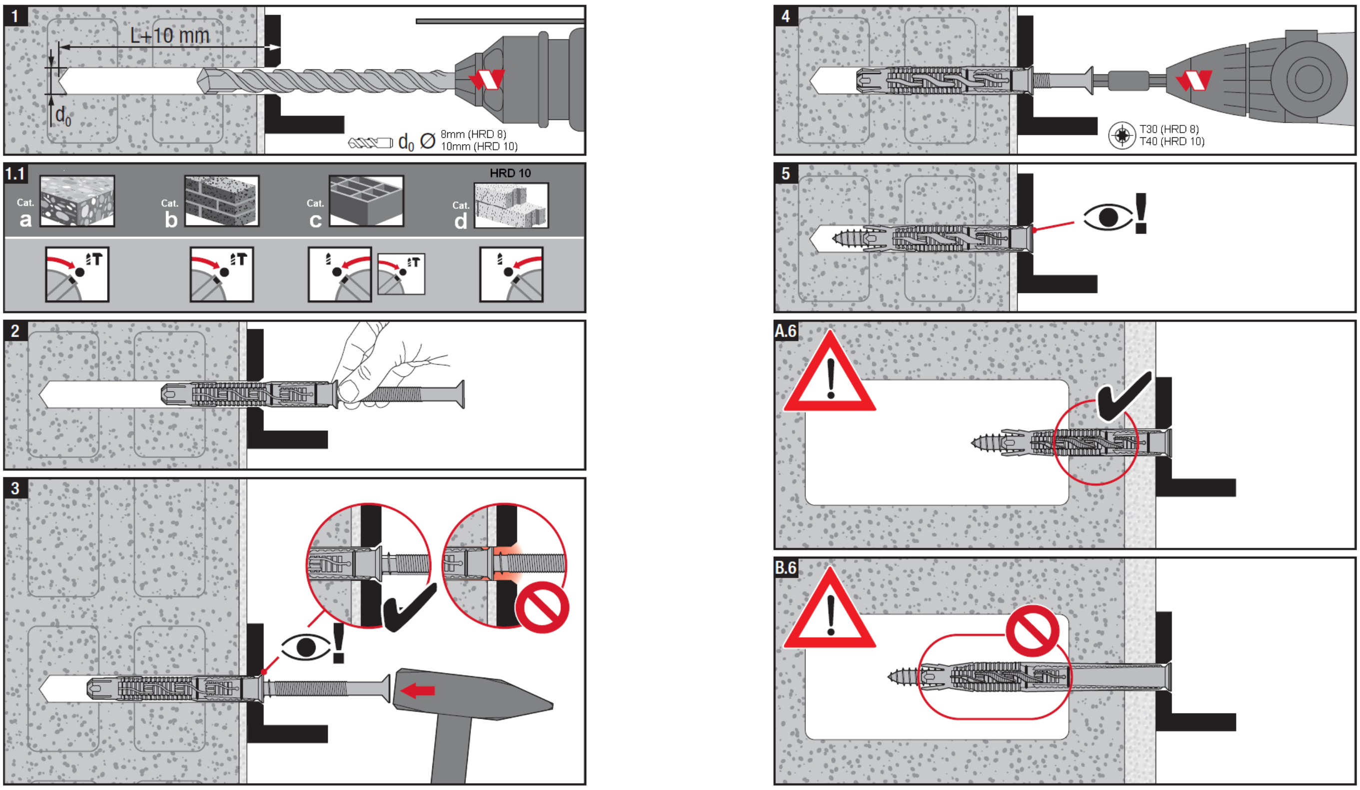


Setting

Installation equipment

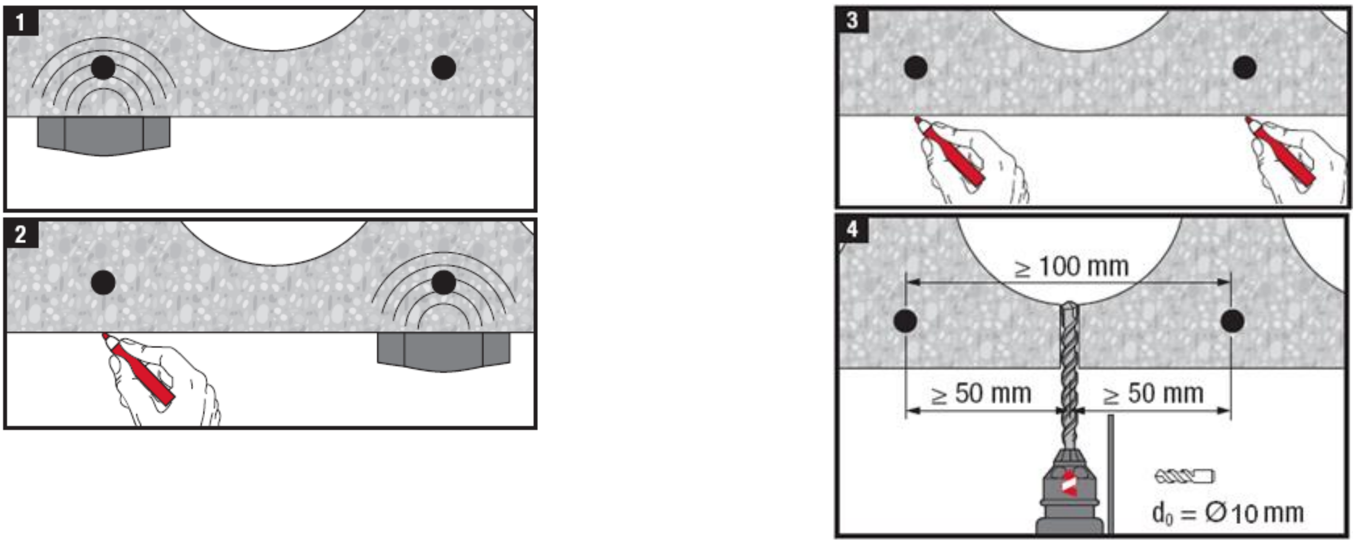
Anchor size	
Rotary hammer	TE2 … TE16
Other tools	hammer, screw driver

Setting instruction



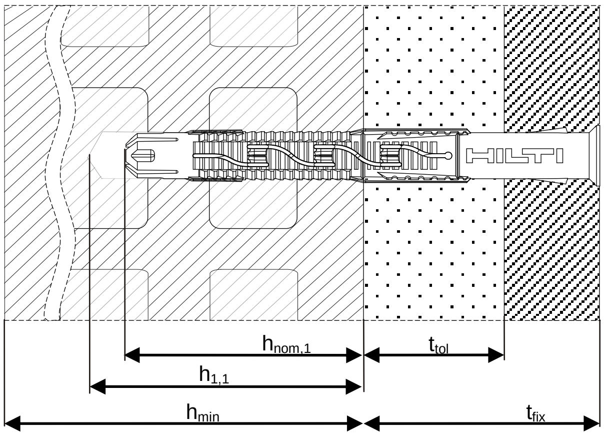
Additional preparation in case of application in precast prestressed hollow core slabs

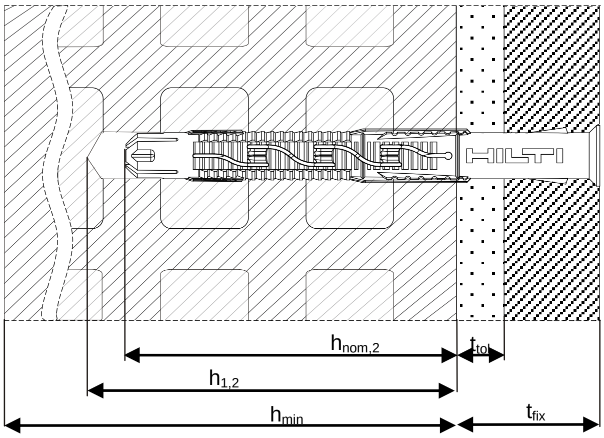
After drilling follow the main instruction above



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

Setting details: depth of drill hole h_1 and nominal anchorage depth h_{nom}





Application with $h_{nom,3}$ = 90mm analogue

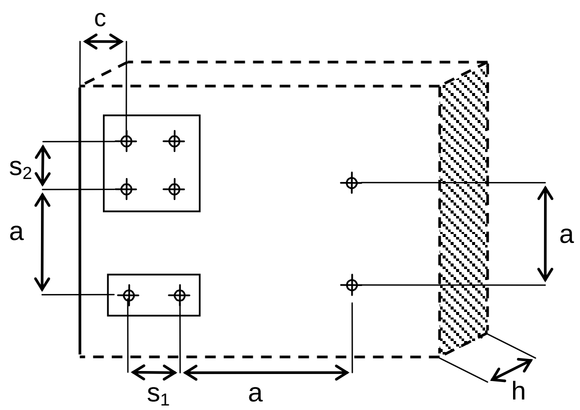
Setting details HRD

				HRD 8	HRD 10
Drill hole diameter		d_o	[mm]	8	10
Cutting diameter of drill bit		$d_{cut} \leq$	[mm]	8,45	10,45
Depth of drilled hole to deepest point		$h_{1,1} \geq$	[mm]	60	60
		$h_{1,2} \geq$	[mm]	-	80
		$h_{1,3} \geq$	[mm]	-	100 [a)]
Overall plastic anchor embedment depth in base material		$h_{nom,1} \geq$	[mm]	50	50
		$h_{nom,2} \geq$	[mm]	-	70
		$h_{nom,3} \geq$	[mm]	-	90 [a)]
Diameter of clearance hole in the fixture	Countersunk screw	$d_f \leq$	[mm]	8,5	11
	Hexhead screw	$d_f \leq$	[mm]	-	12
Installation temperature			[°C]	-10 - +40	

[a)] for use in AAC

Setting parameters

Anchor size				HRD 8	HRD 10	
				h_{nom} =50mm	h_{nom} =50mm	h_{nom} =70mm
Minimum base material thickness	Concrete	h_{min}	[mm]	100	100	120
	Concrete thin skin	h_{min}	[mm]	-	40	-
	Masonry (depending on brick type, see specification of brick types above)	h_{min}	[mm]	115 - 300		
Minimum spacing	Concrete ≥ C16/20	s_{min}	[mm]	100	50	
		for c ≥	[mm]	50	100 c)	
	Concrete C12/15	s_{min}	[mm]	140	70	
		for c ≥	[mm]	70	140 c)	
	Masonry and AAC	a_{min}	[mm]	250	250	
	Masonry and AAC	s_{min1}	[mm]	200 (120 d))	100	
		s_{min2}	[mm]	400 (240 d))	100	
Minimum edge distance	Concrete ≥ C16/20	c_{min}	[mm]	50	50	
		for s ≥	[mm]	100	150 c)	
	Concrete C12/15	c_{min}	[mm]	70	70	
		for s ≥	[mm]	140	210 c)	
	Masonry and AAC	c_{min}	[mm]	100 (60 d))	100	
Critical spacing in concrete a)	Concrete ≥ C16/20	$s_{cr,N}$	[mm]	62	80	125
	Concrete C12/15	$s_{cr,N}$	[mm]	68	90	135
Critical edge distance in concrete b)	Concrete ≥ C16/20	$c_{cr,N}$	[mm]	100	100	
	Concrete C12/15	$c_{cr,N}$	[mm]	140	140	

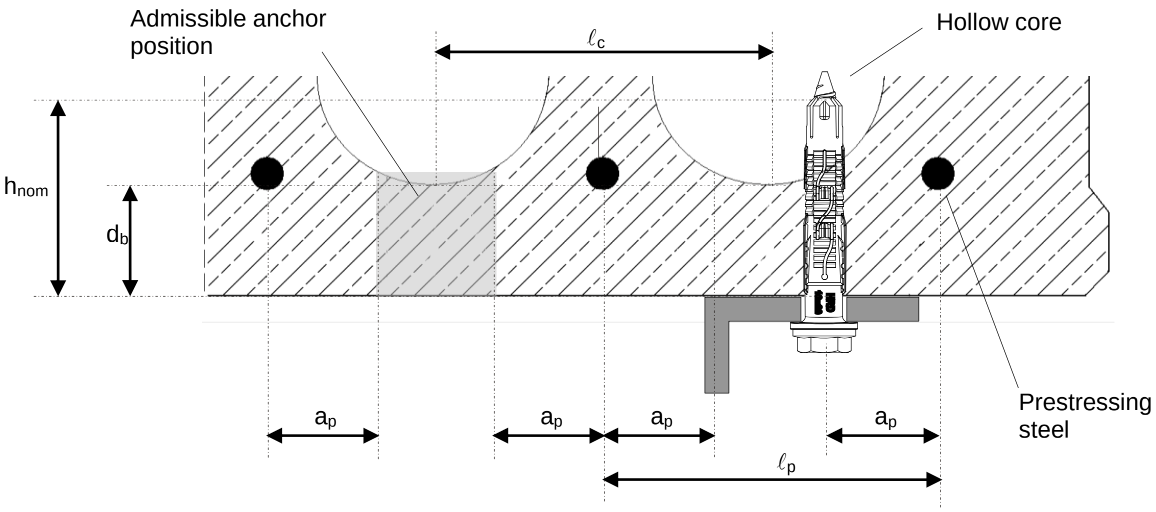


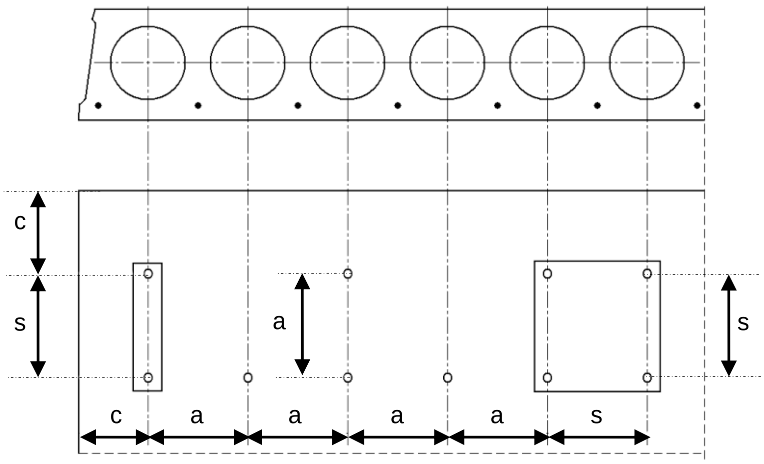
a) For spacing larger than the critical spacing each anchor in a group can be considered in design.
b) For edge distance smaller than critical edge distance the design loads have to be reduced.
c) Linear interpolation allowed
d) only for brick “Doppio Uni” and “Mattone”

Admissible anchor positions, minimum spacing and edge distance of anchors and distance between anchor groups in precast prestressed hollow core slabs

Anchor type			HRD 8	HRD 10
Overall plasic anchor embedment depth in the base material	$h_{nom} \geq$	[mm]	-	50
Bottom flange thickness	$d_b \geq$	[mm]	-	25
Core distance	$\ell_c \geq$	[mm]	-	100
Prestressing steel distance	$\ell_p \geq$	[mm]	-	100
Distance between anchor position and prestressing steel	$a_p \geq$	[mm]	-	50
Minimum edge distance	$c_{min} \geq$	[mm]	-	100
Minimum anchor spacing	$s_{min} \geq$	[mm]	-	100
Minimum distance between anchor groups	$a_{min} \geq$	[mm]	-	100

Schemes of distances and spacing





c_1, c_2 edge distances
s_1, s_2 anchor spacings
a_1, a_2 distances between anchor groups

Design method

Design method according ETAG 020, Annex C. Design resistance according data given in ETA-07/0219, issue 2012-09-18.

- Valid for a group of two anchors
- Influence of edge distance

The design method is based on the following simplifications:

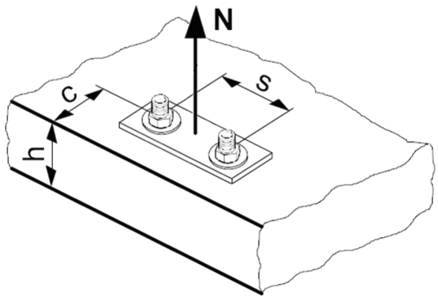
- Minimum base material thickness h_{min}
- All data for concrete C16/20 – C50/60
- No different loads are acting on individual anchors (no eccentricity)
- Shear without lever arm

The values are valid for a single anchor or a anchor group with spacing < $s_{cr,N}$ (for anchor groups with spacing ≥ $s_{cr,N}$ each anchor can be considered as acting like a single anchor).

Tension loading in concrete

The design tensile resistance is the lower value of

- Steel resistance: $\mathbf{N_{Rd,s}}$
- Concrete pull-out resistance: $\mathbf{N_{Rd,p}}$
- Concrete cone resistance: $\mathbf{N_{Rd,c} = N_{Rd,p} \cdot (c/c_{cr,N})}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size		HRD 8	HRD 10	
		h_{nom} =50mm	h_{nom} =50mm	h_{nom} ≥70mm
$N_{Rd,s}$	Carbon steel [kN]	7,3	11,7	11,7
	Stainless steel [kN]	6,8	11,6	11,6

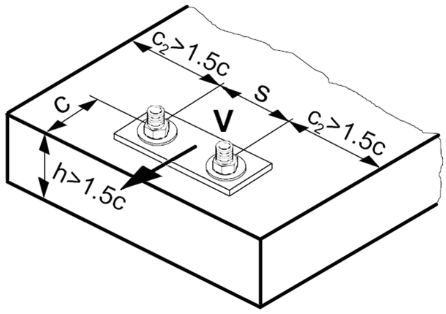
Design pull-out resistance $N_{Rd,p}$
Design concrete cone $N_{Rd,c} = N_{Rd,p} \cdot (c/c_{cr,N})$

Anchor size		HRD 8	HRD 10	
		h_{nom} =50mm	h_{nom} =50mm	h_{nom} ≥70mm
$N_{Rd,p}$	Carbon steel [kN]	1,7	2,5	4,7
	Stainless steel [kN]	1,7	2,5	4,7

Shear loading in concrete

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size		HRD 8	HRD 10	
		h_{nom} =50mm	h_{nom} =50mm	h_{nom} ≥70mm
$V_{Rd,s}$	Carbon steel [kN]	5,5	8,5	8,5
	Stainless steel [kN]	5,2	8,5	8,5

Design concrete edge resistance[a)] $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_c$

Anchor type		HRD 8	HRD 10	
		h_{nom} =50mm	h_{nom} =50mm	h_{nom} ≥70mm
$V^0_{Rd,c}$	[kN]	5,1	5,5	5,8

a) For anchor groups only the anchors close to the edge must be considered

Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 16/20	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	0,89	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance for different base material thickness [a)]

	c [mm]	50	60	70	80	90	100	120	140	160	180	200	220
h = 100 mm	f_c =	0,35	0,46	0,57	0,65	0,73	0,82	0,98	1,14	1,31	1,47	1,63	1,80
h = 120 mm		0,35	0,46	0,59	0,72	0,80	0,89	1,07	1,25	1,43	1,61	1,79	1,97
h = 150 mm		0,35	0,46	0,59	0,72	0,85	1,00	1,20	1,40	1,60	1,80	2,00	2,20
h = 180 mm		0,35	0,46	0,59	0,72	0,85	1,00	1,31	1,53	1,75	1,97	2,19	2,41

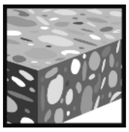
a) The edge distance shall not be smaller than the minimum edge distance c_{min}.
The base material thickness shall not be smaller than the minimum base material thickness h_{min}.

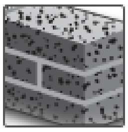
Combined TENSION and SHEAR loading in masonry

The design resistance in masonry and AAC F_{Rd} (see basic loading data) shall be used in each load direction for single anchors and anchor groups.

HRV Frame anchor

Anchor version		Benefits
	HRV-H 10x80 HRV-H 10x100 HRV-HF 10x80 HRV-HF 10x100	• Available in CS and HDG • Suitable for concrete and solid brick • Integrated plastic and steel washers


Concrete


Solid brick

Basic loading data according Hilti technical data assessment

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Non-cracked concrete C16/20 – C50/60, other base material as specified
- Minimum base material thickness
- *Steel* failure
- Shear without lever arm
- Anchors for single point application

Mean ultimate resistance

Anchor size				HRV 10
				h_{nom} =70mm
Concrete C16/20 – C50/60		N_{Rum}	[kN]	8,0
		V_{Rum}	[kN]	*8,9*
Solid clay brick Mz 1,8 DIN 105-100 / EN 771-1 LxWxH [mm]: 240x115x113 hmin [mm]: 115	$f_b \geq 10$ N/mm²	F_{Rum}	[kN]	2,65
	$f_b \geq 20$ N/mm²	F_{Rum}	[kN]	4,0
Russian solid clay brick Density [kg/dm³]: 1,9 LxWxH [mm]: 250x120x65 hmin [mm]: 120	$f_b \geq 10$ N/mm²	F_{Rum}	[kN]	2,65
	$f_b \geq 20$ N/mm²	F_{Rum}	[kN]	4,0

Characteristic resistance

Anchor size				HRV 10
				h_{nom} =70mm
Concrete C16/20 – C50/60		N_{Rk}	[kN]	6,0
		V_{Rk}	[kN]	*8,5*
Solid clay brick Mz 1,8 DIN 105-100 / EN 771-1 LxWxH [mm]: 240x115x113 hmin [mm]: 115	f_b ≥ 10 N/mm²	F_{Rk}	[kN]	2,0
	f_b ≥ 20 N/mm²	F_{Rk}	[kN]	3,0
Russian solid clay brick Density [kg/dm³]: 1,9 LxWxH [mm]: 250x120x65 hmin [mm]: 120	f_b ≥ 10 N/mm²	F_{Rk}	[kN]	2,0
	f_b ≥ 20 N/mm²	F_{Rk}	[kN]	3,0

Design resistance

Anchor size				HRV 10
				h_{nom} =70mm
Concrete C16/20 – C50/60		N_{Rd}	[kN]	3,3
		V_{Rd}	[kN]	6,8
Solid clay brick Mz 1,8 DIN 105-100 / EN 771-1 LxWxH [mm]: 240x115x113 hmin [mm]: 115	f_b ≥ 10 N/mm²	F_{Rd}	[kN]	0,8
	f_b ≥ 20 N/mm²	F_{Rd}	[kN]	1,2
Russian solid clay brick Density [kg/dm³]: 1,9 LxWxH [mm]: 250x120x65 hmin [mm]: 120	f_b ≥ 10 N/mm²	F_{Rd}	[kN]	0,8
	f_b ≥ 20 N/mm²	F_{Rd}	[kN]	1,2

Recommended loads [a)]

Anchor size				HRV 10
				h_{nom} =70mm
Concrete C16/20 – C50/60		N_{rec}	[kN]	2,4
		V_{rec}	[kN]	4,8
Solid clay brick Mz 1,8 DIN 105-100 / EN 771-1 LxWxH [mm]: 240x115x113 hmin [mm]: 115	f_b ≥ 10 N/mm²	F_{rec}	[kN]	0,57
	f_b ≥ 20 N/mm²	F_{rec}	[kN]	0,86
Russian solid clay brick Density [kg/dm³]: 1,9 LxWxH [mm]: 250x120x65 hmin [mm]: 120	f_b ≥ 10 N/mm²	F_{rec}	[kN]	0,57
	f_b ≥ 20 N/mm²	F_{rec}	[kN]	0,86

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HRV frame anchors may be applied in the temperature range given below.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

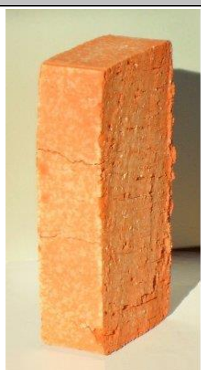
Mechanical properties

Anchor size			HRV 10	
			Galvanised steel	Hot-dip galvanised steel
Nominal tensile strength f_{uk}		[N/mm²]	600	600
Yield strength f_{yk}		[N/mm²]	480	480
Stressed cross-section A_s	tension	[mm²]	27,3	27,3
	shear	[mm²]	28,3	28,3
Moment of resistance W		[mm³]	21,2	21,2
Char. bending resistance $M^0_{Rk,s}$		[Nm]	15,3	15,3

Material quality

Part		Material
Sleeve		Polyamide, colour black
Screw	HRV-H	Carbon steel, galvanised to min. 5 µm
	HRV-HF	Carbon steel, hot-dip galvanized to min. 45 µm

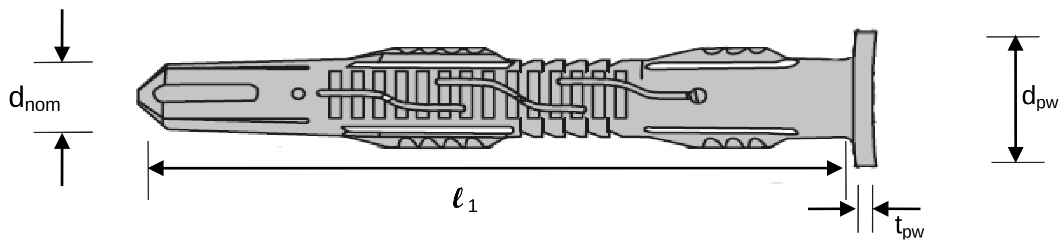
Masonry base materials

Solid clay brick Mz 1,8 DIN 105-100 / EN 771-1 LxWxH [mm]: 240x115x113 hmin [mm]: 115 	Russian solid clay brick Density [kg/dm³]: 1,9 LxWxH [mm]: 250x120x65 hmin [mm]: 120 

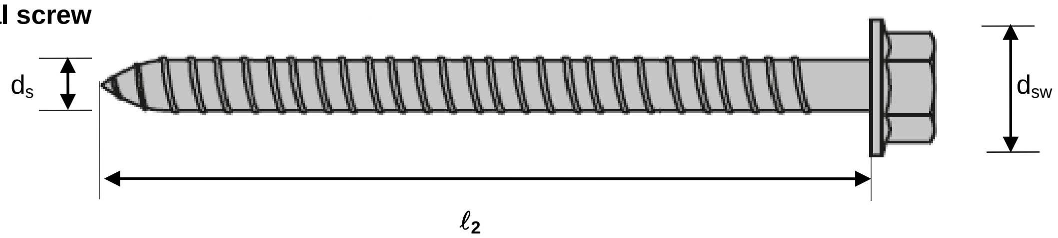
Anchor dimensions

Anchor size			HRV 10
Minimum thickness of fixture	$t_{fix,min}$	[mm]	0
Maximum thickness of fixture	$t_{fix,max}$	[mm]	30
Diameter of the sleeve	d_{nom}	[mm]	10
Minimum length of the sleeve	$\ell_{1,min}$	[mm]	80
Maximum length of the sleeve	$\ell_{1,max}$	[mm]	100
Diameter of plastic washer	d_{pw}	[mm]	17,8
Thickness of plastic washer	t_{pw}	[mm]	2,5
Diameter of the screw	d_S	[mm]	7
Minimum length of the screw	$\ell_{2,min}$	[mm]	75
Maximum length of the screw	$\ell_{2,max}$	[mm]	105
Head diameter of hexhead screw	d_{sw}	[mm]	17,5

Anchor sleeve



Special screw

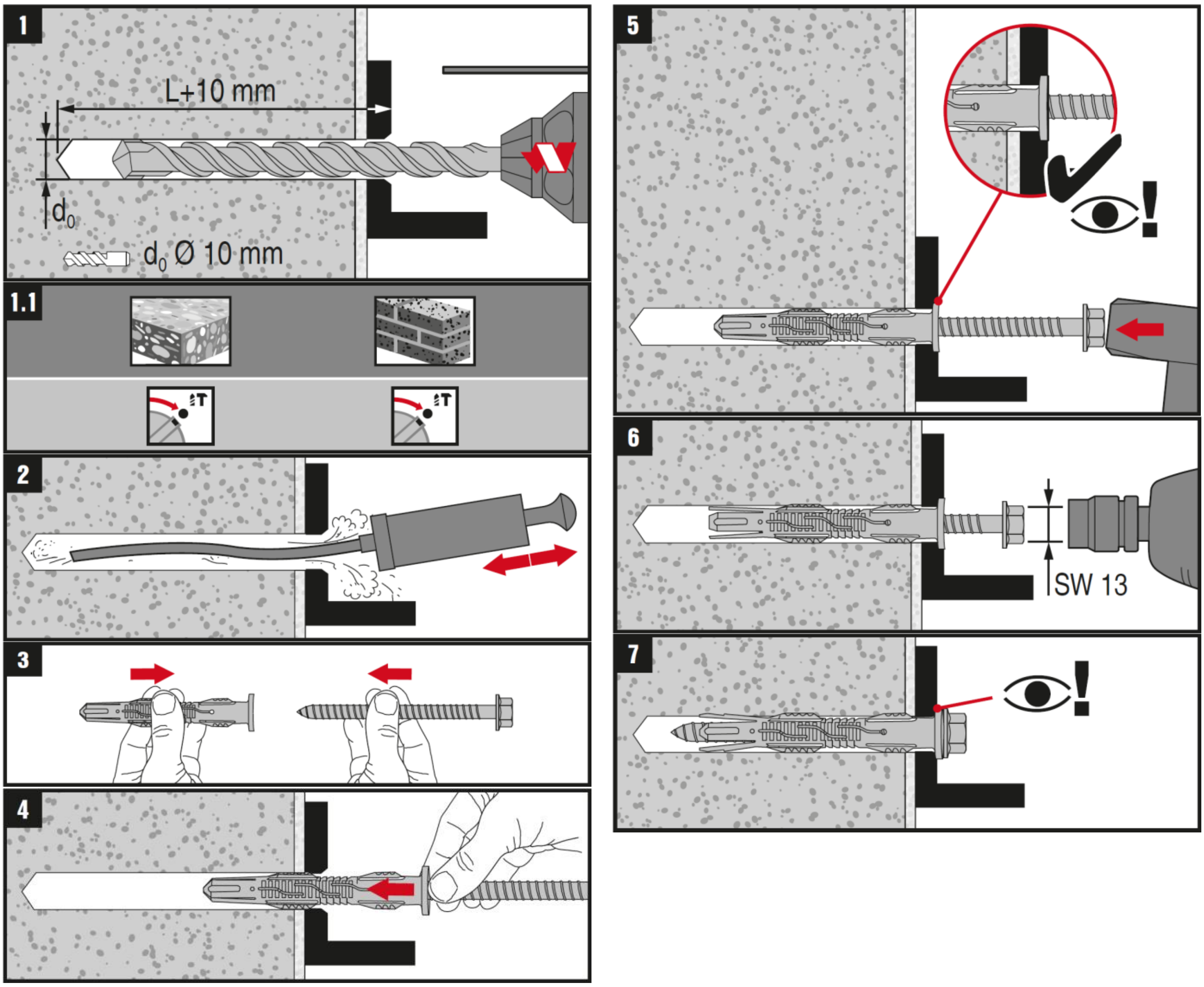


Setting

Installation equipment

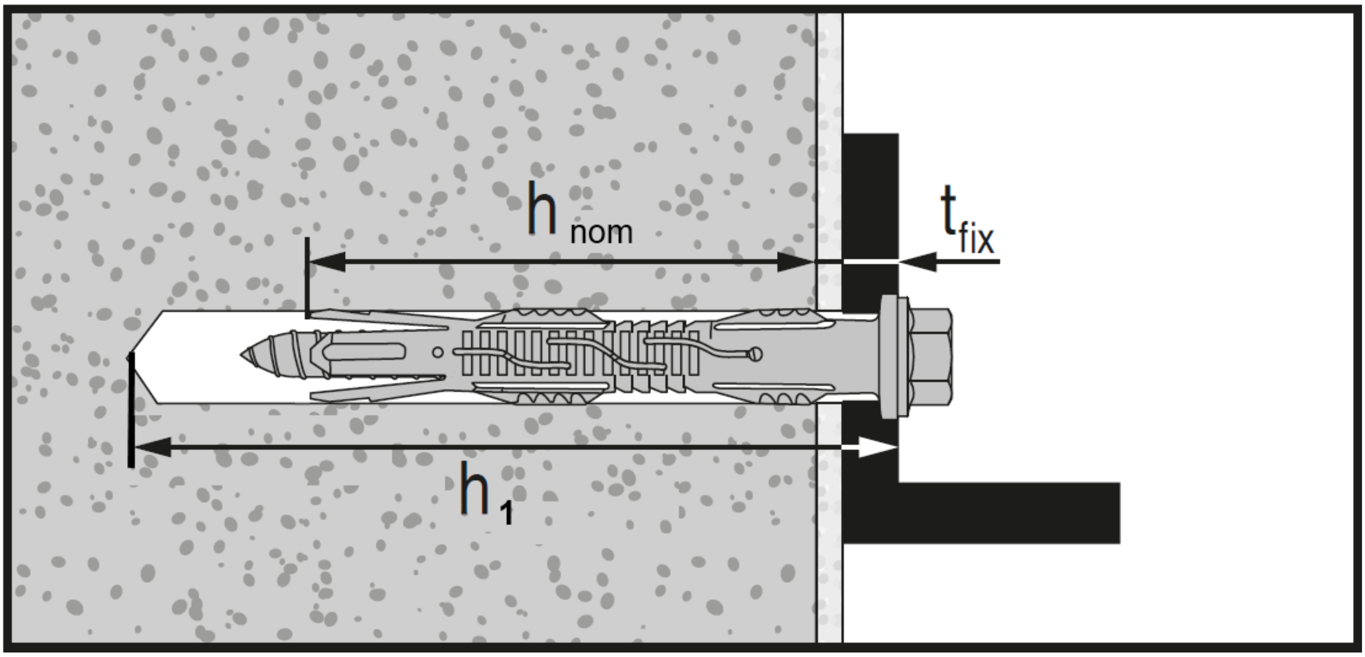
Anchor size	
Rotary hammer	TE2 … TE16
Other tools	hammer, screw driver

Setting instruction



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

Setting details: depth of drill hole h_1 and nominal anchorage depth h_{nom}

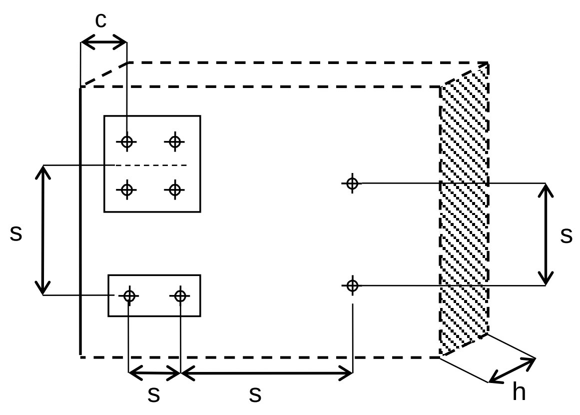


Setting details HRV

			HRV 10
Drill hole diameter	d_o	[mm]	10
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	10,45
Depth of drilled hole to deepest point	$h_1 \geq$	[mm]	80
Overall plastic anchor embedment depth in base material	$h_{nom} \geq$	[mm]	70
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	12
Installation temperature		[°C]	-10 - +40

Setting parameters

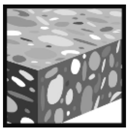
Anchor size				HRV 10
				h_{nom} =70mm
Minimum base material thickness	≥ C16/20	h_{min}	[mm]	120
Minimum spacing	≥ C16/20	s_{min}	[mm]	50
		for c ≥	[mm]	100 [a)]
Minimum edge distance	≥ C16/20	c_{min}	[mm]	50
		for s ≥	[mm]	150 [a)]
Critical spacing for splitting failure	≥ C16/20	$s_{cr,sp}$	[mm]	200
Critical edge distance for splitting failure	≥ C16/20	$c_{cr,sp}$	[mm]	100
Critical spacing for concrete cone failure	≥ C16/20	$s_{cr,N}$	[mm]	210
Critical edge distance for concrete cone failure	≥ C16/20	$c_{cr,N}$	[mm]	105

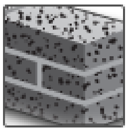


a) Linear interpolation allowed

GD 14 + GRS 12 Scaffolding anchor

	Anchor version	Benefits
	GD 14 (anchor body) GRS 12 (screw)	• Available in CS and HDG • Integrated plastic and steel washers


Concrete


Solid brick

Basic loading data according Hilti technical data assessment

All data in this section applies to
- Correct setting (See setting instruction)
- Load data are only valid for the specified screw
- No edge distance and spacing influence
- Base material as specified in the table

Design resistance [a), b)]

Anchor size			GD 14					
		Screw tipe	GDS 12x90	GDS 12x120	GDS 12x160	GDS 12x190	GDS 12x230	GDS 12x350
Concrete C16/20 – C50/60	N_{Rd}	[kN]	4,2					
	V_{Rd}	[kN]	2,8	2,5	1,0	0,6	0,35	0,13
Solid clay brick Mz 12-2.0	N_{Rd}	[kN]	1,9					
	V_{Rd}	[kN]	1,0	1,0	1,0	0,6	0,35	0,13
Solid sand-lime brick KS 12-2.0	N_{Rd}	[kN]	1,3					
	V_{Rd}	[kN]	0,7	0,7	0,7	0,6	0,35	0,35

a) With partial safety factor γ = 1,8 for concrete and γ = 2,5 for masonry (acc. ETAG 020).
b) Shear load data are determined from the lower value of anchor load capacity in the base material and the serviceability load that ensures a maximum bending of the screw of 1/50 of its lever arm.

Recommended load [a), b)]

Anchor size			GD 14					
		Screw tipe	GDS 12x90	GDS 12x120	GDS 12x160	GDS 12x190	GDS 12x230	GDS 12x350
Concrete C16/20 – C50/60	N_{rec}	[kN]	2,8					
	V_{rec}	[kN]	1,8	1,7	0,65	0,4	0,23	0,09
Solid clay brick Mz 12-2.0	N_{rec}	[kN]	1,3					
	V_{rec}	[kN]	0,65	0,65	0,65	0,4	0,23	0,09
Solid sand-lime brick KS 12-2.0	N_{rec}	[kN]	0,85					
	V_{rec}	[kN]	0,5	0,5	0,5	0,4	0,23	0,09

a) With partial safety factor γ = 1,5 for the loading (acc. EN 12811-1).
b) Shear load data are determined from the lower value of anchor load capacity in the base material and the serviceability load that ensures a maximum bending of the screw of 1/50 of its lever arm.

Service temperature range

Hilti GD scaffolding anchormay be applied in the temperature range given below.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Material quality

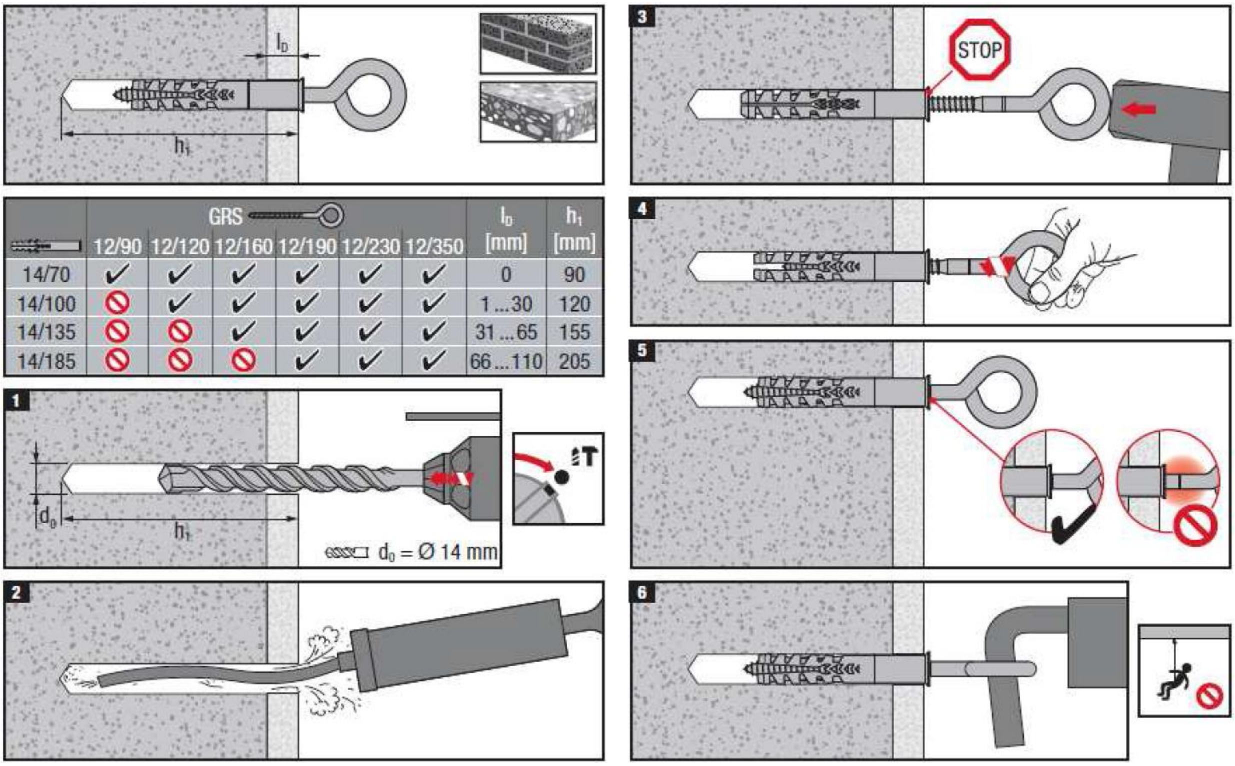
Part	Material
Plastic sleeve	Polyamide

Setting

Installation equipment

Anchor size	GD 14
Rotary hammer	TE 2 – TE 16
Other tools	–

Setting instruction

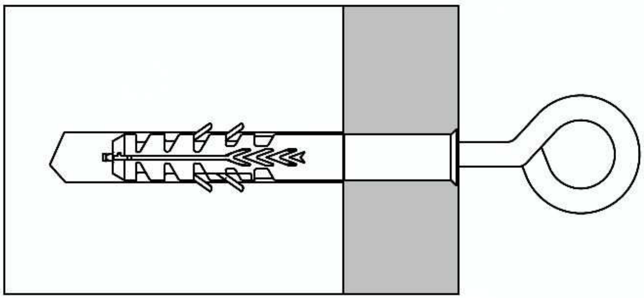


	GRS 12/90	12/120	12/160	12/190	12/230	12/350	l_D [mm]	h_1 [mm]
14/70	✓	✓	✓	✓	✓	✓	0	90
14/100	⊘	✓	✓	✓	✓	✓	1 ...30	120
14/135	⊘	⊘	✓	✓	✓	✓	31 ...65	155
14/185	⊘	⊘	⊘	✓	✓	✓	66...110	205

Use only for fixing scaffolds wall and floor applications. Not applicable for ceiling and façade applications.

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

Setting details: depth of drill hole h_1 and effective anchorage depth h_{nom}



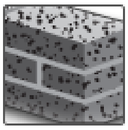
Setting details GD 14

			GD 14
Nominal diameter of drill bit	d_o	[mm]	14
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	14,5
Depth of drilled hole	$h_1 \geq$	[mm]	90
Effective anchorage depth	$h_{nom} \geq$	[mm]	70
Recommended length of screw in base material	l_d	[mm]	75
Installation temperature		[°C]	-10 to +40

HPS-1 Impact anchor

	Anchor version	Benefits
	HPS-1	- impact anchor for light frames, battens and profiles on solid base materials - impact and temperature resistant - high quality plastic


Concrete


Solid brick


Hollow brick


Autoclaved aerated concrete

Basic loading data (for a single anchor)

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Base material as specified in the table
- Minimum base material thickness
- Loads shall be reduced if the temperature sustains above 40°C

Recommended loads a)

Anchor size HPS-1			4/0	5/0	5/5 – 5/15	6/0 – 6/25	6/30 – 6/40	8/0	8/10 – 8/40	8/60 – 8/100
Concrete ≥ C16/20	N_{Rd}	[kN]	0,05	0,10	0,15	0,25	0,25	0,30	0,40	0,40
	V_{Rd}	[kN]	0,15	0,30	0,35	0,55	0,35	0,50	0,90	0,50
Engineering brick, 12 hole, class B	N_{Rd}	[kN]	0,05	0,10	0,15	0,25	0,25	0,30	0,40	0,40
	V_{Rd}	[kN]	0,15	0,30	0,35	0,55	0,35	0,50	0,90	0,50
Perforated brick, 3 hole cammon	N_{Rd}	[kN]	0,05	0,10	0,15	0,20	0,20	0,25	0,30	0,30
	V_{Rd}	[kN]	0,15	0,30	0,35	0,55	0,35	0,50	0,90	0,55
Themalite block, 7 N lightweight	N_{Rd}	[kN]	-	-	0,08	0,15	0,15	0,20	0,25	0,25
	V_{Rd}	[kN]	-	-	0,15	0,25	0,15	0,40	0,40	0,25
Themalite block ½ N lightweight	N_{Rd}	[kN]	-	-	0,05	0,08	0,08	-	0,12	0,12
	V_{Rd}	[kN]	-	-	0,10	0,15	0,10	-	0,25	0,15
Autoclaved aerated concrete AAC 4, AAC 6	N_{Rd}	[kN]	-	-	0,08	0,10	0,10	-	0,15	0,15
	V_{Rd}	[kN]	-	-	0,10	0,12	0,10	-	0,30	0,20
Extruded brick, Boral 10	N_{Rd}	[kN]	0,05	0,10	0,15	0,20	0,20	0,25	0,35	0,35
	V_{Rd}	[kN]	0,15	0,25	0,30	0,40	0,25	0,50	0,90	0,55

a) With overall global safety factor γ = 5 to the characteristic loads and a partial safety factor of γ = 1,4 to the design values.

Service temperature range

Hilti HPS impact anchor may be applied in the temperature range given below.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Material quality

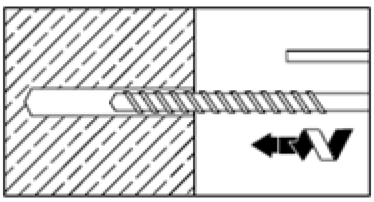
Part	Material
Plastic sleeve	Polyamide 6.6
Screw	Carbon steel, galvanised to 5 µm or Stainless steel, grade A2 or Stainless steel, grade A2, copper-plated

Setting

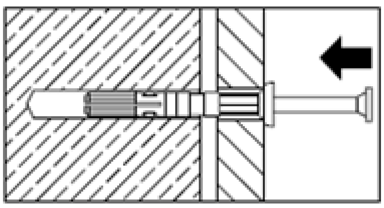
Installation equipment

Anchor size	HPS-1 4	HPS-1 5	HPS-1 6	HPS-1 8
Rotary hammer	TE2 – TE16			
Other tools	Screwdriver			

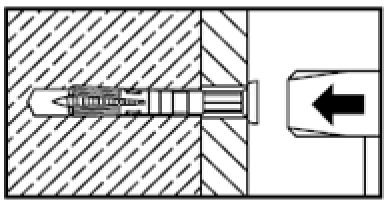
Setting instruction



Drill hole with drill bit

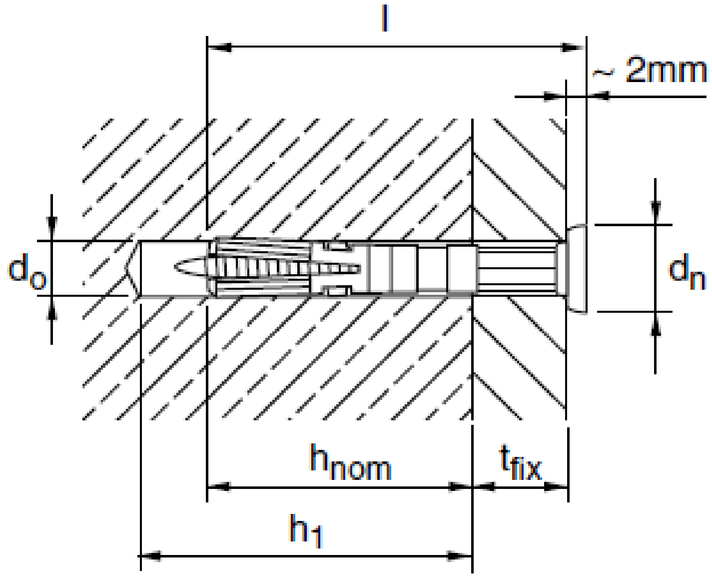


Install anchor.



Hammer in anchor.

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}

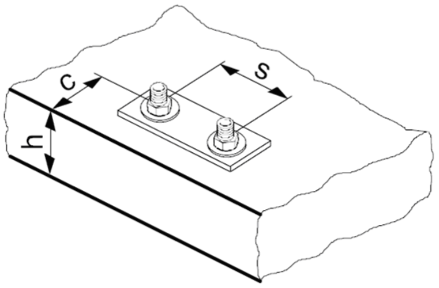


Setting details HPS-1

Anchor size			HPS-1 4	HPS-1 5	HPS-1 6	HPS-1 8
Nominal diameter of drill bit	d_o	[mm]	4	5	6	8
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	4,35	5,35	6,4	8,45
Depth of drill hole	$h_1 \geq$	[mm]	25	30	40	50
Effective anchorage depth	h_{nom}	[mm]	20	20	25	30
Anchor length	l	[mm]	21,5	22 - 37	27 - 67	28,5 – 132,5
Max fixture thickness	t_{fix}	[mm]	2	15	40	100
Installation temperature		[°C]	-10 to +40			

Base material thickness, anchor spacing and edge distance

Anchor size			HPS-1 4/	HPS-1 5/	HPS-1 6/	HPS-1 8/
Spacing	s	[mm]	20	25	30	35
Edge distance	c	[mm]	20	25	30	35



HHD-S Cavity anchor

	Anchor version	Benefits
	HHD-S	- metal undercut anchor with metric screw, esp. for drywall - metal to metal fastening - reliable undercut

Drywall

Basic loading data (for a single anchor)

All data in this section applies to

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Base material as specified in the table
- Borehole drilling without hammering

Recommended loads [a)]

Anchor size			M4	M5	M6	M8
Hollow brick web thickness 20mm	N_{rec}	[kN]	0,1	-	-	-
	V_{rec}	[kN]	0,3	-	-	-
Gypsum board Thickness 10mm	N_{rec}	[kN]	0,2	0,2	0,2	0,2
	V_{rec}	[kN]	0,5	0,5	0,5	0,5
Gypsum board Thickness 12,5mm	N_{rec}	[kN]	0,2	0,2	0,2	0,2
	V_{rec}	[kN]	0,5	0,5	0,5	0,5
Gypsum board Thickness 2x12,5mm	N_{rec}	[kN]	-	0,4	0,3	0,4
	V_{rec}	[kN]	-	1	0,9	1
Fibre reinforced gypsum board Thickness 10mm	N_{rec}	[kN]	0,2	0,3	0,25	0,4
	V_{rec}	[kN]	0,5	0,6	0,8	0,9
Fibre reinforced gypsum board Thickness 12,5mm	N_{rec}	[kN]	0,3	0,5	0,3	0,6
	V_{rec}	[kN]	0,6	1	1	1,2
Fibre reinforced gypsum board Thickness 2x12,5mm	N_{rec}	[kN]	-	0,9	0,8	0,9
	V_{rec}	[kN]	-	1,1	1,8	1,7

a) With overall global safety factor γ = 3 to the characteristic loads and a partial safety factor of γ = 1,4 to the design values.

Materials

Material quality

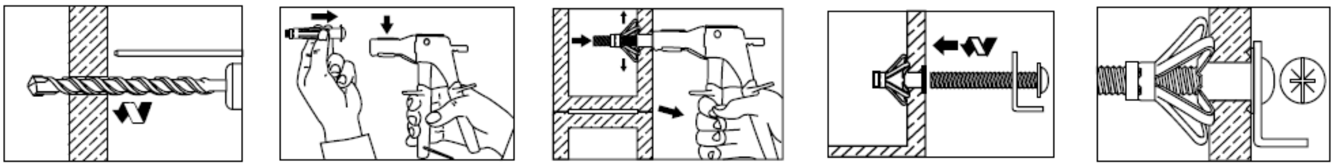
Part	Material
Sleeve	Carbon steel, galvanised
Screw	Carbon steel, galvanised

Setting

Installation equipment

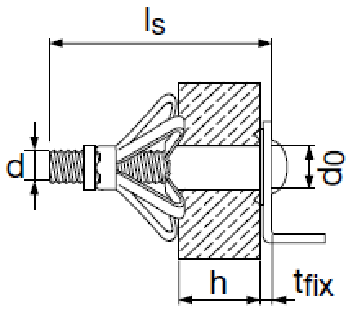
Anchor size	
Rotary hammer	TE2… TE16
Other tools	Screwdriver, HHD-SZ2 expansion tool

Setting instruction



Drill hole with drill bit. | Put anchor into setting tool. | Install anchor with setting tool. | Remove screw from anchor and screw in gain with part being fastened attached.

Setting details:



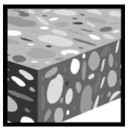
Setting details HHD-S

Anchor version			M4/4	M4/6	M4/12	M4/19	M5/8	M5/12	M5/25
Nominal diameter of drill bit	d_o	[mm]	8	8	8	8	10	10	10
Anchor length	l	[mm]	20	32	38	45	38	52	65
Anchor neck length	h	[mm]	4	6	12,5	19	8	12,5	25
Screw length	$l_S \geq$	[mm]	25	39	45	52	45	58	71
Screw diameter	d		M4	M4	M4	M4	M5	M5	M5
Panel thickness	$h_{min,max}$	[mm]	3 - 4	6 - 7	10 - 13	18 - 20	6 - 8	11 - 13	23 - 25
Max. fixable thickness for pre-setting	t_{fix}	[mm]	15	25	25	25	25	30	30

Anchor version			M6/9	M6/12	M6/24	M6/40	M8/12	M8/24	M8/40
Nominal diameter of drill bit	d_o	[mm]	12	12	12	12	12	12	12
Anchor length	l	[mm]	38	52	65	80	54	66	83
Anchor neck length	h	[mm]	9	12,5	25	40	12,5	25	40
Screw length	$l_S \geq$	[mm]	45	58	71	88	60	72	90
Screw diameter	d		M6	M6	M6	M6	M8	M8	M8
Panel thickness	$h_{min,max}$	[mm]	7 - 9	11 - 13	23 - 25	38 - 40	11 - 13	23 - 25	38 – 40
Max. fixable thickness for pre-setting	t_{fix}	[mm]	20	30	30	30	30	30	35

HCA Coil anchor

Anchor version		Benefits
	HCA 5/8”	- re-usable up to 140 times - high load capacity - big washer: ∅ 34 mm - for temporary external applications



Concrete

Tensile zone

DIBt Approval Reusability

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
DIBt approval (Reusability)	DIBt, Berlin	Z-21.8-2027 / 2014-05-14

Basic loading data for temporary application

All data in this section applies to

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Base material as specified in the table

Basic loading data for temporary application in standard and fresh concrete < 28 days old, $f_{ck,cube}$ ≥ 10 N/mm²:

All data in this section applies to the following conditions:

- Strength class, $f_{ck,cube}$ ≥ 10 N/mm²
- Only temporary use
- Screw is reusable, before each usage it must be checked according Hilti instruction for use with the suited tube Hilti HRG
- Design resistance are valid for single anchor only
- Design resistance are valid for all load direction and valid for both cracked and non-cracked concrete
- Minimum base material thickness
- No edge distance and spacing influence

Design resistance for all directions in cracked in non-cracked concrete

Anchor			HCA 5/8” x 90	HCA 5/8” x 130
Length in concrete	$h_{nom} \geq$	[mm]	80	115
Design resistance for concrete strength **≥ 10 N/mm²**	F_{Rd} [1)]	[kN]	4	12
Design resistance for concrete strength **≥ 15 N/mm²**	F_{Rd} [1)]	[kN]	5	15
Design resistance for concrete strength **≥ 20 N/mm²**	F_{Rd} [1)]	[kN]	6	18

Materials

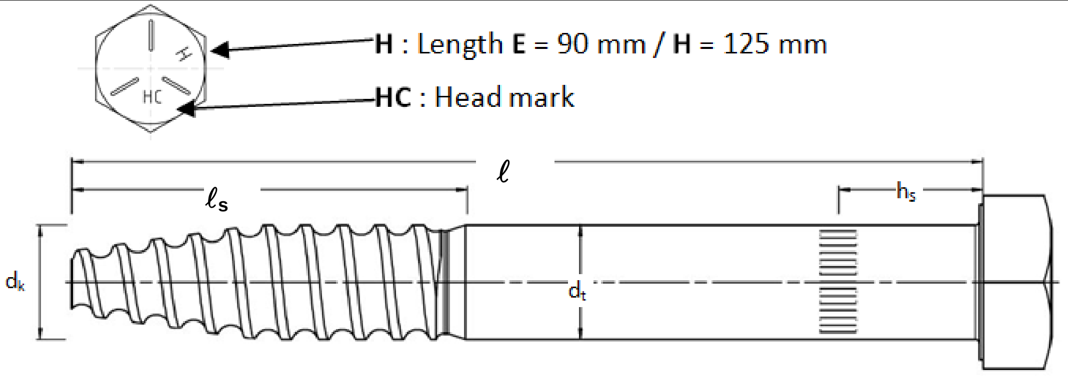
Material quality

Part	Material
Anchor HCA 5/8“	Steel; galvanized; fuk ≥ 850 N/mm2
Coil HCT	Steel; galvanized; 350 N/mm2 ≤ fuk ≤ 800 N/mm2

Anchor dimensions

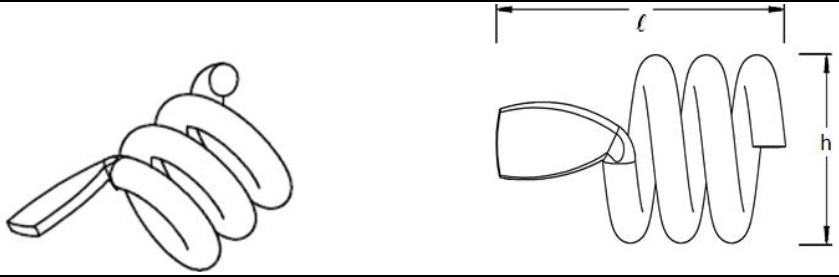
Dimensions and anchor head marks

Anchor			HCA 5/8” x 90	HCA 5/8” x 130
Length in concrete	$h_{nom} \geq$	[mm]	80	115
Anchor length	ℓ	[mm]	90	125
Length of thread	ℓ_s	[mm]	51	
Outer diameter	d_t	[mm]	15,8	
Core diameter	d_k	[mm]	13,1	
Marking for correct installation	h_s	[mm]	20	
Cross section	A_s	[mm²]	196,1	



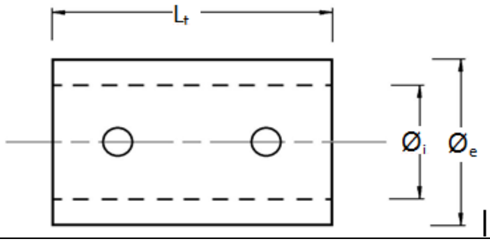
Coil dimensions

Coil			HCT
Length of Coil	ℓ	[mm]	29,3
Height Coil	h	[mm]	15,6



Tube specification

Tube			HRG 16
Inner tube diameter	$Ø_i$	[mm]	15,1
Outer tube diameter	$Ø_e$	[mm]	20,0
Tube length	L_t	[mm]	30,0



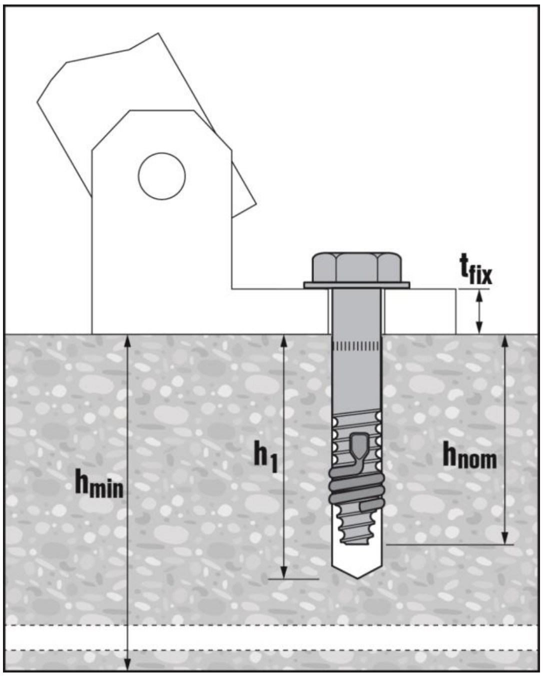
Setting

Installation equipment

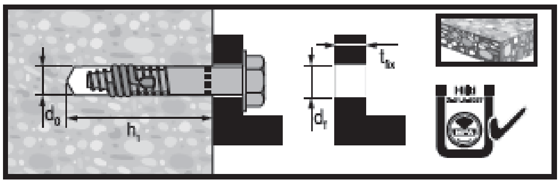
Rotary hammer	TE2… TE80
Other tools	hammer, torque wrench, blow out pump

Setting details

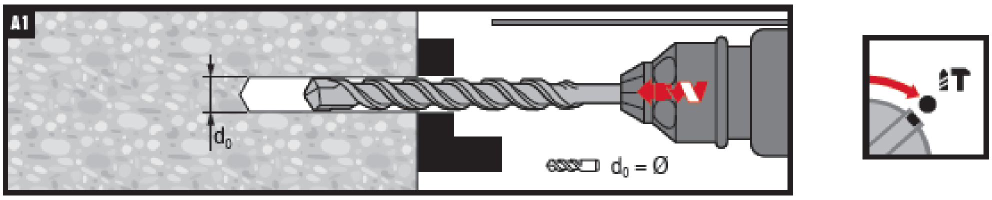
Anchor			HCA 5/8" x 90	HCA 5/8" x 130
Length in concrete	$h_{nom} \geq$	[mm]	80	115
Nominal diameter of drill bit	d_0	[mm]	16	
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	16,5	
Diameter of clearance hole in the fixture	d_f	[mm]	18	
Wrench size (H-type)	SW	[mm]	24	
Thickness of fixture	t_{fix}	[mm]	0 .. 10	
Depth of drill hole	$h_1 \geq$	[mm]	95 - t_{fix}	135 - t_{fix}
Torque moment	T_{min}	[Nm]	180	

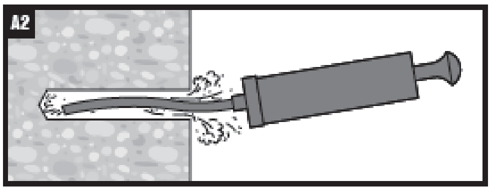


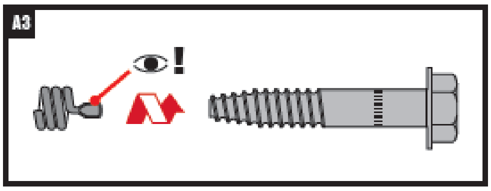
Setting instruction

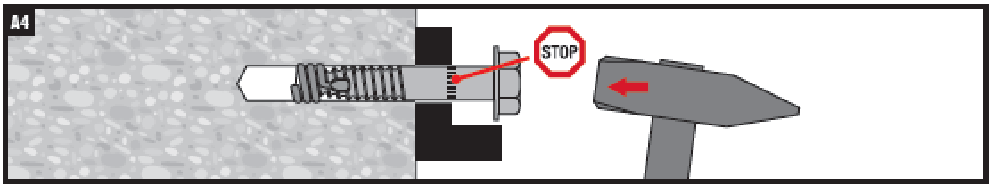


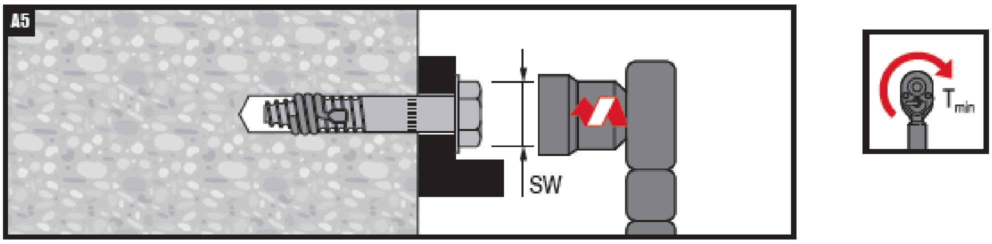
HCA	Ø d_0 [mm]	t_{fix} [mm]	h_1 [mm]	d_f [mm]
16 x 90	16	0....10	95 – t_{fix}	18
16 x 130		0....10	135 – t_{fix}	





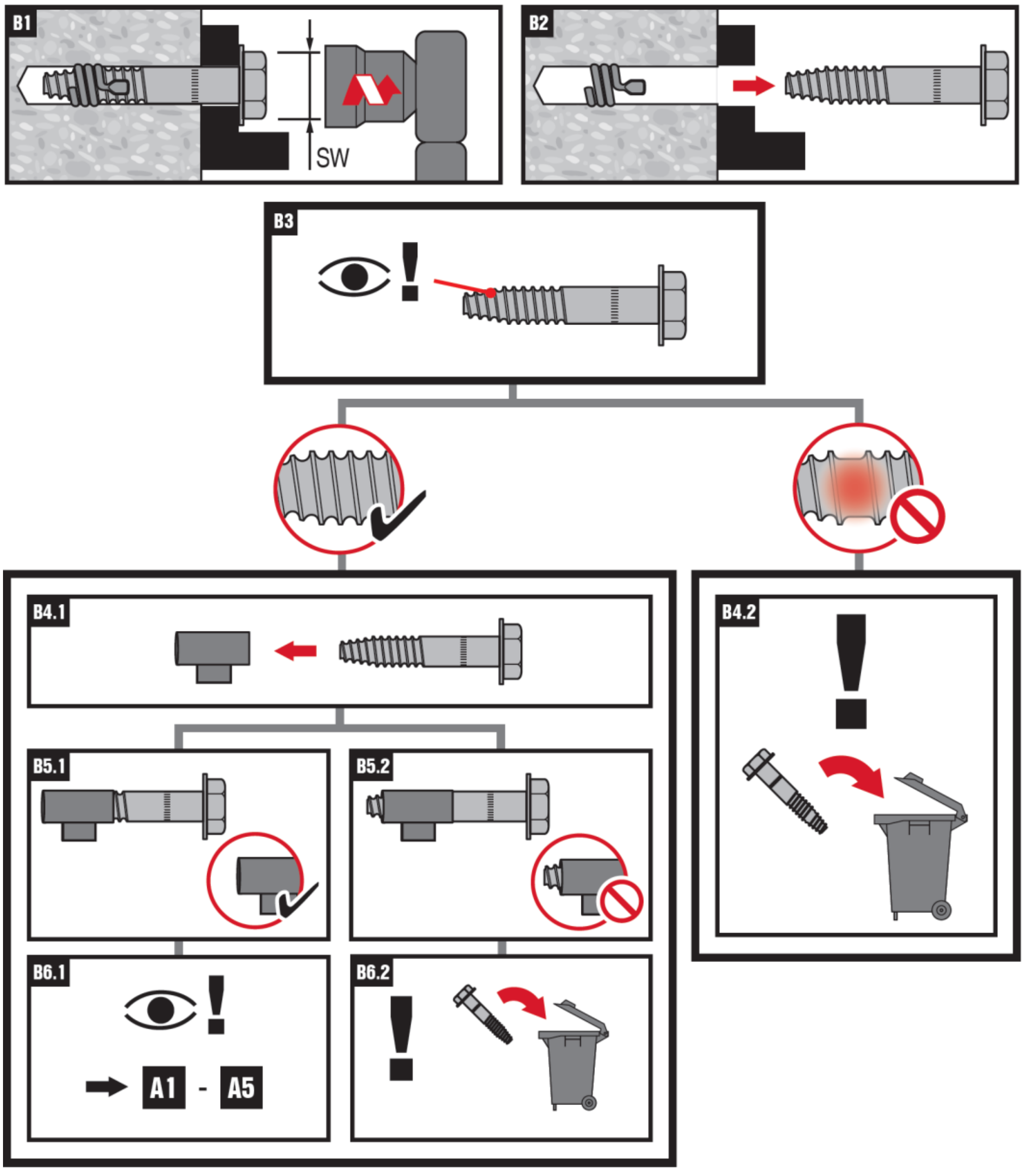






HCA [mm]	SW [mm]	t_{fix} [mm]	T_{min} [Nm]
Ø 16	24	10	180

Setting instruction for re-use in temporary use

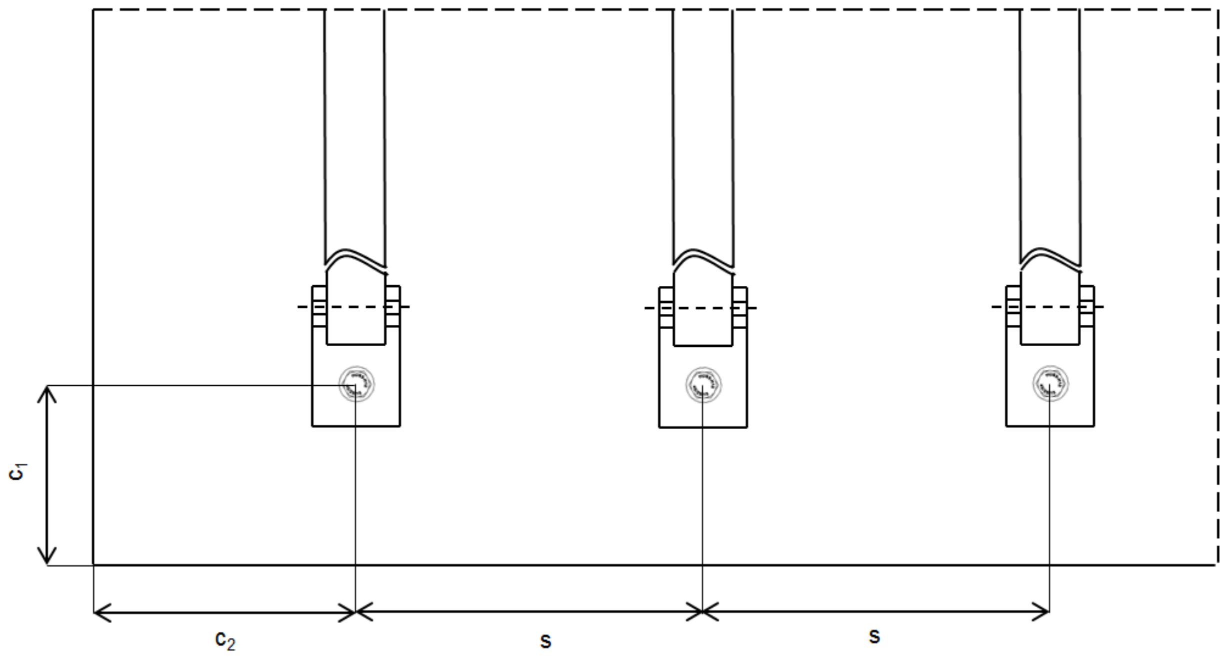


Before re-use of the coil anchor HCA 5/8” the wear shell be proven with the tube HRG 16:
- the anchor is not visible on the back side of the tube
- the anchor thread shell not damaged

Setting parameters

Minimum thickness of concrete member, minimum edge distance and spacing

Anchor			**HCA 5/8" x 90**	**HCA 5/8" x 130**
Length in concrete	$h_{nom} \geq$	[mm]	80	115
Minimum thickness of concrete member	h_{min}	[mm]	200	200
Minimum spacing	s_{min}	[mm]	125	550
Minimum edge distance (load direction 1)	$c_{1,min}$	[mm]	150	350
Minimum edge distance (load direction 2)	$c_{2,min}$	[mm]	200	500



HSP / HFP Drywall plug

Anchor version		Benefits
	HSP	- for light fastenings on drywall panel - self-cutting - quick setting
	HFP	


Drywall

Basic loading data (for a single anchor)

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Base material as specified in the table

Recommended loads

Anchor size		HSP	HFP
Gypsum board Thickness 12,5 mm	N_{rec} [kN]	0,07	0,07
	V_{rec} [kN]	0,18	0,18
Gypsum board Thickness 2x12,5 mm	N_{rec} [kN]	0,1	-
	V_{rec} [kN]	0,27	-
Gypsum panel Thickness 100 mm [a)]	N_{rec} [kN]	0,09	-
	V_{rec} [kN]	0,25	-

a) Pre-drilling with 6mm diameter drill bit

Materials

Material quality

Part	Material
HFP	Polyamide, fibre reinforced
HSP	Zinc die-casting
Screw	Carbon steel, galvanised to min. 5µm

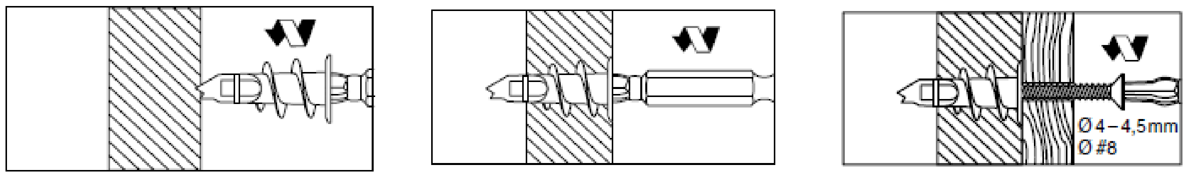
Setting

Installation equipment

Anchor size	
Rotary hammer	-
Other tools	Screwdriver with D-B PH2 HSP/HFP duo-bit

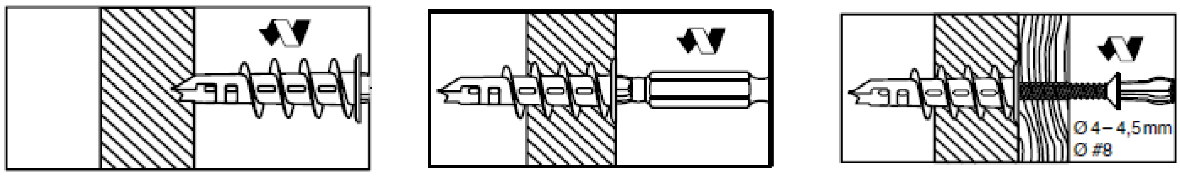
Setting instruction

HFP:



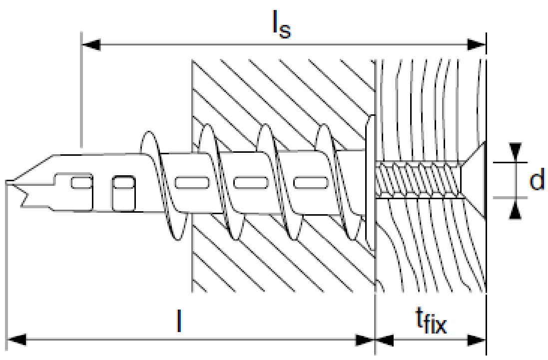
Drive in the plug. Fasten part and drive in screw.

HSP:



Drive in the plug. Fasten part and drive in screw.

Setting details:

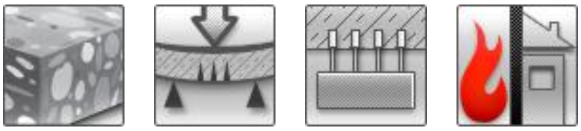


Setting details HSP / HFP

Anchor version			HSP	HFP
Max fixture thickness	t_{fix}	[mm]	15	10
Anchor length	l	[mm]	39	29
Screw length	l	[mm]	15 + t_{fix}	
Screw diameter	d	[mm]	4,5	4,5

HA 8 Ring / hook anchor

Anchor version		Benefits
	HA 8 R1	- 8mm anchor for concrete ceilings - hand-setting - follow-up expansion
	HA 8 H1	



Concrete | Tensile zone | Redundant fastening | Fire resistance

a) Redundant fastening only

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Fire test report	IBMB, Braunschweig	UB 3245/1817-5 / 1997-12-12
Assessment report (fire)	warringtonfire	WF 327804/A / 2013-07-10

Basic loading data (for a single anchor)

All data in this section applies to

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Only for redundant fastening
  Values are only valid for tensile loading
- Concrete ≥ C 20/25 ($f_{ck,cube}$ = 25 N/mm²), ≤ C50/60 ($f_{ck,cube}$ = 60 N/mm²)

Recommended loads

	Non-cracked concrete	Cracked concrete (redundant fastening)
Anchor size		
Tensile N_{rec} [kN]	0,8	0,8

Materials

Material quality

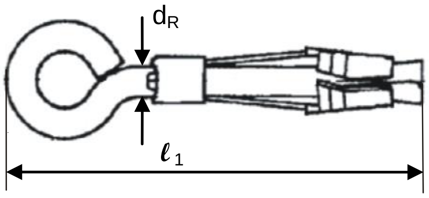
Part	Material
Expansion sleeve	Carbon steel, galvanised to min. 5 µm
Bolt	Carbon steel, galvanised to min. 5 µm

Mechanical properties of HA 8

Anchor size	HA 8 expansion sleeve	HA 8 bolt
Nominal tensile strength f_{uk} [N/mm²]	370	460
Yield strength f_{yk} [N/mm²]	270	220

Anchor dimensions

Anchor size			
Bolt diameter	d_R	[mm]	5
Length of the anchor	ℓ_1	[mm]	66

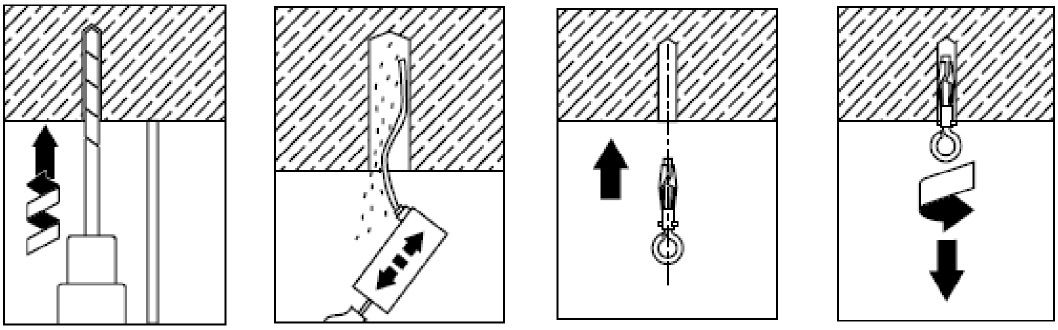


Setting

Installation equipment

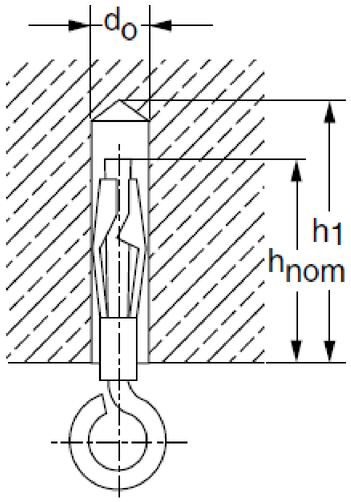
Anchor size	
Rotary hammer	TE2 … TE16
Other tools	hammer, blow out pump

Setting instruction



Drill hole with drill bit. | Blow out dust and fragments. | Install anchor. | Pull to expand the anchor.

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}

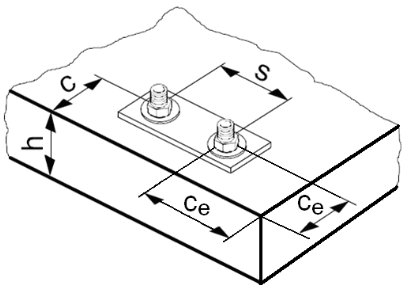


Setting details HA 8

Nominal diameter of drill bit	d_o	[mm]	8
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45
Depth of drill hole	$h_1 \geq$	[mm]	50
Effective anchorage depth	h_{ef}	[mm]	40

Base material thickness, anchor spacing and edge distance

Anchor size			
Minimum base material thickness	h_{min}	[mm]	100
Minimum spacing	s	[mm]	200
Minimum edge distance	c	[mm]	100
Minimum edge distance at the corner	c_e	[mm]	150

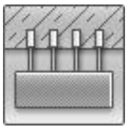


DBZ Wedge anchor

Anchor version		Benefits
	DBZ Carbon steel	- well proven - simple installation - small drill bit diameter - reliable setting thanks to simple visual check - for fixing in cracked concrete, redundant fastening only, e.g. suspended ceilings


Concrete


Tensile zone[a)]


Redundant fastening


Fire resistance


European Technical Approval


CE conformity

a) Redundant fastening only

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt	ETA-06/0179, 2011-09-14
Fire test report	DIBt	ETA-06/0179, 2011-09-14
Assessment report (fire)	warringtonfire	WF 327804/A / 2013-07-10

a) All data given in this section for DBZ wedge anchor according ETA-06/0179, issue 2011-09-14. The anchor is to be used only for redundant fastening for non-structural applications.

Basic loading data for all load directions according design method C of ETAG 001

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete C 20/25 $f_{ck,cube}$ = 25 N/mm² to C50/60, $f_{ck,cube}$ = 60 N/mm²
- Anchors in redundant fastening

Mean ultimate resistance, all load directions

Anchor size		DBZ 6/4,5	DBZ 6/35
Load $F_{Ru,m}$	[kN]	*6,0*	*6,0*

Characteristic resistance, all load directions

Anchor size		DBZ 6/4,5	DBZ 6/35
Resistance F_{Rk}	[kN]	4,0	4,0

Design resistance, all load directions

Anchor size		DBZ 6/4,5	DBZ 6/35
Resistance F_{Rd}	[kN]	2,2	2,2

Recommended loads [a)], all load directions

Anchor size		DBZ 6/4,5	DBZ 6/35
Resistance F_{Rec}	[kN]	1,6	1,6

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Requirements for redundant fastening

The definition of redundant fastening according to Member States is given in the ETAG 001 Part six, Annex 1. In Absence of a definition by a Member State the following default values may be taken

Minimum number of fixing points	Minimum number of anchors per fixing point	Maximum design load of action N_{Sd} per fixing point [a)]
3	1	2 kN
4	1	3 kN

a) The value for maximum design load of actions per fastening point N_{Sd} is valid in general that means all fastening points are considered in the design of the redundant structural system. The value N_{Sd} may be increased if the failure of one (= most unfavourable) fixing point is taken into account in the design (serviceability and ultimate limit state) of the structural system e.g. suspended ceiling.

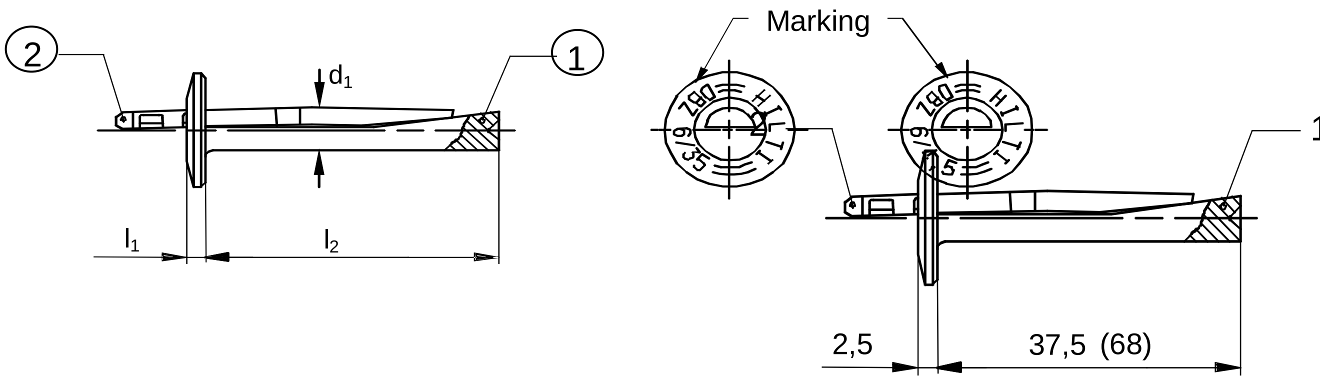
Materials

Mechanical properties of DBZ

Anchor size			DBZ 6/4,5	DBZ 6/35
Nominal tensile strength	f_{uk}	[N/mm²]	390	390
Yield strength	f_{yk}	[N/mm²]	310	310
Stressed cross-section	A_s	[mm²]	26	26
Char. bending resistance	$M^0_{Rk,s}$	[Nm]	5,0	5,0

Material quality of DBZ

Part	Material
1 … Anchor shank	Cold-formed steel; galvanized ≥ 5µm
2 … Expansion pin	Cold-formed steel; galvanized ≥ 5µm



Anchor dimensions

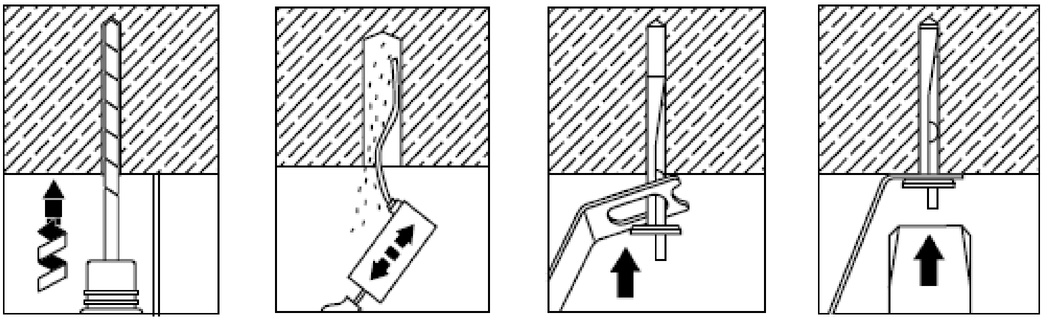
Anchor size			DBZ 6/4,5	DBZ 6/35
Height anchor head	l_1	[mm]	2,5	2,5
Max. distance	d_1	[mm]	6,4	6,4
Length of anchor shaft	l_2	[mm]	37,5	68

Setting

Recommended installation equipment

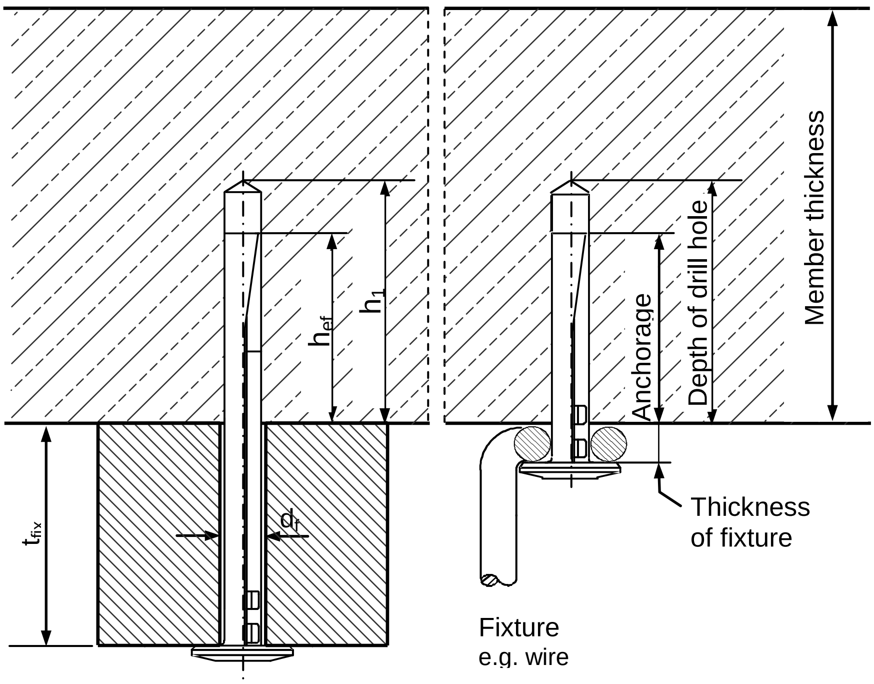
Anchor size	DBZ 6/4,5	DBZ 6/35
Rotary hammer	TE 2 – TE 7	
Other tools	hammer, blow out pump	

Setting instruction



Drill hole with drill bit. | Blow out dust and fragments. | Install anchor with suspended item. | Hammer in anchor.

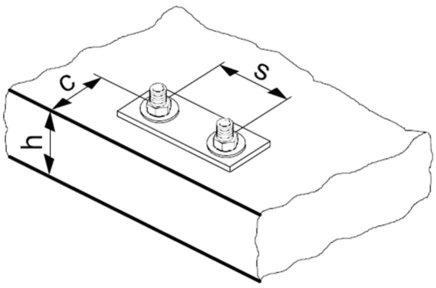
Setting details



Anchor size		DBZ 6/4,5	DBZ 6/35	
Thickness of fixture	t_{fix} [mm]	≤ 4,5	20 ≤ t_{fix} ≤ 35	5 ≤ t_{fix} < 20
Depth of drill hole	h_1 ≥ [mm]	40	55	70
Nominal diameter of drill bit	d_0 [mm]	6	6	
Cutting diameter of drill bit	d_{cut} ≤ [mm]	6,4	6,4	
Clearance hole diameter	d_f ≤ [mm]	7	7	

Base material thickness, anchor spacing and edge distance [a)]

Anchor size		DBZ 6/4,5	DBZ 6/35	
Thickness of fixture	t_{fix} [mm]	≤ 4,5	20 ≤ t_{fix} ≤ 35	5 ≤ t_{fix} < 20
Minimum member thickness	h_{min} ≥ [mm]	80	80	100
Effective anchorage depth	h_{ef} [mm]	32	32	
Critical spacing	s_{cr} [mm]	200	200	
Critical edge distance	c_{cr} [mm]	150	150	

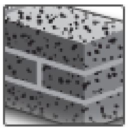


a) The critical spacing (critical edge distance) shall be kept. Smaller spacing (edge distance) than critical spacing (critical edge distance) are not covered by the design method.

HT Metal frame anchor

Anchor version		Benefits
	HT	- fastening door and window frames - no risk of distortion or forces of constraint - expansion cone can not be lost


Concrete


Solid brick


Hollow brick


Autoclaved aerated concrete


Fire resistance

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Fire test report	IBMB, Braunschweig	UB 3016/1114-CM / 2006-03-13
Assessment report (fire)	warringtonfire	WF 327804/A / 2013-07-10

Basic loading data (for a single anchor)

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Base material as specified in the table
- Non-cracked concrete: $f_{cc} \geq 20$ N/mm^2
- Minimum base material thickness

Characteristic resistance

			HT 8	HT10
Concrete, f_{cc} = 30 N/mm²	N_{Rk}	[kN]	4,2	5,0
	V_{Rk}	[kN]	6,6	7,0
Aerated Concrete PP2[a)]	N_{Rk}	[kN]	-	0,3
	V_{Rk}	[kN]	-	0,5
Solid brick Mz 12	N_{Rk}	[kN]	1,8	2,6
	V_{Rk}	[kN]	-	5,0
Sand-lime solid brick, KS 12	N_{Rk}	[kN]	1,8	2,6
	V_{Rk}	[kN]	-	5,0
Sand-lime hollow brick, KSL	N_{Rk}	[kN]	-	1,5
	V_{Rk}	[kN]	-	0,5

a) Rotary drilling only

Recommended loads

			HT 8	HT10
Concrete, f_{cc} = 30 N/mm²	N_{rec}	[kN]	1,4	1,7
	V_{rec}	[kN]	0,5	0,5
Aerated Concrete PP2[a)]	N_{rec}	[kN]	-	0,1
	V_{rec}	[kN]	-	0,15
Solid brick Mz 12	N_{rec}	[kN]	0,6	0,8
	V_{rec}	[kN]	-	0,5
Sand-lime solid brick, KS 12	N_{rec}	[kN]	0,6	0,8
	V_{rec}	[kN]	-	0,5
Sand-lime hollow brick, KSL	N_{rec}	[kN]	-	0,5
	V_{rec}	[kN]	-	0,15

a) Rotary drilling only

Materials

Material quality

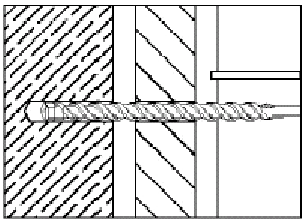
Part	Material
Bolt	steel strength 4.8, zinc plated to 5 µm
Sleeve	steel 02 DIN 17162, sendzimir zinc plated to 20 µm

Setting

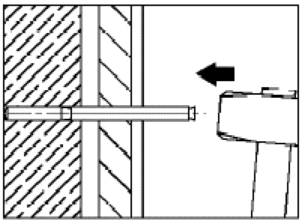
installation equipment

Anchor size	
Rotary hammer	TE1 – TE16
Other tools	hammer, screwdriver

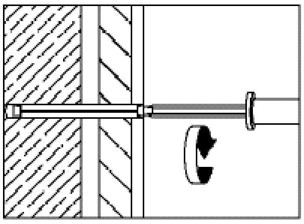
Setting instruction



Drill hole with drill bit.



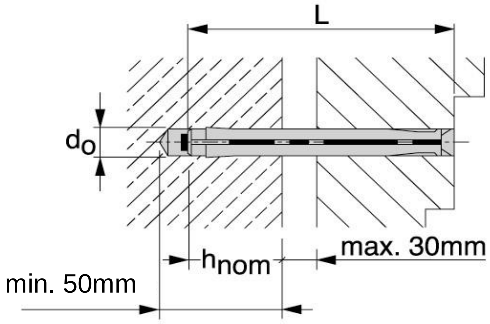
Install anchor.



Drive screw into anchor.

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

Setting details: anchor length L and anchorage depth h_{nom}



Setting details HT

		HT 8	8x72	8x92	8x112
Nominal diameter of drill bit	d_o	[mm]	8	8	8
Depth of drill hole	h_1	[mm]	50	50	50
Anchorage depth	h_{nom}	[mm]	30	30	30
Anchor length	L	[mm]	72	92	112
Torque moment	T_{inst}	[Nm]	4	4	4
Minimum base material thickness	h_{min}	[mm]	100	100	100
Drill bit			TE-CX-8/17		TE-CX-8/22

		HT 8	8x132	8x152	8x182
Nominal diameter of drill bit	d_o	[mm]	8	8	8
Depth of drill hole	h_1	[mm]	50	50	50
Anchorage depth	h_{nom}	[mm]	30	30	30
Anchor length	L	[mm]	132	152	182
Torque moment	T_{inst}	[Nm]	4	4	4
Minimum base material thickness	h_{min}	[mm]	100	100	100
Drill bit			TE-CX-8/22	TE-CX-8/27	

		HT 10	10x72	10x92	10x112
Nominal diameter of drill bit	d_o	[mm]	10	10	10
Depth of drill hole	h_1	[mm]	50	50	50
Anchorage depth	h_{nom}	[mm]	30	30	30
Anchor length	L	[mm]	72	92	112
Torque moment	T_{inst} a)	[Nm]	8/4	8/4	8/4
Minimum base material thickness	h_{min}	[mm]	100	100	100
Drill bit			TE-C-10/17		TE-C-10/22

a) First value: solid base material, second value: hollow base material

		HT 10	10x132	10x152	10x182	10x202
Nominal diameter of drill bit	d_o	[mm]	10	10	10	10
Depth of drill hole	h_1	[mm]	50	50	50	50
Anchorage depth	h_0	[mm]	30	30	30	30
Anchor length	L	[mm]	132	152	182	202
Torque moment	T_{inst} [a]	[Nm]	8/4	8/4	8/4	8/4
Minimum base material thickness	h_{min}	[mm]	100	100	100	100
Drill bit			TE-C-10/22	TE-C-10/27		TE-C-10/37

a) First value: solid base material, second value: hollow base material

HK Ceiling anchor

		Anchor version	Benefits
	HK	-Carbon steel -Stainless steel -High corrosion resistant steel	- well proven - small drill bit diameter - for fixing in cracked concrete, redundant fastening only, e.g. suspended ceilings
	HK I	-Carbon steel -Stainless steel -High corrosion resistant steel	

Concrete | Tensile zone[a)] | Redundant fastening | Fire resistance | European Technical Approval | CE conformity

a) Redundant fastening only

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt	ETA-04/0043, 2013-06-11
Fire test report	DIBt	ETA-04/0043, 2013-06-11
Assessment report (fire)	warringtonfire	WF 327804/A / 2013-07-10

a) All data given in this section for HK Ceiling anchor according ETA-04/0043, issue 2013-06-11. The anchor is to be used only for multiple use for non-structural applications.

Basic loading data (for a single anchor)

All data in this section applies to

- Correct setting (see setting instruction)
- No edge distance and spacing influence.
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm² to C50/60, $f_{ck,cube}$ = 60 N/mm²
- Anchors in multiple use

Characteristic resistance, all load directions

Anchor size (carbon steel)		HK6	HK6L	HK8
Resistance F_{Rk} [a)]	[kN]	2,0	5,0	5,0

Anchor size (stainless steel, HCR)		HK6 -R /-HCR	HK6L -R /-HCR	HK8 -R /-HCR
Resistance F_{Rk} [a)]	[kN]	1,5	3,0	5,0

a) for all load directions (tension, shear and combined tension and shear loads)

Design resistance, all load directions

Anchor size (carbon steel)	HK6	HK6L	HK8
Resistance F_{Rd} a) [kN]	1,1	2,0	2,0

Anchor size (stainless steel, HCR)	HK6 -R /-HCR	HK6L -R /-HCR	HK8 -R /-HCR
Resistance F_{Rd} a) [kN]	0,6	1,2	2,3

a) for all load directions (tension, shear and combined tension and shear loads)

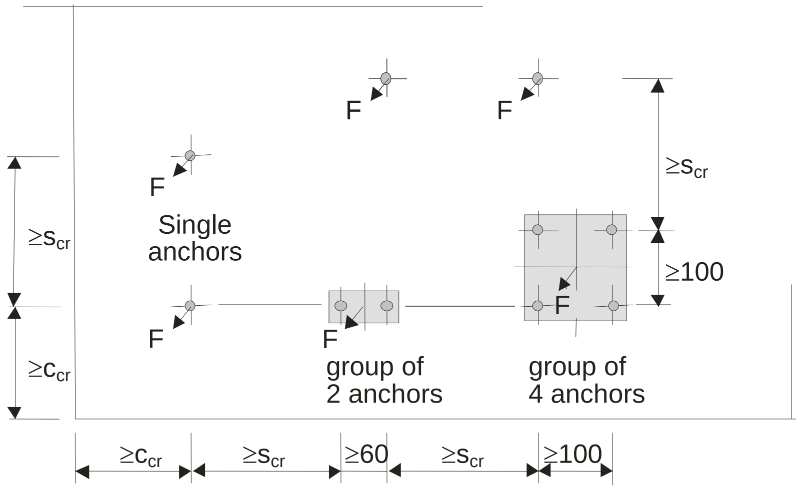
Recommended loads a), all load directions

Anchor size (carbon steel)	HK6	HK6L	HK8
Resistance F_{rec} b) [kN]	0,8	1,4	1,4

Anchor size (stainless steel, HCR)	HK6 -R /-HCR	HK6L -R /-HCR	HK8 -R /-HCR
Resistance F_{rec} b) [kN]	0,4	0,8	1,6

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.
b) for all load directions (tension, shear and combined tension and shear loads)

Special case: Groups of n=2 and/or n=4 anchors with small spacing



The basic loading data for a single anchor is valid for one fixing point.

Fixing points can be:

- **single anchors,**
  or
- **groups of 2 anchors**
  with $s_1 \geq 60$ mm
  or
- **groups of 4 anchors**
  with $s_1 \geq 100$ mm and $s_2 \geq 100$ mm

Requirements for multiple use

The definition of multiple use according to Member States is given in the ETAG 001 Part six, Annex 1. In Absence of a definition by a Member State the following default values may be taken

Minimum number of fixing points	Minimum number of anchors per fixing point	Maximum design load of action N_{Sd} per fixing point a)
3	1	2 kN
4	1	3 kN

a) The value for maximum design load of actions per fastening point N_{Sd} is valid in general that means all fastening points are considered in the design of the redundant structural system. The value N_{Sd} may be increased if the failure of one (= most unfavourable) fixing point is taken into account in the design (serviceability and ultimate limit state) of the structural system e.g. suspended ceiling.

Materials

Mechanical properties of HK

Anchor size (carbon steel)	HK6	HK6L	HK8
Char. bending resistance [a] $M^0_{Rk,s}$ [Nm]	3,6	7,7	18

a) Partial material safety factor γ_{Ms} = 1,25.

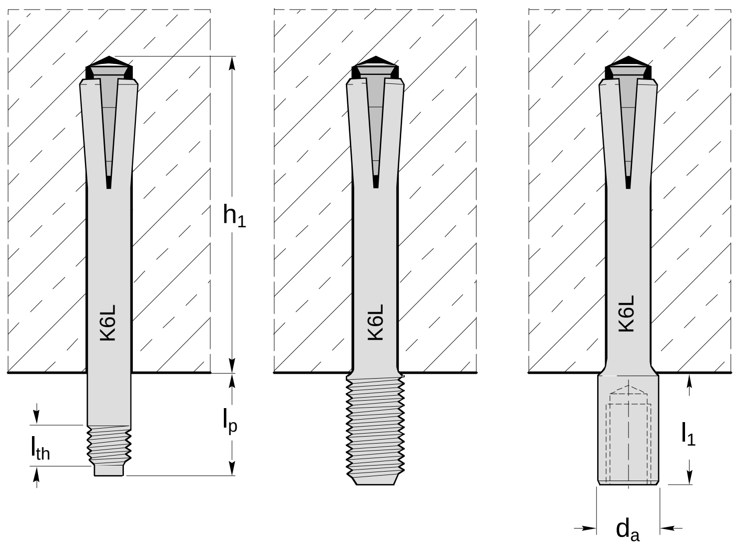
Anchor size (stainless steel, HCR)	HK6 -R /-HCR	HK6L -R /-HCR	HK8 -R /-HCR
Char. bending resistance [a] $M^0_{Rk,s}$ [Nm]	4,0	8,4	20,6

a) Partial material safety factor γ_{Ms} = 1,5.

Material quality of HK

Part	Marking	Material
Anchor HK6 Anchor HK6L Anchor HK8	K6 K6L K8	galvanised steel ≥ 5 µm
Anchor HK6 -R Anchor HK6L -R Anchor HK8 -R	K6E K6LE K8E	stainless steel, 1.4401or 1.4404
	K6X K6LX K8X	stainless steel, 1.4571
Anchor HK6 -HCR Anchor HK6L -HCR Anchor HK8 -HCR	K6C K6LC K8C	high corrosion resistant steel, 1.4529 or 1.4565

Anchor dimension



Anchor size	HK6		HK6L				
	$M6/t_{fix}$	$M8/t_{fix}$	M6/4	$M6/t_{fix}$	$M8/t_{fix}$	I M6	I M8
Thread size	external M6	external M8	external M6	external M6	external M8	internal M6	internal M8

Length of thread l_{th} [mm]	5 … 50	≥ 5	≥ 5	≥ 5	12	12
Length of projection l_p [mm]	t_{fix} + 7	11	≤ 300	≤ 300	-	-
Diameter of sleeve d_a [mm]	-	-	-	-	8	10
Length of sleeve l_1 [mm]	-	-	-	-	15	15

Anchor size	HK8			
	I M8	I M10	I M12	I M8/M10
Thread size	internal M8	internal M10	internal M12	internal M8/M10
Diameter of sleeve d_a [mm]	10	12	14	12
Length of sleeve l_1 [mm]	15	20	20	25

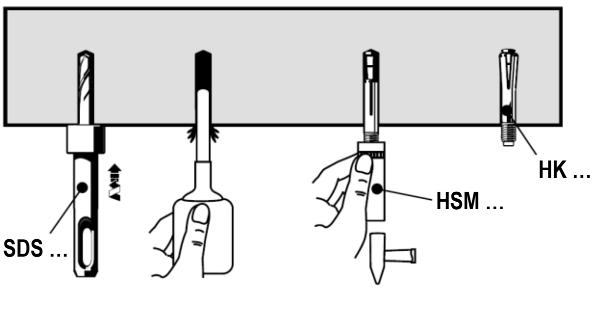
Setting

Recommended installation equipment

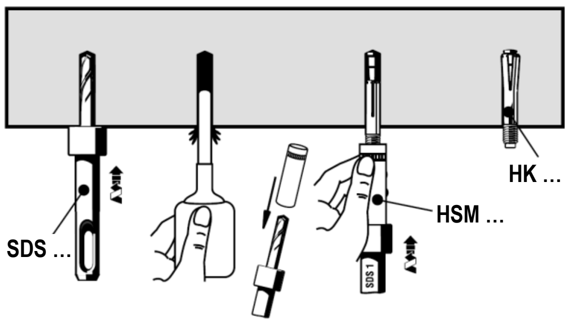
Anchor size	HK6	HKL	HK8
Rotary hammer	TE 2 – TE 16		
Stop drill bit	SDS 2		SDS 3
Setting tool	HSM … / HSM I …		HSM 8 … / HSM 8 I …
Other tools	blow out pump		

Setting instruction

Setting of HK

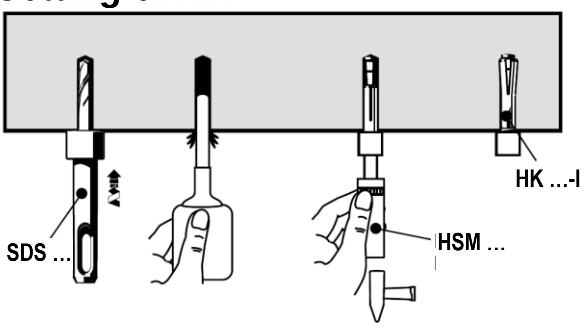


a) with hand setting tool

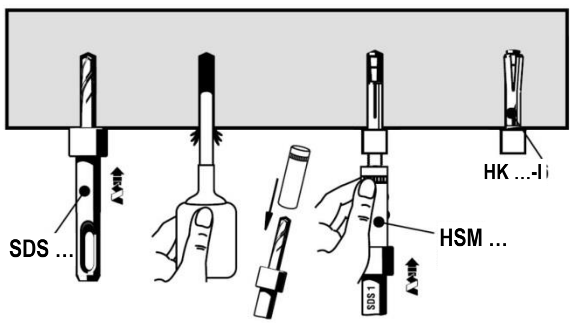


b) with machine setting tool

Setting of HK-I

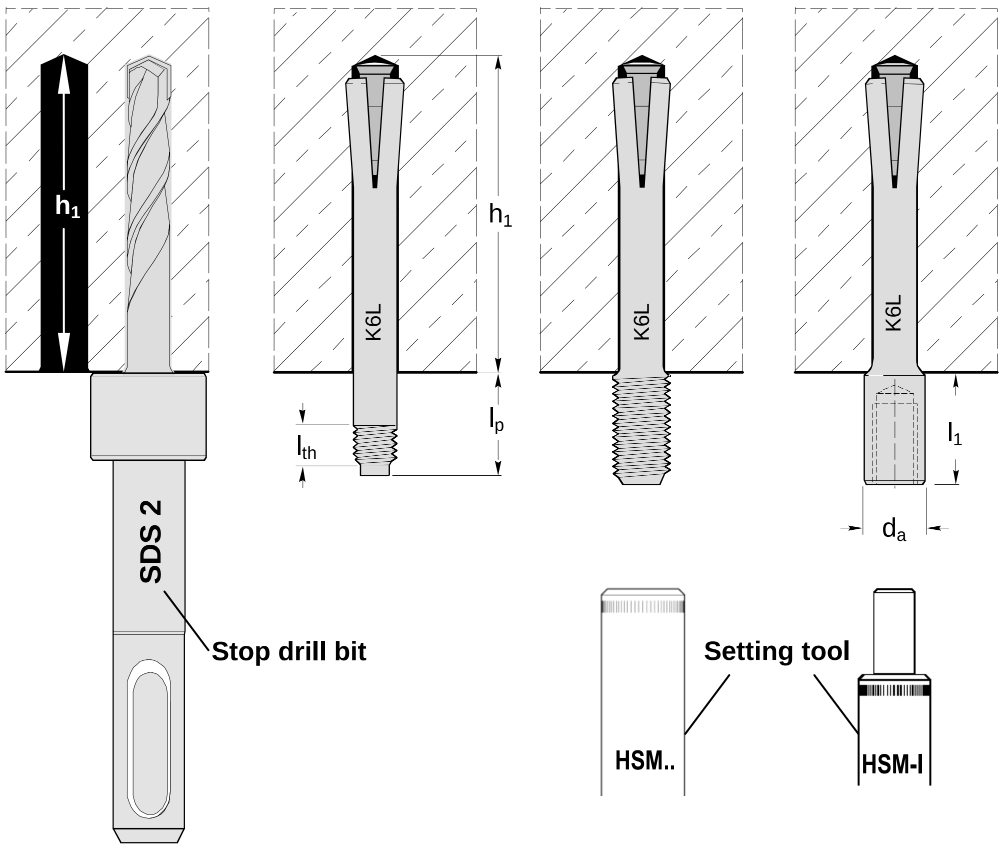


a) with hand setting tool



b) with machine setting tool

Setting details



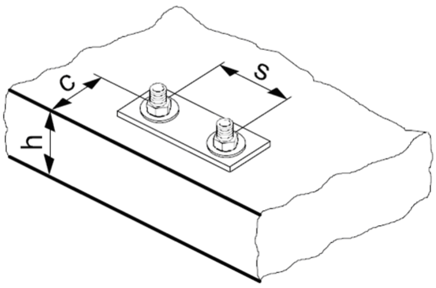
Anchor size		HK6		HK L				
		M6/t_{fix}	M8/t_{fix}	M6/4	M6/t_{fix}	M8/t_{fix}	I M6	I M8
Stop drill bit [a]		SDS 1		SDS 2				
Depth of drill hole [b]	h_1 [mm]	32		42				
Nominal diameter of drill bit	d_0 [mm]	6		6				
Setting tool		HSM 6 / t_{fix}	HSM 8 / t_{fix}	HSM 6 / 4	HSM 6 / t_{fix}	HSM 8 / t_{fix}	HSM I M6	HSM I M8
Clearance hole	d_f ≤ [mm]	7	9	7	7	9	9	12
Max. torque moment	T_{max} [Nm]	5		5				

Anchor size		HK8			
		I M8	I M10	I M12	I M8/M10
Stop drill bit [a]		SDS 3			
Depth of drill hole [b]	h_1 [mm]	43			
Nominal diameter of drill bit	d_0 [mm]	8			
Setting tool		HSM 8 I M8	HSM 8 I M10	HSM 8 I M12	HSM 8 I M8
Clearance hole	d_f ≤ [mm]	12	14	16	14
Max. torque moment	T_{max} [Nm]	10			

a) In case of through stetting choose stop drill bit with appropriate length
b) Use stop drill bit to ensure correct depth of bore hole

Base material thickness, anchor spacing and edge distance [a)]

Anchor size		HK6	HKL	HK8
Minimum member thickness	$h_{min} \geq$ [mm]	80		
Effective anchorage depth	h_{ef} [mm]	26	36	36
Critical spacing	s_{cr} [mm]	200		
Critical edge distance	c_{cr} [mm]	150		



a) The critical spacing (critical edge distance) shall be kept. Smaller spacing (edge distance) than critical spacing (critical edge distance) are not covered by the design method.

HPD Aerated concrete anchor

Anchor version		Benefits
	HPD	- anchor for autoclaved aerated concrete - maximum use of base material capacity - setting without drilling


Autoclaved aerated concrete


Sprinkler approved


Fire resistance

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Allgemeine bauaufsichtliche Zulassung (national approval in Germany) a)	DIBt, Berlin	Z-21.1-1729 / 2011-05-31
Fire test report	IBMB, Braunschweig	UB 3077/3602-Nau- / 2002-02-05
Assessment report (fire)	warringtonfire	WF 327804/A / 2013-07-10
Sprinkler	VdS, Cologne	G 4981083 / 2008-01-01

a) All data given in this section according Z-21.1-1729, issue 2011-05-31.

Basic loading data (for a single anchor)

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Autoclaved aerated concrete (AAC)
- Load data given in the tables is independent of load direction
  Minimum base material thickness

Recommended loads

			Non-cracked AAC [a]			Cracked AAC		
Anchor size			**M6**	**M8**	**M10**	**M6**	**M8**	**M10**
Recommended load for a single anchor								
AAC blocks,	AAC 2	[kN]	0,4	0,4	0,6	-	-	-
	AAC 4, AAC 6	[kN]	0,8	0,8	1,2	-	-	-
AAC wall members	P 3,3	[kN]	0,6	0,6	0,8	-	-	-
	P 4,4	[kN]	0,8	0,8	1,2	-	-	-
AAC ceiling members	P 3,3	[kN]	-	-	-	0,6	0,6	0,8
	P 4,4	[kN]	-	-	-	0,8	0,8	1,2
Recommended load for a group of two anchor with a spacing 100mm ≤ s ≤ 200mm								
AAC blocks,	AAC 2	[kN]	0,4	0,4	0,6	-	-	-
	AAC 4, AAC 6	[kN]	0,8	0,8	1,2	-	-	-
AAC wall members	P 3,3	[kN]	0,6	0,6	0,8	-	-	-
	P 4,4	[kN]	0,8	0,8	1,2	-	-	-
AAC ceiling members	P 3,3	[kN]	-	-	-	0,6	0,6	0,8
	P 4,4	[kN]	-	-	-	0,8	0,8	1,2
Recommended load for a group of two anchor with a spacing s ≥ 200mm								
AAC blocks,	AAC 2	[kN]	0,6	0,6	0,8	-	-	-
	AAC 4, AAC 6	[kN]	1,1	1,1	1,7	-	-	-
AAC wall members	P 3,3	[kN]	0,8	0,8	1,1	-	-	-
	P 4,4	[kN]	1,1	1,1	1,7	-	-	-
AAC ceiling members	P 3,3	[kN]	-	-	-	0,8	0,8	1,1
	P 4,4	[kN]	-	-	-	1,1	1,1	1,7

a) in case of small sized AAC blocks (<= 250mm x 500mm x thickness) the recommended load has to be reduced with a factor 0,6.

Materials

Mechanical properties of HPD

Anchor size			**M6**	**M8**	**M10**
Nominal tensile strength f_{uk}	Carbon steel	[N/mm²]	800	500	500
	Stainless steel	[N/mm²]	750	565	565
Yield strength f_{yk}	Carbon steel	[N/mm²]	-	-	-
	Stainless steel	[N/mm²]	-	-	-
Stressed cross-section A_s		[mm²]	20,1	36,6	58
Moment of resistance W		[mm³]	12,7	31,2	62,3
Char. bending resistance $M^0_{Rk,s}$	Carbon steel	[Nm]	12	19	37
	Stainless steel	[Nm]	11	21	42

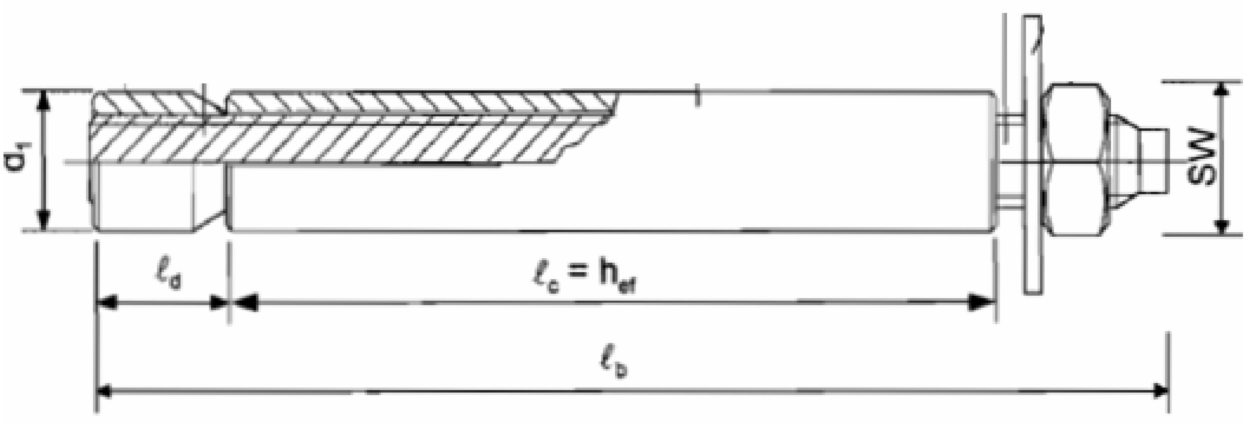
The recommended bending moment shall be calculated by dividing the characteristic bending moment by 1,4 and 1,25

Material quality

Part		Material
All parts	HPD	Carbon steel, galvanised to min. 5 µm
	HPD (stainless steel)	Stainless steel

Anchor dimensions

Anchor size			M6	M8	M10
Minimum thickness of fixture	$t_{fix,min}$	[mm]	0	0	0
Maximum thickness of fixture*	$t_{fix,max}$	[mm]	30	20	30
Anchor diameter	d_1	[mm]	9,8	11,8	13,8
Length of the expansion sleeve	ℓ_c	[mm]	70		
Length of the cone	ℓ_d	[mm]	12		



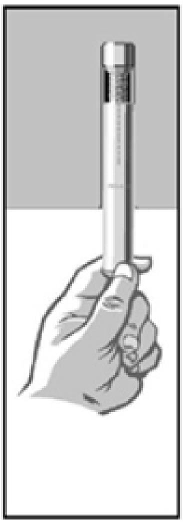
Setting

Installation equipment

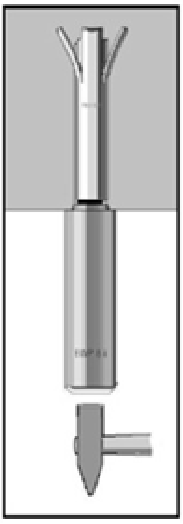
Anchor size		M6/10	M6/30	M8/10	M8/20	M10/10	M10/30
Setting tools	Manual setting tool (to be used with a hammer)	HPE-G 6/10	HPE-G 6/30	HPE-G 8/10	HPE-G 8/20	-	-
	Machine setting (to be used with a rotary hammer in pure hammering mode)	-	-	-	-	HPE-M 10/10	HPE-M 10/30

Setting instruction

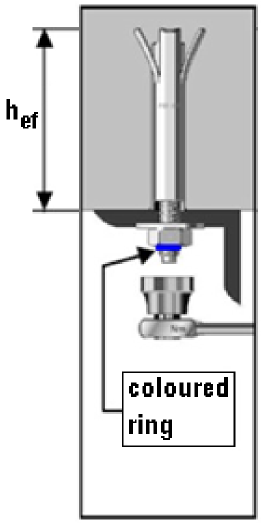
Insert the cone bolt by hammering it in, until setting tool touches surface.



Insert the expansion sleeve over the threaded rod.

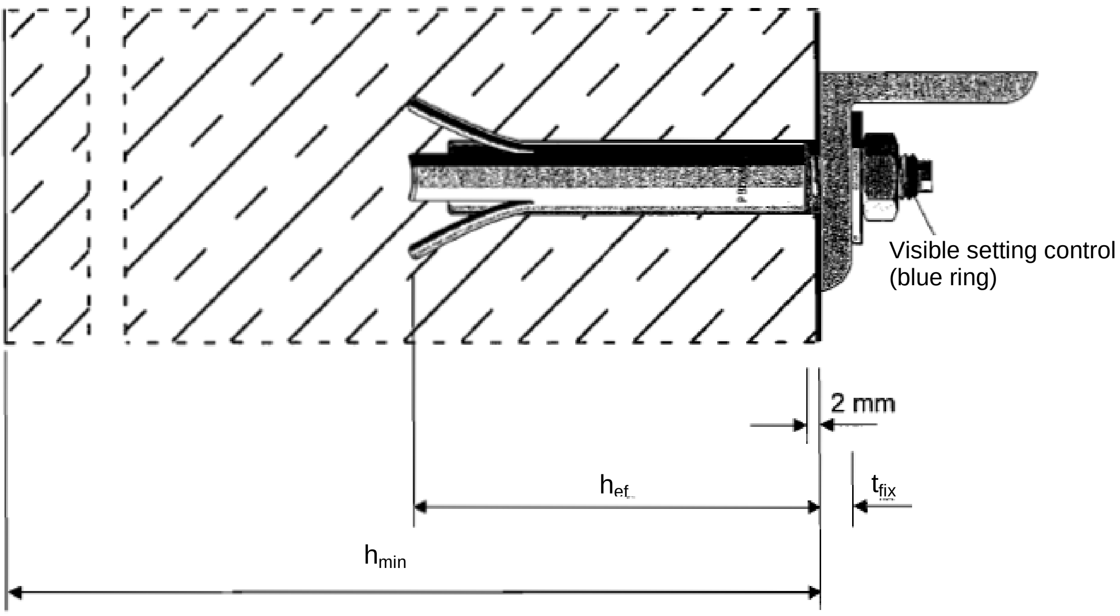


Bash in the sleeve by hammering or with the machine setting tool.



Tighten the nut until the blue ring becomes visible.

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}

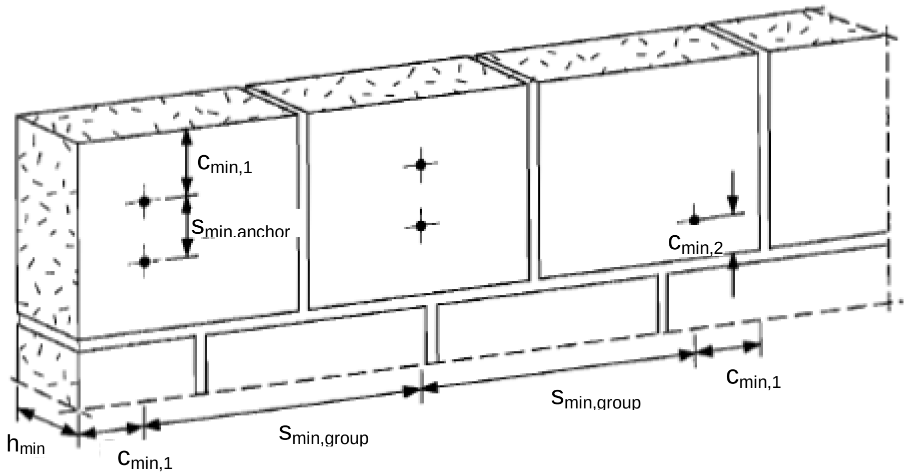


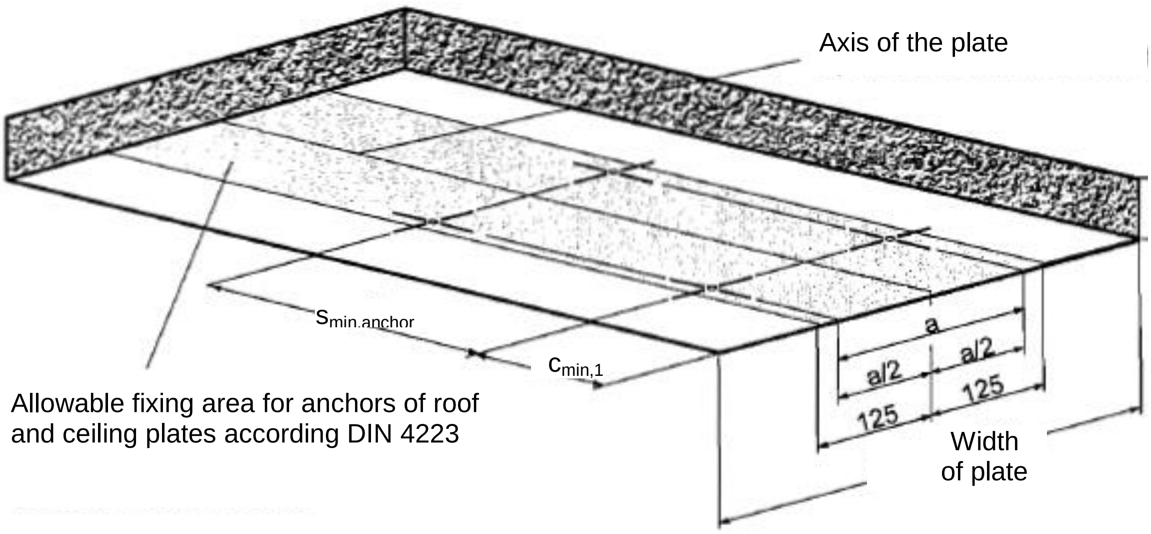
Setting details HPD

			M6	M8	M10
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	7	9	12
Effective anchorage depth	h_{ef}	[mm]	62	62	62
Torque moment	T_{inst}	[Nm]	3	5	8
Width across	SW	[mm]	10	13	17

Base material thickness, anchor spacing and edge distance

Anchor size				M8	M10	M12
Minimum base material thickness		h_{min}	[mm]	175		
Minimum spacing	Of anchors in a group	$s_{min,anchor}$	[mm]	100 / 200		
	Of anchor groups	$s_{min,group}$	[mm]	600		
Minimum edge distance	to member edge and to vertical joints	$c_{min,1}$	[mm]	150	150	150
	to horizontal joints	$c_{min,2}$	[mm]	50	50	50

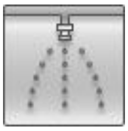




HKH Hollow deck anchor

Anchor version		Benefits
	HKH	- anchor for suspended ceilings & overhead support applications - channel installation - optical setting control

Prestressed hollow core slabs



Sprinkler approved

Fire resistance

Corrosion resistance

Approvals / certificates

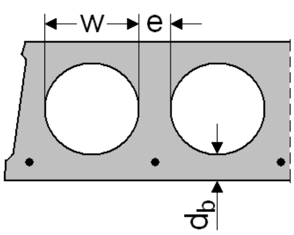
Description	Authority / Laboratory	No. / date of issue
Allgemeine bauaufsichtliche Zulassung (national approval in Germany for single point fastening)[a)]	DIBt, Berlin	Z-21.1-1722 / 2011-10-31
Fire test report	IBMB, Braunschweig	UB 3606 / 8892 / 2002-07-22
Assessment report (fire)	warringtonfire	WF 327804/A / 2013-07-10
Sprinkler	VdS, Cologne	G 4961028 / 2006-09-05

a) All data given in this section according DIBt approval Z-21.1-1722, issue 2011-10-31.

Basic loading data (for a single anchor)

All data in this section applies to

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Hollow decks where $b_H \leq 4{,}2 \cdot b_{st}$
- concrete $f_{cc} \geqq 50$ N/mm²
- Load data for each load direction



Recommended loads

Anchor size			M6	M8	M10	M6	M8	M10	M6	M8	M10
Recommended load for a single anchor											
Cavity to surface thickness d_b [mm]			≥ 25			≥ 30			≥ 40		
Tensile, F_{rec}		[kN]	0,7	0,7	0,9	0,9	0,9	1,2	2,0	2,0	3,0
Recommended load for a group of two anchors with a spacing s ≥ 100 mm and ≤ 200 mm											
Tensile, F_{rec}	spacing s ≥ 100 mm	[kN]	0,9	0,9	1,2	1,2	1,2	1,6	2,5	2,5	4,0
	spacing, s ≥ 200 mm	[kN]	1,1	1,1	1,5	1,5	1,5	2,0	3,3	3,3	5,0
Recommended load for a group of four anchors with a spacing s ≥ 100mm and ≤ 200mm											
Tensile, F_{rec}	spacing, s ≥ 100/100 mm	[kN]	1,2	1,2	1,6	1,6	1,6	2,1	3,5	3,5	5,3
	spacing, s ≥ 100/200 mm	[kN]	1,5	1,5	2,0	2,0	2,0	2,6	4,4	4,4	6,6
	spacing, s ≥ 200/200 mm	[kN]	1,9	1,9	2,5	2,5	2,5	3,3	5,5	5,5	8,3

The given loads are valid for tensile load, shear load and all load directions

All data applies to:

- Hollow decks, classification ≥ C 45/55
- Hollow decks where $b_H \leq 4,2 \cdot b_{st}$

Materials

Mechanical properties of HKH

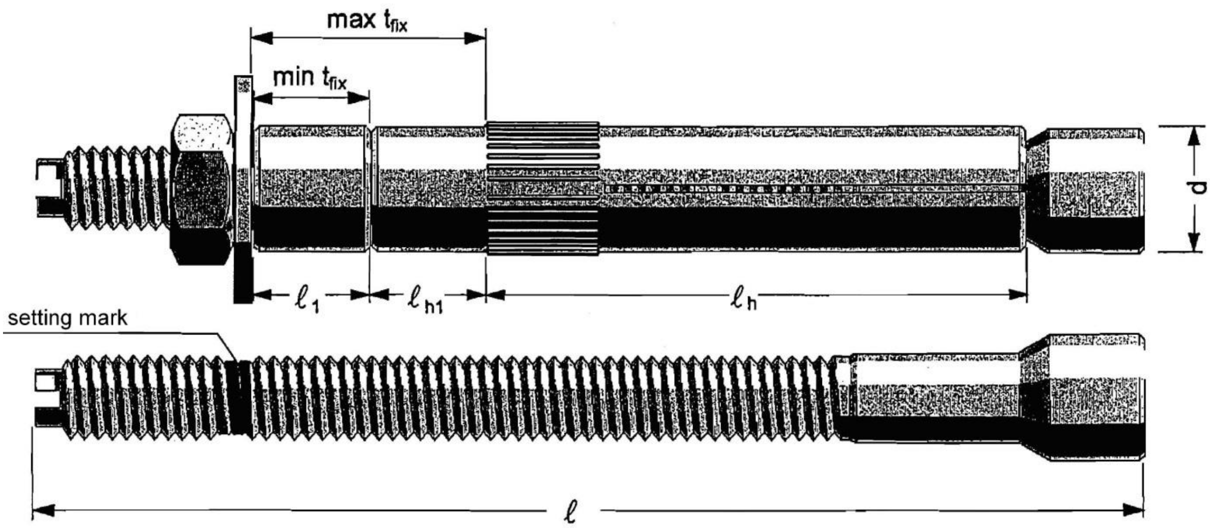
Anchor size			M6	M8	M10
Nominal tensile strength f_{uk}	Carbon steel	[N/mm²]	800	500	500
	Stainless steel	[N/mm²]	700	700	700
admissible bending resistance	Carbon steel	[Nm]	7,0	10,7	21,4
	Stainless steel	[Nm]	4,9	12,1	24,1

Material quality

Part		Material
All parts	HKH (Carbon steel)	galvanised to min. 5 µm
	HKH (stainless steel)	Stainless steel A4

Anchor dimensions

Anchor size		M6	M8	M10
t_{fix}	[mm]	≤ 10	≤ 10	≤ 10
ℓ_1	[mm]	0	0	0
ℓ_{h1}	[mm]	10	10	10
d	[mm]	9,8	11,8	13,8
ℓ	[mm]	86	88	93
ℓ_h	[mm]	55		

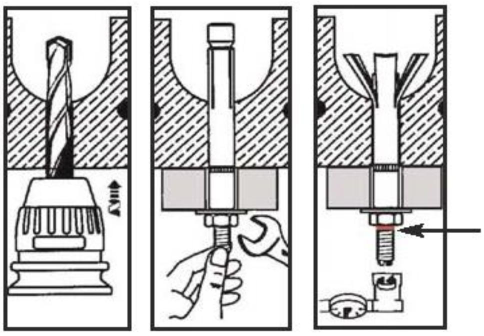


Setting

Installation equipment

Anchor size			M6	M8	M10
Diameter of drill bit	d_0	[mm]	10	12	14
Drill bit			TE-CX-10	TE-CX-12	TE-CX-14
Rotary hammer			TE 6A, TE 6C, TE 6S, TE 15, TE 15-C or TE 18-M		
Setting tools			Torque wrench		
Machine setting tool			available		

Setting instruction



Setting details HKH

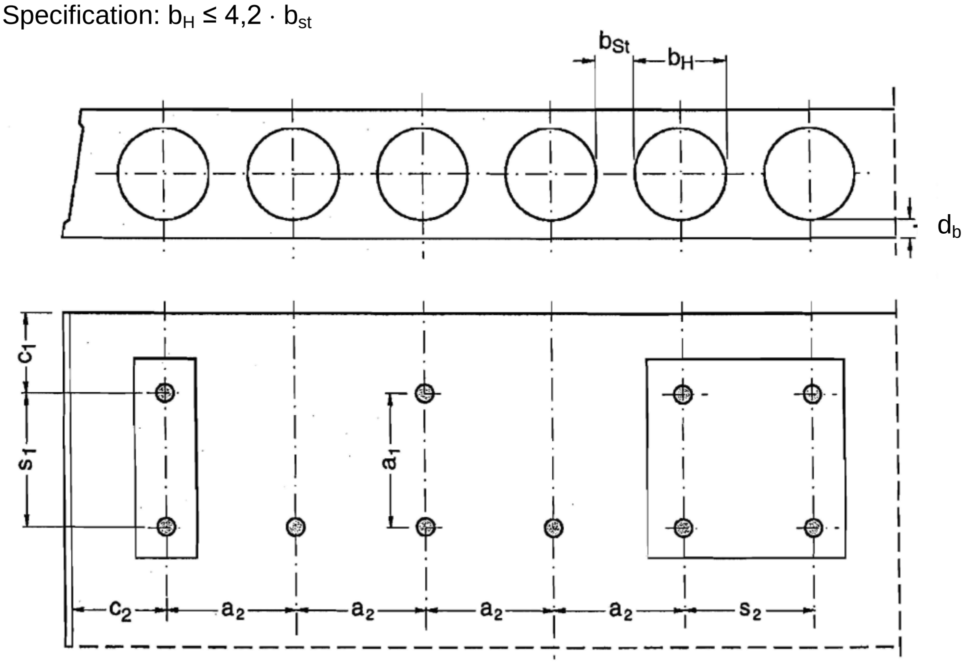
Anchor size			M6	M8	M10
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	12	14	16
Embedment depth for HKH	h_s	[mm]	55 to 65		
Thickness of fixture	t_{fix}	[mm]	≤ 10		
Torque moment	T_{inst}	[Nm]	5	10	20
Width across	SW	[mm]	10	13	17

Base material thickness, anchor spacing and edge distance

Anchor size			**M6**	**M8**	**M10**
Edge distance [a)]	$c \geq$	[mm]	150		
	$c_{min} \geq$	[mm]	100		
Spacing between outer anchors of neighbouring fixation	$a \geq$	[mm]	300		

a) For edge distance < 150 mm the recommended load has to be reduced with $F = 0,75 \cdot F_{rec}$

Specification: $b_H \leq 4,2 \cdot b_{st}$



HTB Hollow wall metal anchor

	Anchor version	Benefits
	HTB	- Ingenious and strong for hollow base materials - Convincing simplicity when setting - Technical superiority with up to 92mm fixing thickness - Load carried by strong metal channel and screw


Drywall

Basic loading data (for a single anchor)

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Base material as specified in the table
- Minimum base material thickness

Characteristic resistance

Anchor size			M5 / M6
Gypsum board Thickness 10 mm	N_{Rk}	[kN]	0,75
	V_{Rk}	[kN]	0,45
Gypsum board Thickness 12,5 mm	N_{Rk}	[kN]	1,20
	V_{Rk}	[kN]	0,90
Gypsum board Thickness 2x12,5 mm	N_{Rk}	[kN]	2,10
	V_{Rk}	[kN]	0,90
Fibre reinforced gypsum board Thickness 10 mm	N_{Rk}	[kN]	1,20
	V_{Rk}	[kN]	1,80
Fibre reinforced gypsum board Thickness 12,5 mm	N_{Rk}	[kN]	1,80
	V_{Rk}	[kN]	3,00
Hollow decks Cavity to surface thickness ≥ 30,0 mm	N_{Rk}	[kN]	1,50
	V_{Rk}	[kN]	-
Hollow brick "Parpaing Creux B40"	N_{Rk}	[kN]	1,35
	V_{Rk}	[kN]	2,70

Design resistance

Anchor size			M5 / M6
Gypsum board Thickness 10 mm	N_{Rd}	[kN]	0,35
	V_{Rd}	[kN]	0,21
Gypsum board Thickness 12,5 mm	N_{Rd}	[kN]	0,56
	V_{Rd}	[kN]	0,42
Gypsum board Thickness 2x12,5 mm	N_{Rd}	[kN]	0,98
	V_{Rd}	[kN]	0,42
Fibre reinforced gypsum board Thickness 10 mm	N_{Rd}	[kN]	0,56
	V_{Rd}	[kN]	0,84
Fibre reinforced gypsum board Thickness 12,5 mm	N_{Rd}	[kN]	0,84
	V_{Rd}	[kN]	1,40
Hollow decks Cavity to surface thickness ≥ 30,0 mm	N_{Rd}	[kN]	0,70
	V_{Rd}	[kN]	-
Hollow brick "Parpaing Creux B40"	N_{Rd}	[kN]	0,63
	V_{Rd}	[kN]	1,26

Recommended loads a)

Anchor size			M5 / M6
Gypsum board Thickness 10 mm	N_{rec}	[kN]	0,25
	V_{rec}	[kN]	0,15
Gypsum board Thickness 12,5 mm	N_{rec}	[kN]	0,40
	V_{rec}	[kN]	0,30
Gypsum board Thickness 2x12,5 mm	N_{rec}	[kN]	0,70
	V_{rec}	[kN]	0,30
Fibre reinforced gypsum board Thickness 10 mm	N_{rec}	[kN]	0,40
	V_{rec}	[kN]	0,60
Fibre reinforced gypsum board Thickness 12,5 mm	N_{rec}	[kN]	0,60
	V_{rec}	[kN]	1,00
Hollow decks Cavity to surface thickness ≥ 30,0 mm	N_{rec}	[kN]	0,50
	V_{rec}	[kN]	-
Hollow brick "Parpaing Creux B40"	N_{rec}	[kN]	0,45
	V_{rec}	[kN]	0,90

a) With overall global safety factor γ = 3 to the characteristic loads and a partial safety factor of γ = 1,4 to the design values

Materials

Material quality

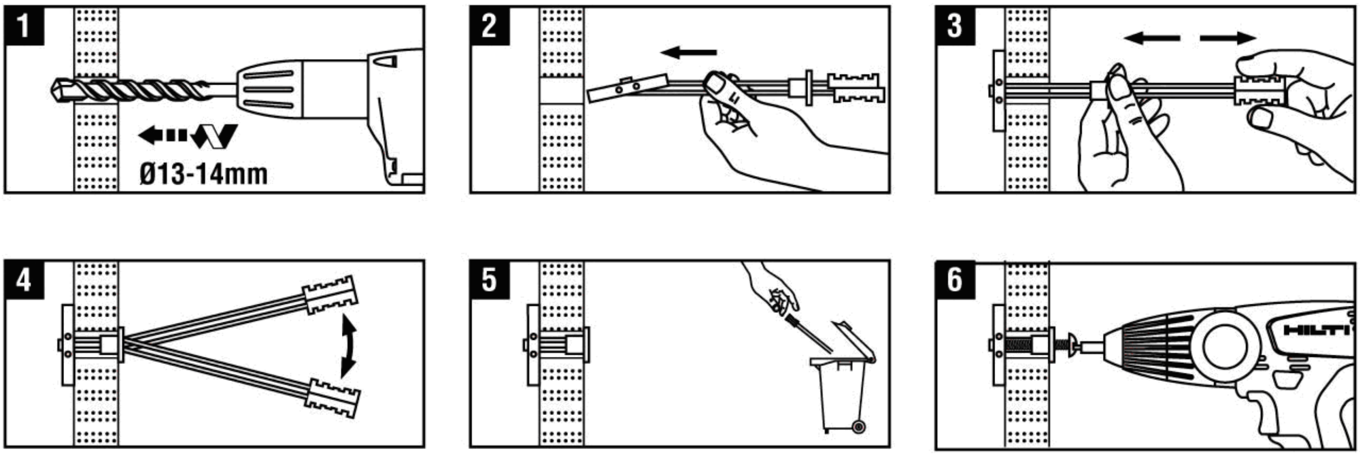
Part	Material
Metal channel	Carbon steel galvanized to 5 microns
Cap washer	Polypropylene copolymer
Legs	High impact polystyrene
Screw	Carbon steel galvanized to 3 microns

Setting

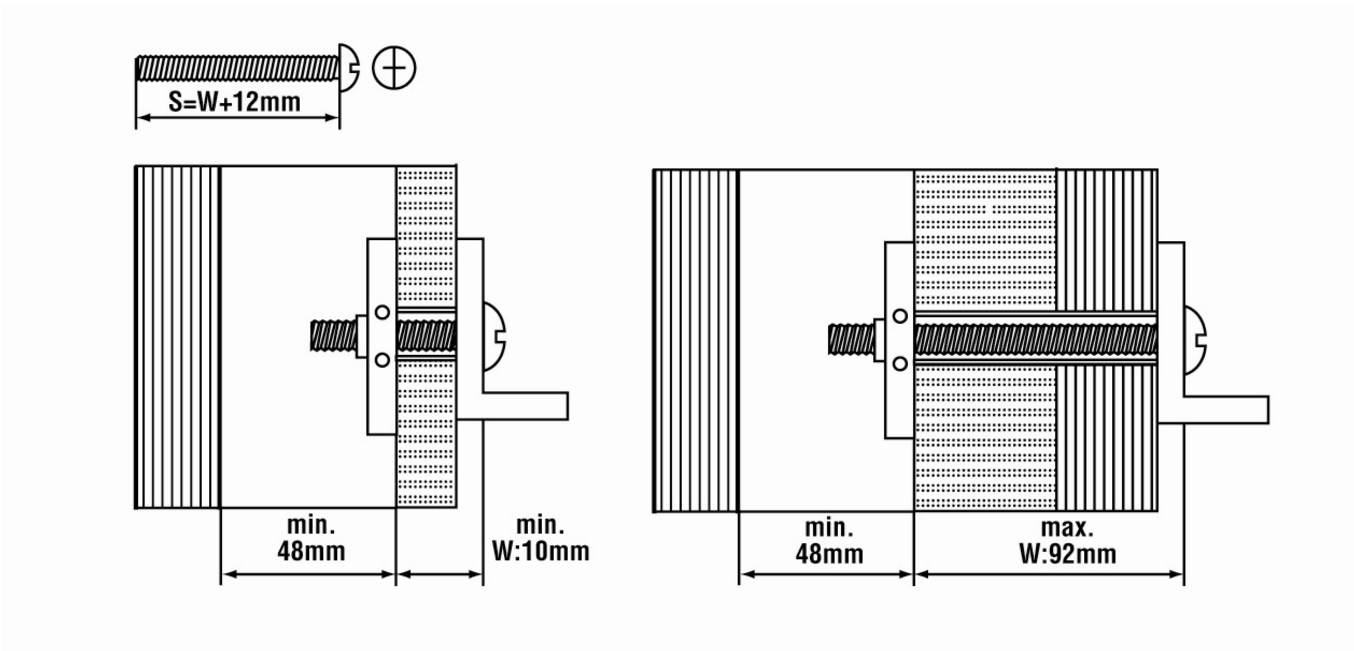
Installation equipment

Anchor size	M5 / M6
Rotary hammer	TE2 … TE16
Other tools	Screwdriver

Setting instruction



Setting details:



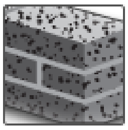
Setting details HTB

Anchor version				M5	M6
Nominal diameter of drill bit		d_o	[mm]	13 - 14	
Thickness of wall and fixture	min	$h + t_{fix}$	[mm]	10	
	max	$h + t_{fix}$	[mm]	92	
Minimum space of cavity		l	[mm]	48	
Screw length		l	[mm]	$12 + h + t_{fix}$	
Screw size		d		M5	M6
Tightening torque		T_{inst}	[Nm]	3	5

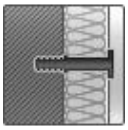
HIF Insulation fastener

Anchor version	Benefits
 HIF	- Especially for soft insulation material 90mm is ideal not to sink in the surface, no additional plate has to be used - Drilling, hammering, done - Speed due to less drilling effort - With anchors up to 240mm insulation thickness the whole application is covered


Concrete


Solid brick


Hollow brick


Insulation


Autoclaved aerated concrete

Basic loading data (for a single anchor)

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Base material as specified in the table
- Minimum base material thickness
- Tensile loads only

Recommended loads [a)]

			HIF
Concrete ≥ C16/20	N_{rec}	[kN]	0,03
Solid clay brick Mz 20 – 1,8 – NF	N_{rec}	[kN]	0,03
Solid sand-lime brick KS 12 – 1,6 – 2DF	N_{rec}	[kN]	0,03
Hollow clay brick [c)] Hlz 12 – 0,8 – 6DF	N_{rec}	[kN]	0,025 [b)]
Hollow sand-lime brick [c)] KSL 12	N_{rec}	[kN]	0,03
Autoclaved aerated concrete AAC 4	N_{rec}	[kN]	0,02

a) Recommended loads N_{rec} are based on an global safety factor γ = 5 to the characteristic resistance. Design resistance N_{Rd} can be derived by multiplying N_{rec} with a partial safety factor of γ_F = 1,4.
b) Drilling without hammering
c) Thickness of web for Hlz ≥ 18mm, for KSL ≥ 25mm

Service temperature range

Hilti HIF insulation fastener may be applied in the temperature range given below.

Temperature range	**Base material temperature**	**Maximum long term base material temperature**	**Maximum short term base material temperature**
Temperature range	-40 °C to +40 °C	+24 °C	+40 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Material quality

Part	**Material**
Plastic sleeve	Polypropylene

Thermal parameters

Point thermal transmittance χ	0,000 W/K [a)]

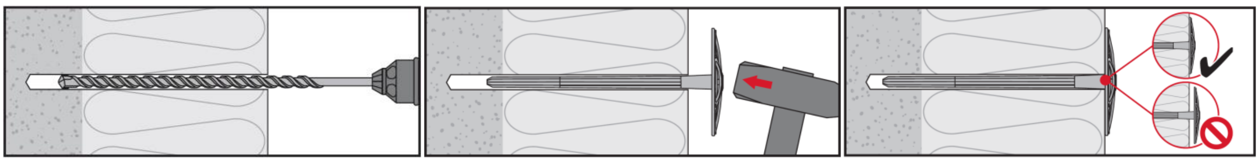
a) According EOTA Technical Report TR 025, the value 0,000 W/K may be taken, if the peak value of the point thermal transmittance χ in the considered range is smaller than 0,0005 W/K.

Setting

Installation equipment

Anchor size	**HIF**
Rotary hammer	TE2 … TE16
Other tools	Hammer

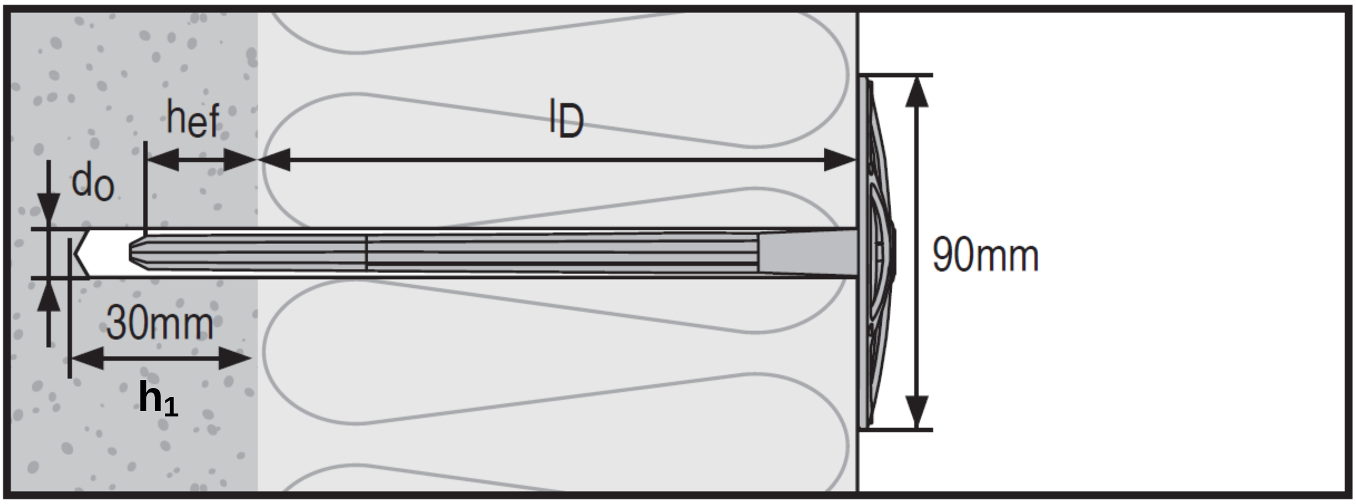
Setting instruction



Drill hole with drill bit

Tap fastener with a hammer

Setting details: depth of drill hole h_1 and effective anchorage depth h_{ef}



Setting details HIF

HIF			80	100	120	140	160	180	200	220	240
Nominal diameter of drill bit	$d_0 \leq$	[mm]	8								
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45								
Depth of drill hole	h_1	[mm]	$l - l_D + 5$ ≥ 30								
Overall plastic anchor embedment depth in base material	$h_{nom} \geq$	[mm]	25								
Effective anchorage depth	$h_{ef} \geq$	[mm]	20								
Anchor length	l	[mm]	105	125	145	165	185	205	225	245	265
Fixture thickness	l_D	[mm]	60-80	80-100	100-120	120-140	140-160	160-180	180-200	200-220	220-240
Installation temperature		[°C]	0 to +40								

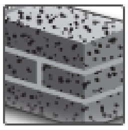
Setting parameters HIF

HIF			80	100	120	140	160	180	200	220	240
Minimum base material thickness	h_{min}	[mm]	100								
Minimum spacing	s_{min}	[mm]	100								
Minimum edge distance	c_{min}	[mm]	100								

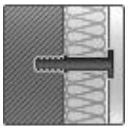
IDP Insulation fastener

Anchor version	Benefits
 IDP	- for insulating up to 15 cm - simple setting


Concrete


Solid brick


Hollow brick


Insulation

Basic loading data (for a single anchor)

All data in this section applies to

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Base material as specified in the table
- Minimum base material thickness
- Loads shall be reduced and number of fasteners shall be increased if the temperature sustains above 40°C

Recommended loads [a)]

		IDP
Concrete ≥ C16/20	N_{rec} [kN]	0,14
Solid clay brick Mz 20 – 1,8 – NF	N_{rec} [kN]	0,14
Solid sand-lime brick KS 12 – 1,6 – 2DF	N_{rec} [kN]	0,14
Hollow clay brick Hlz 12 – 0,8 – 6DF	N_{rec} [kN]	0,04 [b)]
Hollow sand-lime brick KSL 12 – 1,4 – 3DF	N_{rec} [kN]	0,04

a) With overall global safety factor γ = 5 to the characteristic loads and a partial safety factor of γ = 1,4 to the design values.
b) Drilling without hammering

Recommended number of IDP not regarding wind suction

			Number of fasteners per m^2
Expanded polystyrene (EPS) Polyurethane (PU)	density ≤ 40 kg/m^3	thickness ≤ 150 mm	4
Mineral wool	density ≤ 150 kg/m^3	thickness ≤ 100 mm	4
		thickness ≤ 150 mm	6

The data is only valid if no further material is applied on the insulation, e.g. plaster. Otherwise number of fasteners have to be increased.

Materials

Material quality

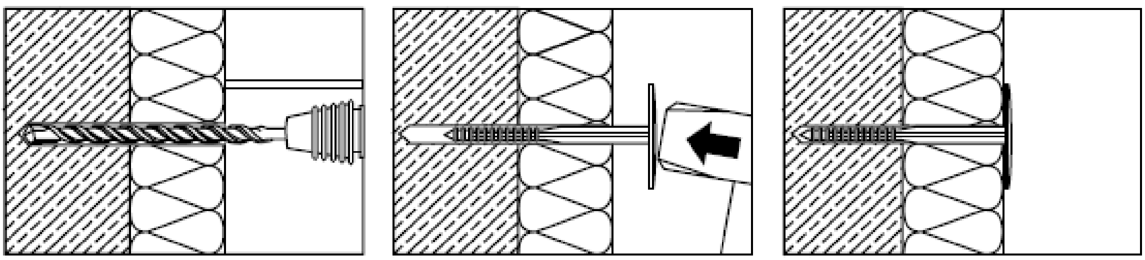
Part	Material
Plastic sleeve	Polypropylene

Setting

installation equipment

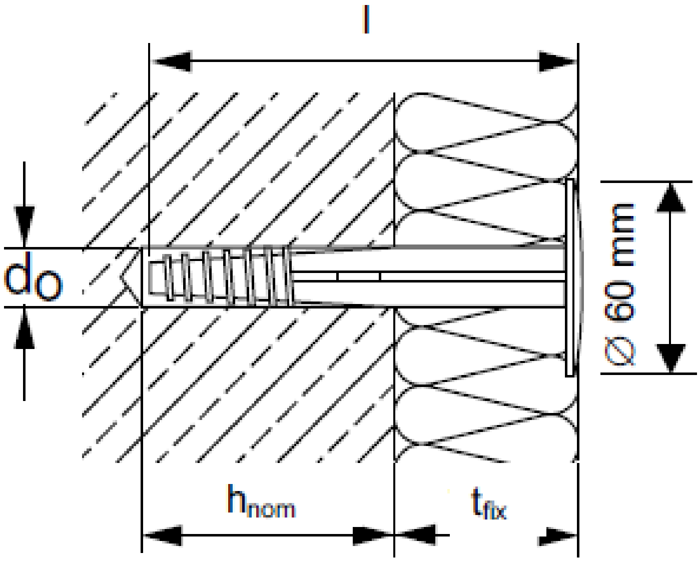
Anchor size	IDP
Rotary hammer	TE2 … TE16
Other tools	Hammer

Setting instruction



Drill hole with drill bit.   Tap in fastener with a hammer.

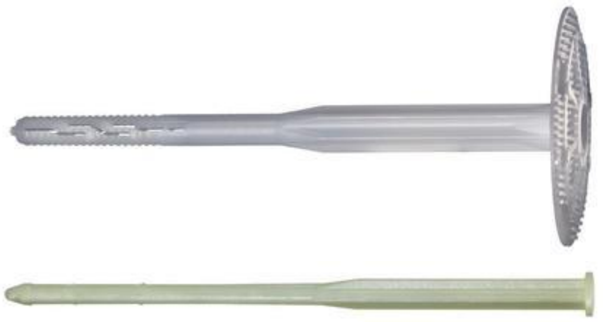
Setting details: depth of drill hole h_1 and effective anchorage depth h_{nom}



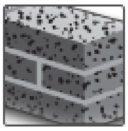
Setting details IDP

Anchor version IDP			0/2	2/4	4/6	6/8	8/10	10/12	13/15
Nominal diameter of drill bit	d_o	[mm]	8						
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45						
Depth of drill hole	$h_1 \geq$	[mm]	$l - t_{fix}$ + 10 mm ≥ 40mm						
Effective anchorage depth	h_{nom}	[mm]	25						
Anchor length	l	[mm]	50	70	90	110	130	150	180
Max fixture thickness	t_{fix}	[mm]	20	40	60	80	100	120	150
Installation temperature		[°C]	0 to +40						

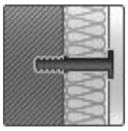
IZ Insulation fastener

Anchor version		Benefits
	IZ	- Insulation fastener esp. for plastered surfaces - 30mm setting depth - perfect flush setting


Concrete


Solid brick


Hollow brick


Insulation

Basic loading data (for a single anchor)

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Base material as specified in the table
- Minimum base material thickness

Recommended loads

		IZ
Concrete ≥ C16/20	N_{rec} [kN]	0,2
Solid clay brick Mz 12 – 2,0	N_{rec} [kN]	0,2
Solid sand-lime brick KS 12 – 1,8	N_{rec} [kN]	0,2
Hollow clay brick Hlz 12 – 1,0	N_{rec} [kN]	0,13[a)]
Hollow sand-lime brick KSL 12 – 1,4	N_{rec} [kN]	0,17

a) Drilling without hammering

Recommended pull-through loads and number of IZ in insulation

		IZ	
		Pull-through loads [kN]	Min. number of fasteners
Expanded polystyrene (EPS	thickness ≥ 40 mm	0,15	5
Mineral wool, type HD	thickness ≥ 40 mm	0,15	5
Mineral wool, type WV	thickness ≥ 40 mm	0,15	4
Mineral wool, type lamella, with slip-on-plate HDT 140	thickness ≥ 40 mm	0,167	4

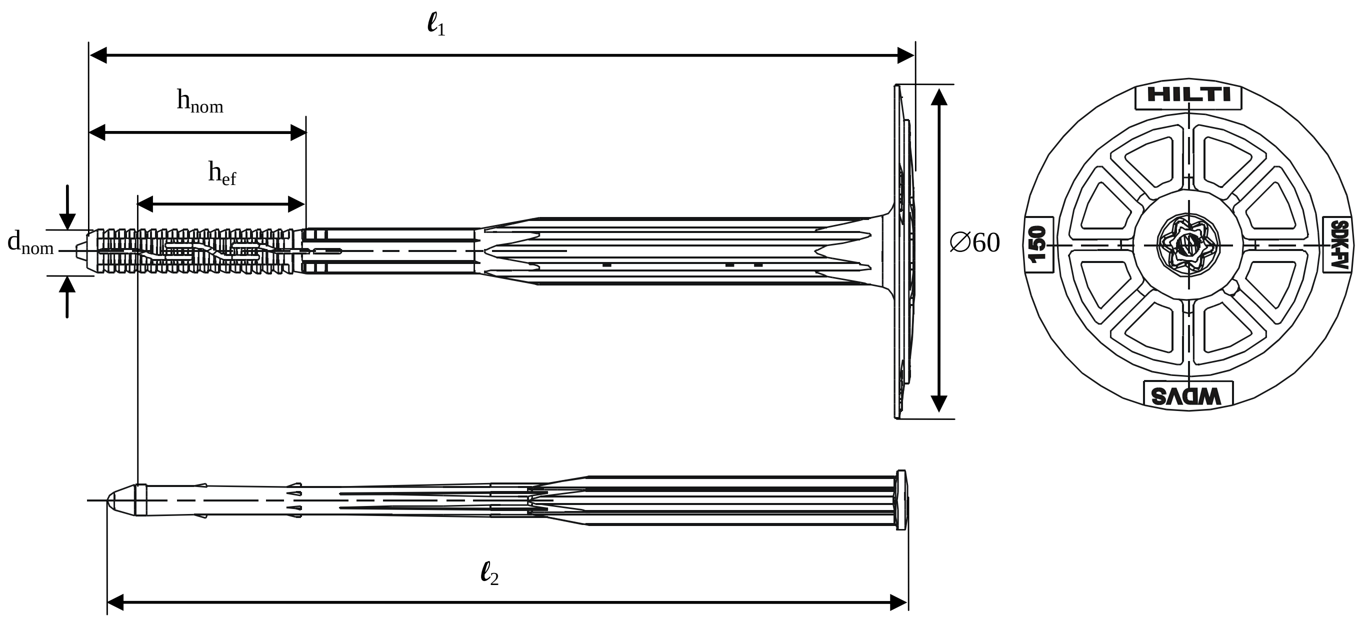
Materials

Material quality

Part	Material
Anchor sleeve	Polypropylene
Expansion pin	Polyamide, fibre reinforced ≥ 50%,

Anchor dimensions

Anchor size			IZ
Minimum thickness of insulation	$h_{D,min}$	[mm]	0
Maximum thickness of insulation	$h_{D,max}$	[mm]	180
Diameter of the sleeve	d_{nom}	[mm]	8
Minimum length of the sleeve	$\ell_{1,min}$	[mm]	70
Maximum length of the sleeve	$\ell_{1,max}$	[mm]	210
Minimum length of the screw	$\ell_{2,min}$	[mm]	65
Maximum length of the screw	$\ell_{2,max}$	[mm]	205

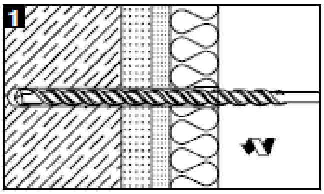


Setting

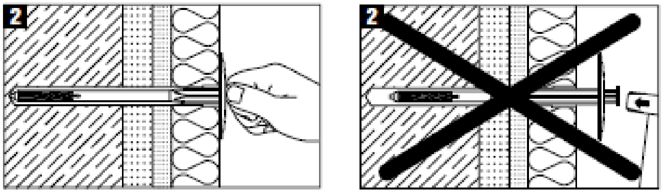
installation equipment

Anchor size	IDP
Rotary hammer	TE2 – TE16
Other tools	Hammer, stepped-drill TE-C 8/12-370 is necessary when t_{tol} > 30mm

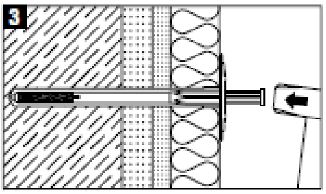
Setting instruction



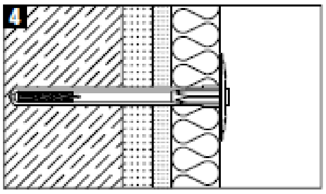
Drill hole with drill bit.



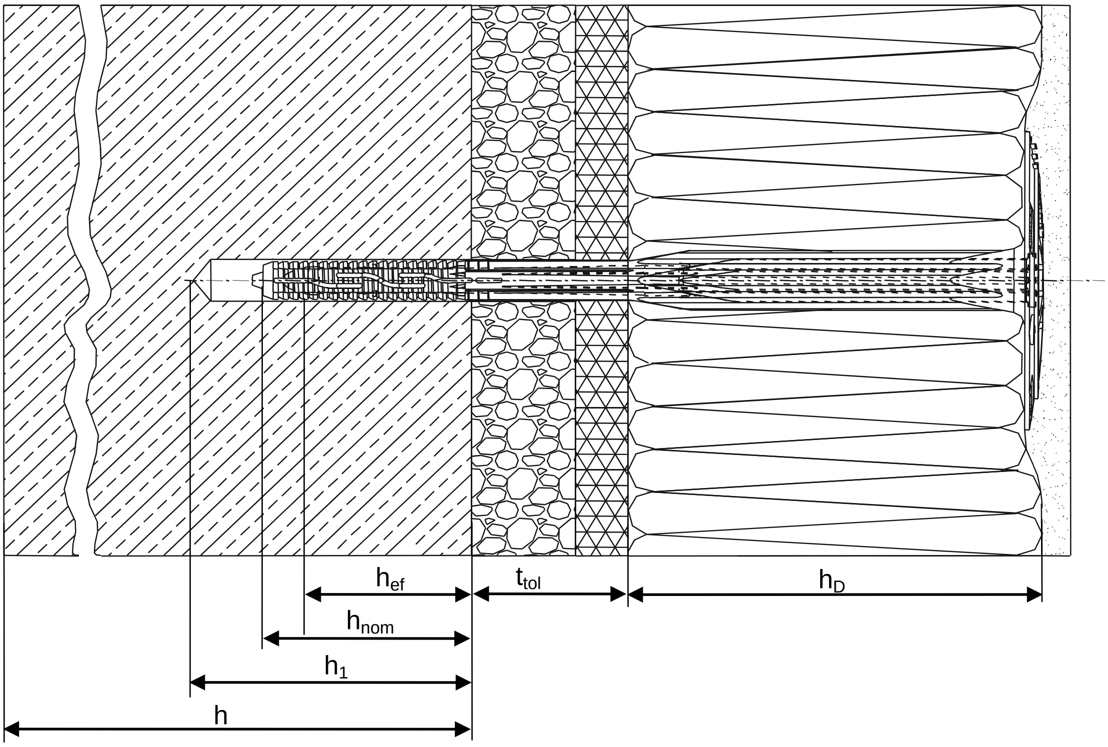
Tap in fastener body only.



Hammer in expansion pin.



Setting details:

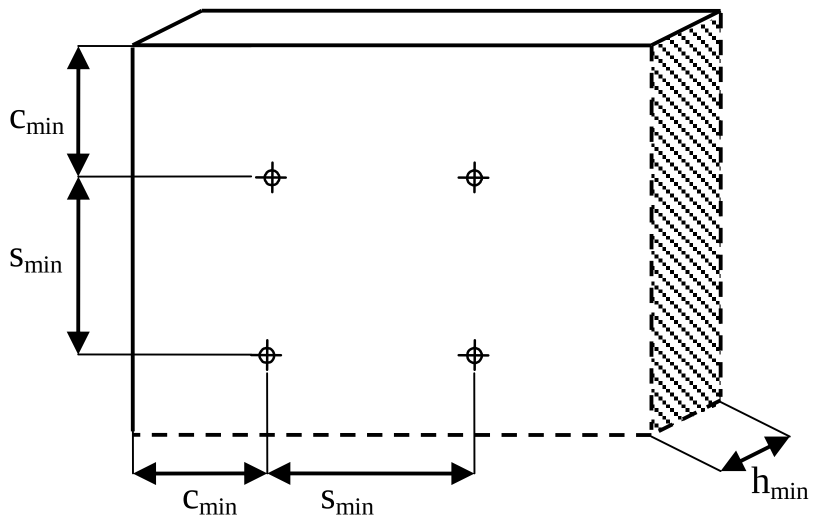


Setting details IZ

Anchor version			
Nominal diameter of drill bit	d_o	[mm]	8
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45
Depth of drill hole	$h_1 \geq$	[mm]	50
Effective anchorage depth	h_{ef}	[mm]	30
Overall embedment depth	h_{nom}	[mm]	40
Installation temperature		[°C]	0 to +40

Setting parameters

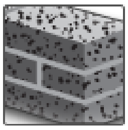
Anchor size			
Minimum base material thickness	h_{min}	[mm]	100
Spacing	s_{min}	[mm]	100
Edge distance	c_{min}	[mm]	100



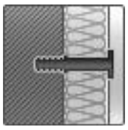
IDMS / IDMR Insulation fastener

Anchor version		Benefits
	IDMS Carbon steel IDMR Stainless steel	- for insulating material up to 15 cm thick - a non-flammable metal fastener - IDMS-T / IDMR-T insulation plate for non self-supporting insulation material


Concrete


Solid brick


Hollow brick


Insulation


Fire resistance

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Fire test report	IBMB, Braunschweig	PB 3136/2315 / 2005-12-02

Basic loading data (for a single anchor)

All data in this section applies to
- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Base material as specified in the table
- Minimum base material thickness
- Loads shall be reduced and number of fasteners shall be increased if the temperature sustains above 40°C

Recommended loads

		IDMS / IDMR
Concrete ≥ C16/20	N_{rec} [kN]	0,1
Solid clay brick Mz 20 – 1,8 – NF	N_{rec} [kN]	0,1
Solid sand-lime brick KS 12 – 1,6 – 2DF	N_{rec} [kN]	0,1
Hollow clay brick Hlz 12 – 0,8 – 6DF	N_{rec} [kN]	0,04[a)]
Hollow sand-lime brick KSL 12 – 1,4 – 3DF	N_{rec} [kN]	0,04

a) Drilling without hammering

Recommended number of IDMS / IDMR not regarding wind suction

			Number of fasteners per m²
Expanded polystyrene (EPS) Polyurethane (PU)	density ≤ 40 kg/m³	thickness ≤ 150 mm	4
Mineral wool	density ≤ 150 kg/m³	thickness ≤ 100 mm	6
		thickness ≤ 150 mm	8

The data is only valid if no further material is applied on the insulation, e.g. plaster. Otherwise number of fasteners has to be increased.

Materials

Material quality

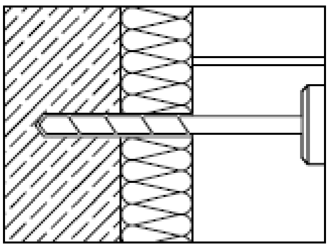
Part	Material
IDMS	Carbon steel, galvanised to 16 µm
IDMR	Stainless steel, grade 1.4301

Setting

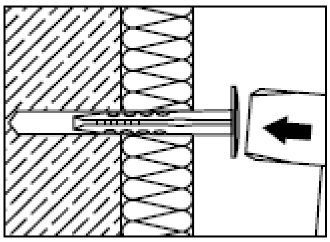
installation equipment

	IDMS / IDMR
Rotary hammer	TE2 – TE16
Other tools	Hammer

Setting instruction

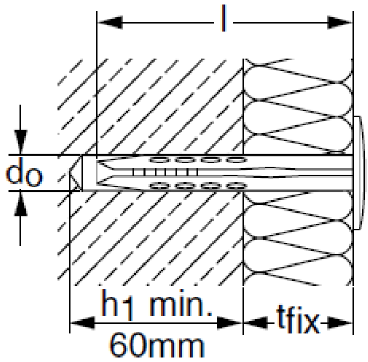


Drill hole with drill bit.



Install the fastener.

Setting details: depth of drill hole h_1 and effective anchorage depth h_{nom}

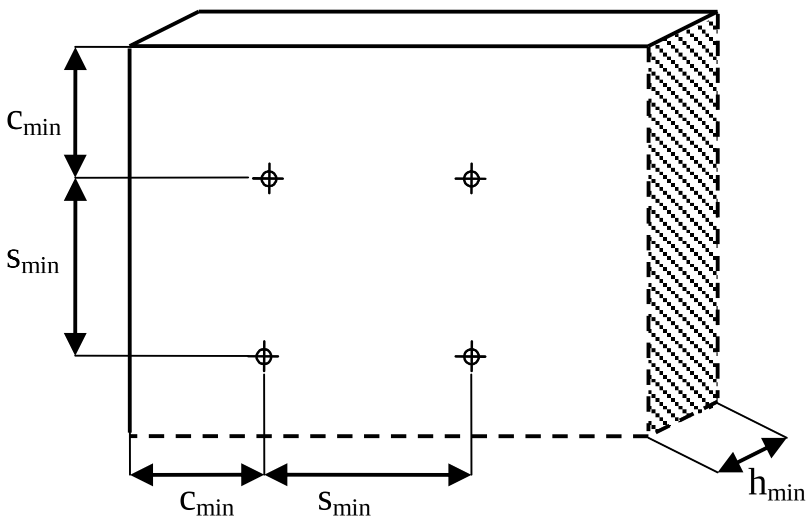


Setting details IDMS / IDMR

Anchor version IDMS / IDMR			**0/3**	**3/6**	**6/9**	**9/12**	**12/15**
Nominal diameter of drill bit	d_o	[mm]	8				
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45				
Depth of drill hole	$h_1 \geq$	[mm]	$l - t_{fix}$ + 10 mm ≥ 60mm				
Effective anchorage depth	h_{nom}	[mm]	$l - t_{fix}$ ≥ 50: full load capacity 30 – 50: load reduction with factor 0,5				
Anchor length	l	[mm]	80	110	140	170	200
Max fixture thickness	t_{fix}	[mm]	30	60	90	120	150

Setting parameters

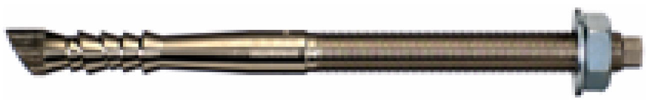
Anchor size			
Minimum base material thickness	h_{min}	[mm]	100
Spacing	s_{min}	[mm]	100
Edge distance	c_{min}	[mm]	100



Adhesive anchoring systems

Adhesive capsule systems
Injection mortar systems

HVZ (HVU-TZ + HAS-TZ) adhesive anchor system

Mortar system		Benefits
	Hilti HVU-TZ foil capsule	- suitable for cracked and non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete
	HAS-TZ HAS-R-TZ HAS-HCR-TZ rod	

Concrete | Tensile zone | Fire resistance | Fatigue | Shock | Corrosion resistance | High corrosion resistance | European Technical Approval | CE conformity

PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-03/0032 / 2013-06-04
Approval for shockproof fastenings in civil defence installations	Federal Office for Cicil Protection, Bern	BZS D 09-602 / 2009-10-28
Fatigue loading	DIBt, Berlin	Z-21.3-1692 / 2013-07-19
Fire test report ZTV-Tunnel	IBMB, Braunschweig	UB 3357/0550-2 / 2001-06-26
Fire test report	IBMB, Brunswick	UB 3357/0550-1 / 2001-04-17
Assessment report (fire)	warringtonfire	WF 327804/B / 2013-07-10

a) All data given in this section according ETA-03/0032, issue 2013-06-04.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- Embedment depth, as specified in the table
- <u>One</u> anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +50°C/80°C)
- Installation temperature range 0°C to +40°C

Embedment depth and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M10x75	M12x95	M16x105	M16x125	M20x170
Embedment depth [mm]	75	95	105	125	170
Base material thickness [mm]	150	190	210	250	340

Mean ultimate resistance a): concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HVZ

	Data according ETA-03/0032, issue 2013-06-04				
Anchor size	M10x75	M12x95	M16x105	M16x125	M20x170
Non cracked concrete					
Tensile $N_{Ru,m}$ HVZ [kN]	*36,8*	*53,3*	72,4	94,1	149,2
Shear $V_{Ru,m}$ HVZ [kN]	*18,9*	*28,4*	*53,6*	*53,6*	*92,4*
Cracked concrete					
Tensile $N_{Ru,m}$ HVZ [kN]	31,2	44,4	51,6	67,1	106,4
Shear $V_{Ru,m}$ HVZ [kN]	*18,9*	*28,4*	*53,6*	*53,6*	*92,4*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HVZ

	Data according ETA-03/0032, issue 2013-06-04				
Anchor size	M10x75	M12x95	M16x105	M16x125	M20x170
Non cracked concrete					
Tensile N_{Rk} HVZ [kN]	32,8	40,0	54,3	70,6	111,9
Shear V_{Rk} HVZ [kN]	*18,0*	*27,0*	*51,0*	*51,0*	*88,0*
Cracked concrete					
Tensile N_{Rk} HVZ [kN]	23,4	33,3	38,7	50,3	79,8
Shear V_{Rk} HVZ [kN]	*18,0*	*27,0*	*51,0*	*51,0*	*88,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HVZ

	Data according ETA-03/0032, issue 2013-06-04				
Anchor size	M10x75	M12x95	M16x105	M16x125	M20x170
Non cracked concrete					
Tensile N_{Rd} HVZ [kN]	21,9	26,7	36,2	47,1	74,6
Shear V_{Rd} HVZ [kN]	14,4	21,6	40,8	40,8	70,4
Cracked concrete					
Tensile N_{Rd} HVZ [kN]	15,6	22,2	25,8	33,5	53,2
Shear V_{Rd} HVZ [kN]	14,4	21,6	40,8	40,8	70,4

Recommended loads a): concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HVZ

	Data according ETA-03/0032, issue 2013-06-04				
Anchor size	M10x75	M12x95	M16x105	M16x125	M20x170
Non cracked concrete					
Tensile N_{rec} HVZ [kN]	15,6	19,0	25,9	33,6	53,3
Shear V_{rec} HVZ [kN]	10,3	15,4	29,1	29,1	50,3
Cracked concrete					
Tensile N_{rec} HVZ [kN]	11,1	15,9	18,4	24,0	38,0
Shear V_{rec} HVZ [kN]	10,3	15,4	29,1	29,1	50,3

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HVZ adhesive anchor with anchor rod HAS-TZ may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HAS-TZ

			Data according ETA-03/0032, issue 2013-06-04				
Anchor size			M10x75	M12x95	M16x105	M16x125	M20x170
Nominal tensile strength f_{uk}	HAS-(R) (HCR)TZ	[N/mm²]	800				
Yield strength f_{yk}	HAS-(R) (HCR)TZ	[N/mm²]	640				
Stressed cross-section A_s	tension	[mm²]	44,2	63,6	113	113	227
	shear	[mm²]	50,3	73,9	141	141	245
Moment of resistance W	HAS-(R) (HCR)TZ	[mm³]	50,3	89,6	236	236	541

Material quality

Part	Material
HAS-TZ	carbon steel strength class 8.8
HAS-R-TZ	stainless steel 1.4401 and 1.4571
HAS-HCR-TZ	high corrosion resistance steel 1.4529 and 1.4547

Anchor dimensions

Anchor size		M10x75	M12x95	M16x105	M16x125	M20x170
Anchor embedment depth	[mm]	75	95	105	125	170

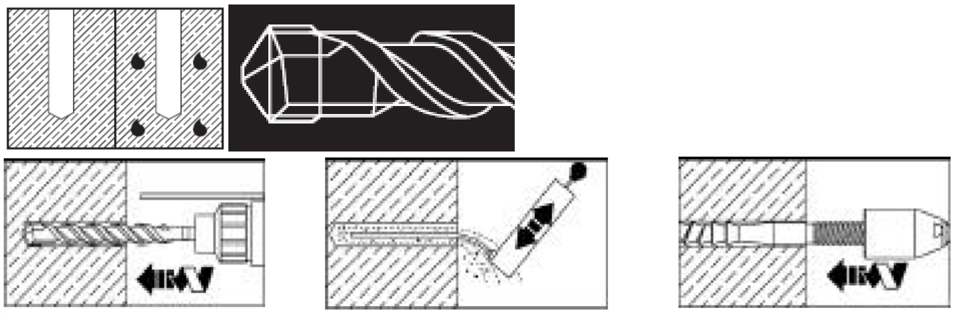
Setting

installation equipment

Anchor size	M10x75	M12x95	M16x105	M16x125	M20x170
Rotary hammer	TE 1 – TE 30		TE 1 – TE 60		TE 30 – TE 80
Tools	Setting tools				

Setting instruction

Dry and water-saturated concrete, hammer drilling



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

For technical data for anchors in diamond drilled holes please contact the Hilti Technical advisory service.

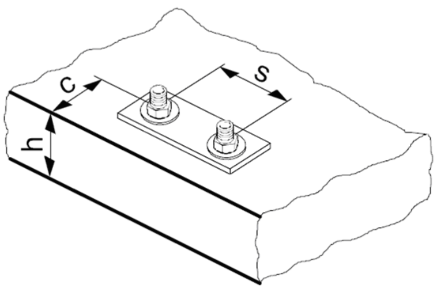
Curing time for general conditions

Data according ETA-03/0032, issue 2013-06-04	
Temperature of the base material	**Curing time before anchor can be fully loaded t_{cure}**
≥ 20 °C	20 min
10 °C to 20 °C	30 min
0 °C to 10 °C	60 min

These data are valid for dry concrete only. In wet concrete the curing time must be doubled.

Setting details

			Data according ETA-03/0032, issue 2013-06-04				
Anchor size			**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
Nominal diameter of drill bit	d_0	[mm]	12	14	18	18	25
Diameter of element	d	[mm]	10	12	16	16	20
Effective anchorage depth	h_{ef}	[mm]	75	95	105	125	170
Drill hole depth	h_1	[mm]	90	110	125	145	195
Minimum base material thickness	h_{min} a)	[mm]	150	190	210	250	340
Diameter of clearance hole in the fixture	d_f	[mm]	12	14	18	18	22
Cracked concrete							
Minimum spacing	s_{min}	[mm]	50	60	70	70	80
Minimum edge distance	c_{min}	[mm]	50	60	70	70	80
Non cracked concrete							
Minimum spacing	s_{min}	[mm]	50	60	70	70	80
Minimum edge distance	c_{min}	[mm]	50	70	85	85	80
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$				
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	$1{,}5\ h_{ef}$				
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\ c_{cr,N}$				
Critical edge distance for concrete cone failure	$c_{cr,N}$ b)		$1{,}5\ h_{ef}$				
Torque moment c)	T_{max}	[Nm]	40	50	90	90	150



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) h: base material thickness ($h \geq h_{min}$)

b) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

c) This is the maximum recommended torque moment to avoid splitting failure during installation for anchors with minimum spacing and/or edge distance.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according data given in ETA-03/0032, issue 2013-06-04.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, Annex C. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

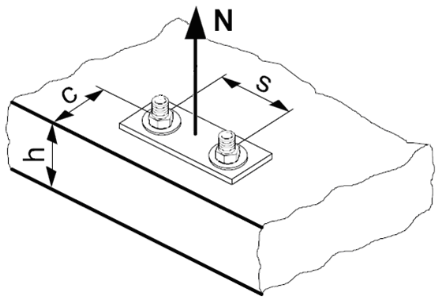
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{h,p}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

	Data according ETA-03/0032, issue 2013-06-04				
Anchor size	**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
$N_{Rd,s}$ HAS-TZ, HAS-R-TZ, HAS-HCR-TZ [kN]	23,3	34,0	60,0	60,0	121,3

Design combined pull-out and concrete cone resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{h,p}$

	Data according ETA-03/0032, issue 2013-06-04				
Anchor size	**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
Embedment depth h_{ef} [mm]	75	95	105	125	170
Non cracked concrete					
$N^0_{Rd,p}$ Temperature range I [kN]	21,9	26,7	36,2	47,1	74,6
Cracked concrete					
$N^0_{Rd,p}$ Temperature range I [kN]	15,6	22,2	25,8	33,5	53,2

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$

Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{h,N} \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{re,N}$

	Data according ETA-03/0032, issue 2013-06-04				
Anchor size	**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
$N^0_{Rd,c}$ Non cracked concrete [kN]	21,9	31,2	36,2	47,1	74,6
$N^0_{Rd,c}$ Cracked concrete [kN]	15,6	22,2	25,8	33,5	53,2

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0.1}$ a)	1	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

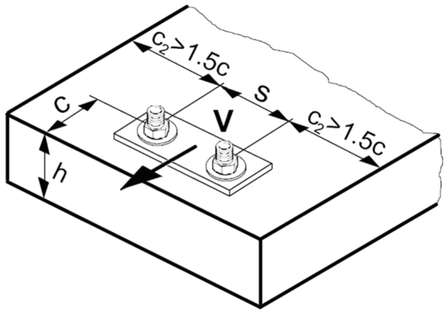
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N}$ = 0,5 + h_{ef}/200mm ≤ 1	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor f_{re} = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp}$ = k · lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

			Data according ETA-03/0032, issue 2013-06-04				
Anchor size			M10x75	M12x95	M16x105	M16x125	M20x170
$V_{Rd,s}$	HAS-TZ	[kN]	14,4	21,6	40,8	40,8	70,4
$V_{Rd,s}$	HAS-R-TZ HAS-HCR-TZ	[kN]	16,0	24,0	44,8	44,8	78,4

Design concrete pryout resistance $V_{Rd,cp}$ = lower value a) of k · $N_{Rd,p}$ and k · $N_{Rd,c}$

k = 1 for h_{ef} < 60 mm **k = 2 for h_{ef} ≥ 60 mm**

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance a) $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4$

		Non-cracked concrete					Cracked concrete				
Anchor size		M10x 75	M12x 95	M16x 105	M16x 125	M20x 170	M10x 75	M12x 95	M16x 105	M16x 125	M20x 170
$V^0_{Rd,c}$	[kN]	3,7	6,7	9,9	10,3	11,0	2,7	3,8	5,3	5,5	7,9

a) For anchor groups only the anchors close to the edge must be considered.

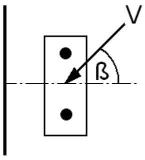
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß		0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\dfrac{1}{(\cos\alpha_V)^2 + \left(\dfrac{\sin\alpha_V}{2,5}\right)^2}}$		1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{2/3} \le 1$	0,22	0,34	0,45	0,54	0,63	0,71	0,79	0,86	0,93	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

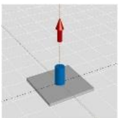
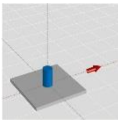
Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

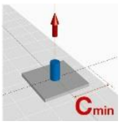
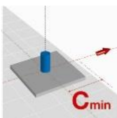
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

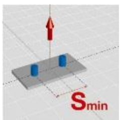
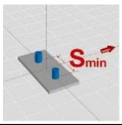
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

			Data according ETA-03/0032, issue 2013-06-04				
Anchor size			**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
Embedment depth		h_{ef} = [mm]	75	95	105	125	170
Base material thickness		h_{min}= [mm]	150	190	210	250	340
	**Tensile N_{Rd}: single anchor, no edge effects**						
	Non cracked concrete						
	HVZ HVZ-R HVZ-HCR	[kN]	21,9	26,7	36,2	47,1	74,6
	Cracked concrete						
	HVZ HVZ-R HVZ-HCR	[kN]	15,6	22,2	25,8	33,5	53,2
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**						
	Non cracked and cracked concrete						
	HVZ	[kN]	14,4	21,6	40,8	40,8	70,4
	HVZ-R HVZ-HCR	[kN]	16,0	24,0	44,8	44,8	78,4

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

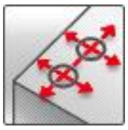
			Data according ETA-03/0032, issue 2013-06-04				
Anchor size			**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
Embedment depth		h_{ef} = [mm]	75	95	105	125	170
Base material thickness		h_{min}= [mm]	150	190	210	250	340
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**						
	Non cracked concrete						
	c_{min}	[mm]	50	70	85	85	80
	HVZ HVZ-R HVZ-HCR	[kN]	13,2	15,7	21,8	26,2	38,9
	Cracked concrete						
	c_{min}	[mm]	50	60	70	70	80
	HVZ HVZ-R HVZ-HCR	[kN]	9,4	14,0	17,1	20,4	27,7
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**						
	Non cracked concrete						
	c_{min}	[mm]	50	70	85	85	80
	HVZ HVZ-R HVZ-HCR	[kN]	3,5	5,1	7,2	7,4	10,3
	Cracked concrete						
	c_{min}	[mm]	50	60	70	70	80
	HVZ HVZ-R HVZ-HCR	[kN]	2,5	4,6	6,9	7,1	7,4

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²
(load values are valid for single anchor)

		Data according ETA-03/0032, issue 2013-06-04				
Anchor size		**M10x75**	**M12x95**	**M16x105**	**M16x125**	**M20x170**
Embedment depth	h_{ef} = [mm]	75	95	105	125	170
Base material thickness	h_{min}= [mm]	150	190	210	250	340
Spacing	s= s_{min}= [mm]	50	60	70	70	80
	Tensile N_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min})					
	Non cracked concrete					
	HVZ HVZ-R HVZ-HCR [kN]	13,4	16,1	22,1	27,9	43,2
	Cracked concrete					
	HVZ HVZ-R HVZ-HCR [kN]	9,5	13,5	15,8	19,9	30,8
	Shear V_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min}) , without lever arm					
	Non cracked concrete					
	HVZ [kN]	14,4	21,6	40,8	40,8	70,4
	HVZ-R HVZ-HCR [kN]	16,0	24,0	44,3	44,8	78,4
	Cracked concrete					
	HVZ [kN]	14,4	21,6	31,6	39,8	61,5
	HVZ-R HVZ-HCR [kN]	16,0	24,0	31,6	39,8	61,5

HVU with HAS/HAS-E rod adhesive anchor system

Mortar system		Benefits
	Hilti HVU foil capsule	- suitable for non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - large diameter applications - high corrosion resistant
	HAS HAS-R HAS-HCR rod	
	HAS-E HAS-E R HAS-E HCR rod	

							
Concrete	Small edge distance and spacing	Fire resistance	Corrosion resistance	High corrosion resistance	European Technical Approval	CE conformity	PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-05/0255 / 2011-06-23
Fire test report	IBMB, Braunschweig	UB-3333/0891-1 / 2004-03-26
Fire test report ZTV-Tunnel	IBMB, Braunschweig	UB 3333/0891-2 / 2003-08-12
Assessment report (fire)	warringtonfire	WF 327804/B / 2013-07-10

a) All data given in this section according ETA-05/0255, issue 2011-06-23

Basic loading data (for a single anchor)

All data in this section applies to For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- <u>One</u> typical embedment depth, as specified in the table
- <u>One</u> anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -5°C to +40°C

Embedment depth a) and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth [mm]	80	90	110	125	170	210	240	270
Base material thickness [mm]	140	160	210	210	340	370	480	540

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HAS

			Data according ETA-05/0255, issue 2011-06-23							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Carbon steel, strength class			5.8	5.8	5.8	5.8	5.8	5.8	8.8	8.8
Tensile $N_{Ru,m}$	HAS	[kN]	*17,9*	*27,3*	*39,9*	*75,6*	*117,6*	*168,0*	249,3	297,4
Shear $V_{Ru,m}$	HAS	[kN]	*8,9*	*13,7*	*20,0*	*37,8*	*58,8*	*84,0*	*182,7*	*221,6*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HAS

			Data according ETA-05/0255, issue 2011-06-23							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Carbon steel, strength class			5.8	5.8	5.8	5.8	5.8	5.8	8.8	8.8
Tensile N_{Rk}	HAS	[kN]	*17,0*	*26,0*	*38,0*	60,0	111,9	140,0	187,8	224,0
Shear V_{Rk}	HAS	[kN]	*8,5*	*13,0*	*19,0*	*36,0*	*56,0*	*80,0*	*174,0*	*211,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HAS

			Data according ETA-05/0255, issue 2011-06-23							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Carbon steel, strength class			5.8	5.8	5.8	5.8	5.8	5.8	8.8	8.8
Tensile N_{Rd}	HAS	[kN]	11,3	17,3	25,3	40,0	74,6	93,3	125,2	149,4
Shear V_{Rd}	HAS	[kN]	6,8	10,4	15,2	28,8	44,8	64,0	139,2	168,8

Recommended loads a): concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HAS

			Data according ETA-05/0255, issue 2011-06-23							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Carbon steel, strength class			5.8	5.8	5.8	5.8	5.8	5.8	8.8	8.8
Tensile N_{rec}	HAS	[kN]	8,1	12,4	18,1	28,6	53,3	66,7	89,4	106,7
Shear V_{rec}	HAS	[kN]	4,9	7,4	10,9	20,6	32,0	45,7	99,4	120,6

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HVU adhesive may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +80 °C	+50 °C	+80 °C
Temperature range III	-40 °C to +120 °C	+72 °C	+120 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HAS

			Data according ETA-05/0255, issue 2011-06-23							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Nominal tensile strength f_{uk}	HAS-(E)(F) 5.8	[N/mm²]	500	500	500	500	500	500	-	-
	HAS-(E)(F) 8.8	[N/mm²]	800	800	800	800	800	800	800	800
	HAS-(E)R	[N/mm²]	700	700	700	700	700	700	500	500
	HAS-(E)HCR	[N/mm²]	800	800	800	800	800	700	-	-
Yield strength f_{yk}	HAS-(E)(F) 5.8	[N/mm²]	400	400	400	400	400	400	-	-
	HAS-(E)(F) 8.8	[N/mm²]	640	640	640	640	640	640	640	640
	HAS –(E)R	[N/mm²]	450	450	450	450	450	450	210	210
	HAS –(E)HCR	[N/mm²]	640	640	640	640	640	400	-	-
Stressed cross-section A_s	HAS	[mm²]	32,8	52,3	76,2	144	225	324	427	519
Moment of resistance W	HAS	[mm³]	27,0	54,1	93,8	244	474	809	1274	1706

Material quality

Part	**Material**
Threaded rod HAS-(E)(F) M8-M24	Strength class 5.8, A_5 > 8% ductile steel galvanized ≥ 5 µm (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HAS-(E)F M8-M30	Strength class 8.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HAS-(E)R	Stainless steel grade A4, A_5 > 8% ductile strength class 70 for ≤ M24 and class 50 for M27 to M30, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Threaded rod HAS-(E)HCR	High corrosion resistant steel, 1.4529; 1.4565 strength ≤ M20: R_m = 800 N/mm², $R_{p\,0.2}$ = 640 N/mm², A_5 > 8% ductile M24: R_m = 700 N/mm², $R_{p\,0.2}$ = 400 N/mm², A_5 > 8% ductile
Washer ISO 7089	Steel galvanized, hot dipped galvanized,
	Stainless steel, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	High corrosion resistant steel, 1.4529; 1.4565
Nut EN ISO 4032	Strength class 8, steel galvanized ≥ 5 µm, hot dipped galvanized ≥ 45 µm,
	Strength class 70, stainless steel grade A4, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	Strength class 70, high corrosion resistant steel, 1.4529; 1.4565

Anchor dimensions

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Anchor rod HAS-E, HAS-R, HAS-ER HAS-HCR	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270
Anchor embedment depth [mm]	80	90	110	125	170	210	240	270

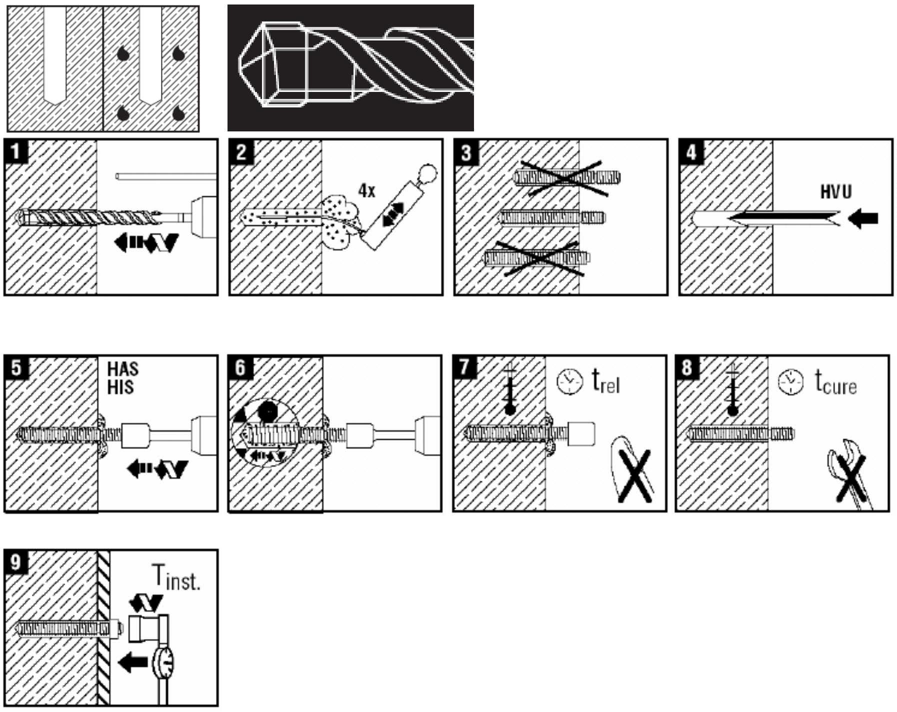
Setting

installation equipment

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Rotary hammer	TE 1 – TE 30			TE 1 – TE 60	TE 50 – TE 60	TE 50 – TE 80		
Other tools	blow out pump or compressed air gun, setting tools							

Setting instruction

Dry and water-saturated concrete, hammer drilling



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

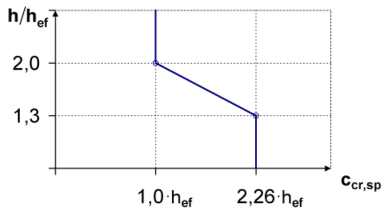
For technical data for anchors in diamond drilled holes please contact the Hilti Technical advisory service.

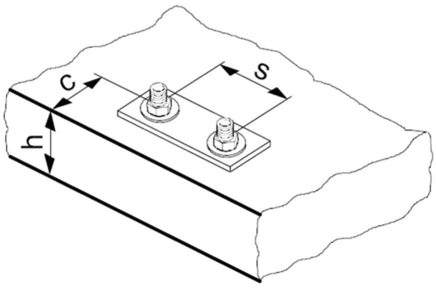
Curing time for general conditions

Data according ETA-05/0255, issue 2011-06-23	
Temperature of the base material	**Curing time before anchor can be fully loaded t_{cure}**
20 °C to 40 °C	20 min
10 °C to 19 °C	30 min
0 °C to 9 °C	1 h
-5 °C to - 1 °C	5 h

Setting details

			Data according ETA-05/0255, issue 2011-06-23							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	24	28	30	35
Effective anchorage and drill hole depth	h_{ef}	[mm]	80	90	110	125	170	210	240	270
Minimum base material thickness	h_{min} a)	[mm]	110	120	140	170	220	270	300	340
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22	26	30	33
Minimum spacing	s_{min}	[mm]	40	45	55	65	90	120	130	135
Minimum edge distance	c_{min}	[mm]	40	45	55	65	90	120	130	135
Critical spacing for splitting failure	$s_{cr,sp}$		$2\ c_{cr,sp}$							
Critical edge distance for splitting failure b)	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$** for $h / h_{ef} \geq 2{,}0$							
			$4{,}6\ h_{ef} - 1{,}8\ h$ for $2{,}0 > h / h_{ef} > 1{,}3$							
			$2{,}26\ h_{ef}$ for $h / h_{ef} \leq 1{,}3$							
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\ c_{cr,N}$							
Critical edge distance for concrete cone failure c)	$c_{cr,N}$		$1{,}5\ h_{ef}$							
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\ c_{cr,N}$							
Critical edge distance for concrete cone failure	$c_{cr,N}$		$1{,}5\ h_{ef}$							
Torque moment c)	T_{max}	[Nm]	10	20	40	80	150	200	270	300





For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) h: base material thickness ($h \geq h_{min}$)

b) h: base material thickness ($h \geq h_{min}$)

c) This is the maximum recommended torque moment to avoid splitting failure during installation for anchors with minimum spacing and/or edge distance.

Simplified design method

Simplified version of the design method according EOTA Technical Report TR 029. Design resistance according data given in ETA-05/0255, issue 2011-06-23.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according EOTA Technical Report TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

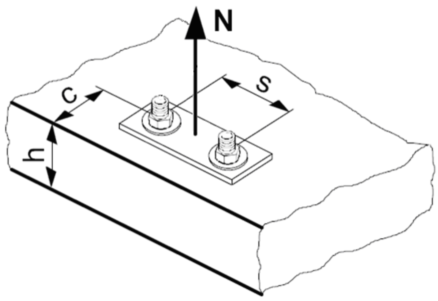
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{h,p}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

			Data according ETA-05/0255, issue 2011-06-23							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,s}$	HAS-(E)(F) 5.8	[kN]	11,3	17,3	25,3	48,0	74,7	106,7	-	-
	HAS-(E)(F) 8.8	[kN]	18,0	28,0	40,7	76,7	119,3	170,7	231,3	281,3
	HAS-(E)-R	[kN]	12,3	19,8	28,3	54,0	84,0	119,8	75,9	92,0
	HAS-(E)-HCR	[kN]	18,0	28,0	40,7	76,7	119,3	106,7	-	-

Design combined pull-out and concrete cone resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{h,p}$

			Data according ETA-05/0255, issue 2011-06-23							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth $h_{ef,typ}$ [mm]			80	90	110	125	170	200	210	270
$N^0_{Rd,p}$	Temperature range I	[kN]	16,7	23,3	33,3	40,0	76,7	93,3	133,3	166,7
$N^0_{Rd,p}$	Temperature range II	[kN]	13,3	16,7	26,7	33,3	50,0	76,7	93,3	113,3
$N^0_{Rd,p}$	Temperature range III	[kN]	6,0	8,0	10,7	16,7	26,7	40,0	50,0	50,0

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{h,N} \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{re,N}$

	Data according ETA-05/0255, issue 2011-06-23							
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
$N^0_{Rd,c}$ [kN]	24,1	28,7	38,8	47,1	74,6	102,5	125,2	149,4

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,14}$ a)	1	1,03	1,06	1,09	1,10	1,12	1,13

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$f_{h,p} = 1$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N}$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$f_{h,N} = 1$

Influence of reinforcement

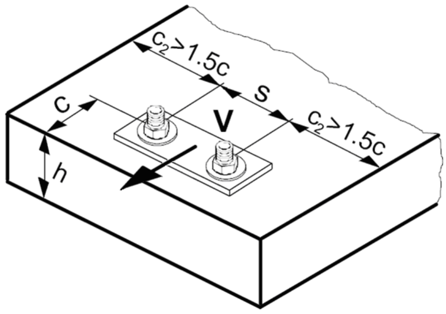
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N}$ = 0,5 + h_{ef}/200mm ≤ 1	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor f_{re} = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp}$ = k · lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

			Data according ETA-05/0255, issue 2011-06-23							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$V_{Rd,s}$	HAS -(E)	[kN]	6,6	10,6	15,2	28,8	44,9	64,1	138,8	168,6
	HAS -(E)F	[kN]	10,6	16,9	24,4	46,1	71,8	102,6	138,8	168,6
	HAS (-E)-R	[kN]	7,5	11,9	17,1	32,4	50,5	72,1	45,5	55,3
	HAS (-E)-HCR	[kN]	10,6	16,9	24,4	46,1	71,8	64,1	-	-

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of k · $N_{Rd,p}$ and k · $N_{Rd,c}$

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
k	2							

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
$V^0_{Rd,c}$	[kN]	5,9	8,5	11,6	18,8	27,3	37	45,1	53,8

a) For anchor groups only the anchors close to the edge must be considered.

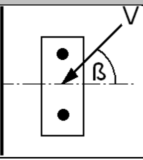
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß		0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \dfrac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\dfrac{\sin\alpha_V}{2{,}5}\right)^2}}$		1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1{,}5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	2,39	2	2,07	1,58	1,82	1,91	1,96	2

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

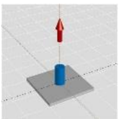
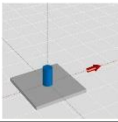
Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

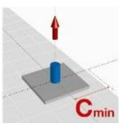
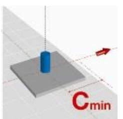
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

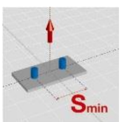
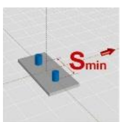
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

		Data according ETA-05/0255, issue 2011-06-23							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Carbon steel, strength class		**5.8**	**5.8**	**5.8**	**5.8**	**5.8**	**5.8**	**8.8**	**8.8**
Embedment depth	h_{ef}: [mm]	80	90	110	125	170	210	240	270
Base material thickness	h_{min}: [mm]	110	120	140	170	220	270	300	340
	**Tensile N_{Rd}: single anchor, no edge effects**								
	HAS-(E)(F) [kN]	11,3	17,3	25,3	40,0	74,6	93,3	125,2	149,4
	HAS-(E)-R [kN]	12,3	19,8	28,3	40,0	74,6	93,3	75,9	92,0
	HAS-(E)-HCR [kN]	16,7	23,3	33,3	40,0	74,6	93,3	-	-
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**								
	HAS-(E)(F) [kN]	6,8	10,4	15,2	28,8	44,8	64,0	139,2	168,8
	HAS-(E)-R [kN]	7,7	11,5	17,3	32,7	50,6	71,8	45,4	55,5
	HAS-(E)-HCR [kN]	9,6	14,4	21,6	40,8	63,2	64,0	-	-

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

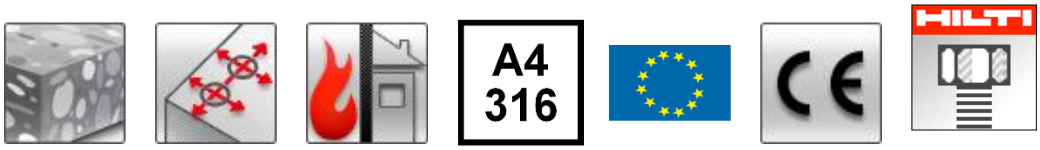
		Data according ETA-05/0255, issue 2011-06-23							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Carbon steel, strength class		**5.8**	**5.8**	**5.8**	**5.8**	**5.8**	**5.8**	**8.8**	**8.8**
Embedment depth	h_{ef}: [mm]	80	90	110	125	170	210	240	270
Base material thickness	h_{min}: [mm]	110	120	140	170	220	270	300	340
Edge distance	$c = c_{min}$: [mm]	40	45	55	65	90	120	130	135
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**								
	HAS-(E)(F) [kN]	9,4	12,7	18,2	22,0	35,5	49,8	59,9	69,9
	HAS-(E)-R [kN]	9,4	12,7	18,2	22,0	35,5	49,8	59,9	69,9
	HAS-(E)-HCR [kN]	9,4	12,7	18,2	22,0	35,5	49,8	-	-
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**								
	HAS-(E)(F) [kN]	3,7	4,7	6,6	8,9	15,1	23,6	27,7	30,7
	HAS-(E)-R [kN]	3,7	4,7	6,6	8,9	15,1	23,6	27,7	30,7
	HAS-(E)-HCR [kN]	3,7	4,7	6,6	8,9	15,1	23,6	-	-

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² (load values are valid for single anchor)

		Data according ETA-05/0255, issue 2011-06-23							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Carbon steel, strength class		**5.8**	**5.8**	**5.8**	**5.8**	**5.8**	**5.8**	**8.8**	**8.8**
Embedment depth	h_{ef}: [mm]	80	90	110	125	170	210	240	270
Base material thickness	h_{min}: [mm]	110	120	140	170	220	270	300	340
Spacing	$s = s_{min}$: [mm]	40	45	55	65	90	120	130	135
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**								
	HAS-(E)(F) [kN]	10,9	14,6	20,6	24,8	41,7	57,7	70,1	82,9
	HAS-(E)-R [kN]	10,9	14,6	20,6	24,8	41,7	57,7	70,1	82,9
	HAS-(E)-HCR [kN]	10,9	14,6	20,6	24,8	41,7	57,7	-	-
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**								
	HAS-(E)(F) [kN]	6,8	10,4	15,2	28,8	44,8	64,0	139,2	168,8
	HAS-(E)-R [kN]	7,7	11,5	17,3	32,7	50,6	71,8	45,4	55,5
	HAS-(E)-HCR [kN]	9,6	14,4	21,6	40,8	63,2	64,0	-	-

HVU with HIS-(R)N sleeve adhesive anchor system

Mortar system		Benefits
	Hilti HVU foil capsule	- suitable for non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete
	HIS-(R)N sleeve	



Concrete	Small edge distance and spacing	Fire resistance	Corrosion resistance	European Technical Approval	CE conformity	PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-05/0255 / 2011-06-23
Fire test report	IBMB, Braunschweig	UB-3333/0891-1 / 2004-03-26
Assessment report (fire)	warringtonfire	WF 327804/B / 2013-07-10

a) All data given in this section according ETA-05/0255, issue 2011-06-23.

Basic loading data (for a single anchor)

All data in this section applies to For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Screw strength class 8.8
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -5°C to +40°C

Embedment depth and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20
Embedment depth [mm]	90	110	125	170	205
Base material thickness [mm]	120	150	180	250	350

Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-05/0255, issue 2011-06-23				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Tensile $N_{Ru,m}$	HIS-N	[kN]	*26,3*	*48,3*	*70,4*	*123,9*	*114,5*
Shear $V_{Ru,m}$	HIS-N	[kN]	*13,7*	*24,2*	*41,0*	*62,0*	*57,8*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-05/0255, issue 2011-06-23				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Tensile N_{Rk}	HIS-N	[kN]	*25,0*	40,0	60,0	95,0	*109,0*
Shear V_{Rk}	HIS-N	[kN]	*13,0*	*23,0*	*39,0*	*59,0*	*55,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-05/0255, issue 2011-06-23				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Tensile N_{Rd}	HIS-N	[kN]	16,7	26,7	40,0	63,3	74,1
Shear V_{Rd}	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7

Recommended loads [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-05/0255, issue 2011-06-23				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Tensile N_{rec}	HIS-N	[kN]	11,9	19,0	28,6	45,2	53,0
Shear V_{rec}	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HVU adhesive may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +80 °C	+50 °C	+80 °C
Temperature range III	-40 °C to +120 °C	+72 °C	+120 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIS-(R)N

			Data according ETA-05/0255, issue 2011-06-23				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Nominal tensile strength f_{uk}	HIS-N	[N/mm²]	490	490	460	460	460
	Screw 8.8	[N/mm²]	800	800	800	800	800
	HIS-RN	[N/mm²]	700	700	700	700	700
	Screw A4-70	[N/mm²]	700	700	700	700	700
Yield strength f_{yk}	HIS-N	[N/mm²]	410	410	375	375	375
	Screw 8.8	[N/mm²]	640	640	640	640	640
	HIS-RN	[N/mm²]	350	350	350	350	350
	Screw A4-70	[N/mm²]	450	450	450	450	450
Stressed cross-section A_s	HIS-(R)N	[mm²]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm²]	36,6	58	84,3	157	245
Moment of resistance W	HIS-(R)N	[mm³]	145	430	840	1595	1543
	Screw	[mm³]	31,2	62,3	109	277	541

Material quality

Part	**Material**
internally threaded sleeves [a)] HIS-N	C-steel 1.0718, steel galvanized ≥ 5µm
internally threaded sleeves [b)] HIS-RN	stainless steel 1.4401 and 1.4571

a) related fastening screw: strength class 8.8, A5 > 8% Ductile
steel galvanized ≥ 5µm

b) related fastening screw: strength class 70, A5 > 8% Ductile
stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362

Anchor dimensions

Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Internal sleeve HIS-(R)N		M8x90	M10x110	M12x125	M16x170	M20x205
Anchor embedment depth	[mm]	90	110	125	170	205

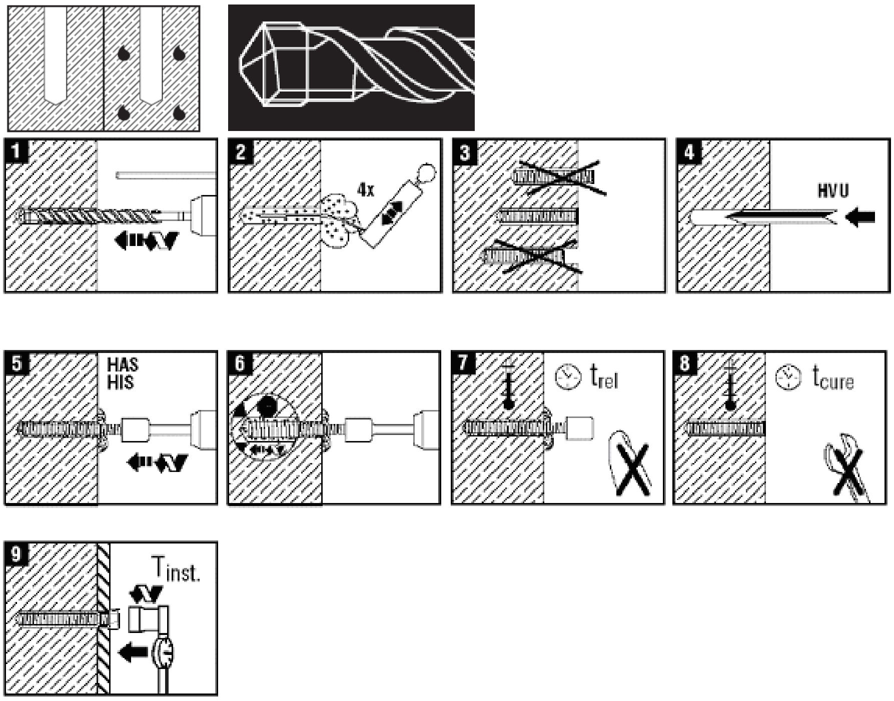
Setting

installation equipment

Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
Rotary hammer	TE1 – TE30	TE1 – TE60	TE1 – TE80	TE50 – TE80	TE60 – TE80
Other tools	blow out pump or compressed air gun, setting tools				

Setting instruction

Dry and water-saturated concrete, hammer drilling



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

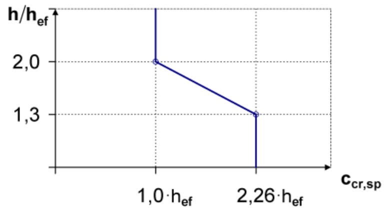
For technical data for anchors in diamond drilled holes please contact the Hilti Technical advisory service.

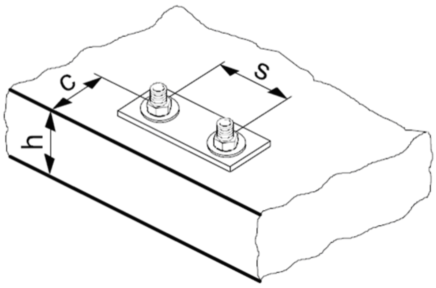
Curing time for general conditions

Data according ETA-05/0255, issue 2011-06-23	
Temperature of the base material	**Curing time before anchor can be fully loaded t_{cure}**
20 °C to 40 °C	20 min
10 °C to 19 °C	30 min
0 °C to 9 °C	1 h
-5 °C to - 1 °C	5 h

Setting details

			Data according ETA-05/0255, issue 2011-06-23				
Anchor size		**Sleeve HIS-(R)N foil capsule**	**M8x90 M10x90**	**M10x110 M12x110**	**M12x125 M16x125**	**M16x170 M20x170**	**M20x205 M24x210**
Nominal diameter of drill bit	d_0	[mm]	14	18	22	28	32
Diameter of element	d	[mm]	12,5	16,5	20,5	25,4	27,6
Effective anchorage and drill hole depth	h_{ef}	[mm]	90	110	125	170	205
Minimum base material thickness	h_{min}	[mm]	120	150	170	230	270
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22
Thread engagement length; min - max	h_s	[mm]	8-20	10-25	12-30	16-40	20-50
Minimum spacing	s_{min}	[mm]	40	45	60	80	125
Minimum edge distance	c_{min}	[mm]	40	45	60	80	125
Critical spacing for splitting failure	$s_{cr,sp}$		$2\ c_{cr,sp}$				
Critical edge distance for splitting failure a)	$c_{cr,sp}$	[mm]	$\mathbf{1{,}0 \cdot h_{ef}}$	for $h / h_{ef} \geq 2{,}0$			
			$\mathbf{4{,}6\ h_{ef} - 1{,}8\ h}$	for $2{,}0 > h / h_{ef} > 1{,}3$			
			$\mathbf{2{,}26\ h_{ef}}$	for $h / h_{ef} \leq 1{,}3$			
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\ c_{cr,N}$				
Critical edge distance for concrete cone failure	$c_{cr,N}$		$1{,}5\ h_{ef}$				
Torque moment b)	T_{max}	[Nm]	10	20	40	80	150





For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) h: base material thickness ($h \geq h_{min}$)

b) This is the maximum recommended torque moment to avoid splitting failure during installation for anchors with minimum spacing and/or edge distance.

Simplified design method

Simplified version of the design method according EOTA Technical Report TR 029. Design resistance according data given in ETA-05/0255, issue 2011-06-23.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according EOTA Technical Report TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

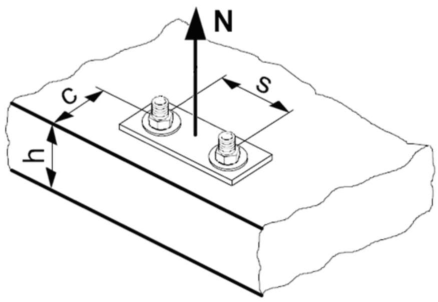
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $\mathbf{N_{Rd,s}}$
- Combined pull-out and concrete cone resistance:
  $\mathbf{N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{h,p}}$
- Concrete cone resistance: $\mathbf{N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}}$
- Concrete splitting resistance (only non-cracked concrete):
  $\mathbf{N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

			Data according ETA-05/0255, issue 2011-06-23				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
$N_{Rd,s}$	HIS-N	[kN]	17,5	30,7	44,7	80,3	74,1
	HIS-RN	[kN]	13,9	21,9	31,6	58,8	69,2

Design combined pull-out and concrete cone resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{h,p}$

			Data according ETA-05/0255, issue 2011-06-23				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth h_{ef} [mm]			**90**	**110**	**125**	**170**	**205**
$N^0_{Rd,p}$	Temperature range I	[kN]	16,7	26,7	40,0	63,3	93,3
$N^0_{Rd,p}$	Temperature range II	[kN]	13,3	23,3	33,3	50,0	63,3
$N^0_{Rd,p}$	Temperature range III	[kN]	6,0	10,7	13,3	26,7	33,3

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{h,N} \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{re,N}$

		Data according ETA-05/0255, issue 2011-06-23				
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
$N^0_{Rd,c}$	[kN]	28,7	38,8	47,1	74,6	98,8

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,28}$ a)	1	1,05	1,12	1,18	1,21	1,25	1,28

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$f_{h,p} = 1$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N}$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$f_{h,N} = 1$

Influence of reinforcement

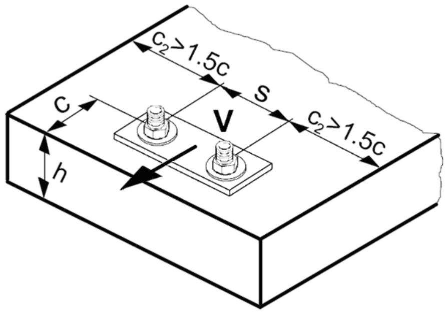
h_{ef} [mm]	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp}$ = k · lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

			Data according ETA-05/0255, issue 2011-06-23				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
$V_{Rd,s}$	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$ [a)]

Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
k			2		

a) $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
$V^0_{Rd,c}$	[kN]	12,4	19,8	28,4	40,7	46,8

a) For anchor groups only the anchors close to the edge must be considered.

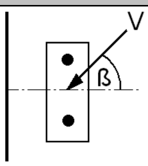
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß		**0°**	**10°**	**20°**	**30°**	**40°**	**50°**	**60°**	**70°**	**80°**	**≥ 90°**
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$		1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1{,}5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0{,}5$$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20
$f_{hef} = 0{,}05 \cdot (h_{ef} / d)^{1,68}$	1,38	1,21	1,04	1,22	1,45

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

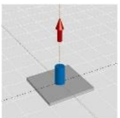
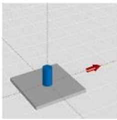
Combined tension and shear loading

For combined tension and shear loading see section "Anchor Design".

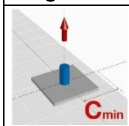
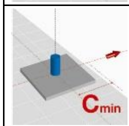
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

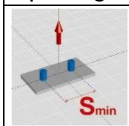
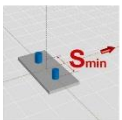
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

	Data according ETA-05/0255, issue 2011-06-23				
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth h_{ef}: [mm]	90	110	125	170	205
Base material thickness h_{min}: [mm]	120	150	170	230	270
 **Tensile N_{Rd}: single anchor, no edge effects**					
HIS-N [kN]	16,7	26,7	40,0	63,3	74,1
HIS-RN [kN]	13,9	21,9	31,6	58,8	69,2
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**					
HIS-N [kN]	10,4	18,4	26,0	39,3	36,7
HIS-RN [kN]	8,3	12,8	19,2	35,3	41,5

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

	Data according ETA-05/0255, issue 2011-06-23				
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth h_{ef}: [mm]	90	110	125	170	205
Base material thickness h_{min}: [mm]	120	150	170	230	270
Edge distance $c = c_{min}$: [mm]	40	45	60	80	125
 **Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**					
HIS-(R)N [kN]	8,9	13,4	21,0	33,5	49,2
 **Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**					
HIS-(R)N [kN]	4,2	5,5	8,5	13,8	25,3

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²
(load values are valid for single anchor)

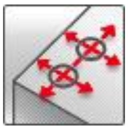
	Data according ETA-05/0255, issue 2011-06-23				
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth h_{ef}: [mm]	90	110	125	170	205
Base material thickness h_{min}: [mm]	120	150	170	230	270
Spacing $s = s_{min}$: [mm]	40	45	60	80	125
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**					
HIS-(R)N [kN]	11,0	16,9	24,4	38,8	56,2
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**					
HIS-N [kN]	10,4	18,4	26,0	39,3	36,7
HIS-RN [kN]	8,3	12,8	19,2	35,3	41,5

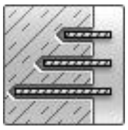
Hilti HIT-RE 500-SD mortar with HIT-V rod

Injection mortar system		Benefits
	Hilti HIT-RE 500-SD 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- suitable for non-cracked and cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - large diameter applications - high corrosion resistant - long working time at elevated temperatures - odourless epoxy - embedment depth range: from 40 … 160 mm for M8 to 120 … 600 mm for M30
	Static mixer	
	HIT-V rod	


Concrete


Tensile zone


Small edge distance and spacing


Variable embedment depth


Fire resistance


Shock


Seismic

Corrosion resistance

High corrosion resistance


European Technical Approval


CE conformity


PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-07/0260 / 2013-06-26
ES report icl. seismic	ICC evaluation service	ESR 2322 / 2014-02-01
Shockproof fastenings in civil defence installations	Federal Office for Cicil Protection, Bern	BZS D 08-604 / 2009-10-21
Fire test report	MFPA, Leipzig	GS-III/B-07-070 / 2008-01-18
Assessment report (fire)	warringtonfire	WF 327804/B / 2013-07-10

a) All data given in this section according ETA-07/0260, issue 2013-06-26.

Basic loading data (for a single anchor)

All data in this section applies to For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range +5°C to +40°C

Embedment depth [a)] and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth [mm]	80	90	110	125	170	210	240	270
Base material thickness [mm]	110	120	140	165	220	270	300	340

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Non cracked concrete										
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	*18,9*	*30,5*	*44,1*	*83,0*	*129,2*	*185,9*	*241,5*	*295,1*
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	*9,5*	*15,8*	*22,1*	*41,0*	*64,1*	*92,4*	*120,8*	*147,0*
Cracked concrete										
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	*18,9*	*30,5*	*44,1*	65,2	110,8	146,1	196,0	226,2
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	*9,5*	*15,8*	*22,1*	*41,0*	*64,1*	*92,4*	*120,8*	*147,0*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Non cracked concrete										
Tensile N_{Rk}	HIT-V 5.8	[kN]	*18,0*	*29,0*	*42,0*	70,6	111,9	153,7	187,8	224,0
Shear V_{Rk}	HIT-V 5.8	[kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*	*115,0*	*140,0*
Cracked concrete										
Tensile N_{Rk}	HIT-V 5.8	[kN]	*16,1*	*22,6*	*31,1*	44,0	74,8	109,6	132,3	152,7
Shear V_{Rk}	HIT-V 5.8	[kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*	*115,0*	*140,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Non cracked concrete										
Tensile N_{Rd}	HIT-V 5.8	[kN]	12,0	19,3	28,0	33,6	53,3	73,2	89,4	106,7
Shear V_{Rd}	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
Cracked concrete										
Tensile N_{Rd}	HIT-V 5.8	[kN]	8,9	12,6	17,3	20,9	35,6	52,2	63,0	72,7
Shear V_{Rd}	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0

Recommended loads [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Non cracked concrete										
Tensile N_{rec}	HIT-V 5.8	[kN]	8,6	13,8	20,0	24,0	38,1	52,3	63,9	76,2
Shear V_{rec}	HIT-V 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3	65,7	80,0
Cracked concrete										
Tensile N_{rec}	HIT-V 5.8	[kN]	6,4	9,0	12,3	15,0	25,4	37,3	45,0	51,9
Shear V_{rec}	HIT-V 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3	65,7	80,0

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-RE 500-SD injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +58 °C	+35 °C	+58 °C
Temperature range III	-40 °C to +70 °C	+43 °C	+70 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIT-V / HAS

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Nominal tensile strength f_{uk}	HIT-V 5.8	[N/mm²]	500	500	500	500	500	500	500	500
	HIT-V 8.8	[N/mm²]	800	800	800	800	800	800	800	800
	HIT-V-R	[N/mm²]	700	700	700	700	700	700	500	500
	HIT-V-HCR	[N/mm²]	800	800	800	800	800	700	700	700
Yield strength f_{yk}	HIT-V 5.8	[N/mm²]	400	400	400	400	400	400	400	400
	HIT-V 8.8	[N/mm²]	640	640	640	640	640	640	640	640
	HIT-V -R	[N/mm²]	450	450	450	450	450	450	210	210
	HIT-V -HCR	[N/mm²]	600	600	600	600	600	400	400	400
Stressed cross-section A_s	HIT-V	[mm²]	36,6	58,0	84,3	157	245	353	459	561
Moment of resistance W	HIT-V	[mm³]	31,2	62,3	109	277	541	935	1387	1874

Material quality

Part	Material
Threaded rod HIT-V(F) 5.8	Strength class 5.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V(F) 8.8	Strength class 8.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V-R	Stainless steel grade A4, A_5 > 8% ductile strength class 70 for ≤ M24 and class 50 for M27 to M30, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Threaded rod HIT-V-HCR	High corrosion resistant steel, 1.4529; 1.4565 strength ≤ M20: R_m = 800 N/mm², $R_{p\,0.2}$ = 640 N/mm², A_5 > 8% ductile M24 to M30: R_m = 700 N/mm², $R_{p\,0.2}$ = 400 N/mm², A_5 > 8% ductile
Washer ISO 7089	Steel galvanized, hot dipped galvanized
	Stainless steel, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	High corrosion resistant steel, 1.4529; 1.4565
Nut EN ISO 4032	Strength class 8, steel galvanized ≥ 5 µm, hot dipped galvanized ≥ 45 µm
	Strength class 70, stainless steel grade A4, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	Strength class 70, high corrosion resistant steel, 1.4529; 1.4565

Anchor dimensions

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Anchor embedment depth [mm]	80	90	110	125	170	210	240	270
Anchor rod HIT-V, HIT-V-R, HIT-V-HCR	Anchor rods HIT-V (-R / -HCR) are available in variable length							

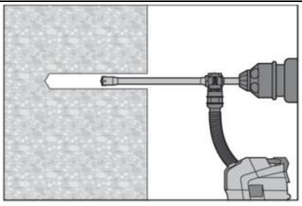
Setting

installation equipment

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Rotary hammer	TE2 – TE16				TE40 – TE70			
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser							

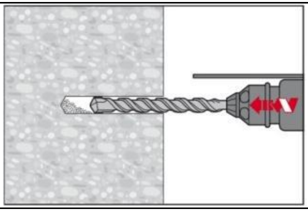
Setting instruction

Bore hole drilling



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 borehole during drilling when using in accordance with the user's manual.

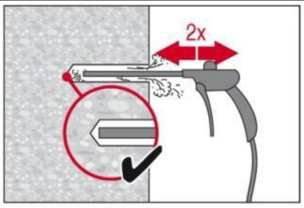
After drilling is complete, proceed to the "injection preparation" step in the instructions for use.



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

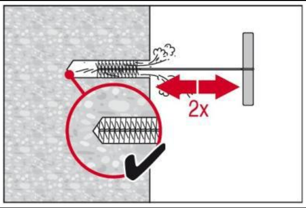
Bore hole cleaning Just before setting an anchor, the bore hole must be free of dust and debris.

Compressed air cleaning (CAC) for all bore hole diameters d_0 and all bore hole depth h_0

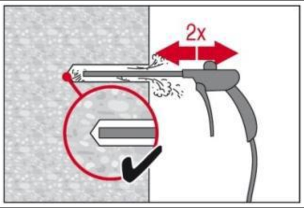


Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m^3/h) until return air stream is free of noticeable dust.

Bore hole diameter ≥ 32 mm the compressor must supply a minimum air flow of 140 m^3/hour.

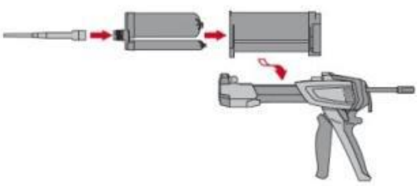


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with the proper brush diameter.

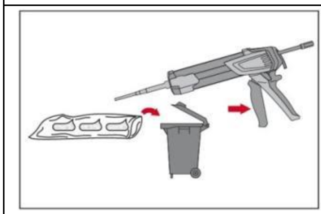


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

Injection preparation



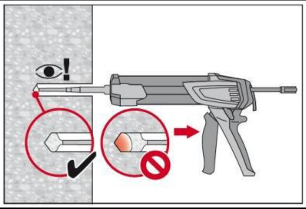
Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser and the mortar. Check foil pack holder for proper function. Do not use damaged foil packs / holders. Insert foil pack into foil pack holder and put holder into HIT-dispenser.



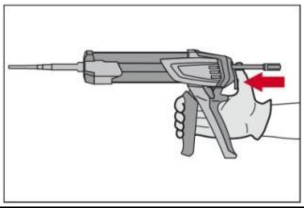
The foil pack opens automatically as dispensing is initiated. Discard initial adhesive. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
Discard quantities are:

3 strokes for 330 ml foil pack,
4 strokes for 500 ml foil pack,
65 ml for 1400 ml foil pack ≤ 5°C.

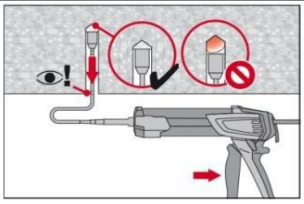
Inject adhesive from the back of the borehole without forming air voids



Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
Fill holes approximately 2/3 full It is required that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.

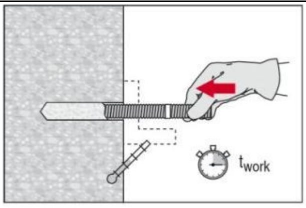


After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

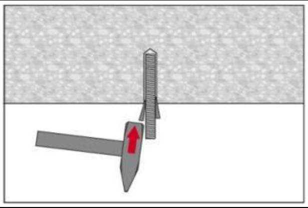


Overhead installation and/or installation with embedment depth h_{ef} > 250mm.
For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (HIT-SZ). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the bore hole by the adhesive pressure.

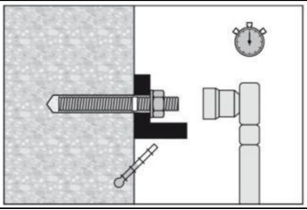
Setting the element



Before use, verify that the element is dry and free of oil and other contaminants.
Mark and set element to the required embedment depth untill working time t_{work} has elapsed.



For overhead installation use piston plugs and fix embedded parts with e.g. wedges HIT-OHW.



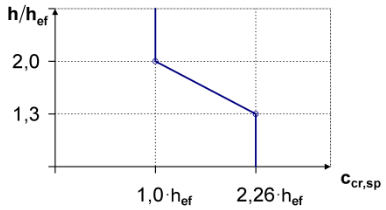
Loading the anchor:
After required curing time t_{cure} the anchor can be loaded.
The applied installation torque shall not exceed given $T_{max.}$

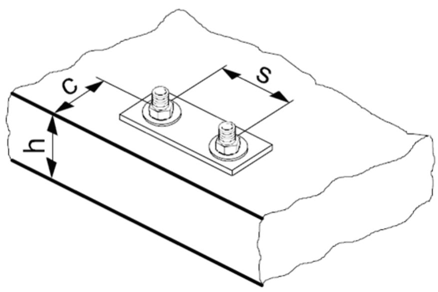
For detailed information on installation see instruction for use given with the package of the product.

Curing time for general conditions

Data according ETA-07/0260, issue 2013-06-26		
Temperature of the base material	**Working time in which anchor can be inserted and adjusted t_{gel}**	**Curing time before anchor can be fully loaded t_{cure}**
40 °C	12 min	4 h
30 °C to 39 °C	12 min	8 h
20 °C to 29 °C	20 min	12 h
15 °C to 19 °C	30 min	24 h
10 °C to 14 °C	90 min	48 h
5 °C to 9 °C	120 min	72 h

Setting details

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	24	28	30	35
Effective anchorage and drill hole depth range [a)]	$h_{ef,min}$	[mm]	40	40	48	64	80	96	108	120
	$h_{ef,max}$	[mm]	160	200	240	320	400	480	540	600
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm		$h_{ef} + 2\ d_0$					
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22	26	30	33
Minimum spacing	s_{min}	[mm]	40	50	60	80	100	120	135	150
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120	135	150
Critical spacing for splitting failure	$s_{cr,sp}$		$2\ c_{cr,sp}$							
Critical edge distance for splitting failure [b)]	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$**	for $h / h_{ef} \geq 2{,}0$						
			$4{,}6\ h_{ef} - 1{,}8\ h$	for $2{,}0 > h / h_{ef} > 1{,}3$						
			$2{,}26\ h_{ef}$	for $h / h_{ef} \leq 1{,}3$						
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\ c_{cr,N}$							
Critical edge distance for concrete cone failure [c)]	$c_{cr,N}$		$1{,}5\ h_{ef}$							
Torque moment [d)]	T_{max}	[Nm]	10	20	40	80	150	200	270	300



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$ (h_{ef}: embedment depth)

b) h: base material thickness ($h \geq h_{min}$)

c) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

d) This is the maximum recommended torque moment to avoid splitting failure during installation for anchors with minimum spacing and/or edge distance.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-07/0260, issue 2013-06-26.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

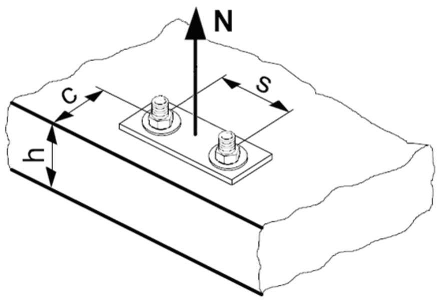
The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:

$$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$$

- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):

$$N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,s}$	HIT-V 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	118,0	153,3	187,3
	HIT-V 8.8	[kN]	19,3	30,7	44,7	84,0	130,7	188,0	244,7	299,3
	HIT-V-R	[kN]	13,9	21,9	31,6	58,8	92,0	132,1	80,4	98,3
	HIT-V-HCR	[kN]	19,3	30,7	44,7	84,0	130,7	117,6	152,9	187,1

Design combined pull-out and concrete cone resistance

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

	Data according ETA-07/0260, issue 2013-06-26							
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Typical embedment depth $h_{ef,typ}$ [mm]	**80**	**90**	**110**	**125**	**170**	**210**	**240**	**270**
Non cracked concrete								
$N^0_{Rd,p}$ Temperature range I [kN]	17,9	25,1	36,9	44,9	76,3	105,6	135,7	157,5
$N^0_{Rd,p}$ Temperature range II [kN]	14,5	20,4	29,9	35,9	61,0	82,9	106,6	133,3
$N^0_{Rd,p}$ Temperature range III [kN]	8,9	12,6	18,4	22,4	35,6	52,8	63,0	78,8
Cracked concrete								
$N^0_{Rd,p}$ Temperature range I [kN]	8,9	12,6	17,3	20,9	35,6	52,8	63,0	72,7
$N^0_{Rd,p}$ Temperature range II [kN]	7,3	9,4	13,8	18,0	28,0	41,5	48,5	60,6
$N^0_{Rd,p}$ Temperature range III [kN]	4,5	5,5	8,1	10,5	15,3	22,6	29,1	36,4

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

	Data according ETA-07/0260, issue 2013-06-26							
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
$N^0_{Rd,c}$ Non cracked concrete [kN]	20,1	24,0	32,4	33,6	53,3	73,2	89,4	106,7
$N^0_{Rd,c}$ Cracked concrete [kN]	14,3	17,1	23,1	24,0	38,0	52,2	63,7	76,1

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ a)	1	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance [a)]

$c/c_{cr,N}$ $c/c_{cr,sp}$	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
$f_{1,N} = 0{,}7 + 0{,}3 \cdot c/c_{cr,N}$ $f_{1,sp} = 0{,}7 + 0{,}3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0{,}5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp} = 0{,}5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing [a)]

$s/s_{cr,N}$ $s/s_{cr,sp}$	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
$f_{3,N} = 0{,}5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp} = 0{,}5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

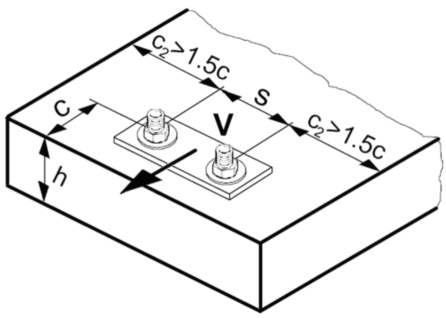
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0{,}5 + h_{ef}/200mm \leq 1$	0,7 [a)]	0,75 [a)]	0,8 [a)]	0,85 [a)]	0,9 [a)]	0,95 [a)]	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
$V_{Rd,s}$	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

k = 1 for $h_{ef} < 60$ mm **k = 2 for $h_{ef} \geq 60$ mm**

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Non-cracked concrete									
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,6	18,7	27,0	36,6	44,5	53,0
Cracked concrete									
$V^0_{Rd,c}$	[kN]	4,2	6,1	8,2	13,2	19,2	25,9	31,5	37,5

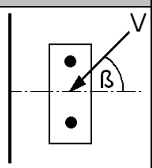
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	**0°**	**10°**	**20°**	**30°**	**40°**	**50°**	**60°**	**70°**	**80°**	**≥ 90°**
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	**0,15**	**0,3**	**0,45**	**0,6**	**0,75**	**0,9**	**1,05**	**1,2**	**1,35**	**≥ 1,5**
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

h_{ef}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

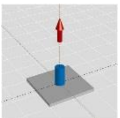
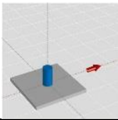
Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

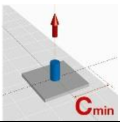
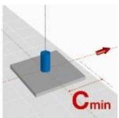
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

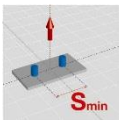
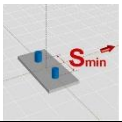
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef,1}$ =	[mm]	48	60	72	96	120	144	162	180
Base material thickness h_{min}=	[mm]	100	100	102	132	168	200	222	250
Tensile N_{Rd}: single anchor, no edge effects									
Non cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	9,3	13,0	17,1	22,6	31,6	41,6	49,6	58,1
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	5,4	8,4	11,3	16,1	22,5	29,6	35,3	41,4
Shear V_{Rd}: single anchor, no edge effects, without lever arm									
Non cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	11,2	18,4	27,2	50,4	78,4	112,8	138,8	162,6
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	11,2	18,4	27,2	50,4	78,4	70,9	92,0	112,0
Cracked concrete									
 HIT-V 5.8	[kN]	6,4	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	6,4	18,4	27,1	45,0	63,1	82,9	99,0	115,9
HIT-V-R	[kN]	6,4	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	6,4	18,4	27,1	45,0	63,1	70,9	92,0	112,0

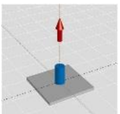
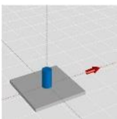
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef,1}$ =	[mm]	48	60	72	96	120	144	162	180
Base material thickness h_{min}=	[mm]	100	100	102	132	168	200	222	250
Edge distance $c = c_{min}$=	[mm]	40	50	60	80	100	120	135	150
Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)									
Non cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	6,3	8,5	9,9	12,9	18,2	23,8	28,2	33,2
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,6	5,6	7,1	9,2	12,9	16,9	20,1	23,7
Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm									
Non cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,4	4,9	6,7	10,8	15,7	21,4	26,0	31,1
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	2,4	3,5	4,7	7,6	11,1	15,1	18,4	22,0

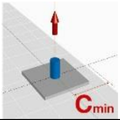
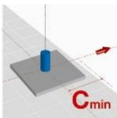
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth	$h_{ef,1}$ =	[mm]	48	60	72	96	120	144	162	180
Base material thickness	h_{min}=	[mm]	100	100	102	132	168	200	222	250
Spacing	$s = s_{min}$=	[mm]	40	50	60	80	100	120	135	150
	Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)									
	Non cracked concrete									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	6,0	8,2	10,3	13,5	19,0	24,9	29,6	34,8
	Cracked concrete									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,6	5,5	7,4	9,6	13,5	17,8	21,1	24,8
	Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm									
	Non cracked concrete									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	88,7	103,9
	HIT-V 8.8	[kN]	7,2	18,4	26,3	40,5	56,5	74,3	88,7	103,9
	HIT-V-R	[kN]	7,2	12,8	19,2	35,3	55,1	74,3	48,3	58,8
	HIT-V-HCR	[kN]	7,2	18,4	26,3	40,5	56,5	70,9	88,7	103,9
	Cracked concrete									
	HIT-V 5.8	[kN]	4,1	12,0	16,8	28,8	40,3	53,0	63,2	74,1
	HIT-V 8.8	[kN]	4,1	12,8	17,3	28,8	40,3	53,0	63,2	74,1
	HIT-V-R	[kN]	4,1	12,8	17,3	28,8	40,3	53,0	48,3	58,8
	HIT-V-HCR	[kN]	4,1	12,8	17,3	28,8	40,3	53,0	63,2	74,1

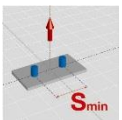
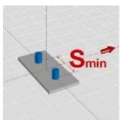
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth	$h_{ef,typ}$ =	[mm]	80	90	110	125	170	210	240	270
Base material thickness	h_{min}=	[mm]	110	120	140	161	218	266	300	340
	Tensile N_{Rd}: single anchor, no edge effects									
	Non cracked concrete									
	HIT-V 5.8	[kN]	12,0	19,3	28,0	33,6	53,3	73,2	89,4	106,7
	HIT-V 8.8	[kN]	17,9	24,0	32,4	33,6	53,3	73,2	89,4	106,7
	HIT-V-R	[kN]	13,9	21,9	31,6	33,6	53,3	73,2	80,4	98,3
	HIT-V-HCR	[kN]	17,9	24,0	32,4	33,6	53,3	73,2	89,4	106,7
	Cracked concrete									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	8,9	12,6	17,3	20,9	35,6	52,2	63,0	72,7
	Shear V_{Rd}: single anchor, no edge effects, without lever arm									
	Non cracked concrete									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0
	Cracked concrete									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	41,9	71,2	70,9	92,0	112,0

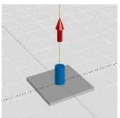
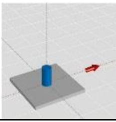
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef,typ}$ =	[mm]	80	90	110	125	170	210	240	270
Base material thickness h_{min} =	[mm]	110	120	140	161	218	266	300	340
Edge distance $c = c_{min}$=	[mm]	40	50	60	80	100	120	135	150
Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)									
Non cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	9,6	11,6	15,5	16,9	26,1	35,6	43,3	51,4
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	4,8	7,0	9,5	12,1	18,6	25,4	30,8	36,7
Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm									
Non cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,7	5,3	7,3	11,5	17,2	23,6	29,0	34,8
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	2,6	3,8	5,2	8,1	12,2	16,7	20,5	24,7

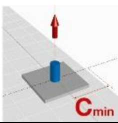
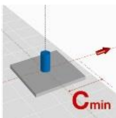
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef,typ}$ =	[mm]	80	90	110	125	170	210	240	270
Base material thickness h_{min}=	[mm]	110	120	140	161	218	266	300	340
Spacing $s = s_{min}$=	[mm]	40	50	60	80	100	120	135	150
Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)									
Non cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	10,9	13,5	18,1	19,2	30,1	41,2	50,3	59,9
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	5,9	8,1	11,1	13,2	21,5	29,4	35,8	42,7
Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm									
Non cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	177,0
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0
Cracked concrete									
 HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	17,9	24,5	35,6	59,6	86,9	104,8	120,6
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	17,9	24,5	35,6	59,6	70,9	92,0	112,0

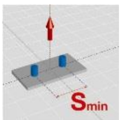
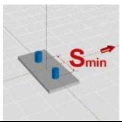
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef,2}$ =	[mm]	96	120	144	192	240	288	324	360
Base material thickness h_{min}=	[mm]	126	150	174	228	288	344	384	430
Tensile N_{Rd}: single anchor, no edge effects									
Non cracked concrete									
HIT-V 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	117,5	140,2	164,3
HIT-V 8.8	[kN]	19,3	30,7	44,7	64,0	89,4	117,5	140,2	164,3
HIT-V-R	[kN]	13,9	21,9	31,6	58,8	89,4	117,5	80,4	98,3
HIT-V-HCR	[kN]	19,3	30,7	44,7	64,0	89,4	117,5	140,2	164,3
Cracked concrete									
 HIT-V 5.8	[kN]	10,7	16,8	22,6	32,2	50,3	72,4	85,1	96,9
HIT-V 8.8	[kN]	10,7	16,8	22,6	32,2	50,3	72,4	85,1	96,9
HIT-V-R	[kN]	10,7	16,8	22,6	32,2	50,3	72,4	80,4	96,9
HIT-V-HCR	[kN]	10,7	16,8	22,6	32,2	50,3	72,4	85,1	96,9
Shear V_{Rd}: single anchor, no edge effects, without lever arm									
Non cracked and cracked concrete									
 HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef,2}$ =	[mm]	96	120	144	192	240	288	324	360
Base material thickness h_{min} =	[mm]	126	150	174	228	288	344	384	430
Edge distance $c = c_{min}$=	[mm]	40	50	60	80	100	120	135	150
Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)									
Non cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	11,6	16,5	21,7	28,6	40,0	52,6	62,7	73,5
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	5,8	9,0	12,2	17,5	27,4	37,5	44,7	52,4
Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm									
Non cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,9	5,7	7,8	12,9	18,9	25,9	31,8	38,1
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	2,8	4,0	5,5	9,1	13,4	18,4	22,5	27,0

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef,2}$ =	[mm]	96	120	144	192	240	288	324	360
Base material thickness h_{min}=	[mm]	126	150	174	228	288	344	384	430
Spacing $s = s_{min}$=	[mm]	40	50	60	80	100	120	135	150
Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)									
Non cracked concrete									
HIT-V 5.8	[kN]	12,0	19,3	26,5	34,9	48,8	64,2	76,6	89,7
HIT-V 8.8	[kN]	13,4	20,1	26,5	34,9	48,8	64,2	76,6	89,7
HIT-V-R	[kN]	13,4	20,1	26,5	34,9	48,8	64,2	76,6	89,7
HIT-V-HCR	[kN]	13,4	20,1	26,5	34,9	48,8	64,2	76,6	89,7
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	7,2	11,0	14,8	20,8	31,7	44,9	52,9	61,1
Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm									
Non cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0
Cracked concrete									
 HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	135,6	154,6
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

Seismic design C1

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:

- Seismic design according to TR045

The following technical data are based on: ETA-07/0260, issue 2013-06-26

Anchorage depth range

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Effective anchorage depth range	$h_{ef,min}$	[mm]	40	40	48	64	80	96	108	120
	$h_{ef,max}$	[mm]	160	200	240	320	400	480	540	600

Tension resistance in case of seismic performance category C1

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Characteristic tension resistance to steel failure										
HIT-V-5.8(F)	$N_{Rk,s,seis}$	[kN]	18	29	42	79	123	177	230	281
HIT-V-8.8(F)	$N_{Rk,s,seis}$	[kN]	29	46	67	126	196	282	367	449
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5							
HIT-V-R	$N_{Rk,s,seis}$	[kN]	26	41	59	110	172	247	230	281
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,87						2,86	
HIT-V-HCR	$N_{Rk,s,seis}$	[kN]	29	46	67	126	196	247	321	393
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5					2,1		
Characteristic bond resistance in cracked concrete C20/25 to C50/60										
Temperature range I: 40°C/24°C	$\tau_{Rk,seis}$	[N/mm²]	6,4	6,4	6	5,3	5	4,6	4,1	3,6
Temperature range II: 58°C/35°C	$\tau_{Rk,seis}$	[N/mm²]	5,2	4,8	4,8	4,5	3,9	3,6	3,1	3
Temperature range III: 70°C/43°C	$\tau_{Rk,seis}$	[N/mm²]	3,2	2,8	2,8	2,6	2,1	2	1,9	1,8
Partial safety factor	$\gamma_{Mp,seis}$	[-]	1,8			2,1				
Concrete cone resistance and splitting resistance										
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]	1,8			2,1				

Displacement under tension load in case of seismic performance category C1 [1)]

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Displacement [1)]	$\delta_{N,seis}$	[mm]	1,5	1,7	1,9	2,3	2,7	3,1	3,4	3,7

1) Maximum displacement during cycling (seismic event).

Shear resistance in case of seismic performance category C1

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Characteristic shear resistance to steel failure										
for HIT-V-5.8(F)	$V_{Rk,s,seis}$	[kN]	6	11	15	27	43	62	81	98
for HIT-V-8.8(F)	$V_{Rk,s,seis}$	[kN]	11	16	24	44	69	99	129	157
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25							
for HIT-V-R	$V_{Rk,s,seis}$	[kN]	9	14	21	39	60	87	81	98
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,56						2,38	
for HIT-V-HCR	$V_{Rk,s,seis}$	[kN]	11	16	24	44	69	87	113	137
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25					1,75		
Concrete pryout resistance and concrete edge resistance										
Partial safety factor	$\gamma_{Mcp,seis} = \gamma_{Mc,seis}$	[-]	1,5							

Displacement under shear load in case of seismic performance category C1 1)

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Displacement1)	$\delta_{V,seis}$	[mm]	3,2	3,5	3,8	4,4	5,0	5,6	6,1	6,5

1) Maximum displacement during cycling (seismic event).

For seismic resistent fastening applications please use the anchor design software PROFIS Anchor.

Hilti HIT-RE 500-SD mortar with HIS-(R)N sleeve

Injection mortar system		Benefits
	Hilti HIT-RE 500-SD 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- suitable for cracked and non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - long working time at elevated temperatures - odourless epoxy
	Statik mixer	
	HIS-(R)N sleeve	

Concrete | Tensile zone | Small edge distance and spacing | Fire resistance | Shock | Seismic | Corrosion resistance | European Technical Approval | CE conformity

PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval a)	DIBt, Berlin	ETA-07/0260 / 2013-06-26
ES report icl. seismic	ICC evaluation service	ESR 2322 / 2014-02-01
Shockproof fastenings in civil defence installations	Federal Office for Cicil Protection, Bern	BZS D 08-604 / 2009-10-21
Fire test report	MFPA, Leipzig	GS-III/B-07-070 / 2008-01-18
Assessment report (fire)	warringtonfire	WF 327804/B / 2013-07-10

a) All data given in this section according ETA-07/0260, issue 2013-06-26.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Screw strength class 8.8
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range +5°C to +40°C

Embedment depth and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20
Embedment depth [mm]	90	110	125	170	205
Base material thickness [mm]	120	150	170	230	270

Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Non cracked concrete							
Tensile $N_{Ru,m}$	HIS-N	[kN]	*26,3*	*48,3*	*70,4*	*123,9*	*114,5*
Shear $V_{Ru,m}$	HIS-N	[kN]	*13,7*	*24,2*	*41,0*	*62,0*	*57,8*
Cracked concrete							
Tensile $N_{Ru,m}$	HIS-N	[kN]	*26,3*	*48,3*	67,1	106,4	*114,5*
Shear $V_{Ru,m}$	HIS-N	[kN]	*13,7*	*24,2*	*41,0*	*62,0*	*57,8*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Non cracked concrete							
Tensile N_{Rk}	HIS-N	[kN]	*25,0*	*46,0*	*67,0*	111,9	*109,0*
Shear V_{Rk}	HIS-N	[kN]	*13,0*	*23,0*	*39,0*	*59,0*	*55,0*
Cracked concrete							
Tensile N_{Rk}	HIS-N	[kN]	25,0	40,0	50,3	79,8	105,7
Shear V_{Rk}	HIS-N	[kN]	*13,0*	*23,0*	*39,0*	*59,0*	*55,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Non cracked concrete							
Tensile N_{Rd}	HIS-N	[kN]	16,8	27,7	33,6	53,3	70,6
Shear V_{Rd}	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
Cracked concrete							
Tensile N_{Rd}	HIS-N	[kN]	13,9	19,0	24,0	38,0	50,3
Shear V_{Rd}	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7

Recommended loads [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Non cracked concrete							
Tensile N_{rec}	HIS-N	[kN]	12,0	19,8	24,0	38,1	50,4
Shear V_{rec}	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2
Cracked concrete							
Tensile N_{rec}	HIS-N	[kN]	9,9	13,6	17,1	27,1	35,9
Shear V_{rec}	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-RE 500-SD injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +58 °C	+35 °C	+58 °C
Temperature range III	-40 °C to +70 °C	+43 °C	+70 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIS-(R)N

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Nominal tensile strength f_{uk}	HIS-N	[N/mm²]	490	490	460	460	460
	Screw 8.8	[N/mm²]	800	800	800	800	800
	HIS-RN	[N/mm²]	700	700	700	700	700
	Screw A4-70	[N/mm²]	700	700	700	700	700
Yield strength f_{yk}	HIS-N	[N/mm²]	410	410	375	375	375
	Screw 8.8	[N/mm²]	640	640	640	640	640
	HIS-RN	[N/mm²]	350	350	350	350	350
	Screw A4-70	[N/mm²]	450	450	450	450	450
Stressed cross-section A_s	HIS-(R)N	[mm²]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm²]	36,6	58	84,3	157	245
Moment of resistance W	HIS-(R)N	[mm³]	145	430	840	1595	1543
	Screw	[mm³]	31,2	62,3	109	277	541

Material quality

Part	Material
internally threaded sleeves [a)] HIS-N	C-steel 1.0718, steel galvanized ≥ 5µm
internally threaded sleeves [b)] HIS-RN	stainless steel 1.4401 and 1.4571

a) related fastening screw: strength class 8.8, A5 > 8% Ductile
steel galvanized ≥ 5µm

b) related fastening screw: strength class 70, A5 > 8% Ductile
stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362

Anchor dimensions

Anchor size	M8	M10	M12	M16	M20
Internal sleeve HIS-(R)N	M8x90	M10x110	M12x125	M16x170	M20x205
Anchor embedment depth [mm]	90	110	125	170	205

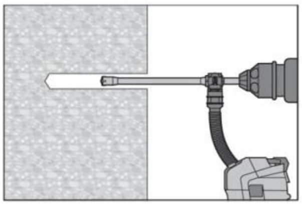
Setting

installation equipment

Anchor size	M8	M10	M12	M16	M20
Rotary hammer	TE 2 – TE 16		TE 40 – TE 70		
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser				

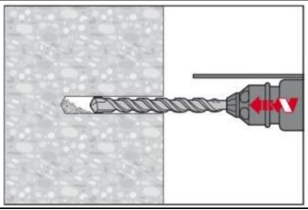
Setting instruction

Bore hole drilling



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 borehole during drilling when using in accordance with the user's manual.

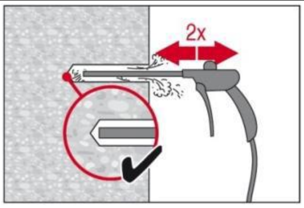
After drilling is complete, proceed to the "injection preparation" step in the instructions for use.



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

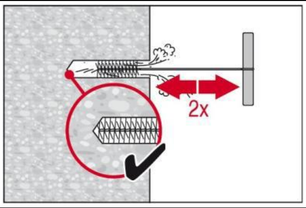
Bore hole cleaning Just before setting an anchor, the bore hole must be free of dust and debris.

Compressed air cleaning (CAC) for all bore hole diameters d_0 and all bore hole depth h_0

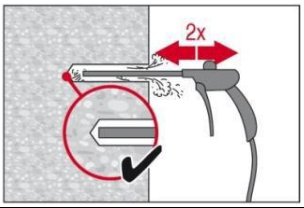


Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust.

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

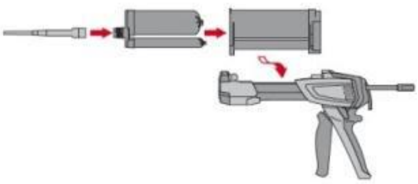


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with the proper brush diameter.

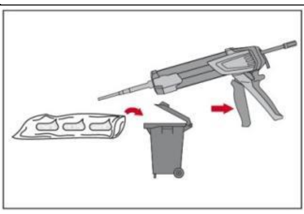


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

Injection preparation

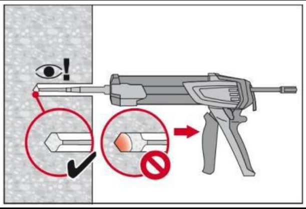


Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser and the mortar. Check foil pack holder for proper function. Do not use damaged foil packs / holders. Insert foil pack into foil pack holder and put holder into HIT-dispenser.

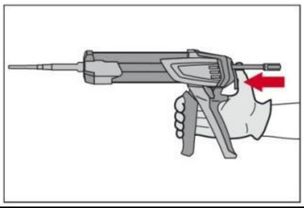


The foil pack opens automatically as dispensing is initiated. Discard initial adhesive. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
Discard quantities are:
- 3 strokes for 330 ml foil pack,
- 4 strokes for 500 ml foil pack,
- 65 ml for 1400 ml foil pack ≤ 5°C.

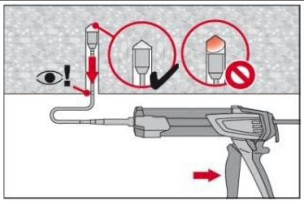
Inject adhesive from the back of the borehole without forming air voids



Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
Fill holes approximately 2/3 full It is required that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.

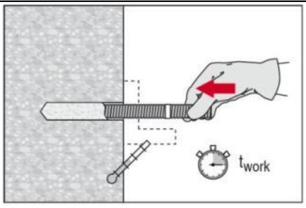


After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

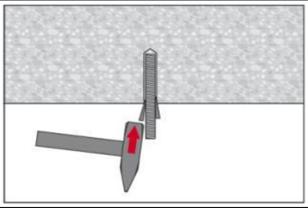


Overhead installation and/or installation with embedment depth h_{ef} > 250mm.
For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (HIT-SZ). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the bore hole by the adhesive pressure.

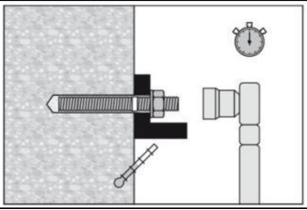
Setting the element



Before use, verify that the element is dry and free of oil and other contaminants.
Mark and set element to the required embedment depth untill working time t_{work} has elapsed.



For overhead installation use piston plugs and fix embedded parts with e.g. wedges HIT-OHW.



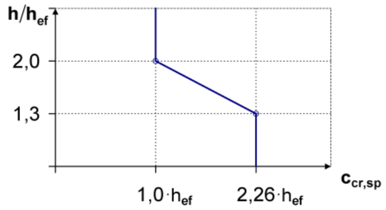
Loading the anchor:
After required curing time t_{cure} the anchor can be loaded.
The applied installation torque shall not exceed given T_{max}.

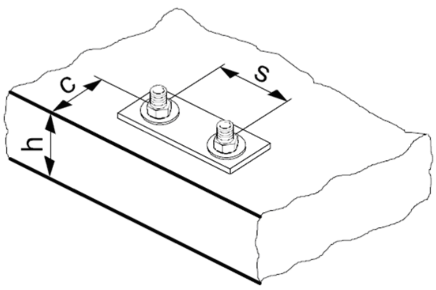
For detailed information on installation see instruction for use given with the package of the product.

Curing time for general conditions

Data according ETA-07/0260, issue 2013-06-26		
Temperature of the base material	Working time in which anchor can be inserted and adjusted t_{gel}	Curing time before anchor can be fully loaded t_{cure}
40 °C	12 min	4 h
30 °C to 39 °C	12 min	8 h
20 °C to 29 °C	20 min	12 h
15 °C to 19 °C	30 min	24 h
10 °C to 14 °C	90 min	48 h
5 °C to 9 °C	120 min	72 h

Setting details

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Nominal diameter of drill bit	d_0	[mm]	14	18	22	28	32
Diameter of element	d	[mm]	12,5	16,5	20,5	25,4	27,6
Effective anchorage and drill hole depth	h_{ef}	[mm]	90	110	125	170	205
Minimum base material thickness	h_{min}	[mm]	120	150	170	230	270
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22
Thread engagement length; min - max	h_s	[mm]	8-20	10-25	12-30	16-40	20-50
Minimum spacing	s_{min}	[mm]	40	45	55	65	90
Minimum edge distance	c_{min}	[mm]	40	45	55	65	90
Critical spacing for splitting failure	$s_{cr,sp}$		$2\ c_{cr,sp}$				
Critical edge distance for splitting failure [a]	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$**	for $h / h_{ef} \geq 2{,}0$			
			$4{,}6\ h_{ef} - 1{,}8\ h$	for $2{,}0 > h / h_{ef} > 1{,}3$			
			$2{,}26\ h_{ef}$	for $h / h_{ef} \leq 1{,}3$			
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\ c_{cr,N}$				
Critical edge distance for concrete cone failure [b]	$c_{cr,N}$		$1{,}5\ h_{ef}$				
Torque moment [c]	T_{max}	[Nm]	10	20	40	80	150



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) h: base material thickness ($h \geq h_{min}$)

b) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

c) This is the maximum recommended torque moment to avoid splitting failure during installation for anchors with minimum spacing and/or edge distance.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-07/0260, issue 2013-06-26.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

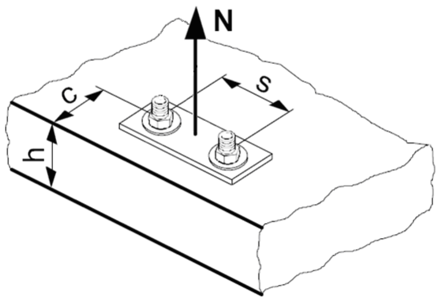
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
$N_{Rd,s}$	HIS-N	[kN]	17,4	30,7	44,7	80,3	74,1
	HIS-RN	[kN]	13,9	21,9	31,6	58,8	69,2

Design combined pull-out and concrete cone resistance

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

	Data according ETA-07/0260, issue 2013-06-26				
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth h_{ef} [mm]	**90**	**110**	**125**	**170**	**205**
Non cracked concrete					
$N^0_{Rd,p}$ Temperature range I [kN]	22,2	28,6	45,2	81,0	95,2
$N^0_{Rd,p}$ Temperature range II [kN]	19,4	23,8	35,7	66,7	81,0
$N^0_{Rd,p}$ Temperature range III [kN]	11,1	14,3	19,0	35,7	45,2
Cracked concrete					
$N^0_{Rd,p}$ Temperature range I [kN]	13,9	19,0	28,6	45,2	54,8
$N^0_{Rd,p}$ Temperature range II [kN]	11,1	16,7	19,0	35,7	45,2
$N^0_{Rd,p}$ Temperature range III [kN]	6,7	9,5	11,9	19,0	23,8

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance [a] $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

	Data according ETA-07/0260, issue 2013-06-26				
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
$N^0_{Rd,c}$ Non cracked concrete [kN]	24,0	27,7	33,6	53,3	70,6
$N^0_{Rd,c}$ Cracked concrete [kN]	17,1	19,8	24,0	38,0	50,3

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ [a]	1	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$f_{h,p} = 1$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N}$ = $0,7 + 0,3 \cdot c/c_{cr,N}$ $f_{1,sp}$ = $0,7 + 0,3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N}$ = $0,5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp}$ = $0,5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N}$ = $0,5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp}$ = $0,5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$f_{h,N} = 1$

Influence of reinforcement

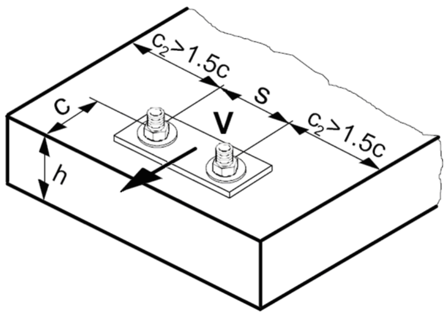
h_{ef} [mm]	80	90	≥ 100
$f_{re,N}$ = $0,5 + h_{ef}/200mm \leq 1$	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp}$ = k · lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			M8	M10	M12	M16	M20
$V_{Rd,s}$	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

k = 1 for h_{ef} < 60 mm
k = 2 for $h_{ef} \geq$ 60 mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20
Non-cracked concrete						
$V^0_{Rd,c}$	[kN]	12,4	19,6	28,2	40,2	46,2
Cracked concrete						
$V^0_{Rd,c}$	[kN]	8,8	13,9	20,0	28,5	32,7

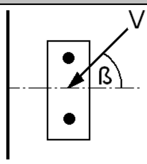
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \frac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20
f_{hef} =	1,38	1,21	1,04	1,22	1,45

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

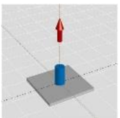
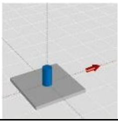
Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

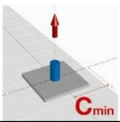
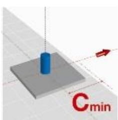
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

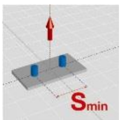
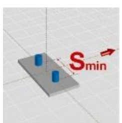
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth		h_{ef} : [mm]	90	110	125	170	205
Base material thickness		h_{min}: [mm]	120	150	170	230	270
	**Tensile N_{Rd}: single anchor, no edge effects**						
	Non cracked concrete						
	HIS-N	[kN]	17,4	27,7	33,6	53,3	70,6
	HIS-RN	[kN]	13,9	21,9	31,6	53,3	69,2
	Cracked concrete						
	HIS-(R)N	[kN]	13,9	19,0	24,0	38,0	50,3
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**						
	Non cracked and cracked concrete						
	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth		h_{ef} = [mm]	90	110	125	170	205
Base material thickness		h_{min}= [mm]	120	150	170	230	270
Edge distance		$c = c_{min}$= [mm]	40	45	55	65	90
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**						
	Non cracked concrete						
	HIS-(R)N	[kN]	11,0	12,4	15,4	23,5	32,0
	Cracked concrete						
	HIS-(R)N	[kN]	7,1	8,9	11,0	16,8	22,8
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**						
	Non cracked concrete						
	HIS-(R)N	[kN]	4,2	5,5	7,6	10,8	17,2
	Cracked concrete						
	HIS-(R)N	[kN]	3,0	3,9	5,4	7,7	12,2

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth		h_{ef} = [mm]	90	110	125	170	205
Base material thickness		h_{min}= [mm]	120	150	170	230	270
Spacing		$s = s_{min}$= [mm]	40	45	55	65	90
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**						
	Non cracked concrete						
	HIS-(R)N	[kN]	13,1	15,2	18,5	29,0	38,8
	Cracked concrete						
	HIS-(R)N	[kN]	8,5	10,8	13,2	20,6	27,6
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**						
	Non cracked and cracked concrete						
	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Seismic design C1

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:
- Seismic design according to TR045

The following technical data are based on: ETA-07/0260, issue 2013-06-26

Anchorage depth range

Anchor size			M8	M10	M12	M16	M20
Effective anchorage depth	h_{ef}	[mm]	90	110	125	170	205

Tension resistance in case of seismic performance category C1

Anchor size				M8	M10	M12	M16	M20
Diameter of element				12,5	16,5	20,5	25,4	27,6
Characteristic tension resistance to steel failure								
HIS-N steel grade 8.8		$N_{Rk,s,seis}$	[kN]	25	46	67	118	109
Partial safety factor		$\gamma_{Ms,seis}$	[-]	1,43	1,5		1,47	
HIS-RN steel grade 70		$N_{Rk,s,seis}$	[kN]	26	41	59	110	166
Partial safety factor		$\gamma_{Ms,seis}$	[-]	1,87				2,4
Characteristic bond resistance in cracked concrete C20/25 to C50/60								
Temperature range I:	40°C/24°C	$N_{Rk,p,seis}$	[N/mm²]	20	30	42	61	71
Temperature range II:	58°C/35°C	$N_{Rk,p,seis}$	[N/mm²]	16	26	28	48	59
Temperature range III:	70°C/43°C	$N_{Rk,p,seis}$	[N/mm²]	9,5	15	17	25	31
Partial safety factor		$\gamma_{Mp,seis}$	[-]	1,8	2,1			
Concrete cone resistance and splitting resistance								
Partial safety factor		$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]	1,8	2,1			

Displacement under tension load in case of seismic performance category C1 [1)]

Anchor size			M8	M10	M12	M16	M20
Displacement [1)]	$\delta_{N,seis}$	[mm]	1,5	1,7	1,9	2,3	2,7

1) Maximum displacement during cycling (seismic event).

Shear resistance in case of seismic performance category C1

Anchor size			M8	M10	M12	M16	M20
Characteristic shear resistance to steel failure							
HIS-N steel grade 8.8	$N_{Rk,s,seis}$	[kN]	9	16	27	41	39
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25		1,5		
HIS-RN steel grade 70	$N_{Rk,s,seis}$	[kN]	9	14	21	39	58
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,56				2,0
Concrete pryout resistance and concrete edge resistance							
Partial safety factor	$\gamma_{Mcp,seis} = \gamma_{Mc,seis}$	[-]	1,5				

Displacement under shear load in case of seismic performance category C1 [1)]

Anchor size			M8	M10	M12	M16	M20
Displacement [1)]	$\delta_{V,seis}$	[mm]	3,2	3,5	3,8	4,4	5,0

1) Maximum displacement during cycling (seismic event).

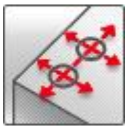
For seismic resistent fastening applications please use the anchor design software PROFIS Anchor.

Hilti HIT-RE 500-SD mortar with rebar (as anchor)

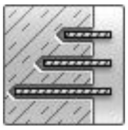
Injection mortar system		Benefits
	Hilti HIT-RE 500-SD 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- suitable for non-cracked and cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - large diameter applications - high corrosion resistant - long working time at elevated temperatures - odourless epoxy - embedment depth range: from 60 … 160 mm for Ø8 to 128 … 640 mm for Ø32
	Statik mixer	
	rebar BSt 500 S	

Concrete

Tensile zone



Small edge distance and spacing



Variable embedment depth

Fire resistance

Seismic

European Technical Approval

CE conformity

PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-07/0260 / 2013-06-26
ES report icl. seismic	ICC evaluation service	ESR 2322 / 2014-02-01
Fire test report	MFPA, Leipzig	GS-III/B-07-070 / 2008-01-18
Assessment report (fire)	warringtonfire	WF 327804/B / 2013-07-10

a) All data given in this section according ETA-07/0260, issue 2013-06-26.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range +5°C to +40°C

Embedment depth [a)] and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Typical embedment depth [mm]	80	90	110	125	125	170	210	270	300
Base material thickness [mm]	110	120	145	165	165	220	275	340	380

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500S

			Data according ETA-07/0260, issue 2013-06-26								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Non cracked concrete											
Tensile $N_{Ru,m}$	BSt 500 S	[kN]	*29,4*	*45,2*	*65,1*	*89,3*	94,1	149,2	204,9	298,7	349,9
Shear $V_{Ru,m}$	BSt 500 S	[kN]	*14,7*	*23,1*	*32,6*	*44,1*	*57,8*	*90,3*	*141,8*	*177,5*	*232,1*
Cracked concrete											
Tensile $N_{Ru,m}$	BSt 500 S	[kN]	23,8	33,5	46,1	57,0	65,2	110,8	146,1	228,7	268,1
Shear $V_{Ru,m}$	BSt 500 S	[kN]	*14,7*	*23,1*	*32,6*	*44,1*	*57,8*	*90,3*	*141,8*	*177,5*	*232,1*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			Data according ETA-07/0260, issue 2013-06-26								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Non cracked concrete											
Tensile N_{Rk}	BSt 500 S	[kN]	*28,0*	42,4	58,3	70,6	70,6	111,9	153,7	224,0	262,4
Shear V_{Rk}	BSt 500 S	[kN]	*14,0*	*22,0*	*31,0*	*42,0*	*55,0*	*86,0*	*135,0*	*169,0*	*221,0*
Cracked concrete											
Tensile N_{Rk}	BSt 500 S	[kN]	16,1	22,6	31,1	38,5	44,0	74,8	109,6	154,4	181,0
Shear V_{Rk}	BSt 500 S	[kN]	*14,0*	*22,0*	*31,0*	*42,0*	*55,0*	*86,0*	*135,0*	*169,0*	*221,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			Data according ETA-07/0260, issue 2013-06-26								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Non cracked concrete											
Tensile N_{Rd}	BSt 500 S	[kN]	16,8	23,6	32,4	39,2	33,6	53,3	73,2	106,7	125,0
Shear V_{Rd}	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
Cracked concrete											
Tensile N_{Rd}	BSt 500 S	[kN]	8,9	12,6	17,3	21,4	20,9	35,6	52,2	73,5	86,2
Shear V_{Rd}	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

Recommended loads [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			Data according ETA-07/0260, issue 2013-06-26								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Non cracked concrete											
Tensile N_{rec}	BSt 500 S	[kN]	12,0	16,8	23,1	28,0	24,0	38,1	52,3	76,2	89,3
Shear V_{rec}	BSt 500 S	[kN]	6,7	10,5	14,8	20,0	26,2	41,0	64,3	80,5	105,2
Cracked concrete											
Tensile N_{rec}	BSt 500 S	[kN]	6,4	9,0	12,3	15,3	15,0	25,4	37,3	52,5	61,5
Shear V_{rec}	BSt 500 S	[kN]	6,7	10,5	14,8	20,0	26,2	41,0	64,3	80,5	105,2

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-RE 500-SD injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +58 °C	+35 °C	+58 °C
Temperature range III	-40 °C to +70 °C	+43 °C	+70 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of rebar BSt 500S

			Data according ETA-07/0260, issue 2013-06-26								
Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Nominal tensile strength f_{uk}	BSt 500 S	[N/mm²]	550	550	550	550	550	550	550	550	550
Yield strength f_{yk}	BSt 500 S	[N/mm²]	500	500	500	500	500	500	500	500	500
Stressed cross-section A_s	BSt 500 S	[mm²]	50,3	78,5	113,1	153,9	201,1	314,2	490,9	615,8	804,2
Moment of resistance W	BSt 500 S	[mm³]	50,3	98,2	169,6	269,4	402,1	785,4	1534	2155	3217

Material quality

Part	Material
rebar BSt 500 S	Geometry and mechanical properties according to DIN 488-2:1986 or E DIN 488-2:2006

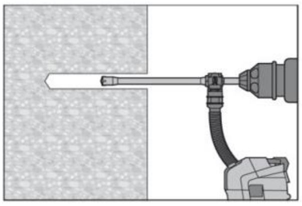
Setting

installation equipment

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Rotary hammer	TE 2 – TE 16					TE 40 – TE 70			
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser								

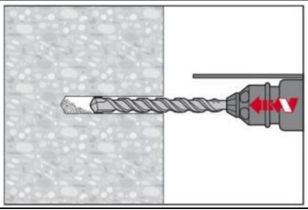
Setting instruction

Bore hole drilling



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 borehole during drilling when using in accordance with the user's manual.

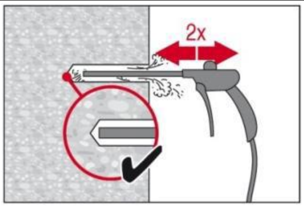
After drilling is complete, proceed to the "injection preparation" step in the instructions for use.



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

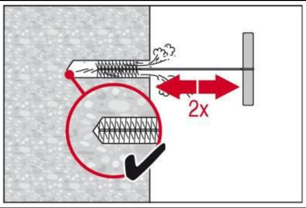
Bore hole cleaning Just before setting an anchor, the bore hole must be free of dust and debris.

Compressed air cleaning (CAC) for all bore hole diameters d_0 and all bore hole depth h_0

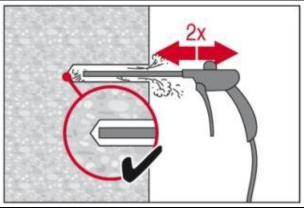


Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust.

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

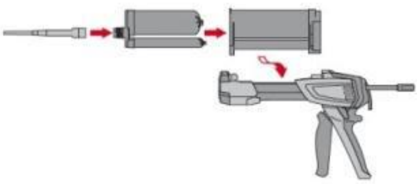


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with the proper brush diameter.

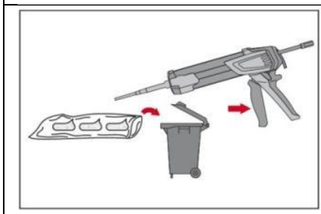


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

Injection preparation



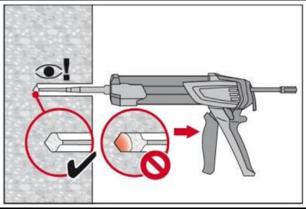
Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser and the mortar. Check foil pack holder for proper function. Do not use damaged foil packs / holders. Insert foil pack into foil pack holder and put holder into HIT-dispenser.



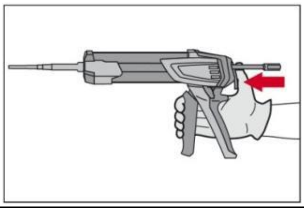
The foil pack opens automatically as dispensing is initiated. Discard initial adhesive. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
Discard quantities are:

3 strokes for 330 ml foil pack,
4 strokes for 500 ml foil pack,
65 ml for 1400 ml foil pack ≤ 5°C.

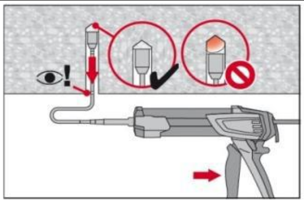
Inject adhesive from the back of the borehole without forming air voids



Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
Fill holes approximately 2/3 full It is required that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.

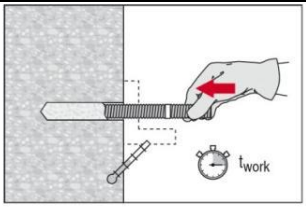


After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

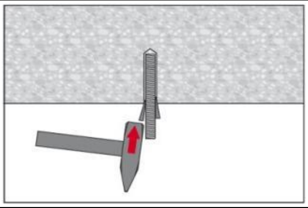


Overhead installation and/or installation with embedment depth h_{ef} > 250mm.
For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (HIT-SZ). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the bore hole by the adhesive pressure.

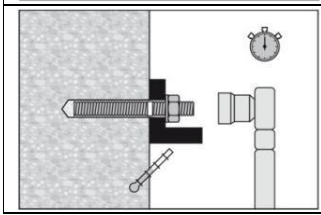
Setting the element



Before use, verify that the element is dry and free of oil and other contaminants.
Mark and set element to the required embedment depth untill working time t_{work} has elapsed.



For overhead installation use piston plugs and fix embedded parts with e.g. wedges HIT-OHW.



Loading the anchor:
After required curing time t_{cure} the anchor can be loaded.
The applied installation torque shall not exceed given T_{max}.

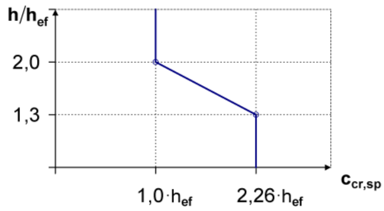
For detailed information on installation see instruction for use given with the package of the product.

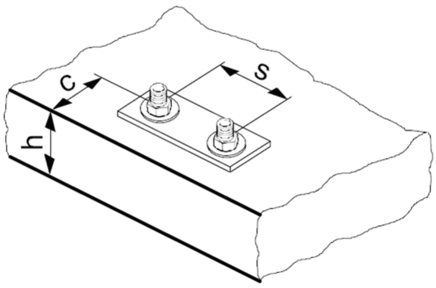
Curing time for general conditions

Data according ETA-07/0260, issue 2013-06-26		
Temperature of the base material	**Working time in which anchor can be inserted and adjusted t_{gel}**	**Curing time before anchor can be fully loaded t_{cure}**
40 °C	12 min	4 h
30 °C to 39 °C	12 min	8 h
20 °C to 29 °C	20 min	12 h
15 °C to 19 °C	30 min	24 h
10 °C to 14 °C	90 min	48 h
5 °C to 9 °C	120 min	72 h

Setting details

			Data according ETA-07/0260, issue 2013-06-26								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Nominal diameter of drill bit	d_0	[mm]	12	14	16	18	20	25	32	35	40
Effective anchorage and drill hole depth range [a)]	$h_{ef,min}$	[mm]	60	60	70	75	80	90	100	112	128
	$h_{ef,max}$	[mm]	160	200	240	280	320	400	500	560	640
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm		$h_{ef} + 2\ d_0$						
Minimum spacing	s_{min}	[mm]	40	50	60	70	80	100	125	140	160
Minimum edge distance	c_{min}	[mm]	40	50	60	70	80	100	125	140	160
Critical spacing for splitting failure	$s_{cr,sp}$		$2\ c_{cr,sp}$								
Critical edge distance for splitting failure [b)]	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$**		for $h / h_{ef} \geq 2{,}0$						
			$4{,}6\ h_{ef} - 1{,}8\ h$		for $2{,}0 > h / h_{ef} > 1{,}3$						
			$2{,}26\ h_{ef}$		for $h / h_{ef} \leq 1{,}3$						
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\ c_{cr,N}$								
Critical edge distance for concrete cone failure [c)]	$c_{cr,N}$		$1{,}5\ h_{ef}$								





For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$ (h_{ef}: embedment depth)

b) h: base material thickness ($h \geq h_{min}$)

c) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-07/0260, issue 2009-01-12.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the

exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

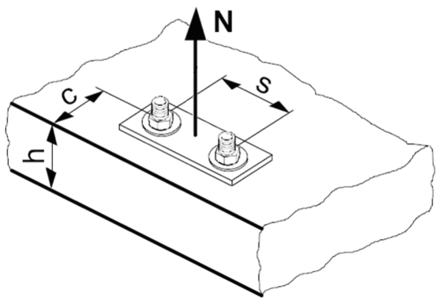
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
$N_{Rd,s}$ BSt 500 S [kN]	20,0	30,7	44,3	60,7	79,3	123,6	192,9	242,1	315,7

Design combined pull-out and concrete cone resistance

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Typical embedment depth $h_{ef,typ}$ [mm]	**80**	**90**	**110**	**125**	**125**	**170**	**210**	**270**	**300**
Non cracked concrete									
$N^0_{Rd,p}$ Temperature range I [kN]	16,8	23,6	34,6	42,8	41,9	71,2	102,1	147,0	186,7
$N^0_{Rd,p}$ Temperature range II [kN]	13,4	18,8	27,6	36,7	32,9	56,0	86,4	113,1	143,6
$N^0_{Rd,p}$ Temperature range III [kN]	7,8	11,0	16,1	21,4	20,9	33,1	51,1	67,9	86,2
Cracked concrete									
$N^0_{Rd,p}$ Temperature range I [kN]	8,9	12,6	17,3	21,4	20,9	35,6	55,0	73,5	86,2
$N^0_{Rd,p}$ Temperature range II [kN]	7,3	10,2	13,8	18,3	18,0	28,0	43,2	56,5	71,8
$N^0_{Rd,p}$ Temperature range III [kN]	4,5	5,5	8,1	10,7	10,5	15,3	23,6	33,9	43,1

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
$N^0_{Rd,c}$ Non cracked concrete [kN]	20,1	24,0	32,4	39,2	33,6	53,3	73,2	106,7	125,0
$N^0_{Rd,c}$ Cracked concrete [kN]	14,3	17,1	23,1	28,0	24,0	38,0	52,2	76,1	89,1

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ a)	1	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N}$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

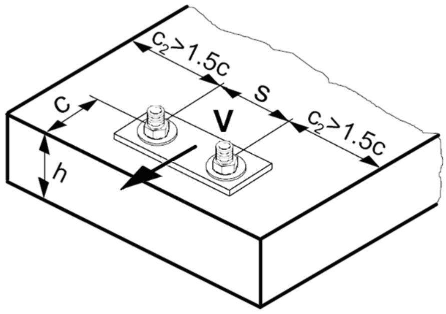
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N}$ = 0,5 + h_{ef}/200mm ≤ 1	0,7 [a)]	0,75 [a)]	0,8 [a)]	0,85 [a)]	0,9 [a)]	0,95 [a)]	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor f_{re} = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

		Data according ETA-07/0260, issue 2013-06-26								
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
$V_{Rd,s}$ BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

k = 1 for h_{ef} < 60 mm
k = 2 for h_{ef} ≥ 60 mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

		Data according ETA-07/0260, issue 2013-06-26								
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Non-cracked concrete										
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,6	15,0	18,7	27,0	39,2	47,3	59,0
Cracked concrete										
$V^0_{Rd,c}$	[kN]	4,2	6,1	8,2	10,6	13,2	19,2	27,7	33,5	41,8

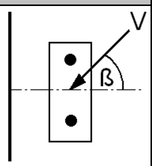
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß		0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \frac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$		1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

h_{ef}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

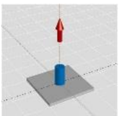
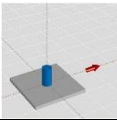
Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

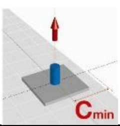
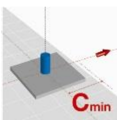
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

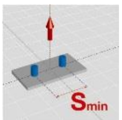
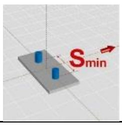
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,1}$ = [mm]	60	60	72	84	96	120	150	168	192
Base material thickness h_{min}= [mm]	100	100	104	120	136	170	214	238	272
 **Tensile N_{Rd}: single anchor, no edge effects**									
Non cracked concrete									
BSt 500 S [kN]	12,6	13,0	17,1	21,6	22,6	31,6	44,2	52,4	64,0
Cracked concrete									
BSt 500 S [kN]	6,7	8,4	11,3	14,4	16,1	22,5	31,5	37,3	45,6
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**									
Non cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
Cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	88,2	104,5	127,7

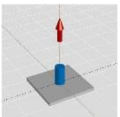
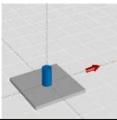
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,1}$ = [mm]	60	60	72	84	96	120	150	168	192
Base material thickness h_{min}= [mm]	100	100	104	120	136	170	214	238	272
Edge distance $c = c_{min}$= [mm]	40	50	60	70	80	100	125	140	160
 **Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**									
Non cracked concrete									
BSt 500 S [kN]	7,6	8,5	10,0	12,5	13,1	18,3	25,6	30,3	37,0
Cracked concrete									
BSt 500 S [kN]	4,0	5,6	7,6	9,7	10,8	15,2	21,2	25,2	30,7
 **Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**									
Non cracked concrete									
BSt 500 S [kN]	3,5	4,9	6,7	8,6	10,8	15,7	22,9	27,7	34,6
Cracked concrete									
BSt 500 S [kN]	2,5	3,5	4,7	6,1	7,6	11,1	16,2	19,6	24,5

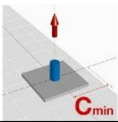
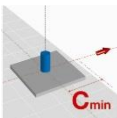
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

		Data according ETA-07/0260, issue 2013-06-26								
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,1}$ =	[mm]	60	60	72	84	96	120	150	168	192
Base material thickness h_{min}=	[mm]	100	100	104	120	136	170	214	238	272
Spacing s = s_{min}=	[mm]	40	50	60	70	80	100	125	140	160
Tensile N_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min})										
 Non cracked concrete										
BSt 500 S	[kN]	7,8	8,2	10,4	13,0	13,6	19,0	26,6	31,5	38,5
Cracked concrete										
BSt 500 S	[kN]	4,4	5,5	7,4	9,3	9,7	13,6	19,0	22,5	27,4
Shear V_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min}) , without lever arm										
 Non cracked concrete										
BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	56,5	79,0	93,7	114,4
Cracked concrete										
BSt 500 S	[kN]	9,3	12,8	17,3	22,0	28,8	40,3	56,3	66,8	81,6

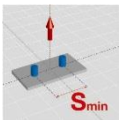
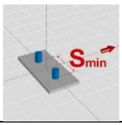
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-07/0260, issue 2013-06-26								
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,typ}$ =	[mm]	80	90	110	125	125	170	210	270	300
Base material thickness h_{min}=	[mm]	110	120	142	161	165	220	274	340	380
Tensile N_{Rd}: single anchor, no edge effects										
 Non cracked concrete										
BSt 500 S	[kN]	16,8	23,6	32,4	39,2	33,6	53,3	73,2	106,7	125,0
Cracked concrete										
BSt 500 S	[kN]	8,9	12,6	17,3	21,4	20,9	35,6	52,2	73,5	86,2
Shear V_{Rd}: single anchor, no edge effects, without lever arm										
 Non cracked concrete										
BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
cracked concrete										
BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

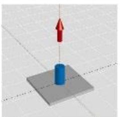
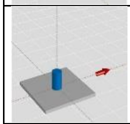
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-07/0260, issue 2013-06-26								
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,typ}$ =	[mm]	80	90	110	125	125	170	210	270	300
Base material thickness h_{min}=	[mm]	110	120	142	161	165	220	274	340	380
Edge distance c = c_{min}=	[mm]	40	50	60	70	80	100	125	140	160
Tensile N_{Rd}: single anchor, min. edge distance (c = c_{min})										
 Non cracked concrete										
BSt 500 S	[kN]	9,1	11,6	15,5	18,9	17,0	26,1	36,1	50,4	59,5
Cracked concrete										
BSt 500 S	[kN]	4,3	6,0	8,4	10,5	10,3	17,4	25,7	35,9	42,4
Shear V_{Rd}: single anchor, min. edge distance (c = c_{min}) , without lever arm										
 Non cracked concrete										
BSt 500 S	[kN]	3,7	5,3	7,3	9,5	11,5	17,2	25,0	31,6	39,3
Cracked concrete										
BSt 500 S	[kN]	2,6	3,8	5,2	6,7	8,1	12,2	17,7	22,4	27,9

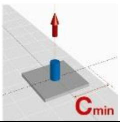
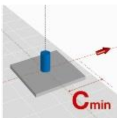
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,typ}$ = [mm]	80	90	110	125	125	170	210	270	300
Base material thickness h_{min}= [mm]	110	120	142	161	165	220	274	340	380
Spacing $s = s_{min}$= [mm]	40	50	60	70	80	100	125	140	160
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**									
Non cracked concrete									
BSt 500 S [kN]	10,4	13,5	18,1	22,0	19,2	30,1	41,4	59,5	69,8
Cracked concrete									
BSt 500 S [kN]	5,9	8,1	11,1	13,7	13,2	21,5	29,5	42,4	49,8
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**									
Non cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
Cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	35,6	57,3	87,5	112,7	142,1

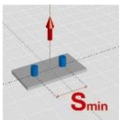
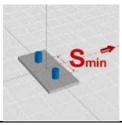
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,2}$ = [mm]	96	120	144	168	192	240	300	336	384
Base material thickness h_{min}= [mm]	126	150	176	204	232	290	364	406	464
 **Tensile N_{Rd}: single anchor, no edge effects**									
Non cracked concrete									
BSt 500 S [kN]	20,0	30,7	44,3	57,5	64,0	89,4	125,0	148,1	181,0
Cracked concrete									
BSt 500 S [kN]	10,7	16,8	22,6	28,7	32,2	50,3	78,5	91,5	110,3
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**									
Non cracked and cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,2}$ = [mm]	96	120	144	168	192	240	300	336	384
Base material thickness h_{min}= [mm]	126	150	176	204	232	290	364	406	464
Edge distance $c = c_{min}$= [mm]	40	50	60	70	80	100	125	140	160
 **Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**									
Non cracked concrete									
BSt 500 S [kN]	11,0	16,5	21,7	27,3	28,6	40,0	55,9	66,2	80,9
Cracked concrete									
BSt 500 S [kN]	5,8	9,1	12,3	15,9	17,8	27,8	44,1	51,4	61,9
 **Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**									
Non cracked and cracked concrete									
BSt 500 S [kN]	3,9	5,7	7,8	10,2	12,9	18,9	27,8	33,9	42,6
Cracked concrete									
BSt 500 S [kN]	2,8	4,0	5,5	7,2	9,1	13,4	19,7	24,0	30,2

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
			Data according ETA-07/0260, issue 2013-06-26								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth	$h_{ef,2}$ =	[mm]	96	120	144	168	192	240	300	336	384
Base material thickness	h_{min}=	[mm]	126	150	176	204	232	290	364	406	464
Spacing	s = s_{min}=	[mm]	40	50	60	70	80	100	125	140	160
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min})**										
	Non cracked concrete										
	BSt 500 S	[kN]	12,8	19,4	26,5	33,4	34,9	48,8	68,2	80,9	98,8
	Cracked concrete										
	BSt 500 S	[kN]	7,2	11,0	14,8	18,9	20,9	31,9	48,6	56,9	68,9
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min}) , without lever arm**										
	Non cracked concrete										
	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
	Cracked concrete										
	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

Seismic design C1

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:
- Seismic design according to TR045

The following technical data are based on: ETA-07/0260, issue 2013-06-26

Anchorage depth range

Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ26	Φ28	Φ30	Φ32
Effective anchorage depth range	$h_{ef,min}$	[mm]	60	60	70	80	80	90	100	104	115	120	130
	$h_{ef,max}$	[mm]	160	200	240	280	320	400	500	520	540	600	660

Tension resistance in case of seismic performance category C1

Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ26	Φ28	Φ30	Φ32
Characteristic tension resistance to steel failure													
Rebar B500B Acc. to DIN 488:2009-08	$N_{Rk,s,seis}$	[kN]	28	43	62	85	111	173	270	-	339	-	442
Partial safety factor Acc. to DIN 488:2009-08	$\gamma_{Ms,seis}$	[-]	1,4							-	1,4	-	1,4
Characteristic bond resistance in cracked concrete C20/25 to C50/60													
Temp. range I: 40°C/24°C	$\tau_{Rk,seis}$	[N/mm²]	6,4	6,4	6	5,4	5,3	5	4,6	4,5	4	3,6	3,4
Temp. range II: 58°C/35°C	$\tau_{Rk,seis}$	[N/mm²]	5,2	5,2	4,8	4,7	4,5	3,9	3,6	3,5	3,1	3,0	2,9
Temp. range III: 70°C/43°C	$\tau_{Rk,seis}$	[N/mm²]	3,2	2,8	2,8	2,7	2,6	2,1	2	1,9	1,8	1,8	1,7
Partial safety factor	$\gamma_{Mp,seis}$	[-]	1,8				2,1						
Concrete cone resistance and splitting resistance													
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]	1,8				2,1						

Displacement under tension load in case of seismic performance category C1 [1)]

Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ26	Φ28	Φ30	Φ32
Displacement [1)]	$\delta_{N,seis}$	[mm]	1,5	1,7	1,9	2,1	2,3	2,7	3,2	3,3	3,5	3,7	3,9

1) Maximum displacement during cycling (seismic event).

Shear resistance in case of seismic performance category C1

Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ26	Φ28	Φ30	Φ32
Characteristic shear resistance to steel failure													
Rebar B500B Acc. to DIN 488:2009-08	$N_{Rk,s,seis}$	[kN]	10	15	22	29	39	60	95	-	118	-	155
Partial safety factor Acc. to DIN 488:2009-08	$\gamma_{Ms,seis}$	[-]	1,5							-	1,5	-	1,5
Concrete pryout resistance and concrete edge resistance													
Partial safety factor	$\gamma_{Mcp,seis} = \gamma_{Mc,seis}$	[-]	1,5										

Displacement under shear load in case of seismic performance category C1 [1)]

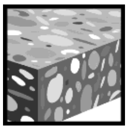
Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ26	Φ28	Φ30	Φ32
Displacement[1)]	$\delta_{V,seis}$	[mm]	3,2	3,5	3,8	4,1	4,4	5,0	5,8	5,9	6,2	6,5	6,8

1) Maximum displacement during cycling (seismic event).

For seismic resistent fastening applications please use the anchor design software PROFIS Anchor.

Hilti HIT-RE 500-SD mortar with HIT-CS(-F) rod

Injection mortar system		Benefits
	Hilti HIT-RE 500-SD (available as 330 ml, 500 ml or 1400 ml foil pack)	- suitable for cracked and non-cracked concrete C 20/25 to C 50/60 - wet and dry concrete - high loading capacity - 8.8. steel grade - hot dip galvanized coating 55 µm (HIT-CS-F) - electrogalvanized 5 µm (HIT-CS)
	Static mixer	
	HIT-CS-F rod (55µm)	
	HIT-CS rod (5µm)	


Concrete


Tensile zone

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Test report	CMA *	20121C01764 / 2012-08-10

* National Research Center of Testing Techniques for Building Materials, only valid for HIT-CS-F

Basic loading data (for a single anchor)

All data in this section is Hilti technical data and applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- min. in service base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C
- Installation temperature range +5°C to +40°C

Mean Ultimate Resistance

		non-cracked concrete			cracked concrete		
Anchor size		**M12x110**	**M16x125**	**M20x170**	**M12x110**	**M16x125**	**M20x170**
Tensile $N_{Ru,m}$	[kN]	*68,6*	93,7	148,6	55,1	66,8	105,9
Shear $V_{Ru,m}$	[kN]	*35,4*	*65,9*	*102,9*	*35,4*	*65,9*	*102,9*

Characteristic Resistance

		non-cracked concrete			cracked concrete		
Anchor size		M12x110	M16x125	M20x170	M12x110	M16x125	M20x170
Tensile N_{Rk}	[kN]	58,3	70,6	111,9	41,5	50,3	79,8
Shear V_{Rk}	[kN]	*33,7*	*62,8*	*98,0*	*33,7*	*62,8*	*98,0*

Design Resistance

		non-cracked concrete			cracked concrete		
Anchor size		M12x110	M16x125	M20x170	M12x110	M16x125	M20x170
Tensile N_{Rd}	[kN]	32,4	39,2	62,2	23,1	28,0	44,3
Shear V_{Rd}	[kN]	27,0	50,2	78,4	27,0	50,2	78,4

Recommended loads [a)]

		non-cracked concrete			cracked concrete		
Anchor size		M12x110	M16x125	M20x170	M12x110	M16x125	M20x170
Tensile N_{rec}	[kN]	23,1	28,0	44,4	16,5	20,0	31,7
Shear V_{rec}	[kN]	19,3	35,9	56,0	19,3	35,9	56,0

c) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

Mechanical properties of HIT-CS-F

Anchor size		M12x110	M16x125	M20x170
Nominal tensile strength f_{uk}	[N/mm²]	800	800	800
Yield strength f_{yk}	[N/mm²]	640	640	640
Stressed cross-section of the thread for shear A_s	[mm²]	84,3	157	245
relevant cross-section for tensile loading $A_{s,c}$	[mm²]	81,7	157	237,8
Moment of resistance W	[mm³]	109	277	541
Char. bending resistance $M^0_{Rk,s}$ with 8.8 Steel Grade	[Nm]	105	266	519

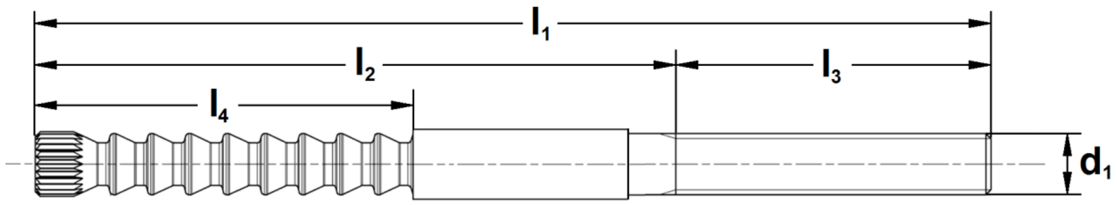
Material quality

Part	**Material**	
	HIT-CS-F	**HIT-CS**
Anchor Body	Carbon steel; hot dip galvanized to min. 55 µm, coated	Carbon steel; electrogalvanized to min. 5 µm, coated
Washer	DIN 934-class 8-AZ (according to DIN ISO 965-5); hot dip galvanized to min. 55 µm	Property class 8 acc.to DIN EN ISO 898-2, electrogalvanized to min. 5 µm
Nut	Carbon steel; hot dip galvanized to min. 55 µm	DIN 125-1-size-140HV, electrogalvanized to min. 5 µm

Anchor dimensions of HIT-CS-F

Anchor size			M12x110	M16x125	M20x170
Norminal diameter	d_1	[mm]	12	16	20
Length of anchor	l_1	[mm]	160 to 660	190 to 675	240 to 720
Embedment depth	$l_2 = h_{nom}$	[mm]	110	125	170
Length of thread	l_3	[mm]	50 to 550	65 to 550	70 to 550
Length of helix	l_4	[mm]	60	80	110

Anchor rod



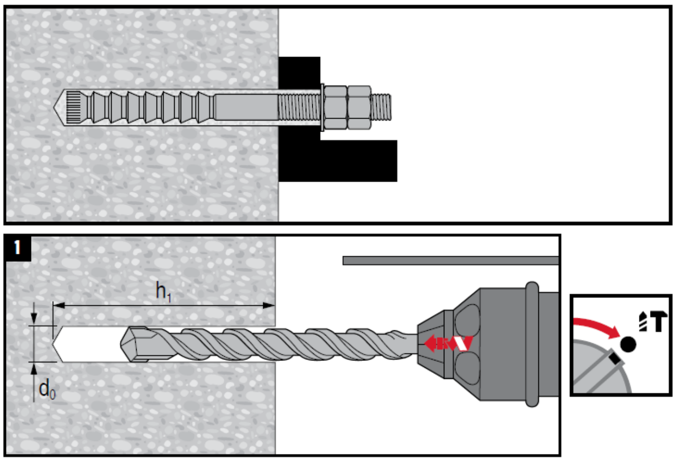
Setting

Installation equipment

Anchor size	M12x110	M16x125	M20x170
Rotary hammer	TE 16 – TE 80		
Other tools	Compressed air gun, set of brushes, dispenser		

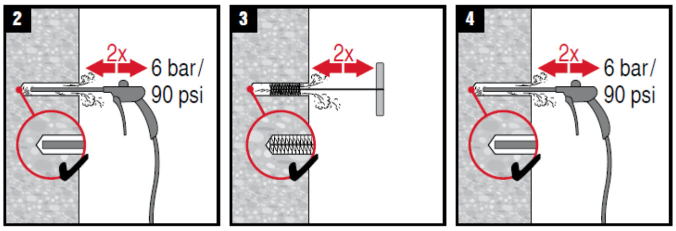
Setting instruction

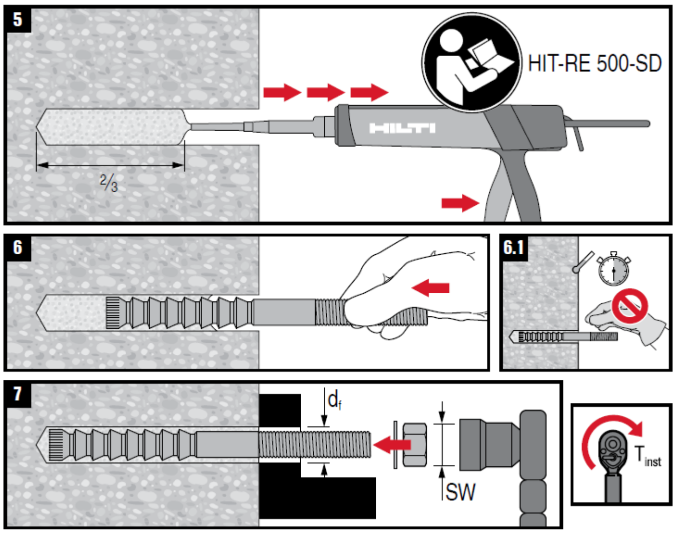
For detailed information on installation see instruction for use given with the package of the product.



1.1

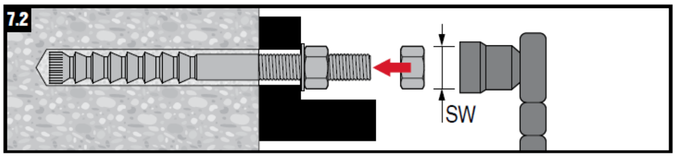
HIT-CS-F	Ø d_0 [mm]	h_1 [mm]
M12 x 110	Ø 14	115
M16 x 125	Ø 18	130
M20 x 170	Ø 24	175





7.1

HIT-CS-F	d_f [mm]	SW [mm]	T_{inst} [Nm]
M12 x 110	14	19	40
M16 x 125	18	24	80
M20 x 170	22	30	150

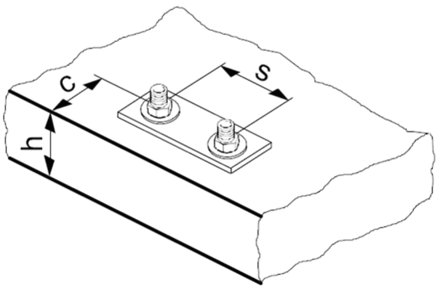


Curing time for general conditions

Temperature of the base material	Working time in which anchor can be inserted and adjusted t_{gel}	Curing time before anchor can be fully loaded t_{cure}
40 °C	12 min	4 h
30 °C to 39 °C	12 min	8 h
20 °C to 29 °C	20 min	12 h
15 °C to 19 °C	30 min	24 h
10 °C to 14 °C	90 min	48 h
5 °C to 9 °C	120 min	72 h

Setting details

Anchor size			M12x110		M16x125		M20x170	
Anchor type			**HIT-CS-F**	**HIT-CS**	**HIT-CS-F**	**HIT-CS**	**HIT-CS-F**	**HIT-CS**
Nominal diameter of drill bit	d_o	[mm]	14		18		22	
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	14,5		18,5		22,5	
Effective anchorage depth	h_{ef}	[mm]	102		117		158	
Nominal anchorage depth	h_{nom}	[mm]	110		125		170	
Depth of drill hole	$h_1 \geq$	[mm]	115		130		175	
Minimum base material thickness	h_{min} a)	[mm]	140		170	200	230	250
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	14		18		22	
Minimum spacing and minimum edge distance	s_{min}	[mm]	60	90	80	100	100	120
	c_{min}	[mm]	60	90	80	100	100	120
Critical edge distance for splitting failure	$s_{cr,sp}$	[mm]	7 hef		7 hef		7 hef	
	$c_{cr,sp}$	[mm]	3,5 hef		3,5 hef		3,5 hef	
Critical edge distance for concrete cone failure	$s_{cr,N}$	[mm]	330		375		510	
	$c_{cr,N}$	[mm]	165		187,5		255	
Max. torque moment	T_{inst}	[Nm]	40		80		150	



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) h: base material thickness ($h \geq h_{min}$)

Simplified design method

Simplified version of the design method according ETAG 001, Annex C.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing.

The design method is based on the following simplification:

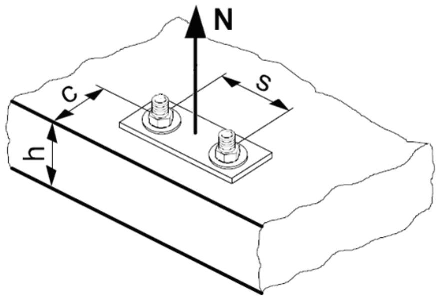
- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size	M12	M16	M20
$N_{Rd,s}$ [kN]	43,6	98,1	126,8

Design pull-out a resistance $N_{Rd,p} = N^0_{Rd,p}$

	Non-cracked concrete			Cracked concrete		
Anchor size	**M12**	**M16**	**M20**	**M12**	**M16**	**M20**
Embedment depth h_{ef} [mm]	**110**	**125**	**170**	**110**	**125**	**170**
$N^0_{Rd,p}$ [kN]	No pull-out failure					

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N}$
Design splitting resistance $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp}$

	Non-cracked concrete			Cracked concrete		
Anchor size	**M12**	**M16**	**M20**	**M12**	**M16**	**M20**
$N^0_{Rd,c}$ [kN]	32,4	39,2	62,2	23,1	28,0	44,3

Influencing factors

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance [a)]

$c/c_{cr,N}$ $c/c_{cr,sp}$	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N}$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing [a)]

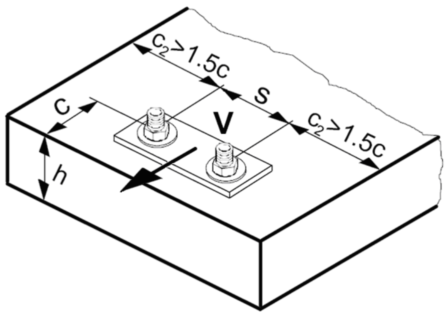
$s/s_{cr,N}$ $s/s_{cr,sp}$	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size	**M12**	**M16**	**M20**
$V_{Rd,s}$ HIT-CS-F [kN]	27,0	50,2	78,4

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$

k = 2

Design concrete edge resistance [a)] $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4$

	Non-cracked concrete			**Cracked concrete**		
Anchor size	**M12**	**M16**	**M20**	**M12**	**M16**	**M20**
$V^0_{Rd,c}$ [kN]	11,6	18,7	27,0	8,2	13,2	19,2

a) For anchor groups only the anchors close to the edge must be considered.

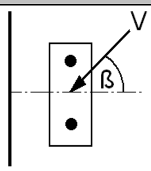
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{2/3} \leq 1$	0,22	0,34	0,45	0,54	0,63	0,71	0,79	0,86	0,93	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Combined tension and shear loading

The following equations must be satisfied

$\beta_N \leq 1$

$\beta_V \leq 1$

$\beta_N + \beta_V \leq 1{,}2$ or $\beta_N^{\alpha} + \beta_V^{\alpha} \leq 1$

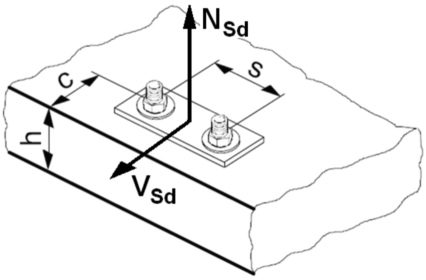
With

$\beta_N = N_{Sd} / N_{Rd}$ and

$\beta_V = V_{Sd} / V_{Rd}$

N_{Sd} (V_{Sd}) = **tension (shear) design action**

N_{Rd} (V_{Rd}) = **tension (shear) design resistance**



Annex C of ETAG 001	**Simplified design method**
α = **2,0** if N_{Rd} and V_{Rd} are governed by steel failure α = **1,5** for all other failure modes	Failure mode is not considered for the simplified method α = **1,5** for all failure modes (leading to conservative results

Hilti HIT-RE 500 mortar with HIT-V / HAS rod

Injection mortar system

Hilti
HIT-RE 500
330 ml foil pack

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

Statik mixer

HAS rod

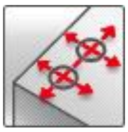
HAS-E rod

HIT-V rod

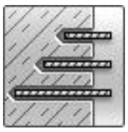
Benefits

- suitable for non-cracked concrete C 20/25 to C 50/60
- high loading capacity
- suitable for dry and water saturated concrete
- under water application
- large diameter applications
- high corrosion resistant
- long working time at elevated temperatures
- odourless epoxy
- embedment depth range:
  from 40 … 160 mm for M8
  to 120 … 600 mm for M30

Concrete



Small edge distance and spacing



Variable embedment depth

Fire resistance

Corrosion resistance

High corrosion resistance

Diamond drilled holes

European Technical Approval

CE conformity

PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval a)	DIBt, Berlin	ETA-04/0027 / 2013-06-26
Fire test report	IBMB, Braunschweig	UB 3565 / 4595 / 2006-10-29 UB 3588 / 4825 / 2005-11-15
Assessment report (fire)	warringtonfire	WF 327804/B / 2013-07-10

a) All data given in this section according ETA-04/0027, issue 2013-06-26.

Basic loading data (for a single anchor)

All data in this section applies to — For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperature range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range +5°C to +40°C

Embedment depth [a)] and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Typical embedment depth [mm]	80	90	110	125	170	210	240	270	300	330	360
Base material thickness [mm]	110	120	140	165	220	270	300	340	380	410	450

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

For hammer drilled holes and hollow drill bit:
Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			ETA-04/0027, issue 2013-06-26 for hammer drilling and hollow drill bit								Additional Hilti technical data		
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	*18,9*	*30,5*	*44,1*	*83,0*	*129,2*	*185,9*	*241,5*	*295,1*	*364,4*	*428,9*	459,9
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	*9,5*	*15,8*	*22,1*	*41,0*	*64,1*	*92,4*	*120,8*	*147,0*	*182,2*	*214,5*	*256,2*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			ETA-04/0027, issue 2013-06-26 for hammer drilling and hollow drill bit								Additional Hilti technical data		
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile N_{Rk}	HIT-V 5.8	[kN]	*18,0*	*29,0*	*42,0*	70,6	111,9	153,7	187,8	224,0	262,4	302,7	344,9
Shear V_{Rk}	HIT-V 5.8	[kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*	*115,0*	*140,0*	*173,5*	*204,3*	*244,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			ETA-04/0027, issue 2013-06-26 for hammer drilling and hollow drill bit								Additional Hilti technical data		
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile N_{Rd}	HIT-V 5.8	[kN]	12,0	19,3	27,7	33,6	53,3	73,2	89,4	106,7	125,0	144,2	164,3
Shear V_{Rd}	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0	138,8	163,4	195,2

Recommended loads [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			ETA-04/0027, issue 2013-06-26 for hammer drilling and hollow drill bit								Additional Hilti technical data		
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile N_{rec}	HIT-V 5.8	[kN]	8,6	13,8	19,8	24,0	38,1	52,3	63,9	76,2	89,3	103,0	117,3
Shear V_{rec}	HIT-V 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3	65,7	80,0	99,1	116,7	139,4

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

For diamond drilling:
Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			ETA-04/0027, issue 2013-06-26 for diamond drilling							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	*18.9*	*30.5*	*44.1*	*83,0*	*129.2*	*185.9*	*241.5*	287.2
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	*9.5*	*15.8*	*22.1*	*41,0*	*64,1*	*92,4*	*120,8*	*147,0*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			ETA-04/0027, issue 2013-06-26 for diamond drilling							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Tensile N_{Rk}	HIT-V 5.8	[kN]	*18,0*	*29,0*	*42,0*	70,6	111,9	153,7	183,2	216,3
Shear V_{Rk}	HIT-V 5.8	[kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*	*115,0*	*140,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			ETA-04/0027, issue 2013-06-26 for diamond drilling							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Tensile N_{Rd}	HIT-V 5.8	[kN]	12,0	19,3	28,0	33,6	53,3	73,2	87,3	103,0
Shear V_{Rd}	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0

Recommended loads [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			ETA-04/0027, issue 2013-06-26 for diamond drilling							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Tensile N_{rec}	HIT-V 5.8	[kN]	8,6	13,8	20,0	24,0	38,1	52,3	62,3	73,6
Shear V_{rec}	HIT-V 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3	65,7	80,0

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-RE 500 injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +58 °C	+35 °C	+58 °C
Temperature range III	-40 °C to +70 °C	+43 °C	+70 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIT-V / HAS

			Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Nominal tensile strength f_{uk}	HIT-V/HAS 5.8	[N/mm²]	500	500	500	500	500	500	500	500	500	500	500
	HIT-V/HAS 8.8	[N/mm²]	800	800	800	800	800	800	800	800	800	800	800
	HIT-V/HAS -R	[N/mm²]	700	700	700	700	700	700	500	500	500	500	500
	HIT-V/HAS -HCR	[N/mm²]	800	800	800	800	800	700	700	700	500	500	500
Yield strength f_{yk}	HIT-V/HAS 5.8	[N/mm²]	400	400	400	400	400	400	400	400	400	400	400
	HIT-V/HAS 8.8	[N/mm²]	640	640	640	640	640	640	640	640	640	640	640
	HIT-V/HAS -R	[N/mm²]	450	450	450	450	450	450	210	210	210	210	210
	HIT-V/HAS -HCR	[N/mm²]	600	600	600	600	600	400	400	400	250	250	250
Stressed cross-section A_s	HAS	[mm²]	32,8	52,3	76,2	144	225	324	427	519	647	759	913
	HIT-V	[mm²]	36,6	58,0	84,3	157	245	353	459	561	694	817	976
Moment of resistance W	HAS	[mm³]	27,0	54,1	93,8	244	474	809	1274	1706	2321	2949	3891
	HIT-V	[mm³]	31,2	62,3	109	277	541	935	1387	1874	2579	3294	4301

Material quality

Part	Material
Threaded rod HIT-V(F), HAS 5.8 M8 – M24	Strength class 5.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V(F), HAS 8.8 M27 – M39	Strength class 8.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V-R, HAS-R	Stainless steel grade A4, A_5 > 8% ductile strength class 70 for ≤ M24 and class 50 for M27 to M30, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Threaded rod HIT-V-HCR, HAS-HCR	High corrosion resistant steel, 1.4529; 1.4565 strength ≤ M20: R_m = 800 N/mm², $R_{p\,0.2}$ = 640 N/mm², A_5 > 8% ductile M24 to M30: R_m = 700 N/mm², $R_{p\,0.2}$ = 400 N/mm², A_5 > 8% ductile
Washer ISO 7089	Steel galvanized, hot dipped galvanized
	Stainless steel, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	High corrosion resistant steel, 1.4529; 1.4565
Nut EN ISO 4032	Strength class 8, steel galvanized ≥ 5 µm, hot dipped galvanized ≥ 45 µm,
	Strength class 70, stainless steel grade A4, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	Strength class 70, high corrosion resistant steel, 1.4529; 1.4565

Anchor dimensions

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Anchor rod HAS, HAS-E, HAS-R, HAS-ER HAS-HCR	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270	M33x300	M36x330	M39x360
Anchor embedment depth [mm]	80	90	110	125	170	210	240	270	300	330	360
Anchor rod HIT-V, HIT-V-R, HIT-V-HCR	Anchor rods HIT-V (-R / -HCR) are available in variable length										

Setting

installation equipment

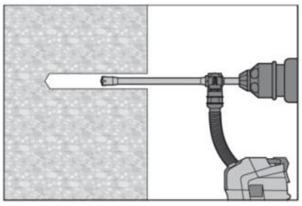
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Rotary hammer	TE2 – TE16				TE40 – TE70			
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser							
Additional Hilti recommended tools	DD EC-1, DD 100 … DD xxx [a)]							

a) For anchors in diamond drilled holes load values for combined pull-out and concrete cone resistance have to be reduced (see section “Setting instruction”)

Setting instruction

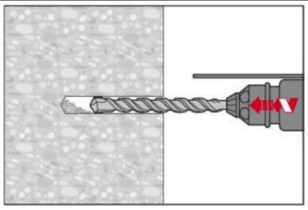
Bore hole drilling

a) Hilti hollow drill bit (for dry and wet concrete only)



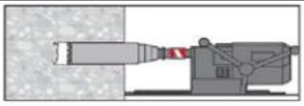
Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment. This drilling system removes the dust and cleans the bore hole during drilling when used in accordance with the user's manual.
After drilling is complete, proceed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

b) Hammer drilling (dry or wet concrete and installation in flooded holes (no sea water))



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

c) Diamond coring (for dry and wet concrete only)

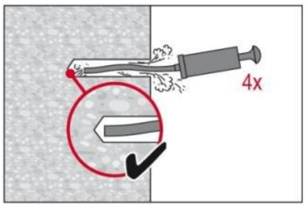


Diamond coring is permissible when diamond core drilling machine and the corresponding core bit are used.

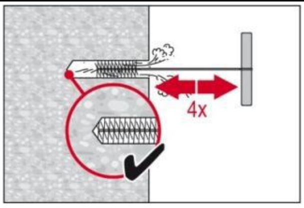
Bore hole cleaning

Just before setting an anchor, the bore hole must be free of dust and debris.

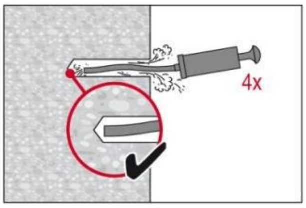
a) Manual Cleaning (MC) non-cracked concrete only
for bore hole diameters $d_0 \leq$ 20mm and bore hole depth $h_0 \leq$ 20d or $h_0 \leq$ 250 mm (d = diameter of element)



The Hilti manual pump may be used for blowing out bore holes up to diameters $d_0 \leq$ 20 mm and embedment depths up to $h_{ef} \leq$ 10d.
Blow out at least 4 times from the back of the bore hole until return air stream is free of noticeable dust

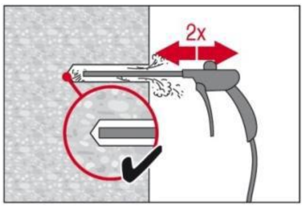


Brush 4 times with the specified brush size (brush diameter ≥ bore hole) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole - if not the brush is too small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



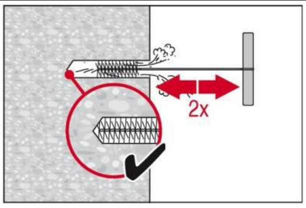
Blow out again with manual pump at least 4 times until return air stream is free of noticeable dust.

b) Compressed air cleaning (CAC)
for all bore hole diameters d_0 and all bore hole depth h_0

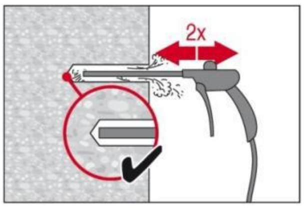


Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m^3/h) until return air stream is free of noticeable dust.

Bore hole diameter ≥ 32 mm the compressor must supply a minimum air flow of 140 m^3/hour.

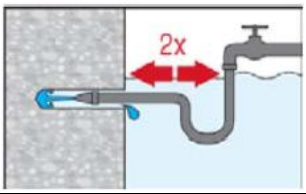


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole - if not the brush is too small and must be replaced with the proper brush diameter.

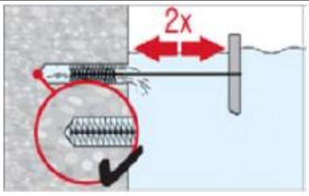


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

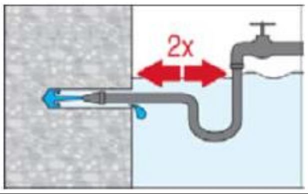
c) Cleaning for under water
for all bore hole diameters d_0 and all bore hole depth h_0



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

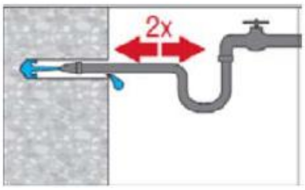


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole - if not the brush is too small and must be replaced with the proper brush diameter.

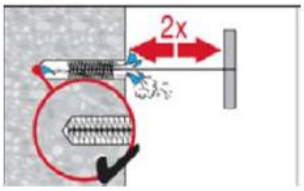


Flush again 2 times the hole by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.

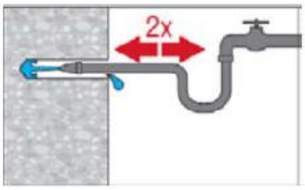
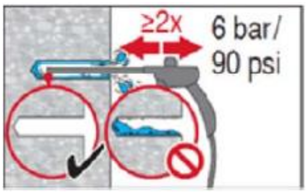
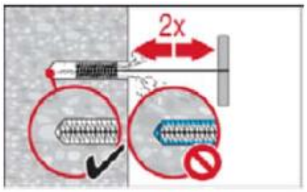
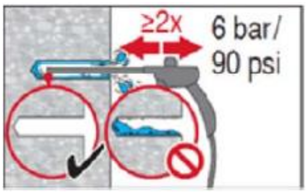
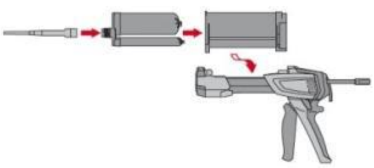
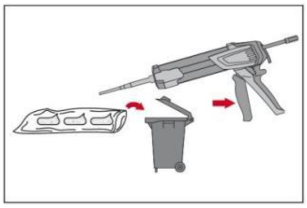
d) Cleaning of hammer drilled holes and diamond cored holes
for all bore hole diameters d_0 and all bore hole depth h_0

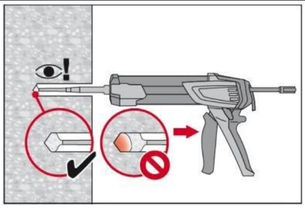
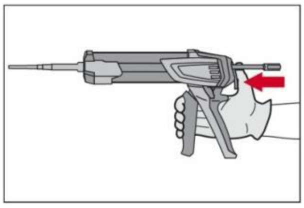
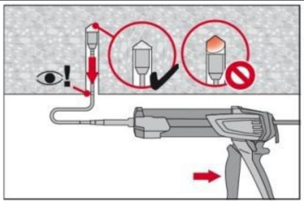
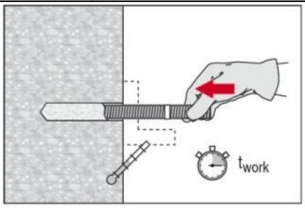
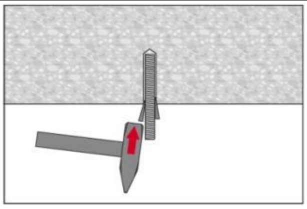
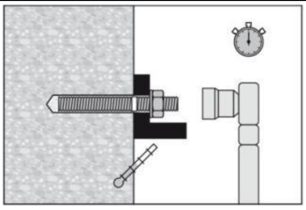


Flush 2 times the hole by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.



Brush 2 times with the specified brush size 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 bore hole - if not the brush is too small and must be replaced with the proper brush diameter.

	Flush again 2 times the hole 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 hole 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. Bore hole diameter ≥ 32 mm the compressor must supply a minimum air flow of 140 m^3/hour.
	Brush 2 times with the specified brush size 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 bore hole - if not the brush is too small and must be replaced with the proper brush diameter.
	Blow again with compressed air 2 times until return air stream is free of noticeable dust and water.
Injection preparation	
	Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle. Observe the instruction for use of the dispenser and mortar. Check foil pack holder for proper function. Do not use damaged foil packs / holders. Insert foil pack into foil pack holder and put holder into HIT-dispenser.
	The foil pack opens automatically as dispensing is initiated. Discard initial adhesive. Depending on the size of the foil pack an initial amount of adhesive has to be discarded. Discard quantities are: 2 strokes for 330 ml foil pack, 3 strokes for 500 ml foil pack, 65 ml for 1400 ml foil pack.

Inject adhesive from the back of the borehole without forming air voids	
	Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull. Fill holes approximately 2/3 full. It is required that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.
	After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.
	Overhead installation and/or installation with embedment depth h_{ef} > 250mm. 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 HIT-SZ. Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the bore hole by the adhesive pressure. **Under water application:** fill borehole completely with mortar.
Setting the element	
	Before use, verify that the element is dry and free of oil and other contaminants. Mark and set element to the required embedment depth untill working time t_{work} has elapsed.
	For overhead installation use piston plugs and fix embedded parts with e.g. wedges HIT-OHW.
	Loading the anchor: After required curing time t_{cure} the anchor can be loaded. The applied installation torque shall not exceed $T_{max.}$

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

Curing time for general conditions

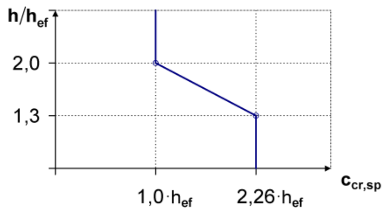
Data according ETA-04/0027, issue 2013-06-26		
Temperature of the base material	Working time in which anchor can be inserted and adjusted t_{gel}	Curing time before anchor can be fully loaded t_{cure}
40 °C	12 min	4 h
30 °C to 39 °C	12 min	8 h
20 °C to 29 °C	20 min	12 h
15 °C to 19 °C	30 min	24 h
10 °C to 14 °C	90 min	48 h
5 °C to 9 °C	120 min	72 h

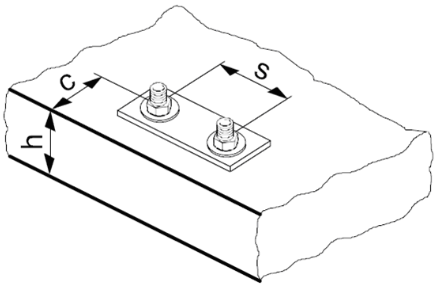
For dry concrete curing times may be reduced according to the following table.
For installation temperatures below +5 °C all load values have to be reduced according to the load reduction factors given below.

Curing time for dry concrete

Additional Hilti technical data			
Temperature of the base material	Working time in which anchor can be inserted and adjusted t_{gel}	Reduced curing time before anchor can be fully loaded $t_{cure,dry}$	Load reduction factor
40 °C	12 min	4 h	1
30 °C	12 min	8 h	1
20 °C	20 min	12 h	1
15 °C	30 min	18 h	1
10 °C	90 min	24 h	1
5 °C	120 min	36 h	1
0 °C	3 h	50 h	0,7
-5 °C	4 h	72 h	0,6

Setting details

			Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**	**M33**	**M36**	**M39**
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	24	28	30	35	37	40	42
Effective anchorage and drill hole depth range [a)]	$h_{ef,min}$	[mm]	40	40	48	64	80	96	108	120	132	144	156
	$h_{ef,max}$	[mm]	160	200	240	320	400	480	540	600	660	720	780
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			$h_{ef} + 2\,d_0$							
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22	26	30	33	36	39	42
Minimum spacing	s_{min}	[mm]	40	50	60	80	100	120	135	150	165	180	195
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120	135	150	165	180	195
Critical spacing for splitting failure	$s_{cr,sp}$		$2\,c_{cr,sp}$										
Critical edge distance for splitting failure [b)]	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$** for $h / h_{ef} \geq 2{,}0$ **$4{,}6\,h_{ef} - 1{,}8\,h$** for $2{,}0 > h / h_{ef} > 1{,}3$ **$2{,}26\,h_{ef}$** for $h / h_{ef} \leq 1{,}3$										
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\,c_{cr,N}$										
Critical edge distance for concrete cone failure [c)]	$c_{cr,N}$		$1{,}5\,h_{ef}$										
Torque moment [d)]	T_{max}	[Nm]	10	20	40	80	150	200	270	300	330	360	390



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$ (h_{ef}: embedment depth)

b) h: base material thickness ($h \geq h_{min}$)

c) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

d) This is the maximum recommended torque moment to avoid splitting failure during installation for anchors with minimum spacing and/or edge distance.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-04/0027, issue 2009-05-20.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

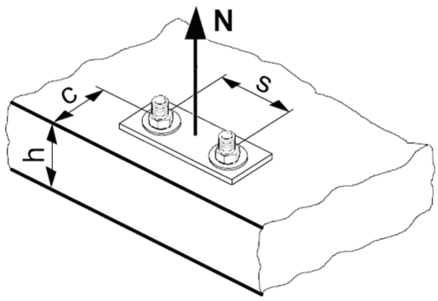
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

			Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
$N_{Rd,s}$	HAS 5.8	[kN]	11,3	17,3	25,3	48,0	74,7	106,7	-	-	-	-	-
	HIT-V 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	118,0	153,3	187,3	231,3	272,3	325,3
	HAS 8.8	[kN]	-	-	-	-	-	-	231,3	281,3	345,1	404,8	486,9
	HIT-V 8.8	[kN]	19,3	30,7	44,7	84,0	130,7	188,0	244,7	299,3	370,1	435,7	520,5
	HAS (-E)-R	[kN]	12,3	19,8	28,3	54,0	84,0	119,8	75,9	92,0	113,2	132,8	159,8
	HIT-V-R	[kN]	13,9	21,9	31,6	58,8	92,0	132,1	80,4	98,3	122,6	144,3	172,4
	HAS (-E)-HCR	[kN]	18,0	28,0	40,7	76,7	120,0	106,7	144,8	175,7	134,8	158,1	190,2
	HIT-V-HCR	[kN]	19,3	30,7	44,7	84,0	130,7	117,6	152,9	187,1	144,6	170,2	203,3

Design combined pull-out and concrete cone resistance for anchors [a)]

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

			Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**	**M33**	**M36**	**M39**
Typical embedment depth $h_{ef,typ}$ [mm]			**80**	**90**	**110**	**125**	**170**	**210**	**240**	**270**	**300**	**330**	**360**
Hammer drilling + Hilti hollow drill bit	$N^0_{Rd,p}$ [kN]	Temp range I	15.3	21.5	31.6	44.9	76.3	105.6	135.7	157.5	171,0	203,3	232,9
	$N^0_{Rd,p}$ [kN]	Temp range II	12.4	17.5	25.7	35.9	61.0	82.9	106.6	133.3	136,8	162,6	186,3
	$N^0_{Rd,p}$ [kN]	Temp range III	7.7	10.8	15.8	22.4	35.6	52.8	63.0	78.8	82,1	97,6	111,8
Diamond coring	$N^0_{Rd,p}$ [kN]	Temp range I	14.5	20.4	29.9	35.9	56.0	75.4	87.2	103.0	-	-	-
	$N^0_{Rd,p}$ [kN]	Temp range II	12.3	17.3	25.3	28.4	45.8	60.3	67.9	78.8	-	-	-
	$N^0_{Rd,p}$ [kN]	Temp range III	7.3	10.2	15.0	16.5	25.4	33.9	43.6	48.5	-	-	-

a) **Additional Hilti technical data (not part of ETA-04/0027, issue 2013-06-26):**
The design values for combined pull-out and concrete cone resistance may be increased by 20 % for anchor installation in dry concrete (concrete not in contact with water before/during installation and curing).

Design concrete cone resistance [a)] $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance $N_{Rd,sp}$ [a)] $= N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

	Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**	**M33**	**M36**	**M39**
$N^0_{Rd,c}$ [kN]	17,2	20,5	27,7	33,6	53,3	73,2	89,4	106,7	125,0	144,2	164,3

a) **Additional Hilti technical data (not part of ETA-04/0027, issue -2013-06-26):**
The design values for concrete cone and splitting resistance may be increased by 20 % for anchor installation in dry concrete (concrete not in contact with water before/during installation and curing).

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ [a)]	1	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N}$ = $0{,}7 + 0{,}3 \cdot c/c_{cr,N}$ $f_{1,sp}$ = $0{,}7 + 0{,}3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N}$ = $0{,}5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp}$ = $0{,}5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N}$ = $0{,}5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp}$ = $0{,}5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

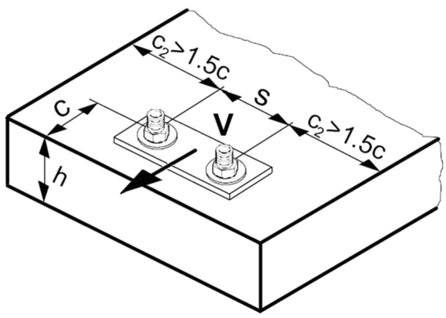
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N}$ = $0{,}5 + h_{ef}/200\text{mm} \le 1$	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor f_{re} = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
			Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
$V_{Rd,s}$	HAS 5.8	[kN]	6,8	10,4	15,2	28,8	44,8	64,0	-	-	-	-	-
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0	138,8	163,4	195,2
	HAS 8.8	[kN]	-	-	-	-	-	-	139,2	168,8	207,0	242,9	292,2
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2	222,1	261,4	312,3
	HAS (-E)-R	[kN]	7,7	12,2	17,3	32,7	50,6	71,8	45,8	55,5	67,9	79,7	95,9
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8	72,9	85,8	102,5
	HAS (-E)-HCR	[kN]	10,4	16,8	24,8	46,4	72,0	64,0	86,9	105,7	80,9	94,9	114,1
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0	86,8	102,1	122,0

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

k = 1 for h_{ef} < 60 mm
k = 2 for h_{ef} ≥ 60 mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Non-cracked concrete												
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,6	18,7	27,0	36,6	44,5	53,0	62,1	71,7	81,9

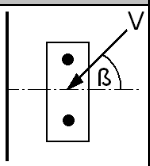
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4
$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

h_{ef}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

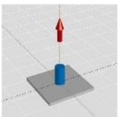
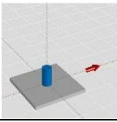
Combined tension and shear loading for hammer drilling or hollow drill bit

For combined tension and shear loading see section “Anchor Design”.

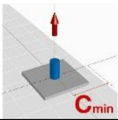
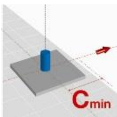
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

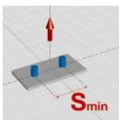
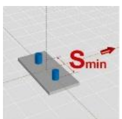
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

			Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**	**M33**	**M36**	**M39**
Embedment depth	$h_{ef,1}$ =	[mm]	48	60	72	96	120	144	162	180	198	216	234
Base material thickness	h_{min}=	[mm]	100	100	102	132	168	200	222	250	272	296	324
	Tensile N_{Rd}: single anchor, no edge effects												
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	8,0	11,2	14,7	22,6	31,6	41,6	49,6	58,1	67,0	76,3	86,1
	Shear V_{Rd}: single anchor, no edge effects, without lever arm												
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0	138,8	163,4	195,2
	HIT-V 8.8	[kN]	11,2	18,4	27,2	50,4	78,4	112,8	138,8	162,6	187,6	213,8	241,0
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8	72,9	85,8	102,5
	HIT-V-HCR	[kN]	11,2	18,4	27,2	50,4	78,4	70,9	92,0	112,0	86,8	102,1	122,0

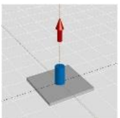
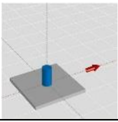
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

			Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**	**M33**	**M36**	**M39**
Embedment depth	$h_{ef,1}$ =	[mm]	48	60	72	96	120	144	162	180	198	216	234
Base material thickness	h_{min}=	[mm]	100	100	102	132	168	200	222	250	272	296	324
Edge distance	$c = c_{min}$=	[mm]	40	50	60	80	100	120	135	150	165	180	195
	Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)												
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	5,4	7,3	8,5	12,9	18,2	23,8	28,2	33,2	38,1	43,4	49,2
	Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm												
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,4	4,9	6,7	10,8	15,7	21,4	26,0	31,1	36,5	42,2	48,3

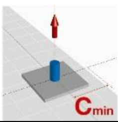
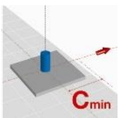
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

			Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**	**M33**	**M36**	**M39**
Embedment depth	$h_{ef,1}$ =	[mm]	48	60	72	96	120	144	162	180	198	216	234
Base material thickness	h_{min}=	[mm]	100	100	102	132	168	200	222	250	272	296	324
Spacing	$s = s_{min}$=	[mm]	40	50	60	80	100	120	135	150	165	180	195
	Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)												
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	5,1	7,0	8,8	13,5	19,0	24,9	29,6	34,8	40,1	45,6	51,5
	Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm												
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	88,7	103,9	119,9	136,6	154,0
	HIT-V 8.8	[kN]	7,2	18,4	26,3	40,5	56,5	74,3	88,7	103,9	119,9	136,6	154,0
	HIT-V-R	[kN]	7,2	12,8	19,2	35,3	55,1	74,3	48,3	58,8	72,9	85,8	102,5
	HIT-V-HCR	[kN]	7,2	18,4	26,3	40,5	56,5	70,9	88,7	103,9	86,8	102,1	122,0

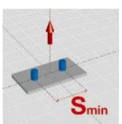
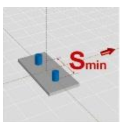
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**	**M33**	**M36**	**M39**
Embedment depth $h_{ef,typ}$ =	[mm]	80	90	110	125	170	210	240	270	300	330	360
Base material thickness h_{min}=	[mm]	110	120	140	161	218	266	300	340	374	410	450
 **Tensile N_{Rd}: single anchor, no edge effects**												
HIT-V 5.8	[kN]	12,0	19,3	27,7	33,6	53,3	73,2	89,4	106,7	125,0	144,2	164,3
HIT-V 8.8	[kN]	15,3	20,5	27,7	33,6	53,3	73,2	89,4	106,7	125,0	144,2	164,3
HIT-V-R	[kN]	13,9	20,5	27,7	33,6	53,3	73,2	80,4	98,3	122,6	144,2	164,3
HIT-V-HCR	[kN]	15,3	20,5	27,7	33,6	53,3	73,2	89,4	106,7	125,0	144,2	164,3
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**												
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0	138,8	163,4	195,2
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2	222,1	261,4	312,3
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8	72,9	85,8	102,5
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0	86,8	102,1	122,0

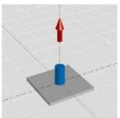
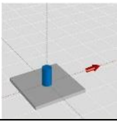
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**	**M33**	**M36**	**M39**
Embedment depth $h_{ef,typ}$ =	[mm]	80	90	110	125	170	210	240	270	300	330	360
Base material thickness h_{min}=	[mm]	110	120	140	161	218	266	300	340	374	410	450
Edge distance $c = c_{min}$=	[mm]	40	50	60	80	100	120	135	150	165	180	195
 **Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**												
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	8,2	10,0	13,3	16,9	26,1	35,6	43,3	51,4	60,0	69,1	78,6
 **Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**												
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,7	5,3	7,3	11,5	17,2	23,6	29,0	34,8	41,1	47,8	54,9

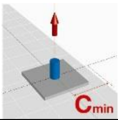
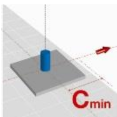
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

		Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**	**M33**	**M36**	**M39**
Embedment depth $h_{ef,typ}$ =	[mm]	80	90	110	125	170	210	240	270	300	330	360
Base material thickness h_{min}=	[mm]	110	120	140	161	218	266	300	340	374	410	450
Spacing $s = s_{min}$=	[mm]	40	50	60	80	100	120	135	150	165	180	195
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**												
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	9,3	11,6	15,5	19,2	30,1	41,2	50,3	59,9	70,1	80,8	92,0
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**												
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0	138,8	163,4	195,2
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	177,0	207,0	238,5	271,5
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8	72,9	85,8	102,5
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0	86,8	102,1	122,0

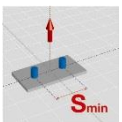
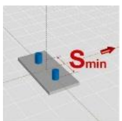
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

			Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**	**M33**	**M36**	**M39**
Embedment depth	$h_{ef,2}$ =	[mm]	96	120	144	192	240	288	324	360	396	432	468
Base material thickness	h_{min}=	[mm]	126	150	174	228	288	344	384	430	470	512	558
	**Tensile N_{Rd}: single anchor, no edge effects**												
	HIT-V 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	117,5	140,2	164,3	189,5	215,9	243,5
	HIT-V 8.8	[kN]	18,4	28,7	41,4	64,0	89,4	117,5	140,2	164,3	189,5	215,9	243,5
	HIT-V-R	[kN]	13,9	21,9	31,6	58,8	89,4	117,5	80,4	98,3	122,6	144,3	172,4
	HIT-V-HCR	[kN]	18,4	28,7	41,4	64,0	89,4	117,5	140,2	164,3	144,6	170,2	203,3
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**												
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0	138,8	163,4	195,2
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2	222,1	261,4	312,3
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8	72,9	85,8	102,5
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0	86,8	102,1	122,0

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

			Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**	**M33**	**M36**	**M39**
Embedment depth	$h_{ef,2}$ =	[mm]	96	120	144	192	240	288	324	360	396	432	468
Base material thickness	h_{min}=	[mm]	126	150	174	228	288	344	384	430	470	512	558
Edge distance	$c = c_{min}$=	[mm]	40	50	60	80	100	120	135	150	165	180	195
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**												
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	9,9	14,1	18,6	28,6	40,0	52,6	62,7	73,5	84,8	96,6	108,9
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**												
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,9	5,7	7,8	12,9	18,9	25,9	31,8	38,1	45,0	52,3	60,0

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

			Data according ETA-04/0027, issue 2013-06-26								Additional Hilti technical data		
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**	**M33**	**M36**	**M39**
Embedment depth	$h_{ef,2}$ =	[mm]	96	120	144	192	240	288	324	360	396	432	468
Base material thickness	h_{min}=	[mm]	126	150	174	228	288	344	384	430	470	512	558
Spacing	$s = s_{min}$=	[mm]	40	50	60	80	100	120	135	150	165	180	195
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**												
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	11,5	17,3	22,7	34,9	48,8	64,2	76,6	89,7	103,5	117,9	133,0
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**												
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0	138,8	163,4	195,2
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2	222,1	261,4	312,3
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8	72,9	85,8	102,5
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0	86,8	102,1	122,0

Hilti HIT-RE 500 mortar with HIS-(R)N sleeve

Injection mortar system		Benefits
	Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack) Statik mixer HIS-(R)N sleeve	- suitable for non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - under water application for hammer drilled holes - long working time at elevated temperatures - odourless epoxy

Concrete | Small edge distance and spacing | Fire resistance | Corrosion resistance | European Technical Approval | CE conformity | Diamond drilled holes | PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-04/0027 / 2013-06-26
Fire test report	IBMB, Brunswick	UB 3565 / 4595 / 2006-10-29 UB 3588 / 4825 / 2005-11-15
Assessment report (fire)	warringtonfire	WF 327804/B / 2013-07-10

a) All data given in this section according ETA-04/0027, issue 2013-06-26.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Screw strength class 8.8
- Base material thickness, as specified in the table
- <u>One</u> typical embedment depth, as specified in the table
- <u>One</u> anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range +5°C to +40°C

Embedment depth and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20
Embedment depth [mm]	90	110	125	170	205
Base material thickness [mm]	120	150	170	230	270

For hammer drilled holes and hollow drill bit:
Mean ultimate resistance [a]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-04/0027, issue 2013-06-26 for hammer drilling and hollow drill bit				
Anchor size			M8	M10	M12	M16	M20
Tensile $N_{Ru,m}$	HIS-N	[kN]	*26,3*	*48,3*	*70,4*	*123,9*	*114,5*
Shear $V_{Ru,m}$	HIS-N	[kN]	*13,7*	*24,2*	*41,0*	*62,0*	*57,8*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-04/0027, issue 2013-06-26 for hammer drilling and hollow drill bit				
Anchor size			M8	M10	M12	M16	M20
Tensile N_{Rk}	HIS-N	[kN]	*25,0*	*46,0*	*67,0*	111,9	*109,0*
Shear V_{Rk}	HIS-N	[kN]	*13,0*	*23,0*	*39,0*	*59,0*	*55,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-04/0027, issue 2013-06-26 for hammer drilling and hollow drill bit				
Anchor size			M8	M10	M12	M16	M20
Tensile N_{Rd}	HIS-N	[kN]	16,8	27,7	33,6	53,3	70,6
Shear V_{Rd}	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7

Recommended loads [a]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-04/0027, issue 2013-06-26 for hammer drilling and hollow drill bit				
Anchor size			M8	M10	M12	M16	M20
Tensile N_{rec}	HIS-N	[kN]	12,0	19,8	24,0	38,1	50,4
Shear V_{rec}	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

For diamond drilling:

Mean ultimate resistance [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-04/0027, issue 2013-06-26 for diamond drilling				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Tensile $N_{Ru,m}$	HIS-N	[kN]	*26,3*	*48,3*	*70,4*	*123.9*	*114.5*
Shear $V_{Ru,m}$	HIS-N	[kN]	*13,7*	*24,2*	*41,0*	*62,0*	*57,8*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-04/0027, issue 2013-06-26 for diamond drilling				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Tensile N_{Rk}	HIS-N	[kN]	*25,0*	*46,0*	*67,0*	111,9	*109,0*
Shear V_{Rk}	HIS-N	[kN]	*13,0*	*23,0*	*39,0*	*59,0*	*55,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-04/0027, issue 2013-06-26 for diamond drilling				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Tensile N_{Rd}	HIS-N	[kN]	16,7	27,7	33,6	53,3	66,7
Shear V_{Rd}	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7

Recommended loads [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-04/0027, issue 2013-06-26 for diamond drilling				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Tensile N_{rec}	HIS-N	[kN]	11,9	19,8	24,0	38,1	47,6
Shear V_{rec}	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-RE 500 injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +58 °C	+35 °C	+58 °C
Temperature range III	-40 °C to +70 °C	+43 °C	+70 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIS-(R)N

			Data according ETA-04/0027, issue 2013-06-26				
Anchor size			M8	M10	M12	M16	M20
Nominal tensile strength f_{uk}	HIS-N	[N/mm²]	490	490	460	460	460
	Screw 8.8	[N/mm²]	800	800	800	800	800
	HIS-RN	[N/mm²]	700	700	700	700	700
	Screw A4-70	[N/mm²]	700	700	700	700	700
Yield strength f_{yk}	HIS-N	[N/mm²]	410	410	375	375	375
	Screw 8.8	[N/mm²]	640	640	640	640	640
	HIS-RN	[N/mm²]	350	350	350	350	350
	Screw A4-70	[N/mm²]	450	450	450	450	450
Stressed cross-section A_s	HIS-(R)N	[mm²]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm²]	36,6	58	84,3	157	245
Moment of resistance W	HIS-(R)N	[mm³]	145	430	840	1595	1543
	Screw	[mm³]	31,2	62,3	109	277	541

Material quality

Part	Material
internally threaded sleeves [a] HIS-N	C-steel 1.0718, steel galvanized ≥ 5µm
internally threaded sleeves [b] HIS-RN	stainless steel 1.4401 and 1.4571

a) related fastening screw: strength class 8.8, A5 > 8% Ductile
steel galvanized ≥ 5µm
b) related fastening screw: strength class 70, A5 > 8% Ductile
stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362

Anchor dimensions

Anchor size		M8	M10	M12	M16	M20
Internal sleeve HIS-(R)N		M8x90	M10x110	M12x125	M16x170	M20x205
Anchor embedment depth	[mm]	90	110	125	170	205

Setting

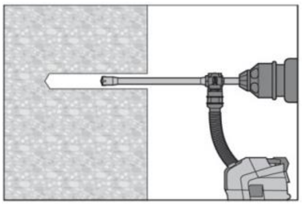
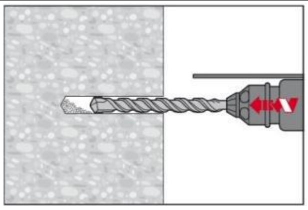
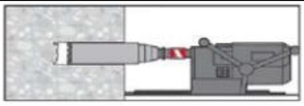
installation equipment

Anchor size	M8	M10	M12	M16	M20
Rotary hammer	TE 2 – TE 16		TE 40 – TE 70		
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser				
Additional Hilti recommended tools	DD EC-1, DD 100 … DD xxx [a)]				

a) For anchors in diamond drilled holes load values for combined pull-out and concrete cone resistance have to be reduced (see section “Setting instruction”)

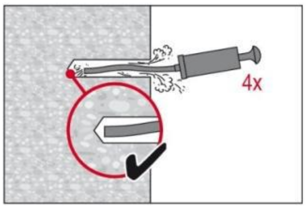
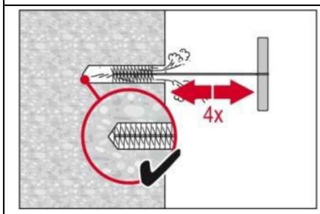
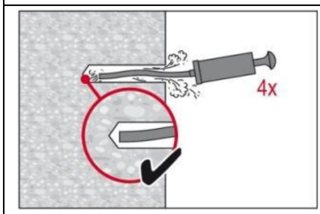
Setting instruction

Bore hole drilling

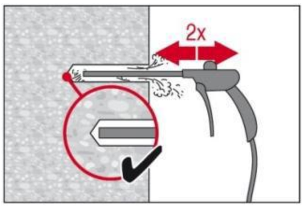
a) Hilti hollow drill bit	(for dry and wet concrete only)
	Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment. This drilling system removes the dust and cleans the bore hole during drilling when used in accordance with the user’s manual. After drilling is complete, proceed to the “injection preparation” step in the instructions for use.
b) Hammer drilling	(dry or wet concrete and installation in flooded holes (no sea water))
	Drill Hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.
c) Diamond coring	(for dry and wet concrete only)
	Diamond coring is permissible when diamond core drilling machine and the corresponding core bit are used.

Bore hole cleaning Just before setting an anchor, the bore hole must be free of dust and debris.

a) Manual Cleaning (MC) non-cracked concrete only
for bore hole diameters $d_0 \leq$ 20mm and bore hole depth $h_0 \leq 20d$ or $h_0 \leq$ 250 mm (d = diameter of element)

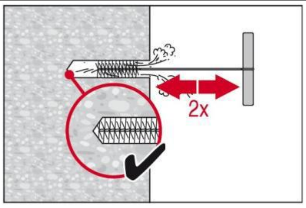
	The Hilti manual pump may be used for blowing out bore holes up to diameters $d_0 \leq$ 20 mm and embedment depths up to $h_{ef} \leq 10d$. Blow out at least 4 times from the back of the bore hole until return air stream is free of noticeable dust
	Brush 4 times with the specified brush size (brush diameter ≥ bore hole) 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 bore hole - if not the brush is too small and must be replaced with the proper brush diameter.
	Blow out again with manual pump at least 4 times until return air stream is free of noticeable dust.

b) Compressed air cleaning (CAC)
for all bore hole diameters d_0 and all bore hole depth h_0

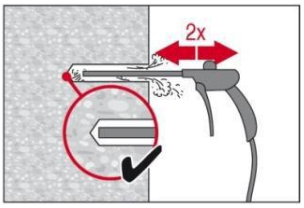


Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust.

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

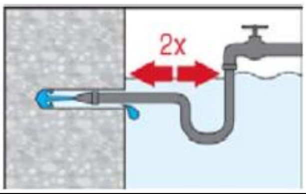


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole - if not the brush is too small and must be replaced with the proper brush diameter.

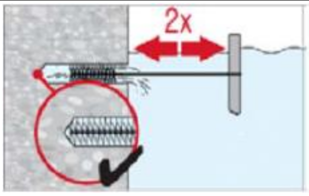


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

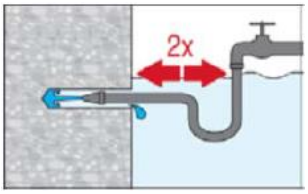
c) Cleaning for under water
for all bore hole diameters d_0 and all bore hole depth h_0



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

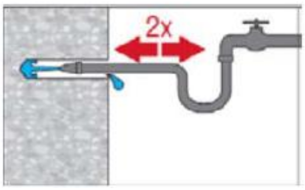


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole - if not the brush is too small and must be replaced with the proper brush diameter.

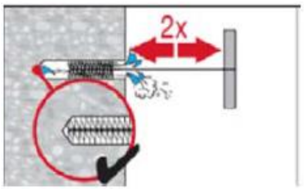


Flush again 2 times the hole by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.

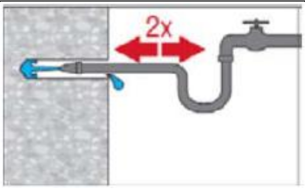
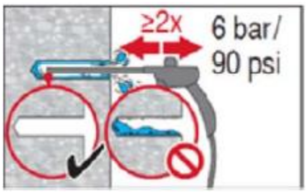
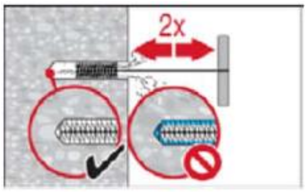
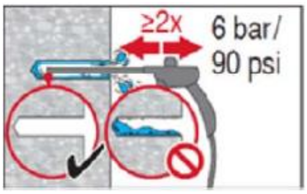
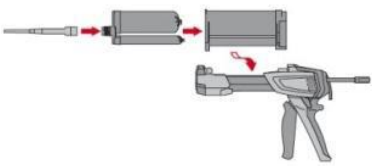
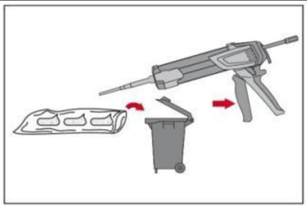
d) Cleaning of hammer drilled holes and diamond cored holes
for all bore hole diameters d_0 and all bore hole depth h_0

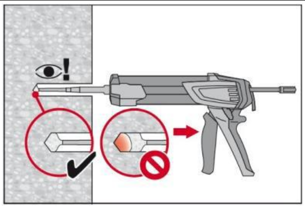
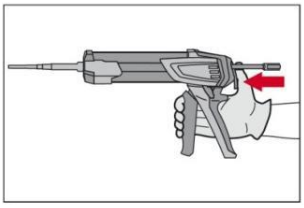
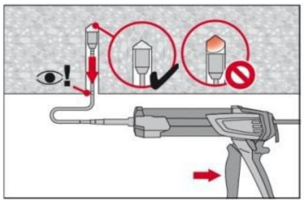
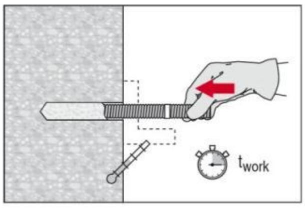
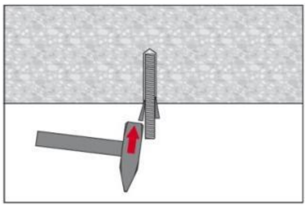
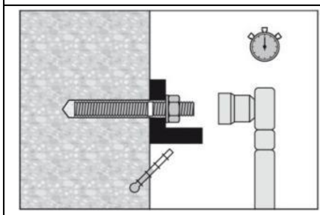


Flush 2 times the hole by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.



Brush 2 times with the specified brush size 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 bore hole - if not the brush is too small and must be replaced with the proper brush diameter.

	Flush again 2 times the hole 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 hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust and water. Bore hole diameter ≥ 32 mm the compressor must supply a minimum air flow of 140 m³/hour.
	Brush 2 times with the specified brush size 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 bore hole - if not the brush is too small and must be replaced with the proper brush diameter.
	Blow again with compressed air 2 times until return air stream is free of noticeable dust and water.
Injection preparation	
	Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle. Observe the instruction for use of the dispenser and mortar. Check foil pack holder for proper function. Do not use damaged foil packs / holders. Insert foil pack into foil pack holder and put holder into HIT-dispenser.
	The foil pack opens automatically as dispensing is initiated. Discard initial adhesive. Depending on the size of the foil pack an initial amount of adhesive has to be discarded. Discard quantities are: 2 strokes for 330 ml foil pack, 3 strokes for 500 ml foil pack, 65 ml for 1400 ml foil pack.

Inject adhesive from the back of the borehole without forming air voids	
	Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull. Fill holes approximately 2/3 full. It is required that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.
	After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.
	Overhead installation and/or installation with embedment depth h_{ef} > 250mm. 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 HIT-SZ. Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the bore hole by the adhesive pressure. **Under water application:** fill borehole completely with mortar.
Setting the element	
	Before use, verify that the element is dry and free of oil and other contaminants. Mark and set element to the required embedment depth untill working time t_{work} has elapsed.
	For overhead installation use piston plugs and fix embedded parts with e.g. wedges HIT-OHW.
	Loading the anchor: After required curing time t_{cure} the anchor can be loaded. The applied installation torque shall not exceed $T_{max.}$

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

Curing time for general conditions

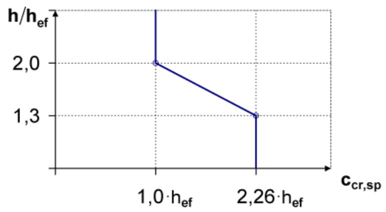
Data according ETA-04/0027, issue 2013-06-26		
Temperature of the base material	Working time in which anchor can be inserted and adjusted t_{gel}	Curing time before anchor can be fully loaded t_{cure}
40 °C	12 min	4 h
30 °C to 39 °C	12 min	8 h
20 °C to 29 °C	20 min	12 h
15 °C to 19 °C	30 min	24 h
10 °C to 14 °C	90 min	48 h
5 °C to 9 °C	120 min	72 h

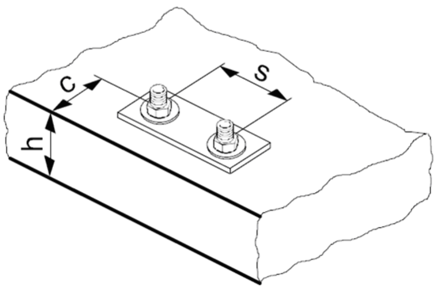
For dry concrete curing times may be reduced according to the following table.
For installation temperatures below +5 °C all load values have to be reduced according to the load reduction factors given below.

Curing time for dry concrete

Additional Hilti technical data			
Temperature of the base material	Working time in which anchor can be inserted and adjusted t_{gel}	Reduced curing time before anchor can be fully loaded $t_{cure,dry}$	Load reduction factor
40 °C	12 min	4 h	1
30 °C	12 min	8 h	1
20 °C	20 min	12 h	1
15 °C	30 min	18 h	1
10 °C	90 min	24 h	1
5 °C	120 min	36 h	1
0 °C	3 h	50 h	0,7
-5 °C	4 h	72 h	0,6

Setting details

			Data according ETA-04/0027, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Nominal diameter of drill bit	d_0	[mm]	14	18	22	28	32
Diameter of element	d	[mm]	12,5	16,5	20,5	25,4	27,6
Effective anchorage and drill hole depth	h_{ef}	[mm]	90	110	125	170	205
Minimum base material thickness	h_{min}	[mm]	120	150	170	230	270
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22
Thread engagement length; min - max	h_s	[mm]	8-20	10-25	12-30	16-40	20-50
Minimum spacing	s_{min}	[mm]	40	45	55	65	90
Minimum edge distance	c_{min}	[mm]	40	45	55	65	90
Critical spacing for splitting failure	$s_{cr,sp}$		2 $c_{cr,sp}$				
Critical edge distance for splitting failure [a]	$c_{cr,sp}$	[mm]	**1,0 · h_{ef}**	for h / h_{ef} ≥ 2,0			
			4,6 h_{ef} - 1,8 h	for 2,0 > h / h_{ef} > 1,3			
			2,26 h_{ef}	for h / h_{ef} ≤ 1,3			
Critical spacing for concrete cone failure	$s_{cr,N}$		2 $c_{cr,N}$				
Critical edge distance for concrete cone failure [c]	$c_{cr,N}$		1,5 h_{ef}				
Torque moment [c]	T_{max}	[Nm]	10	20	40	80	150



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) h: base material thickness (h ≥ h_{min})

b) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

c) This is the maximum recommended torque moment to avoid splitting failure during installation for anchors with minimum spacing and/or edge distance.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-04/0027, issue 2013-06-26.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

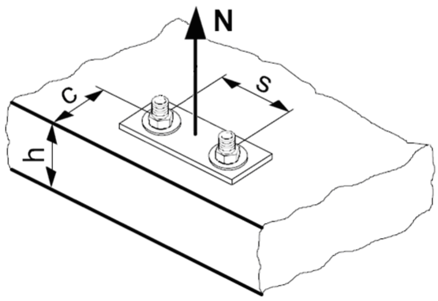
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

			Data according ETA-04/0027, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
$N_{Rd,s}$	HIS-N	[kN]	16,8	30,7	44,7	80,3	74,1
	HIS-RN	[kN]	13,9	21,9	31,6	58,8	69,2

Design combined pull-out and concrete cone resistance a)

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

				Data according ETA-04/0027, issue 2013-06-26				
Anchor size				**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth h_{ef} [mm]				**90**	**110**	**125**	**170**	**205**
Hammer drilling + Hilti hollow drill bit	$N^0_{Rd,p}$	Temp range I	[kN]	19,0	28,6	45,2	81,0	95,2
	$N^0_{Rd,p}$	Temp range II	[kN]	16,7	23,8	35,7	66,7	81,0
	$N^0_{Rd,p}$	Temp. range III	[kN]	9,5	14,3	19,0	35,7	45,2
Diamond coring	$N^0_{Rd,p}$	Temp range I	[kN]	22,2	28,6	35,7	54,8	66,7
	$N^0_{Rd,p}$	Temp range II	[kN]	19,4	27,8	33,3	45,2	54,8
	$N^0_{Rd,p}$	Temp. range III	[kN]	11,1	16,7	22,2	35,7	45,2

a) **Additional Hilti technical data (not part of ETA-04/0027, issue 2009-05-20):**
The design values for combined pull-out and concrete cone resistance may be increased by 20 % for anchor installation in dry concrete (concrete not in contact with water before/during installation and curing).

Design concrete cone resistance a) $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance $N_{Rd,sp}$ a) $= N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

		Data according ETA-04/0027, issue 2013-06-26				
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
$N^0_{Rd,c}$	[kN]	20,5	27,7	33,6	53,3	70,6

a) **Additional Hilti technical data (not part of ETA-04/0027, issue 2009-05-20):**
The design values for concrete cone and splitting resistance may be increased by 20 % for anchor installation in dry concrete (concrete not in contact with water before/during installation and curing).

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ a)	1	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$f_{h,p} = 1$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0{,}7 + 0{,}3 \cdot c/c_{cr,N}$ $f_{1,sp} = 0{,}7 + 0{,}3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0{,}5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp} = 0{,}5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0{,}5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp} = 0{,}5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$f_{h,N} = 1$

Influence of reinforcement

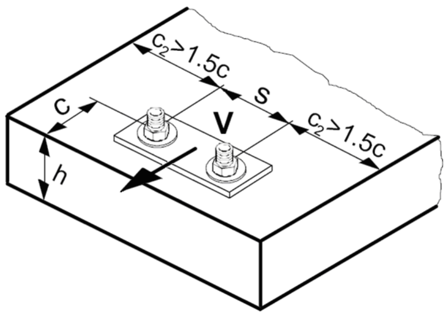
h_{ef} [mm]	80	90	≥ 100
$f_{re,N} = 0{,}5 + h_{ef}/200mm \leq 1$	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

			Data according ETA-04/0027, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
$V_{Rd,s}$	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

k = 1 for h_{ef} < 60 mm
k = 2 for $h_{ef} \geq$ 60 mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Non-cracked concrete						
$V^0_{Rd,c}$	[kN]	12,4	19,6	28,2	40,2	46,2

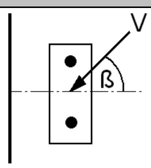
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	**0°**	**10°**	**20°**	**30°**	**40°**	**50°**	**60°**	**70°**	**80°**	**≥ 90°**
$f_\beta = \frac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	**0,15**	**0,3**	**0,45**	**0,6**	**0,75**	**0,9**	**1,05**	**1,2**	**1,35**	**≥ 1,5**
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20
f_{hef} =	1,38	1,21	1,04	1,22	1,45

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
f_c = $(d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

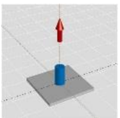
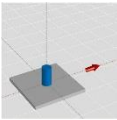
Combined tension and shear loading for hammer drilling or hollow drill bit

For combined tension and shear loading see section “Anchor Design”.

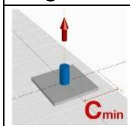
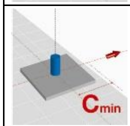
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

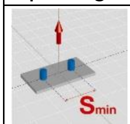
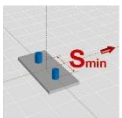
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-04/0027, issue 2013-06-26				
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth h_{ef} =	[mm]	90	110	125	170	205
Base material thickness h_{min}=	[mm]	120	150	170	230	270
 **Tensile N_{Rd}: single anchor, no edge effects**						
HIS-N	[kN]	16,8	27,7	33,6	53,3	70,6
HIS-RN	[kN]	13,9	21,9	31,6	53,3	69,2
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**						
HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-04/0027, issue 2013-06-26				
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth h_{ef} =	[mm]	90	110	125	170	205
Base material thickness h_{min}=	[mm]	120	150	170	230	270
Edge distance $c = c_{min}$=	[mm]	40	45	55	65	90
 **Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**						
HIS-(R)N	[kN]	9,4	12,4	15,4	23,5	32,0
 **Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**						
HIS-(R)N	[kN]	4,2	5,5	7,6	10,8	17,2

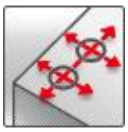
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

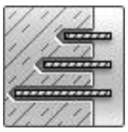
		Data according ETA-04/0027, issue 2013-06-26				
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth h_{ef} =	[mm]	90	110	125	170	205
Base material thickness h_{min}=	[mm]	120	150	170	230	270
Spacing $s = s_{min}$=	[mm]	40	45	55	65	90
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**						
HIS-(R)N	[kN]	11,2	15,2	18,5	29,0	38,8
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**						
HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Hilti HIT-RE 500 mortar with rebar (as anchor)

Injection mortar system		Benefits
	Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- suitable for non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - under water application - large diameter applications - long working time at elevated temperatures - odourless epoxy - embedment depth range: from 60 … 160 mm for Ø8 to 128 … 640 mm for Ø32
	Statik mixer	
	rebar BSt 500 S	


Concrete


Small edge distance and spacing


Variable embedment depth


Diamond drilled holes


European Technical Approval


CE conformity


PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-04/0027 / 2013-06-26

a) All data given in this section according ETA-04/0027, issue 2013-06-26

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- <u>One</u> typical embedment depth, as specified in the table
- <u>One</u> anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range +5°C to +40°C

Embedment depth [a] and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

	ETA-04/0027, issue issue 2013-06-26									Additional Hilti tech. data	
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Typical embedment depth [mm]	80	90	110	125	125	170	210	270	300	330	360
Base material thickness [mm]	110	120	145	165	165	220	275	340	380	420	470

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

For hammer drilled holes and hollow drill bit:
Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500S

			ETA-04/0027, issue issue 2013-06-26 for hammer drilling and hollow drill bit									Additional Hilti tech. data	
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Tensile $N_{Ru,m}$	BSt 500 S	[kN]	*29,4*	*45,2*	*65,1*	*89,3*	94,1	149,2	204,9	298,7	349,9	403,6	459,9
Shear $V_{Ru,m}$	BSt 500 S	[kN]	*14,7*	*23,1*	*32,6*	*44,1*	*57,8*	*90,3*	*141,8*	*177,5*	*232,1*	*293,9*	*362,9*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			ETA-04/0027, issue issue 2013-06-26 for hammer drilling and hollow drill bit									Additional Hilti tech. data	
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Tensile N_{Rk}	BSt 500 S	[kN]	*28,0*	42,4	58,3	70,6	70,6	111,9	153,7	224,0	262,4	302,7	344,9
Shear V_{Rk}	BSt 500 S	[kN]	*14,0*	*22,0*	*31,0*	*42,0*	*55,0*	*86,0*	*135,0*	*169,0*	*221,0*	*279,9*	*345,6*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			ETA-04/0027, issue issue 2013-06-26 for hammer drilling and hollow drill bit									Additional Hilti tech. data	
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Tensile N_{Rd}	BSt 500 S	[kN]	14,4	20,2	27,7	33,6	33,6	53,3	73,2	106,7	125,0	144,2	164,3
Shear V_{Rd}	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3	186,6	230,4

Recommended loads [a]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			ETA-04/0027, issue issue 2013-06-26 for hammer drilling and hollow drill bit									Additional Hilti tech. data	
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Tensile N_{rec}	BSt 500 S	[kN]	10,3	14,4	19,8	24,0	24,0	38,1	52,3	76,2	89,3	103,0	117,3
Shear V_{rec}	BSt 500 S	[kN]	6,7	10,5	14,8	20,0	26,2	41,0	64,3	80,5	105,2	133,3	164,6

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

For diamond drilling:

Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500S

			ETA-04/0027, issue issue 2013-06-26 for diamond drilling								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**32**
Tensile $N_{Ru,m}$	BSt 500 S	[kN]	*29,4*	45,0	*65,1*	68,2	91,8	141,8	178,7	243,2	262,8
Shear $V_{Ru,m}$	BSt 500 S	[kN]	*14,7*	*23,1*	*32,6*	*44,1*	*57,75*	*90,3*	*141,8*	*177,5*	*232,1*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			ETA-04/0027, issue issue 2013-06-26 for diamond drilling								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**32**
Tensile $N_{Ru,m}$	BSt 500 S	[kN]	24,1	33,9	49,8	51,8	69,1	106,8	134,6	183,2	197,9
Shear $V_{Ru,m}$	BSt 500 S	[kN]	*14,0*	*22,0*	*31,0*	*42,0*	*55,0*	*86,0*	*135,0*	*169,0*	*221,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			ETA-04/0027, issue issue 2013-06-26 for diamond drilling								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**32**
Tensile $N_{Ru,m}$	BSt 500 S	[kN]	13,4	18,9	27,7	28,8	32,9	50,9	64,09	87,3	94,3
Shear $V_{Ru,m}$	BSt 500 S	[kN]	9,3	14,67	20,7	28,0	36,7	57,3	90,0	112,7	147,3

Recommended loads [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			ETA-04/0027, issue issue 2013-06-26 for diamond drilling								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**32**
Tensile $N_{Ru,m}$	BSt 500 S	[kN]	9,6	13,5	19,8	20,6	23,5	36,3	45,8	62,3	67,3
Shear $V_{Ru,m}$	BSt 500 S	[kN]	6,7	10,5	14,8	20,0	26,2	41,0	64,3	80,5	105,2

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-RE 500 injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +58 °C	+35 °C	+58 °C
Temperature range III	-40 °C to +70 °C	+43 °C	+70 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of rebar BSt 500S

			Data according ETA-04/0027, issue 2013-06-26									Additional Hilti tech. data	
Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Nominal tensile strength f_{uk}	BSt 500 S	[N/mm²]	550	550	550	550	550	550	550	550	550	550	550
Yield strength f_{yk}	BSt 500 S	[N/mm²]	500	500	500	500	500	500	500	500	500	500	500
Stressed cross-section A_s	BSt 500 S	[mm²]	50,3	78,5	113,1	153,9	201,1	314,2	490,9	615,8	804,2	1018	1257
Moment of resistance W	BSt 500 S	[mm³]	50,3	98,2	169,6	269,4	402,1	785,4	1534	2155	3217	4580	6283

Material quality

Part	Material
rebar BSt 500 S	Geometry and mechanical properties according to DIN 488-2:1986 or E DIN 488-2:2006

Setting

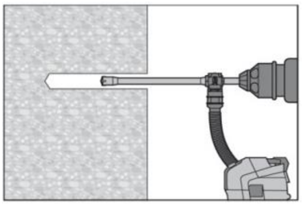
installation equipment

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36
Rotary hammer	TE 2 – TE 16					TE 40 – TE 70				
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser									

Setting instruction

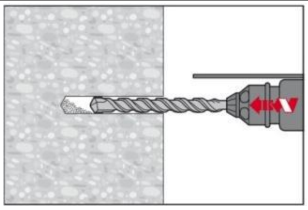
Bore hole drilling

a) Hilti hollow drill bit (for dry and wet concrete only)



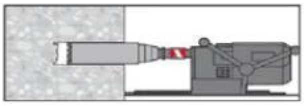
Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment. This drilling system removes the dust and cleans the bore hole during drilling when used in accordance with the user's manual.
After drilling is complete, proceed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

b) Hammer drilling (dry or wet concrete and installation in flooded holes (no sea water))



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

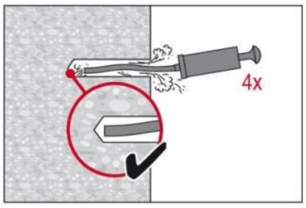
c) Diamond coring (for dry and wet concrete only)



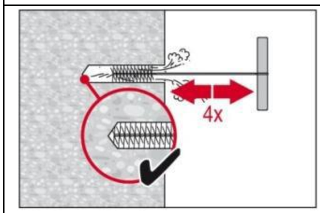
Diamond coring is permissible when diamond core drilling machine and the corresponding core bit are used.

Bore hole cleaning Just before setting an anchor, the bore hole must be free of dust and debris.

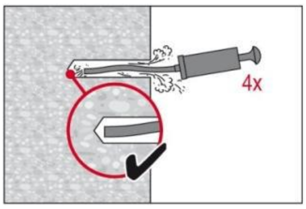
a) Manual Cleaning (MC) non-cracked concrete only
for bore hole diameters $d_0 \leq$ 20mm and bore hole depth $h_0 \leq 20d$ or $h_0 \leq$ 250 mm (d = diameter of element)



The Hilti manual pump may be used for blowing out bore holes up to diameters $d_0 \leq$ 20 mm and embedment depths up to $h_{ef} \leq 10d$.
Blow out at least 4 times from the back of the bore hole until return air stream is free of noticeable dust

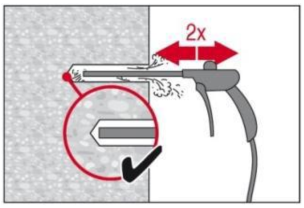


Brush 4 times with the specified brush size (brush diameter ≥ bore hole) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole - if not the brush is too small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



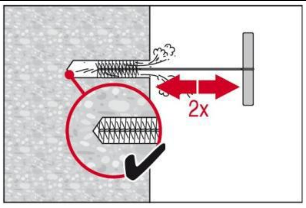
Blow out again with manual pump at least 4 times until return air stream is free of noticeable dust.

b) Compressed air cleaning (CAC)
for all bore hole diameters d_0 and all bore hole depth h_0

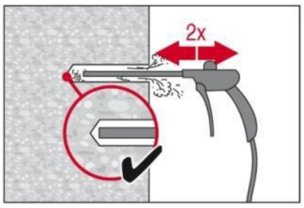


Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust.

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

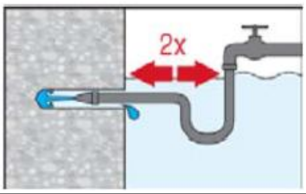


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole - if not the brush is too small and must be replaced with the proper brush diameter.

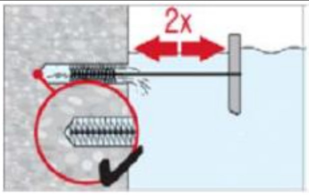


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

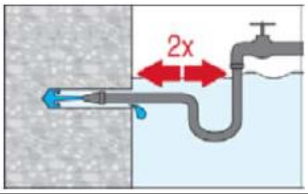
c) Cleaning for under water
for all bore hole diameters d_0 and all bore hole depth h_0



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

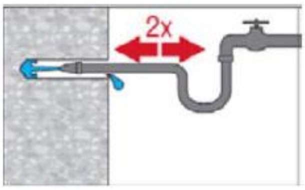


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole - if not the brush is too small and must be replaced with the proper brush diameter.

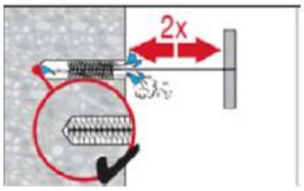


Flush again 2 times the hole by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.

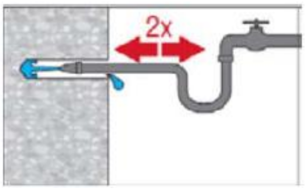
d) Cleaning of hammer drilled holes and diamond cored holes
for all bore hole diameters d_0 and all bore hole depth h_0



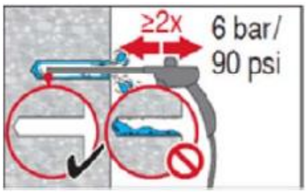
Flush 2 times the hole by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.



Brush 2 times with the specified brush size 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 bore hole - if not the brush is too small and must be replaced with the proper brush diameter.

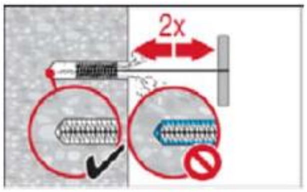


Flush again 2 times the hole by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.

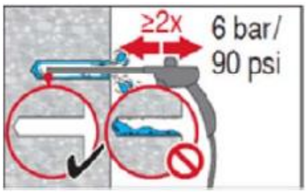


Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust and water.

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

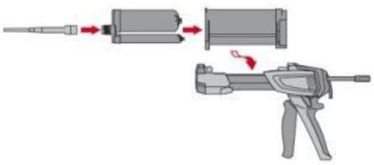


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole - if not the brush is too small and must be replaced with the proper brush diameter.

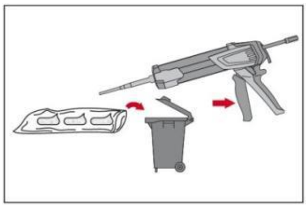


Blow again with compressed air 2 times until return air stream is free of noticeable dust and water.

Injection preparation



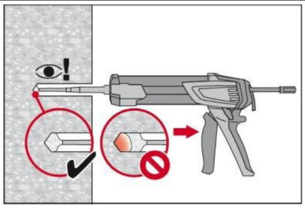
Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle. Observe the instruction for use of the dispenser and mortar.
Check foil pack holder for proper function. Do not use damaged foil packs / holders.
Insert foil pack into foil pack holder and put holder into HIT-dispenser.



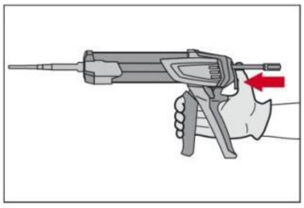
The foil pack opens automatically as dispensing is initiated. Discard initial adhesive. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
Discard quantities are:

- 2 strokes for 330 ml foil pack,
- 3 strokes for 500 ml foil pack,
- 65 ml for 1400 ml foil pack.

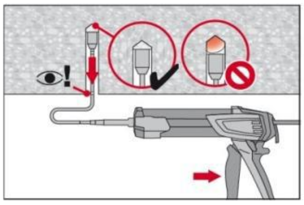
Inject adhesive from the back of the borehole without forming air voids



Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
Fill holes approximately 2/3 full. It is required that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.



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

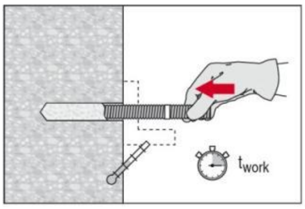


Overhead installation and/or installation with embedment depth h_{ef} > 250mm.

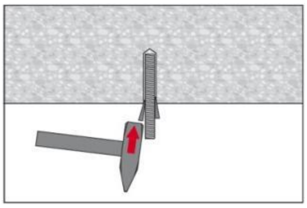
For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug HIT-SZ. Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded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

Under water application: fill borehole completely with mortar.

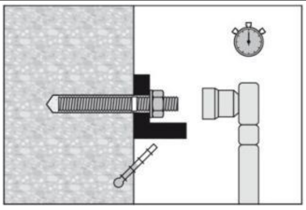
Setting the element



Before use, verify that the element is dry and free of oil and other contaminants.
Mark and set element to the required embedment depth untill working time t_{work} has elapsed.



For overhead installation use piston plugs and fix embedded parts with e.g. wedges HIT-OHW.



Loading the anchor:
After required curing time t_{cure} the anchor can be loaded.
The applied installation torque shall not exceed $T_{max.}$

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

Curing time for general conditions

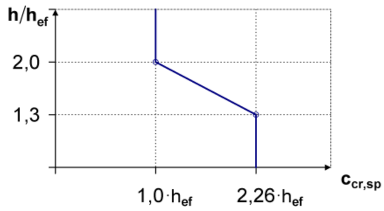
Data according ETA-04/0027, issue 2013-06-26			Additional Hilti technical data
Temperature of the base material	Working time in which anchor can be inserted and adjusted t_{gel}	Curing time before anchor can be fully loaded t_{cure}	Preparation work may continue. Do not apply design load. $t_{cure, ini}$
40 °C	12 min	4 h	2 h
30 °C to 39 °C	12 min	8 h	4 h
20 °C to 29 °C	20 min	12 h	6 h
15 °C to 19 °C	30 min	24 h	8 h
10 °C to 14 °C	90 min	48 h	12 h
5 °C to 9 °C	120 min	72 h	18 h

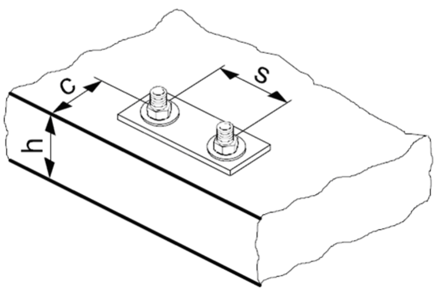
For dry concrete curing times may be reduced according to the following table.
For installation temperatures below +5 °C all load values have to be reduced according to the load reduction factors given below.

Curing time for dry concrete

Additional Hilti technical data			
Temperature of the base material	Working time in which anchor can be inserted and adjusted t_{gel}	Reduced curing time before anchor can be fully loaded $t_{cure,dry}$	Load reduction factor
40 °C	12 min	4 h	1
30 °C	12 min	8 h	1
20 °C	20 min	12 h	1
15 °C	30 min	18 h	1
10 °C	90 min	24 h	1
5 °C	120 min	36 h	1
0 °C	3 h	50 h	0,7
-5 °C	4 h	72 h	0,6

Setting details

			Data according ETA-04/0027, issue 2013-06-26									Additional Hilti tech. data	
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Nominal diameter of drill bit	d_0	[mm]	12	14	16	18	20	25	32	35	40	45	55
Effective anchorage and drill hole depth range [a]	$h_{ef,min}$	[mm]	60	60	70	75	80	90	100	112	128	144	160
	$h_{ef,max}$	[mm]	160	200	240	280	320	400	500	560	640	720	800
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm		$h_{ef} + 2\ d_0$								
Minimum spacing	s_{min}	[mm]	40	50	60	70	80	100	125	140	160	180	200
Minimum edge distance	c_{min}	[mm]	40	50	60	70	80	100	125	140	160	180	200
Critical spacing for splitting failure	$s_{cr,sp}$		$2\ c_{cr,sp}$										
Critical edge distance for splitting failure [b]	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$**	for $h / h_{ef} \geq 2{,}0$									
			$4{,}6\ h_{ef} - 1{,}8\ h$	for $2{,}0 > h / h_{ef} > 1{,}3$									
			$2{,}26\ h_{ef}$	for $h / h_{ef} \leq 1{,}3$									
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\ c_{cr,N}$										
Critical edge distance for concrete cone failure [c]	$c_{cr,N}$		$1{,}5\ h_{ef}$										



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$ (h_{ef}: embedment depth)

b) h: base material thickness ($h \geq h_{min}$)

c) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-04/0027, issue 2013-06-26.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

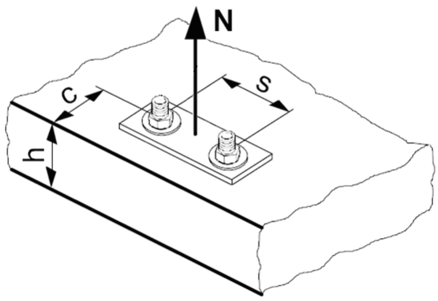
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $\mathbf{N_{Rd,s}}$
- Combined pull-out and concrete cone resistance:
  $\mathbf{N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}}$
- Concrete cone resistance: $\mathbf{N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}}$
- Concrete splitting resistance (only non-cracked concrete):
  $\mathbf{N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

	Data according ETA-04/0027, issue 2013-06-26									Additional Hilti tech. data	
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
$N_{Rd,s}$ BSt 500 S [kN]	20,0	30,7	44,3	60,7	79,3	123,6	192,9	242,1	315,7	400	494

Design combined pull-out and concrete cone resistance [a)]

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

				Data according ETA-04/0027, issue 2013-06-26									Additional Hilti tech. data	
Anchor size				**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Typical embedment depth $h_{ef,typ}$ [mm]				**80**	**90**	**110**	**125**	**125**	**170**	**210**	**270**	**300**	**330**	**360**
Hammer drilling + Hollow drill bit	$N^0_{Rd,p}$	Temp. range I	[kN]	14,4	20,2	29,6	36,7	41,9	71,2	102,1	147,0	186,7	192,8	216,1
	$N^0_{Rd,p}$	Temp. range II	[kN]	11,5	16,2	23,7	31,4	32,9	56,0	86,4	113,1	143,6	154,2	172,9
	$N^0_{Rd,p}$	Temp. range III	[kN]	6,7	9,4	13,8	18,3	20,9	33,1	51,1	67,9	86,2	92,5	103,7
Diamond coring	$N^0_{Rd,p}$	Temp. range I	[kN]	13.4	18.8	27.6	33.6	32.9	50.9	66.8	90.5	100.5	-	-
	$N^0_{Rd,p}$	Temp. range II	[kN]	10.6	14.9	21.9	27.5	25.4	40.7	55.0	73.5	79.0	-	-
	$N^0_{Rd,p}$	Temp. range III	[kN]	6.7	9.4	13.8	16.8	15.0	22.9	31.4	39.6	50.3	-	-

a) **Additional Hilti technical data (not part of ETA-04/0027, issue 2013-06-26):**
The design values for combined pull-out and concrete cone resistance may be increased by 20 % for anchor installation in dry concrete (concrete not in contact with water before/during installation and curing).

Design concrete cone resistance [a)] $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance $N_{Rd,sp}$ [a)] $= N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

		Data according ETA-04/0027, issue 2013-06-26									Additional Hilti tech. data	
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
$N^0_{Rd,c}$	[kN]	17,2	20,5	27,7	33,6	33,6	53,3	73,2	106,7	125,0	144,2	164,3

a) **Additional Hilti technical data (not part of ETA-04/0027, issue 2009-05-20):**
The design values for concrete cone and splitting resistance may be increased by 20 % for anchor installation in dry concrete (concrete not in contact with water before/during installation and curing).

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ [a)]	1	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0{,}7 + 0{,}3 \cdot c/c_{cr,N}$ $f_{1,sp} = 0{,}7 + 0{,}3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0{,}5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp} = 0{,}5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0{,}5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp} = 0{,}5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

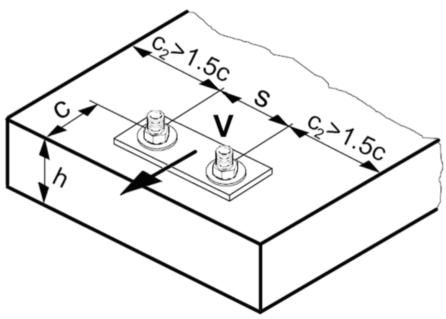
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0{,}5 + h_{ef}/200mm \leq 1$	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

	Data according ETA-04/0027, issue 2013-06-26									Additional Hilti technical data	
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
$V_{Rd,s}$ BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3	186,6	230,4

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

k = 2 for $h_{ef} \geq 60$ mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Non-cracked concrete											
$V^0_{Rd,c}$ [kN]	5,9	8,6	11,6	15,0	18,7	27,0	39,2	47,3	59,0	71,7	85,5

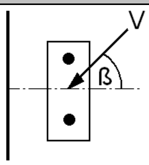
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	**0°**	**10°**	**20°**	**30°**	**40°**	**50°**	**60°**	**70°**	**80°**	**≥ 90°**
$f_\beta = \sqrt{\dfrac{1}{(\cos\alpha_V)^2 + \left(\dfrac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	**0,15**	**0,3**	**0,45**	**0,6**	**0,75**	**0,9**	**1,05**	**1,2**	**1,35**	**≥ 1,5**
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

h_{ef}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

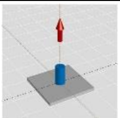
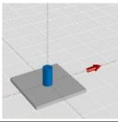
Combined tension and shear loading for hammer drilling or hollow drill bit

For combined tension and shear loading see section "Anchor Design".

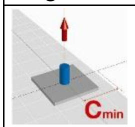
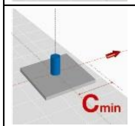
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action $\gamma = 1,4$. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

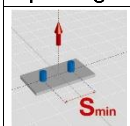
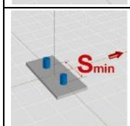
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-04/0027, issue 2013-06-26									Additional Hilti tech. data	
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Embedment depth	$h_{ef,1}$ = [mm]	60	60	72	84	96	120	150	168	192	216	240
Base material thickness	h_{min}= [mm]	100	100	104	120	136	170	214	238	272	306	350
	**Tensile N_{Rd}: single anchor, no edge effects**											
BSt 500 S	[kN]	10,8	11,2	14,7	18,5	22,6	31,6	44,2	52,4	64,0	76,3	89,4
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**											
BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3	186,6	230,4

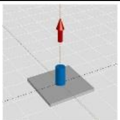
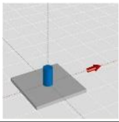
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-04/0027, issue 2013-06-26									Additional Hilti tech. data	
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Embedment depth	$h_{ef,1}$ = [mm]	60	60	72	84	96	120	150	168	192	216	240
Base material thickness	h_{min}= [mm]	100	100	104	120	136	170	214	238	272	306	350
Edge distance	$c = c_{min}$= [mm]	40	50	60	70	80	100	125	140	160	180	200
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**											
BSt 500 S	[kN]	6,5	7,3	8,6	10,8	13,1	18,3	25,6	30,3	37,0	44,1	52,5
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**											
BSt 500 S	[kN]	3,5	4,9	6,7	8,6	10,8	15,7	22,9	27,7	34,6	42,2	50,4

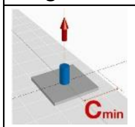
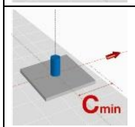
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

		Data according ETA-04/0027, issue 2013-06-26									Additional Hilti tech. data	
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Embedment depth	$h_{ef,1}$ = [mm]	60	60	72	84	96	120	150	168	192	216	240
Base material thickness	h_{min}= [mm]	100	100	104	120	136	170	214	238	272	306	350
Spacing	$s = s_{min}$= [mm]	40	50	60	70	80	100	125	140	160	180	200
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**											
BSt 500 S	[kN]	6,7	7,0	8,9	11,2	13,6	19,0	26,6	31,5	38,5	45,9	54,1
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**											
BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	56,5	79,0	93,7	114,4	136,6	159,9

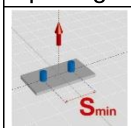
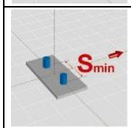
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-04/0027, issue 2013-06-26									Additional Hilti tech. data	
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Embedment depth $h_{ef,typ}$ = [mm]	80	90	110	125	125	170	210	270	300	330	360
Base material thickness h_{min}= [mm]	110	120	142	161	165	220	274	340	380	420	470
 **Tensile N_{Rd}: single anchor, no edge effects**											
BSt 500 S [kN]	14,4	20,2	27,7	33,6	33,6	53,3	73,2	106,7	125,0	144,2	164,3
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**											
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3	186,6	230,4

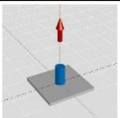
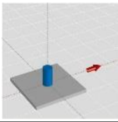
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-04/0027, issue 2013-06-26									Additional Hilti tech. data	
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Embedment depth $h_{ef,typ}$ = [mm]	80	90	110	125	125	170	210	270	300	330	360
Base material thickness h_{min}= [mm]	110	120	142	161	165	220	274	340	380	420	470
Edge distance $c = c_{min}$= [mm]	40	50	60	70	80	100	125	140	160	180	200
 **Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**											
BSt 500 S [kN]	7,8	10,0	13,3	16,2	17,0	26,1	36,1	50,4	59,5	69,1	79,3
 **Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**											
BSt 500 S [kN]	3,7	5,3	7,3	9,5	11,5	17,2	25,0	31,6	39,3	47,8	56,9

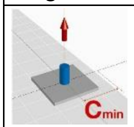
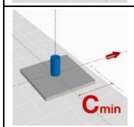
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

	Data according ETA-04/0027, issue 2013-06-26									Additional Hilti tech. data	
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Embedment depth $h_{ef,typ}$ = [mm]	80	90	110	125	125	170	210	270	300	330	360
Base material thickness h_{min}= [mm]	110	120	142	161	165	220	274	340	380	420	470
Spacing $s = s_{min}$= [mm]	40	50	60	70	80	100	125	140	160	180	200
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**											
BSt 500 S [kN]	8,9	11,6	15,5	18,9	19,2	30,1	41,4	59,5	69,8	80,8	92,3
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**											
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3	186,6	230,4

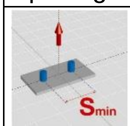
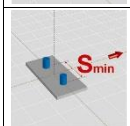
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-04/0027, issue 2013-06-26									Additional Hilti tech. data	
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Embedment depth $h_{ef,2}$ = [mm]	96	120	144	168	192	240	300	336	384	432	480
Base material thickness h_{min}= [mm]	126	150	176	204	232	290	364	406	464	522	590
 **Tensile N_{Rd}: single anchor, no edge effects**											
BSt 500 S [kN]	17,2	26,9	38,8	49,3	64,0	89,4	125,0	148,1	181,0	215,9	252,9
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**											
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3	186,6	230,4

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-04/0027, issue 2013-06-26									Additional Hilti tech. data	
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Embedment depth $h_{ef,2}$ = [mm]	96	120	144	168	192	240	300	336	384	432	480
Base material thickness h_{min}= [mm]	126	150	176	204	232	290	364	406	464	522	590
Edge distance $c = c_{min}$= [mm]	40	50	60	70	80	100	125	140	160	180	200
 **Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**											
BSt 500 S [kN]	9,4	14,1	18,6	23,4	28,6	40,0	55,9	66,2	80,9	96,6	113,1
 **Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**											
BSt 500 S [kN]	3,9	5,7	7,8	10,2	12,9	18,9	27,8	33,9	42,6	52,3	62,7

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

	Data according ETA-04/0027, issue 2013-06-26									Additional Hilti tech. data	
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**	**Ø36**	**Ø40**
Embedment depth $h_{ef,2}$ = [mm]	96	120	144	168	192	240	300	336	384	432	480
Base material thickness h_{min}= [mm]	126	150	176	204	232	290	364	406	464	522	590
Spacing $s = s_{min}$= [mm]	40	50	60	70	80	100	125	140	160	180	200
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**											
BSt 500 S [kN]	10,9	16,6	22,7	28,6	34,9	48,8	68,2	80,9	98,8	117,9	138,1
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**											
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3	186,6	230,4

Hilti HIT-HY 200 mortar with HIT-Z rod

Injection mortar system		Benefits
	Hilti HIT-HY 200-A 500 ml foil pack (also available as 330 ml foil pack)	- No cleaning required: Zero succeptability to borehole cleaning conditions with dry and water saturated concrete base material - Maximum load performance in cracked concrete and uncracked concrete - Suitable for cracked and non-cracked concrete C 20/25 to C 50/60 - Suitable for use with diamond cored holes in non-cracked or cracked concrete with no load reductions - Two mortar (Hilti HIT-HY 200-A and Hilti HIT-HY 200-R) versions available with different curing times and same performance
	Hilti HIT-HY 200-R 500 ml foil pack (also available as 330 ml foil pack)	
	Static mixer	
	HIT-Z HIT-Z-R rod	

Concrete	Tensile zone	Fire resistance	Corrosion resistance	European Technical Approval	CE conformity	No cleaning required for approved loads	PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-12/0006 / 2013-03-15 (HIT-HY 200-A) ETA-12/0028 / 2013-03-15 (HIT-HY 200-R)
Fire test report	IBMB, Brunswick	3501/676/13 / 2012-08-03

a) All data given in this section according ETA-12/0006 and ETA-12/0028, issue 2013-03-15.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- Embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)

- Installation temperature range +5°C to +40°C

Embedment depth and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20
Typical embedment depth [mm]	70	90	110	145	180
Base material thickness [mm]	130	150	170	245	280

Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², element HIT-Z

Anchor size			M8	M10	M12	M16	M20
Non-cracked concrete							
Tensile $N_{Ru,m}$	HIT-Z	[kN]	*25,2*	*39,9*	*57,8*	*100,8*	*153,3*
Shear $V_{Ru,m}$	HIT-Z	[kN]	*12,6*	*20,0*	*28,4*	*50,4*	*76,7*
Cracked concrete							
Tensile $N_{Ru,m}$	HIT-Z	[kN]	*25,2*	*39,9*	55,1	83,4	115,4
Shear $V_{Ru,m}$	HIT-Z	[kN]	*12,6*	*20,0*	*28,4*	*50,4*	*76,7*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², element HIT-Z

Anchor size			M8	M10	M12	M16	M20
Non-cracked concrete							
Tensile N_{Rk}	HIT-Z	[kN]	*24,0*	*38,0*	54,3	88,2	122,0
Shear V_{Rk}	HIT-Z	[kN]	*12,0*	*19,0*	*27,0*	*48,0*	*73,0*
Cracked concrete							
Tensile N_{Rk}	HIT-Z	[kN]	21,1	30,7	41,5	62,9	86,9
Shear V_{Rk}	HIT-Z	[kN]	*12,0*	*19,0*	*27,0*	*48,0*	*73,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², element HIT-Z

Anchor size			M8	M10	M12	M16	M20
Non-cracked concrete							
Tensile N_{Rd}	HIT-Z	[kN]	16,0	25,3	36,2	58,8	81,3
Shear V_{Rd}	HIT-Z	[kN]	9,6	15,2	21,6	38,4	58,4
Cracked concrete							
Tensile N_{Rd}	HIT-Z	[kN]	14,1	20,5	27,7	41,9	58,0
Shear V_{Rd}	HIT-Z	[kN]	9,6	15,2	21,6	38,4	58,4

Recommended loads [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², element HIT-Z

Anchor size			M8	M10	M12	M16	M20
Non-cracked concrete							
Tensile N_{rec}	HIT-Z	[kN]	11,4	18,1	25,9	42,0	58,1
Shear V_{rec}	HIT-Z	[kN]	6,9	10,9	15,4	27,4	41,7
Cracked concrete							
Tensile N_{rec}	HIT-Z	[kN]	10,0	14,6	19,8	29,9	41,4
Shear V_{rec}	HIT-Z	[kN]	6,9	10,9	15,4	27,4	41,7

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-HY 200 injection mortar with anchor rod HIT-Z may be applied in the temperature ranges given below. An elevated base material temperature leads to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +80 °C	+40 °C	+80 °C
Temperature range III	-40 °C to +120 °C	+72 °C	+120 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIT-Z and HIT-Z-R

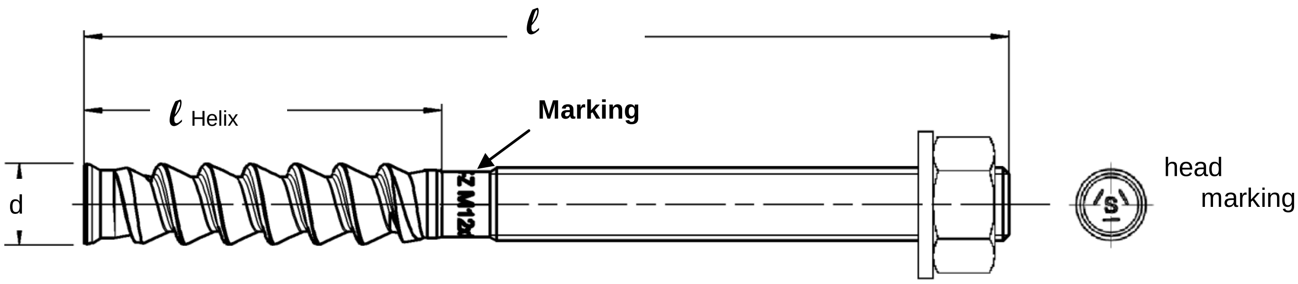
Anchor size			M8	M10	M12	M16	M20
Nominal tensile strength f_{uk}	HIT-Z / HIT-Z-R	[N/mm²]	650	650	650	610	595
Yield strength f_{yk}	HIT-Z / HIT-Z-R	[N/mm²]	520	520	520	490	480
Stressed cross-section of thread A_s	HIT-Z	[mm²]	36,6	58,0	84,3	157	245
Moment of resistance W	HIT-Z	[mm³]	31,9	62,5	109,7	278	542

Material quality

Part	Material
HIT-Z	C-steel cold formed, steel galvanized ≥ 5µm
HIT-Z-R	stainless steel cold formed, A4

Anchor dimensions

Anchor size			M8	M10	M12	M16	M20
Length of anchor	min ℓ	[mm]	80	95	105	155	215
	max ℓ	[mm]	120	160	196	240	250
Helix length	ℓ_{Helix}	[mm]	50	60	60	96	100



Installation equipment

Anchor size	M8	M10	M12	M16	M20
Rotary hammer	TE 2 – TE 40			TE 40 - TE 70	

Curing and working time

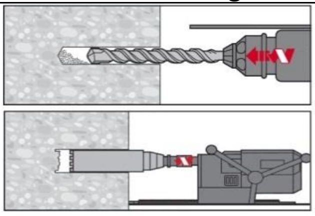
Temperature of the base material	HIT-HY 200-R	
	Working time in which anchor can be inserted and adjusted t_{work}	Curing time before anchor can be loaded t_{cure}
5 °C	1 hour	4 hour
6 °C to 10 °C	40 min	2,5 hour
11 °C to 20 °C	15 min	1,5 hour
21 °C to 30 °C	9 min	1 hour
31 °C to 40 °C	6 min	1 hour

Curing and working time

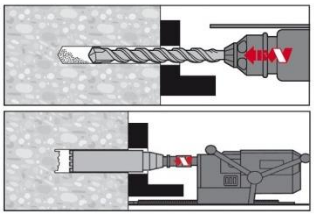
Temperature of the base material	HIT-HY 200-A	
	Working time in which anchor can be inserted and adjusted t_{work}	Curing time before anchor can be loaded t_{cure}
5 °C	25 min	2 hour
6 °C to 10 °C	15 min	75 min
11 °C to 20 °C	7 min	45 min
21 °C to 30 °C	4 min	30 min
31 °C to 40 °C	3 min	30 min

Setting instruction

Bore hole drilling



Pre-setting: Drill hole to the required drilling depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.
Diamond coring is permissible when diamond core drilling machine and the corresponding core bit are used.

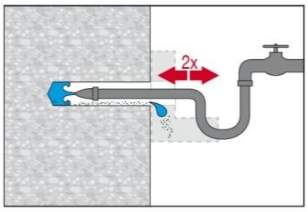


Through-setting: Drill hole through the clearance hole in the fixture to the required drilling depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.
Diamond coring is permissible when diamond core drilling machine and the corresponding core bit are used.

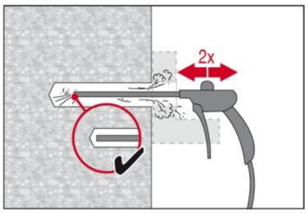
Bore hole cleaning[a)]

a) No cleaning required for hammer drilled boreholes

b) Hole flushing and evacuation for wet-drilled diamond cored holes or flooded holes

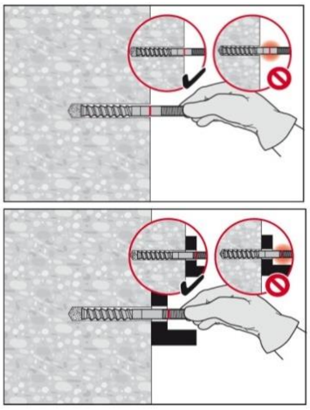


Flush 2 times from the back of the hole over the hole length.



Blow 2 times the hole with oil-free compressed air (min. 6 bar at 6 m³/h) to evacuate the water

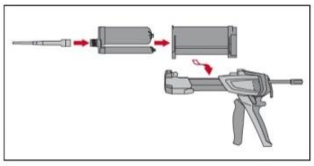
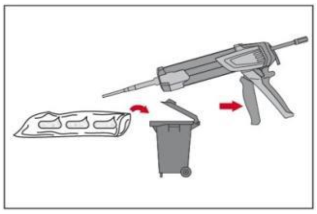
Check of setting depth and compress of the drilling dust



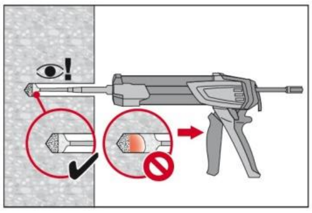
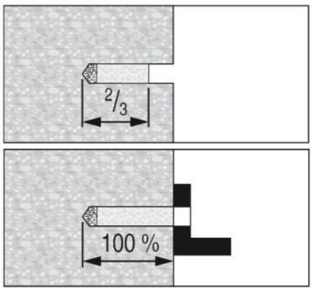
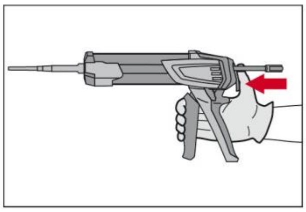
Mark the element and check the setting depth and compress the drilling dust. The element has to fit in the hole until the required embedment depth.
If it is not possible to compress the dust, remove the dust in the drill hole or drill deeper.

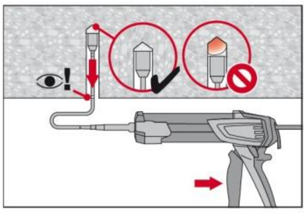
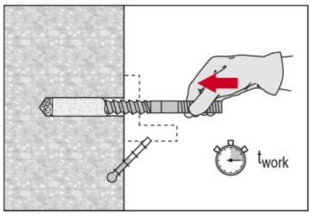
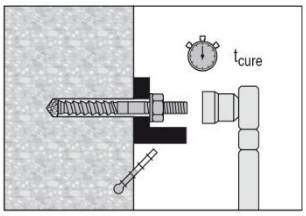
a) When drilling downward with non-cleaning the required drilling depths can vary due to accumulation of dust in the hole.

Injection preparation

	Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle. Observe the instruction for use of the dispenser. Check foil pack holder for proper function. Do not use damaged foil packs / holders. Swing foil pack holder with foil pack into HIT-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. Discard quantities are 2 strokes for 330 ml foil pack 3 strokes for 500 ml foil pack

Inject adhesive from the back of the borehole without forming air voids

	Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
	Fill holes approximately 2/3 full for Pre-setting and 100% full for through-setting, or as required to ensure that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.
	After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

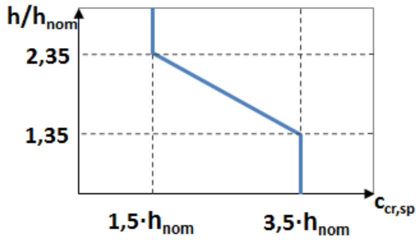
Overhead installation	
	For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately piston plug HIT-SZ. Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the bore hole by the adhesive pressure
Setting the element	
	Before use, verify that the element is dry and free of oil and other contaminants. Set element to the required embedment depth until working time t_{work} has elapsed. After setting the element the annular gap between the anchor and the fixture (through-setting) or concrete (pre-setting) has to be completely filled with mortar.
	After required curing time t_{cure} remove excess mortar. Apply indicated torque moment to activate anchor functioning principles. The anchor can be loaded.

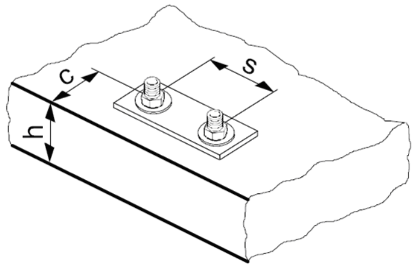
For detailed information on installation see instruction for use given with the package of the product.

Setting details

Anchor size			M8	M10	M12	M16	M20
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	22
Nominal embedment depth range	$h_{nom,min}$	[mm]	60	60	60	96	100
	$h_{nom,max}$	[mm]	100	120	150	200	220
Borehole condition 1 Minimum base material thickness	h_{min}	[mm]	h_{nom} + 60 mm			h_{nom} + 100 mm	
Borehole condition 2 Minimum base material thickness	h_{min}	[mm]	h_{nom} + 30 mm ≥100 mm			h_{nom} + 45 mm ≥45 mm	
Pre-setting: Diameter of clearance hole in the fixture	$d_f \le$	[mm]	9	12	14	18	22
Through-setting: Diameter of clearance hole in the fixture	$d_f \le$	[mm]	11	14	16	20	24
Torque moment	T_{inst}	[Nm]	10	25	40	80	150

Critical edge distance and critical spacing

Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$	
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	$1{,}5 \cdot h_{nom}$ for $h / h_{nom} \geq 2{,}35$	
			$6{,}2\ h_{nom} - 2{,}0\ h$ for $2{,}35 > h / h_{nom} > 1{,}35$	
			$3{,}5\ h_{nom}$ for $h / h_{nom} \leq 1{,}35$	
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$	
Critical edge distance for concrete cone failure	$c_{cr,N}$	[mm]	$1{,}5\ h_{nom}$	

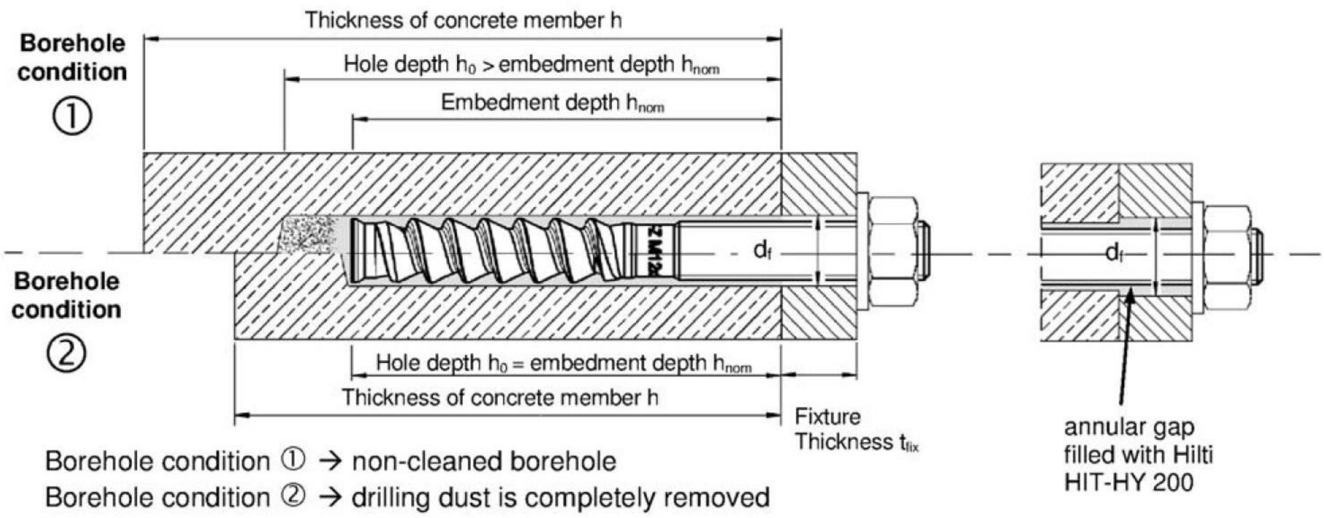


For spacing (or edge distance) smaller than critical spacing (or critical edge distance) the design loads have to be reduced.

a) Embedment depth range: $h_{nom,min} \leq h_{nom} \leq h_{nom,max}$

Pre-setting:
Install anchor before positioning fixture

Through-setting:
Install anchor through positioned fixture



Minimum edge distance and spacing

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

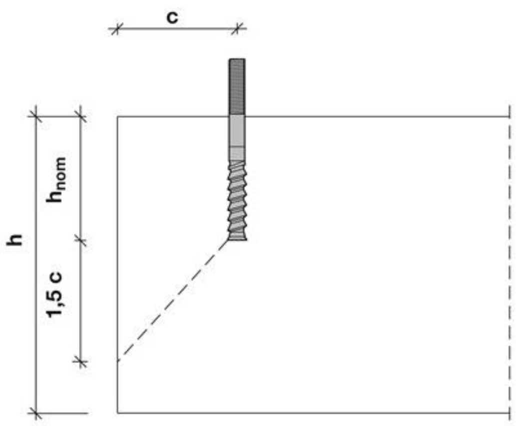
$$A_{i,req} < A_{i,cal}$$

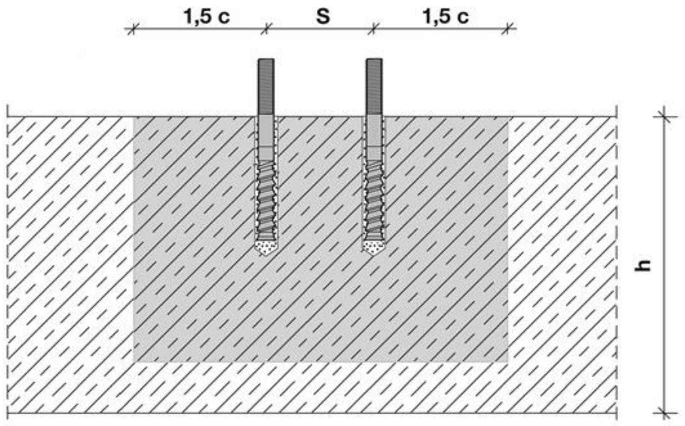
Required interaction area $A_{i,req}$

Anchor size		M8	M10	M12	M16	M20
Cracked concrete	[mm²]	19200	40800	58800	94700	148000
Uncracked concrete	[mm²]	22200	57400	80800	128000	198000

Calculate interaction area $A_{i,cal}$

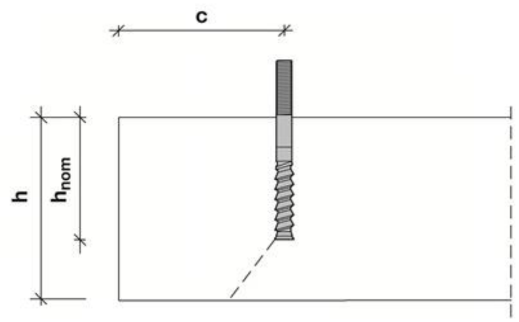
Member thickness $h \geq h_{nom} + 1{,}5 \cdot c$

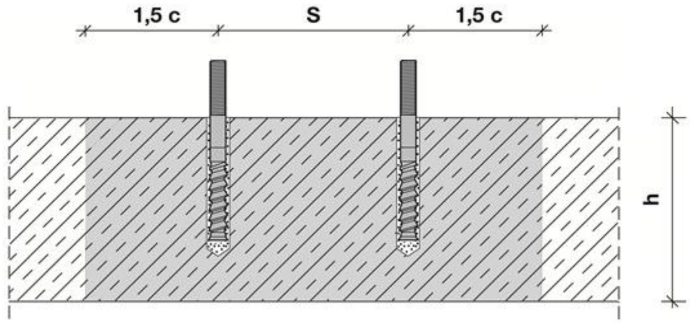




Single anchor and group of anchors with s > 3·c	[mm²]	$A_{i,cal} = (6 \cdot c) \cdot (h_{nom} + 1{,}5 \cdot c)$	with $c \geq 5 \cdot d$
Group of anchors with s ≤ 3·c	[mm²]	$A_{i,cal} = (3 \cdot c + s) \cdot (h_{nom} + 1{,}5 \cdot c)$	with $c \geq 5 \cdot d$ and $s \geq 5 \cdot d$

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





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

Best case minimum edge distance and spacing with required member thickness and embedment depth

Anchor size			M8	M10	M12	M16	M20
Cracked concrete							
Member thickness	h ≥	[mm]	140	200	240	300	370
Embedment depth	h_{nom} ≥	[mm]	80	120	150	200	220
Minimum spacing	s_{min}	[mm]	40	50	60	80	100
Corresponding edge distance	c ≥	[mm]	40	55	65	80	100
Minimum edge distance	c_{min} =	[mm]	40	50	60	80	100
Corresponding spacing	s ≥	[mm]	40	60	65	80	100
Non cracked concrete							
Member thickness	h ≥	[mm]	140	230	270	340	410
Embedment depth	h_{nom} ≥	[mm]	80	120	150	200	220
Minimum spacing	s_{min}	[mm]	40	50	60	80	100
Corresponding edge distance	c ≥	[mm]	40	70	80	100	130
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100
Corresponding spacing	s ≥	[mm]	40	145	160	160	235

Best case minimum member thickness and embedment depth with required minimum edge distance and spacing (borehole condition 1)

Anchor size			M8	M10	M12	M16	M20
Cracked concrete							
Member thickness	h_{min}	[mm]	120	120	120	196	200
Embedment depth	$h_{nom,min}$	[mm]	60	60	60	96	100
Minimum spacing	s_{min}	[mm]	40	50	60	80	100
Corresponding edge distance	c ≥	[mm]	40	100	140	135	215
Minimum edge distance	c_{min} =	[mm]	40	60	90	80	125
Corresponding spacing	s ≥	[mm]	40	160	220	235	365
Non cracked concrete							
Member thickness	h_{min}	[mm]	120	120	120	196	200
Embedment depth	$h_{nom,min}$	[mm]	60	60	60	96	100
Minimum spacing	s_{min}	[mm]	40	50	60	80	100
Corresponding edge distance	c ≥	[mm]	50	145	200	190	300
Minimum edge distance	c_{min}	[mm]	40	80	115	110	165
Corresponding spacing	s ≥	[mm]	65	240	330	310	495

Minimum edge distance and spacing – Explanation

Minimum edge and spacing geometrical requirements are determined by testing the installation conditions in which two anchors with a given spacing can be set close to an edge without forming a crack in the concrete due to tightening torque.

The HIT-Z boundary conditions for edge and spacing geometry can be found in the tables to the left. If the embedment depth and slab thickness are equal to or greater than the values in the table, then the edge and spacing values may be utilized.

PROFIS Anchor software is programmed to calculate the referenced equations in order to determine the optimized related minimum edge and spacing based on the following variables:

Cracked or uncracked concrete	For cracked concrete it is assumed that a reinforcement is present which limits the crack width to 0,3 mm, allowing smaller values for minimum edge distance and minimum spacing
Anchor diameter	For smaller anchor diameter a smaller installation torque is required, allowing smaller values for minimum edge distance and minimum spacing
Slab thickness and embedment depth	Increasing these values allows smaller values for minimum edge distance and minimum spacing

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-12/0006 (HIT-HY 200-A) and ETA-12/0028 (HIT-HY 200-R) issued on 2013-03-15

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The simplified calculated design loads take a conservative approach: They will be lower than the exact values according to ETAG 001, TR 029. For an optimized design, anchor calculation can be performed using PROFIS anchor design software.

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

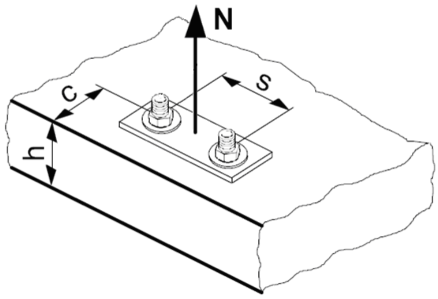
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $\mathbf{N_{Rd,s}}$
- Combined pull-out and concrete cone resistance: $\mathbf{N_{Rd,p}}$
- Concrete cone resistance: $\mathbf{N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}}$
- Concrete splitting resistance (only non-cracked concrete):
  $\mathbf{N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20
$N_{Rd,s}$	HIT-Z / HIT-Z-R	[kN]	16,0	25,3	36,7	64,0	97,3

Design combined pull-out and concrete cone resistance $N_{Rd,p}$ [a)]

Anchor size			M8	M10	M12	M16	M20
Non-cracked concrete							
$N^0_{Rd,p}$	Temperature range I	[kN]	20,1	30,2	36,2	77,2	100,5
$N^0_{Rd,p}$	Temperature range II	[kN]	18,4	27,6	33,2	70,8	92,2
$N^0_{Rd,p}$	Temperature range III	[kN]	16,8	25,1	30,2	64,3	83,8
Cracked concrete							
$N^0_{Rd,p}$	Temperature range I	[kN]	18,4	27,6	33,2	70,8	92,2
$N^0_{Rd,p}$	Temperature range II	[kN]	16,8	25,1	30,2	64,3	83,8
$N^0_{Rd,p}$	Temperature range III	[kN]	15,1	22,6	27,1	57,9	75,4

a) The combined pull-out and concrete cone resistance is independent from the embedment depth.

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

Anchor size			M8	M10	M12	M16	M20
$h_{nom,typ}$		[mm]	70	90	110	145	180
$N^0_{Rd,c}$	Non cracked concrete	[kN]	19,7	28,7	38,8	58,8	81,3
$N^0_{Rd,c}$	Cracked concrete	[kN]	14,1	20,5	27,7	41,9	58,0

a) Splitting resistance must only be considered for non-cracked concrete.

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p}$ =	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min}. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min}. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{nom}/h_{nom,typ})^{1,5}$$

Influence of reinforcement

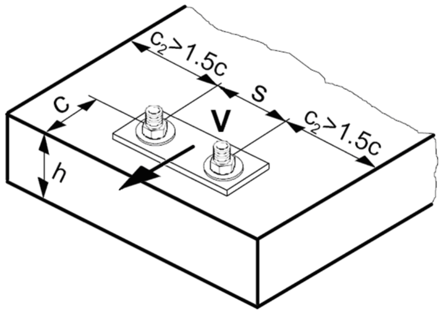
h_{nom} [mm]	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{nom}/200mm \leq 1$	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp}$ = k · lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20
$V_{Rd,s}$	HIT-Z	[kN]	9,6	15,2	21,6	38,4	58,4
$V_{Rd,s}$	HIT-Z-R	[kN]	11,2	18,4	26,4	45,6	70,4

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of k · $N_{Rd,p}$ and k · $N_{Rd,c}$

k = 2 for $h_{ef} \geq 60$ mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance [a)] $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4$

		Non-cracked concrete					Cracked concrete				
Anchor size		M8	M10	M12	M16	M20	M8	M10	M12	M16	M20
$V^0_{Rd,c}$	[kN]	5,8	8,6	11,6	18,9	27,4	4,1	6,0	8,2	13,3	19,4

a) For anchor groups only the anchors close to the edge must be considered.

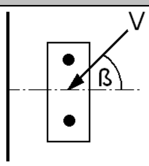
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\dfrac{1}{(\cos\alpha_V)^2 + \left(\dfrac{\sin\alpha_V}{2{,}5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1{,}5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{nom})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{nom}	Single anchor	Group of two anchors s/h_{nom}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

h_{nom}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0,05 \cdot (h_{nom} / d)^{1,68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0,05 \cdot (h_{nom} / d)^{1,68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

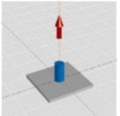
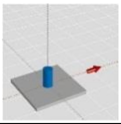
For combined tension and shear loading see section “Anchor Design”.

Precalculated values – design resistance values

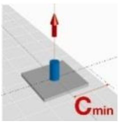
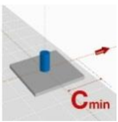
All data applies to:
- temperature range I (see service temperature range)
- no effects of dense reinforcement
- borehole condition 1

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

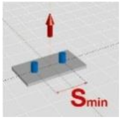
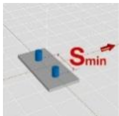
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

Anchor size			M8	M10	M12	M16	M20
Embedment depth	$h_{nom,min}$ =	[mm]	60	60	60	96	100
Base material thickness	h_{min} =	[mm]	120	120	120	196	200
	**Tensile N_{Rd}: single anchor, no edge effects**						
	Non-cracked concrete						
	HIT-Z / HIT-Z-R	[kN]	15,6	15,6	15,6	31,7	33,7
	Cracked concrete						
	HIT-Z / HIT-Z-R	[kN]	11,2	11,2	11,2	22,6	24,0
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**						
	Non-cracked concrete						
	HIT-Z	[kN]	9,6	15,2	21,6	38,4	58,4
	HIT-Z-R	[kN]	11,2	18,4	26,4	45,6	67,3
	Cracked concrete						
	HIT-Z	[kN]	9,6	15,2	21,6	38,4	48,0
	HIT-Z-R	[kN]	11,2	18,4	22,3	45,1	48,0

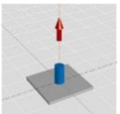
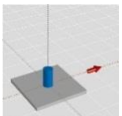
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

Anchor size			M8	M10	M12	M16	M20
Embedment depth	$h_{nom,min}$ =	[mm]	60	60	60	96	100
Base material thickness	h_{min} =	[mm]	120	120	120	196	200
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**						
	Non-cracked concrete						
	c_{min}	[mm]	40	80	115	110	165
	HIT-Z / HIT-Z-R	[kN]	7,8	10,5	13,2	20,1	25,7
	Cracked concrete						
	c_{min}	[mm]	40	80	115	110	165
	HIT-Z / HIT-Z-R	[kN]	6,7	10,2	11,2	18,5	24,0
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**						
	Non-cracked concrete						
	c_{min}	[mm]	40	80	115	110	165
	HIT-Z	[kN]	3,5	9,2	12,8	16,3	26,0
	HIT-Z-R	[kN]	3,5	9,2	12,8	16,3	26,0
	Cracked concrete						
	c_{min}	[mm]	40	80	115	110	165
	HIT-Z	[kN]	2,5	6,5	9,1	11,6	18,4
	HIT-Z-R	[kN]	2,5	6,5	9,1	11,6	18,4

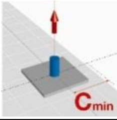
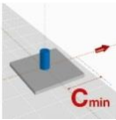
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²
(load values are valid for single anchor)

Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth	$h_{nom,min}$ =	[mm]	60	60	60	96	100
Base material thickness	h_{min}=	[mm]	120	120	120	196	200
	Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)						
	Non-cracked concrete						
	s_{min}	[mm]	40	50	60	80	100
	HIT-Z / HIT-Z-R	[kN]	8,9	9,2	9,5	18,7	20,3
	Cracked concrete						
	s_{min}	[mm]	40	50	60	80	100
	HIT-Z / HIT-Z-R	[kN]	6,8	7,1	7,4	14,4	16,0
	Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm						
	Non-cracked concrete						
	s_{min}	[mm]	40	50	60	80	100
	HIT-Z	[kN]	9,6	15,2	20,9	38,4	44,9
	HIT-Z-R	[kN]	11,2	18,4	20,9	40,5	44,9
	Cracked concrete						
	s_{min}	[mm]	40	50	60	80	100
	HIT-Z	[kN]	9,6	14,3	14,9	28,8	32,0
	HIT-Z-R	[kN]	11,2	14,3	14,9	28,8	32,0

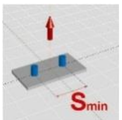
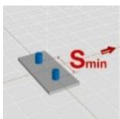
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth	$h_{nom,typ}$ =	[mm]	70	90	110	145	180
Base material thickness	h_{min}=	[mm]	130	150	170	245	280
	Tensile N_{Rd}: single anchor, no edge effects						
	Non-cracked concrete						
	HIT-Z / HIT-Z-R	[kN]	16,0	25,3	36,2	58,8	81,3
	Cracked concrete						
	HIT-Z / HIT-Z-R	[kN]	14,1	20,5	27,7	41,9	58,0
	Shear V_{Rd}: single anchor, no edge effects, without lever arm						
	Non-cracked concrete						
	HIT-Z	[kN]	9,6	15,2	21,6	38,4	58,4
	HIT-Z-R	[kN]	11,2	18,4	26,4	45,6	70,4
	Cracked concrete						
	HIT-Z	[kN]	9,6	15,2	21,6	38,4	58,4
	HIT-Z-R	[kN]	11,2	18,4	26,4	45,6	70,4

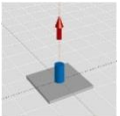
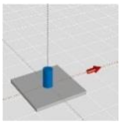
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

	Anchor size		M8	M10	M12	M16	M20
	Embedment depth	$h_{nom,typ}$ = [mm]	70	90	110	145	180
	Base material thickness	h_{min}= [mm]	130	150	170	245	280
	Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)						
	Non-cracked concrete						
	c_{min}	[mm]	40	65	80	90	120
	HIT-Z / HIT-Z-R	[kN]	9,1	13,7	18,1	27,0	37,2
	Cracked concrete						
	c_{min}	[mm]	40	65	80	90	120
	HIT-Z / HIT-Z-R	[kN]	7,9	12,8	17,4	24,4	34,9
	Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm						
	Non-cracked concrete						
	c_{min}	[mm]	40	65	80	90	120
	HIT-Z	[kN]	3,6	7,5	10,6	13,8	21,8
	HIT-Z-R	[kN]	3,6	7,5	10,6	13,8	21,8
	Cracked concrete						
	c_{min}	[mm]	40	65	80	90	120
	HIT-Z	[kN]	2,6	5,3	7,5	9,8	15,5
	HIT-Z-R	[kN]	2,6	5,3	7,5	9,8	15,5

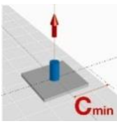
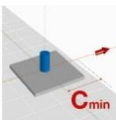
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²
(load values are valid for single anchor)

	Anchor size		M8	M10	M12	M16	M20
	Embedment depth	$h_{nom,typ}$ = [mm]	70	90	110	145	180
	Base material thickness	h_{min}= [mm]	130	150	170	245	280
	Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)						
	Non-cracked concrete						
	s_{min}	[mm]	40	50	60	80	100
	HIT-Z / HIT-Z-R	[kN]	10,9	15,7	21,0	32,1	44,1
	Cracked concrete						
	s_{min}	[mm]	40	50	60	80	100
	HIT-Z / HIT-Z-R	[kN]	8,4	12,1	16,4	24,8	34,3
	Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm						
	Non-cracked concrete						
	s_{min}	[mm]	40	50	60	80	100
	HIT-Z	[kN]	9,6	15,2	21,6	38,4	58,4
	HIT-Z-R	[kN]	11,2	18,4	26,4	45,6	70,4
	Cracked concrete						
	s_{min}	[mm]	40	50	60	80	100
	HIT-Z	[kN]	9,6	15,2	21,6	38,4	58,4
	HIT-Z-R	[kN]	11,2	18,4	26,4	45,6	68,7

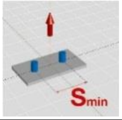
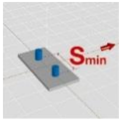
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

	Anchor size		M8	M10	M12	M16	M20
	Embedment depth $h_{nom,max}$ =	[mm]	100	120	150	200	220
	Base material thickness h_{min}=	[mm]	160	180	210	300	320
	Tensile N_{Rd}: single anchor, no edge effects						
	Non-cracked concrete						
	HIT-Z / HIT-Z-R	[kN]	16,0	25,3	36,2	64,0	97,3
	Cracked concrete						
	HIT-Z / HIT-Z-R	[kN]	16,0	25,3	33,2	64,0	78,3
	Shear V_{Rd}: single anchor, no edge effects, without lever arm						
	Non-cracked concrete						
	HIT-Z	[kN]	9,6	15,2	21,6	38,4	58,4
	HIT-Z-R	[kN]	11,2	18,4	26,4	45,6	70,4
	Cracked concrete						
	HIT-Z	[kN]	9,6	15,2	21,6	38,4	58,4
	HIT-Z-R	[kN]	11,2	18,4	26,4	45,6	70,4

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

	Anchor size		M8	M10	M12	M16	M20
	Embedment depth $h_{nom,max}$ =	[mm]	100	120	150	200	220
	Base material thickness h_{min}=	[mm]	160	180	210	300	320
	Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)						
	Non-cracked concrete						
	c_{min}	[mm]	40	55	65	80	105
	HIT-Z / HIT-Z-R	[kN]	10,1	15,6	18,6	38,7	46,3
	Cracked concrete						
	c_{min}	[mm]	40	55	65	80	105
	HIT-Z / HIT-Z-R	[kN]	9,2	14,3	17,1	33,5	41,1
	Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm						
	Non-cracked concrete						
	c_{min}	[mm]	40	55	65	80	105
	HIT-Z	[kN]	3,9	6,4	8,7	13,0	19,6
	HIT-Z-R	[kN]	3,9	6,4	8,7	13,0	19,6
	Cracked concrete						
	c_{min}	[mm]	40	55	65	80	105
	HIT-Z	[kN]	2,8	4,6	6,2	9,2	13,9
	HIT-Z-R	[kN]	2,8	4,6	6,2	9,2	13,9

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²
(load values are valid for single anchor)

Anchor size		M8	M10	M12	M16	M20
Embedment depth $h_{nom,max}$ =	[mm]	100	120	150	200	220
Base material thickness h_{min}=	[mm]	160	180	210	300	320
Tensile N_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min})						
Non-cracked concrete						
s_{min}	[mm]	40	50	60	80	100
HIT-Z / HIT-Z-R	[kN]	11,5	17,2	20,6	44,0	57,9
 Cracked concrete						
s_{min}	[mm]	40	50	60	80	100
HIT-Z / HIT-Z-R	[kN]	10,5	15,8	18,9	38,5	45,1
Shear V_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min}) , without lever arm						
Non-cracked concrete						
s_{min}	[mm]	40	50	60	80	100
HIT-Z	[kN]	9,6	15,2	21,6	38,4	58,4
HIT-Z-R	[kN]	11,2	18,4	26,4	45,6	70,4
Cracked concrete						
 s_{min}	[mm]	40	50	60	80	100
HIT-Z	[kN]	9,6	15,2	21,6	38,4	58,4
HIT-Z-R	[kN]	11,2	18,4	26,4	45,6	70,4

Seismic design C1 and C2

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:

- Seismic design according to TR045

The following technical data are based on: ETA-12/0006 and ETA-12/0028, issue 2013-03-15

Anchorage depth range

Anchor size			M8	M10	M12	M16	M20
Nominal anchorage depth range	$h_{nom,min}$	[mm]	60	60	60	96	100
	$h_{nom,max}$	[mm]	100	120	144	192	220

Tension resistance in case of seismic performance category C1

Anchor size			M8	M10	M12	M16	M20
Characteristic tension resistance to steel failure							
HIT-Z / HIT-Z-R	$N_{Rk,s,seis}$	[kN]	24	38	55	96	146
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5				
Characteristic bond resistance in cracked concrete C20/25 to C50/60							
Temperature range I: 24°C/40°C	$\tau_{Rk,seis}$	[N/mm²]	21				
Temperature range II: 50°C/80°C	$\tau_{Rk,seis}$	[N/mm²]	19				
Temperature range III: 72°C/120°C	$\tau_{Rk,seis}$	[N/mm²]	17				
Partial safety factor	$\gamma_{Mp,seis}$	[-]	1,5				
Concrete cone resistance and splitting resistance							
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]	1,5				

Displacement under tension load in case of seismic performance category C1 1)

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

1) Maximum displacement during cycling (seismic event).

Shear resistance in case of seismic performance category C1 1)

Anchor size			M8	M10	M12	M16	M20
Characteristic shear resistance to steel failure							
HIT-Z	$V_{Rk,s,seis}$	[kN]	7	17	16	28	45
HIT-Z-R	$V_{Rk,s,seis}$	[kN]	8	19	22	31	48
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25				
Concrete pryout resistance and concrete edge resistance							
Partial safety factor	$\gamma_{Mcp,seis} = \gamma_{Mc,seis}$	[-]	1,5				

1) Reduction factor α_{gap} = 1,0 when using the Hilti Dynamic Set

Displacement under shear load in case of seismic performance category C1 1)

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

1) Maximum displacement during cycling (seismic event).

Tension resistance in case of seismic performance category C2

Anchor size			M12	M16
Characteristic tension resistance to steel failure				
HIT-Z / HIT-Z-R	$N_{Rk,s,seis}$	[kN]	55	96
Partial safety factor [1]	$\gamma_{Ms,seis}$	[-]	1,5	
Characteristic bond resistance in cracked concrete C20/25 to C50/60				
Temperature range I: 24°C/40°C	$\tau_{Rk,seis}$	[N/mm²]	13	19
Temperature range II: 50°C/80°C	$\tau_{Rk,seis}$	[N/mm²]	12	17
Temperature range III: 72°C/120°C	$\tau_{Rk,seis}$	[N/mm²]	10	16
Partial safety factor	$\gamma_{Mp,seis}$	[-]	1,5	
Concrete cone resistance and splitting resistance				
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]	1,5	

Displacement under tension load in case of seismic performance category C2

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

Shear resistance in case of seismic performance category C2 [1]

Anchor size			M12	M16
Characteristic shear resistance to steel failure				
HIT-Z	$V_{Rk,s,seis}$	[kN]	11	17
HIT-Z-R	$V_{Rk,s,seis}$	[kN]	16	21
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25	
Concrete pryout resistance and concrete edge resistance				
Partial safety factor	$\gamma_{Mcp,seis} = \gamma_{Mc,seis}$	[-]	1,5	

1) Reduction factor α_{gap} = 1,0 when using the Hilti Dynamic Set

Displacement under shear load in case of seismic performance category C2

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

For seismic resistent fastening applications please use the anchor design software PROFIS Anchor.

Hilti HIT-HY 200 mortar with HIT-V rod

Injection mortar system

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

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

Static mixer

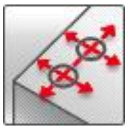
HIT-V rods
HIT-V-R rods
HIT-V-HCR rods

Benefits

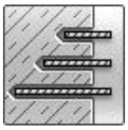
- Suitable for non-cracked and cracked concrete C 20/25 to C 50/60
- Approved automatic cleaning with the use of the hollow drill-bit
- High loading capacity, excellent handling and fast curing
- Small edge distance and anchor spacing possible
- Large diameter applications
- Max In service temperature range up to 120°C short term/ 72°C long term
- Manual cleaning for borehole diameter up to 20mm and $h_{ef} \leq$ 10d for non-cracked concrete only
- Embedment depth range: from 60 ... 160 mm for M8 to 120 ... 600 mm for M30
- Two mortar (A and R) versions available with different curing times and same performance

Concrete

Tensile zone



Small edge distance and spacing



Variable embedment depth

Fire resistance

Corrosion resistance

High corrosion resistance

European Technical Approval

CE conformity

Approved automatic cleaning while drilling

PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval a)	DIBt, Berlin	ETA-11/0493 / 2013-06-20 (Hilti HIT-HY 200-A) ETA-12/0084 / 2013-06-20 (Hilti HIT-HY 200-R)
Fire test report	IBMB, Brunswick	3501/676/13 / 2012-08-03

a) All data given in this section according ETA-11/0493 and ETA-12/0084, issue 2013-06-20.

Basic loading data (for a single anchor)

All data in this section applies to For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -10°C to +40°C

Embedment depth [a)] and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth h_{ef}	[mm]	80	90	110	125	170	210	240	270
Base material thickness h	[mm]	110	120	140	165	220	270	300	340

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

Mean ultimate resistance: concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	*18,9*	*30,5*	*44,1*	*83,0*	*129,2*	*185,9*	*241,5*	*295,1*
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	*9,5*	*15,8*	*22,1*	*41,0*	*64,1*	*92,4*	*120,8*	*147,0*
Cracked concrete										
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	16,0	22,5	44,0	66,7	105,9	145,4	177,7	212,0
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	*9,5*	*15,8*	*22,1*	*41,0*	*64,1*	*92,4*	*120,8*	*147,0*

Characteristic resistance: concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tensile N_{Rk}	HIT-V 5.8	[kN]	*18,0*	*29,0*	*42,0*	70,6	111,9	153,7	187,8	224,0
Shear V_{Rk}	HIT-V 5.8	[kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*	*115,0*	*140,0*
Cracked concrete										
Tensile N_{Rk}	HIT-V 5.8	[kN]	12,1	17,0	33,2	50,3	79,8	109,6	133,9	159,7
Shear V_{Rk}	HIT-V 5.8	[kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*	*115,0*	*140,0*

Design resistance: concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tensile N_{Rd}	HIT-V 5.8	[kN]	12,0	19,3	28,0	39,2	62,2	85,4	104,3	124,5
Shear V_{Rd}	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
Cracked concrete										
Tensile N_{Rd}	HIT-V 5.8	[kN]	6,7	9,4	18,4	27,9	44,3	60,9	74,4	88,7
Shear V_{Rd}	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0

Recommended loads [a)]: concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tensile N_{rec}	HIT-V 5.8	[kN]	8,6	13,8	20,0	28,0	44,4	61,0	74,5	88,9
Shear V_{rec}	HIT-V 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3	65,7	80,0
Cracked concrete										
Tensile N_{rec}	HIT-V 5.8	[kN]	4,8	6,7	13,2	19,9	31,7	43,5	53,1	63,4
Shear V_{rec}	HIT-V 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3	65,7	80,0

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-HY 200 injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +80 °C	+50 °C	+80 °C
Temperature range III	-40 °C to +120 °C	+72 °C	+120 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIT-V

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal tensile strength f_{uk}	HIT-V 5.8	[N/mm²]	500	500	500	500	500	500	500	500
	HIT-V 8.8	[N/mm²]	800	800	800	800	800	800	800	800
	HIT-V-R	[N/mm²]	700	700	700	700	700	700	500	500
	HIT-V-HCR	[N/mm²]	800	800	800	800	800	700	700	700
Yield strength f_{yk}	HIT-V 5.8	[N/mm²]	400	400	400	400	400	400	400	400
	HIT-V 8.8	[N/mm²]	640	640	640	640	640	640	640	640
	HIT-V -R	[N/mm²]	450	450	450	450	450	450	210	210
	HIT-V-HCR	[N/mm²]	640	640	640	640	640	400	400	400
Stressed cross-section A_s	HIT-V	[mm²]	36,6	58,0	84,3	157	245	353	459	561
Moment of resistance W	HIT-V	[mm³]	31,2	62,3	109	277	541	935	1387	1874

Material quality

Part	Material
Threaded rod HIT-V(F)	Strength class 5.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V(F)	Strength class 8.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V-R	Stainless steel grade A4, A_5 > 8% ductile strength class 70 for ≤ M24 and class 50 for M27 to M30, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Threaded rod HIT-V-HCR	High corrosion resistant steel, 1.4529; 1.4565 strength ≤ M20: R_m = 800 N/mm², $R_{p\,0.2}$ = 640 N/mm², A_5 > 8% ductile M24 to M30: R_m = 700 N/mm², $R_{p\,0.2}$ = 400 N/mm², A_5 > 8% ductile
Washer ISO 7089	Steel galvanized, hot dipped galvanized,
	Stainless steel, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	High corrosion resistant steel, 1.4529; 1.4565
Nut EN ISO 4032	Strength class 8, steel galvanized ≥ 5 µm, hot dipped galvanized ≥ 45 µm,
	Strength class 70, stainless steel grade A4, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	Strength class 70, high corrosion resistant steel, 1.4529; 1.4565

Anchor dimensions

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Anchor rod HIT-V, HIT-V-R, HIT-V-HCR	Anchor rods HIT-V (-R / -HCR) are available in variable length							

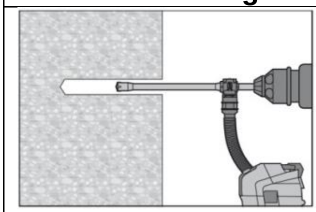
Setting

installation equipment

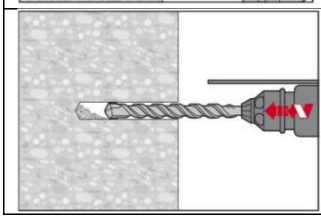
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Rotary hammer	TE 2 – TE 16				TE 40 – TE 70			
Other tools, hammer drilling	compressed air gun or blow out pump, set of cleaning brushes, dispenser							

Setting instruction

Bore hole drilling



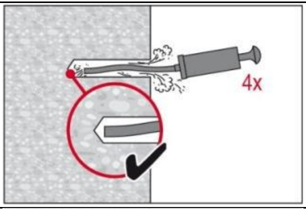
Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment. This drilling method properly cleans the borehole and removes dust while drilling. After drilling is complete, proceed to the “injection preparation” step in the instructions for use.



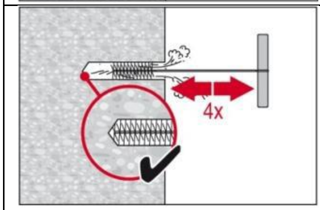
Drill Hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.

Bore hole cleaning Just before setting an anchor, the bore hole must be free of dust and debris.

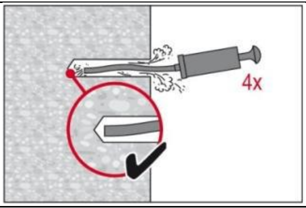
a) Manual Cleaning (MC) non-cracked concrete only
for bore hole diameters $d_0 \leq$ 20mm and bore hole depth $h_0 \leq$ 10d



The Hilti manual pump may be used for blowing out bore holes up to diameters $d_0 \leq$ 20 mm and embedment depths up to $h_{ef} \leq$ 10d.
Blow out at least 4 times from the back of the bore hole until return air stream is free of noticeable dust

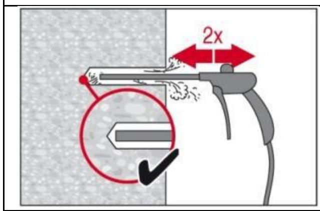


Brush 4 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with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

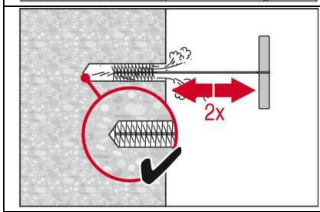


Blow out again with manual pump at least 4 times until return air stream is free of noticeable dust.

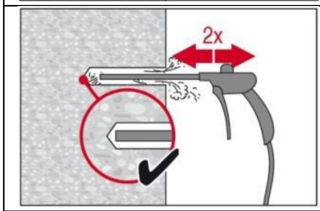
b) Compressed air cleaning (CAC)
for all bore hole diameters d_0 and all bore hole depth h_0



Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust. Bore hole diameter ≥ 32 mm the compressor must supply a minimum air flow of 140 m³/hour.

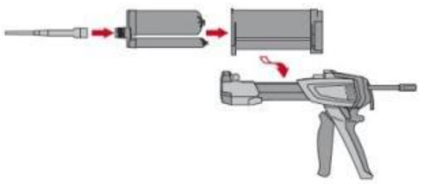
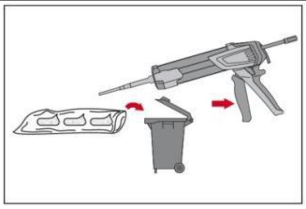


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with the proper brush diameter.

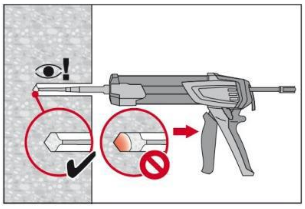
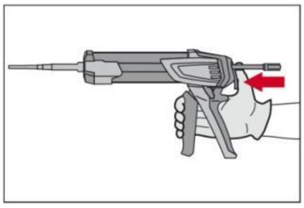
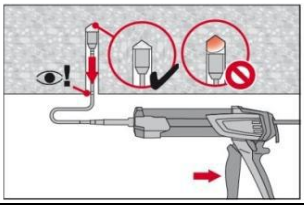


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

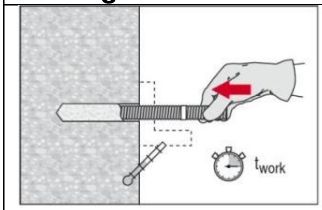
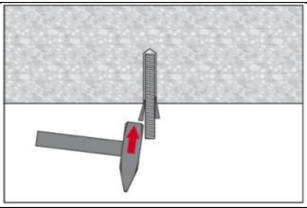
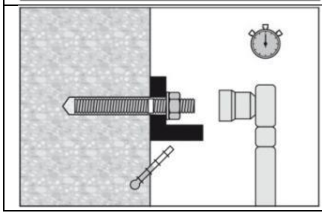
Injection preparation

	Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle. Observe the instruction for use of the dispenser. Check foil pack holder for proper function. Do not use damaged foil packs / holders. Swing foil pack holder with foil pack into HIT-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. 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.

Inject adhesive from the back of the borehole without forming air voids

	Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull. Fill holes approximately 2/3 full, or as required to ensure that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.
	After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.
	Overhead installation and/or installation with embedment depth h_{ef} > 250mm. 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 bore hole by the adhesive pressure.

Setting the element

	Before use, verify that the element is dry and free of oil and other contaminants. Mark and set element to the required embedment depth untill working time t_{work} has elapsed.
	For overhead installation use piston plugs and fix embedded parts with e.g. wedges
	Loading the anchor: After required curing time t_{cure} the anchor can be loaded. The applied installation torque shall not exceed $T_{max.}$

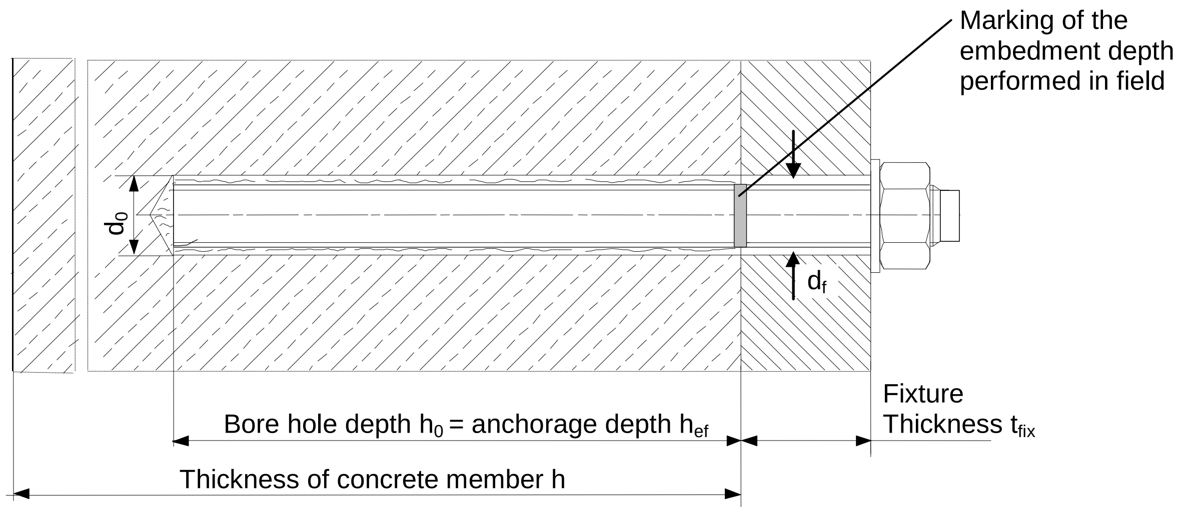
For detailed information on installation see instruction for use given with the package of the product.

Working time, curing time

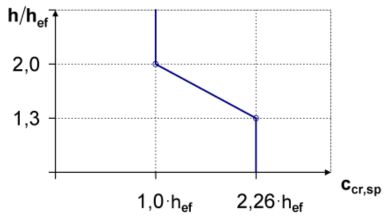
Temperature of the base material	Hilti HIT-HY 200-R	
	Working time in which anchor can be inserted and adjusted t_{work}	Curing time before anchor can be loaded t_{cure}
-10 °C to -5 °C	3 hour	20 hour
-4 °C to 0 °C	2 hour	8 hour
1 °C to 5 °C	1 hour	4 hour
6 °C to 10 °C	40 min	2,5 hour
11 °C to 20 °C	15 min	1,5 hour
21 °C to 30 °C	9 min	1 hour
31 °C to 40 °C	6 min	1 hour

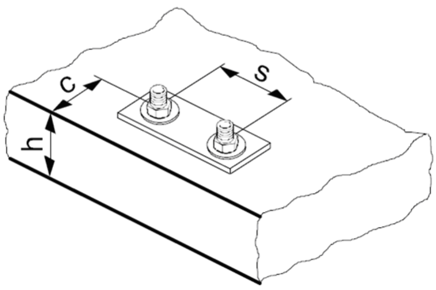
Temperature of the base material	Hilti HIT-HY 200-A	
	Working time in which anchor can be inserted and adjusted t_{work}	Curing time before anchor can be loaded t_{cure}
-10 °C to -5 °C	1,5 hour	7 hour
-4 °C to 0 °C	50 min	4 hour
1 °C to 5 °C	25 min	2 hour
6 °C to 10 °C	15 min	75 min
11 °C to 20 °C	7 min	45 min
21 °C to 30 °C	4 min	30 min
31 °C to 40 °C	3 min	30 min

Setting details



Setting details

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	22	28	30	35
Effective embedment and drill hole depth range a) for HIT-V	$h_{ef,min}$	[mm]	60	60	70	80	90	96	108	120
	$h_{ef,max}$	[mm]	160	200	240	320	400	480	540	600
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm			$h_{ef} + 2\ d_0$				
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22	26	30	33
Torque moment	T_{max} b)	[Nm]	10	20	40	80	150	200	270	300
Minimum spacing	s_{min}	[mm]	40	50	60	80	100	120	135	150
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120	135	150
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$							
Critical edge distance for splitting failure c)	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$**	for $h / h_{ef} \geq 2{,}0$						
			$4{,}6\ h_{ef} - 1{,}8\ h$	for $2{,}0 > h / h_{ef} > 1{,}3$						
			$2{,}26\ h_{ef}$	for $h / h_{ef} \leq 1{,}3$						
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$							
Critical edge distance for concrete cone failure d)	$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$							



For spacing (or edge distance) smaller than critical spacing (or critical edge distance) the design loads have to be reduced.

a) Embedment depth range: $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$

b) Maximum recommended torque moment to avoid splitting failure during installation with minimum spacing and/or edge distance.

c) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

d) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the safe side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-11/0493 issued 2013-06-20 for HIT-HY 200-A and ETA-12/0084 issued 2013-06-20 for HIT-HY 200-R. Both mortars possess identical technical load performance.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The simplified calculated design loads take a conservative approach: They will be lower than the exact values according to ETAG 001, TR 029. For an optimized design, anchor calculation can be performed using PROFIS anchor design software.

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

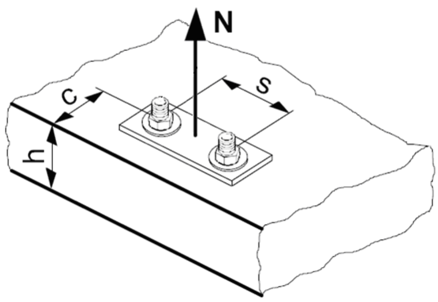
The design tensile resistance is the lower value of

- Steel resistance: $\mathbf{N_{Rd,s}}$
- Combined pull-out and concrete cone resistance:

$$\mathbf{N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}}$$

- Concrete cone resistance: $\mathbf{N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}}$
- Concrete splitting resistance (only non-cracked concrete):

$$\mathbf{N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,s}$	HIT-V 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	118,0	153,3	187,3
	HIT-V 8.8	[kN]	19,3	30,7	44,7	84,0	130,7	188,0	244,7	299,3
	HIT-V-R	[kN]	13,9	21,9	31,6	58,8	92,0	132,1	80,4	98,3
	HIT-V-HCR	[kN]	19,3	30,7	44,7	84,0	130,7	117,6	152,9	187,1

Design combined pull-out and concrete cone resistance

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth $h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	170	210	240	270
Non-cracked concrete									
$N^0_{Rd,p}$ Temperature range I	[kN]	22,3	31,4	46,1	69,8	118,7	175,9	169,6	212,1
$N^0_{Rd,p}$ Temperature range II	[kN]	19,0	26,7	39,2	59,3	100,9	149,5	135,7	169,6
$N^0_{Rd,p}$ Temperature range III	[kN]	15,6	22,0	32,3	48,9	83,1	123,2	124,4	155,5
Cracked concrete									
$N^0_{Rd,p}$ Temperature range I	[kN]	6,7	9,4	18,4	27,9	47,5	70,4	90,5	113,1
$N^0_{Rd,p}$ Temperature range II	[kN]	5,0	7,1	15,0	22,7	38,6	57,2	73,5	91,9
$N^0_{Rd,p}$ Temperature range III	[kN]	4,5	6,3	12,7	19,2	32,6	48,4	62,2	77,8

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
$N^0_{Rd,c}$ Non-cracked concrete	[kN]	20,1	24,0	32,4	39,2	62,2	85,4	104,3	124,5
$N^0_{Rd,c}$ Cracked concrete	[kN]	14,3	17,1	23,1	28,0	44,3	60,9	74,4	88,7

a) Splitting resistance must only be considered for non-cracked concrete.

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p}$ =	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ / $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ / $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ / $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min}. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing [a)]

$s/s_{cr,N}$ / $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N}$ = $0,5\cdot(1 + s/s_{cr,N}) \leq 1$ / $f_{3,sp}$ = $0,5\cdot(1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min}. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

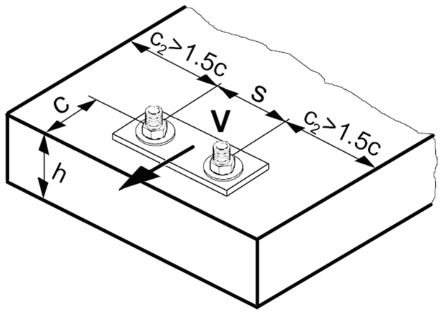
h_{ef} [mm]	60	70	80	90	≥ 100
$f_{re,N}$ = $0,5 + h_{ef}/200mm \leq 1$	0,8 [a)]	0,85 [a)]	0,9 [a)]	0,95 [a)]	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$V_{Rd,s}$	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	110,3

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 2$$

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance, $N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete									
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,6	18,7	27,0	36,6	44,5	53,0
Cracked concrete									
$V^0_{Rd,c}$	[kN]	4,2	6,1	8,2	13,2	19,2	25,9	31,5	37,5

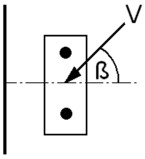
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

h_{ef}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0{,}05 \cdot (h_{ef} / d)^{1{,}68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81

h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0{,}05 \cdot (h_{ef} / d)^{1{,}68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0{,}19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

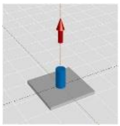
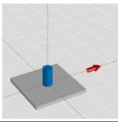
For combined tension and shear loading see section “Anchor Design”.

Precalculated values – design resistance values

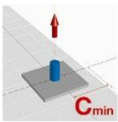
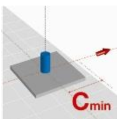
All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

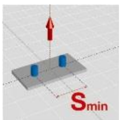
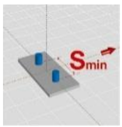
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	96	108	120
Base material thickness	$h = h_{min}$	[mm]	90	90	100	116	138	152	168	190
	Tensile N_{Rd}: single anchor, no edge effects									
	Non-cracked concrete									
	HIT-V 5.8	[kN]	12,0	13,0	16,4	20,1	24,0	26,4	31,5	36,9
	HIT-V 8.8	[kN]	13,0	13,0	16,4	20,1	24,0	26,4	31,5	36,9
	HIT-V-R	[kN]	13,0	13,0	16,4	20,1	24,0	26,4	31,5	36,9
	HIT-V-HCR	[kN]	13,0	13,0	16,4	20,1	24,0	26,4	31,5	36,9
	Cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	5,0	6,3	11,7	14,3	17,1	18,8	22,4	26,3
	Shear V_{Rd}: single anchor, no edge effects, without lever arm									
	Non-cracked concrete									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	63,3	75,6	88,5
	HIT-V 8.8	[kN]	12,0	18,4	27,2	48,2	57,5	63,3	75,6	88,5
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	63,3	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	48,2	57,5	63,3	75,6	88,5
	Cracked concrete									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	41,0	45,1	53,9	63,1
	HIT-V 8.8	[kN]	12,0	15,1	27,2	34,3	41,0	45,1	53,9	63,1
	HIT-V-R	[kN]	8,3	12,8	19,2	34,3	41,0	45,1	48,3	58,8
	HIT-V-HCR	[kN]	12,0	15,1	27,2	34,3	41,0	45,1	53,9	63,1

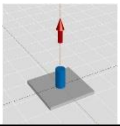
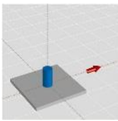
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	96	108	120
Base material thickness	$h = h_{min}$	[mm]	90	90	100	116	134	152	168	190
Edge distance	$c = c_{min}$	[mm]	40	50	60	80	100	120	135	150
	Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)									
	Non-cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	7,1	7,8	9,7	12,8	16,5	20,7	24,2	28,9
	Cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	3,0	4,2	8,0	10,7	13,7	16,4	19,5	22,9
	Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm									
	Non-cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	3,5	4,9	6,6	10,2	13,9	17,9	21,5	25,9
	Cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	2,5	3,5	4,7	7,2	9,9	12,7	15,3	18,3

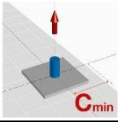
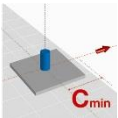
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth
(load values are valid for single anchor)

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth $h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	96	108	120
Base material thickness $h = h_{min}$	[mm]	90	90	100	116	134	152	168	190
Spacing $s = s_{min}$	[mm]	40	50	60	80	100	120	135	150
Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)									
Non-cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	7,7	7,9	10,0	12,6	15,4	17,9	21,2	25,0
Cracked concrete									
 HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	3,5	4,4	7,5	9,5	11,7	13,3	15,9	18,6
Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm									
Non-cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	39,4	44,9	53,5	62,7
HIT-V 8.8	[kN]	12,0	18,4	25,4	32,1	39,4	44,9	53,5	62,7
HIT-V-R	[kN]	8,3	12,8	19,2	32,1	39,4	44,9	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	25,4	32,1	39,4	44,9	53,5	62,7
Cracked concrete									
 HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	7,2	9,6	16,8	22,9	28,1	32,0	38,2	44,7

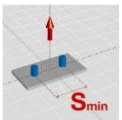
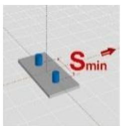
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth $h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	170	210	240	270
Base material thickness $h = h_{min}$	[mm]	110	120	140	161	214	266	300	340
Tensile N_{Rd}: single anchor, no edge effects									
Non-cracked concrete									
HIT-V 5.8	[kN]	12,0	19,3	28,0	39,2	62,2	85,4	104,3	124,5
HIT-V 8.8	[kN]	19,3	24,0	32,4	39,2	62,2	85,4	104,3	124,5
HIT-V-R	[kN]	13,9	21,9	31,6	39,2	62,2	85,4	80,4	98,3
HIT-V-HCR	[kN]	19,3	24,0	32,4	39,2	62,2	85,4	104,3	124,5
Cracked concrete									
 HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	6,7	9,4	18,4	27,9	44,3	60,9	74,4	88,7
Shear V_{Rd}: single anchor, no edge effects, without lever arm									
Non-cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	110,3
Cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
 HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	110,3

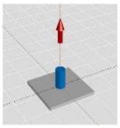
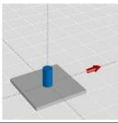
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	170	210	240	270
Base material thickness	$h = h_{min}$	[mm]	110	120	140	161	214	266	300	340
Edge distance	$c = c_{min}$	[mm]	40	50	60	80	100	120	135	150
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**									
	Non-cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	9,6	11,6	15,5	19,9	30,5	41,5	50,5	60,0
	Cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	3,6	5,2	10,2	16,5	25,2	34,2	41,5	49,3
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**									
	Non-cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	3,7	5,3	7,3	11,5	17,2	23,6	29,0	34,8
	Cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	2,6	3,8	5,2	8,1	12,2	16,7	20,5	24,7

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth
(load values are valid for single anchor)

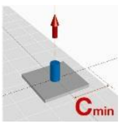
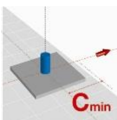
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	170	210	240	270
Base material thickness	$h = h_{min}$	[mm]	110	120	140	161	214	266	300	340
Spacing	s	[mm]	40	50	60	80	100	120	135	150
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**									
	Non-cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	11,2	13,5	18,1	22,4	35,1	48,1	58,6	69,9
	Cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	4,6	6,4	11,6	17,0	26,5	36,2	44,2	52,6
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**									
	Non-cracked concrete									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	177,0
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	110,3
	Cracked concrete									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8	[kN]	9,4	13,4	26,1	40,7	63,6	86,9	106,0	126,2
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR	[kN]	9,4	13,4	26,1	40,7	63,6	70,9	92,0	110,3

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d [a)]

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth h_{ef} = 12 d [a)] [mm]		96	120	144	192	240	288	324	360
Base material thickness h = h_{min} [mm]		126	150	174	228	284	344	384	430
	**Tensile N_{Rd}: single anchor, no edge effects**								
	Non-cracked concrete								
	HIT-V 5.8 [kN]	12,0	19,3	28,0	52,7	82,0	118,0	153,3	187,3
	HIT-V 8.8 [kN]	19,3	30,7	44,7	74,6	104,3	137,1	163,6	191,6
	HIT-V-R [kN]	13,9	21,9	31,6	58,8	92,0	132,1	80,4	98,3
	HIT-V-HCR [kN]	19,3	30,7	44,7	74,6	104,3	117,6	152,9	187,1
	Cracked concrete								
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR [kN]	8,0	12,6	24,1	42,9	67,0	96,5	116,6	136,6
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**								
	Non-cracked concrete								
	HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8 [kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR [kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	110,3
	Cracked concrete								
	HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8 [kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR [kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	110,3

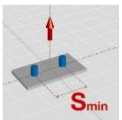
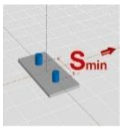
a) d = element diameter

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d [a)]

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth h_{ef} = 12 d [a)] [mm]		96	120	144	192	240	288	324	360
Base material thickness h = h_{min} [mm]		126	150	174	228	284	344	384	430
Edge distance c = c_{min} [mm]		40	50	60	80	100	120	135	150
	**Tensile N_{Rd}: single anchor, min. edge distance (c = c_{min})**								
	Non-cracked concrete								
	HIT-V 5.8 [kN]	11,8	16,5	21,7	33,4	46,7	61.3	73.2	85,7
	HIT-V 8.8 [kN]	11,8	16,5	21,7	33,4	46,7	61.3	73.2	85,7
	HIT-V-R [kN]	11,8	16,5	21,7	33,4	46,7	61.3	73.2	85,7
	HIT-V-HCR [kN]	11,8	16,5	21,7	33,4	46,7	61.3	73.2	85,7
	Cracked concrete								
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR [kN]	4,2	6,5	12,5	22,2	34,7	48,9	58,4	68,4
	**Shear V_{Rd}: single anchor, min. edge distance (c = c_{min}) , without lever arm**								
	Non-cracked concrete								
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR [kN]	3,9	5,7	7,8	12,9	18,9	25,9	31,8	38,1
	Cracked concrete								
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR [kN]	2,8	4,0	5,5	9,1	13,4	18,4	22,5	27,0

a) d = element diameter

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d [a)]
(load values are valid for single anchor)

Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth h_{ef} = 12 d [a)]	[mm]	96	120	144	192	240	288	324	360
Base material thickness h = h_{min}	[mm]	126	150	174	228	284	344	384	430
Spacing s=s_{min}	[mm]	40	50	60	80	100	120	135	150
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min})**									
Non-cracked concrete									
HIT-V 5.8	[kN]	12,0	19,3	26,5	40,8	57,0	74,9	89,4	104,6
HIT-V 8.8	[kN]	14,4	20,1	26,5	40,8	57,0	74,9	89,4	104,6
HIT-V-R	[kN]	13,9	20,1	26,5	40,8	57,0	74,9	80,4	98,3
HIT-V-HCR	[kN]	14,4	20,1	26,5	40,8	57,0	74,9	89,4	104,6
Cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	5,5	8,5	15,4	26,5	40,1	55,7	66,4	77,8
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min}) , without lever arm**									
Non-cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	110,3
Cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	11,0	17,2	27,2	50,4	78,4	112,8	147,2	179,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	11,0	17,2	27,2	50,4	78,4	70,9	92,0	110,3

a) d = element diameter

Seismic design C1

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:
- Seismic design according to TR045

The following technical data are based on: ETA-11/0493 and ETA-12/0084, issue 2013-06-20

Anchorage depth range

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Effective anchorage depth range	$h_{ef,min}$	[mm]	60	60	70	80	90	96	108	120
	$h_{ef,max}$	[mm]	160	200	240	320	400	480	540	600

Tension resistance in case of seismic performance category C1

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Characteristic tension resistance to steel failure										
HIT-V-5.8(F)	$N_{Rk,s,seis}$	[kN]	-	29	42	79	123	177	230	281
HIT-V-8.8(F)	$N_{Rk,s,seis}$	[kN]	-	46	67	126	196	282	367	449
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5							
HIT-V-R	$N_{Rk,s,seis}$	[kN]	-	41	59	110	172	247	230	281
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,87						2,86	
HIT-V-HCR	$N_{Rk,s,seis}$	[kN]	-	46	67	126	196	247	321	393
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5					2,1		
Characteristic bond resistance in cracked concrete C20/25 to C50/60										
Temperature range I: 40°C/24°C	$\tau_{Rk,seis}$	[N/mm²]	-	5,2	7,0					
Temperature range II: 80°C/50°C	$\tau_{Rk,seis}$	[N/mm²]	-	3,9	5,7					
Temperature range III: 120°C/72°C	$\tau_{Rk,seis}$	[N/mm²]	-	3,5	4,8					
Partial safety factor	$\gamma_{Mp,seis}$	[-]	1,8							
Concrete cone resistance and splitting resistance										
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]	1,8							

Displacement under tension load in case of seismic performance category C1 [1)]

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Displacement [1)]	$\delta_{N,seis}$	[mm]	-	0,8	0,8	0,8	0,8	0,8	0,8	0,8

1) Maximum displacement during cycling (seismic event).

Shear resistance in case of seismic performance category C1

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Characteristic shear resistance to steel failure										
for HIT-V-5.8(F)	$V_{Rk,s,seis}$	[kN]	-	11	15	27	43	62	81	98
for HIT-V-8.8(F)	$V_{Rk,s,seis}$	[kN]	-	16	24	44	69	99	129	157
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25							
for HIT-V-R	$V_{Rk,s,seis}$	[kN]	-	14	21	39	60	87	81	98
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,56						2,38	
for HIT-V-HCR	$V_{Rk,s,seis}$	[kN]	-	16	24	44	69	87	113	137
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25					1,75		
Concrete pryout resistance and concrete edge resistance										
Partial safety factor	$\gamma_{Mcp,seis} = \gamma_{Mc,seis}$	[-]	1,5							

Displacement under shear load in case of seismic performance category C1 [1)]

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Displacement[1)]	$\delta_{V,seis}$	[mm]	-	3,5	3,8	4,4	5,0	5,6	6,1	6,5

1) Maximum displacement during cycling (seismic event).

For seismic resistent fastening applications please use the anchor design software PROFIS Anchor.

Hilti HIT-HY 200 mortar with HIS-(R)N sleeve

Injection mortar system		Benefits
	Hilti HIT-HY 200-A 500 ml foil pack (also available as 330 ml)	- Suitable for cracked and non-cracked concrete C 20/25 to C 50/60. - Approved automatic cleaning with the use of the hollow drill-bit - High loading capacity, excellent handling, and fast curing
	Hilti HIT-HY 200-R 500 ml foil pack (also available as 330 ml)	- Small edge distance and anchor spacing possible - Corrosion resistant
	Static mixer	- In service temperature range up to 120°C short term/72°C long term - Manual cleaning for anchor size M8 and M10
	Internal threaded sleeve HIS-N HIS-RN	- Two mortar (A and R) versions available with different curing times and same performance

Concrete | Tensile zone | Small edge distance and spacing | Corrosion resistance | European Technical Approval | CE conformity | Approved automatic cleaning while drilling | PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-11/0493 / 2013-06-20 (Hilti HIT-HY 200-A) ETA-12/0084 / 2013-06-08 (Hilti HIT-HY 200-R)

a) All data given in this section according ETA-11/0493 and ETA-12/0084, issue 2013-06-20.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -10°C to +40°C

Embedment depth and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Base material thickness	h	[mm]	120	150	170	230	270

Mean ultimate resistance: concrete C 20/25 , anchor HIS-N with screw 8.8

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Non cracked concrete							
Tensile $N_{Ru,m}$	HIS-N	[kN]	*26,3*	*48,3*	*70,4*	*123,9*	*114,5*
Shear $V_{Ru,m}$	HIS-N	[kN]	*13,7*	*24,2*	*41,0*	*62,0*	*57,8*
Cracked concrete							
Tensile $N_{Ru,m}$	HIS-N	[kN]	*26,3*	*48,3*	66,8	105,9	*114,5*
Shear $V_{Ru,m}$	HIS-N	[kN]	*13,7*	*24,2*	*41,0*	*62,0*	*57,8*

Characteristic resistance: concrete C 20/25 , anchor HIS-N with screw 8.8

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Non cracked concrete							
Tensile N_{Rk}	HIS-N	[kN]	*25,0*	*46,0*	*67,0*	111,9	*109,0*
Shear V_{Rk}	HIS-N	[kN]	*13,0*	*23,0*	*39,0*	*59,0*	*55,0*
Cracked concrete							
Tensile N_{Rk}	HIS-N	[kN]	24,7	39,9	50,3	79,8	105,7
Shear V_{Rk}	HIS-N	[kN]	*13,0*	*23,0*	*39,0*	*59,0*	*55,0*

Design resistance: concrete C 20/25 , anchor HIS-N with screw 8.8

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Cracked concrete							
Tensile N_{Rd}	HIS-N	[kN]	17,5	30,7	44,7	74,6	74,1
Shear V_{Rd}	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
Non cracked concrete							
Tensile N_{Rd}	HIS-N	[kN]	16,5	26,6	33,5	53,2	70,4
Shear V_{Rd}	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7

Recommended loads [a)]: concrete C 20/25 , anchor HIS-N with screw 8.8

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Non cracked concrete							
Tensile N_{rec}	HIS-N	[kN]	12,5	27,9	31,9	53,3	53,0
Shear V_{rec}	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2
Cracked concrete							
Tensile N_{rec}	HIS-N	[kN]	11,8	19,0	24,0	38,0	50,3
Shear V_{rec}	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-HY 200 injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +80 °C	+50 °C	+80 °C
Temperature range III	-40 °C to +120 °C	+72 °C	+120 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIS-(R)N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Nominal tensile strength f_{uk}	HIS-N	[N/mm²]	490	460	460	460	460
	Screw 8.8	[N/mm²]	800	800	800	800	800
	HIS-RN	[N/mm²]	700	700	700	700	700
	Screw A4-70	[N/mm²]	700	700	700	700	700
Yield strength f_{yk}	HIS-N	[N/mm²]	410	375	375	375	375
	Screw 8.8	[N/mm²]	640	640	640	640	640
	HIS-RN	[N/mm²]	350	350	350	350	350
	Screw A4-70	[N/mm²]	450	450	450	450	450
Stressed cross-section A_s	HIS-(R)N	[mm²]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm²]	36,6	58	84,3	157	245
Moment of resistance W	HIS-(R)N	[mm³]	145	430	840	1595	1543
	Screw	[mm³]	31,2	62,3	109	277	541

Material quality

Part	Material
Internal threaded sleeve [a)] HIS-N	C-steel 1.0718, Steel galvanized ≥ 5µm
Internal threaded sleeve [b)] HIS-RN	Stainless steel 1.4401 and 1.4571

a) related fastening screw: strength class 8.8, A5 > 8% Ductile
steel galvanized ≥ 5µm

b) related fastening screw: strength class 70, A5 > 8% Ductile
stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362

Anchor dimensions

Anchor size Internal threaded sleeve HIS-N / HIS-RN			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205

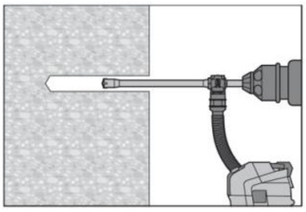
Setting

installation equipment

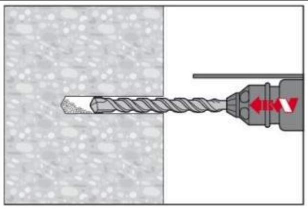
Anchor size	M8x90	M10x110	M12x125	M16x170	M20x205
Rotary hammer	TE 2 – TE 16		TE 40 – TE 70		
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser				

Setting instruction

Bore hole drilling



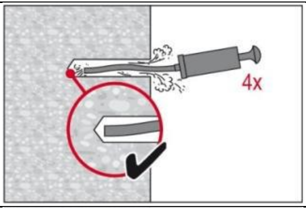
Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment. This drilling method properly cleans the borehole and removes dust while drilling. After drilling is complete, proceed to the “injection preparation” step in the instructions for use.



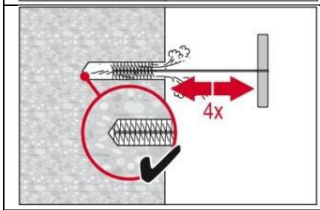
Drill Hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.

Bore hole cleaning Just before setting an anchor, the bore hole must be free of dust and debris.

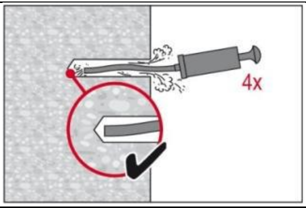
a) Manual Cleaning (MC) non-cracked concrete only
for bore hole diameters $d_0 \leq$ 20mm and bore hole depth $h_0 \leq$ 10d



The Hilti manual pump may be used for blowing out bore holes up to diameters $d_0 \leq$ 20 mm and embedment depths up to $h_{ef} \leq$ 10d.
Blow out at least 4 times from the back of the bore hole until return air stream is free of noticeable dust

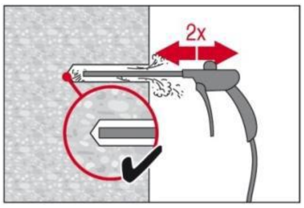


Brush 4 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with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

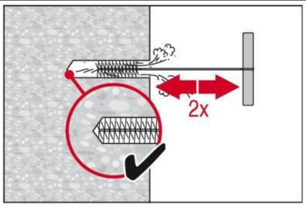


Blow out again with manual pump at least 4 times until return air stream is free of noticeable dust.

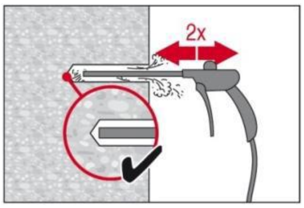
b) Compressed air cleaning (CAC)
for all bore hole diameters d_0 and all bore hole depth h_0



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

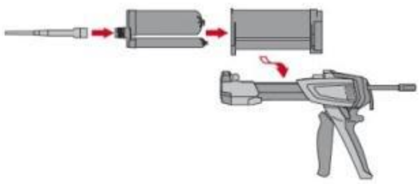


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with the proper brush diameter.

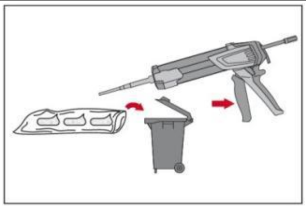


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

Injection preparation

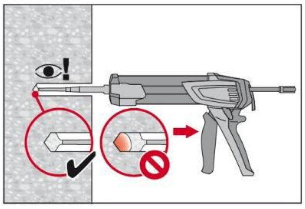


Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle. Observe the instruction for use of the dispenser. Check foil pack holder for proper function. Do not use damaged foil packs / holders. Swing foil pack holder with foil pack into HIT-dispenser.

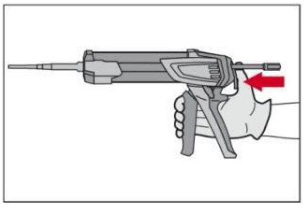


Discard initial adhesive. The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
Discard quantities are:
- 2 strokes for 330 ml foil pack,
- 3 strokes for 500 ml foil pack,
- 4 strokes for 500 ml foil pack ≤ 5°C.

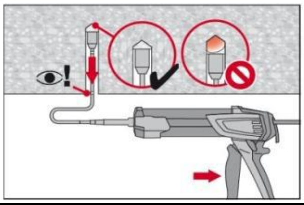
Inject adhesive from the back of the borehole without forming air voids



Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull. Fill holes approximately 2/3 full, or as required to ensure that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.

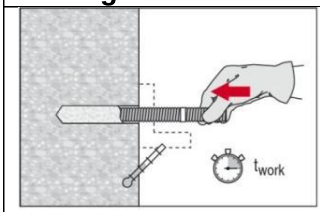


After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

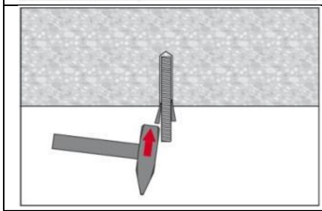


Overhead installation and/or installation with embedment depth h_{ef} > 250mm. For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug. Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the bore hole by the adhesive pressure.

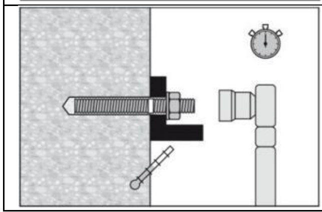
Setting the element



Before use, verify that the element is dry and free of oil and other contaminants.
Mark and set element to the required embedment depth untill working time t_{work} has elapsed.



For overhead installation use piston plugs and fix embedded parts with e.g. wedges



Loading the anchor:
After required curing time t_{cure} the anchor can be loaded.
The applied installation torque shall not exceed $T_{max.}$

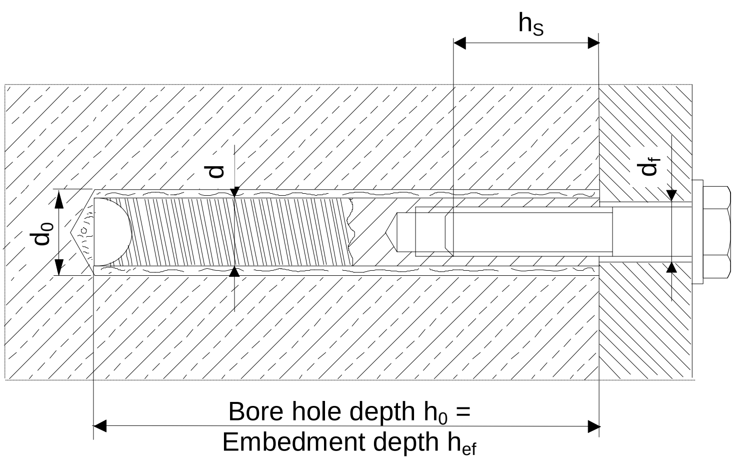
For detailed information on installation see instruction for use given with the package of the product.

Working time, curing time

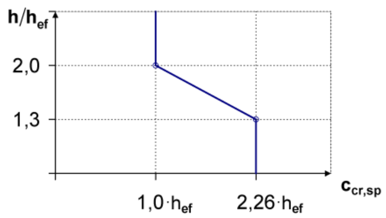
Temperature of the base material	Hilti HIT-HY 200-R	
	Working time in which anchor can be inserted and adjusted t_{work}	Curing time before anchor can be fully loaded t_{cure}
-10 °C to -5 °C	3 hour	20 hour
-4 °C to 0 °C	2 hour	8 hour
1 °C to 5 °C	1 hour	4 hour
6 °C to 10 °C	40 min	2,5 hour
11 °C to 20 °C	15 min	1,5 hour
21 °C to 30 °C	9 min	1 hour
31 °C to 40 °C	6 min	1 hour

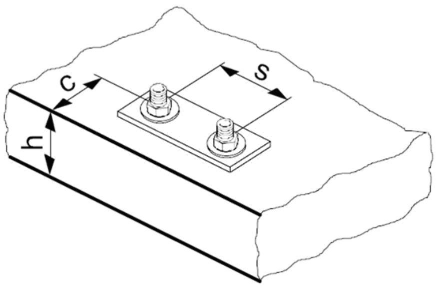
Temperature of the base material	Hilti HIT-HY 200-A	
	Working time in which anchor can be inserted and adjusted t_{work}	Curing time before anchor can be fully loaded t_{cure}
-10 °C to -5 °C	1,5 hour	7 hour
-4 °C to 0 °C	50 min	4 hour
1 °C to 5 °C	25 min	2 hour
6 °C to 10 °C	15 min	75 min
11 °C to 20 °C	7 min	45 min
21 °C to 30 °C	4 min	30 min
31 °C to 40 °C	3 min	30 min

Setting details



Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Nominal diameter of drill bit	d_0	[mm]	14	18	22	28	32
Diameter of element	d	[mm]	12,5	16,5	20,5	25,4	27,6
Effective anchorage and drill hole depth	h_{ef}	[mm]	90	110	125	170	205
Minimum base material thickness	h_{min}	[mm]	120	150	170	230	270
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22
Thread engagement length; min - max	h_s	[mm]	8-20	10-25	12-30	16-40	20-50
Torque moment [a)]	T_{max}	[Nm]	10	20	40	80	150
Minimum spacing	s_{min}	[mm]	40	45	55	65	90
Minimum edge distance	c_{min}	[mm]	40	45	55	65	90
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$				
Critical edge distance for splitting failure [b)]	$c_{cr,sp}$	[mm]	**$1,0 \cdot h_{ef}$** for $h / h_{ef} \geq 2,0$ **$4,6\ h_{ef} - 1,8\ h$** for $2,0 > h / h_{ef} > 1,3$ **$2,26\ h_{ef}$** for $h / h_{ef} \leq 1,3$				
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$				
Critical edge distance for concrete cone failure [c)]	$c_{cr,N}$	[mm]	$1,5\ h_{ef}$				





For spacing (or edge distance) smaller than critical spacing (or critical edge distance) the design loads have to be reduced.

a) Maximum recommended torque moment to avoid splitting failure during installation with minimum spacing and/or edge distance.

b) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

c) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the safe side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-11/0493 issued 2013-06-20 for HIT-HY 200-A and ETA-12/0084 issued 2013-06-20 for HIT-HY 200-R. Both mortars possess identical technical load performance.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The simplified calculated design loads take a conservative approach: They will be lower than the exact values according to ETAG 001, TR 029. For an optimized design, anchor calculation can be performed using PROFIS anchor design software.

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

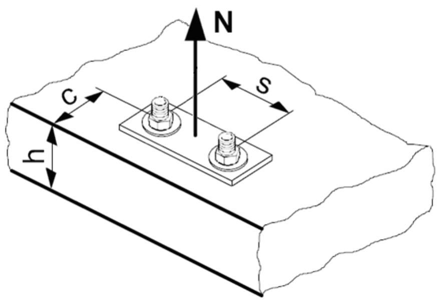
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
$N_{Rd,s}$	HIS-N with screw 8.8	[kN]	17,5	30,7	44,7	80,3	74,1
	HIS-RN with screw A4-70	[kN]	13,9	21,9	31,6	58,8	69,2

Design combined pull-out and concrete cone resistance

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Non cracked concrete							
$N^0_{Rd,p}$	Temperature range I	[kN]	30,6	49,4	69,8	117,6	154,7
$N^0_{Rd,p}$	Temperature range II	[kN]	25,9	41,8	59,0	99,5	130,4
$N^0_{Rd,p}$	Temperature range III	[kN]	22,4	36,1	51,0	85,9	112,6
Cracked concrete							
$N^0_{Rd,p}$	Temperature range I	[kN]	16,5	26,6	37,6	63,3	83,0
$N^0_{Rd,p}$	Temperature range II	[kN]	13,0	20,9	29,5	49,7	65,2
$N^0_{Rd,p}$	Temperature range III	[kN]	11,8	19,0	26,8	45,2	59,3

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$

Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

Anchor size		M8	M10	M12	M16	M20
Non cracked concrete						
$N^0_{Rd,c}$	[kN]	28,7	38,8	47,1	74,6	98,8
Cracked concrete						
$N^0_{Rd,c}$	[kN]	20,5	27,7	33,5	53,2	70,4

a) Splitting resistance must only be considered for non-cracked concrete.

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,10}$ a)	$f_{B,p} = 1$						

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$f_{h,p} = 1$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min}. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing [a)]

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0{,}5\cdot(1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0{,}5\cdot(1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min}. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$f_{h,N} = 1$

Influence of reinforcement

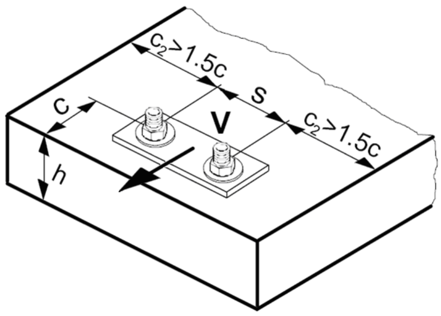
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0{,}5 + h_{ef}/200mm \leq 1$	0,7 [a)]	0,75 [a)]	0,8 [a)]	0,85 [a)]	0,9 [a)]	0,95 [a)]	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp}$ = k · lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
$V_{Rd,s}$	HIS-N with screw 8.8	[kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN with screw A4-70	[kN]	8,3	12,8	19,2	35,3	41,5

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of k · $N_{Rd,p}$ and k · $N_{Rd,c}$

k = 2

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Non-cracked concrete						
$V^0_{Rd,c}$	[kN]	12,4	19,6	28,2	40,2	46,2
Cracked concrete						
$V^0_{Rd,c}$	[kN]	8,8	13,9	20,0	28,5	32,7

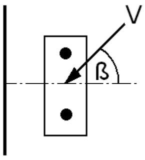
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	**0°**	**10°**	**20°**	**30°**	**40°**	**50°**	**60°**	**70°**	**80°**	**≥ 90°**
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	**0,15**	**0,3**	**0,45**	**0,6**	**0,75**	**0,9**	**1,05**	**1,2**	**1,35**	**≥ 1,5**
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20
f_{hef} =	1,38	1,21	1,04	1,22	1,45

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

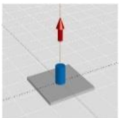
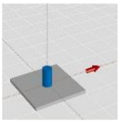
For combined tension and shear loading see section “Anchor Design”.

Precalculated values – design resistance values

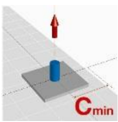
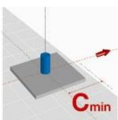
All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

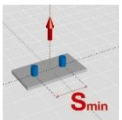
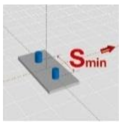
Design resistance: non-cracked- concrete C 20/25

Anchor size		M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth h_{ef}	[mm]	90	110	125	170	205
Base material thickness $h = h_{min}$	[mm]	120	150	170	230	270
Tensile N_{Rd}: single anchor, no edge effects 						
Non-cracked concrete						
HIS-N	[kN]	17,5	30,7	44,7	74,6	74,1
HIS-RN	[kN]	13,9	21,9	31,6	58,8	69,2
Cracked concrete						
HIS-N	[kN]	16,5	26,6	33,5	53,2	70,4
HIS-RN	[kN]	13,9	21,9	31,6	53,2	69,2
Shear V_{Rd}: single anchor, no edge effects, without lever arm 						
Non-cracked concrete						
HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5
Cracked concrete						
HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Design resistance: non-cracked- concrete C 20/25

Anchor size		M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth h_{ef}	[mm]	90	110	125	170	205
Base material thickness $h = h_{min}$	[mm]	120	150	170	230	270
Edge distance $c = c_{min}$	[mm]	40	45	55	65	90
Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$) 						
Non-cracked concrete						
HIS-N	[kN]	13,1	17,5	21,6	33,1	44,9
HIS-RN	[kN]	13,1	17,5	21,6	33,1	44,9
Cracked concrete						
HIS-N	[kN]	8,4	13,2	17,1	25,9	35,9
HIS-RN	[kN]	8,4	13,2	17,1	25,9	35,9
Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm 						
Non-cracked concrete						
HIS-N	[kN]	4,2	5,5	7,6	10,8	17,2
HIS-RN	[kN]	4,2	5,5	7,6	10,8	17,2
Cracked concrete						
HIS-N	[kN]	3,0	3,9	5,4	7,7	12,2
HIS-RN	[kN]	3,0	3,9	5,4	7,7	12,2

Design resistance: non-cracked- concrete C 20/25

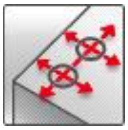
Anchor size		M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef} [mm]	90	110	125	170	205
Base material thickness	$h = h_{min}$ [mm]	120	150	170	230	270
Spacing	$s = s_{min}$ [mm]	40	45	55	65	90
Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)						
Non-cracked concrete						
HIS-N	[kN]	15,8	21,3	25,9	40,6	54,3
HIS-RN	[kN]	13,9	21,3	25,9	40,6	54,3
 Cracked concrete						
HIS-N	[kN]	10,1	15,4	19,2	30,0	40,4
HIS-RN	[kN]	10,1	15,4	19,2	30,0	40,4
Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm						
Non-cracked concrete						
HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5
 Cracked concrete						
HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Hilti HIT-HY 200 mortar with rebar (as anchor)

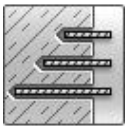
Injection mortar system		Benefits
	Hilti HIT-HY 200-A 500 ml foil pack (also available as 330 ml)	- suitable for cracked and non-cracked concrete C 20/25 to C 50/60. - Approved automatic cleaning with the use of the hollow drill-bit - high loading capacity, excellent handling - HY 200-R version with extended curing time for rebar applications - small edge distance and anchor spacing possible - large diameter applications - in service temperature range up to 120°C short term/72°C long term - manual cleaning for anchor size Ø8 to Ø16 and embedment depth $h_{ef} \leq 10d$ for non-cracked concrete - embedment depth range: from 60 ... 160 mm for Ø8 to 128 ... 640 mm for Ø32 - two mortar (A and R) versions available with different curing times and same performance
	Hilti HIT-HY 200-R 500 ml foil pack (also available as 330 ml)	
	Static mixer	
	rebar BSt 500 S	

Concrete

Tensile zone



Small edge distance and spacing



Variable embedment depth

European Technical Approval

CE conformity

Approved automatic cleaning while drilling

PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval a)	DIBt, Berlin	ETA-11/0493 / 2013-06-20 (Hilti HIT-HY 200-A) ETA-12/0084 / 2013-06-20 (Hilti HIT-HY 200-R)

a) All data given in this section according ETA-11/0493 and ETA-12/0084, issue 2013-06-20.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range +5°C to +40°C

Embedment depth [a)] and base material thickness for the basic loading data.

Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

	Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Typical embedment depth [mm]	80	90	110	125	145	170	210	270	300
Base material thickness [mm]	110	120	145	165	185	220	275	340	380

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500S

			Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Non cracked concrete											
Tensile $N_{Ru,m}$	BSt 500 S	[kN]	*29,4*	45,0	*65,1*	87,6	116,1	148,6	204,0	297,4	348,4
Shear $V_{Ru,m}$	BSt 500 S	[kN]	*14,7*	*23,1*	*32,6*	*44,1*	*57,8*	*90,3*	*141,8*	*177,5*	*232,1*
Cracked concrete											
Tensile $N_{Ru,m}$	BSt 500 S	[kN]	-	18,8	38,5	51,1	67,7	99,3	145,4	212,0	248,3
Shear $V_{Ru,m}$	BSt 500 S	[kN]	-	*23,1*	*32,6*	*44,1*	*57,8*	*90,3*	*141,8*	*177,5*	*232,1*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Non cracked concrete											
Tensile N_{Rk}	BSt 500 S	[kN]	24,1	33,9	49,8	66,0	87,5	111,9	153,7	224,0	262,4
Shear V_{Rk}	BSt 500 S	[kN]	*14,0*	*22,0*	*31,0*	*42,0*	*55,0*	*86,0*	*135,0*	*169,0*	*221,0*
Cracked concrete											
Tensile N_{Rk}	BSt 500 S	[kN]	-	14,1	29,0	38,5	51,0	74,8	109,6	159,7	187,1
Shear V_{Rk}	BSt 500 S	[kN]	-	*22,0*	*31,0*	*42,0*	*55,0*	*86,0*	*135,0*	*169,0*	*221,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Non cracked concrete											
Tensile N_{Rd}	BSt 500 S	[kN]	16,1	22,6	33,2	44,0	58,3	74,6	102,5	149,4	174,9
Shear V_{Rd}	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
Cracked concrete											
Tensile N_{Rd}	BSt 500 S	[kN]	-	9,4	19,4	25,7	34,0	49,8	73,0	106,5	124,7
Shear V_{Rd}	BSt 500 S	[kN]	-	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

Recommended loads a): concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Non cracked concrete											
Tensile N_{rec}	BSt 500 S	[kN]	11,5	16,2	23,7	31,4	41,6	53,3	73,2	106,7	125,0
Shear V_{rec}	BSt 500 S	[kN]	6,7	10,5	14,8	20,0	26,2	41,0	64,3	80,5	105,2
Cracked concrete											
Tensile N_{rec}	BSt 500 S	[kN]	-	6,7	13,8	18,3	24,3	35,6	52,2	76,1	89,1
Shear V_{rec}	BSt 500 S	[kN]	-	10,5	14,8	20,0	26,2	41,0	64,3	80,5	105,2

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-HY 200 injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +80 °C	+50 °C	+80 °C
Temperature range III	-40 °C to +120 °C	+72 °C	+120 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of rebar BSt 500S

			Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Nominal tensile strength f_{uk}	BSt 500 S	[N/mm²]	550	550	550	550	550	550	550	550	550
Yield strength f_{yk}	BSt 500 S	[N/mm²]	500	500	500	500	500	500	500	500	500
Stressed cross-section A_s	BSt 500 S	[mm²]	50,3	78,5	113,1	153,9	201,1	314,2	490,9	615,8	804,2
Moment of resistance W	BSt 500 S	[mm³]	50,3	98,2	169,6	269,4	402,1	785,4	1534	2155	3217

Material quality

Part	Material
rebar BSt 500 S	Geometry and mechanical properties according to DIN 488-2:1986 or E DIN 488-2:2006

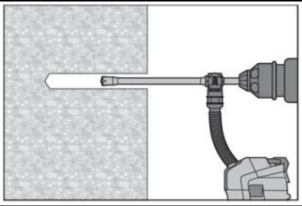
Setting

Installation equipment

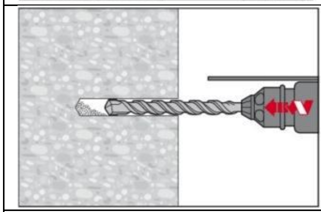
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Rotary hammer	TE 2 – TE 16					TE 40 – TE 70			
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser								

Setting instruction

Bore hole drilling



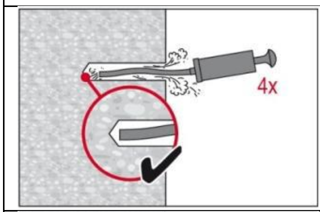
Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment. This drilling method properly cleans the borehole and removes dust while drilling.
After drilling is complete, proceed to the "injection preparation" step in the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



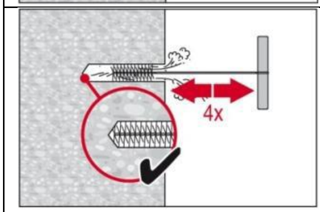
Drill Hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.

Bore hole cleaning Just before setting an anchor, the bore hole must be free of dust and debris.

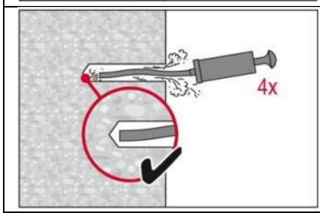
a) Manual Cleaning (MC) non-cracked concrete only
for bore hole diameters $d_0 \le$ 20mm and bore hole depth $h_0 \le 10d$



The Hilti manual pump may be used for blowing out bore holes up to diameters $d_0 \le 20$ mm and embedment depths up to $h_{ef} \le 10d$.
Blow out at least 4 times from the back of the bore hole until return air stream is free of noticeable dust

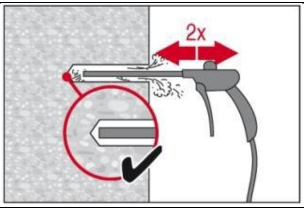


Brush 4 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with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

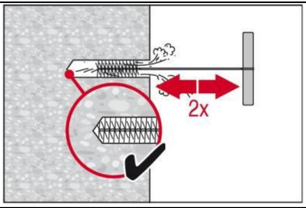


Blow out again with manual pump at least 4 times until return air stream is free of noticeable dust.

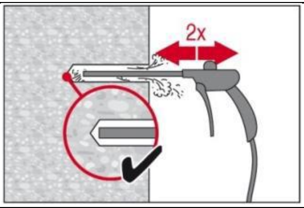
b) Compressed air cleaning (CAC)
for all bore hole diameters d_0 and all bore hole depth h_0



Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust. Bore hole diameter ≥ 32 mm the compressor must supply a minimum air flow of 140 m³/hour.

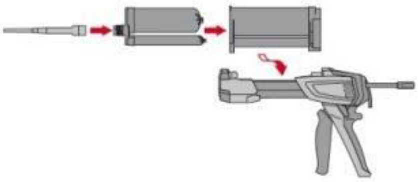


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with the proper brush diameter.

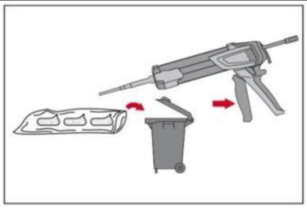


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

Injection preparation

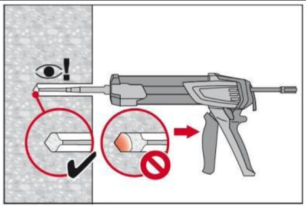


Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle. Observe the instruction for use of the dispenser. Check foil pack holder for proper function. Do not use damaged foil packs / holders. Swing foil pack holder with foil pack into HIT-dispenser.

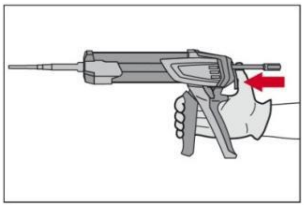


Discard initial adhesive. The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
Discard quantities are:
- 2 strokes for 330 ml foil pack,
- 3 strokes for 500 ml foil pack,
- 4 strokes for 500 ml foil pack ≤ 5°C.

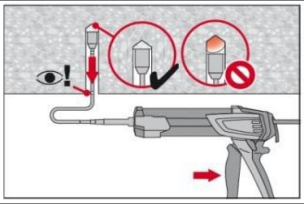
Inject adhesive from the back of the borehole without forming air voids



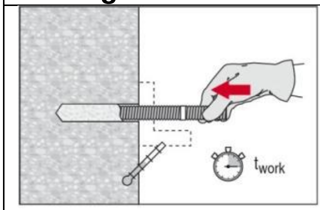
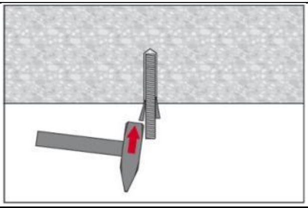
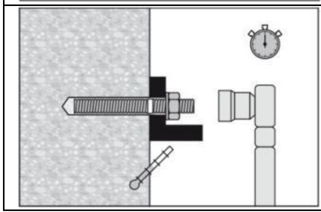
Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull. Fill holes approximately 2/3 full, or as required to ensure that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.



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



Overhead installation and/or installation with embedment depth h_{ef} > 250mm. 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 bore hole by the adhesive pressure.

Setting the element	
	Before use, verify that the element is dry and free of oil and other contaminants. Mark and set element to the required embedment depth untill working time t_{work} has elapsed.
	For overhead installation use piston plugs and fix embedded parts with e.g. wedges
	Loading the anchor: After required curing time t_{cure} the anchor can be loaded. The applied installation torque shall not exceed $T_{max.}$

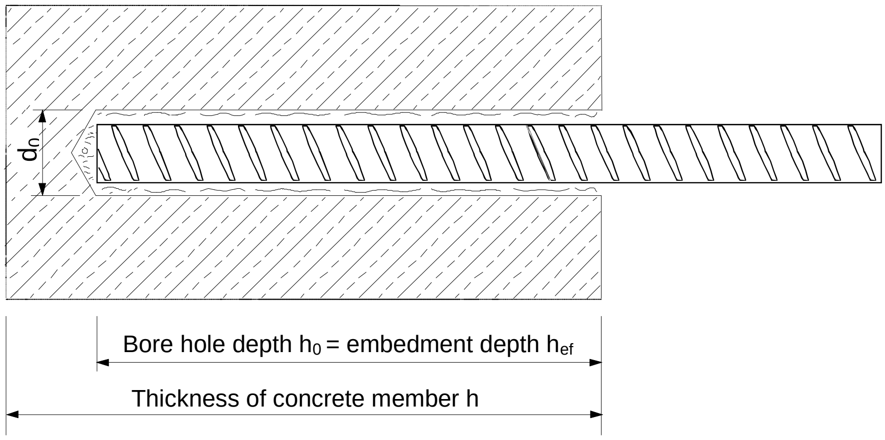
For detailed information on installation see instruction for use given with the package of the product.

Working time, curing time

Temperature of the base material	Hilti HIT-HY 200-R	
	Working time in which anchor can be inserted and adjusted t_{work}	Curing time before anchor can be loaded t_{cure}
-10 °C to -5 °C	3 hour	20 hour
-4 °C to 0 °C	2 hour	8 hour
1 °C to 5 °C	1 hour	4 hour
6 °C to 10 °C	40 min	2,5 hour
11 °C to 20 °C	15 min	1,5 hour
21 °C to 30 °C	9 min	1 hour
31 °C to 40 °C	6 min	1 hour

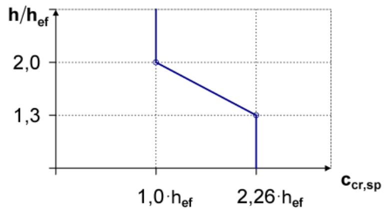
Temperature of the base material	Hilti HIT-HY 200-A	
	Working time in which anchor can be inserted and adjusted t_{work}	Curing time before anchor can be loaded t_{cure}
-10 °C to -5 °C	1,5 hour	7 hour
-4 °C to 0 °C	50 min	4 hour
1 °C to 5 °C	25 min	2 hour
6 °C to 10 °C	15 min	75 min
11 °C to 20 °C	7 min	45 min
21 °C to 30 °C	4 min	30 min
31 °C to 40 °C	3 min	30 min

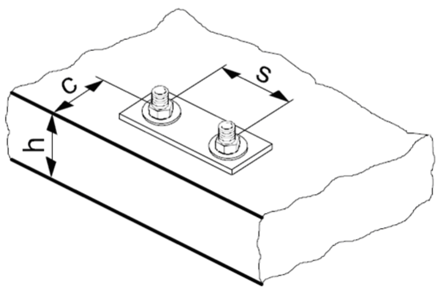
Setting details



Setting details

			Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Nominal diameter of drill bit	d_0	[mm]	12 (10)[a)]	14 (12)[a)]	16 (14)[a)]	18	20	25	32	35	40
Effective anchorage and drill hole depth range [b)]	$h_{ef,min}$	[mm]	60	60	70	75	80	90	100	112	128
	$h_{ef,max}$	[mm]	160	200	240	280	320	400	500	560	640
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm			$h_{ef} + 2\ d_0$					
Minimum spacing	s_{min}	[mm]	40	50	60	70	80	100	125	140	160
Minimum edge distance	c_{min}	[mm]	40	50	60	70	80	100	125	140	160
Critical spacing for splitting failure	$s_{cr,sp}$		$2\ c_{cr,sp}$								
Critical edge distance for splitting failure [c)]	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$**	for $h / h_{ef} \geq 2{,}0$							
			$4{,}6\ h_{ef} - 1{,}8\ h$	for $2{,}0 > h / h_{ef} > 1{,}3$							
			$2{,}26\ h_{ef}$	for $h / h_{ef} \leq 1{,}3$							
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\ c_{cr,N}$								
Critical edge distance for concrete cone failure [d)]	$c_{cr,N}$		$1{,}5\ h_{ef}$								





For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) both given values for drill bit diameter can be used

b) $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$ (h_{ef}: embedment depth)

c) h: base material thickness ($h \geq h_{min}$)

d) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-11/0493 issued 2013-06-20 for HIT-HY 200-A and ETA-12/0084 issued 2013-06-20 for HIT-HY 200-R. Both mortars possess identical technical load performance.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The simplified calculated design loads take a conservative approach: They will be lower than the exact values according to ETAG 001, TR 029. For an optimized design, anchor calculation can be performed using PROFIS anchor design software.

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

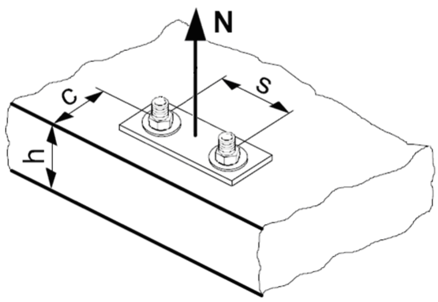
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

		Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
$N_{Rd,s}$ BSt 500 S	[kN]	20,0	30,7	44,3	60,7	79,3	123,6	192,9	242,1	315,7

Design combined pull-out and concrete cone resistance

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

	Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Typical embedment depth $h_{ef,typ}$ [mm]	**80**	**90**	**110**	**125**	**145**	**170**	**210**	**270**	**300**
Non cracked concrete									
$N^0_{Rd,p}$ Temperature range I [kN]	16,1	22,6	33,2	44,0	58,3	85,5	131,9	190,0	241,3
$N^0_{Rd,p}$ Temperature range II [kN]	13,4	18,8	27,6	36,7	48,6	71,2	110,0	158,3	201,1
$N^0_{Rd,p}$ Temperature range III [kN]	11,4	16,0	23,5	31,2	41,3	60,5	93,5	134,6	170,9
Cracked concrete									
$N^0_{Rd,p}$ Temperature range I [kN]	-	9,4	19,4	25,7	34,0	49,8	77,0	110,8	140,7
$N^0_{Rd,p}$ Temperature range II [kN]	-	7,5	15,2	20,2	26,7	39,2	60,5	87,1	110,6
$N^0_{Rd,p}$ Temperature range III [kN]	-	6,6	13,8	18,3	24,3	35,6	55,0	79,2	100,5

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

	Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
$N^0_{Rd,c}$ Non cracked concrete [kN]	24,1	28,7	38,8	47,1	58,8	74,6	102,5	149,4	174,9
$N^0_{Rd,c}$ Cracked concrete [kN]	-	20,5	27,7	33,5	41,9	53,2	73,0	106,5	124,7

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ a)	1						

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance [a)]

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N}$ = $0{,}7 + 0{,}3 \cdot c/c_{cr,N}$ $f_{1,sp}$ = $0{,}7 + 0{,}3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N}$ = $0{,}5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp}$ = $0{,}5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing [a)]

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N}$ = $0{,}5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp}$ = $0{,}5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

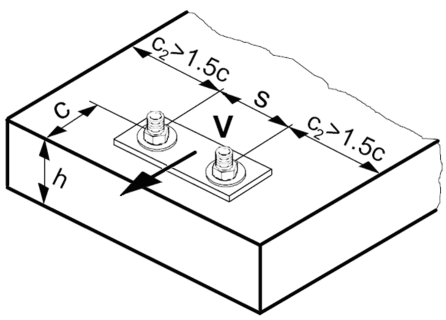
h_{ef} [mm]	60	70	80	90	≥ 100
$f_{re,N}$ = $0{,}5 + h_{ef}/200\text{mm} \leq 1$	0,8 [a)]	0,85 [a)]	0,9 [a)]	0,95 [a)]	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor f_{re} = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp}$ = **k** · lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

	Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
$V_{Rd,s}$ BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

k = 2

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

		Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Non-cracked concrete										
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,6	15,0	18,7	27,0	39,2	47,3	59,0
Cracked concrete										
$V^0_{Rd,c}$	[kN]	-	6,1	8,2	10,6	13,2	19,2	27,7	33,5	41,8

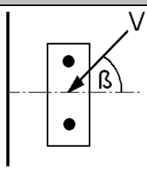
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

h_{ef}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

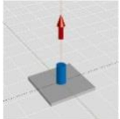
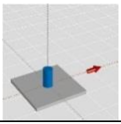
Combined tension and shear loading

For combined tension and shear loading see section "Anchor Design".

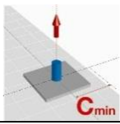
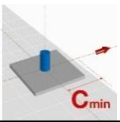
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

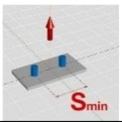
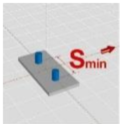
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth	$h_{ef,1}$ = [mm]	60	60	72	84	96	120	150	168	192
Base material thickness	h_{min}= [mm]	90	90	104	120	136	170	214	238	272
	**Tensile N_{Rd}: single anchor, no edge effects**									
	Non cracked concrete									
	BSt 500 S [kN]	12,1	15,1	20,6	25,9	31,7	44,3	61,8	73,3	89,6
	Cracked concrete									
	BSt 500 S [kN]	-	6,3	12,7	17,2	22,5	31,5	44,1	52,3	63,9
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**									
	Non cracked concrete									
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
	Cracked concrete									
	BSt 500 S [kN]	-	12,6	20,7	28,0	36,7	57,3	88,2	104,5	127,7

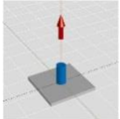
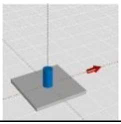
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth	$h_{ef,1}$ = [mm]	60	60	72	84	96	120	150	168	192
Base material thickness	h_{min}= [mm]	90	90	104	120	136	170	214	238	272
Edge distance	$c = c_{min}$= [mm]	40	50	60	80	100	120	135	150	150
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**									
	Non cracked concrete									
	BSt 500 S [kN]	7,3	9,4	12,0	16,0	20,4	27,9	37,2	43,7	50,4
	Cracked concrete									
	BSt 500 S [kN]	-	4,2	8,5	12,6	17,3	23,7	31,0	36,6	41,6
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**									
	Non cracked concrete									
	BSt 500 S [kN]	3,5	4,9	6,7	10,3	13,7	19,3	25,2	30,2	32,0
	Cracked concrete									
	BSt 500 S [kN]	-	3,5	4,7	7,3	9,7	13,6	17,8	21,4	22,7

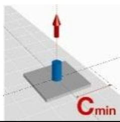
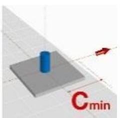
**Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)**

		Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth	$h_{ef,1}$ = [mm]	60	60	72	84	96	120	150	168	192
Base material thickness	h_{min}= [mm]	90	90	104	120	136	170	214	238	272
Spacing	$s = s_{min}$= [mm]	40	50	60	80	100	120	135	150	150
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**									
	Non cracked concrete									
	BSt 500 S [kN]	7,9	9,5	12,4	16,0	19,9	27,5	37,8	44,6	53,3
	Cracked concrete									
	BSt 500 S [kN]	-	4,5	8,4	11,6	15,2	21,0	28,7	33,9	40,2
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**									
	Non cracked concrete									
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	80,4	95,1	112,9
	Cracked concrete									
	BSt 500 S [kN]	-	8,0	16,2	22,7	30,3	42,1	57,3	67,8	80,5

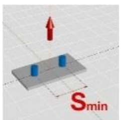
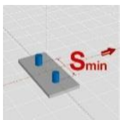
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,typ}$ = [mm]		80	90	110	125	145	170	210	270	300
Base material thickness h_{min}= [mm]		110	120	142	161	185	220	274	340	380
	**Tensile N_{Rd}: single anchor, no edge effects**									
	Non cracked concrete									
	BSt 500 S [kN]	16,1	22,6	33,2	44,0	58,3	74,6	102,5	149,4	174,9
	Cracked concrete									
	BSt 500 S [kN]	-	9,4	19,4	25,7	34,0	49,8	73,0	106,5	124,7
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**									
	Non cracked concrete									
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
	cracked concrete									
	BSt 500 S [kN]	-	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

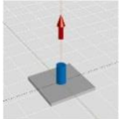
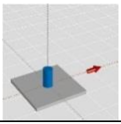
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,typ}$ = [mm]		80	90	110	125	145	170	210	270	300
Base material thickness h_{min}= [mm]		110	120	142	161	185	220	274	340	380
Edge distance $c = c_{min}$= [mm]		40	50	60	80	100	120	135	150	150
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**									
	Non cracked concrete									
	BSt 500 S [kN]	9,2	12,9	18,6	23,7	30,4	38,9	51,7	72,0	81,9
	Cracked concrete									
	BSt 500 S [kN]	-	5,4	11,1	15,6	21,6	31,0	43,2	59,2	66,5
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**									
	Non cracked concrete									
	BSt 500 S [kN]	3,7	5,3	7,3	11,2	15,8	21,5	27,5	34,3	36,5
	Cracked concrete									
	BSt 500 S [kN]	-	3,8	5,2	7,9	11,2	15,2	19,5	24,3	25,8

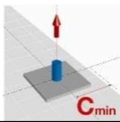
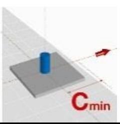
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I (load values are valid for single anchor)

		Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,typ}$ = [mm]		80	90	110	125	145	170	210	270	300
Base material thickness h_{min}= [mm]		110	120	142	161	185	220	274	340	380
Spacing $s = s_{min}$= [mm]		40	50	60	80	100	120	135	150	150
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**									
	Non cracked concrete									
	BSt 500 S [kN]	10,6	14,5	20,8	26,9	33,9	43,1	58,5	83,9	97,1
	Cracked concrete									
	BSt 500 S [kN]	-	6,5	12,7	16,9	22,4	31,5	44,3	63,1	72,7
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**									
	Non cracked concrete									
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
	Cracked concrete									
	BSt 500 S [kN]	-	14,7	20,7	28,0	36,7	57,3	88,7	112,7	145,5

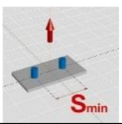
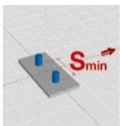
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

			Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth	$h_{ef,2}$ =	[mm]	96	120	144	168	192	240	300	336	384
Base material thickness	h_{min}=	[mm]	126	150	176	204	232	290	364	406	464
	**Tensile N_{Rd}: single anchor, no edge effects**										
	Non cracked concrete										
	BSt 500 S	[kN]	19,3	30,2	43,4	59,1	77,2	120,6	174,9	207,4	253,3
	Cracked concrete										
	BSt 500 S	[kN]	-	12,6	25,3	34,5	45,0	70,4	110,0	137,9	180,2
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**										
	Non cracked										
	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
	Cracked concrete										
	BSt 500 S	[kN]	-	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

			Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth	$h_{ef,2}$ =	[mm]	96	120	144	168	192	240	300	336	384
Base material thickness	h_{min}=	[mm]	126	150	176	204	232	290	364	406	464
Edge distance	$c = c_{min}$=	[mm]	40	50	60	80	100	120	135	150	150
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**										
	Non cracked concrete										
	BSt 500 S	[kN]	11,0	17,2	24,8	33,9	42,4	58,6	79,7	94,3	111,7
	Cracked concrete										
	BSt 500 S	[kN]	-	7,2	14,5	20,9	28,5	43,7	64,0	75,7	88,6
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**										
	Non cracked and cracked concrete										
	BSt 500 S	[kN]	3,9	5,7	7,8	12,0	16,9	23,6	30,5	36,7	39,6
	Cracked concrete										
	BSt 500 S	[kN]	-	4,0	5,5	8,5	12,0	16,7	21,6	26,0	28,1

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

			Data according ETA-11/0493 and ETA-12/0084, issue 2013-06-20								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth	$h_{ef,2}$ =	[mm]	96	120	144	168	192	240	300	336	384
Base material thickness	h_{min}=	[mm]	126	150	176	204	232	290	364	406	464
Spacing	$s = s_{min}$=	[mm]	40	50	60	80	100	120	135	150	150
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**										
	Non cracked concrete										
	BSt 500 S	[kN]	12,9	19,9	28,1	38,4	49,9	69,5	96,2	113,9	137,6
	Cracked concrete										
	BSt 500 S	[kN]	-	8,8	17,0	23,3	30,5	46,3	69,3	84,9	102,1
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**										
	Non cracked concrete										
	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
	Cracked concrete										
	BSt 500 S	[kN]	-	14,3	20,7	28,0	36,7	57,3	90,0	112,7	147,3

Seismic design C1

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:
- Seismic design according to TR045

The following technical data are based on: ETA-11/0493 and ETA-12/0084, issue 2013-06-20

Anchorage depth range

Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ28	Φ32
Effective anchorage depth range	$h_{ef,min}$	[mm]	60	60	70	75	80	90	100	112	128
	$h_{ef,max}$	[mm]	160	200	240	280	320	400	500	560	640

Tension resistance in case of seismic performance category C1

Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ28	Φ32
Characteristic tension resistance to steel failure											
Rebar B500B Acc. to DIN 488:2009-08	$N_{Rk,s,seis}$	[kN]	-	43	62	85	111	173	270	339	442
Partial safety factor Acc. to DIN 488:2009-08	$\gamma_{Ms,seis}$	[-]	1,4								
Characteristic bond resistance in cracked concrete C20/25 to C50/60											
Temp. range I: 40°C/24°C	$\tau_{Rk,seis}$	[N/mm²]	-	4,4	6,1						
Temp. range II: 80°C/50°C	$\tau_{Rk,seis}$	[N/mm²]	-	3,5	4,8						
Temp. range III: 120°C/72°C	$\tau_{Rk,seis}$	[N/mm²]	-	3	4,4						
Partial safety factor	$\gamma_{Mp,seis}$	[-]	1,5								
Concrete cone resistance and splitting resistance											
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]	1,5								

Displacement under tension load in case of seismic performance category C1 [1)]

Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ28	Φ32
Displacement [1)]	$\delta_{N,seis}$	[mm]	-	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3

1) Maximum displacement during cycling (seismic event).

Shear resistance in case of seismic performance category C1

Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ28	Φ32
Characteristic shear resistance to steel failure											
Rebar B500B Acc. to DIN 488:2009-08	$N_{Rk,s,seis}$	[kN]	-	15	22	29	39	60	95	118	155
Partial safety factor Acc. to DIN 488:2009-08	$\gamma_{Ms,seis}$	[-]	1,5								
Concrete pryout resistance and concrete edge resistance											
Partial safety factor	$\gamma_{Mcp,seis} = \gamma_{Mc,seis}$	[-]	1,5								

Displacement under shear load in case of seismic performance category C1 [1)]

Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ28	Φ32
Displacement[1)]	$\delta_{V,seis}$	[mm]	-	3,5	3,8	4,1	4,4	5,0	5,8	6,2	6,8

1) Maximum displacement during cycling (seismic event).

For seismic resistent fastening applications please use the anchor design software PROFIS Anchor.

Hilti HIT-HY 110 mortar with HIT-V / HAS rod

Injection mortar system

Hilti
HIT-HY 110
500 ml foil pack

(also available as 330 ml foil pack)

Static mixer

HAS rods
HAS-F rods
HAS-R rods
HAS-HCR rods

HAS-E rods
HAS-E-R rods

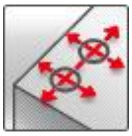
HIT-V rods
HIT-V-F
HIT-V-R rods
HIT-V-HCR rods

Benefits

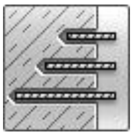
- suitable for non-cracked concrete C 20/25 to C 50/60
- suitable for dry and water saturated concrete
- small edge distance and anchor spacing possible
- large diameter applications
- high corrosion resistant
- in service temperature range up to 120°C short term/72°C long term
- manual cleaning for drill hole sizes ≤ 18 mm and embedment depth $h_{ef} \leq 10d$
- embedment depth range

M8:	60 to	160 mm
M30:	120 to	600 mm

Concrete



Small edge distance and spacing



Variable embedment depth

A4
316

Corrosion resistance

HCR
highMo

High corrosion resistance

European Technical Approval

CE

CE conformity

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European Technical Approval [a)]	DIBt, Berlin	ETA-08/0341 / 2013-03-18

a) All data given in this section according ETA-08/0341 issue 2013-03-18.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -5°C to +40°C

Embedment depth [a)] and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth h_{ef} [mm]	80	90	110	125	170	210	240	270
Base material thickness h [mm]	110	120	140	165	220	270	300	340

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

Mean ultimate resistance: non-cracked concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	*18,9*	*30,5*	*44,1*	75,4	121,1	168,9	203,6	237,5
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	*9,5*	*15,8*	*22,1*	*41,0*	*64,1*	*92,4*	*120,8*	*147,0*

Characteristic resistance: non-cracked concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Tensile N_{Rk}	HIT-V 5.8	[kN]	*18,0*	*29,0*	*42,0*	56,5	90,8	126,7	152,7	178,1
Shear V_{Rk}	HIT-V 5.8	[kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*	*115,0*	*140,0*

Design resistance: non-cracked concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Tensile N_{Rd}	HIT-V 5.8	[kN]	12,0	17,3	25,3	26,9	43,2	60,3	72,7	84,8
Shear V_{Rd}	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0

Recommended loads [a)]: non-cracked concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Tensile N_{rec}	HIT-V 5.8	[kN]	8,6	12,3	18,1	19,2	30,9	43,1	51,9	60,6
Shear V_{rec}	HIT-V 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3	65,7	80,0

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-HY 110 injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +80 °C	+50 °C	+80 °C
Temperature range III	-40 °C to +120 °C	+72 °C	+120 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIT-V / HAS

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal tensile strength f_{uk}	HIT-V/HAS 5.8	[N/mm²]	500	500	500	500	500	500	500	500
	HIT-V/HAS 8.8	[N/mm²]	800	800	800	800	800	800	800	800
	HIT-V/HAS -R	[N/mm²]	700	700	700	700	700	700	500	500
	HIT-V/HAS -HCR	[N/mm²]	800	800	800	800	800	700	700	700
Yield strength f_{yk}	HIT-V/HAS 5.8	[N/mm²]	400	400	400	400	400	400	400	400
	HIT-V/HAS 8.8	[N/mm²]	640	640	640	640	640	640	640	640
	HIT-V/HAS -R	[N/mm²]	450	450	450	450	450	450	210	210
	HIT-V/HAS -HCR	[N/mm²]	600	600	600	600	600	400	400	400
Stressed cross-section A_s	HAS	[mm²]	32,8	52,3	76,2	144	225	324	427	519
	HIT-V	[mm²]	36,6	58,0	84,3	157	245	353	459	561
Moment of resistance W	HAS	[mm³]	27,0	54,1	93,8	244	474	809	1274	1706
	HIT-V	[mm³]	31,2	62,3	109	277	541	935	1387	1874

Material quality

Part	Material
Threaded rod HIT-V(-F), HAS(-E)(-F) 5.8: M8 – M24	Strength class 5.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V(-F), HAS(-E) 8.8: M27 – M30	Strength class 8.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V-R, HAS-R	Stainless steel grade A4, A_5 > 8% ductile strength class 70 for ≤ M24 and class 50 for M27 to M30, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Threaded rod HIT-V-HCR, HAS-HCR	High corrosion resistant steel, 1.4529; 1.4565 strength ≤ M20: R_m = 800 N/mm², $R_{p\,0.2}$ = 640 N/mm², A_5 > 8% ductile M24 to M30: R_m = 700 N/mm², $R_{p\,0.2}$ = 400 N/mm², A_5 > 8% ductile
Washer ISO 7089	Steel galvanized, hot dipped galvanized,
	Stainless steel, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	High corrosion resistant steel, 1.4529; 1.4565
Nut EN ISO 4032	Strength class 8, steel galvanized ≥ 5 µm, hot dipped galvanized ≥ 45 µm
	Strength class 70, stainless steel grade A4, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	Strength class 70, high corrosion resistant steel, 1.4529; 1.4565

Anchor dimensions

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Anchor rod HAS, HAS-F, HAS-R, HAS-HCR HAS-E, HAS-E-R	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270
Embedment depth h_{ef} [mm]	80	90	110	125	170	210	240	270
Anchor rod HIT-V, HIT-V-R, HIT-V-HCR	Anchor rods HIT-V (-R / -HCR) are available in variable length							

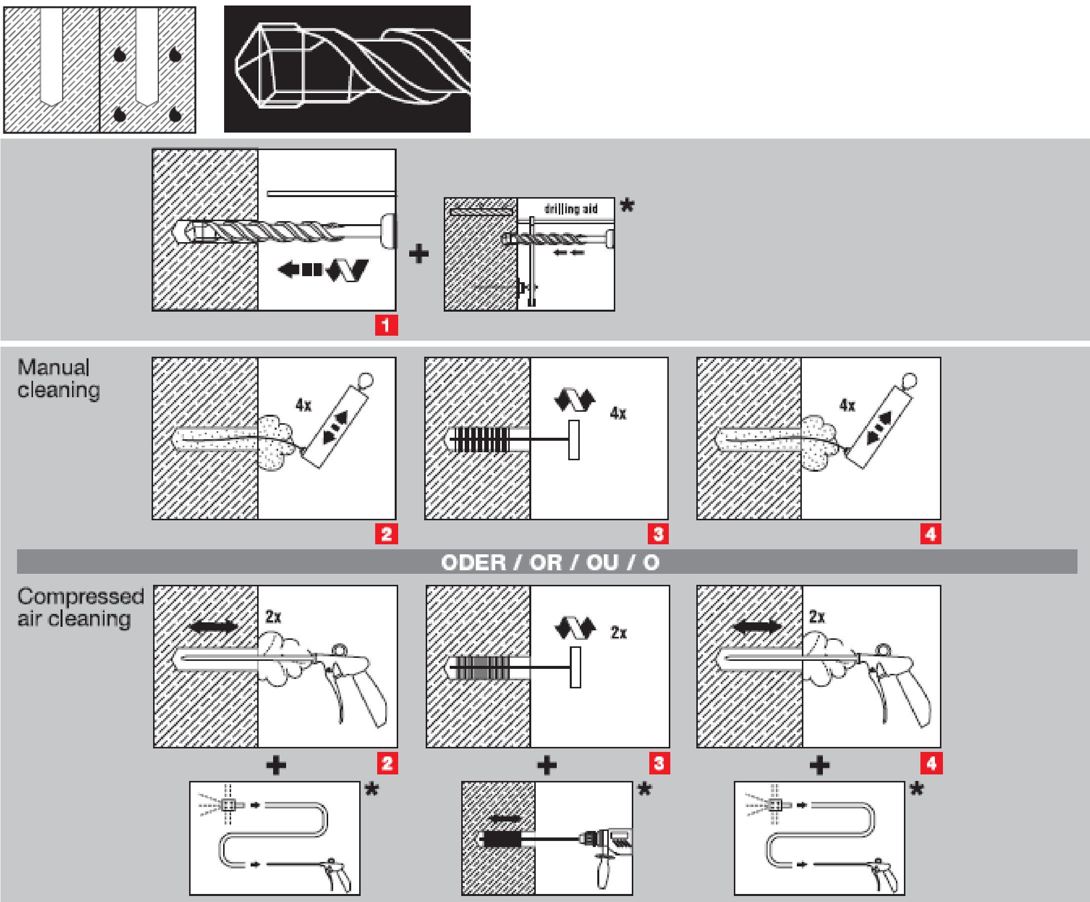
Setting

installation equipment

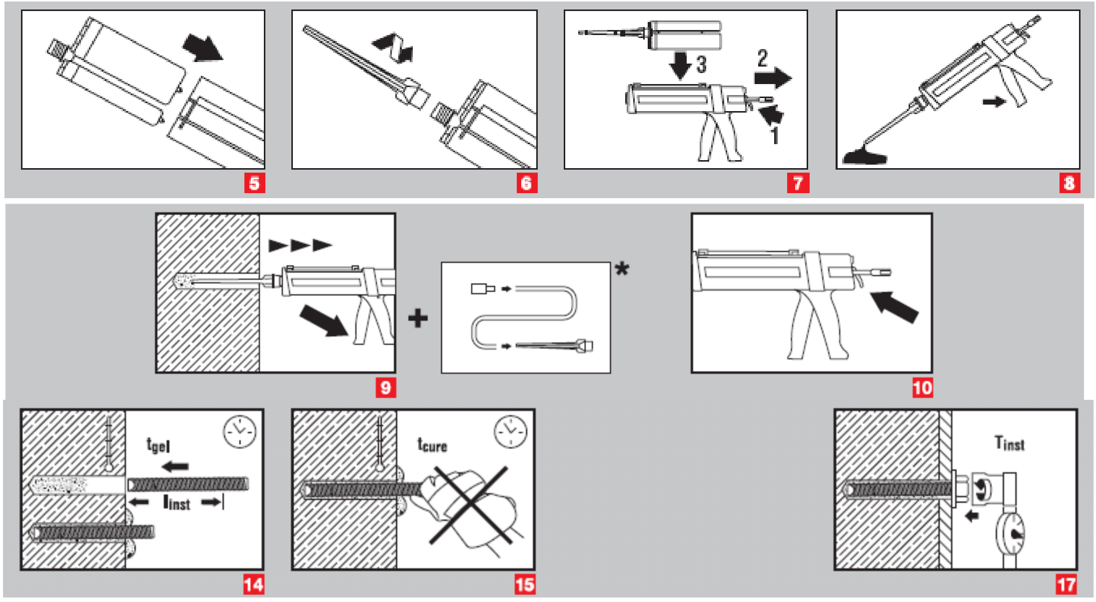
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Rotary hammer	TE 2 – TE 30				TE 40 – TE 70			
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser							

Setting instruction

Dry and water-saturated concrete, hammer drilling



a)



b)

<u>a) Note:</u> Manual cleaning for drill hole sizes $d_0 \leq$ 18mm and embedment depth $h_{ef} \leq$ 10 d only!
Compressed air cleaning for all bore hole diameters and all bore hole depth
<u>b) Note:</u> Extension and piston plug needed for overhead installation and/or embedment depth > 250mm!

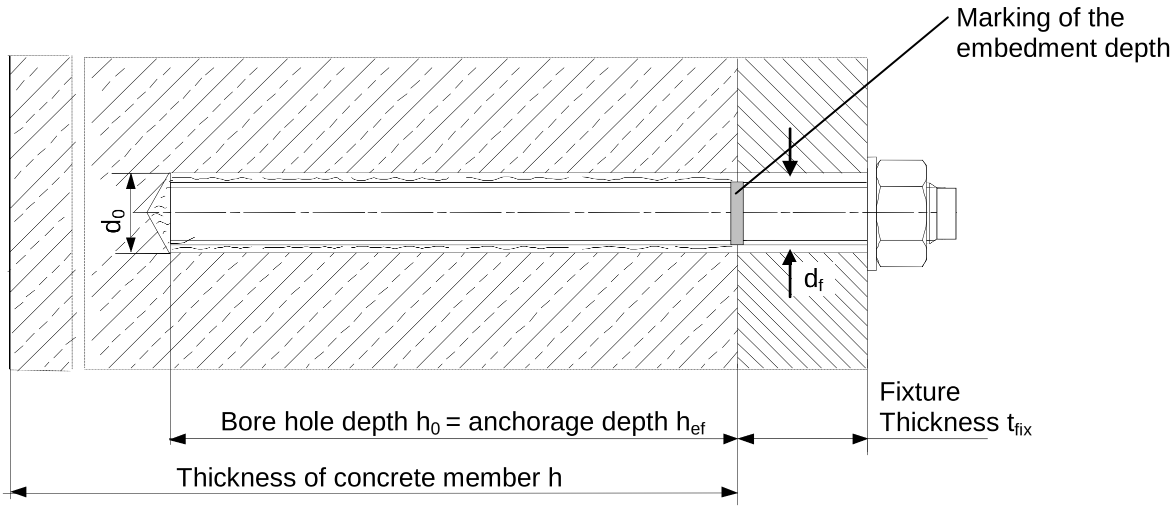
For detailed information on installation see instruction for use given with the package of the product.

Working time, Curing time

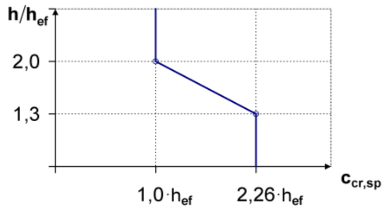
Temperature of the base material T_{BM}	Working time t_{gel}	Curing time t_{cure} a)
-5 °C to -1 °C	90 min	9 h
0 °C to 4 °C	45 min	4,5 h
5 °C to 9 °C	20 min	2 h
10 °C to 19 °C	6 min	90 min
20 °Cto 29 °C	4 min	50 min
30 °C to 40 °C	2 min	40 min

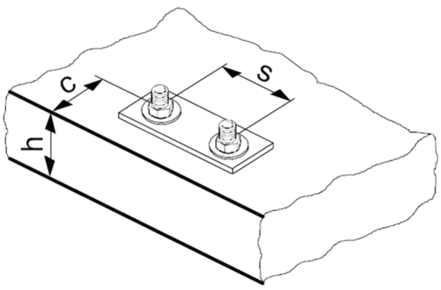
a) The curing time data are valid for dry anchorage base only. For water saturated anchorage bases the curing times must be doubled.

Setting details



Setting details

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	22	28	30	35
Effective embedment and drill hole depth range a) **for HIT-V**	$h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
	$h_{ef,max}$	[mm]	160	200	240	320	400	480	540	600
Effective anchorage and drill hole depth **for HAS**	h_{ef}	[mm]	80	90	110	125	170	210	240	270
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm		$h_{ef} + 2\ d_0$					
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22	26	30	33
Torque moment	T_{max} b)	[Nm]	10	20	40	80	150	200	270	300
Minimum spacing	s_{min}	[mm]	40	50	60	80	100	120	135	150
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120	135	150
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$							
Critical edge distance for splitting failure c)	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$**	for $h / h_{ef} \geq 2{,}0$						
			$4{,}6\ h_{ef} - 1{,}8\ h$	for $2{,}0 > h / h_{ef} > 1{,}3$						
			$2{,}26\ h_{ef}$	for $h / h_{ef} \leq 1{,}3$						
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$							
Critical edge distance for concrete cone failure d)	$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$							



For spacing (or edge distance) smaller than critical spacing (or critical edge distance) the design loads have to be reduced.

a) Embedment depth range: $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$

b) Maximum recommended torque moment to avoid splitting failure during installation with minimum spacing and/or edge distance.

c) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

d) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

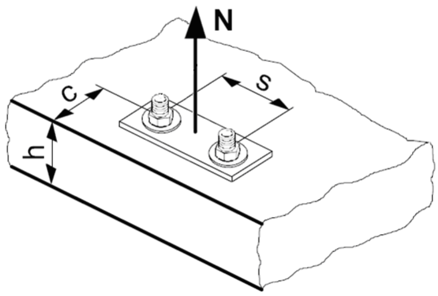
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $\mathbf{N_{Rd,s}}$
- Combined pull-out and concrete cone resistance:
  $$\mathbf{N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}}$$
- Concrete cone resistance: $\mathbf{N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}}$
- Concrete splitting resistance (only non-cracked concrete):
  $$\mathbf{N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,s}$	HAS 5.8	[kN]	11,3	17,3	25,3	48,0	74,7	106,7	-	-
	HIT-V 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	118,0	153,3	187,3
	HAS 8.8	[kN]	-	-	-	-	-	-	231,3	281,3
	HIT-V 8.8	[kN]	19,3	30,7	44,7	84,0	130,7	188,0	244,7	299,3
	HAS (-E)-R	[kN]	12,3	19,8	28,3	54,0	84,0	119,8	75,9	92,0
	HIT-V-R	[kN]	13,9	21,9	31,6	58,8	92,0	132,1	80,4	98,3
	HAS (-E)-HCR	[kN]	18,0	28,0	40,7	76,7	120,0	106,7	144,8	175,7
	HIT-V-HCR	[kN]	19,3	30,7	44,7	84,0	130,7	117,6	152,9	187,1

Design combined pull-out and concrete cone resistance

$\mathbf{N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}}$

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth $h_{ef} = h_{ef,typ}$		**[mm]**	**80**	**90**	**110**	**125**	**170**	**210**	**240**	**270**
$N^0_{Rd,p}$	Temperature range I	[kN]	14,7	17,3	25,3	26,9	43,2	60,3	72,7	84,8
$N^0_{Rd,p}$	Temperature range II	[kN]	10,1	11,8	17,3	18,0	28,0	37,7	48,5	60,6
$N^0_{Rd,p}$	Temperature range III	[kN]	8,7	10,2	15,0	15,0	25,4	33,9	38,8	48,5

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
$N^0_{Rd,c}$	[kN]	24,1	24,0	32,4	33,6	53,3	73,2	89,4	106,7

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,15}$ a)	1,00	1,03	1,06	1,09	1,11	1,13	1,14

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \le 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \le 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \le 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \le 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min}. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \le 1$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \le 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min}. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

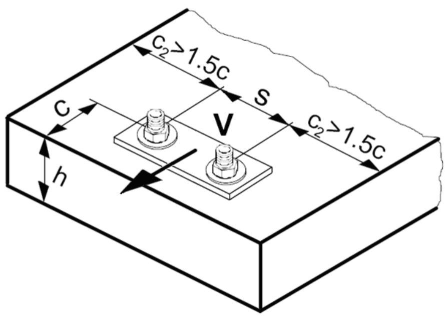
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N}$ = 0,5 + h_{ef}/200mm ≤ 1	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp}$ = k · lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$V_{Rd,s}$	HAS 5.8	[kN]	6,8	10,4	15,2	28,8	44,8	64,0	-	-
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HAS 8.8	[kN]	-	-	-	-	-	-	139,2	168,8
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HAS (-E)-R	[kN]	7,7	12,2	17,3	32,7	50,6	71,8	45,8	55,5
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HAS (-E)-HCR	[kN]	10,4	16,8	24,8	46,4	72,0	64,0	86,9	105,7
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

Design concrete pryout resistance $V_{Rd,cp}$ = lower value a) of k · $N_{Rd,p}$ and k · $N_{Rd,c}$

k = 2 for h_{ef} ≥ 60 mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete									
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,6	18,7	27,0	36,6	44,5	53,0

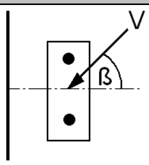
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \frac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

h_{ef}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

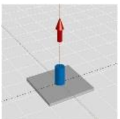
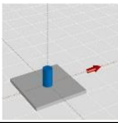
For combined tension and shear loading see section “Anchor Design”.

Precalculated values – design resistance values

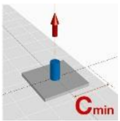
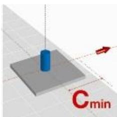
All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

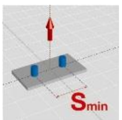
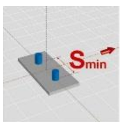
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
Base material thickness	$h = h_{min}$	[mm]	100	100	100	116	138	156	170	190
	**Tensile N_{Rd}: single anchor, no edge effects**									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	11,1	11,5	16,1	17,2	20,5	24,0	27,7	31,6
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	67,3	77,7	88,5
	HIT-V 8.8	[kN]	12,0	18,4	27,2	48,2	57,5	67,3	77,7	88,5
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	67,3	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	48,2	57,5	67,3	77,7	88,5

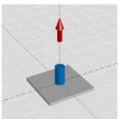
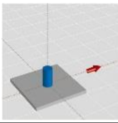
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
Base material thickness	$h = h_{min}$	[mm]	100	100	100	116	138	156	170	190
Edge distance	$c = c_{min}$	[mm]	40	50	60	80	100	120	135	150
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	6,7	7,8	9,7	11,0	14,5	18,1	21,0	24,8
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,5	4,9	6,6	10,2	14,1	18,3	21,8	25,9

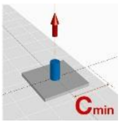
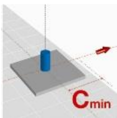
**Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth
(load values are valid for single anchor)**

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
Base material thickness	$h = h_{min}$	[mm]	100	100	100	116	138	156	170	190
Spacing	$s = s_{min}$	[mm]	40	50	60	80	100	120	135	150
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	7,4	7,6	10,0	10,8	13,4	16,0	18,6	21,5
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	39,4	47,1	54,7	62,7
	HIT-V 8.8	[kN]	12,0	17,7	24,9	32,1	39,4	47,1	54,7	62,7
	HIT-V-R	[kN]	8,3	12,8	19,2	32,1	39,4	47,1	48,3	58,8
	HIT-V-HCR	[kN]	12,0	17,7	24,9	32,1	39,4	47,1	54,7	62,7

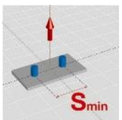
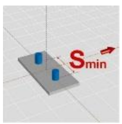
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth $h_{ef} = h_{ef,typ}$ [mm]		80	90	110	125	170	210	240	270
Base material thickness $h = h_{min}$ [mm]		110	120	140	161	218	266	300	340
	**Tensile N_{Rd}: single anchor, no edge effects**								
	HIT-V 5.8 [kN]	12,0	17,3	25,3	26,9	43,2	60,3	72,7	84,8
	HIT-V 8.8 [kN]	14,7	17,3	25,3	26,9	43,2	60,3	72,7	84,8
	HIT-V-R [kN]	13,9	17,3	25,3	26,9	43,2	60,3	72,7	84,8
	HIT-V-HCR [kN]	14,7	17,3	25,3	26,9	43,2	60,3	72,7	84,8
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**								
	HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8 [kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR [kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

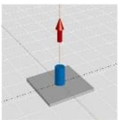
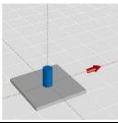
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth $h_{ef} = h_{ef,typ}$ [mm]		80	90	110	125	170	210	240	270
Base material thickness $h = h_{min}$ [mm]		110	120	140	161	218	266	300	340
Edge distance $c = c_{min}$ [mm]		40	50	60	80	100	120	135	150
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	8,6	10,1	14,7	16,4	26,7	37,8	46,3	55,0
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	3,7	5,3	7,3	11,5	17,2	23,6	29,0	34,8

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth
(load values are valid for single anchor)

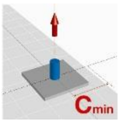
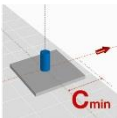
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth $h_{ef} = h_{ef,typ}$ [mm]		80	90	110	125	170	210	240	270
Base material thickness $h = h_{min}$ [mm]		110	120	140	161	218	266	300	340
Spacing s [mm]		40	50	60	80	100	120	135	150
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	9,9	11,3	16,3	17,5	28,2	39,4	47,9	56,5
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**								
	HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8 [kN]	12,0	18,4	27,2	45,7	72,4	100,5	120,9	140,7
	HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR [kN]	12,0	18,4	27,2	45,7	72,4	70,9	92,0	112,0

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d a)

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth h_{ef} = 12 d a)	[mm]	96	120	144	192	240	288	324	360
Base material thickness h = h_{min}	[mm]	126	150	174	228	288	344	384	430
 **Tensile N_{Rd}: single anchor, no edge effects**									
HIT-V 5.8	[kN]	12,0	19,3	28,0	41,4	61,0	82,7	98,2	113,1
HIT-V 8.8	[kN]	17,7	23,0	33,2	41,4	61,0	82,7	98,2	113,1
HIT-V-R	[kN]	13,9	21,9	31,6	41,4	61,0	82,7	80,4	98,3
HIT-V-HCR	[kN]	17,7	23,0	33,2	41,4	61,0	82,7	98,2	113,1
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

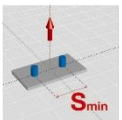
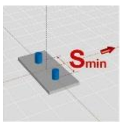
a) d = element diameter

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d a)

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth h_{ef} = 12 d a)	[mm]	96	120	144	192	240	288	324	360
Base material thickness h = h_{min}	[mm]	126	150	174	228	288	344	384	430
Edge distance c = c_{min}	[mm]	40	50	60	80	100	120	135	150
 **Tensile N_{Rd}: single anchor, min. edge distance (c = c_{min})**									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	10,3	13,4	19,3	25,2	37,7	51,9	62,6	73,4
 **Shear V_{Rd}: single anchor, min. edge distance (c = c_{min}) , without lever arm**									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,9	5,7	7,8	12,9	18,9	25,9	31,8	38,1

a) d = element diameter

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d a)
(load values are valid for single anchor)

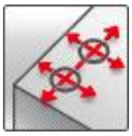
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth h_{ef} = 12 d a)	[mm]	96	120	144	192	240	288	324	360
Base material thickness h = h_{min}	[mm]	126	150	174	228	288	344	384	430
Spacing s=s_{min}	[mm]	40	50	60	80	100	120	135	150
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min})**									
HIT-V 5.8	[kN]	12,0	15,5	22,0	28,0	41,2	55,8	66,6	77,3
HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	12,1	15,5	22,0	28,0	41,2	55,8	66,6	77,3
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min}) , without lever arm**									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

a) d = element diameter

Hilti HIT-HY 110 mortar with HIS-(R)N sleeve

Injection mortar system		Benefits
	Hilti HIT-HY 110 500 ml foil pack (also available as 330 ml foil pack)	- suitable for non-cracked concrete C 20/25 to C 50/60 - suitable for dry and water saturated concrete - small edge distance and anchor spacing possible - corrosion resistant - in service temperature range up to 120°C short term/72°C long term - manual cleaning for drill hole sizes ≤ 18 mm
	Static mixer	
	Internal threaded sleeve HIS-N HIS-RN	


Concrete


Small edge distance and spacing

Corrosion resistance


European Technical Approval

CE conformity

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European Technical Approval [a)]	DIBt, Berlin	ETA-08/0341 / 2013-03-18

a) All data given in this section according ETA-08/0341 issue 2013-03-18.

Basic loading data (for a single anchor)

All data in this section applies to For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- <u>One</u> anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -5°C to +40°C

**Embedment depth and base material thickness for the basic loading data.
Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.**

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Base material thickness	h	[mm]	120	150	170	230	270

Mean ultimate resistance: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile $N_{Ru,m}$	HIS-N	[kN]	*26,3*	*48,3*	*70,4*	*123,9*	*114,5*
Shear $V_{Ru,m}$	HIS-N	[kN]	*13,7*	*24,2*	*41,0*	*62,0*	*57,8*

Characteristic resistance: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile N_{Rk}	HIS-N	[kN]	*25,0*	40,0	60,0	111,9	*109,0*
Shear V_{Rk}	HIS-N	[kN]	*13,0*	*23,0*	*39,0*	*59,0*	*55,0*

Design resistance: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile N_{Rd}	HIS-N	[kN]	17,5	26,7	40,0	62,2	74,1
Shear V_{Rd}	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7

Recommended loads [a)]: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile N_{rec}	HIS-N	[kN]	12,5	19,0	28,6	44,4	53,0
Shear V_{rec}	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-HY 110 injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +80 °C	+50 °C	+80 °C
Temperature range III	-40 °C to +120 °C	+72 °C	+120 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIS-(R)N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Nominal tensile strength f_{uk}	HIS-N	[N/mm²]	490	490	460	460	460
	Screw 8.8	[N/mm²]	800	800	800	800	800
	HIS-RN	[N/mm²]	700	700	700	700	700
	Screw A4-70	[N/mm²]	700	700	700	700	700
Yield strength f_{yk}	HIS-N	[N/mm²]	410	410	375	375	375
	Screw 8.8	[N/mm²]	640	640	640	640	640
	HIS-RN	[N/mm²]	350	350	350	350	350
	Screw A4-70	[N/mm²]	450	450	450	450	450
Stressed cross-section A_s	HIS-(R)N	[mm²]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm²]	36,6	58	84,3	157	245
Moment of resistance W	HIS-(R)N	[mm³]	145	430	840	1595	1543
	Screw	[mm³]	31,2	62,3	109	277	541

Material quality

Part	Material
Internal threaded sleeve a) HIS-N	C-steel 1.0718, Steel galvanized ≥ 5µm
Internal threaded sleeve a) HIS-RN	Stainless steel 1.4401 and 1.4571

a) related fastening screw: strength class 8.8, A5 > 8% Ductile
steel galvanized ≥ 5µm

b) related fastening screw: strength class 70, A5 > 8% Ductile
stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362

Anchor dimensions

Anchor size Internal threaded sleeve HIS-N / HIS-RN			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	80	90	110	125	170

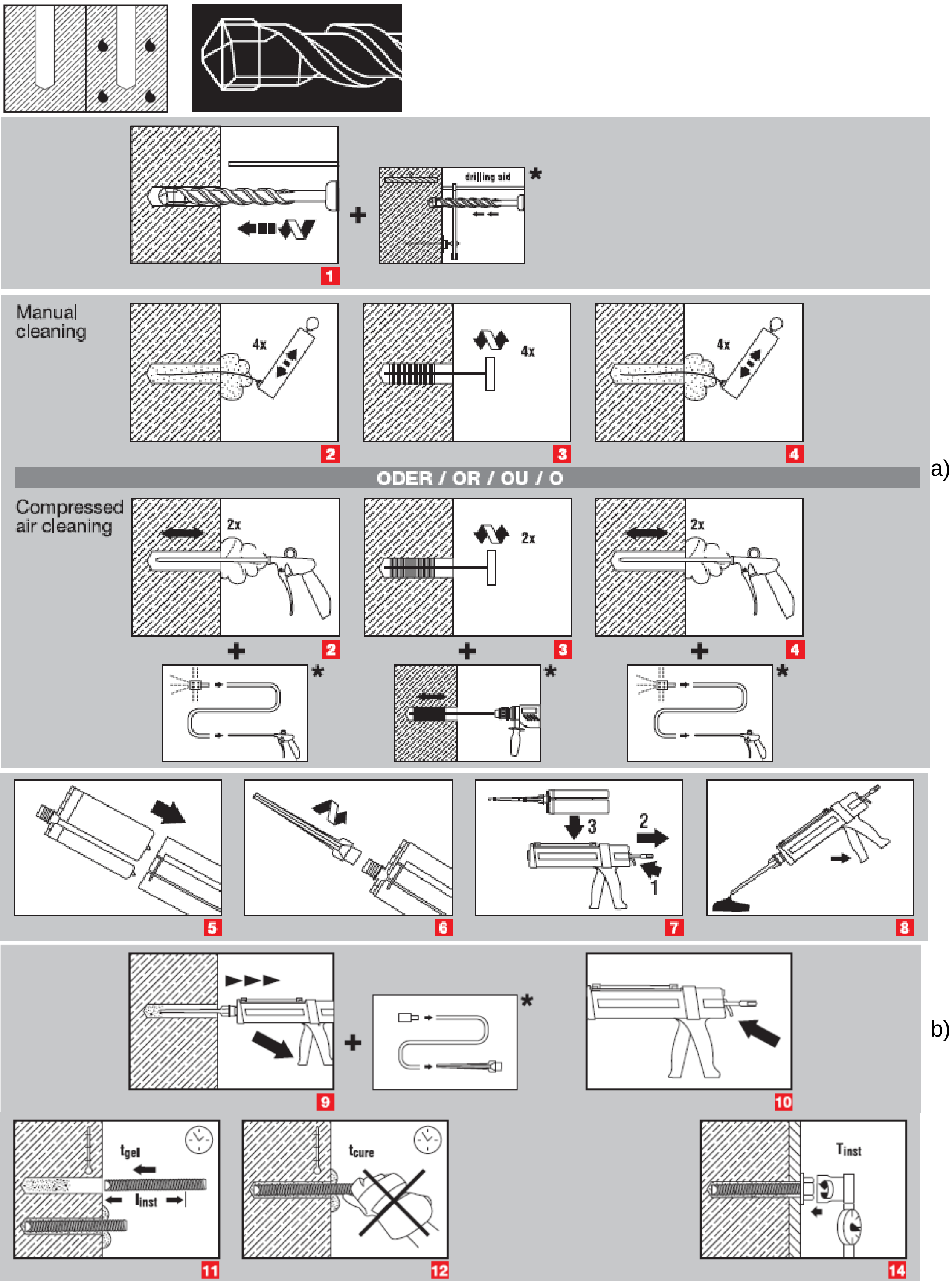
Setting

installation equipment

Anchor size	M8x90	M10x110	M12x125	M16x170	M20x205
Rotary hammer	TE 2 – TE 30		TE 40 – TE 70		
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser				

Setting instruction

Dry and water-saturated concrete, hammer drilling



a) Note: **Manual cleaning for drill hole sizes $d_0 \leq$ 18mm only!**
Compressed air cleaning for all bore hole diameters and all bore hole depth
b) Note: **Extension and piston plug needed for overhead installation!**

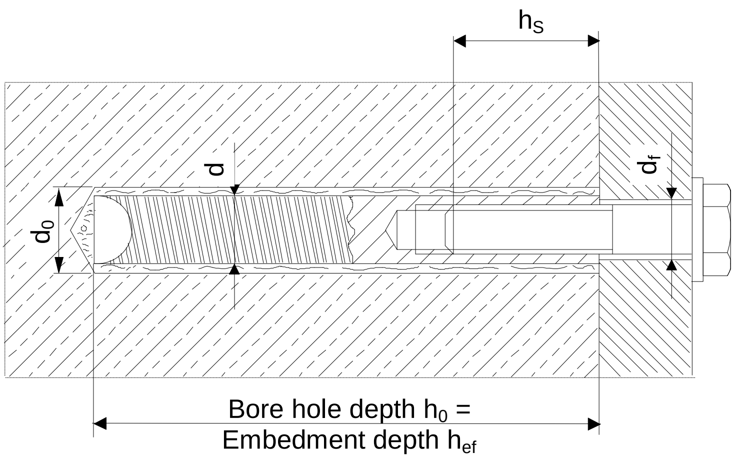
For detailed information on installation see instruction for use given with the package of the product.

Working time, Curing time

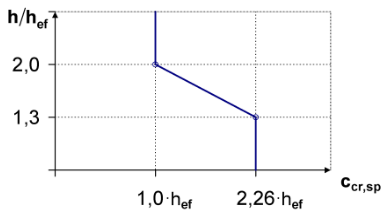
Temperature of the base material T_{BM}	Working time t_{gel}	Curing time t_{cure} a)
-5 °C to -1 °C	90 min	9 h
0 °C to 4 °C	45 min	4,5 h
5 °C to 9 °C	20 min	2 h
10 °C to 19 °C	6 min	90 min
20 °Cto 29 °C	4 min	50 min
30 °C to 40 °C	2 min	40 min

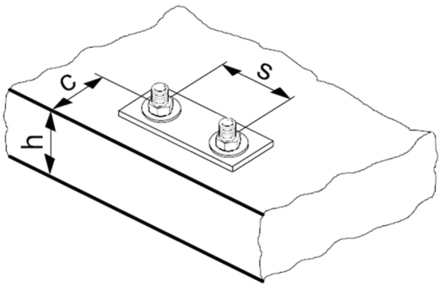
a) The curing time data are valid for dry anchorage base only. For water saturated anchorage bases the curing times must be doubled.

Setting details



Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Nominal diameter of drill bit	d_0	[mm]	14	18	22	28	32
Diameter of element	d	[mm]	12,5	16,5	20,5	25,4	27,6
Effective anchorage and drill hole depth	h_{ef}	[mm]	90	110	125	170	205
Minimum base material thickness	h_{min}	[mm]	120	150	170	230	270
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22
Thread engagement length; min - max	h_s	[mm]	8-20	10-25	12-30	16-40	20-50
Torque moment [a]	T_{max}	[Nm]	10	20	40	80	150
Minimum spacing	s_{min}	[mm]	40	45	55	65	90
Minimum edge distance	c_{min}	[mm]	40	45	55	65	90
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$				
Critical edge distance for splitting failure [b]	$c_{cr,sp}$	[mm]	**1,0 · h_{ef}**	for $h / h_{ef} \geq 2,0$			
			4,6 h_{ef} - 1,8 h	for $2,0 > h / h_{ef} > 1,3$			
			2,26 h_{ef}	for $h / h_{ef} \leq 1,3$			
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	2 $c_{cr,N}$				
Critical edge distance for concrete cone failure [c]	$c_{cr,N}$	[mm]	1,5 h_{ef}				





For spacing (or edge distance) smaller than critical spacing (or critical edge distance) the design loads have to be reduced.

a) Maximum recommended torque moment to avoid splitting failure during installation with minimum spacing and/or edge distance.

b) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

c) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

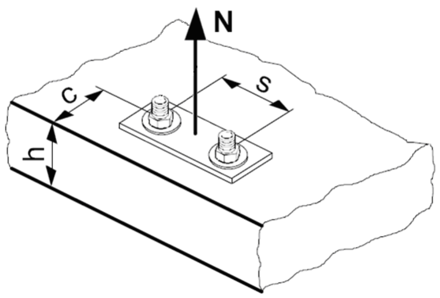
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
$N_{Rd,s}$	HIS-N	[kN]	17,5	30,7	44,7	80,3	74,1
	HIS-RN	[kN]	13,9	21,9	31,6	58,8	69,2

Design combined pull-out and concrete cone resistance
$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
$N^0_{Rd,p}$	Temperature range I	[kN]	23,3	26,7	40,0	63,9	77,8
$N^0_{Rd,p}$	Temperature range II	[kN]	13,3	20,0	26,7	41,7	52,8
$N^0_{Rd,p}$	Temperature range III	[kN]	10,7	13,3	20,0	27,8	33,3

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

Anchor size		M8	M10	M12	M16	M20
$N^0_{Rd,c}$	[kN]	28,7	38,8	47,1	62,2	82,3

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,15}$ a)	1,00	1,03	1,06	1,09	1,11	1,13	1,14

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = 1$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min}. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min}. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = 1$$

Influence of reinforcement

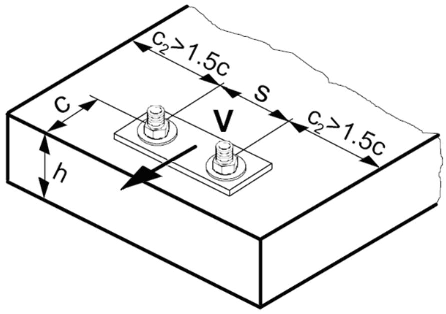
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp}$ = k · lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
$V_{Rd,s}$	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of k · $N_{Rd,p}$ and k · $N_{Rd,c}$

k = 2 for $h_{ef} \geq$ 60 mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20
Non-cracked concrete						
$V^0_{Rd,c}$	[kN]	12,4	19,6	28,2	40,2	46,2

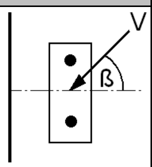
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20
f_{hef} =	1,38	1,21	1,04	1,22	1,45

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

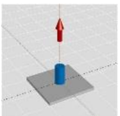
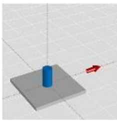
For combined tension and shear loading see section "Anchor Design".

Precalculated values – design resistance values

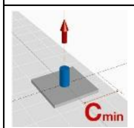
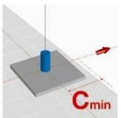
All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

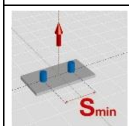
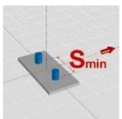
Design resistance: non-cracked- concrete C 20/25

Anchor size		M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth h_{ef}	[mm]	90	110	125	170	205
Base material thickness $h = h_{min}$	[mm]	120	150	170	230	270
 **Tensile N_{Rd}: single anchor, no edge effects**						
HIS-N	[kN]	17,5	26,7	40,0	62,2	74,1
HIS-RN	[kN]	13,9	21,9	31,6	58,8	69,2
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**						
HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Design resistance: non-cracked- concrete C 20/25

Anchor size		M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth h_{ef}	[mm]	90	110	125	170	205
Base material thickness $h = h_{min}$	[mm]	120	150	170	230	270
Edge distance $c = c_{min}$	[mm]	40	45	55	65	90
 **Tensile N_{Rd}: single single anchor, min. edge distance ($c = c_{min}$)**						
HIS-N	[kN]	11,9	13,4	20,4	27,5	37,4
HIS-RN	[kN]	11,9	13,4	20,4	27,5	37,4
 **Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**						
HIS-N	[kN]	4,2	5,5	7,6	10,8	17,2
HIS-RN	[kN]	4,2	5,5	7,6	10,8	17,2

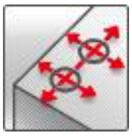
Design resistance: non-cracked- concrete C 20/25

Anchor size		M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth h_{ef}	[mm]	90	110	125	170	205
Base material thickness $h = h_{min}$	[mm]	120	150	170	230	270
Spacing $s = s_{min}$	[mm]	40	45	55	65	90
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**						
HIS-N	[kN]	14,3	16,9	24,2	33,8	45,2
HIS-RN	[kN]	13,9	16,9	24,2	33,8	45,2
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**						
HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

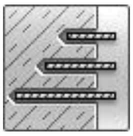
Hilti HIT-HY 110 mortar with rebar (as anchor)

<table>
<tr><th colspan="2">Injection mortar system</th><th>Benefits</th></tr>
<tr><td></td><td>Hilti
HIT-HY 110
500 ml foil pack
(also available as 330 ml foil pack)</td><td rowspan="3">- suitable for non-cracked concrete C 20/25 to C 50/60
- suitable for dry and water saturated concrete
- small edge distance and anchor spacing possible
- large diameter applications
- in service temperature range up to 120°C short term/72°C long term
- manual cleaning for drill hole sizes ≤ 18 mm and embedment depth $h_{ef} \le 10d$
- embedment depth range
Ø8: 60 to 160 mm
Ø25: 120 to 500 mm</td></tr>
<tr><td></td><td>Static mixer</td></tr>
<tr><td></td><td>rebar BSt 500 S</td></tr>
</table>

Concrete



Small edge distance and spacing



Variable embedment depth

European Technical Approval

CE conformity

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European Technical Approval [a)]	DIBt, Berlin	ETA-08/0341 / 2013-03-18

a) All data given in this section according ETA-08/0341 issue 2013-03-18.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- Anchor material: rebar BSt 500 S
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -5°C to +40°C

Embedment depth [a] and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth $h_{ef} = h_{ef,typ}$ [b] [mm]	80	90	110	125	170	210	240
Base material thickness h [mm]	110	120	140	165	220	270	300

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.
b) $h_{ef,typ}$: Typical embedment depth

Mean ultimate resistance: non-cracked concrete C 20/25 , anchor BSt 500 S

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Tensile $N_{Ru,m}$	BST 500 S	[kN]	22,8	32,0	47,0	55,0	72,9	106,8	164,9
Shear $V_{Ru,m}$	BST 500 S	[kN]	*14,7*	*23,1*	*32,6*	*44,1*	*57,8*	*90,3*	*141,8*

Characteristic resistance: non-cracked concrete C 20/25 , anchor BSt 500 S

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Tensile N_{Rk}	BST 500 S	[kN]	17,1	24,0	35,2	41,2	54,7	80,1	123,7
Shear V_{Rk}	BST 500 S	[kN]	*14,0*	*22,0*	*31,0*	*42,0*	*55,0*	*86,0*	*135,0*

Design resistance: non-cracked concrete C 20/25 , anchor BSt 500 S

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Tensile N_{Rd}	BST 500 S	[kN]	11,4	13,4	19,6	19,6	26,0	38,1	58,9
Shear V_{Rd}	BST 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

Recommended loads [a]: non-cracked concrete C 20/25 , anchor BSt 500 S

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Tensile N_{rec}	BST 500 S	[kN]	8,1	9,5	14,0	14,0	18,6	27,2	42,1
Shear V_{rec}	BST 500 S	[kN]	6,7	10,5	14,8	20,0	26,2	41,0	64,3

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-HY 110 injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +80 °C	+50 °C	+80 °C
Temperature range III	-40 °C to +120 °C	+72 °C	+120 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of rebar BSt 500S

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Nominal tensile strength f_{uk}	BSt 500 S	[N/mm²]	550						
Yield strength f_{yk}	BSt 500 S	[N/mm²]	500						
Stressed cross-section A_s	BSt 500 S	[mm²]	50,3	78,5	113,1	153,9	201,1	314,2	490,9
Moment of resistance W	BSt 500 S	[mm³]	50,3	98,2	169,6	269,4	402,1	785,4	1534

Material quality

Part	Material
rebar BSt 500 S	Mechanical properties according to DIN 488-1:1984 Geometry according to DIN 488-21:1986

Anchor dimensions

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
rebar BSt 500 S	rebar are available in variable length						

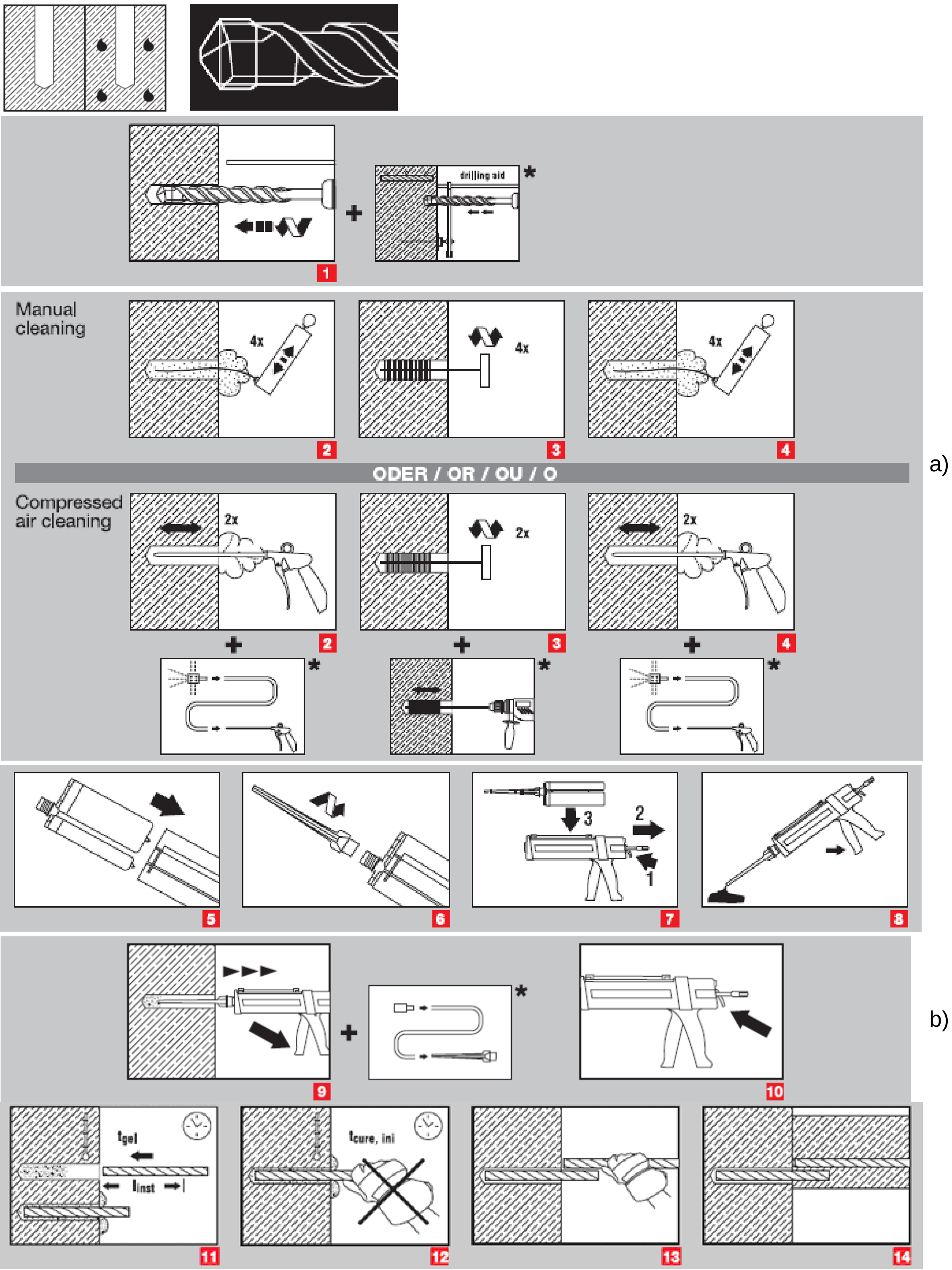
Setting

installation equipment

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Rotary hammer	TE 2 – TE 30					TE 40 – TE 70	
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser						

Setting instruction

Dry and water-saturated concrete, hammer drilling



a) Note: **Manual cleaning for drill hole sizes $d_0 \leq 18$mm and embedment depth $h_{ef} \leq 10$ d only!**
Compressed air cleaning for all bore hole diameters and all bore hole depth
b) Note: **Extension and piston plug needed for overhead installation and/or embedment depth > 250mm!**

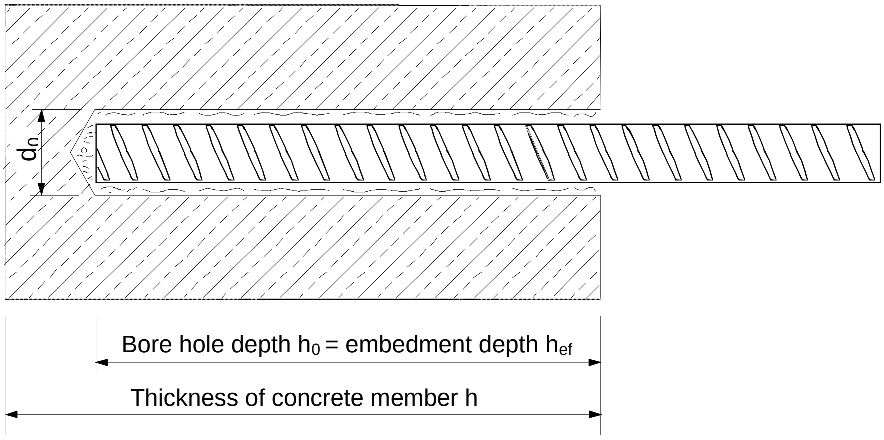
For detailed information on installation see instruction for use given with the package of the product.

Working time, Curing time

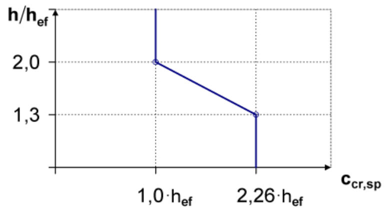
Temperature of the base material T_{BM}	Working time t_{gel}	Curing time t_{cure} a)
-5 °C to -1 °C	90 min	9 h
0 °C to 4 °C	45 min	4,5 h
5 °C to 9 °C	20 min	2 h
10 °C to 19 °C	6 min	90 min
20 °Cto 29 °C	4 min	50 min
30 °C to 40 °C	2 min	40 min

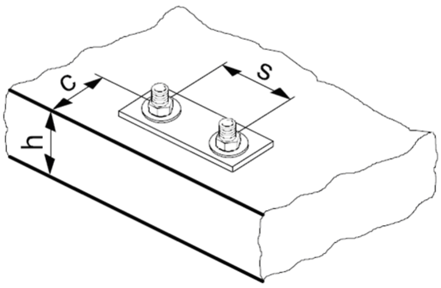
a) The curing time data are valid for dry anchorage base only. For water saturated anchorage bases the curing times must be doubled.

Setting details



Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Nominal diameter of drill bit	d_0	[mm]	12	14	16	18	20	25	32
Effective embedment and drill hole depth range [a)]	$h_{ef,min}$	[mm]	60	60	70	75	80	90	100
for rebar BSt 500 S	$h_{ef,max}$	[mm]	160	200	240	280	320	400	500
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm		$h_{ef} + 2\ d_0$				
Minimum spacing	s_{min}	[mm]	40	50	60	70	80	100	150
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120	150
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$						
Critical edge distance for splitting failure [b)]	$c_{cr,sp}$	[mm]	$\mathbf{1{,}0 \cdot h_{ef}}$	for $h / h_{ef} \geq 2{,}0$					
			$\mathbf{4{,}6\ h_{ef} - 1{,}8\ h}$	for $2{,}0 > h / h_{ef} > 1{,}3$					
			$\mathbf{2{,}26\ h_{ef}}$	for $h / h_{ef} \leq 1{,}3$					
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$						
Critical edge distance for concrete cone failure [c)]	$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$						





For spacing (or edge distance) smaller than critical spacing (or critical edge distance) the design loads have to be reduced.

a) Embedment depth range: $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$

b) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

c) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

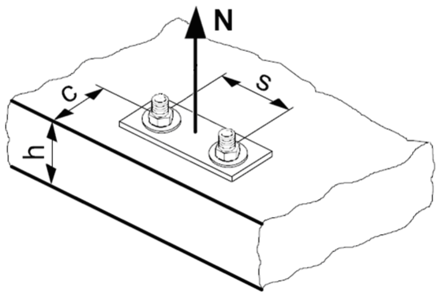
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
$N_{Rd,s}$	BSt 500 S	[kN]	20,0	30,7	44,3	60,7	79,3	123,6	192,9

Design combined pull-out and concrete cone resistance
$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth h_{ef} = Typical embedment depth $h_{ef,typ}$		[mm]	80	90	110	125	145	170	210
$N^0_{Rd,p}$	Temperature range I	[kN]	11,4	13,4	19,6	19,6	26,0	38,1	58,9
$N^0_{Rd,p}$	Temperature range II	[kN]	8,0	9,4	13,8	13,1	17,4	25,4	39,3
$N^0_{Rd,p}$	Temperature range III	[kN]	6,7	7,9	11,5	11,8	15,6	22,9	35,3

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
$N^0_{Rd,c}$	[kN]	24,1	24,0	32,4	33,6	42,0	53,3	73,2

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,15}$ a)	1,00	1,03	1,06	1,09	1,11	1,13	1,14

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min}. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min}. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

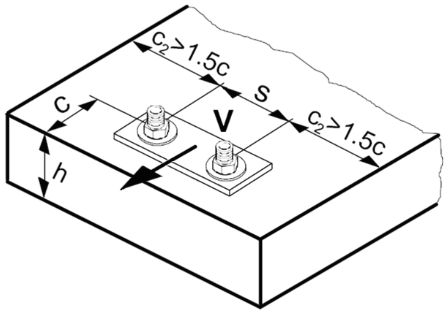
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp}$ = k · lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
$V_{Rd,s}$	Rebar BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

k = 2 for h_{ef} ≥ 60 mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Non-cracked concrete								
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,6	15,0	18,7	27,0	39,2

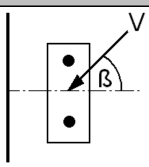
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

h_{ef}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

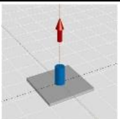
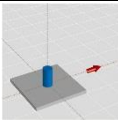
For combined tension and shear loading see section "Anchor Design".

Precalculated values – design resistance values

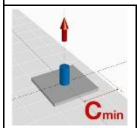
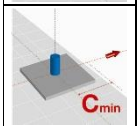
All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

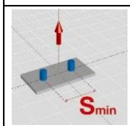
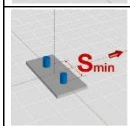
Design resistance: non- cracked concrete C 20/25 - minimum embedment depth

Anchor size		ø8	ø10	ø12	ø14	ø16	ø20	ø25
Embedment depth	$h_{ef} = h_{ef,min}$ [mm]	60	60	70	80	90	100	110
Base material thickness	$h = h_{min}$ [mm]	100	100	102	116	130	150	174
	**Tensile N_{Rd}: single anchor, no edge effects**							
	BSt 500 S [kN]	8,5	8,9	12,5	12,6	16,2	22,4	27,7
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**							
	BSt 500 S [kN]	9,3	14,7	20,7	25,1	32,3	44,9	55,5

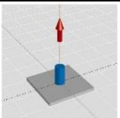
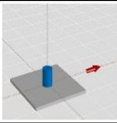
Design resistance: non- cracked concrete C 20/25 - minimum embedment depth

Anchor size		ø8	ø10	ø12	ø14	ø16	ø20	ø25
Embedment depth	$h_{ef} = h_{ef,min}$ [mm]	60	60	70	80	90	100	110
Base material thickness	$h = h_{min}$ [mm]	100	100	102	116	130	150	174
Edge distance	$c = c_{min}$ [mm]	40	50	60	80	100	120	135
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**							
	BSt 500 S [kN]	5,3	6,0	8,5	9,4	13,0	17,4	21,5
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**							
	BSt 500 S [kN]	3,5	4,9	6,6	10,0	13,2	17,4	21,8

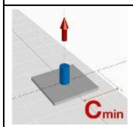
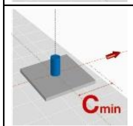
Design resistance: non- cracked concrete C 20/25 - minimum embedment depth
(load values are valid for single anchor)

Anchor size		ø8	ø10	ø12	ø14	ø16	ø20	ø25
Embedment depth	$h_{ef} = h_{ef,min}$ [mm]	60	60	70	80	90	100	110
Base material thickness	$h = h_{min}$ [mm]	100	100	100	116	138	156	170
Spacing	$s = s_{min}$ [mm]	40	50	60	80	100	120	135
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**							
	BSt 500 S [kN]	5,9	6,2	8,5	8,7	11,1	15,2	19,3
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**							
	BSt 500 S [kN]	9,3	11,4	16,0	16,2	20,9	29,9	40,4

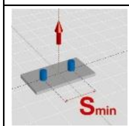
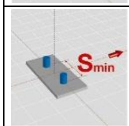
Design resistance: non- cracked concrete C 20/25 - typical embedment depth

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth $h_{ef} = h_{ef,typ}$ [mm]	80	90	110	125	145	170	210
Base material thickness $h = h_{min}$ [mm]	110	120	142	161	185	220	274
 **Tensile N_{Rd}: single anchor, no edge effects**							
BSt 500 S [kN]	11,4	13,4	19,6	19,6	26,0	38,1	58,9
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**							
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

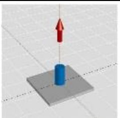
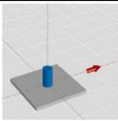
Design resistance: non- cracked concrete C 20/25 - typical embedment depth

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth $h_{ef} = h_{ef,typ}$ [mm]	80	90	110	125	145	170	210
Base material thickness $h = h_{min}$ [mm]	110	120	142	161	185	220	274
Edge distance $c = c_{min}$ [mm]	40	50	60	80	100	120	135
 **Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**							
BSt 500 S [kN]	7,0	8,3	12,1	13,4	18,8	26,9	37,0
 **Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**							
BSt 500 S [kN]	3,7	5,3	7,3	11,2	15,8	21,5	27,5

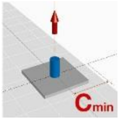
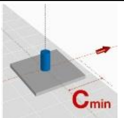
Design resistance: non- cracked concrete C 20/25 - typical embedment depth
(load values are valid for single anchor)

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth $h_{ef} = h_{ef,typ}$ [mm]	80	90	110	125	145	170	210
Base material thickness $h = h_{min}$ [mm]	110	120	142	161	185	220	274
Spacing $s = s_{min}$ [mm]	40	50	60	80	100	120	135
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**							
BSt 500 S [kN]	8,0	9,3	13,4	13,7	18,0	25,8	40,2
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**							
BSt 500 S [kN]	9,3	14,7	20,7	23,3	30,8	45,6	72,9

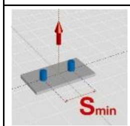
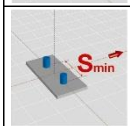
Design resistance: non- cracked concrete C 20/25 - embedment depth = 12 d [a)]

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth h_{ef} = 12 d [a)]	[mm]	96	120	144	168	192	240	300
Base material thickness h = h_{min}	[mm]	126	150	176	204	232	290	364
 **Tensile N_{Rd}: single anchor, no edge effects**								
BSt 500 S	[kN]	13,7	17,8	25,6	26,4	34,5	53,9	84,1
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**								
BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

Design resistance: non- cracked concrete C 20/25 - embedment depth = 12 d [a)]

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth h_{ef} = 12 d [a)]	[mm]	96	120	144	168	192	240	300
Base material thickness h = h_{min}	[mm]	126	150	176	204	232	290	364
Edge distance c = c_{min}	[mm]	40	50	60	80	100	120	135
 **Tensile N_{Rd}: single anchor, min. edge distance (c = c_{min})**								
BSt 500 S	[kN]	8,4	11,0	15,8	18,1	24,9	37,9	55,9
 **Shear V_{Rd}: single anchor, min. edge distance (c = c_{min}), without lever arm**								
BSt 500 S	[kN]	3,9	5,7	7,8	12,0	16,9	23,6	30,5

Design resistance: non- cracked concrete C 20/25 - embedment depth = 12 d [a)]
(load values are valid for single anchor)

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth h_{ef} = 12 d [a)]	[mm]	96	120	144	168	192	240	300
Base material thickness h = h_{min}	[mm]	126	150	176	204	232	290	364
Spacing s = s_{min}	[mm]	40	50	60	80	100	120	135
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min})**								
BSt 500 S	[kN]	9,7	12,5	17,9	18,7	24,2	37,3	59,2
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min}), without lever arm**								
BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

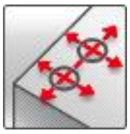
a) d = element diameter

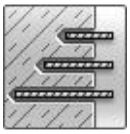
Hilti HIT-HY 100 mortar with HIT-V rod

Injection mortar system		Benefits
	Hilti HIT-HY 100 500 ml foil pack (also available as 330 ml foil pack)	- suitable for cracked and non-cracked concrete C20/25 to C50/60 - suitable for dry and water saturated concrete - small edge distance and anchor spacing possible - high corrosion resistant - in service temperature range up to 80°C short term/50°C long term - manual cleaning for drill hole sizes ≤ 18 mm and embedment depth h_{ef} ≤ 10d - embedment depth range M8: 60 to 160 mm M30: 120 to 600 mm
	Static mixer	
	HIT-V rods HIT-V-F HIT-V-R rods HIT-V-HCR rods	


Concrete


Tensile zone


Small edge distance and spacing


Variable embedment depth

A4 316
Corrosion resistance

HCR highMo
High corrosion resistance


European Technical Approval

CE
CE conformity

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European Technical Approval [a)]	CSTB, Paris France	ETA-14/0009 / 2014-05-24

a) All data given in this section according ETA-14/0009 issue 2014-05-24.

Basic loading data (for a single anchor)

All data in this section applies to For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- <u>One</u> typical embedment depth, as specified in the table
- <u>One</u> anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -10°C to +40°C

Embedment depth a) and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth h_{ef} [mm]	80	90	110	125	170	210	240	270
Base material thickness h [mm]	110	120	140	165	220	270	300	340

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

Mean ultimate resistance: concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	*18,9*	*30,5*	*44,1*	*83,0*	*129,2*	*185,9*	*241,5*	287,2
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	*9,5*	*15,8*	*22,1*	*41,0*	*64,1*	*92,4*	*120,8*	*147,0*
Cracked concrete										
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	-	20,6	30,3	45,9	-	-	-	-
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	-	15,8	22,1	41,0	-	-	-	-

Characteristic resistance: concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tensile N_{Rk}	HIT-V 5.8	[kN]	*18,0*	*29,0*	*42,0*	70,6	111,9	153,7	187,8	216,3
Shear V_{Rk}	HIT-V 5.8	[kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*	*115,0*	*140,0*
Cracked concrete										
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	-	15,6	22,8	34,6	-	-	-	-
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	-	15,0	21,0	39,0	-	-	-	-

Design resistance: concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tensile N_{Rd}	HIT-V 5.8	[kN]	12,0	19,3	28,0	39,2	62,2	85,4	104,3	120,2
Shear V_{Rd}	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
Cracked concrete										
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	-	8,6	12,7	19,2	-	-	-	-
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	-	12,0	16,8	31,2	-	-	-	-

Recommended loads a): concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tensile N_{rec}	HIT-V 5.8	[kN]	8,6	13,8	20,0	28,0	44,4	61,0	74,5	85,8
Shear V_{rec}	HIT-V 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3	65,7	80,0
Cracked concrete										
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	-	6,2	9,1	13,7	-	-	-	-
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	-	8,6	12,0	22,3	-	-	-	-

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-HY 100 injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIT-V

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal tensile strength f_{uk}	HIT-V 5.8	[N/mm²]	500	500	500	500	500	500	500	500
	HIT-V 8.8	[N/mm²]	800	800	800	800	800	800	800	800
	HIT-V-R	[N/mm²]	700	700	700	700	700	700	500	500
	HIT-V-HCR	[N/mm²]	800	800	800	800	800	700	700	700
Yield strength f_{yk}	HIT-V 5.8	[N/mm²]	400	400	400	400	400	400	400	400
	HIT-V 8.8	[N/mm²]	640	640	640	640	640	640	640	640
	HIT-V-R	[N/mm²]	450	450	450	450	450	450	210	210
	HIT-V-HCR	[N/mm²]	600	600	600	600	600	400	400	400
Stressed cross-section A_s	HIT-V	[mm²]	36,6	58,0	84,3	157	245	353	459	561
Moment of resistance W	HIT-V	[mm³]	31,2	62,3	109	277	541	935	1387	1874

Material quality

Part	Material
Threaded rod HIT-V(-F), 5.8: M8 – M24	Strength class 5.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V(-F), 8.8: M27 – M30	Strength class 8.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V-R	Stainless steel grade A4, A_5 > 8% ductile strength class 70 for ≤ M24 and class 50 for M27 to M30, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Threaded rod HIT-V-HCR	High corrosion resistant steel, 1.4529; 1.4565 strength ≤ M20: R_m = 800 N/mm², $R_{p\,0.2}$ = 640 N/mm², A_5 > 8% ductile M24 to M30: R_m = 700 N/mm², $R_{p\,0.2}$ = 400 N/mm², A_5 > 8% ductile
Washer ISO 7089	Steel galvanized, hot dipped galvanized,
	Stainless steel, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	High corrosion resistant steel, 1.4529; 1.4565
Nut EN ISO 4032	Strength class 8, steel galvanized ≥ 5 µm, hot dipped galvanized ≥ 45 µm
	Strength class 70, stainless steel grade A4, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	Strength class 70, high corrosion resistant steel, 1.4529; 1.4565

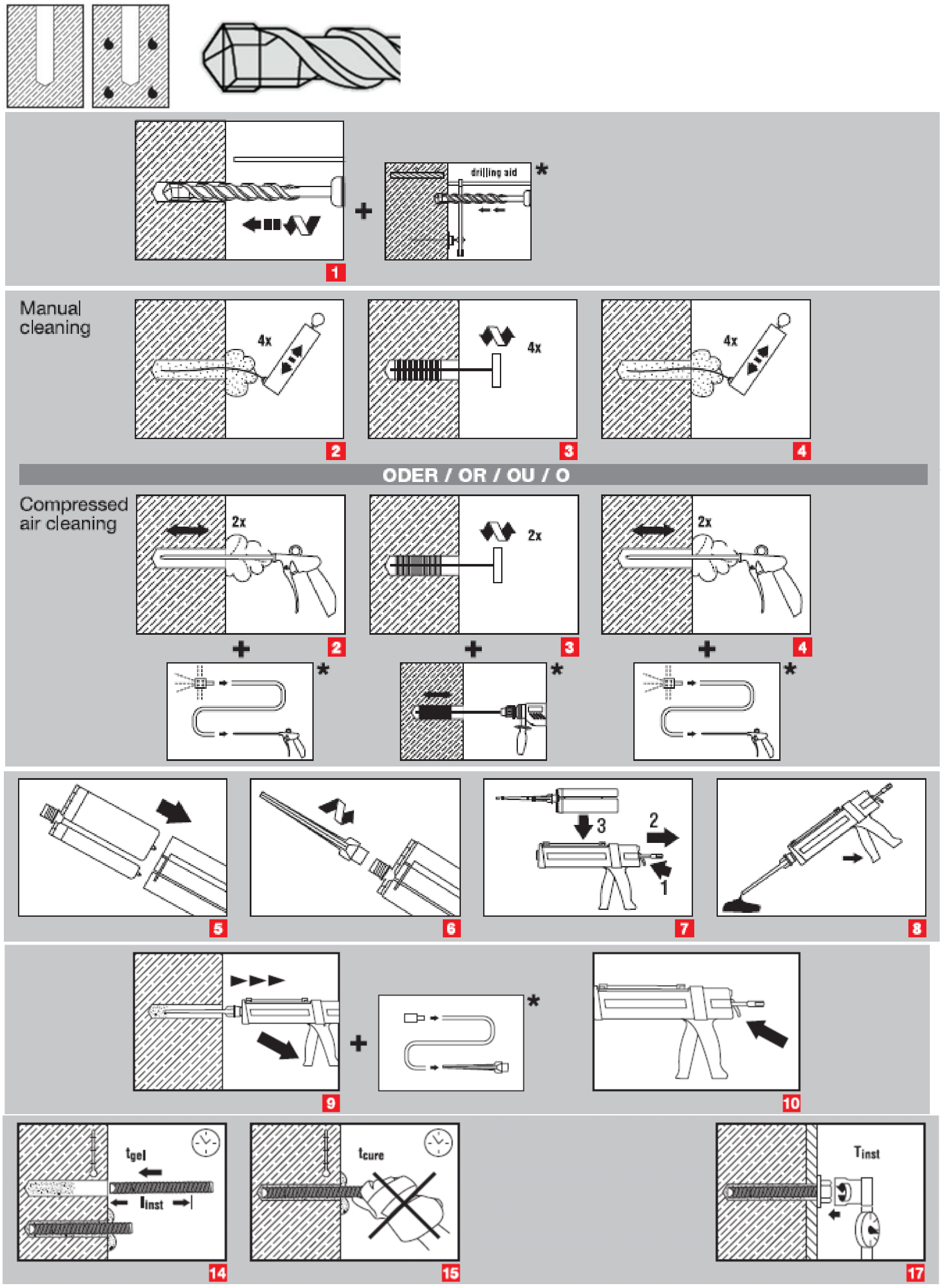
Setting

installation equipment

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Rotary hammer	TE 2 – TE 30				TE 40 – TE 70			
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser							

Setting instruction

Dry and water-saturated concrete, hammer drilling



a)

b)

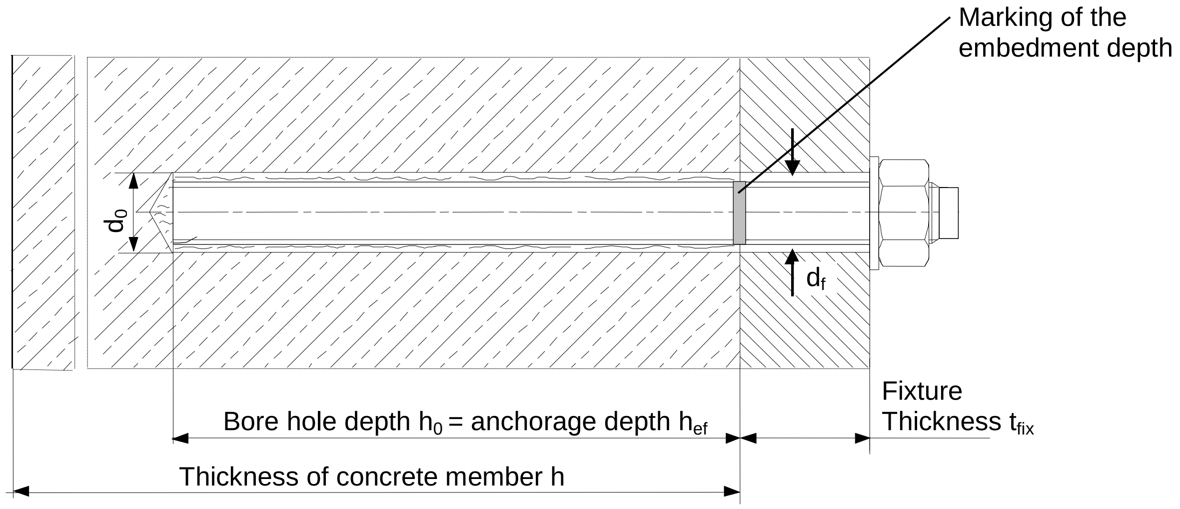
a) Note: **Manual cleaning for drill hole sizes $d_0 \leq$ 18mm and embedment depth $h_{ef} \leq$ 10 d only!**
Compressed air cleaning for all bore hole diameters and all bore hole depth
b) Note: **Extension and piston plug needed for overhead installation and/or embedment depth > 250mm!**

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

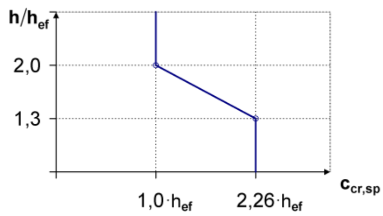
Working time, Curing time

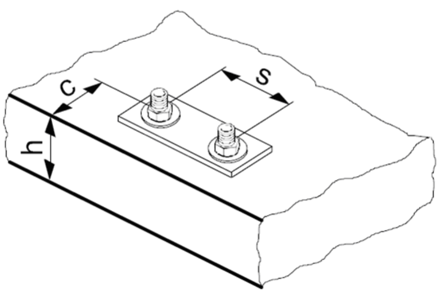
Temperature of the base material T_{BM}	Working time t_{gel}	Curing time t_{cure} a)
-10 °C < TBM < -6 °C	180 min	12 h
-5 °C < TBM < -1 °C	40 min	4 h
0 °C < TBM < +4 °C	20 min	2 h
+5 °C < TBM < +9 °C	8 min	1 h
+10 °C < TBM < +14 °C	7 min	50 min
+15 °C < TBM < +19 °C	6 min	40 min
+20 °C < TBM < +24 °C	5 min	30 min
+25 °C < TBM < +29 °C	3 min	30 min
+30 °C < TBM ≤ +40 °C	2 min	30 min

Setting details



Setting details

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	22	28	30	35
Effective embedment and drill hole depth range a)	$h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
for HIT-V	$h_{ef,max}$	[mm]	160	200	240	320	400	480	540	600
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			$h_{ef} + 2\ d_0$				
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22	26	30	33
Torque moment	T_{max} b)	[Nm]	10	20	40	80	150	200	270	300
Minimum spacing	s_{min}	[mm]	40	50	60	80	100	120	135	150
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120	135	150
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$							
Critical edge distance for splitting failure c)	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$** for $h / h_{ef} \geq 2{,}0$ **$4{,}6\ h_{ef} - 1{,}8\ h$** for $2{,}0 > h / h_{ef} > 1{,}3$ **$2{,}26\ h_{ef}$** for $h / h_{ef} \leq 1{,}3$							
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$							
Critical edge distance for concrete cone failure d)	$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$							



For spacing (or edge distance) smaller than critical spacing (or critical edge distance) the design loads have to be reduced.

a) Embedment depth range: $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$

b) Maximum recommended torque moment to avoid splitting failure during installation with minimum spacing and/or edge distance.

c) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

d) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

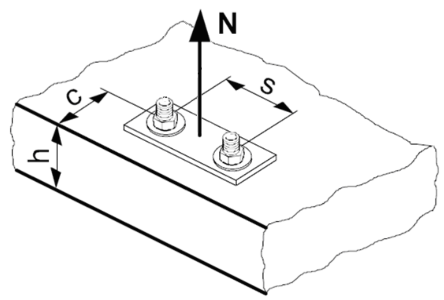
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,s}$	HIT-V 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	118,0	153,3	187,3
	HIT-V 8.8	[kN]	19,3	30,7	44,7	84,0	130,7	188,0	244,7	299,3
	HIT-V-R	[kN]	13,9	21,9	31,6	58,8	92,0	132,1	80,4	98,3
	HIT-V-HCR	[kN]	19,3	30,7	44,7	84,0	130,7	117,6	152,9	187,1

Design combined pull-out and concrete cone resistance

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth $h_{ef} = h_{ef,typ}$		[mm]	80	90	110	125	170	210	240	270
Non-cracked concrete										
$N^0_{Rd,p}$	Temperature range I	[kN]	15,6	22,0	32,3	45,4	71,2	96,8	113,1	120,2
$N^0_{Rd,p}$	Temperature range II	[kN]	13,4	18,8	27,6	41,9	65,3	88,0	101,8	99,0
Cracked concrete										
$N^0_{Rd,p}$	Temperature range I	[kN]	-	8,6	12,7	19,2	-	-	-	-
$N^0_{Rd,p}$	Temperature range II	[kN]	-	-	-	-	-	-	-	-

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$N^0_{Rd,c}$	Non-cracked concrete	[kN]	20,1	24,0	32,4	39,2	62,2	85,4	104,3	124,5
$N^0_{Rd,c}$	Cracked concrete	[kN]	-	17,1	23,1	27,9	-	-	-	-

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,15}$ a)	1,00	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min}. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min}. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

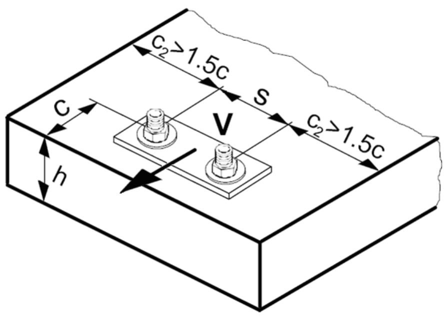
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N}$ = 0,5 + h_{ef}/200mm ≤ 1	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp}$ = k · lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$V_{Rd,s}$	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of k · $N_{Rd,p}$ and k · $N_{Rd,c}$

k = 2 for h_{ef} ≥ 60 mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete									
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,6	18,7	27,0	36,6	44,5	53,0
Cracked concrete									
$V^0_{Rd,c}$	[kN]	-	6,1	8,2	13,2	-	-	-	-

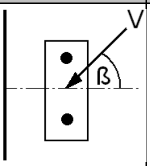
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß		0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \frac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$		1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

h_{ef}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

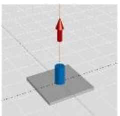
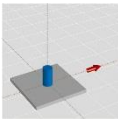
For combined tension and shear loading see section "Anchor Design".

Precalculated values – design resistance values

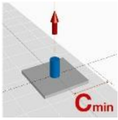
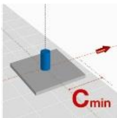
All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

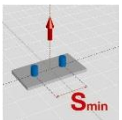
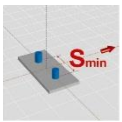
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth

Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef} = h_{ef,min}$		[mm]	60	60	70	80	90	100	110	120
Base material thickness $h = h_{min}$		[mm]	100	100	100	116	138	156	170	190
	Tensile N_{Rd}: single anchor, no edge effects									
	Non-cracked concrete									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	11,7	13,0	16,4	20,1	24,0	28,1	32,4	36,9
	Cracked concrete									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	-	5,8	8,1	12,3	-	-	-	-
	Shear V_{Rd}: single anchor, no edge effects, without lever arm									
	Non-cracked concrete									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	67,3	77,7	88,5
	HIT-V 8.8	[kN]	12,0	18,4	27,2	48,2	57,5	67,3	77,7	88,5
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	67,3	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	48,2	57,5	67,3	77,7	88,5
	Cracked concrete									
	HIT-V 5.8	[kN]	-	12,0	16,8	29,5	-	-	-	-
	HIT-V 8.8	[kN]	-	13,8	19,4	29,5	-	-	-	-
	HIT-V-R	[kN]	-	12,8	19,2	29,5	-	-	-	-
	HIT-V-HCR	[kN]	-	13,8	19,4	29,5	-	-	-	-

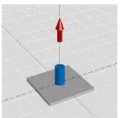
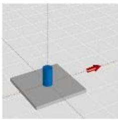
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
Base material thickness	$h = h_{min}$	[mm]	100	100	100	116	138	156	170	190
Edge distance	$c = c_{min}$	[mm]	40	50	60	80	100	120	135	150
	Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)									
	Non-cracked concrete									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	7,1	7,8	9,7	12,8	16,5	21,1	24,5	28,9
	Cracked concrete									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	-	3,9	5,5	9,1	-	-	-	-
	Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm									
	Non-cracked concrete									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,5	4,9	6,6	10,2	14,1	18,3	21,8	25,9
	Cracked concrete									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	-	3,5	4,7	7,2	-	-	-	-

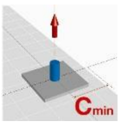
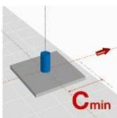
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth
(load values are valid for single anchor)

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
Base material thickness	$h = h_{min}$	[mm]	100	100	100	116	138	156	170	190
Spacing	$s = s_{min}$	[mm]	40	50	60	80	100	120	135	150
	Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)									
	Non-cracked concrete									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	7,4	7,9	10,0	12,6	15,4	18,7	21,6	25,0
	Cracked concrete									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	-	4,1	5,6	8,5	-	-	-	-
	Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm									
	Non-cracked concrete									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	39,4	47,1	54,7	62,7
	HIT-V 8.8	[kN]	12,0	17,7	24,9	32,1	39,4	47,1	54,7	62,7
	HIT-V-R	[kN]	8,3	12,8	19,2	32,1	39,4	47,1	48,3	58,8
	HIT-V-HCR	[kN]	12,0	17,7	24,9	32,1	39,4	47,1	54,7	62,7
	Cracked concrete									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	-	8,8	12,4	19,7	-	-	-	-

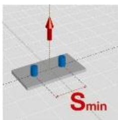
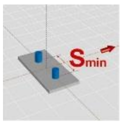
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth

Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	170	210	240	270
Base material thickness $h = h_{min}$	[mm]	110	120	140	161	218	266	300	340
Tensile N_{Rd}: single anchor, no edge effects									
Non-cracked concrete									
HIT-V 5.8	[kN]	12,0	19,3	28,0	39,2	62,2	85,4	104,3	120,2
HIT-V 8.8	[kN]	15,6	22,0	32,3	39,2	62,2	85,4	104,3	120,2
HIT-V-R	[kN]	13,9	21,9	31,6	39,2	62,2	85,4	80,4	98,3
HIT-V-HCR	[kN]	15,6	22,0	32,3	39,2	62,2	85,4	104,3	120,2
Cracked concrete 									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	-	8,6	12,7	19,2	-	-	-	-
Shear V_{Rd}: single anchor, no edge effects, without lever arm									
Non-cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0
Cracked concrete 									
HIT-V 5.8	[kN]	-	12,0	16,8	31,2	-	-	-	-
HIT-V 8.8	[kN]	-	18,4	27,2	46,1	-	-	-	-
HIT-V-R	[kN]	-	12,8	19,2	35,3	-	-	-	-
HIT-V-HCR	[kN]	-	18,4	27,2	46,1	-	-	-	-

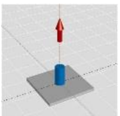
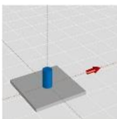
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth

Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	170	210	240	270
Base material thickness $h = h_{min}$	[mm]	110	120	140	161	218	266	300	340
Edge distance $c = c_{min}$	[mm]	40	50	60	80	100	120	135	150
Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)									
Non-cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	8,6	11,6	15,5	19,7	30,5	41,5	50,5	60,0
Cracked concrete 									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	-	4,8	7,0	11,3	-	-	-	-
Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm									
Non-cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,7	5,3	7,3	11,5	17,2	23,6	29,0	34,8
Cracked concrete 									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	-	3,8	5,2	8,1	-	-	-	-

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth
(load values are valid for single anchor)

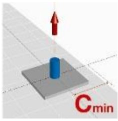
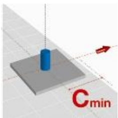
	Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
	Embedment depth $h_{ef} = h_{ef,typ}$ [mm]	80	90	110	125	170	210	240	270
	Base material thickness $h = h_{min}$ [mm]	110	120	140	161	218	266	300	340
	Spacing s [mm]	40	50	60	80	100	120	135	150
	Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)								
	Non-cracked concrete								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	9,9	13,4	18,1	22,4	35,1	48,1	58,6	69,9
	Cracked concrete								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	-	5,9	8,6	12,8	-	-	-	-
	Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm								
	Non-cracked concrete								
	HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8 [kN]	12,0	18,4	27,2	45,7	72,4	100,5	120,9	140,7
	HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR [kN]	12,0	18,4	27,2	45,7	72,4	70,9	92,0	112,0
	Cracked concrete								
	HIT-V 5.8 [kN] HIT-V 8.8 [kN] HIT-V-R [kN] HIT-V-HCR [kN]	-	12,0	16,8	28,0	-	-	-	-

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d [a)]

	Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
	Embedment depth h_{ef} = 12 d [a)] [mm]	96	120	144	192	240	288	324	360
	Base material thickness $h = h_{min}$ [mm]	126	150	174	228	288	344	384	430
	Tensile N_{Rd}: single anchor, no edge effects								
	Non-cracked concrete								
	HIT-V 5.8 [kN]	12,0	19,3	28,0	52,7	82,0	118,0	152,7	160,2
	HIT-V 8.8 [kN]	18,8	29,3	42,2	69,7	100,5	132,7	152,7	160,2
	HIT-V-R [kN]	13,9	21,9	31,6	58,8	92,0	132,1	80,4	98,3
	HIT-V-HCR [kN]	18,8	29,3	42,2	69,7	100,5	117,6	152,7	160,2
	Cracked concrete								
	HIT-V 5.8 [kN] HIT-V 8.8 [kN] HIT-V-R [kN] HIT-V-HCR [kN]	-	11,5	16,6	29,5	-	-	-	-
	Shear V_{Rd}: single anchor, no edge effects, without lever arm								
	Non-cracked concrete								
	HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8 [kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR [kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0
	Cracked concrete								
	HIT-V 5.8 [kN]	-	12,0	16,8	31,2	-	-	-	-
	HIT-V 8.8 [kN]	-	18,4	27,2	50,4	-	-	-	-
	HIT-V-R [kN]	-	12,8	19,2	35,3	-	-	-	-
	HIT-V-HCR [kN]	-	18,4	27,2	50,4	-	-	-	-

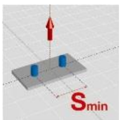
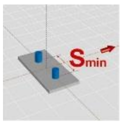
a) d = element diameter

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d [a)]

Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth h_{ef} = 12 d [a)]	[mm]	96	120	144	192	240	288	324	360
Base material thickness $h = h_{min}$	[mm]	126	150	174	228	288	344	384	430
Edge distance $c = c_{min}$	[mm]	40	50	60	80	100	120	135	150
Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)									
Non-cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	10,4	16,2	21,7	33,4	46,7	61,3	73,2	85,7
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	-	6,4	9,2	16,6	-	-	-	-
Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,9	5,7	7,8	12,9	18,9	25,9	31,8	38,1
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	-	4,0	5,5	9,1	-	-	-	-

a) d = element diameter

**Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d [a)]
(load values are valid for single anchor)**

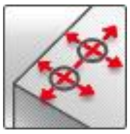
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth h_{ef} = 12 d [a)]		[mm]	96	120	144	192	240	288	324	360
Base material thickness $h = h_{min}$		[mm]	126	150	174	228	288	344	384	430
Spacing $s=s_{min}$		[mm]	40	50	60	80	100	120	135	150
	Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)									
	Non-cracked concrete									
	HIT-V 5.8	[kN]	12,0	18,5	26,0	40,8	57,0	74,9	89,4	103,8
	HIT-V 8.8	[kN]	12,1	18,5	26,0	40,8	57,0	74,9	89,4	103,8
	HIT-V-R	[kN]	12,1	18,5	26,0	40,8	57,0	74,9	80,4	98,3
	HIT-V-HCR	[kN]	12,1	18,5	26,0	40,8	57,0	74,9	89,4	103,8
	Cracked concrete									
	HIT-V 5.8	[kN]	-	8,0	11,4	20,0	-	-	-	-
	HIT-V 8.8	[kN]								
	HIT-V-R	[kN]								
	HIT-V-HCR	[kN]								
	Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm									
	Non-cracked concrete									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0
	Cracked concrete									
	HIT-V 5.8	[kN]	-	12,0	16,8	31,2	-	-	-	-
	HIT-V 8.8	[kN]	-	15,7	22,7	40,3	-	-	-	-
	HIT-V-R	[kN]	-	12,8	19,2	35,3	-	-	-	-
	HIT-V-HCR	[kN]	-	15,7	22,7	40,3	-	-	-	-

a) d = element diameter

Hilti HIT-HY 100 mortar with HIS-(R)N sleeve

Injection mortar system		Benefits
	Hilti HIT-HY 100 500 ml foil pack (also available as 330 ml foil pack) Static mixer Internal threaded sleeve HIS-N HIS-RN	- suitable for non-cracked concrete C 20/25 to C 50/60 - suitable for dry and water saturated concrete - small edge distance and anchor spacing possible - corrosion resistant - in service temperature range up to 80°C short term/50°C long term - manual cleaning for drill hole sizes ≤ 18 mm

Concrete



Small edge distance and spacing

Corrosion resistance

European Technical Approval

CE conformity

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European Technical Approval [a)]	CSTB, Paris France	ETA-14/0009 / 2014-05-24

a) All data given in this section according ETA-14/0009 issue 2014-05-24.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -10°C to +40°C

Embedment depth and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Base material thickness	h	[mm]	120	150	170	230	270

Mean ultimate resistance: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile $N_{Ru,m}$	HIS-N	[kN]	*26,3*	*48,3*	*70,4*	*123,9*	*114,5*
Shear $V_{Ru,m}$	HIS-N	[kN]	*13,7*	*24,2*	*41,0*	*62,0*	*57,8*

Characteristic resistance: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile N_{Rk}	HIS-N	[kN]	*25,0*	*46,0*	*67,0*	95,0	*109,0*
Shear V_{Rk}	HIS-N	[kN]	*13,0*	*23,0*	*39,0*	*59,0*	*55,0*

Design resistance: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile N_{Rd}	HIS-N	[kN]	17,5	27,8	39,2	52,8	63,9
Shear V_{Rd}	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7

Recommended loads [a)]: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile N_{rec}	HIS-N	[kN]	12,5	19,8	28,0	37,7	45,6
Shear V_{rec}	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-HY 100 injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIS-(R)N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Nominal tensile strength f_{uk}	HIS-N	[N/mm²]	490	490	460	460	460
	Screw 8.8	[N/mm²]	800	800	800	800	800
	HIS-RN	[N/mm²]	700	700	700	700	700
	Screw A4-70	[N/mm²]	700	700	700	700	700
Yield strength f_{yk}	HIS-N	[N/mm²]	410	410	375	375	375
	Screw 8.8	[N/mm²]	640	640	640	640	640
	HIS-RN	[N/mm²]	350	350	350	350	350
	Screw A4-70	[N/mm²]	450	450	450	450	450
Stressed cross-section A_s	HIS-(R)N	[mm²]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm²]	36,6	58	84,3	157	245
Moment of resistance W	HIS-(R)N	[mm³]	145	430	840	1595	1543
	Screw	[mm³]	31,2	62,3	109	277	541

Material quality

Part	Material
Internal threaded sleeve [a)] HIS-N	C-steel 1.0718, Steel galvanized ≥ 5µm
Internal threaded sleeve [a)] HIS-RN	Stainless steel 1.4401 and 1.4571

a) related fastening screw: strength class 8.8, A5 > 8% Ductile steel galvanized ≥ 5µm

b) related fastening screw: strength class 70, A5 > 8% Ductile stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362

Anchor dimensions

Anchor size Internal threaded sleeve HIS-N / HIS-RN			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	80	90	110	125	170

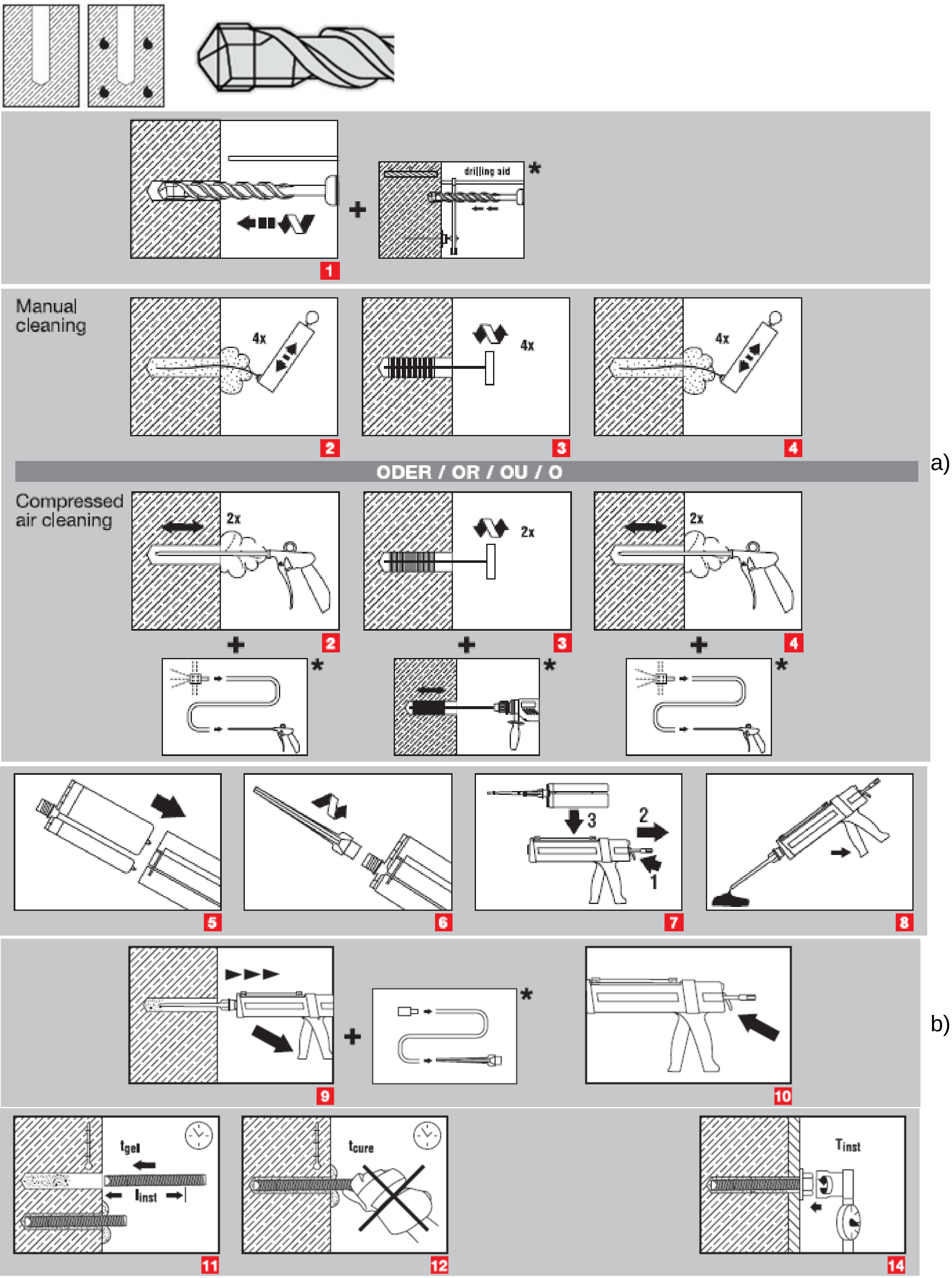
Setting

installation equipment

Anchor size	M8x90	M10x110	M12x125	M16x170	M20x205
Rotary hammer	TE 2 – TE 30		TE 40 – TE 70		
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser				

Setting instruction

Dry and water-saturated concrete, hammer drilling



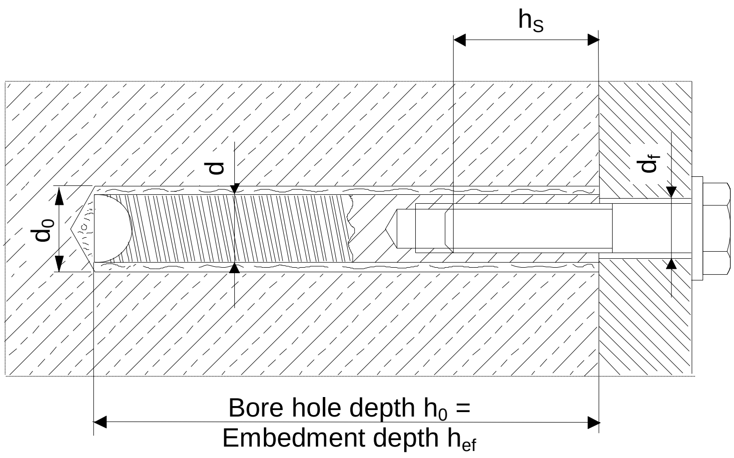
a) Note: **Manual cleaning for drill hole sizes $d_0 \leq$ 18mm only!**
Compressed air cleaning for all bore hole diameters and all bore hole depth
b) Note: **Extension and piston plug needed for overhead installation!**

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

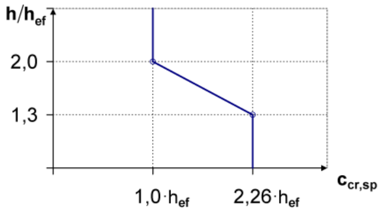
Working time, Curing time

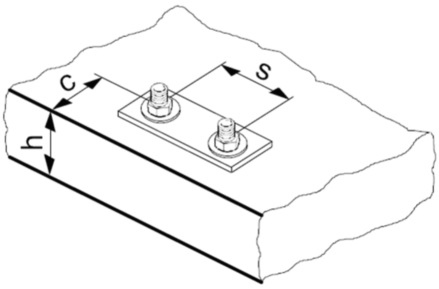
Temperature of the base material T_{BM}	Working time t_{gel}	Curing time t_{cure} a)
-10 °C < TBM < -6 °C	180 min	12 h
-5 °C < TBM < -1 °C	40 min	4 h
0 °C < TBM < +4 °C	20 min	2 h
+5 °C < TBM < +9 °C	8 min	1 h
+10 °C < TBM < +14 °C	7 min	50 min
+15 °C < TBM < +19 °C	6 min	40 min
+20 °C < TBM < +24 °C	5 min	30 min
+25 °C < TBM < +29 °C	3 min	30 min
+30 °C < TBM ≤ +40 °C	2 min	30 min

Setting details



Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Nominal diameter of drill bit	d_0	[mm]	14	18	22	28	32
Diameter of element	d	[mm]	12,5	16,5	20,5	25,4	27,6
Effective anchorage and drill hole depth	h_{ef}	[mm]	90	110	125	170	205
Minimum base material thickness	h_{min}	[mm]	120	150	170	230	270
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22
Thread engagement length; min - max	h_s	[mm]	8-20	10-25	12-30	16-40	20-50
Torque moment a)	T_{max}	[Nm]	10	20	40	80	150
Minimum spacing	s_{min}	[mm]	40	45	55	65	90
Minimum edge distance	c_{min}	[mm]	40	45	55	65	90
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$				
Critical edge distance for splitting failure b)	$c_{cr,sp}$	[mm]	**$1,0 \cdot h_{ef}$**	for $h / h_{ef} \geq 2,0$			
			$4,6\ h_{ef} - 1,8\ h$	for $2,0 > h / h_{ef} > 1,3$			
			$2,26\ h_{ef}$	for $h / h_{ef} \leq 1,3$			
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$				
Critical edge distance for concrete cone failure c)	$c_{cr,N}$	[mm]	$1,5\ h_{ef}$				





For spacing (or edge distance) smaller than critical spacing (or critical edge distance) the design loads have to be reduced.

a) Maximum recommended torque moment to avoid splitting failure during installation with minimum spacing and/or edge distance.

b) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

c) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

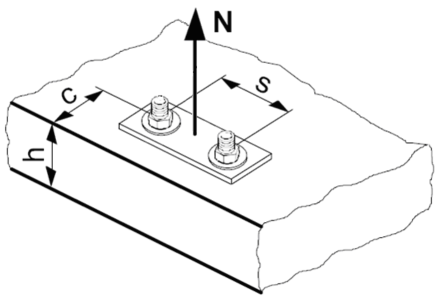
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
$N_{Rd,s}$	HIS-N	[kN]	17,5	30,7	44,7	80,3	74,1
	HIS-RN	[kN]	13,9	21,9	31,6	58,8	69,2

Design combined pull-out and concrete cone resistance
$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
$N^0_{Rd,p}$	Temperature range I	[kN]	19,4	27,8	41,7	52,8	63,9
$N^0_{Rd,p}$	Temperature range II	[kN]	16,7	27,8	33,3	52,8	52,8

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

Anchor size		M8	M10	M12	M16	M20
$N^0_{Rd,c}$	[kN]	24,0	32,4	39,2	62,2	82,3

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,15}$ a)	1,00	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = 1$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min}. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min}. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = 1$$

Influence of reinforcement

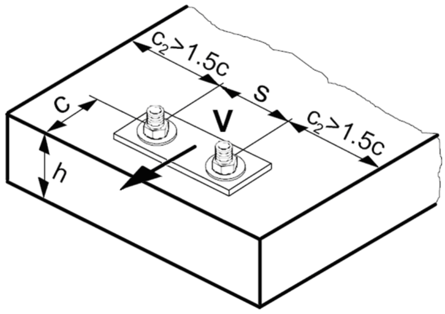
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $\mathbf{V_{Rd,s}}$
- Concrete pryout resistance: $\mathbf{V_{Rd,cp}}$ **= k** · lower value of $\mathbf{N_{Rd,p}}$ and $\mathbf{N_{Rd,c}}$
- Concrete edge resistance: $\mathbf{V_{Rd,c}} = \mathbf{V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c}$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
$V_{Rd,s}$	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of k · $N_{Rd,p}$ and k · $N_{Rd,c}$

k = 2 for $h_{ef} \geq 60$ mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20
Non-cracked concrete						
$V^0_{Rd,c}$	[kN]	12,4	19,6	28,2	40,2	46,2

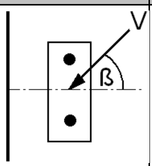
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\dfrac{1}{(\cos\alpha_V)^2 + \left(\dfrac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20
f_{hef} =	1,38	1,21	1,04	1,22	1,45

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = \quad (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

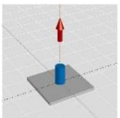
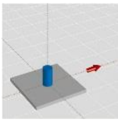
For combined tension and shear loading see section “Anchor Design”.

Precalculated values – design resistance values

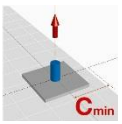
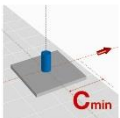
All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

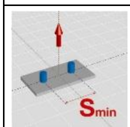
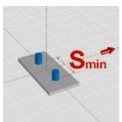
Design resistance: non-cracked- concrete C 20/25

Anchor size		**M8x90**	**M10x110**	**M12x125**	**M16x170**	**M20x205**
Embedment depth	h_{ef} [mm]	90	110	125	170	205
Base material thickness	$h = h_{min}$ [mm]	120	150	170	230	270
	**Tensile N_{Rd}: single anchor, no edge effects**					
	HIS-N [kN]	17,5	27,8	39,2	52,8	63,9
	HIS-RN [kN]	13,9	21,9	31,6	52,8	63,9
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**					
	HIS-N [kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN [kN]	8,3	12,8	19,2	35,3	41,5

Design resistance: non-cracked- concrete C 20/25

Anchor size		**M8x90**	**M10x110**	**M12x125**	**M16x170**	**M20x205**
Embedment depth	h_{ef} [mm]	90	110	125	170	205
Base material thickness	$h = h_{min}$ [mm]	120	150	170	230	270
Edge distance	$c = c_{min}$ [mm]	40	45	55	65	90
	**Tensile N_{Rd}: single single anchor, min. edge distance ($c = c_{min}$)**					
	HIS-N [kN]	9,9	13,8	18,0	26,0	34,8
	HIS-RN [kN]	9,9	13,8	18,0	26,0	34,8
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**					
	HIS-N [kN]	3,5	4,6	6,4	9,0	14,3
	HIS-RN [kN]	3,5	4,6	6,4	9,0	14,3

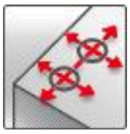
Design resistance: non-cracked- concrete C 20/25

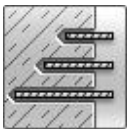
Anchor size		**M8x90**	**M10x110**	**M12x125**	**M16x170**	**M20x205**
Embedment depth	h_{ef} [mm]	90	110	125	170	205
Base material thickness	$h = h_{min}$ [mm]	120	150	170	230	270
Spacing	$s = s_{min}$ [mm]	40	45	55	65	90
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**					
	HIS-N [kN]	11,9	16,6	21,6	31,6	40,4
	HIS-RN [kN]					
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**					
	HIS-N [kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN [kN]	8,3	12,8	19,2	35,3	41,5

Hilti HIT-HY 100 mortar with rebar (as anchor)

Injection mortar system		Benefits
	Hilti HIT-HY 100 500 ml foil pack (also available as 330 ml foil pack)	- suitable for cracked and non-cracked concrete C 20/25 to C 50/60 - suitable for dry and water saturated concrete - small edge distance and anchor spacing possible - large diameter applications - in service temperature range up to 120°C short term/72°C long term - manual cleaning for drill hole sizes ≤ 18 mm and embedment depth $h_{ef} \leq 10d$ - embedment depth range Ø8: 60 to 160 mm Ø25: 120 to 500 mm
	Static mixer	
	rebar B500 B	


Concrete


Small edge distance and spacing


Variable embedment depth

European Technical Approval

CE conformity

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European Technical Approval [a)]	CSTB, Paris	ETA-14/0009 / 2014-05-24

a) All data given in this section according ETA-14/0009 issue 2014-05-24.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- Anchor material: rebar B500 B
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -5°C to +40°C

Embedment depth [a)] and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth $h_{ef} = h_{ef,typ}$ [b)] [mm]	80	90	110	125	145	170	210
Base material thickness h [mm]	110	120	140	165	185	220	274

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.
b) $h_{ef,typ}$: Typical embedment depth

Mean ultimate resistance: concrete C 20/25 , anchor B500 B

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Non-cracked concrete									
Tensile $N_{Ru,m}$	B500 B	[kN]	25,4	35,7	52,3	69,3	91,9	134,7	204,0
Shear $V_{Ru,m}$	B500 B	[kN]	*14,7*	*23,1*	*32,6*	*44,1*	*57,8*	*90,3*	*141,8*
Cracked concrete									
Tensile $N_{Ru,m}$	B500 B	[kN]	-	20,6	30,3	40,1	38,7	-	-
Shear $V_{Ru,m}$	B500 B	[kN]	-	*23,1*	*32,6*	*44,1*	*57,8*	-	-

Characteristic resistance: concrete C 20/25 , anchor B500 B

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Non-cracked concrete									
Tensile N_{Rk}	B500 B	[kN]	19,1	26,9	39,4	52,2	69,2	101,5	153,7
Shear V_{Rk}	B500 B	[kN]	*14,0*	*22,0*	*31,0*	*42,0*	*55,0*	*86,0*	*135,0*
Cracked concrete									
Tensile N_{Rk}	B500 B	[kN]	-	15,6	22,8	30,2	29,2	-	-
Shear V_{Rk}	B500 B	[kN]	-	*22,0*	*31,0*	*42,0*	*55,0*	-	-

Design resistance: concrete C 20/25 , anchor B500 B

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Non-cracked concrete									
Tensile N_{Rd}	B500 B	[kN]	10,6	14,9	21,9	29,0	38,5	56,4	85,4
Shear V_{Rd}	B500 B	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
Cracked concrete									
Tensile N_{Rd}	B500 B	[kN]	-	8,6	12,7	16,8	16,2	-	-
Shear V_{Rd}	B500 B	[kN]	-	14,7	20,7	28,0	36,7	-	-

Recommended loads [a)]: concrete C 20/25 , anchor B500 B

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Non-cracked concrete									
Tensile N_{rec}	B500 B	[kN]	7,6	10,7	15,6	20,7	27,5	40,3	61,0
Shear V_{rec}	B500 B	[kN]	6,7	10,5	14,8	20,0	26,2	41,0	64,3
Cracked concrete									
Tensile N_{rec}	B500 B	[kN]	-	6,2	9,1	12,0	11,6	-	-
Shear V_{rec}	B500 B	[kN]	-	10,5	14,8	20,0	26,2	-	-

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-HY 100 injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of rebar B500 B

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Nominal tensile strength f_{uk}	B500 B	[N/mm²]	550						
Yield strength f_{yk}	B500 B	[N/mm²]	500						
Stressed cross-section A_s	B500 B	[mm²]	50,3	78,5	113,1	153,9	201,1	314,2	490,9
Moment of resistance W	B500 B	[mm³]	50,3	98,2	169,6	269,4	402,1	785,4	1534

Material quality

Part	Material
rebar B500 B	EN 1992-1-1:2004 and AC:2010, Annex C Bars and de-coiled rods Class B or C with fyk and k according to NDP or NCL of EN 1992-1-1/NA:2013

Anchor dimensions

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
rebar B500 B	rebar are available in variable length						

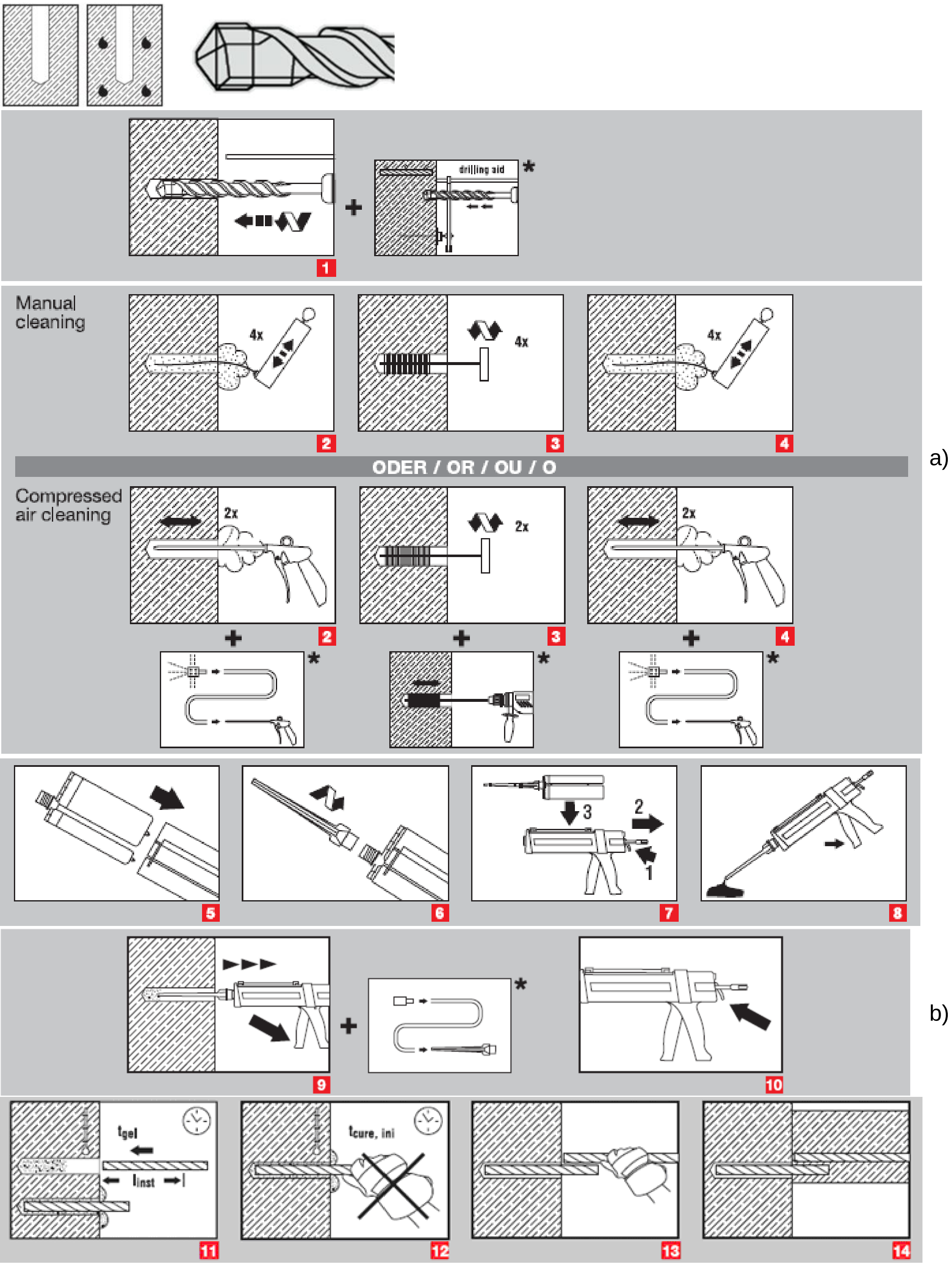
Setting

installation equipment

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Rotary hammer	TE 2 – TE 30					TE 40 – TE 70	
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser						

Setting instruction

Dry and water-saturated concrete, hammer drilling



a) Note: Manual cleaning for drill hole sizes $d_0 \leq$ 18mm and embedment depth $h_{ef} \leq$ 10 d only!
Manual cleaning for uncracked concrete only!
Compressed air cleaning for all bore hole diameters and all bore hole depth
b) Note: Extension and piston plug needed for overhead installation and/or embedment depth > 250mm!

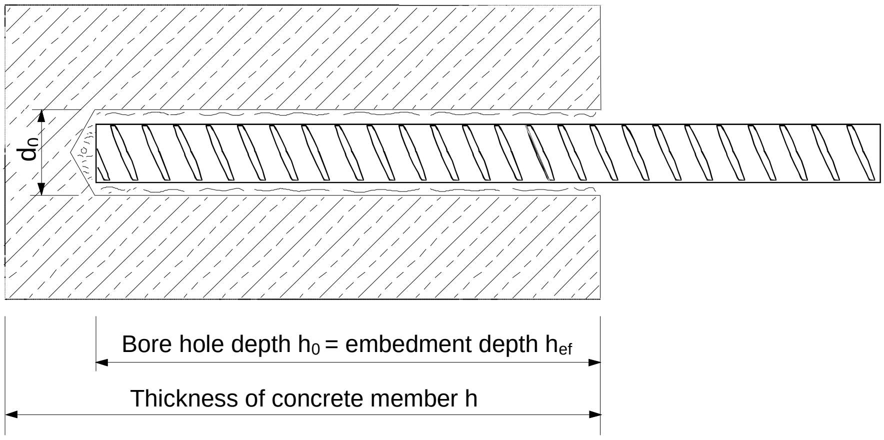
For detailed information on installation see instruction for use given with the package of the product.

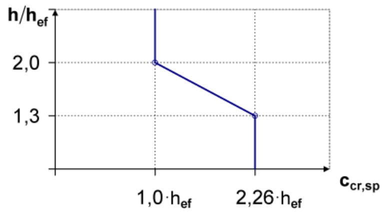
Working time, Curing time

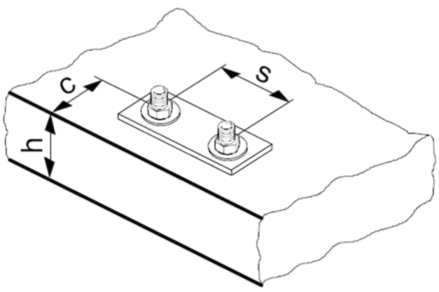
Temperature of the base material T_{BM}	Working time t_{gel}	Curing time t_{cure} a)
-5 °C to -1 °C	90 min	9 h
0 °C to 4 °C	45 min	4,5 h
5 °C to 9 °C	20 min	2 h
10 °C to 19 °C	6 min	90 min
20 °Cto 29 °C	4 min	50 min
30 °C to 40 °C	2 min	41 min

a) The curing time data are valid for dry anchorage base only. For water saturated anchorage bases the curing times must be doubled.

Setting details



Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Nominal diameter of drill bit	d_0	[mm]	12	14	16	18	20	25	32
Effective embedment and drill hole depth range a)	$h_{ef,min}$	[mm]	60	60	70	80	80	90	100
for rebar B500 B	$h_{ef,max}$	[mm]	160	200	240	280	320	400	500
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm		$h_{ef} + 2\ d_0$				
Minimum spacing	s_{min}	[mm]	40	50	60	70	80	100	125
Minimum edge distance	c_{min}	[mm]	40	50	60	70	80	100	125
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$						
Critical edge distance for splitting failure b)	$c_{cr,sp}$	[mm]	$\mathbf{1{,}0 \cdot h_{ef}}$ for $h / h_{ef} \geq 2{,}0$						
			$\mathbf{4{,}6\ h_{ef} - 1{,}8\ h}$ for $2{,}0 > h / h_{ef} > 1{,}3$						
			$\mathbf{2{,}26\ h_{ef}}$ for $h / h_{ef} \leq 1{,}3$						
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$						
Critical edge distance for concrete cone failure c)	$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$						



For spacing (or edge distance) smaller than critical spacing (or critical edge distance) the design loads have to be reduced.

a) Embedment depth range: $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$

b) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

c) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

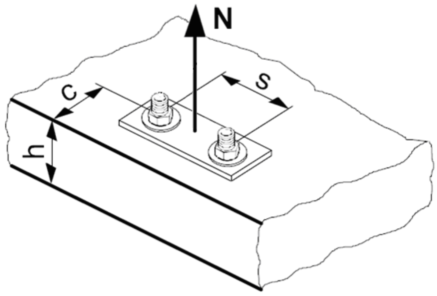
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
$N_{Rd,s}$	B500 B	[kN]	20,0	30,7	44,3	60,7	79,3	123,6	192,9

Design combined pull-out and concrete cone resistance

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth h_{ef} = Typical embedment depth $h_{ef,typ}$		[mm]	80	90	110	125	145	170	210
Non-cracked concrete									
$N^0_{Rd,p}$	Temperature range I	[kN]	10,6	14,9	21,9	29,0	38,5	56,4	87,0
$N^0_{Rd,p}$	Temperature range II	[kN]	8,9	12,6	18,4	24,4	32,4	47,5	73,3
Cracked concrete									
$N^0_{Rd,p}$	Temperature range I	[kN]	-	8,6	12,7	16,8	22,3	-	-
$N^0_{Rd,p}$	Temperature range II	[kN]	-	6,3	9,2	12,2	16,2	-	-

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
$N^0_{Rd,c}$ Non-cracked concrete [kN]	20,1	24,0	32,4	39,2	49,0	62,2	85,4
$N^0_{Rd,c}$ Cracked concrete [kN]	-	17,1	23,1	28,0	34,9	-	-

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,15}$ a)	1,00	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min}. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min}. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

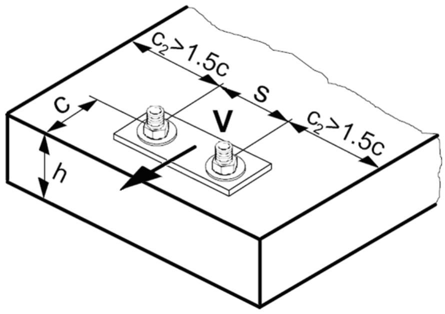
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N}$ = 0,5 + h_{ef}/200mm ≤ 1	0,7 [a)]	0,75 [a)]	0,8 [a)]	0,85 [a)]	0,9 [a)]	0,95 [a)]	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp}$ = k · lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
$V_{Rd,s}$ Rebar B500 B [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of k · $N_{Rd,p}$ and k · $N_{Rd,c}$

k = 2 for h_{ef} ≥ 60 mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Non-cracked concrete							
$V^0_{Rd,c}$ [kN]	5,9	8,6	11,6	15,0	18,7	27,0	39,2
Cracked concrete							
$V^0_{Rd,c}$ [kN]	-	6,1	8,2	10,6	13,2	-	-

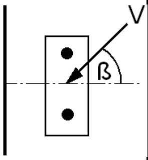
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

h_{ef}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81

h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

Combined tension and shear loading

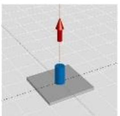
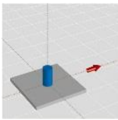
For combined tension and shear loading see section “Anchor Design”.

Precalculated values – design resistance values

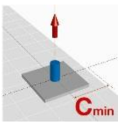
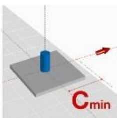
All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

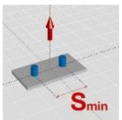
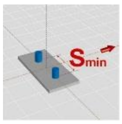
Design resistance: concrete C 20/25 - minimum embedment depth

Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	80	90	100
Base material thickness	$h = h_{min}$	[mm]	90	90	100	116	120	140	164
	**Tensile N_{Rd}: single anchor, no edge effects**								
	Non-cracked concrete								
	B500 B	[kN]	8,0	9,9	13,9	18,6	20,1	24,0	28,1
	Cracked concrete								
	B500 B	[kN]	-	5,8	8,1	10,8	12,3	-	-
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**								
	Non-cracked concrete								
	B500 B	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	67,3
	Cracked concrete								
	B500 B	[kN]	-	13,8	19,4	25,8	29,5	-	-

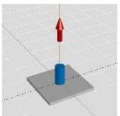
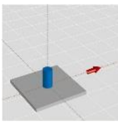
Design resistance: concrete C 20/25 - minimum embedment depth

Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	80	90	100
Base material thickness	$h = h_{min}$	[mm]	90	90	100	116	120	140	164
Edge distance	$c = c_{min}$	[mm]	40	50	60	70	80	100	125
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**								
	Non-cracked concrete								
	B500 B	[kN]	4,8	6,7	9,5	12,0	13,1	17,1	22,9
	Cracked concrete								
	B500 B	[kN]	-	3,9	5,5	7,4	9,2	-	-
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**								
	Non-cracked concrete								
	B500 B	[kN]	3,5	4,9	6,6	8,5	10,4	14,2	19,5
	Cracked concrete								
	B500 B	[kN]	-	3,5	4,7	6,0	7,4	-	-

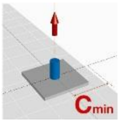
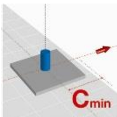
Design resistance: concrete C 20/25 - minimum embedment depth
(load values are valid for single anchor)

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	80	90	100
Base material thickness	$h = h_{min}$	[mm]	90	90	100	116	120	140	164
Spacing	$s = s_{min}$	[mm]	40	50	60	70	80	100	125
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**								
	Non-cracked concrete								
	B500 B	[kN]	5,4	6,8	9,3	12,2	12,7	15,7	19,3
	Cracked concrete								
	B500 B	[kN]	-	4,1	5,6	7,4	8,5	-	-
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**								
	Non-cracked concrete								
	B500 B	[kN]	9,3	14,7	20,7	28,0	32,1	39,4	47,7
	Cracked concrete								
	B500 B	[kN]	-	8,8	12,4	16,7	19,7	-	-

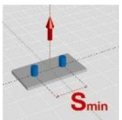
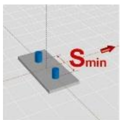
Design resistance: concrete C 20/25 - typical embedment depth

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	145	170	210
Base material thickness	$h = h_{min}$	[mm]	110	120	142	161	185	220	274
	**Tensile N_{Rd}: single anchor, no edge effects**								
	Non-cracked concrete								
	B500 B	[kN]	10,6	14,9	21,9	29,0	38,5	56,4	85,4
	Cracked concrete								
	B500 B	[kN]	-	8,6	12,7	16,8	22,3	-	-
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**								
	Non-cracked concrete								
	B500 B	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
	Cracked concrete								
	B500 B	[kN]	-	14,7	20,7	28,0	36,7	-	-

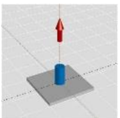
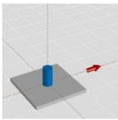
Design resistance: concrete C 20/25 - typical embedment depth

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef} = h_{ef,typ}$ [mm]	80	90	110	125	145	170	210
Base material thickness	$h = h_{min}$ [mm]	110	120	140	161	185	220	274
Edge distance	$c = c_{min}$ [mm]	40	50	60	70	80	100	125
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**							
	Non-cracked concrete							
	B500 B [kN]	6,4	9,0	13,2	17,5	23,1	30,5	42,1
	Cracked concrete							
	B500 B [kN]	-	5,2	7,6	10,1	13,4	-	-
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**							
	Non-cracked concrete							
	B500 B [kN]	3,7	5,3	7,3	9,5	11,9	17,2	25,0
	Cracked concrete							
	B500 B [kN]	-	3,8	5,2	6,7	8,4	-	-

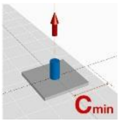
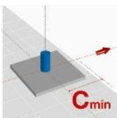
Design resistance: concrete C 20/25 - typical embedment depth
(load values are valid for single anchor)

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef} = h_{ef,typ}$ [mm]	80	90	110	125	145	170	210
Base material thickness	$h = h_{min}$ [mm]	110	120	140	161	185	220	274
Spacing	$s = s_{min}$ [mm]	40	50	60	70	80	100	125
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**							
	Non-cracked concrete							
	B500 B [kN]	7,4	10,1	14,7	19,1	25,0	35,1	48,3
	Cracked concrete							
	B500 B [kN]	-	6,0	8,8	11,5	15,1	-	-
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**							
	Non-cracked concrete							
	B500 B [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
	Cracked concrete							
	B500 B [kN]	-	12,3	18,0	23,9	31,6	-	-

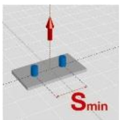
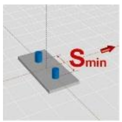
Design resistance: concrete C 20/25 - embedment depth = 12 d [a)]

	Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Embedment depth	$h_{ef} = 12\ d$ [a)]	[mm]	96	120	144	168	192	240	300
Base material thickness	$h = h_{min}$	[mm]	126	150	174	204	232	290	364
	**Tensile N_{Rd}: single anchor, no edge effects**								
	Non-cracked concrete								
	B500 B	[kN]	12,7	19,9	28,7	39,0	50,9	79,6	124,4
	Cracked concrete								
	B500 B	[kN]	-	11,5	16,6	22,6	29,5	-	-
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**								
	Non-cracked concrete								
	B500 B	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
	Cracked concrete								
	B500 B	[kN]	-	14,7	20,7	28,0	36,7	-	-

Design resistance: concrete C 20/25 - embedment depth = 12 d [a)]

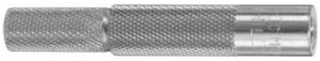
	Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Embedment depth	$h_{ef} = 12\ d$ [a)]	[mm]	96	120	144	168	192	240	300
Base material thickness	$h = h_{min}$	[mm]	126	150	174	204	232	290	364
Edge distance	$c = c_{min}$	[mm]	40	50	60	70	80	100	125
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**								
	Non-cracked concrete								
	B500 B	[kN]	7,7	12,0	17,2	23,5	30,6	46,7	65,2
	Cracked concrete								
	B500 B	[kN]	-	6,9	10,0	13,6	17,7	-	-
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**								
	Non-cracked concrete								
	B500 B	[kN]	3,9	5,7	7,8	10,2	12,9	18,9	27,8
	Cracked concrete								
	B500 B	[kN]	-	4,0	5,5	7,2	9,1	-	-

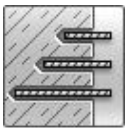
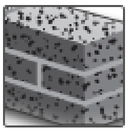
Design resistance: concrete C 20/25 - embedment depth = 12 d [a)]
(load values are valid for single anchor)

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	h_{ef} = 12 d [a)] [mm]	96	120	144	168	192	240	300
Base material thickness	$h = h_{min}$ [mm]	126	150	174	204	232	290	364
Spacing	$s = s_{min}$ [mm]	40	50	60	70	80	100	125
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**							
	Non-cracked concrete							
	B500 B [kN]	8,9	13,8	19,6	26,4	34,1	52,1	79,4
	Cracked concrete							
	B500 B [kN]	-	8,1	11,6	15,7	20,3	-	-
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**							
	Non-cracked concrete							
	B500 B [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
	Cracked concrete							
	B500 B [kN]	-	14,7	20,7	28,0	36,7	-	-

a) d = element diameter

Hilti HIT-HY 70 mortar for masonry

Injection mortar system		Benefits
	Hilti HIT-HY 70 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- chemical injection fastening for all type of base materials: - hollow and solid - clay bricks, sand-lime bricks, normal and light weight concrete blocks, aerated light weight concrete, natural stones - two-component hybrid mortar - rapid curing - versatile and convenient handling - flexible setting depth and fastening thickness - small edge distance and anchor spacing - mortar filling control with HIT-SC sleeves - suitable for overhead fastenings - in-service temperatures: short term: max.80°C long term: max 50°C
	Mixer	
	HIT-V rod	
	HAS, HAS-E rod	
	HIT-IC internal threaded sleeve	
	HIS-RN sleeve	
	HIT-SC composite sleeve	

								
Concrete	Variable embedment depth	Solid brick	Hollow brick	Autoclaved aerated concrete	Fire resistance	Corrosion resistance	High corrosion resistance	PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European Technical Approval	DIBt, Berlin	ETA-09/0265 / 2009-09-28
Allgemeine bauaufsichtliche Zulassung (national German approval)	DIBt, Berlin	Z-21.3-1830 / 2011-12-01
Fiche technique SOCOTEC [a)]	SOCOTEC, Paris	YX 0047 06.2012
Fire test report	MFPA, Leipzig	PB III/B-07-157 / 2012-03-03
Assessment report (fire)	warringtonfire	WF 327804/B / 2013-07-10

Basic loading data (for a single anchor)

All data in the table below applies to

- Load values valid for holes drilled with TE rotary hammers in hammering mode
- Correct anchor setting (see instruction for use, setting details)
- Steel quality of fastening elements: see data below
- Steel quality for screws for HIT-IG, HIT-IC and HIS-N: min. strength 5.8 / HIS-RN: A4-70
- Threaded rods of appropriate size (diameter and length) and a minimum steel quality of 5.6 can be used
- Base material temperature during installation and curing must be between -5°C through +40°C

(Exception: solid clay bricks (e.g. Mz12): +5°C till 40°C**)**

Recommended loads [a] F_{rec} for brick breakout and pull out in [kN]
Solid masonry: HIT-HY 70 with HIT-V, HAS, HAS-E and HIT-IC

			HIT-V, HAS, HAS-E				HIT-IC		
Anchor size									
Base material	**Setting depth** [mm]		**M6**	**M8**	**M10**	**M12**	**M8**	**M10**	**M12**
Solid clay brick Mz12/2,0 DIN 105/ EN 771-1 f_b [b] ≥ 12 N/mm²  Germany, Austria, Switzerland	80	N_{rec} [kN]	-	1,0	1,7	1,7	1,7	1,7	1,7
		V_{rec} [kN]	-	1,0	1,7	1,7	1,7	1,7	1,7
		N_{rec} [kN]	-	3,0 [c]	3,0 [c]	3,0 [c]	3,0 [c]	3,0 [c]	3,0 [c]
		V_{rec} [kN]	-	3,0 [c]	3,0 [c]	3,0 [c]	3,0 [c]	3,0 [c]	3,0 [c]
Solid sand-lime brick KS 12/2,0 DIN 106/ EN 771-2 f_b [b] ≥12 N/mm²  Germany, Austria, Switzerland	80	N_{rec} [kN]	-	1,0	1,7	1,7	1,7	1,7	1,7
		V_{rec} [kN]	-	1,0	1,7	1,7	1,7	1,7	1,7
		N_{rec} [kN]	-	3,0 [d]	3,0 [d]	3,0 [d]	3,0 [d]	3,0 [d]	3,0 [d]
		V_{rec} [kN]	-	3,0 [d]	3,0 [d]	3,0 [d]	3,0 [d]	3,0 [d]	3,0 [d]

a) Recommended load values for German base materials are based on national regulations.
b) f_b = brick strength
c) Values only valid for Mz (DIN 105) with brick strength ≥ 29 N/mm², density 2,0 kg/dm³, minimum brick size NF (24,0cm x 11,5cm x 7,1cm), not covered by national German approval Z-21.3-1830 / 2009-01-20
d) Values only valid for KS (DIN 106) with brick strength ≥ 23 N/mm², density 2,0 kg/dm³, minimum brick size NF (24,0cm x 11,5cm x 7,1cm), not covered by national German approval Z-21.3-1830 / 2009-01-20

Recommended loads [a)] F_{rec} for brick breakout and pull out in [kN]
Solid masonry: HIT-HY 70 with HIT-V, HAS, HAS-E and HIT-IC

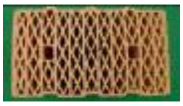
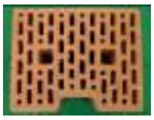
			HIT-V, HAS, HAS-E				HIT-IC		
Anchor size									
Base material	**Setting depth** [mm]		**M6**	**M8**	**M10**	**M12**	**M8**	**M10**	**M12**
Aerated concrete PPW 2-0,4 DIN 4165/ EN 771-4 f_b [b)] ≥ 2 N/mm²  Germany, Austria, Switzerland	80	N_{rec} [kN]	-	0,5	0,6	0,6	0,6	0,6	0,6
		V_{rec} [kN]	-	0,1	0,1	0,2	0,2	0,4	0,4
Lightweight concrete acc. TGL (haufwerks-poriger Leichtbeton), Germany	80	N_{rec} [kN]	-	1,0	1,0	1,5	1,5	1,5	1,5
		V_{rec} [kN]	-	1,0	1,0	1,5	1,5	1,5	1,5

a) Recommended load values for German base materials are based on national regulations.
b) f_b = brick strength

Basic loading data (for a single anchor)

All data in the table below applies to
- Load values valid for holes drilled with TE rotary hammers **in sensitive** hammering mode
- Correct anchor setting (see instruction for use, setting details)
- Steel quality of fastening elements: see data above;
- Steel quality for screws for HIT-IG: min. strength 5.8
- Threaded rods of appropriate size (diameter and length) and a minimum steel quality of 5.6 can be used

Recommended loads [a] F_{rec} for brick breakout and pull out in [kN]:
Hollow masonry: HIT-HY 70 with HIT-SC and HIT-V, HAS, HAS-E and HIT-IC

			HIT-V, HAS, HAS-E				HIT-IC			
Anchor size			**M6**	**M8**	**M10**	**M12**	**M8**	**M10**		**M12**
Base material	**Setting depth** [mm]		**HIT-SC 12x…**	**HIT-SC 16x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 22x…**	**HIT-SC 22x…**
HlzB 6 DIN 105/ EN 771-1 f_b [b] ≥ 6 N/mm²  Germany, Austria, Switzerland	50	N_{rec} [kN]	0,3	0,4	0,4	0,8	-	-	-	-
		V_{rec} [kN]	0,3	0,4	0,4	0,4	-	-	-	-
	80	N_{rec} [kN]	-	0,8	0,8	0,8	0,8	0,8	0,8	0,8
		V_{rec} [kN]	-	0,8	0,8	0,8	0,8	0,8	0,8	0,8
	100	N_{rec} [kN]	-	0,8	0,8	0,8	-	-	-	-
		V_{rec} [kN]	-	0,8	0,8	0,8	-	-	-	-
	130	N_{rec} [kN]	-	0,84	0,84	0,8	-	-	-	-
		V_{rec} [kN]	-	0,8	0,8	0,8	-	-	-	-
	160	N_{rec} [kN]	-	0,91	0,91	0,8	-	-	-	-
		V_{rec} [kN]	-	0,8	0,8	0,8	-	-	-	-
Hlz 12 DIN 105/ EN 771-1 f_b [b] ≥12 N/mm²  Germany, Austria, Switzerland	50	N_{rec} [kN]	0,6	0,8	0,8	0,8	-	-	-	-
		V_{rec} [kN]	0,6	0,8	0,8	0,8	-	-	-	-
	80	N_{rec} [kN]	-	1,0	1,0	1,0	1,0	1,0	1,0	1,0
		V_{rec} [kN]	-	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	100	N_{rec} [kN]	-	1,54	1,54	1,54	-	-	-	-
		V_{rec} [kN]	-	1,4	1,4	1,4	-	-	-	-
	130	N_{rec} [kN]	-	1,68	1,68	1,54	-	-	-	-
		V_{rec} [kN]	-	1,4	1,4	1,4	-	-	-	-
	160	N_{rec} [kN]	-	1,82	1,82	1,54	-	-	-	-
		V_{rec} [kN]	-	1,4	1,4	1,4	-	-	-	-

a) Recommended load values for German base materials are based on national regulations.
b) f_b = brick strength

Recommended loads [a)] F_{rec} for brick breakout and pull out in [kN]:
Hollow masonry: HIT-HY 70 with HIT-SC and HIT-V, HAS, HAS-E and HIT-IC

			HIT-V, HAS, HAS-E				HIT-IC			
Anchor size			**M6**	**M8**	**M10**	**M12**	**M8**	**M10**		**M12**
Base material	**Setting depth** [mm]		**HIT-SC 12x…**	**HIT-SC 16x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 22x…**	**HIT-SC 22x…**
KSL 12 DIN 106/ EN 771-2 f_b [b)] $\geq$ 12 N/mm²  Germany, Austria, Switzerland	50	N_{rec} [kN]	0,5	0,7	0,7	0,7	-	-	-	-
		V_{rec} [kN]	0,5	0,7	0,7	0,7	-	-	-	-
	80	N_{rec} [kN]	-	1,4	1,4	1,4	1,4	1,4	1,0	1,0
		V_{rec} [kN]	-	1,4	1,4	1,4	1,4	1,4	1,0	1,0
	100	N_{rec} [kN]	-	1,4	1,4	1,4	-	-	-	-
		V_{rec} [kN]	-	1,4	1,4	1,4	-	-	-	-
	130	N_{rec} [kN]	-	1,44	1,44	1,4	-	-	-	-
		V_{rec} [kN]	-	1,4	1,4	1,4	-	-	-	-
	160	N_{rec} [kN]	-	1,56	1,56	1,4	-	-	-	-
		V_{rec} [kN]	-	1,4	1,4	1,4	-	-	-	-

a) Recommended load values for German base materials are based on national regulations.
b) f_b = brick strength

Recommended loads a) F_{rec} for brick breakout and pull out in [kN]:
Hollow masonry: HIT-HY 70 with HIT-SC and HIT-V, HAS, HAS-E and HIT-IC

			HIT-V, HAS, HAS-E				HIT-IC			
Anchor size			**M6**	**M8**	**M10**	**M12**	**M8**	**M10**		**M12**
Base material	**Setting depth** [mm]		**HIT-SC 12x…**	**HIT-SC 16x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 22x…**	**HIT-SC 22x…**
Hbl 2 DIN 18 151/ EN 771-3 f_b b) ≥ 2 N/mm²  Germany, Austria, Switzerland	50	N_{rec} [kN]	0,3	0,5	0,5	0,5	-	-	-	-
		V_{rec} [kN]	0,3	0,5	0,5	0,5	-	-	-	-
	80	N_{rec} [kN]	-	0,5	0,5	0,5	0,5	0,5	0,5	0,5
		V_{rec} [kN]	-	0,5	0,5	0,5	0,5	0,5	0,5	0,5
	100	N_{rec} [kN]	-	0,7	0,7	0,7	-	-	-	-
		V_{rec} [kN]	-	0.6	0.6	0.6	-	-	-	-
	130	N_{rec} [kN]	-	0.72	0.72	0,7	-	-	-	-
		V_{rec} [kN]	-	0,6	0,6	0,6	-	-	-	-
	160	N_{rec} [kN]	-	0,78	0,78	0,7	-	-	-	-
		V_{rec} [kN]	-	0,6	0,6	0,6	-	-	-	-
Hbl 4 DIN 18 151/ EN 771-3 f_b b) ≥ 4 N/mm²  Germany, Austria, Switzerland	50	N_{rec} [kN]	0,4	0,6	0,6	0,6	-	-	-	-
		V_{rec} [kN]	0,4	0,6	0,6	0,6	-	-	-	-
	80	N_{rec} [kN]	-	0,8	0,8	0,8	0,8	0,8	0,8	0,8
		V_{rec} [kN]	-	0,8	0,8	0,8	0,8	0,8	0,8	0,8
Hbn 4 DIN 18 153/ EN 771-3 f_b b) ≥ 4 N/mm²  Germany, Austria, Switzerland	50	N_{rec} [kN]	0,4	0,6	0,6	0,6	-	-	-	-
		V_{rec} [kN]	0,4	0,6	0,6	0,6	-	-	-	-
	80	N_{rec} [kN]	-	0,8	0,8	0,8	0,8	0,8	0,8	0,8
		V_{rec} [kN]	-	0,8	0,8	0,8	0,8	0,8	0,8	0,8

a) Recommended load values for German base materials are based on national regulations.
b) f_b = brick strength

Recommended loads [a] F_{rec} for brick breakout and pull out in [kN]:
Hollow masonry: HIT-HY 70 with HIT-SC and HIT-V, HAS, HAS-E and HIT-IC

			HIT-V, HAS, HAS-E				HIT-IC			
Anchor size			**M6**	**M8**	**M10**	**M12**	**M8**	**M10**		**M12**
Base material	**Setting depth** [mm]		**HIT-SC 12x…**	**HIT-SC 16x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 22x…**	**HIT-SC 22x…**
Brique creuse C40 NF-P 13-301/ EN 771-1 f_b [b] ≥ 4 N/mm²  France	80	N_{rec} [kN]	-	0,5	0,5	0,5	0,5	0,5	0,5	0,5
		V_{rec} [kN]	-	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	100	N_{rec} [kN]	-	0,5	0,5	0,5	-	-	-	-
		V_{rec} [kN]	-	1,0	1,0	1,0	-	-	-	-
	130	N_{rec} [kN]	-	0,5	0,5	0,5	-	-	-	-
		V_{rec} [kN]	-	1,0	1,0	1,0	-	-	-	-
	160	N_{rec} [kN]	-	0,5	0,5	0,5	-	-	-	-
		V_{rec} [kN]	-	1,0	1,0	1,0	-	-	-	-
Parpaing creux B40 NF-P 14-301/ EN 771-3 f_b [b] ≥ 4 N/mm²  France	80	N_{rec} [kN]	-	0,7	0,7	0,7	0,7	0,7	0,7	0,7
		V_{rec} [kN]	-	1,5	1,5	1,5	1,5	1,5	1,5	1,5
	100	N_{rec} [kN]	-	0,7	0,7	0,7	-	-	-	-
		V_{rec} [kN]	-	1,5	1,5	1,5	-	-	-	-
	130	N_{rec} [kN]	-	0,7	1,2	1,2	-	-	-	-
		V_{rec} [kN]	-	1,5	1,7	1,7	-	-	-	-
	160	N_{rec} [kN]	-	0,7	1,2	1,2	-	-	-	-
		V_{rec} [kN]	-	1,5	1,7	1,7	-	-	-	-

a) Recommended load values for French base materials are based on national regulations.
b) f_b = brick strength

Recommended loads F_{rec} for brick breakout and pull out in [kN]: Hollow masonry: HIT-HY 70 with HIT-SC and HIT-V, HAS, HAS-E and HIT-IC
Values in brackets: mean ultimate loads $F_{u,m}$ [kN]:

			HIT-V, HAS, HAS-E				HIT-IC			
Anchor size			M6	M8	M10	M12	M8	M10		M12
Base material	Setting depth [mm]		HIT-SC 12x…	HIT-SC 16x…	HIT-SC 16x…	HIT-SC 18x…	HIT-SC 16x…	HIT-SC 18x…	HIT-SC 22x…	HIT-SC 22x…
Mattone Alveolater 50 EN 771-1 f_b [b)] ≥ 16 N/mm²  Italy	50	N_{rec} [kN]	0,9 (4,2)	1,1	1,1 (4,9)	1,25	-	-	-	-
		V_{rec} [kN]	1,2 (5,8)	1,2	1,2	1,2	-	-	-	-
	80	N_{rec} [kN]	1,1 (5,0)	1,5	1,5	1,7	1,5 (7,0)	1,7	1,7	1,7
		V_{rec} [kN]	1,2 (5,3)	1,2	1,2	1,2	1,2	1,2	2,0	2,0
	100	N_{rec} [kN]	-	1,5	1,5	1,7	-	-	-	-
		V_{rec} [kN]	-	1,2	1,2	1,2	-	-	-	-
	130	N_{rec} [kN]	-	2,3 (10,4)	2,3	2,8	-	-	-	-
		V_{rec} [kN]	-	1,2	1,2	1,2	-	-	-	-
	160	N_{rec} [kN]	-	2,3	2,3	2,8	-	-	-	-
		V_{rec} [kN]	-	1,2	1,2	1,2	-	-	-	-
Doppio uni EN 771-1 f_b [b)] ≥ 27 N/mm²  Italy	50	N_{rec} [kN]	0,65 (2,9)	0,65	0,65	0,65	-	-	-	-
		V_{rec} [kN]	1,3 (5,7)	1,3	1,3 (6,6)	1,3	-	-		
	80	N_{rec} [kN]	1,0 (5,0)	1,0	1,0 (6,8)	1,0	1,0	1,0	1,0	1,0 (4,5)
		V_{rec} [kN]	1,3 (6,1)	1,9	1,9 (8,5)	1,9	1,9	1,9	2,0	2,0
	100	N_{rec} [kN]	-	1,0	1,0	1,0	-	-	-	-
		V_{rec} [kN]	-	1,9	1,9	1,9	-	-	-	-
	130	N_{rec} [kN]	-	2,0	2,0 (12,1)	2,0	-	-	-	-
		V_{rec} [kN]	-	1,9	1,9	1,9	-	-	-	-
	160	N_{rec} [kN]	-	2,0	2,0	2,0	-	-	-	-
		V_{rec} [kN]	-	1,9	1,9	1,9	-	-	-	-
Foratino 4 Fori EN 771-1 f_b [b)] ≥ 7 N/mm  Italy	80	N_{rec} [kN]	0,6 (2,7)	0,7 (3,3)	0,7	1,0	0,7	1,0	1,0	1,0 (5,2)
		V_{rec} [kN]	0,9	0,9	0,9	0,9	0,9	0,9	1,0	1,0
	100	N_{rec} [kN]	-	0,7	0,7	1,0	-	-	-	-
		V_{rec} [kN]	-	0,9	0,9	0,9	-	-	-	-
	130	N_{rec} [kN]	-	1,5 (6,7)	1,5	1,9	-	-	-	-
		V_{rec} [kN]	-	0,9	0,9	0,9	-	-	-	-
	160	N_{rec} [kN]	-	1,5 (7,3)	1,5	1,5	-	-	-	-
		V_{rec} [kN]	-	0,9	0,9	1,0	-	-	-	-

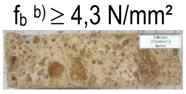
a) Recommended load values with consideration of a global safety factor γ_{global} = 3,0: $F_{rec} = F_{Rk} / \gamma_{global}$
b) f_b = brick strength

Recommended loads F_{rec} for brick breakout and pull out in [kN]: Hollow masonry: HIT-HY 70 with HIT-SC and HIT-V, HAS, HAS-E and HIT-IC
Values in brackets: mean ultimate loads $F_{u,m}$ [kN]:

			HIT-V, HAS, HAS-E				HIT-IC			
Anchor size			**M6**	**M8**	**M10**	**M12**	**M8**	**M10**		**M12**
Base material	**Setting depth** [mm]		**HIT-SC 12x…**	**HIT-SC 16x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 22x…**	**HIT-SC 22x…**
Mattone rosso EN 771-1 f_b [b)] ≥ 26 N/mm²  Italy	50	N_{rec} [kN]	0,35 (1,7)	0,45	0,45 (2,0)	0,45	-	-	-	-
		V_{rec} [kN]	-	-	-	-	-	-		
	80	N_{rec} [kN]	0,5 (2,9)	0,5 (2,1)	0,5 (3,3)	0,6	0,5	0,6	0,6 (4,2)	0,6
		V_{rec} [kN]	-	-	-	-	-	-	-	-
Blocchi cem 2 Fori EN 771-3 f_b [b)] ≥ 8 N/mm²  Italy	50	N_{rec} [kN]	1,0 (5,8)	1,25 (6,6)	1,25	1,25				
		V_{rec} [kN]	1,5 (7,2)	1,5	1,5	1,5				
	80	N_{rec} [kN]	1,0 (4,6)	1,25 (6,8)	1,25	1,25	1,25	1,25	1,25 (5,6)	1,25
		V_{rec} [kN]	1,5 (7,1)	2,0	2,0	2,0	2,0	2,0	2,0	2,0

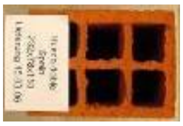
a) Recommended load values with consideration of a global safety factor γ_{global} = 3,0: $F_{rec} = F_{Rk} / \gamma_{global}$
b) f_b = brick strength

Recommended loads [a)] F_{rec} for brick breakout and pull out in [kN]
Solid masonry: HIT-HY 70 with HIT-V, HAS, HAS-E and HIT-IC

			HIT-V, HAS, HAS-E or Rebar [c)]				
Anchor size							
Base material	**Setting depth** [mm]		**Rod M8 or Rebar Ø8** [d)]	**Rod M10 or Rebar Ø10** [d)]	**Rod M12 or Rebar Ø12** [d)]	**Rod M14 or Rebar Ø14** [d)]	**Rod M16 or Rebar Ø16** [d)]
Volcanic rock (Tufo) EN 771-3 f_b [b)] ≥ 4,3 N/mm²  Italy	80	N_{rec} [kN]	0,9	-	-	-	-
		V_{rec} [kN]	0,9	-	-	-	-
	100	N_{rec} [kN]	-	1,2	-	-	-
		V_{rec} [kN]	-	1,2	-	-	-
	120	N_{rec} [kN]	-	-	1,5	-	-
		V_{rec} [kN]	-	-	1,5	-	-
	140	N_{rec} [kN]	-	-	-	1,8	-
		V_{rec} [kN]	-	-	-	1,8	-
	160	N_{rec} [kN]	-	-	-	-	2,1
		V_{rec} [kN]	-	-	-	-	2,1

a) Recommended load values with consideration of a global safety factor γ_{global} = 3,0: $F_{rec} = F_{Rk} / \gamma_{global}$
b) f_b = brick strength
c) Minimum base material thickness h = setting depth + 50mm.
d) Drill bit diameters for rebars BSt 500S:
Ø8: d_0=12mm; Ø10: d_0=14mm; Ø12: d_0=16mm; Ø14: d_0=18mm; Ø16: d_0=20mm;

Recommended loads F_{rec} for brick breakout and pull out in [kN]: Hollow masonry: HIT-HY 70 with HIT-SC and HIT-V, HAS, HAS-E and HIT-IC
Values in brackets: mean ultimate loads $F_{u,m}$ [kN]:

			HIT-V, HAS, HAS-E				HIT-IC			
Anchor size			**M6**	**M8**	**M10**	**M12**	**M8**	**M10**		**M12**
Base material	**Setting depth** [mm]		**HIT-SC 12x…**	**HIT-SC 16x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 22x…**	**HIT-SC 22x…**
Hueco doble EN 771-1 f_b [b)] ≥ 4 N/mm²  Spain	50	N_{rec} [kN]	0,5 (2,6)	0,5 (2,0)	0,5 (2,4)	0,5	-	-	-	-
		V_{rec} [kN]	0,9 (4,2)	0,9	0,9	0,9	-	-	-	-
	80	N_{rec} [kN]	0,7 (3,1)	0,9 (3,8)	0,9 (4,0)	1,1	0,9 (4,0)	1,1	1,1 (6,3)	1,1
		V_{rec} [kN]	1,0 (4,8)	1,0 (4,5)	1,0	1,0	1,0	1,0	1,7	1,7
Termoarcilla EN 771-1 f_b [b)] ≥ 22 N/mm²  Spain	50	N_{rec} [kN]	0,5 (3,1)	0,7	0,7	0,7	-	-	-	-
		V_{rec} [kN]	1,2 (5,5)	1,2	1,2	1,2	-	-		
	80	N_{rec} [kN]	0,5 (2,4)	1,1 (5,2)	1,1	1,3	1,1	1,3	1,3 (5,8)	1,3
		V_{rec} [kN]	1,2 (5,6)	1,2	1,2	1,2	1,2	1,2	2,0	2,0
Ladrillo cara vista EN 771-1 f_b [b)] ≥ 42 N/mm²  Spain	50	N_{rec} [kN]	0,8 (4,5)	0,8 (3,6)	0,8	0,8				
		V_{rec} [kN]	1,5 (6,9)	1,6 (8,6)	1,6	1,6				
	80	N_{rec} [kN]	0,8	1,9	1,9	2,3	1,9 (8,5)	2,3	2,3	2,3 (10,4)
		V_{rec} [kN]	1,5	2,0 (12,4)	2,0	2,0	2,0	2,0	2,0	2,0
Clinker medi-terraneo EN 771-1 f_b [b)] ≥ 78 N/mm²  Spain	50	N_{rec} [kN]	0,7 (3,3)	0,7 (3,1)	0,7	0,7	-	-	-	-
		V_{rec} [kN]	1,5 (6,4)	1,6 (7,8)	1,6	1,6	-	-	-	-
	80	N_{rec} [kN]	0,7	1,8 (8,0)	1,8	2,1	1,8 (8,3)	2,1	2,1	2,1 (9,7)
		V_{rec} [kN]	1,4 (6,4)	2,0 (9,5)	2,0	2,0	2,0 (14,4)	2,0	2,0	2,0

a) Recommended load values with consideration of a global safety factor γ_{global} = 3,0: $F_{rec} = F_{Rk} / \gamma_{global}$
b) f_b = brick strength

Recommended loads F_{rec} for brick breakout and pull out in [kN]:
Hollow masonry: HIT-HY 70 with HIT-SC and HIT-V, HAS, HAS-E and HIT-IC

			HIT-V, HAS, HAS-E				HIT-IC			
Anchor size			**M6**	**M8**	**M10**	**M12**	**M8**	**M10**		**M12**
Base material	**Setting depth** [mm]		**HIT-SC 12x…**	**HIT-SC 16x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 22x…**	**HIT-SC 22x…**
Concrete Block EN 771-3 f_b [b)] ≥ 7,0 N/mm² L x H x B [mm] 440 x 215 x 215  (Shell thickness 48 mm) Great Britain	50	N_{rec} [kN]	0,3	0,8	1,1	2,0	-	-	-	-
		V_{rec} [kN]	1,0	1,6	2,0	2,0	-	-	-	-
	80	N_{rec} [kN]	0,3	0,8	1,1	2,0	-	-	-	-
		V_{rec} [kN]	1,0	1,6	2,0	2,0	-	-	-	-
Concrete Block EN 771-3 f_b [b)] ≥ 7 N/mm² L x H x B [mm] 440 x 215 x 138  (Shell thickness 48 mm) Great Britain	50	N_{rec} [kN]	0,4	0,6	0,7	1,5	-	-	-	-
		V_{rec} [kN]	0,9	1,7	1,7	1,7	-	-	-	-
	80	N_{rec} [kN]	0,4	0,6	0,7	1,5	-	-	-	-
		V_{rec} [kN]	0,9	1,7	1,7	1,7	-	-	-	-
Concrete Block EN 771-3 f_b [b)] ≥ 7 N/mm² L x H x B [mm] 440 x 215 x 112  (Shell thickness 48 mm) Great Britain	50	N_{rec} [kN]	0,5	0,8	0,9	0,9	-	-	-	-
		V_{rec} [kN]	1,1	1,3	1,3	1,3	-	-	-	-

a) Recommended load values with consideration of a global safety factor γ_{global} = 3,0: $F_{rec} = F_{Rk} / \gamma_{global}$
b) f_b = brick strength

Recommended loads F_{rec} for brick breakout and pull out in [kN]:
Hollow masonry: HIT-HY 70 with HIT-SC and HIT-V, HAS, HAS-E and HIT-IC

			HIT-V, HAS, HAS-E				HIT-IC			
Anchor size			**M6**	**M8**	**M10**	**M12**	**M8**	**M10**		**M12**
Base material	**Setting depth** [mm]		**HIT-SC 12x…**	**HIT-SC 16x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 22x…**	**HIT-SC 22x…**
Dense Concrete EN 771-3 f_b [b)] ≥ 14 N/mm² L x H x B [mm] 440 x 215 x 100  Great Britain	50	N_{rec} [kN]	1,5	2,5	2,5	2,5	-	-	-	-
		V_{rec} [kN]	1,3	2,5	2,5	2,5	-	-	-	-
Dense Concrete EN 771-3 f_b [b)] ≥ 14 N/mm² L x H x B [mm] 440 x 215 x 140  Great Britain	50	N_{rec} [kN]	1,5	2,5	2,5	2,5				
		V_{rec} [kN]	1,3	2,5	2,5	2,5				
	80	N_{rec} [kN]	1,5	3,0	3,0	3,0	3,0	3,0	3,0	4,0
		V_{rec} [kN]	1,3	2,5	2,5	2,5	2,5	2,5	3,0	3,0
Thermalite/ Celcon EN 771-3 f_b [b)] ≥ 6 N/mm² L x H x B [mm] 440 x 100 x 215  Great Britain	50	N_{rec} [kN]	0,7	0,8	0,8	0,8	-	-	-	-
		V_{rec} [kN]	0,5	0,6	0,6	0,6	-	-	-	
	80	N_{rec} [kN]	1,3	1,5	1,5	1,7	1,5	1,7	1,7	1,7
		V_{rec} [kN]	0,9	1,0	1,0	1,0	1,0	1,0	1,2	1,2
Nostell Red Multi EN 771-3 f_b [b)] ≥ 70 N/mm² L x H x B [mm] 215 x 102 x 65  Great Britain	50	N_{rec} [kN]	1,0	2,0	2,0	2,0				
		V_{rec} [kN]	1,5	3,0	3,0	3,0				
	80	N_{rec} [kN]	1,0	3,0	3,0	3,0	3,0	3,5	3,5	3,5
		V_{rec} [kN]	1,5	3,0	3,0	3,0	3,0	3,0	3,0	3,0

a) Recommended load values with consideration of a global safety factor γ_{global} = 3,0: $F_{rec} = F_{Rk} / \gamma_{global}$
b) f_b = brick strength

Recommended loads F_{rec} for brick breakout and pull out in [kN]:
Hollow masonry: HIT-HY 70 with HIT-SC and HIT-V, HAS, HAS-E and HIT-IC

			HIT-V, HAS, HAS-E				HIT-IC			
Anchor size			**M6**	**M8**	**M10**	**M12**	**M8**	**M10**		**M12**
Base material	**Settin g depth** [mm]		**HIT-SC 12x…**	**HIT-SC 16x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 22x…**	**HIT-SC 22x…**
London yellow Multi Stock EN 771-3 f_b [b)] ≥ 16 N/mm² L x H x B [mm] 215 x 100 x 65	50	N_{rec} [kN]	1,0	1,3	1,3	1,7	-	-	-	-
		V_{rec} [kN]	1,4	1,9	1,9	1,9	-	-	-	-
	80	N_{rec} [kN]	2,0	3,0	3,0	3,0	3,0	3,0	3,0	4,0
Great Britain		V_{rec} [kN]	1,4	2,5	2,5	2,5	2,5	2,5	3,0	3,0

a) Recommended load values with consideration of a global safety factor γ_{global} = 3,0: $F_{rec} = F_{Rk} / \gamma_{global}$
b) f_b = brick strength

Recommended loads [a)] F_{rec} for brick breakout and/or pull out in [kN]:
Hollow masonry: HIT-HY 70 with HIT-SC and HIT-V, HAS, HAS-E and HIT-IC

			HIT-V, HAS, HAS-E				HIT-IC		
Anchor size									
Base material	**Setting depth** [mm]	**Base material**	**M6**	**M8**	**M10**	**M12**	**M8**	**M10**	**M12**
Dense Concrete EN 771-3 f_b [b)] ≥ 14 N/mm² L x H x B [mm] 440 x 215 x 100  Great Britain	80	N_{rec} [kN]	-	2,5	2,5	2,5	-	-	-
		V_{rec} [kN]	-	2,5	2,5	3,0	-	-	-
Dense Concrete EN 771-3 f_b [b)] ≥ 14 N/mm² L x H x B [mm] 440 x 215 x 140  Great Britain	80	N_{rec} [kN]	-	3,5 [c)]	4,0 [c)]	4,5 [c)]	-	-	-
		V_{rec} [kN]	-	2,5	2,5	3,0	-	-	

a) Recommended load values with consideration of a global safety factor γ_{global} = 3,0: $F_{rec} = F_{Rk} / \gamma_{global}$
b) f_b brick strength
c) The minimum value of brick break out and/or pull out given in the table and of pull out of one brick is decisive.

Recommended loads F_{rec} for brick breakout and pull out in [kN]:
Hollow masonry: HIT-HY 70 with HIT-SC and HIT-V, HAS, HAS-E and HIT-IC

			HIT-V, HAS, HAS-E				**HIT-IC**			
Anchor size			**M6**	**M8**	**M10**	**M12**	**M8**	**M10**		**M12**
Base material	**Setting depth** [mm]		**HIT-SC 12x…**	**HIT-SC 16x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 22x…**	**HIT-SC 22x…**
Fire light brick Scoria Blend f_b [b)] ≥ 16 N/mm² L x H x B [mm] 230 x 110 x 119  (Shell thickness 19 mm) Australia	50	N_{rec} [kN]	0,5	0,5	0,5	0,8	-	-	-	-
		V_{rec} [kN]	1,0	1,5	1,5	1,5	-	-		
	80	N_{rec} [kN]	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8
		V_{rec} [kN]	1,25	2,0	2,0	2,0	2,0	2,0	2,0	2,0
Hollow Block f_b [b)] ≥ 15 N/mm² L x H x B [mm] 390 x 190 x 190  (Shell thickness 30 mm) Australia	50	N_{rec} [kN]	0,6	0,6	0,6	0,6	-	-	-	-
		V_{rec} [kN]	1,0	1,5	1,5	1,5	-	-	-	-
	80	N_{rec} [kN]	0,6	0,9	0,9	1,7	0,9	1,7	1,7	1,7
		V_{rec} [kN]	1,25	2,0	2,0	2,0	2,0	2,0	2,0	2,0
Clay common (Standard) f_b [b)] ≥ 84 N/mm² L x H x B [mm] 230 x 110 x 76  (Shell thickness 20 mm) Australia	50	N_{rec} [kN]	1,5	1,5	1,5	1,5	-	-	-	-
		V_{rec} [kN]	2,0	2,0	2,0	2,0	-	-	-	-
	80	N_{rec} [kN]	2,0	3,0	3,0	3,0	3,0	4,0	4,0	4,0
		V_{rec} [kN]	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0

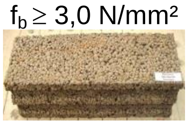
a) Recommended load values with consideration of a global safety factor $\gamma_{global} = 3{,}0$: $F_{rec} = F_{Rk} / \gamma_{global}$
b) f_b = brick strength

Recommended loads [a] F_{rec} for brick breakout and pull out in [kN]
Solid masonry: HIT-HY 70 with HIT-V, HAS, HAS-E and HIT-IC

			HIT-V, HAS, HAS-E				HIT-IC		
Anchor size									
Base material	**Setting depth** [mm]		**M6**	**M8**	**M10**	**M12**	**M8**	**M10**	**M12**
Clay common (Dry pressed) f_b [b] ≥ 25 N/mm² L x H x B [mm] 230 x 110 x 76  Australia	80	N_{rec} [kN]	-	2,5	3,0	4,0	2,5	3,0	4,0
		V_{rec} [kN]	-	2,0	2,0	2,0	2,0	2,0	2,0
Calduran Solid sand-lime brick f_b [b] ≥ 22 N/mm² L x H x B [mm] 437x198x100  Netherlands	80	N_{rec} [kN]	-	-	2,5 [c]	3,0 [c]	3,0 [c]	3,0 [c]	4,0 [c]
		V_{rec} [kN]	-	-	3,0	4,0	3,0	3,0	4,0
Calduran Solid sand-lime brick f_b [b] ≥ 22 N/mm² L x H x B [mm] 437x298x215  Netherlands	80	N_{rec} [kN]	-	-	2,5 [c]	3,0 [c]	3,0 [c]	3,0 [c]	4,0 [c]
		V_{rec} [kN]	-	-	3,0	4,0	3,0	3,0	4,0

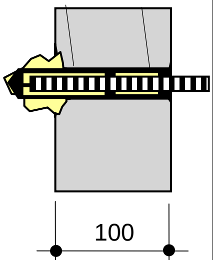
a) Recommended load values with consideration of a global safety factor γ_{global} = 3,0: $F_{rec} = F_{Rk} / \gamma_{global}$
b) f_b = brick strength
c) The minimum value of brick break out and/or pull out given in the table and of pull out of one brick is decisive.

Recommended loads F_{rec} for brick breakout and pull out in [kN]:
Hollow masonry: HIT-HY 70 with HIT-SC and HIT-V, HAS, HAS-E and HIT-IC

			HIT-V, HAS, HAS-E				HIT-IC			
Anchor size			**M6**	**M8**	**M10**	**M12**	**M8**	**M10**		**M12**
Base material	**Setting depth** [mm]		**HIT-SC 12x…**	**HIT-SC 16x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 22x…**	**HIT-SC 22x…**
Wienerberger Powerbrick f_b [b)] ≥ 41 N/mm² L x H x B [mm] 285x135x135  Belgium	50	N_{rec} [kN]	1,0	1,25	1,25	1,25	-	-	-	-
		V_{rec} [kN]	1,5	2,0	2,0	2,0	-	-	-	-
	80	N_{rec} [kN]	1,5	1,75	1,75	2,0	1,75	2,0	2,0	2,0
		V_{rec} [kN]	1,5	3,0	3,0	3,0	3,0	3,0	4,0	4,0
Wienerberger Thermobrick f_b [b)] ≥ 21 N/mm² L x H x B [mm] 285x135x138  Belgium	50	N_{rec} [kN]	0,5	0,75	0,75	1,0	-	-	-	-
		V_{rec} [kN]	1,0	1,25	1,25	1,25	-	-	-	-
	80	N_{rec} [kN]	1,5	1,75	1,75	1,75	1,75	1,75	1,75	1,75
		V_{rec} [kN]	1,5	2,0	2,0	2,0	2,0	2,0	2,5	2,5
Concrete hollow brick f_b [b)] ≥ 6 N/mm² L x H x B [mm] 600x500x92  (Shell thickness 15 mm) Finland	50	N_{rec} [kN]	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
		V_{rec} [kN]	0,5	0,75	0,75	0,75	0,75	0,75	1,0	1,0
Leca typ 3 EN 771-3 f_b ≥ 3,0 N/mm²  Sweden	80	N_{rec} [kN]	-	2,0	2,0	2,0	2,0	2,0	2,0	2,0
		V_{rec} [kN]	-	1,2	1,2	1,2	1,2	1,2	2,0	2,0

a) Recommended load values with consideration of a global safety factor γ_{global} = 3,0: $F_{rec} = F_{Rk} / \gamma_{global}$
b) f_b = brick strength

Recommended loads F_{rec} for brick breakout and pull out in [kN]:
Hollow masonry: HIT-HY 70 with HIT-SC and HIT-V, HAS, HAS-E and HIT-IC
Values in brackets: mean ultimate loads $F_{u,m}$ [kN]:

			HIT-V, HAS, HAS-E				HIT-IC			
Anchor size			**M6**	**M8**	**M10**	**M12**	**M8**	**M10**		**M12**
Base material	**Setting depth** [mm]		**HIT-SC 12x…**	**HIT-SC 16x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 16x…**	**HIT-SC 18x…**	**HIT-SC 22x…**	**HIT-SC 22x…**
Concrete block f_b [b)] ≥ 23 N/mm² L x H x B [mm] 390 x 190 x 120  (Shell thickness 25 mm) Japan	50	N_{rec} [kN]	1,25 (8,1)	1,5	1,5	2,0	-	-	-	-
		V_{rec} [kN]	1,25 (6,7)	1,5 (11,4)	1,5	1,5	-	-	-	-
	80	N_{rec} [kN]	1,25 (9,0)	1,5 (10,3)	1,5	2,0	1,5 (9,2)	2,0	2,0	2,0 (12,1)
		V_{rec} [kN]	1,25 (7,1)	1,5	1,5	1,5	1,5 (11,4)	1,5	2,0	2,0 (15,9)
Spancrete (Hollow Core Slab) f_b [b)] ≥ 83 N/mm² L x H x B [mm] 1000 x1000 x125  (Shell thickness 27,5 mm) Japan	50	N_{rec} [kN]	1,25 (8,5)	2,0 (15,0)	2,0	2,5	2,5 (13,9)	2,5	2,5 (19,3)	-
		V_{rec} [kN]	1,25 (7,0)	2,5 (12,0)	2,5	2,5	2,5 (21,3)	2,5	3,0 (28,1)	-
Aereted concrete block f_b [b)] ≥ 6 N/mm² L x H x B [mm] 1900 x 600 x 100 Special application: through fastening HIT-SC …x85 HIT-SC …x50  Japan	130	N_{rec} [kN]	1,25 (8,1)	1,75 (8,6)	1,75	2,0	-	-	-	-
		V_{rec} [kN]	0,75 (6,3)	1,00 (9,2)	1,00	1,00	-	-	-	-

a) Recommended load values with consideration of a global safety factor γ_{global} = 3,0: $F_{rec} = F_{Rk} / \gamma_{global}$
b) f_b = brick strength

Recommended loads a) F_{rec} for brick breakout and pull out in [kN]
Solid masonry: HIT-HY 70 with HIT-V, HAS, HAS-E and HIT-IC
Values in brackets: mean ultimate loads $F_{u,m}$ [kN]:

			HIT-V, HAS, HAS-E				HIT-IC		
Anchor size									
Base material	Setting depth [mm]		M6	M8	M10	M12	M8	M10	M12
Aereted concrete block f_b b) ≥ 6 N/mm² L x H x B [mm] 1900 x 600 x 100  Japan	50	N_{rec} [kN]	-	-	-	0,75	-	-	0,75 (4,0)
		V_{rec} [kN]	-	-	-	1,0	-	-	1,0 (8,6)
	80	N_{rec} [kN]	-	-	1,5 (7,3)	1,75	-	1,75 (7,4)	1,75 (8,0)
		V_{rec} [kN]	-	-	0,75 (4,2)	1,0 (4,7)	-	1,0 (4,6)	1,0 (5,8)

a) Recommended load values with consideration of a global safety factor γ_{global} = 3,0: $F_{rec} = F_{Rk} / \gamma_{global}$
b) f_b brick strength

Design

Influence of joints:

If the joints of the masonry are not visible the recommended load N_{rec} has to be reduced with the factor α_j = 0.75.

If the joints of the masonry are visible (e.g. unplastered wall) following has to be taken into account:
- The recommended load N_{rec} may be used only, if the wall is designed such that the joints are to be filled with mortar.
- If the wall is designed such that the joints are not to be filled with mortar then the recommended load N_{rec} may be used only, if the minimum edge distance c_{min} to the vertical joints is observed. If this minimum edge distance c_{min} can not be observed then the recommended load N_{rec} has to be reduced with the factor α_j = 0.75.

The decisive resistance to tension loads is the lower value of N_{rec} (brick breakout, pull out) and $N_{max,pb}$ (pull out of one brick).

Pull out of one brick:

The allowable load of an anchor or a group of anchors in case of pull out of one brick, $N_{max,pb}$ [kN], is given in the following tables:

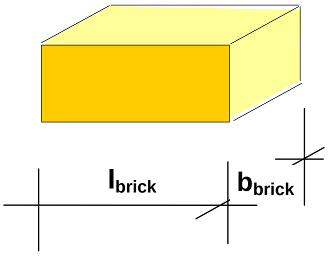
Clay bricks:

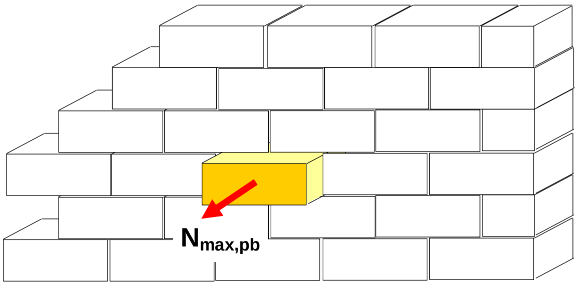
$N_{max,pb}$ [kN]		brick breadth b_{brick} [mm]					
		80	120	200	240	300	360
brick length l_{brick} [mm]	240	1,1	1,6	2,7	3,3	4,1	4,9
	300	1,4	2,1	3,4	4,1	5,1	6,2
	500	2,3	3,4	5,7	6,9	8,6	10,3

All other brick types:

$N_{max,pb}$ [kN]		brick breadth b_{brick} [mm]					
		80	120	200	240	300	360
brick length l_{brick} [mm]	240	0,8	1,2	2,1	2,5	3,1	3,7
	300	1,0	1,5	2,6	3,1	3,9	4,6
	500	1,7	2,6	4,3	5,1	6,4	7,7

$N_{max,pb}$ = *resistance for pull out of one brick*
l_{brick} = *length of the brick*
b_{brick} = *breadth of the brick*





For all applications outside of the above mentioned base materials and / or setting conditions site tests have to be made for the determination of load values.
Due to the wide variety of natural stones site tests have to be made for determine of load values.

Materials

Material quality HAS

Part	Material
Threaded rod HAS-(E)	Strength class 5.8, A_5 > 8% ductile steel galvanized ≥ 5 µm
Threaded rod HAS-(E)R	Stainless steel grade A4, A_5 > 8% ductile strength class 70, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Washer ISO 7089	Steel galvanized,
	Stainless steel, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Nut EN ISO 4032	Strength class 8, steel galvanized ≥ 5 µm
	Strength class 70, stainless steel grade A4, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	Strength class 70, high corrosion resistant steel, 1.4529; 1.4565

Material quality HIT-A

Part	Material
HIT-AC rod	Carbon steel strength 5.8; galvanized to min. 5 µm
HIT-ACR rod	Stainless steel, grade A4-70; 1.4401; 1.4404; 1.4571
HIT-AN rod	Carbon steel strength 3.6; galvanized to min. 5 µm

Material quality sleeves

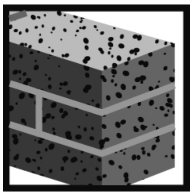
Part	Material
HIT-IG sleeve	Carbon steel 1.0718; galvanized to min. 5 µm
HIT-IC sleeve	Carbon steel; galvanized to min. 5 µm
HIT-SC sleeve	PA/PP

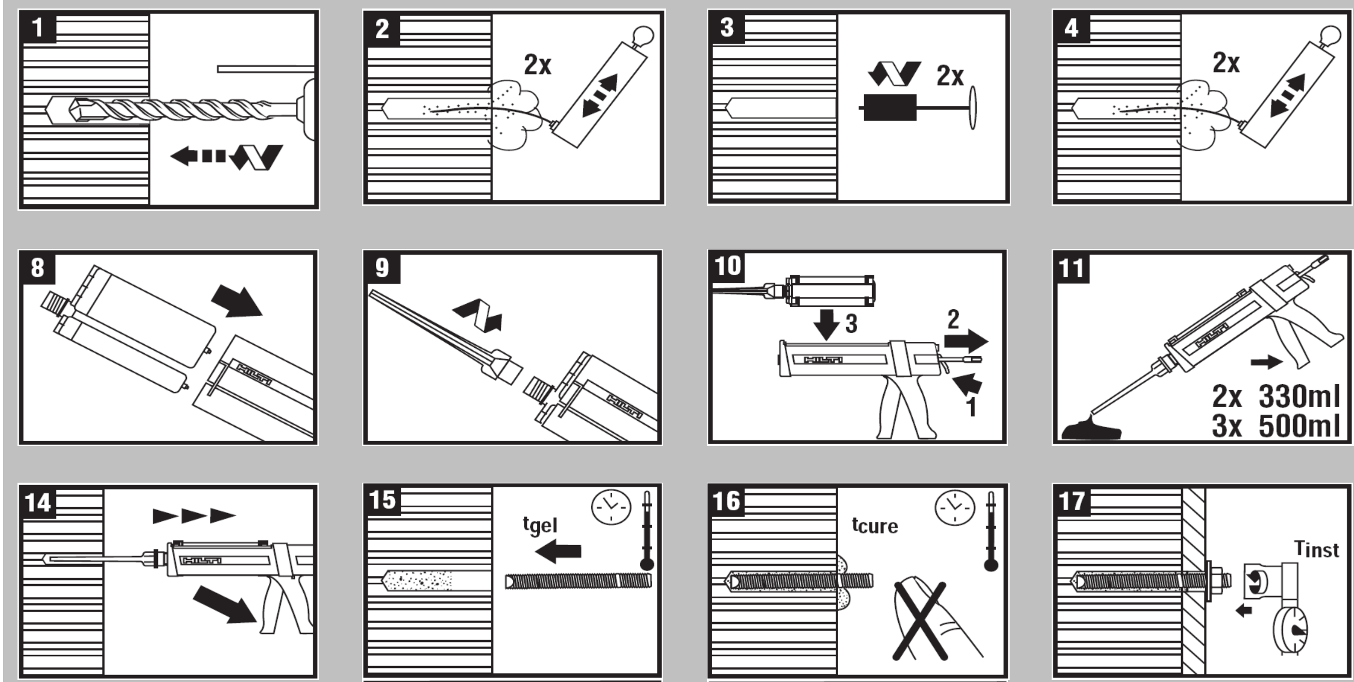
Setting

Installation equipment

Anchor size	M6	M8	M10	M12
Rotary hammer	TE2 – TE16			
Other tools	blow out pump, set of cleaning brushes, dispenser			

Setting instruction in solid base materials

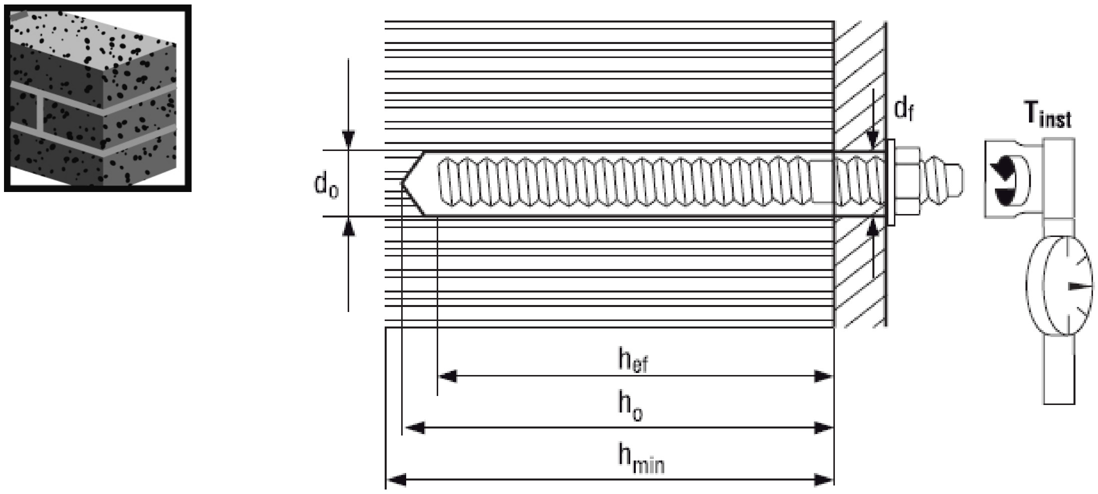




15	°F	°C	t_{gel}
	23	-5	10 min
	32	0	10 min
	41	5	10 min
	50	10	7 min
	68	20	4 min
	86	30	2 min
	104	40	1 min

16	°F	°C	t_{cure}
	23	-5	6 h
	32	0	4 h
	41	5	2.5 h
	50	10	1.5 h
	68	20	45 min
	86	30	30 min
	104	40	20 min

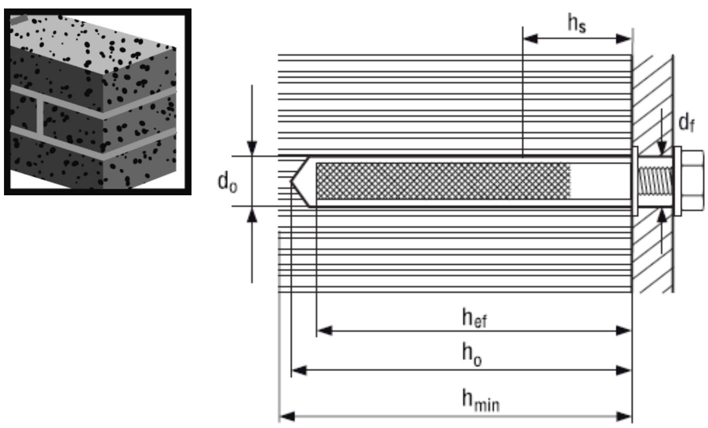
Setting details: hole depth h_0 and effective anchorage depth in solid base materials

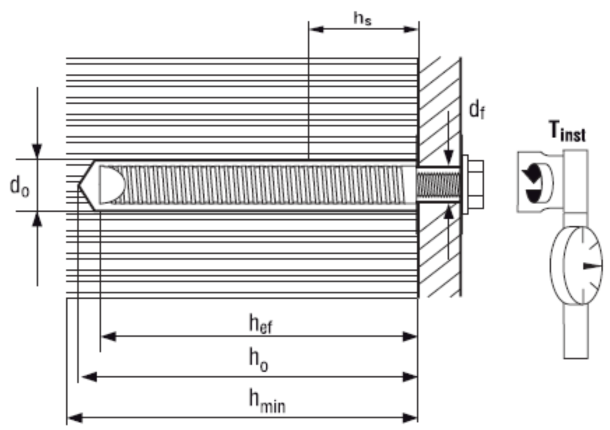


Setting details HIT-AC, HIT-V, HIT-V, HAS, HAS-E, HAS-R

Anchor size			HIT-V			HIT-V, HAS, HAS-E, HAS-R			
			M8	M10	M12	M8	M10	M12	M16
Nominal diameter of drill bit	d_0	[mm]	10	12	14	10	12	14	18
Effective anchorage depth	h_{ef}	[mm]	80	80	80	80	90	110	125
Hole depth	h_0	[mm]	85	85	85	85	95	115	130
Minimum base material thickness	h_{min}	[mm]	115	115	115	110	120	140	170
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	9	12	14	18
Minimum spacing[a)]	s_{min}	[mm]	100	100	100	100	100	100	100
Minimum edge distance [a)]	c_{min}	[mm]	100	100	100	100	100	100	100
Torque moment	T_{inst}	[Nm]	5	8	10	5	8	10	10
Filling volume		[ml]	4	5	7	4	6	10	15

a) In case of **shear loads towards a free edge**: **c_{min} = 200 mm**
A distance from the edge of a broken brick of c_{min} = 200 mm is recommended, e.g. around window or door frames.



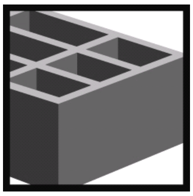


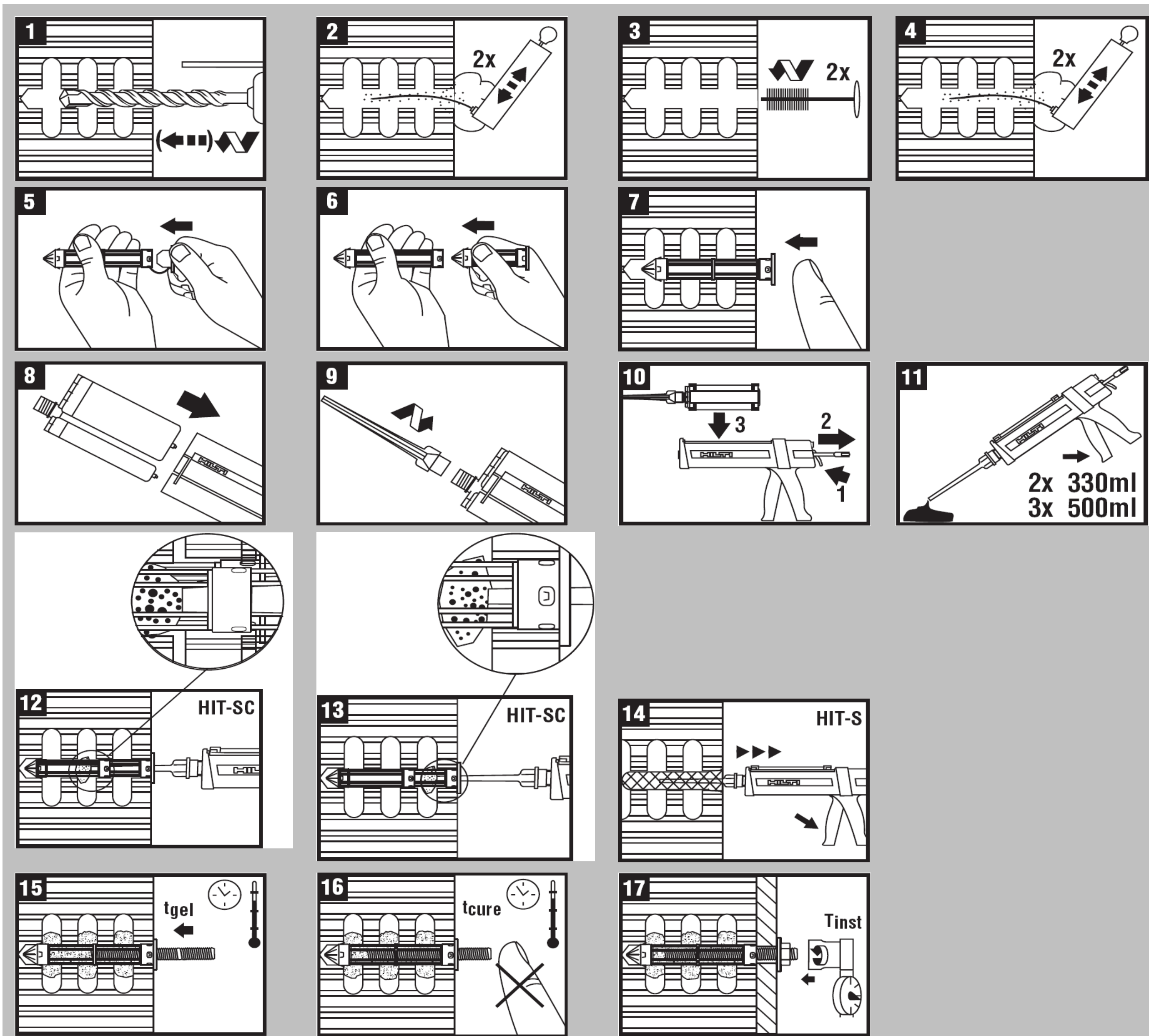
Setting details HIT-IC

Anchor size			HIT-IC			HIS-N/RN		
			M8	M10	M12	M8	M10	M12
Nominal diameter of drill bit	d_0	[mm]	14	16	18	14	18	22
Effective anchorage depth	h_{ef}	[mm]	80	80	80	90	110	125
Hole depth	h_0	[mm]	85	85	85	95	115	130
Minimum base material thickness	h_{min}	[mm]	115	115	115	120	150	170
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	9	12	14
Length of bolt engagement	h_S	[mm]	min. 10 – max. 75			min. 8 max.20	min. 10 max.25	min 12 max.30
Minimum spacing [a)]	s_{min}	[mm]	100	100	100	100	100	100
Minimum edge distance [a)]	c_{min}	[mm]	100	100	100	100	100	100
Torque moment	T_{inst}	[Nm]	5	8	10	5	8	10
Filling volume		[ml]	6	6	6	6	10	16

a) In case of **shear loads towards a free edge**: **c_{min} = 20 cm**
A distance from the edge of a broken brick of c_{min} = 20 cm is recommended, e.g. around window or door frames.

Setting instruction in hollow base material – using 330 ml foil pack



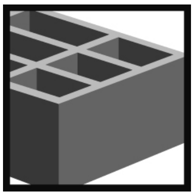


15	°F	°C	t_{gel}
	23	-5	10 min
	32	0	10 min
	41	5	10 min
	50	10	7 min
	68	20	4 min
	86	30	2 min
	104	40	1 min

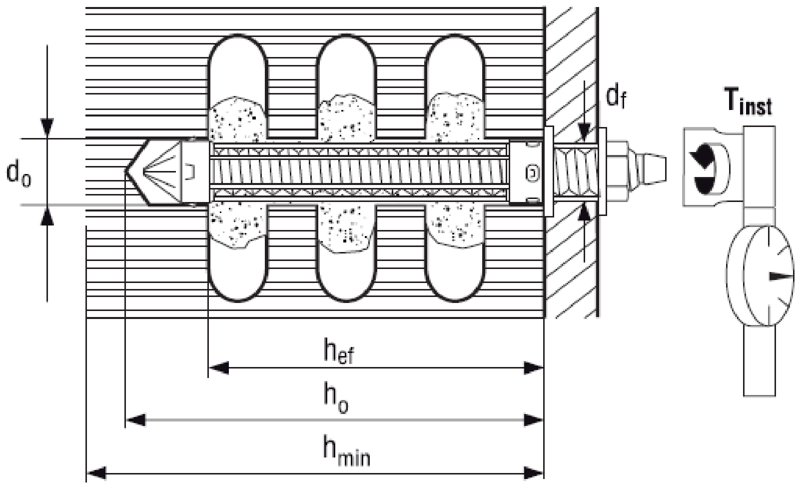
16	°F	°C	t_{cure}
	23	-5	6 h
	32	0	4 h
	41	5	2.5 h
	50	10	1.5 h
	68	20	45 min
	86	30	30 min
	104	40	20 min

Setting details: hole depth h_0 and effective anchorage depth in hollow base materials

HAS / HIT-V with HIT-SC



HIT-V, HAS

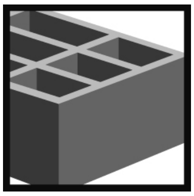


Setting details HIT-V / HAS with sieve sleeve

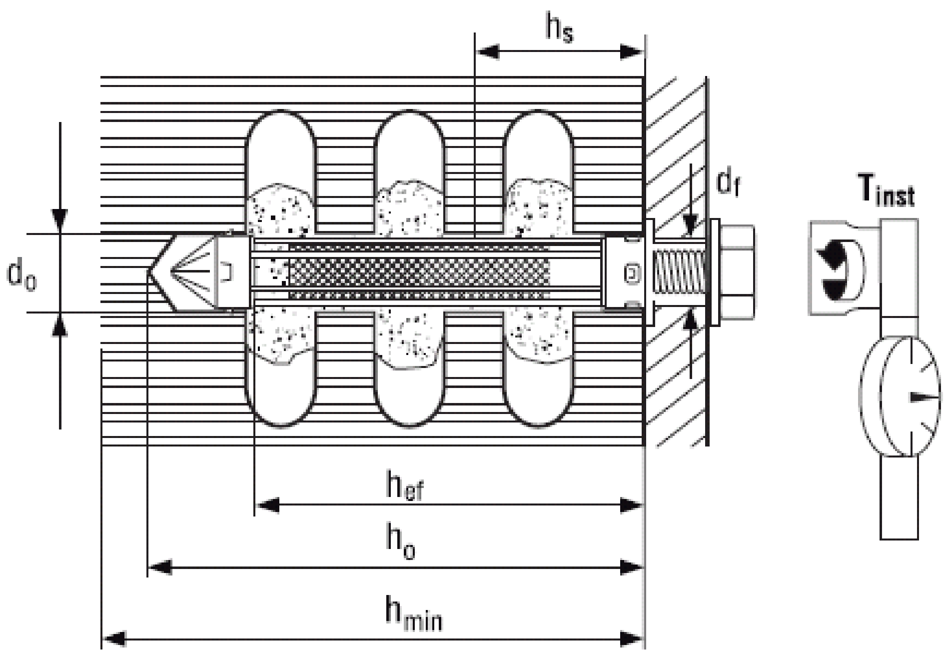
Anchor size			M6		M8		M10		M12			
Sieve sleeve HIT SC			**12x50**	**12x85**	**16x50**	**16x85**	**16x50**	**16x85**	**18x50**	**18x85**	**22x50**	**22x85**
Nominal diameter of drill bit	d_0	[mm]	12	12	16	16	16	16	18	18	22	22
Effective anchorage depth	h_{ef}	[mm]	50	80	50	80	50	80	50	80	50	80
Hole depth	h_0	[mm]	60	95	60	95	60	95	60	95	60	95
Minimum base material thickness	h_{min}	[mm]	80	115	80	115	80	115	80	115	80	115
Diameter of clearance hole in the fixture	d_f	[mm]	7	7	9	9	12	12	14	14	14	14
Minimum spacing [a)]	s_{min}	[mm]	100	100	100	100	100	100	100	100	100	100
Minimum edge distance [a)]	c_{min}	[mm]	100	100	100	100	100	100	100	100	100	100
Torque moment	T_{inst}	[Nm]	3	3	3	3	4	4	6	6	6	6
Filling volume		[ml]	12	24	18	30	18	30	18	36	30	55

Setting details: hole depth h_0 and effective anchorage depth in hollow base materials

HIT-IC with HIT-SC



HIT-IC



Setting details HIT-IC with sieve sleeve

Anchor size			HIT-IC		
			M8	**M10**	**M12**
Sieve sleeve HIT SC			**16x85**	**18x85**	**22x85**
Nominal diameter of drill bit	d_0	[mm]	16	18	22
Effective anchorage depth	h_{ef}	[mm]	80	80	80
Hole depth	h_0	[mm]	95	95	95
Minimum base material thickness	h_{min}	[mm]	115	115	115
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14
Length of bolt engagement	h_S	[mm]	min. 10 – max. 75		
Minimum spacing [a)]	s_{min}	[mm]	100	100	100
Minimum edge distance [a)]	c_{min}	[mm]	100	100	100
Torque moment	T_{inst}	[Nm]	3	4	6
Filling volume		[ml]	30	36	45

a) In case of **shear loads towards a free edge**: **c_{min} = 20 cm**
A distance from the edge of a broken brick of c_{min} = 20 cm is recommended, e.g. around window or door frames.

Hilti HIT-CT 1 mortar with HIT-V rod

Injection mortar system

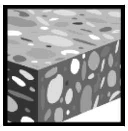
Hilti
HIT-CT 1
330 ml foil pack
(also available
as 500 ml
foil pack)

Static mixer

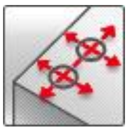
HIT-V(-F) rods
HIT-V-R rods
HIT-V-HCR rods

Benefits

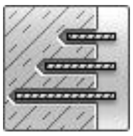
- Hilti **Clean-Tec** technology: clean of critical hazardous substances, environmentaly and user friendly.
- Hilti **SAFEset** technology: drilling with Hilti hollow drill bit and vacuum properly cleans the borehole and removes dust. No further cleaning needed.
- suitable for non-cracked concrete C 20/25 to C 50/60
- suitable for dry and water saturated concrete
- high loading capacity
- rapid curing
- in service temperature range up to 80°C short term/50°C long term
- manual cleaning
  for anchor size M8 to M16 and embedment depth $8d \le h_{ef} \le 10d$
- compressd air cleaning
  for anchor size M8 to M25 and embedment depth $8d \le h_{ef} \le 12d$



Concrete



Small edge distance and spacing



Variable embedment depth

A4 316

Corrosion resistance

HCR highMo

High corrosion resistance

Clean-Tec

Hilti Clean technology

SAFEset

Hilti SAFEset technology

PROFIS Anchor design software

CE conformity

European Technical Approval

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	CSTB, Paris	ETA-11/0354 / 2012-08-27

a) All data given in this section according ETA-11/0354 issue 2012-08-27.

Basic loading data (for a single anchor)

All data in this section applies to For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -5°C to +40°C

Embedment depth a) and base material thickness for the basic loading data.
Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20	M24
Typical embedment depth h_{ef} [mm]	80	90	110	130	170	210
Base material thickness h [mm]	110	120	140	170	220	270

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

Mean ultimate resistance: non-cracked concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	*18,9*	*30,5*	*44,1*	87,1	135,3	190,0
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	*9,5*	*15,8*	*22,1*	*41,0*	*64,1*	*92,4*

Characteristic resistance: non-cracked concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24
Tensile N_{Rk}	HIT-V 5.8	[kN]	*18,0*	*29,0*	*42,0*	65,3	101,5	142,5
Shear V_{Rk}	HIT-V 5.8	[kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*

Design resistance: non-cracked concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24
Tensile N_{Rd}	HIT-V 5.8	[kN]	12,0	17,3	25,3	36,3	56,4	79,2
Shear V_{Rd}	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4

Recommended loads a): non-cracked concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24
Tensile N_{rec}	HIT-V 5.8	[kN]	8,6	12,3	18,1	25,9	40,3	56,5
Shear V_{rec}	HIT-V 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations. According ETAG 001, annex C, the partial safety factor is γ_G = 1,35 for permanent actions and γ_Q = 1,5 for variable actions.

Service temperature range

Hilti HIT-CT 1injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIT-V

Anchor size			M8	M10	M12	M16	M20	M24
Nominal tensile strength f_{uk}	HIT-V(-F) 5.8	[N/mm²]	500	500	500	500	500	500
	HIT-V(-F) 8.8	[N/mm²]	800	800	800	800	800	800
	HIT-V -R	[N/mm²]	700	700	700	700	700	700
	HIT-V -HCR	[N/mm²]	800	800	800	800	800	700
Yield strength f_{yk}	HIT-V(-F) 5.8	[N/mm²]	400	400	400	400	400	400
	HIT-V(-F) 8.8	[N/mm²]	640	640	640	640	640	640
	HIT-V -R	[N/mm²]	450	450	450	450	450	450
	HIT-V -HCR	[N/mm²]	600	600	600	600	600	400
Stressed cross-section A_s	HIT-V	[mm²]	36,6	58,0	84,3	157	245	353
Moment of resistance W	HIT-V	[mm³]	31,2	62,3	109	277	541	935

Material quality

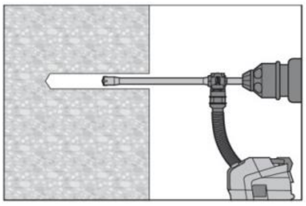
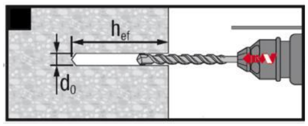
Part	Material
Threaded rod HIT-V(-F) 5.8	Strength class 5.8, A_5 > 8% ductile steel galvanized ≥ 5 µm (-F) hot dipped galvanized ≥ 45 µm
Threaded rod HIT-V(-F) 8.8	Strength class 8.8, A_5 > 8% ductile steel galvanized ≥ 5 µm (-F) hot dipped galvanized ≥ 45 µm (M8-M16 only)
Threaded rod HIT-V-R	Stainless steel grade A4, A_5 > 8% ductile strength class 70 for ≤ M24 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Threaded rod HIT-V-HCR	High corrosion resistant steel, 1.4529; 1.4565 strength ≤ M20: R_m = 800 N/mm², $R_{p\,0.2}$ = 640 N/mm², A_5 > 8% ductile M24: R_m = 700 N/mm², $R_{p\,0.2}$ = 400 N/mm², A_5 > 8% ductile
Washer ISO 7089	Steel galvanized, hot dipped galvanized
	Stainless steel, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	High corrosion resistant steel, 1.4529; 1.4565
Nut EN ISO 4032	Strength class 8 steel galvanized ≥ 5 µm hot dipped galvanized ≥ 45 µm
	Strength class 70, stainless steel grade A4, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	Strength class 70, EN ISO 3506-2, high corrosion resistant steel, 1.4529; 1.4565

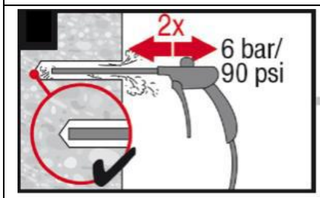
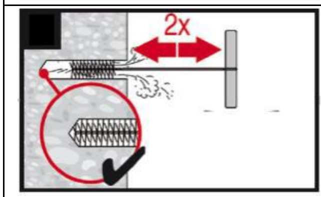
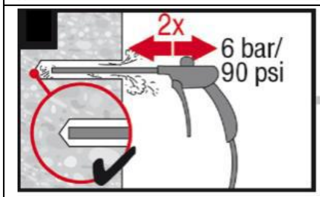
Anchor dimensions

Anchor size	M8	M10	M12	M16	M20	M24
Anchor rod HIT-V, HIT-V-F HIT-V-R, HIT-V-HCR	Anchor rods HIT-V (-F/ -R / -HCR) are available in variable length					

Setting instruction

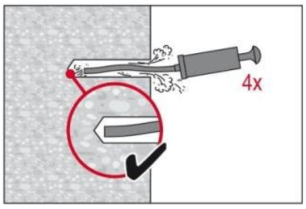
Dry and water-saturated concrete, hammer drilling

Bore hole drilling	
	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 method properly cleans the borehole and removes dust while drilling. After drilling is complete, proceed to the “injection preparation” step in the instructions for use.
	Drill hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.

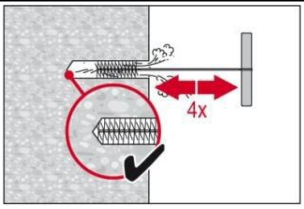
Bore hole cleaning	Just before setting an anchor, the bore hole must be free of dust and debris by one of two cleaning methods described below:
a) Compressed air cleaning (CAC)	For all bore hole diameters d_0 and all bore hole depth h_0
	Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust.
	Brush 2 times with the specified brush size (brush Ø ≥ bore hole Ø, see Table 5) 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 bore hole -- if not, the brush is too small and must be replaced with the proper brush diameter.
	Blow again with compressed air 2 times until return air stream is free of noticeable dust.

b) Manual Cleaning (MC)

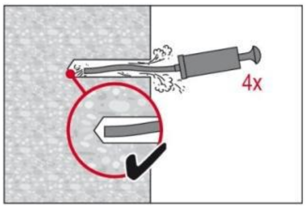
As an alternative to compressed air cleaning, a manual cleaning is permitted for hammer drilled boreholes for bore hole diameters $d_0 \leq 20mm$ and bore hole depth $h_0 \leq 10d_S$. The borehole must be free of dust, debris, water, ice, oil, grease and other contaminants prior to mortar injection.



The Hilti manual pump may be used for blowing out bore holes up to diameters $d_0 \leq 20$ mm and embedment depths up to $h_{ef} \leq 10d_S$.
Blow out at least 4 times from the back of the bore hole until return air stream is free of noticeable dust.

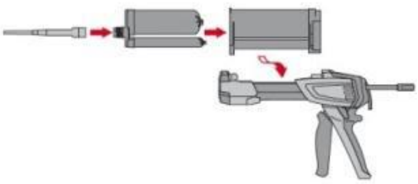


Brush 4 times with the specified brush size (brush Ø ≥ bore hole Ø, see Table 5) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the bore hole -- if not, the brush is too small and must be replaced with the proper brush diameter.

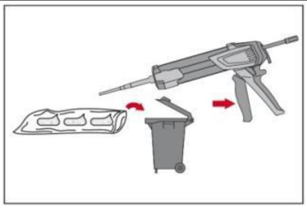


Blow out again with manual pump at least 4 times until return air stream is free of noticeable dust.

Injection preparation

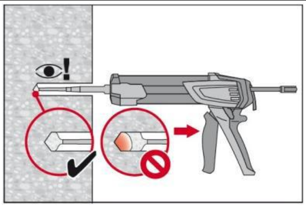


Observe the Instruction for Use of the dispenser.
Observe the Instruction for Use of the mortar.
Tightly attach Hilti HIT-RE-M mixing nozzle to foil pack manifold.
Insert foil pack into foil pack holder and swing holder into the dispenser.

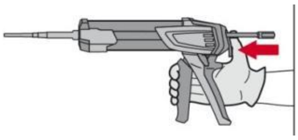


Discard initial adhesive. The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
Discard quantities are
- 2 strokes for 330 ml foil pack
- 3 strokes for 500 ml foil pack

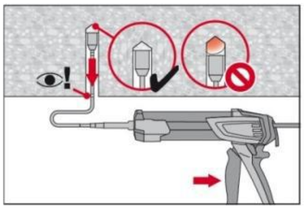
Inject adhesive from the back of the borehole without forming air voids



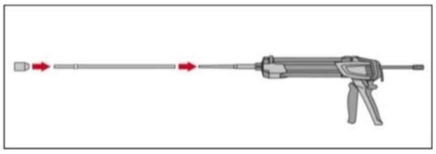
Injection method for borehole depth ≤ 250 mm:
Inject the mortar from the back of the hole towards the front and slowly withdraw the mixing nozzle step by step after each trigger pull. **Important! Use extensions for deep holes > 250 mm**. Fill holes approximately 2/3 full, or as required to ensure that 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 (only for manual dispenser). This will prevent further mortar discharge from the mixing nozzle.



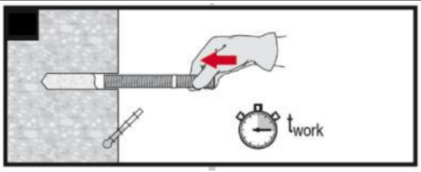
Piston plug injection for borehole depth > 250 mm or overhead applications: Assemble mixing nozzle, extension(s) and appropriately sized piston plug. Insert piston plug to back of the hole. Begin injection allowing the pressure of the injected adhesive mortar to push the piston plug towards the front of the hole. After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle. The proper injection of mortar using a piston plug HIT-SZ prevents the creation of air voids. The piston plug must be insertable to the back of the borehole without resistance. During injection the piston plug will be pressed towards the front of the borehole slowly by mortar pressure. Attention! Pulling the injection or when changing the foil pack, the piston plug is rendered inactive and air voids may occur.



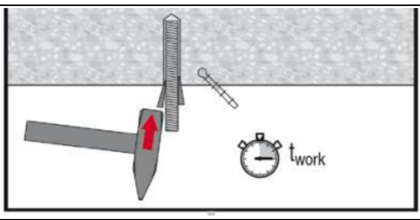
Dispenser types with related foil pack sizes:

HDM 330	Manual dispenser	(330 ml)
HDM 500	Manual dispenser	(330 / 500 ml)
HDE 500-A22	Electric dispenser	(330 / 500 ml)

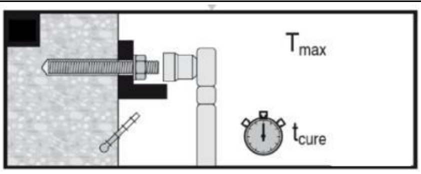
Setting the element



Before use, verify that the element is dry and free of oil and other contaminants. Mark and set element to the required embedment depth till working time t_{work} has elapsed. The working time t_{work} is given in the table below.



For overhead installation use piston plugs and fix embedded parts with e.g. wedges.



Loading the anchor: After required curing time t_{cure} (see Table below) the anchor can be loaded.

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 T_{BM}	Working time t_{gel}	Curing time t_{cure} a)
-5 °C ≤ T_{BM} < 0 °C	60 min	6 h
0 °C ≤ T_{BM} < 5 °C	40 min	3 h
5 °C ≤ T_{BM} < 10 °C	25 min	2 h
10 °C ≤ T_{BM} < 20 °C	10 min	90 min
20 °C ≤ T_{BM} < 30 °C	4 min	75 min
30 °C ≤ T_{BM} ≤ 40 °C	2 min	60 min

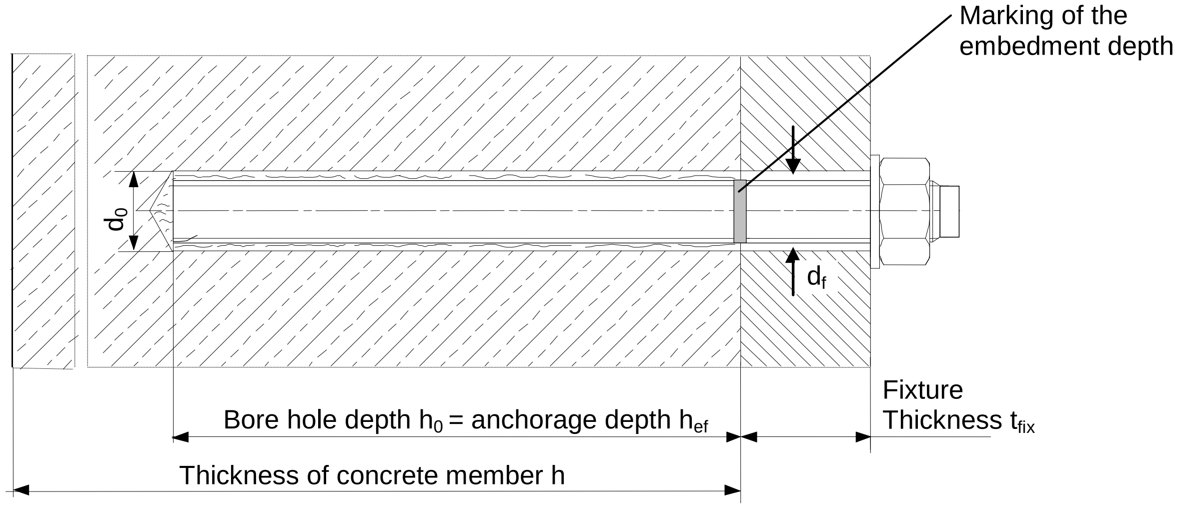
a) The curing time data are valid for dry anchorage base only. For water saturated anchorage bases the curing times must be doubled.

Setting

installation equipment

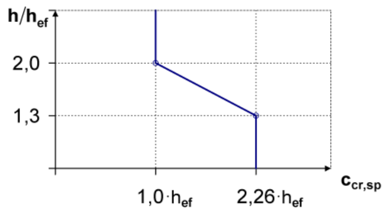
Anchor size	M8	M10	M12	M16	M20	M24
Rotary hammer	TE 2 – TE 16				TE 40 – TE 70	
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser					

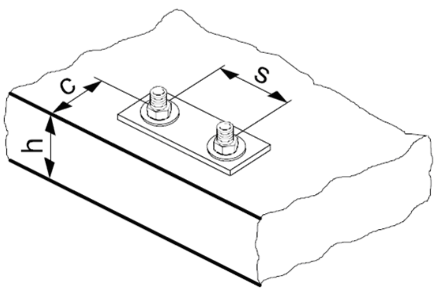
Setting details



Setting details

Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	22	28
Effective embedment and drill hole depth range [a] **for HIT-V**	$h_{ef,min}$	[mm]	64	80	96	128	160	192
	$h_{ef,max}$	[mm]	96	120	144	192	240	288
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			$h_{ef} + 2\ d_0$		
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22	26
Torque moment	T_{max} [b]	[Nm]	10	20	40	80	150	200
Minimum spacing	s_{min}	[mm]	40	50	60	80	100	120
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$					
Critical edge distance for splitting failure [c]	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$**	for $h / h_{ef} \geq 2{,}0$				
			$4{,}6\ h_{ef} - 1{,}8\ h$	for $2{,}0 > h / h_{ef} > 1{,}3$:				
			$2{,}26\ h_{ef}$	for $h / h_{ef} \leq 1{,}3$:				
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$					
Critical edge distance for concrete cone failure [d]	$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$					





For spacing (or edge distance) smaller than critical spacing (or critical edge distance) the design loads have to be reduced.

a) Embedment depth range: $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$

b) Maximum recommended torque moment to avoid splitting failure during installation with minimum spacing and/or edge distance.

c) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

d) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-08/0341, issue 2008-12-02.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

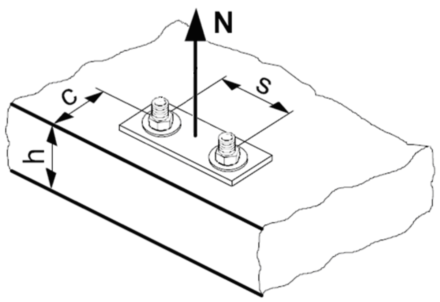
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24
$N_{Rd,s}$	HIT-V(-F) 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	118,0
	HIT-V(-F) 8.8	[kN]	19,3	30,7	44,7	84,0	130,7	188,0
	HIT-V-R	[kN]	13,9	21,9	31,6	58,8	92,0	132,1
	HIT-V-HCR	[kN]	19,3	30,7	44,7	84,0	130,7	117,6

Design combined pull-out and concrete cone resistance
$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

Anchor size		M8	M10	M12	M16	M20	M24
Typical embedment depth $h_{ef} = h_{ef,typ}$	**[mm]**	**80**	**90**	**110**	**130**	**170**	**210**
$N^0_{Rd,p}$ Temperature range I	[kN]	13,4	17,3	25,3	36,3	56,4	79,2
$N^0_{Rd,p}$ Temperature range II	[kN]	12,3	17,3	23,0	34,5	53,4	74,8

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

Anchor size		M8	M10	M12	M16	M20	M24
$N^0_{Rd,c}$	[kN]	20,1	24,0	32,4	41,6	62,2	85,4

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,15}$ a)	1,00	1,03	1,06	1,09	1,11	1,13	1,14

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The edge distance shall not be smaller than the minimum edge distance c_{min}. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min}. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

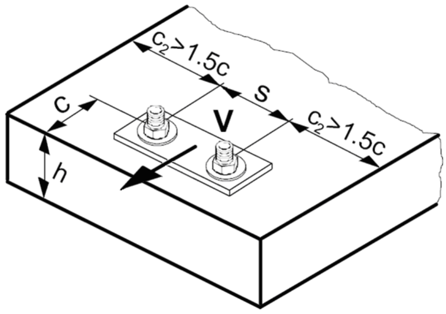
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $\mathbf{V_{Rd,s}}$
- Concrete pryout resistance: $\mathbf{V_{Rd,cp} = k}$ · lower value of $\mathbf{N_{Rd,p}}$ and $\mathbf{N_{Rd,c}}$
- Concrete edge resistance: $\mathbf{V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c}$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24
$V_{Rd,s}$	HIT-V(-F) 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4
	HIT-V(-F) 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of k · $N_{Rd,p}$ and k · $N_{Rd,c}$

k = 2 for $h_{ef} \geq 60$ mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $\mathbf{V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c}$

Anchor size		M8	M10	M12	M16	M20	M24
Non-cracked concrete							
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,6	18,7	27,0	36,6

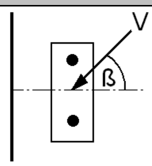
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_ß$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4
$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

h_{ef}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81

h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

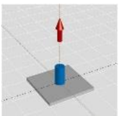
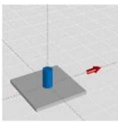
Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

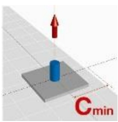
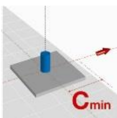
Precalculated values – design resistance values

All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

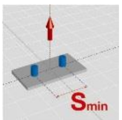
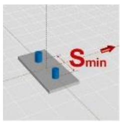
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth

Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Embedment depth	h_{ef} = $h_{ef,min}$	[mm]	64	80	96	128	160	192
Base material thickness	h = h_{min}	[mm]	100	110	126	164	204	248
	**Tensile N_{Rd}: single anchor, no edge effects**							
	HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	10,7	15,4	22,1	35,7	53,1	72,4
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**							
	HIT-V(-F) 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4
	HIT-V(-F) 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9

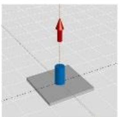
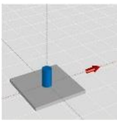
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth

Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Embedment depth	h_{ef} = $h_{ef,min}$	[mm]	64	80	96	128	160	192
Base material thickness	h = h_{min}	[mm]	100	110	126	164	204	248
Edge distance	c = c_{min}	[mm]	40	50	60	80	100	120
	**Tensile N_{Rd}: single anchor, min. edge distance (c = c_{min})**							
	HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	6,3	9,0	12,9	21,3	31,9	43,6
	**Shear V_{Rd}: single anchor, min. edge distance (c = c_{min}), without lever arm**							
	HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	3,6	5,2	7,1	11,6	16,9	23,0

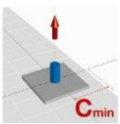
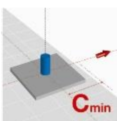
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth (load values are valid for single anchor)

Anchor size			M8	M10	M12	M16	M20	M24
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	64	80	96	128	160	192
Base material thickness	$h = h_{min}$	[mm]	100	110	126	164	204	248
Spacing	$s = s_{min}$	[mm]	40	50	60	80	100	120
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**							
	HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	7,0	10,0	14,0	22,6	33,1	44,8
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**							
	HIT-V(-F) 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4
	HIT-V(-F) 8.8	[kN]	12,0	18,4	26,7	43,2	64,1	87,5
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5
	HIT-V-HCR	[kN]	12,0	18,4	26,7	43,2	64,1	70,9

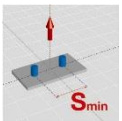
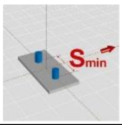
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth

Anchor size			M8	M10	M12	M16	M20	M24
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	130	170	210
Base material thickness	$h = h_{min}$	[mm]	110	120	140	166	214	266
	**Tensile N_{Rd}: single anchor, no edge effects**							
	HIT-V(-F) 5.8	[kN]	12,0	17,3	25,3	36,3	56,4	79,2
	HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	13,4	17,3	25,3	36,3	56,4	79,2
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**							
	HIT-V(-F) 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4
	HIT-V(-F) 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9

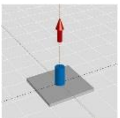
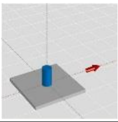
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth

Anchor size			M8	M10	M12	M16	M20	M24
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	130	170	210
Base material thickness	$h = h_{min}$	[mm]	110	120	140	166	214	266
Edge distance	$c = c_{min}$	[mm]	40	50	60	80	100	120
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**							
	HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	7,7	10,1	14,7	21,6	33,9	48,0
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**							
	HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	3,7	5,3	7,3	11,6	17,2	23,6

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth (load values are valid for single anchor)

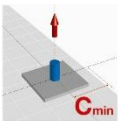
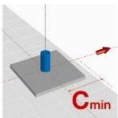
Anchor size		M8	M10	M12	M16	M20	M24
Embedment depth $h_{ef} = h_{ef,typ}$	[mm]	80	90	110	130	170	210
Base material thickness $h = h_{min}$	[mm]	110	120	140	166	214	266
Spacing s	[mm]	40	50	60	80	100	120
Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)							
 HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	8,9	11,3	16,3	23,0	35,4	49,7
Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm							
 HIT-V(-F) 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4
HIT-V(-F) 8.8	[kN]	12,0	18,4	27,2	43,7	67,4	94,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5
HIT-V-HCR	[kN]	12,0	18,4	27,2	43,7	67,4	70,9

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d a)

Anchor size		M8	M10	M12	M16	M20	M24
Embedment depth h_{ef} = 12 d a)	[mm]	96	120	144	192	240	288
Base material thickness $h = h_{min}$	[mm]	126	150	174	228	288	344
Tensile N_{Rd}: single anchor, no edge effects							
 HIT-V(-F) 5.8	[kN]	12,0	19,3	28,0	52,7	79,6	108,6
HIT-V(-F) 8.8	[kN]	16,1	23,0	33,2	53,6	79,6	108,6
HIT-V-R	[kN]	13,9	21,9	31,6	53,6	79,6	108,6
HIT-V-HCR	[kN]	16,1	23,0	33,2	53,6	79,6	108,6
Shear V_{Rd}: single anchor, no edge effects, without lever arm							
 HIT-V(-F) 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4
HIT-V(-F) 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9

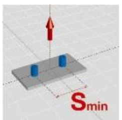
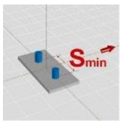
a) d = element diameter

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d a)

Anchor size		M8	M10	M12	M16	M20	M24
Embedment depth h_{ef} = 12 d a)	[mm]	96	120	144	192	240	288
Base material thickness $h = h_{min}$	[mm]	126	150	174	228	284	344
Edge distance $c = c_{min}$	[mm]	40	50	60	80	100	120
Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)							
 HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	9,2	13,4	19,3	31,9	47,9	66,2
Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm							
 HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	3,9	5,7	7,8	12,9	18,9	25,9

a) d = element diameter

**Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d [a)]
(load values are valid for single anchor)**

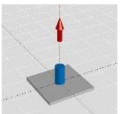
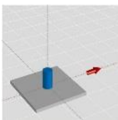
Anchor size			M8	M10	M12	M16	M20	M24
Embedment depth	h_{ef} = 12 d [a)]	[mm]	96	120	144	192	240	288
Base material thickness	h = h_{min}	[mm]	126	150	174	228	284	344
Spacing	s=s_{min}	[mm]	40	50	60	80	100	120
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min})**							
	HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	10,8	15,5	22,0	35,4	52,1	70,9
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min}) , without lever arm**							
	HIT-V(-F) 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4
	HIT-V(-F) 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9

a) d = element diameter

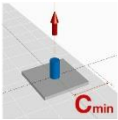
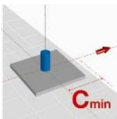
Precalculated values – recommended load values

All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

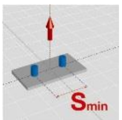
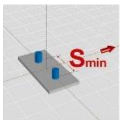
Recommended loads: non-cracked concrete C 20/25 - minimum embedment depth

Anchor size			M8	M10	M12	M16	M20	M24
Embedment depth	h_{ef} = $h_{ef,min}$	[mm]	64	80	96	128	160	192
Base material thickness	h = h_{min}	[mm]	100	110	126	164	204	248
	**Tensile N_{rec}: single anchor, no edge effects**							
	HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	7,6	11,0	15,8	25,5	37,9	51,7
	**Shear V_{rec}: single anchor, no edge effects, without lever arm**							
	HIT-V(-F) 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3
	HIT-V(-F) 8.8	[kN]	8,6	13,1	19,4	36,0	56,0	80,6
	HIT-V-R	[kN]	5,9	9,1	13,7	25,2	39,4	56,8
	HIT-V-HCR	[kN]	8,6	13,1	19,4	36,0	56,0	50,6

Recommended loads: non-cracked concrete C 20/25 - minimum embedment depth

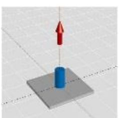
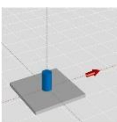
Anchor size			M8	M10	M12	M16	M20	M24
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	64	80	96	128	160	192
Base material thickness	$h = h_{min}$	[mm]	100	110	126	164	204	248
Edge distance	$c = c_{min}$	[mm]	40	50	60	80	100	120
	**Tensile N_{rec}: single anchor, min. edge distance ($c = c_{min}$)**							
	HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	4,5	6,4	9,2	15,2	22,8	31,1
	**Shear V_{rec}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**							
	HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	2,6	3,7	5,1	8,3	12,1	16,4

Recommended loads: non-cracked concrete C 20/25 - minimum embedment depth (load values are valid for single anchor)

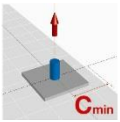
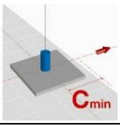
Anchor size			M8	M10	M12	M16	M20	M24
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	64	80	96	128	160	192
Base material thickness	$h = h_{min}$	[mm]	100	110	126	164	204	248
Spacing	$s = s_{min}$	[mm]	40	50	60	80	100	120
	**Tensile N_{rec}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**							
	HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	5,0	7,1	10,0	16,1	23,6	32,0
	**Shear V_{rec}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**							
	HIT-V(-F) 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3
	HIT-V(-F) 8.8	[kN]	8,6	13,1	19,1	30,9	45,8	62,5
	HIT-V-R	[kN]	5,9	9,1	13,7	25,2	39,4	56,8
	HIT-V-HCR	[kN]	8,6	13,1	19,1	30,9	45,8	50,6

For the recommended loads an overall partial safety factor for action γ = 1,4 is considered. The partial safety factors for action depend on the type of loading and shall be taken from national regulations. According ETAG 001, annex C, the partial safety factor is γ_G = 1,35 for permanent actions and γ_Q = 1,5 for variable actions.

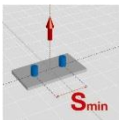
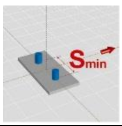
Recommended loads: non-cracked concrete C 20/25 - typical embedment depth

Anchor size			M8	M10	M12	M16	M20	M24
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	130	170	210
Base material thickness	$h = h_{min}$	[mm]	110	120	140	166	214	266
	**Tensile N_{rec}: single anchor, no edge effects**							
	HIT-V(-F) 5.8	[kN]	8,6	12,4	18,1	25,9	40,3	56,6
	HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	9,6	12,4	18,1	25,9	40,3	56,6
	**Shear V_{rec}: single anchor, no edge effects, without lever arm**							
	HIT-V(-F) 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3
	HIT-V(-F) 8.8	[kN]	8,6	13,1	19,4	36,0	56,0	80,6
	HIT-V-R	[kN]	5,9	9,1	13,7	25,2	39,4	56,8
	HIT-V-HCR	[kN]	8,6	13,1	19,4	36,0	56,0	50,6

Recommended loads: non-cracked concrete C 20/25 - typical embedment depth

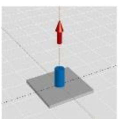
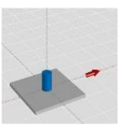
Anchor size		M8	M10	M12	M16	M20	M24
Embedment depth $h_{ef} = h_{ef,typ}$	[mm]	80	90	110	130	170	210
Base material thickness $h = h_{min}$	[mm]	110	120	140	166	214	266
Edge distance $c = c_{min}$	[mm]	40	50	60	80	100	120
 **Tensile N_{rec}: single anchor, min. edge distance ($c = c_{min}$)**							
HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	5,5	7,2	10,5	15,4	24,2	34,3
 **Shear V_{rec}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**							
HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	2,6	3,8	5,2	8,3	12,3	16,9

Recommended loads: non-cracked concrete C 20/25 - typical embedment depth
(load values are valid for single anchor)

Anchor size		M8	M10	M12	M16	M20	M24
Embedment depth $h_{ef} = h_{ef,typ}$	[mm]	80	90	110	130	170	210
Base material thickness $h = h_{min}$	[mm]	110	120	140	166	214	266
Spacing s	[mm]	40	50	60	80	100	120
 **Tensile N_{rec}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**							
HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	6,4	8,1	11,6	16,4	25,3	35,5
 **Shear V_{rec}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**							
HIT-V(-F) 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3
HIT-V(-F) 8.8	[kN]	8,6	13,1	19,4	31,2	48,1	67,3
HIT-V-R	[kN]	5,9	9,1	13,7	25,2	39,4	56,8
HIT-V-HCR	[kN]	8,6	13,1	19,4	31,2	48,1	50,6

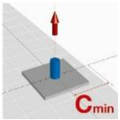
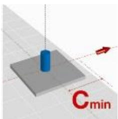
For the recommended loads an overall partial safety factor for action γ = 1,4 is considered. The partial safety factors for action depend on the type of loading and shall be taken from national regulations. According ETAG 001, annex C, the partial safety factor is γ_G = 1,35 for permanent actions and γ_Q = 1,5 for variable actions.

Recommended loads: non-cracked concrete C 20/25 - embedment depth = 12 d a)

Anchor size		M8	M10	M12	M16	M20	M24
Embedment depth $h_{ef} = 12\,d$ a)	[mm]	96	120	144	192	240	288
Base material thickness $h = h_{min}$	[mm]	126	150	174	228	284	344
 **Tensile N_{rec}: single anchor, no edge effects**							
HIT-V(-F) 5.8	[kN]	8,6	13,8	20,0	37,6	56,9	77,6
HIT-V(-F) 8.8	[kN]	11,5	16,4	23,7	38,3	56,9	77,6
HIT-V-R	[kN]	9,9	15,6	22,6	38,3	56,9	77,6
HIT-V-HCR	[kN]	11,5	16,4	23,7	38,3	56,9	77,6
 **Shear V_{rec}: single anchor, no edge effects, without lever arm**							
HIT-V(-F) 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3
HIT-V(-F) 8.8	[kN]	8,6	13,1	19,4	36,0	56,0	80,6
HIT-V-R	[kN]	5,9	9,1	13,7	25,2	39,4	56,8
HIT-V-HCR	[kN]	8,6	13,1	19,4	36,0	56,0	50,6

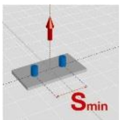
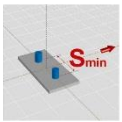
a) d = element diameter

Recommended loads: non-cracked concrete C 20/25 - embedment depth = 12 d [a)]

Anchor size			M8	M10	M12	M16	M20	M24
Embedment depth h_{ef} = 12 d [a)]		[mm]	96	120	144	192	240	288
Base material thickness $h = h_{min}$		[mm]	126	150	174	228	284	344
Edge distance $c = c_{min}$		[mm]	40	50	60	80	100	120
	**Tensile N_{rec}: single anchor, min. edge distance ($c = c_{min}$)**							
	HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	6,6	9,6	13,8	22,8	34,2	47,3
	**Shear V_{rec}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**							
	HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	2,8	4,1	5,6	9,2	13,5	18,5

a) d = element diameter

Recommended loads: non-cracked concrete C 20/25 - embedment depth = 12 d [a)]
(load values are valid for single anchor)

Anchor size			M8	M10	M12	M16	M20	M24
Embedment depth h_{ef} = 12 d [a)]		[mm]	96	120	144	192	240	288
Base material thickness $h = h_{min}$		[mm]	126	150	174	228	284	344
Spacing $s=s_{min}$		[mm]	40	50	60	80	100	120
	**Tensile N_{rec}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**							
	HIT-V(-F) 5.8 HIT-V(-F) 8.8 HIT-V-R HIT-V-HCR	[kN]	7,7	11,1	15,7	25,3	37,2	50,6
	**Shear V_{rec}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**							
	HIT-V(-F) 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3
	HIT-V(-F) 8.8	[kN]	8,6	13,1	19,4	36,0	56,0	80,6
	HIT-V-R	[kN]	5,9	9,1	13,7	25,2	39,4	56,8
	HIT-V-HCR	[kN]	8,6	13,1	19,4	36,0	56,0	50,6

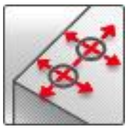
For the recommended loads an overall partial safety factor for action γ = 1,4 is considered. The partial safety factors for action depend on the type of loading and shall be taken from national regulations. According ETAG 001, annex C, the partial safety factor is γ_G = 1,35 for permanent actions and γ_Q = 1,5 for variable actions.

a) d = element diameter

Hilti HIT-ICE mortar with HIT-V / HAS rod

Injection mortar system		Benefits
	Hilti HIT-ICE 296 ml cartridge	- suitable for non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - high corrosion resistant - odourless resin - low installation temperature (range -23 °C to +32 °C)
	Statik mixer	
	HAS rod	
	HAS-E rod	
	HIT-V rod	

Concrete



Small edge distance and spacing

Corrosion resistance

High corrosion resistance

PROFIS Anchor design software

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Installation temperature range -18°C to +32°C

Embedment depth a) and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20	M24
Embedment depth [mm]	80	90	110	125	170	210
Base material thickness [mm]	110	120	140	165	220	270

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			Hilti technical data					
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	*18,9*	*30,5*	*44,1*	59,9	101,9	127,1
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	*9,5*	*15,8*	*22,1*	*41,0*	*64,1*	*92,4*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			Hilti technical data					
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Tensile N_{Rk}	HIT-V 5.8	[kN]	17,6	23,5	35,3	44,9	76,4	95,3
Shear V_{Rk}	HIT-V 5.8	[kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			Hilti technical data					
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Tensile N_{Rd}	HIT-V 5.8	[kN]	8,4	11,2	16,8	21,4	36,4	45,4
Shear V_{Rd}	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4

Recommended loads [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			Hilti technical data					
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Tensile N_{rec}	HIT-V 5.8	[kN]	6,0	8,0	12,0	15,3	26,0	32,4
Shear V_{rec}	HIT-V 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-ICE injection mortar may be applied in the temperature range given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +70 °C	+43 °C	+70 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIT-V / HAS

			Hilti technical data					
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Nominal tensile strength f_{uk}	HIT-V/HAS 5.8	[N/mm²]	500	500	500	500	500	500
	HIT-V 8.8	[N/mm²]	800	800	800	800	800	800
	HIT-V/HAS -R	[N/mm²]	700	700	700	700	700	700
	HIT-V/HAS -HCR	[N/mm²]	800	800	800	800	800	700
Yield strength f_{yk}	HIT-V/HAS 5.8	[N/mm²]	400	400	400	400	400	400
	HIT-V 8.8	[N/mm²]	640	640	640	640	640	640
	HIT-V/HAS -R	[N/mm²]	450	450	450	450	450	450
	HIT-V/HAS -HCR	[N/mm²]	600	600	600	600	600	400
Stressed cross-section A_s	HAS	[mm²]	32,8	52,3	76,2	144	225	324
	HIT-V	[mm²]	36,6	58,0	84,3	157	245	353
Moment of resistance W	HAS	[mm³]	27,0	54,1	93,8	244	474	809
	HIT-V	[mm³]	31,2	62,3	109	277	541	935

Material quality

Part	**Material**
Threaded rod HIT-V(F), HAS 5.8	Strength class 5.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V(F) 8.8	Strength class 8.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V-R, HAS-R	Stainless steel grade A4, A_5 > 8% ductile strength class 70, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Threaded rod HIT-V-HCR, HAS-HCR	High corrosion resistant steel, 1.4529; 1.4565 strength ≤ M20: R_m = 800 N/mm², $R_{p\,0.2}$ = 640 N/mm², A_5 > 8% ductile M24: R_m = 700 N/mm², $R_{p\,0.2}$ = 400 N/mm², A_5 > 8% ductile
Washer ISO 7089	Steel galvanized, hot dipped galvanized,
	Stainless steel, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	High corrosion resistant steel, 1.4529; 1.4565
Nut EN ISO 4032	Strength class 8, steel galvanized ≥ 5 µm, hot dipped galvanized ≥ 45 µm,
	Strength class 70, stainless steel grade A4, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	Strength class 70, high corrosion resistant steel, 1.4529; 1.4565

Anchor dimensions

Anchor size	M8	M10	M12	M16	M20	M24
Anchor rod HAS, HAS-E, HAS-R, HAS-ER HAS-HCR	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210
Anchor embedment depth [mm]	80	90	110	125	170	210
Anchor rod HIT-V, HIT-V-R, HIT-V-HCR	Anchor rods HIT-V (-R / -HCR) are available in variable length					

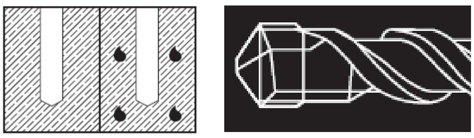
Setting

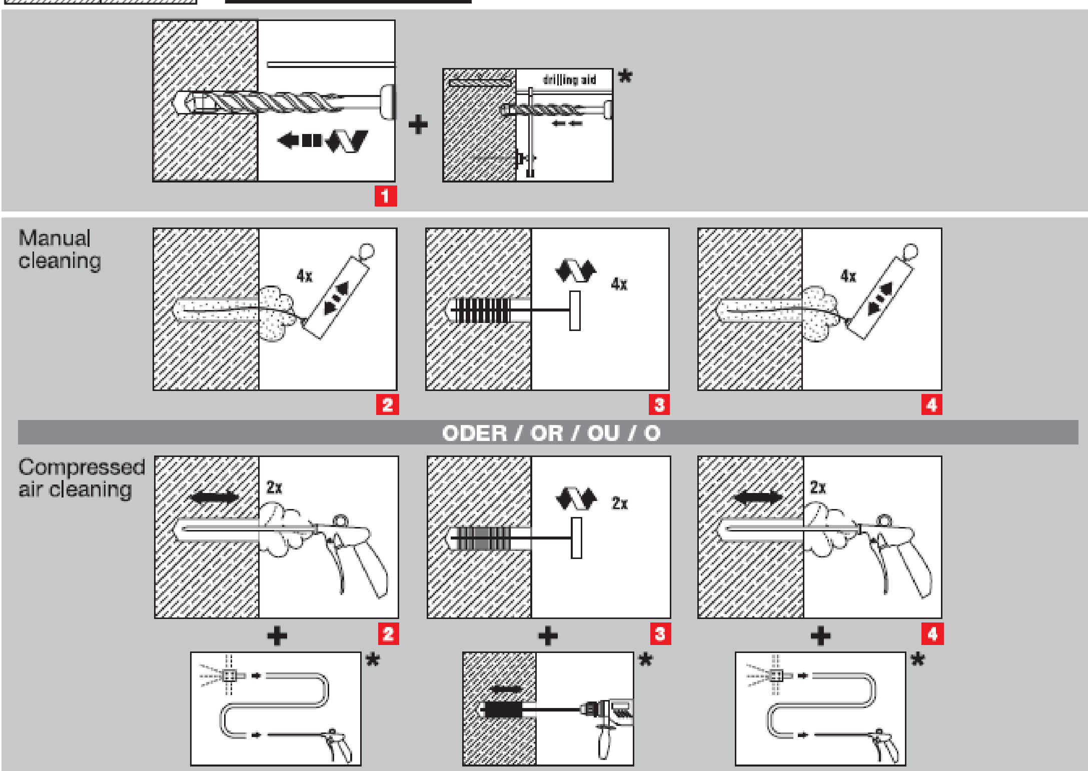
installation equipment

Anchor size	M8	M10	M12	M16	M20	M24
Rotary hammer	TE 2 – TE 16				TE 40 – TE 50	
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser					

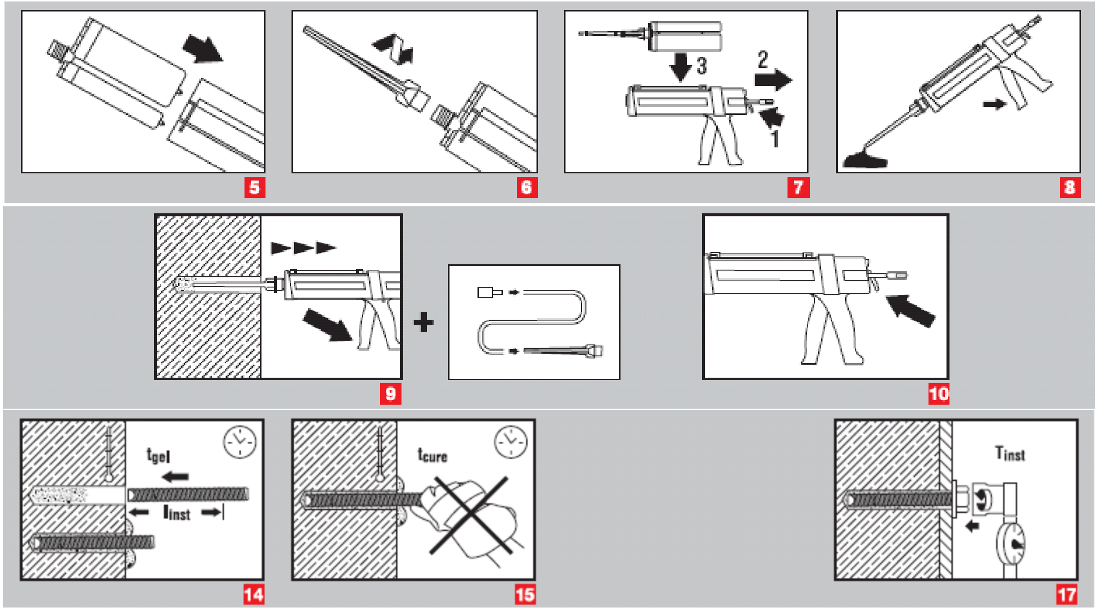
Setting instruction

Dry and water-saturated concrete, hammer drilling





a)



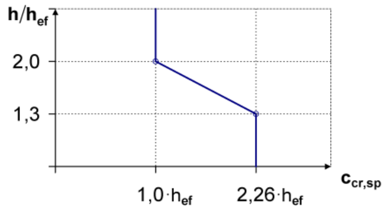
a) Note: Manual cleaning for element sizes d ≤ 16mm and embedment depth h_{ef} ≤ 10 d only!
Brush bore hole with required steel brush HIT-RB

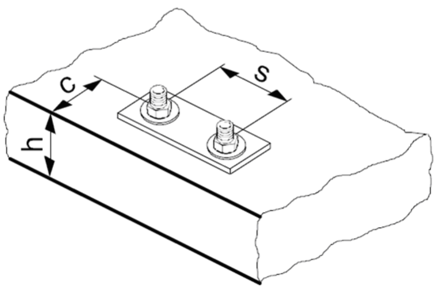
For detailed information on installation see instruction for use given with the package of the product.

Curing time for general conditions

Hilti technical data		
Temperature of the base material	**Curing time before anchor can be fully loaded t_{cure}**	**Working time in which anchor can be inserted and adjusted t_{gel}**
32 °C	35 min	1 min
21 °C	45 min	2,5 min
16 °C	1 h	5 min
4 °C	1 ½ h	15 min
- 7 °C	6 h	1 h
- 18 °C	24 h	1,5 h
- 23 °C	36 h	1,5 h

Setting details

			Hilti technical data					
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	24	28
Effective anchorage and drill hole depth	h_{ef}	[mm]	80	90	110	125	170	210
Minimum base material thickness b)	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			h_{ef} + 2 d_0		
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22	26
Minimum spacing	s_{min}	[mm]	40	50	60	80	100	120
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120
Critical spacing for splitting failure	$s_{cr,sp}$		2 $c_{cr,sp}$					
Critical edge distance for splitting failure c)	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$** for $h / h_{ef} \geq 2{,}0$					
			$4{,}6\ h_{ef}$ - $1{,}8\ h$ for $2{,}0 > h / h_{ef} > 1{,}3$					
			$2{,}26\ h_{ef}$ for $h / h_{ef} \leq 1{,}3$					
Critical spacing for concrete cone failure	$s_{cr,N}$		2 $c_{cr,N}$					
Critical edge distance for concrete cone failure b)	$c_{cr,N}$		1.5 h_{ef}					
Torque moment c)	T_{inst}	[Nm]	10	20	40	80	150	200



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) h: base material thickness ($h \geq h_{min}$)

b) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

c) This is the maximum recommended torque moment to avoid splitting failure during installation for anchors with minimum spacing and/or edge distance.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given by Hilti.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

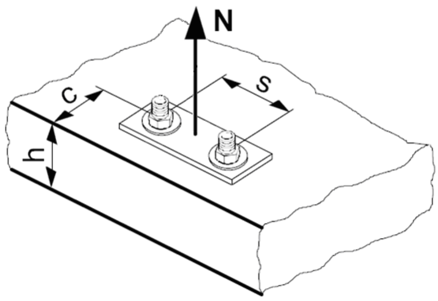
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $\mathbf{N_{Rd,s}}$
- Combined pull-out and concrete cone resistance:
  $\mathbf{N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}}$
- Concrete cone resistance: $\mathbf{N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}}$
- Concrete splitting resistance (only non-cracked concrete):
  $\mathbf{N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

			Hilti technical data					
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
$N_{Rd,s}$	HAS 5.8	[kN]	11,1	17,6	25,4	48,1	74,8	106,8
	HIT-V 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	118,0
	HIT-V 8.8	[kN]	19,3	30,7	44,7	84,0	130,7	188,0
	HAS (-E)-R	[kN]	12,4	19,8	28,6	54,1	84,1	120,2
	HIT-V-R	[kN]	13,9	21,9	31,6	58,8	92,0	132,1
	HAS (-E)-HCR	[kN]	17,7	28,2	40,6	76,9	119,6	106,8
	HIT-V-HCR	[kN]	19,3	30,7	44,7	84,0	130,7	117,6

Design combined pull-out and concrete cone resistance

$\mathbf{N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}}$

			Hilti technical data					
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Typical embedment depth $h_{ef,typ}$ [mm]			**80**	**90**	**110**	**125**	**170**	**210**
$N^0_{Rd,p}$	Temperature range I	[kN]	8,4	11,2	16,8	21,4	36,4	45,4

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

		Hilti technical data					
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
$N^0_{Rd,c}$	[kN]	17,2	20,5	27,7	33,6	53,3	73,2

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ a)	1	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = 1$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = 1$$

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N}$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of reinforcement

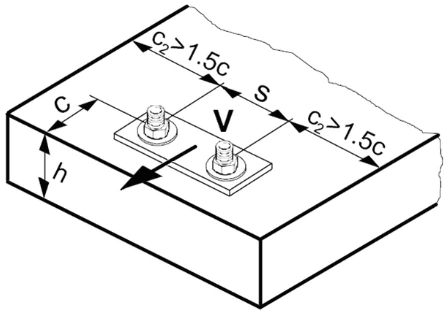
h_{ef} [mm]	80	90	≥ 100
$f_{re,N}$ = 0,5 + h_{ef}/200mm ≤ 1	0,9 [a)]	0,95 [a)]	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp}$ = k · lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

			Hilti technical data					
Anchor size			M8	M10	M12	M16	M20	M24
$V_{Rd,s}$	HAS 5.8	[kN]	6,6	10,6	15,2	28,8	44,9	64,1
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8
	HAS (-E)-R	[kN]	7,5	11,9	17,1	32,4	50,5	72,1
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5
	HAS (-E)-HCR	[kN]	10,6	16,9	24,4	46,1	71,8	64,1
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of k · $N_{Rd,p}$ and k · $N_{Rd,c}$

k = 2

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20	M24
Non-cracked concrete							
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,6	18,7	27,0	36,6

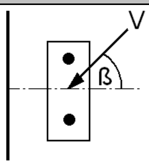
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2\ a)}$	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \dfrac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\dfrac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4
$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20	M24
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	2,39	2	2,07	1,58	1,82	1,91

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

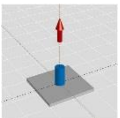
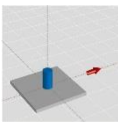
Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

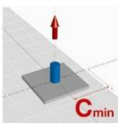
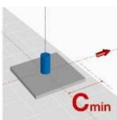
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

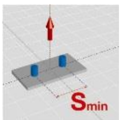
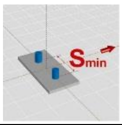
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

	Hilti technical data					
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Embedment depth $h_{ef,typ}$ = [mm]	80	90	110	125	170	210
Base material thickness h_{min}= [mm]	110	120	140	161	218	266
Tensile N_{Rd}: single anchor, no edge effects						
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	8,4	11,2	16,8	21,4	36,4	45,4
Shear V_{Rd}: single anchor, no edge effects, without lever arm						
 HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4
HIT-V 8.8 [kN]	12,0	18,4	27,2	50,4	78,4	112,8
HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5
HIT-V-HCR [kN]	12,0	18,4	27,2	50,4	78,4	70,9

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

	Hilti technical data					
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Embedment depth $h_{ef,typ}$ = [mm]	80	90	110	125	170	210
Base material thickness h_{min}= [mm]	110	120	140	161	218	266
Edge distance $c = c_{min}$= [mm]	40	50	60	80	100	120
Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)						
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	5,2	7,0	10,4	13,8	23,5	30,7
Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm						
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	3,7	5,3	7,3	11,5	17,2	23,6

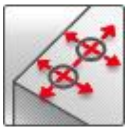
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² (load values are valid for single anchor)

	Hilti technical data					
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Embedment depth $h_{ef,typ}$ = [mm]	80	90	110	125	170	210
Base material thickness h_{min}= [mm]	110	120	140	161	218	266
Spacing $s = s_{min}$= [mm]	40	50	60	80	100	120
Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)						
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	5,9	7,8	11,5	14,8	24,9	31,9
Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm						
 HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4
HIT-V 8.8 [kN]	12,0	18,4	27,2	36,4	61,0	75,7
HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	75,7
HIT-V-HCR [kN]	12,0	18,4	27,2	36,4	61,0	70,9

Hilti HIT-ICE mortar with HIS-(R)N sleeve

Injection mortar system		Benefits
	Hilti HIT-ICE 296 ml cartridge	- suitable for non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - odourless resin - low installation temperature (range -23 °C to +32 °C)
	Statik mixer	
	HIS-(R)N sleeve	

Concrete



Small edge distance and spacing

Corrosion resistance

PROFIS Anchor design software

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Screw strength class 8.8
- Base material thickness, as specified in the table
- Embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Installation temperature range -18°C to +32°C

Embedment depth and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20
Embedment depth [mm]	90	110	125	170	205
Base material thickness [mm]	120	150	170	230	270

Mean ultimate resistance [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

	Hilti technical data				
Anchor size	M8	M10	M12	M16	M20
Tensile $N_{Ru,m}$ HIS-N [kN]	*27,3*	48,2	61,0	105,6	*114,5*
Shear $V_{Ru,m}$ HIS-N [kN]	*13,7*	*24,2*	*41,0*	*62,0*	*57,8*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Hilti technical data				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Tensile N_{Rk}	HIS-N	[kN]	24,2	36,1	45,8	79,2	94,7
Shear V_{Rk}	HIS-N	[kN]	*13,0*	*23,0*	*39,0*	*59,0*	*55,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Hilti technical data				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Tensile N_{Rd}	HIS-N	[kN]	11,5	17,2	21,8	37,7	45,1
Shear V_{Rd}	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7

Recommended loads [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Hilti technical data				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Tensile N_{rec}	HIS-N	[kN]	8,2	12,3	15,6	26,9	32,2
Shear V_{rec}	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-ICE injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	**Base material temperature**	**Maximum long term base material temperature**	**Maximum short term base material temperature**
Temperature range I	-40 °C to +70 °C	+43 °C	+70 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIS-(R)N

			Hilti technical data				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Nominal tensile strength f_{uk}	HIS-N	[N/mm²]	490	490	460	460	460
	Screw 8.8	[N/mm²]	800	800	800	800	800
	HIS-RN	[N/mm²]	700	700	700	700	700
	Screw A4-70	[N/mm²]	700	700	700	700	700
Yield strength f_{yk}	HIS-N	[N/mm²]	410	410	375	375	375
	Screw 8.8	[N/mm²]	640	640	640	640	640
	HIS-RN	[N/mm²]	350	350	350	350	350
	Screw A4-70	[N/mm²]	450	450	450	450	450
Stressed cross-section A_s	HIS-(R)N	[mm²]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm²]	36,6	58	84,3	157	245
Moment of resistance W	HIS-(R)N	[mm³]	145	430	840	1595	1543
	Screw	[mm³]	31,2	62,3	109	277	541

Material quality

Part	**Material**
internally threaded sleeves [a)] HIS-N	C-steel 1.0718, steel galvanized ≥ 5µm
internally threaded sleeves [b)] HIS-RN	stainless steel 1.4401 and 1.4571

a) related fastening screw: strength class 8.8, A5 > 8% Ductile
steel galvanized ≥ 5µm

b) related fastening screw: strength class 70, A5 > 8% Ductile
stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362

Anchor dimensions

Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Internal sleeve HIS-(R)N		M8x90	M10x110	M12x125	M16x170	M20x205
Anchor embedment depth	[mm]	90	110	125	170	205

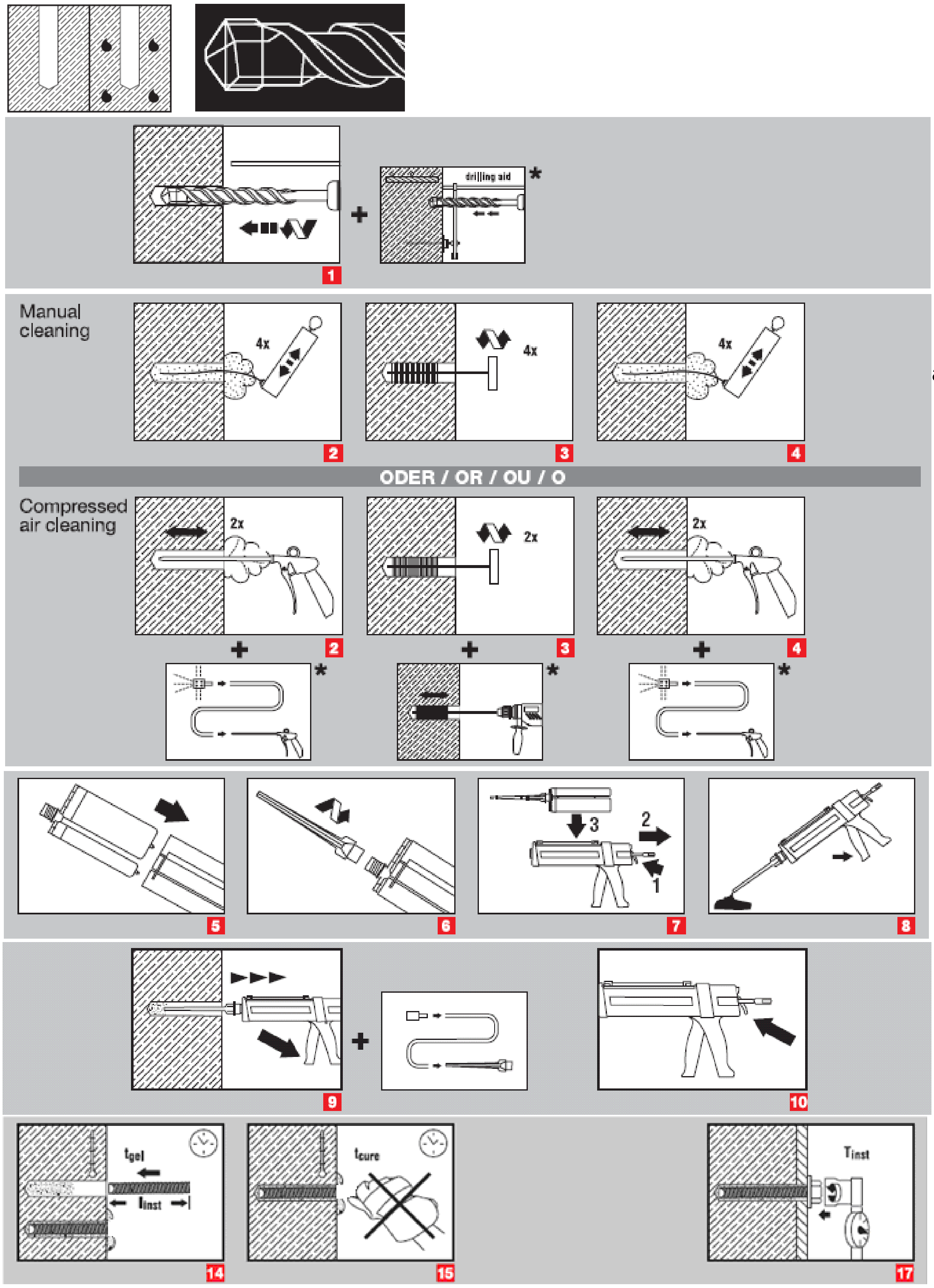
Setting

installation equipment

Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
Rotary hammer	TE 2 – TE 16		TE 40 – TE 50		
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser				

Setting instruction

Dry and water-saturated concrete, hammer drilling



a)

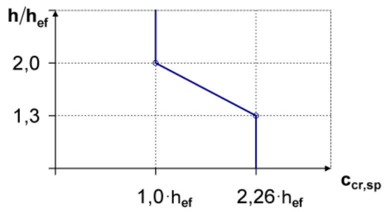
a) <u>Note:</u> Manual cleaning for HIS-(R)N M8 and HIS-(R)N M10 only!
Brush bore hole with required steel brush HIT-RB

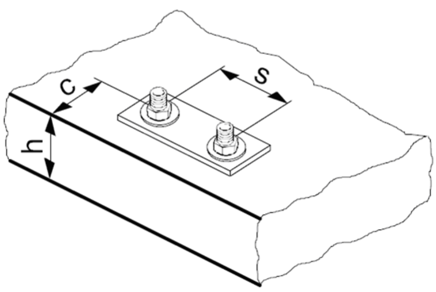
For detailed information on installation see instruction for use given with the package of the product.

Curing time for general conditions

Hilti technical data		
Temperature of the base material	**Curing time before anchor can be fully loaded t_{cure}**	**Working time in which anchor can be inserted and adjusted t_{gel}**
32 °C	35 min	1 min
21 °C	45 min	2,5 min
16 °C	1 h	5 min
4 °C	1 ½ h	15 min
- 7 °C	6 h	1 h
- 18 °C	24 h	1,5 h
- 23 °C	36 h	1,5 h

Setting details

			Hilti technical data				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Nominal diameter of drill bit	d_0	[mm]	14	18	22	28	32
Diameter of element	d	[mm]	12,5	16,5	20,5	25,4	27,6
Effective anchorage and drill hole depth	h_{ef}	[mm]	90	110	125	170	205
Minimum base material thickness [a)]	h_{min}	[mm]	120	150	170	230	270
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22
Thread engagement length; min - max	h_s	[mm]	8-20	10-25	12-30	16-40	20-50
Minimum spacing	s_{min}	[mm]	40	45	55	65	90
Minimum edge distance	c_{min}	[mm]	40	45	55	65	90
Critical spacing for splitting failure	$s_{cr,sp}$		$2\ c_{cr,sp}$				
Critical edge distance for splitting failure [a)]	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$**	for $h / h_{ef} \geq 2{,}0$			
			$4{,}6\ h_{ef} - 1{,}8\ h$	for $2{,}0 > h / h_{ef} > 1{,}3$			
			$2{,}26\ h_{ef}$	for $h / h_{ef} \leq 1{,}3$			
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\ c_{cr,N}$				
Critical edge distance for concrete cone failure	$c_{cr,N}$	[b)]	$1.5\ h_{ef}$				
Torque moment [c)]	T_{inst}	[Nm]	10	20	40	80	150



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) h: base material thickness ($h \geq h_{min}$)

b) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

c) This is the maximum recommended torque moment to avoid splitting failure during installation for anchors with minimum spacing and/or edge distance.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given by Hilti.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

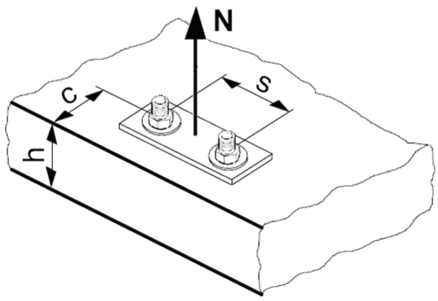
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

			Hilti technical data				
Anchor size			M8	M10	M12	M16	M20
$N_{Rd,s}$	HIS-N	[kN]	17,4	30,7	44,7	80,3	74,1
	HIS-RN	[kN]	13,9	21,9	31,6	58,8	69,2

Design combined pull-out and concrete cone resistance
$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

			Hilti technical data				
Anchor size			M8	M10	M12	M16	M20
Embedment depth h_{ef} [mm]			90	110	125	170	205
$N^0_{Rd,p}$	Temperature range I	[kN]	11,5	17,2	21,8	37,7	45,1

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

		Hilti technical data				
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
$N^0_{Rd,c}$	[kN]	20,5	27,7	33,6	53,3	70,6

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ a)	1	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = 1$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N}$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = 1$$

Influence of reinforcement

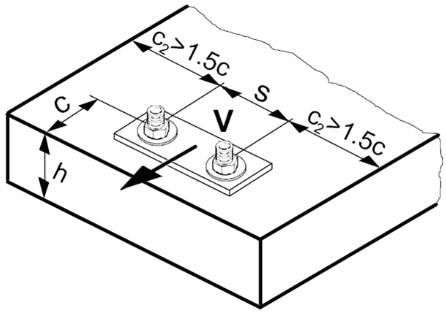
h_{ef} [mm]	80	90	≥ 100
$f_{re,N}$ = 0.5 + h_{ef}/200mm ≤ 1	0.9 a)	0.95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

			Hilti technical data				
Anchor size			M8	M10	M12	M16	M20
$V_{Rd,s}$	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Design concrete pryout resistance $V_{Rd,cp}$ = lower value a) of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

k = 1 for h_{ef} < 60 mm
k = 2 for h_{ef} ≥ 60 mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20
Non-cracked concrete						
$V^0_{Rd,c}$	[kN]	12,4	19,6	28,2	40,2	46,2

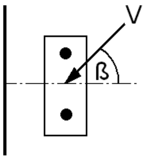
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
f_B = $(f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20
f_{hef} =	1,38	1,21	1,04	1,22	1,45

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

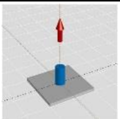
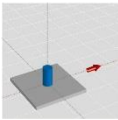
Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

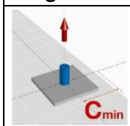
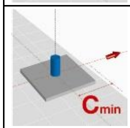
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

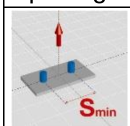
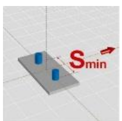
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

		Hilti technical data				
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth	h_{ef} = [mm]	90	110	125	170	205
Base material thickness	h_{min}= [mm]	120	150	170	230	270
	**Tensile N_{Rd}: single anchor, no edge effects**					
	HIS-(R)N [kN]	11,5	17,2	21,8	37,7	45,1
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**					
	HIS-N [kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN [kN]	8,3	12,8	19,2	35,3	41,5

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

		Hilti technical data				
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth	h_{ef} = [mm]	90	110	125	170	205
Base material thickness	h_{min}= [mm]	120	150	170	230	270
Edge distance	$c = c_{min}$= [mm]	40	45	55	65	90
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**					
	HIS-(R)N [kN]	6,1	8,8	11,3	19,1	25,5
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**					
	HIS-(R)N [kN]	4,2	5,5	7,6	10,8	17,2

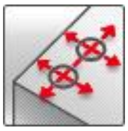
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²
(load values are valid for single anchor)

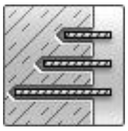
		Hilti technical data				
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth	h_{ef} = [mm]	90	110	125	170	205
Base material thickness	h_{min}= [mm]	120	150	170	230	270
Spacing	$s = s_{min}$= [mm]	40	45	55	65	90
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**					
	HIS-(R)N [kN]	7,7	11,2	14,1	23,8	29,9
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**					
	HIS-N [kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN [kN]	8,3	12,8	19,2	35,3	41,5

Hilti HIT-ICE mortar with rebar (as anchor)

Injection mortar system		Benefits
	Hilti HIT-ICE 296 ml cartridge	- suitable for non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - high corrosion resistant - odourless resin - low installation temperature (range -23 °C – 32 °C)
	Statik mixer	
	rebar BSt 500 S	


Concrete


Small edge distance and spacing


Variable embedment depth


PROFIS Anchor design software

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Installation temperature range -18°C to +32°C

Embedment depth [a)] and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

	Hilti technical data						
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Typical embedment depth [mm]	80	90	110	125	125	170	210
Base material thickness [mm]	110	120	145	165	165	220	275

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500S

			Hilti technical data						
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Tensile $N_{Ru,m}$	BSt 500 S	[kN]	20,2	28,3	40,0	51,8	63,6	84,6	105,8
Shear $V_{Ru,m}$	BSt 500 S	[kN]	14,7	23,1	32,6	44,1	57,8	90,3	141,8

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			Hilti technical data						
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Tensile N_{Rk}	BSt 500 S	[kN]	15,1	21,2	30,0	38,9	47,7	63,4	79,4
Shear V_{Rk}	BSt 500 S	[kN]	*14,0*	*22,0*	*31,0*	*42,0*	*55,0*	*86,0*	*135,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			Hilti technical data						
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Tensile N_{Rd}	BSt 500 S	[kN]	7,2	10,1	14,3	18,5	22,7	30,2	37,8
Shear V_{Rd}	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

Recommended loads [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			Hilti technical data						
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Tensile N_{rec}	BSt 500 S	[kN]	5,1	7,2	10,2	13,2	16,2	21,6	27,0
Shear V_{rec}	BSt 500 S	[kN]	6,7	10,5	14,8	20,0	26,2	41,0	64,3

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-ICE injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+43 °C	+70 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of rebar BSt 500S

			Hilti technical data						
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Nominal tensile strength f_{uk}	BSt 500 S	[N/mm²]	550	550	550	550	550	550	550
Yield strength f_{yk}		[N/mm²]	500	500	500	500	500	500	500
Stressed cross-section A_s	BSt 500 S	[mm²]	50,3	78,5	113,1	153,9	201,1	314,2	490,9
Moment of resistance W	BSt 500 S	[mm³]	50,3	98,2	169,6	269,4	402,1	785,4	1534

Material quality

Part	Material
rebar BSt 500 S	Geometry and mechanical properties according to DIN 488-2:1986 or E DIN 488-2:2006

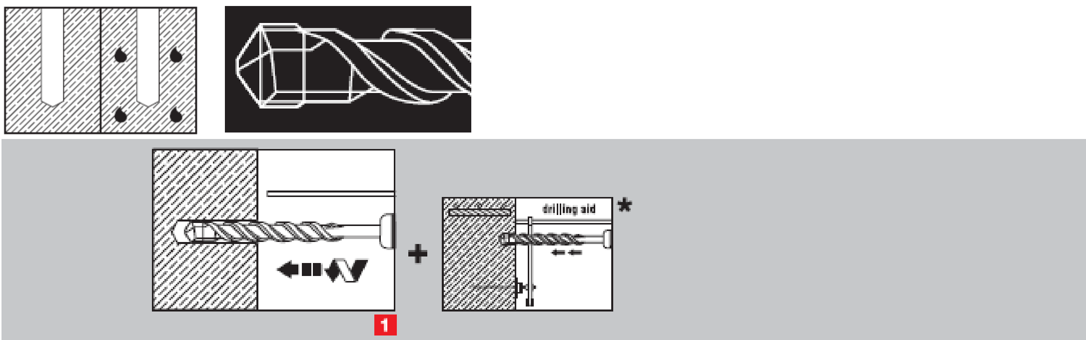
Setting

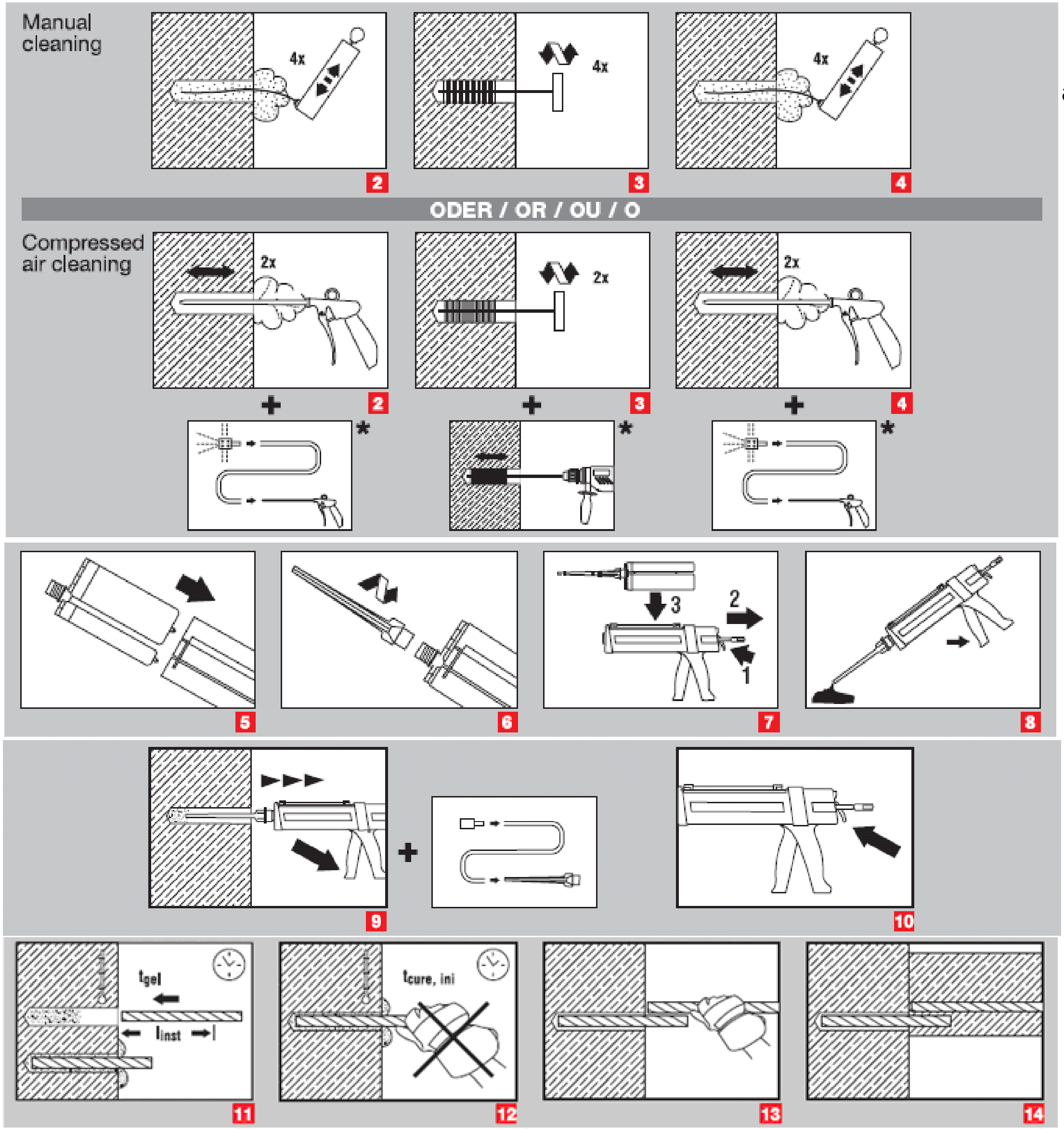
installation equipment

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Rotary hammer	TE 2 – TE 16					TE 40 – TE 70	
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser						

Setting instruction

Dry and water-saturated concrete, hammer drilling





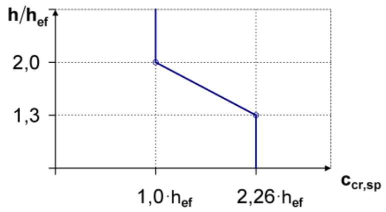
a)

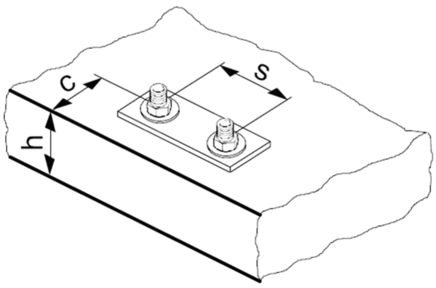
<u>a) Note:</u> Manual cleaning for element sizes d ≤ 16mm and embedment depth h_{ef} ≤ 10 d only!
Brush bore hole with required steel brush HIT-RB
For detailed information on installation see instruction for use given with the package of the product.

Curing time for general conditions

Hilti technical data		
Temperature of the base material	**Curing time before anchor can be fully loaded t_{cure}**	**Working time in which anchor can be inserted and adjusted t_{gel}**
32 °C	35 min	1 min
21 °C	45 min	2,5 min
16 °C	1 h	5 min
4 °C	1 ½ h	15 min
- 7 °C	6 h	1 h
- 18 °C	24 h	1,5 h
- 23 °C	36 h	1,5 h

Setting details

			Hilti technical data						
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Nominal diameter of drill bit	d_0	[mm]	12	14	16	18	20	25	32
Effective anchorage and drill hole depth	h_{ef}	[mm]	80	90	110	125	125	170	210
Minimum base material thickness a)	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm		$h_{ef} + 2\ d_0$				
Minimum spacing	s_{min}	[mm]	40	50	60	70	80	100	125
Minimum edge distance	c_{min}	[mm]	40	50	60	70	80	100	125
Critical spacing for splitting failure	$s_{cr,sp}$		$2\ c_{cr,sp}$						
Critical edge distance for splitting failure b)	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$** for $h / h_{ef} \geq 2{,}0$ **$4{,}6\ h_{ef} - 1{,}8\ h$** for $2{,}0 > h / h_{ef} > 1{,}3$ **$2{,}26\ h_{ef}$** for $h / h_{ef} \leq 1{,}3$						
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\ c_{cr,N}$						
Critical edge distance for concrete cone failure c)	$c_{cr,N}$		$1.5\ h_{ef}$						



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) h: base material thickness ($h \geq h_{min}$)

b) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given by Hilti.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

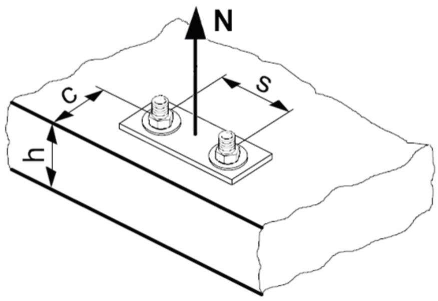
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

	Hilti technical data						
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
$N_{Rd,s}$ BSt 500 S [kN]	20,0	30,7	44,3	60,7	79,3	123,6	192,9

Design combined pull-out and concrete cone resistance
$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

	Hilti technical data						
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Typical embedment depth $h_{ef,typ}$ [mm]	**80**	**90**	**110**	**125**	**125**	**170**	**210**
$N^0_{Rd,p}$ Temperature range I [kN]	7,2	10,1	14,3	18,5	22,7	30,2	37,8

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

	Hilti technical data						
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
$N^0_{Rd,c}$ [kN]	17,2	20,5	27,7	33,6	33,6	53,3	73,2

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ a)	1	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = 1$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = 1$$

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N}$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of reinforcement

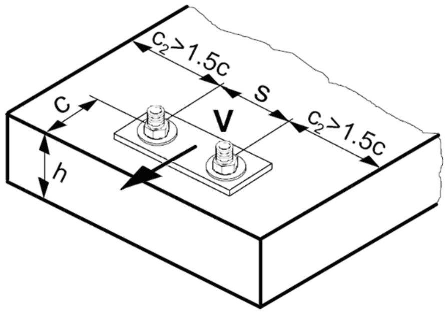
h_{ef} [mm]	80	90	≥ 100
$f_{re,N} = 0.5 + h_{ef}/200mm \leq 1$	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

	Hilti technical data						
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
$V_{Rd,s}$ BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

Design concrete pryout resistance $V_{Rd,cp}$ = lower value [a] of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

k = 2

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Non-cracked concrete							
$V^0_{Rd,c}$ [kN]	5,9	8,6	11,6	15,0	18,7	27,0	39,2

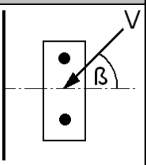
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	**C 20/25**	**C 25/30**	**C 30/37**	**C 35/45**	**C 40/50**	**C 45/55**	**C 50/60**
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	**0°**	**10°**	**20°**	**30°**	**40°**	**50°**	**60°**	**70°**	**80°**	**≥ 90°**
$f_\beta = \sqrt{\dfrac{1}{(\cos\alpha_V)^2 + \left(\dfrac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	**0,15**	**0,3**	**0,45**	**0,6**	**0,75**	**0,9**	**1,05**	**1,2**	**1,35**	**≥ 1,5**
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	2,39	2,00	2,07	1,98	1,58	1,82	1,79

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

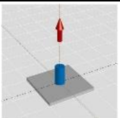
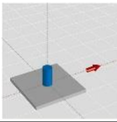
Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

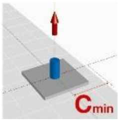
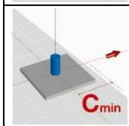
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action $\gamma = 1,4$. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

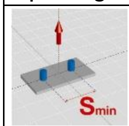
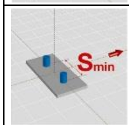
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

		Hilti technical data						
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Embedment depth $h_{ef,typ}$ =	[mm]	80	90	110	125	125	170	210
Base material thickness h_{min}=	[mm]	110	120	142	161	165	220	274
 **Tensile N_{Rd}: single anchor, no edge effects**								
BSt 500 S	[kN]	7,2	10,1	14,3	18,5	22,7	30,2	37,8
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**								
BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

		Hilti technical data						
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Embedment depth $h_{ef,typ}$ =	[mm]	80	90	110	125	125	170	210
Base material thickness h_{min}=	[mm]	110	120	142	161	165	220	274
Edge distance $c = c_{min}$=	[mm]	40	50	60	70	80	100	125
 **Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**								
BSt 500 S	[kN]	4,6	6,4	9,2	12,0	14,4	20,5	27,2
 **Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**								
BSt 500 S	[kN]	3,7	5,3	7,3	9,5	11,5	17,2	25,0

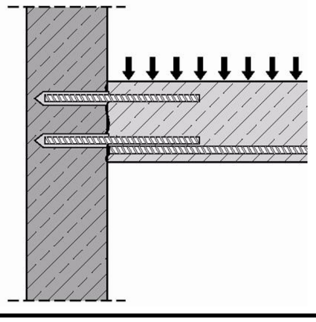
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²
(load values are valid for single anchor)

		Hilti technical data						
Anchor size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**
Embedment depth $h_{ef,typ}$ =	[mm]	80	90	110	125	125	170	210
Base material thickness h_{min}=	[mm]	110	120	142	161	165	220	274
Spacing $s = s_{min}$=	[mm]	40	50	60	70	80	100	125
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**								
BSt 500 S	[kN]	5,2	7,2	10,1	13,0	15,5	21,5	27,6
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm**								
BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	50,6	63,4

Post-installed rebar connections

Basics, design and installation

Injection mortar systems for post-installed rebars



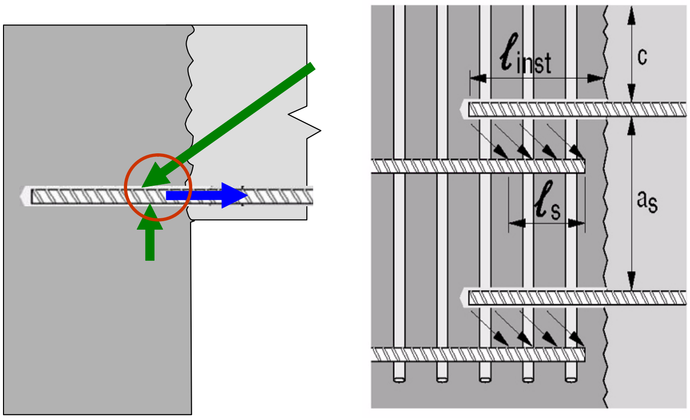
Basics, design and installation of post installed rebars

Content

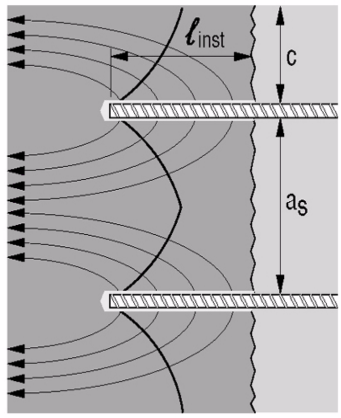
1 Basics of post installed rebar connections

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”



anchor situation

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 EOTA [3]

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

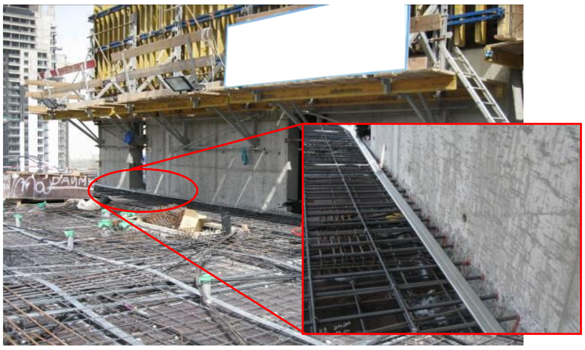
1.3 Application examples

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

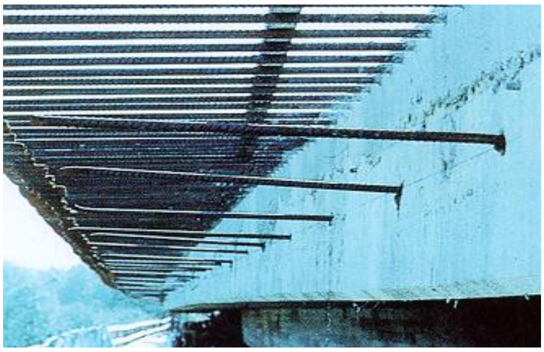
New slab constructions

Joint strengthening

Cantilevers/balconies

Post-installed rebar connections in infrastructure requalifications

Slab widening



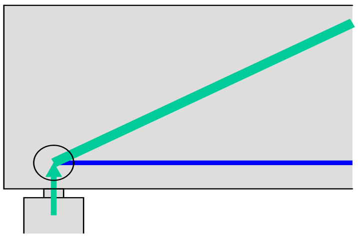
Structural upgrade

Slab strengthening

Sidewalk upgrade

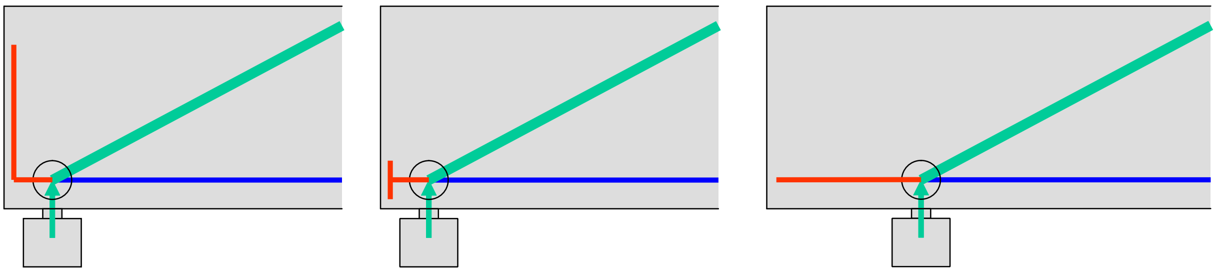
1.4 Anchorage and Splice

Development Length



simple support

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 idealization. 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 in 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.



Typical solutions for anchoring of the reinforcement

Overlap Splices

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.

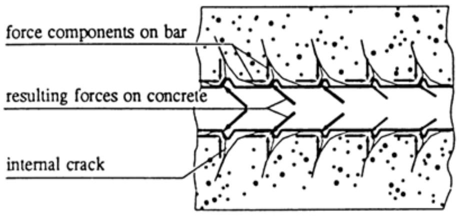
Forces are transmitted from one bar to another by lapping the bars. The detailing of laps between bars shall be such that:

- 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

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°.



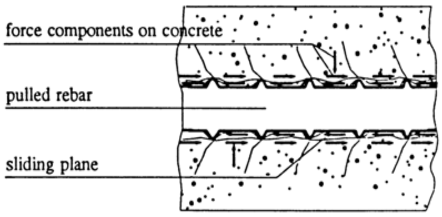
Load transfer from ribbed bars into

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

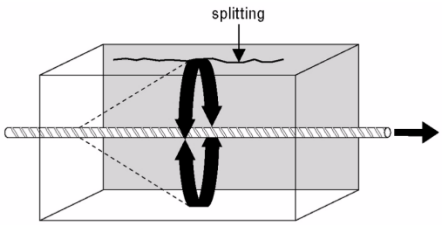
Bond failure is caused by pull-out of the bar if the confinement (concrete cover, transverse reinforcement) is sufficient to prevent splitting of the concrete cover. In that case the concrete keys are sheared off and a sliding plane around the bar is created. Thus, the force transfer mechanism changes 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.



Bond failure of ribbed bars

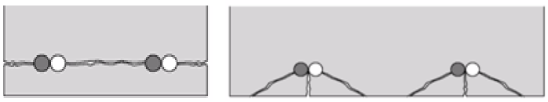
Splitting failure:

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.



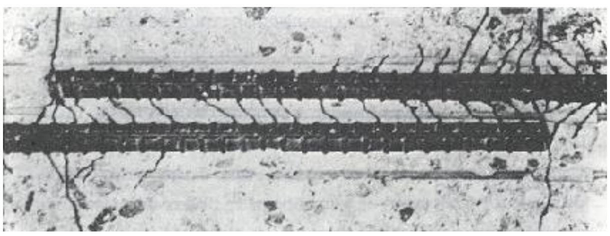
Splitting

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 in Overlap Splices



Load transfer at lap 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

Assessment criteria

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)

Approvals with or without exceptions

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 fulfil 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 $\ell_{b,min}$ and the minimum overlap length $\ell_{0,min}$ 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 [1], 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 gives an overview of the design approach and design examples, technical data from the rebar approvals can be found in section 6.

2. For applications which are not covered by “ETA/EC2 Design Method”, the design approach of Eurocode 2 has been extended on the basis of extensive internal as well as external research [6 - 8] as well as assessments [9]. This method is called

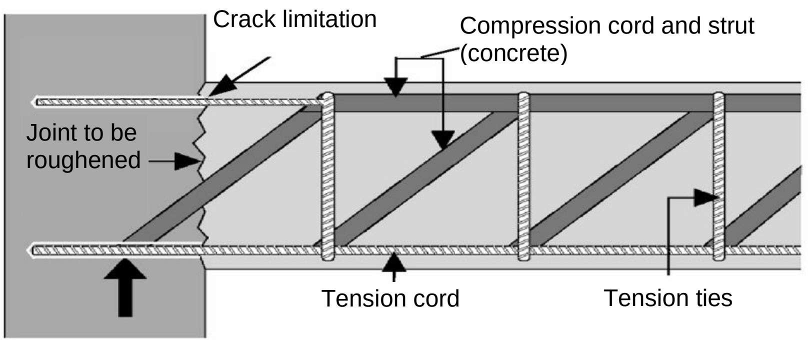
   “Hit Rebar Design Method”

   which offers an extended range of applications (please see section 2.3 for an overview of the design approach as well as design examples.

2.1 Loads on Reinforcing Bars

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}.



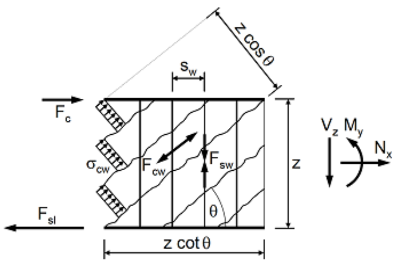
Strut-and-tie-model

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:

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



truss model in modern codes

2.2 Approval Based ETA/EC2 Design Method

2.2.1 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]:

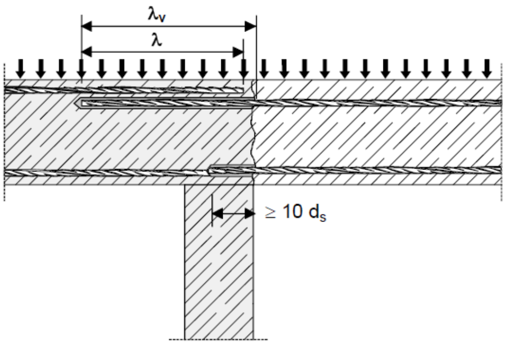


Figure 1.1: Overlap joint for rebar connections of slabs and beams

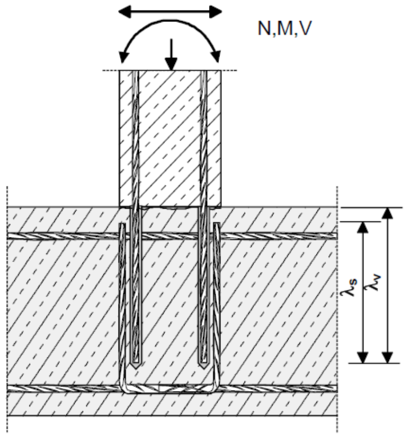


Figure 1.2: Overlap joint at a foundation of a column or wall where the rebars are stressed in tension

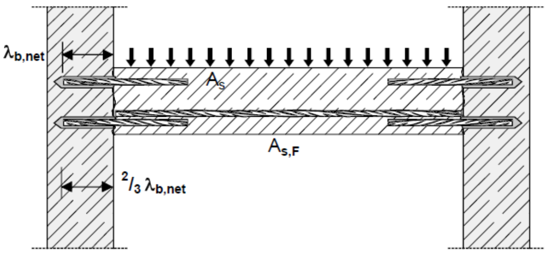


Figure 1.3: End anchoring of slabs or beams, designed as simply supported

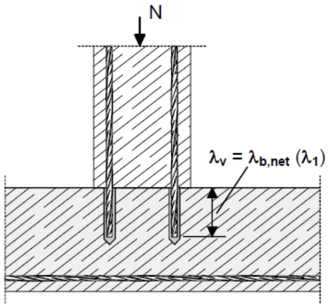


Figure 1.4: Rebar connection for components stressed primarily in compression. The rebars are stressed in compression

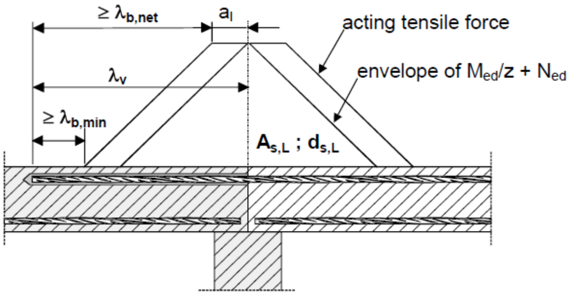


Figure 1.5: Anchoring of reinforcement to cover the line of acting tensile force

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.

2.2.2 Design of Development and Overlap Length with Eurocode 2

The following reflect the design relevant sections from EOTA TR023, chapter 4 “Assumptions under which the fitness of use is to be assessed” and from the specific European Technical Approvals:

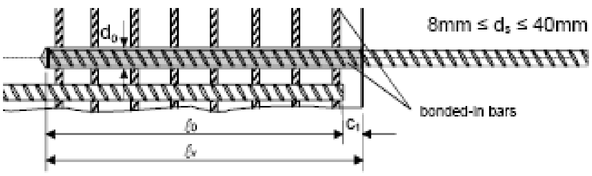
Design method for post-installed rebar connections

- The post-installed rebar connections assessed according to this Technical Report shall be designed as straight cast-in-place rebars according to EC2 using the values of the design bond resistance f_{bd} for deformed bars as given in the relevant approval.
- Overlap joint for rebars: For calculation of the effective embedment depth of overlap joints the concrete cover at end-face of the post-installed rebar c_1 shall be considered:

  $\ell_v \geq \ell_0 + c_1$

  with: ℓ_0 = required lap length

  c_1 = concrete cover at end-face of bonded-in rebar



front cover c_1

- The definition of the bond region in EC2 is valid also for post-installed rebars.
- The conditions in EC2 concerning detailing (e.g. concrete cover in respect to bond and corrosion resistance, bar spacing, transverse reinforcement) shall be complied with.
- The transfer of shear forces between new and old concrete shall be designed according to EC2 [1].

Additional provisions

- To prevent damage of the concrete during drilling the following requirements have to be met:
  - Minimum concrete cover:

    $c_{min} = 30 + 0{,}06\ l_v \geq 2d_s$ (mm) for hammer drilled holes

    $c_{min} = 50 + 0{,}08\ l_v \geq 2d_s$ (mm) for compressed air drilled holes

    The factors 0,06 and 0,08 should take into account the possible deviations during the drilling process. This value might be smaller if special drilling aid devices are used.

    Furthermore the minimum concrete cover given in clause 4.4.1.2, EC2: EN 1992-1-1: 2004 shall be observed.
  - Minimum clear spacing between two post-installed bars a = 40 mm $\geq 4d_s$
- To account for potentially different behaviour of post-installed and cast-in-place rebars in cracked concrete,
  - in general, the minimum lengths $l_{b,min}$ and $l_{o,min}$ given in the EC 2 for anchorages and overlap splices shall be increased by a factor of 1.5. This increase may be neglected under certain conditions. The relevant approval states under which conditions the factor can be neglected for a specific adhesive.

Preparation of the joints

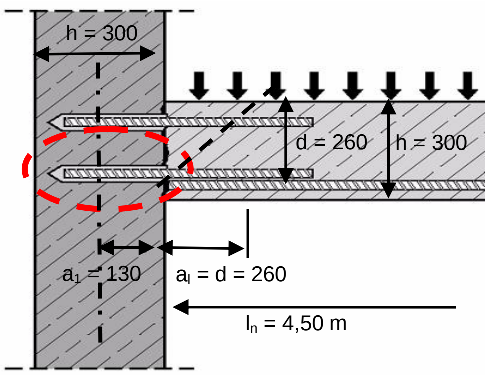
- The surface of the joint between new and existing concrete should be prepared (roughing, keying) according to the envisaged intended use according to EC2.
- In case of a connection being made between new and existing concrete where the surface layer of the existing concrete is carbonated, the layer should be removed in the area of the new reinforcing bar (with a diameter d_s+60mm) prior to the installation of the new bar.

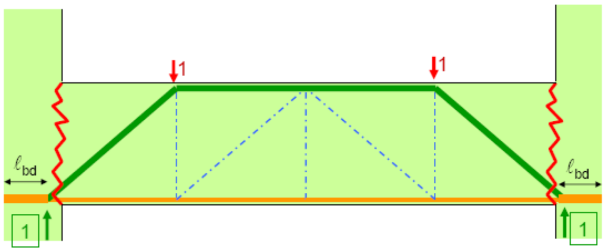
Transverse reinforcement

The requirements of transverse reinforcement in the area of the post-installed rebar connection shall comply with clause 8.7.4, EC2: EN 1992-1-1:2011.

2.2.3 Design Examples

a) End support of slab, simply supported





slab: l_n = 4,50m, Q_k = 20 kN/m^2, h = 300 mm, d = 260 mm

wall: h = 300 mm

Concrete strength class: C20/25, dry concrete

Reinforcement: f_{yk} = 500 N/mm2, γ_s = 1.15

Loads: $G_k = 25\ kN/m^3 \cdot h$ = 7.5 kN/m²;
$S_d = (1.50 \cdot Q_d + 1.35 \cdot G_k)$ = 40.1 kN/m²

Structural analysis (design forces):
$M_{Ed} = S_d \cdot l_n^2 / 8$ = 102 kNm/m
$V_{Ed} = S_d \cdot l_n / 2$ = 90.3 kN/m

Bottom reinforcement required at mid span:
$A_{s,rqd,m} = (M_{sd} \cdot \gamma_s) / (0.9 \cdot d \cdot f_{yk})$ = 998 mm²/m

reinforcement provided at mid span: ∅16, s = 200 mm
$A_{s,prov,m}$ = 1005 mm²/m

Bottom reinforcement at support:

Tension force to be anchored: $F_E = |V_{Ed}| \cdot a_l / (0.9d)$ = 100 kN/m {Clause 9.2.1.4(2), EC2: EN 1992-1-1:2004}
Steel area required: $A_{s,rqd} = F_E \cdot \gamma_s / f_{yk}$ = 231 mm²/m

Minimum reinforcement to be anchored at support:
$A_{s,min} = k_c \cdot k \cdot f_{ct,eff} \cdot A_s / \sigma_s$ = 0,4·1· 2,2·150·1000/500 = 264 mm²/m {Clause 7.3.2(2), EC2: EN 1992-1-1:2011}
$A_{s,min}$ = 0,50 · 988 = 499 mm^2/m {Clause 9.3.1.2(1), EC2: EN 1992-1-1:2011}
$A_{s,min}$ = 0,25 · 1010 = 251 mm²/m {Clause 9.2.1.4(1), EC2: EN 1992-1-1:2011}

Decisive is 499 mm²/m ⇒ reinforcement provided: ∅12, s = 200 mm ⇒ $A_{s,prov}$ = 565 mm²/m;
Installation by wet diamond core drilling: Hilti HIT-RE 500 is suitable adhesive (see Tech data, sect. 2.2.3)

Basic anchorage length {EC2: EN 1992-1-1:2004, section 8.4.3}:
$\ell_{b,rqd} = (d_s / 4) \times (\sigma_{sd} / f_{bd})$
with: d_s = diameter of the rebar = 12 mm
σ_{sd} = calculated design stress of the rebar = $(A_{s,rqd} / A_{s,prov}) \cdot (f_{yk}/\gamma_s)$ = (231 / 565) · (500 / 1,15) = 177 N/mm²
f_{bd} = design value of bond strength according to corresponding ETA (= 2,3 N/mm²)
$\ell_{b,rqd}$ = (12 / 4) x (177 / 2.3) = 231 mm

Design anchorage length {EC2: EN 1992-1-1:2011, section 8.4.4}:
$\ell_{bd} = \alpha_1 \alpha_2 \alpha_3 \alpha_4 \alpha_5 \ell_{b,rqd} \geq \ell_{b,min}$

with: $\ell_{b,rqd}$ as above
α_1 = 1,0 for straight bars
$\alpha_2 = 1 – 0,15(c_d – ø)/ø$ $(0,7 \leq \alpha_2 \leq 1,0)$
α_2 is for the effect of concrete cover, in this case half the clear spacing: c_d=(200-12)/2=94mm
α_2 = 0,7 Straight bars, $c_d = \min(a/2, c_1, c)$
α_3 = 1,0 because of no transverse reinforcement
α_4 = 1,0 because of no welded transverse reinforcement
α_5 = 1,0 influence of transverse pressure is neglected in this example

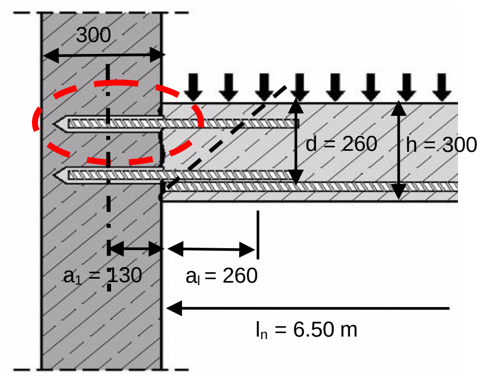
ℓ_{bd} = 0,7 · 231 = 162 mm

minimum anchorage length {Clause 8.4.4(1), EC2: EN 1992-1-1:2011}:

$\ell_{b,min}$ = max {0,3$\ell_{b,rqd}$; 10ϕ; 100mm} = 120 mm

ℓ_{bd} controls → drill hole length **l_{ef} = 162 mm**

Top reinforcement at support:



Minimum reinforcement:

a) 25% of bottom steel required at mid-span
   {Clause 9.3.1.2(2), EC2: EN 1992-1-1:2004}
   $A_{s,req}$ = 0,25 · 988 = 247 mm^2/m

b) requirement for crack limitation :
   {Clause 7.3.2(2), EC2: EN 1992-1-1:2004}
   $A_{s,min}$ = 0,4 · 1 · 2,2 · 150 · 1000 / 435 = <u>303 mm^2/m</u>

Decisive is 303 mm²/m
⇒ reinforcement provided: ∅10, s = 200 mm; $A_{s,prov}$ = 393 mm²/m

Design stress in bar: $\sigma_{sd} = f_{yd} \cdot A_{s,min} / A_{s,prov}$ = 335 N/mm^2

$\ell_{b,rqd}$ = (d_s / 4) x (σ_{sd} / f_{bd}) = (10 / 4) x (335 / 2.3) = 364 mm

$\ell_{bd} = \alpha_1\ \alpha_2\ \alpha_3\ \alpha_4\ \alpha_5\ \ell_{b,rqd}$ = 0,7 · 364 = 255 mm

$\ell_{b,min}$ = max {0,3$\ell_{b,rqd}$; 10ϕ; 100mm} = 120 mm

Therefore, drill hole length **l_{ef} = 255 mm**

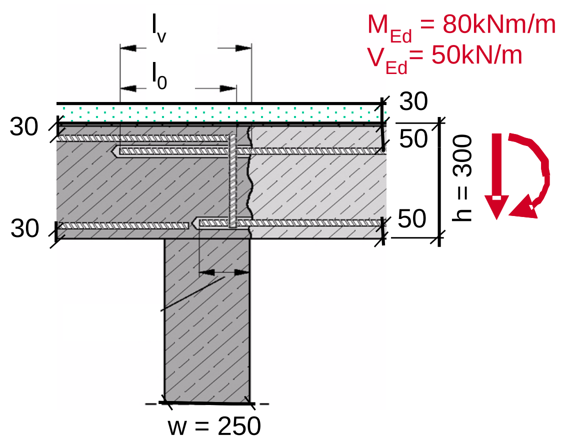
If <u>wet diamond core drilling</u> is used {Clause 8.4.4(1), EC2: EN 1992-1-1:2011}:

$\ell_{b,min}$ = max {0,3$\ell_{b,rqd}$; 10ϕ; 100mm} · 1.5 = 180 mm (as wet diamond core drilling is used, the minimum values according do EC2 have to be multiplied by 1.5, see tech data)

-> in this case the minimum length will control, drill hole length for the lower layer will be **$l_{ef,diamond,lower}$ = 180 mm** and will remain for the upper layer **$l_{ef,diamond,upper}$ = 255 mm**.

b) splice on support

General information for design example



- Bending moment: M_{Ed}=80 kNm/m; shear: V_{Ed} = 50 kN/m
- slab: cover cast-in bars c_c = 30 mm (top, bottom); cover new bars: c_n = 50mm h = 300 mm;
- top reinforcement (new and existing): ϕ16, s = 200 mm; $A_{s,prov}$ = 1005 mm^2/m; cover to face c_1 = 30 mm
- bottom reinforcement: ϕ10, s=200 mm; $A_{s,prov}$=393 mm^2/m
- Concrete strength class: C25/30
- Properties of reinforcement: f_{yk} = 500 N/mm^2
- Fire resistance: R60 (1 hour), Light weight plaster for fire protection: t_p=30 mm; maximum steel stress in fire $\sigma_{Rd,fi}$ = 322 N/mm^2
- Hilti HIT-RE 500

Cast-in reinforcement top

$l_{0,ci} = \alpha_1\, \alpha_2\, \alpha_3\, \alpha_5\, \alpha_6\, l_{b,rqd,ci} \geq l_{0,min}$

η_1 = (d- ϕ/2 > 250mm)	0.7		poor bond condition
z_{ci} =	239	mm	(from static calculation)
$A_{s,req}$= $(M_{Ed}/z)\cdot(\gamma_S/f_{yk})$=(80/0.239)·(1.15/0.5) =	770	mm^2/m	
σ_{sd} = $(A_{s,rqd} / A_{s,prov}) \cdot (f_{yk}/\gamma_s)$ = (770 / 1005) · (500 / 1.15) =	333	N/mm^2	
f_{bd} = $2.25\cdot\eta_1\cdot0.7\cdot0.3\cdot f_{ck}^{2/3}/\gamma_c$= $2.25\cdot0.7\cdot0.7\cdot0.3\cdot25^{2/3}$/1. 5=	1.89	N/mm^2	(ETA 08/0105)

$l_{b,rqd,pi}$ = $(\phi / 4) \cdot (\sigma_{sd} / f_{bd})$ = (16 / 4) · (333 / 1.89) = 705 mm

α_1 =	0.7	hooked end of cast-in bars
α_2 = (1 - 0.15(c_d – ø)/ø ≥ 0.7) = 1-0.15(30-16)/16 =	0.87	
α_3 =	1.0	no transverse reinforcement
α_5 =	1.0	no transverse pressure
α_6 =	1.5	splice factor

$l_{0,min}$ = max{0.3·1.5·705; 15·16; 200} = 317 mm

$l_{0,ci}$ = 0.70·0.87·1.5·705 = 643 mm

Post-installed reinforcement top

The required design lap length l_0 shall be determined in accordance with EC2: EN 1992-1-1:2004, section 8.7.3:

$l_{0,pi} = \alpha_1\, \alpha_2\, \alpha_3\, \alpha_5\, \alpha_6\, l_{b,rqd,pi} \geq l_{0,min}$

d = h-c_n-ϕ/2 = 300 – 50 – 16/2 =	242	mm	
η_1 = (d- ϕ/2 < 250mm)	1.0		good bond condition
z =	228	mm	(from static calculation)
$A_{s,req}$= $(M_{Ed}/z)\cdot(\gamma_S/f_{yk})$=(80/0.228)·(1.15/0.5) =	807	mm^2/m	
σ_{sd} = $(A_{s,rqd} / A_{s,prov}) \cdot (f_{yk}/\gamma_s)$ = (807 / 1005) · (500 / 1.15) =	349	N/mm^2	
f_{bd} = design value of bond strength according to 2.2.3 =	2.7	N/mm^2	(ETA 08/0105)

$l_{b,rqd,pi}$ = $(\phi / 4) \cdot (\sigma_{sd} / f_{bd})$ = (16 / 4) · (349 / 2.7) = 516 mm

α_1 =	1.0	for straight bars

α_2	$= (1 - 0.15(c_d – ø)/ø \geq 0.7) = 1\text{-}0.15(50\text{-}16)/16 =$	0.7		
α_3	=	1.0		no transverse reinforcement
α_5	=	1.0		no transverse pressure
α_6	=	1.5		splice factor

$l_{0,min}$ = max{0.3·1.5·515; 15·16; 200} = 240 mm

$l_{0,pi}$ = 0.7·1.5·530 = 542 mm

Fire resistance post-installed reinforcement top:

γ_L	=	1.4		assumed safety factor loads
$\sigma_{sd,fi}$	$= \sigma_{sd}/\gamma_L = 358/1.4 =$	249	N/mm^2	$< \sigma_{Rd,fi} \rightarrow$ ok
c_{fi}	$= c_n + t_p = 30 + 50 =$	80	mm	cover effective against fire
$f_{bd,fi}$	= (sect. 2.4.1, table fire parallel)	1.4	N/mm^2	(DIBt Z-21.8-1790)

$l_{0,pi,fi}$ $= (\phi/4)\cdot(\sigma_{sd,fi}/f_{bd,fi}) = (16/4)\cdot(249/1.4) =$ 711 mm

Embedment depth for post-installed rebars top:

e	$= [(s/2)^2 + (c_n\text{-}c_c)^2]^{0.5} - \phi = [100^2 + (50\text{-}30)^2]^{0.5} \text{-}16 =$	86	mm	clear spacing between spliced bars
Δl_0	$= e\text{-}4\phi = 86 - 4\cdot16 =$	22	mm	

l_0 $= \max(l_{0,pi} ; l_{0,pi,fi} ; l_{0,ci} ; l_{0,min}) + \Delta l_0 = 711 + 22 =$ 733 mm

c_f = 30 mm

w/2 = 125 mm

l_v $= l_0 + \max(w/2; c_f) = 758 + 125 =$ 858 mm

Embedment depth for post-installed rebars bottom:

Concrete in compression, no force on bars → anchorage with minimum embedment length.

f_{min}	=	1.0	mm	(ETA 08/0105)
$l_{b,min}$	$= f_{min}\cdot\max(10\phi; 100mm) = 1.0\cdot\max(10\cdot10; 100) =$	100	mm	

w/2 = 125 mm

l_v $= l_{b,min} + w/2 = 100 + 125 =$ 225 mm

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 [1]. The so-called "splitting design" allows to design for the full strength of the adhesive [5, 9].

- 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. The frame node model is a proposed strut and tie model to design moment resisting frame node connections with straight connection bars [6, 7].

2.3.1 Splitting Design

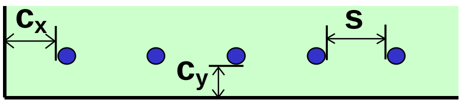
The factor α_2 of Eurocode 2 [1] gives an explicit consideration for splitting and spalling as a function of concrete cover and bar spacing. European Technical Approvals recommend the same procedure for post-installed rebar connections:

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

$$f_{bd} \quad according\ to\ technical\ \ data\,(ETA's\ for\ post-installed\ anchors) \qquad (1)$$

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

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



cover dimension

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:

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

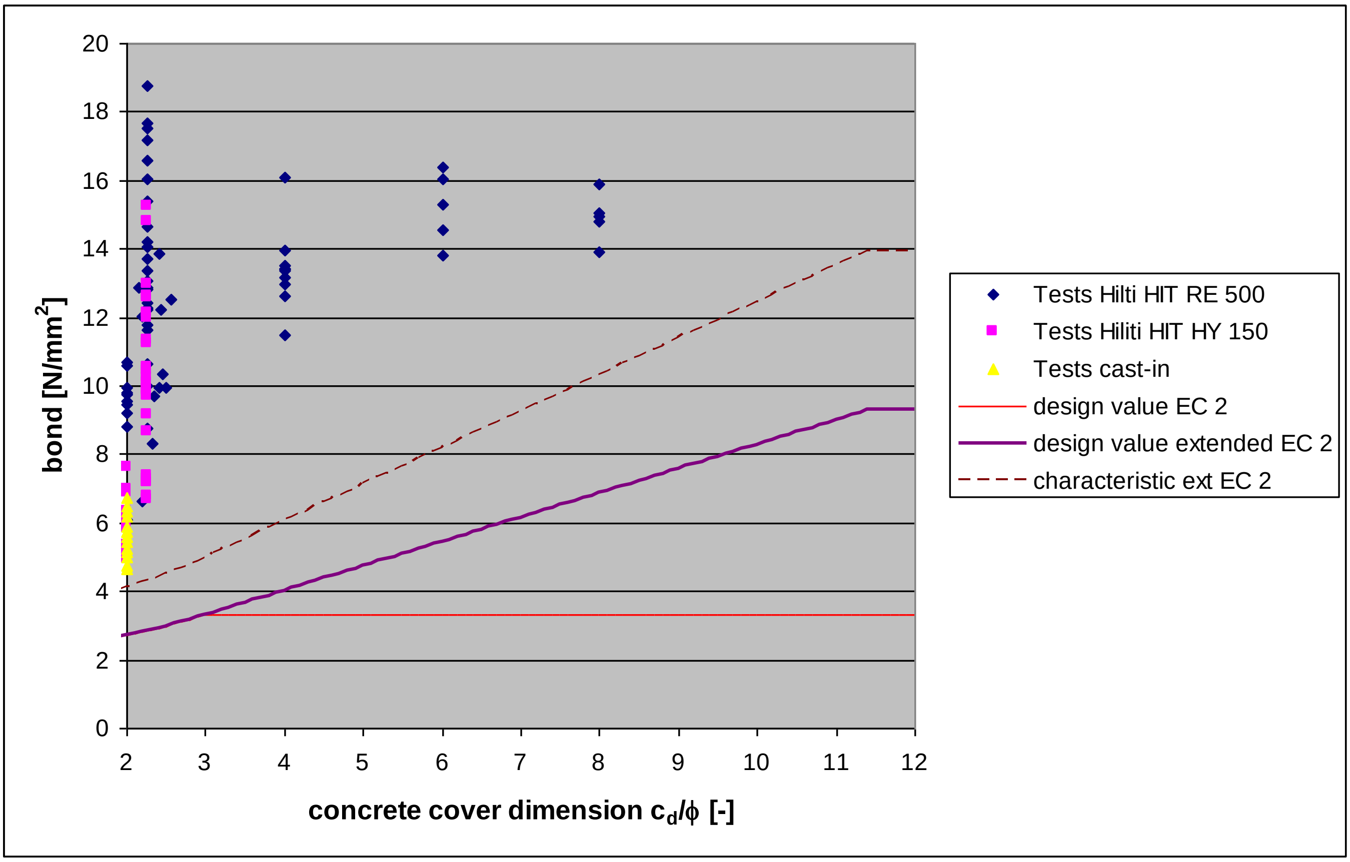
For cover dimensions exceeding the range of Eurocode 2, i.e. for $c_d/\phi > 3$ (bonded-in bars only), an adapted factor α_2' is used to create a linear extension of the bond strength function:

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

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

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 $\alpha_2' \geq 0.25$

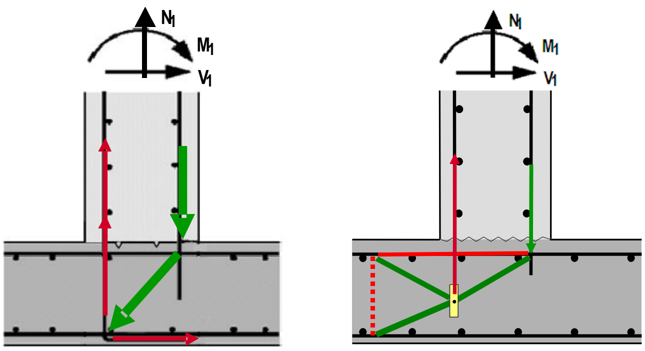
Below is a typical design bond stress f_{bd} curve as a function of the minimum edge distance/spacing distance, c_d is shown for a concrete class C20/25 and for a rebar with a diameter of not more than 32mm. In this figure the equivalent design bond stresses according to EC 2 and resulting from the above described definition of α_2 and α_2' are plotted. The design bond strength is defined by an inclined line and it increases with larger values of c_d. The diagram also shows the characteristic value of the bond strength ($f_{bd} \cdot \gamma_c$ where γ_c=1.5).



The increase in the design bond stress is limited by the maximum pull-out bond stress, which is a value given by the standards in the case of a cast-in reinforcement. For post-installed reinforcement, the maximum design bond stress is a function of the bonding agent and not necessarily equals that of cast-in bars; it will be taken from the relevant anchor approval. Thus, the limitation for bond failure in the code has been replaced by the specific design bond stress of the bonding agent for the specific application conditions and the splitting function has been adapted according to the tests.

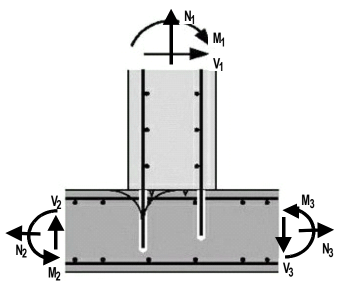
2.3.2 Strut and Tie Model for Frame Nodes

If frame nodes (or moment resisting connections in general) are designed with cast-in reinforcement, they usually require bent bars according to the standard reinforced concrete design rules. Anchoring the reinforcement of moment resisting connections with straight bars would, at least at first sight, result in concrete that is under tension, and therefore in a possible concrete cone failure. As this failure mode is brittle, such an anchorage is not allowed by the standard concrete design rules. In cooperation with the Technical University of Munich, Hilti performed a research programme in order to provide a strut-and-tie model for frame nodes with straight connection bars [6, 7]. The main differences to the standard cast-in solution are that the compression strut is anchored in the bonding area of the straight bar rather than in the bend of the bar and that, therefore, first the inner lever arm inside the node is reduced and second, splitting forces in the transition zone between D- and B-region must be considered.



Global Equilibrium of the Node

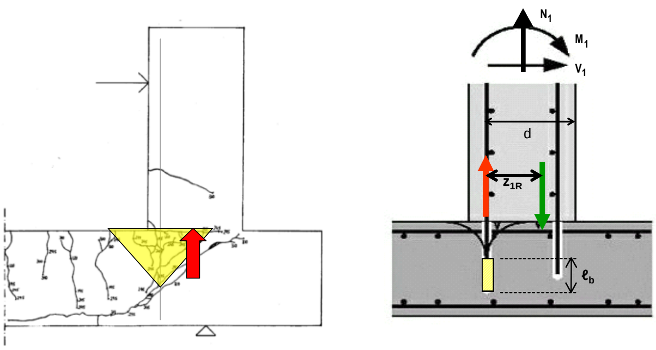
In order to check the struts and ties inside the node, the reactions N_2, V_2, M_2, N_3, V_3, M_3 at the other ends of the node need to be defined. Normally, they result from the structural analysis outside the node region and will be determined by the designer in charge.



Global equilibrium of the node

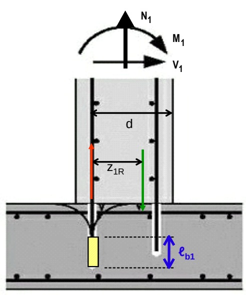
Tension in connecting bars

The loading of the wall in the figures results in a tensile force in the reinforcement on the left hand side and in a compression force on the right hand side. Initial tests and computer simulations led to the consideration that the straight bar has a tendency to push a concrete cone against the interface with the wall. Thus the compressive stress is in the interface not concentrated on the outside of the wall, but distributed over a large part of the interface, which leads to a reduced lever arm in the wall section. The recommended reduction factor is 0.85 for opening moments and 1.0 for closing moments.



Anchorage length

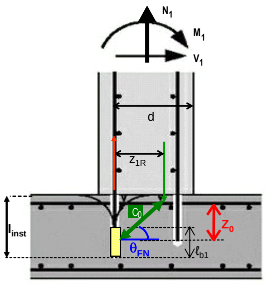
While the equilibrium inside of frame nodes with cast-in hooked bars can be modeled with the compression strut continuing from the vertical compression force and anchored in the bend at the level of the lower reinforcement, straight bars are anchored by bond stresses at a level above the lower reinforcement.
As bending cracks are expected to occur along the bar from the top of the base concrete, the anchorage zone is developing from the lower end of the bar and its length ℓ_b is that required to develop the steel stress calculated form the section forces M_1, N_1 and V_1.



$$\ell_b = \frac{\sigma_{sd} \cdot \phi}{4 \cdot f_{bd}}$$

with σ_{sd} design steel stress in the connection bars [MPa]
ϕ diameter of the vertical bar [mm]
f_{bd} design bond strength of cast-in bar to concrete or of the adhesive mortar [MPa]

Installation length



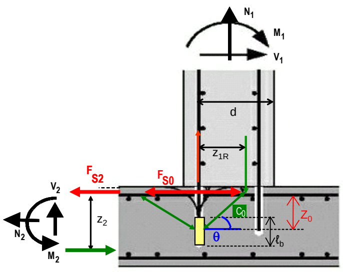
The strut-and-tie model requires that the angle θ between the inclined compression strut C_0 and the horizontal direction is 30º to 60º. For low drill hole lengths the resulting strut angle will be less than 30º. In such situations the design will not work as tests have shown. Also in order to remain as close as possible to the original solution with the bent bar, it is recommended to drill the holes as deep as possible in order to achieve a large strut angle θ_{FN}.

Note that PROFIS Rebar will preferrably propose the installation length such that the strut angle θ_{FN} is 60º. In cases where the existing section is too thin for this, it will propose the maximum possible embedment depth which is defined for bonded anchors in ETAG 001, part 5, section 2.2.2 as

$\ell_{inst,max} = h_{member} - \max(2 \cdot d_0; 30mm)$

with $\ell_{inst,max}$ maximum possible installation length [mm]
h_{member} thickness of the existing concrete member [mm]
d_0 diameter of the drilled hole [mm]

Tension in Existing Reinforcement



For a drilled hole depth l_{inst} and a concrete cover of the upper reinforcement to the center of the bars of c_s, the lever arm inside z_0 the node is:

$$z_0 = l_{inst} - \frac{\ell_b}{2} - c_s$$

The lever arm inside the node z_0 is smaller than the lever arm of the slab z_2. The tension in the upper slab reinforcement in the node region, F_{S0}, is higher than the tension calculated for the slab with z_2; the tensile resistance of the existing upper reinforcement $A_{s0,prov}$ must therefore be checked separately as follows:

$F_{s2} = M_2/z_2 + N_2/2$ (tension in existing reinforcement outside node area)

$H_{s2} = \left(M_1 + (V_2 + V_3) \cdot \frac{z_1}{2}\right) \cdot \left(\frac{1}{z_0} - \frac{1}{z_2}\right) + V_1 \cdot \left(\frac{z_1}{z_0} - 1\right)$ (additional tension in node due to reduced lever arm)

$F_{s0} = F_{s2} + H_{s2}$ (steel tension in node area)

$A_{s0,rqd} = F_{s0}/(f_{yk}/\gamma_s)$ (steel area required in existing part for forces from new part)

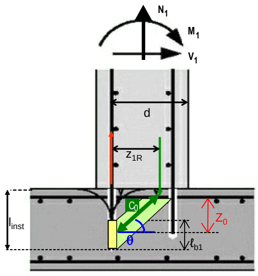
If $A_{s0,prov} \geq A_{s0,rqd}$ the reinforcement of the existing part is sufficient, provided that the forces from the new part are the only load on the section. This is the analysis obtainable from PROFIS Rebar.

As mentioned further above, a more sophisticated check needs to be made if there are also other loads in the system. Basically it would mean replacing F_{s2} as evaluated by under “global equilibrium” above by that evaluated in the complete static design.

The shallower the embedment of the post-installed vertical bar is, the more the moment resistance of the slab in the node region is reduced compared to a node with hooked bar. For this reason, it is also recommended to provide deep embedment of the connecting bars rather than trying to optimize mortar consumption by trying to recommend the shortest possible embedment depth.

Concrete Compressive Strut

The strut-and-tie model assumes that the compression strut C_0 is anchored at the center of the anchorage zone and that its thickness corresponds to the length of the anchorage zone ℓ_b.



$F_{c0} = \dfrac{M_1 + (V_2 + V_3) \cdot z_1 / 2}{z_0}$ (horizontal component of concrete strut force)

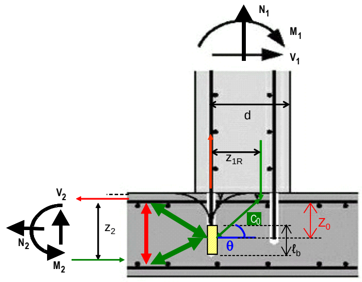
$D_0 = F_{c0} / \cos\theta_{FN}$ (concrete force in direction of strut)

$\sigma_{Rd,max} = \nu' \cdot k_2 \cdot \alpha_{cc} \cdot f_{ck} / \gamma_c$ (reduced concrete strength in tension-compression node according to ENV1992-1-1, 4.5.4(4b). Standard parameters: $\nu'=1-f_{ck}/250$; $k_2=0.85$; $\alpha_{cc}=1.0$; $\gamma_c=1.5$, subject to variations in National Application Documents)

$D_{0,R} = \sigma_{Rd,max} \cdot \ell_b \cdot w \cdot \cos\theta_{FN}$ (resistance of concrete in strut direction, w=width of section)

If $D_{0R} \geq D_0$ the concrete strut can take up the loads introduced from the new section.

Splitting of Concrete in Transition Area



On the left hand side of the anchorage zone, the compression force is continuing through additional struts to the tension and compression zones of the B-region of the slab where the equilibrium of the horizontal forces is given. The vertical components of these struts are taken up by tensile stresses in the concrete. Normally there is no vertical reinforcement in the slab to take up the tension force. The loads and thermal solicitations of a slab do not lead to horizontal cracking; therefore it is possible to attribute the tension force to the tensile capacity of the concrete. On the safe side, the maximum splitting stress has been taken as that caused by a concentrated load C_0 on the center of the anchorage zone. It has been shown that the occurring splitting stress $\max\sigma_{sp}$ can be calculated as

$$\max \sigma_{sp} = \left(M_1 + \frac{(V_2 + V_3) \cdot z_1}{2} \right) \cdot \left(1 - \frac{z_0}{z_2} \right) \cdot \left(1 - \frac{\ell_b}{2 \cdot z_2} \right) \cdot \left(\frac{2.42}{b \cdot z_2^2} \right) \leq f_{ct}$$

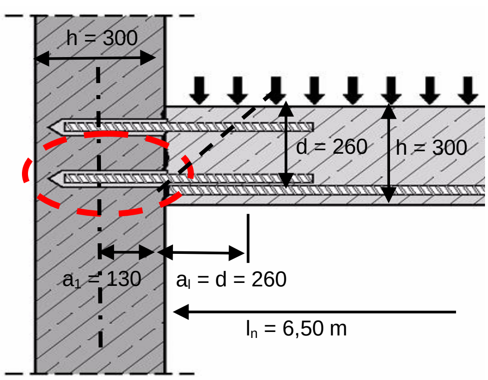
with:

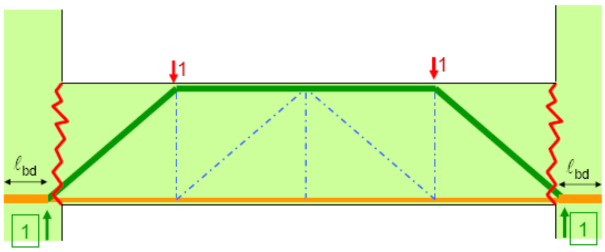
M_1, V_2, V_3:	external forces on node according to figure 5
z_2	inner lever arm of slab section outside node region
b	width of the wall section
$f_{ctd} = \alpha_{ct} \cdot 0.7 \cdot 0.3 \cdot f_{ck}^{2/3} / \gamma_c$	tensile strength of concrete (Standard value in EC2: α_{ct}=1.0, subject to variations in National Application Documents)

If the calculated maximum splitting stress is smaller than the tensile strength of the concrete f_{ct}, then the base plate can take up the splitting forces without any additional shear reinforcement.

2.3.3 Design Examples

a) End support of slab, simply supported





slab: l_n = 4,50m, Q_k = 20 kN/m^2, h = 300 mm, d = 260 mm

wall: h = 300 mm

Concrete strength class: C20/25, dry concrete

Reinforcement: f_{yk} = 500 N/mm^2, γ_s = 1.15

Loads: $G_k = 25$ kN/m$^3 \cdot$h = 7.5 kN/m²;
$S_d = (1.50 \cdot Q_d + 1.35 \cdot G_k)$ = 40.1 kN/m²

Structural analysis (design forces):
$M_{Ed} = S_d \cdot l_n{}^2 / 8$ = 102 kNm/m
$V_{Ed} = S_d \cdot l_n$□ $/ 2$ = 90.3 kN/m

Bottom reinforcement required at mid span:
$A_{s,rqd,m} = (M_{sd} \cdot \gamma_s) / (0.9 \cdot d \cdot f_{yk})$ = 998 mm²/m

reinforcement provided at mid span: ∅16, s = 200 mm
$A_{s,prov,m}$ = 1005 mm²/m

Bottom reinforcement at support:

Tension force to be anchored: $F_{Ed}=|V_{Ed}| \cdot a_l/(0.9d)$ = 100 kN/m (Clause 9.2.1.4(2), EC2: EN 1992-1-1:2004)

Steel area required: $A_{s,rqd} = F_{Ed} \cdot \gamma_s / f_{yk}$ = 231 mm²/m

Minimum reinforcement to be anchored at support:

$A_{s,min} = k_c \cdot k \cdot f_{ct,eff} \cdot A_s / \sigma_s = 0,4 \cdot 1 \cdot 2,2 \cdot 150 \cdot 1000/500$ = 264 mm²/m (Clause 7.3.2(2), EC2: EN 1992-1-1:2011)
$A_{s,min} = 0.5 \cdot A_{s,rqd,m} = 0,50 \cdot 988$ = 499 mm^2/m (Clause 9.3.1.2(1), EC2: EN 1992-1-1:2011)

$A_{s,min} = 0.25 \cdot A_{s,prov,m} = 0,25 \cdot 1010$ = 251 mm²/m (Clause 9.2.1.4(1), EC2: EN 1992-1-1:2011)

Decisive is 499 mm²/m ⇒ reinforcement provided: ∅12, s = 200 mm ⇒ $A_{s,prov}$ = 565 mm²/m;

Installation by hammer drilling; Hilti HIT-RE 500

Minimum anchorage length

$\sigma_{sd} = (A_{s,rqd} / A_{s,prov}) \cdot (f_{yk}/\gamma_s) = (23 /565) \cdot (500/1,15)$ = 177 N/mm²

$f_{bd,EC2}$ = 2,3 N/mm² (EC 2 for minimum length. see tech. data, sect. 6)

$\ell_{b,rqd} = (\phi / 4) \times (\sigma_{sd} / f_{bd}) = (12 / 4) \times (177 / 2.3)$ = 231 mm

$\ell_{b,min} = \max \{0.3\ell_{b,rqd}; 10\phi; 100\text{mm}\}$ = 120 mm (Clause 8.4.4(1), EC2: EN 1992-1-1:2011)

Development length:

Cover dimension: $c_d = (s - \phi)/2$ = = 94 mm

Confinement $c_d/\phi = 94/12$ = 7.8

Splitting bond strength for c_d/ϕ >3:

$$\alpha_2' = \frac{1}{\frac{1}{0.7} + \delta \cdot \frac{c_d - 3\phi}{\phi}} = \frac{1}{\frac{1}{0.7} + 0.306 \cdot \frac{94 - 3 \cdot 12}{12}} = 0.344$$

$$f_{bd,spl,2} = \frac{f_{bd,EC2}}{\max(\alpha_2';0.25)} = \frac{2.3}{0.344} = 6.7 N/mm^2$$

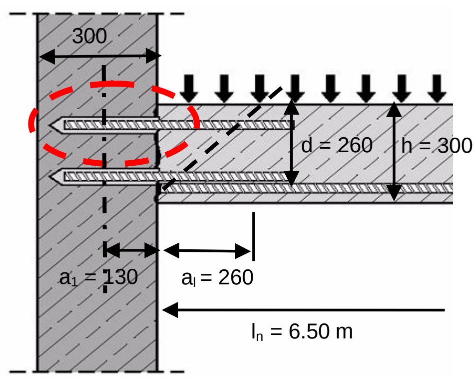
Pullout bond strength: $f_{bd,p}$ = 8.6 N/mm^2 (see tech. data, sect. 6)

Applicable design bond strength: $f_{bd} = \min(f_{bd,spl}; f_{bd,p})$ = 6.7 N/mm2

Design development length: $\ell_{bd} = (\phi/4)\cdot(\sigma_{sd}/f_{bd})$ = 80 mm

Minimum length controls → drill hole length **l_{ef} = 120 mm**

Top reinforcement at support:



Minimum reinforcement:

a) 25% of bottom steel required at mid-span
{Clause 9.3.1.2(2), EC2: EN 1992-1-1:2004}
$A_{s,req}$ = 0,25 · 988 = 247 mm^2/m

b) requirement for crack limitation :
{Clause 7.3.2(2), EC2: EN 1992-1-1:2004}
$A_{s,min}$ = 0,4 · 1 · 2,2 · 150 · 1000 / 435 = 303 mm^2/m

Decisive is 303 mm²/m
⇒ reinforcement provided: ∅10, s = 200 mm; $A_{s,prov}$ = 393 mm²/m

Design stress in bar: $\sigma_{sd} = f_{yd} \cdot A_{s,min} / A_{s,prov}$ = 335 N/mm^2

Minimum anchorage length

σ_{sd} = $(A_{s,rqd} / A_{s,prov}) \cdot (f_{yk}/\gamma_s)$ = (23 /565)·(500/1,15) = 335 N/mm²

$f_{bd,EC2}$ = 2,3 N/mm² (EC 2 for minimum length. see tech. data, sect. 6)

$\ell_{b,rqd}$ = $(\phi / 4) \times (\sigma_{sd} / f_{bd})$ = (10 / 4) x (335 / 2.3) = 364 mm

$\ell_{b,min}$ = max {$0.3\ell_{b,rqd}$; 10ϕ; 100mm} = 110 mm (Clause 8.4.4(1), EC2: EN 1992-1-1:2011)

Development length:

Cover dimension: $c_d = (s - \phi)/2$ = = 95 mm

Confinement c_d/ϕ = 95/10 = 9.5

Splitting bond strength for c_d/ϕ >3:

$$\alpha_2' = \frac{1}{\frac{1}{0.7} + \delta \cdot \frac{c_d - 3\phi}{\phi}} = \frac{1}{\frac{1}{0.7} + 0.306 \cdot \frac{95 - 3 \cdot 10}{10}} = 0.293$$

$$f_{bd,spl,2} = \frac{f_{bd,EC2}}{\max(\alpha_2';0.25)} = \frac{2.3}{0.293} = 7.9 N/mm^2$$

Pullout bond strength: $f_{bd,p}$ = 8.6 N/mm^2 (see tech. data, sect. 6)

Applicable design bond strength: $f_{bd} = \min(f_{bd,spl}; f_{bd,p})$ = 7.9 N/mm2

Design development length: $\ell_{bd} = (\phi/4)\cdot(\sigma_{sd}/f_{bd})$ = 97 mm

Minimum length controls → drill hole length $\mathbf{l_{ef} = 110}$ **mm**

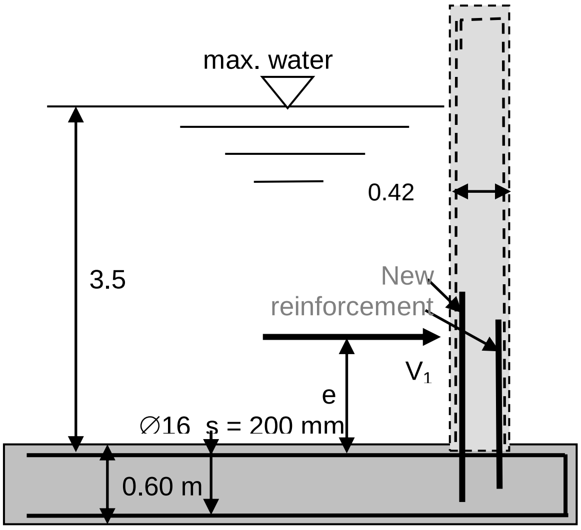
Therefore, drill hole length $\mathbf{l_{ef} = 110}$**mm**

If wet diamond core drilling is used:

$\ell_{b,min}$ = max {0,3$\ell_{b,rqd}$; 10ϕ; 100mm} · 1.5 = 180 mm (as wet diamond core drilling is used, the minimum values according do EC2 have to be multiplied by 1.5, see tech data)

-> in this case the minimum length will control, drill hole length $\mathbf{l_{ef} = 180}$**mm** for upper and lower layers

b) Wall bending connection



Note: transverse reinforcement not

Geometry:

h_1 = 420 mm; $h_2 = h_3$ = 600 mm;

d_1 = 380 mm; $d_2 = d_3$ = 560 mm;

z_1 = 360 mm; $z_2 = z_3$ = 520 mm

$A_{s0} = A_{s2} = A_{s3}$ = 1005 mm^2/m (∅16 s = 200 mm)

$c_S = h_2 - d_2$ = 40 mm

Material:

Concrete: C20/25 (new and existing parts), γ_s = 1.5

Steel grade: 500 N/ mm^2, γ_s = 1.15

Safety factor for variable load: γ_Q = 1.5

HIT-RE 500-SD (temperature range I)

Acting loads:

$V_{1d} = \gamma_Q \cdot p \cdot h^2 / 2 = 1.4 \cdot 10 \cdot 3.5^2 / 2$ = 92 kN/m

$e = h / 3 = 3.5 / 3$ = 1.17 m

$M_{1d} = V_{1d} \cdot e = 92 \cdot 1.17$ = 107 kNm/m

Force in post-installed reinforcement

$z_{1r} = 0.85 \cdot z_1 = 0.85 \cdot 360$ = 306 mm (opening moment → reduced inner lever arm)

$F_{s1d} = M_{1d} / z_{1r} = 107 / 0.306$ = 350 kN/m

$A_{s1,rqd} = F_{s1d} / (f_{yk}/\gamma_{Ms})$ = 350'000 / (500 / 1.15) = 805 mm^2/m

Select ϕ12mm, spacing s_1 = 125mm → $A_{s1,prov}$ = 905 mm^2

→ drilled hole diameter: d_0 = 16 mm

Stress in bar: $\sigma_{sd} = F_{s1d} / A_{s1,prov}$ = 386 N/mm^2

anchorage length

$f_{bd,EC2}$ = 2.3 N/mm2 (EC 2 for minimum length)

$\ell_{b,rqd,EC2} = (\phi/4) \cdot (\sigma_{sd}/f_{bd,EC2})$ = 504 mm

$\ell_{b,min} = \max\{0,3\ell_{b,rqd,EC2}; 10\phi; 100\text{ mm}\}$ = 151 mm

$f_{bd,b}$ = 8.3 N/mm^2 (see tech. data, sect. 6)

$c_d = s_1/2 - \phi/2$ = 56.5 mm > 3ϕ

$$\alpha_2' = \frac{1}{\max\left[\frac{1}{0.7} + \delta \cdot \frac{c_d - 3\phi}{\phi}; 0.25\right]}$$ = 0.512

$$f_{bd,spl2} = \frac{f_{bd}}{\max[\alpha_2'; \; 0.25]}$$ = 4.5 N/mm^2

$f_{bd} = \min\{f_{bd,b}; f_{bd,spl}\}$ = 4.5 N/mm^2

$\ell_{b1} = \max\{(\phi/4)\cdot(\sigma_{sd} / f_{bd}); \ell_{b,min}\}$ = 258 mm

Drilled hole length

$\ell_{inst,max}$ = $h_2 – \max\{2d_0; 30mm\}$ = 568 mm (maximum possible hole length)

$\ell_{inst,60}$ = $c_s + z_{1R} \cdot \tan 60° + \ell_{b1} / 2$ = 672 mm (hole length corresponding to θ=60°)

$\ell_{inst,60}$ > $\ell_{inst,max}$ → select hole length $\ell_{inst} = \ell_{inst,max}$ = 568 mm

Strut angle with $\ell_{inst,max}$: $\tan\theta = (\ell_{inst,max} - c_s - \ell_{b1}/2)/z_{1R}$ → θ_{FN} = 53°

check: $\theta > 30°$ → ok

Reaction in Foundation:

$-M_{2d}$ = $M_{1d} + V_{1d} \cdot z_2 / 2 = 107 + 0.25 \cdot 92$ = 131 kNm/m

N_{2d} = $-V_{1d}$ = -92 kN/m

$M_{s3} = 0$; $V_{2d} = V_{3d} = 0$; $N_1 = N_3 = 0$

Check of foundation reinforcement

F_{s2d} = $M_{2d} / z_2 + N_{2d} / 2$ = 298 kNm/m (tension outside node area)

z_0 = $\ell_{inst} - c_s - \ell_{b1} / 2 = 568 – 40 - 258/2$ = 399 mm (lever arm in node area)

H_{s2d} = $M_{1d} \cdot (1/z_0 – 1/z_2) + V_{1d} \cdot (z_1/z_0 - 1)$ = 53 kNm/m (additional force in node area)

$F_{s2d,node}$ = $F_{s2d} + H_{s2d}$ = 351 kNm/m (tension in node area)

$A_{s2,rqd}$ = $F_{s2d,node} / (f_{yk}/\gamma_{Ms}) = 351'000 / (500 / 1.15)$ = 808 mm^2/m

A_{s2} > $A_{s2,rqd}$ → ok (A_{s2} is given)

Check concrete compressive strut

F_{c0d} = M_{1d} / z_0 = 268 kN/m

D_{0d} = $F_{c0d} / \cos\theta_{FN}$ = 441 kN/m

α_{ct} = 1.0 (EC2: EN 1992-1-1:2004, 3.1.6(1))

ν' = $1-f_{ck}/250$ = 0.92 (EC2: EN 1992-1-1:2004, 6.5.2(2))

k_2 = 0.85 (EC2: EN 1992-1-1:2004, 6.5.4(4b))

D_{0Rd} = $\alpha_{ct} \cdot \nu' \cdot k_2 \cdot f_{ck} / \gamma_c \cdot \ell_{b1} \cdot \cos\theta_{FN}$ = 1639 kN/m

D_{0Rd} > D_{0d} → ok

Check concrete splitting in plane of foundation

α_{ct} = 1.0 (EC2: EN 1992-1-1:2004, 3.1.6(2))

$f_{ctk,0.05}$ = $\alpha_{ct} \cdot 0.7 \cdot 0.3 \cdot f_{ck}^{2/3} / \gamma_c$ = 1.03 N/mm^2 (table 3.1, EC2: EN 1992-1-1:2004)

$M_{sp,d}$ = $F_{c0d} \cdot z_0 \cdot (1 – z_0/z_2) \cdot (1 – \ell_{b1}/(2z_2))$ = $1.87 \cdot 10^7$ Nmm/m

W_{sp} = $1000mm \cdot z_2^2 / 2.41$ = $1.12 \cdot 10^8$ mm^3/m

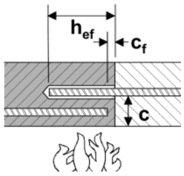
$\max\sigma_{sp}$ = $M_{sp,d} / W_{sp}$ = 0.17 N/mm^2

$f_{ctk,0.05}$ > $\max\sigma_{sp}$ → ok

2.4 Load Case Fire

The bond strength in slabs under fire has been evaluated in tests and is certified by reports of the Technical University of Brunswik, Germany. The conformity with the German standards is confirmed in DIBt German national approvals, the one with British Standard BS8110:1997 in the Warrington Fire Report. French cticm Approvals also give data for beams. These documents are downloadable from the Intranet for the different adhesive mortars.

There are two types of design tables corresponding to the basic fire situations “parallel” and “anchorage”.



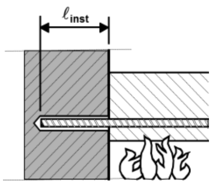
In the fire situation “**parallel**” the only parameter is the clear distance from the fire exposed concrete surface to the perimeter of the bar (“clear concrete cover c”). From this parameter, one can directly read the bond strength of the adhesive for specific fire durations.

In fire design, it is not necessary to re-calculate influences like bond condition or alpha factors. It is sufficient to prove that the calculated splice or anchorage length is sufficient to transmit the load under fire with the given fire bond strength $\tau_{Rd,fi}$.

Clear concrete cover c [mm]	Max. bond stress, τ_c [N/ F30	F60	F90	F120
10	0	0	0	0
20	0,494			
30	0,665			
40	0,897	0,481		
50	1,200	0,623		
60	1,630	0,806	0,513	
70	2,197	1,043	0,655	0,487
80	2,962	1,351	0,835	0,614
90	3,992	1,748	1,065	0,775
100	5,382	2,263	1,358	0,977
110	7,255	2,930	1,733	1,233
120	9,780	3,792	2,210	1,556
130	11,00	4,909	2,818	1,963
140		6,355	3,594	2,477
150		8,226	4,584	3,125

$$F_{fire} = f_{bd,fi} * \phi * \pi * h_{ef}$$

Fire design table for situation „parallel“



In the fire situation “**anchorage**” the tables directly show the fire resistance as a force [kN] for given diameters, embedment depths and fire durations.

The tables mention a maximum steel force in fire. It is important to know that this value is derived for a specific assumed value of $f_{yk,fi}$ (see sect. 2.1.2) and will be different for other values of $f_{yk,fi}$. In the published tables $f_{yk,fi}$=322N/mm^2 was normally assumed; if this value was given as e.g. $f'_{yk,fi}$=200N/mm^2 the maximum force for bar diameter 8mm in the table below would be Max. $F'_{s,T}$=10.1kN. This would then imply that in the columns on the right side, all values would be cut off at 10.1kN, i.e. the values 16.2 or 13.01 would not appear any more.)That means that there is no such thing as a given maximum force in fire.

Intermediate values between those given in the fire design tables may be interpolated linearly. Extrapolating is not permitted.

Bar Ø [mm]	Drill hole Ø [mm]	Max. $F_{s,T}$ [kN]	ℓ_{inst} [mm]	F30 [kN]	F60 [kN]	F90 [kN]
8	12	16,2	80	2,18	0,73	0,24
			120	8,21	2,90	1,44
			170	16,2	9,95	5,99
			210		16,2	13,01
			230			16,2
			250			
			300			
10	14	25,3	100	5,87	1,95	0,84
			150	16,86	8,06	4,45
			190	25,3	16,83	11,86
			230		25,3	20,66
			260			25,3
			280			
			320			
			120	12,32	4,35	2,16
			180	28,15	17,56	11,59

$$R_{fire} = \phi \cdot \pi \cdot \sum_{i=1}^{n} \tau_{crit,\theta i} \cdot \ell_i$$

Fire design table for situation „anchorage“

2.5 Fatigue of bonded-in reinforcement for joints

General notes

For load bearing elements which are subjected to considerable cyclic stress the bonded-in connections should be designed for fatigue. In that case evidence for fatigue of reinforcing steel bars, concrete and bond should be provided separately.
For simple cases it is reasonable to use simplified methods on the safe side.
The partial safety factors for loads are specified in the code for reinforced concrete.
The partial safety factors for material are specified in Table 4.3.

Table 4.3: Partial safety factors for materials subjected to cyclic loading

Evidence for	concrete	bond	reinforcing bars (steel)
Partial safety factor	1.5	1.8	1.15

Fatigue of reinforcing bars (steel)

The resistance for fatigue of reinforcing bars (steel) is specified in the actual code for reinforced concrete. The behaviour of the steel of reinforcing bars bonded-in by means of HIT-Rebar is at least as good as cast-in place reinforcement.

Fatigue of bond and concrete (simplified approach)

As a simple and conservative approach on the safe side evidence for fatigue is proven if the following equation is valid:

$F_{Sd,fat} \leq N_{Rd} \cdot f_{fat}$

where:

$F_{Sd,fat}$ Design value of the anchorage force for the ruling loading model for fatigue.
N_{Rd} Design resistance for static load of the anchorage (bond and concrete).
f_{fat} Reduction factor for fatigue for bond and concrete: $f_{fat} = 0.5$
If max/min of cycles is known, reduction factors are shown in Figure 4.13.

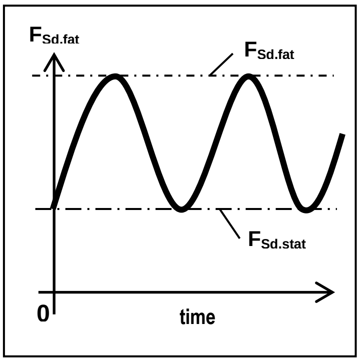
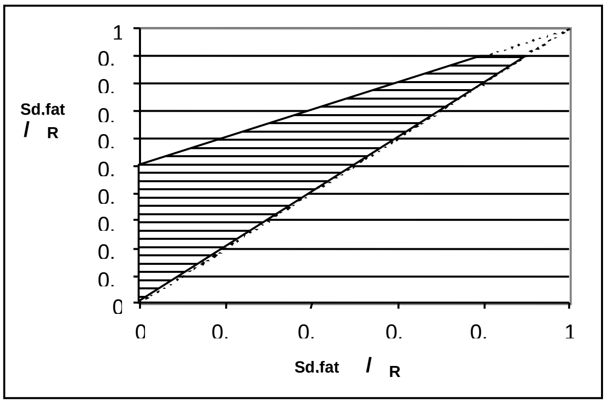


Diagram for a simplified approach
with $2 \cdot 10^6$ cycles (Weyrauch diagram)



Reduction factors for fatigue for bond and concrete

If the simplified method is not satisfying, additional information using the “Woehler” - lines is available.
Ask Hilti Technical Service for the Hilti Guideline: TWU-TPF 06a/02 HIT-Rebar: Fatigue.

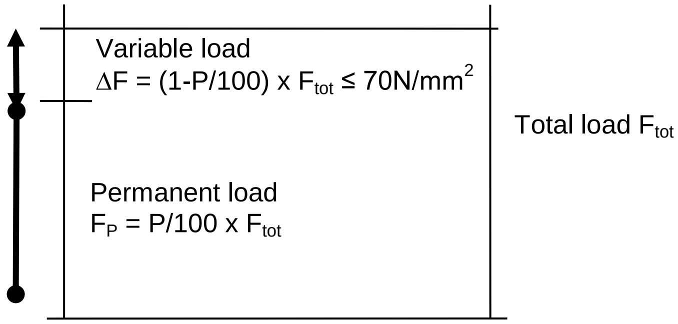
Design Approach

Steel resistance:

The steel resistance under fatigue load is calculated from the part of the load which is permanent, the allowable stress variation and the steel yield strength. The safety factors are the same as those used for static design (taken from ENV 1992-2-2:1996, sect. 4.3.7.2).

$\Delta\sigma_{s,\max} = \ldots$ maximum allowable stress variation, usually given by codes, e.g. ENV 1992-2-2:1996, sect. 4.3.7.5: $\Delta\sigma_{s,\max} = 70N/mm^2$

P percentage of the load which is permanent: $0 \le P \le 100$



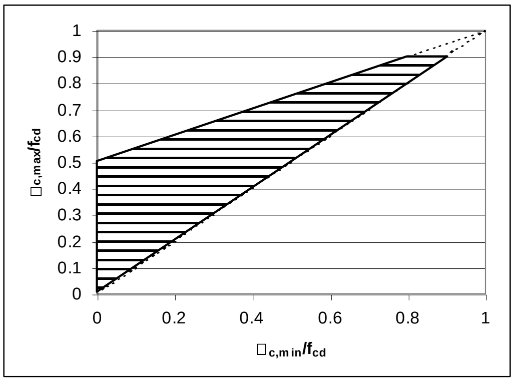
The reduction factor on steel resistance due to dynamic loading is then:

$$f_{red,s,dyn} = \frac{\min(f_{yk}; \frac{70}{1-P/100})}{f_{yk}}$$

And the steel strength taken into account for fatigue loading is

$$\sigma_{s,\max,dyn} = f_{red,s,dyn} \cdot f_{yk}$$

Concrete Resistance



The concrete resistance calculated for static loading is reduced by a reduction factor for fatigue loads, $f_{red,c,dyn}$, which is applied to all types of concrete failure, i.e. splitting, shear in uncracked and shear in cracked concrete. This factor is calculated from the Weyrauch diagram of Eurocode 2 (ENV 1992-2-2:1996, section 4.3.7.4):

$$f_{red,c,dyn} = 0.5 + 0.45 \cdot \frac{P}{100} \le 0.9$$

For P=100 (only permanent loads), $f_{red,c,dyn}$ is, of course 1.0, but as soon as P<100, $f_{red,c,dyn} \le 0.9$.

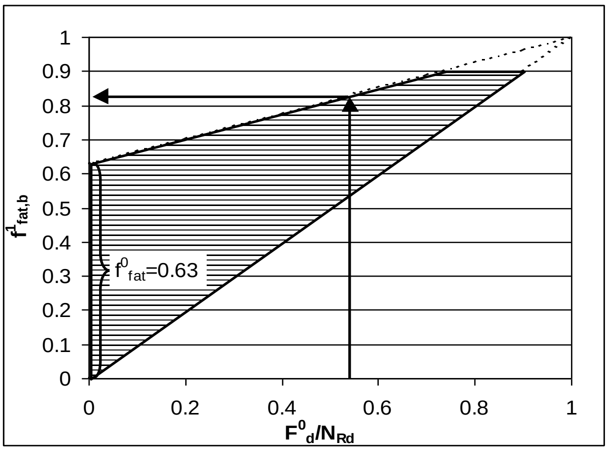
Bond Resistance

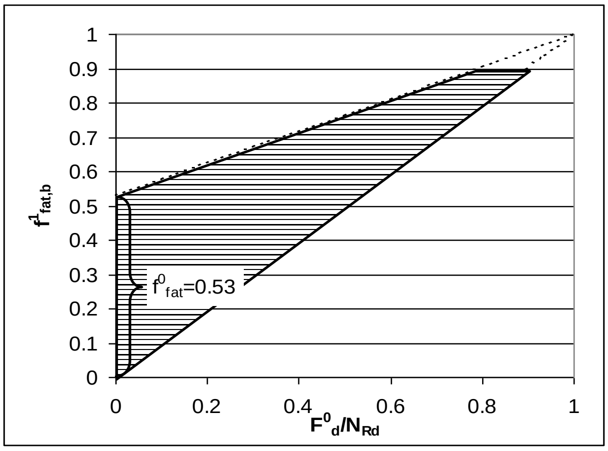
The bond resistance calculated for static loading is reduced by a reduction factor for fatigue loads, $f_{red,b,dyn}$. This factor is calculated from the Weyrauch diagram based on in-house testing and literature reviews [8]. It has to be chosen between two formulas depending on the situation.

a) in general: $f_{red,b,dyn} = 0.63 + 0.37 \cdot \frac{P}{100} \le 0.9$

b) HIT-RE 500 in diamond drilled, water saturated hole: $f_{red,b,dyn} = 0.53 + 0.47 \cdot \frac{P}{100} \le 0.9$

For P=100 (only permanent loads), $f_{red,c,dyn}$ is, of course 1.0, but as soon as P<100, $f_{red,c,dyn} \leq 0.9$.





2.6 Seismic design of structural post-installed rebar

An increasing population density, the concentration of valuable assets in urban centers and society's dependence on a functioning infrastructure demand a better understanding of the risks posed by earthquakes. In several areas around the globe, these risks have been reduced through appropriate building codes and state of the art construction practices. The development of pre-qualification methods to evaluate building products for seismic conditions additionally contributes to safer buildings for generations to come.

Approval DTA 3/10-649 [10] delivered by CSTB, a member of EOTA, recognizes Hilti HIT-RE 500-SD injectable mortar as a product qualified for structural rebar applications in seismic zones. This national approval requires that qualified products have an ETA approval for rebar, an ETA approval for anchorage in cracked concrete, as well as an ICC-ES pre-qualification for seismic conditions.

The design procedure is fully details in the approval and, in addition to detailing rules of EC2/rebar ETA, consider the following detailing rules of EN1998-1:2004 (Eurocode 8) [11]:

- max f_{yk} =500N/mm2
- restricted concrete strengths range: C20/25 to C45/55
- only ductile reinforcement (class C)
- no combination of post-installed and e.g. bent connection bars to ensure displacement compatibility
- columns under tension in critical (dissipation) zones: increase l_{bd} and l_0, respectively, by 50%
- specific bond strength $f_{bd,seism}$ presented in the following table

By applying engineering judgment, engineers can use this French application document when designing seismic structural post-installed rebar connections. This mentioned practice is presently the only available and fully operational code based procedure in Europe and can as such be considered state-of-the-art.

2.7 Corrosion behaviour

The Swiss Association for Protection against Corrosion (SGK) was given the assignment of evaluating the corrosion behaviour of fastenings post-installed in concrete using the Hilti HIT-HY 200 and Hilti HIT-RE 500 injection systems.

Corrosion tests were carried out. The behaviour of the two systems had to be evaluated in relation to their use in field practice and compared with the behaviour of cast-in reinforcement. The SGK can look back on extensive experience in this field, especially on expertise in the field of repair and maintenance work.
The result can be summarized as follows:

Hilti HIT-HY 200

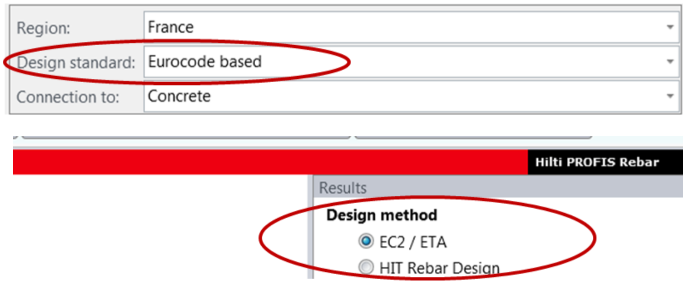
- The Hilti HIT-HY 200 systems in combination with reinforcing bars can be considered resistant to corrosion when they are used in sound, alkaline concrete. The alkalinity of the adhesive mortar safeguards the initial passivation of the steel. Owing to the porosity of the adhesive mortar, an exchange takes place with the alkaline pore solution of the concrete.
- If rebars are bonded-in into chloride-free concrete using this system, in the event of later chloride exposure, the rates of corrosion are about half those of rebars that are cast-in.
- In concrete containing chlorides, the corrosion behaviour of the system corresponds to that of cast-in rebars. Consequently, the use of unprotected steel in concrete exposed to chlorides in the past or possibly in the future is not recommended because corrosion must be expected after only short exposure times.

Hilti HIT-RE 500 + Hilti HIT-RE 500-SD

- If the Hilti HIT-RE 500 system is used in corrosive surroundings, a sufficiently thick coat of adhesive significantly increases the time before corrosion starts to attack the bonded-in steel.
- The HIT-RE 500 system may be described as resistant to corrosion, even in concrete that is carbonated and contains chlorides, if a coat thickness of at least 1 mm can be ensured. In this case, the unprotected steel in the concrete joint and in the new concrete is critical.
- If the coat thickness is not ensured, the HIT-RE 500 system may be used only in sound concrete. A rebar may then also be in contact with the wall of the drilled hole. At these points, the steel behaves as though it has a thin coating of epoxy resin.
- In none of the cases investigated did previously rusted steel (without chlorides) show signs of an attack by corrosion, even in concrete containing chlorides.
- Neither during this study an acceleration of corrosion was found at defective points in the adhesive nor was there any reference to this in literature. Even if a macro-element forms, the high resistance to it spreading inhibits a locally increased rate of corrosion.
- Information in reference data corresponds with the results of this study.

3 Design Programme PROFIS Rebar

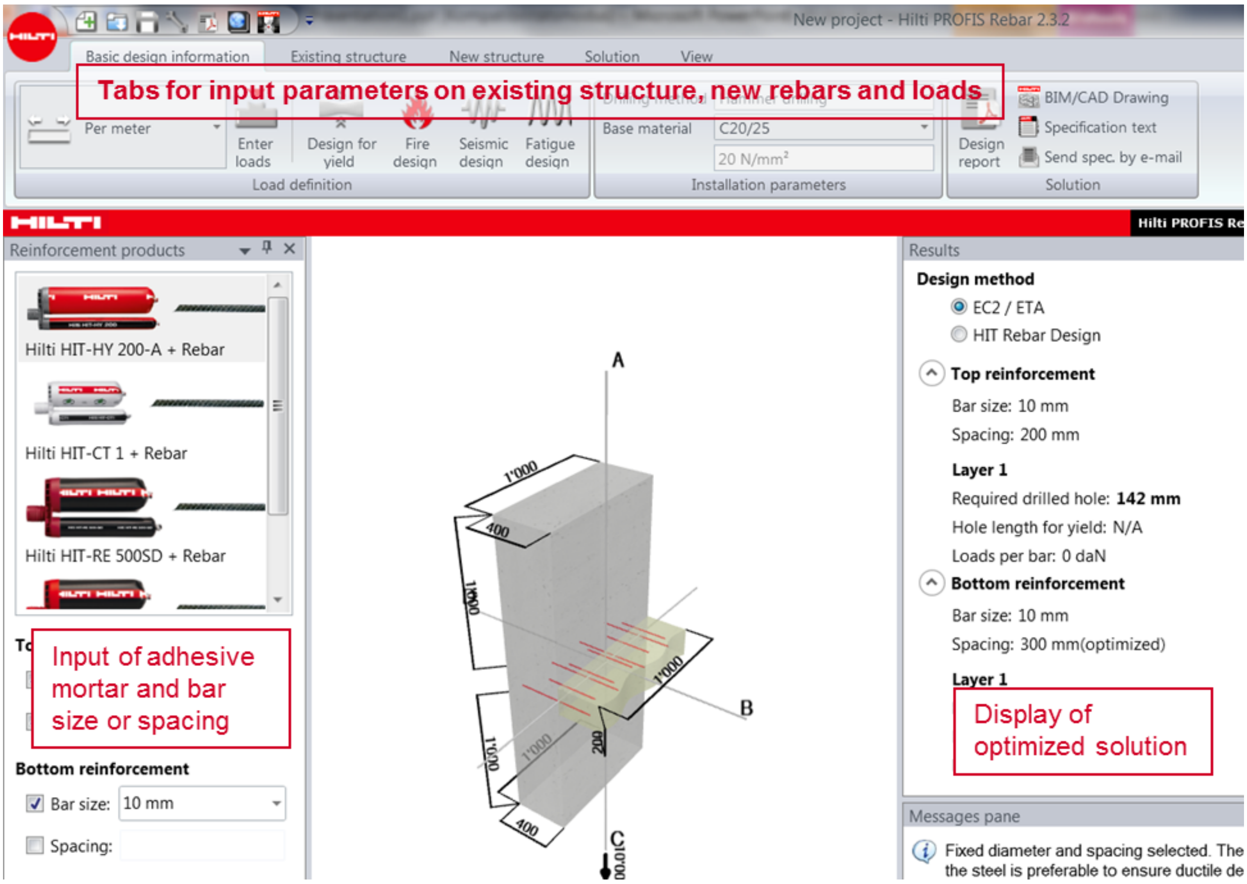
The PROFIS Rebar™ design programme allows rapid and safe design of post-installed reinforcement connections.



When a new project is opened, the user selects between the design methods “Eurocode based” and “ACI based” design methods. After this, the necessary data concerning existing structure, new rebars and loads have to be defined.

The results pane to the right of the drawing lets the user switch between the methods “EC2 / ETA” (see section 2.2) and “HIT rebar design” (see section 2.3).

In the left hand ribbon of the screen, the user can then select the adhesive mortar to be used and either the bar size or the spacing for top and bottom layers. Based on the input data, the program calculates the section forces in steel and concrete as well as the position of the neutral axis. (Elastic-plastic behaviour of the steel is assumed, strain hardening is not taken into account.)

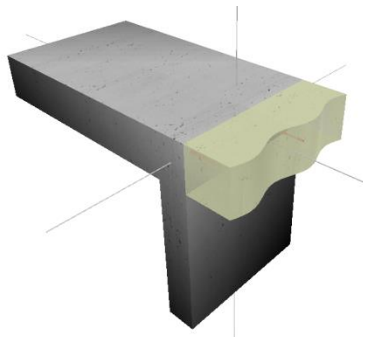
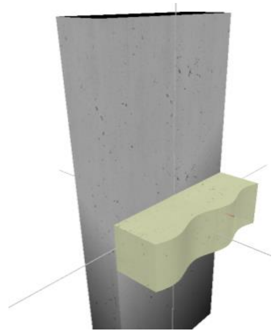


In the right hand ribbon the optimized solution, i.e. the one which uses the least possible cross section of connecting steel is indicated immediately.

Under the “calculation” tab, the user can get all possible solutions and select the appropriate one from a table.

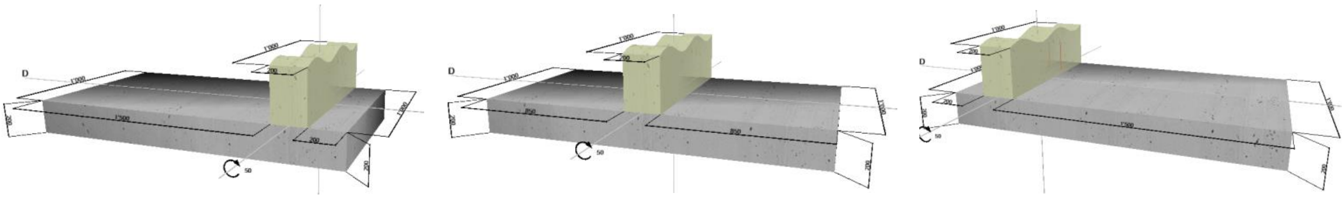
Under the “solution tab” it is possible to print a design report, to download installation instructions or approvals, to access the Hilti online technical library or to send a specification by e-mail

The applications are shown in the following table. For each case the table shows if there is a solution and if yes, which cast-in reinforcement must be defined in order to obtain a solution:

	New and existing members parallel  **design method:**		New and existing members perpendicular  **design method:**	
Load	**EC2 / ETA**	**Hit Rebar**	**EC2 / ETA**	**Hit Rebar**
compression and/or shear	With high compression requiring compressive reinforcement, existing reinforcement to be spliced is needed		definition of cast-in reinforcement not required	
bending moment, shear and/or compression	Overlap splice: Parallel cast-in reinforcement to be defined		*No solution, concrete in tension → PROFIS Anchor*	Frame node: Perpendicular cast-in reinforcement to be defined
tension with or without bending moment and/or shear	Overlap splice: Parallel cast-in reinforcement to be defined		*No solution, concrete in tension → PROFIS Anchor*	

Assumptions made by PROFIS Rebar in frame node design

Note that PROFIS Rebar is making simplified assumptions: it considers only the reactions to N_1, V_1, M_1 and it attributes them to the side of the base slab which is defined longer. If both sides of the base slab have the same length, the reaction is distributed to both sides equally:



$$M_2 = -M_1 + V_1 \cdot \frac{z_2}{2} + N_1 \cdot \frac{z_1}{2}$$
$$M_3 = 0$$
$$V_2 = N_1; \qquad V_3 = 0$$
$$N_2 = V_1; \qquad N_3 = 0$$

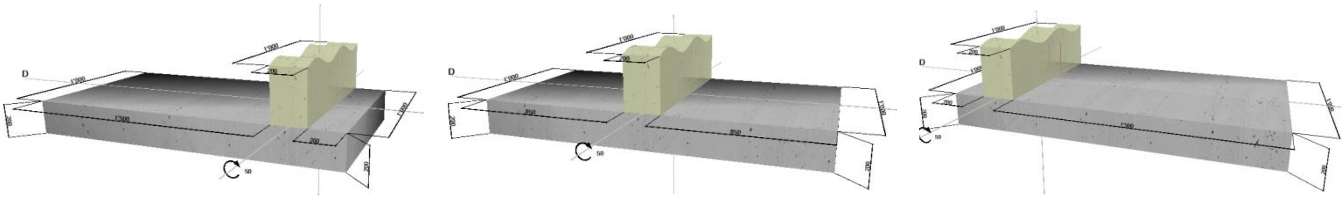
$$M_2 = 0$$
$$M_3 = -M_1 + V_1 \cdot \frac{z_2}{2} + N_1 \cdot \frac{z_1}{2}$$
$$V_2 = 0; \qquad V_3 = N_1$$
$$N_2 = 0; \qquad N_3 = V_1$$

$$M_2 = 0.5 \cdot \left(-M_1 + V_1 \cdot \frac{z_2}{2} + N_1 \cdot \frac{z_1}{2} \right)$$
$$M_3 = 0.5 \cdot \left(-M_1 + V_1 \cdot \frac{z_2}{2} + N_1 \cdot \frac{z_1}{2} \right)$$
$$V_2 = V_3 = N_1 / 2;$$
$$N_2 = N_3 = V_1 / 2$$

Global equilibrium of the node as assumed in PROFIS Rebar

It is important to realize that the checks made by PROFIS Rebar are ONLY for the efforts introduced by the loading of the new concrete part. If the existing part is already loaded by other efforts, the total loading needs to be considered separately by the designer.

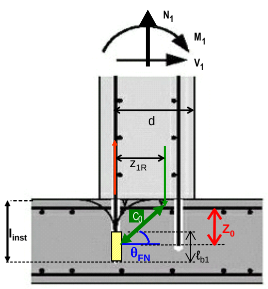
In analogy to the global equilibrium of the node, PROFIS Rebar makes the distinction between opening and closing moment on the basis of the length of the existing perpendicular parts on each side of the new part. The case where both perpendicular members have the same length is considered as opening moment since this yields results on the safe side.



opening moment | opening moment | closing moment

Figure 6: opening and closing moments assumed in PROFIS Rebar

Embedment depth:



- PROFIS Rebar will check the maximum possible setting depth according to ETAG 001, part 5: $h_{ef,max}=h_{member}-\max(2d_0; 30mm)$
- If $h_{ef,max}$ results in a strut angle $\theta_{FN}>60°$, the drill hole length will be selected such that $\theta_{FN}=60°$
- If $h_{ef,max}$ results in a strut angle $30° \leq \theta_{FN} \leq 60°$, the drill hole length will be $h_{ef,max}$
- If $h_{ef,max}$ results in a strut angle $\theta_{FN}<30°$, the strut angle is too small and the model provides no solution.

4 References

[1] EN 1992-1-1:2011 Part 1-1: General rules and rules for buildings (Eurocode 2); January 2011

[2] EOTA: Technical Report TR 023, Assessment of post- installed rebar connections, Edition Nov. 2006

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[4] EOTA: ETAG 001, part 5. bonded anchors. Brussels, 2008.

[5] Kunz, J., Muenger F.: Splitting and Bond Failure of Post-Installed Rebar Splices and Anchorings. Bond in Concrete. fib, Budapest, 20 to 22 November 2002

[6] Hamad, B.S., Al-Hammoud, R., Kunz, J.: Evaluation of Bond Strength of Bonded-In or Post-Installed Reinforcement. ACI Structural Journal, V. 103, No. 2, March – April 2006.

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[8] HIT-Rebar – Design of bonded-in reinforcement using Hilti HIT-HY 150 or Hilti HIT-RE 500 for predominantly cyclic (fatigue) loading. Hilti Corporate Research, TWU-TPF-06a/02-d, Schaan 2002

[9] Randl, N: Expertise zu Sonderfällen der Bemessung nachträglich eingemörtelter Bewehrungsstäbe; Teile A, B, C. University of Applied Science of Carinthia. Spittal (Austria), 2011.

[10] CSTB: Document Technique d'Application 3/10-649 Relevant de l'Agrément Technique Europeen ATE 09/0295. Marne la Valée (France), June 2010.

Eurocode 8: Auslegung von Bauwerken gegen Erdbeben – Teil 1: Grundlagen, Erdbebeneinwirkungen und Regeln für Hochbauten; Deutsche Fassung EN 1998-1:2004. April 2006

5 Installation of Post-Installed Reinforcement

5.1 Joint to be roughened

The model of inclined compressive struts is used to transfer the shear forces through the construction joint at the interface between concrete cast at different times. Therefore a rough interface is required to provide sufficient cohesion in the construction joint {Clause 6.2.5(2), EC2: EN 1992-1-1:2004}. Rough means a surface with at least 3 mm roughness (R_t > 3 mm), achieved by raking, exposing the aggregate or other methods giving an equivalent behaviour.

5.2 Drilling

5.2.1 Standard Drilling

Injection anchor systems are used to fix reinforcement bars into concrete. Fast cure products are generally used with rebar diameters up to 25mm and moderate hole depths of up to about 1.5m, depending on the ambient temperature. Slow cure systems can be used with larger bar diameters and deep holes: The deepest rebar fixing to our knowledge so far was 12m. As rebar embedment lengths are usually much longer than with standard anchor applications, there are a number of additional system components helping to provide high quality of installation:

Drilling aid: Rebars are usually situated close to the concrete surface. If a long drill hole is not parallel to the surface, the inner lever arm of the structure will decrease along the hole if the deviation is away from the surface and even worse, the hole may penetrate the concrete surface or result in insufficient cover if the deviation is towards the surface. According to the rebar approvals, the deviations to be taken into account are 0.08 times the hole length (4.6°) for compressed air drilling, 0.06 times the hole length (3.4°) with hammer drilling and 0.02 times the hole length (1.1°) if a drilling aid is used (optical help or drilling rig, see fig. 11).

Figure 2.9: drilling aids

Depending on the required minimum concrete cover in every section of the post-installed rebar, the minimum “edge distance” at the start of the drilled hole is then:

$c_{min} = 50 + 0{,}08\ l_v \geq 2\phi$ [mm] for compressed air drilled holes

$c_{min} = 30 + 0{,}06\ l_v \geq 2\ \phi$ [mm] for hammer drilled holes

$c_{min} = 30 + 0{,}02\ l_v \geq 2\ \phi$ [mm] if a drilling aid is used

5.3 Hole cleaning

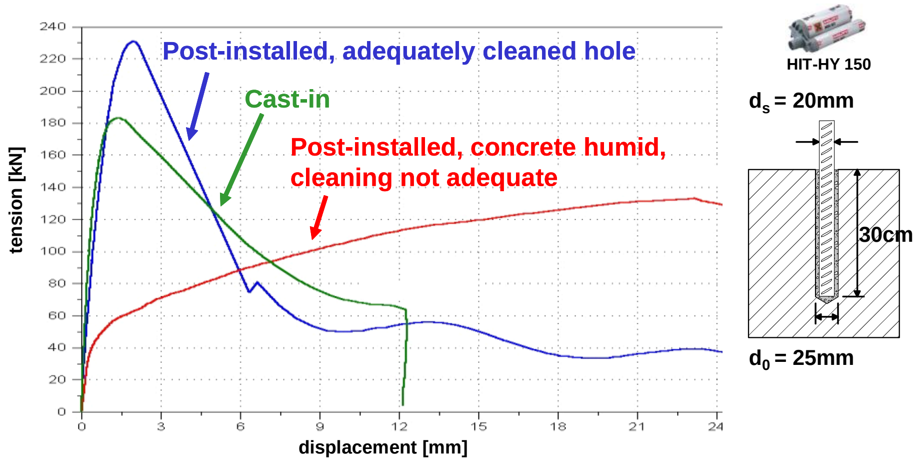
The holes should be blown out using compressed, oil free air. Extension tubes and air nozzles directing the air to the hole walls should be used, if holes are deeper than 250mm.

Deeper holes than 250mm should as well be brushed by machine brushing using steel brushes and brush extensions:

Screw the round steel brush HIT-RB to the 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.

The rebar approvals (ETA) give detailed information on the cleaning procedure for each product.

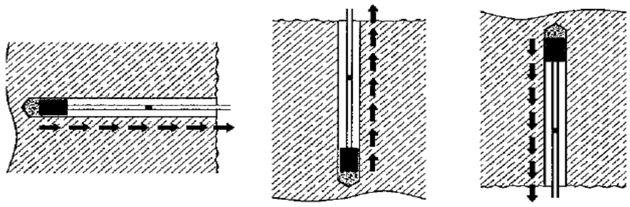
The following figure underlines the importance of adequate hole cleaning: For drilled holes cleaned according to the instruction, the post-installed bar (blue line) shows higher stiffness and higher resistance than the equivalent cast-in bar. With substandard cleaning (red line), however, stiffness and resistance are clearly below those of the cast-in bar.



5.4 Injection and bar installation

It is important that air bubbles are avoided during the injection of the adhesive: when the bar is installed later, the air will be compressed and may eject part of the adhesive from the hole when the pressure exceeds the resistance of the liquid adhesive, thus endangering the installer. Moreover, the presence of air may prevent proper curing of the adhesive.

In order to reach the bottom of the drilled holes, mixer extensions shall be used. The holes should be filled with HIT to about 2/3. Marking the extension tubes at 1/3 of the hole length from the tip will help to dispense the correct amount of adhesive. Piston plugs ensure filling of the holes without air bubbles.



After injecting the HIT, the rebars should be inserted into the hole with a slight rotating movement. When rebars are installed overhead, dripping cups OHC can be used to prevent excess HIT from falling downward in an uncontrolled manner.

5.5 Installation instruction

For correct installation and the linked products, please refer to the detailed “Hilti HIT Installation guide for fastenings in concrete”, Hilti Corp., Schaan W3362 1007 as well as to the product specific rebar approvals.

5.6 Mortar consumption estimation for post-installed rebars

Hilti suplies a perfectly matched, quick and easy system for making reliable post-installed rebar connections. When embedment depth and rebar diameter are known, just calculate the number of Hilti HIT cartridges needed.

In the following table please find the quantity of mortar required for one fastening point, in ml. In this estimation, we consider 80% of the mortar is used for fastening, the rest being used for the first pull outs and waste.

The greyed area should not be used since it is not in accordance with the design codes requirering a depth of at least 10 drilling diameters.

Mortar consumption estimation for post-installed rebars (in ml)

Rebar Ø d_s [mm]	8	10	12	14	16	18	20	22	24
Drill bit Ø d_0 [mm]	12	14	16	18	20	22	25	28	32
Hole depth [mm]									
100	8,0	9,6	11,2	12,8	14,3	15,9	22,2	29,3	43,4
120	9,6	11,5	13,4	15,3	17,2	19,1	26,6	35,2	52,1
140	11,2	13,4	15,6	17,8	20,1	22,3	31,0	41,1	60,8
160	12,8	15,3	17,9	20,4	22,9	25,5	35,4	46,9	69,5
180	14,4	17,2	20,1	22,9	25,8	28,6	39,9	52,8	78,2
200	16,0	19,2	22,3	25,5	28,7	31,8	44,3	58,7	86,9
240	19,2	23,0	26,8	30,6	34,4	38,2	53,2	70,4	104,2
260	20,8	24,9	29,0	33,1	37,3	41,4	57,6	76,3	112,9
280	22,4	26,8	31,3	35,7	40,1	44,6	62,0	82,1	121,6
300	24,0	28,7	33,5	38,2	43,0	47,7	66,5	88,0	130,3
320	25,6	30,7	35,7	40,8	45,9	50,9	70,9	93,9	139,0
340	27,2	32,6	38,0	43,3	48,7	54,1	75,3	99,7	147,7
360	28,8	34,5	40,2	45,9	51,6	57,3	79,8	105,6	156,4
380	30,4	36,4	42,4	48,4	54,5	60,5	84,2	111,5	165,1
400	32,0	38,3	44,7	51,0	57,3	63,7	88,6	117,3	173,7
450	36,0	43,1	50,2	57,4	64,5	71,6	99,7	132,0	195,5
500	40,0	47,9	55,8	63,7	71,7	79,6	110,8	146,7	217,2
550	44,0	52,7	61,4	70,1	78,8	87,5	121,8	161,3	238,9
600	48,0	57,5	67,0	76,5	86,0	95,5	132,9	176,0	260,6
650	52,0	62,3	72,6	82,9	93,1	103,4	144,0	190,7	282,3
700	56,0	67,1	78,1	89,2	100,3	111,4	155,1	205,3	304,0
750	60,0	71,9	83,7	95,6	107,5	119,4	166,1	220,0	325,8
800	64,0	76,6	89,3	102,0	114,6	127,3	177,2	234,7	347,5
850	68,0	81,4	94,9	108,3	121,8	135,3	188,3	249,3	369,2
900	72,0	86,2	100,5	114,7	129,0	143,2	199,4	264,0	390,9
950	76,0	91,0	106,1	121,1	136,1	151,2	210,4	278,7	412,6
1000	80,0	95,8	111,6	127,5	143,3	159,1	221,5	293,3	434,3
1200	96,0	115,0	134,0	153,0	172,0	191,0	265,8	352,0	521,2
1400	111,9	134,1	156,3	178,4	200,6	222,8	310,1	410,7	608,1
1600	127,9	153,3	178,6	203,9	229,3	254,6	354,4	469,3	694,9
1800	143,9	172,4	200,9	229,4	257,9	286,4	398,7	528,0	781,8
2000	159,9	191,6	223,3	254,9	286,6	318,3	443,0	586,7	868,7
2500	199,9	239,5	279,1	318,7	358,2	397,8	553,8	733,3	1085,8
3000	239,9	287,4	334,9	382,4	429,9	477,4	664,6	880,0	1303,0
3200	255,9	306,5	357,2	407,9	458,5	509,2	708,9	938,7	1389,9

25	26	28	30	32	34	36	40	Rebar Ø d_s [mm]
32	35	35	37	40	45	45	55	Drill bit Ø d_0 [mm]
								Hole depth [mm]
38,8	53,1	42,9	45,6	55,8	83,6	70,4	136,4	100
46,6	63,7	51,5	54,7	67,0	100,3	84,5	163,7	120
54,3	74,3	60,0	63,8	78,1	117,0	98,6	190,9	140
62,1	84,9	68,6	73,0	89,3	133,8	112,7	218,2	160
69,9	95,5	77,2	82,1	100,4	150,5	126,7	245,5	180
77,6	106,1	85,8	91,2	111,6	167,2	140,8	272,8	200
93,2	127,4	102,9	109,4	133,9	200,6	169,0	327,3	240
100,9	138,0	111,5	118,6	145,1	217,4	183,1	354,6	260
108,7	148,6	120,1	127,7	156,2	234,1	197,1	381,9	280
116,5	159,2	128,7	136,8	167,4	250,8	211,2	409,1	300
124,2	169,8	137,2	145,9	178,6	267,5	225,3	436,4	320
132,0	180,4	145,8	155,0	189,7	284,3	239,4	463,7	340
139,7	191,0	154,4	164,2	200,9	301,0	253,5	491,0	360
147,5	201,7	163,0	173,3	212,0	317,7	267,6	518,3	380
155,3	212,3	171,6	182,4	223,2	334,4	281,6	545,5	400
174,7	238,8	193,0	205,2	251,1	376,2	316,8	613,7	450
194,1	265,3	214,4	228,0	279,0	418,0	352,0	681,9	500
213,5	291,9	235,9	250,8	306,9	459,8	387,2	750,1	550
232,9	318,4	257,3	273,6	334,8	501,6	422,4	818,3	600
252,3	344,9	278,8	296,4	362,7	543,4	457,6	886,5	650
271,7	371,5	300,2	319,2	390,6	585,2	492,9	954,7	700
291,1	398,0	321,7	342,0	418,5	627,0	528,1	1022,9	750
310,5	424,5	343,1	364,8	446,4	668,8	563,3	1091,0	800
329,9	451,1	364,5	387,6	474,3	710,6	598,5	1159,2	850
349,3	477,6	386,0	410,4	502,2	752,4	633,7	1227,4	900
368,7	504,1	407,4	433,2	530,1	794,2	668,9	1295,6	950
388,2	530,7	428,9	456,0	558,0	836,0	704,1	1363,8	1000
465,8	636,8	514,6	547,2	669,6	1003,2	844,9	1636,6	1200
543,4	742,9	600,4	638,4	781,2	1170,4	985,7	1909,3	1400
621,0	849,0	686,2	729,6	892,8	1337,6	1126,5	2182,1	1600
698,7	955,2	772,0	820,8	1004,4	1504,8	1267,3	2454,9	1800
776,3	1061,3	857,7	912,0	1116,0	1672,0	1408,1	2727,6	2000
970,4	1326,6	1072,2	1140,0	1395,0	2090,0	1760,2	3409,5	2500
1164,5	1592,0	1286,6	1368,0	1674,0	2508,1	2112,2	4091,4	3000
1242,1	1698,1	1372,4	1459,2	1785,6	2675,3	2253,0	4364,2	3200

Hilti HIT-RE 500-SD mortar with rebar (as post-installed connection)

Injection mortar system		Benefits
	Hilti HIT-RE 500-SD 330 ml foil pack (also available as 500 ml and 1400 ml foil pack) Statik mixer Rebar	- 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 - odourless epoxy - suitable for embedment length till 3200 mm

Concrete	Fire resistance	Diamond drilled holes	European Technical Approval	Corossion tested	PROFIS Rebar design software

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-09/0295 / 2013-05-09
Application document	CSTB, Marne la Vallée	DTA-3/10-649 / 2010-06-17
European technical approval	DIBt, Berlin	ETA-07/0260 / 2013-06-26
Assessment	MFPA Leipzig GmbH	GS 3.2/09-122 / 2010-05-26

a) All data given in this section according to the approvals mentioned above, ETA-09/0295 issue 2013-05-09 and ETA-07/0260 issue 2013-06-26.

Materials

Reinforcmenent bars according to EC2 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, $f_{R,min}$	Nominal bar size (mm) 8 to 12 > 12	 0,040 0,056	

Setting details

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

Curing time for general conditions

Data according ETA-09/0295, issue 2013-05-09			
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} < 10 °C	2 h	18 h	72 h
10 °C ≤ T_{BM} < 15 °C	90 min	12 h	48 h
15 °C ≤ T_{BM} < 20 °C	30 min	9 h	24 h
20 °C ≤ T_{BM} < 25 °C	20 min	6 h	12 h
25 °C ≤ T_{BM} < 30 °C	20 min	5 h	12 h
30 °C ≤ T_{BM} < 40 °C	12 min	4 h	8 h
T_{BM} = 40 °C	12 min	4 h	4 h

For dry concrete curing times may be reduced according to the following table. For installation temperatures below +5 °C all load values have to be reduced according to the load reduction factors given below.

Curing time for dry concrete

Additional Hilti technical data				
Temperature of the base material	Working time in which rebar can be inserted and adjusted t_{gel}	Initial curing time $t_{cure,ini}$	Reduced curing time before rebar can be fully loaded t_{cure}	Load reduction factor
T_{BM} = -5 °C	4 h	36 h	72 h	0,6
T_{BM} = 0 °C	3 h	25 h	50 h	0,7
T_{BM} = 5 °C	2 ½ h	18 h	36 h	1
T_{BM} = 10 °C	2 h	12 h	24 h	1
T_{BM} = 15 °C	1 ½ h	9 h	18 h	1
T_{BM} = 20 °C	30 min	6 h	12 h	1
T_{BM} = 30 °C	20 min	4 h	8 h	1
T_{BM} = 40 °C	12 min	2 h	4 h	1

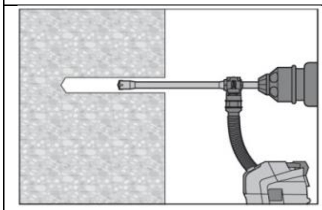
Setting instruction

Safety Regulations:

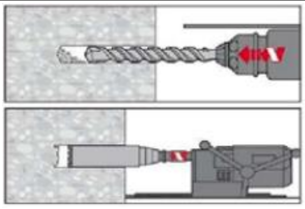
Review the Material Safety Data Sheet (MSDS) before use for proper and safe handling!
Wear well-fitting protective goggles and protective gloves when working with Hilti HIT-RE 500-SD.
Important: Observe the installation instruction of the manufacturer provided with each foil pack.

1. Drill hole

Note: Before drilling, remove carbonized concrete; clean contact areas (see Annex B1)
In case of aborted drill hole the drill hole shall be filled with mortar.



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

Hammer drill (HD)

Compressed air drill (CA)

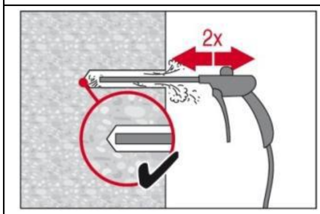
Diamond core wet (DD) and dry (PCC)

3. Bore hole cleaning

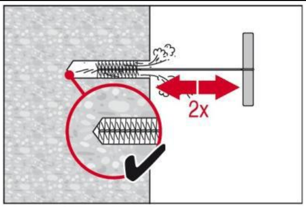
(Not needed with Hilti TE-CD and Hilti TE-YD drill bit)
The borehole must be free of dust, debris, water, ice, oil, grease and other contaminants prior to mortar injection.

Just before setting an anchor, the bore hole must be free of dust and debris by one of two cleaning methods described below

Compressed air cleaning (CAC)

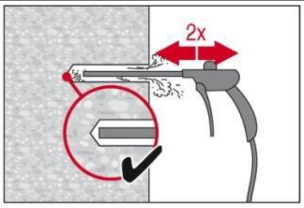


Blowing
2 times from the back of the hole with oil-free compressed air (min. 6 bar at 100 litres per minute (LPM)) until return air stream is free of noticeable dust. Bore hole diameter ≥ 32 mm the compressor must supply a minimum air flow of 140 m³/hour.
If required use additional accessories and extensions for air nozzle and brush to reach back of hole.



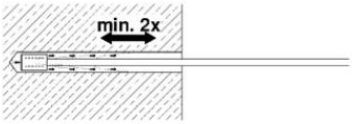
Brushing

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 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.



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.

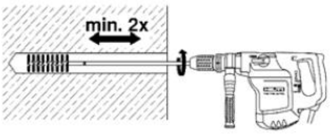


Deep boreholes – Blowing

For boreholes deeper than 250mm (for Ø=8mm – 12mm) or deeper than 20 Ø (for Ø>12mm) use the appropriate air nozzle Hilti HIT-DL

Safety tip: Do not inhale concrete dust.

The application of the dust collector Hilti HIT-DRS is recommended.



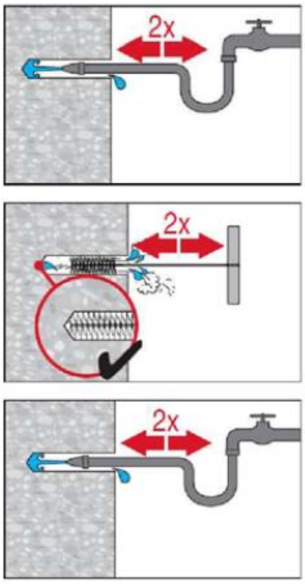
Deep boreholes – Brushing

For boreholes deeper than 250 mm (for Ø=8mm – 12mm) or deeper than 20 Ø (for Ø>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 operational slowly.
- Start brushing operation once brush is inserted in borehole.

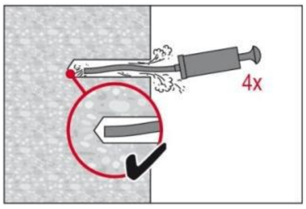
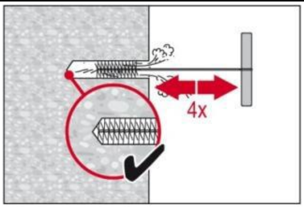
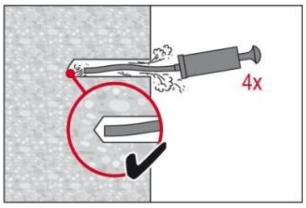


In addition for wet diamond coring (DD):

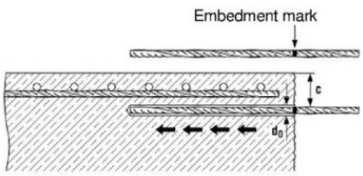
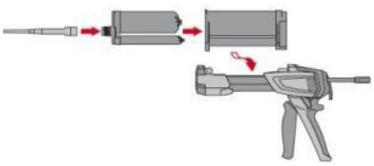
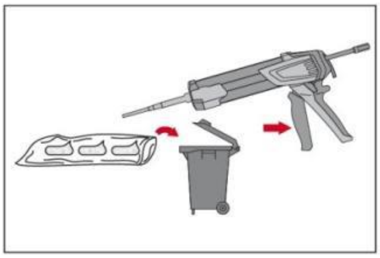
For wet diamond coring please observe the following steps in addition **prior to** compressed air cleaning:

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.

Manual Cleaning (MC) Manual cleaning is permitted for hammer drilled boreholes up to hole diameters $d_0 \leq$ 20mm and depths ℓ_v resp. $\ell_{e,ges.} \leq$ 160mm.

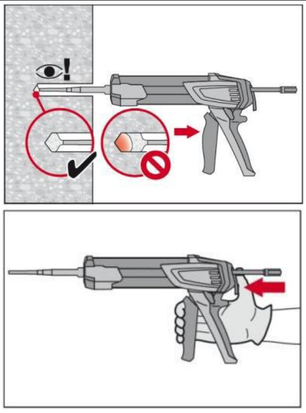
 	Blowing 4 strokes with Hilti blow-out pump from the back of the hole until return air stream is free of noticeable dust.
 	Brushing 4 times with the specified brush HIT_RB size (brush Ø ≥ borehole Ø) by inserting the round steel wire brush to the back of the hole with a twisting motion. The brush shall 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.
 	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 (MC) Hilti hand pump recommended for blowing out bore hole with diameters d<20mm and bore hole depth h_0<160mm

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 tapte) **,** ℓ_v Insert rebar in borehole, to verify hole and setting depth ℓ_v resp. $\ell_{e,ges}$
	- Observe the Instruction for Use of the dispenser and the mortar. - Tightly attach Hilti HIT-RE-M mixing nozzle to foil pack manifold. - Insert foil pack into foil pack holder and swing holder into the 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 decribed 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,

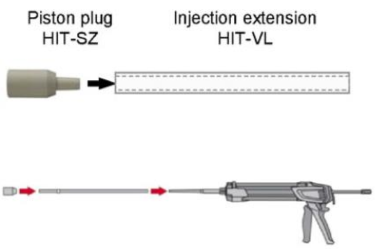
4.Inject mortar into borehole Forming air pockets be avoided

4.1 Injection method for borehole depth ≤ 250 mm

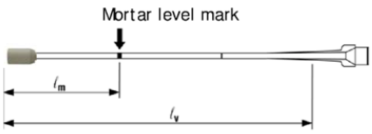


Inject the mortar from the back of the hole towards the front and slowly withdraw the mixing nozzle step by step after each trigger pull.
Fill holes approximately 2/3 full, or as required to ensure that the annular gap between the rebar and the concrete is completely filled with adhesive over the embedment length.
After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle.

4.2 Injection method for borehole depth > 250 mm or overhead application

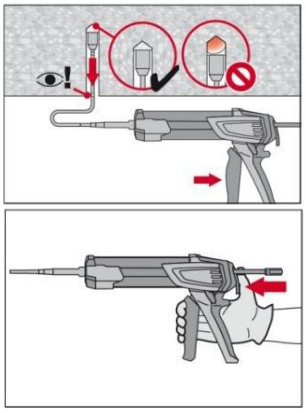


Assemble mixing nozzle HIT-RE-M, extension(s) and piston plug HIT-SZ.
For combinations of several injection extansions use coupler HIT-VL K. A substitution of the injection extansion for a plastic hose or a combination of both is permitted.
The combination of HIT-SZ piston plug with HIT-VL 16 pipe and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



Mark the required mortar level ℓ_m and embedment depth ℓ_b resp.

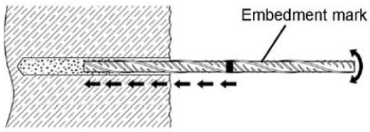
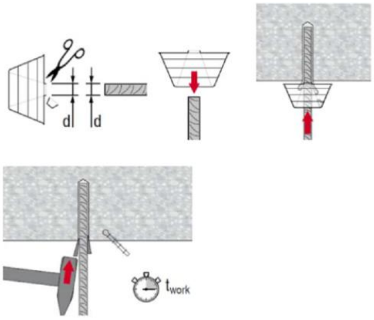
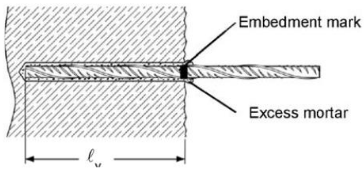
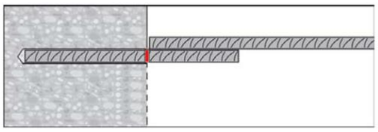
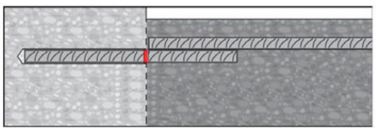
$\ell_{e,ges}$ with tape or marker on the injection extension.



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 morat 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.

5.Insert rebar	
	For easy installation insert the rebar slowly twisted into the boreholeuntil the embedment mark is at the concrete surface level.
	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.
	After installing the rebar the annular gap must be completely filled with mortar.
	After installing the rebar the annular gap must be completely filled with mortar. Proper installation can be verified when: Desired anchoring embedment is reached ℓ_v: embedment mark at concrete surface. Excess mortar flows out of the borehole after the rebar has been fully inserted until the embedment mark.
	Full load may be applied only after the curing time "t_{cure}" has elapsed.

Fitness for use

Some creep tests have been conducted in accordance with ETAG guideline 001 part 5 and TR 023 in the following conditions : in dry environnement at 50 °C during 90 days.
These tests show an excellent behaviour of the post-installed connection made with HIT-RE 500-SD: 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 keton (MEK)		+
	Trichlor ethylene		+
	Xylol (mixture)	+	
Products from job site	Concrete plasticizer	+	
	Diesel	+	
	Engine oil	+	
	Petrol	+	
	Oil for form work	+	
Environnement	Sslt water	+	
	De-mineralised water	+	
	Sulphurous atmosphere (80 cycles)	+	

Electrical Conductivity

HIT-RE 500-SD 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 realize 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	
			Wet (DD)	Dry (PCC)
8	12 (10 a))	-	12 (10 a))	-
10	14 (12 a))	-	14 (12 a))	-
12	16 (14 a))	17	16 (14 a))	-
14	18	17	18	-
16	20	20	20	-
18	22	22	22	-
20	25	26	25	-
22	28	28	28	-
24	32	32	32	35
25	32	32	32	35
26	35	35	35	35
28	35	35	35	35
30	37	35	37	35
32	40	40	40	47
34	45	42	42	47
36	45	45	47	47
40	55	57	52	52

a) Max. installation length l = 250 mm.

Basic design data for rebar design according to rebar ETA

Bond strength in N/mm² according to ETA 09/0295 for good bond conditions for hammer drilling, compressed air drilling, dry diamond core drilling

Rebar (mm)	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 - 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

Bond strength in N/mm² according to ETA 09/0295 for good bond conditions for wet diamond core drilling

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

Pullout design bond strength for Hit Rebar design

Design bond strength in N/mm² according to ETA 07/0260 (values in table are design values, $f_{bd,po} = \tau_{Rk}/\gamma_{Mp}$

<table>
<tr><td colspan="16">Hammer or compressed air drilling.
Water saturated, water filled or submerged hole.
Uncracked concrete C20/25.</td></tr>
<tr><td rowspan="3">temperature range</td><td colspan="15">Bar diameter</td></tr>
<tr><td colspan="13">Data according to ETA 04/0027</td><td colspan="2">Hilti tech data</td></tr>
<tr><td>8</td><td>10</td><td>12</td><td>14</td><td>16</td><td>20</td><td>22</td><td>24</td><td>25</td><td>26</td><td>28</td><td>30</td><td>32</td><td>36</td><td>40</td></tr>
<tr><td>I: 40°C/24°C</td><td colspan="3">7,1</td><td colspan="3">6,7</td><td colspan="7">6,2</td><td>5,2</td><td>4,8</td></tr>
<tr><td>II: 58°C/35°C</td><td colspan="4">5,7</td><td colspan="6">5,2</td><td colspan="3">4,8</td><td>4,3</td><td>3,8</td></tr>
<tr><td>III: 70°C/43°C</td><td colspan="5">3,3</td><td colspan="5">3,1</td><td colspan="3">2,9</td><td colspan="2">2,4</td></tr>
</table>

Increasing factor in non-cracked concrete: $f_{B,p}=(f_{cck}/25)^{0,1}$ (f_{cck}: characteristic compressive strength on cube)

Additional Hilti Technical Data:

If the concrete is dry (not in contact with water before/during installation and curing), the pullout design bond strength may be increased by 20%.

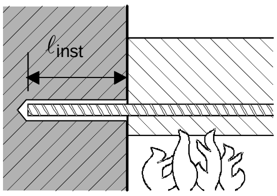
If the hole was produced by wet diamond coring, the pullout design bond strength has to be reduced by 30%.

Reduction factor for splitting with large concrete cover: δ = 0,306 (Hilti additional data)

Fire Resistance

according to MFPA Leipzig, report GS 3.2/09-122

a) fire situation “anchorage”



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

Bar ∅	Drill hole ∅	Max. $F_{s,T}$	ℓ_{inst}	Fire resistance of bar in [kN]					
[mm]	[mm]	[kN]	[mm]	R30	R60	R90	R120	R180	R240
8	10	16,19	65	1,38	0,57	0,19	0,05	0	0
			80	2,35	1,02	0,47	0,26	0	0
			95	3,87	1,68	0,88	0,55	0,12	0
			115	7,30	3,07	1,71	1,14	0,44	0,18
			150	16,19	8,15	4,59	3,14	1,41	0,8
			180		16,19	9,99	6,75	2,94	1,7
			205			16,19	12,38	5,08	2,86
			220				16,19	6,95	3,82
			265					16,19	8,57
			305						16,19
10	12	25,29	80	2,94	1,27	0,59	0,33	0	0
			100	5,68	2,45	1,31	0,85	0,24	0
			120	10,66	4,44	2,48	1,68	0,68	0,31
			140	17,57	7,76	4,38	2,99	1,33	0,73
			165	25,29	15,06	8,5	5,79	2,58	1,5
			195		25,29	17,63	12,18	5,12	2,93
			220			25,29	20,66	8,69	4,78
			235				25,29	11,8	6,30
			280					25,29	13,86
			320						25,29
12	16	36,42	95	5,80	2,52	1,32	0,83	0,18	0
			120	12,79	5,33	2,97	2,01	0,82	0,37
			145	23,16	10,68	6,02	4,12	1,84	1,03
			180	36,42	24,29	14,99	10,12	4,41	2,55
			210		36,42	27,38	20,65	8,47	4,74
			235			36,42	31,01	14,16	7,56
			250				36,42	19,13	9,89
			295					36,42	21,43
			335						36,42
14	18	49,58	110	10,92	4,65	2,55	1,70	0,61	0,20
			140	24,60	10,87	6,13	4,19	1,86	1,03
			170	39,12	23,50	13,55	9,20	4,07	2,37
			195	49,58	35,6	24,69	17,05	7,17	4,10
			225		49,58	39,20	31,34	13,48	7,34
			250			49,58	43,44	22,32	11,54
			265				49,58	29,49	15,00
			310					49,58	31,98
			350						49,58

Bar ∅	Drill hole ∅	Max. $F_{s,T}$	ℓ_{inst}	Fire resistance of bar in [kN]					
[mm]	[mm]	[kN]	[mm]	R30	R60	R90	R120	R180	R240
16	**20**	**64,75**	130	22,59	9,42	5,30	3,61	1,56	0,80
			160	39,17	21,33	11,95	8,15	3,65	2,11
			190	55,76	37,92	24,45	17,25	7,35	4,22
			210	64,75	48,98	36,51	27,53	11,29	6,32
			240		64,75	53,10	44,12	20,88	11,04
			265			64,75	57,94	33,7	17,14
			280				64,75	42,0	22,17
			325					64,75	44,84
			365						64,75
20	**25**	**101,18**	160	48,97	26,67	14,93	10,18	4,56	2,64
			200	76,61	54,31	38,73	27,5	11,42	6,48
			240	101,18	81,96	66,37	55,15	26,10	13,8
			270		101,18	87,11	75,88	45,58	23,36
			295			101,18	93,16	62,86	35,72
			310				101,18	73,23	45,69
			355					101,18	76,79
			395						101,18
25	**30**	**158,09**	200	95,77	67,89	48,41	34,37	14,27	8,10
			250	138,96	111,09	91,60	77,51	39,86	20,61
			275	158,09	132,69	113,2	99,17	61,30	31,81
			305		158,09	139,12	125,09	87,22	52,79
			330			158,09	146,69	108,82	74,39
			345				158,09	121,77	87,34
			390					158,09	126,22
			430						158,09
32	**40**	**259,02**	255	183,40	147,72	122,78	104,82	56,35	28,80
			275	205,52	169,84	144,90	126,94	78,46	40,71
			325	259,02	225,13	200,19	182,23	133,75	89,68
			368		259,02	238,89	220,93	172,46	128,39
			380			259,02	243,05	194,58	150,51
			395				259,02	211,16	167,09
			440					259,02	216,86
			480						259,02
36	**42 - 46**	**327,82**	290	249,87	209,73	181,67	161,46	106,93	59,10
			325	293,41	253,27	225,21	205,01	150,47	100,89
			355	327,82	290,59	262,54	242,33	187,80	138,22
			385		327,82	299,86	279,65	225,12	175,54
			410			327,82	310,75	256,22	206,64
			425				327,82	274,88	225,30
			470					327,82	281,28
			510						327,82
40	**47**	**404,71**	320	319,10	274,50	243,33	220,87	160,28	105,19
			355	367,48	322,88	291,71	269,25	208,66	153,57
			385	404,71	364,35	333,18	310,72	250,13	195,04
			415		404,71	374,64	352,19	291,60	236,51
			440			404,71	386,75	326,16	271,07
			455				404,71	346,89	291,80
			500					404,71	354,01
			540						404,71

b) bar connection parallel to slab or wall surface exposed to fire

Max. bond stress, τ_T , 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.

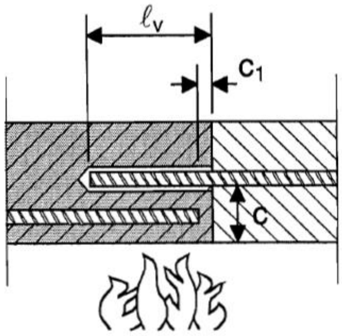
$F_{s,T} \leq (\ell_{inst} - c_f) \cdot \phi \cdot \pi \cdot \tau_T$ where: $(\ell_{inst} - c_f) \geq \ell_s$;

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

τ_T = bond stress when exposed to fire



Critical temperature-dependent bond stress, τ_c, concerning "overlap joint" for Hilti HIT-RE 500-SD 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>10</td><td>0</td><td rowspan="3">0</td><td rowspan="5">0</td><td rowspan="6">0</td><td rowspan="8">0</td><td rowspan="10">0</td></tr>
<tr><td>20</td><td>0,49</td></tr>
<tr><td>30</td><td>0,66</td></tr>
<tr><td>40</td><td>0,89</td><td>0,48</td></tr>
<tr><td>50</td><td>1,21</td><td>0,62</td></tr>
<tr><td>60</td><td>1,63</td><td>0,80</td><td>0,51</td></tr>
<tr><td>70</td><td>2,19</td><td>1,04</td><td>0,65</td><td>0,49</td></tr>
<tr><td>80</td><td>2,96</td><td>1,35</td><td>0,83</td><td>0,61</td></tr>
<tr><td>90</td><td>3,99</td><td>1,75</td><td>1,06</td><td>0,77</td><td>0,45</td></tr>
<tr><td>100</td><td>5,38</td><td>2,26</td><td>1,36</td><td>0,97</td><td>0,55</td></tr>
<tr><td>110</td><td>7,25</td><td>2,93</td><td>1,73</td><td>1,23</td><td>0,67</td><td>0,47</td></tr>
<tr><td>120</td><td>9,78</td><td>3,79</td><td>2,21</td><td>1,55</td><td>0,81</td><td>0,55</td></tr>
<tr><td>130</td><td rowspan="19">11,00</td><td>4,91</td><td>2,81</td><td>1,96</td><td>0,98</td><td>0,64</td></tr>
<tr><td>140</td><td>6,35</td><td>3,59</td><td>2,47</td><td>1,18</td><td>0,76</td></tr>
<tr><td>150</td><td>8,22</td><td>4,58</td><td>3,12</td><td>1,43</td><td>0,89</td></tr>
<tr><td>160</td><td>10,65</td><td>5,84</td><td>3,94</td><td>1,73</td><td>1,04</td></tr>
<tr><td>170</td><td rowspan="15">11,00</td><td>7,45</td><td>4,97</td><td>2,10</td><td>1,23</td></tr>
<tr><td>180</td><td>9,51</td><td>6,27</td><td>2,54</td><td>1,44</td></tr>
<tr><td>190</td><td rowspan="13">11,00</td><td>7,91</td><td>3,07</td><td>1,69</td></tr>
<tr><td>200</td><td>9,99</td><td>3,71</td><td>1,99</td></tr>
<tr><td>210</td><td rowspan="11">11,00</td><td>4,49</td><td>2,34</td></tr>
<tr><td>220</td><td>5,44</td><td>2,75</td></tr>
<tr><td>230</td><td>6,58</td><td>3,22</td></tr>
<tr><td>240</td><td>7,96</td><td>3,79</td></tr>
<tr><td>250</td><td>9,64</td><td>4,45</td></tr>
<tr><td>260</td><td rowspan="6">11,00</td><td>5,23</td></tr>
<tr><td>270</td><td>6,14</td></tr>
<tr><td>280</td><td>7,21</td></tr>
<tr><td>290</td><td>8,47</td></tr>
<tr><td>300</td><td>9,95</td></tr>
<tr><td>310</td><td>11,00</td></tr>
</table>

Basic design data for seismic rebar design

Bond strength $f_{bd,seism}$ in N/mm² according to DTA-3/10-649 for good bond conditions for hammer drilling, compressed air drilling, dry diamond core drilling

Rebar (mm)	Concrete class					
	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55
8	2,3	2,7	3,0	3,4	3,7	4,0
10	2,3	2,7	3,0	3,4	3,7	4,0
12	2,3	2,7	3,0	3,4	3,7	3,7
14	2,3	2,7	3,0	3,4	3,7	3,7
16	2,3	2,7	3,0	3,4	3,7	3,7
18	2,3	2,7	3,0	3,4	3,7	3,7
20	2,3	2,7	3,0	3,4	3,7	3,7
22	2,3	2,7	3,0	3,0	3,4	3,4
24	2,3	2,7	3,0	3,0	3,4	3,4
25	2,3	2,7	3,0	3,0	3,4	3,4
26	2,3	2,7	3,0	3,0	3,0	3,0
28	2,3	2,7	3,0	3,0	3,0	3,0
30	2,3	2,7	3,0	3,0	3,0	3,0
32	2,3	2,7	3,0	3,0	3,0	3,0
34	2,3	2,6	2,9	2,7	2,7	2,7
36	2,2	2,6	2,9	2,7	2,7	2,7
40	2,1	2,5	2,7	2,7	2,7	2,7

Minimum anchorage length

The multiplication factor for minimum anchorage length shall be considered as 1,0 for all drilling methods.

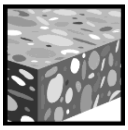
Minimum anchorage and lap lengths for C20/25; maximum hole lengths (ETA 09/0295)

Rebar		Hammer drilling, Compressed air drilling, Dry diamond coring drilling		Wet diamond coring drilling		
Diameter 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	492	510	738	765	3200
36	500	532	540	797	810	3200
40	500	616	621	925	932	3200

$l_{b,min}$ (8.6) and $l_{0,min}$ (8.11) are calculated for good bond conditions with maximum utilisation of rebar yield strength f_{yk} = 500 N/mm² and α_6 = 1,0

Hilti HIT-RE 500 mortar with rebar (as post-installed connection)

Injection mortar system		Benefits
	Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- suitable for non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - under water application - large diameter applications - high corrosion resistant - long working time at elevated temperatures - odourless epoxy
	Static mixer	
	Rebar	

							
Concrete	Fire resistance	Diamond drilled holes	European Technical Approval	DIBt approval	Drinking water appoved	Corossion tested	PROFIS Rebar design software

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-08/0105 / 2014-04-30
European technical approval	DIBt, Berlin	ETA-04/0027 / 2013-06-26
DIBt approval	DIBt, Berlin	Z-21.8-1790 / 2009-03-16
Fire test report	IBMB Braunschweig	3357/0550-5 / 2002-07-30
Assessment report (fire)	Warringtonfire	WF 327804/B / 2013-07-10

a) All data given in this section according to the approvals mentioned above, ETA-08/0105 issue on 2014-04-30 and ETA-04/0027 issue on 2013-06-26.

Materials

Reinforcmenent bars according to EC2 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, $f_{R,min}$	Nominal bar size (mm) 8 to 12 > 12	 0,040 0,056	

Setting details

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

Curing time for general conditions

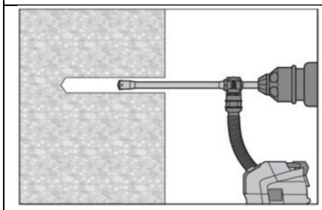
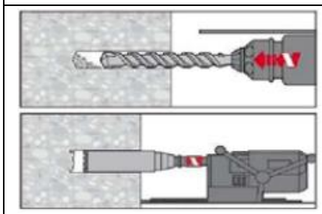
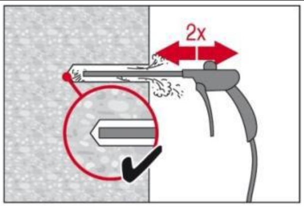
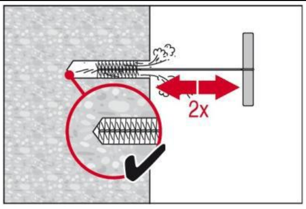
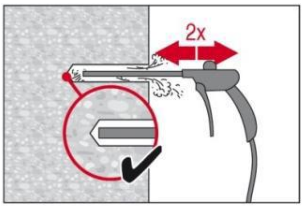
Data according ETA-08/0105, issue 2014-04-30			
Temperature of the base material	Working time in which rebar can be inserted and adjusted t_{gel}	Initial curing time $t_{cure,ini}$	Curing time before rebar can be fully loaded t_{cure}
5 °C ≤ T_{BM} < 10 °C	2 h	18 h	72 h
10 °C ≤ T_{BM} < 15 °C	90 min	12 h	48 h
15 °C ≤ T_{BM} < 20 °C	30 min	9 h	24 h
20 °C ≤ T_{BM} < 25 °C	20 min	6 h	12 h
25 °C ≤ T_{BM} < 30 °C	20 min	5 h	12 h
30 °C ≤ T_{BM} < 40 °C	12 min	4 h	8 h
T_{BM} = 40 °C	12 min	4 h	4 h

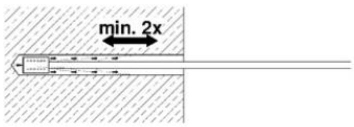
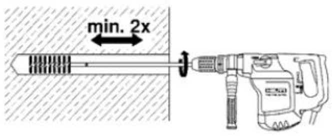
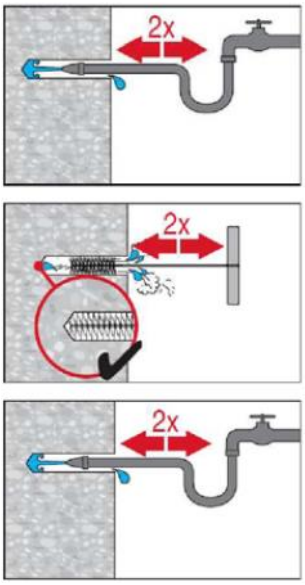
For dry concrete curing times may be reduced according to the following table. For installation temperatures below +5 °C all load values have to be reduced according to the load reduction factors given below.

Curing time for dry concrete

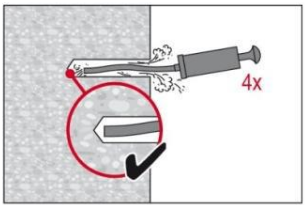
Additional Hilti technical data				
Temperature of the base material	Working time in which rebar can be inserted and adjusted t_{gel}	Initial curing time $t_{cure,ini}$	Reduced curing time before rebar can be fully loaded t_{cure}	Load reduction factor
T_{BM} = -5 °C	4 h	36 h	72 h	0,6
T_{BM} = 0 °C	3 h	25 h	50 h	0,7
T_{BM} = 5 °C	2 ½ h	18 h	36 h	1
T_{BM} = 10 °C	2 h	12 h	24 h	1
T_{BM} = 15 °C	1 ½ h	9 h	18 h	1
T_{BM} = 20 °C	30 min	6 h	12 h	1
T_{BM} = 30 °C	20 min	4 h	8 h	1
T_{BM} = 40 °C	12 min	2 h	4 h	1

Setting instruction

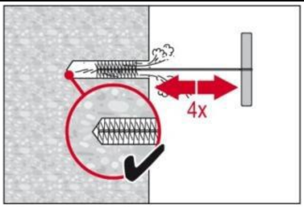
Safety Regulations: 	Review the Material Safety Data Sheet (MSDS) before use for proper and safe handling! Wear well-fitting protective goggles and protective gloves when working with Hilti HIT-RE 500. Important: Observe the installation instruction of the manufacturer provided with each foil pack.
1. Drill hole	Note: Before drilling, remove carbonized concrete; clean contact areas (see Annex B1) In case of aborted drill hole the drill hole shall be filled with mortar.
	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 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 the hole to the required embedment depth using a hammer-drill with carbid drill bit set in rotation hammer mode, a compressed air drill or a diamond core machine. Hammer drill (HD)  Compressed air drill (CA)  Diamond core wet (DD) and dry (PCC) 
4. Bore hole cleaning	(Not needed with Hilti TE-CD and Hilti TE-YD drill bit) The borehole must be free of dust, debris, water, ice, oil, grease and other contaminants prior to mortar injection. Just before setting an anchor, the bore hole must be free of dust and debris by one of two cleaning methods described below
Compressed air cleaning (CAC)	
	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. If required use additional accessories and extensions for air nozzle and brush to reach back of hole.
	Brushing 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 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.
	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 Ø=8mm – 12mm) or deeper than 20 Ø (for Ø>12mm) use the appropriate air nozzle Hilti HIT-DL Safety tip: Do not inhale concrete dust. The application of the dust collector Hilti HIT-DRS is recommended.
 	Deep boreholes – Brushing For boreholes deeper than 250 mm (for Ø=8mm – 12mm) or deeper than 20 Ø (for Ø>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 operational slowly. - Start brushing operation once brush is inserted in borehole.
 	In addition for wet diamond coring (DD): For wet diamond coring please observe the following steps in addition **prior to** 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.

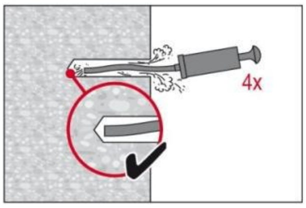
Manual Cleaning (MC) Manual cleaning is permitted for hammer drilled boreholes up to hole diameters $d_0 \leq$ 20mm and depths ℓ_v resp. $\ell_{e,ges.}$ ≤ 160mm.



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 HIT_RB size (brush Ø ≥ borehole Ø) 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.

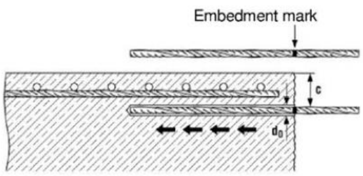


Blowing
4 strokes with Hilti blow-out pump from the back of the hole until return air stream is free of noticeable dust.

Manual Cleaning (MC)

Hilti hand pump recommended for blowing out bore hole with diameters d<20mm and bore hole depth h_0<160mm

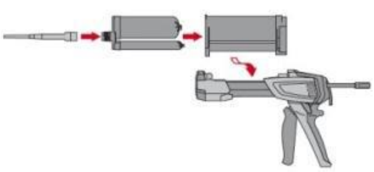
3.Rebar preparation and foil pack preparation



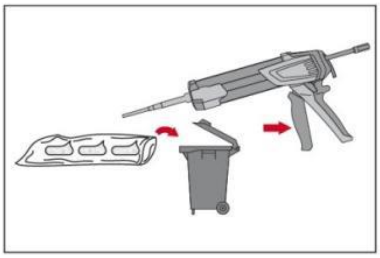
Before use, make sure the rebar is dry and free of oil or other residue.

Mark the embedment depth on the rebar. (e.g. with tapte) **,** ℓ_v

Insert rebar in borehole, to verify hole and setting depth ℓ_v resp. $\ell_{e,ges}$



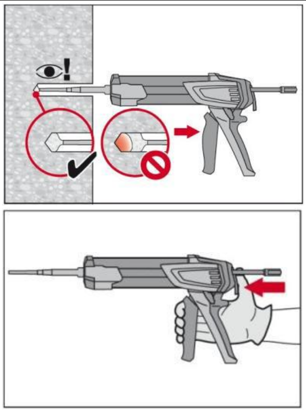
- Observe the Instruction for Use of the dispenser and the mortar.
- Tightly attach Hilti HIT-RE-M mixing nozzle to foil pack manifold.
- Insert foil pack into foil pack holder and swing holder into the dispenser.



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 decribed 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,

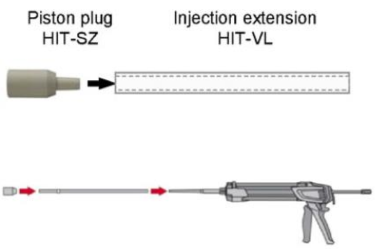
4.Inject mortar into borehole Forming air pockets be avoided

4.1 Injection method for borehole depth ≤ 250 mm

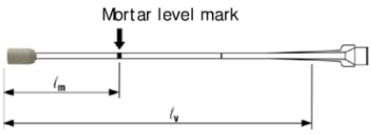


Inject the mortar from the back of the hole towards the front and slowly withdraw the mixing nozzle step by step after each trigger pull.
Fill holes approximately 2/3 full, or as required to ensure that the annular gap between the rebar and the concrete is completely filled with adhesive over the embedment length.
After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle.

4.2 Injection method for borehole depth > 250 mm or overhead application

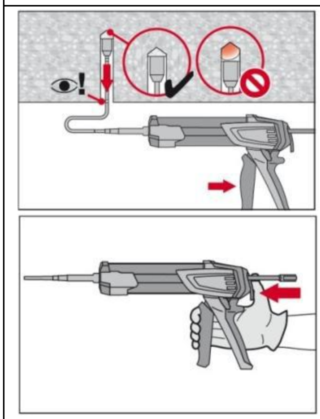


Assemble mixing nozzle HIT-RE-M, extension(s) and piston plug HIT-SZ.
For combinations of several injection extansions use coupler HIT-VL K. A substitution of the injection extansion for a plastic hose or a combination of both is permitted.
The combination of HIT-SZ piston plug with HIT-VL 16 pipe and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



Mark the required mortar level ℓ_m and embedment depth ℓ_b resp.

$\ell_{e,ges}$ with tape or marker on the injection extension.

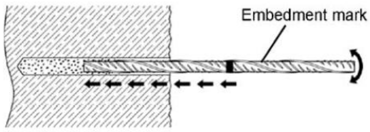


Insert piston plug to back of the hole. Begin injection allowing the pressure of the injected adhesive mortar to push the piston plug towards the front of the hole.
Fill holes approximately 2/3 full, or as required to ensure that the annular gap between the rebar and the concrete is completely filled with adhesive over the embedment length.

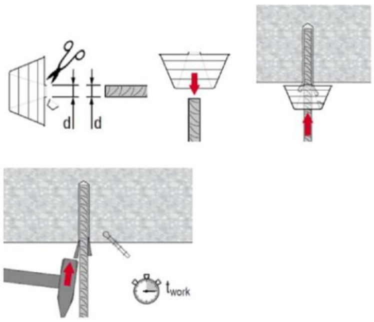
Injection until the morat level mark ℓ_m becomes visible.

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

5.Insert rebar



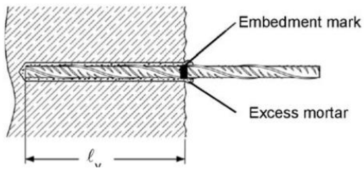
For easy installation insert the rebar slowly twisted into the boreholeuntil the embedment mark is at the concrete surface level.



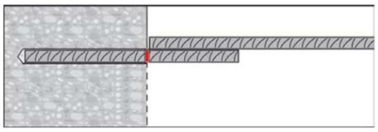
Overhead application:

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.



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

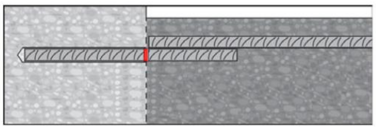


After installing the rebar the annular gap must be completely filled with mortar.

Proper installation can be verified when:

Desired anchoring embedment is reached ℓ_v: embedment mark at concrete surface.

Excess mortar flows out of the borehole after the rebar has been fully inserted until the embedment mark.



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

Fitness for use

Some creep tests have been conducted in accordance with ETAG guideline 001 part 5 and TR 023 in the following conditions : in dry environnement at 50 °C during 90 days.
These tests show an excellent behaviour of the post-installed connection made with HIT-RE 500: 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 keton (MEK)		+
	Trichlor ethylene		+
	Xylol (mixture)	+	
Products from job site	Concrete plasticizer	+	
	Diesel	+	
	Engine oil	+	
	Petrol	+	
	Oil for form work	+	
Environnement	Sslt water	+	
	De-mineralised water	+	
	Sulphurous atmosphere (80 cycles)	+	

Electrical Conductivity

HIT-RE 500 in the hardened state **does not conduct electrically**. Its electric resistivity is $66 \cdot 10^{12}$ Ω.m (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) Hollow Drill Bit (HDB)	Compressed air drill (CA)	Diamond coring	
			Wet (DD)	Dry (PCC)
8	12 (10 [a)])	-	12 (10 [a)])	-
10	14 (12 [a)])	-	14 (12 [a)])	-
12	16 (14 [a)])	17	16 (14 [a)])	-
14	18	17	18	-
16	20	20	20	-
18	22	22	22	-
20	25	26	25	-
22	28	28	28	-
24	32	32	32	35
25	32	32	32	35
26	35	35	35	35
28	35	35	35	35
30	37	35	37	35
32	40	40	40	47
34	45	42	42	47
36	45	45	47	47
40	55	57	52	52

a) Max. installation length l = 250 mm.

Basic design data for rebar design according to rebar ETA

Bond strength in N/mm² according to ETA 08/0105 for good bond conditions for hammer drilling, compressed air drilling, dry diamond core drilling

Rebar (mm)	Concrete class								
	C12/15	**C16/20**	**C20/25**	**C25/30**	**C30/37**	**C35/45**	**C40/50**	**C45/55**	**C50/60**
8 - 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

Bond strength in N/mm² according to ETA 08/0105 for good bond conditions for wet diamond core drilling

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

Pullout design bond strength for Hit Rebar design

Design bond strength in N/mm² according to ETA 04/0027 (values in table are design values, $f_{bd,po} = \tau_{Rk}/\gamma_{Mp}$

<table>
<tr><td colspan="16">Hammer or compressed air drilling.
Water saturated, water filled or submerged hole.
Uncracked concrete C20/25.</td></tr>
<tr><td rowspan="3">temperature range</td><td colspan="15">Bar diameter</td></tr>
<tr><td colspan="13">Data according to ETA 04/0027</td><td colspan="2">Hilti tech data</td></tr>
<tr><td>8</td><td>10</td><td>12</td><td>14</td><td>16</td><td>20</td><td>22</td><td>24</td><td>25</td><td>26</td><td>28</td><td>30</td><td>32</td><td>36</td><td>40</td></tr>
<tr><td>I: 40°C/24°C</td><td colspan="3">7,1</td><td colspan="3">6,7</td><td colspan="7">6,2</td><td>5,2</td><td>4,8</td></tr>
<tr><td>II: 58°C/35°C</td><td colspan="4">5,7</td><td colspan="6">5,2</td><td colspan="3">4,8</td><td>4,3</td><td>3,8</td></tr>
<tr><td>III: 70°C/43°C</td><td colspan="5">3,3</td><td colspan="5">3,1</td><td colspan="3">2,9</td><td colspan="2">2,4</td></tr>
</table>

Increasing factor in non-cracked concrete: $f_{B,p}=(f_{cck}/25)^{0,1}$ (f_{cck}: characteristic compressive strength on cube)

Additional Hilti Technical Data:

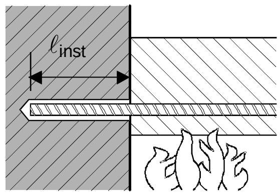
If the concrete is dry (not in contact with water before/during installation and curing), the pullout design bond strength may be increased by 20%.

If the hole was produced by wet diamond coring, the pullout design bond strength has to be reduced by 30%.

Reduction factor for splitting with large concrete cover: δ = 0,306 (Hilti additional data)

Fire Resistance according to DIBt Z-21.8-1790

a) fire situation "anchorage"



Maximum force in rebar in conjunction with HIT-RE 500 as a function of embedment depth for the fire resistance classes F30 to F180 (yield strength f_{yk} = 500 N/mm²) according EC2[a)].

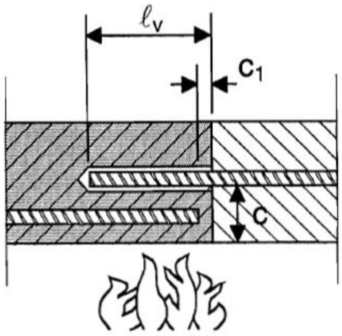
Bar ∅	Drill hole ∅	Max. $F_{s,T}$	ℓ_{inst}	Fire resistance of bar in [kN]				
[mm]	[mm]	[kN]	[mm]	R30	R60	R90	R120	R180
8	10	16,19	80	2,4	1,0	0,5	0,3	0
			95	3,9	1,7	0,3	0,6	0,1
			115	7,3	3,1	1,7	1,1	0,4
			150	16,2	8,2	4,6	3,1	1,4
			180		16,2	10,0	6,7	2,9
			205			16,2	12,4	5,1
			220				16,2	7,0
			265					16,2
10	12	25,29	100	5,7	2,5	1,3	0,8	0,2
			120	10,7	4,4	2,5	1,7	0,7
			140	17,6	7,8	4,4	3,0	1,3
			165	25,3	15,1	8,5	5,8	2,6
			195		25,3	17,6	12,2	5,1
			220			25,3	20,7	8,7
			235				25,3	11,8
			280					25,3
12	16	36,42	120	12,8	5,3	3,0	2,0	0,8
			150	25,2	12,2	6,9	4,7	2,1
			180	36,4	24,3	15,0	10,1	4,4
			210		36,2	27,4	20,6	8,5
			235			36,4	31,0	14,2
			250				36,4	19,1
			295					36,4
14	18	49,58	140	24,6	10,9	6,1	4,2	1,9
			170	39,1	23,5	13,5	9,2	4,1
			195	49,6	35,6	24,7	17,1	7,2
			225		49,6	39,2	31,3	13,5
			250			49,6	43,4	22,3
			265				49,6	29,5
			310					49,6
16	20	64,75	160	39,2	21,3	11,9	8,1	3,6
			190	55,8	37,9	25,5	17,3	7,3
			210	64,8	49,0	36,5	27,5	11,3
			240		64,8	53,1	44,1	20,9
			265			64,8	57,9	33,7
			280				64,8	42,0
			325					64,8

Bar ∅	Drill hole ∅	Max. $F_{s,T}$	ℓ_{inst}					
[mm]	[mm]	[kN]	[mm]	R30	R60	R90	R120	R180
20	**25**	**101,18**	200	76,6	54,3	38,7	27,5	11,4
			240	101,2	82,0	66,4	55,1	26,1
			270		101,2	87,1	75,9	45,6
			295			101,2	93,2	62,9
			310				101,2	73,2
			355					101,2
25	**30**	**158,09**	250	139,0	111,1	91,6	77,6	39,9
			275	158,1	132,7	113,2	99,2	61,3
			305		158,1	139,1	125,1	87,2
			330			158,1	146,7	108,8
			345				158,1	121,8
			390					158,1
28	**35**	**198.3**	280	184,7	153,4	131,6	115,9	73,5
			295	198,3	168,0	146,1	130,4	88,0
			330		198,3	180,0	164,3	121,9
			350			198,3	183,6	141,2
			370				198,3	160,6
			410					198,3
32	**40**	**259,02**	320	255,3	219,6	194,7	176,7	128,2
			325	259,0	225,1	200,2	182,2	133,8
			360		259,0	238,9	220,9	172,5
			380			259,0	243,1	194,6
			395				259,0	211,2
			440					259,0
40	**47**	**404,71**	400	404,7	385,1	353,9	331,5	270,9
			415		404,7	374,6	352,2	291,6
			440			404,7	386,8	326,2
			455				404,7	346,9
			500					404,7

[a] For tables according the standards to DIN 1045-1988, NF-ENV 1991-2-2(EC2), Österreichische Norm B 4700-2000, British-, Singapore- and Australian Standards see Warringtonfire report WF 166402 or/and IBMB Braunschweig report No 3357/0550-5.

b) fire situation parallel

Max. bond stress, τ_T , 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.



$F_{s,T} \leq (\ell_{inst} - c_f) \cdot \phi \cdot \pi \cdot \tau_T$ 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

τ_T = bond stress when exposed to fire

Critical temperature-dependent bond stress, τ_c, concerning "overlap joint" for Hilti HIT-RE 500 injection adhesive in relation to fire resistance class and required minimum concrete coverage c.

<table>
<tr><th rowspan="2">Clear concrete cover c
[mm]</th><th colspan="5">Max. bond stress, τ_c [N/mm²]</th></tr>
<tr><th>R30</th><th>R60</th><th>R90</th><th>R120</th><th>R180</th></tr>
<tr><td>30</td><td>0,7</td><td>0</td><td rowspan="5">0</td><td rowspan="7">0</td><td rowspan="12">0</td></tr>
<tr><td>35</td><td>0,8</td><td>0,4</td></tr>
<tr><td>40</td><td>0,9</td><td>0,5</td></tr>
<tr><td>45</td><td>1,0</td><td>0,5</td></tr>
<tr><td>50</td><td>1,2</td><td>0,6</td></tr>
<tr><td>55</td><td>1,4</td><td>0,7</td><td>0,5</td></tr>
<tr><td>60</td><td>1,6</td><td>0,8</td><td>0,5</td></tr>
<tr><td>65</td><td>1,9</td><td>0,9</td><td>0,6</td><td>0,4</td></tr>
<tr><td>70</td><td rowspan="22">2,2</td><td>1,0</td><td>0,7</td><td>0,5</td></tr>
<tr><td>75</td><td>1,2</td><td>0,7</td><td>0,5</td></tr>
<tr><td>80</td><td>1,4</td><td>0,8</td><td>0,6</td></tr>
<tr><td>85</td><td>1,5</td><td>0,9</td><td>0,7</td></tr>
<tr><td>90</td><td>1,7</td><td>1,1</td><td>0,8</td><td>0,5</td></tr>
<tr><td>95</td><td>2,0</td><td>1,2</td><td>0,9</td><td>0,5</td></tr>
<tr><td>100</td><td rowspan="16">2,2</td><td>1,4</td><td>1,0</td><td>0,6</td></tr>
<tr><td>105</td><td>1,6</td><td>1,1</td><td>0,6</td></tr>
<tr><td>110</td><td>1,7</td><td>1,2</td><td>0,7</td></tr>
<tr><td>115</td><td>2,0</td><td>1,4</td><td>0,7</td></tr>
<tr><td>120</td><td rowspan="12">2,2</td><td>1,6</td><td>0,8</td></tr>
<tr><td>125</td><td>1,7</td><td>0,9</td></tr>
<tr><td>130</td><td>2,0</td><td>1,0</td></tr>
<tr><td>135</td><td rowspan="9">2,2</td><td>1,1</td></tr>
<tr><td>140</td><td>1,2</td></tr>
<tr><td>145</td><td>1,3</td></tr>
<tr><td>150</td><td>1,4</td></tr>
<tr><td>155</td><td>1,6</td></tr>
<tr><td>160</td><td>1,7</td></tr>
<tr><td>165</td><td>1,9</td></tr>
<tr><td>170</td><td>2,1</td></tr>
<tr><td>175</td><td>2,2</td></tr>
</table>

Minimum anchorage length

According to ETA-08/0105, issue 2014-04-30, the minimum anchorage length shall be increased by factor 1,5 for wet diamond core drilling. For all the other given drilling methods the factor is 1,0.

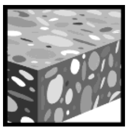
Minimum anchorage and lap lengths for C20/25; maximum hole lengths (ETA 08/0105)

Rebar		Hammer drilling, Compressed air drilling, Dry diamond coring drilling		Wet diamond coring drilling		
Diameter 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	492	510	738	765	3200
36	500	532	540	797	810	3200
40	500	616	621	925	932	3200

* $l_{b,min}$ (8.6) and $l_{0,min}$ (8.11) are calculated for good bond conditions with maximum utilisation of rebar yield strength f_{yk} = 500 N/mm² and α_6 = 1,0

Hilti HIT-HY 200 mortar with rebar (as post-installed connection)

Injection mortar system		Benefits
	Hilti HIT-HY 200-R 330 ml foil pack (also available as 500 ml foil pack)	- 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 - Two mortar (A and R) versions available with different curing times and same performance
	Hilti HIT-HY 200-A 330 ml foil pack (also available as 500 ml foil pack)	
	Static mixer	
	Rebar	



Concrete

Fire resistance

European Technical Approval

Corrosion tested

PROFIS Rebar design software

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 [a)]	DIBt, Berlin	ETA-12/0083 / 2013-06-05 (HIT-HY 200-R) ETA-11/0492 / 2013-06-05 (HIT-HY 200-A)
Fire test report	CSTB, Paris	26033756

a) All data given in this section according ETA-12/0083, issued 2013-06-05 and ETA-11/0492, issued 2013-06-05.

Materials

Reinforcement bars according to EC2 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, $f_{R,min}$	Nominal bar size (mm) 8 to 12 > 12	 0,040 0,056	

Setting details

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

Working time, curing time[a)]

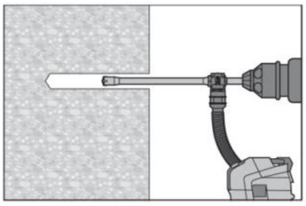
Temperature of the base material	**HIT-HY 200-R**	
	Working time in which anchor can be inserted and adjusted t_{work}	**Curing time before anchor can be fully loaded t_{cure}**
-10 °C to -5 °C	3 hour	20 hour
-4 °C to 0 °C	2 hour	7 hour
1 °C to 5 °C	1 hour	3 hour
6 °C to 10 °C	40 min	2 hour
11 °C to 20 °C	15 min	1 hour
21 °C to 30 °C	9 min	1 hour
31 °C to 40 °C	6 min	1 hour

Temperature of the base material	**HIT-HY 200-A**	
	Working time in which anchor can be inserted and adjusted t_{work}	**Curing time before anchor can be fully loaded t_{cure}**
-10 °C to -5 °C	1,5 hour	7 hour
-4 °C to 0 °C	50 min	4 hour
1 °C to 5 °C	25 min	2 hour
6 °C to 10 °C	15 min	1 hour
11 °C to 20 °C	7 min	30 min
21 °C to 30 °C	4 min	30 min
31 °C to 40 °C	3 min	30 min

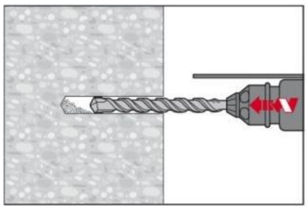
Setting instruction

a) Dry and water-saturated concrete, hammer drilling

Bore hole drilling



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 method properly cleans the borehole and removes dust while drilling. After drilling is complete, proceed to the “injection preparation” step in the instructions for use.

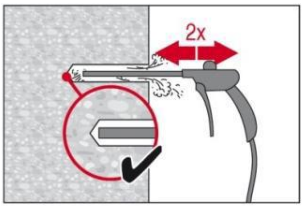


Drill hole to the required embedment depth using a hammer-drill with carbide drill bit set in rotation hammer mode, a Hilti hollow drill bit or a compressed air drill.

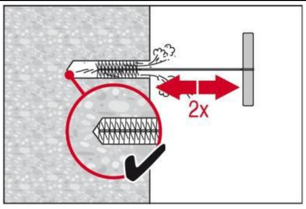
Bore hole cleaning Just before setting an anchor, the bore hole must be free of dust and debris by one of two cleaning methods described below

b) Compressed air cleaning (CAC)

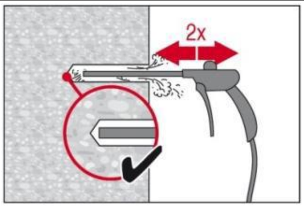
For all bore hole diameters d_0 and all bore hole depth h_0



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



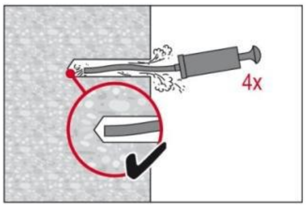
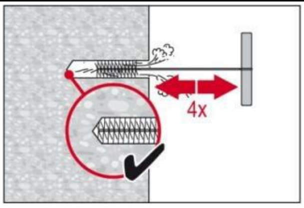
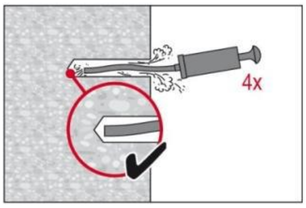
Brushing 2 times with the specified brush size (brush Ø ≥ borehole Ø) by inserting the round steel brush to the back of the hole in a twisting motion. The brush shall produce natural resistance as it enters the anchor hole. If this is not the case, please use a new brush or a brush with a larger diameter.



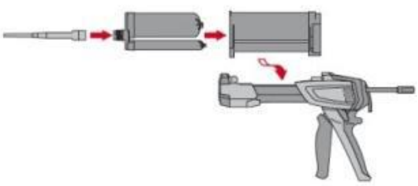
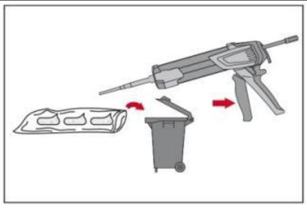
Blowing 2 times again with compressed air until return air stream is free of noticeable dust.

a) Manual Cleaning (MC)

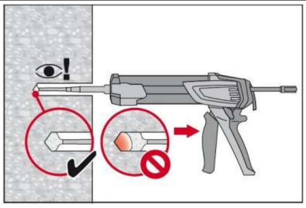
As an alternative to compressed air cleaning, a manual cleaning is permitted for hammer drilled boreholes up to hole diameters d_0 ≤ 20mm and depths ℓ_v resp. $\ell_{e,ges.}$ ≤ 160mm or 10 * d. The borehole must be free of dust, debris, water, ice, oil, grease and other contaminants prior to mortar injection.

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

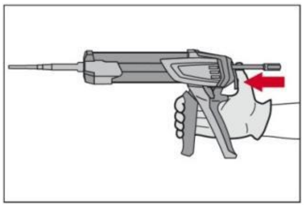
Injection preparation

	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 swing 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. 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.

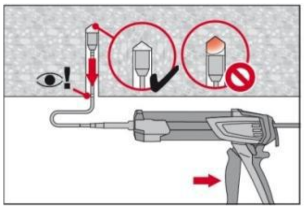
Inject adhesive from the back of the borehole without forming air voids



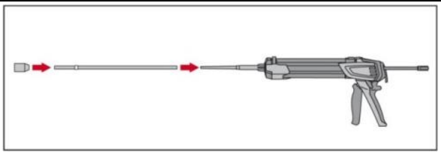
Injection method for borehole depth ≤ 250 mm:
Inject the mortar from the back of the hole towards the front and slowly withdraw the mixing nozzle step by step after each trigger pull. **Important! Use extensions for deep holes (> 250 mm)**. Fill holes approximately 2/3 full, or as required to ensure 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 (only for manual dispenser). This will prevent further mortar discharge from the mixing nozzle.

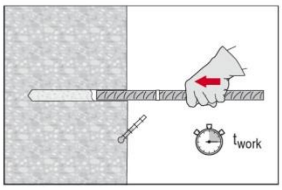


Piston plug injection for borehole depth > 250 mm or overhead applications: Assemble mixing nozzle, extension(s) and appropriately sized piston plug. Insert piston plug to back of the hole. Begin injection allowing the pressure of the injected adhesive mortar to push the piston plug towards the front of the hole. After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle.
The proper injection of mortar using a piston plug HIT-SZ prevents the creation of air voids. The piston plug must be insertable to the back of the borehole without resistance. During injection the piston plug will be pressed towards the front of the borehole slowly by mortar pressure. Attention! Pulling the injection or when changing the foil pack, the piston plug is rendered inactive and air voids may occur.

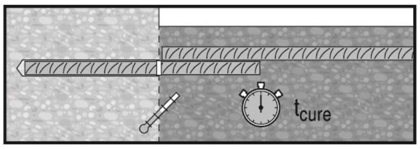


HDM 330	Manual dispenser	(330 ml)
HDM 500	Manual dispenser	(330 / 500 ml)
HDE 500-A22	Electric dispenser	(330 / 500 ml)

Setting the element



Before use, verify that the element is dry and free of oil and other contaminants.
Mark and set element to the required embedment depth until working time t_{work} has elapsed.



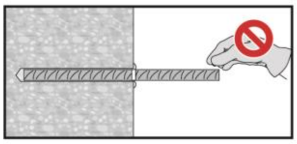
After installing the rebar the annular gap must be completely filled with mortar.

Proper installation can be verified when:

Desired anchoring embedment is reached ℓ_v:

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} preparation work may continue.

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

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		Methylethylketon	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 $15{,}5 \cdot 10^{9}\ \Omega \cdot cm$ (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)
8	12 (10 [a)])	-
10	14 (12 [a)])	-
12	16 (14 [a)])	17
14	18	17
16	20	20
18	22	22
20	25	26
22	28	28
24	32	32
25	32	32
26	35	35
28	35	35
30	37	35
32	40	40

a) Max. installation length I = 250 mm.

Basic design data for rebar design according to ETA

Bond strength

Bond strength in N/mm² according to ETA for good bond conditions

Rebar (mm)	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 - 32	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3

Minimum anchorage length

Minimum and maximum embedment depths and lap lengths for C20/25 according to ETA

Rebar		$l_{b,min}$* [mm]	$l_{0,min}$ * [mm]	Concrete temp. ≥ -10°C l_{max} [mm]	Concrete temp. ≥ 0°C l_{max} [mm]
Diameter d_s [mm]	$f_{y,k}$ [N/mm²]				
8	500	113	200	700	1000
10	500	142	200	700	1000
12	500	170	200	700	1000
14	500	198	210	700	1000
16	500	227	240	700	1000
18	500	255	270	700	1000
20	500	284	300	700	1000
22	500	312	330	700	1000
24	500	340	360	700	1000
25	500	354	375	700	1000
26	500	369	390	700	1000
28	500	397	420	700	1000
30	500	425	450	700	1000
32	500	454	480	700	1000

* $l_{b,min}$ (8.6) and $l_{0,min}$ (8.11) are calculated for good bond conditions with maximum utilisation of rebar yield strength f_{yk} = 500 N/mm² and α_6 = 1,0

Hilti HIT-HY 110 mortar with rebar (as post-installed connection)

Injection mortar system		Benefits
	Hilti HIT-HY 110 500 ml foil pack (also available as 330 ml foil pack)	- suitable for concrete C 12/15 to C 50/60 - suitable for dry and water saturated concrete - for rebar diameters up to 25 mm - non corrosive to rebar elements - good loading capacity and fast cure - suitable for applications down to -5 °C - Suitable for embedment depth up to 1500 mm depending on the rebar diameter
	Static mixer	
	rebar	

Concrete

European Technical Approval

CE conformity

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European Technical Assessment [a)]	DIBt, Berlin	ETA-13/1037 / 2014-05-26

a) All data given in this section according ETA-13/1037 issue 2014-05-26.

Materials

Designation	Reinforcement bars
Rebar EN 1992-1-1:2004/AC:2010, Annex C	Bars and de-coiled rods Class B or C with f_{yk} section EN 1992-1-1/NA:2013 $f_{uk} = f_{tk} = k \cdot f_{yk}$

Setting details

Working time, Curing time

Temperature of the base material T_{BM}	Working time t_{work} a)	Curing time t_{cure}
-5 °C to -1 °C	90 min	9 h
0 °C to 4 °C	45 min	4,5 h
5 °C to 9 °C	20 min	2 h
10 °C to 19 °C	6 min	90 min
20 °Cto 29 °C	4 min	50 min
30 °C to 40 °C b)	2 min	40 min

a) The temperature of the foil pack must be between +5 °C and +25 °C during injection.
b) Foil pack temperature must be between +15 °C to +20 °C

Installation equipment

Rebar (mm)	8	10	12	14	16	18	20	22	24	25
Rotary hammer	TE 2 – TE 40					TE 40 – TE 70				
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser									

Drilling diameters

Rebar (mm)	Drill bit diameters d_0 [mm]	
	Hammer drill (HD)	Compressed air drill (CA)
8	12 (10) a)	-
10	14 (12) a)	-
12	16 (14) a)	17
14	18	17
16	20	20
18	22	22
20	25	26
22	28	28
24	32	32
25	32	32

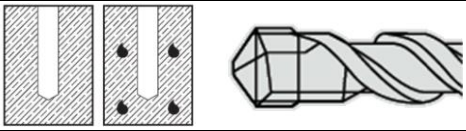
a) Values in brackets valid for maximimum drilling depth of 250 mm

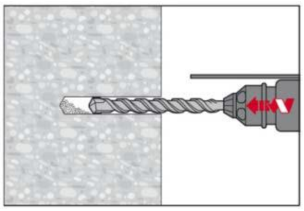
Dispensers and corresponding maximum embedment depth $\ell_{v,max}$

Rebar (mm)	Dispenser	
	HDM 330, HDM 500	HDE 500
Ø d_s [mm]	$\ell_{v,max}$ [mm]	$\ell_{v,max}$ [mm]
8	700	1000
10	700	1000
12	700	1150
14	700	1300
16	700	1500
18	500	
20	500	
22	500	
24	500	
25	500	

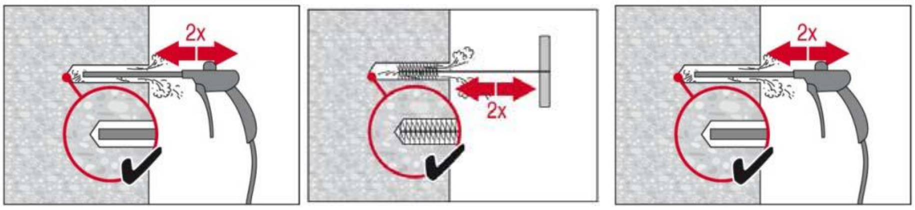
Setting instruction

Dry and water-saturated concrete, hammer drilling

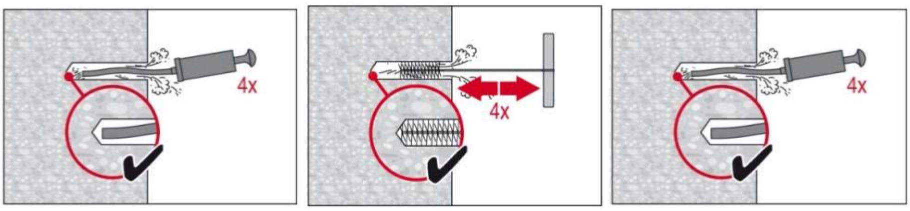




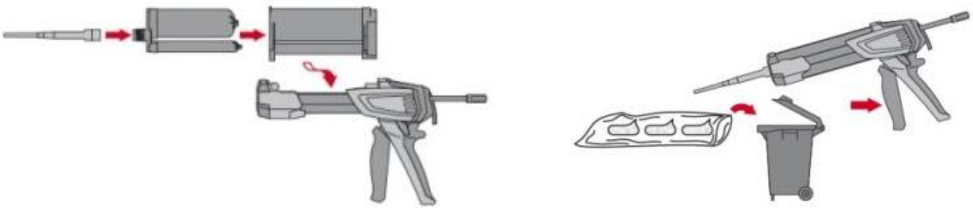
Drill hole



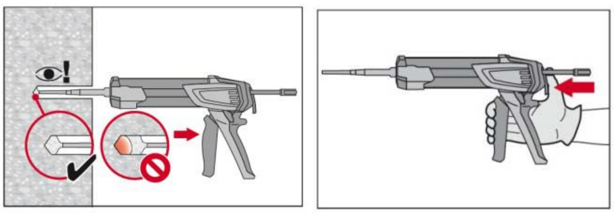
Compressed air cleaning



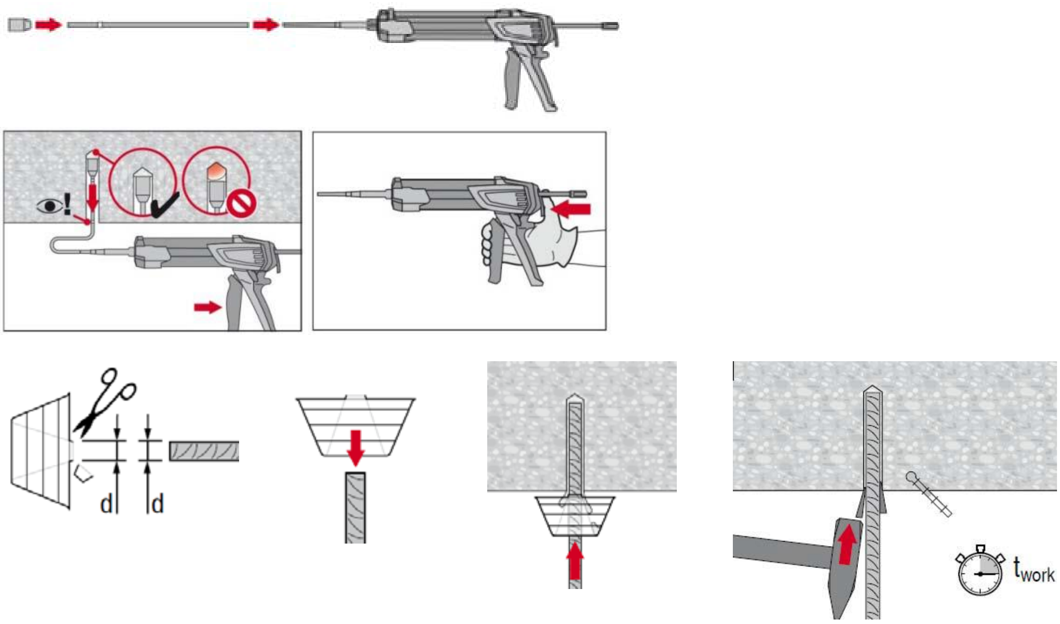
Manual cleaning for diameters $d_0 \leq 18$ mm and bore hole depth $h_0 \leq 160$ mm.



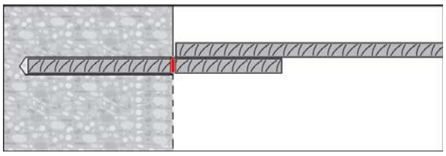
Injection system preparation



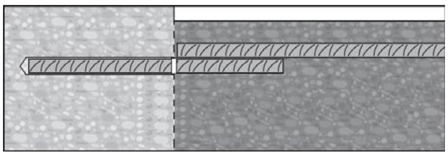
Injection method for borehole depth ≤ 250 mm



Injection method for borehole depth > 250 mm or overhead applications



Observe the working time "t_{work}"



Full load may be applied only after the curing time "t_{cure}"

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

Basic design data for rebar design

Bond strength in N/mm² for good bond conditions for all drilling methods

Rebar (mm)	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 - 25	1,6	2,0	2,3	2,7	3,0	3,0	3,0	3,4	3,7

Minimum anchorage length

The minimum anchorage length $\ell_{b,min}$ and the minimum lap length $\ell_{0,min}$ according to EN 1992-1-1:2004+AC:2010 ($\ell_{b,min}$ acc. to Eq. 8.6 and Eq. 8.7 and $\ell_{0,min}$ acc. to Eq. 8.11) shall be multiplied by a factor according to Table below.

Concrete class	Drilling method	Factor
C12/15 to C25/30	Hammer drilling (HD) and compressed air drilling (CA)	1,0
C30/37		1,1
C35/45 to C40/50		1,2
C45/55 to C50/60		1,3

Service temperature range

Hilti HIT-HY 110 injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Fitness for use

Creep behaviour
Creep tests have been conducted in accordance with national standards in different conditions:
- in wet environnement at 23 °C during 90 days
- in dry environnement at 43 °C during 90 days.

These tests show an excellent behaviour of the post-installed connection made with HIT-HY 110: low displacements with long term stabilisation, failure load after exposure above reference load.

Precalculated values

Example of pre-calculated values
Rebar yield strength f_{yk} = 500 N/mm², concrete C25/30, good bond conditions

Rebar [mm]	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]
	$\alpha_1=\alpha_2=\alpha_3=\alpha_4=\alpha_5=1{,}0$			α_2 or α_5= 0,7 $\alpha_1 = \alpha_3 = \alpha_4 = 1{,}0$		
8	100	6,8	7,5	100	9,7	8
	170	11,5	13	140	13,6	11
	250	17,0	19	180	17,4	14
	322	**21,9**	24	**225**	**21,8**	17
10	121	10,3	11	121	14,7	11
	220	18,7	20	170	20,6	15
	310	26,3	28	230	27,9	21
	403	**34,2**	36	**282**	**34,2**	26
12	145	14,8	15	145	21,1	15
	260	26,5	27	210	30,5	22
	370	37,7	39	270	39,3	29
	483	**49,2**	51	**338**	**49,1**	36
14	169	20,1	20	169	28,7	20
	300	35,6	36	240	40,7	29
	430	51,1	52	320	54,3	39
	564	**67,0**	68	**395**	**67,0**	48
16	193	26,2	26	193	37,4	26
	340	46,1	46	280	54,3	38
	490	66,5	67	370	71,7	50
	644	**87,4**	87	**451**	**87,4**	61
18	218	33,3	33	218	47,5	33
	310	47,3	47	310	67,6	47
	410	62,6	62	410	89,4	62
	500	**76,3**	75	**500**	**109,1**	75
20	242	41,1	51	242	58,6	51
	330	56,0	70	330	80,0	70
	410	69,6	87	410	99,4	87
	500	**84,8**	106	**500**	**121,2**	106
22	266	49,6	75	266	70,9	75
	340	63,4	96	340	90,6	96
	420	78,4	119	420	112,0	119
	500	**93,3**	141	**500**	**133,3**	141
24	290	59,0	122	290	84,3	122
	360	73,3	152	360	104,7	152
	430	87,5	182	430	125,1	182
	500	**101,8**	211	**500**	**145,4**	211
25	302	64,0	114	302	91,5	114
	370	78,5	139	370	112,1	139
	430	91,2	162	430	130,3	162
	500	**106,0**	188	**500**	**151,5**	188

* Values corresponding to the minimum anchorage length. The maximum permissible load 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 "$1{,}2*(d_0^2-d_s^2)*\pi*lb/4$" for hammer drilling

Example of pre-calculated values for "overlap joints"
Rebar yield strength f_{yk} = 500 N/mm², concrete C25/30, good bond conditions

Rebar [mm]	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]
	$\alpha_1=\alpha_2=\alpha_3=\alpha_5=\alpha_6=1,0$			α_2 or α_5= 0,7 $\alpha_1=\alpha_3=\alpha_6=1,0$		
8	200	13,6	15	200	19,4	15
	240	16,3	18	210	20,4	16
	280	19,0	21	220	21,3	17
	323	**21,9**	24	**226**	**21,9**	17
10	200	17,0	18	200	24,2	18
	270	22,9	24	230	27,9	21
	330	28,0	30	250	30,3	23
	402	**34,1**	36	**281**	**34,1**	25
12	200	20,4	21	200	29,1	21
	290	29,5	31	250	36,4	26
	390	39,7	41	290	42,2	31
	483	**49,2**	51	**338**	**49,1**	36
14	210	24,9	25	210	35,6	25
	330	39,2	40	270	45,8	33
	450	53,4	54	330	56,0	40
	563	**66,9**	68	**394**	**66,8**	48
16	240	32,6	33	240	46,5	33
	370	50,2	50	310	60,1	42
	510	69,2	69	380	73,7	52
	644	**87,4**	87	**451**	**87,4**	61
18	270	41,2	41	270	58,9	41
	350	53,4	53	350	76,3	53
	420	64,1	63	420	91,6	63
	500	**76,3**	75	**500**	**109,1**	75
20	300	50,9	64	300	72,7	64
	370	62,8	78	370	89,7	78
	430	72,9	91	430	104,2	91
	500	**84,8**	106	**500**	**121,2**	106
22	330	61,6	93	330	88,0	93
	390	72,8	110	390	104,0	110
	440	82,1	124	440	117,3	124
	500	**93,3**	141	**500**	**133,3**	141
24	360	73,3	152	360	104,7	152
	410	83,5	173	410	119,2	173
	450	91,6	190	450	130,9	190
	500	**101,8**	211	**500**	**145,4**	211
25	375	79,5	141	375	113,6	141
	420	89,1	158	420	127,2	158
	460	97,5	173	460	139,4	173
	500	**106,0**	188	**500**	**151,5**	188

* Values corresponding to the minimum anchorage length. The maximum permissible load 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 "$1,2*(d_0^2-d_s^2)*\pi*lb/4$" for hammer drilling

Hilti HIT-HY 100 mortar with rebar (as post-installed connection)

Injection mortar system		Benefits
	Hilti HIT-HY 100 500 ml foil pack (also available as 330 ml foil pack)	- suitable for concrete C 12/15 to C 50/60 - high loading capacity and fast cure - suitable for dry and water saturated concrete - for rebar diameters up to 25 mm - non corrosive to rebar elements - suitable for applications down to -10 °C - Suitable for embedment depth up to 700 mm depending on the rebar diameter
	Static mixer	
	rebar	


Concrete


European Technical Approval


CE conformity

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European Technical Assessment [a)]	CSTB, France	ETA-14/0001 / 2014-02-12

a) All data given in this section according ETA-14/0001 issue 2014-02-12.

Materials

Designation	Reinforcment bars
Rebar EN 1992-1-1:2004/AC:2010, Annex C	Bars and de-coiled rods Class B or C with f_{yk} section EN 1992-1-1/NA:2013 $f_{uk} = f_{tk} = k \cdot f_{yk}$

Setting details

Working time, Curing time

Temperature of the base material T_{BM}	Working time t_{work} a)	Curing time t_{cure}
-10 °C < T_{BM} < -6 °C	180 min	12 h
-5 °C < T_{BM} < -1 °C	40 min	4 h
0 °C < T_{BM} < +4 °C	20 min	2 h
+5 °C < T_{BM} < +9 °C	8 min	1 h
+10 °C < T_{BM} < +14 °C	7 min	50 min
+15 °C < T_{BM} < +19 °C	6 min	40 min
+20 °C < T_{BM} < +24 °C	5 min	30 min
+25 °C < T_{BM} < +29 °C	3 min	30 min
+30 °C < T_{BM} ≤ +40 °C	2 min	30 min

Installation equipment

Anchor size	8	10	12	14	16	18	20	22	24	25
Rotary hammer	TE 2 – TE 40					TE 40 – TE 70				
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser									

Drilling diameters

Rebar (mm)	Drill bit diameters d_0 [mm]	
	Hammer drill (HD)	Compressed air drill (CA)
8	12 (10) a)	-
10	14 (12) a)	-
12	16 (14) a)	17
14	18	17
16	20	20
18	22	22
20	25	26
22	28	28
24	32	32
25	32	32

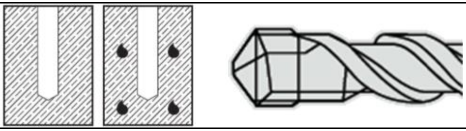
a) Values in brackets valid for maximimum drilling depth of 250 mm

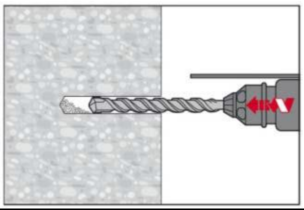
Dispensers and corresponding maximum embedment depth $\ell_{v,max}$

Rebar (mm)	Dispenser HDM 330, HDM 500, HDE 500 HIT-MD 2000, HIT-MD 2500 HIT-ED 3500, HIT-P300F, HIT-P3500F
Ø d_s [mm]	$\ell_{v,max}$ [mm]
8 to 16	700
18 to 25	500

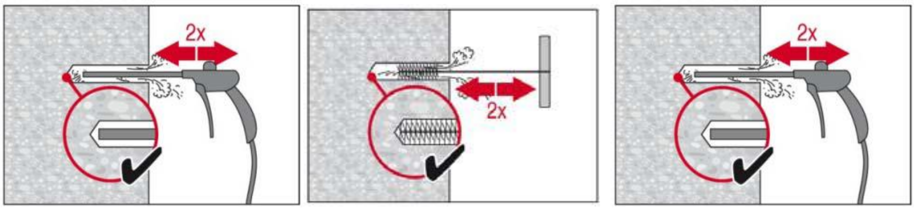
Setting instruction

Dry and water-saturated concrete, hammer drilling

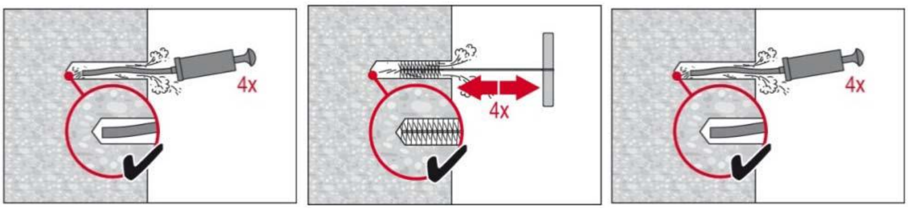




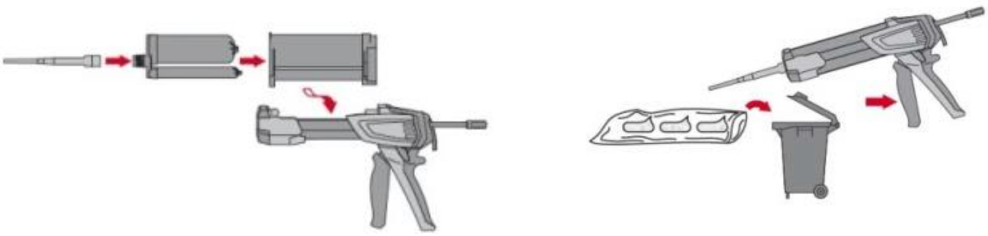
Drill hole



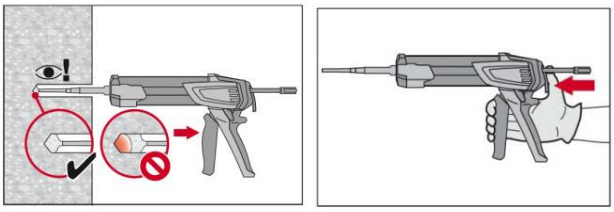
Compressed air cleaning



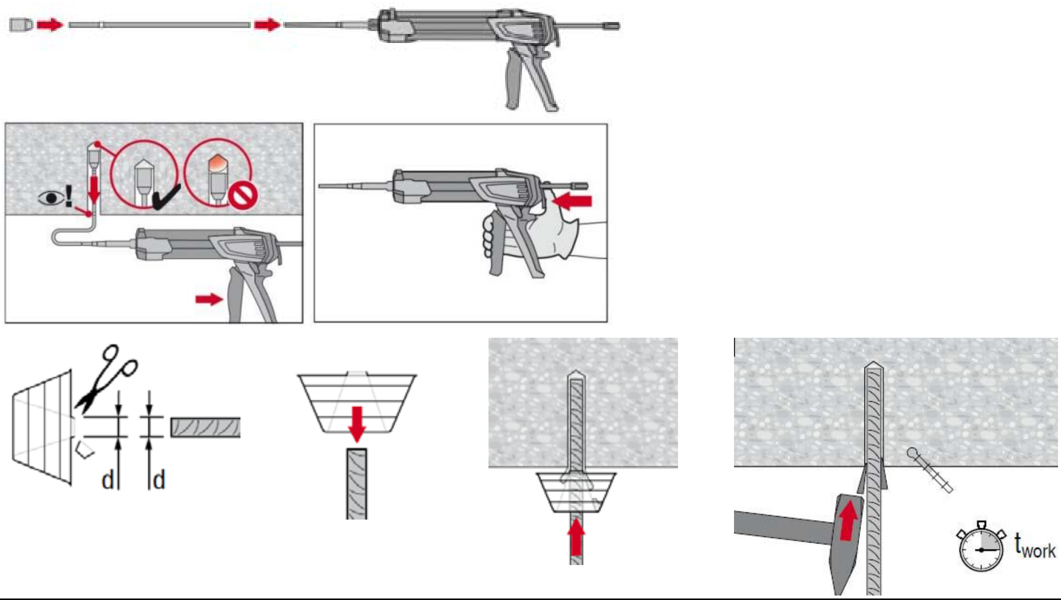
Manual cleaning for diameters $d_0 \leq 18$ mm and bore hole depth $h_0 \leq 160$ mm.



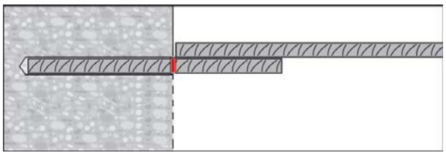
Injection system preparation



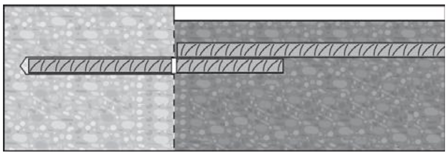
Injection method for borehole depth ≤ 250 mm



Injection method for borehole depth > 250 mm or overhead applications



Observe the working time “t_{work}”



Full load may be applied only after the curing time “t_{cure}“

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

Basic design data for rebar design

Bond strength in N/mm² for good bond conditions for all drilling methods

Rebar (mm)	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 – 24	1,6	2,0	2,3	2,7	3,0	3,4	3,4	3,4	3,7
25	1,6	2,0	2,3	2,7	3,0	3,4	3,7	3,7	3,7

Minimum anchorage length

The minimum anchorage length $\ell_{b,min}$ and the minimum lap length $\ell_{0,min}$ according to EN 1992-1-1:2004+AC:2010 ($\ell_{b,min}$ acc. to Eq. 8.6 and Eq. 8.7 and $\ell_{0,min}$ acc. to Eq. 8.11) shall be multiplied by a factor according to Table below.

Concrete class	Drilling method	Factor
C12/15 to C50/60	Hammer drilling and compressed air drilling	1,5

Service temperature range

Hilti HIT-HY 100 injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range	-40 °C to +80 °C	+50 °C	+80 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Fitness for use

Creep behaviour

Creep tests have been conducted in accordance with ETAG guideline 001 part 5 and TR 023 in the following conditions: in dry environnement at 50 °C during 90 days.

These tests show an excellent behaviour of the post-installed connection made with HIT-HY 100:
low displacements with long term stability, failure load after exposure above reference load.

Resistance to chemical substances

Chemical substance	Comment	Resistance
Sulphuric acid	23°C	+
Under sea water	23°C	+
Under water	23°C	+
Alkaline medium	pH = 13,2, 23°C	+

Precalculated values

Example of pre-calculated values

Rebar yield strength f_{yk} = 500 N/mm², concrete C25/30, good bond conditions

Rebar [mm]	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]
	$\alpha_1=\alpha_2=\alpha_3=\alpha_4=\alpha_5=1{,}0$			α_2 or α_5= 0,7 $\alpha_1=\alpha_3=\alpha_4=1{,}0$		
8	150	10,2	11	150	14,5	11
	210	14,3	16	180	17,4	14
	260	17,6	20	200	19,4	15
	322	**21,9**	24	**226**	**21,9**	17
10	181	15,4	16	181	21,9	16
	260	22,1	24	210	25,4	19
	330	28,0	30	250	30,3	23
	403	**34,2**	36	**281**	**34,1**	25
12	218	22,2	23	218	31,7	23
	310	31,6	33	260	37,8	27
	390	39,7	41	300	43,6	32
	483	**49,2**	51	**338**	**49,1**	36
14	254	30,2	31	254	43,1	31
	360	42,8	43	300	50,9	36
	460	54,6	55	350	59,4	42
	564	**67,0**	68	**394**	**66,8**	48
16	290	39,4	39	290	56,2	39
	410	55,6	56	340	65,9	46
	530	71,9	72	400	77,6	54
	644	**87,4**	87	**451**	**87,4**	61
18	326	49,8	49	326	71,1	49
	380	58,0	57	380	82,9	57
	440	67,2	66	440	96,0	66
	500	**76,3**	75	**500**	**109,1**	75
20	363	61,6	77	363	88,0	77
	410	69,6	87	410	99,4	87
	450	76,3	95	450	109,1	95
	500	**84,8**	106	**500**	**121,2**	106
22	399	74,5	113	399	106,4	113
	430	80,2	122	430	114,6	122
	470	87,7	133	470	125,3	133
	500	**93,3**	141	**500**	**133,3**	141
24	435	88,6	184	435	126,5	184
	460	93,6	194	460	133,8	194
	480	97,7	203	480	139,6	203
	500	**101,8**	211	**500**	**145,4**	211
25	453	96,1	170	453	137,2	170
	470	99,7	177	470	142,4	177
	480	101,8	181	480	145,4	181
	500	**106,0**	188	**500**	**151,5**	188

* Values corresponding to the minimum anchorage length. The maximum permissible load 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 "$1{,}2*(d_0^2-d_s^2)*\pi*lb/4$" for hammer drilling

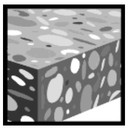
Example of pre-calculated values for "overlap joints"
Rebar yield strength f_{yk} = 500 N/mm², concrete C25/30, good bond conditions

Rebar [mm]	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]
	$\alpha_1=\alpha_2=\alpha_3=\alpha_5=\alpha_6=1{,}0$			α_2 or $\alpha_5 = 0{,}7$ $\alpha_1 = \alpha_3 = \alpha_6 = 1{,}0$		
8	200	13,6	15	200	19,4	15
	240	16,3	18	210	20,4	16
	280	19,0	21	220	21,3	17
	322	**21,9**	24	**226**	**21,9**	17
10	200	17,0	18	200	24,2	18
	270	22,9	24	230	27,9	21
	340	28,8	31	250	30,3	23
	403	**34,2**	36	**281**	**34,1**	25
12	200	20,4	21	200	29,1	21
	290	29,5	31	250	36,4	26
	390	39,7	41	290	42,2	31
	483	**49,2**	51	**338**	**49,1**	36
14	210	24,9	25	210	35,6	25
	330	39,2	40	270	45,8	33
	450	53,4	54	330	56,0	40
	564	**67,0**	68	**394**	**66,8**	48
16	240	32,6	33	240	46,5	33
	370	50,2	50	310	60,1	42
	510	69,2	69	380	73,7	52
	644	**87,4**	87	**451**	**87,4**	61
18	270	41,2	41	270	58,9	41
	350	53,4	53	350	76,3	53
	420	64,1	63	420	91,6	63
	500	**76,3**	75	**500**	**109,1**	75
20	300	50,9	64	300	72,7	64
	370	62,8	78	370	89,7	78
	430	72,9	91	430	104,2	91
	500	**84,8**	106	**500**	**121,2**	106
22	330	61,6	93	330	88,0	93
	390	72,8	110	390	104,0	110
	440	82,1	124	440	117,3	124
	500	**93,3**	141	**500**	**133,3**	141
24	360	73,3	152	360	104,7	152
	410	83,5	173	410	119,2	173
	450	91,6	190	450	130,9	190
	500	**101,8**	211	**500**	**145,4**	211
25	375	79,5	141	375	113,6	141
	420	89,1	158	420	127,2	158
	460	97,5	173	460	139,4	173
	500	**106,0**	188	**500**	**151,5**	188

* Values corresponding to the minimum anchorage length. The maximum permissible load 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 "$1{,}2*(d_0^2-d_s^2)*\pi*lb/4$" for hammer drilling

Hilti HIT-CT 1 mortar with rebar (as post-installed connection)

Injection mortar system		Benefits
	Hilti HIT-CT 1 330 ml foil pack (also available as 500 ml foil pack)	- Hilti **Clean-Tec** technology: clean of critical hazardous substances, environmentaly and user friendly. - Hilti **SAFEset** technology: drilling with Hilti hollow drill bit and vacuum properly cleans the borehole and removes dust. No further cleaning needed. - suitable for concrete C12/15 to C50/60 - high loading capacity and fast curing - hybrid chemistry - suitable for dry and water saturated concrete - for rebar diameters up to 25 mm - non corrosive to rebar elements - good load capacity at elevated temperatures, and suitable for applications down to -5 °C
	Static mixer	
	Rebar	



Concrete

Hilti Clean technology

European Technical Approval

CE conformity

PROFIS Rebar design software

Hilti SAFEset technology

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 [a)]	CSTB, Paris	ETA-11/0390 / 2012-08-27
Fire test report	DiBT, Berlin	Z-21.8-2004

a) All data given in this section according ETA-11/0354 issue 2012-08-27.

Materials

Reinforcmenent bars according to EC2 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, $f_{R,min}$	Nominal bar size (mm) 8 to 12 > 12	 0,040 0,056	

Setting details

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

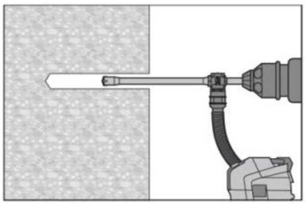
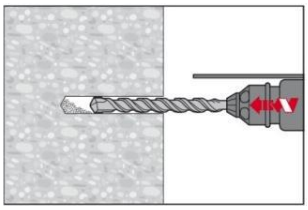
Working time, Curing time

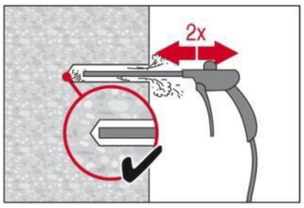
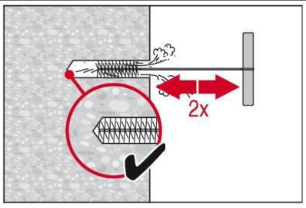
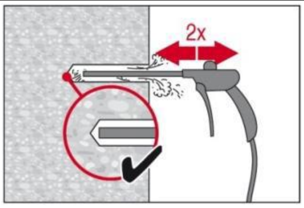
Temperature of the base material T_{BM}	**Working time t_{gel}**	**Curing time t_{cure} a)**
-5 °C ≤ T_{BM} < 0 °C	60 min	6 h
0 °C ≤ T_{BM} < 5 °C	40 min	3 h
5 °C ≤ T_{BM} < 10 °C	25 min	2 h
10 °C ≤ T_{BM} < 20 °C	10 min	90 min
20 °C ≤ T_{BM} < 30 °C	4 min	75 min
30 °C ≤ T_{BM} ≤ 40 °C	2 min	60 min

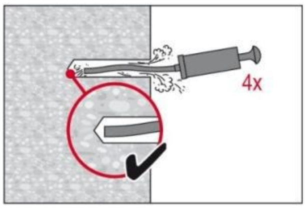
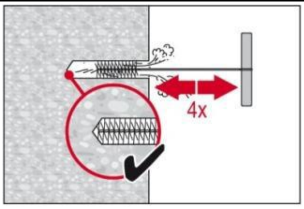
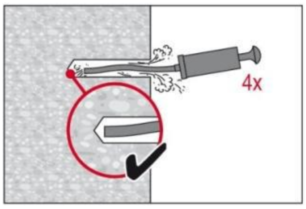
a) The curing time data are valid for dry anchorage base only. For water saturated anchorage bases the curing times must be doubled.

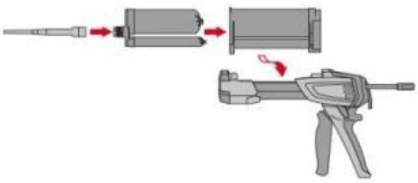
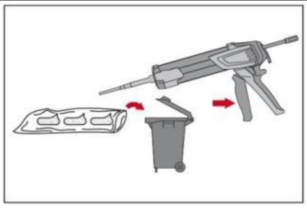
Setting instruction

Dry and water-saturated concrete, hammer drilling

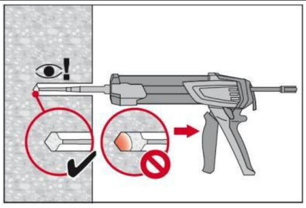
Bore hole drilling	
	Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment. This drilling method properly cleans the borehole and removes dust while drilling. After drilling is complete, proceed to the “injection preparation” step in the instructions for use.
	Drill hole to the required embedment depth using a hammer-drill with carbide drill bit set in rotation hammer mode, a Hilti hollow drill bit or a compressed air drill.

Bore hole cleaning	Just before setting an anchor, the bore hole must be free of dust and debris by one of two cleaning methods described below
a) Compressed air cleaning (CAC)	For all bore hole diameters d_0 and all bore hole depth h_0
	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. If required use additional accessories and extensions for air nozzle and brush to reach back of hole.
	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.
	Blowing 2 times again with compressed air until return air stream is free of noticeable dust.

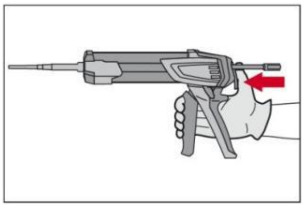
b) Manual Cleaning (MC)	As an alternative to compressed air cleaning, a manual cleaning is permitted for hammer drilled boreholes up to hole diameters $d_0 \leq 20$mm and depths ℓ_v resp. $\ell_{e,ges.} \leq 160$mm or 10*d. The borehole must be free of dust, debris, water, ice, oil, grease and other contaminants prior to mortar injection.
	4 strokes with Hilti blow-out pump from the back of the hole until return air stream is free of noticeable dust.
	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 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 Ø,
	4 strokes with Hilti blow-out pump from the back of the hole until return air stream is free of noticeable dust.

Injection 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 swing 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. Discard quantities are 2 strokes for 330 ml foil pack 3 strokes for 500 ml foil pack

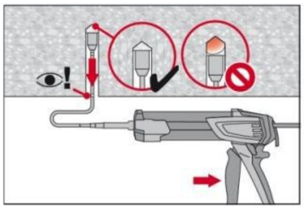
Inject adhesive from the back of the borehole without forming air voids



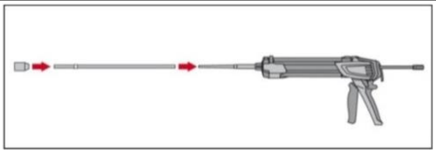
Injection method for borehole depth ≤ 250 mm:
Inject the mortar from the back of the hole towards the front and slowly withdraw the mixing nozzle step by step after each trigger pull. **Important! Use extensions for deep holes > 250 mm**. Fill holes approximately 2/3 full, or as required to ensure that 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 (only for manual dispenser). This will prevent further mortar discharge from the mixing nozzle.



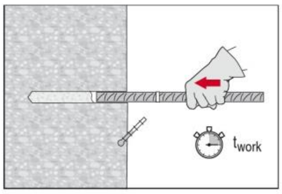
Piston plug injection for borehole depth > 250 mm or overhead applications: Assemble mixing nozzle, extension(s) and appropriately sized piston plug. Insert piston plug to back of the hole. Begin injection allowing the pressure of the injected adhesive mortar to push the piston plug towards the front of the hole. After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle.
The proper injection of mortar using a piston plug HIT-SZ prevents the creation of air voids. The piston plug must be insertable to the back of the borehole without resistance. During injection the piston plug will be pressed towards the front of the borehole slowly by mortar pressure. Attention! Pulling the injection or when changing the foil pack, the piston plug is rendered inactive and air voids may occur.



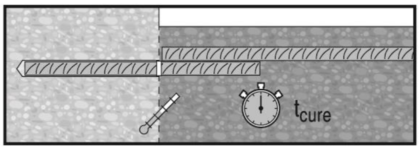
Dispenser types with related foil pack sizes:

HDM 330	Manual dispenser	(330 ml)
HDM 500	Manual dispenser	(330 / 500 ml)
HDE 500-A22	Electric dispenser	(330 / 500 ml)

Setting the element



Before use, verify that the element is dry and free of oil and other contaminants.
Mark and set element to the required embedment depth until working time twork has elapsed.



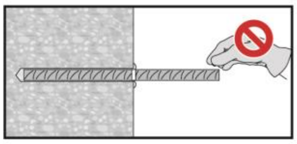
After installing the rebar the annular gap must be completely filled with mortar.

Proper installation can be verified when:

Desired anchoring embedment is reached ℓ_v:

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} preparation work may continue.

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

Fitness for use

Creep behaviour

Creep tests have been conducted in dry environment at 50°C during 90 days.

These tests show an excellent behaviour of the post installed connection made with HIT-CT 1: low displacements with long term stabilisation, failure load after exposure above reference load.

Resistance to chemical substances

Chemical	Resistance	Chemical	Resistance
Acetic acid 100%	*o*	*Methanol 100%*	*o*
Acetic acid 10%	+	*Peroxide of hydrogen 30%*	*o*
Hydrochloric Acid 20%	+	*Solution of phenol (sat.)*	-
Nitric Acid 40%	-	*Sodium hydroxide pH=14*	+
Phosphoric Acid 40%	+	*Solution of chlorine (sat.)*	+
Sulphuric acid 40%	+	*Solution of hydrocarbons (60 % vol Toluene, 30 % vol Xylene,10 % vol Methyl naphtalene)*	+
Ethyl acetate 100%	*o*		
Acetone 100%	-		
Ammoniac 5%	*o*	*Salted solution 10%*	+
Diesel 100%	+	*sodium chloride*	
Gasoline 100%	+	*Suspension of concrete (sat.)*	+
Ethanol 96%	*o*	*Chloroform 100%*	+
Machine oils 100%	+	*Xylene 100%*	+

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

Electrical Conductivity

HIT-CT 1 in the hardened state **is not conductive electrically**. Its electric resistivity is $1{,}4 \cdot 10^{10}\ \Omega \cdot m$ (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)
8	12 (10[a])	-
10	14 (12[a])	-
12	16 (14[a])	17
14	18	17
16	20	20
20	25	26
25	32	32

a) Max. installation length l = 250 mm.

Basic design data for rebar design

Bond strength

Bond strength in N/mm² according to EC2 for good bond conditions for all drilling methods

Rebar (mm)	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 - 25	1,6	2,0	2,3	2,7	3,0	3,0	3,0	3,0	3,0

Minimum anchorage length

Minimum and maximum embedment depths and lap lengths for C20/25 according to ETA

The minimum anchorage length according to EC 2 shall be multiplied by the factor

- 1,0 for concrete class ≤ C20/25
- 1,2 for concrete class C25/30
- 1,4 for concrete class ≤ C20/25

Minimum and maximum embedment depth and lap lengths for C25/30

Rebar		Hammer drilling, Compressed air drilling		
Diameter d_s [mm]	**$f_{y,k}$ [N/mm²]**	**$l_{b,min}$* [mm]**	**$l_{0,min}$ * [mm]**	**l_{max} [mm]**
8	500	136	240	700
10	500	170	240	700
12	500	204	240	700
14	500	238	252	700
16	500	272	288	700
18	500	306	324	500
20	500	340	360	500
22	500	374	396	500
24	500	408	432	500
25	500	425	450	500

*$l_{b,min}$ (8.6) and $l_{0,min}$ (8.11) are calculated for good bond conditions with maximum utilisation of rebar yield strength f_{yk} = 500 N/mm² and α_6 = 1,0

Rail anchoring systems

Introduction

Bottom-up – post-installed method

Top-down – cast-in method

Introduction to Hilti rail anchoring systems

1 The Hilti direct fixation (DFF) generation for bottom-up, top-down, elastic and rigid applications

Hilti offers solution for both construction methods, Top-down (cast-in) and bottom up (post-installed) construction method.

Bottom–up is described as the concrete slab is poured first. The rail is set in position while all associated components are clipped to the rail besides Hilti DFF. The holes for anchors are cored in the top of the slab while the holes in the baseplates are used as drilling pattern (high accuracy). Afterwards the borehole is filled with Hilti injection mortar and Hilti DFF are inserted into the mortar filled borehole
.

Bottom-up construction method

Hilti direct fixation fastener

Top down is described as the rail is set and supported on props in the correct position. Baseplates and all associated components (clips, Hilti rail anchors, etc.) are clipped to the rail while the concrete is then poured up to a given level or the underside of the baseplate.

Top down construction method


Clipped components before concrete pouring

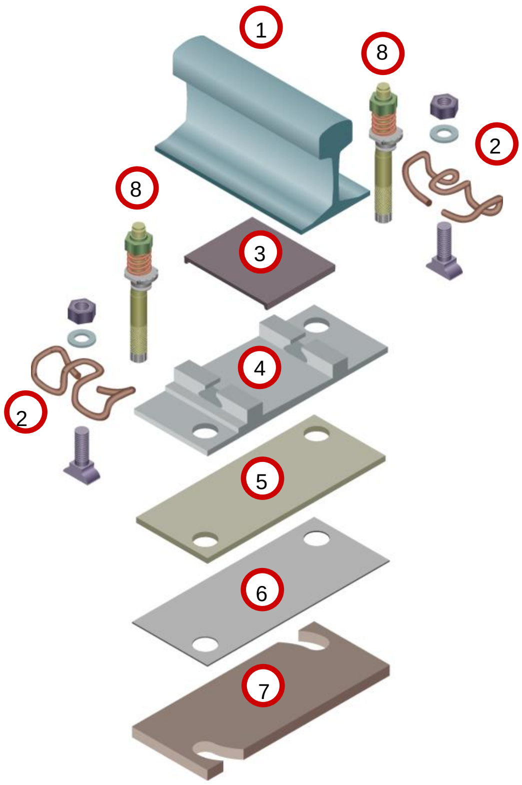

Support after concrete pouring

Hilti provides elastic fasteners if elastomeric pads are situated between rib plate and concrete surface. The necessary movement of the baseplate is ensured by Hilti DFF adapted with compression springs (9) which will be pre-tensioned during installation.

Hilti provides rigid systems if no elastomeric pads are situated between rib plate and concrete surface (tram washes, depots) where the baseplate will not move up and down in the area of the anchors. Hilti rigid rail anchors are also used if **sandwich base-plates or so called floating plates** should be fastened.

This boundary condition is taken into account by equipping Hilti rail anchors with spring washers (rigid) (10)

2 Hilti direct fixation fasteners ensure that major components of a modular baseplate support works



(1) **Rail** to provide guide way for rolling stocks

(2) To secure the rail to the baseplate in general two pieces of **elastic clips** fitted with electrical insulation are used. The elastic clips ensure sufficient force transfer to the rail to retrain longitudinal movement of the rail. These are attached to the baseplate via T-bolts including nut and washer.

(3) The **rail pad** is located between the rail and baseplate to reduce abrasion as the rail moves with temperature.

(4) The **baseplate/rib plate** may be steel iron plates which seat the rail foot and provide anchoring points for the Hilti rail anchors and clips. The baseplate also incline the rail towards the center of the track either by an angle of 1:20 or 1:40 due to the conical wheel thread of the wheels on the rail.

(5) The **elastic pad** is providing the necessary elasticity between the baseplate and concrete slab and manages resilience in terms of noise and vibration.

(6) (7) **Shims** are packing pieces of varying thickness to accommodate variations in the concrete surface located between the elastic pad and concrete surface.

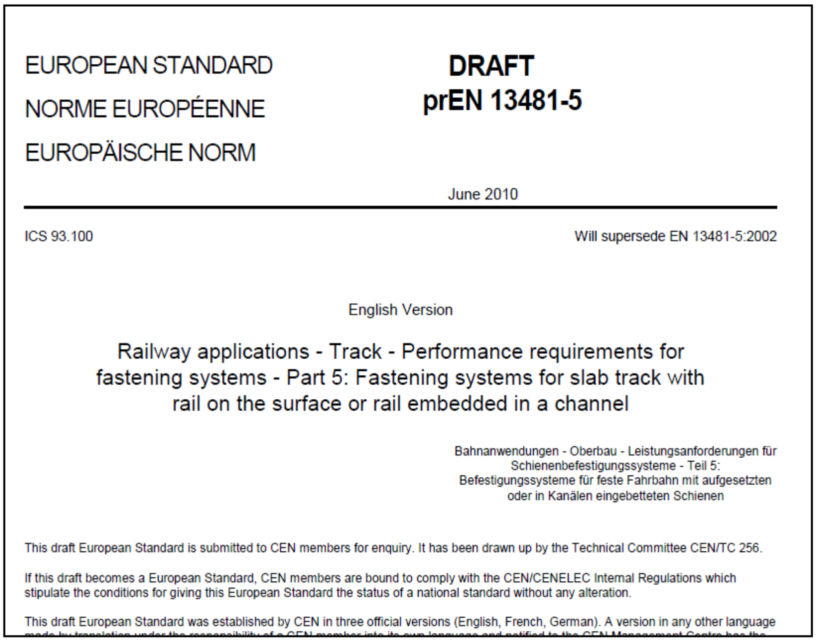
Additional **non-shrink Hilti epoxy grout** (Hilti CB-G EG) can be used to accommodate concrete surface irregularities.

(8) **Hilti direct fixation fasteners (2 or 4 pics. per baseplate) to provide a reliable load transfer from the support into the slab (concrete sleepers)**

3 State-of-the art testing while Hilti direct fixation fasteners are going beyond

Hilti Rail anchors are tested by third party according to the new European standard DIN EN 13481-5 and the former standards[1)].Therefore Hilti rail anchors provide:

- **Sufficient fatigue resistant** (repeated loading) to ensure that the horizontal guidance forces are transferred from the rail to the base material, see section 4
- **Sufficient electrical resistance** to avoid stray current, see section 5
- the possibility of **dismantling the complete support after exposure** to severe environmental conditions
- **Sufficient tension resistance**, see section 6



EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

DRAFT
prEN 13481-5

June 2010

ICS 93.100

Will supersede EN 13481-5:2002

English Version

Railway applications - Track - Performance requirements for fastening systems - Part 5: Fastening systems for slab track with rail on the surface or rail embedded in a channel

Bahnanwendungen - Oberbau - Leistungsanforderungen für Schienenbefestigungssysteme - Teil 5: Befestigungssysteme für feste Fahrbahn mit aufgesetzten oder in Kanälen eingebetteten Schienen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 256.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language

European standard for performance requirements for fastening systems – Part 5: Fastening systems for slab track with rail on the surface or rail embedded in channel

Hilti rail anchors go beyond the scope and requirements of DIN EN 13481-5 by means of tested under not expected concrete conditions (cracks in slab track), installation safety, electrical insulation and highest loads.

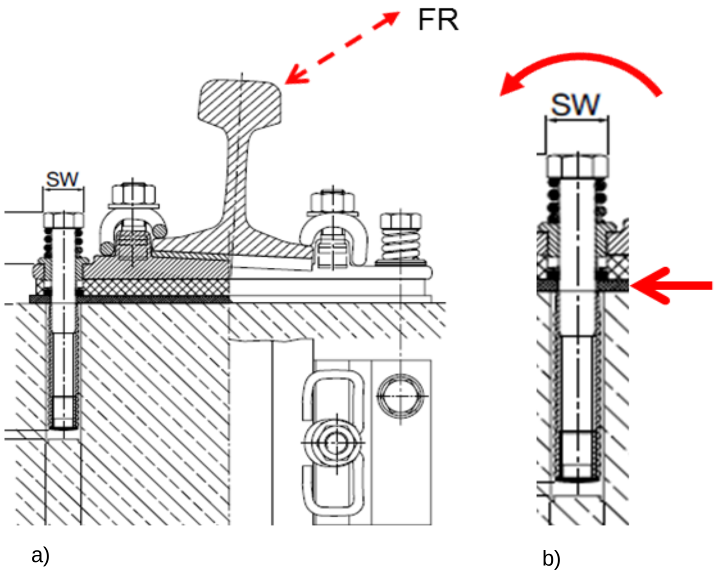
1) Testing recommended by the Research and Test Establishment of the International Railway association ORE or ERRI (see also CEN/TC, Part 4 «Railway applications – permanent way, test methods for fastening systems/biaxial load test, June 1996).

4 Hilti DFF keep position even under high fatigue loading

Forces acting on the rail (F_R) by rolling stock are loading Hilti direct fixation fastners under shear by means of cantilever bending. The orientation and value of the forces are taken account by the DIN EN 13481-5 and the former standards[1)] in a realistic way based on axle load of the rolling stock, maximum speed and curve radii.

All Hilti rail anchor resist more than $3x10^6$ load cycles under the tested boundary conditions without showing any damage.

Due to High steel strength and manufacturing quality Hilti direct fixation fasteners cover the largest lever arm possible to provide you the most flexible solution concerning load and fixing height. In general only 2 anchors per baseplate are needed (straight track). This results in less installation time and costs in combination with a reliable solution.



a) Cross section and inclined load F_R by rolling stock
b) Cantilever bending of Hilti direct fixation fasteners by means of shear force and moment

Hilti rail anchor goes beyond !

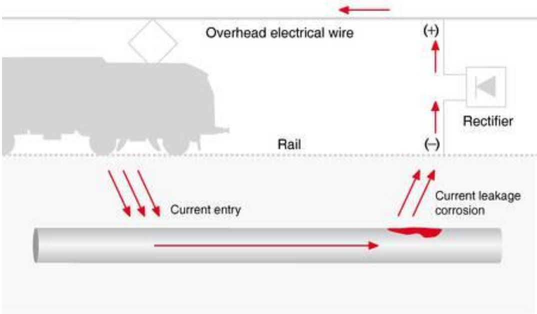
While the axle load of DIN EN 13481-5 is limited to 250 kN (25tons), Hilti showed that the HRC rail anchor family resists axle loads up to 390 kN (39tons) without showing any damage.

We do not believe in plastic if it comes to load transfer

All parts of Hilti rail anchors which are taking up tension load and/or bending moment are made out of high strength steel to ensure a reliable load transfer mechanism.

5 Hilti rail anchors brings electrical current to the intended path

Stray currents can be described as electrical current which do not follow the intended path. Effectively stray currents are electrical charges leaking into the ground while the hazard of stray currents emerges whenever this rogue DC charge comes into contact with anything metallic, whereupon it will begin the corrosion process (e.g. pipes).

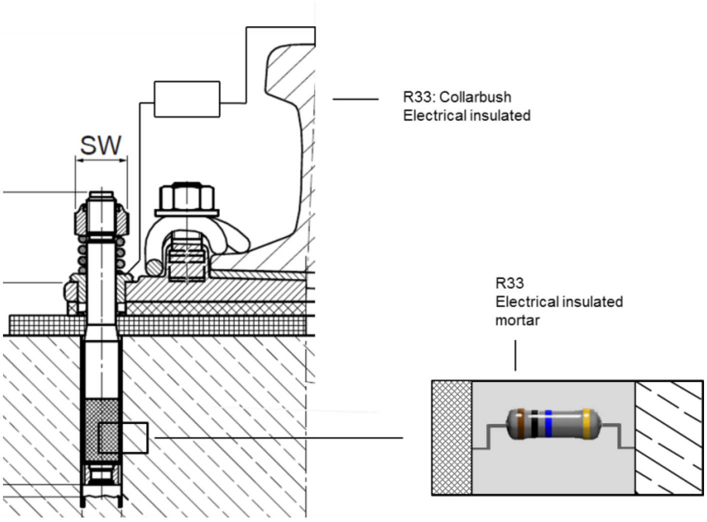


Stray current acting on a metallic pipe

One part of reducing stray current such as rail-to-earth resistance can be controlled via Hilti rail anchors by combining Hilti electrical resistance mortar (HIT RE 500 & HIT RE 500 SD) with Hilti electrical resistance collar bushes.

The European standard is measuring the electrical insulation during test, the minimum required resistance value is R_{33}= 5.0kΩ (wet conditions),

With Hilti rail anchors always 5.0kΩ < R_{33} ≤ 33 kΩ were achieved based on the used system.



6 The state-of the art testing standard DIN EN 13481-5

According to DIN EN 13481-5 “Railway applications – Track – Performance requirements for fastening systems – Part 5: Fastening systems for slab track with rail on surface or rail embedded in a channel”, direct fixation fasteners should in addition resist a tension load of 60 kN for 3 minutes. However it is not clearly stated if these pullout tests should be performed after or before the fatigue tests by means of 3 Mio. load cycles.

This is clear for us. Providing top quality direct fixation fasteners Hilti performs the discussed pullout test after and with the already fatigue loaded anchor to take account of all conditions in a realistic way

With Hilti direct fixation fasteners pullout loads of up to 150 kN after fatigue loading are measured.

HRT-WH Rail anchor with Hilti HVU or Hilti HIT-RE 500

Fastening system		Benefits
	Hilti HRT-WH	- for fastening rails to concrete slab track - for bottom-up (post-installed) construction method
	Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- verified for axle loads up to 250 kN - high electrical insulation values concerning stray currency - corrosion resistance -- additional sizes and accessoiries available - chisel point - setting through rib plate possible - different support stiffness
	Hilti HVU foil capsule	- complete installation and system portfolio - 2 and 4 anchor configuration

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Rail anchor testing	Technical University of Munich	Report no. 1893 / 2001-05-06

Application field covered

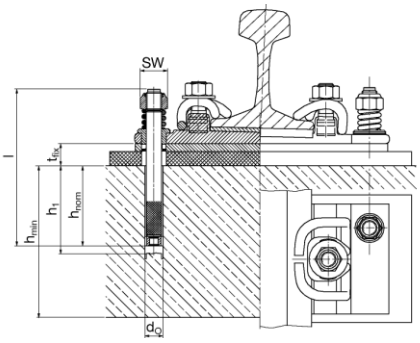
Selection of Hilti rail anchors for fastening rails to concrete track slab, based on axle load (A), stiffness (c) and thickness (t) of elastic pad

Anchor *	Elastic pad, t (mm)**	Tramway A = 100 kN	Metro A = 135 kN	Commuter A = 170 kN	Full Size A = 250 kN
HRT-WH M22x200	10				
	20				
Criteria	V_{max}	60 km/h	80 km/h	120 km/h	≥ 250 km/h
	R_{min} (V_{max})***	70 m (25 km/h)	200 m (60 km/h)	350 m (80 km/h)	3000 m
	Support spacing	750 mm	750 mm	700 mm	650 mm

* Configuration of base plate (support):  -> = Anchors per support

** Stiffness of elastic pad: t = 10mm -> c = 20-30 kN/mm
t = 20mm -> c = 10-20 kN/mm

*** Indicative value: V_{max} is a function of the existing superelevation (cant) and the lateral acceleration.

Setting details	HRT WH 22x200		
	**Hilti mortar type**	**HVU M20x110**	**HIT-RE 500**
	Nominal diameter of drill bit d_0 [mm]	25	
	Nominal drilling depth h_1 [mm]	120	110
	Embedment depth h_{nom} [mm]	110	
	Minimum member thickness h_{min} [mm]	200	
	Length of anchor l [mm]	200	
	Maximum fixing height t_{fix} [mm]	35	
	Spring deflection S_{inst} [mm]	5	
	Spring length L_{st} [mm]	22	
	Wrench size S_{inst} [mm]	32	

Curing time for general conditions HVU capsule

Temperature of the base material	Curing time before anchor can be fully loaded t_{cure}
20 °C to 40 °C	20 min
10 °C to 19 °C	30 min
0 °C to 9 °C	1 h
-5 °C to - 1 °C	5 h

Curing time for general conditions HIT-RE 500

Temperature of the base material	Curing time before anchor can be fully loaded t_{cure}
40 °C	4h
30 °C to 39 °C	8h
20 °C to 29 °C	12h
15 °C to19 °C	24h
10 °C to 14 °C	48h
5 °C to 9 °C	72h

Specification

HRT-WH Rail Anchor

Stopnut (M22-SW32)
Material: 5S (DIN 985,EN ISO 7040,DIN 267), blue zinc plated: Fe/Zn 5B (DIN 50961)
Fixing device: Nylon, torque force 68 Nm
Service temperature: -50°C up to 120°C

Washer (24/39/3 mm)
Material: Steel grade 4.6 (DIN 126), blue zinc plated: Fe/Zn 5B (DIN 50961)

Double coilSpring Fe 6
Material: Spring steel, Int. Ø= 24 mm, Ext. Ø= 44 mm, original height: 22 mm, compressed height: 17 mm, cathaphoretic coating 7 µ

Collar Bush (Sealing Lip)
Material: Plastic, int. Ø= 22 mm, ext. Ø= 36 mm
Volume resitivity: 1.2×10^{12} Ω cm
Flexible lower portion of collar bush to prevent any excess injection mortar HIT-RE or foilcapsule (HVU) from restricting managed system compression

Anchor Body (Ø 22 mm)
High grade steel (DIN/ISO 898/1)
Blue zinc plated: Fe/Zn 10B (DIN 50961)
Designed to withstand high axle loads of 250 kN, cone heads fits setting tool TE-Y-E M20 to set the anchor with the HVU foil capsule

Thread (M22)
To provide adequate bonding with foil capsule HVU or HIT-RE 500 mortar and transfer tension loading to the lower part of the concrete slab

Chisel Point
To provide adequate mixing of the HVU foil capsule and to transfer the torsionloading via the mortar to the concrete

HRT Rail anchor with Hilti HIT-RE 500

Fastening system		Benefits
	Hilti HRT Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- for fastening rails to concrete slab track - for bottom-up (post-installed) construction method - verified for axle loads up to 170 kN - high electrical insulation values concerning stray currency - corrosion resistance - for diamond core drilled holes with roughening - additional sizes and accessoiries available - setting through rib plate possible - different support stiffness - complete installation and system portfolio - 2 and 4 anchor configuration

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Rail anchor testing	Technical University of Munich	Report no. 1584a / 1995-08-15
		Report no. 1726 / 1998-04-04

Application field covered

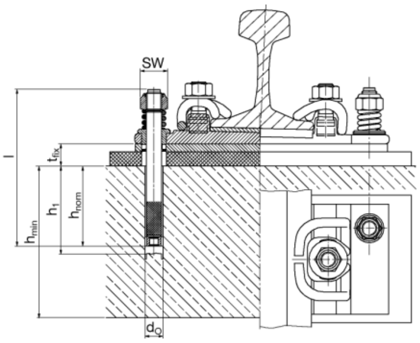
Selection of Hilti rail anchors for fastening rails to concrete track slab, based on axle load (A), stiffness (c) and thickness (t) of elastic pad

Anchor *	Elastic pad, t (mm)**	Tramway A = 100 kN	Metro A = 135 kN	Commuter A = 170 kN	Full Size A = 250 kN
HRT M22x215	10				
	20				
	30				
Criteria	V_{max}	60 km/h	80 km/h	120 km/h	≥250 km/h
	R_{min} (V_{max})***	70 m (25 km/h)	200 m (60 km/h)	350 m (80 km/h)	3000 m
	Support spacing	750 mm	750 mm	700 mm	650 mm

* Configuration of base plate (support):  -> = Anchors per support

** Stiffness of elastic pad: t = 10mm -> c = 20-30 kN/mm
t = 20mm -> c = 10-20 kN/mm
t = 30mm -> c = 5-10 kN/mm

*** Indicative value: V_{max} is a function of the existing superelevation (cant) and the lateral acceleration.

Setting details	HRT WH 22x200	
	**Anchor size**	**M22**
	Hilti mortar type	**HIT-RE 500**
	Nominal diameter of drill bit d_0 [mm]	25
	Nominal drilling depth h_1 [mm]	110
	Embedment depth h_{nom} [mm]	106
	Minimum member thickness h_{min} [mm]	160
	Length of anchor l [mm]	215
	Maximum fixing height t_{fix} [mm]	40
	Spring deflection S_{inst} [mm]	8
	Spring length L_{st} [mm]	35
	Wrench size S_{inst} [mm]	38

Curing time for general conditions HIT-RE 500

Temperature of the base material	Curing time before anchor can be fully loaded t_{cure}
40 °C	4h
30 °C to 39 °C	8h
20 °C to 29 °C	12h
15 °C to19 °C	24h
10 °C to 14 °C	48h
5 °C to 9 °C	72h

Specification

	Hilti HRT Rail Anchor
	**Stopnut (M22-SW32)** Material: 5S (DIN 985,EN ISO 7040,DIN 267), blue zinc plated: Fe/Zn 5B (DIN 50961) Fixing device : Nylon, torque force 68 Nm Service temperature: -50°C up to 120°C **Spring 35mm** Wire grade: C7 (DIN 2076), yellow zinc plated: Fe/Zn 7C (DIN 50961) Spring rate: 373 N/mm Deformation: 8mm ➔ 3.0 kN compression **Collar Bush (Sealing Lip)** Material: Plastic, int. Ø= 22 mm, ext. Ø= 36 mm Volume resitivity: 1.2 x 10^{12} Ω cm Flexible lower portion of collar bush to prevent any excess injection mortar from restricting managed system compression **Anchor Body (Ø 22 mm)** Material: High grade carbon steel (DIN/ISO 898/1) Yellow zinc plated: Fe/Zn 10C (DIN 50961) Designed to withstand high dynamic loads resulting from train axle loads up to 170 kN **Knurling** To provide adequate bonding with HIT-RE 500 mortar and transfer tension and torsion loadings to the lower part of the concrete slab **Centering Bush** To centrally locate the anchor within the cored hole to provide an uniforme wrapping of the anchor rod with the injection mortar. To avoid the contact between the concrete slab reinforcement and the anchor body

HRC / HRC-DB Rail anchor with Hilti HIT-RE 500

Fastening system		Benefits
	Hilti HRC	- for fastening rails to concrete slab track - for bottom-up (post-installed) construction method - verified for axle loads up to 250 kN - high electrical insulation values concerning stray currency - corrosion resistance - additional sizes and accessoires available - horizontal adjustment when used with ex-center collar bush - different support stiffness - complete installation and system portfolio - 2 and 4 anchor configuration
	Hilti HRC-DB	
	Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	

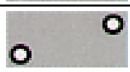
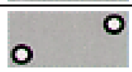
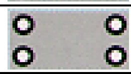
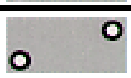
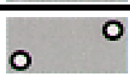
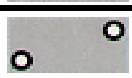
Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Rail anchor testing	Technical University of Munich	Report no. 1584b / 1995-08-15
		Report no. 1584d / 1995-08-15
		Report no. 1609 / 1995-12-06
EBA approval [a)]	German Federal Railway Office	21.62 Iozb (561/00) / 2001-05-29

a) EBA approval (HRC-DB), shimming up to 25mm to take account of settlement

Application field covered

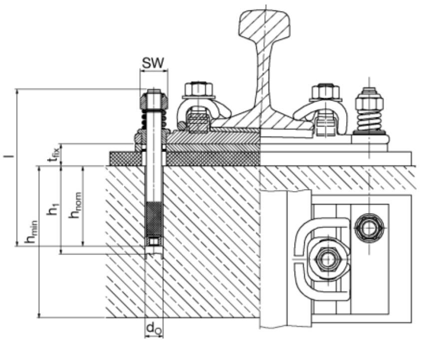
Selection of Hilti rail anchors for fastening rails to concrete track slab, based on axle load (A), stiffness (c) and thickness (t) of elastic pad

Anchor *	Elastic pad, t (mm)**	Tramway A = 100 kN	Metro A = 135 kN	Commuter A = 170 kN	Full Size A = 250 kN
HRC M22x215	10				
	20				
	30				
HRC-DB M22x225	10 +26mm shim				
Criteria	V_{max}	60 km/h	80 km/h	120 km/h	≥250 km/h
	R_{min} (V_{max})***	70 m (25 km/h)	200 m (60 km/h)	350 m (80 km/h)	3000 m
	Support spacing	750 mm	750 mm	700 mm	650 mm

* Configuration of base plate (support):  -> = Anchors per support

** Stiffness of elastic pad: t = 10mm -> c = 20-30 kN/mm
t = 20mm -> c = 10-20 kN/mm
t = 30mm -> c = 5-10 kN/mm

*** Indicative value: V_{max} is a function of the existing superelevation (cant) and the lateral acceleration.



Setting details	HRC M22x215 / HRC-DB M22x225		
	Anchor	**HRC M22**	**HRC-DB M22**
	Hilti mortar type	**HIT-RE 500**	
	Nominal diameter of drill bit d_0 [mm]	30	
	Nominal drilling depth h_1 [mm]	110	
	Embedment depth h_{nom} [mm]	106	
	Minimum member thickness h_{min} [mm]	160	
	Length of anchor l [mm]	215	225
	Maximum fixing height t_{fix} [mm]	40	50
	Spring deflection S_{inst} [mm]	8	
	Spring length L_{st} [mm]	35	
	Wrench size S_{inst} [mm]	38	

Curing time for general conditions HIT-RE 500

Temperature of the base material	Curing time before anchor can be fully loaded t_{cure}
40 °C	4h
30 °C to 39 °C	8h
20 °C to 29 °C	12h
15 °C to19 °C	24h
10 °C to 14 °C	48h
5 °C to 9 °C	72h

Specification

Hilti HRC Rail Anchor	
	**Stopnut (M22-SW32)** Material: 5S (DIN 985,EN ISO 7040,DIN 267), blue zinc plated: Fe/Zn 5B (DIN 50961) Fixing device : Nylon, torque force 68 Nm Service temperature: -50°C up to 120°C **Spring 35mm** Wire Grade: C7 (DIN 2076), Yellow Zinc Plated: Fe/Zn 7C (DIN 50961) Spring Rate: 373 N/mm Deformation: 8mm ➔ 3.0 kN compression **Collar Bush (Sealing Lip)** Material: Plastic, int. Ø= 22 mm, ext. Ø= 36 mm Volume Resitivity: 1.2×10^{12} Ω cm Flexible lower portion of collar bush to prevent any excess injection mortar from restricting managed system compression **Anchor Body (Ø 22 mm)** Material: High grade carbon steel (DIN/ISO 898/1), yellow zinc plated: Fe/Zn 10C (DIN 50961) Designed to withstand high dynamic loads resulting from train axle loads up to 250 kN **Knurling** To provide adequate bonding with HIT-RE/HY mortar and transfer tension and torsion loadings to the lower part of the concrete slab **Centering Bush** To centrally locate the anchor within the cored hole to provide an uniforme wrapping of the anchor rod with the injection mortar. To avoid the contact between the concrete slab reinforcement and the anchor body

HRA Rail anchor with Hilti HIT-RE 500 or HVU-G/EA glass capsule

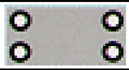
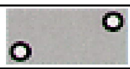
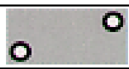
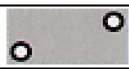
Fastening system		Benefits
	Hilti HRA, type a	- for fastening rails to concrete slab track - for bottom-up (post-installed) construction method - verified for axle loads up to 250 kN - high electrical insulation values concerning stray currency - corrosion resistance -- with spring or double coil spring - additional sizes and accessoiries available - different support stiffness - complete installation and system portfolio - 2 and 4 anchor configuration
	Hilti HRA, type b	
	Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	
	Hilti HVU-G/EA glass capsule	

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Rail anchor testing	Technical University of Munich	Report no. 1584c / 1995-08-15 Report no. 1584d / 1995-08-15

Application field covered

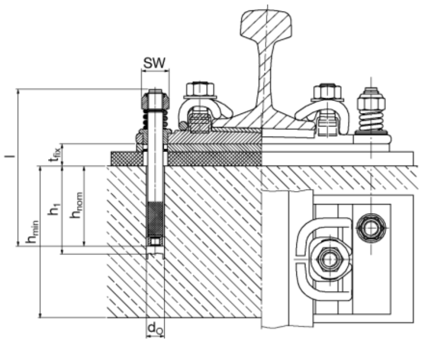
Selection of Hilti rail anchors for fastening rails to concrete track slab, based on axle load (A), stiffness (c) and thickness (t) of elastic pad

Anchor *	Elastic pad, t (mm)**	Tramway A = 100 kN	Metro A = 135 kN	Commuter A = 170 kN	Full Size A = 250 kN
HRA M22x220a M22x220b M22x270 M22x310	10				
	20				
	30				
Criteria	V_{max}	60 km/h	80 km/h	120 km/h	≥250 km/h
	R_{min} (V_{max})***	70 m (25 km/h)	200 m (60 km/h)	350 m (80 km/h)	3000 m
	Support spacing	750 mm	750 mm	700 mm	650 mm

* Configuration of base plate (support):  -> = Anchors per support

** Stiffness of elastic pad: t = 10mm -> c = 20-30 kN/mm
t = 20mm -> c = 10-20 kN/mm
t = 30mm -> c = 5-10 kN/mm

*** Indicative value: V_{max} is a function of the existing superelevation (cant) and the lateral acceleration.



Setting details	HRA M22				
	Anchor	HRA M22			
		220a	220b	270	310
	Hilti mortar type	HIT-RE 500 HVU-G/EA glass capsule			
	Nominal diameter of drill bit d_0 [mm]	35			
	Nominal drilling depth h_1 [mm]	120	120	130	130
	Embedment depth h_{nom} [mm]	110	110	125	125
	Minimum member thickness h_{min} [mm]	160			
	Length of anchor l [mm]	220	220	270	310
	Maximum fixing height t_{fix} [mm]	50	40	65	105
	Spring deflection S_{inst} [mm]	5	8	12	12
	Spring length L_{st} [mm]	22	35	55	55
	Wrench size S_{inst} [mm]	38			

Curing time for dry conditions HVU-G/EA glass capsule

Temperature of the base material	Curing time before anchor can be fully loaded t_{cure}
30 °C	20 min
20 °C to 29 °C	30 min
10 °C to19 °C	1,5 h
-5 °C to 9 °C	6 h

The curing time data for water satutated anchorage bases must be doubled

Curing time for general conditions HIT-RE 500

Temperature of the base material	Curing time before anchor can be fully loaded t_{cure}
40 °C	4h
30 °C to 39 °C	8h
20 °C to 29 °C	12h
15 °C to19 °C	24h
10 °C to 14 °C	48h
5 °C to 9 °C	72h

Specification

	Hilti HRA Rail Anchor, type a
	**Stopnut (M22-SW38)** Material; 5S (DIN 982), Zinc plated Fe/Zn 7C (DIN 50961) **Spring (35mm/55mm)** Wire Grade: C7 (DIN 2076), yellow zinc plated: Fe/Zn 7C (DIN 50961) Spring Rate: 373 N/mm **Washer (W 24 x39 x 3 mm)** Zinc plated Fe/ZN 5B (DIN 50961) **Collar Bush** Material; Plastic, int Ø= 28 mm, ext Ø= 35.5 mm Electrical Insulation; 3.5 x 10^{12} Ω **Plastic Wrapping** Designed to eliminate stray current loss. Ext Ø= 32 mm **Anchor Body** High grade carbon steel. Designed to withstand high dynamic loads resulting from train axle loads up to 250 kN **Bonding Ribs** To provide adequate bonding with injection mortar HIT-RE 500 mortar and HVU-G/EA capsule **Chisel Point** To provide torsional resistance and ensure mixing of HVU-G/EA capsule

Hilti HRA Rail Anchor, type b

Stopnut (M22-SW38)
Material; 5S (DIN 982), Zinc plated Fe/Zn 7C (DIN 50961)

Double coilSpring Fe 6 (22 mm)
Spring steel, Int ∅= 24mm, Ext ∅= 44 mm, Original Heigth: 22mm
Compressed Heigth: 17mm, Cathaphoretic coatings 7 µ

Washer (W 24 x39 x 3 mm)
Zinc plated Fe/ZN 5B (DIN 50961)

Collar Bush
Material; Plastic, int Ø= 28 mm, ext Ø= 35.5 mm
Electrical Insulation; 3.5×10^{12} Ω

Plastic Wrapping
Designed to eliminate stray current loss. Ext Ø= 32 mm

Anchor Body
High grade carbon steel. Designed to withstand high dynamic loads resulting from train axle loads up to 250 kN

Bonding Ribs
To provide adequate bonding with injection mortar HIT-RE 500 mortar and HVU-G/EA capsule

Chisel Point
To provide torsional resistance and ensure mixing of HVU-G/EA capsule

HRT-I Rail anchor with Hilti HIT-RE 500

Fastening system		Benefits
	Hilti HRT-I (rigid)	- for fastening rails to concrete slab track - for bottom-up (post-installed) construction method - verified for axle loads up to 250 kN - high electrical insulation values concerning stray currency - corrosion resistance - with spring (elastic) or spring washer (rigid) - additional sizes and accessoiries available - bolt removable - different support stiffness - complete installation and system portfolio - 2 and 4 anchor configuration
	Hilti HRT-I (elastic)	
	Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Rail anchor testing	Technical University of Munich	Report no. 2824 / 2011-12-21 Report no. 2883 / 2012-05-21

Application field covered

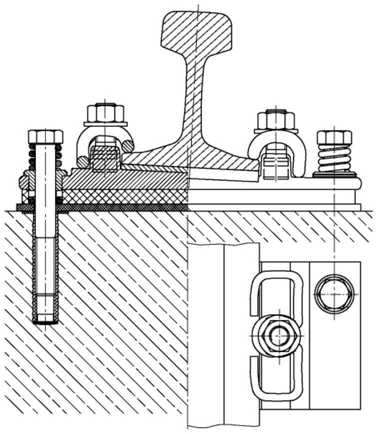
Selection of Hilti rail anchors for fastening rails to concrete track slab, based on axle load (A), stiffness (c) and thickness (t) of elastic pad

Anchor *	Elastic pad, t (mm)**	Tramway A = 100 kN	Metro A = 135 kN	Commuter A = 180 kN	Full Size A = 250 kN
HRT- I M22	15				-
	25				-
HRT- I M27	10				
	20				
	30				-
Criteria	V_{max}	60 km/h	80 km/h	120 km/h	≥250 km/h
	R_{min} (V_{max})***	70 m (25 km/h)	200 m (60 km/h)	300 m (80 km/h)	3000 m
	Support spacing	750 mm	750 mm	700 mm	650 mm

* Configuration of base plate (support):  -> = Anchors per support

** Stiffness of elastic pad: t = 10mm -> c = 20-30 kN/mm
t = 20mm -> c = 10-20 kN/mm
t = 30mm -> c = 5-10 kN/mm

*** Indicative value: V_{max} is a function of the existing superelevation (cant) and the lateral acceleration.

Setting details	HRT-I-M22x190/HRT-I M27x240		
	**Anchor**	**HRT–I M22**	**HRT–I M27**
	Hilti mortar type	**HIT-RE 500**	
	Nominal diameter of drill bit d_0 [mm]	32	35
	Nominal drilling depth h_1 [mm]	125	155
	Embedment depth h_{nom} [mm]	120	150
	Minimum member thickness h_{min} [mm]	-	
	Length of anchor l [mm]	160	200
	Maximum fixing height t_{fix} [mm]	-	-
	Spring deflection S_{inst} [mm]	8	10
	Spring length L_{st} [mm]	35	40
	Wrench size S_{inst} [mm]	32	41

Curing time for general conditions HIT-RE 500

Temperature of the base material	Curing time before anchor can be fully loaded t_{cure}
40 °C	4h
30 °C to 39 °C	8h
20 °C to 29 °C	12h
15 °C to19 °C	24h
10 °C to 14 °C	48h
5 °C to 9 °C	72h

Specification

Hilti HRT-I (elastic) Rail Anchor		
	**Bolt (M22, SW32)** Material: 10.9 (DIN 931,EN ISO 4014,), hot dipped galvanized Head: Hexagonal **Spring (35 mm)** Wire Grade: C7 (DIN 2076), Yellow Zinc Plated: Fe/Zn 7C (DIN 50961), spring Rate: 373 N/mm, deformation: 8mm **Collar Bush (Sealing Lip)** Material: Plastic , Int. Ø= 23 mm, Ext. Ø= 36 mm Volume resitivity: 1.2 x 10^{12} Ω cm Flexible lower portion of collar bush to prevent any excess injection mortar HIT-RE on the anchor shaft **Sealingwasher (22.0/36.0/5.0)** To prevent any excess injection mortar HIT-RE on the anchor shaft. **Insert Body Ø 28 mm** Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 120 mm	**Bolt (M27, SW41)** Material: 8.8 (DIN 931,EN ISO 4014), blue zinc plated: Fe/Zn 10B (DIN 50961) Head: Hexagonal **Spring (40 mm)** Wire Grade: C7 (DIN 2076), yellow zinc plated: Fe/Zn 7C (DIN 50961), spring Rate: 300 N/mm, deformation: 10mm → 3.0 kN compression **Collar Bush (Sealing Lip)** Material: Plastic , int. Ø= 28 mm, ext. Ø= 36 mm Volume Resitivity: 1.2 x 10^{12} Ω cm Flexible lower portion of collar bush to prevent any excess injection mortar HIT-RE on the anchor shaft **Sealingwasher (27.0/36.0/5.0)** To prevent any excess injection mortar HIT-RE on the anchor shaft. **Insert Body Ø 33 mm** Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 150 mm

Hilti HRT-I (rigid) Rail Anchor

Bolt (M22, SW32)
Material: 10.9 (DIN 931,EN ISO 4014,), hot dipped galvanized
Head: Hexgonal

Spring washer (22.5/35.9/4.0)
Wire Grade: C7 (DIN 2076), blue zinc plated: Fe/Zn 10B (DIN 50961), deformation: 4mm

Washer (23.0/44.0/4.0)
Material: 4.8 (DIN 125), blue zinc plated: Fe/Zn 10B (DIN 50961)
Int. Ø= 23 mm, Ext. Ø= 44 mm

Collar Bush
Material: Plastic, int. Ø: 22.2 mm, ext. Ø: 24.2 mm; collar Ø: 44 mm, height: 2/12/14 mm to provide insulation against stray current.

Sealingwasher (22.0/36.0/5.0)
PE-Hard foam LD29, black**,** to prevent any excess injection mortar HIT-RE on the anchor shaft.

Insert Body (Ø 28 mm)
Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 120 mm

Bolt (M27, SW41)
Material: 8.8 (DIN 931,EN ISO 4014), blue zinc plated: Fe/Zn 10B (DIN 50961)
Head: Hexgonal

Spring washer (27.5/41.5/5.0)
Wire Grade: C7 (DIN 2076), blue zinc plated: Fe/Zn 10B (DIN 50961), deformation: 4mm

Washer (28.0/49.0/4.0)
Material: 4.8 (DIN 125), blue zinc plated: Fe/Zn 10B (DIN 50961)
Int. Ø= 28 mm, Ext. Ø= 49 mm

Collar Bush
Material: Plastic, int. Ø: 27.2 mm, ext. Ø: 30.5 mm; collar Ø: 49 mm, height: 2/12/14 mm to provide insulation against stray current.

Sealingwasher (27.0/36.0/5.0)
PE-Hard foam LD29, black**,** to prevent any excess injection mortar HIT-RE on the anchor shaft.

Insert Body (Ø 33 mm)
Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 150 mm

HRT-IP Rail Anchor for cast-in/top down construction method

Fastening system	Benefits
 Hilti HRT–IP (elastic)  Hilti HRT-IP (rigid)	- for fastening rails to concrete slab track - for top-down (cast-in) construction method - verified for axle loads up to 250 kN - high electrical insulation values concerning stray currency - corrosion resistance - with spring (elastic) or spring washer (rigid) - additional accessoiries available different support stiffness - fixing plate to support assembling - bolt removable - identical system for post-installed/bottom up construction method available (HRT-I) → Rehabilitation - 2 and 4 anchor configuration

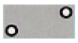
Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Rail anchor testing	Technical University of Munich	Report no. 2824 / 2011-12-21
		Report no. 2883 / 2012-05-21

Application field covered

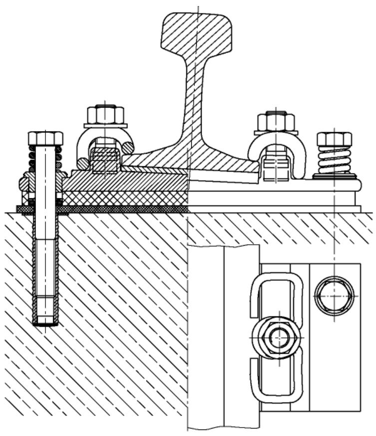
Selection of Hilti rail anchors for fastening rails to concrete track slab, based on axle load (A), stiffness (c) and thickness (t) of elastic pad

Anchor *	Elastic pad, t (mm)**	Tramway A = 100 kN	Metro A = 135 kN	Commuter A = 180 kN	Full Size A = 250 kN
HRT- IP M22	15				-
	25				-
HRT – IP M27	10				
	20				
	30				-
Criteria	V_{max}	60 km/h	80 km/h	120 km/h	≥250 km/h
	R_{min} (V_{max})***	70 m (25 km/h)	200 m (60 km/h)	300 m (80 km/h)	3000 m
	Support spacing	750 mm	750 mm	700 mm	650 mm

* Configuration of base plate (support):  -> = Anchors per support

** Stiffness of elastic pad: t = 10mm -> c = 20-30 kN/mm
t = 20mm -> c = 10-20 kN/mm
t = 30mm -> c = 5-10 kN/mm

*** Indicative value: V_{max} is a function of the existing superelevation (cant) and the lateral acceleration.

Setting details	HRT-IP M22x190/HRT-IP M27x240		
	**Anchor**	**HRT–IP M22**	**HRT–IP M27**
	Embedment depth h_{nom} [mm]	*120*	*150*
	Minimum member thickness h_{min} [mm]	-	
	Length of anchor l [mm]	*160*	*200*
	Maximum fixing height t_{fix} [mm]	-	-
	Spring deflection S_{inst} [mm]	*8*	*10*
	Spring length L_{st} [mm]	*35*	*40*
	Wrench size S_{inst} [mm]	*38*	*41*

Specification

Hilti HRT-IP (elastic) Rail Anchor	
Bolt (M22, SW32) Material: 10.9 (DIN 931,EN ISO 4014,), hot dipped galvanized Head: Hexgonal	**Bolt (M27, SW41)** Material: 8.8 (DIN 931,EN ISO 4014), Blue Zinc Plated: Fe/Zn 10B (DIN 50961) Head: Hexgonal
Spring (35 mm) Wire Grade: C7 (DIN 2076), yellow zinc plated: Fe/Zn 7C (DIN 50961), Spring rate: 373 N/mm, deformation: 8mm	**Spring (40 mm)** Wire Grade: C7 (DIN 2076), Yellow Zinc Plated: Fe/Zn 7C (DIN 50961), spring Rate: 300 N/mm, deformation: 10mm ➔ 3.0 kN compression
Collar Bush Material: Plastic , int. Ø= 27 mm, ext. Ø= 36 mm Volume resitivity: 1.2 x 10^{12} Ω cm	**Collar Bush** Material: Plastic , int. Ø= 28 mm, ext. Ø= 36 mm Volume resitivity: 1.2 x 10^{12} Ω cm
Sealingwasher (22.0/36.0/5.0) To prevent any excess concrete on the anchor shaft	**Sealingwasher (27.0/36.0/5.0)** To prevent any excess concrete on the anchor shaft
Fixing plate (26.2/50.0/2.0) To fix the rigid pad (HDPE) and elastic pad to the support assembling during concrete slab pouring.	**Fixing plate (31.2/50.0/2.0)** To fix the rigid pad (HDPE) and elastic pad to the support assembling during concrete slab pouring.
Insert Body (Ø 28 mm) Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 120 mm	**Insert Body (Ø 33 mm)** Material: Carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 150 mm

Hilti HRT-IP (rigid) Rail Anchor		
Bolt (M22, SW32) Material: 10.9 (DIN 931,EN ISO 4014,), hot dipped galvanized Head: Hexgonal **Spring washer (22.5/35.9/4.0)** Wire Grade: C7 (DIN 2076), blue zinc plated: Fe/Zn 10B (DIN 50961), deformation: 4mm **Washer (23.0/44.0/4.0)** Material: 4.8 (DIN 125), blue zinc plated: Fe/Zn 10B (DIN 50961) Int. Ø= 23 mm, Ext. Ø= 44 mm **Collar Bush** Material: Plastic, int. Ø: 22.2 mm, ext. Ø: 24.2 mm; collar Ø: 44 mm, height: 2/12/14 mm to provide insulation against stray current. **Sealingwasher (22.0/36.0/5.0)** PE-Hard foam LD29, black**,** to prevent any excess injection mortar HIT-RE on the anchor shaft. **Fixing plate (26.2/50.0/2.0)** To fix the rigid pad (HDPE) and elastic pad to the support assembling during concrete slab pouring. **Insert Body (Ø 28 mm)** Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 120 mm	**or** **Bolt (M27, SW41)** Material: 8.8 (DIN 931,EN ISO 4014), Blue Zinc Plated: Fe/Zn 10B (DIN 50961) Head: Hexgonal **Spring washer (27.5/41.5/5.0)** Wire Grade: C7 (DIN 2076), blue zinc plated: Fe/Zn 10B (DIN 50961), deformation: 4mm **Washer (28.0/49.0/4.0)** Material: 4.8 (DIN 125), blue zinc plated: Fe/Zn 10B (DIN 50961) Int. Ø= 28 mm, Ext. Ø= 49 mm **Collar Bush** Material: Plastic, int. Ø: 27.2 mm, ext. Ø: 30.5 mm; collar Ø: 49 mm, height: 2/12/14 mm to provide insulation against stray current. **Sealingwasher (27.0/36.0/5.0)** PE-Hard foam LD29, black**,** to prevent any excess injection mortar HIT-RE on the anchor shaft. **Fixing plate (31.2/55.0/2.0)** To fix the rigid pad (HDPE) and elastic pad to the support assembling during concrete slab pouring. **Insert Body (Ø 33 mm)** Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 150 mm	

Hilti worldwide

Afghanistan
Ansary Engineering Products & Services (AEP), Hilti Division, Kabul
Phone +93 799 481 935

Algeria
BFIX SARL, Algiers
Phone+213 216 013 60
Fax+213 216 055 03

Angola
Agrinsul S.A.R.L, Luanda
Phone+244 222 395 884
Fax+244 222 397 935

Argentina
Hilti Argentina, S.R.L., Buenos Aires
Phone+54 11 4721 4400
Fax+54 11 4721 4410

Aruba
Carfast Holding N.V, Oranjestad
Phone +297-5-828-449
Fax +297-5-832-582

Australia
Hilti (Aust.) Pty. Ltd., Rhodes
Phone+61 2 8748 1000
Fax+61 2 8748 1190

Austria
Hilti Austria Ges.m.b.H., Wien
Phone+43 1 66101
Fax+43 1 66101 257

Azerbaijan
HCA Ltd., Baku
Phone+994 12 598 0955
Fax+994 12 598 0957

Bahrain
Hilti Bahrain W.L.L., Manama
Phone +973 17 702 101
Fax +973 17 702 151

Bangladesh
Aziz & Company Ltd., Hilti Division,
Dhaka
Phone+8802 881 4461
Fax+8802 8827028

Barbados
Williams Equipment, Ltd., St.Michel
Phone+1 246 425 5000
Fax+1 246 417 9140

Belgium
Hilti Belgium S.A., Asse (Zellik)
Phone+32 2 4677911
Fax+32 2 4665802

Belize
Benny's Homecenter Ltd., Belize City,
Phone+501 227 2126
Fax+501 227 4340

Benin
La Roche S.A.R.L., Cotonou
Phone+229 21330775
Fax+229 21331920

Bhutan
Hilti Regional Office
Middle East & South Asia Region, Dubai
Phone+9714 8060300
Fax+9718 4480485

Bolivia
Genex, S.A., Santa Cruz
Phone+591 3 343 1819
Fax+591 3 343 1819

Bosnia and Herzegovina
Hilti Systems BH d.o.o.
Sarajevo,
Sarajevo-Ilidža
Phone +387 33 761 100
Fax +387 33 761 101

Botswana
Turbo Agencies, Gaborone
Phone+267 312288
Fax+267 352925

Brazil
Hilti do Brasil Comercial Ltda., Barueri
Phone+55 11 4134 9000
Fax+55 11 4134 9021

Bulgaria
Hilti (Bulgaria) GmbH, Sofia
Phone +359 2976 00 11
Fax +359 2974 01 23

Canada
Hilti (Canada) Ltd.,
Mississauga, Ontario
Phone 1-800-363-4458
Fax 1-800-363-4459

Cayman Islands
Active Traders Ltd., Georgetown
Phone +345-769-4458
Fax +345-769-5886

Chile
Hilti Chile, Ltda.,Santiago
Phone+562 655 3000
Fax+562 365 0505

China
Hilti (China) Ltd., Shanghai
Phone+86 21 6485 3158
Fax+86 21 6485 0311

Colombia
Hilti Colombia, Bogotá
Phone+571 3810121/3810134
Fax+571 3810131

Costa Rica
Superba S.A., La Uruca, San José
Phone+506 255 1044
Fax+506 255 1110

Croatia
Hilti Croatia d.o.o., Sesvete-Zagreb
Phone+385 1 2030 777
Fax+385 1 2030 766

Cyprus
Cyprus Trading Corp. Ltd., Nicosia
Phone+357 22 740340
Fax+357 22 482892

Czech Republik
Hilti CR spol. s r.o, Prag-Pruhonice
Phone+420 2 611 95 611
Fax+420 2 726 80 440

Denmark
Hilti Danmark A/S, Rødovre
Phone +45 88 8000
Fax +45 44 88 8084

Dominican Republik
Dalsan C por A, Santo Domingo
Phone+1 809 565 4431
Fax+1 809 541 7313

Ecuador
Quifatex S.A., Quito
Phone+593 2 247 7400
Fax+593 2 247 8600

Egypt
M.A.P.S.O. for Marine Propulsion & Supply S.A.E., Cairo
Phone +202 2 698 47 77
Fax+202 2 698 82 60

El Salvador
Electrama, S.A. de C.V., San Salvador
Phone+503 274 9745
Fax+503 274 9747

Estonia
Hilti Eesti OÜ, Tallinn
Phone+372 6 550 900
Fax+372 6 550 901

Ethiopia
A. Sarafian Industrial Accessories & Tools, Addis Ababa
Phone+251 115512408
Fax+251 115519068

Fiji
Central Pacific Agencies, Suva
Phone+ 679 336 2580

Finland
Hilti (Suomi) OY, Vantaa
Phone+358 9 47870 0
Fax+358 9 47870 100

France
Hilti France S.A., Magny-les-Hameaux
Phone+33 1 3012 5000
Fax+331 3012 5012

Gabon
CECA-GADIS, Libreville
Phone+241 740747
Fax+241 720416

Georgia
ICT Georgia Ltd., Tbilisi
Phone+995 32 25 38 42

Germany
Hilti Deutschland GmbH, Kaufering
Phone+49 8191/90-0
Fax+49 8191/90-1122

Ghana
Auto Parts Limited, Accra
Phone+233 21225924
Fax+233 21224899

Great Britain
Hilti (Gt. Britain) Ltd., Manchester
Phone+44 161 886 1000
Fax+44 161 872 1240

Greece
Hilti Hellas SA, Likovrisi
Phone+30210 288 0600
Fax+30210 288 0607

Guatemala
Equipos y Fijaciones, S.A., Guatemala City
Phone+502 339 3583
Fax+502 339 3585

Guyana
Agostini's Fastening Systems Ltd., Port of Spain
Phone +1 868 623 2236
Fax+1 868 624 6751

Honduras
Lazarus & Lazarus, S.A., San Pedro Sula
Phone+504 565 8882
Fax+504 565 8624

Hong Kong
Hilti (Hong Kong) Ltd., Tsimshatsui, Kowloon
Phone+852 8228 8118
Fax+852 2764 3234 (main)

Hungary
Hilti (Hungária), Budapest
Phone+36 1 4366 300
Fax+36 1 4366 390

Iceland
HAGI ehf HILTI Iceland, Reykjavik
Phone+354 4143700
Fax+354 4143720

India
Hilti India Pvt Ltd., New Dehli
Phone +91 11 4270 1111
Fax+91 11 2637 1634

Indonesia
P.T. Hilti Nusantara, Jakarta
Phone+62 21 / 789-0850
Fax+62 21 / 789-0845

Iran
Madavi Company, Hilti Division, Tehran
Phone+98 21 81 721
Fax+98 21 887 61 523

Iraq
Systems Engineering Services Co. (SESCO), Hilti Division, Baghdad
Phone+964 1 778 8933
Phone+964 7901 309592

Ireland
Hilti (Fastening Systems) Ltd., Dublin
Phone+353 1 886
Fax+353 1 886 3569

Israel
Hilti (Israel) Ltd., Petach Tikva
Phone+972 3 930 4499
Fax+972 3 930 2095

Italy
Hilti Italia S.p.A., Milano
Phone+3902 212721
Fax+3902 25902189

Jamaica
Evans Safety Ltd., Kingston
Phone+1 876 929 5546
Fax+1 876 926 2069

Japan
Hilti (Japan) Ltd., Yokohama
Phone+81 45 943 6211
Fax+81 45 943 6231

Jordan
Newport Trading Agency, Hilti Division, Amman
Phone +962 6 4026829
Fax+962 6 4026794

Kazakhstan
EATC Ltd., Almaty
Phone +7327 298 01 80
Fax+7 3272 50 39 57

Korea
Hilti (Korea) Ltd., Seoul,
Phone +82 2 2007 2802
Fax +82 2 2007 2809

Kuwait
Works & Building Co, Hilti Division, Safat
Phone+965 844 855
Fax+965 4831379

Latvia
Hilti Services Limited, Riga
Phone+371 762 8822
Fax+371 762 8821

Lebanon
Chehab Brothers S.A.L., Hilti Division, Beirut
Phone+9611 244435
Fax+9611 243623

Libya
Wemco Workshop & Maintenance Equipments Co., Tripoli
Phone+ 218 21 4801213
Fax+ 218 21 4802810

Liechtenstein
Hilti Aktiengesellschaft, Schaan Liechtenstein
Phone+423 234 2111
Fax+423 234 2965

Lithuania
UAB Hilti Complete Systems, Vilnius
Phone+370 6 872 7898
Fax+370 5 271 5341

Luxembourg
Hilti G.D. Luxembourg, Bertrange
Phone+352 310 705
Fax+352 310 751

Macedonia
Famaki-ve doel, Skopje
Phone+389 2 246 96
Fax+389 2 246 99 97

Madagascar
Société F. Bonnet Et Fils, Antananarivo
Phone+261 202220326
Fax+261 202222253

Malaysia
Hilti (Malaysia) Sdn. Bhd., Petaling Jaya
Phone+60 3 563 38583
Fax+60 3 563 37100

Maldives
Aima Con. Co. Pvt. Ltd, Hilti Division, Malé
Phone +960 3330909
Fax+960 3313366

Malta
Panta Marketing & Services Ltd., Msida
Phone+356 21 441 361
Fax+356 21 440 000

Mauritius
Ireland Blyth Limited, Port Louis
Phone+230 207 05 00
Fax+230 207 04 41

Mexico
Hilti Mexicana, S.A. de C.V., Mexico City
Phone+5255 5387-1600
Fax+5255 5281-5967

Moldova
Sculcom Grup SRL, Chisinau
Phone+373 22 212488
Fax+373 22 238196

Mongolia
PSC CO. LTD., Hilti Division, Ulaan Baatar
Phone+976 +50 88 45 84
Fax+976 50 88 45 85

Morocco
Mafix SA, Casablanca
Phone+2122 257301
Fax+2122 257364

Mozambique
Diatecnica Lda., Maputo
Phone+2581 303816
Fax+2581 303804

Namibia
A. Huester Machinetool Company (Pty) Ltd., Windhoek
Phone+26461 237083
Fax+26461 227696

Nepal
INCO (P) Ltd., Kathmandu
Phone+9771 4431 992
Fax+9771 4432 728

Netherlands
Hilti Nederland B.V., Berkel en Rodenrijs
Phone+3110 5191111
Fax+3110 5191199

Netherlands Antilles
Fabory Carribbean Fasteners N.V., Davelaar
Phone+599 9 737 6288
Fax+599 9 737 6225

New Zealand
Hilti (New Zealand) Ltd., Auckland
Phone +64 9 571 9995
Fax +64 9 571 9942

Nicaragua
Fijaciones de Nicaragua, Managua
Phone+505 270 4567
Fax+505 278 5331

Nigeria
Top Brands Import Ltd., Hilti Division
Ikeja
Phone +234 1 817 97 601
Fax+234 1 496 22 00

Norway
Motek AS, Oslo
Phone+47 230 52 500
Fax+47 22 640 063

Oman
Bin Salim Enterprices LLC, Hilti Division, Muscat
Phone+968 245 63078
Fax+968 245 61193

Pakistan
Hilti Pakistan (Pvt) Ltd
Lahore
Phone +9242 111144584
Fax +9242 37500521

Palestine
Shaer United Co. for Modern Technology, Beit Jala
Phone+970 2 276 5840
Fax+970 2 274 7355

Panama
Cardoze & Lindo, Ciudad de Panamá
Phone+507 274 9300
Fax+507 267 1122

Peru
Química Suiza SA, Lima
Phone+511 211 4000
Fax+511 211 4050

Philippines
Hilti (Philippines) Inc., Makati City
Phone+632 784 7100
Fax+632 784 7101

Poland
Hilti (Poland) Sp. z o.o., Warsaw
Phone +48 320 5500
Fax +48 22 320 5500

Portugal
Hilti (Portugal), Produtos e Servicos, Lda., Matosinhos – Senhora Da Hora,
Phone +351 229 568 100
Fax+35122 9568190

Puerto Rico
Hilti Caribe, Inc., Hato Rey,
Phone+1-787 281 6160
Fax+1 787 281 6155

Qatar
Hilti Qatar
Doha
Phone+974 4425022
Fax+974 435 6098

Romania
Hilti Romania S.R.L., Otopeni
Phone+40 213523000

Russia
Hilti Distribution Ltd., Moscow
Phone+7 495 792 52 52
Fax+7 495 792 52 53

République de Djibouti
Les Etablissements TANI, Djibouti
Phone +235 35 03 37
Fax+235 35 23 33

Saudi Arabia
TFT Ltd
Jeddah
Phone +9662 6983660
Fax +9662 6974696

Senegal
Senegal-Bois, Dakar
Phone+2218 323527
Fax+2218 321189

Serbia Montenegro
Hilti SMN d.o.o., Belgrade
Phone +381-11-2379-515
Fax+381-11-2379-514

Singapore
Hilti Far East Private
Ltd., Singapore
Phone+65 6777 7887,
Fax+65 6777 3057

Slovakia
Hilti Slovakia spol. s r.o.,
Bratislava
Phone+421 248 221 211
Fax+421 248 221 255

Slovenja
Hilti Slovenija d.o.o., Trzin
Phone+386 1 56809 33
Fax+386 1 56371 12

South Africa
Hilti (South Africa) (Pty) Ltd.,
Midrand
Phone+2711 2373000
Fax+2711 2373111

Spain
Hilti Española S.A., Madrid
Phone+3491 3342200
Fax+3491 3580446

Sri Lanka
Hunter & Company Ltd.,Hilti
Division
Phone+94 114713352
Fax +94 114723208

St. Lucia
Williams Equipment Ltd,
Castries
Phone +1 758 450-3272
Fax+1 758-450-4206

St.Maarten, N.A.
Carfast Holding N.V., Cole Bay
Phone +599 544 4760
Fax +599-544-4763

Sudan
PEMECO INDUSTRIAL
SUPPLIES CO. LTD. Khartoum
Phone+249 15 517 5031
Fax+249 15 517 5032

Sweden
Hilti Svenska AB, Arlöv
Phone+46 40 539 300
Fax+46 40 435 196

Switzerland
Hilti (Schweiz) AG, Adliswil
Phone+41 844 84 84 85
Fax+41 844 84 84 86

Syria
Al-Safadi Brothers Co., Hilti
Division
Damascus
Phone+96311 6134211
Fax+96311 6123818

Taiwan
Hilti Taiwan Co., Ltd., Taipei
Phone+886 2 2357 9090
Fax+886 2 2397 3730

Tanzania
Coastal Steel Industrial Limited,
Hilti Division, Dar es Salaam
Phone+255 222865662
Fax+255 222865692

Thailand
Hilti (Thailand) Ltd.,
Bangkok Metropolis
Phone+66 2 751 4123
Phone-2-751 4127
Fax+66 2 751 4116

Trinidad and Tobago
Agostini's Fastening Systems
Ltd., TT- Port of Spain
Phone+1 868 623 2236
Fax+1 868 624 6751

Tunisia
Permetal SA, Tunis C.U.N
Phone+216 71 766 911
Fax+216 71 766 807

Turkey
Hilti Insaat Malzemeleri Tic
.A.S.,
Umraniye/Istanbul
Phone+90 216 528 6800
Fax+90 216 528 6898

Turkmenistan
Zemmer Legal, Ashgabat

Uganda
Casements (Africa) Ltd.,
Kampala
Phone+25641 234000
Fax+25641 234301

Ukraine
HILTI (Ukraine) Ltd., Kyiv
Phone +380 44 390 5566
Fax+380 44 390 5565

United Arab Emirates
Hilti Emirates L.L.C.
Phone+9714 8854445
Fax+9714 8854405

USA
Hilti, Inc.,Tulsa
Phone (866) 445-8827
Fax 1-800-879-7000

Uruguay
Seler Parrado, S.A., Montevideo
Phone+598 2 902 3515
Fax+598 2 902 0880

Uzbekistan
BNZ Industrial Support,
Tashkent
Phone +998 90 186 2792
Fax +99871 361

Venezuela
Inversiones Hilti de Venezuela,
S.A., Caracas
Phone+58 -212-2034200
Fax+58-212-2034310

Vietnam
Hilti AG Representative Office,
Ho Chi Minh City
Phone+84 8 930 4091
Fax+84 8 930 4090

Yemen
Nasser Ziad Establishment, Hilti
Division, Sana'a
Phone+9671 275238
Fax+9671 272854

Zambia
BML Electrical Limited, Kitwe
Phone+260 (2) 226644

Zimbabwe
Glynn's Bolts (Pvt.) Ltd., Harare
Phone+2634 754042-48
Fax+2634 754049